

## UNDERFLOOR HEATING/COOLING

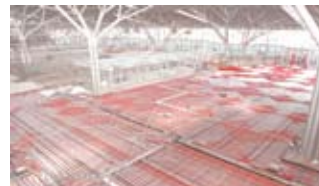
### TECHNICAL INFORMATION

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## LIVE BETTER WITH REHAU QUALITY AND INNOVATION

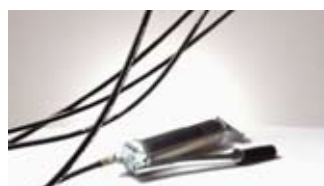
**REHAU TODAY** • REHAU was founded in Germany in 1948. Today, our proficiency in developing innovative solutions has made us a global leader in polymer processing technologies, providing a wide range of products and services to the Construction, Automotive and Industrial sectors. Through continuing research and development, REHAU consistently delivers cost-effective products designed with the environment in mind. Stringent quality control and safety guidelines ensure that our products comply with the highest international standards. We take pride in our expertise and versatility to remain at the forefront of technology. As an independent and privately owned company, REHAU focuses on building long-lasting partnerships and alliances with our customers.

**REHAU EVERYWHERE** • With over 120 branches, 44 plants and 15 training academies across 53 countries, REHAU is one of the world's leading polymer solutions providers. REHAU products are found in a wide range of applications. From sound-absorbing roller shutter systems and energy efficient PVC windows to automotive bumper systems, REHAU is a part of our day-to-day lives.

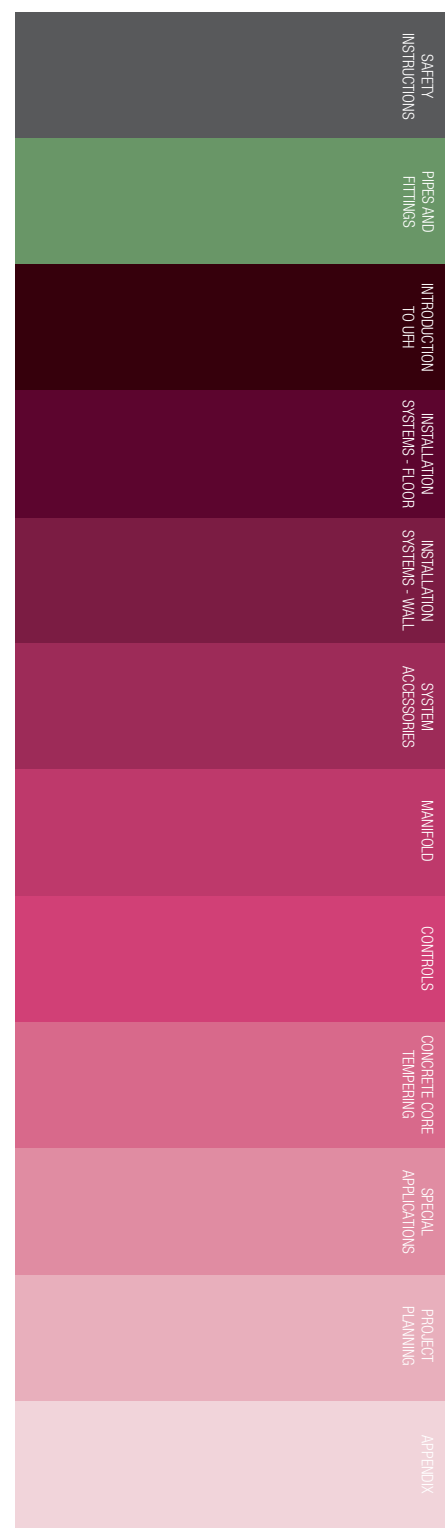


### REHAU, a global name where quality and innovation merge to inspire better living.

*From top, left to right: intelligent heating and cooling systems • contemporary roller shutter storage solutions • energy-efficient window solutions • quality edgeband for the furniture industry • gasket seals and profiles for domestic appliances • robust hot and cold water plumbing systems • sophisticated automobile bumpers • the latest trends in synthetic weaving materials • high-pressure hoses for various industrial applications • acoustic domestic drainage systems • advanced pipe aerator solutions.*



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# 1. SAFETY INSTRUCTIONS AND INFORMATION ON THIS DOCUMENT



- Read the safety recommendations and operating instructions carefully and completely for your own safety and for the safety of other people before starting with assembly.
- Retain the operating instructions and keep them handy.
- If you do not understand the safety recommendations or individual assembly instructions, or if they are unclear, contact your respective REHAU sales office.

## Intended use

The underfloor heating and cooling systems and system components from REHAU may only be planned, installed and operated in accordance with this technical information. Any other use is unintended and therefore impermissible.



- Observe all applicable national and international laying, installation, accident-prevention and safety regulations when installing piping systems and observe the notes in this technical information. Areas of use not dealt with in this technical information (special applications) require consultation with our applications department.
- Please contact your REHAU sales office.



## General precautionary measures

- Observe the generally applicable accident prevention and safety regulations when installing piping systems.
- Keep the work area clean and free of impeding objects.
- Provide sufficient lighting at the work area.
- Keep children, house pets and unauthorised persons away from tools and the assembly sites. This is especially important in cases of renovation in inhabited areas.
- Use only the intended components for the respective REHAU system. The use of components or tools from other companies which are not from the respective REHAU installation system can lead to accidents or other dangers.



## Work clothing

- Wear protective glasses, suitable work clothing, safety shoes, a protective helmet and, if you have long hair, a hairnet.
- Do not wear loose clothing or jewellery, as they can get caught by moving parts.
- Wear a protective helmet when performing assembly work at head level or above your head.



## When assembling the system

- Always read and comply with the respective operating instructions of the REHAU assembly tool used.
- The REHAU pipe cutters have a sharp blade. The REHAU pipe cutters have to be stored and handled in a safe way to prevent injuries.
- When shortening pipes, maintain a safe distance between the hand holding the object and the pipe cutter.
- Never put your hands near the area where the tool is cutting or on moving parts.
- The expanded pipe end returns to its original shape (memory effect) after the expansion process. Do not insert any foreign objects into the expanded pipe end during this phase.
- Never put your hands near the area where the tool is clamping or on moving parts.
- The fitting can fall out of the pipe until completion of clamping. Danger of injury!
- When performing service and conversion work and when changing the place of assembly, always unplug the power plug of the tool or secure it against being switched on inadvertently.

## NOTES ON THIS TECHNICAL INFORMATION

### Applicability

This technical information applies

for the DIN standard.

## Navigating

A detailed table of contents with hierarchical titles and the corresponding page numbers is found at the beginning of each chapter.

## Symbols and Logos



Safety Information



Legal Information



Important Information



Information on the Web



Your Advantages



Action to be performed



- Please check at regular intervals whether a more recent version of this technical information is available for your own safety and to ensure correct usage of our products. The date of issue of your technical information is always printed at the bottom right on the cover page (e.g. 3.07 for March 2006). The current technical information is available from your REHAU sales office, specialist wholesaler as well as on the Internet as a download at: **www.REHAU.com**

## 2.

# PIPES AND FITTINGS

### 2.1 Overview of REHAU's series of heating pipes



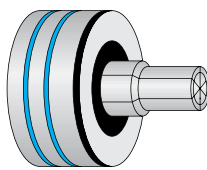
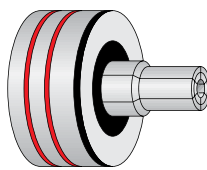
	underfloor heating/cooling system	
	RAUTITAN pink	RAUTHERM S
Pipe		
Field of application	Radiator Panels Underfloor heating/cooling	Underfloor heating/cooling
Dimensions	16 x 2.2 mm 20 x 2.8 mm 25 x 3.5 mm 32 x 4.4 mm 40 x 5.5 mm 50 x 6.9 mm 63 x 8.6 mm	12 x 2,0 mm 14 x 1,5 mm 16 x 2,0 mm 17 x 2,0 mm 20 x 2,0 mm 25 x 2,3 mm
RAUTITAN fitting	16 x 2.2 mm/20 x 2.8 mm 25 x 3.5 mm/32 x 4.4 mm 40 x 5.5 mm/50 x 6.9 mm 63 x 8.6 mm	REHAU-Formteilprogramm und Schiebehülsen für RAUTHERM S 12 x 2,0 mm/14 x 1,5 mm 16 x 2,0 mm/17 x 2,0 mm 20 x 2,0 mm/25 x 2,3 mm
Tool	RAUTOOL universal compression tool	
Expander head		

Table. 2-1

## 2.2 PE-X material

### 2.2.1 Crosslinking of polyethylene



- corrosion resistant: no pitting corrosion
- is not inclined to scaling
- polymeric piping material decreases the sound transmission along the pipe
- abrasion resistant
- Toxic-free and peace of mind

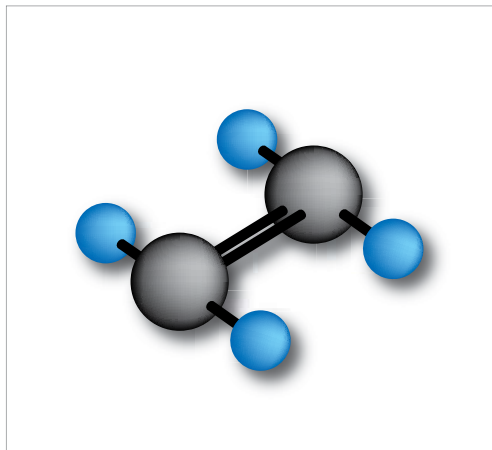


Illustration 2-1: Ethylene

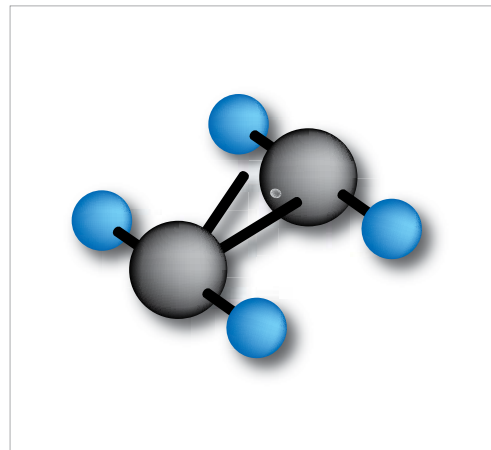


Illustration 2-2: Ethylene, opening double-bond

REHAU pipes are made from PE-X and are produced by Peroxide-crosslinking of polyethylene under high pressure.

### 2.2.2 Peroxide-crosslinked polyethylene

Peroxide-crosslinked polyethylene is designated as PE-Xa. This type of crosslinking takes place at high temperatures and pressures. The individual molecules of the polyethylene are bonded into a three-dimensional network.

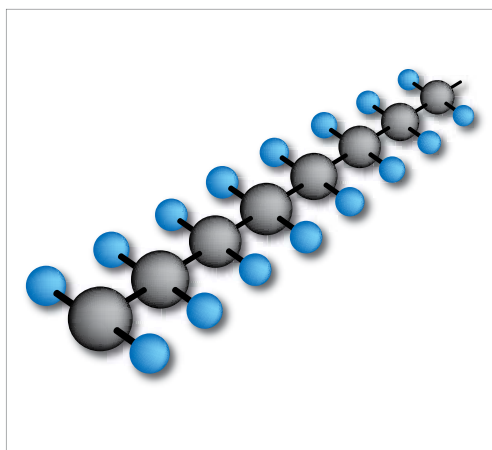


Illustration 2-3: Polyethylene (PE)

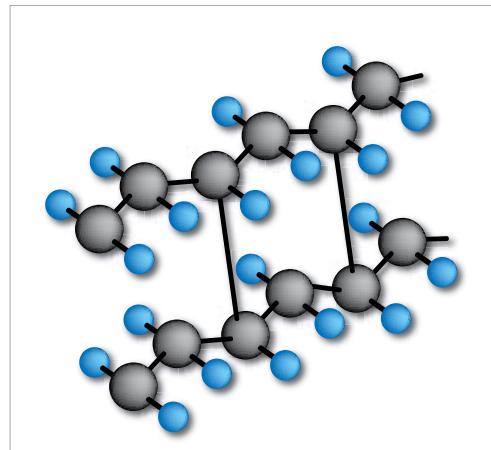


Illustration 2-4: Crosslinked polyethylene (PE-X)

A characteristic of this high-pressure crosslinking is that it takes place in molten state above the crystallite melting point. The crosslinking reaction takes place during pipe forming in the tooling.

This crosslinking method ensures a uniform and very high level of crosslinking over the whole cross-section of the pipe, even for thick-walled pipes.

### 2.2.3 Material testing at REHAU

At REHAU all types of pipes are subjected to continuous quality control and undergo a various number of tests and long-term trials to maintain the high quality of REHAU pipes.

Below we present some of the standard tests from the REHAU testing laboratory. In the case of polymer materials that are exposed to thermal and mechanical stress, it should be noted that deformation and strength depend on the temperature and the duration of the stress.

In order to determine acceptable long-term stress levels, it is necessary to investigate mechanical behaviour over a long period and at different temperatures. This also applies to pipes subject to internal pressure.

#### Burst testing

In burst testing, REHAU pipes are subjected to increasing pressure in a test frame until the pipe bursts. The bursting pressure is about seven times the maximum operating pressure.



Illustration 2-5: Result of a burst test with RAUTITAN flex universal pipe

#### Notch test

The impact resistance of REHAU pipes is tested in an impact-test device.

Under controlled conditions, a hammer-like ballistic pendulum strikes a pipe to be tested. REHAU crosslinked polyethylene pipes show a very high resistance against this sort of massive mechanical impact.

The sample experiment represented in Illustration 2-6 shows the impact toughness of a REHAU pipe which does not break at a pipe temperature of  $-30^{\circ}\text{C}$ .



Illustration 2-6: RAUTITAN flex universal pipe in impact-testing device

#### Tensile-strength test

In a tensile-strength testing machine, REHAU pipes are stretched lengthways by a high force under controlled conditions until they break.

Compared with metal pipes, REHAU crosslinked polyethylene pipes show an extraordinarily high level of stretchability.

The length of the stretched pipe can be many times the original pipe length.

The REHAU compression sleeve connection is safe against being

pulled apart under operational conditions:

The pipe will not be pulled out of the connection.



Illustration 2-7: Tensile-strength testing procedure

#### Endurance testing

The use of pipes in domestic installations requires a lifespan of 50 years or more.

In order to be able to detect even long-term effects due to e.g. temperature fluctuations, pressure and mechanical stresses, REHAU pipes are exposed in long-term tests to extreme temperature and pressure conditions and periodically tested with the described testing methods. Then the REHAU pipes are examined photo-optically.



Illustration 2-8: REHAU pipes in endurance testing (under pressure in water basin)

The necessary parameters were developed on the basis of experience over more than 25 years in the laboratory and in practice in a multitude of experiments and comprehensive test on pipes made out of high-pressure crosslinked polyethylene.

The pipes in the foreground (Illustration 2-8: brown surface) have been being tested since the earliest days of production in a test basin at REHAU at  $95^{\circ}\text{C}$  and 10 bar. Further tests are carried out in accordance with the applicable standards and regulations. These include determination of the degree of crosslinking, shrinkage testing, temperature-change tests, impulse pressure testing, and many others.

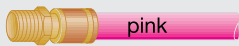

## 2.3 Fields of application

### RAUTITAN installation system may be deployed in any:

- Hot and Cold Water Services
- Radiator panels
- Underfloor heating/cooling

For underfloor heating and underfloor radiator heating we recommend REHAU systems with RAUTITAN pink pipe with oxygen barrier.

### 2.3.1 Areas of application for REHAU PE-Xa pipes

Field of application	REHAU-pipe	
	RAUTITAN pink	RAUTHERM S
	 pink	 RAUTHERM S
Drinking water installation	–	–
Radiator connection	++	–
Underfloor heating/cooling	++	++

++ : Especially recommended

+ : Suitable

– : Not suitable

Table 2-2: Areas of application for REHAU pipes

## Areas of application of REHAU heating pipes in the Underfloor heating/cooling



Installation System		REHAU-pipe	
		Heating Pipe RAUTITAN pink	Heating Pipe RAUTHERM S
			
REHAU Varionova studded panel system		16 x 2,2 mm	14 x 2.0 17 x 2.0
REHAU vario studded panel system		16 x 2,2 mm	14 x 1,5 mm 17 x 2,0 mm
REHAU stapling system		16 x 2,2 mm	14 x 1,5 mm 17 x 2,0 mm
REHAU RAUFIX system	for 12/14	–	14 x 1,5 mm
	for 16/17/20	16 x 2,2 mm	17 x 2,0 mm 20 x 2,0 mm
REHAU pipe grid system		16 x 2,2 mm 20 x 2,8 mm	17 x 2,0 mm 20 x 2,0 mm
REHAU dry system		16 x 2,2 mm	16 x 2,0 mm
REHAU base panel TS-14		–	14 x 1,5 mm

Table 2-3: Areas of application of REHAU heating pipes in the Underfloor heating/cooling

### 2.3.2 REHAU heating/cooling installation pipe RAUTITAN pink

- Pipe made from RAU-PE-Xa
  - Peroxide-crosslinked polyethylene (PE-Xa)
  - With oxygen-barrier layer
  - Oxygen-tight according to DIN 4726 standard
  - Complies with DIN 16892
- Field of application
  - Underfloor heating/cooling
  - Radiator panels
  - Heating installation in buildings.

**§** RAUTITAN pink heating pipe may not be used in drinking water installations!



Illustration 2-9: RAUTITAN pink Heating pipe

#### Operating parameters

- Recommended application parameters
  - Permanent operating pressure 6 bar
  - Permanent operating temperature 70°C
  - Operating life: 50 years
- Composition of heating water according to VDI 203

#### **§** German approvals and quality certifications

- DIN CERTCO registration confirms that the pipes are suitable for use in heating installations in accordance with DIN 16892 and have the necessary impermeability to oxygen.

#### Approvals outside Germany

National approval outside Germany may vary in the respective countries from the German approvals. When using the RAUTITAN pink heating installation system in other countries, consult your REHAU sales office.

#### Delivery Make-up

d [mm]	s [mm]	DN	Volume [l/m]	Length [m]	Format
16	2.2	12	0.106	6	Straight length
				200	Coil
20	2.8	15	0.163	6	Straight length
				120	Coil
25	3.5	20	0.254	6	Straight length
				25	Coil
32	4.4	25	0.423	6	Straight length
				25	Coil
40	5.5	32	0.661	6	Straight length
50	6.9	40	1.029	6	Straight length
63	8.6	50	1.633	6	Straight length

Table 2-4: RAUTITAN pink Delivery Make-up

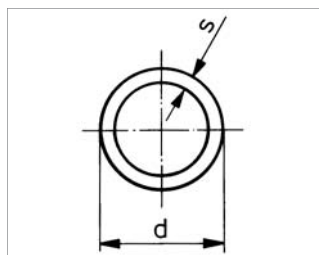


Illustration 2-10: Diameter/Wall thickness

### 2.3.3 REHAU RAUTHERM S Heating Pipe

- Pipe from RAU-PE-Xa
  - Peroxide crosslinked polyethylene (PE-Xa)
  - With oxygen barrier layer
  - Oxygen-tight in accordance with DIN 4726
  - In accordance with DIN 16892
- Area of Application
  - Panel heating/cooling
  - Heating installation in buildings
  - The safety-related equipment of the heat generators must be in accordance with DIN 4751, parts 1 to 3

**§** RAUTHERM S heating pipe may not be used in drinking water installations!

#### Operating parameters

- Recommended application parameters
  - Continuous operating pressure: 3 bar
  - Continuous operating temperature: 70 °C
  - Operating period: 50 years
- Maximum application parameters
  - Maximum operating pressure: 6 bar
  - Maximum operating temperature: 90 °C
  - Temporary failure temperature: 100 °C
- Quality of the heating water according to VDI 2035

**§**

#### German approvals and quality certifications

- The RAUTHERM S heating pipe is in accordance with DIN 16892 and DIN 4726
- DIN CERTCO registration for dimensions 14, 17, 20 and 25 (registration number 3V226 PE-Xa or 3V227 PE-Xa) certifies the use of the pipes in heating installation in accordance with DIN 4726/DIN EN ISO 15875, as well as the necessary tightness against oxygen diffusion



Illustration 2-11: RAUTHERM S heating pipe

#### Delivery Make-up

d [mm]	s [mm]	Volume [l/m]	Length [m]	Format
12	2.0	0.050	150	Coil
			300	Coil
14	1.5	0.095	120	Coil
			240	Coil
			500	Coil
16	2.0	0.113	120	Coil
17	2.0	0.113	120	Coil
			240	Coil
			500	Coil
20	2.0	0.201	120	Coil
			240	Coil
25	2.3	0.327	120	Coil
63	8.6	1.633	6	Coil

Tab. 2-5: RAUTHERM S heating pipe make-up for delivery

#### Approvals outside of Germany

National approvals outside of Germany can differ from the German approvals in the respective countries. When using the RAUTHERM S heating pipe in other countries, contact your local REHAU sales office.



## 2.4 Pipe technical data



The values in the following table should be used as a guide.



The use of inhibitors, anti-freeze agents and other drinking or heating water additives requires the authorisation of the respective manufacturer and of our application engineering section.

→ In this case, please ask your REHAU sales office.





### Caution!

#### Material damage through overloading!

It is not permissible to place maximum temperature and pressure demands on the pipe at the same time.



→ Prevent simultaneous loading with maximum temperature and pressure by building in appropriate devices (pressure reducers).

Technical data	Unit	REHAU-Pipe	
		RAUTITAN pink	RAUTHERM S
			
Material	–	PE-Xa Coated with EVAL	
Colour (surface)	–	magenta	red
Impact toughness at 20°C	–	without breaking	
Impact toughness at -20°C	–	without breaking	
When laid with support channel: Sizes 16–40 Sizes 50 and 63	[mm/(m·K)]	0.15 0.04 0.1	0.15 – –
Thermal conductivity	[W/(m·K)]	0.35	
Pipe roughness	[mm]	0.007	
Operating pressure (max.)	[bar]	10	6
Operating temperature (max.)	[°C]	90	
Short-term maximum temperature (malfunction)	[°C]	100	
Oxygen diffusion (according to DIN 4726)	–	impervious to oxygen	
Material constant C	–	12	
Building Material Class (Germany)	–	B2	
Minimum bending radius without aid	–	8 x d (when laid at temperature > 0°C)	5 x d (when laid at temperature > 0°C)
Minimum bending radius with bending spring/tool d = pipe diameter	–	5 x d	
Available sizes	[mm]	16-63	12-25


Tab. 2-6

## Pipe markings

### Description ..... REHAU pink

REHAU logo .....	REHAU
Manufacturer's mark .....	RAUTITAN pink
Dimensions .....	16x2.2
Article Number .....	136042
Nominal diameter/outside diameter .....	DN/OD16
Pressure rating .....	PN20
Dimensional class .....	SDR 7.4/S3.2
Pipe material .....	PE-Xa 80
Australian Standard Number .....	AS 2492
WaterMark logo .....	
License number .....	LN 1413
Country of manufacturer .....	Made in Germany
Application .....	HEATING ONLY
Oxygen barrier .....	oxygen barrier according DIN 4726
DIN logo .....	
DIN certification number .....	3V252
ISO standard .....	ISO 15875
Operating pressure .....	PB 12/60°C
Operating pressure .....	PB 11/70°C
Operating pressure .....	PB 9/90°C
Dutch certification for underfloor heating .....	KOMO vloerverw
Dutch certification for radiator heating .....	KOMO CV
Russian certification .....	CPT-Logo
Machine number .....	M15
Shift number .....	A
Hour of production .....	13
Date of production .....	051220
Running meter marking .....	019m

### Description ..... RAUTHERM S

REHAU logo .....	REHAU
Manufacturer's mark .....	RAUTHERM S
Dimensions .....	20x2.0
Oxygen barrier .....	sauerstoffdicht
Pipe generic name .....	RAU-VPE
DIN standard for pipe .....	DIN 16892
DIN standard for oxygen barrier .....	DIN 4726
DIN logo .....	
DIN certification number .....	3V226
Pipe material .....	PE-Xa
Austrian Certification .....	ÖNORM.B.5153.geprüft
Belgien Certification .....	ATG.1937
Operating pressure .....	PB 10/60°C
Operating pressure .....	PB 6/90°C
Russian certification .....	'CPT-Logo'
Machine number .....	M15
Shift number .....	A
Hour of production .....	13
Date of production .....	061220
Running meter marking .....	019m

## 2.5 Handling and Storage



### Caution! Potential damage to pipe material through UV radiation!

UV radiation can permanently damage PE-X pipes.

→ Always transport and store PE-Xa pipes with adequate protection from UV radiation.

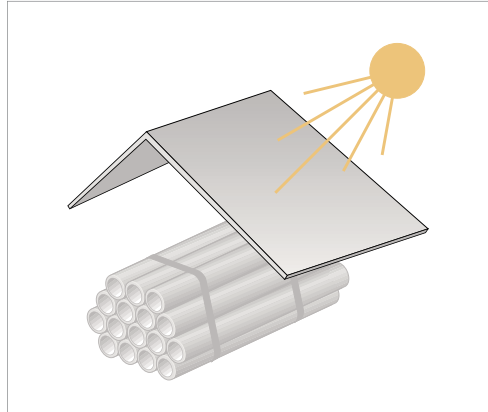


Illustration 2-12: Protect pipes from direct sunlight

Take due care to avoid unnecessary damage to pipe and components:

- Always load and unload using competent persons.
- Only transport in a fashion suitable for the material.
- Do not drag pipe across any surfaces.
- Always store on flat surface making sure there are no sharp objects underneath the pipe or in its vicinity.
- Protect from any potential mechanical damage.
- Provide protection against dirt, bore dust, mortar, oils, greases, paints etc.
- Protect from UV radiation using opaque and UV proof tarps or similar.
- During construction ensure adequate protection from direct sunlight.

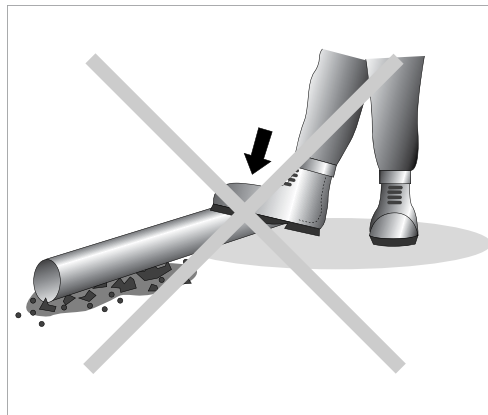


Illustration 2-13: Always store on flat surface making sure there are no sharp objects underneath the pipe or in its vicinity



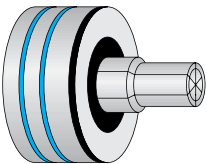
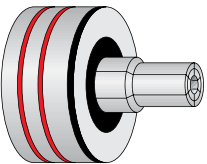
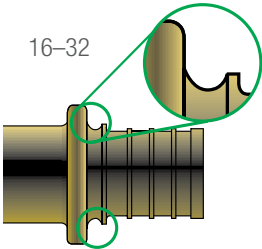
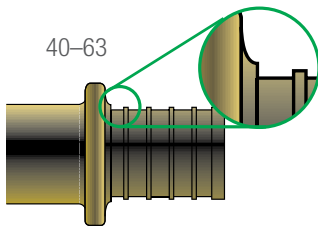
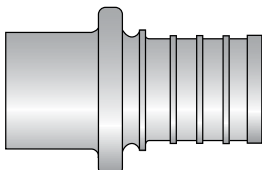
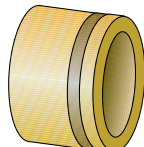
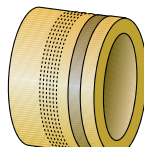
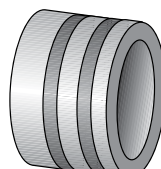
	RAUTITAN pink	Heating Pipe RAUTHERM S
		
<b>REHAU expander head</b>		
<b>REHAU fitting</b>	 	
<b>REHAU compression sleeve</b>	 	
	one circumferential groove	Two circular grooves

Table 2-7

## 2.6 Fittings

### 2.6.1 Fittings for the RAUTITAN pipe system family



- Use in sanitary and heating installations
- Suitable for all pipe types within the RAUTITAN installation system
- Permanently watertight compression sleeve connection technology according to DIN 1988 and DVGW worksheet W 534

- Embedded installation approved under DIN 18389 (VOB, German Construction Contract Procedures)
- Robust connection technology, high building-site capabilities
- No O-ring required (self-sealing pipe material)
- Simple visual inspection
- Water pressure may be applied immediately
- Pipe and fitting internal diameters are adjusted by expanding the pipe
- Brass fittings through which drinking water flows are made of special dezincification-resis-

- tant brass in accordance with DIN EN 12164, DIN EN 12165 and DIN EN 12168 grade A (strictest level of requirements)
- Universal compression sleeves for all types of REHAU pipes in the RAUTITAN domestic installation system as to prevent mix-ups
- May be used with RAUPEX SDR 7.4 pipes from REHAU industrial pipe systems
- DVGW registration (all sizes)
- For RAUTITAN pipes in drinking water installations
- For REHAU compression sleeve connections

- Production of REHAU compression sleeve connection with REHAU RAUTOOL tool
- Specially designed for the RAUTITAN range of fittings
- Developed and managed directly by REHAU

### Dimensions in RAUTITAN fitting range/RAUPEX SDR 7.4

16 x 2.2   20 x 2.8   25 x 3.5  
 32 x 4.4   40 x 5.5   50 x 6.9  
 63 x 8.6

### Material

- Fittings in the RAUTITAN installation system are made of special dezincification-resistant brass in accordance with DIN EN 12164, DIN EN 12165 and DIN EN 12168 grade A (strictest level of requirements), stainless steel.
- RAUTITAN system transitions and press transitions, both made from stainless steel, are manufactured in accordance with DIN EN 10088, part 3 (material designation 1.4404/1.4571).
- Special fittings that are used exclusively in heating installations are made of brass, copper or stainless steel.
- The compression sleeves are made of thermally destressed brass in accordance with DIN EN 12164, DIN EN 12165 and DIN EN 12168.
- More detailed material specifications can be obtained from the REHAU supply range.



Illustration 2-14: RAUTITAN fittings



### Caution!

#### Material damage!

Highly corrosive water can lead to permanent damage to the fitting.

→ Check with REHAU for installations where water quality is highly corrosive (volcanic areas, high sulphur content in water, etc) or suspected to be corrosive or in areas with known problems of fitting corrosion.



Illustration 2-15: RAUTITAN fittings for drinking water and heating installations

### Identifying the moulded parts for the heating installation



Fittings for the RAUTITAN installation system to be used exclusively for the heating applications are identified by their pink representative color or as stated in their packaging.

Fittings for the heating system are listed separately in the REHAU price list. These fittings include, e.g. REHAU elbow joint sets, REHAU T-joint sets or REHAU crossover fittings.

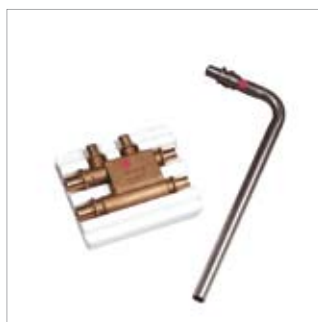


Illustration 2-16: RAUTITAN fittings are exclusively for use in heating application.

### Dezincification resistance

- The effect of specific kinds of drinking water on standard brass alloys, e.g. brass rods, can lead to a certain type of corrosion called dezincification.
- Fittings used with the RAUTITAN domestic installation systems are made of special dezincification-resistant brass and have been tested suitable for potable

water installation in accordance with DIN EN 12164, DIN EN 12165 and DIN EN 12168 grade A.

- Fittings made of dezincification-resistant brass have been proven in practice and have been used for many decades.

### Resistance to stress cracking

Brass fittings and compression sleeves for use with the RAUTITAN plumbing installation system are designed with the ability to resist pressure according to DIN EN 12164, DIN EN 12165 and DIN EN 12168 grade A.

### Erosion/Impingement damage

- Erosion refers to the wearing off of a material beginning from the surface area and is caused by high water flow velocities.
- Impingement refers to a damaging process that includes erosion and corrosion.

The RAUTITAN pipe systems are expanded before compression of the joint. The cross-sectional area of the pipe will shrink to the approximate internal bore dimension of the fitting.

This hydraulic and corrosion-resistant advantage has been used in the RAUTITAN plumbing installation systems as compared to other systems in which their pipes are not expanded at the joints.



The production of REHAU fittings in sizes 16 to 32 without prestop ceased at the end of 1997. Since then only fittings with prestop have been produced in sizes 16-32.

## 2.6.2 Additional notes about RAUTITAN fittings

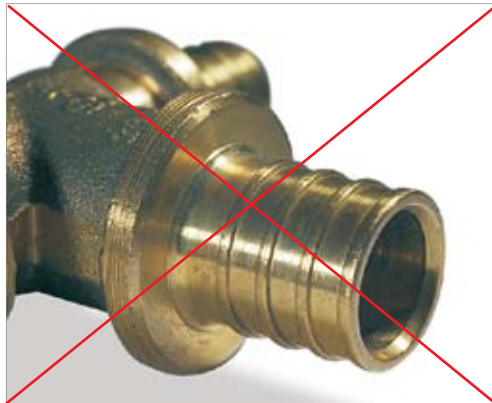


Illustration 2-17: Fitting with unformed pre-stop, sizes 16-32.

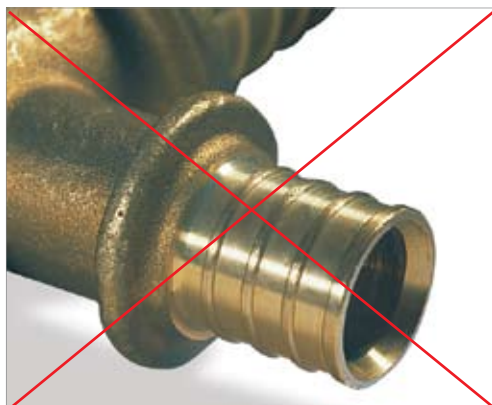
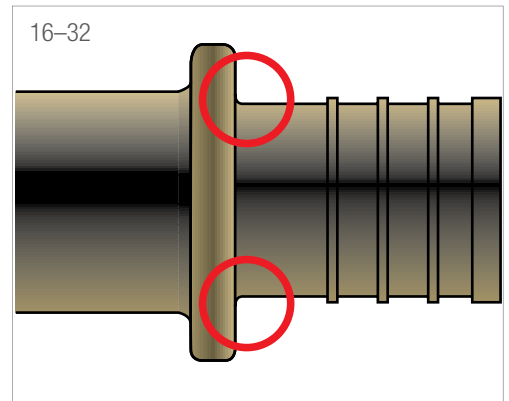


Illustration 2-18: Fitting with partially formed pre-stop, sizes 16-32

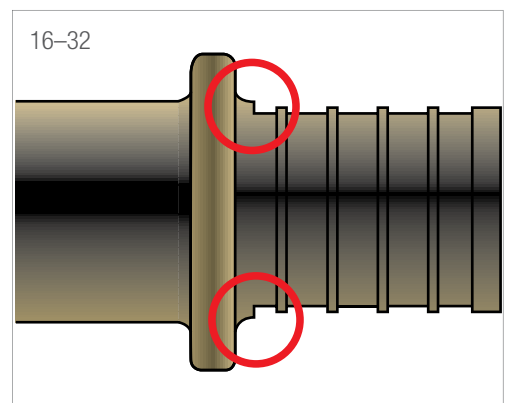
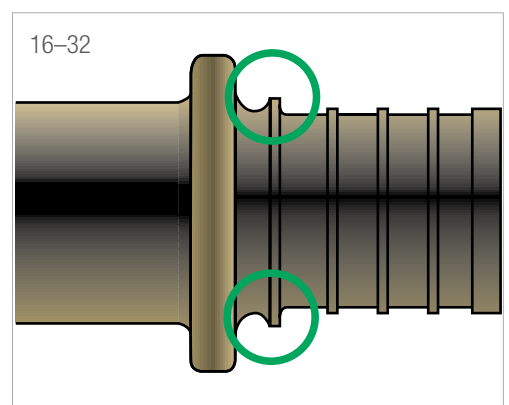


Illustration 2-19: Fitting with completely formed pre-stop, sizes 16-32



### Fitting contours of REHAU's RAUTITAN range of fittings

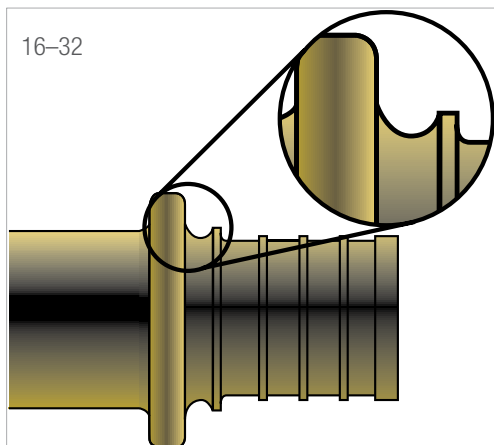


Illustration 2-20: Fitting contour for sizes 16-32, REHAU RAUTITAN fitting range

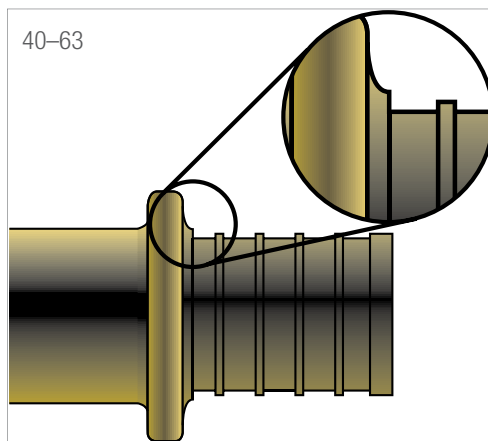


Illustration 2-21: Fitting contour for sizes 40-63, REHAU RAUTITAN fitting range

### 2.6.3 RAUTITAN compression sleeve



- Suitable for all pipe types within the RAUTITAN installation system
- Permanently leak-proof compression sleeve connector technology
  - According to DIN 1988 and DVG worksheet W534
  - Embedded installation approved under DIN 18380 (VOB)
- One common sleeve type for the complete pipe family prevents potential mix-up.

#### Dimensions of RAUTITAN compression sleeve

16 x 2.2   20 x 2.8   25 x 3.5   32 x 4.4  
 40 x 5.5   50 x 6.9   63 x 8.6

#### Material

The compression sleeves consist of thermally destressed brass in accordance with

- DIN EN 12164
- DIN EN 12165
- DIN EN 12168

#### Features

- Brass-coloured
- One circumferential groove
- Sizes 32 and 40 also with a circumferential lengthways knurling



Illustration 2-22: Compression sleeve for RAUTITAN installation system, sizes 16-25 and 50/63



Illustration 2-23: Compression sleeve for RAUTITAN installation system, sizes 32/40, with additional lengthwise knurling

### 2.6.4 REHAU Fittings for REHAU RAUTHERM S Heating Pipe

Compression Sleeve Connection with RAUTHERM S Heating Pipe.



- Permanently tight jointing technique in accordance with DIN 18380 (VOB), also allowed in the screed
- Without o-ring (self-tightening pipe material)
- Silver-coloured surface coating for easy distinction from fittings of RAUTITAN domestic installation system
- Hydraulic adjustment of pipe dimension and inner dimension of fittings through pipe expansion
- Setting-up of REHAU compression sleeve connections with REHAU RAUTOOL tool

#### Dimensions

12 x 2,0 14 x 1,5 16 x 2,0  
17 x 2,0 20 x 2,0 25 x 2,3

#### Material

- Brass with silver-coloured surface coating



The silver-coloured fittings and compression sleeves are exclusively used for connecting the red RAUTHERM S heating pipe in heating installations.



Fig. 2-24: Compression sleeve fitting for panel heating/cooling

### 2.6.5 REHAU Compression Sleeves for Underfloor Heating/Cooling

Dimensions		Characteristics
12 x 2,0	One circumferential groove, without silver-coloured surface coating	
16 x 2,0	One circumferential groove, brass with silver-coloured surface coating	
14 x 1,5	Two circumferential grooves, brass with silver-coloured surface coating	Approx. 5 mm shorter than REHAU compression sleeves of RAUTITAN domestic installation system
17 x 2,0		
20 x 2,0 25 x 2,3		

Table 2-8



Fig. 2-25 Compression sleeve for underfloor heating/cooling



## 2.6.6 Connection to other pipe systems



### Caution!

#### Material damage!

Making compression sleeve connections in an inappropriate way can result in leaks.

- Only start with the compression sleeve joints after soldering.
- Always allow solder joint to cool down first.

- For change over from other pipe systems to the REHAU RAUTITAN pipe system family, e.g. in case of repair work or when extending existing systems, a threaded connection must always be used due to warranty issues and also to provide a clear separation between both systems.
- As an exception, the RAUTITAN barb fitting made from DR brass can be used for solder or crimp connections and the stainless steel barb for crimp connections when joining up to stainless steel pipe systems.
- When connecting the RAUTITAN pipe system to other soldered or metal crimp fitting systems (crimping systems in accordance with DVGW worksheet W534), always use the RAUTITAN barb fitting.
- Connections to solder or crimp systems made from copper or mild steel (heating installations) are possible.
- When used together with metal crimp system make sure the crimp end of the RAUTITAN barb has no cracks and is not deformed.
- Always follow the recommendations of the crimp fitting manufacturer.



- For connections to stainless steel systems only use the RAUTITAN stainless steel barb or use threaded connectors made from stainless steel.

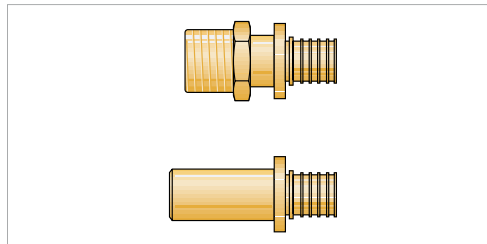


Illustration 2-26: RAUTITAN fittings for connection to other materials

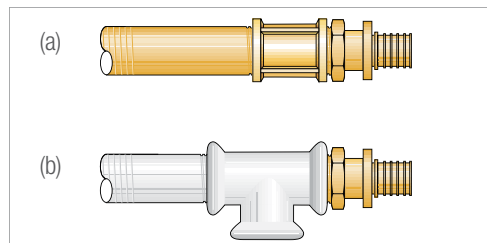


Illustration 2-27: RAUTITAN straight connector with external thread screwed into:

- (a) brass fittings
- (b) systems with galvanised pipes and fittings

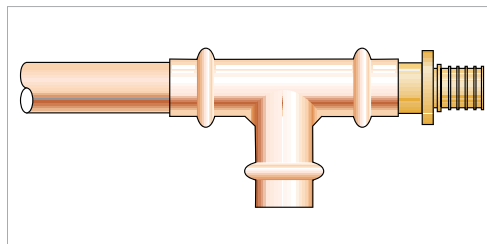


Illustration 2-28: RAUTITAN connecting barb with copper pressure system

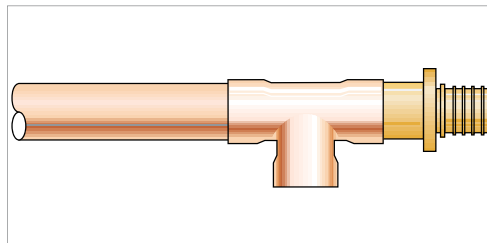


Illustration 2-29: RAUTITAN connecting barb soldered into copper system

### Connecting to Stainless-Steel Systems

- For indirect connections of the RAUTITAN pipe system to another manufacturer's stainless steel system, e.g. via valves, meter or similar fittings, fittings other than the RAUTITAN stainless steel barbs can be used.

→ For direct connections between the RAUTITAN pipe system and other stainless steel systems, the RAUTITAN stainless steel barbs and threaded connectors must be used.

**i** There is a great difference in strength between stainless steel and dezincification resistant brass. When using threaded connectors in smaller sizes (up to size 32 or with threads up to R1/Rp1), this difference in material strength can result in the brass fittings being subjected to stresses above their capability without visible signs. If the connections are made in a vice prior to installation, the stainless steel thread can permanently damage the brass thread due to the usually high torques applied in this situation.

Thick-walled fittings, such as concealed valves, controls or threaded transitions in larger sizes, are less prone to this type of failure.



### Caution! Material damage from corrosion!

Please follow fitting manufacturer advice with regards to suitable thread sealing methods.

- Do not use sealing tapes or sealants (e.g. made from Teflon) that release water-soluble chloride ions.
- Use sealants that do not give off water-soluble chloride ions (e.g. hemp).

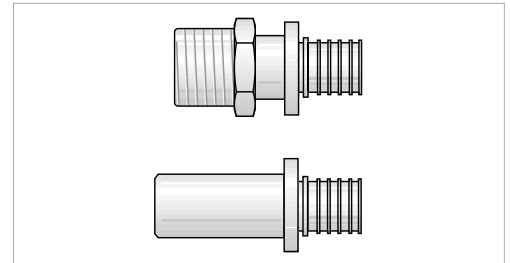


Illustration 2-30: RAUTITAN system transition with external thread and RAUTITAN stainless-steel system press transition.

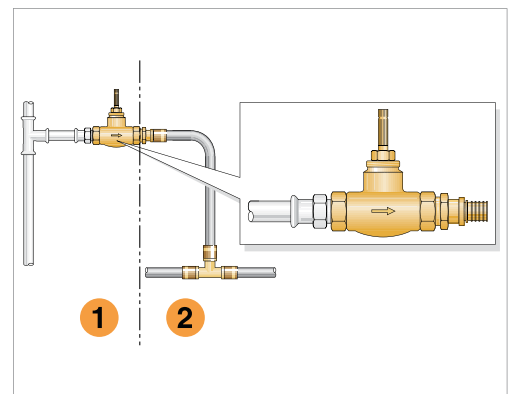


Illustration 2-31: Connecting to a concealed valve (example)  
1 Stainless-steel system with concealed valve  
2 RAUTITAN with straight connectors

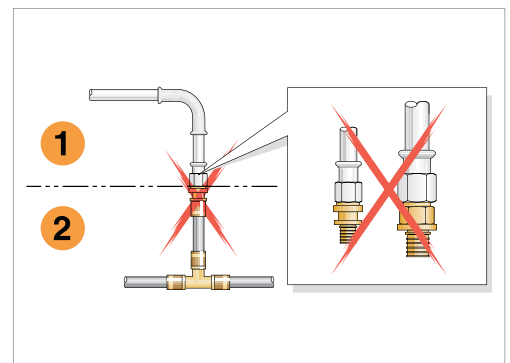


Illustration 2-32: No direct transition from stainless-steel systems to RAUTITAN systems up to size 32 or with threads up to R1/Rp1  
1 Stainless-steel system  
2 RAUTITAN with straight connectors



### Caution!

#### Material damage from using wrong fittings!

Installing the wrong fittings can damage or destroy the fittings.

→ Observe the size specifications given on the fittings.

Combining brass and stainless steel fittings in one connection has been standard practice for a long time.

Manufacturers of stainless steel systems do not clearly specify the requirements for direct connections to other systems in regards to warranty cover.

REHAU specifies solely its RAUTITAN stainless steel barbs and threaded connectors for direct connections to stainless steel pipe systems.

Installation and handling guidelines for RAUTITAN stainless steel adapters are the same as for RAUTITAN barb and thread fittings made from DR brass.

### 2.6.7 Connection to valves, meters and similar fittings

Straight tap connectors with gasket make it simple to connect to any type of valve, meter and similar fittings.



Illustration 2-33: RAUTITAN straight connector with gasket

RAUTITAN pipe sizes	RAUTITAN straight connector with gasket for flat surfaces		Valves, meters and similar fittings Fittings with external threads to connect to pipe threads according to DIN3546, part 1
	Item No.	Item description	
16	139551-002	16 - ½ " FI Nut	–
16	137144-001	16 - ¾ " FI Nut	G ¾
20	139561-002	20 - ½ " FI Nut	–
20	139571-002	20 - ¾ " FI Nut	G ¾
25	139912-001	25 - ¾ " FI Nut	–
25	139922-001	25 - 1" FI Nut	G 1
32	139932-001	32 - 1" FI Nut	–
32	241475-001	32 - ¼ " FI Nut	G 1¼
32	137154-001	32 - ½ " FI Nut	–
40	137265-001	40 - ½ " FI Nut	G 1½
40	137164-001	40 - 2" FI Nut	–
50	137275-001	50 - 1¾ " FI Nut	G 1¾
63	137285-001	63 - 2 ¾ FI Nut	G 2¾

Table 2-9: Possible connection to valves, meters and similar fittings

**Caution!****Material damage from corrosion!**

Corrosion can destroy fittings.

- Protect fittings and compression sleeves against contact with masonry or with screed, cement, plaster, quick-setting adhesive, aggressive media and other corrosive materials and substances by appropriate wrapping.
- Protect fittings, pipes and compression sleeves from moisture.
- Make sure that sealants, cleaning agents, mounting foams etc. used contain no components containing ammonia.

**Caution!****Material damage!**

Impermissibly high stresses on materials can damage fittings.

- Avoid excessive tightening of threaded connections.
- Use correct spanner.
- Don't squeeze fitting too tight in vice.
- Using a pipe wrench can damage fittings.
- Do not use excessive amounts of hemp in threaded connections. Thread ridges must still be recognisable.
- Do not cause plastic deformation of fitting, e.g. by hitting with hammer.

## 2.6.8 Handling instructions for fittings

The following instructions are to be followed for handling threaded fittings:

- Only use sealants approved (e.g. by DVGW) for gas and water installations.
- Do not extend the operating levers of fitting tools, e.g. with pipes.
- Screw fitting and pipe together so as to leave thread run-out visible.
- Check compatibility of different thread types before twisting them together, e.g. for tolerance and ease of turning.
- When using long threads, observe the maximum possible length for screwing-in and ensure that there is sufficient depth of thread in the corresponding internally threaded part.

The following thread types on fittings with threaded transitions connections exist:

- Threads in accordance with ISO 7-1 and DIN EN 10226-1:  
Rp = external threads, parallel  
R = external threads, tapered
- Threads in accordance with ISO 228:  
G = external threads, parallel, non sealing thread



For extending systems, REHAU recommends threaded fittings made from DR brass.

## Positioning fittings

**Caution!****Material damage!**

Aligning fittings with inappropriate tools or in an inappropriate manner can lead to damaged threads and stress corrosion cracking.

- Always align fittings using appropriate tools, e.g. pipe nipple or spanner.

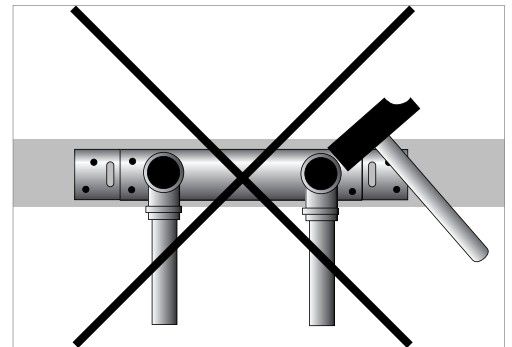


Illustration 2-34: Do not align fittings with hammer

### Protection against corrosion or damage

- In aggressive environments (e.g. animal enclosure, enclosed in concrete, sea water atmosphere, cleaning agents, embedded into concrete), provide adequate and impermeable protection for REHAU pipes and fittings against corrosion.
- Protect fittings, pipes and compression sleeves from moisture.
- Protect REHAU systems against mechanical damage.

## 2.7 REHAU RAUTOOL installation tools



### Warning! Danger of injury!

Inappropriate handling of certain REHAU tools can result in severe cutting injuries, crushed or severed limbs.

→ Before using REHAU tools carefully read through and observe the instructions in the relevant operating manual.

→ If these operating manuals are not available with the REHAU tool, please order them.



→ You can download operating manuals on the Internet from [www.REHAU.com](http://www.REHAU.com)



Only fully functional and undamaged original REHAU RAUTOOL installation tools guarantee easy installation and safe connection technology.

→ Stop using damaged tools and send them to the nearest REHAU sales office for repair.



### Caution! Joint Integrity failure!

RAUTOOL compression tools are only suitable on RAUTITAN pipes and fittings.

→ When used with other pipes or fittings, joint integrity will not be guaranteed.



- RAUTOOL installation tools are specially designed for the RAUTITAN range of fittings
- Developed and managed directly by REHAU
- RAUTOOL installation tools are constantly being improved and developed.
- Various types of drive may be chosen for RAUTOOL installation tools
- With connection sizes 16-40:
  - Expansion and compression may be carried out without changing of tool
  - Hydraulic or manual expansion possible
- With connection sizes 16–32:
  - Double compression jaws, 2 pipe sizes may be processed without changing of tool
- Flexible and favourable tool handling
  - Compact construction
  - Easy installation even in tight situations (unfavourable installation position)
  - Separation of drive unit and compression tool with hydraulic tools, RAUTOOL H1,

E2 and G1

- No calibration of REHAU pipes necessary with REHAU compression sleeve connection
- REHAU pipes in any size are cut to length with REHAU pipe cutters, saving time and space. There is no need to use rolling pipe cutters.
- RAUTOOL installation tools need no maintenance. Only in the case of the battery-powered RAUTOOL A2, a LED display gives a visual indication that service is due.

### REHAU RAUTOOL compression sleeve tools

- For the REHAU RAUTITAN domestic installation system
- For REHAU underfloor heating/cooling

#### 2.7.1 RAUTOOL L1

- Manual tool with dual compression jaw (16/20)
- Field of application: Sizes 16-32

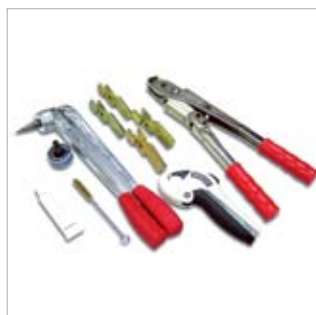


Illustration 2-35: RAUTOOL L1

#### 2.7.2 RAUTOOL M1

- Manual tool with double compression jaw for 2 pipe sizes
- Field of application: Sizes 16-40



→ Use the original M1 compression jaw with RAUTOOL M1.

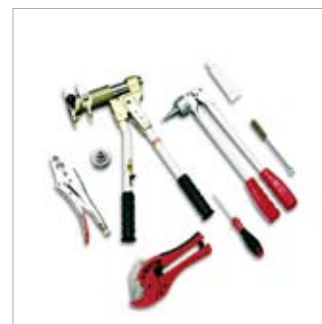


Illustration 2-36: RAUTOOL M1

#### 2.7.3 RAUTOOL H1

- Mechanical-hydraulic tool with double compression jaw for 2 pipe sizes
- Field of application: Sizes 16–40
- Operated by foot/hand pump

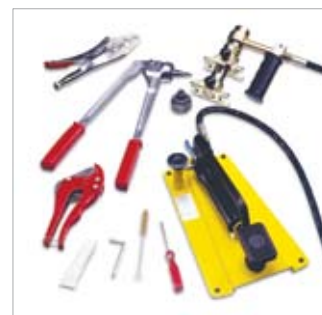


Illustration 2-37: RAUTOOL H1

#### 2.7.4 RAUTOOL E2

- Electro-hydraulic tool with double compression jaw for 2 pipe sizes
- Field of application: Sizes 16–40
- Operated by electric hydraulic unit connected to the tool cylinder by an electro-hydraulic hose
- The tool cylinder can optionally be used for hydraulic expansion.



Illustration 2-38: RAUTOOL E2

#### 2.7.5 RAUTOOL A2

- Battery-hydraulic tool with double compression jaw for 2 pipe sizes
- Field of application: Sizes 16–40
- Operated by battery-powered hydraulic unit positioned directly on tool cylinder
- The tool cylinder can optionally be used for hydraulic expansion.



Illustration 2-39: RAUTOOL A2

#### 2.7.6 RAUTOOL G1

- Tool for pipe sizes 50-63 (optionally available in size 40 x 5.5)
- Operated by electro-hydraulic unit
- The tool cylinder is used for expansion and moulding.



Illustration 2-40: RAUTOOL G1

#### 2.7.7 RAUTOOL HG1

- Tool for pipe sizes 50-63 (optionally available in size 40 x 5.5)
- Operated by mechanical-hydraulic unit.
- The tool cylinder is used for expansion and compression.

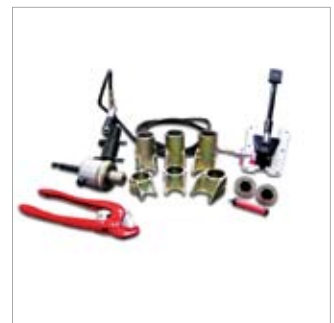


Illustration 2-41: RAUTOOL HG1



All accessories for the hydraulic tools RAUTOOL H1, RAUTOOL E1/E2 and RAUTOOL A1/A2 are interchangeable. Expander tools and expander heads within the REHAU RO expander system for pipe sizes up to 32 are also fully interchangeable.

## 2.8 REHAU pipe cutters



### Warning! Cutting injuries!

Inappropriate handling and storage of REHAU pipe cutters can result in severe cutting injuries, crushed or severed limbs.

- Always hold the pipe at a safe distance from the pipe cutter.
- Handle and store REHAU pipe cutters safely to prevent any injury through the sharp blade.

→ When cutting REHAU pipes to length:

- Use the correct REHAU pipe cutter for the pipe size.
- Cut pipes burr-free and at square.
- REHAU pipe cutters must be in good working condition.

→ Check cutter blade regularly for damage, and replace blade or complete cutter as necessary.

- A damaged or blunt blade can cause burrs or mark the pipe and may cause the pipe to tear during expansion.

### 2.8.1.1 REHAU 25 pipe cutter

- For burr-free cutting of PE-X pipes up to size 25

### 2.8.1.2 REHAU 40 pipe cutter

- For burr-free cutting of PE-X pipes up to size 40

### 2.8.1 REHAU 63 pipe cutter

- For burr-free cutting of PE-X pipes in sizes 40-63






Pipe sizes		to 25	to40	40 to 63
RAUTITAN pink		<b>REHAU 25 pipe cutter</b>  	<b>REHAU 40 stabil pipe cutter</b>  	<b>REHAU 63 pipe cutter</b>  
RAUTHERM S				

Table 2-10: Selection of REHAU pipe cutters

## 2.9 REHAU expander tools

### 2.9.1 How to identify correct REHAU expander head

- Pipe dimension designation
- Chamfered expander segments



#### Caution!

#### Material damage!

Expanding pipes with the wrong expander head can cause leakages.

- Always use the correct REHAU expander head according to pipe size and type.



Illustration 2-42: REHAU expander heads

Pipe sizes		REHAU expander heads	REHAU expander bits	Expander head for RAUTOOL G1
RAUTITAN pink				
RAUTHERM S				

Table 2-11: Selection of REHAU pipe expander tools



## 2.9.2 Possible combinations of REHAU expander heads with expander tools

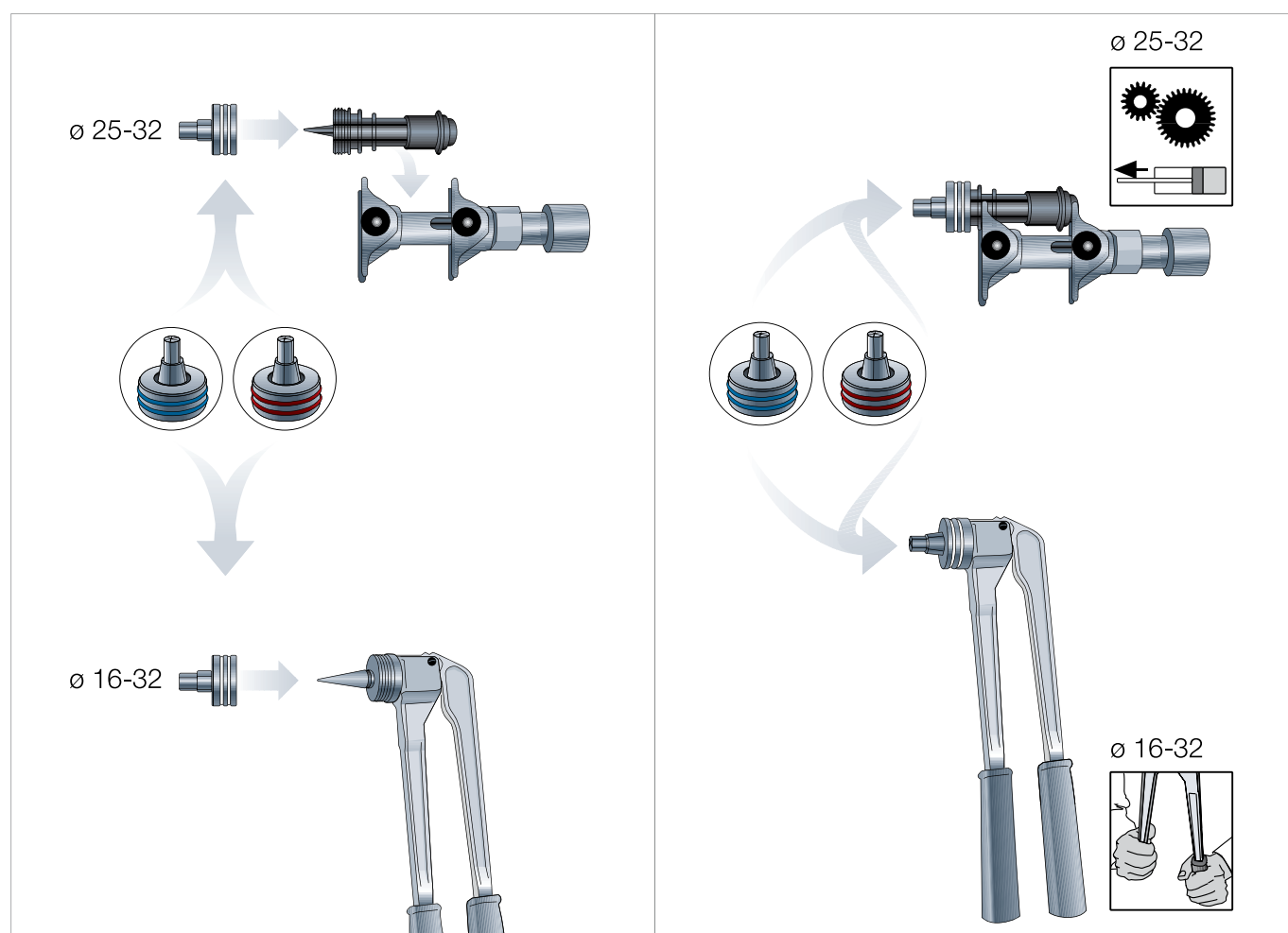


Illustration 2-43: Possible combinations of REHAU expander heads with REHAU RO expander tool or REHAU universal expander bit 25/32 system RO

## 2.9.3 REHAU expander bits

- REHAU Universal Expander Bit 25/32 System RO
- Use REHAU 40 x 5.5 expander bit in combination with REHAU tools RAUTOOL H1, E1, E2, A1 and A2

**i** Hydraulic tool allows effortless expansion of pipes.



For pipe sizes 25 and 32, REHAU recommends its universal expander bit system RO as an alternative to the manual expansion tool. The universal expander bit is used in combination with the 25/32 dual compression jaws.

## 2.9.4 Expander heads for REHAU RAUTITAN pink



Illustration 2-44

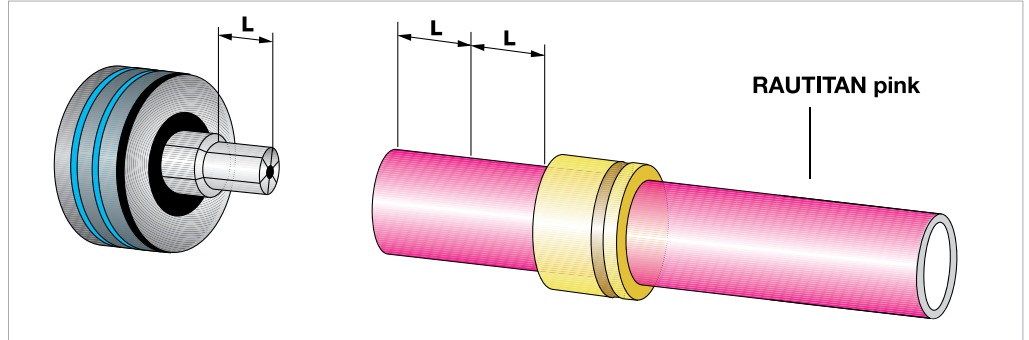


Illustration 2-45: RAUTITAN pipes - Expander head with blue marking



→ Only expand RAUTITAN pipes with blue-marked expander heads

REHAU 40 x 5.5 expander bit can only be used for expansion with REHAU tools RAUTOOL H1, E1, E2, A1 and A2.

- Expander of pipes in size 40 x 5.5 with
  - REHAU expander bit 40 x 5.5
  - Expander head of RAUTOOL G1
- Expansion of pipes in sizes 50 and 63 with
  - Expander head of RAUTOOL G1



The flexibility of the oxygen barrier on the RAUTITAN pink pipe can sometimes vary from that of the inner layer made from cross-linked PE. This can cause small tears in the oxygen barrier during the expansion process, particularly if done at low ambient temperatures.

However, such tears have no effect on the overall performance of the pipe. Because they are restricted to the area of the compression sleeve joint and as such are shielded from both sides by impermeable metal, the effect on the oxygen diffusion requirements according to DIN 4726 are negligible.



Illustration 2-46: Expander head of RAUTOOL G1



Illustration 2-48: Expander insert for the tools RAUTOOL E2 and A2



Illustration 2-47: REHAU expander bit 40 x 5.5

### 2.9.5 Expanding Heads for REHAU RAUTHERM S Heating Pipe



Illustration 2-49 Expanding head with red marking for RAUTHERM S 17–25 heating pipes

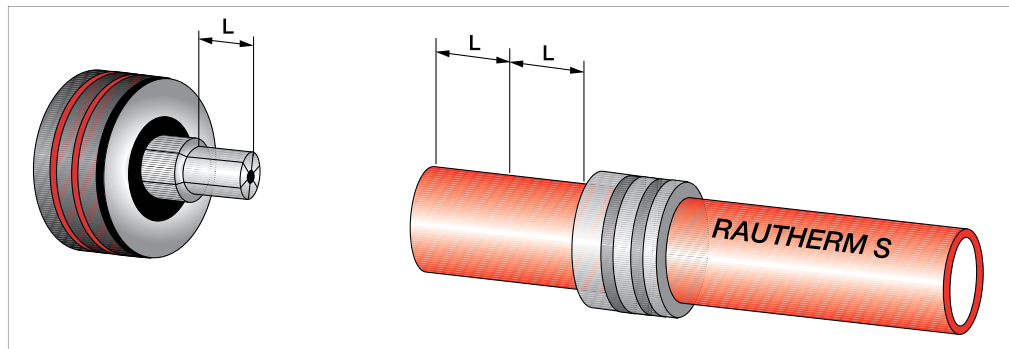


Illustration 2-50: RAUTHERM S heating pipe – expanding head with red marking



→ Expand RAUTHERM S 17–25 heating pipes only with expanding heads with red markings.

The 16 x 2.0 RAUTHERM S pipe is expanded with 16 x 2.2 expanding head (blue-coloured marking).



The RAUTHERM S heating pipe is coated with an oxygen barrier layer. The oxygen barrier layer is not always as flexible as the basic pipe that is made of crosslinked polyethylene. Therefore, it might,

under certain circumstances (e.g. low processing temperatures), result in slight cracks in the barrier layer during expansion of the pipe. However, these cracks do not compromise the usability of the pipe nor influence the tightness of

the compression sleeve connection. As these cracks are located in the area of the compression sleeve connection, and are surrounded by diffusion-tight metal on both sides, they do not present significant influence on the oxygen tightness in accordance with DIN 4726.

## 2.9.6 Expansion of REHAU pipes



### Caution!

#### Material damage!

Use of defective expander heads can damage the pipe.

- Do not use defective expander heads.



### Caution!

#### Material damage!

Dirty or defective expander heads can reduce the integrity of the joint.

- Do not put any grease or similar matter on the surface of the expander mandrel.
- Grease REHAU expander heads only from inside.
- Do not use any dirty or defective expander heads, pipes or connection components.

When expanding REHAU pipes take note:

- With REHAU compression sleeve connections from size 16, expand all pipes using the same procedure.
- Use the correct REHAU expander head according to pipe size.
- Screw the REHAU expander (16-32) head completely onto the REHAU expansion tool (must not come loose when tool is rotated).
- Only expand REHAU pipes using a complete and intact expander head.
- Always insert the expander segments fully into the pipe.

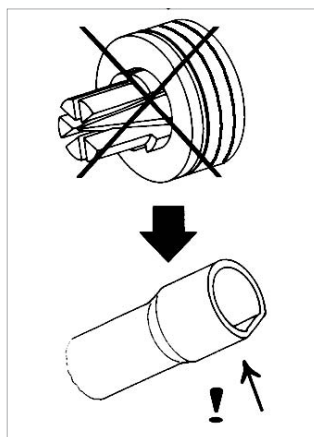


Illustration 2-51: Damaged pipe from defective expander head

- Ensure REHAU expander heads operate smoothly and are free from any dirt. If necessary clean and lubricate from inside.



Required accessories (brush, lubricating grease, etc.) are provided with each REHAU tool kit.

- When expanding the pipe, the effected area must have a uniform temperature.
- Localized hot spots (e.g. through flood lights etc) have to be avoided.
- Expand the pipe cold and insert the fitting.



- Ensure a uniform expansion over the whole circumference of the pipe.
- Trim back and dispose of any pipe sections which are not evenly expanded.

### 1. Step Expand pipe end once.

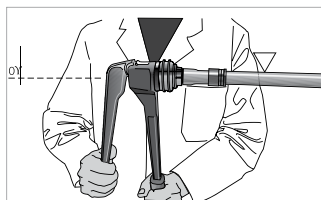


Illustration 2-52: Expansion procedure 1

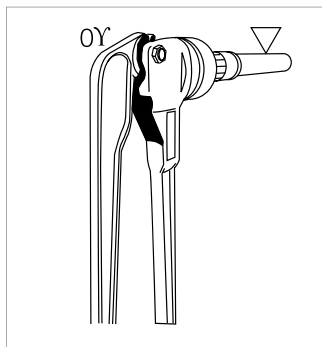


Illustration 2-53

### 2. Step Rotate expansion tool about 30°; pipe remains in initial position.

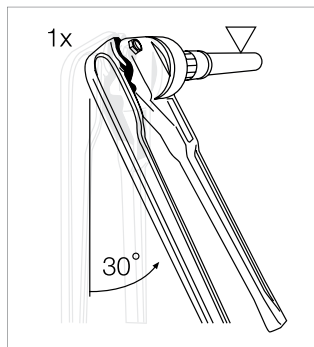


Illustration 2-54

### 3. Step Expand pipe end again.

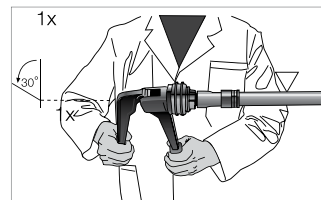


Illustration 2-55: Expansion procedure 2

## 2.10 Jointing of REHAU compression sleeve connection



### Warning! Danger of injury!

Inappropriate handling of REHAU tools can result in severe cutting injuries, crushed or severed limbs.

- Always read the operating instructions carefully before using the REHAU tools and follow the instructions given.
- Observe the safety instructions and information in the present technical information.



### Caution! Material damage!

Soiled or damaged system components, pipes and fittings can reduce the integrity of the joint.

- Do not use soiled system components, pipes or fittings.



The step by step instructions on how to make a compression sleeve joint on the following pages are applicable to pipe sizes 16 to 32. The handling of tools and the details on how to make a compression sleeve joint with larger pipes must be obtained from the respective operating instructions.



You can download operating manuals on the Internet from

**[www.REHAU.com](http://www.REHAU.com)**



- Universal REHAU compression sleeve technology
- Permanently leakproof connection
- No O-ring required (self-sealing pipe material)
- Simple visual inspection
- Joints can be immediately subjected to water pressure.
- Pipe does not have to be calibrated or deburred.
- Robust jointing system, which is ideal for harsh conditions on construction sites.



→ Only use REHAU RAUTOOLS to make REHAU compression sleeve joints.



To make installations easier at temperatures around (-10°C), which is the lower limit for handling the pipes, we recommend hydraulically operated RAUTOOLS.

### 2.10.1 Cutting pipe to length



**Warning!**  
**Cutting injuries from sharp blade!**

Inappropriate handling of REHAU pipe cutters can result in severe cutting injuries, crushed or severed limbs.

→ Maintain safe distance for the holding hand from the pipe cutter.

- Check that the pipe cutter is in working condition before starting work.
- Note the pipe size and use the appropriate pipe cutter.
- Cut pipe burr-free and at right angles using pipe cutter.

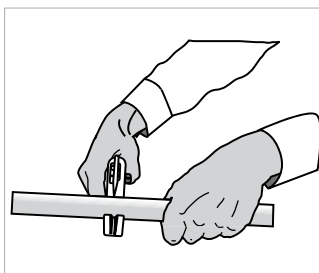


Illustration 2-56: Cut pipes at right angles.

### 2.10.2 Sliding the sleeve over the pipe

→ Slide the REHAU compression sleeve onto the pipe with the square face first so the chamfered end faces towards the joint.

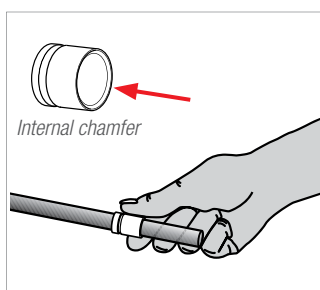


Illustration 2-57: Sliding the sleeve over the pipe

### 2.10.3 Expanding pipe with expander tool



**Caution!**  
**Material damage!**

Inappropriate handling of REHAU expander tools can cause pipe damage and result in leakages.

- Use a REHAU expander head designated for the respective REHAU pipe type.
- Maintain minimum distance between pipe end and compression sleeve (at least two times compression sleeve length).
- Insert only REHAU compression sleeve fittings into the expanded pipe end (no foreign objects).

- Expansion procedure:
- Expand pipe end once.
- Rotate expander tool by 30° while leaving the pipe in its original position.
- Expand pipe end again.

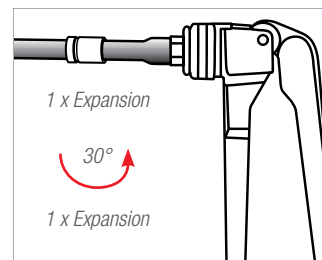


Illustration 2-58: Expanding pipe with expander tool



The pipe is expanded cold and the fitting is inserted into the pipe.

- Push expander segments fully into the pipe all the way to the end stop.
- Make sure to hold the expander parallel to the pipe when expanding and not at an angle.

### 2.10.4 Insert fitting into expanded pipe



#### Warning! Danger of injury!!

The fitting may fall out of the pipe at any time until the joint is fully completed.

→ Until the joint is completed, hold the components in such a way that they cannot come apart when placed into the compression tool jaws or during compression.

→ Immediately push in fitting all the way to the pre-stop, once the pipe is expanded.

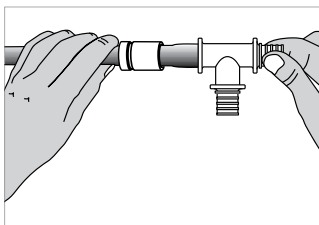


Illustration 2-59: Inserting fitting into expanded pipe



If the pipe is expanded correctly the fitting can be inserted without force.

The pipe is shrinking back again (memory effect) and after a short time the fitting is held firmly inside the pipe.

### 2.10.5 Inserting components into compression tool jaws



#### Warning! Danger of injury!

Inappropriate handling of certain REHAU tools can result in severe cutting injuries, crushed or severed limbs.

→ Always read the operating instructions carefully before using the REHAU tools and follow the instructions given.

→ Use the correct compression jaws for the respective size.

→ Do align the tool properly with the pipe and fitting (as shown in illustration) ensuring the fitting and sleeve are fully inside the jaws and in full contact.

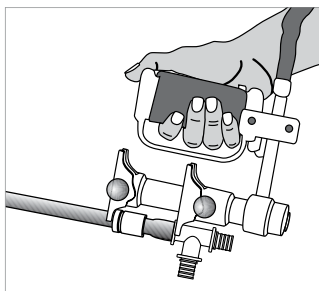


Illustration 2-60: Insert compression sleeve connection into compression tool



An expansion of the sleeve does not reduce the quality of the REHAU compression sleeve connection and does mainly occur when older REHAU expansion heads are used.

Using older REHAU expander heads on RAU-PE-Xa pipes, the compression process can result in pipe material being pushed together in front of the sleeve creating a bulge. In this case stop the compression process immediately before the bulge (about 2mm gap between sleeve and fitting collar).

### 2.10.6 Slide the compression sleeve up as far as the fitting collar



#### Caution! Potential damage to component!

Incorrect handling during the compression sleeve jointing process can result in damage to pipes, fittings, sleeves or tools.

→ Do align the tool properly with the pipe and fitting (as shown in illustration) ensuring the fitting and sleeve are fully inside the jaws and stay in full contact with them at all times.

→ Push the compression sleeve up completely to the fitting collar

→ Do not use any lubricant, water, or the likewise when making a REHAU compression sleeve connection.

- Operate the pressure switch or pedal on the tool.
- Slide the compression sleeve up completely to the fitting collar.

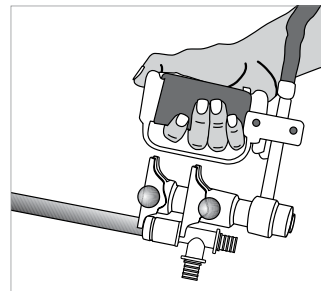


Illustration 2-61: Sliding up compression sleeve

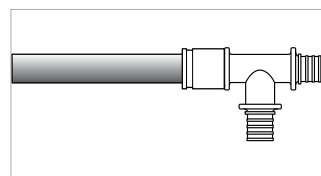


Illustration 2-62: RAUTITAN compression sleeve connection after compression

- Clean and grease tool after use.
- Store tool in dry conditions.

## 2.11 Taking apart a REHAU compression sleeve connection

### 2.11.1 Cutting out the fitting



#### Warning! Cutting injuries!!

Inappropriate handling of REHAU pipe cutters can result in severe cutting injuries, crushed or severed limbs.

→ Always hold the pipe at a safe distance from the pipe cutter.

→ Cut out the fitting completely from the existing pipework using a REHAU pipe cutter.

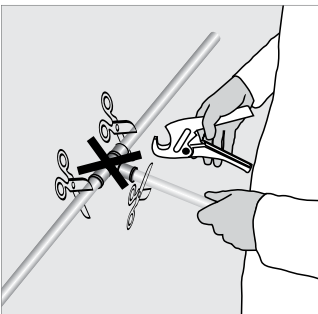


Illustration 2-63: Cutting out fittings

### 2.11.2 Heating up fitting



#### Warning! Danger of burns!!

Inappropriate handling of the hot air gun can result in burns.

→ Observe the safety instructions in the user manual of the hot air gun.

→ Heat up the cut out fitting with a hot air gun.

→ At a temperature of about 135°C pull the sleeve of the fitting.

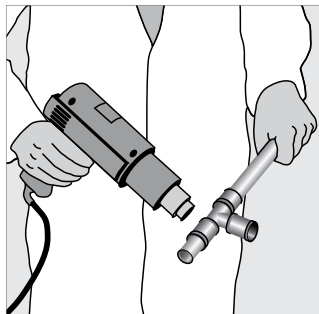


Illustration 2-64: Heating up the fitting

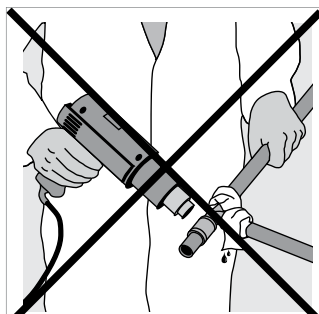


Illustration 2-65: Incorrect procedure, not allowed



Not permitted!

→ The fitting must always be completely removed from the pipework before it can be heated up!

### 2.11.3 Pulling off the compression sleeve



#### Caution! Material damage!

Compression sleeves and pieces of pipe which have already been compressed once may not be used again for a new connection.

→ Dispose of removed compression sleeves together with the removed pieces of pipe.



- Used fittings with no damage can be used again.



In cases where these instructions are not followed (e.g. if fittings are heated while still connected to the main pipework), the REHAU warranty is void.

- Pull pipe off the fitting.
- Clean fitting from any dirt.
- Fitting can be used again if undamaged.
- Do not use removed sleeves and pipes again.
- Dispose of removed compression sleeves together with the removed pieces of pipe.

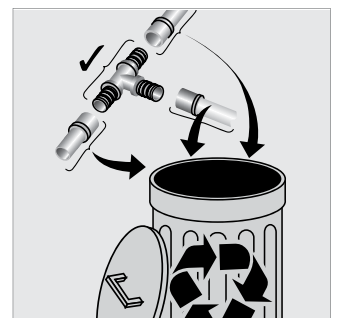


Illustration 2-66: Pulling off compression sleeve, throwing out compression sleeve and pipe



## 2.12 Details of REHAU compression sleeve connection

### General notes

- Permanently leakproof connection technology (according to DVGW worksheet W534 and DIN 4726).
- Can be used in concealed in-

stallations, such as wall chases or embedded in screed/concrete without need for access (according to DIN 18380).

- No O-ring required for additional sealing.

- May only be used with corresponding REHAU fittings.
- Only use REHAU RAUTOOL compression sleeve tools for the connection.

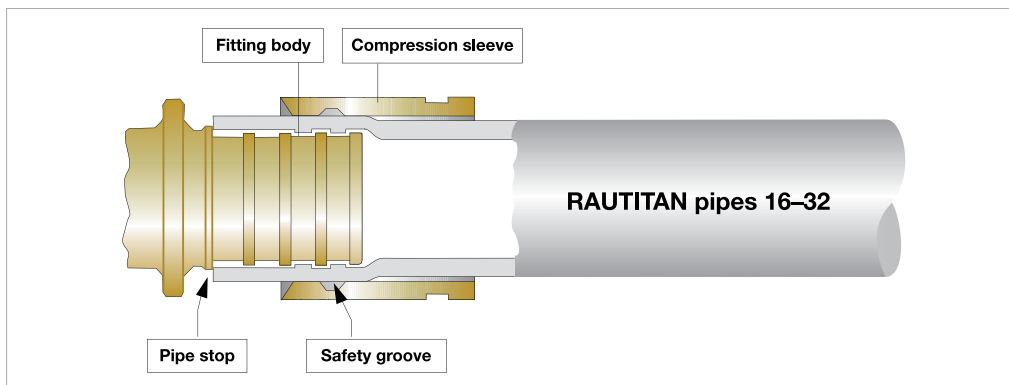


Illustration 2-67: Compression sleeve connection with REHAU RAUTITAN pipes in sizes 16-32

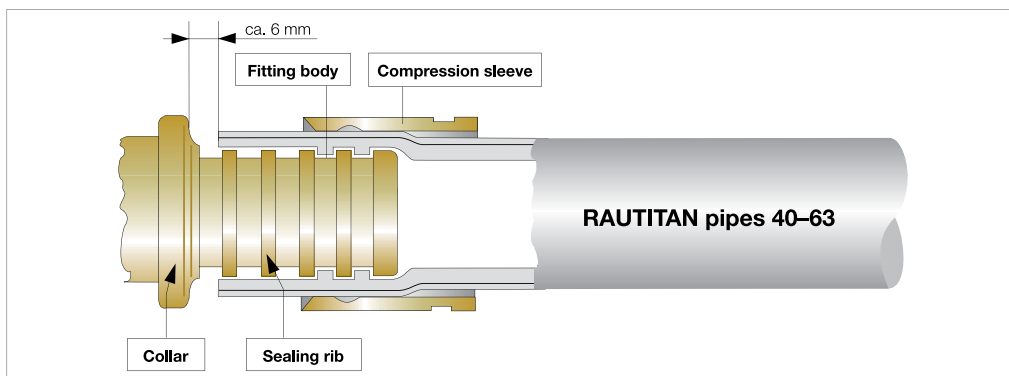


Illustration 2-68: Compression sleeve connection with REHAU RAUTITAN pipes in sizes 40-63

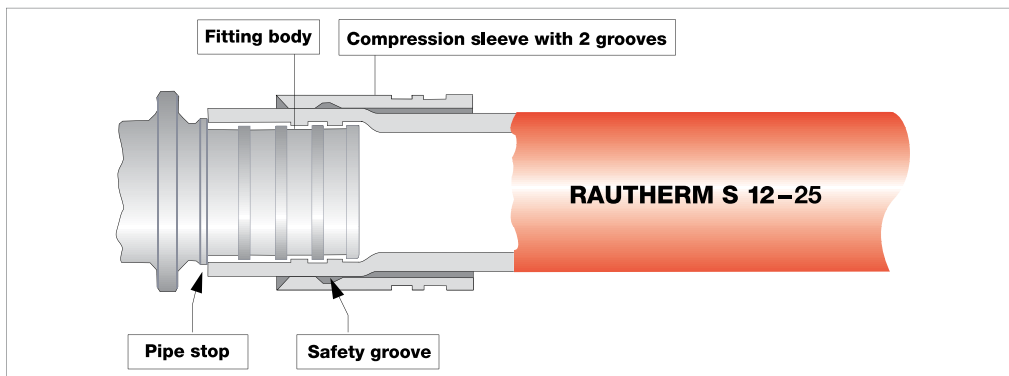


Illustration 2-69: Compression sleeve connection with RAUTHERM S pipes in sizes 12-25

## 2.13 Bending RAUTITAN pipes

### 2.13.1 Bending RAUTITAN pipes



Using hot air gun or similar heater to heat up the RAUTITAN pink pipe is not permitted as it may damage the oxygen barrier of the pipe.

It is not always necessary to use elbows for pipe sizes 16 to 32. With REHAU pipe bend brackets, 45° and 90° bends can be bend at ambient temperature, easily and quickly.

We recommend the use of REHAU compression sleeve fittings for pipe dimensions between 40 and 63.

### Minimum bending radius

When bending pipes without the use of pipe bend bracket, the minimum bending radius is 8 times the outer diameter of the pipe.

When using the pipe bend brackets for plumbing installation, the minimum bending radius is 3 times the pipe diameter and for heating installation, the minimum bending radius is 5 times the pipe diameter.

The minimum bending radius is determined with respect to the pipe centre.

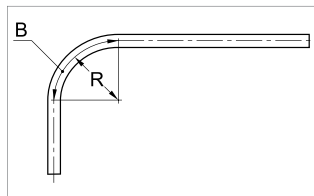


Illustration 2-70: R = Bending radius  
B = Bent arc length

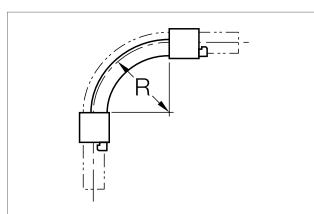


Illustration 2-71: REHAU pipe guide bends Sanitary/Heater 5 x d 90 degrees for dimension 32; R = bending radius

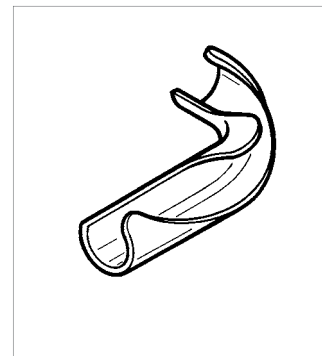


Illustration 2-72: REHAU pipe bend bracket Plumbing/Heating 5 x Ø 90° for dimensions 16-25

REHAU pipe	RAUTITAN pink/RAUTHERM S Heating installation system with REHAU pipe bend brackets, Sanitary/Heater 5 x d 90°		RAUTITAN pink/ RAUTHERM S Manual bending (90°), 8 x d	
	R	B	R	B
16	80	126	128	201
20	100	157	160	251
25	125	196	200	314
32	160	251	256	402

Table 2-12: Minimum bending radii of RAU-PE-Xa pipes

## 2.14 Laying the REHAU pipes

### 2.14.1 Installation in areas with asphalt screed

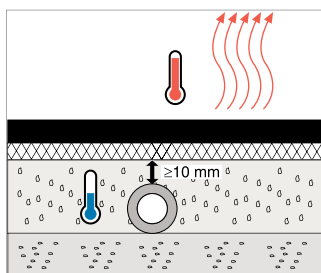


Illustration 2-73: Laying under hot asphalt screeds

Hot asphalt screeds are laid at temperatures of around 250°C. The following measures must at least be taken to protect the pipes from these high temperatures:

- Lay pipes directly onto subfloor.
- Embed pipes completely in insulation granules.

Use insulation granules made from volcanic pearlite (this material can also be used for leveling purposes and has good acoustic and thermal insulation properties).

There is no limit on the maximum thickness for the layer of insulation granules:

- Cover the pipes with at least 10mm of compacted material.
- For layers of 40mm thickness and more mechanically compact the material manually before placing the thermal insulation cover on top.



→ Always agree with the company laying the asphalt screed on suitable insulation measures to prevent any damage to the pipes from excessive heat.



Layer with natural or crushed sand must not be used for leveling according to DIN 18560. A thermal insulation cover is required to provide adequate support to walk on and to lay the hot asphalt screed. Such thermal covers are a combination of pearlites and elastic fibres made into one board. People can immediately walk on them once they are laid.

### 2.14.2 Installation in combination with bitumen sheets and coatings

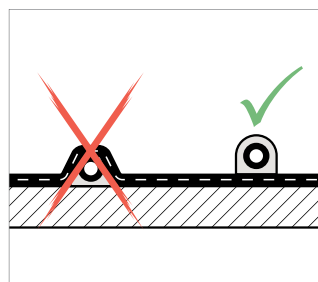


Illustration 2-74 Only install pipes on top of bitumen sheet

- Allow the bitumen sheets or bituminous coatings that contain solvents to dry completely before laying the pipes.
- Adhere to the setting time specified by the manufacturer.
- Before laying the pipes, ensure that the pipes nor the drinking water are not adversely affected.
- Protect the pipe adequately from heating while laying the pipes near flaming bitumen sheets.



Pipes must never be laid underneath a bitumen sheet.

### 2.14.3 Installation in areas exposed to UV radiation

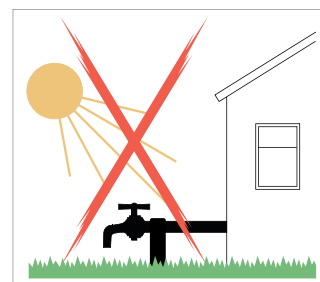


Illustration 2-75: Do not install in areas exposed to UV radiation

- Polyethylene (PE) and cross-linked polyethylene (PE-X) are not UV resistant. They are not suitable for unprotected installations or storage outside.
- UV radiation (e.g. sunlight) may damage the pipe. If pipes are installed in areas where they could be exposed to UV radiation, they must be completely covered in a suitable manner.

#### 2.14.4 External installation

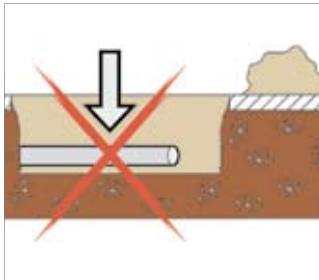


Illustration 2-76: Underground laying is not permitted

In external installations (e.g. underground car parks, open vented spaces) REHAU pipes must be protected from:

- UV radiation
- Frost
- High temperatures
- Damages



Underground laying of the RAUTITAN domestic installation system is not permitted. Use the REHAU underground engineering systems for underground laying "Potable water systems made of RAU-PE-Xa cross-linked polyethylene". Visit our website for further information:

[www.REHAU.com](http://www.REHAU.com)

#### 2.14.5 Potential equalisation

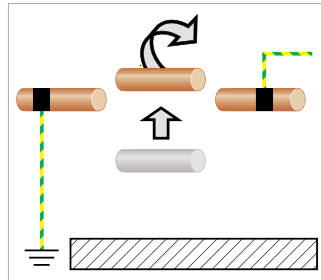


Illustration 2-77: Potential equalisation while replacing pipes



In accordance with DIN VDE 0100, RAUTITAN pipelines should not be used as an earthing conductor for electrical units.

→ In installations, where metallic water service pipes forming a part of an earth electrode for an electrical installation are cut or uncoupled and replaced with the RAUTITAN installation system, a trained electrician must be consulted.

#### 2.14.6 Heat trace systems

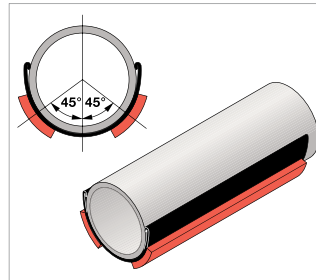


Illustration 2-78: Example of trace heating fitted to RAUTITAN with support channel

- Heating cables should always be fitted to PE-Xa pipes following the manufacturer's installation and operating instructions.
- If pipes are installed with support channel, the heating cable must be fitted to the outside of the support channel.

#### 2.14.7 Exposure to excessive heat



Illustration 2-79: Protect pipes from excessive heat

During construction, maintenance or repair work in close proximity care must be taken not to expose the RAUTITAN pipe system to a naked flame (soldering), flood lights or other localized heat sources, as this can result in permanent damage or a significant reduction in performance life.

## 2.15 Pressure Testing

### 2.15.1 Pressure test and flushing

A visual check must be carried out prior to pressure testing to ensure all compression sleeve joints have been secured completely. Flushing of the system should occur prior to and after pressure testing.

### 2.15.2 Flushing the pipe system

Installers must comply with DIN 1988 requirements. Coarse foreign particules can be removed simply by flushing the pipe system with water.

### 2.15.3 Pressure test procedure

Prior to concealment, fill the finished pipework with water, taking care to avoid air pockets. The pressure test must be conducted in accordance with DIN 1988.

### Notes

A further factor that may influence the test result can be caused by the temperature difference between the pipe and test medium caused by the high coefficient of thermal expansion of plastic pipes. A temperature change of 10K corresponds approximately to a pressure change of 0.5 to 1 bar. For this reason, every effort should be made to ensure that the temperature of the test medium remains constant when carrying out pressure tests on system components made from plastic pipes. In this context it is important to carry out a visual inspection of

all joints while the pressure test is in progress since experience has shown that minor leakages cannot always be detected simply by monitoring a pressure gauge. Following the pressure test, the drinking water pipes must be flushed thoroughly.

### 2.15.4 Rehau recommendations

It is recommended that polymer plumbing system be pressure tested to DIN 1988. The procedure consists of two parts, starting with the preliminary test and followed by the maintest.

#### Preliminary test

The preliminary test involves applying a test pressure equal to 1.5 times the permissible operating pressure. This pressure must be

re-stored twice within the space of 30 minutes at intervals of ten minutes. Following a test period of a further 30 minutes, the test pressure must not have fallen by more than 0.6 bar. Leakage must not occur.

#### Main test

The main test must be conducted immediately after the preliminary test. The test takes 2 hours. At the end of this period, the test pressure recorded after the preliminary test must not have fallen by more than 0.2 bar. Leakage must not occur at any point in the system being tested.

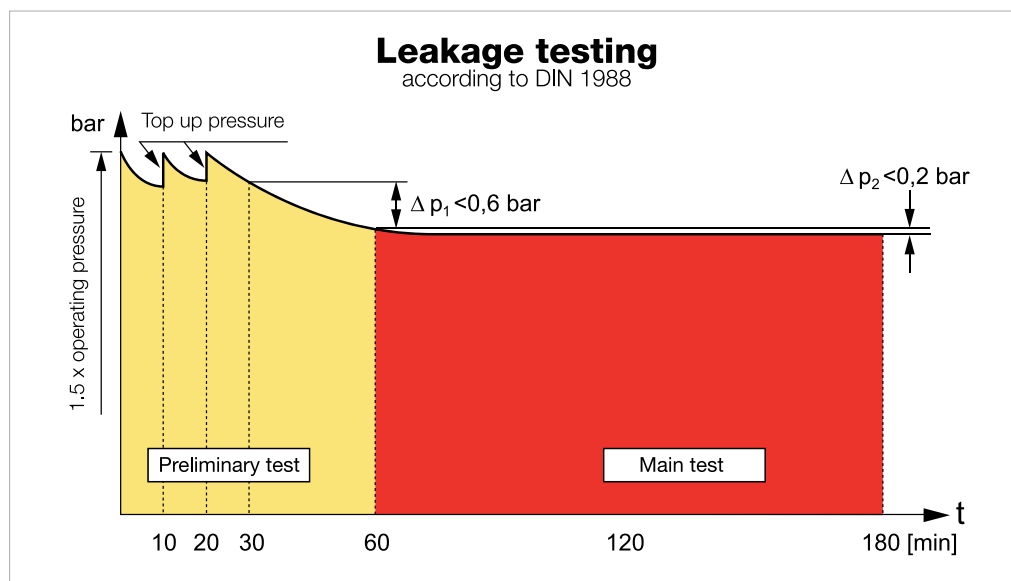


Illustration 2-80: Pressure test to DIN 1988

# 3.

# INTRODUCTION TO UNDERFLOOR HEATING/COOLING

## 3.1 Underfloor heating

### Thermal comfort

REHAU underfloor heating systems provide heat on the basis of low surface temperatures and even temperature distribution with mild and comfortable radiated energy. In contrast to static heating systems, a radiative equilibrium is generated between people and the surfaces enclosing the room, thus achieving optimum comfort.

### Energy-saving

The comfort level is found at considerably lower room temperatures during heating due to the highly radiative energy of the REHAU underfloor heating system. This can be lowered by 1 °C to 2 °C as a result. This means annual energy savings of 6 % to 12 %.

### Environmentally friendly

Due to the high heating capacity even with low flow temperatures, the REHAU underfloor heating systems can be easily combined with gas condensing boilers, heat pumps and thermal solar power systems.

### Hypo-allergenic

Due to the minimal convection draft of the REHAU underfloor heating system, hardly any air movement within a room. This makes dust circulation and carbonisation of dust a thing of the past. This aids in protecting the air passages of people both with and without allergies.

### Aesthetically appealing rooms without a radiator

The REHAU underfloor heating systems

- allow the user to decorate and arrange a room as desired
- allow the architect more freedom in planning
- reduce the risk for injury, e.g. in kindergartens, schools, hospitals and nursing homes

### Room temperatures according to DIN EN 12831 Supplement 1

- in living rooms and common rooms: 20 °C
- in bathrooms: 24 °C

### Guideline values of Working Premises Guidelines (ASR 6 from May/01)

- seated activity: 19–20 °C
- non-seated activity: 12–19 °C depending on work intensity

### Surface temperatures

For medical and physiological reasons, the maximum permissible surface temperatures for surfaces directly contacted by people must be observed:

- floor:
  - occupied areas: 29 °C
  - areas seldom walked/stood on (perimeter zones) 35 °C
- wall: 35 °C

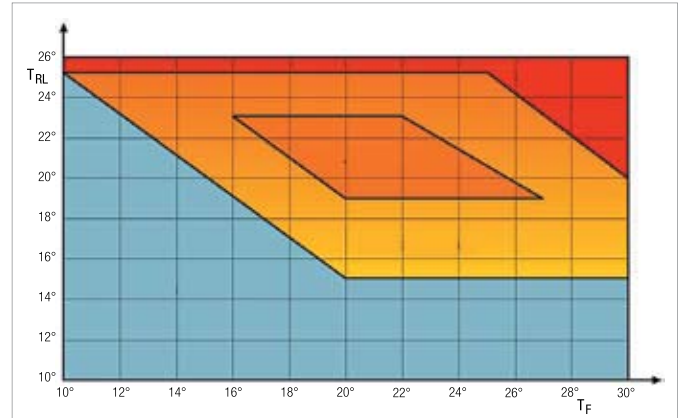


Illustration 3-1: Thermal comfort, depending on the room temperature  $T_{RL}$  and the temperature of the surfaces enclosing the room  $T_F$ .

■ uncomfortably warm   
 ■ comfortable   
 ■ still comfortable   
 ■ uncomfortably cold

### Exemplary temperature profiles in heated rooms

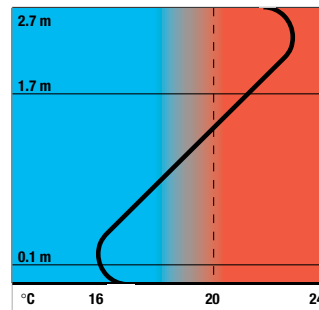


Illustration 3-2: Radiator heating

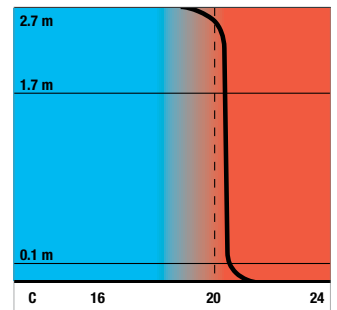


Illustration 3-4: Underfloor heating

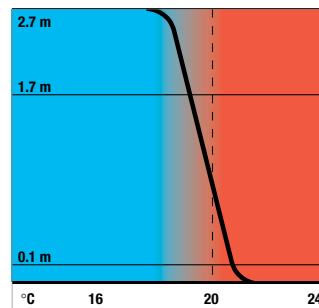


Illustration 3-3: Ideal heat distribution

### 3.2 Underfloor cooling



- High comfort level
- Draught-free
- Minimal investment costs
- Minimal operating costs
- Environmentally friendly
- Unrestricted room arrangement

#### Thermal comfort

The thermal comfort for a person in a room is determined by the:

- activity of the person
- clothing worn by the person
- air temperature
- air speed
- humidity
- surface temperatures

Heat emission from a person's body occurs mainly via three mechanisms:

- radiation
- evaporation
- convection

The human body feels at its best when it can regulate at least 50 % of its heat emission via radiation.

**i** With REHAU underfloor cooling, the exchange of energy between a person and the cooling surface occurs over a large area and mainly via radiation and thus provides optimum preconditions for a comfortable room climate.

#### Classical climate systems

Classical climate systems deal with the cooling loads which occur via **air exchange**, with the following negative effects:

- draughts
- high speed of air in room
- cold air temperatures
- high level of noise

This causes occupants to experience an uncomfortable room climate, designated **Sick Building Syndrome**.

Economical disadvantages of classical climate control systems:

- high investment costs
- high annual costs

#### Cooling capacity

The **normal cooling capacity** of REHAU underfloor cooling is **50 W/m<sup>2</sup>**, according to DIN 4715-1.

The capacity was determined with:

- the RAUFIX system
- installation pipe spacing 10 cm
- RAUTHERM S 17 x 2.0 mm
- coolant under-temperature 10 K
- temperature spread 2K

Under **realistic, day-to-day conditions**, at

- surface temperature of 19–20 °C
- room temperature of 26 °C values from **35–40 W/m<sup>2</sup>** can be reached.

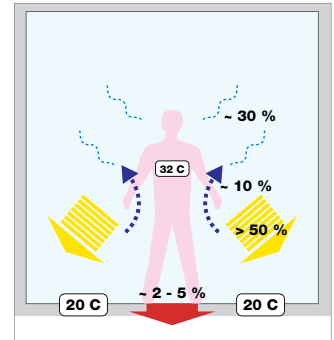
#### Effects on cooling capacity

The maximum achievable capacity for underfloor cooling depends on:

- floor/wall surface and insulation
- installation pipe spacing
- pipe dimension
- floor/wall construction
- system

Each of the factors affects the cooling capacity to a different degree, however.

**i** The floor/wall finishing and installation pipe spacing have significant influence on the "soft cooling" output.



Radiation



Evaporation



Convection



Heat conduction

Illustration 3-5: The heat balance of a person

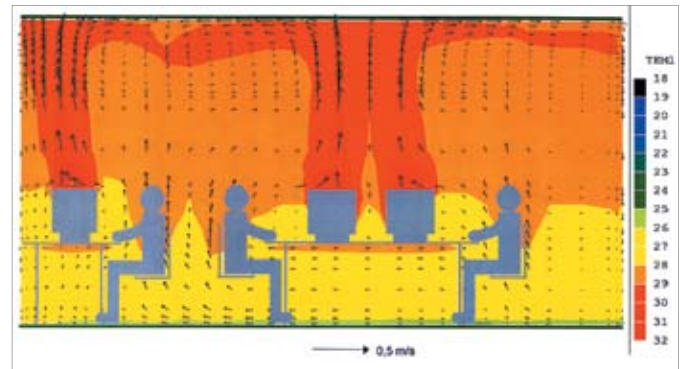
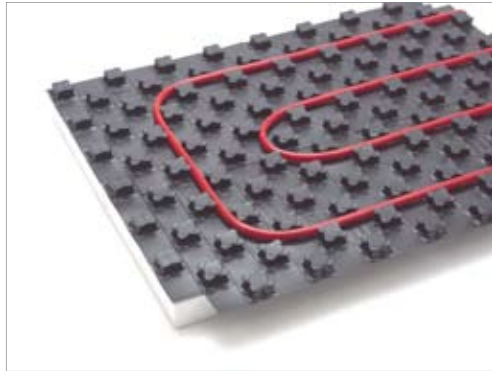


Illustration 3-6: Air temperatures and speeds with underfloor cooling

# 4.

# INSTALLATION SYSTEMS – FLOOR

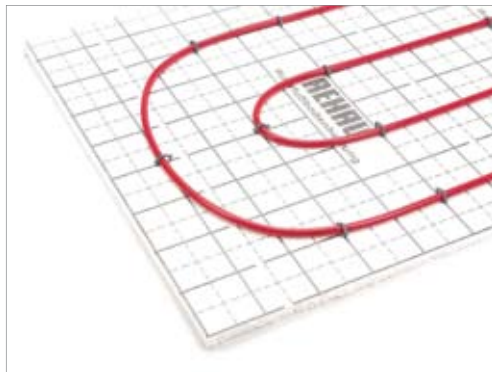
REHAU Varionova studded panel system



REHAU pipe grid system



REHAU stapling system



REHAU dry system



REHAU RAUFIX system



REHAU base panel TS-14





## 4.1 Basics

### 4.1.1 Standards and guidelines

The following standards and guidelines have to be complied when planning and installing REHAU systems for floor heating/cooling:

- DIN 18202, Dimensional tolerances in buildings
- DIN 18195, Water-proofing of buildings
- DIN EN 13163–13171, Heating insulation products for buildings
- DIN 4108, Thermal insulation in buildings
- DIN 4109, Sound protection in buildings
- VDI 4100, Sound protection in residential buildings
- DIN 18560, Heated screeds
- DIN EN 1264, Underfloor heating systems
- Energy Conservation Ordinance (EnEV)
- VDI 2078, Cooling load calculation
- DIN 1055-3, Design loads for buildings
- DIN 4102, Fire protection in buildings

### 4.1.2 Customer-side requirements

- The rooms must be roofed, and windows and doors must be installed.
- The walls must be plastered.
- To assemble the heating circuit manifold cabinets, niches/wall recesses and wall and ceiling openings must be available for the connection lines.
- Power and water connections must be available (for assembly tool and pressure test).
- The raw ceiling must be sufficiently secure, clean-swept and dry, and the evenness tolerances according to DIN 18202 must be fulfilled.
- The “level markers” must be present and checked.
- Building water-proofing according to DIN 18195 must be fulfilled for components touching the ground.

- An installation plan with a specification of the exact arrangement of heating circuits and the required pipe lengths for each heating circuit must be available.

- A valid expansion joint plan must be available for any joints which may be required.

## 4.2 Planning

### 4.2.1 Heating and impact sound proofing insulation



- It is impermissible to install more than two layers of impact sound proofing insulation in a floor.
- The sum of the compressibility of all insulation layers may not exceed the following values:
  - 5 mm with floor loads  $\leq 3 \text{ kN/m}^2$
  - 3 mm with floor loads  $\leq 5 \text{ kN/m}^2$
- Empty conduits or other pipelines have to be installed in the compensating insulation layer. The height of the compensating insulation layer corresponds to the height of the empty conduits or pipelines.
- Empty conduits or other pipelines may not interrupt the required impact sound proofing insulation.
- When using polystyrene insulations on bituminous building water-proofing which contains solvents or building water-proofing which has been processed with bituminous adhesives, a membrane must be provided between the two component layers.

### Determining the required impact sound proofing insulation

The right impact sound proofing insulation is decisive for sound protection in floors. The impact sound improvement dimension depends on the dynamic rigidity of the insulation and the screed mass used. DIN 4109 and VDI 4100, which deal with sound protection, contain the required data for impact sound proofing insulation. If the adjusted, assessed standard impact sound level of the ceiling is  $\leq$  the requirement according to DIN 4109/VDI 4100, the selected impact sound proofing insulation may be used.

The following applies for the determination if the ceiling construction is specified:

$$L_{n,w,R} = L_{n,w,eq,R} - \Delta L_{w,R} + 2\text{dB}$$

where:

$L_{n,w,R}$  = adjusted, assessed standard impact sound level

$L_{n,w,eq,R}$  = equivalent, assessed standard impact sound level (of raw ceiling)

$\Delta L_{w,R}$  = impact sound improvement dimension of screen/insulation layer

2 dB = correction value

### Requirements for heating insulation according to EnEV and DIN EN 1264

The thermal requirements for the building envelope are set by the Energy-Saving Ordinance (EnEV) and are indicated in the "energy demand pass" created for the specific building.

Regardless of the building envelope presented in the energy demand pass, certain additional minimum thermal conductance resistances have to be taken into account when underfloor heating is used against the ground, with a lower outside temperature or against unheated rooms (see Table 4-1, Page 50).

In accordance with the specification from the Deutschen Institut für Bautechnik (DIBt, German Institute for Building Technology), the additional specific transmission heat losses of underfloor heating drop and therefore do not need to be taken into account when calculating the annual energy requirement (according to DIN V 4108-6) in cases where heating insulation with a heat transmission resistance of at least 2.0 m<sup>2</sup>K/W between the heating surface and the outer structure or the structure against an unheated room is used.

Application	Minimum heat transmission resistance	Possible additional insulation required
1: Heated room one storey down	$R \geq 0.75 \text{ m}^2 \text{ K/W}$	$R_{\text{additional insulation}} = 0.75 - R_{\text{system panel}}$
2: Unheated room, room heated at intervals or directly on the ground <sup>1)</sup>	$R \geq 1.25 \text{ m}^2 \text{ K/W}$	$R_{\text{additional insulation}} = 1.25 - R_{\text{system panel}}$
3: Lower outside temperature	$R \geq 2.00 \text{ m}^2 \text{ K/W}$ ( $-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$ )	$R_{\text{additional insulation}} = 2.00 - R_{\text{system panel}}$

Table 4-1: Minimum requirements of the heating insulation below the underfloor heating/cooling systems according to DIN EN 1264

<sup>1)</sup> This should be increased in case of a groundwater level  $\geq 5 \text{ m}$

## 4.2.2 Wet construction

### Floor


The example floor from REHAU heating and cooling systems is shown in the diagram.

### Using wet screed

The following items, in particular, must be heeded if wet screed is used:

- The entire surface must be fully sealed (formation of a tray).
- The continuous operating temperature may not exceed 55 °C.
- Calcium-sulphate screeds are only partially suitable for rooms exposed to moisture. The manufacturer's specifications must be observed.

### Screeds and expansion joints

 The specifications in DIN 18560 apply for the planning and installing of heated screeds. In addition, the processing instructions and permissible applications from the screed manufacturer also apply.

The following specifications must be agreed upon in the planning phase by the architect, the planner, the heating installer, the screed installer and the flooring material installer involved:

- Type and thickness of the screed and the flooring materials
- Surface distribution of the screed and arrangement/formation of the joints
- Number of test points for residual moisture measurement

### Flooring materials and expansion joints

With **hard** materials (ceramic tiles, parquet etc.), the joints must be drawn up to the top edge of the materials. This measure is also recommended for **soft** flooring materials (synthetic and textile materials) to prevent bowing or channelling. Approval by the flooring material installer is absolutely necessary for all flooring materials.

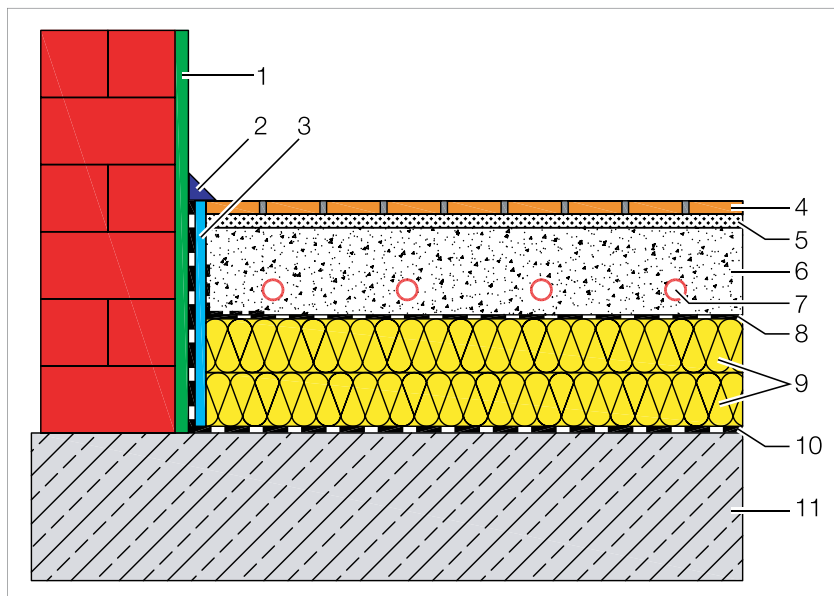


Illustration 4-1: Cross-sectional example of underfloor heating and cooling system with wet construction

1. Interior wall finishing
2. Skirting
3. REHAU edge insulation strips
4. Flooring material
5. Mortar bed
6. Screed
7. REHAU pipe
8. Membrane
9. Heating and impact sound proofing insulation
10. Building water-proofing (if necessary)
11. Raw flooring



Incorrect arrangement and formation of joints is the most common cause of screed damage in floors.



The following applies in accordance with DIN 18560 and DIN EN 1264:

- A joint plan is to be made by the building designer and submitted to the personnel responsible for installation as part of the specification of services.
- In addition to the all-round separation via edge insulation strips, heated screeds have to be separated via joints at the following points:
  - with screed surfaces > 40 m<sup>2</sup> or
  - with side lengths > 8 m or
  - with side ratios a/b > 1/2
  - over movement joints of the building
  - with heavily springy fields ≤ 8 m

### Arrangement of expansion joints

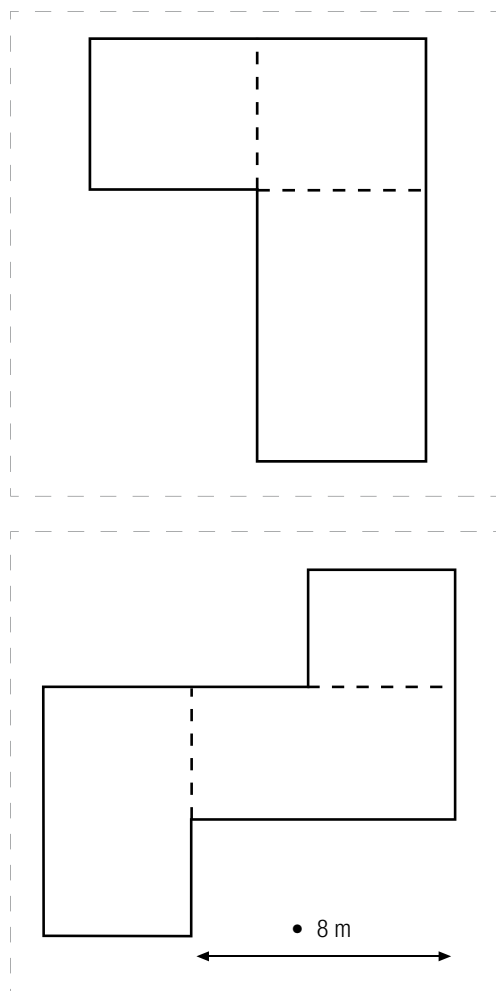


Illustration 4-2: Joint arrangement

- - - Expansion joint  
 The temperature-related changes in length of a screed panel can be calculated as follows:  
 $\Delta l = l_0 \times \alpha \times \Delta T$   
 $\Delta l$  = change in length (m)  
 $l_0$  = panel length (m)  
 $\alpha$  = coefficient of linear expansion (1/K)  
 $\Delta T$  = temperature differential (K)

### Arrangement of the heating circuits

Heating circuits and joints have to be coordinated with one another as follows:

- The pipe registers have to be planned and installed in such a way that they do not cross joints.
- Only connection pipes may cross the joints.
- In these areas, the heating pipes have to be protected from any shear stress when a protective sleeve (REHAU corrugated pipe or an insulating shell) extending to approximately 20 cm on each side of the joint.

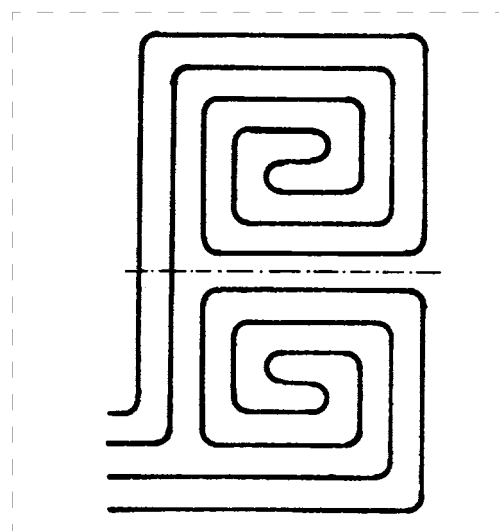


Illustration 4-3: Proper joint arrangement with heating circuits

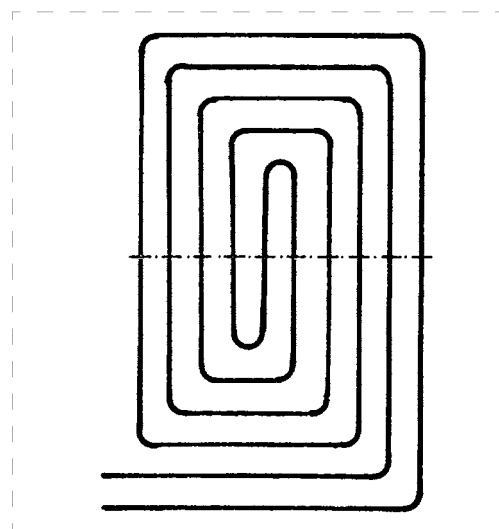


Illustration 4-4: Improper joint arrangement with heating circuits

### 4.2.3 Dry construction/Dry screed elements

#### Loading and area of use



Dry screeds made of gypsum fibres may not be subjected to temperatures above 45 °C.

The guaranteed point and area loads from the manufacturer are the ultimate gauge for loading of the entire floor and for the area where the REHAU dry installation systems on solid and wood truss ceilings are used.

#### REHAU dry system

Application (with area load qK [kN/m <sup>2</sup> ])	Fermacell 2E11 screed element (thickness = 20 mm) <sup>1)</sup>	Fermacell 2E22 screed element (thickness = 25 mm) <sup>2)</sup>	Fermacell 2E22 + 12.5 mm screed element (thickness = 37.5 mm) <sup>3)</sup>	Knauf Brio 18 screed element (thickness = 18 mm) <sup>4)</sup>	Knauf Brio 23 screed element (thickness = 23 mm) <sup>4)</sup>
- Living rooms, hallways and attics in residential buildings, hotel rooms incl. accompanying bathrooms A1 (1.0) + A2 (1.5) + A3 (2.0)	√	√	√	√	√
- Office rooms, hallways, attics in office buildings, physicians' practices, waiting rooms in physicians' practices incl. the hallway B1 (2.0) - Retail space with up to 50 m <sup>2</sup> floor space in residential and office buildings D1 (2.0)	√	√	√	-	√
- Hallways in hotels, convalescent homes, residential schools etc., treatment rooms incl. operating rooms without heavy equipment B2 (3.0) - Areas with tables; e.g. waiting rooms, lecture halls, classrooms, school rooms, dining halls, cafés, restaurants, reception rooms C1 (3.0)	-	√	√	-	-
- Hallways in hospitals, convalescent homes, treatment rooms incl. operating rooms with heavy equipment B3 (5.0) - Areas with large congregations of people, e.g. hallways to lecture halls and classrooms, churches, theatres or cinemas C2 (4.0) - Convention halls, congregation rooms, waiting rooms, concert halls C5 (5.0) - Column-free areas, e.g. museum areas, exhibition areas etc. and entrance areas in public buildings and hotels C3 (5.0) - Sports and recreation areas, e.g. dance halls, sport halls, gymnastics and weight rooms, stages C4 (5.0) - Areas in retail stores and warehouses D2 (5.0)	-	-	√	-	-

Table 4-2: Applications of the REHAU dry system in accordance with DIN 1055 in conjunction with Fermacell and Knauf dry screed elements

<sup>1)</sup> maximum permissible point load: 1.5 kN

<sup>2)</sup> maximum permissible point load: 2.5 kN

<sup>3)</sup> maximum permissible point load: 3.5 kN

<sup>4)</sup> Application with higher requirements only after consultation with Knauf floor applications technology department

## REHAU base panel TS-14

Application (with area load qK [kN/m <sup>2</sup> ])	Fermacell 2E11 screed element (thickness = 20 mm) <sup>1)</sup>	Fermacell 2E22 screed element (thickness = 25 mm) <sup>2)</sup>	Fermacell 2E22 + 10.0 mm screed element (thickness = 35 mm) <sup>3)</sup>	Knauf Brio 18 screed element (thickness = 18 mm) <sup>4)</sup>	Knauf Brio 23 screed element (thickness = 23 mm) <sup>4)</sup>
- Living rooms, hallways and attics in residential buildings, hotel rooms incl. accompanying bathrooms A1 (1.0) + A2 (1.5) + A3 (2.0)	√	√	√	√	√
- Office rooms, hallways, attics in office buildings, physicians' practices, waiting rooms in physicians' practices incl. the hallway B1 (2.0) - Retail space with up to 50 m <sup>2</sup> floor space in residential and office buildings D1 (2.0)	√	√	√	-	-
- Hallways in hotels, convalescent homes, residential schools etc., treatment rooms incl. operating rooms without heavy equipment B2 (3.0) - Areas with tables; e.g. waiting rooms, lecture halls, classrooms, school rooms, dining halls, cafés, restaurants, reception rooms C1 (3.0)	-	√	√	-	-
- Hallways in hospitals, convalescent homes, treatment rooms incl. operating rooms with heavy equipment B3 (5.0) - Areas with large congregations of people, e.g. hallways to lecture halls and classrooms, churches, theatres or cinemas C2 (4.0) - Convention halls, congregation rooms, waiting rooms, concert halls C5 (5.0) - Column-free areas, e.g. museum areas, exhibition areas etc. and entrance areas in public buildings and hotels C3 (5.0) - Sports and recreation areas, e.g. dance halls, sport halls, gymnastics and weight rooms, stages C4 (5.0) - Areas in retail stores and warehouses D2 (5.0)	-	-	√	-	-

Table. 4-3: Applications of the REHAU base panel TS-14 in accordance with DIN 1055 in conjunction with Fermacell and Knauf dry screed elements

<sup>1)</sup> maximum permissible point load: 1.5 kN

<sup>2)</sup> maximum permissible point load: 2.5 kN

<sup>3)</sup> maximum permissible point load: 3.5 kN

<sup>4)</sup> Application with heightened requirements only after consultation with Knauf floor applications technology department

## Requirements of the structural slab

The structural slab must be capable of bearing the load, dry and clean. Since dry screed panels acting as a load-distribution layer above the REHAU dry installation systems are not self-levelling, the subsurface must be perfectly flat in order to accept the REHAU dry installation systems. The evenness of the structural slab must therefore be checked and unevenness must be compensated for using suitable measures before beginning the installation.

Suitable measures are:

- For unevenness from 0–10 mm:
  - small areas: Apply spackle (Knauf + Fermacell).
  - large areas: Apply self-levelling liquid spackle (Knauf + Fermacell).
- For deeper unevenness:
  - use self-interlocking loose-fill insulation and cover with at least 10 mm-thick gypsum fibre boards (Fermacell).
  - use bound compensating mortar for a thickness of 15 mm to max. 800 mm.

## Wood truss ceilings

It is possible to use the REHAU dry installation systems on wood truss ceilings if installed according to the installation guidelines of the dry screed manufacturer named. The structural condition of wood truss ceilings must be checked before beginning installation. The subsurface may not give or be springy. Tighten loose planks if necessary. The requirements of planking/boarding regarding the required thickness of the planking must be complied with. If in doubt, get static verification of the load bearing capacity of the raw ceiling.

## Heating insulation

Supplementary heating insulation panels must fulfil the following requirements:

- Expanded polystyrene (EPS):
  - Density: at least 30 kg/m<sup>3</sup>
  - Thickness: maximum 60 mm
- Hard polyurethane foam (PUR):
  - Density: at least 33 kg/m<sup>3</sup>
  - Thickness: maximum 90 mm
- Up to two additional layers of heating insulation panels may be installed offset with the REHAU dry installation system.

## Impact sound proof insulation

Only the following materials are permissible as supplementary impact sound proofing insulation:

- wood-fibre insulation panel (Knauf + Fermacell).
- mineral-wool insulation panel (Fermacell)

When using mineral-wool insulation panels under the underfloor heating system, a loosely installed 10 mm thick gypsum fibre board is to be installed between the mineralwool insulation panel and the underfloor heating system (Fermacell).

## Permissible layout variants

The permissible layout variants of the REHAU dry installation systems depend on the heating and impact sound proofing requirements of the building designer and the evenness of the bare floor.

#### 4.2.4 Installation systems and heating circuits

The thermal requirement of a room can be covered regardless of the installation system. The installation system only affects the temperature distribution at the floor surface and in the room.

The thermal requirement of a room decreases from the exterior wall area to the interior of the room. The heating pipes are therefore generally installed closer together in the area with a higher thermal requirement (at the perimeter zones) than in the occupied area.

##### Perimeter zones

The necessity of also planning an perimeter zones depends on

- the type of exterior wall (U value of the wall, portion and quality of the window surfaces)
- the type of the room

##### Installation spacing

Decreased installation pipe spacing in the perimeter zones and increased installation in the areas occupied longer (possible with the reverse spiral and double-meander laying patterns) provides:

- A high level of comfort in the entire room
- Pleasant floor temperatures despite high heating capacity
- Reduction of the required flow temperature and thus less energy consumption

#### Installation systems of REHAU underfloor heating/cooling

The following installation systems are available for the heating circuits of REHAU underfloor heating/cooling:

- Reverse spiral
  - REHAU Varionova studded panel
  - REHAU vario studded panel
  - REHAU stapling system
  - REHAU pipe grid
- Double-meander
  - REHAU Varionova studded panel (with bottom impact sound proof insulation 30-2 only)
  - REHAU vario studded panel
  - REHAU stapling system
  - REHAU RAUFIX
  - REHAU pipe grid
- Single-meander
  - REHAU Varionova studded panel (with bottom impact sound proof insulation 30-2 only)
  - REHAU vario studded panel
  - REHAU stapling system
  - REHAU RAUFIX
  - REHAU pipe grid
  - REHAU dry system
  - REHAU base panel TS-14



### Reverse spiral installation system

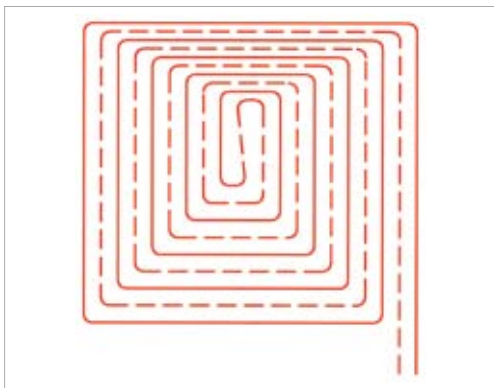


Illustration 4-5: Reverse spiral installation system with integrated denser perimeter zone

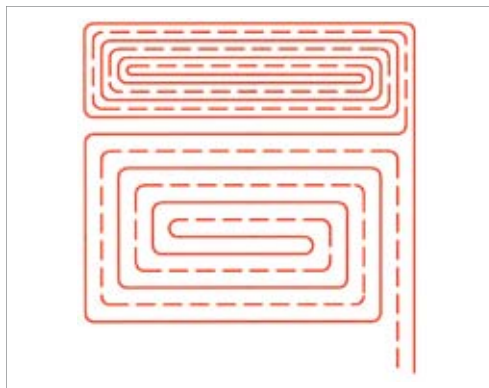


Illustration 4-6: Reverse spiral installation system with preceding perimeter zone



- Even temperature distribution over the entire heating circuit
- Protective installation of the heating pipe due to easy-to-use 90° pipe bends

### Double-meander installation system

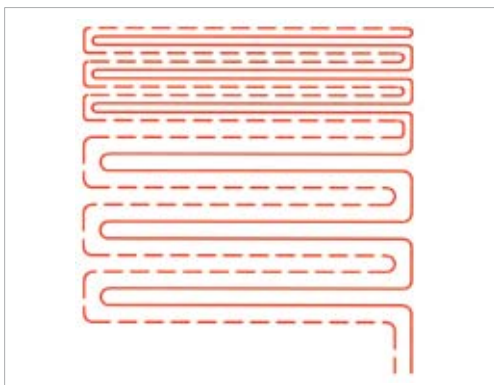


Illustration 4-7: Double-meander installation system with integrated denser perimeter zone

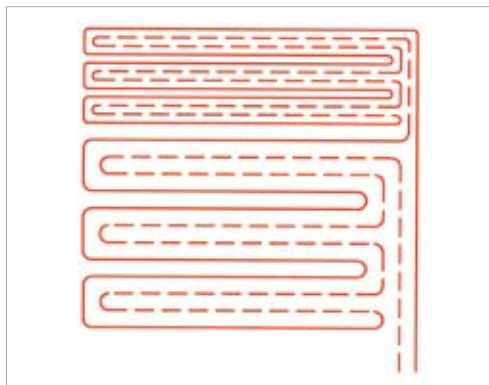


Illustration 4-8: Double-meander installation system with preceding perimeter zone



- Even temperature distribution over the entire heating circuit



With the double-meander installation type, the permissible bending radius of the heating pipe must be complied with in the case of the 180° redirection bends.

### Single-meander installation system

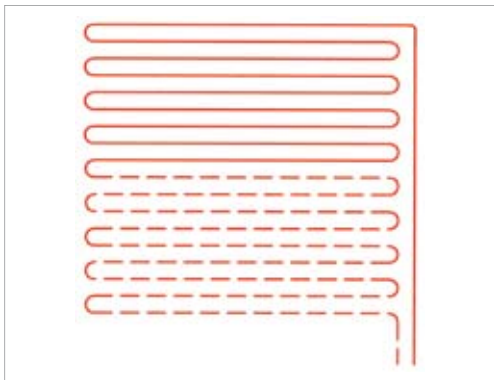


Illustration 4-9: Single-meander installation system

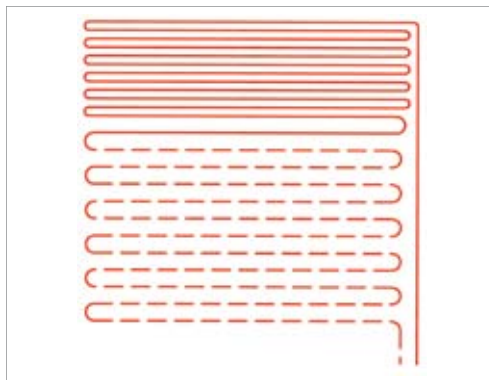


Illustration 4-10: Single-meander installation system with denser perimeter zone




With the single-meander installation system, the permissible bending radius of the heating pipe must be complied with in the case of the 180° redirection bends.

#### 4.2.5 Notes on commissioning

Commissioning of the REHAU underfloor heating/cooling systems includes the following steps:

- Flush, fill and deaerate the pipes/circuits.
- Perform pressure test.
- Perform functional heating.
- Warm up if necessary.

The following information have to be considered here:

 The pressure test and functional heating have to be performed and logged in accordance with the Pressure-test log: REHAU underfloor heating/cooling (see Appendix) and the Functional-heating log for REHAU underfloor heating/cooling (see Appendix).



#### Functional heating

- The following time must pass between screed application and functional heating:
  - with cement screeds, 21 days
  - with anhydrite liquid screeds, 7 days
  - or as per the manufacturer's specifications
- When switching off the floor heating after the warm-up phase, the screed is to be protected from drafts and rapid cooling.



#### Warming up

- The residual moisture content of the screed which is required for use must be determined by a company handling the flooring material via suitable measurement procedures.
- Warming up may be ordered by the customer so as to achieve the required residual moisture. (Special service according to VOB)

#### 4.2.6 Flooring materials

 The manufacturer's recommendations regarding assembly, application and operation have to be followed precisely.

##### Textile flooring material

Carpets should generally be glued down to ensure better heat transmission. The thickness of the carpet should not exceed 10 mm.

##### Parquet

Wood parquet can be used with floor heating. Joint formation must also be taken into consideration.

Gluing is appropriate. It must be thoroughly ensured that the wood and screed moisture levels correspond to the normally permissible values during installation and that the adhesive remains permanently elastic.

##### Synthetic flooring materials

Synthetic flooring materials are also in principle suitable for use with floor heating. Gluing synthetic panels or strips is recommended.

##### Stone, clinker, ceramic


Stone, clinker or other ceramic floor tops are the best for use in conjunction with floor heating.

The usual installation work involved in tile and panel laying can be performed without any limitations:

- Thin-bed installation on hardened screed
- Thick-bed installation on hardened screed
- Mortar bed on separation layer

##### Determining the heat transmission resistance

When making the heat-related calculations for floor heating (determination of the heating water temperature and pipe spacing), the heat transmission resistance of the flooring materials is to be taken into account.

 The heat transmission resistance of the floor material may not exceed the value  $R_{\lambda, B} = 0.15 \text{ m}^2 \text{ K/W}$ .

The heat transmission resistance values of the flooring materials should be calculated properly for every construction scenario. The values from the table can be used for estimation purposes.


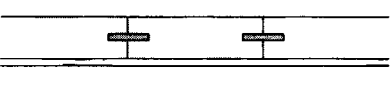
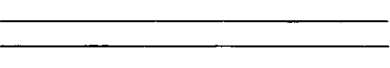


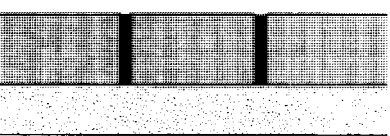
Flooring materials	Thickness d [mm]	Thermal conductivity $\lambda$ [W/mK]	Heat transmission resistance $R_{\lambda, B}$ [m <sup>2</sup> K/W]
Textile flooring materials 	10	0.07	max. 0.15
Parquet Adhesive compound 	8	0.2	0.04
	2	0.2	0.01
	total 10		total 0.05
Synthetic flooring materials, e.g. PVC 	5	0.23	0.022
Ceramic floor tiles Thin-bed mortar 	10	1.0	0.01
	2	1.4	0.001
	total 12		total 0.011
Ceramic floor tiles Mortar bed 	10	1.0	0.01
	10	1.4	0.007
	total 20		total 0.017
Natural or synthetic stone panels here: marble, mortar bed 	15	3.5	0.004
	10	1.4	0.007
	total 25		total 0.011

Table 4-4: Thermal conductivity and heat transmission resistance of common flooring materials

### 4.3 REHAU Varionova studded panel system



- Suitable for REHAU 14–17 mm pipes
- Easy and quick installation
- Very easy to walk on
- Secure pipe attachment
- Easy section fitting

#### System components

- REHAU Varionova studded panel
  - with impact sound proof insulation 30-2
  - without bottom insulation
- REHAU linking strip
- REHAU connection strip
- REHAU studded bridge
- REHAU panel retainer

#### REHAU pipes which can be used

For REHAU studded panel with bottom impact sound proof insulation 30-2:

- RAUTHERM S
  - 14 x 1.5 mm
  - 17 x 2.0 mm
- RAUTITAN pink
  - 16 x 2.2 mm

#### For REHAU studded panel without bottom insulation:

- RAUTHERM S
  - 14 x 1.5 mm

#### Accessories

- REHAU edge insulation strip
- REHAU expansion joint profile
- REHAU filler profile

#### Description

The REHAU Varionova studded panel is available with bottom impact sound insulation 30-2 or without bottom insulation. In both versions, the multifunction polystyrene membrane ensures excellent pipe retention, ease of walking and a secure seal against screed mixing water and moisture. In the version with impact sound insulation, the insulation made of quality-controlled polystyrene foam fulfils the requirements of DIN EN 13163. The grid attached to the bottom enables quick, straight cuts.

The special stud contour enables installation pipe spacing of 5 cm and multiples thereof and secure pipe retention at pipe-redirection points as well. The connection studs moulded onto two sides of the panel enable quick and secure connection and prevent sound and heat bridges. The panel connection technology can be detached without any damage.

The REHAU linking strips, REHAU connection strips and REHAU studded bridges can be used for both variants of the REHAU Varionova studded panel. The REHAU Varionova studded panel system is intended for use with screeds according to DIN 18560.



Illustration 4-11: REHAU Varionova studded panel system with bottom impact sound insulation 30-2



Illustration 4-12: Top REHAU Varionova studded panel with bottom impact sound insulation 30-2



Illustration 4-14: Top REHAU Varionova studded panel without bottom insulation



Illustration 4-13: Panel connection technology



Illustration 4-15: Sections easy to fit using REHAU linking strips

### Assembly

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.
- Secure REHAU edge insulation strips.
- Install REHAU system installation materials if necessary.
- Cut REHAU Varionova studded panels and install starting from the REHAU edge insulation strips.



- The film overhang must be cut along the edge insulation strip with the REHAU Varionova studded panel with bottom impact sound insulation 30-2.
- Secure REHAU Varionova studded panel without bottom insulation to the bottom insulation with REHAU panel retainers.
- Glue film base of the REHAU edge insulation strip to the REHAU Varionova studded panel without tensioning it.
- Straight-cut remnants of a REHAU Varionova studded panel can be processed further with linking strips.



Illustration 4-16: Bridge insert in use

- Connect one end of the REHAU pipe to the REHAU manifold.
- Lay the REHAU pipe in the stud grid of the REHAU Varionova studded panel.
- With 45° installation, secure the REHAU pipe with the REHAU studded bridge.
- Connect the other end of the REHAU pipe to the REHAU manifold.
- Assemble expansion joint profile and filler profile.



Illustration 4-17: Panel retainer

The REHAU panel retainer ensures secure attachment of the REHAU Varionova studded panel without bottom insulation to the customer-side insulation.



Illustration 4-18: Connection strip

Door transitions and screed movement joints are handled securely with the REHAU connection strip. REHAU system insulation is installed at the bottom near the connection strip as required.

### Technical data

System panel		REHAU Varionova studded panel with bottom impact sound proofing insulation 30-2	REHAU Varionova studded panel without bottom insulation
Insulation material		EPS 040 DES sg	
Multifunction film material		Polystyrene film	Polystyrene film
Sizes	Length	1,450 mm	1,450 mm
	Width	850 mm	850 mm
	Total thickness	50/48 mm	24 mm
	Insulation layer thickness under heating pipe	30 mm	-
Construction size	Length	1,400 mm	1,400 mm
	Width	800 mm	800 mm
	Area	1.12 m <sup>2</sup>	1.12 m <sup>2</sup>
Installation pipe spacing		5 cm and multiples	5 cm and multiples
Pipe lift		≤ 5 mm	≤ 5 mm
Type comply with DIN 18560 and DIN EN		A	A
Thermal conductivity		0.040 W/mK	-
Heat transmission resistance		0.75 m <sup>2</sup> K/W	-
Material class comply with DIN 4102		B2	B2
Fire behaviour comply with DIN EN 13501		E	E
Max. area load		5.0 kN/m <sup>2</sup>	60 kN/m <sup>2</sup> <sup>1)</sup>
Impact sound improvement dimension <sup>2)</sup> Δ LW, R		28	-

<sup>1)</sup> depending on the insulation used

<sup>2)</sup> with a solid ceiling and a screed installed on the impact sound insulation with a mass ≥ 70 kg/m<sup>2</sup>

**Minimum insulation requirements comply with DIN EN 1264-4**

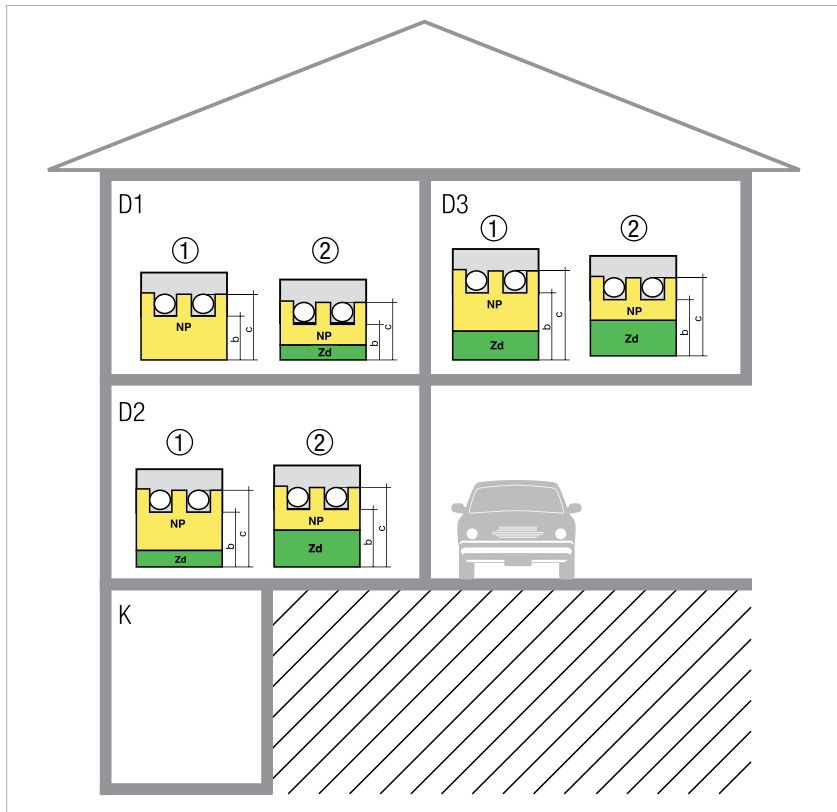


Illustration 4-19: Minimum insulation layer constructions with the REHAU Varionova studded panel system

- 1 REHAU Varionova studded panel with bottom impact sound proofing insulation 30-2
- 2 REHAU Varionova studded panel without bottom impact sound proofing insulation
- K Cellar
- NP Studded panel
- Zd Additional insulation

**D1 Insulation scenario 1:**

**$R \geq 0.75 \text{ m}^2\text{K/W}$**

Heated room one storey below

**D2 Insulation scenario 2:**

**$R \geq 1.25 \text{ m}^2\text{K/W}$**

(This should be increased in case of a groundwater level  $\leq 5 \text{ m}$ )

An unheated room or a room heated at intervals one storey below or directly on the ground

**D3 Insulation scenario 3:**

**$R \geq 2.00 \text{ m}^2\text{K/W}$**

Lower outside design temperature:

$-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$



These minimum insulation requirements have to be followed irrespective of the insulation required for the building envelope by the EnEV (see "Requirements for heating insulation according to EnEV and DIN EN 1264", Page 50).

<b>REHAU Varionova studded panel with bottom impact sound proofing insulation</b>			
	<b>Insulation scenario 1</b>	<b>Insulation scenario 2</b>	<b>Insulation scenario 3</b>
<b>Additional insulation Zd [mm]</b>		Zd = 20	Zd = 50
		EPS DEO 035	EPS DEO 040
<b>Insulation thickness [mm]</b>	b = 28	b = 48	b = 78
<b>Construction height to top edge of pipe [mm]</b>	c <sub>14</sub> = 42 c <sub>16</sub> = 44 c <sub>17</sub> = 45	c <sub>14</sub> = 62 c <sub>16</sub> = 64 c <sub>17</sub> = 65	c <sub>14</sub> = 92 c <sub>16</sub> = 94 c <sub>17</sub> = 95

Table 4-5: Recommended minimum insulation layer constructions with REHAU Varionova studded panel with bottom impact sound proofing insulation 30-2

<b>REHAU Varionova studded panel without bottom insulation</b>						
	<b>with impact sound requirement</b>			<b>without impact sound requirement</b>		
	<b>Insulation scenario 1</b>	<b>Insulation scenario 2</b>	<b>Insulation scenario 3</b>	<b>Insulation scenario 1</b>	<b>Insulation scenario 2</b>	<b>Insulation scenario 3</b>
<b>Additional insulation Zd [mm]</b>	Zd = 30-2	Zd = 50-2	Zd = 70-2	Zd = 30	Zd = 50 -2	Zd = 50
	EPS DES 040	EPS DES 040	EPS DES 035	EPS DES 040	EPS DEO 040	PUR DEO 025
<b>Insulation thickness [mm]</b>	b = 28	b = 48	b = 68	b = 30	b = 50	b = 50
<b>Construction height to top edge of pipe [mm]</b>	c <sub>14</sub> = 46 c <sub>16</sub> = 48	c <sub>14</sub> = 66 c <sub>16</sub> = 68	c <sub>14</sub> = 86 c <sub>16</sub> = 88	c <sub>14</sub> = 48 c <sub>16</sub> = 50	c <sub>14</sub> = 68 c <sub>16</sub> = 70	c <sub>14</sub> = 68 c <sub>16</sub> = 70

Table 4-6: Recommended minimum insulation layer construction with REHAU Varionova studded panel without bottom insulation



**Recommended minimum screed construction height comply with DIN 18560-2 for the REHAU Varionova studded panel with bottom impact sound proofing insulation 30-2**

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	
≤ 3	Cover	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	
≤ 4	Cover	c = 70 mm	c = 70 mm	c = 70 mm	
	Construction height	h = 84 mm	h = 86 mm	h = 87 mm	
≤ 5	Cover	c = 75 mm	c = 75 mm	c = 75 mm	
	Construction height	h = 89 mm	h = 91 mm	h = 92 mm	

Table 4-7: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F4** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	
≤ 3	Cover	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	
≤ 4	Cover	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	
≤ 5	Cover	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	

Table 4-8: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F5** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	
≤ 3	Cover	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	
≤ 4	Cover	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	
≤ 5	Cover	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	

Table 4-9: Screed construction heights for **calcium sulphate liquid screed CAF of Bending Tensile Strength Class F4** comply with DIN 18560-2



Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 44 mm	h = 46 mm	h = 47 mm	
≤ 3	Cover	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	
≤ 4	Cover	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	
≤ 5	Cover	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	

Table 4-10: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F5 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 44 mm	h = 46 mm	h = 47 mm	
≤ 3	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	
≤ 4	Cover	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 64 mm	
≤ 5	Cover	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	

Table 2-11: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F7 comply with DIN 18560-2

**i** With the Varionova studded panel without bottom insulation, the pipe is lifted 3 mm by the ridges running between the studs. This reduces the dimension c specified in the tables by 3 mm. The minimum covering depth of 30 mm comply with DIN 18560-2 over the top of the pipe is to be complied with.

### Heat-related tests

The REHAU Varionova studded panel system is tested and certified for its heat-related properties comply with DIN EN 1264.



Registration number: 7 F 218

**§** When planning and assembling the REHAU Varionova studded panel system the requirements of DIN EN 1264, Part 4, must be complied with.

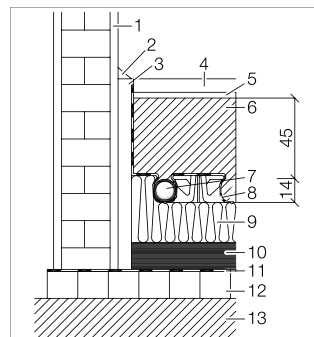


Illustration 4-20: REHAU Varionova studded panel with installed RAUTHERM S pipe

- 1 Interior wall furnishing
- 2 Skirting
- 3 Edge insulation strip
- 4 Natural or synthetic stone tiles
- 5 Mortar bed
- 6 Screed comply with DIN 18560
- 7 RAUTHERM S pipe
- 8 Film base of the edge insulation strip
- 9 REHAU Varionova studded panel
- 10 Heating and impact sound proofing insulation
- 11 Moisture barrier (complies with DIN 18195)
- 12 Structural slab
- 13 Ground

#### 4.4 REHAU vario studded panel system



- Liquid screed can be used
- Easy and quick installation
- Flexible pipe guide
- Environmentally friendly: 100% recyclable

##### System components

- REHAU vario studded panel
  - without impact sound proofing insulation
  - with impact sound proofing insulation (PST 17-2)

##### REHAU pipes which can be used

- RAUTHERM S
  - 14 x 1.5 mm
  - 17 x 2.0 mm
- RAUTITAN flex
  - 16 x 2.2 mm

##### Accessories

- REHAU edge insulation strip
- REHAU expansion joint profile
- REHAU filler profile

##### Description

The REHAU vario studded panel consists of quality-controlled polystyrene foam and fulfils the requirements of the DIN EN 13163. The top-laminated polystyrene film seals against screed mixing water and moisture in accordance with DIN 18560 and DIN EN 1264.

The alternating arrangement of stud fields and empty fields enables installation pipe spacing of 5 cm and multiples thereof and extremely flexible pipe guides with the capability of directional changes from 15° to 180°.

This makes the system especially suitable for installation of the pipes near columns, ventilation and electrical outlets, projections and bays, non-vertical walls etc. The circumferential hook notch ensures quick and secure connection and prevents sound and heat bridges from forming.

The REHAU vario studded panel with PST 17-2 offers additional impact sound proofing insulation. The grid attached to the bottom enables quick and straight cuts. The REHAU vario studded panel system is intended for use with screeds comply with DIN 18560.



Illustration 4-21: REHAU vario studded panel system



Illustration 4-22: Top of the REHAU vario studded panel



Illustration 4-24: Bottom of the REHAU vario studded panel



Illustration 4-23: Hook notch of the REHAU vario studded panel



Illustration 4-25: Hook notch of the REHAU vario studded panel with PST 17-2

### Assembly

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.
- Secure REHAU edge insulation strips.
- Install REHAU system installation materials if necessary.
- Cut REHAU vario studded panels to size with REHAU insulation cutters and install them starting from the REHAU edge insulation strips.



Illustration 4-26: Installing pipes on the REHAU vario studded panel



- The stud grid pattern must match where two panels meet so that the intended pipe installation pipe spacing can be maintained.
- Cut the hook notches along the REHAU edge insulation strip to prevent hollow spots under the screed layer.
- Glue film base of the REHAU edge insulation strip to the REHAU vario studded panel without tensioning it.
- Straight cut remnants of a finished installation row can be used to start a new installation row.

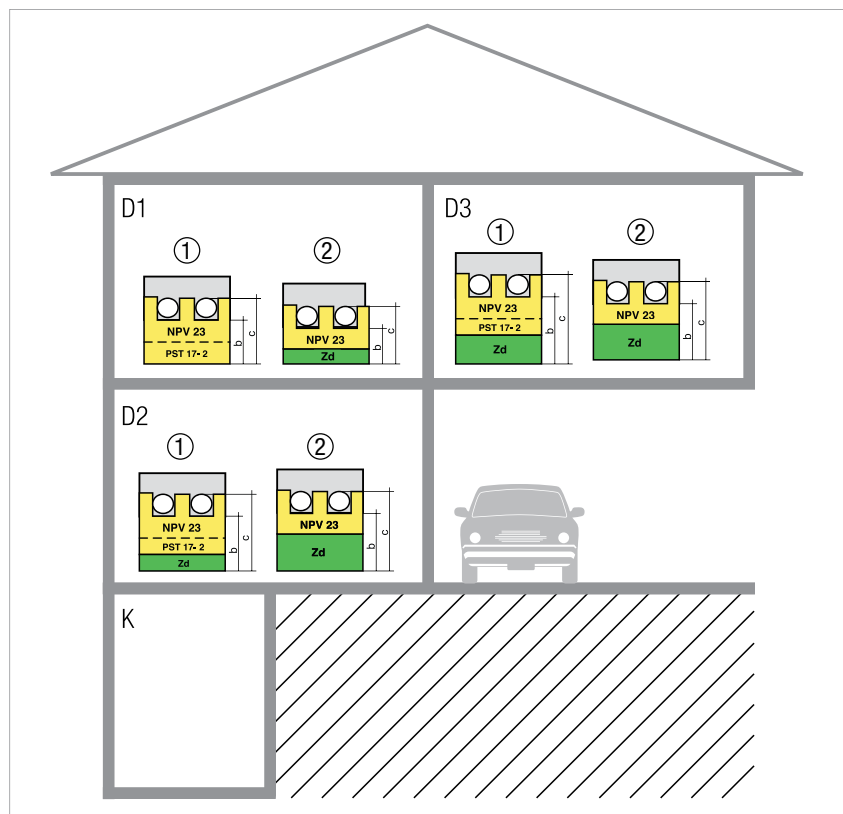
- Connect one end of the REHAU pipe to the REHAU manifold.
- Install the REHAU pipe in the stud grid of the REHAU vario studded panel.
- Connect the other end of the REHAU pipe to the REHAU manifold.
- Assemble expansion joint profile and filler profile.

### Technical data

System panel		Vario studded panel	Vario studded panel with PST 17-2
Base panel material		EPS 035 DE0	EPS 035/045 DESsg
Membrane material		Polystyrene film	Polystyrene film
Sizes	Length	1,230 mm	1,230 mm
	Width	830 mm	830 mm
	Total thickness	46 mm	63/61 mm
	Insulation layer thickness under heating pipe	23 mm	40 mm
Construction size	Length	1,200 mm	1,200 mm
	Width	800 mm	800 mm
	Area	0.96 m <sup>2</sup>	0.96 m <sup>2</sup>
Installation pipe spacing		5 cm and multiples	5 cm and multiples
Pipe lift		≤ 5 mm	≤ 5 mm
Type comply with DIN 18560 and DIN EN		A	A
Thermal conductivity		0.035 W/mK	0.035/0.045 W/mK
Heat transmission resistance		0.65 m <sup>2</sup> K/W	1.00 m <sup>2</sup> K/W
Material class comply with DIN 4102		B2	B2
Fire behaviour comply with DIN EN 13501		E	E
Design load		80.0 kN/m <sup>2</sup>	5.0 kN/m <sup>2</sup> <sup>1)</sup>
Impact sound improvement dimension <sup>1)</sup> Δ		-	26

<sup>1)</sup> with a solid ceiling and a cement screed installed on the impact sound proofing insulation with a mass ≥ 70 kg/m<sup>2</sup>

**Minimum insulation requirements comply with DIN EN 1264-4**



**D1 Insulation scenario 1:**

$R \geq 0.75 \text{ m}^2\text{K/W}$

Heated room one storey below

**D2 Insulation scenario 2:**

$R \geq 1.25 \text{ m}^2\text{K/W}$

(This should be increased in case of a groundwater level  $\leq 5 \text{ m}$ )

An unheated room or a room heated at intervals one storey below or directly on the ground

**D3 Insulation scenario 3:**

$R \geq 2.00 \text{ m}^2\text{K/W}$

Lower outside design temperature:

$-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$

**i** These minimum insulation requirements have to be followed irrespective of the insulation required for the building envelope by the EnEV (see "Requirements for heating insulation according to EnEV and DIN EN 1264", Page 50).

Illustration 4-27: Minimum insulation layer constructions with the REHAU vario studded panel system

1 REHAU vario studded panel with bottom impact sound proofing insulation (ISDI)

2 vario studded panel without bottom impact sound proofing insulation (ISDI)

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NPV vario studded panel

Zd Additional insulation

	Insulation scenario 1		Insulation scenario 2		Insulation scenario 3	
	with ISDI	without ISDI	with ISDI	without ISDI	with ISDI	without ISDI
<b>Additional insulation Zd [mm]</b>		Zd = 10	Zd = 10	Zd = 30	Zd = 40	Zd = 50
		EPS 040 DEO dm	EPS 035 DEO dh	EPS 040 DEO dm	EPS 035 DEO dh	EPS 035 DEO dh
<b>Insulation thickness [mm]</b>	b = 38	b = 33	b = 48	b = 53	b = 78	b = 73
<b>Construction height to top edge of pipe [mm]</b>	c <sub>14</sub> = 52 c <sub>16</sub> = 54 c <sub>17</sub> = 55	c <sub>14</sub> = 47 c <sub>16</sub> = 49 c <sub>17</sub> = 50	c <sub>14</sub> = 62 c <sub>16</sub> = 64 c <sub>17</sub> = 65	c <sub>14</sub> = 67 c <sub>16</sub> = 69 c <sub>17</sub> = 70	c <sub>14</sub> = 92 c <sub>16</sub> = 94 c <sub>17</sub> = 95	c <sub>14</sub> = 87 c <sub>16</sub> = 89 c <sub>17</sub> = 90

Table 4-12: Recommended minimum insulation layer constructions

**Recommended minimum screed construction heights comply with DIN 18560-2**

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	
≤ 3	Cover	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	
≤ 4	Cover	c = 70 mm	c = 70 mm	c = 70 mm	
	Construction height	h = 84 mm	h = 86 mm	h = 87 mm	
≤ 5	Cover	c = 75 mm	c = 75 mm	c = 75 mm	
	Construction height	h = 89 mm	h = 91 mm	h = 92 mm	

Table 4-13: Screed construction heights for cement screed CT of Bending Tensile Strength Class F4 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	
≤ 3	Cover	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	
≤ 4	Cover	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	
≤ 5	Cover	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	

Table 4-14: Screed construction heights for cement screed CT of Bending Tensile Strength Class F5 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	
≤ 3	Cover	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	
≤ 4	Cover	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	
≤ 5	Cover	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	

Table 4-15 Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F4 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 44 mm	h = 46 mm	h = 47 mm	
≤ 3	Cover	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	
≤ 4	Cover	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	
≤ 5	Cover	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	

Table 4-16: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F5 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 44 mm	h = 46 mm	h = 47 mm	
≤ 3	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	
≤ 4	Cover	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	
≤ 5	Cover	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	

Table 4-17: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F7 comply with DIN 18560-2

### Heat-related tests

The REHAU vario studded panel system is tested and certified for its heat-related properties comply with DIN EN 1264.

§ When planning and assembling the REHAU vario studded panel system, the requirements of DIN EN 1264, Part 4, must be complied with.



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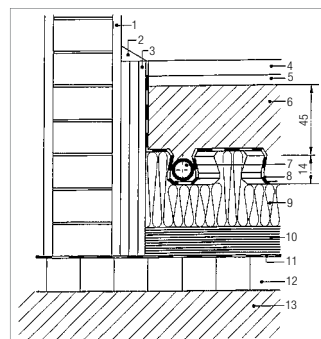


Illustration 4-28: REHAU vario studded panel with installed RAUTHERM S pipe

- 1 Interior wall furnishing
- 2 Skirting
- 3 Edge insulation strip
- 4 Natural or synthetic stone tiles
- 5 Mortar bed
- 6 Screed comply with DIN 18560
- 7 RAUTHERM S pipe
- 8 Film base of the edge insulation strip
- 9 Vario studded panel
- 10 Heating and impact sound proofing insulation
- 11 Moisture barrier (complies with DIN 18195)
- 12 Structural slab
- 13 Ground



#### 4.5 REHAU stapling system



- Quick installation
- Highly flexible installation
- Liquid screed can be used
- Combined heating and impact sound insulation

##### System components

- REHAU stapling panels
  - in roll form
  - in folded panels
- REHAU RAUTAC staples
- REHAU staples
- REHAU multi stapling unit

##### Accessories

- REHAU edge insulation strips
- REHAU expansion joint profile
- REHAU adhesive tape
- REHAU adhesive tape dispenser

##### Description

The REHAU stapling panel consists of quality-controlled polystyrene according to DIN EN 13163. It guarantees compliance with heating and impact sound proofing insulation values according to DIN EN 1264 and EnEV.

The REHAU stapling panel is coated with a water-proof and tear-proof polyethylene cloth film which seals against screed mixing water and moisture. The long-side film projection prevents heat and sound bridges. Pipe installation corresponds to construction type A according to DIN 18560 and DIN EN 13813.

The REHAU stapling panel is especially suitable for small winding rooms due to its smaller installation pipe size. Installation pipe spacing of 5 cm and multiples thereof can be implemented.

The pressed-on installation grid allows quick and precise pipe installation.

The REHAU stapling system is intended for use with screeds comply with DIN 18560.



Illustration 4-29: REHAU stapling system

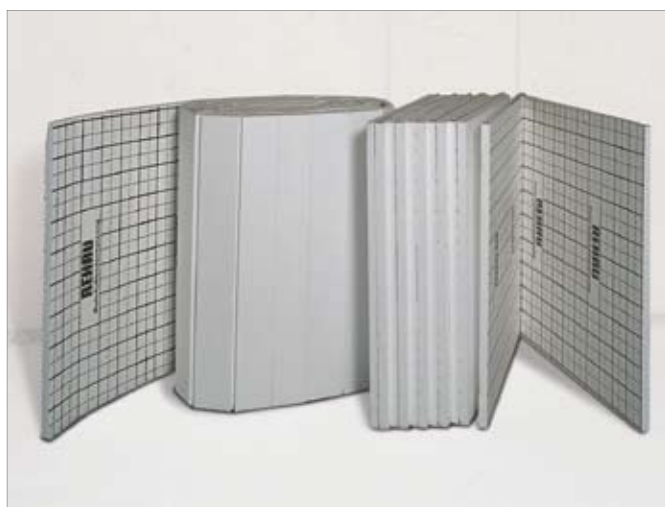


Illustration 4-30: REHAU stapling panel in roll form and folded panels

### Assembly

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.
- Secure REHAU edge insulation strips.
- Install REHAU stapling panel starting from the REHAU edge insulation strips. The REHAU stapling panel must contact the REHAU edge insulation strips firmly.

- Attach the film overlap of the REHAU stapling panel to the textile membrane with REHAU adhesive tape.
- Place the self-adhesive film base of the REHAU edge insulation strip onto the REHAU stapling panel and secure it there.
- Connect the REHAU pipe to the REHAU manifold.

- Install REHAU pipe in accordance with the installation grid and secure at a spacing of 50 cm with the REHAU RAUTAC stapling unit or REHAU stapling unit. Always set stapling unit on the stapling panel vertically over the pipes.



- When setting the staples, press the handle down evenly and then pull it back completely. This will ensure the staplers are being secured properly.

REHAU stapling panel		20-2	30-2	30-3	30-2	50-2	70-2
Format		Roll of insulation			Folding panels		
Base panel material		EPS 040 DES sg	EPS 040 DES sg	EPS 040 DES sm	EPS 040 DES sg	EPS 040 DES sg	EPS 035 DES sg
Textile membrane material		PE	PE	PE	PE	PE	PE
Sizes	Length [m]	12	12	12	2	2	2
	Width [m]	1	1	1	1	1	1
	Thickness [mm]	20	30	30	30	50	70
	Area [m <sup>2</sup> ]	12	12	12	2	2	2
Installation pipe spacing [cm]		5 and multiples thereof	5 and multiples thereof	5 and multiples thereof	5 and multiples thereof	5 and multiples thereof	5 and multiples thereof
Pipe lift [mm]		≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
Type according to DIN 18560 and DIN EN 13813		A	A	A	A	A	A
Thermal conductivity [W/mK]		0.040	0.040	0.040	0.040	0.040	0.035
Heat transmission resistance [m <sup>2</sup> K/W]		0.50	0.75	0.75	0.75	1.25	2.00
Material class according to DIN 4102 <sup>1)</sup>		B2	B2	B2	B2	B2	B2
Fire behaviour according to DIN EN 13501		E	E	E	E	E	E
Design load [kN/m <sup>2</sup> ]		5.0	5.0	4.0	5.0	5.0	10.0
Dynamic rigidity [MN/m <sup>3</sup> ]		30	20	20	20	15	30
Impact snd. imp. dim. ΔLw,R (dB) <sup>2)</sup>		26	28	28	28	29	26

<sup>1)</sup> The specification of the material class refers to the factory composite consisting of the polystyrene base panel and the polyethylene film

<sup>2)</sup> With a structural slab and a cement screed installed on the impact sound proofing insulation with a mass ≥ 70 kg/m<sup>2</sup>



#### 4.5.1 RAUTAC staples and REHAU staples



Illustration 4-31: RAUTAC staples and REHAU staples

The staples are joined by heating to form magazines of 30 staples each. The usual securing strap and any impairment of the setting procedure via gluing with remains of the securing strap does not apply.

#### 4.5.2 RAUTAC staples

##### REHAU pipes which can be used

- RAUTHERM S 14 x 1.5 mm
- RAUTHERM S 17 x 2.0 mm
- RAUTITAN flex 16 x 2.2 mm
- RAUTITAN stabil 16.2 x 2.6 mm

##### Description

RAUTAC staples guarantee non-buoying attachment of REHAU pipes due to their specially formed retaining barbs.



Illustration 4-32: RAUTAC staples

#### 4.5.3 REHAU staples

##### REHAU pipes which can be used

- RAUTHERM S 20 x 2.0 mm
- RAUTITAN flex 20 x 2.8

##### Description

REHAU staples prevent lifting of REHAU pipes due to their specially formed retaining barbs.



Illustration 4-33: REHAU staples

#### 4.5.4 REHAU multi stapling unit

##### REHAU staples which can be used

- RAUTAC staples
- REHAU staples

##### Description

The REHAU multi stapling unit is used for setting RAUTAC staples/REHAU staples on the REHAU stapling panels. A clip fixing tool is still required for further processing of both staples.

The staples magazines are inserted into the magazine rod shaft. A feeding aid increases the pressure on the staples and ensures proper setting of the staples and thus short installation times.

Even downward pressure on the ergonomically-shaped actuator handle inserts the staples into the cloth film of the REHAU stapling panels. When the actuator handle is released, it returns to its original position via a spring, and the setting procedure can be repeated straight away.



Illustration 4-34: REHAU multi stapling unit

#### 4.5.5 Upgrade set for RAUTAC stapling unit and REHAU stapling unit


 To use the heated staples magazine with the devices named in the heading, the clip fixing tool must be equipped with an upgrade set. You can obtain this at your respective REHAU sales office.



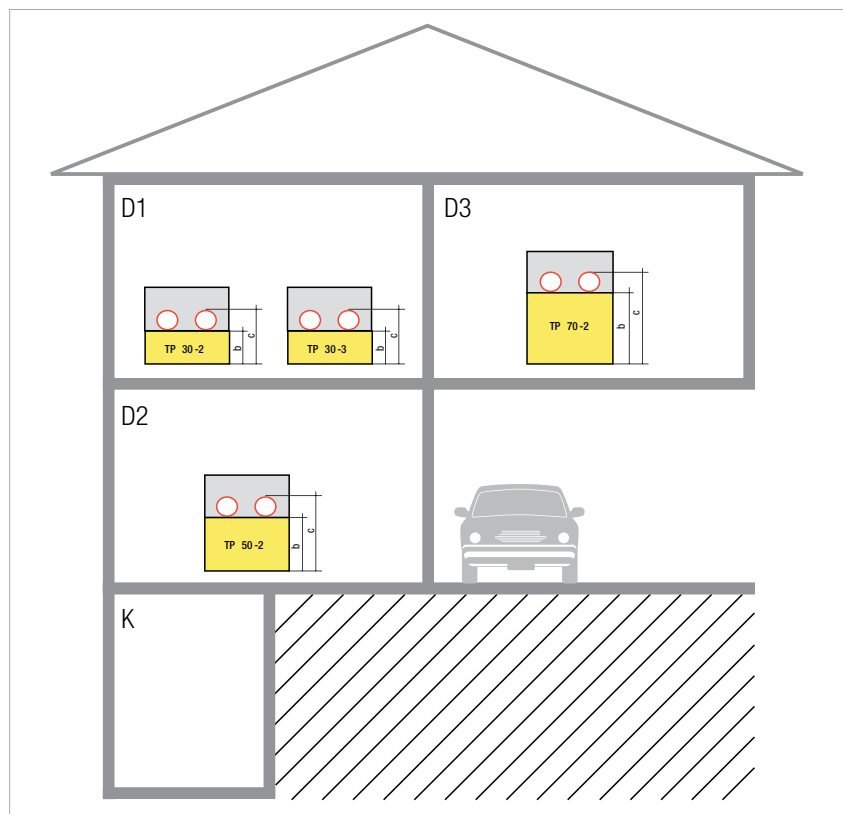
Illustration 4-35: Mounted upgrade set

In just a few steps, the upgrade set is mounted to the stapling unit. Installation instructions are included with each upgrade set for this purpose.

A feeding aid which applies pressure to the staples magazine is included with the upgrade set.

→ Attach the feeding aid to the full magazine rod to ensure even feeding of the staples and optimum loading pressure.

### Minimum insulation requirements according to DIN EN 1264-4



**D1 Insulation scenario 1:**

$R \geq 0.75 \text{ m}^2\text{K/W}$

Heated room one storey below

**D2 Insulation scenario 2:**

$R \geq 1.25 \text{ m}^2\text{K/W}$

(This should be increased in case of a groundwater level  $\leq 5 \text{ m}$ )

An unheated room or a room heated at intervals one storey below or directly on the ground

**D3 Insulation scenario 3:**

$R \geq 2.00 \text{ m}^2\text{K/W}$

Lower outside design temperature:

$-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$



These minimum insulation requirements have to be followed irrespective of the insulation required for the building envelope by the EnEV (see "Requirements for heating insulation according to EnEV and DIN EN 1264", Page 50).

Illustration 4-36: Minimum insulation layer constructions with REHAU RAUTAC staples and REHAU staples

K Cellar

	Insulation scenario 1	Insulation scenario 2	Insulation scenario 3
	<b>with impact sound proofing insulation</b>		
Insulation thickness [mm]	b = 28/27	b = 48	b = 68
Construction height to top edge of pipe [mm]	c <sub>14</sub> = 42/41 c <sub>16</sub> = 44/43 c <sub>17</sub> = 45/44 c <sub>20</sub> = 48/47	c <sub>14</sub> = 62 c <sub>16</sub> = 64 c <sub>17</sub> = 65 c <sub>20</sub> = 68	c <sub>14</sub> = 82 c <sub>16</sub> = 84 c <sub>17</sub> = 85 c <sub>20</sub> = 88

Table 4-12: Recommended minimum insulation layer constructions

**Recommended minimum screed construction heights comply with DIN 18560-2**

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 45 mm	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	h = 65 mm	
≤ 3	Cover	c = 65 mm	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	h = 85 mm	
≤ 4	Cover	c = 70 mm	c = 70 mm	c = 70 mm	c = 70 mm	
	Construction height	h = 84 mm	h = 86 mm	h = 87 mm	h = 90 mm	
≤ 5	Cover	c = 75 mm	c = 75 mm	c = 75 mm	c = 75 mm	
	Construction height	h = 89 mm	h = 91 mm	h = 92 mm	h = 95 mm	

 Table 4-13: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F4** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	h = 60 mm	
≤ 3	Cover	c = 55 mm	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	h = 75 mm	
≤ 4	Cover	c = 60 mm	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	h = 80 mm	
≤ 5	Cover	c = 65 mm	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	h = 85 mm	

 Table 4-14: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F5** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	h = 60 mm	
≤ 3	Cover	c = 50 mm	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	h = 70 mm	
≤ 4	Cover	c = 60 mm	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	h = 80 mm	
≤ 5	Cover	c = 65 mm	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	h = 85 mm	

 Table 4-15: Screed construction heights for **calcium sulphate liquid screed CAF of Bending Tensile Strength Class F4** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 44 mm	h = 46 mm	h = 47 mm	h = 50 mm	
≤ 3	Cover	c = 45 mm	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	h = 65 mm	
≤ 4	Cover	c = 50 mm	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	h = 70 mm	
≤ 5	Cover	c = 55 mm	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	h = 75 mm	

Table 4-16: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F5 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 44 mm	h = 46 mm	h = 47 mm	h = 50 mm	
≤ 3	Cover	c = 40 mm	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	h = 60 mm	
≤ 4	Cover	c = 45 mm	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	h = 70 mm	
≤ 5	Cover	c = 50 mm	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	h = 70 mm	

Table 4-17: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F7 comply with DIN 18560-2

### Heat-related tests

The REHAU RAUTAC stapling system is tested and certified for its heat-related properties according to DIN EN 1264.



When planning and assembling the REHAU RAUTAC stapling system, the requirements of DIN EN 1264, Part 4, must be complied with.



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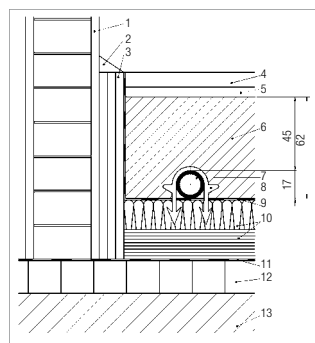


Illustration 4-37: REHAU stapling panel (combined heating and impact sound insulation) with staples for attachment of the RAUTHERM S pipe

- 1 Interior wall furnishing
- 2 Skirting
- 3 Edge insulation strip
- 4 Natural or synthetic stone tiles
- 5 Mortar bed
- 6 Screed comply with DIN 18560
- 7 RAUTHERM S pipe
- 8 Staple
- 9 Membrane according to DIN 18560, polyethylene film
- 10 Heating and impact sound proofing insulation, polyethylene laminated
- 11 Moisture barrier (complies with DIN 18195)
- 12 Structural slab
- 13 Ground

## 4.6 REHAU RAUFIX system



- Force-fit pipe attachment
- No tools required for rail assembly
- Precise rail attachment
- Easy system construction

### System components

- REHAU RAUFIX rail 12/14
- REHAU RAUFIX rail 16/17/20
- REHAU retaining pin

### REHAU pipes which can be used

- with REHAU RAUFIX rail 12/14:
  - RAUTHERM S 14 x 1.5 mm
- with REHAU RAUFIX rail 16/17/20:
  - RAUTHERM S 17 x 2.0 mm
  - RAUTHERM S 20 x 2.0 mm
  - RAUTITAN flex 16 x 2.2 mm
  - RAUTITAN stabil 16.2 x 2.6 mm

### Accessories

- REHAU adhesive tape
- REHAU adhesive tape dispenser
- REHAU edge insulation strips
- REHAU expansion joint profile
- REHAU system installation materials
- REHAU membrane

### Description

The REHAU RAUFIX rail made of polypropylene, with a pipe lift of 5 mm corresponds to type A in accordance with DIN 18560 and DIN EN 13813. With single- and double-meander-type pipe guidance, installation spacing of 5 cm and multiples thereof can be implemented.

The connectors moulded into the REHAU RAUFIX rail enable connection of the pipe bracket without tools. The top-side retaining clip ensures pipe attachment will not be lifted. Hooks on the top retaining clips of the REHAU RAUFIX rail guarantee firm clipping of the pipes. Securing at the connector enables reliable and quick connection of the 1 m REHAU RAUFIX rails. The bottom barbs of the REHAU RAUFIX rails guarantee exact securing in the REHAU additional insulation.

The REHAU RAUFIX system is intended for use with screeds comply with DIN 18560.



Illustration 4-38: REHAU RAUFIX system



Illustration 4-39: REHAU RAUFIX rails

The perforated floor panel of the REHAU RAUFIX rail receives the REHAU retaining pins. The specially formed barbs of the REHAU retaining pins ensure firm seating of the REHAU RAUFIX rail in the floor.




Illustration 4-40: REHAU retaining pin

The REHAU membrane made of tear-proof polyethylene corresponds to the requirements of DIN 18560 and DIN EN 1264. It provides a seal against screed mixing water. Heat and sound bridges are prevented. The robust covering provides the REHAU retaining pins with strong hold.



Illustration 4-41: REHAU membrane

 The REHAU membrane does not replace any moisture barrier which may be required.

## Assembly

**i** In temperatures below +10 °C and/or installation pipe spacing ≤ 15 cm, RAUTHERM S pipes 17 x 2.0 mm and 20 x 2.0 mm and RAUTITAN flex pipes 16 x 2.2 mm have to be warmed and installed with the REHAU pipe unwinder (warm) and a heater.

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.
- Secure REHAU edge insulation strips.
- Install REHAU system installation materials if necessary.

**i** Damage to the REHAU membrane impairs its function.

- Do not damage the REHAU membrane when installing it.
- Any holes or tears in the REHAU membrane have to be completely repaired with REHAU adhesive tape.

- Install REHAU membrane so that it overlaps at least 8 cm.
- Fully seal overlapping sections of REHAU membrane with REHAU adhesive tape.
- Attach self-adhesive film base of the REHAU edge insulation strip without tension to the REHAU membrane.
- Connect REHAU RAUFIX rails to form the desired length and press parallel into the floor with a spacing of 1 m.

**i** When using liquid screeds, the spacing between the REHAU RAUFIX rails may need to be reduced.



Illustration 4-42: Pressing REHAU RAUFIX rail into the floor

- Secure REHAU RAUFIX rail with REHAU retaining pin with a spacing of 40 cm.
- Press REHAU retaining pin into the floor through the REHAU RAUFIX rails.

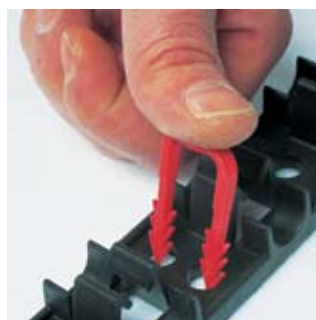


Illustration 4-43: Pressing REHAU retaining pins into the floor

- Connect one end of the REHAU pipe to the REHAU manifold.
- Install REHAU pipe in the retaining clips.
- Connect the other end of the REHAU pipe to the REHAU manifold.
- Secure REHAU pipe in area of direction change with additional REHAU RAUTAC staples or REHAU retaining pins.
- Assemble the REHAU expansion joint profile.

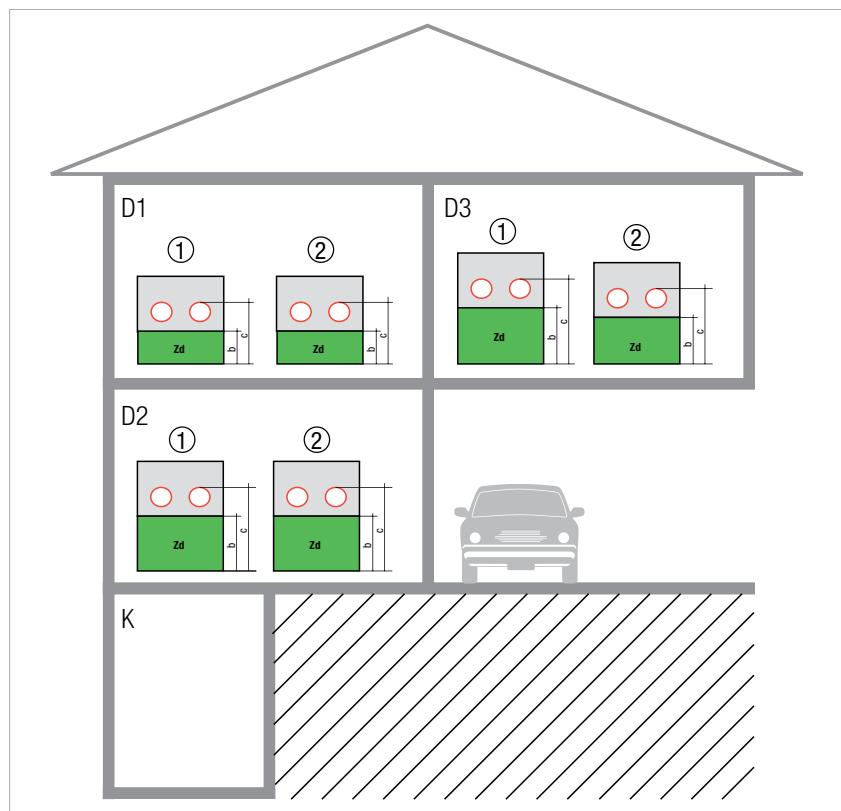
## Technical data RAUFIX rails

Rail material	Polypropylene
Rail length	1 m
Rail height (without bottom barbs)	
Rail 12/14	24 mm
Rail 16/17/20	27 mm
Rail width	
Rail 12/14	40 mm
Rail 16/17/20	50 mm
Pipe lift	5 mm
Installation pipe spacing	5 cm and multiples thereof

## Technical data REHAU retaining pins

Pin material	Polypropylene
Pin length	50 mm
Tip distance	20 mm

### Minimum insulation requirements comply with DIN EN 1264-4



#### D1 Insulation scenario 1:

$$R \geq 0.75 \text{ m}^2\text{K/W}$$

Heated room one storey below

#### D2 Insulation scenario 2:

$$R \geq 1.25 \text{ m}^2\text{K/W}$$

(This should be increased in case of a groundwater level  $\leq 5 \text{ m}$ )

An unheated room or a room heated at intervals one storey below or directly on the ground

#### D3 Insulation scenario 3:

$$R \geq 2.00 \text{ m}^2\text{K/W}$$

Lower outside design temperature:

$$-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$$



These minimum insulation requirements have to be followed irrespective of the insulation required for the building envelope by the EnEV (see "Requirements for heating insulation according to EnEV and DIN EN 1264", Page 50).

Illustration 4-44: Minimum insulation layer constructions with REHAU RAUFIX system

- 1 with impact sound proofing insulation (ISDI)
- 2 without impact sound proofing insulation (ISDI)
- K Cellar
- Zd Additional insulation

	Insulation scenario 1		Insulation scenario 2		Insulation scenario 3	
	with ISDI	without ISDI	with ISDI	without ISDI	with ISDI	without ISDI
<b>Additional insulation Zd [mm]</b>	Zd = 30 - 2	Zd = 30	Zd = 50 - 2	Zd = 50	Zd = 70 - 2	Zd = 50
	EPS 040	EPS 040	EPS 040	EPS 040	EPS 035	PUR 025
	DES sg	DEO dm	DES sg	DEO dm	DES sg	DEO dh
<b>Insulation thickness [mm]</b>	b = 28	b = 30	b = 48	b = 50	b = 68	b = 50
<b>Construction height to top edge of pipe [mm]</b>	c <sub>14</sub> = 47	c <sub>14</sub> = 49	c <sub>14</sub> = 67	c <sub>14</sub> = 69	c <sub>14</sub> = 87	c <sub>14</sub> = 69
	c <sub>16</sub> = 49	c <sub>16</sub> = 51	c <sub>16</sub> = 69	c <sub>16</sub> = 71	c <sub>16</sub> = 89	c <sub>16</sub> = 71
	c <sub>17</sub> = 50	c <sub>17</sub> = 52	c <sub>17</sub> = 70	c <sub>17</sub> = 72	c <sub>17</sub> = 90	c <sub>17</sub> = 72
	c <sub>20</sub> = 53	c <sub>20</sub> = 55	c <sub>20</sub> = 73	c <sub>20</sub> = 75	c <sub>20</sub> = 93	c <sub>20</sub> = 75

Table 4-24: Recommended minimum insulation layer constructions



**Recommended minimum screed construction heights comply with DIN 18560-2**

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 45 mm	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	h = 70 mm	
≤ 3	Cover	c = 60 mm	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	h = 85 mm	
≤ 4	Cover	c = 65 mm	c = 65 mm	c = 65 mm	c = 65 mm	
	Construction height	h = 84 mm	h = 86 mm	h = 87 mm	h = 90 mm	
≤ 5	Cover	c = 70 mm	c = 70 mm	c = 70 mm	c = 70 mm	
	Construction height	h = 89 mm	h = 91 mm	h = 92 mm	h = 95 mm	

Table 4-25: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F4** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 35 mm	c = 35 mm	c = 35 mm	c = 40 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	h = 60 mm	
≤ 3	Cover	c = 50 mm	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	h = 75 mm	
≤ 4	Cover	c = 55 mm	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	h = 80 mm	
≤ 5	Cover	c = 60 mm	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	h = 85 mm	

Table 4-26: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F5** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	h = 65 mm	
≤ 3	Cover	c = 45 mm	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	h = 70 mm	
≤ 4	Cover	c = 55 mm	c = 55 mm	c = 55 mm	c = 55 mm	
	Construction height	h = 74 mm	h = 76 mm	h = 77 mm	h = 80 mm	
≤ 5	Cover	c = 60 mm	c = 60 mm	c = 60 mm	c = 60 mm	
	Construction height	h = 79 mm	h = 81 mm	h = 82 mm	h = 85 mm	

Table 4-27 Screed construction heights for **calcium sulphate liquid screed CAF of Bending Tensile Strength Class F4** comply with DIN 18560-2



Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 49 mm	h = 51 mm	h = 52 mm	h = 55 mm	
≤ 3	Cover	c = 40 mm	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	h = 65 mm	
≤ 4	Cover	c = 45 mm	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	h = 70 mm	
≤ 5	Cover	c = 50 mm	c = 50 mm	c = 50 mm	c = 50 mm	
	Construction height	h = 69 mm	h = 71 mm	h = 72 mm	h = 75 mm	

Table 4-28: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F5 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTHERM S 14x1.5 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 49 mm	h = 51 mm	h = 52 mm	h = 55 mm	
≤ 3	Cover	c = 35 mm	c = 35 mm	c = 35 mm	c = 35 mm	
	Construction height	h = 54 mm	h = 56 mm	h = 57 mm	h = 60 mm	
≤ 4	Cover	c = 40 mm	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 59 mm	h = 61 mm	h = 62 mm	h = 65 mm	
≤ 5	Cover	c = 45 mm	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 64 mm	h = 66 mm	h = 67 mm	h = 70 mm	

Table 4-29: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F7 comply with DIN 18560-2

### Heat-related tests

The REHAU RAUFIX system is tested and certified for its heat-related properties according to DIN EN 1264.



Registration number: 7 F 026

§ When planning and assembling the REHAU RAUFIX stapling system, the requirements of DIN EN 1264, Part 4, must be complied with.

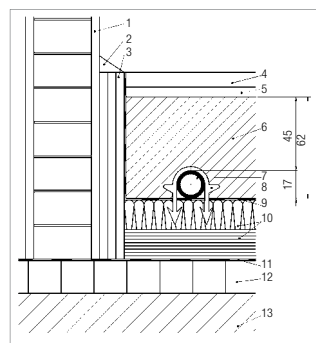


Illustration 4-45 REHAU RAUFIX rail as a pipe carrier element with installed RAUTHERM S pipe

- 1 Interior wall furnishing
- 2 Skirting
- 3 Edge insulation strip
- 4 Natural or synthetic stone tiles
- 5 Mortar bed
- 6 Screed comply with DIN 18560
- 7 RAUTHERM S pipe
- 8 RAUFIX rail
- 9 Membrane according to DIN 18560, polyethylene film or bituminous paper
- 10 Heating and impact sound proofing insulation
- 11 Moisture barrier (complies with DIN 18195)
- 12 Structural slab
- 13 Ground

## 4.7 REHAU pipe grid system



- Can be used universally and independent of the selected insulation
- Suitable for heavy-load areas when used on PUR insulation
- Quick installation of pipe grid
- Liquid screed can be used

### System components

- REHAU pipe grid RM 100
- REHAU grid ties
- REHAU twisting tool for grid ties
- REHAU twist-on clip
- REHAU clip fixing tool
- REHAU chain dowel

### REHAU pipes which can be used

- RAUTHERM S 17 x 2.0 mm
- RAUTHERM S 20 x 2.0 mm
- RAUTITAN flex 16 x 2.2 mm
- RAUTITAN flex 20 x 2.8 mm

### Accessories

- REHAU edge insulation strips
- REHAU expansion joint profile
- REHAU adhesive tape
- REHAU adhesive tape dispenser
- REHAU system installation materials
- REHAU membrane

### Description

The REHAU pipe grid system enables heated screeds of type A according to DIN 18560 and DIN EN 13813 to be used.

The REHAU pipe grid allows for an installation pipe spacing of 5 cm and multiples thereof.

Using the REHAU twisting tool and the REHAU grid ties, the REHAU pipe grids can be connected easily and securely.

The REHAU pipe grid system is intended for use with screeds pursuant to DIN 18560.



Illustration 4-46: REHAU pipe grid system



Illustration 4-47: REHAU twisting tool and REHAU grid ties

The REHAU twist-on clip made of polypropylene guarantees secure attachment of the REHAU pipes to the REHAU pipe grid via the two top-side moulded clips with barbs and the four bottom-side moulded clips..



Illustration 4-49: REHAU twist-on clip

The REHAU chain dowel prevents the pipe grid buoying when liquid screeds are used.



Illustration 4-40: REHAU retaining pin

The REHAU twist-on clip can be comfortably lipped on in a upright posture with the REHAU clip fixing tool.



Illustration 4-50: REHAU clip fixing tool

The REHAU membrane made of tear-proof polyethylene corresponds to the requirements of DIN 18560 and DIN EN 1264. It provides a seal against screed mixing water. Heat and sound bridges are prevented.



Illustration 4-51: REHAU membrane

**i** The REHAU membrane does not replace any moisture barrier which may be required.

### Assembly

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.
- Secure REHAU edge insulation strips.
- Install REHAU system installation materials if necessary.



Large-scale damage to the REHAU membrane impairs its function.

- Larger holes or tears in the REHAU membrane have to be completely repaired with REHAU adhesive tape.

- Install REHAU membrane so that it overlaps at least 8 cm.
- Fully seal overlapping sections of REHAU membrane with REHAU adhesive tape.
- Attach self-adhesive film base of the edge insulation strip without tension to the REHAU membrane.



The use of common construction-steel grids is not permitted for REHAU underfloor heating/cooling.



When using liquid screeds, the pipe grid can float up.

- Secure pipe grid with REHAU chain dowels.

- Lay REHAU pipe grids with the tightly-knit side at the edge insulation strips at a spacing of approx. 5 cm.
- Install REHAU pipe grids overlapping at the edges and twist the edge mesh with the REHAU grid ties.



The pipe grid must be separated near expansion joints through the floor.

- Secure REHAU twist-on clips on the pipe grid with the REHAU clip fixing tool according to the planned pipe path. Heed the following here:



- The spacing of the twist-on clips should be approx. 50 cm on straight pipe sections and approx. 10 cm with curves with tight bending radii.
- The minimum bending radius for the respective REHAU pipe to be used must be complied with.

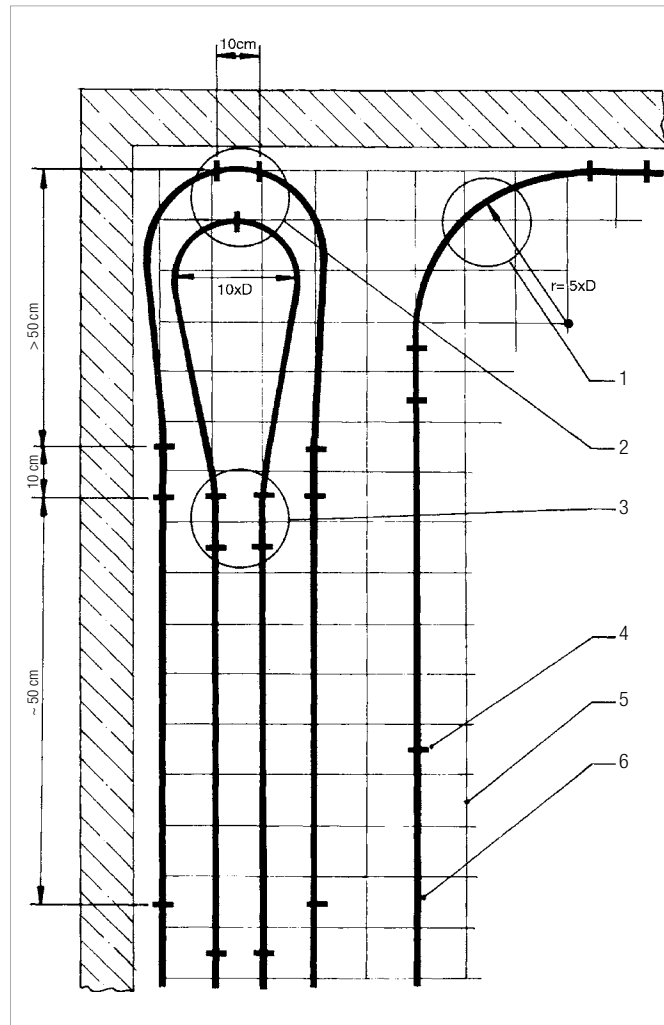
- Place twist-on clip near the manifold from the outside inward. First position the pipe clips for the flow pipe at double the pipe spacing and then position the pipe clips for the return pipes with the planned

pipe spacing.

- Clockwise rotation leads to attachment to the cross bar and anti-clockwise rotation leads to attachment to the longitudinal bar of the pipe grid.
- Connect one end of the REHAU pipe to the REHAU manifold.
- Install REHAU pipe in the twist-on clips.
- Connect the other end of the REHAU pipe to the manifold.
- Assemble the REHAU expansion joint profile.

### Technical data

Material	Steel wire
Wire thickness	3 mm
Length, incl. edge mesh	2,050 mm
Width, incl. edge mesh	1,050 mm
Width of the edge mesh on a longitudinal and cross side	50 mm
Effective installation area	2 m <sup>2</sup>
Grid dimension	100 mm
Installation pipe spacing	5 cm and multiples thereof



- 1 90° redirection
- 2 Apex
- 3 Pre-loop attachment
- 4 Twist-on clip
- 5 Pipe grid
- 6 Pipe

Illustration. 4-52: Turning loop and redirection in heating pipe register

### Minimum insulation requirements comply with DIN EN 1264-4



#### D1 Insulation scenario 1:

$$R \geq 0.75 \text{ m}^2\text{K/W}$$

Heated room one storey below

#### D2 Insulation scenario 2:

$$R \geq 1.25 \text{ m}^2\text{K/W}$$

(This should be increased in case of a groundwater level  $\leq 5 \text{ m}$ )

An unheated room or a room heated at intervals one storey below or directly on the ground

#### D3 Insulation scenario 3:

$$R \geq 2.00 \text{ m}^2\text{K/W}$$

Lower outside design temperature:

$$-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$$

**i** These minimum insulation requirements have to be followed irrespective of the insulation required for the building envelope by the EnEV (see "Requirements for heating insulation according to EnEV and DIN EN 1264", Page 50).

Illustration 4-53: Minimum insulation layer constructions with the REHAU pipe grid system

- 1 with impact sound proofing insulation (ISDI)
- 2 without impact sound proofing insulation (ISDI)
- K Cellar
- Zd Additional insulation

	Insulation scenario 1		Insulation scenario 2		Insulation scenario 3	
	with ISDI	without ISDI	with ISDI	without ISDI	with ISDI	without ISDI
<b>Additional insulation Zd [mm]</b>	Zd = 30 - 2	Zd = 30	Zd = 50 - 2	Zd = 50	Zd = 70 - 2	Zd = 50
	EPS 040	EPS 040	EPS 040	EPS 040	EPS 035	PUR 025
	DES sg	DEO dm	DES sg	DEO dm	DES sg	DEO dh
<b>Insulation thickness [mm]</b>	b = 28	b = 30	b = 48	b = 50	b = 68	b = 50
<b>Construction height to top edge of pipe [mm]</b>	c <sub>16</sub> = 58	c <sub>16</sub> = 60	c <sub>16</sub> = 78	c <sub>16</sub> = 80	c <sub>16</sub> = 98	c <sub>16</sub> = 80
	c <sub>17</sub> = 59	c <sub>17</sub> = 61	c <sub>17</sub> = 79	c <sub>17</sub> = 81	c <sub>17</sub> = 99	c <sub>17</sub> = 81
	c <sub>20</sub> = 62	c <sub>20</sub> = 64	c <sub>20</sub> = 82	c <sub>20</sub> = 84	c <sub>20</sub> = 102	c <sub>20</sub> = 84

Table 4-30: Recommended minimum insulation layer constructions

**Recommended minimum screed construction heights comply with DIN 18560-2**

Area load [kN/m <sup>2</sup> ]		RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 45 mm	c = 45 mm	c = 45 mm	
	Construction height	h = 75 mm	h = 76 mm	h = 79 mm	
≤ 3	Cover	c = 51 mm	c = 51 mm	c = 51 mm	
	Construction height	h = 81 mm	h = 82 mm	h = 85 mm	
≤ 4	Cover	c = 56 mm	c = 56 mm	c = 56 mm	
	Construction height	h = 86 mm	h = 87 mm	h = 90 mm	
≤ 5	Cover	c = 61 mm	c = 61 mm	c = 61 mm	
	Construction height	h = 91 mm	h = 92 mm	h = 95 mm	

Table 4-31: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F4** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 60 mm	h = 61 mm	h = 64 mm	
≤ 3	Cover	c = 41 mm	c = 41 mm	c = 41 mm	
	Construction height	h = 71 mm	h = 72 mm	h = 75 mm	
≤ 4	Cover	c = 46 mm	c = 46 mm	c = 46 mm	
	Construction height	h = 76 mm	h = 77 mm	h = 80 mm	
≤ 5	Cover	c = 51 mm	c = 51 mm	c = 51 mm	
	Construction height	h = 81 mm	h = 82 mm	h = 85 mm	

Table 4-32: Screed construction heights for **cement screed CT of Bending Tensile Strength Class F5** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTITAN flex 16x2.2 mm	RAUTHERM S 17x2.0 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 70 mm	h = 71 mm	h = 74 mm	
≤ 3	Cover	c = 40 mm	c = 40 mm	c = 40 mm	
	Construction height	h = 70 mm	h = 71 mm	h = 74 mm	
≤ 4	Cover	c = 46 mm	c = 46 mm	c = 46 mm	
	Construction height	h = 76 mm	h = 77 mm	h = 80 mm	
≤ 5	Cover	c = 51 mm	c = 51 mm	c = 51 mm	
	Construction height	h = 81 mm	h = 82 mm	h = 85 mm	

Table 4-33: Screed construction heights for **calcium sulphate liquid screed CAF of Bending Tensile Strength Class F4** comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTITAN flex 16x2.2 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 60 mm	h = 61 mm	h = 64 mm	
≤ 3	Cover	c = 31 mm	c = 31 mm	c = 31 mm	
	Construction height	h = 61 mm	h = 62 mm	h = 65 mm	
≤ 4	Cover	c = 36 mm	c = 36 mm	c = 36 mm	
	Construction height	h = 66 mm	h = 67 mm	h = 70 mm	
≤ 5	Cover	c = 41 mm	c = 41 mm	c = 41 mm	
	Construction height	h = 71 mm	h = 72 mm	h = 75 mm	

Table 4-34: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F5 comply with DIN 18560-2

Area load [kN/m <sup>2</sup> ]		RAUTITAN flex 16x2.2 mm	RAUTITAN flex 16x2.2 mm	RAUTHERM S 20x2.0 mm	Construction plan
≤ 2	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 60 mm	h = 61 mm	h = 64 mm	
≤ 3	Cover	c = 30 mm	c = 30 mm	c = 30 mm	
	Construction height	h = 60 mm	h = 61 mm	h = 64 mm	
≤ 4	Cover	c = 31 mm	c = 31 mm	c = 31 mm	
	Construction height	h = 61 mm	h = 62 mm	h = 65 mm	
≤ 5	Cover	c = 36 mm	c = 36 mm	c = 36 mm	
	Construction height	h = 66 mm	h = 67 mm	h = 70 mm	

Table 4-35: Screed construction heights for calcium sulphate liquid screed CAF of Bending Tensile Strength Class F7 comply with DIN 18560-2

### Heat-related tests

The REHAU pipe grid system is tested and certified for its heat-related properties comply with DIN EN 1264.



Registration number: 7 F 025

§ When planning and assembling the REHAU pipe grid system, the requirements of DIN EN 1264, Part 4, must be complied with.

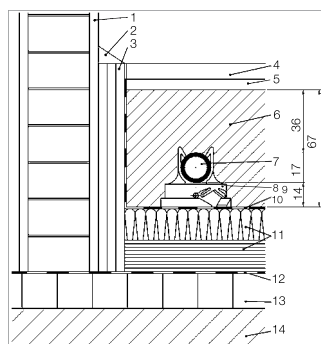


Illustration 4-54: REHAU pipe grid (RTM) with twist-on clip for attachment of the RAUTHERM S pipe

- 1 Interior wall furnishing
- 2 Skirting
- 3 Edge insulation strip
- 4 Natural or synthetic stone tiles
- 5 Mortar bed
- 6 Screed comply with DIN 18560
- 7 RAUTHERM S pipe
- 8 REHAU twist-on clip
- 9 REHAU pipe grid RM 100 made of galvanised steel wire
- 10 Membrane according to DIN 18560, polyethylene film or bituminous paper
- 11 Heating and impact sound proofing insulation
- 12 Moisture barrier (complies with DIN 18195)
- 13 Structural slab
- 14 Ground



## 4.8 REHAU dry system



- Quick and safe installation due to factory-laminated heat-diffusion plates
- Easy and quick cutting to size via integrated predetermined break grooves
- Heat-conductive plates need not be lifted when heating pipe is installed
- Very robust; can be walked on with no problem
- Minimal construction height

### System components

- REHAU installation panel
  - VA 12.5 (for edge areas)
  - VA 25 (for occupied areas)
- REHAU redirection panel
  - VA 12.5 (for edge areas)
  - VA 25 (for occupied areas)
- REHAU transition panel
- REHAU filler panel
- REHAU pipe channel cutter

### REHAU pipes which can be used

- RAUTHERM S 16 x 2.0 mm
- RAUTITAN flex 16 x 2.2 mm
- RAUTITAN stabil 16.2 x 2.6 mm

### Accessories

- REHAU edge insulation strips
- REHAU membrane
- REHAU system installation materials



The REHAU dry system is intended for use with dry screed elements (see Chap. 4.2.3, Page 53). Combination with wet screeds comply with DIN 18560 is possible.



If the REHAU dry system is used for cooling in conjunction with a dry screed, condensation may form on the pipe or the front or rear side of the gypsum fibre boards.

→ To prevent condensation, use the REHAU heating/cooling control set in conjunction with the dew-point sensor or other suitable control and monitoring equipment.

### Description

The REHAU dry system enables floor heaters of type B according to DIN 18560 and DIN EN 13813 on solid and wood truss ceilings to be used.

All system panels of the REHAU dry system consist of expanded polystyrene and fulfil the requirements of DIN EN 13163.

The REHAU installation panels also feature factory-laminated heat-diffusion aluminium profiles on the top side for inserting the heating pipes and transverse heat distribution. Integrated predetermined break grooves ensure trouble-free and quick shortening of the installation panels at the construction site. The REHAU redirection panels are used for redirection of the heating pipes near bordering walls.



Illustration 4-55: REHAU dry system

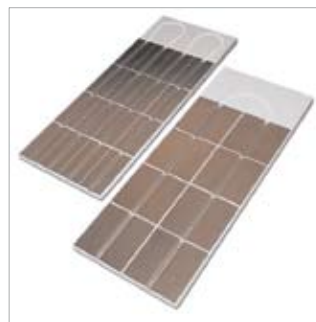


Illustration 4-56: REHAU installation panels VA 12.5/VA 25 with REHAU redirection panels



Illustration 4-57: REHAU redirection panels and REHAU transition panels

The REHAU transition panel is used for the transition from VA 12.5 to VA 25 cm.



The REHAU dry system can also be installed in conjunction with wet screeds. The REHAU membrane is to be installed overlapping on the system panels. The film overlapping and the film base of the edge insulation strip have to be adhered carefully.

The requirements for additional heat and/ or impact sound proof insulation specified for using dry screed elements do not apply here.



The REHAU filler panels are intended for the following areas:

- before the manifold (approx. 1 m around it)
- near projections, columns, ventilation outlets etc.
- to fill up empty areas with a non-squared ground plot.



Illustration 4-58: REHAU filler panel

Individual pipe guides are cut into the filler panels at the construction site with the REHAU pipe groove cutter.



Illustration 4-59: REHAU pipe groove cutter

### Technical data

System panels/ Designation	Installation panels VA 12.5 and 25 cm	Redirection panels VA 12.5 and 25 cm Transition panel	Filler panel
Material	EPS 035 DE0 with laminated aluminium heat-conductive profiles	EPS 035 DE0	EPS 035 DE0
Length [mm]	1,000	250	1,000
Width [mm]	500	Redirection panels: 500 Transition panel: 375	500
Thickness [mm]	30	30	30
Thermal conductivity [W/mK]	0.035	0.035	0.035
Heat transmission resistance [m <sup>2</sup> K/W]	0.80	0.80/0.70	0.85
Compressive stress at 2 % [kPa]	45.0	45.0	60.0
Material class according to DIN 4102	B2	B1	B1
Fire behaviour according to DIN EN 13501	E	E	E

## Assembly



When using dry screed elements, the REHAU impact sound insulations may not be used with the REHAU dry system.

- When used in conjunction with impact sound insulation with EPS heating insulation, install the heating insulation first.
- When used in conjunction with impact sound proofing insulation with PUR heating insulation, install the impact sound proofing insulation first.



All external accessories, incl. loose-fill insulation must be approved by the manufacturer of the dry screed elements for use in conjunction with the REHAU dry system.

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.
- Secure REHAU edge insulation strips.
- Install REHAU system installation materials if necessary.

### Caution!

#### Burn and fire hazard!

- Never grasp the hot cutting blade of the REHAU pipe groove cutter.
- Do not leave the REHAU pipe groove cutter unattended while in operation.
- Do not set the REHAU pipe groove cutter down on flammable surfaces.

- Install REHAU system panels without gaps in accordance with the installation plan (see Illustration. 2-60). Cut individual pipe guides into the filler panels with the REHAU pipe groove cutter if necessary.
- Connect one end of the REHAU pipe to the REHAU manifold.
- Install REHAU pipe in the guide grooves of the system panels.
- Connect the other end of the REHAU pipe to the REHAU manifold.
- Press compression sleeve joints either near the REHAU redirection panels flush with the top side of the REHAU redirection panel or position them near the REHAU installation panels by cutting the heat-conductive plate using a disc grinder.
- Install REHAU membrane on the dry system above the pipe.

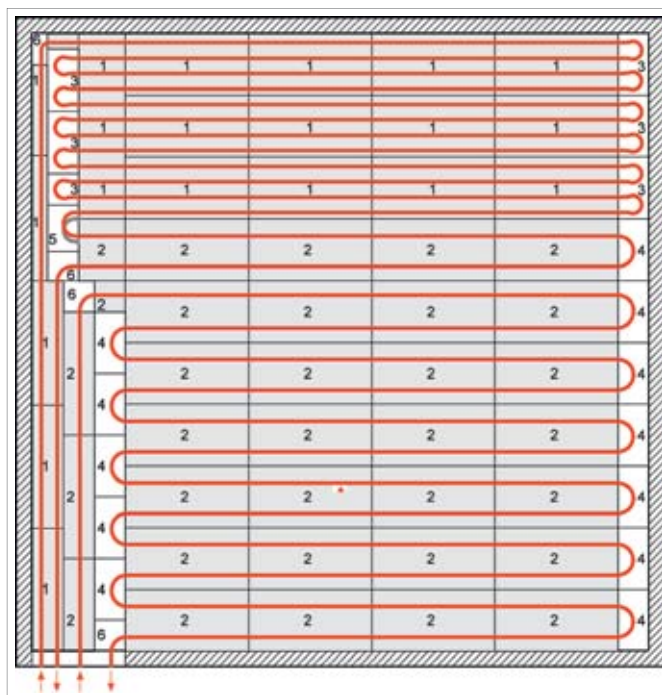


Illustration 4-60: Example installation plan for the REHAU dry system

- 1 REHAU installation panel VA 12.5
- 2 REHAU installation panel VA 25
- 3 REHAU redirection panel VA 12.5
- 4 REHAU redirection panel VA 25
- 5 REHAU transition panel
- 6 REHAU filler panel



- Install only breathable drip protection (e.g. natron or bituminous paper) on wood truss ceilings because of the risk of mould growth.
- Attach REHAU membrane or drip protection to the film base of the REHAU edge insulation strip.

**Minimum insulation requirements comply with DIN EN 1264-4**

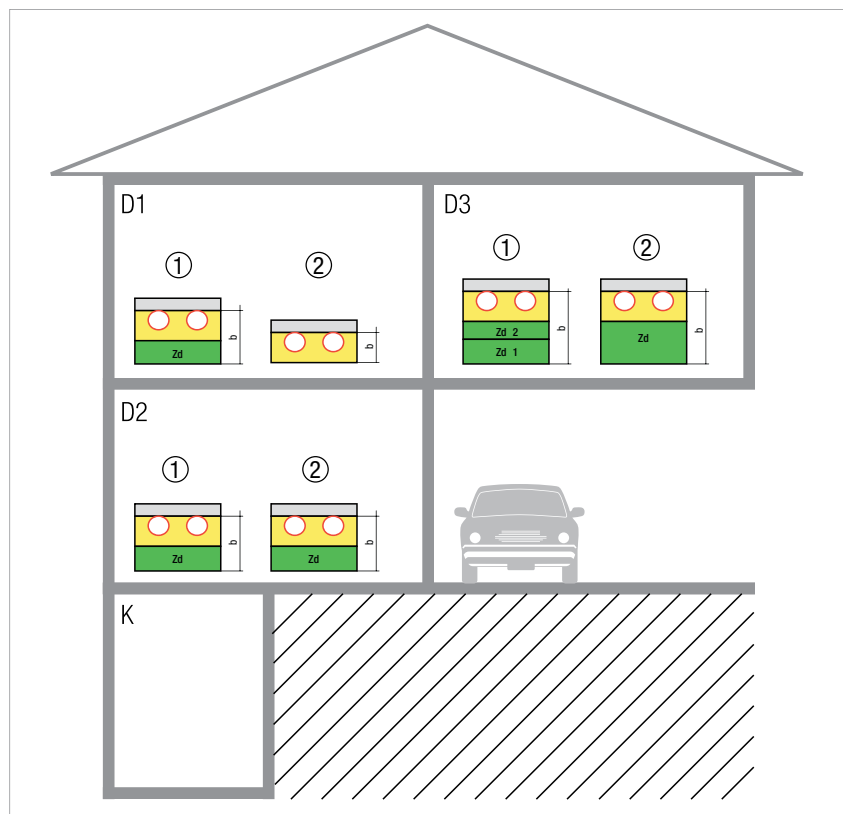


Illustration 4-61: Minimum insulation layer constructions with the REHAU dry system

- 1 with impact sound proofing insulation (ISDI)
- 2 without impact sound proofing insulation (ISDI)
- K Cellar
- Zd Additional insulation

**D1 Insulation scenario 1:**

$R \geq 0.75 \text{ m}^2\text{K/W}$

Heated room one storey below

**D2 Insulation scenario 2:**

$R \geq 1.25 \text{ m}^2\text{K/W}$

(This should be increased in case of a groundwater level  $\leq 5 \text{ m}$ )

An unheated room or a room heated at intervals one storey below or directly on the ground

**D3 Insulation scenario 3:**

$R \geq 2.00 \text{ m}^2\text{K/W}$

Lower outside design temperature:

$-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$

**i** These minimum insulation requirements have to be followed irrespective of the insulation required for the building envelope by the EnEV (see "Requirements for heating insulation according to EnEV and DIN EN 1264", Page 50).

**i** Applications and construction heights of the dry screed elements are presented separately (see Table 4-2, Page 53).

	Insulation scenario 1		Insulation scenario 2		Insulation scenario 3	
	with ISDI	without ISDI	with ISDI	without ISDI	with ISDI	without ISDI
<b>Additional insulation Zd [mm]</b>	Zd = 20 - 2 Wood fibre/ Mineral wool insulation WLG 040		Zd = 20 - 2 Wood fibre/ Mineral wool insulation WLG 040	Zd = 20 EPS 035 DEO	Zd 2 = 20 - 2 Wood fibre/ Mineral wool insulation WLG 040 Zd 1 = 30 EPS 035 DEO	Zd = 50 EPS 035 DEO
<b>Insulation thickness [mm]/ Construction height to top edge of pipe [mm]</b>	b = 48	b = 30	b = 48	b = 50	b = 78	b = 80

Table 4-36: Recommended minimum insulation layer constructions

**Recommended minimum screed construction heights comply with DIN 18560-2**

Area load [kN/m <sup>2</sup> ]	Cement screed CT Bending Tensile Strength Class		Calcium sulphate liquid screed CAF Bending Tensile Strength Class			Construction plan
	F4	F5	F4	F5	F7	
≤ 2	h = 45 mm	h = 40 mm	h = 35 mm	h = 30 mm	h = 30 mm	
≤ 3	h = 65 mm	h = 55 mm	h = 50 mm	h = 45 mm	h = 40 mm	
≤ 4	h = 70 mm	h = 60 mm	h = 60 mm	h = 50 mm	h = 45 mm	
≤ 5	h = 75 mm	h = 65 mm	c = 65 mm	c = 55 mm	c = 50 mm	

Table 4-37: Screed construction heights according to DIN 18560-2 (with RAUTHERM S pipe 16x2.0 mm or RAUTTAN flex pipe 16x2.2 mm)

**Heat-related tests**

The REHAU dry system is tested and certified for its heat-related properties comply with DIN EN 1264.

**§** When planning and assembling the REHAU dry system, the requirements of DIN EN 1264, Part 4, must be complied with.



Registration number: 7 F 106

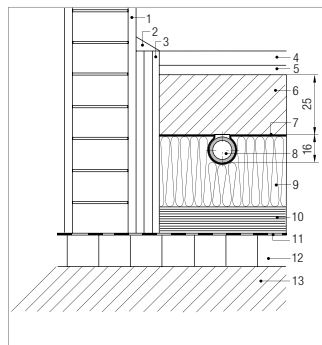


Illustration 4-62: REHAU dry system with installed RAUTHERM S pipe

- 1 Interior wall furnishing
- 2 Skirting
- 3 Edge insulation strip
- 4 Natural or synthetic stone tiles
- 5 Mortar bed
- 6 Dry screed
- 7 Heat-conductive plate, laminated at position 9
- 8 RAUTHERM S pipe
- 9 REHAU installation panel made of polystyrene foam
- 10 Heating and impact sound proofing insulation
- 11 Moisture barrier
- 12 Structural slab
- 13 Ground

#### 4.9 REHAU base panel TS-14



- Minimal construction height
- Easy and quick cutting of the heat conductive slats to size via integrated predetermined break points
- Optimum clamping action of the redirection slats TS-14 via offset bracket spikes



The REHAU base panel TS-14 is intended for use with dry screed elements (see Table 4-3, Page 54). Combination with wet screeds comply with DIN 18560 is possible.

- REHAU base panel TS-14
- REHAU heat-diffusion slat TS-14
- REHAU redirection slat TS-14
- REHAU filler panel TS-14

#### REHAU pipes which can be used

- RAUTHERM S 14 x 1.5 mm

#### Accessories

- REHAU pipe groove cutter
- REHAU edge insulation strips
- REHAU membrane
- REHAU system installation materials



If the REHAU base panel TS-14 is used for cooling in conjunction with a dry screed, condensation may form on the pipe or the front

or rear side of the gypsum fibre boards.

→ To prevent condensation, use the REHAU heating/cooling control set in conjunction with the dew-point sensor or other suitable control and monitoring equipment.



The REHAU base panel TS-14 can also be installed in conjunction with wet screeds. The REHAU membrane is to be installed overlapping on the system panels. The membrane overlapping and the membrane base of the edge insulation strip have to be adhered carefully.

The requirements for additional heat and/or impact sound proofing insulation specified for using dry screed elements do not apply here.

#### Description

The REHAU base panel TS-14 enables floor heaters of type B according to DIN 18560 and DIN EN 13813 on solid and wood truss ceilings to be used.

The REHAU base panel TS-14 and the REHAU filler panel TS-14 consist of expanded polystyrene and fulfil the requirements of DIN EN 13163.

With the REHAU base panel TS-14, single meander-type installation with an installation pipe spacing of 12.5 cm is possible.



Illustration 4-63 REHAU base panel TS-14 system



Illustration 4-64: REHAU base panel TS-14



Illustration 4-65: REHAU heat-conductive slat TS-14

The transverse heat distribution occurs almost full-surface via the heat-conductive slats TS-14 and via the redirection slats TS-14.

The predetermined break points of the REHAU heat-conductive slats TS-14 guarantee trouble-free and quick cutting on site.

The REHAU heat-conductive slats TS-14 with OMEGA groove are force-fit in the REHAU base panel TS-14 with OMEGA groove.

The REHAU redirection slats TS-14 are installed in the redirection area.



Illustration 4-66: REHAU redirection slat TS-14

The REHAU filler panels TS-14 are intended for the following areas:

- before the manifold (approx. 1 m around it)
- near projections, columns, ventilation outlets etc.
- to fill up empty areas with a non-squared ground plot



Illustration 4-67: REHAU filler panel

Individual pipe guides are cut into the filler panels at the construction site with the REHAU pipe groove cutter.



Illustration 4-68: REHAU pipe groove cutter

### Assembly



When used with dry screed elements, the REHAU impact sound proofing insulations may not be used with the REHAU base panel TS-14.

- When used in conjunction with impact sound proofing insulation with EPS heating insulation, install the heating insulation first.
- When used in conjunction with impact sound proofing insulation with PUR heating insulation, install the impact sound insulation first.



All external accessories, incl. loose-fill insulation must be approved by the manufacturer of the dry screed elements for use in conjunction with the REHAU dry system.

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.
- Secure REHAU edge insulation strips.
- Install REHAU system installation materials if necessary.



### Caution!

#### Burn and fire hazard!

- Do not grip the hot cutting blade of the REHAU pipe groove cutter.
- Do not leave the REHAU pipe channel cutter unattended while in operation.
- Do not set the REHAU pipe groove cutter down on flammable surfaces.

- Install REHAU system panels without gaps in accordance with the plan (see Illustration 4-70).

Cut individual pipe guides in the filler panels with the REHAU pipe groove cutter if necessary. Clamp heat-conductive slats TS-14 in the base panels TS-14.

- Connect one end of the REHAU pipe to the REHAU manifold.
- Clamp REHAU pipe in the OMEGA grooves of the heat-conductive slats and, in the edge areas, in the redirection slats TS-14.
- Do not position compression sleeve joints either near the REHAU redirection slats TS-14 or near the REHAU heat-conductive slats TS-14.

- Connect the other end of the REHAU pipe to the REHAU manifold.
- Install REHAU membrane on the system panels above the pipe.



- Use only breathable drip protection (e.g. natron or bituminous paper) on wood truss ceilings because of the risk of mould growth.

- Attach REHAU membrane or drip protection to the membrane base of the REHAU edge insulation strip.

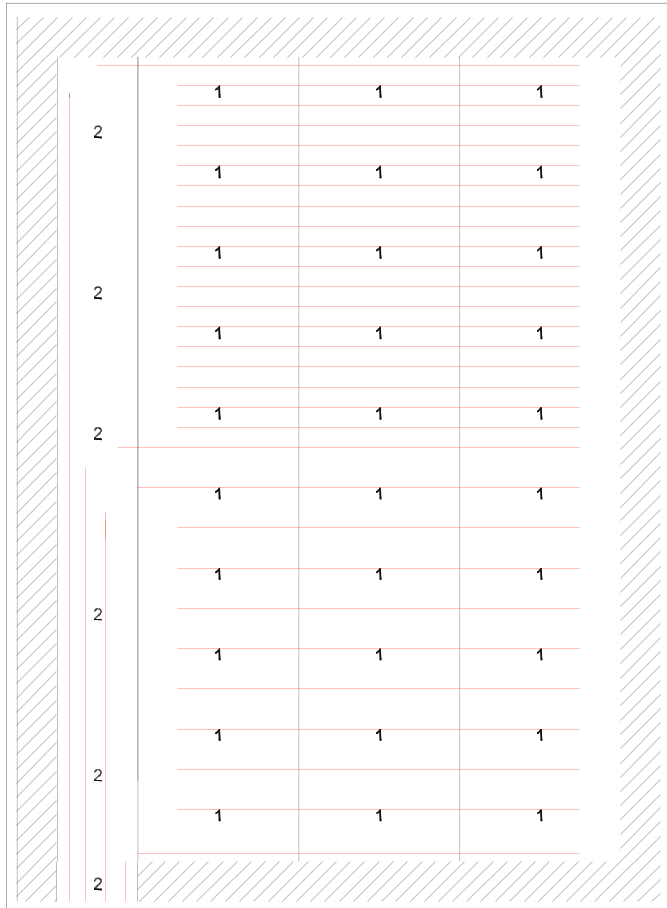


Illustration 4-69: Example installation plan for the REHAU base panel TS-14

- 1 REHAU base panel TS-14 with clamped-in heat-conductive and redirection slats TS-14
- 2 REHAU filler panel

#### Technical data

System panels/ Designation	Base panel TS-14 VA 12.5 cm	Filler panel TS-14
Material	EPS 035 DEO dh	EPS 035 DEO dh
Length [mm]	1000	1000
Width [mm]	500	500
Thickness [mm]	25	25
Thermal conductivity [W/mK]	0.035	0.035
Heat transmission resistance [m <sup>2</sup> K/W]	0.50	0.70
Compressive stress at 2 % [kPa]	60.0	60.0
Material class according to DIN 4102	B2	B1
Fire behaviour according to DIN EN 13501	E	E

**Minimum insulation requirements comply with DIN EN 1264-4**

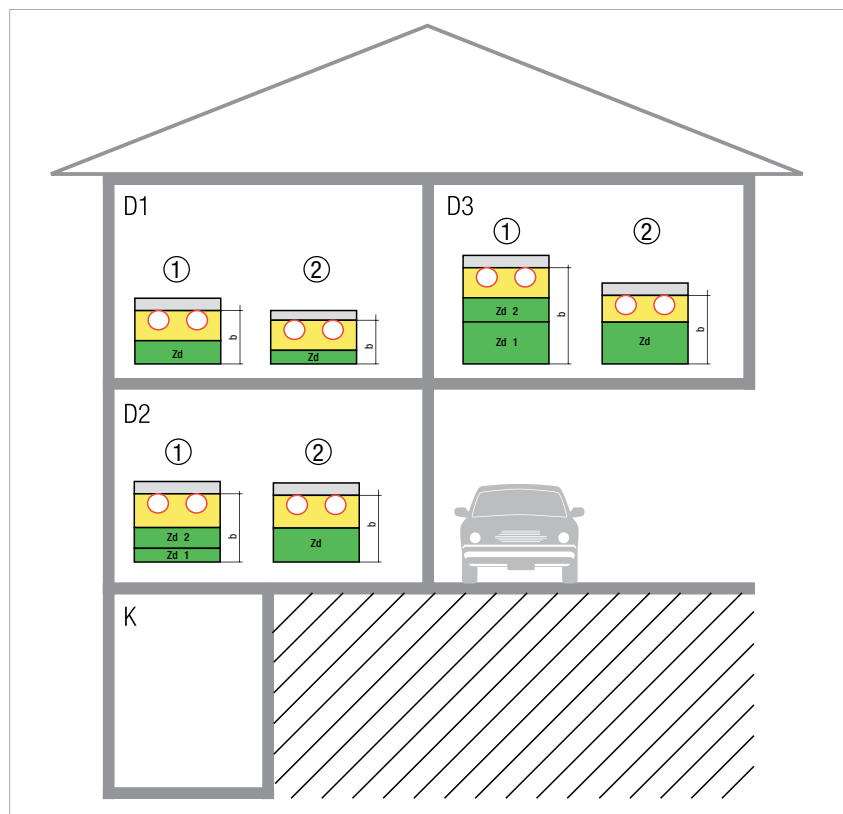


Illustration 4-70: Minimum insulation layer constructions with REHAU base panel TS-14 system

- 1 with impact sound proofing insulation (ISDI)
- 2 without impact sound proofing insulation (ISDI)
- K Cellar
- Zd Additional insulation

**D1 Insulation scenario 1:**

**$R \geq 0.75 \text{ m}^2\text{K/W}$**   
Heated room one storey below

**D2 Insulation scenario 2:**

**$R \geq 1.25 \text{ m}^2\text{K/W}$**   
(This should be increased in case of a groundwater level  $\leq 5 \text{ m}$ )  
An unheated room or a room heated at intervals one storey below or directly on the ground

**D3 Insulation scenario 3:**

**$R \geq 2.00 \text{ m}^2\text{K/W}$**   
Lower outside design temperature:  
 $-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$

**i** These minimum insulation requirements have to be followed irrespective of the insulation required for the building envelope by the EnEV (see "Requirements for heating insulation according to EnEV and DIN EN 1264", Page 50).

**i** Applications and construction heights of the dry screed elements are presented separately (see Table 4-2, Page 53).

	Insulation scenario 1		Insulation scenario 2		Insulation scenario 3	
	with ISDI	without ISDI	with ISDI	without ISDI	with ISDI	without ISDI
<b>Additional insulation Zd [mm]</b>	Zd = 20 - 2 Wood fibre/ Mineral wool insulation WLG 040	Zd = 10 EPS 035 DEO dh	Zd 2 = 20 - 2 Wood fibre/ Mineral wool insulation WLG 040 Zd 1 = 10 mm EPS 035 DEO dh	Zd = 30 EPS 035 DEO dh	Zd 2 = 20 - 2 Wood fibre/ Mineral wool insulation WLG 040 Zd 1 = 40 PUR 025 DEO dh	Zd = 40 PUR 025 DEO dh
<b>Insulation thickness [mm]/ Construction height to top edge of pipe [mm]</b>	b = 43	b = 35	b = 53	b = 55	b = 83	b = 65

Table 4-38: Recommended minimum insulation layer constructions



**Recommended minimum screed construction heights comply with DIN 18560-2**

Area load [kN/m <sup>2</sup> ]	Cement screed CT Bending Tensile Strength Class		Calcium sulphate liquid screed CAF Bending Tensile Strength Class			Construction plan
	F4	F5	F4	F5	F7	
≤ 2	h = 45 mm	h = 40 mm	h = 35 mm	h = 30 mm	h = 30 mm	
≤ 3	h = 65 mm	h = 55 mm	h = 50 mm	h = 45 mm	h = 40 mm	
≤ 4	h = 70 mm	h = 60 mm	h = 60 mm	h = 50 mm	h = 45 mm	
≤ 5	h = 75 mm	h = 65 mm	c = 65 mm	c = 55 mm	c = 50 mm	

Table 4-39: Screed construction heights according to DIN 18560-2 (with RAUTHERM S pipe 14x1.5 mm)

**Heat-related tests**

The REHAU base panel TS-14 system is tested and certified for its heat-related properties comply with DIN EN 1264.



Registration number: 7 F 186

**§** When planning and assembling the REHAU base panel TS-14 system, the requirements of DIN EN 1264, Part 4, must be complied with.

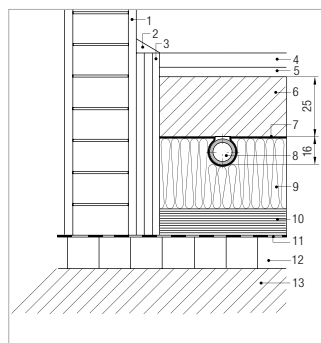


Illustration 4-71: REHAU base panel TS-14 system with installed RAUTHERM S pipe

- 1 Interior wall furnishing
- 2 Skirting
- 3 Edge insulation strip
- 4 Natural or synthetic stone tiles
- 5 Mortar bed
- 6 Dry screed
- 7 Heat-conductive plate, clamped in position 9
- 8 RAUTHERM S pipe
- 9 REHAU installation panel made of polystyrene foam
- 10 Heating and impact sound proofing insulation
- 11 Moisture barrier (according to DIN 18195)
- 12 Structural slab
- 13 Ground

# 5.

# INSTALLATION SYSTEMS – WALL

REHAU wall heating/cooling with wet construction

REHAU climate element system



## 5.1 Basics

### 5.1.1 Standards and guidelines

The following standards and guidelines have to be complied when planning and installing REHAU systems for wall heating/cooling:

- DIN 1186 Building gypsum
- DIN 4102 Fire protection in buildings
- DIN 4108 Thermal insulation in buildings
- DIN 4109 Sound protection in buildings
- DIN 4726 Synthetic pipelines
- DIN 18180 Gypsum plasterboard
- DIN EN 520 Gypsum board
- DIN 18181 Gypsum plasterboard in buildings
- DIN 18182 Accessories for the installation of gypsum plasterboard
- DIN 18195 Water-proofing of buildings
- DIN 18202 Tolerances for buildings
- DIN 18350 Plaster and stucco work
- DIN 18550 Plaster
- DIN 18557 Factory mortar
- DIN EN 1264 underfloor heating systems
- DIN EN 13162-13171 Heating insulation for buildings
- Energy Conservation Ordinance (EnEV)

### 5.1.2 Customer-side requirements

Before starting with assembly of REHAU wall heating/cooling systems, the following requirements must be fulfilled:

- The construction project to be outfitted with the REHAU wall heating/cooling system must already be at the building shell stage.
- Windows and doors must be installed.
- If REHAU wall heating/cooling systems are installed in walls touching the ground, the sealing work must be completed according to DIN 18195.
- The horizontal and vertical level tolerances and angular tolerances according to DIN 18202 must be checked.

- The level markers must be mounted as the height specification "1 m above finished floor" in all rooms.
- The 230 V power supply and water supply must be ensured.
- If the REHAU climate element system is installed, the average relative humidity during the installation phase may not exceed 70 %.

### 5.1.3 Applications

REHAU wall heating/cooling systems can be used in almost all building types and areas of use. Can be used as full-load heating or to cover base or peak loads.

REHAU offers the optimum solution for every construction situation with:

- REHAU wall heating/cooling with wet construction
- the REHAU climate element system (abbreviated CES in the following) as wall heating/cooling with dry construction

#### Main applications of REHAU wall heating/cooling with wet construction

- New construction and renovation of dwellings, separately and in conjunction with REHAU underfloor heating and cooling systems
- Representative entrance areas
- Bathrooms, saunas and tepidaria as a supplement to REHAU underfloor heating and cooling systems

#### Main applications of the REHAU climate element system

- New construction and renovation of dwellings, separately and in conjunction with REHAU underfloor heating and cooling systems
- Representative entrance areas
- Attic construction
- Construction of wood houses according to the Low Energy Standard

### 5.1.4 System concepts

REHAU wall heating/cooling systems can be used:

- as full-load heaters
- in conjunction with REHAU underfloor heating and cooling systems
- as additional heating to supplement static heating surfaces

#### REHAU wall heating/cooling systems as full-load heaters

Due to the more stringent requirements for thermal insulation, it is now possible to fully cover the thermal requirements of buildings with one of the REHAU wall heating/cooling systems. Low-energy houses, in particular, are predestined for using these systems.

#### REHAU wall heating/cooling systems in conjunction with REHAU underfloor heating/cooling systems

These combinations are recommended for areas with the highest comfort demands, such as

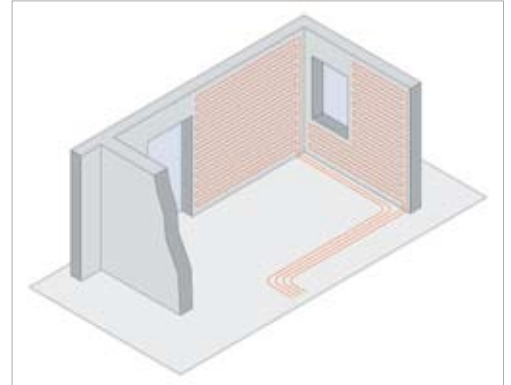
- occupied areas in dwellings
- bathrooms
- saunas
- tepidaria
- other wet areas

The REHAU climate element system is not suitable for:

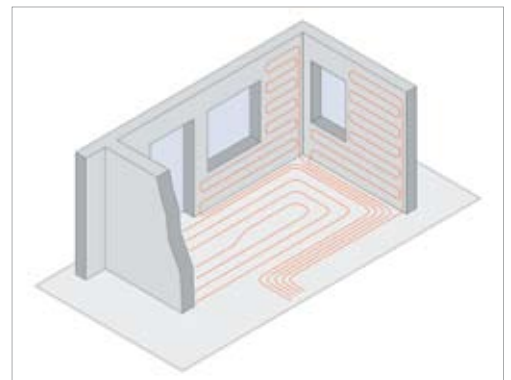
- commercial rooms exposed to moisture
- residential or commercial wet rooms

#### The REHAU wall heating/cooling systems used as additional heating supplementary to static heating surfaces

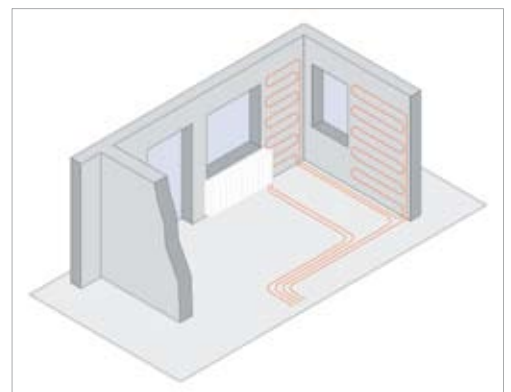
With this combination, base loads are covered with one of the REHAU wall heating/cooling systems and peak loads with static heating surfaces. This variant is especially sensible for use in building renovation.



*Illustration 5-1: The REHAU wall heating/cooling used as full-load heating*



*Illustration 5-2: REHAU wall heating/cooling in conjunction with REHAU underfloor heating/cooling systems*



*Illustration 5-3: REHAU wall heating/cooling used as additional heating supplementary to static heating surfaces*

## 5.2 Planning

### 5.2.1 Additional coordination requirements

In addition to the usual coordination requirements of a construction project, the architect/professional planner must heed the following:

- Determination of open areas for cabinets, shelves and paintings together with the developer.
- Early coordination between the heating installer and plasterer regarding the work schedule and any required preliminary treatment of the area to contain wall heating/cooling.
- Sufficient drying times for wall heating plaster to avoid plaster damage.

### 5.2.2 Fire and sound protection requirements

If REHAU wall heating/cooling systems are used in conjunction with construction and additions which must fulfil the fire and/or sound proofing requirements, these requirements must be fulfilled by the wall/sub-structure. The architect or professional planner must make certain determinations concerning this matter.

### 5.2.3 Marginal thermal conditions

- For comfort reasons, the design plan should not allow the wall surface temperature to exceed +35 °C.
- The maximum permissible continuous operating temperature of the REHAU climate element system is +45 °C.
- When planning REHAU wall heating/cooling with wet construction, the minimum and maximum permissible operating temperatures in accordance with the specifications from the plaster manufacturer have to be complied with.

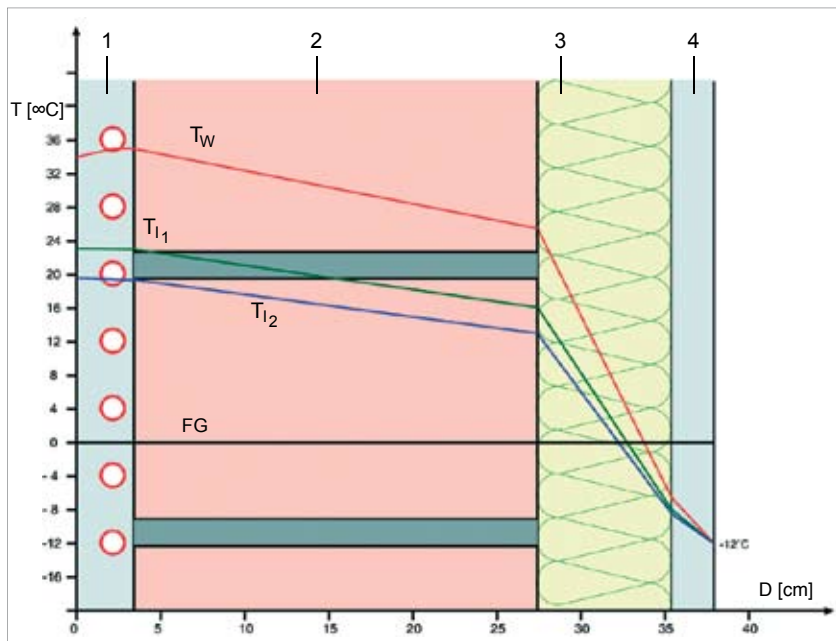


Illustration 5-4 Comparison of the temperature patterns in a multi-layer exterior wall with a U value < 0.35 W/m<sup>2</sup>K

1	Plaster	T <sub>W</sub>	Wall temperature = 35 °C
2	Vertical coring lightweight brick	T <sub>I1</sub>	Inside temperature = 24 °C
3	Heating insulation	T <sub>I2</sub>	inside temperature = 20 °C
4	Heating insulation plaster	FG	Frost penetration depth

## 5.2.4 Heating insulation

### Temperature shift during heating

The temperature pattern through the wall is shifted to higher temperatures with REHAU wall heating/cooling systems. This shifts the frost point toward the outside of the wall. The danger of frost formation within the wall with outer heating insulation is thus almost completely eliminated.

In addition, using the entire solid wall to retain heat is possible due to outer heating insulation.



- The thermal conductivity coefficient of the component layers between the wall heating/cooling and the outside air or to building parts with considerably lower internal temperatures is to be dimensioned in accordance with EnEV. The requirements from the energy demand pass may need to be taken into account.
  - A U value of at least 0.35 W/m<sup>2</sup>K is sensible.
  - When renovating, a U value < 0.45 W/m<sup>2</sup>K or 0.35 W/m<sup>2</sup>K for exterior walls according to EnEV, Appendix 3, applies.
- Wall heating/cooling in walls to unknown areas have to be carried out so that the heat transmission resistance of the entire structure  $R = 0.75 \text{ (m}^2\text{K)/W}$  does not fail. The calculation is performed starting from the heating pipe level.

The requirements of the thermal conductivity coefficients ( $U_w$  value) of an area occupied by wall heating/cooling are independent of the arrangement of the wall (e.g. exterior wall/interior wall).

The  $U_w$  value is calculated in a way similar to the method in DIN EN ISO 6946, however the inner heat transmission coefficient  $1/\alpha_i$  is not taken into account.



- The dew point may need shifting when arranging the insulation.
- Required heating insulations have to be installed as far to the outside of an exterior wall as possible; appropriate commercially available heating insulation bonding systems have to be used here.

If interior heating insulations are required, they should consist of the following materials:

- Cement-bound insulating particle boards or multi-layer insulating particle boards
- Cement or magnesite-bound insulating wool boards or multi-layer insulating wool boards
- Heating insulation panels made of polystyrene EPS foam
- Heating insulation panels made of extruded polystyrene XPS
- Insulating cork boards
- Mineral wool PTP

In addition, the specifications of the respective plaster manufacturer regarding the use of bonding agents have to be considered.

## 5.2.5 Heating areas

### REHAU climate element system

The following maximum number of panels per heating circuit applies for the REHAU climate element system with serial connection of the individual CES panels:

- max. 3 large VA60 CES panels
- max. 5 large VA104 CES panels
- max. 6 small VA60 CES panels
- max. 9 small VA104 CES panels
- max. 4 transverse VA75 CES panels

If the REHAU climate element system is connected using the Tichelmann principle, up to 20 CES panels (of the same type) can be connected to the REHAU manifold with a heating circuit, regardless of the panel type used.

### REHAU wall heating/cooling with wet construction

For REHAU wall heating/cooling with wet construction:

- max. heating field width: 10 m
- max. heating field height: 2 m

Walls greater than 10 m in width have to be divided into several wall heating areas of max. 10 m wide. Due to heat-related changes in length of the plaster, expansion joints between the wall heating areas have to be integrated into the design, depending on the specifications of the plaster manufacturer.

The maximum heating field sizes for REHAU wall heating/cooling with wet construction, depending on the installation pipe spacing and type of heating field connection, are shown in the table.

The reason for this is the attempt to avoid heating circuits with losses in pressure higher than 300 mbar. Optimally adapted circulation pumps working at full capacity help save energy.

Sensible installation pipe spacing for both single and double-meander-type installation:

- installation pipe spacing of 10 cm
- installation pipe spacing of 15 cm

Maximum heating areas of the REHAU wall heating/cooling with wet construction, depending on the installation pipe spacing and type of connection <sup>1)</sup>			
Installation pipe spacing	Separate connection for each individual wall heating area	Serial connection of several wall heating fields as a heating circuit	Connection of several wall heating fields using the Tichelmann principle
10 cm	9 m <sup>2</sup>	Total for all wall heating areas ≤ 9 m <sup>2</sup>	max. 3 wall heating fields with max. 9 m <sup>2</sup> wall heating area each
15 cm	12 m <sup>2</sup>	Total for all wall heating areas ≤ 12 m <sup>2</sup>	max. 2 wall heating fields with max. 12 m <sup>2</sup> wall heating area each
20 cm	15 m <sup>2</sup>	Total for all wall heating areas ≤ 15 m <sup>2</sup>	max. 2 wall heating fields with max. 15 m <sup>2</sup> wall heating area each
30 cm	20 m <sup>2</sup>	Total for all wall heating areas ≤ 20 m <sup>2</sup>	max. 2 wall heating fields with max. 15 m <sup>2</sup> wall heating area each

Table 5-1: Maximum heating area sizes of the REHAU wall heating/cooling with wet construction

<sup>1)</sup> Determined at an average heating medium excess temperature of 15 K, 6 K spread, thermal conductivity of wall heating plaster = 0.87 W/mK

## 5.2.6 Hydraulic connection

The following types of hydraulic connection of REHAU wall heating/cooling systems are possible:

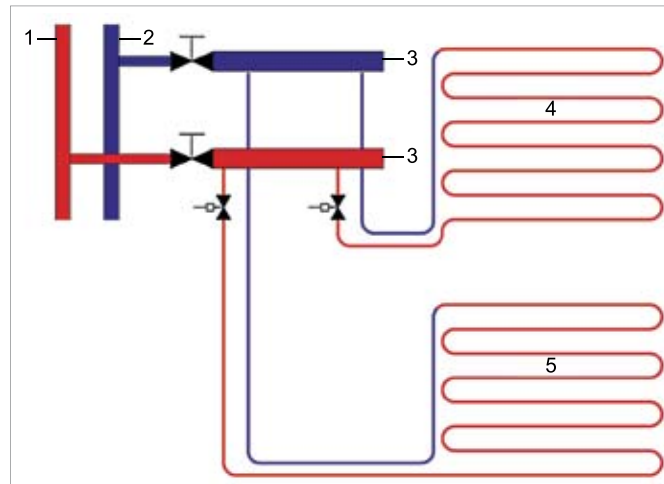
- separate,
- serial or
- using the Tichelmann principle



Connection using the Tichelmann principle agrees that

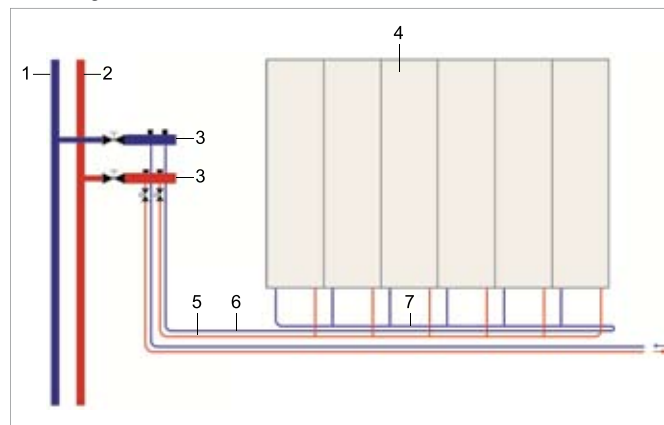
- all wall heating/cooling areas of a heating circuit to have the same pipe length in the case of REHAU wall heating/cooling with wet construction.
- only CES panels of a single type can be used per heating circuit with the REHAU climate element system.





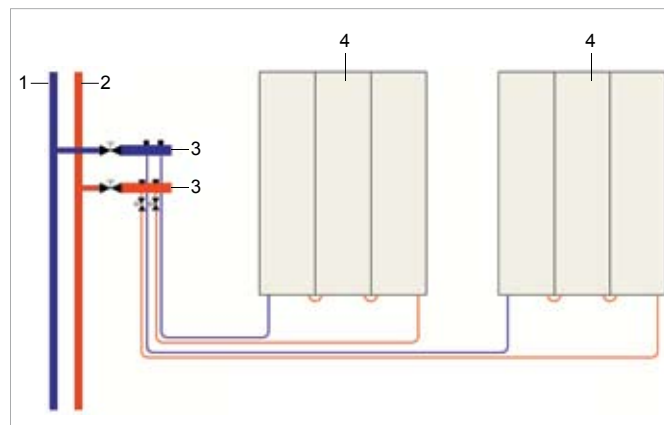
- 1 Flow
- 2 Return
- 3 REHAU manifold
- 4 Wall heating area 1
- 5 Wall heating area 2

Illustration 5-5: Schematic representation of the separate connection of each individual wall heating areas



- 1 Return
- 2 Flow
- 3 REHAU manifold
- 4 REHAU climate element system panels

Illustration 5-6: Schematic representation of the serial connection of several wall heating areas



- 1 Return
- 2 Flow
- 3 REHAU manifold
- 4 REHAU climate element system panels
- 5 Connection line, flow
- 6 Return, Tichelmann
- 7 Connection line, return

Illustration 5-7: Schematic representation of the connection of several wall heating areas using the Tichelmann principle



## 5.2.7 Performance diagrams and tables



Performance diagrams and tables are found on the REHAU homepage under

**www.REHAU.de**

The correlations and dependencies between heating and cooling capacity, installation pipe spacing and wall furnishing are shown in performance diagrams and tables for REHAU wall heating/cooling with wet construction and for the REHAU climate element system. To prevent different diagrams from being required for different room temperatures, the display type is based on the average excess or insufficient heating water temperature.

The diagrams and tables for wall heating plasters were created with the following thermal conductivities over the pipe apex for the REHAU wall heating/cooling with wet construction:

- $\lambda = 0.7 \text{ W/mK}$ ,
- $\lambda = 0.8 \text{ W/mK}$
- $\lambda = 0.87 \text{ W/mK}$

and for plaster coverings of

- 10 mm
- 15 mm

Data on the performance of an installation pipe spacing of 60 mm, 75 mm and 104 mm has been compiled in a diagram/table for the REHAU climate element system.

In addition, there is a nomogram for determining the heat emission from the back of wall heating areas. The heat emission, which depends on the wall construction and temperature differential between the front and rear side of the wall, is displayed here.

## 5.2.8 Control technology

The control technology used for the REHAU wall heating/cooling systems corresponds with that of the REHAU underfloor heating/cooling systems.

## Positioning the individual room control

In addition to the general rules which must be considered, e.g. not behind curtains, not in draughts, not subject to direct sunlight, the following items must be heeded when positioning the individual room control in conjunction with REHAU wall heating/cooling systems:



- Individual room control may not be positioned directly on a heated/cooled surface!
- Individual room control must be no less than 20 cm from the next wall heating/cooling field!

## Power lines in heated areas



If power lines are installed in heated areas, DIN VDE 0298, Part 4, "Use of cables and insulated lines in high-voltage systems – Recommended values for current carrying capacity of cables and lines in buildings and flexible lines" is to be complied with.



The maximum permissible temperature of PVC-sheathed lines (NYM type) is +70 °C

Depending on the installation conditions, the installation type, the surrounding temperature and the wire diameter, the VDE guideline DIN VDE 0298 defines maximum current values which ensure that this limit is not reached. Before installing electrical cables in heated areas, conversion tables must be used to determine the maximum permissible current values depending on the wire diameter and surrounding temperature.

The value determined in this way must be taken into account by selecting appropriate fuses.

## 5.2.9 Determination of pressure loss

Pressure loss of the CES panels of the REHAU climate element system are shown in the pressure-loss diagram (see Illustration 5-8). The pressure losses of pipes made of CPE for REHAU wall heating/cooling with wet construction are presented in the pressure-loss diagram (see Illustration. 5-9).

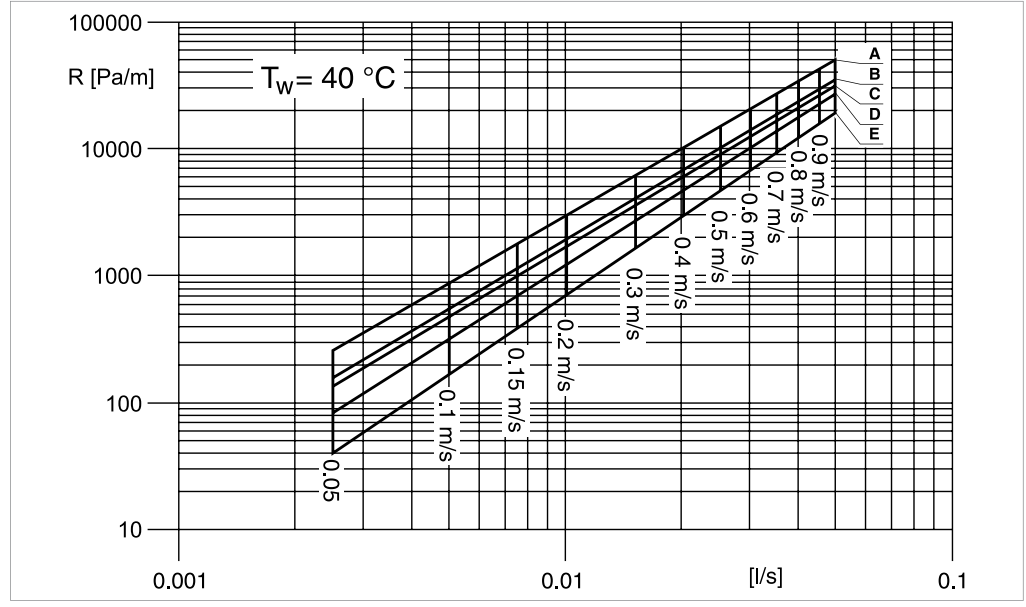


Illustration 5-8: Pressure-loss diagram of the CES panels of the REHAU climate element system (water temperature  $T_w$ : 40 °C)

- |   |               |   |              |   |              |
|---|---------------|---|--------------|---|--------------|
| A | large VA 60   | C | large VA 104 | E | small VA 104 |
| B | transv. VA 75 | D | small VA 60  |   |              |

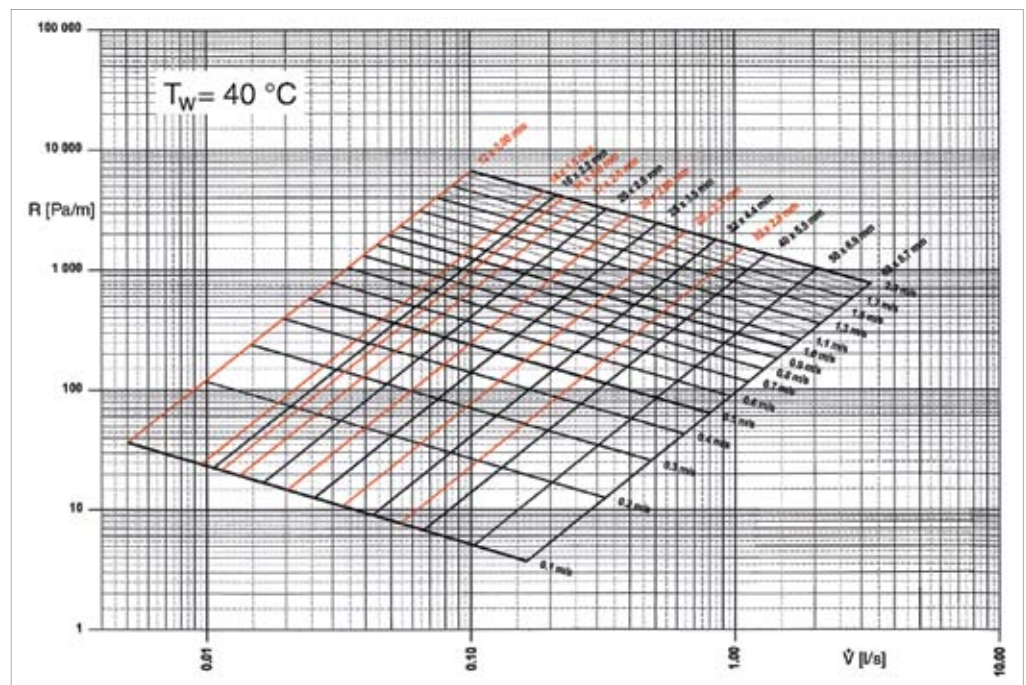


Illustration 5-9: Pressure-loss diagram for pipes made of RAU-VPE (water temperature  $T_w$ : 40 °C)

- |   |               |                                      |                               |
|---|---------------|--------------------------------------|-------------------------------|
| R | Pressure loss | <span style="color: black;">—</span> | Universal RAUTITAN flex pipes |
| V | Volume flow   | <span style="color: red;">—</span>   | RAUTHERM S pipes              |

### 5.3 Notes on commissioning

Commissioning of the REHAU wall heating/cooling systems includes the following steps:

- Flushing, filling and deaerating
- Pressure test
- Functional heating

The following information must be considered here:

#### Flushing, filling and deaerating



- To flush out all air bubbles, a minimum volume flow value must be ensured:  
This is:
  - wall heating/cooling with wet construction:  
1.5 l/min. (corresponds to a flow speed of 0.25 m/s)
  - climate element system:  
0.8 l/min. (corresponds to a flow speed of 0.2 m/s)
- To complete the filling process, hydraulic balancing among the heating circuits must occur in accordance with the design plan.

#### Pressure test



- The pressure test is to be performed and logged in accordance with the REHAU Commissioning log for wall heating/cooling (see Appendix).
- The pressure test must occur before plastering/spackle application begins.
- If a danger of frost is present, suitable measures have to be taken, e.g.
  - tempering of the building
  - use of anti-freeze agents (As soon as anti-freeze agents are no longer necessary, the agents have to be removed by emptying and refilling the system with water at least three times.)
- The test pressure is to be generated for two hours after the first application.
- The pressure test has been passed if, after 12 hours, water has not exited at any point in the wall heating/cooling set-up, the connection line or the manifold and the test pressure has not dropped more than 0.1 bar per hour.

#### Functional heating



- Functional heating is to be performed and logged in accordance with the REHAU Commissioning log for wall heating/cooling (see Appendix).
- The specifications regarding functional heating before, during and after plastering differ by plaster manufacturer and plaster type. These specifications must always be observed and complied with for this reason.

## 5.4 REHAU wall heating/cooling with wet construction



- Quick and flexible pipe installation
- Flexible connection options for wall heating fields
- No damage of pipes due to the rounded edges of the RAUFIX rail
- Secure pipe attachment

### System components

- REHAU RAUFIX rail 12/14 without moulded barbs on the bottom side
- REHAU redirection bracket
- REHAU adapter 14 x R1/2"
- REHAU pipe bend bracket 90° with moulded retaining flap
- REHAU coupler 14 x 1.5 mm
- REHAU compression sleeve 14 x 1.5 mm
- REHAU reducing coupler 17 - 14
- REHAU tee 17- 14 - 17

### REHAU pipes which can be used

- RAUTHERM S 14 x 1.5 mm
- RAUTHERM S 17 x 2.0 mm used as a connection line

### Accessories

- REHAU protective sleeve 12/14
- REHAU protective sleeve 17

### Description

The REHAU RAUFIX rail 12/14 consists of impact-resistant and highly stable polypropylene. It is used for the attachment of pipes carrying a medium at the bare wall. An installation pipe spacing of 5 cm and multiples thereof are possible.

The pipe lift resulting from the RAUFIX rail is 5 mm.

The REHAU redirection bracket is used to firmly secure pipes at pipe redirection points.

The wall heating/cooling fields are RAUTHERM S pipe with a nominal width of 14 x 1.5 mm. The connection lines to the REHAU manifold are RAUTHERM S pipes with a nominal width of 14 x 1.5 mm or 17 x 2.0 mm.

The REHAU pipe bend bracket 90° made of fibreglass-reinforced polyamide enables optimum, kink-free pipe redirection from the vertical wall heating/cooling level to the horizontal level of the connection lines. Secure attachment is made possible by the moulded retaining flap.

Several wall heating/cooling areas can be combined to form a heating circuit with the Tichelmann system using the tee 17-14-17 and the reducing coupler 17-14 and connected to an outlet of the REHAU manifold. The RAUTHERM S pipe with a nominal width of 17 x 2.0 mm is used as the connection line here.



Illustration 5-10: REHAU wall heating/cooling with wet construction



Illustration 5-11: REHAU RAUFIX rail 12/14



Illustration 5-12: REHAU pipe bend bracket 90° with moulded retaining flap

The connection lines are lead out of the screed and into the manifold cabinet securely and without damaging the pipe with the protective sleeve 12/14 and 17.



Illustration 5-13: REHAU fittings

### 5.4.1 Assembly



The pipes are laid in a single- or double meander layout:

- horizontally
- from the flow
- upward

- Set REHAU manifold cabinet in place.
- Install REHAU manifold.



Commercially available nails or nailed dowels with 13 to 20 mm holding disc diameter (e.g. 8 x 60) can be used for the attachment of the RAUFIX rails and the redirection bracket.

- Secure RAUFIX rails vertically to the bare wall. Maintain the following spacing here:
  - between two rails:  $\leq 50$  cm
  - between rail and room corner or beginning of the heating area: approx. 40 cm
  - between the attachment points:  $\leq 40$  cm
- Secure redirection bracket to the bare wall at a distance of approx. 30 cm from the first RAUFIX rail.
- Produce the wall heating/cooling area with the planned installation pipe spacing.



Optimum ventilation is guaranteed when the average installation pipe spacing of 10 cm is achieved by alternating between an installation pipe spacing of 5 cm and 15 cm.

- Clip RAUTHERM S pipe into the RAUFIX rail and redirection bracket.
- Attach pipe bend bracket 90° as the transition point from the vertical to the horizontal level.
- Clip connection lines into the pipe bend bracket 90°.
- Insulate connection lines if necessary.
- Attach connection lines to the manifold.

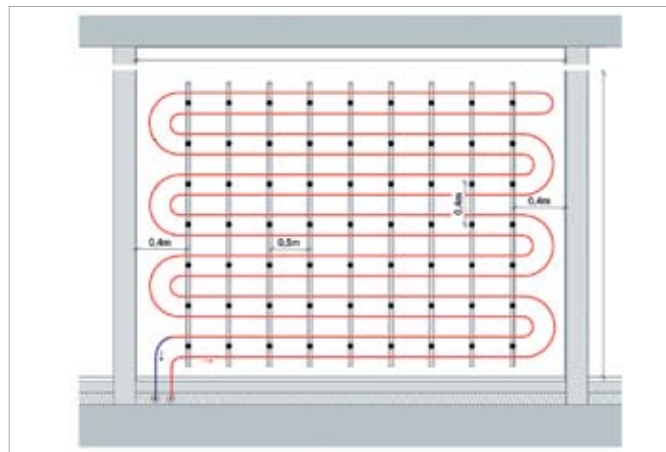


Illustration 5-14: Single-meander design

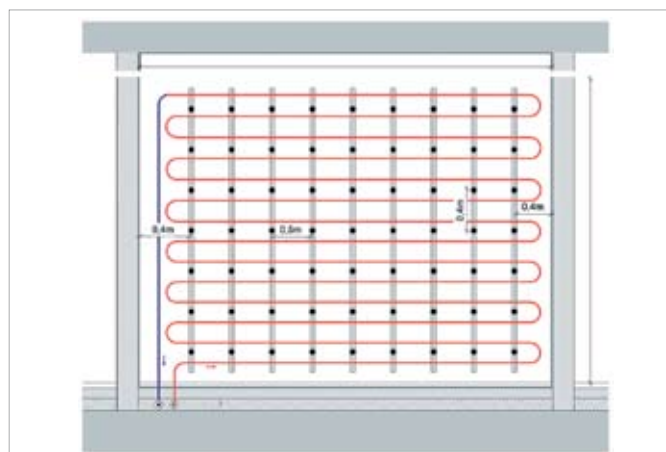


Illustration 5-15: Double-meander design

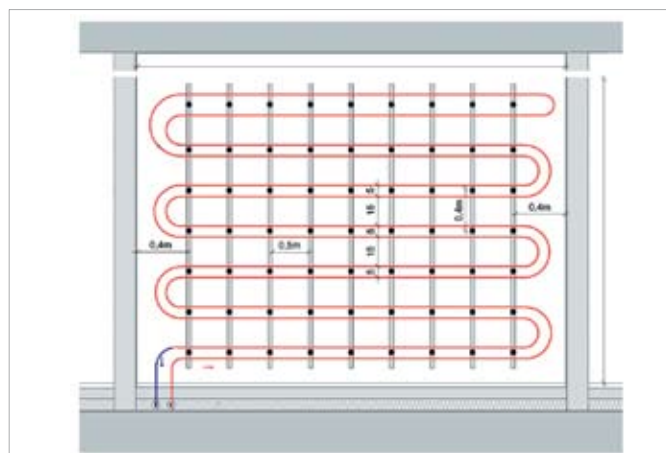


Illustration 5-16: Installation with an average installation pipe spacing of 10 cm avoiding air sack formation at the redirection

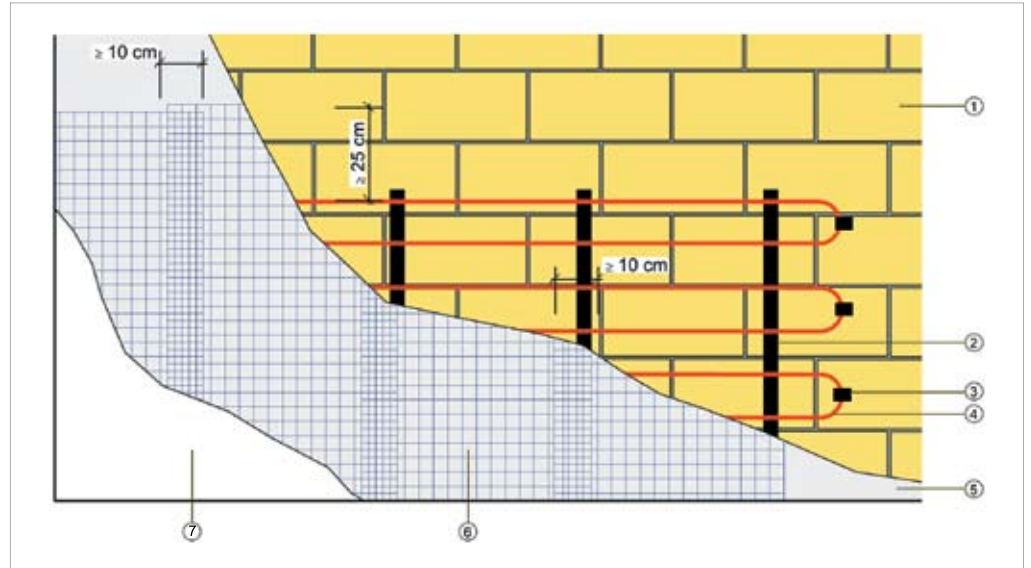


Illustration 5-17: Schematic representation of the structure of wall heating/cooling with wet construction

- 1 Bare wall
- 2 RAUFIX rail
- 3 Redirection bracket
- 4 RAUTHERM S 14x1.5
- 5 1st plaster layer
- 6 Plaster reinforcement
- 7 2nd plaster layer



## 5.4.2 Wall heating plasters

Professional application of wall heating plasters is required for properly functioning wall heating/cooling.

### Plaster types

Plasters for wall heating/cooling systems must have good thermal conductivity. Light base plasters or heating insulation plasters are therefore not suitable.

Only special plaster mortars with the following binding agents are suitable for wall heating systems

- gypsum/lime
- lime
- lime/cement
- cement
- Special plasters recommended by manufacturers, e.g. loam plaster.

Only special plaster mortars with the following binding agents are suitable for wall cooling systems

- lime/cement
- cement


The general application of wall heating plasters depends on the

- use of the room
- moisture load of the room
- permanent operating temperature
- subsequent and further treatment of the wall

Application	Plasters
Interior rooms in a house with minimal or no moisture load	Loam plasters Gypsum/lime plasters Lime plasters Lime/cement plasters Cement plasters
Rooms of a house exposed to moisture, e.g. kitchens and bathrooms, with intermittent moisture load and wall cooling	Lime/cement plasters Cement plasters
Wet rooms and public rooms exposed to moisture with a heavy moisture load and wall cooling	Cement plasters Special plasters

Table 5-2: Plaster applications

### Requirement of the plastered surface

 The permissible tolerances regarding evenness, verticality and conformance have to be complied with DIN 18202.

The plastered surface must fulfil the following requirements:

- even
- load-bearing and firm
- stable in shape
- non-hydrophobic
- homogeneous
- evenly absorbent
- raw and dry
- dust-free
- free of soiling
- frost-free
- tempered above +5 °C

### Plastered surface pre-treatment

The plastered surface pre-treatment creates a firm and lasting bond between the plaster and the plastered surface and must be agreed upon with the plasterer before assembly begins.

Among other things, the following items must be agreed upon here:

- the compensation of empty spots
- the removal/protection of metal parts with a risk of corrosion
- dust removal
- the closing of joints, breakthroughs and slots
- the application of a substance to compensate for varying absorbency and/or heavy absorbency of surfaces (e.g. gas concrete)
- the application of a bonding agent on sealed and/or poorly absorbing surfaces (e.g. heating insulation on the inside of exterior wall)

#### Plaster reinforcement

Plaster reinforcement with textile fibreglass mesh serves to limit tears and is obligatory for wall heating/cooling surfaces.

The following requirements of textile fibreglass mesh must be fulfilled:

- Approval as plaster reinforcement
- Tear-resistance lengthwise and crosswise higher than 1,500 N/5 cm
- stable with regard to wall heating plasters (pH values 8 to 11)
- Stitch width is 7 x 7 mm with installed textile fibreglass mesh
- Stitch width is 4 x 4 mm with textile fibreglass mesh spackled on



- The installation method is to be agreed upon with the plasterer before beginning plastering work.
- The specifications of the plaster manufacturer have to be observed.
- The reinforcement with textile fibreglass mesh must occur in the outer third of the plaster layer over the pipe apex.

There are two installation methods for applying the textile fibreglass mesh:

#### - Installing the textile fibreglass mesh

This method is used for single-layer plaster scenarios

- Apply plaster layer with approx. 2/3 of the intended plaster thickness.
- Install textile fibreglass mesh at least 25 cm past the area at risk with at least 10 cm of overlap.
- Lay textile fibreglass mesh so that it is taut.
- Apply remaining plaster layer.
- For plasters containing gypsum, process areas no larger than 20 m<sup>2</sup> "wet on wet". Comply with minimum plaster cover of 10 mm over the pipe apex.

#### - Attaching textile glass fibre mesh via spackle

This method is used for multi-layer plaster scenarios.

- Apply the first plaster layer and allow it to harden.
- Apply spackle.
- Press textile fibreglass mesh in. Sheets must be laid overlapping at least 10 cm.
- Ensure "adhesive penetration" at crossing points.
- Coat textile fibreglass mesh with spackle all over. Comply with the layer thickness specified by the manufacturer.
- Apply the second plaster layer after the spackle has dried out according to the manufacturer's specifications.



- With a wall heating system length over 10 m, joints have to be planned due to heat-related changes in length (via plaster profiles).
- Condensation can form on the pipe during cooling.
- To prevent condensation, use the REHAU heating/cooling control set in conjunction with the dew-point sensor or other suitable control and monitoring equipment.
- For plasters containing gypsum, the flow temperature of 45°C may not be exceeded.



## 5.5 REHAU climate element system



- Quick and easy assembly of pre-made CES panels
- No waiting time for plaster to dry out
- Pipes need not be embedded in spackle
- Minimal construction height
- Heats up quickly
- Surfaces suitable for further handling



The basis of the REHAU climate element system are the gypsum fibre boards from the Fermacell company, which are made of gypsum, water and recycled paper. These raw materials are pressed into stable boards without any other binding agents, dried, made hydrophobic via a water-repelling agent and cut to the respective size. The boards have been tested and found to be environmentally friendly, contain no substances harmful to people and have no odour whatsoever.

### System components

- REHAU large VA60 CES panel
- REHAU small VA60 CES panel
- REHAU large VA104 CES panel
- REHAU small VA104 CES panel
- REHAU transverse VA75 CES panel
- REHAU clamping ring screw joint 12 x 2.0 mm
- REHAU coupler 12 x 2.0 mm
- REHAU compression sleeve 12 x 2.0 mm
- REHAU reducing coupler 17-12
- REHAU adapter 12 x 2.0 mm to R ½
- REHAU tee 17-12-17
- Compression sleeve 17 x 2.0 mm
- Fermacell joint adhesive

### REHAU pipes which can be used

- RAUTHERM S 12 x 2.0 mm
- RAUTHERM S 17 x 2.0 mm used as a connection line

## Accessories

- REHAU protective sleeve 12/14 and 17



If the REHAU climate element system is used for cooling, condensation may form on the pipe or the front or rear side of the gypsum fibre boards.

→ To prevent condensation, use the REHAU heating/cooling control set in conjunction with the dew-point sensor or other suitable control and monitoring equipment.

## Description

The REHAU climate element system consists of gypsum fibre boards with milled grooves and in-built RAUTHERM S pipes with a nominal width of 12 x 2.0 mm. These are closed with caps so as to protect against soiling during transport and storage.

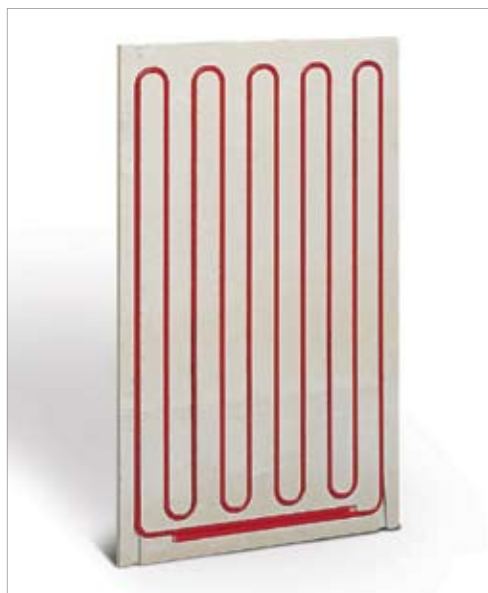


Illustration 5-18: CES panel (small VA60)



Illustration 5-19: CES panel (small VA104)



Illustration 5-20: Fitting product range for the REHAU climate element system

### Applications

The REHAU climate element system can be used in all

- household and commercial areas without any moisture load or with minimal load
- rooms in a house exposed to moisture with intermittent moisture load in the form of sprayed water.

This corresponds to Moisture Load Class I determined by the National Research Group for Dry Construction. The REHAU climate element system is not suitable for rooms of Moisture Load Classes II through IV.

These include

- rooms in commercial zones exposed to moisture such as bathrooms, etc. in inns
- household or commercial wet rooms, such as saunas, canteen kitchens and swimming baths.




The CES panels may not be used in areas with an average relative humidity  $\geq 80\%$  at  $20\text{ }^{\circ}\text{C}$ .

### Transportation and storage

The REHAU CES panels

- are delivered on pallets
- have to be stored flat and dry on a level surface
- have to be protected from moisture and soiling
- have to be transported on their edge at the construction site
- may only be installed after drying out, if they were moist.

CES panel	Large VA60	Small VA60	Large VA104	Small VA104	Transverse VA75
Depiction					
Panel length	200 cm	100 cm	200 cm	100 cm	83 cm
Panel width	62 cm	62 cm	62 cm	62 cm	125 cm
Panel thickness	18 mm	18 mm	18 mm	18 mm	18 mm
Installation pipe spacing	60 mm	60 mm	104 mm	104 mm	75 mm
Weight	24.18 kg	12.09 kg	24.18 kg	12.09 kg	20.23 kg
Installed pipe length	20.0 m	10.0 m	12.4 m	6.5 m	14.4 m
Characteristic thermal conductivity	$\lambda = 0.36 \text{ W/mK}$				
Diffusion resistance factor	$\mu = 11$				
Raw density	$\rho = 1,180 \pm 60 \text{ kg/m}^3$				
Material class	A2 according to DIN 4102				

### 5.5.1 Substructures

Proper overall construction of the wall is very important for optimum functioning of the REHAU climate element system.

#### General requirements

- Contact surface for CES panels at least 50 mm wide
- Edge covering of CES panels and substructure at least 20 mm
- Spacing between two vertical supports of the substructure max. 310 mm

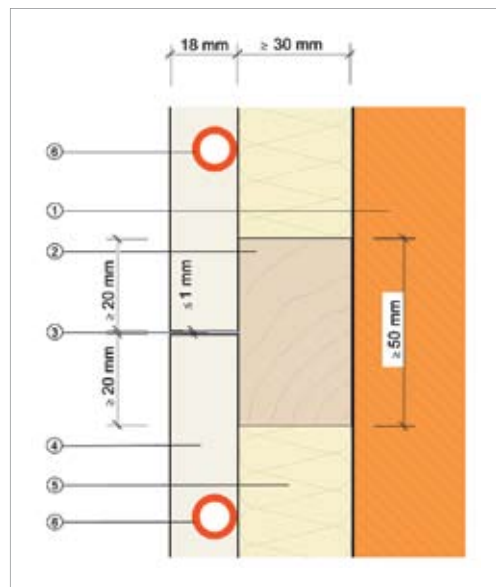


Illustration 5-21: Dimensions of the substructure (view from above)

- 11 Bare wall
- 2 Substructure
- 3 Butt joint with joint adhesive
- 4 CES panel
- 5 Heating insulation
- 6 RAUTHERM S 12 x 2.0 mm

The REHAU climate element system can in principle be integrated into three different wall structures:

- on the interior side of exterior walls
- on one or both sides of walls separating rooms
- in pitched roof areas

Substructures for the REHAU climate element system can be built

- as a full-surface wood substructure
- in timber frame construction
- from metal profiles

#### Full-surface substructures

In case of assembly of the CES panels on full-surface substructures, the area where the panels meet is to be separated with smooth plastic tape between the joint adhesive and the bearing layer underneath.

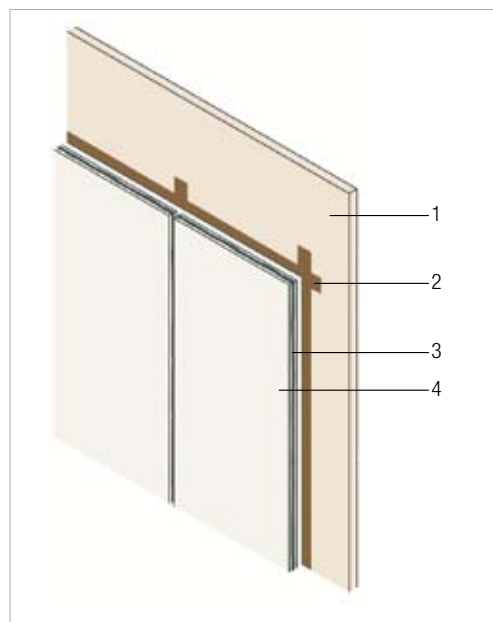


Illustration 5-22: CES panel on full-surface wood substructure

- 1 Full-surface wood substructure
- 2 Separation layer (e.g. plastic tape)
- 3 Butt joint, 1 mm with joint adhesive
- 4 CES panel

### Timber frame construction substructures

If substructures for the REHAU climate element system are made of wood frames and supports, the following items must be complied with:

- The wood used must be suitable for timber construction and must be dry during installation.
- Wood lath used must have a minimum thickness of 30 x 50 mm.
- Casings in timber construction may not be springy.
- The centre distance of the load-bearing structure may not be more than 750 mm.

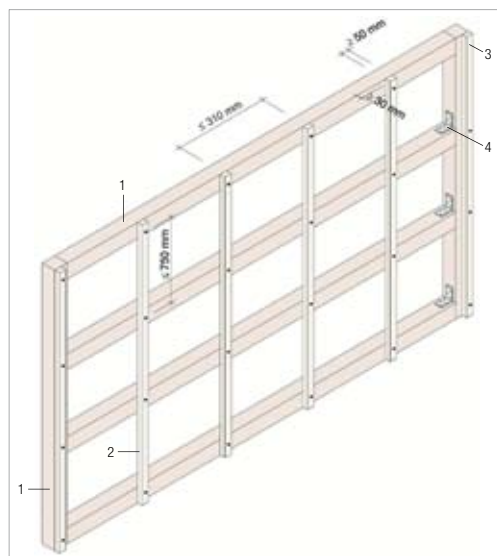


Illustration 5-23: Example timber frame construction substructure

- 1 Load-bearing structure
- 2 Wood lath, uprights
- 3 Attachment via partially-driven nails
- 4 Attachment via connection brackets

### Metal-construction substructures

Comply with the following when using metal profiles for the substructure of the REHAU climate element system:

- All metal profiles and fastening elements must be protected against corrosion.
- Frame construction must comply with DIN 18182, Part 1.
- The metallic profile sheet thickness must be at least 0.6 mm and no more than 0.7 mm.
- Attachment of the C and U profiles to walls must occur vertically and flush.
- Vertically positioned CW profiles may only be connected to UW profiles via connection or attachment elements (brackets).
- Create horizontal attachment points no more than 70 cm apart and vertical attachment points no more than 100 cm apart.

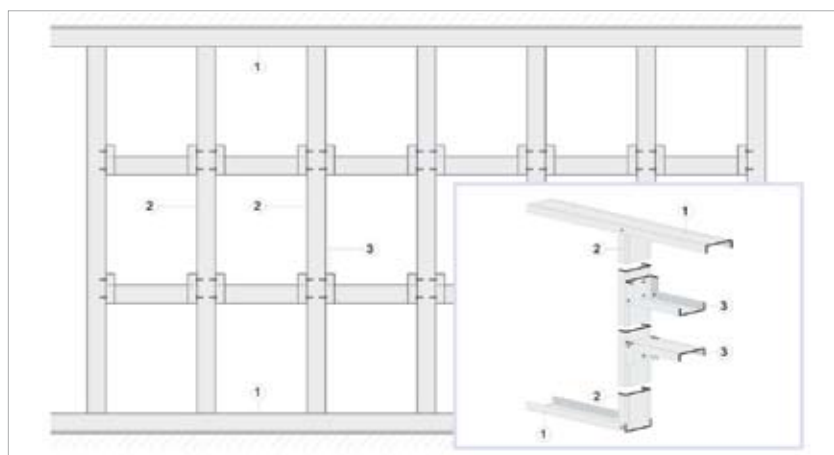


Illustration 5-24: Example metal construction substructure

- 1 UW connection profile
- 2 CW upright profile
- 3 UW profile with folded bar

### Assembly

- Assemble substructure.
- Set REHAU manifold cabinet in place.
- Install REHAU manifold.

**i** The pipes of the CES panels always face the rear wall. The individual CES panels are always attached from one panel side toward the other or from the middle of the CES panel outward.

- Secure the first CES panel with the bottom edge at least 7 cm over the top edge of the raw ceiling at the pre-center-punched points of the CES panel on the substructure (wood or metal) with Fermacell dry wall screws, 3.9 x 45 mm (wood) or 3.9 x 30 (metal).

**i** About 20 dry wall screws are used per m<sup>2</sup> of CES

panel.

- Provide the first CES panel near the edge with Fermacell joint adhesive.
- Butt the second CES panel up against the first CES panel with max. 1 mm joint width, align it and attach it to the substructure as described above.
- Assemble all additional CES panels of the heating field without cross joints as described.
- Cover thermally inactive areas such as those described above with commercially available

Fermacell gypsum fibre boards with a thickness of 18 mm without cross joints.

- Create connection lines and attach to the manifold.
- Flush, fill and deaerate wall heating circuits.
- Perform a pressure test, set the operating pressure and maintain it.
- Spackle surface and complete surface work.

**i** The currently applicable installation guidelines from the gypsum fibre board manufacturer must be complied with.

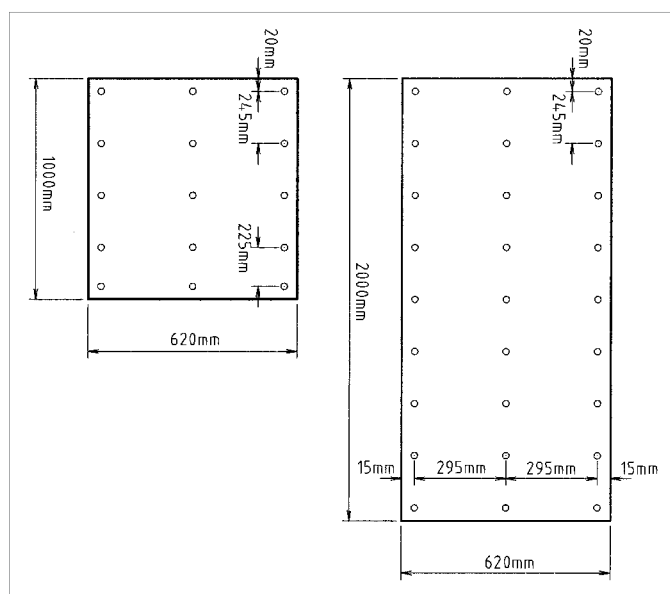


Illustration 5-25: Attachment points and assembly spacing of the REHAU CES panels with a width of 62 cm

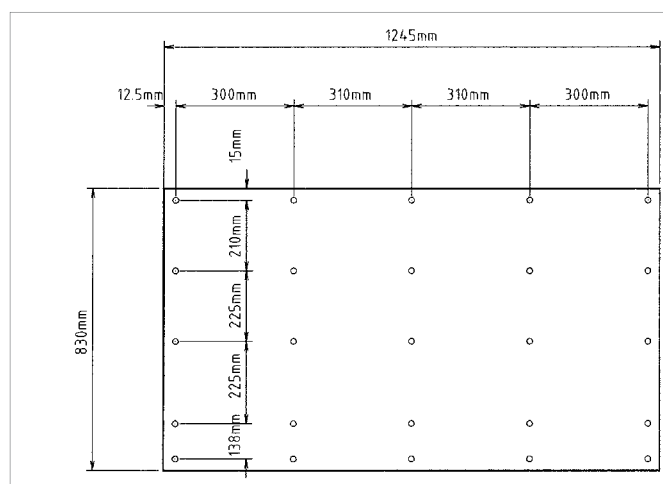


Illustration 5-26: Attachment points and assembly spacing of the REHAU CES panels with a width of 125 cm

### Attachment of the CES panels with brackets

The attachment of the CES panels with brackets according to DIN 18182, Part 2, may only occur with wood substructures. The attachment spacing and number of brackets to be used can be obtained from the documentation of the gypsum fibre board manufacturer.

### Joint formation

Differentiation must be made among the following

- movement joints
- expansion joints
- butt joints

### Movement joints

Movement joints are always necessary in assembly walls with the REHAU climate element system when movement joints are also required in the building.

### Expansion joints

CES panels are subject to changes in length with a varying room climate (expansion and contraction). This is to be compensated for via the placement of expansion joints.



Expansion joints have to be placed at a spacing of max. 800 cm!

### Butt joints

Butt joints arise between CES panels and between CES panels and commercially available gypsum fibre boards while making wall surfaces homogeneous during assembly.

- Butt joints may be max. 1 mm wide.

- Fermacell gypsum fibre boards have to be used for dry construction panels which contact CES panels.

- Butt joints have to be created during the attachment of the individual CES panels using the Fermacell joint adhesive in the assembly sequence: panel, adhesive, panel.

Consumption: one cartridge containing 310 ml (430 g) is sufficient for the joints of approx. 8 m<sup>2</sup> of climate element system.

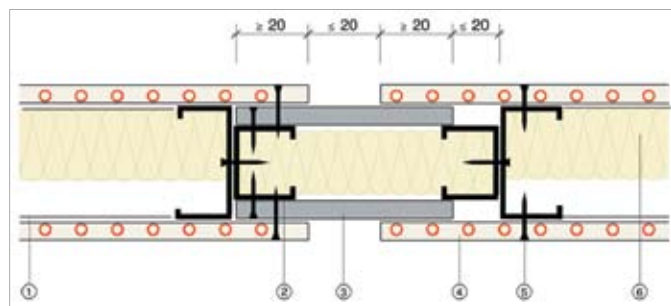


Illustration 5-27: Example schematic representation of the construction of movement and expansion joints

- 1 U sheet profile, galvanised
- 2 C sheet profile, galvanised
- 3 Gypsum fibre board
- 4 CES panel
- 5 Dry wall screw
- 6 Heating insulation

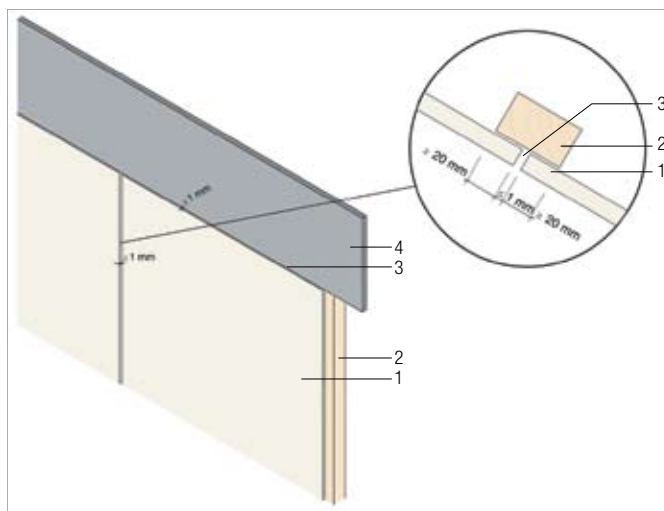



Illustration 5-28: Example schematic representation of the construction of butt joints

- 1 CES panel
- 2 Wood lath as a load-bearing structure
- 3 Butt joint with joint adhesive
- 4 Gypsum fibre board

### Floating wall and façade connections

Hollow outer façades can be subject to pressure and suction movements caused by wind. For connections of room-separating walls which feature the REHAU climate element system, this must be taken into account when constructing the connection between the metallic or wood substructure and the outer façade. In addition, a separation between the climate element system and neighbouring materials, e.g. plaster, exposed concrete or masonry is required.

 The CES panel may not be attached to a connection profile!

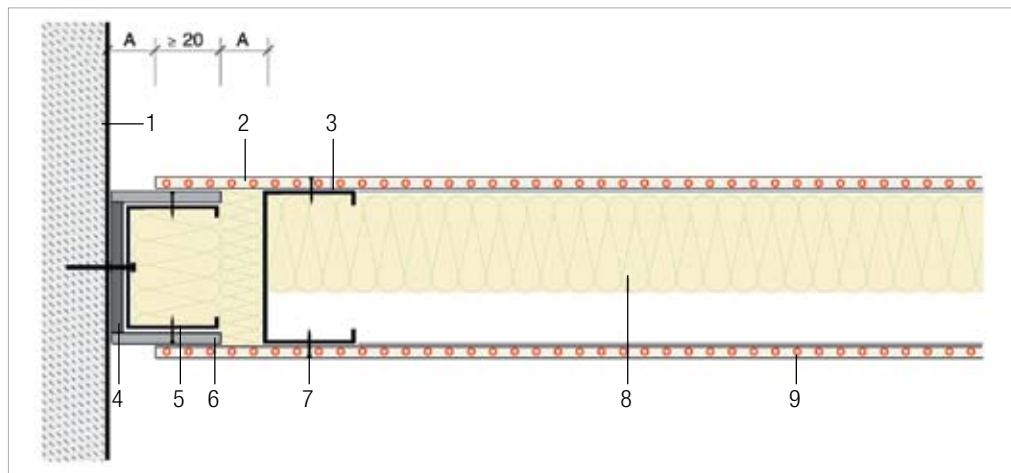


Illustration 5-29: Example schematic representation of the construction of the floating wall and façade connection

- |   |                              |   |                           |
|---|------------------------------|---|---------------------------|
| 1 | Exterior wall                | 6 | Gypsum fibre board strips |
| 2 | CES panel                    | 7 | Dry wall screw            |
| 3 | CW sheet profile, galvanised | 8 | Heating insulation        |
| 4 | Elastic seal                 | 9 | RAUTHERM S 12 x 2.0 mm    |
| 5 | Connection profile           | A | Movement dimension        |



## 5.5.2 Spackle work

### Fine spackle work on the surface

Fermacell fine spackle is used for fine spackle work on the REHAU climate element system. Impact spots and sunken screw heads are smoothed over with spackle. Commercially available smoothing trowels or spatulas can be used here.

### Requirements

Before beginning with fine spackle work, the surface of the CES panels must be

- evenly dry
- free of gypsum and mortar remains
- dust-free

Do not perform fine spackle work until drying of the following is complete

- CES panels
- neighbouring gypsum fibre boards
- wet screeds or wet plaster in the same room

### Consumption

- surface spackle: approx. 0.2 kg/m<sup>2</sup>
- joint filling: approx. 0.1 kg/m<sup>2</sup>

### Surface treatment

The surface of the CES panels can be covered with

- wall panels/tiles
- textured plaster
- surface paint
- wallpaper

### Requirements

- All butt joints, scratches and sunken screws have to be filled with Fermacell fine spackle, smoothed, sanded and evenly dried.
- The surface of the CES panels and neighbouring gypsum fibre panels have to be dried out evenly and sanded evenly.
- Xeric primers required for textured plasters or paints must be applied and dried according to the manufacturer's specifications.
- Surfaces coming into contact with water, such as shower and bathtub areas, must be provided with additional liquid sealing film or sealing adhesive systems and must be dried out.

### Applying wall panels/tiles

The following specifications must be complied with:

- The moisture of the CES panels must be less than 1.3 %.
- Thin-bed installation must be the method used.
- Use xeric tile adhesives, such as plastic modified cement powder adhesive, flex adhesive.
- The tiles may not be predunked.
- Use flexible joint mortar for joints.
- The tile adhesive must be fully dried out before forming joints occurs.
- In any case, the installation guidelines from the respective adhesive manufacturer have to be complied with.

### Applying textured plasters

The following specifications must

be complied with:

- The moisture of the CES panels must be less than 1.3 %.
- Synthetic and mineral plasters must be approved by the respective manufacturer for use in conjunction with gypsum fibre boards.
- Only thin textured plasters up to 4 mm in thickness may be used.
- Joints have to be reinforced with a glass fleece strip.

### Application of surface paints

- Latex, dispersion and lacquer paints are suitable for this purpose.
- Mineral paints such as lime and silicate paints must be approved by the respective manufacturer for use in conjunction with gypsum fibre boards.
- The application must proceed according to the manufacturer's specifications.

### Application of wallpaper

- All wallpapers except vinyl wallpapers are suitable for this purpose.
- Adhesion can occur with commercially available wallpaper paste.
- Priming is only necessary if the wallpaper manufacturer specifies this.
- For dense wallpapers, xeric wallpaper paste must be used.

### Locating pipes carrying a medium

Pipes carrying a medium in the CES panels can be located with thermal film while heating. For this

purpose, the thermal film is applied to the area to be inspected and the climate element system is commissioned. Thermal films can be used multiple times.

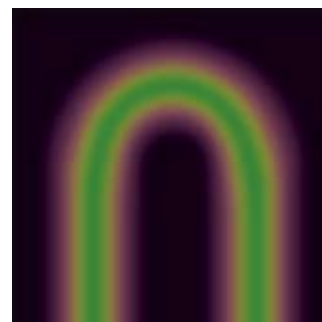


Illustration 5-30: Locating the pipes carrying a medium via thermal film

### Individual loads hanging on a wall

**i** Nails, hollow space dowels, tipping dowel, special dowels for gypsum fibre boards and picture hooks may only be used in conjunction with the REHAU climate element system if the RAUTHERM S pipes carrying a medium have been located beforehand.

Individual loads up to 35 kg, regardless of the number of attachment points, can be attached to CES panels with these attachment elements:

- 1 attachment point: up to 15 kg
- 2 attachment points: up to 25 kg
- 3 attachment points: up to 35 kg

The specifications regarding the mounting of installation elements have to be complied with.

# 6.

# SYSTEM ACCESSORIES

## 6.1 REHAU edge insulation strip



- Rear adhesive strip
- Self-adhesive film base
- Liquid screed can be used
- Optimum corner formation



Illustration 6-1: REHAU edge insulation strip

### Application

- REHAU Varionova studded panel
- REHAU vario studded panel
- REHAU stapling system
- REHAU RAUFIX
- REHAU pipe grid
- REHAU dry system
- REHAU base panel TS-14

### Description

The profiled polyethylene wall of the REHAU edge insulation strip ensures clear formation of wall corners and projections. The laminated adhesive strips on the polyethylene rear wall side and film base guarantee the best adhesion power and quick assembly.

The tear-proof film base prevents the penetration of moisture and screed mixing water. Sound and heat bridges are prevented. The REHAU edge insulation strip offers the option of moving 5 mm required according to DIN 18560 for heated screeds.

### Technical data

Insulating profile material	PE
Film base material	PE
Material class according to DIN 4102	B2
Fire behaviour according to DIN 13501	E
Height [mm]	180
Film base length [mm]	280
Thickness [mm]	10

### Assembly

**i** The REHAU edge insulation strip must be installed overlapping at least 5 cm where strips meet.

- Pull off adhesive strip protection from polyethylene rear wall.
- Attach REHAU edge insulation strip with film base toward the room.

The REHAU lettering faces upward.

- Lay membrane base loosely on the insulation.
- Pull off adhesive strip protection at film base.
- Attach membrane base.



Illustration 6-2: Attaching the film base on the REHAU vario studded panel

## 6.2 REHAU expansion joint profile REHAU filler profile



- Self-adhesive
- Flexible
- Quick assembly



Illustration 6-3: REHAU expansion joint profile and REHAU filler profile

### Application

- REHAU Varionova studded panel
- REHAU vario studded panel
- REHAU stapling system
- REHAU RAUFIX
- REHAU pipe grid
- REHAU dry fit system
- REHAU base panel TS-14

## Description

The REHAU expansion joint profile and the REHAU filler profile are used for forming permanently elastic joints with heated screeds and for bordering screed fields. The self-adhesive base of the expansion joint profile and filler profile ensures secure retention on the REHAU underfloor heating systems.

- Expansion joint profile:

Height x Thickness x Length  
100 x 10 x 1200 mm

- filler profile:

Height x Thickness x Length  
24 x 18 x 1,200 mm

## Assembly on Varionova and vario studded panel



Illustration 6-4: REHAU expansion joint profile and filler profile in vario studded panel



- Assembly of the expansion joint profile on all other REHAU installation systems is done without a filler profile. The pipe lead-throughs of connection lines may need to be notched here.
- Assembly occurs after pipe installation.

- If necessary, slit approx. 30 cm long pipe sleeves made of REHAU protective sleeve and clip them over the connection lines near the expansion joints.
- Pull off protective strip at the base of the filler profile.
- Cut the filler profile to length and attach it to the Varionova or vario studded panel.
- Pull off protective strip at the base of the expansion joint profile.
- Attach expansion joint profile to filler profile and studs.

## 6.3 REHAU system installation materials

### System components

- REHAU expanded polystyrene impact sound proofing insulation
- REHAU additional expanded polystyrene heating insulation
- REHAU PUR polystyrene heating insulation

### Application

As additional insulation for the REHAU systems:

- REHAU Varionova studded panel
- REHAU vario studded panel
- REHAU stapling system
- REHAU RAUFIX
- REHAU pipe grid
- REHAU dry system
- REHAU base panel TS-14



Only the additional heating insulation EPS 035 DEO with a density of  $\geq 30 \text{ kg/m}^3$  or PUR is permissible for the REHAU dry system and the REHAU base panel TS-14 in conjunction with dry screed panels.

### Description

The REHAU additional heating and/or impact sound proofing insulation consists of CFC-free, expanded polystyrene hard foam according to DIN EN 13163.

The REHAU additional heating insulation PUR consists of CFC-free and quality controlled PUR hard foam according to DIN EN 13165 coated with a diffusion-proof aluminium film on both sides.

### Assembly



When installing multi-layer insulation layers, up to two layers may consist of impact sound proof insulations. The compressibility of the entire insulation layer may not exceed the following values:

- 5 mm with floor loads  $\leq 3 \text{ kN/m}^2$
- 3 mm with floor loads  $\leq 5 \text{ kN/m}^2$

- Install the system insulations over the entire surface without gaps in a group and directly contacting one another without forming cross joints.
- Install multi-layer insulation layers so that there is an offset of  $\geq 10 \text{ cm}$  between the joints of the top and bottom layer.
- When combining impact sound proofing insulation with heating insulation under wet screeds, first install the impact sound proofing insulation (does not apply for impact sound proofing insulation system panels and, in the case of pipe compensation, heating insulation panels).

Technical data

Designation and type	Expanded polystyrene impact sound proofing insulation						Additional expanded polystyrene heating insulation										Aluminiumlaminated additional PUR heating insulation		
	30-2	50-2	70-2	10	10	10	10	10	20	30	30	30	30	40	50	50	50	50	PUR 40
<b>Material</b>	EPS 040 DES sg	EPS 040 DES sg	EPS 035 DES sg	EPS 040 DEO dm	EPS 035 DEO dh	EPS 035 DEO dh	EPS 040 DEO dm	EPS 035 DEO dh	EPS 035 DEO dh	EPS 040 DEO dm	EPS 035 DEO dh	EPS 035 DEO dh	EPS 035 DEO dh	EPS 035 DEO dh	EPS 040 DEO dm	EPS 035 DEO dh	EPS 035 DEO dh	PUR 025 DEO dh	PUR 025 DEO dh
<b>Article No.</b>	239053-001	239303-001	239093-001	239113-001	239123-001	286328-001	239133-001	239313-001	239323-001	239143-001	239153-001	239163-001	239183-001	227828-001	227838-001				
<b>Nominal thickness d<sub>n</sub></b> (mm)	30	50	70	10	10	10	10	20	30	30	30	30	30	40	50	50	50	40	50
<b>Compressability c</b> (mm)	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Length (mm)</b>	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.200	1.200
<b>Width (mm)</b>	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	600	600
<b>Density (kg/m<sup>2</sup>)</b>	-	-	-	20	25	30	20	30	30	20	30	30	30	25	20	25	30	30	30
<b>Thermal conductivity (W/mK)</b>	0.040	0.040	0.035	0.040	0.035	0.0035	0.040	0.035	0.035	0.040	0.035	0.035	0.035	0.035	0.040	0.035	0.035	0.025	0.025
<b>Heat transmission resistance (m<sup>2</sup>K/W)</b>	0.75	1.25	2.00	0.25	0.25	0.25	0.25	0.55	0.85	1.10	1.30	1.40	1.40	1.40	1.60	1.60	1.60	2.00	2.00
<b>Design load max. (kN/m<sup>2</sup>)</b>	5.0	5.0	10.0	20.0	28.0	36.0	20.0	36.0	36.0	28.0	28.0	36.0	36.0	28.0	20.0	28.0	36.0	100.0	100.0
<b>Dynamic rigidity (MN/m<sup>3</sup>)</b>	20	15	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Impact sound improvement dimension<sup>1)</sup> (dB)</b>	28	29	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Material class according to DIN 4102</b>	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B2	B2
<b>Fire behaviour according to DIN EN 13051</b>	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E

<sup>1)</sup> Impact sound improvement dimension  $\Delta L_{wR}$  with a solid ceiling and a cement screed installed on the impact sound proofing insulation with a mass  $\geq 70$  kg/m<sup>2</sup>

## 6.4 REHAU adhesive tape/ REHAU dispenser



- Good adhesion
- Good tear resistance
- Extremely light dispenser



Illustration 6-5: REHAU adhesive tape



Illustration 6-6: REHAU dispenser

### Application

- For urgently necessary adhesion of the film overlapping with the following REHAU installation system:
  - REHAU stapling system
  - REHAU RAUFIX system
  - REHAU pipe grid system
  - REHAU dry system and base panel TS-14 in conjunction with wet screeds
- For urgently needed adhesion of

the film base with edge insulation strips without laminated adhesive strips.

### Technical data

Roller width	50 mm
Roller length	66 m
Tear-resistance	at least 10 N/mm <sup>2</sup>

## 6.5 REHAU hydraulic test pump



- Precision test pump for precise and quick pressure and leaks tests
- Pressure test with water and antifreeze agent possible
- Filling and pressure test in one step



Illustration 6-7: REHAU hydraulic test pump

### Application

The pressure and leak tests of the heating circuits of the REHAU underfloor heating/cooling systems required by DIN EN 1264, Part 4, are performed with the REHAU hydraulic test pump.

### Technical data

Sizes	720 x 170 x 260 mm
Container volume	12 litres
Pressure range	0–60 bar
Suction volume	approx. 45 ml / stroke
Connection	R ½"
Weight	approx. 8 kg

## 6.6 REHAU screed component P



- Improvement of the flow properties and workability
- Homogenisation of the screed microstructure
- Improvement of the bending tensile strength and compressive strength
- Improvement of the heat-related properties



Illustration 6-8: REHAU screed component P

### Application

The REHAU screed component P is suitable for use with all cement screeds according to DIN 18560.

### Area-based consumption

General: 0.035 kg screed component P for each centimetre of screed and m<sup>2</sup> of area.

### Technical data

Unit of delivery	10 kg canister
Density	1.1 g/cm <sup>3</sup>
pH value	8
Fire behaviour	non-flammable
Storage	cool and dry, not below 0 °C
Shelf-life	see package insert
Ecological rating	harmless

## 6.7 REHAU screed component "Mini" with REHAU synthetic fibres



- Generation of thin-layered synthetics modified screeds
- Increase in the bending tensile strength and compressive strength
- Less mixing water is used
- Improvement of workability



Illustration 6-9: REHAU screed component "Mini"

Thin-layer heated screeds must be generated in such a way that pipes are covered by at least 30 mm according to DIN 18560, Part 2. The REHAU screed component "Mini" supports and completes this requirement while increasing the cement content at the same time.

### Application

- For cement screeds according to DIN 18560
- For all REHAU underfloor heating/cooling systems

### Description

By adding the REHAU screed component "Mini", the REHAU synthetic fibres and increasing the cement content,

- the thickness of heated screeds can be reduced to a minimum of 30 mm of screed cover over the pipe apex according to DIN 18560, depending on the design load (1.5 kN/m<sup>2</sup>).
- the strength class of the cement screed is increased from F4 to F5
- tear formation during the drying and hardening process is minimised.

### Area-based consumption

- Generally 0.2 kg of screed component "Mini" for each centimetre of screed and m<sup>2</sup> of area.
- Generally 10 g of synthetic fibres for each centimetre of screed and m<sup>2</sup> of area.

### The following applies for the mixing ration in a mixer:

- 60 kg of cement CEM 32.5
- 150 kg gravel sand 0–4 mm
- 100 kg gravel sand 4–8 mm
- approx. 20 litres of water
- 3.12 kg of screed component "Mini"
- 0.20 kg of synthetic fibres

### Technical data

Unit of delivery	25 kg canister
Density	1.05 g/cm <sup>3</sup>
pH value	8
Fire behaviour	flame resistant
Storage	dry, not below 0 °C
Shelf-life	see package insert
Ecological rating	biodegradable

## 6.8 REHAU test point for residual moisture



Illustration 6-10 REHAU test point for residual moisture

### Description

Depending on the type of top flooring, the screed may not exceed a certain residual moisture level before being covered.

This is why CM measurements are carried out by the top floor layer to determine the residual moisture in the screed. Samples of the screed must be removed for this purpose.

For moisture tests at unmarked test points, damage to the heating system cannot be ruled out. This is why test points for residual moisture are used for identifying these sensitive areas.

The test points for residual moisture are positioned on the surface of the heating system with their four retaining feet before the screed is installed. For this purpose, the four attachment holes can be pre-cut with a sharp tool for the feet of the respective test point in the membrane of the heating system. The number and position of the test points are determined by the architect/planner. If necessary, at least one test point is included in each room.

## 6.9 REHAU pipe unwinder (cold)



- Quick and uncomplicated handling
- Easy time-saving installation of the RAUTHERM S, RAUTITAN-stabil and RAUTITAN flex pipes
- Makes "one-man installation" possible



Illustration 4-11: REHAU pipe unwinder (cold)

### Application

- RAUTHERM S pipes
- RAUTITAN flex pipes
- RAUTITAN stabil pipes

In nominal widths up to 20 mm and pipe rolls up to 600 m.

### Description

REHAU pipes carrying a medium are quickly and easily installed at the construction site with the REHAU pipe unwinder (cold).

### Assembly



Illustration 6-12: REHAU pipe unwinder (cold) before assembly

- Loosen transportation securing screw.
- Fold out moving feet.
- Pull out foot extensions.
- Fold out support arms.
- Fold securing arms up.
- Pull out extensions up to the maximum ring height/width.

### Technical data

Total diameter	1.40 m
Height of pipe unwinder installed (max.)	approx. 86 cm
Material	steel, galvanised
Weight without pipe roll	approx. 12.5 kg

## 6.10 REHAU pipe unwinder (warm)



- Simplified installation of medium-carrying pipes
  - at low outdoor temperatures

- and in unheated rooms
- with narrow installation pipe spacing
- for installation with large pipe rolls (up to 600 m in length)



Illustration 6-13: REHAU pipe unwinder (warm)

### Application

- Suitable for pipe rolls
- up to 600 m in length with outer pipe diameters of up to 17 mm
  - up to 500 m in length with outer pipe diameter of 20 mm
  - up to 350 m in length with outer pipe diameter of 25 mm
  - up to 200 m in length with outer pipe diameter of 32 mm.

### Requirements for use

- Rotating current of 400 V/16 A for temperature-control unit
- Water connection available
- Manifold installed in the intended position



Use of the REHAU pipe unwinder (warm) is mandatory when installing the REHAU underfloor heating/cooling systems with RAUFIX rail in conjunction with RAUTHERM S pipes with nominal widths of 17 x 2.0 mm and 20 x 2.0 mm or RAUTITAN flex pipes

16 x 2.2 with an installation pipe spacing  $\leq 15$  cm and installation temperatures under  $+10$  °C.

### Description

The REHAU pipe unwinder (warm) consists of the dispenser to which a temperature control unit with a circulating pump can be connected. By circulating 50 °C to 60 °C water, the pipes to be installed become soft and pliable even under adverse conditions, making laying quick and easy.

### Assembly

- Flow/return of the temperature-control unit connected to the flow/return of the REHAU manifold.
- Place pipe roll on the pipe unwinder.
- Connect flow pipe roll to the corresponding manifold outlet.
- Connect return pipe roll to the drum lance of the pipe unwinder and install the hose connection back to the manifold from there.
- Fill pipe roll and temperature-control unit with water and commission it.

### Technical data

Length	1.20 m
Width	0.78 m
Height	0.93 m
Weight without pipe roll	approx. 37 kg



# 7.

# MANIFOLD

## 7.1 REHAU manifolds



- High-quality dezincification-resistant brass
- Flat-joint connection points
- Greater assembly convenience due to offset arrangement of connecting nipples
- Two-sided manifold connection possible
- Pre-assembled on brackets

### Variants

- Manifold HKV
- Manifold HKV-D

### Application

The HKV/HKV-D manifolds are used for the distribution and

adjustment of the volume flow in low-temperature underfloor heating/cooling system.

The HKV/HKV-D manifolds have to be operated with heating water comply with VDI 2035. For systems with corrosion particles or contaminants in the heating water, dirt traps or filters with a mesh size of no more than 0.8 mm have to be installed in the heating system to protect the measurement and regulation equipment of the manifold. The maximum permissible permanent operating pressure is 6 bar at 80 °C. The maximum permissible test pressure is 8 bar at 20 °C.

### Accessories

- REHAU manifold cabinets for flush or surface mounting

- REHAU heat meter connection set
- REHAU temperature control station TRS-V
- REHAU fixed value control set 1"

### HKV

- Fine-control valves in flow
- Thermostat insert for REHAU actuator in return
- Connection ball valve in flow and return



Illustration 7-1: REHAU manifold HKV

- Manifold end piece with deaerate or/emptier
- Galvanised brackets with sound insulation inserts

### HKV-D

Like HKV, but also includes:

- Flow rate meter and quick-stop in flow
- Thermostat insert with flow rate control in return



Illustration 7-2: REHAU manifold HKV-D

### Technical data

Material	Brass
Manifold/collector	consist of separate brass pipe NW 1"
Heating circuits	for 2 to 12 heating circuits (groups)
HKV	1 thermostat insert per heating circuit in return. 1 fine-control valve per heating circuit in flow.
HKV-D	1 flow rate meter with quick-stop per heating circuit in flow. 1 thermostat insert with flow rate control per heating circuit in return.
Manifold end caps	with bleed valve and filling/emptying valve
Circuit ports spacing	55 mm
Connection for eurocone 3/4"	for REHAU clamping ring screw joints
Retainer/bracket	sound insulated, for wall and cabinet assembly

Manifold size	2	3	4	5	6	7	8	9	10	11	12
L in mm	190	245	300	355	410	465	520	575	630	685	740
Total size in mm	307	362	417	472	527	582	637	692	747	802	857

Table 7-1: Construction dimensions of REHAU manifolds



**Connection dimensions of REHAU manifold HKV**

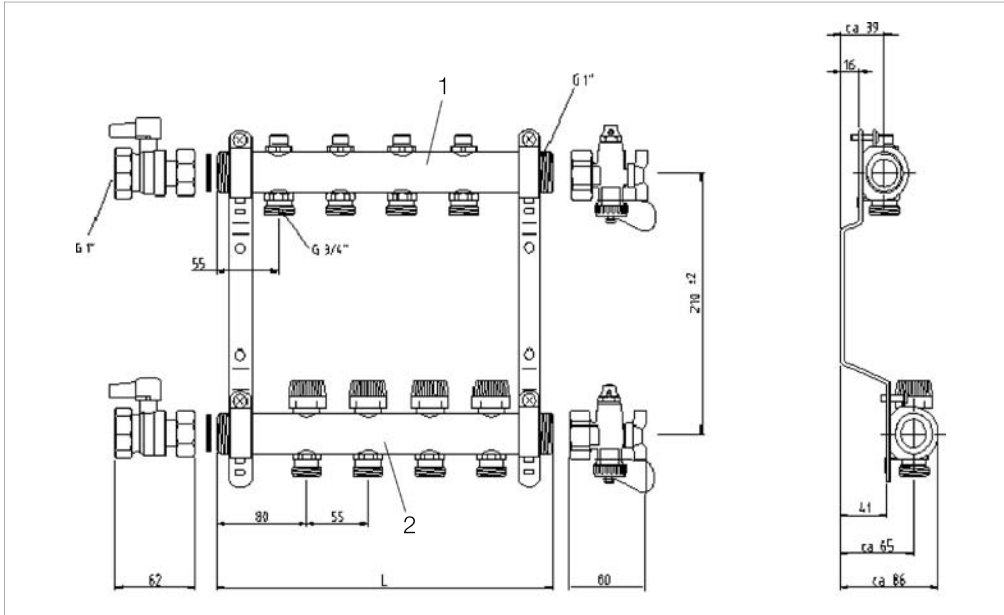


Illustration 7-3: Connection dimensions of REHAU manifold HKV

1 Flow

2 Return

**Connection dimensions of REHAU manifold HKV-D**

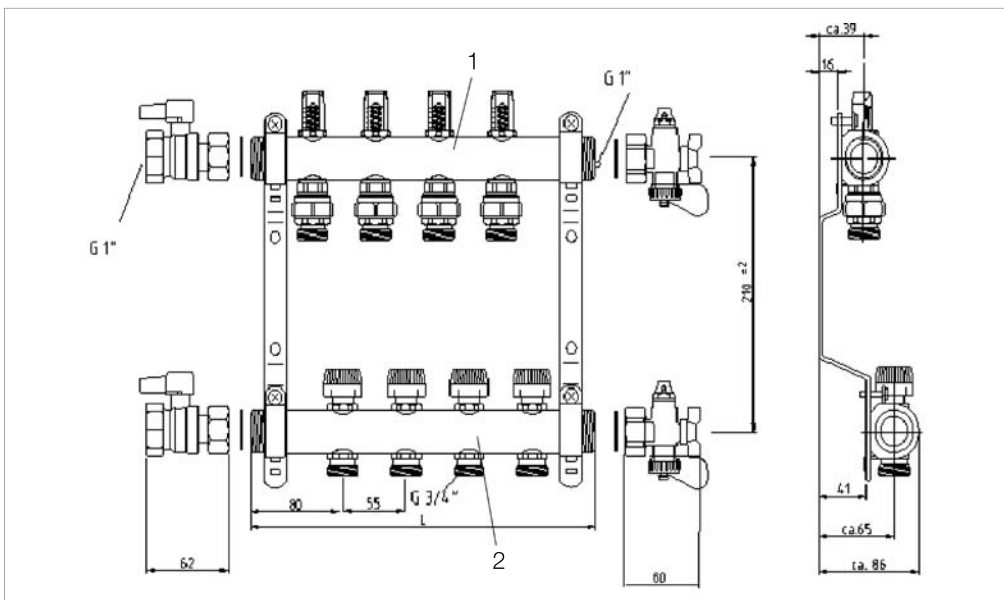


Illustration 7-4: Connection dimensions of REHAU manifold HKV-D

1 Flow

2 Return

**Assembly**

- In REHAU manifold cabinet:
  - Attach brackets of the manifold to the sliding C profile rails. The manifold attachment can be shifted horizontally and vertically.
- On the wall:
  - Attach manifold with included attachment set (four plastic dowels S 8 + four screws 6 x 50) through the holes in the manifold bracket.

## 7.2 REHAU manifold cabinets

### Manifold cabinet UP



Illustration 7-5: REHAU manifold cabinet UP

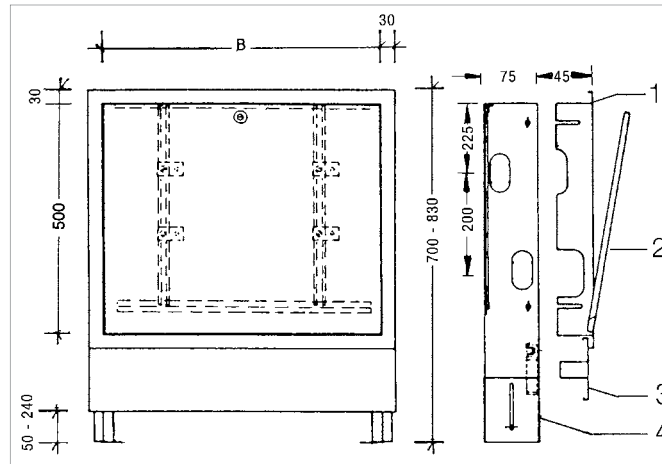


Illustration 7-6: Connection dimensions of manifold cabinet UP

The REHAU manifold cabinet UP is designed for flush-mounted installation. It consists of sendzimirised galvanised steel plate which can be adjusted vertically and depth-wise. The side walls are provided with cut-outs for flow/return, on the

right or left as desired. The redirection pipe, which ensures secure pipe guidance in the connection area, can be adjusted or removed. In addition, the adjustable screed end plate ensures clean fitting to the surface.

At the top, the manifold cabinet is equipped with a standard rail for accepting the REHAU control components. Up to 10 different cabinet sizes can be accessed according to the following table.

Cabinet type	1	2	3	4	5	6	7	8	9	10
Height of the cabinet [mm] <sup>1)</sup> , without frame	700– 850	700– 850	700– 850	700– 850	700– 850	700– 850	700– 850	700– 850	700– 850	700– 850
Total width of the cabinet on the outside [mm] “B”, without frame	450	554	665	754	835	868	954	1,033	1,154	1,303
Total depth of the cabinet <sup>2)</sup> on the outside [mm]	110– 160	110– 160	110– 160	110– 160	110– 160	110– 160	110– 160	110– 160	110– 160	110– 160
Required raw cut-out, width [mm]	500	600	700	800	900	900	1,000	1,100	1,200	1,350
Required raw cut-out, height [mm] min./max.	702/852	702/852	702/852	702/852	702/852	702/852	702/852	702/852	702/852	702/852
Required raw cut-out, depth [mm]	125– 175	125– 175	125– 175	125– 175	125– 175	125– 175	125– 175	125– 175	125– 175	125– 175
Cabinet weight [kg]	10.9	12.4	14.2	16.0	17.1	17.7	18.9	20.5	21.7	23.0

Table 7-2: Cabinet sizes and dimensions for built-in cabinet (intended for wall installation/flush-mounted installation)

<sup>1)</sup> Height is continuously adjustable between 700 and 850 mm via adjustable housing feet

<sup>2)</sup> The ability to adjust the frame continuously between 110 and 160 mm enables the in-built cabinet to be adapted to a variety of niche depths

## Manifold cabinet AP



Illustration 6-7: REHAU manifold cabinet AP

A surface-mounted manifold cabinet with a housing made of send-zimised galvanised steel plating is also part of the product range. The end plate can be removed. The manifold cabinet is equipped with a universal bracket for the manifolds and a standard rail for accepting the REHAU control components.

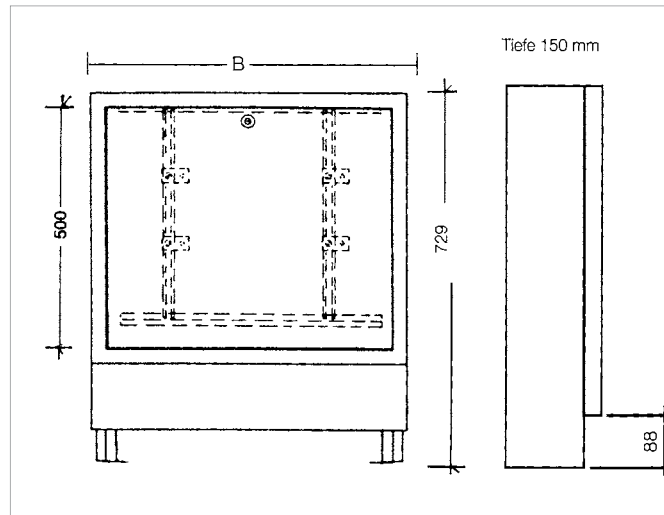


Illustration 7-8: Connection dimensions of manifold cabinet AP

Cabinet type	2	4	7	9	10
Construction height of the cabinet [mm]	729	729	729	729	729
Total width of the cabinet "B" [mm]	605	605	1,005	1,205	1,353
Total depth of the cabinet on the outside [mm]	150	150	150	150	150
Cabinet weight [kg]	11.6	14.2	17.6	20.7	22.0

Table 7-3: Cabinet sizes and dimensions (intended for surface-mounted installation)

## Selection table for the required cabinet sizes

→ Select in this order:

- Number of HKV/HKVD outlets
- Variants:
  - Flush-mounted
  - Surface-mounted
- Set-up: with (●) / without (○):
  - Heat meter connection set (WMZ)
  - Fixed value control set (FWRS)
  - Temperature control station manifold (TRS-V)

Number of HKV/HKVD outlets	Set-up	Flush-mounted variant UP type ...					Surface-mounted variant AP type ...				
	WMZ	○	○	●	●	○	○	○	●	●	○
	FWRS	○	●	○	●	○	○	●	○	●	○
	TRS-V	○	○	○	○	●	○	○	○	○	●
2		1	2	2	4	3	2	2	2	4	4
3		1	3	3	5	3	2	4	4	7	4
4		2	3	3	6	4	2	4	4	7	4
5		2	4	4	7	4	2	4	4	7	4
6		3	5	4	8	5	4	4	4	7	7
7		3	5	5	8	6	4	7	7	9	7
8		4	6	6	9	7	4	7	7	9	7
9		5	7	7	9	8	7	7	7	9	9
10		6	8	8	1	⊗	7	7	9	9	9
11		7	8	8	1	⊗	7	9	9	1	⊗
12		7	9	9	1	⊗	7	9	9	1	⊗

## REHAU manifold cabinet UP 75 mm



Illustration 7-9: REHAU manifold cabinet UP 75 mm

The REHAU manifold cabinet UP 75 mm is designed for flush-mounted assembly, e.g. in stud-frame walls. It consists of sendzimirised galvanised steel plate which can be adjusted vertically and depth-wise. The side walls are provided with cut-outs for flow/return, on the right or left as desired. In addition, the adjustable screed end plate ensures clean fitting to the surface. At the top, the manifold cabinet is equipped with a standard rail for accepting the REHAU control components.

Up to four different cabinet sizes can be accessed according to the following table.

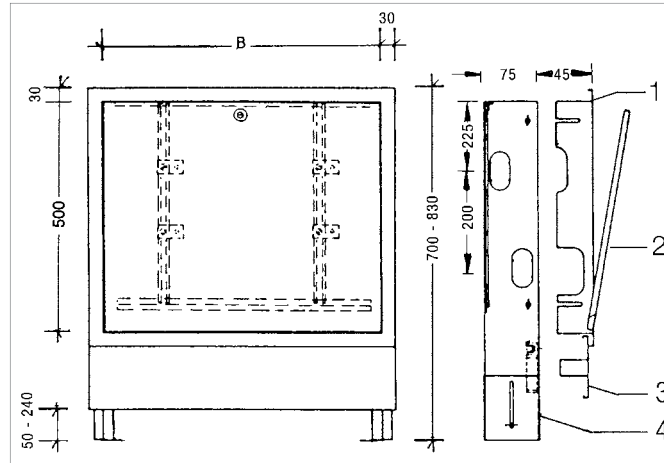


Illustration 7-10: Connection dimensions of manifold cabinet UP 75 mm

Cabinet type	1	2	3	4
Height of the cabinet [mm] <sup>1)</sup> , without frame	700–850	700–850	700–850	700–850
Total width of the cabinet on the outside [mm] “B”, without frame	554	754	954	1154
Total depth of the cabinet <sup>2)</sup> on the outside [mm]	75-120	75-120	75-120	75-120
Required raw cut-out, width [mm]	600	800	1000	1200
Required raw cut-out, height [mm] min./max.	702/852	702/852	702/852	702/852
Required raw cut-out, depth [mm]	90/135	90/135	90/135	90/135
Cabinet weight [kg]	9.7	11.9	15.1	18.3

Table 7-4: Cabinet sizes and dimensions for in-built cabinet

<sup>1)</sup> Height is continuously adjustable between 700 and 850 mm via adjustable housing feet

<sup>2)</sup> The ability to adjust the frame continuously between 110 and 160 mm enables the in-built cabinet to be adapted to a variety of niche depths

### Selection table for the required cabinet sizes

→ Select in this order:

1. Number of HKV/HKVD outlets
2. Set-up: with (●) / without (○) heat meter connection set (WMZ)

Number of HKV/HKV-D outlets	Set-up	
	WMZ <sup>1)</sup>	○ ○
2		3 4
3		3 4
4		4 4
5		4 4
6		5 7
7		6 7
8		7 7
9		8 9
10		8 9
11		9 9
12		9 9

<sup>1)</sup> Attention: heat meter connection set (WMZ) can be used with a pulled-out cabinet depth of ≥ 100 mm or greater

### 7.3 REHAU heat meter connection set



- Flat-joint connection at the manifold
- Assembly to left or right side of manifold possible
- Control of the entire manifold mass flow possible

#### System components

- Adapter for receiving a heat meter with connection
  - G 3/4" with a length of 110 mm
  - G 1" with a length of 130 mm
- Openings for assembly of the immersion probe of the computer unit
- Stop or control valve for control of the total manifold mass flow

#### Assembly



Due to differing depths of the heat meter computer unit and the specified cabinet depth, the installation of a separately assembled computer unit is also possible.

#### Attention!

→ Position return manifold bar of the HKV/HKV-D upward, since the heat meter should be built into the return as standard!

- The REHAU heat meter connection set is screwed directly to the manifold with the 1" screw connection nuts and the included seals.
- The ball stop valves accompanying the manifold can be assembled to the lower connections of the heat meter connection set.

An 8 mm hexagonal spanner is required for setting the total mass flow in accordance with the diagram shown here.

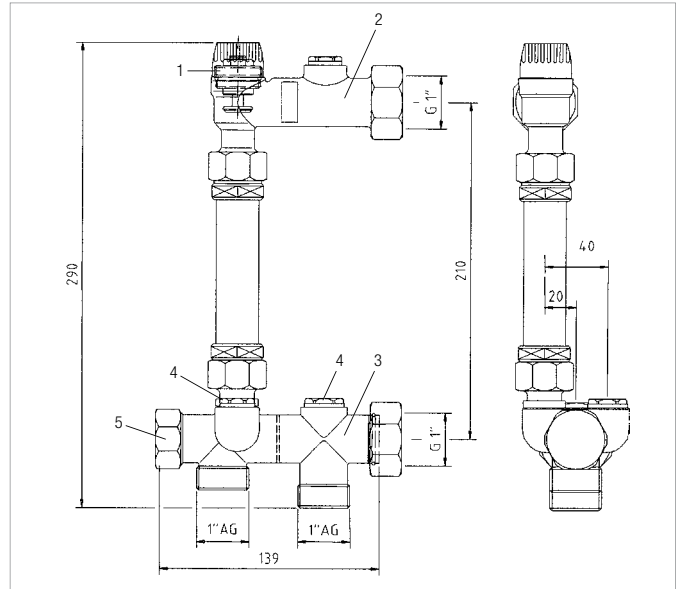


Illustration 7-11: Construction dimensions of heat meter connection set

- |   |                            |   |                                  |
|---|----------------------------|---|----------------------------------|
| 1 | Control valve              | 4 | Plug 1/2" for accepting VL probe |
| 2 | Return manifold connection | 5 | Connection cap 1"                |
| 3 | Supply manifold connection |   |                                  |

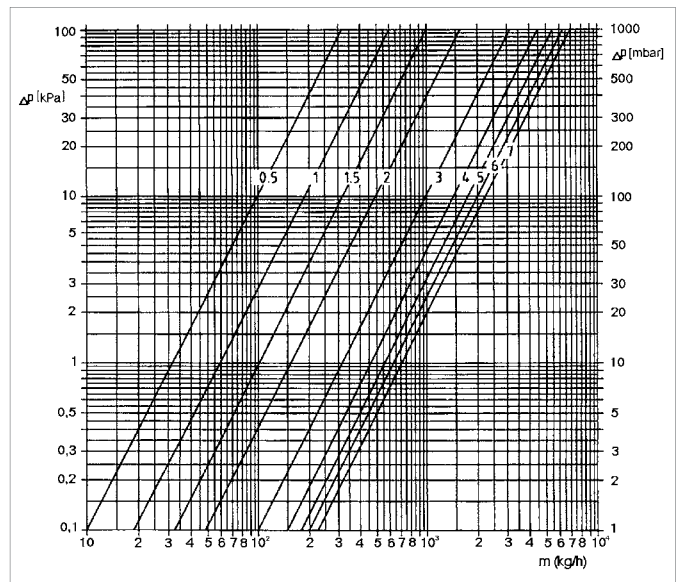


Illustration 7-12: Setting diagram for heat meter connection set control valve

- $m$  Mass flow
- $\Delta p$  Pressure loss
- 0.5–7 Adjustment tool rotations

### 8.1 Basics

#### Legal requirements

Economical operation of a heating system is decisively determined by:

- Dimensions and design
- Servicing
- Control technology

Up to 20 % of the annual energy requirement of a heating system can be saved through suitable and professionally installed control technology.

Legislators have thus stipulated in the Energy Conservation Ordinance (EnEV) which control components have to be provided in order to operate heating systems as efficiently as possible.

#### Suitable control technology

Control technology for heating systems can be divided into two categories, based on their tasks:

##### - Temperature control

The task is to keep a sufficient amount of energy available at all times.

This generally occurs via calculation of the average outside temperature (heating curve) in conjunction with a timer function (reduced/normal operation). Control groups suitable for this are described on the following pages.

##### - Individual room temperature control

The task is to allot the appropriate amount of energy for each room. This occurs via

the control of the flow-through (operation of actuators for the heating circuit valves).

A timer function is also necessary here.

If this is missing, the room temperature controllers continue to call for the same room temperature in the setback phase of flow temperature control. This controlling back and forth negates a large part of the possible savings.

Suitable control technology is found in the following sections.

#### Basic information on the control of floor heating systems

A room heated via the floor represents a very stable system due to the great storage capacity involved.

On the one hand, this means that short temperature fluctuations, e.g. from airing out, are compensated for quickly. On the other hand, it means that heating up a very cool room takes more time.

This characteristic puts special demands on the control technology:

- To prevent overheating of the rooms, the controllers used must be adapted to the control task.
- Properly timed heating and temperature setback of the rooms should be controlled automatically to achieve the highest level of comfort with the lowest possible consumption of energy.



The REHAU control systems are tailored to this purpose; they provide regulative behaviour adapted to floor heating and can be controlled via time programs.

#### Self-control effect

In principle, the self-control effect appears with every heating system.

It is based on the fact that the heating capacity depends on the temperature differential between the surface temperature of the heating surface and the room temperature.

This means that a rising temperature in the room reduces the heat output, and dipping temperatures increase it.

This becomes more effective as the difference between the temperature of the heating surface

and the ambient temperature gets smaller.

The specific capacity of a heating surface is yielded from the correlation:

$$q_H = \alpha_{\text{total}} (\vartheta_H - \vartheta_R)$$

where:

$q_H$  = Heating capacity of the surface/m<sup>2</sup>

$\alpha_{\text{total}}$  = Heat transmission coefficient

$\vartheta_R$  = Room temperature

$\vartheta_H$  = Temperature of the heating surface

This achieves its maximum effectiveness for floor heating, with its average surface temperature of 25 °C.

Thus this effect supports the functioning of room temperature control when the flow temperature control is set properly, but does not make it redundant.

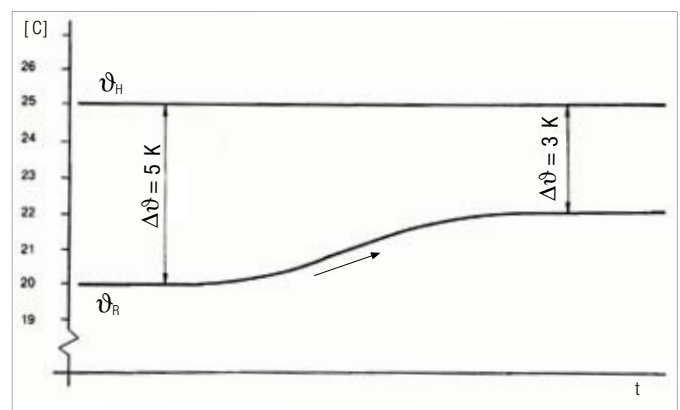


Table 8-1: Effect of self-control: Heating capacity  $q = 55 \text{ W/m}^2$  is reduced to  $q = 33 \text{ W/m}^2$  via the self-control effect

$\vartheta_H$  Temperature of the heating surface

$\vartheta_R$  Room temperature

→ Increase of the room temperature via extraneous heat influences

## 8.2 REHAU temperature control station TRS-V



- Compact unit ready for assembly
- Can be assembled on the left or right at the manifold
- Flat-joint connection points, without exception
- Flow temperature control controlled by outside conditions
- Energy-saving due to an electronically controlled pump
- Controller with screed heat-up function



Illustration 8-1: REHAU temperature control station TRS-V

### System components

- Electronic heating controller, programmed ready for operation
- 3-way mixer kvs = 5.0 m<sup>3</sup>/h DN 20 with actuator
- Electronically controlled pump Wilo E 25/1-5 - Maximum limiting thermostat cabled to pump
- Outside temperature sensor
- Flow temperature sensor, assembled and cabled

### Application

Control station for underfloor heating systems

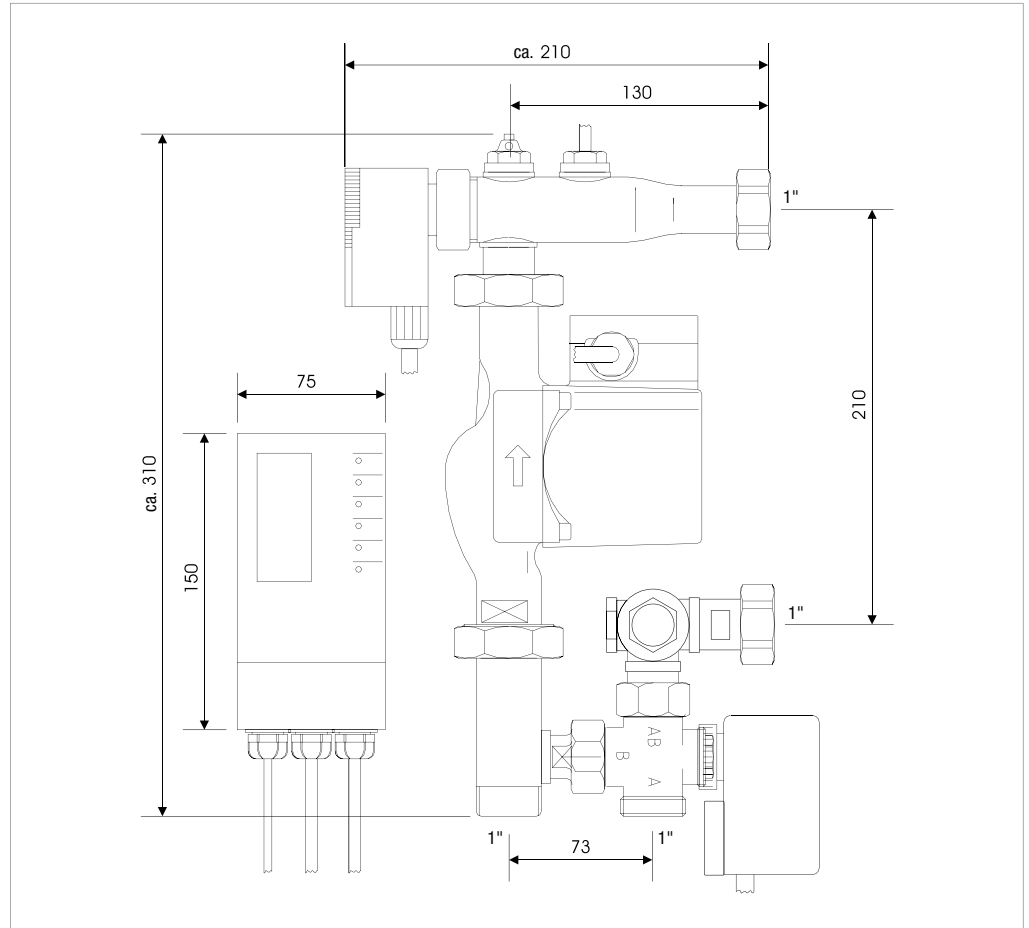


Illustration 8-2: Dimensions of REHAU temperature control station TRS-V

- as a home control station in multi-family houses with a central supply
- in conjunction with radiator heating.

### Accessories

- Room temperature sensor for correction of the flow temperature ("locking on" to the room temperature)
- Return temperature sensor (start-up control or return temperature limitation)

### Description

- The electronic controller has the following factory settings:
- Flow temperature control controlled by outside conditions based on a heating curve with a slope of 0.6
  - Daily setback times from 10 p.m. to 6 a.m.
  - Pump activation with setpoint flow temperatures over 22 °C (heating)
  - Pump stop for 30 min when setback starts

The pump is controlled by an automatic day and night control with fuzzy logic (day and night control).



For systems with reversing valves for hot water heating, there is a potential for problems with the hydraulics here, as the primary-side flow or return is cut off.

→ Check hydraulic suitability beforehand!

## Assembly



### Caution!

Installation of the system may only be carried out by a trained professional electrician.

→ Note the following:

- current national regulations
- information in the accompanying assembly instructions

**i** All electrical components are connected via distinctive connectors. This makes assembly of the unit easier and prevents damage to the controller.

- Make all pipe connections.
- Assemble controller to the rear wall of the manifold cabinet.
- Attach cable of the outside temperature sensor to the probe connector.
- Attach mains connection cable to manifold socket.
- Attach all electrical connections.

### Technical data

Dimensions (W x H x D)	260 x 380 x 155 mm
Temperature sensor	Ni1000
Supply voltage	230 V AC
Max. permissible operating temp.	+110 °C
Min. permissible operating temp.	+15 °C

Max. permissible operating press.	10 bar
-----------------------------------	--------

### Pump

Head	1–5 m
Flow rate	max. 3.5 m <sup>3</sup> /h
Power consumption	36–99 W
Length	130 mm

### 3-way mixer

kvs value	5.0 m <sup>3</sup> /h
Nominal width	DN 20

### Materials

Fittings	Hot-pressed brass
Pipe lines	Brass pipe
O-rings	EPDM elastomere

## 8.3 REHAU fixed value control set



- Expansion of an existing radiator system for REHAU underfloor heating system
- Control of the desired flow temperature
- Flat-joint connection at the REHAU heating circuit manifolds
- Assembly to left or right side of manifold possible



Illustration 8-2: REHAU fixed value control set

### System components

- Grundfos UPS 25/60 pump, length 130 mm, with immersion thermostat attached for temperature limitation
- Thermostat valve ½", setting range 20 – 50 °C, temperature measurement via immersion probe
- Control valve ½" for adjustment of the mass flow
- Connection bracket with temperature sensor and bleed valve ½"
- Connection bracket with filling/emptying valve ½"

### Description

- Works on the addition control principle
- Setting of the desired flow temperature at the thermostat valve.
- Degree of openness of the thermostat valve is set via the mixed temperature measured at the immersion probe after the return collector.
- The temperature limiter switches the circulation pump off if the set maximum temperature is exceeded. The pump is switched

on again automatically once the temperature drops below the maximum temperature.

### Pump control

For need-based control of the circulation pump, the mains supply of the fixed value control set is operated via the pump/power module of the RAUMATIC M or the RAUMATIC R when actuators are used.

The circulation pump is switched off with closed valves here.

### Capacity limits

The table below provides an indication of the achievable heating capacity depending on the primary-side flow temperature:

T <sub>flow</sub>	max. heating capacity
50 °C	3.3 kW
55 °C	4.7 kW
60 °C	5.9 kW
65 °C	7.2 kW
70 °C	8.5 kW





For systems with reversing valves for hot water heating, there is a potential for problems here, as the primary-side flow or return is cut off.

→ Check hydraulic suitability beforehand!

### Assembly



### Caution!

Installation of the system may only be carried out by a trained professional electrician.

- Note the following:
- current national regulations
  - information in the accompanying assembly instructions



The capillary tube of the temperature sensor may not be kinked.

- Install according to system plan (see Illustration. 8-4).
- Set return screw joint according to accompanying assembly instructions.

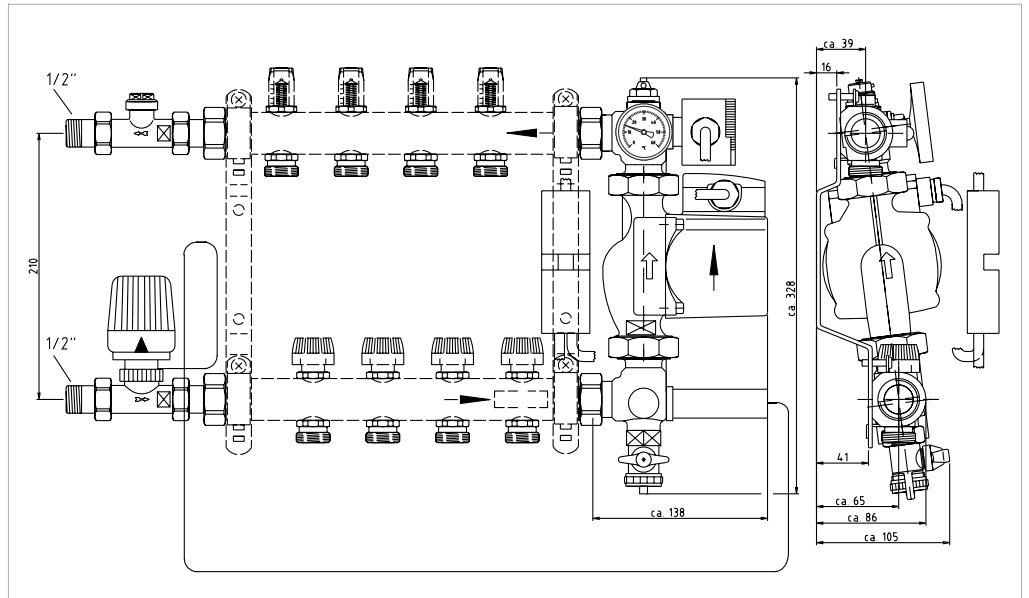


Illustration 8-3: REHAU fixed value control set with HKV-D

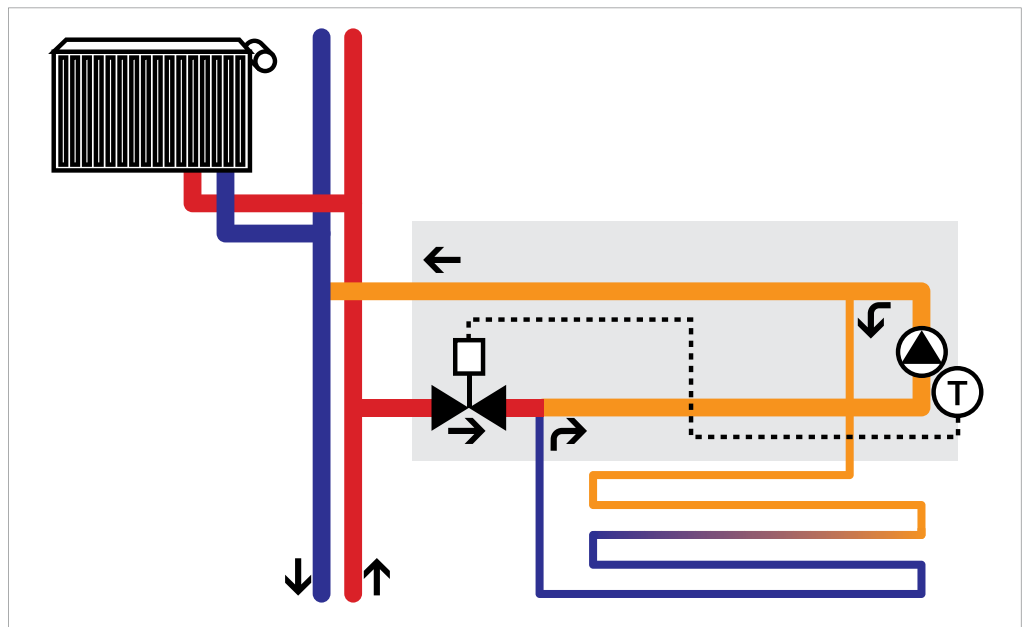


Illustration 8-4: System plan

## 8.4 REHAU compact stations

### 8.4.1 REHAU temperature control station TRS-20



- Compact unit ready for assembly
- Flat-joint connection points, without exception
- Flow temperature control controlled by outside conditions
- Energy-saving due to an electronically controlled pump
- Heating insulation shell made of expanded polypropylene
- Controller with screed heat-up function



Illustration 6-5: REHAU temperature control station TRS-20

#### System components

- Electronic heating controller, programmed ready for operation
- 3-way mixer kvs = 4.0 m<sup>3</sup>/h DN 20 with actuator
- Electronically controlled pump Wilo E 25/1-5
- Maximum limiting thermostat cabled to pump
- Outside temperature sensor
- Flow temperature sensor, assembled and cabled

- Temperature Sensor in flow and return

#### Application

Control station for underfloor heating systems for installation in a central location or at the boiler.

#### Accessories

- Room temperature sensor for correction of the flow temperature ("locking on" to the room temperature)
- Return temperature sensor (start-up control or return temperature limitation)

#### Description

The assembly is installed on a wall attachment bracket and is fully pre-wired.

The electronic controller has the following factory settings:

- Flow temperature control controlled by outside conditions based on a heating curve with a slope of 0.6
- Daily setback times from 10 p.m.–6 a.m.
- Automatic pump activation while heating

The pump is controlled by an automatic day and night control with fuzzy logic (day and night control).

## Assembly



#### Caution!

Installation of the system may only be carried out by a trained professional electrician.

→ Note the following:

- current national regulations
- information in the accompanying assembly instructions

→ Make pipe connections.

→ Assemble unit.

→ Attach cable of the outside temperature sensor to the probe connector.

→ Attach mains connection cable to manifold socket.

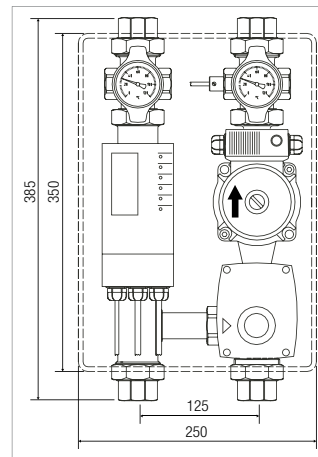


Illustration 8-6: Dimensions of REHAU temperature control station TRS-20

## Technical Data

Dimensions (W x H x D)	250 x 385 x 260 mm
------------------------	--------------------

Wall distance to centre of pipe	100 mm
---------------------------------	--------

Temperature sensor	Ni1000
--------------------	--------

Supply voltage	230 V AC
----------------	----------

Max. permissible operating temp.	+110 °C
----------------------------------	---------

Min. permissible operating temp.	+15 °C
----------------------------------	--------

Max. permissible operating press.	10 bar
-----------------------------------	--------

Connections	1"
-------------	----

#### Pump

Head	1–5 m
------	-------

Flow rate	max. 3.5 m <sup>3</sup> /h
-----------	----------------------------

Power consumption	36–99 W
-------------------	---------

Length	130 mm
--------	--------

#### 3-way mixer

kvs value	4.0 m <sup>3</sup> /h
-----------	-----------------------

Nominal width	DN 20
---------------	-------

Housing	Red bronze, dull nickel plated
---------	--------------------------------

#### Materials

Fittings	Hot-pressed brass
----------	-------------------

Pipe lines	Brass pipe
------------	------------

O-rings	EPDM elastomere
---------	-----------------

Heating insulation shell	Expanded polypropylene
--------------------------	------------------------

## 8.4.2 REHAU pump mixer group PMG-25, PMG-32



- Compact units ready for assembly
- Flat-joint connection points, without exception
- Energy-saving due to an electronically controlled pump
- Heating insulation shell made of expanded polypropylene



Illustration 6-7 REHAU pump mixer group PMG-25/32

### System components

- 3-way mixer DN 25 / DN 32 with actuator 3-point, 230 V
- Electronically controlled pump Wilo E 25/1-5 / Wilo E 30/1-5 .
- Temperature sensor in flow and return

### Applications

Pump mixer station for underfloor heating systems for assembly in a central location or at the boiler.

### Description

The assembly is installed on a wall attachment bracket and is fully pre-wired. Expandable via the REHAU flow temperature control set into an independent control station.



### Caution!

Installation of the system may only be carried out by a trained professional electrician.

→ Note the following:

- current national regulations
- information in the accompanying assembly instructions

### Technical data

Width	250 mm
Height	395 mm
Depth	230 mm
<b>3-way mixer</b>	
kvs value	8.0 m <sup>3</sup> /h or 18 m <sup>3</sup> /h
Nominal width	DN 25 or DN 32
Housing	Red bronze, dull nickel plated

## 8.4.3 REHAU flow temperature control set



- Electronic heating controller, programmed ready for operation
- Flow temperature control controlled by outside conditions
- Outside temperature sensor and flow temperature sensor, Ni 1000
- Maximum limiting thermostat
- Pre-wired with connectors for easy installation
- Operating voltage 230 V AC

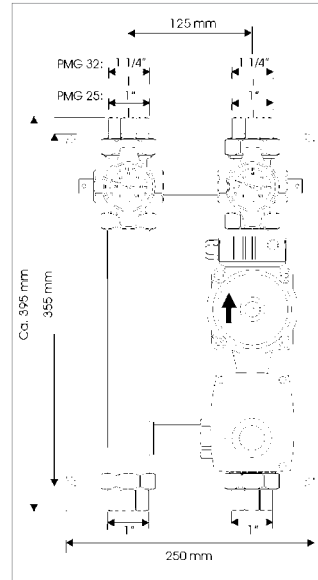


Illustration 8-8: Dimensions of REHAU pump mixer group PMG-25/32

### Accessories

- Room temperature sensor for correction of the flow temperature ("locking on" to the room temperature)
- Return temperature sensor (start-up control or return temperature limitation)

### Description

The electronic controller has the following factory settings:

- Flow temperature control controlled by outside conditions based on a heating curve with a slope of 0.6
- Daily setback times from 10 p.m. to 6 a.m.
- Automatic pump activation while heating



Illustration 8-9: REHAU flow temperature control set



### Caution!

Installation of the system may only be carried out by a trained professional electrician.

→ Note the following:

- current national regulations
- information in the accompanying assembly instructions

## 8.5 RAUMATIC M room temperature control



- Well-thought-out complete solution
- High temperature control precision
- Easy, quick and safe to install
- Screw-less connection technology with all components
- Modular expandable system
- Attractive design
- Available as 24 V and 230 V system

### System components

- System socket for room thermostat
- Room thermostat, room thermostat Comfort, room thermostat Control, room thermostat E
- Distribution controller
- Actuator

### Expansions

- Timer module
- Pump/power module
- Expansion module room thermostats
- Expansion module actuators



The REHAU room thermostats (including the Comfort and Control variants) can only be used in conjunction with the REHAU system socket for room controllers!

### Description

With the most simple variant, the room thermostats in conjunction with the distribution controller are sufficient. The distribution controller enables the connection of up to six room temperature thermostats and a maximum of 14 actuators.

### 8.5.1 System components

#### REHAU system socket



- The electrical connections can be made by the installer in the construction phase.
- The room controllers are simply attached for commissioning of the system.

The system socket fits all room thermostats of the RAUMATIC M series (except thermostat E).

#### REHAU room thermostat

- Room temperature thermostat with "softclick" setpoint value adjuster and large temperature scale with one-quarterdegree increments.
- The setpoint temperature range can be limited when the operating button is removed.
- The setback temperature is set to 4 K.
- Control of temperature setback occurs via the timer module.



Illustration 8-10: RAUMATIC M components

#### REHAU room thermostat Komfort

Using a switch ball located on the side, this thermostat also offers the capability to switch to the following operating modes:

- Automatic (control via timer module)
- Comfort temperature
- Temperature setback
  - displayed on the control via an illuminated "moon" symbol
  - The setback temperature can be set from 2 K to 6 K

#### REHAU room thermostat Control

In addition to the functions of the "Comfort" type, this thermostat offers:

- Plug-in digital clock for individual programming of the setback times
- Pilot clock function, i.e.: forwarding of the setback times to other room temperature thermostats

#### Technical data of room thermostat, room thermostat Komfort, room thermostat Control

Colour	Pure white (similar to RAL 9003)
Operating voltage	24 V or 230 V
Switching temperature differential	approx. 0.2 K
Switching capability	5 REHAU actuators
Protection rating	IP20

#### Colours

All thermostat models are also available in the following colours upon request

- Yellow (similar to RAL 1004)
- Green (similar to RAL 6029)
- Blue (similar to RAL 5002)
- Red (similar to RAL 3003)
- Grey
- Black

- Office grey
- Metallic blue-black
- Metallic champagne
- Metallic bronze
- Metallic platinum

### REHAU thermostat E (230 V only)



Illustration 8-11: REHAU thermostat E

- Bimetallic room temperature control with thermal recirculation
- Adjustable temperature range of 5–30 °C
- Input for temperature setback
- The setpoint temperature range can be limited when the operating button is removed
- Direct assembly to the wall or flush-mount box (not suitable for REHAU system socket)
- Connection via screw terminals
- Compatible with the other components of the RAUMATIC M system (230 V)

### Technical data

Integrated temperature range restriction

Switching contact	Opener for actuators 230 V normally closed
-------------------	--

Connection for temperature setback via timer or hand switch

Switching differential	approx. 0.5 K, thermal recirculation
------------------------	--------------------------------------

Setback approx. 4 K

Temperature range	5–30 °C
-------------------	---------

Width	76 mm
-------	-------

Height	76 mm
--------	-------

Depth	23 mm
-------	-------

Housing colour	Alpine white
----------------	--------------

Operating voltage	230 V
-------------------	-------

Switching capacity	10 (4) A, 250 V AC
--------------------	--------------------

Protection rating	IP30
-------------------	------

Protection class	II
------------------	----



- All connections are of the plug-in type
- Diagnosis LED for operating actuator and fuse fault
- Easy attachment of the expansion components (no wiring necessary)
- Up to six room temperature controls and up to 14 actuators can be connected
- Integrated fuse DIN rail or wall assembly mounting

The distribution controller is used to connect the components of the RAUMATIC M system.

### REHAU actuator



- Thermal actuator, normally closed
- Clear status display
- Easy assembly
- Overhead mounting possible
- “First-open function” for operation of the underfloor heating during the construction phase (before assembly of the controls)
- Adaptation to various valves and manifolds makes is possible
- Protection rating IP54



A special adapter is required with overhead installation of the actuators.

→ Please contact your REHAU sales office!

### 8.5.2 Description of the expansion options

#### REHAU timer module

The REHAU timer module is a week timer and offers two independent time programs.

#### REHAU pump/power module

The REHAU pump/power module is used for need-based operation of the circulation pump (switch-off, if none of the controls call for heat). The follow-up time can be set.

#### REHAU expansion module room thermostat

Connection option for two additional thermostats with four

actuators each (max. 14 actuators per distribution controller).

### REHAU expansion module actuators

The REHAU actuators expansion module offers the option to connect 2 x 4 additional actuators (max. 14 actuators per distribution controller).

### 8.5.3 Notes on planning

A four-lead cable is required for connection of the control (one lead is for temperature setback here).

- 24 V system:
  - required cross-section:
    - 1 mm<sup>2</sup> (up to 40 m cable length)
    - 1.5 mm<sup>2</sup> (up to 70 m cable length)
- 230 V system:
  - NYM 4 x 1.5 or
  - NYM 5 x 1.5 (with earth cable)



- We recommend using rigid cables for the 24 V system as well, as they can easily be inserted into the plug terminals without wire-end ferrules.
- The system socket is assembled on commercially available flush-mount boxes according to DIN 49073.
- The power supply to the regulating manifolds should have its own fuse.
- When installing controls in bathrooms (see DIN VDE 100, Part 701, for this), we recommend using the 24 V system.

### 8.5.4 Assembly and commissioning



#### Caution!

Installation of the system may only be carried out by a trained professional electrician.

→ Note the following:

- current national regulations
- information in the accompanying assembly instructions

→ Connect system socket and assemble on flush-mounted box. (with thermostat E: Assemble control on wall or flush-mounted box.)

→ Connect thermostat and assemble on wall or flush-mounted box.

→ Attach actuators to distribution controller.

→ Plug actuators into valve adapter.

**i** When delivered, the actuators are open (first-open function).

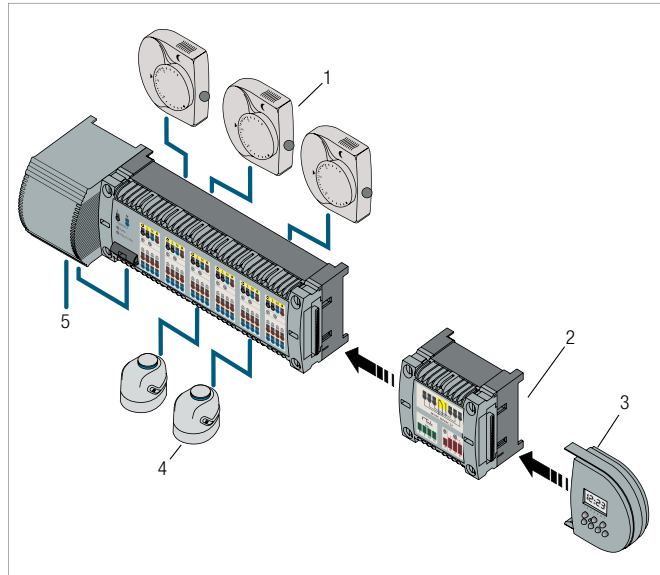
→ Attach additional system components (timer module etc.) if necessary.

→ Connect mains supply to distribution controller.

→ Attach cover to distribution controller.

→ Switch on mains fuse. The operation indicator illuminates.

→ Switch mains fuse off again.



- 1 Thermostat (max. six)
- 2 Pump/power module
- 3 Timer module
- 4 Actuators (max. 14)
- 5 230 V AC mains

Illustration 8-12: Connection plan of the RAUMATIC M components

#### Once painting work etc. is complete:

→ Attach thermostat to system socket and lock in place.

→ Check functioning and room arrangement:

- Switch on mains fuse.
- Set controls to maximum in turn and leave switched on.

The respective LED (actuator activated) illuminates. The first-open function is nullified after 15 minutes.

- Set control to minimum. The actuators close after max. 5 min.

### 8.5.5 REHAU distribution controller EIB 6-channel / 12-channel



- Integrated bus coupler
- Max. 13 actuators can be connected
- Constant or switching actuating variable can be selected
- Noise-free switching due to TRIAC technology

- Summer operation with protective function to prevent against stuck valves (selectable)

The distribution controller EIB represents the link between an EIB system with EIB room temperature controllers and the REHAU actuators 24 V.

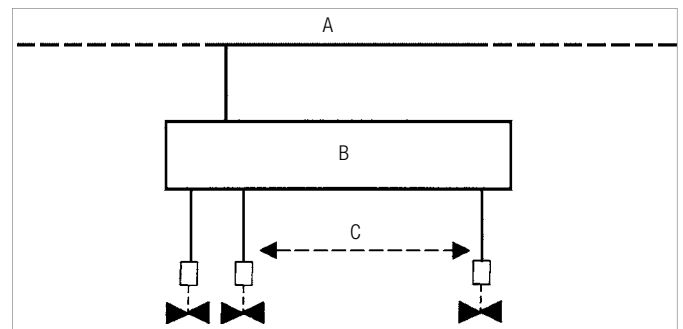


Illustration 8-13: REHAU distribution controller EIB in EIB system

- A Bus line EIB
- B REHAU distribution controller EIB
- C max. 13 actuators

## 8.6 RAUMATIC R radio temperature control



- Economical radio temperature control for underfloor heating
- No wiring necessary
- Clear, quick installation free of mix-ups
- Easiest commissioning
- Modern appealing design
- Clear operating/indicator displays
- Connection for pump/power module and timer module
- All other advantages of the RAUMATIC M system

### System components

- Radio room control
- Radio distribution controller
- Timer module
- Pump/power module 24 V
- Actuator 24 V

### Basic set-up

The following is required for the basic set-up:

- One radio room control per room
- Radio distribution controller
- One REHAU actuator 24 V

### Expansions

**i** The timer module and pump/power module are identical to the expansions of the RAUMATIC M system 24 V.

- The timer module can operate two separated areas with one time program via the distribution controller.

- The pump/power module switches the circulation pump off if no controls call for heat.



The system can be supplemented with a radio receiver in case of highly unfavourable reception conditions.

- Please contact your REHAU sales office.

### 8.6.1 Description of system components

#### Radio room control

- Room temperature control with wireless radio transmission, transmission of the temperature information and encoding for the radio distribution controller.
- Rotary "soft-click" setpoint value knob with one-quarter-degree increments
  - Selectable operating mode (temperature setback "ON", "OFF" or "AUTOMATIC")
  - Narrow band transmitter on 868 MHz

#### Technical data

Transmit frequency band	868 MHz
Transmission power	< 10 mW
Range	approx. 30 m in a house
Battery	2 x 1.5 V Mignon (AA, LRG), alkaline



Illustration 8-13: REHAU distribution controller EIB in EIB system

Battery life	approx. 5 years
Temp. setting range	10 °C–28 °C
Colour	Pure white
Dimensions (W x H x D)	118 x 79 x 27 mm
Mignon batteries included	

#### Radio distribution controller, 6 x, 24 V



- Working frequency 868 MHz
- Suitable for six radio room temperature controls
- 13 REHAU actuators 24 V can be connected
- Modular expandability via integrated interface
- Automatic setback via two heating programs (C1/C2) via timer module available as an option

Connection system for radio room control and actuators 24 V.

- Control displays for:
  - Operating voltage
  - Radio room control switching output
  - Defective fuse
- Functions:
  - Frost protection (anti-freeze mode)
  - Radio link test as an aid during commissioning



## Technical data

Operating voltage	230 V 50/60 Hz
Transformer	230 V / 24 V, 50/60 Hz, 50 VA
Maximum power consumption	50 W
Frequency band	868 MHz
Protection type	IP 20
Protection class	II
Dimensions W x H x D	302 x 70 x 75 mm
Colour of housing bottom section	Silver-grey (RAL 7001)
Colour of housing cover	Transparent

### 8.6.2 Assembly and commissioning




#### Caution!

Installation of the system may only be carried out by a trained professional electrician.

- Note the following:
- current national regulations
  - information in the accompanying assembly instructions
- 
- Assemble distribution controller in manifold cabinet.
- Attach actuators to distribution controller.


- Plug actuators into valve adapter.

 When delivered, the actuators are open (first-open function).

- Attach additional system components (timer module etc.) if necessary.

→ Attach mains supply to transformer of the distribution controller.

- Switch on mains fuse.  
The operation indicator illuminates. After approx. 5 sec, all diodes illuminate and the distribution controller is ready for assignment of the controls.

 After switching on the mains fuse, the distribution controller automatically opens the outputs. The first-open function is nullified after 8 minutes at the latest.

- Assign the room temperature controls to the individual zones according to the accompanying assembly instructions.

- Assign room temperature controls from the intended assembly site outward.
- Label room temperature controls below the setpoint adjuster.

→ Assemble controls at the intended site.

→ Make an assignment check of the radio controls at the radio distribution controller according to the accompanying assembly instructions.

### 8.7 REHAU control technology heating/cooling



- Ensures optimum cooling output
- Prevent water condensation
- Fully automatic and need-based changing of Heating/Cooling operating modes
- Prevention of floor under-cooling
- Modular construction suitable for a variety of system concepts

#### System components

- Heating/cooling control set, consisting of:
  - Central control ZR-HK
  - Flow temperature sensor F-VL
  - Outside temperature sensor F-AT
  - Floor temperature sensor F-BT
  - Humidity/temperature transducer MU-FT
- Individual room control ER-HK
- Actuator HK
- Port zone valve DV for heating and cooling pipes, complete with drive
- 3-way valve MV with continuous drive
- Distribution controller RV-HK
- Remote control HK


 A 24 V safety transformer is to be provided for the components with 24 V operating voltage connected to the central control ZR-RK and for each distribution controller RV-HK to be installed. Dimensioning depends

on the number of connected components. Suitable types can be suggested upon request.

#### Accessories

- Dew-point sensor TPW

#### Application

 A combined underfloor pipe heating/cooling system requires carefully tuned control technology.

A smaller permissible working range is in effect right during cooling due to the minimum surface temperature which must be maintained and the risk of condensation.

To obtain the highest possible effectiveness, this range must be fully exploited.

By using suitable sensors and sophisticated control technology, the REHAU heating/cooling control system fulfils these requirements. The special method of foresighted activation of cooling represents a distinctive feature.

The highest possible effectiveness of the cooling system is achieved due to the option of individual adaptation to the building characteristics.



## 8.7.1 Description of system components

### REHAU central control ZR-HK



Illustration 8-15: REHAU central heating/cooling control ZR-HK

- Flow temperature control controlled by outside conditions during heating
- Automatic switching between heating/neutral zone/cooling
- Activation of cooling following the foresighted method for achieving the highest possible effectiveness
- Prevention of condensation during cooling by limiting the cooling water temperature according to the calculated dew point
- Maintaining the minimum floor temperature of 20 °C during cooling
- Operation of the valve drives (switching between heating/cooling)
- Activation of the heat or chiller and the respective pumps



The MV (mixing valve) three-way valve is operated via a 0–10 V signal.

→ If valve/drive combinations other than MV15/MV20/MV25 are used, use a 0–10 V continuous drive and a supply voltage of 24 V AC.

### REHAU individual room temperature controller ER-HK



Illustration 8-16: REHAU individual room temperature control ER-HK

- Control of the volume flow of the heating/cooling circuits
- Switching between heating and cooling via central control
- Activation of setback mode via external contact

### REHAU humidity/temperature transducer MU-FT



Illustration 8-17: REHAU humidity/temperature transducer MU-FT

- Measurement of
- relative humidity
  - room temperature
- In reference room for:
- calculation of the dew point
  - determining the criteria for switching between heating and cooling via the central heating/cooling control ZR-HK

### REHAU port zone valve DV



Illustration 8-18 REHAU port zone valve DV with actuator

- For switching the heating and cooling pipes via four valves
- Complete with drive 24 V AC The following valves are available as

standard:

- Port zone valve DV 20 Nominal width DN 20, kvs value 4.5 m<sup>3</sup>/h
- Port zone valve DV 25 Nominal width DN 25, kvs value 5.5 m<sup>3</sup>/h
- Port zone valve DV 32 Nominal width DN 32, kvs value 10 m<sup>3</sup>/h

### REHAU 3-way valve MV



Illustration 8-19: REHAU 3-way valve MV with actuator

- For regulating the flow temperature via return intermixing
  - Complete with drive 24 V AC/DC
- The following valves are available as standard:
- 3-way valve MV 15 Nominal width DN 15, kvs value 2.5 m<sup>3</sup>/h
  - 3-way valve MV 20 Nominal width DN 20, kvs value 5.0 m<sup>3</sup>/h
  - 3-way valve MV 25 Nominal width DN 25, kvs value 6.5 m<sup>3</sup>/h

### REHAU actuator HK



Illustration 8-20: REHAU actuator HK

- Suitable for the heating circuit manifold HKV and HKV-D
- Position indication via see-through window on the side
- Operating voltage 24 V AC
- Protection type IP 44; in case of horizontal assembly, IP 43

### Distribution controller RV-HK



Illustration 8-21: Distribution controller RV-HK

- For the connection of max. six REHAU individual room temperature controls ERHK and 12 actuators HK
- Connection option for controls during heating/cooling and purely heating

- Control inputs for
  - Switching between heating/cooling
  - Setback
- Integrated overvoltage protection, integrated fuse

### REHAU remote control HK



Illustration 8-22: REHAU remote control HK

- Remote control of the control ZR-HK:
  - Operating mode Heating/Cooling specification
  - Switching between presence/absence
  - Correction of the setpoint values
- Display of the operating mode, presence/absence, time and outside temperature
- 76 x 76 mm housing, pure white (RAL 9010).


### REHAU flow temperature sensor F-VT

- Flow temperature measurement
  - For heating and cooling
  - Sensor encapsulated in brass sleeve diameter of 6 mm, 50 mm long
  - With bracket and tensioning band for attachment at pipe

### REHAU outside temperature sensor F-BT

- Measurement of the outside temperature for
  - need-based guidance of the flow temperature during heating
  - determining the criteria for switching between heating and cooling

### REHAU floor temperature sensor F-BT

-  Observe the installation information of the floor temperature sensor!

Measurement of the floor temperature at the top of the screed layer

### 8.7.2 Method of functioning of system components



- Bathrooms, kitchens and similar rooms may not be cooled. There is a risk of condensation on the floor due to the possibility of quickly rising humidity levels.
- Using the distribution controller RV-HK ensures that the connected individual room temperature controls ER-HK only operate in the desired operating mode.
- The pipelines from the chiller to the manifolds must be insulated airtight.

### Taking the dew-point temperature into account

The formation of water condensation must be reliably prevented. This also applies both for the cooled surfaces and for the supply lines to the manifolds.

To avoid costly airtight insulation of the heating circuit manifolds, the flow temperature is brought to the dew point with a safety margin.

### Ex works setting:

Safety margin 2 K

The fact that the limitation of the flow temperature is usually determined by the "floor temperature" criterion means that there is no loss in output during by far the majority of the operating time.

### Taking the floor temperature into account

When the measured floor temperature approaches the limit value of 20 °C, the flow temperature is raised.

### Linking both criteria

The higher of the two setpoint values determined for the flow temperature is used for control. This ensures that both of the two criteria are complied with.

### REHAU dew-point sensor TPW

It is recommended that the dew-point sensor TPW be assembled at the flow of the heating circuit manifold. When condensation begins, the operating voltage of the individual room controls is disconnected and the flow of coolant stops.

This measure is indispensable as soon as a decisive statement regarding the distribution of the room humidity due to the spatial conditions or the type of use cannot be made.

### Switching between operating modes Heating/Cooling

#### Automatic switching

For activation of heating, the average outside temperature is used as the criterion (average value calculation can be set in the range of 0–72 h):

Guideline values:

- Average value calculation over 48 h

- Undershooting of a limit value of 15 °C
- Hysteresis 0.5 K.



#### Activation of cooling

Commonly applied methods are limited to just considering the outside and inside temperatures.

The central control ZR-HK employs calculative processing of the relevant temperature values in conjunction with evaluation of the trend of the interior temperature.

This special method of calculation offers the following advantages:

- Timely activation of cooling
- Consideration of the building characteristics
- Consideration of internal loads
- Prevention of unnecessary chiller standby periods

The result of this “foresighted” functioning of the control is the highest possible effectiveness of an underfloor pipe cooling system when otherwise economical functioning is given.

#### Manual switching

The following operating modes can be selected via the operating buttons of the control and the optional remote control which can be connected:

- Automatic
- Off (anti-freeze)
- Heating
- Cooling

### Measures for the prevention of damage from malfunctioning



In accordance with DIN EN 1264, a safety device which is independent of the operating unit and which deactivates the circulation pump in case of impermissibly high flow temperatures must be present.

→ Install a limiting thermostat on the customer side.

The control signals sent by the central control ZR-HK are the result of the processing of measured values according to predetermined parameterising.

Damage to the sensors, the processing electronics or incorrect parameterising by the user can lead to malfunctions.

It will not damage the system, however.

Suitable measures have to be used to securely prevent any possible malfunctions before they happen. We recommend using the SIEMENS compact controller LOGO!230RC-L with the REHAU system.

#### Advantages of the compact controller

- Prevention of malfunctions
- Flexible adaptation to the system conditions
- Minimal wiring required
- Diagnosis options

The compact controller represents the link between the flow temperature control and the heating/cooling system.

The integrated logic and time-based locks enable it to ensure that all connected components (valve drives, pumps, boilers, chillers) are operated correctly.

Example programs for the SIEMENS compact controller LOGO!230RC-L are available for different system models. These programs can easily be adapted to other applications.

The conditions of the inputs and outputs shown on the display make commissioning easier.

### 8.7.3 Notes on assembly



#### Caution!

Installation of the system may only be carried out by a trained professional electrician.

→ Note the following:

- current national regulations
- information in the accompanying assembly instructions

#### Central control ZR-HK



- To protect the control from humidity and dust, it must be kept in an enclosed housing or installed in a switch panel.
- The control must be connected to the mains voltage all year long.

#### Assembly position

Socket, preferably on a standard rail or directly on the wall.

#### Individual room temperature control ER-HK



When the distribution controller RV-HK is used, the following functions are ensured:

- Switching between heating and cooling occurs via the connection of output 4 to input c/o (change-over).
- Controls for rooms which are only heated (bathroom, kitchen) are

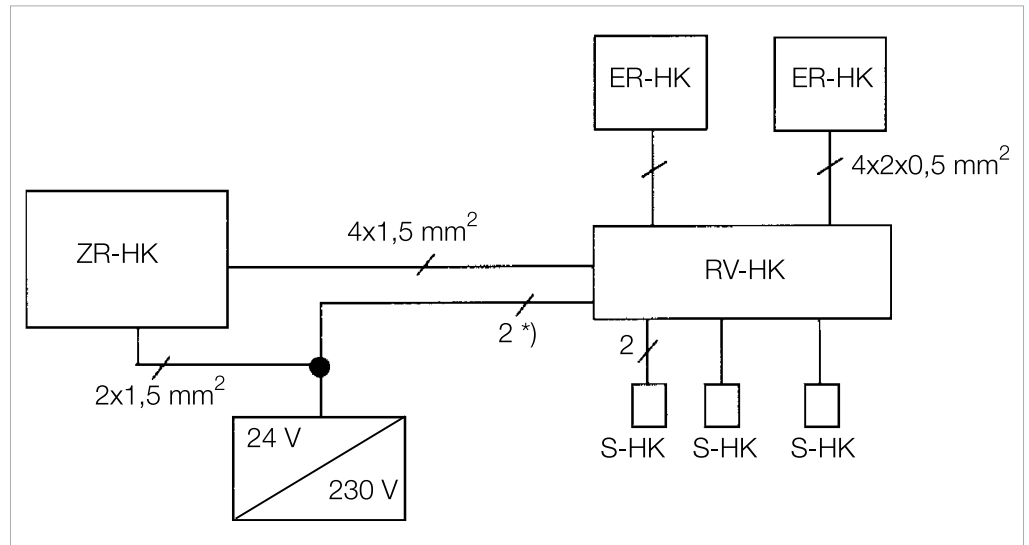


Illustration 8-23: Schematic of the principle of the connection lines to the distribution controller RV-HK

ZR-HK: Central control HK  
ER-HK: Individual room control HK

RV-HK: Distribution controller HK  
S-HK: Actuators HK

\*) Dimension cable diameter as needed

supplied with operating voltage which is switched off during cooling. The actuators configured as being “normally closed” thus securely close the relevant zones.

#### Assembly position

- Approx. 150 cm above the floor
- Not in a draughty area
- Not near heat sources
- Not covered or in niches

#### Flow temperature sensor F-VL

#### Assembly position

- Approx. 30 cm after the circulation pump
- Before 3-way valve
- In an immersion sleeve or at-

tached to the pipe with a bracket and fastener

#### Humidity/temperature transducer MU-FT

#### Assembly position

- 90–150 cm above the floor
- Not in a draughty area
- Not near heat sources
- Not covered or in niches

#### Outside temperature sensor F-AT

#### Assembly position

- On the northern façade of the building
- Not near exhaust-air equipment or windows to be opened

## Floor temperature sensor F-BT

**i** Positioning must occur in such a way that the probe measures the minimum occurring floor temperature during cooling. Here, the main focus is on the occupied areas, i.e. the locally-occurring cooler areas are acceptable as long as they are in hallways, for example.

### Assembly position

- In an area of higher installation density, i.e. near the manifold
  - If there are several manifolds, the manifold which supplies the reference room should be selected
  - In the area in which the outgoing pipes are no longer insulated
  - In an area in which pipes are installed and are used during cooling; these are generally the supply lines of the reference room
- Insert the probe in a thin-walled metallic protective sleeve (dia. 15 mm) as close as possible to the surface into the floor.

**i** The minimum bending radius of the protective sleeve (40 mm with an internal diameter of 15 mm) may not be fall below so that the probe can be inserted easily.

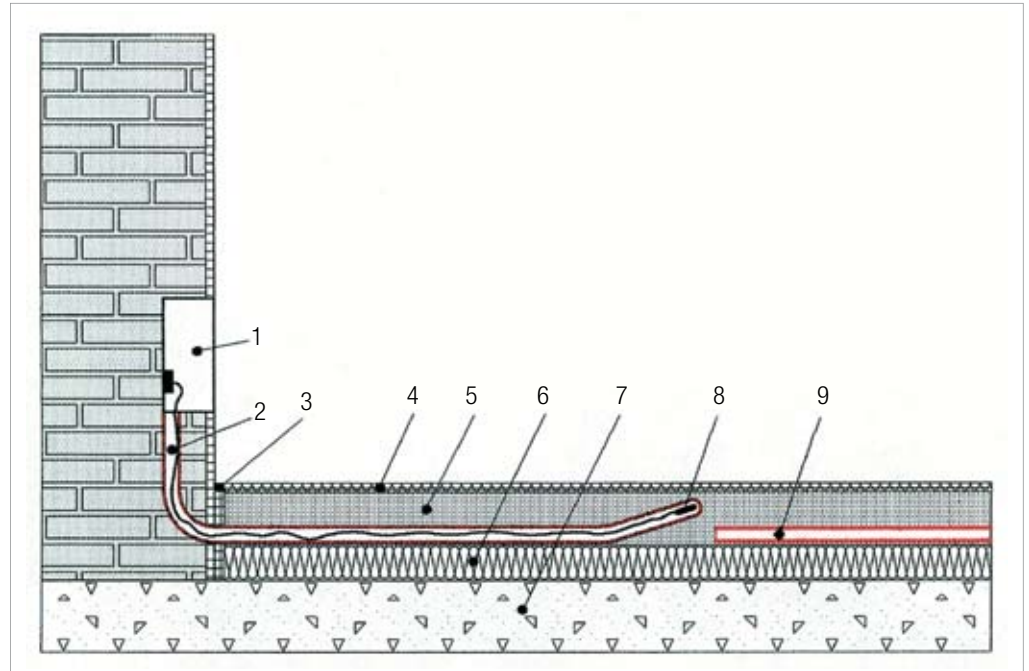


Illustration 8-24: Assembly of the floor temperature sensor

- |   |                                 |   |  |
|---|---------------------------------|---|--|
| 1 | Connection box                  | 6 | REHAU heating and impact sound proofing insulation |
| 2 | Empty conduits                  | 7 | Structural slab                                    |
| 3 | REHAU edge insulation materials | 8 | Floor temperature sensor                           |
| 4 | Flooring material               | 9 | RAUTHERM S pipe                                    |
| 5 | Screed                          |   |  |

- Close off protective sleeve at the front.
- Secure closed sleeve end approx. 10 mm below the top of the screed. For information on installation (see Illustration 8-24).



- The protective sleeve must be secured carefully before the screed is installed.
- Depending on the local conditions, a terminal point can be set in a wall box or the cable of the probe (3 m long) can be lead further along empty conduits.

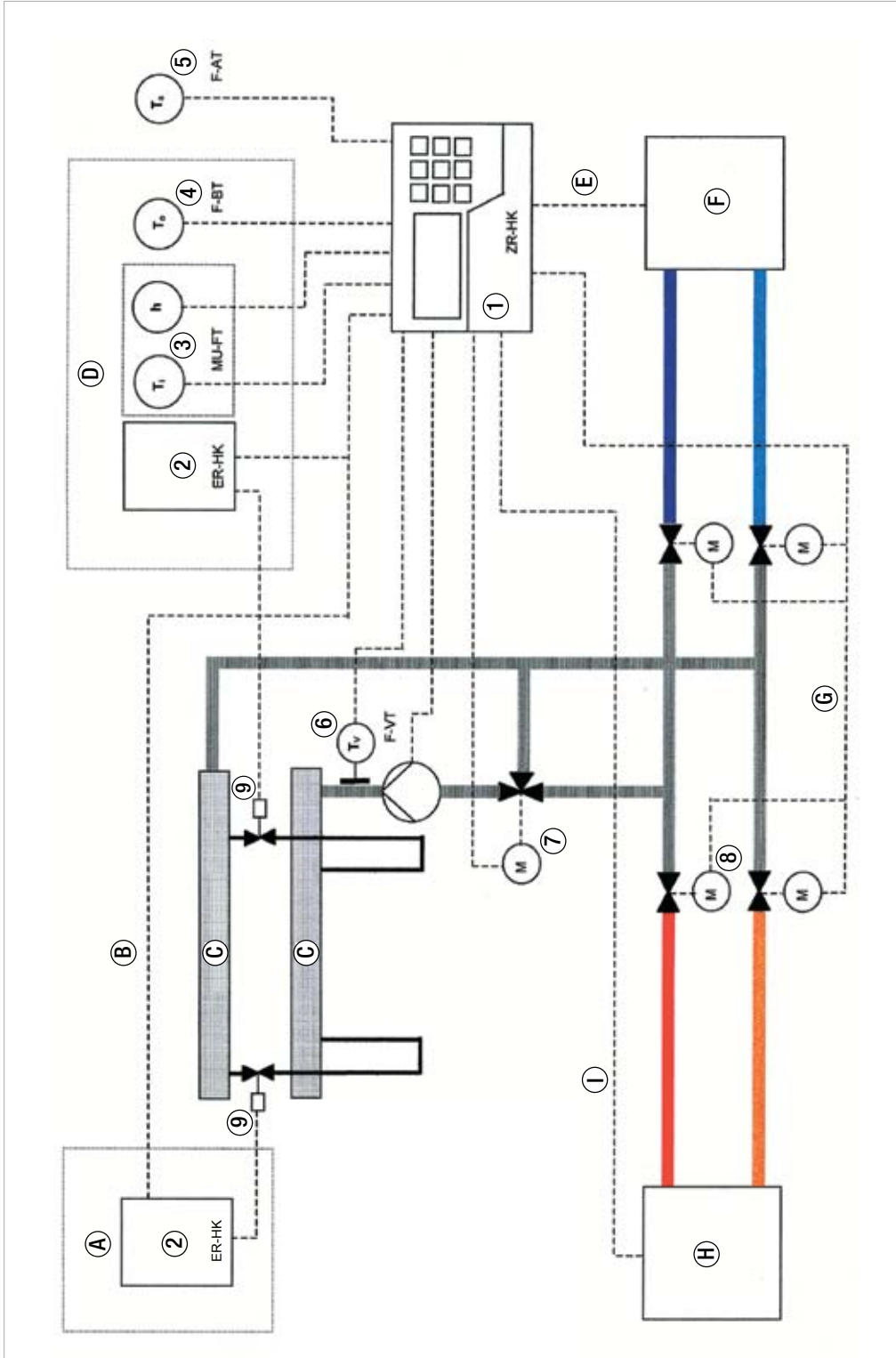


Illustration 8-25: Hydraulic and control plan with underfloor pipe heating/cooling

- |   |   |   |                |   |                                    |
|---|---|---|----------------|---|------------------------------------|
| 1 | Central control ZR-HK                     | D | Reference room | 7 | 3-way valve with drive             |
| 2 | Individual room temperature control ER-HK | E | Cooling enable | 8 | Reversing valves with therm. drive |
| 3 | Humidity/temperature transducer MU-FT     | F | Chiller        | 9 | Actuators HK                       |
| 4 | Floor temperature sensor F-BT             | G | Switching H/C  | A | Room                               |
| 5 | Outside temperature sensor F-AT           | H | Heat generator | B | Changeover, setback signal         |
| 6 | Flow temperature sensor F-VT              | I | Heating enable | C | Manifold                           |

## 8.7.4 Technical data

### Control set HK

#### Central control ZR-HK

- Week timer with automatic daylight savings function
- Parameter set for immediate commissioning, backup via a plug-in memory module
- Front panel with LCD display, keypad and lead-sealable slider switch Manual/Automatic/Service modes
- 144 x 96 mm housing is made of flame retardant pure-white thermoplastic and complies with DIN 43700
- Assembly on the wall, switch panel or tophat rail
- Socket with screw clamp

#### Humidity/temperature transducer MU-FT

- Capacitive probe with measurement range of 5–95 % rel. hum.
- Temperature measurement, measurement range 0 – 50 °C
- Output signals 0–10 V
- 76 x 76 mm housing is made of pure white thermoplastic
- Socket for 2 x 1.5 mm<sup>2</sup> cables, suitable for direct wall assembly
- Supply voltage 24 V AC, ± 20 %, 50–60 Hz, power consumption approx. 0.8 VA

#### Flow temperature sensor F-VT

- Thin-nickel-coat sensor according to DIN 43760
- Sensor encapsulated in brass sleeve, dia. 6 mm, 50 mm long
- Measurement range of –20

°C–100 °C

- Connection cable 2 x 0.5 mm<sup>2</sup>, 1 m
- Protection type IP 55 according to EN 60529 with bracket and tensioning band for attachment to the pipe

#### Floor temperature sensor F-BT

Technical data same as F-VT, except the cable length is 3 m

#### Outside temperature sensor F-AT

- Thin-nickel-coat sensor according to DIN 43760
- Measurement range of –50 °C – +80°C
- Cable inserted at the back or from below for cable screw connection, conduit thread 11
- Protection type IP 42 according to EN 60529

#### Individual room control HK

##### Individual room thermostat ER-HK

- Electronic room thermostat for heating and cooling with switching output
- Temperature setting range 10–30 °C, switching differential 0.5 K
- Switching between the Heating/Cooling operating modes and reduced/normal operation via external contact
- Supply voltage 24 V AC
- Electrical rating (ohmic load as with thermal actuators, for example) of 8 A
- 76 x 76 mm housing is made of flame retardant pure white

thermoplastic (RAL 9010)

- Suitable for wall assembly or assembly on a flush-mount box

#### Actuator HK

- With position indication
- The drive is delivered as normally closed
- Can be made “normally open” by removing a plug-in
- Resilience 105 N
- Run time of 3 min., stroke 3 mm
- Attached to the zone valve with union nut M 30 x 1.5
- Suitable for the heating circuit manifold HKV and HKV-D
- Adapter for various valve types available
- Supply voltage 24 V AC
- Current consumption during switch-on max. 250 mA

#### Distribution controller RV-HK

- Operating voltage 24 V ±15 %, 50/60 Hz
- Integrated fuse 4 A
- Connection terminals
  - for max. 1.5 mm<sup>2</sup> flexible
  - 2.5 mm<sup>2</sup> rigid
- Permissible ambient temperature 0–50 °C
- Protection type IP 20
- Dimensions W x H x D: 390 x 88 x 38 mm
- For the connection of max. six REHAU individual room temperature controls ERHK and 12 actuators HK
- Control inputs for switching between heating/cooling (C/O) and setback (N/R)
- Connection option for controls during heating/cooling and purely heating

- Resistive overvoltage protector
- For wall assembly



## Valves and drives HK

### Port zone valves

Valve body made of red bronze with threaded pipe connection, spindle made of stainless steel with soft-sealing valve head, gland with double O-ring seal  
 Nominal pressure PN 16  
 Leakage rate 0.0001 % of kvs  
 Valve stroke 4 mm  
 The port zone valves are supplied with a thermal actuator and an appropriate threaded nozzle set, union nut and seal.

### Actuator for port zone valves

- With position indication
- Run time of 3 min., stroke 4.5 mm, resilience N = 125 N
- Operating voltage 24 VAC  $\pm$  20 %, power consumption during operation 3 W
- Starting power 6 VA, starting current 250 mA
- Can be switched from "normally closed" to "normally open" by removing a plug-in
- Housing made of self-extinguishing plastic, pure white

### 3-way valves

Valve body made of brass with male thread, valve body is nickel plated, spindle is made of stainless steel with soft-sealing valve head, gland with double O-ring seal, nominal pressure PN 16. Supply with continuous valve drive and appropriate threaded nozzle set, union nut and seal.

Valve	Nominal width	kvs	$\Delta p_{max}$
DV 20	DN 20	4.5 m <sup>3</sup> /h	1.5 bar
DV 25	DN 25	5.5 m <sup>3</sup> /h	1.0 bar
DV 32	DN 32	10.0 m <sup>3</sup> /h	3.5 bar

Table 8-2: Port zone valves

Valve	Nominal width	kvs
DV 15	DN 15	2.5 m <sup>3</sup> /h
DV 20	DN 20	5.0 m <sup>3</sup> /h
DV 25 <sup>1)</sup>	DN 25	6.5 m <sup>3</sup> /h

Table 8-3: 3-way valves

<sup>1)</sup> Valve body not nickel plated

### Actuator for 3-way valve

- Integrated LED for checking the operating condition
- Run time 60 sec., stroke 4.5 mm, thrust 120 N
- Operating voltage 24 V DC/AC, power consumption 5 VA
- Plastic housing, light grey
- Connection cable 1.5 m
- Protection type IP 40 according to EN 60529

### Expansions HK

#### Remote control HK

- For remote control of the control ZR-HK
- Operating mode Heating/Cooling/Automatic/Off specification
- Switching between presence/absence, correction of the setpoint values
- Display of the operating mode, presence/absence, time and outside temperature
- Connection to central control ZR-HK via max. 30 m long connection cable 4 x 0.5 mm.

### Dew-point sensor TPW

- For protection against condensation
- Attachment to pipe dia. 10–100 mm with tensioning band
- Switchover contact 1 A, 24 V (responds at 95 %  $\pm$  4 %) and output signal 0–10 V for 70 %–85 % rel. hum.
- Housing made of pure white flame retardant thermoplastic with spring suspended dew-point sensor.



## 9.1 Introduction

### 9.1.1 General information

Modern architecture, climatic influences, increasing IT usage and increased comfort requirements place great demands on innovative building technology. Concrete core temperature control is a cooling and heating system designed for the future which fulfils these requirements.



- Minimal investment costs
- Highest level of comfort and performance
- “Soft cooling” without draughts
- Reduced level of air exchange in conjunction with air conditioning units
- No Sick Building Syndrome
- By activation of the storage masses, smaller chiller unit is required
- Low and energetically favourable flow temperature level
- The use of alternative cooling and heating water generation systems is possible



Illustration 9-1: Historical building



Illustration 9-2: Concrete core temperature control concreting section

### 9.1.2 Principle

The principle of concrete core temperature control is based on the utilisation of the storage mass of building components.

This principle can be seen in the summer with historical buildings, e.g. castles and churches, with very thick outer walls. Due to the large amount of storage mass of these walls, comfortably cool room temperatures can even be enjoyed in the summer when the outside temperature is high. The heat loads arising in the room are absorbed by cool solid building elements.

Concrete core temperature control supports the storage characteristic of solid concrete parts via pipes carrying cooling and heating water. This makes for “limitless” storage.

## 9.2 System variations

### 9.2.1 REHAU BKT modules



- Quick assembly
- Variable module dimensions
- Standard and special shapes

#### System components

- REHAU BKT modules
- REHAU BKT form
- REHAU BKT spacer
- REHAU BKT grid ties/REHAU- cable ties
- REHAU protective sleeve

#### Pipe dimensions

- RAUTHERM S 17 x 2.0 mm
- RAUTHERM S 20 x 2.0 mm

Prefabrication of the REHAU BKT modules ensures a high standard of quality and short assembly times.

### 9.2.2 REHAU concrete core temperature control installed on site



- Flexible adaptation of the concrete core temperature control circuits to the building shape
- Variable concrete core temperature control circuit lengths
- Easy pipe installation

#### System components

- REHAU RAUTHERM S pipe
- REHAU BKT form
- REHAU compressed-air pipe cap
- REHAU RAUFIX rail

- REHAU BKT grid ties/REHAU- cable ties
- REHAU protective sleeve
- REHAU coupler
- REHAU compression sleeve
- REHAU BKT protective tape

#### Pipe dimensions

- RAUTHERM S 17 x 2.0 mm
- RAUTHERM S 20 x 2.0 mm

The concrete core temperature control circuits can be adapted flexibly to any building shape due to pipe installation directly on the construction field.



Illustration 9-3: REHAU BKT modules



Illustration 9-4: REHAU BKT modules on pre-fabricated concrete parts



Illustration 9-5: REHAU concrete core temperature control installed on site

### 9.3 System components

#### REHAU BKT modules and REHAU BKT RAUFIX modules

For use with REHAU RAUTHERM S pipe, oxygen impermeable comply with DIN 4726 with dimensions of 17 x 2.0 mm or 20 x 2.0 mm.

The pipe ends are sealed with a dummy plug and a compressed-air pipe cap. This occurs with the patented and permanently sealed REHAU compression-sleeve connection EPO 339 248 BA.

You can choose between the following pipe installation types:

- Double meander (DM)
- Single meander (EM)

The double-meander pipe installation type features a more even temperature profile over the entire module surface in comparison to single meander.

Especially with large-area modules, this leads to more homogeneous temperature distribution in the construction component and to more even temperatures on the surface of the construction components.

You can choose between the following values for the installation pipe spacing:

- 15 cm (VA 15)
- 20 cm (VA 20)

Each module is supplied with two connection lines for the flow and return, each of which are 2 m long. The connection lines are secured to the module for transport.

#### REHAU BKT modules

Securing of the REHAU RAUTHERM S pipe to the steel grids for concrete occurs at the factory with REHAU BKT grid ties.

#### REHAU BKT RAUFIX modules

Securing of the REHAU RAUTHERM S pipe occurs via a RAUFIX rail.



Deviating lengths of the connection lines can be implemented by REHAU on request.

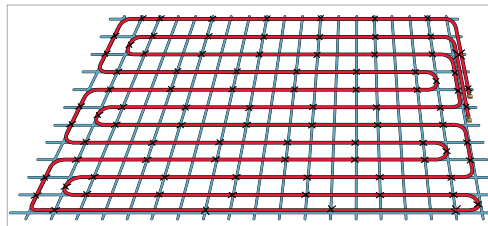


Illustration 9-6: REHAU BKT module DM

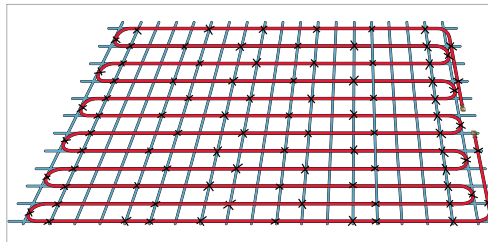


Illustration 9-7: REHAU BKT module EM

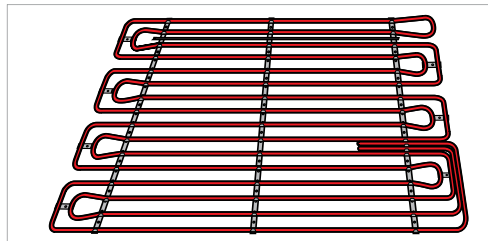


Illustration 9-8: REHAU-BKT-RAUFIX module DM

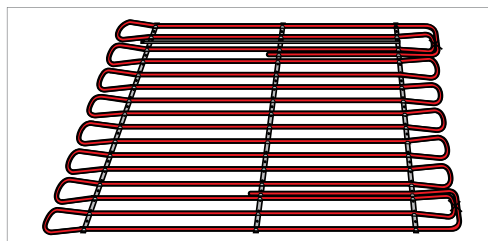


Illustration 9-9: REHAU-BKT-RAUFIX module EM


**Thermically active area of the REHAU BKT modules and REHAU BKT RAUFIX modules DM/EM, VA 15/20**

The REHAU BKT modules and REHAU BKT RAUFIX modules are custom tailored with the following dimensions:

- |                       |            |
|-----------------------|------------|
| VA 15                 | VA20       |
| - Width: 0.9 - 2.4m   | 0.8 - 2.4m |
| - Length: 1.35 - 6.3m | 1.4 - 6.4m |

The dimension is selected depending on the:

- pipe installation type
- pipe dimension
- installation pipe spacing

 Upon request, special sizes and shapes can be supplied instead of standard modules.

**Installation pipe spacing 150 mm/VA 15**

Width [m]	0.90	1.20	1.50	1.80	2.10	2.40
Length [m]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]
1.35	1.22	1.62	2.03	2.43	2.84	3.24
1.50	1.35	1.80	2.25	2.70	3.15	3.60
1.65	1.49	1.98	2.48	2.97	3.47	3.96
1.80	1.62	2.16	2.70	3.24	3.78	4.32
1.95	1.76	2.34	2.93	3.51	4.10	4.68
2.10	1.89	2.52	3.15	3.78	4.41	5.04
2.25	2.03	2.70	3.38	4.05	4.73	5.40
2.40	2.16	2.88	3.60	4.32	5.04	5.76
2.55	2.30	3.06	3.83	4.59	5.36	6.12
2.70	2.43	3.24	4.05	4.86	5.67	6.48
2.85	2.57	3.42	4.28	5.13	5.99	6.84
3.00	2.70	3.60	4.50	5.40	6.30	7.20
3.15	2.84	3.78	4.73	5.67	6.62	7.56
3.30	2.97	3.96	4.95	5.94	6.93	7.92
3.45	3.11	4.14	5.18	6.21	7.25	8.28
3.60	3.24	4.32	5.40	6.48	7.56	8.64
3.75	3.38	4.50	5.63	6.75	7.88	9.00
3.90	3.51	4.68	5.85	7.02	8.19	9.36
4.05	3.65	4.86	6.08	7.29	8.51	9.72
4.20	3.78	5.04	6.30	7.56	8.82	10.08
4.35	3.92	5.22	6.53	7.83	9.14	10.44
4.50	4.05	5.40	6.75	8.10	9.45	10.80
4.65	4.19	5.58	6.98	8.37	9.77	11.16
4.80	4.32	5.76	7.20	8.64	10.08	11.52
4.95	4.46	5.94	7.43	8.91	10.40	11.88
5.10	4.59	6.12	7.65	9.18	10.71	12.24
5.25	4.73	6.30	7.88	9.45	11.03	12.60
5.40	4.86	6.48	8.10	9.72	11.34	12.96
5.55	5.00	6.66	8.33	9.99	11.66	13.32
5.70	5.13	6.84	8.55	10.26	11.97	13.68
5.85	5.27	7.02	8.78	10.53	12.29	14.04
6.00	5.40	7.20	9.00	10.80	12.60	14.40
6.15	5.54	7.38	9.23	11.07	12.92	14.76
6.30	5.67	7.56	9.45	11.34	13.23	15.12

### Installation pipe spacing 200 mm/VA 20

Width [m]	0.90	1.20	1.50	1.80	2.10
Length [m]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]	active area [m <sup>2</sup> ]
1.40	1.12	1.68	2.24	2.80	3.36
1.60	1.28	1.92	2.56	3.20	3.84
1.80	1.44	2.16	2.88	3.60	4.32
2.00	1.60	2.40	3.20	4.00	4.80
2.20	1.76	2.64	3.52	4.40	5.28
2.40	1.92	2.88	3.84	4.80	5.76
2.60	2.08	3.12	4.16	5.20	6.24
2.80	2.24	3.36	4.48	5.60	6.72
3.00	2.40	3.60	4.80	6.00	7.20
3.20	2.56	3.84	5.12	6.40	7.68
3.40	2.72	4.08	5.44	6.80	8.16
3.60	2.88	4.32	5.76	7.20	8.64
3.80	3.04	4.56	6.08	7.60	9.12
4.00	3.20	4.80	6.40	8.00	9.60
4.20	3.36	5.04	6.72	8.40	10.08
4.40	3.52	5.28	7.04	8.80	10.56
4.60	3.68	5.52	7.36	9.20	11.04
4.80	3.84	5.76	7.68	9.60	11.52
5.00	4.00	6.00	8.00	10.00	12.00
5.20	4.16	6.24	8.32	10.40	12.48
5.40	4.32	6.48	8.64	10.80	12.96
5.60	4.48	6.72	8.96	11.20	13.44
5.80	4.64	6.96	9.28	11.60	13.92
6.00	4.80	7.20	9.60	12.00	14.40
6.20	4.96	7.44	9.92	12.40	14.88
6.40	5.12	7.68	10.24	12.80	15.36

The dimensions refer to the thermally active area

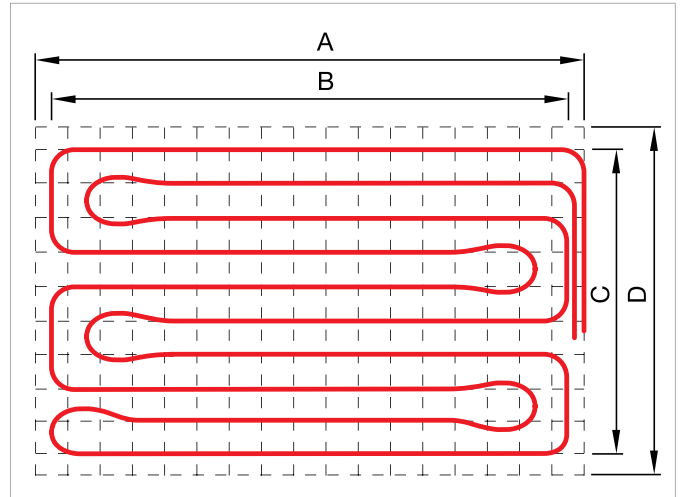


Illustration 9-10: Installation dimensions

- A Module length: thermally active length in m
  - B Module length with pipe: A-VA in m
  - C Module width with pipe: D-VA in m
  - D Module width: thermally active width in m
- Thermally active module area:  $A \times B$  in m<sup>2</sup>

**REHAU BKT reinforcement basket**



Illustration 9-11: REHAU BKT reinforcement basket

The REHAU BKT reinforcement basket made of steel-reinforced concrete with synthetic feet is used for vertical positioning of the REHAU BKT modules in the concrete ceiling. It is set-up on the boarding. Easy assembling is guaranteed by applying REHAU BKT modules.

Material	BSt 500/550
Bar thickness	5.5 mm
Total height	70–200 mm

**REHAU BKT grid ties**



Illustration 9-12: REHAU BKT grid ties

The REHAU BKT grid ties consists of plastic sheathed wire. It is used for the attachment of the REHAU BKT modules to the reinforcement and for securing to the REHAU BKT spacers. It can also be used with the REHAU concrete core temperature control on site.

Material	Plastic-sheathed wire
Wire diameter	1.4 mm
Length	140 mm
Colour	Black

**REHAU BKT S snake**

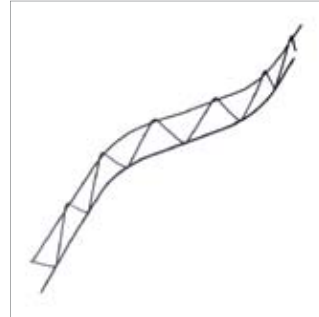


Illustration 9-13: REHAU BKT S snake

The REHAU BKT S snake made of steel reinforced concrete is used for vertical positioning of the REHAU BKT modules in the concrete ceiling. It is set-up on the lower reinforcement. Easy assembling is guaranteed by using REHAU BKT modules in the case of visible concrete ceilings.

Material	Steel wire
Bar thickness	4 mm
Total height	20–200 mm

**REHAU twisting tool**



Illustration 9-14: REHAU twisting tool

The REHAU twisting tool made of metal with plastic sheathing is used for proper and quick twisting of the REHAU BKT grid ties. It is used during the attachment work for REHAU BKT modules and with the REHAU concrete core temperature control installed on site.

Material	Steel
Length	310 mm
twisting tool diameter	30 mm
Colour	Black

### REHAU BKT form



Illustration 9-15: REHAU BKT form

The REHAU BKT form made of impact resistant polyethylene is used for leading the connection lines of the REHAU BKT modules out of the concrete ceiling. It can be used as an individual form and also as multiple form via moulded connectors.

Material	Polyethylene
Length	400 mm
Width	50 mm
Height	60 mm
Pipe diameter	17 x 2.0 / 20 x 2.0

### REHAU cable ties



Illustration 9-16: REHAU cable ties

The REHAU cable tie made of polyamide is used for the attachment of the REHAU BKT modules to the reinforcement and for securing to the REHAU BKT spacers. It can also be used with the REHAU concrete core temperature control on site.

Material	Polyamide
Length	178 mm
Width	4.8 mm
Colour	Natural

### REHAU RAUFIX rail



Illustration 9-17: REHAU RAUFIX rail

The REHAU RAUFIX rail, without barbs, made of polypropylene is used for pipe securing of concrete core temperature control on pre-fabricated concrete parts. Pipe installation can be executed in either single- or double-meander style. An installation spacing of 5 cm and multiples thereof are possible.

Material	Polypropylene
Pipe diameter	17 x 2.0 / 20 x 2.0
Length	1 m (can be coupled)
Colour	Black

### REHAU dummy plug



Illustration 9-18: REHAU Dummy plug

The REHAU dummy plug is used to seal the pipe ends and is assembled to the REHAU RAUTHERM S pipe with the REHAU compression-sleeve joint.

Material	Brass
Pipe diameter	17 x 2.0 / 20 x 2.0

**REHAU protective sleeve**



*Illustration 9-19: REHAU Protective sleeve*

The REHAU protective sleeve made of polyethylene is used for expansion joints. It can also be used for leading connection lines through from the concrete ceiling to above the ceiling.

Material	Polypropylene
Pipe diameter	17 x 2.0 / 20 x 2.0
Length	1 m (can be coupled)
Colour	Black

**REHAU compressed-air pipe cap**



*Illustration 9-20: REHAU Compressed-air pipe cap*

The REHAU compressed-air pipe cap is used for pressure tests at the construction site and is assembled to the REHAU BKT modules with the REHAU compression sleeve joint at the factory. With the REHAU concrete core temperature control installed on site, it is assembled by the customer.

Material	Brass
Pipe diameter	17 x 2.0 / 20 x 2.0
Length	59/58 mm

**REHAU manometer**



*Illustration 9-21: REHAU Manometer*

The REHAU manometer is used in conjunction with the REHAU compressed-air plug nipple during pressure test at the construction site. The pressure tests are to be performed before concreting and after inspection of the lower boarding level at the construction site.

Material	Steel
Length	40 mm
Connection	R 1/4"

**REHAU compressed-air plug nipple**



*Illustration 9-22: REHAU Compressed-air plug nipple*

The REHAU compressed-air plug nipple is used in conjunction with the REHAU manometer during pressure test at the construction site. The pressure tests are to be performed before concreting and after inspection of the lower boarding level at the construction site.

Material	Brass
Length	33 mm
Connection	R <sub>p</sub> 1/4"



### REHAU compression sleeve



Illustration 9-23: REHAU Compression sleeve

The REHAU compression sleeve made of galvanized brass is clamped onto the fitting support body with the RAUTHERM S pipe in case of the REHAU compression sleeve joint. This results in a permanently sealed connection according to DIN 18380 (VOB).

Material	Galvanised brass
Pipe diameter	17 x 2.0 / 20 x 2.0
Length	20 mm

### REHAU coupler



Illustration 9-24: REHAU Coupler

The REHAU coupler is used to connect pipe ends with the REHAU concrete core temperature control installed on site. In conjunction with the REHAU compression sleeve, a permanently sealed connection according to DIN 18380 (VOB) is possible.


Material	Galvanised brass
Pipe diameter	17 x 2.0 / 20 x 2.0
Length	53 mm

### REHAU BKT protective tape



Illustration 9-25: REHAU Protective tape

The REHAU protective tape made of soft polyvinyl chloride is used to protect the REHAU compression sleeve joint from direct contact with concrete according to DIN 18560.

 Each REHAU compression sleeve joint in concrete must be sheathed with REHAU protective tape according to DIN 18560.

Material	Soft PVC
Tape width	50 mm
Tape length	33 m
Colour	Red

#### Technical data

Length	4.0 m
Width	1.0 m
Height	2.2 m
Material	Painted steel
Weight	235 kg



#### Caution!

REHAU BKT transport frames may only be transported with the load secured.



Illustration 9-26: REHAU BKT transport frame

### REHAU BKT transport frame

The REHAU BKT modules are transported on REHAU transport frames directly to the construction site. They are hung in multiple layers on the support arms and secured there. The transport frames are suitable for customer-side crane transport and are equipped with a fork lift attachment. Once unloading is complete, the REHAU transport frames can be consolidated and returned together.

The REHAU transport frames feature the highest possible level of security and correspond with the EC Machine Directive 89/392/ECC, Appendix II A and the EC Machine Directive 93/44/ECC taking EN 292 DIN 15018, Parts 1 and 2 into account. In addition, they are subject to an annual inspection.

## 9.4 Assembly at the construction site

**i** The REHAU concrete core temperature control is assembled by the professional personnel of the company performing the work.

1. Assemble REHAU forms.
  - Level REHAU forms on the lower form and secure with the supplied nails according to the dimensioned assembly plans.
  - Have customer install lower reinforcement.

**i** The assembly plans refer to the reference axes/points of the building.

2. Assemble REHAU BKT S snakes.
  - Set up REHAU BKT S snakes on the boarding.
  - Secure REHAU BKT S snakes to the lower reinforcement with REHAU BKT pipe grids.
3. Assemble REHAU BKT modules.
  - Align REHAU BKT modules on the REHAU BKT S snakes and secure them.
  - Install and secure connection lines.
  - Apply a test pressure of 6 bar at the construction site.
  - Fully insert connection lines into the REHAU forms and secure them.

4. Perform pressure tests.
  - Perform visual inspection.
  - Carry out first pressure test with 6 bar compressed air.
  - Fully insert connection lines into the REHAU forms and secure them.
  - Monitor concreting.
  - Perform the second pressure test after inspection of the lower boarding level.

**i** On-site assembly of REHAU BKT modules corresponding to the assembly of an industrial underfloor heating system.

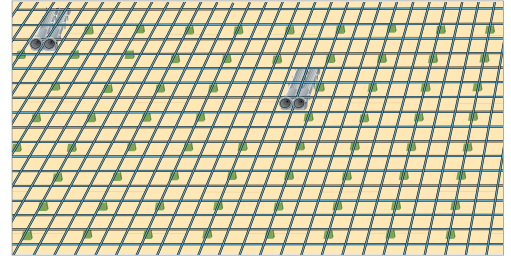


Illustration 9-27: Step 1 - Assemble REHAU forms

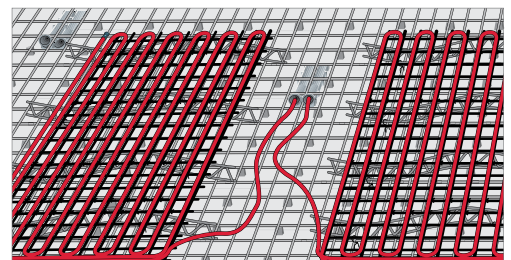


Illustration 9-28: Step 2 - Assemble REHAU BKT S snakes

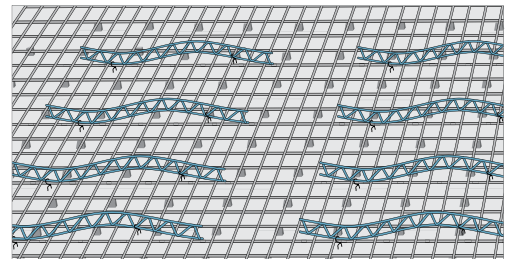


Illustration 9-29: Step 3 - Assemble REHAU BKT modules

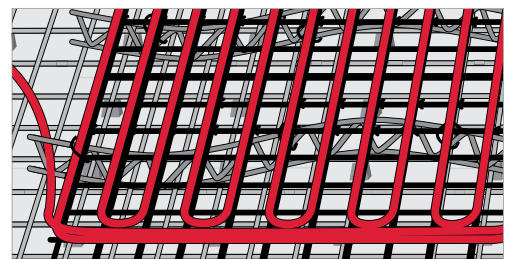


Illustration 9-30: Step 4 - Perform pressure tests

## 9.5 Analysis of two system variants



In order to make a comprehensive assessment of the functioning of the concrete core temperature control in a building during heating and cooling, it makes sense to perform a thermal simulation and a current simulation due to inactivity of the system.

The astonishingly simple structure of the concrete core temperature control and the attainable cooling and heating capacity make possible the implementation of a variety of innovative building-related system variants.

A building simulation in the example of a fictitious reference project typical for a large number of office and administration buildings in terms of its usage and size shows the functioning of the following concrete core temperature control system variants when heating and cooling.

- Concrete core temperature control system variants with static heating surfaces and supporting climate control unit
- Concrete core temperature control system variants with static heating surfaces and window ventilation

The concrete core temperature control system variants are analysed with the following points in mind:

- Load-surge behaviour
- Air temperature distribution
- Air current distribution
- Comfort
- Cost effectiveness

Due to the system-related inactivity of this technology, the behaviour in case of sudden load changes is of special interest for the evaluation of the concrete core temperature control system variants.

To cases are examined:

- Cooling: Doubling of the internal loads with cooling
- Heating: Sudden decrease in the heat requirement in winter

### Characteristic comfort values

In addition to a variety of factors, the thermal comfort significantly affects the feeling of wellness in occupied areas.

A room air condition can be called comfortable if the following marginal conditions are fulfilled:

- Operative room temperature:
  - $T_{op \text{ summer}}: \leq +27 \text{ } ^\circ\text{C}$
  - $T_{op \text{ winter}}: = +21 \text{ } ^\circ\text{C}$
- Room air speed:
  - $w_{+27^\circ\text{C}}: \leq 0.30 \text{ m/s}$
  - $w_{+21^\circ\text{C}}: \leq 0.16 \text{ m/s}$
- Temperature gradient:  $TG \leq 2\text{K}$
- Relative humidity:  $30 \% \leq \phi \leq 65 \%$
- Absolute humidity:  $x \leq 11.5 \text{ g/kg}$

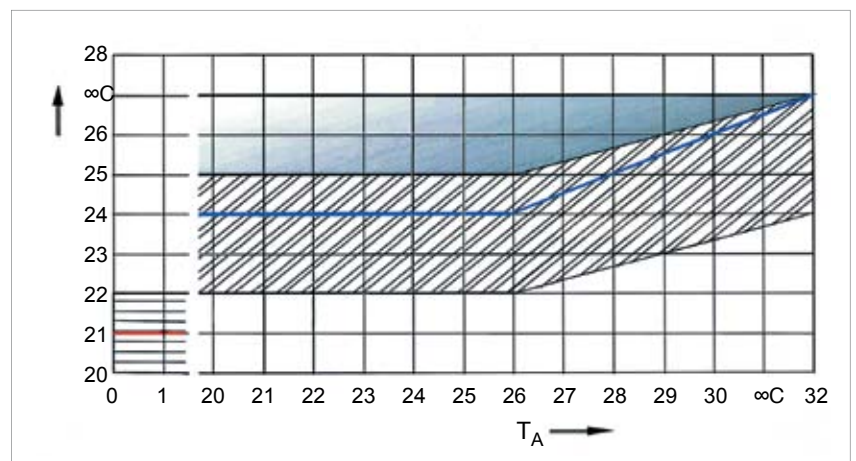



Illustration 9-31: Setpoint values of the operative room temperatures according to DIN 1946

- Setpoint value progression during heating
- Common setpoint value progression for climate control units during cooling
- /// Spectrum of setpoint values according to DIN 1946 T2
- Tolerance range for concrete core temperature control
- $T_A$  Outside temperature

## Operative room temperature

 The operative room temperature or dry resulting temperature is formed from the average value of the room air temperature and the radiative temperature of the enclosing surfaces of the room.


It takes into account that the apparent temperature does not only depend on the room air temperature, but also the radiative exchange between people and surfaces enclosing the room. DIN 1946, Part 2, specifies a spectrum of comfortable operative room temperatures depending on the outside temperature (see Illustration 7-31).

While the operative room air temperatures can be between +22 °C and +25 °C with an outside temperature of +26 °C, room air conditions up to +27 °C are permissible with outside air conditions of +32 °C.

In comparison to dynamic climate systems, the room-based adjustment of an exact outside temperature-dependent temperature setpoint with the concrete core temperature control is not possible.

The following simulations, however, illustrate that comfortable room air conditions can be realised with the concrete core temperature control during heating and cooling if it was designed properly.

### 9.5.1 Marginal conditions for cooling

 The marginal conditions for heating can be requested at a REHAU sales office in your area.

#### Thermal simulation

A successive five days of warm summer with increasing temperatures up to a maximum value of +32.5 °C is specified as a weather condition. On the first and second days, the room is used in a way which would warrant normal operation. The inner cooling loads are doubled in the middle of the period. Instead of 1090 W, 2180 W are suddenly released.

This can occur, for example, when an additional eight people and an overhead projector are present in the room due to a meeting. An uncommon, but realistic, extreme case is assumed here. The concrete core temperature control is strained to the extreme during cooling.

#### Current simulation

The current simulation at the defined reference room was performed in an exemplary fashion under the following conditions for the hot fifth day of the thermal simulation.

- Day: 3 August
- Time: 4 p.m.
- Toutside: +32.5 °C
- Top setpoint: +27 °C
- Sky: clear

#### Reference building

The entire building is occupied by one building user. There is no basement.

Building data:

- Location: Essen, Germany
- Cooling load zone: 3 according to VDI 2078
- Tmax outside: +32 °C
- Tmin outside: -10 °C according to DIN 4701
- Long side: north/south
- Short side: east/west
- Storeys: 4
- Useful area: 1,340 m<sup>2</sup>
- Building length: 33.5 m
- Building width: 13.9 m
- Building height: 13.5 m
- Building weight: 876 kg/m<sup>2</sup> heavy construction type
- A/V ratio: 0.352 m<sup>2</sup>/m<sup>3</sup>

#### Reference room

A defined standard room on a mezzanine storey facing south is examined in the reference building. Supporting ceilings and outer walls are constructed as solid concrete parts. Partition walls are lightweight construction gypsum plasterboards with mineral fibre

insulation.

Room data:

- Floor space: 30.4 m<sup>2</sup>
- Clearance: 3.0 m
- Height between floors: 3.3 m
- Room volume: 90.7 m<sup>3</sup>
- Ceilings: 28 cm concrete, 7 cm screed, 1 cm dressing plates
- Inner walls: lightweight construction
- Glazing g: 0.62

- Sun protection z: 0.25
- Usage time: 8 a.m. to 6 p.m.
- Population density: 1/10 m<sup>2</sup>
- Thermal requirements according to DIN 4701:1007 W 31.1 W/m<sup>2</sup>
- Cooling load according to VDI 2078: 1656 W 54.5 W/m<sup>2</sup>

Determination of the cooling load occurred according to VDI 2078 and parallel to the simulation program TRNSYS for a fair day in July.

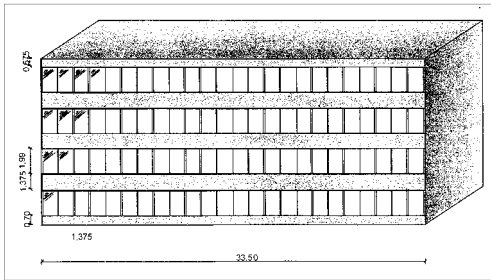


Illustration 9-32: Reference building

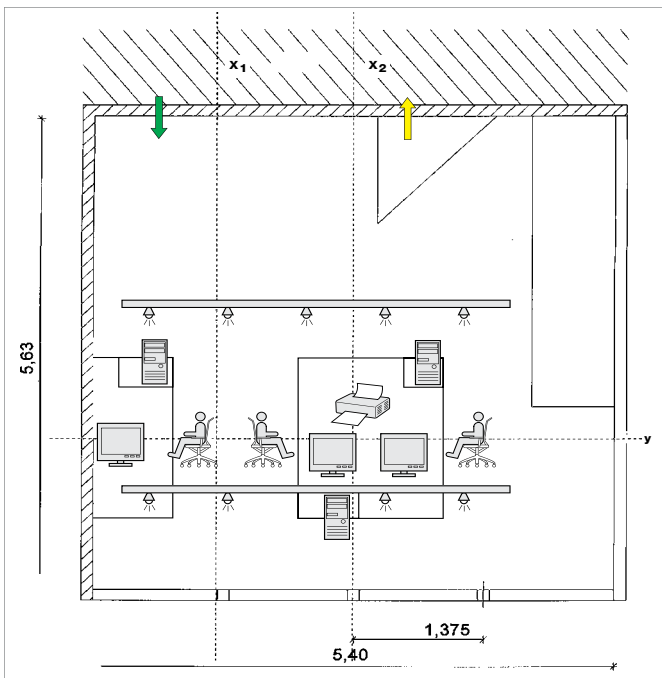


Illustration 9-33: Ground plot reference room

### 9.5.2 Concrete core temperature control system variants with static heating surfaces and supporting climate control unit

The combination of the concrete core temperature control, a supporting climate control unit and static heating surfaces optimises the following factors:

- dynamic system behaviour
- humidity control

The climate control unit is only in operation while the building is used, i.e. 8 a.m. to 6 p.m. The supply air is brought into the room via source-air outlets near the floor. Source-air systems are suitable for use in conjunction with concrete core temperature control systems due to their draught-free air flow.

The exhaust air is sucked out of the room via below ceiling ventilation grates in the hallway separation wall. The storey distribution lines for concrete core temperature control and the climate control unit are found in the empty space above suspended ceilings in the hallways. Activation of the solid concrete ceilings therefore no longer makes sense in these areas.

### Concrete core temperature control

The surface-related data refers to the active concrete core temperature control area of the reference room:

- Active area: 21.3 m<sup>2</sup>
- Degree of occupation: 70 %
- RAUTHERM S: 17 x 2.0 mm
- Pipe position: neutral zone
- Installation pipe spacing: 15 cm
- Installation type: DM
- Troom: +26 °C
- Cooling capacity ceiling: 36 W/m<sup>2</sup>
- Cooling capacity floor: 14 W/m<sup>2</sup>
- Tflow, cooling: +17 °C
- Troom: +21 °C
- Heating capacity ceiling: 8 W/m<sup>2</sup>
- Heating capacity floor: 5 W/m<sup>2</sup>
- Tflow, heating: +25 °C

### Supporting full climate control unit

- Air exchange: once every 2.5 h only outsideair
- Tsupply air, cooling: + 20 °C constant
- Tsupply air, heating: +21 °C constant
- Air treatment:
  - humidifying
  - dehumidifying
  - heating
  - cooling

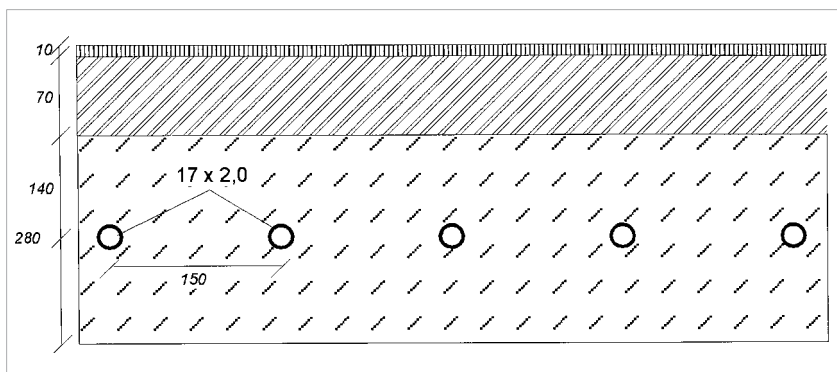


Illustration 9-35: Ceiling structure concrete core temperature control cross section

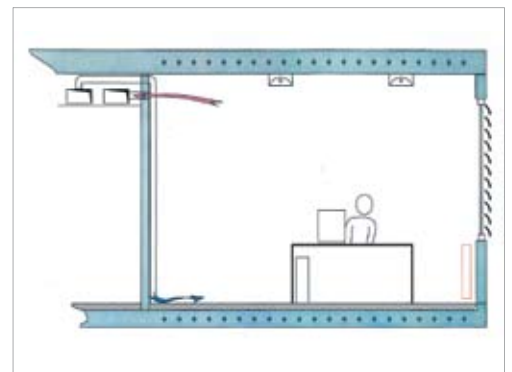


Illustration 9-34 Reference room cross section  
 Internal loads: three people, three PCs at 150 W each, one printer at 50 W, illumination at 365 W, Glazing:  $g = 0.62$   
 Sun protection:  $z = 0.25$



## Results of the thermal simulation for cooling



- During normal operation, comfortable room temperatures of +24 °C to +25 °C are reached.
- The maximum operative room temperature with a load surge is +26.5 °C.
- To reach the fixed daily initial temperature of +22 °C, the concrete core must be partially cooled during the night.

### Room temperatures

The maximum room temperatures of +24 to +25 °C of the first and second days are at the upper limit of the setpoint value range during the time of usage according to DIN 1946.

With a load surge on the third day, the setpoint value of the operative room temperature is only exceeded by 1.5 K to 2.0 K according to DIN 1946.

The maximum room temperature with a load surge is +26.5 °C. The tolerance limit of the concrete core temperature control of +27 °C is not exceeded.

During normal operation of the hot fourth and fifth days, the effects of the load surge have already abated. The room temperatures of approx. +25 °C lie in the setpoint value range. The fixed daily initial temperature of the system of +22 °C lies at the lower limit of the setpoint value range at the beginning of the time of usage.

### Output

The “foresighted” control strategy of the concrete core temperature control regulates the operating time of the system so that the daily initial value of +22 °C is reached.

To ensure these comfortable initial conditions every day, only occasional cooling of the concrete core is necessary at night.

Additional heat loads present during the day, e.g. the increased interior cooling loads, are relieved after a delay via the occasional night operation of the concrete core temperature control.

The “foresighted” control of the concrete core temperature control deactivates the active storage system at the right time during the night to avoid under-cooling of the room at the start of the operating time.

The cooling capacity of the supporting climate control unit curbs overshooting of the room temperature with a load surge.

The “self-control effect” of the system leads to varying output of the concrete core temperature control.

A wave-type progression of the cooling capacity of the concrete core temperature control dependent on the room temperature fluctuation is set.

The cooling capacity of the solid component is primarily proportional to the temperature differential.

The short-term increase in output of the concrete core temperature control can be traced back to the increased room temperature.

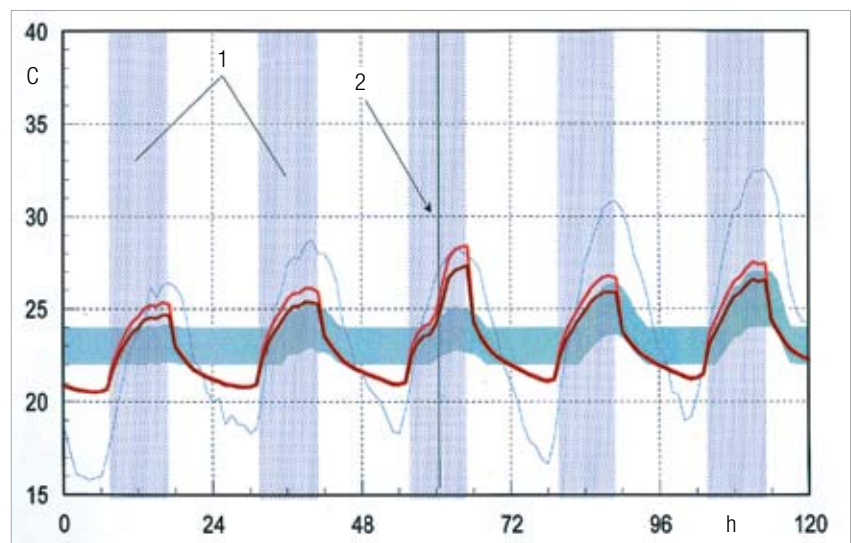


Illustration 9-36: Temperature progressions during cooling over time

- Room air
- Outside air
- Operative temperature
- Setpoint value
- 1 Operating time
- 2 Load surge

**i** The thermal simulation for heating can be requested at a REHAU sales office in your area.

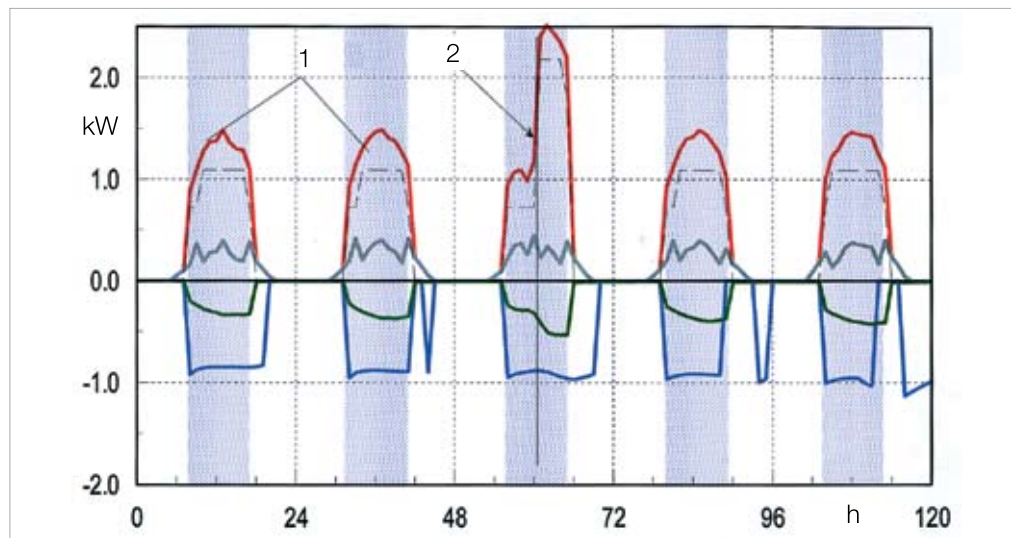


Illustration 9-37: Output progressions during cooling over time

- |   |  |
|---|--|
| <span style="color: blue;">■</span> Sunshine                                | <span style="color: green;">■</span> Ventilation |
| <span style="color: black;">- - -</span> Interior heat loads                | 1 Operating time                                 |
| <span style="color: red;">■</span> Sum of heat loads                        | 2 Load surge                                     |
| <span style="color: blue;">■</span> Concrete core temperature control water |  |

### Results of the current simulation during cooling



- At head height, comfortable operative room temperatures of +24 °C to +26 °C are reached.
- The air speeds in the occupied area of < 0.1 m/s fulfil the comfort criteria.
- The humidity can be regulated by a climate control system.
- A vertical temperature gradient of 4 K is set in the occupied area.

### Room temperatures

Horizontal layers of air which are clearly separate from one another and are characteristic of draught-free underfloor cooling systems are formed. A comfortably cool "sea" of air with room air temperatures between +23 °C and +25 °C forms up to a height of approx. 1 m.

The room air temperatures at head height, i.e. 1.35 m above the ground, lie between +25 °C and +27 °C. The actual apparent operative room temperatures at head height lie between +24 °C and +26 °C. The setpoint value of +27 °C is not exceeded. A layer of air with room air temperatures between +20 °C and +22 °C forms via the air outlet up to the centre of the room near the floor near hallways.

### Surface temperatures

The system reaches the following surface temperatures:

- Floor: +23 °C to +24 °C
- Ceiling: +21 °C to +22 °C

In comparison to cooling ceilings, which have surface temperatures of approx. +17 °C, the risk of under-shooting the dew point is clearly lower with concrete core temperature control.



### Air speeds

The room air speeds in the occupied area up to a height of approx. 1.5 m are  $< 0.1$  m/s and lie clearly under the comfort limit of 0.3 m/s for room air speeds during cooling. Three room air rolls, caused by the interior heat sources (three PCs at the workstations), arise in the reference room.

Warm-air currents arise immediately above these heat sources to the ceiling with air speeds up to 0.25 m/s.

The air ventilation can speed up to 0.2 m/s on the floor near the corridor.

### Temperature gradient

With a vertical temperature gradient of 4 K in the occupied area up to a room height of approx. 1.8 m, the system does not fulfil the comfort requirements in this regard.

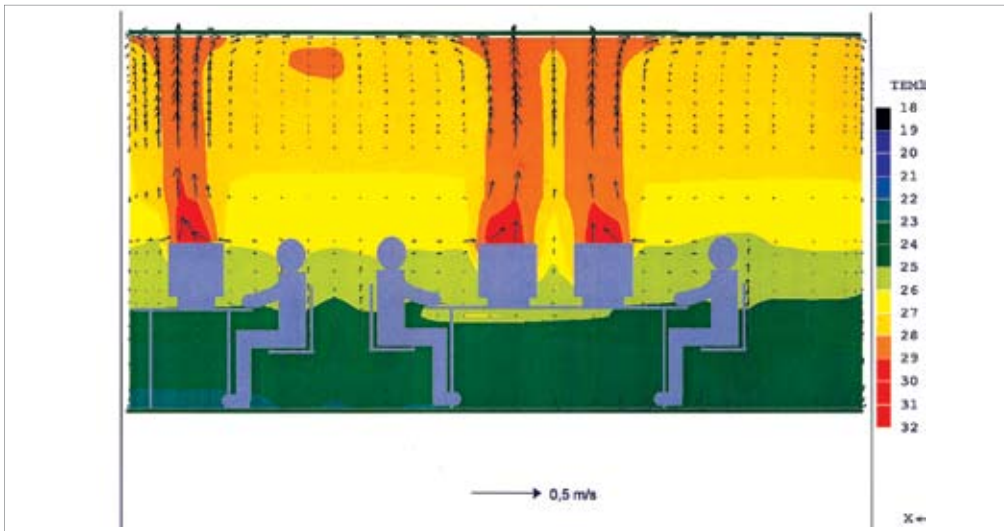


Illustration 9-38: Room air temperatures and air currents during cooling, reference room, over Y (see Illustration 9-33)

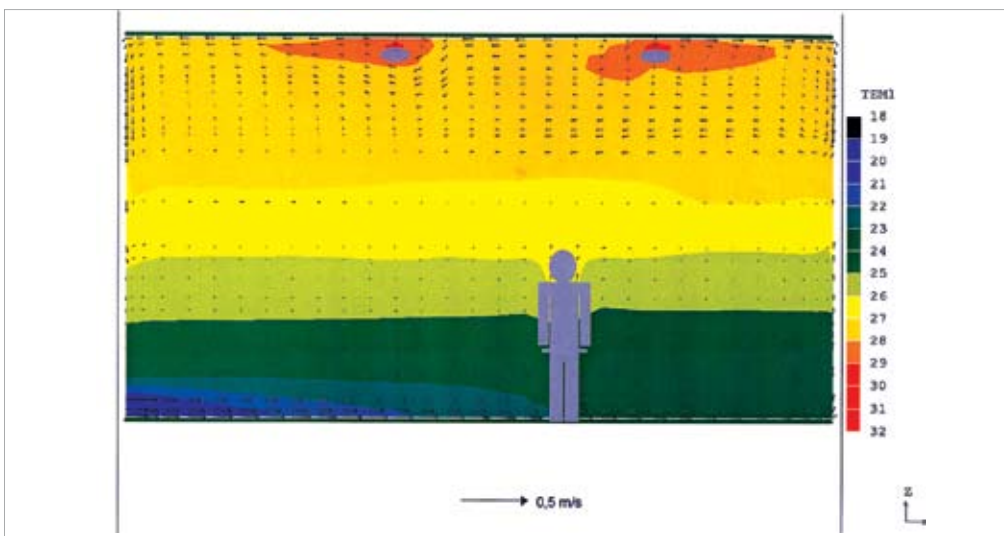


Illustration 9-39: Room air temperatures and air currents during cooling, reference room, over X1 (see Illustration 9-33)



The current simulation during heating can be requested at a REHAU sales office in your area.

### 9.5.3 Concrete core temperature control system variants with static heating surfaces and window ventilation

With this system variant, the entire thermal requirement of the reference room must be covered by combining concrete core temperature control and static heating surfaces.

The following factors are optimised during the winter via conventional radiators:

- Dynamic system behaviour
- Heating during extremely cold periods

The required outside air exchange is implemented as forced ventilation by occasional opening of the windows. Window ventilation only occurs during the operating time of the building. The static heating surfaces are found in the parapet area.

#### Concrete core temperature control

The surface-related data refers to the active concrete core temperature control area of the reference room.

- Active area: 21.3 m<sup>2</sup>
- Degree of occupation: 70 %
- RAUTHERM S: 17 x 2.0 mm
- Pipe position: neutral zone
- Installation pipe spacing: 15 cm
- Installation type: DM

- T<sub>room</sub>: +26 °C
- Cooling cap. ceiling: 36 W/m<sup>2</sup>
- Cooling cap. floor: 14 W/m<sup>2</sup>
- T<sub>flow, cooling</sub>: +17 °C

- T<sub>room</sub>: +21 °C
- Heating cap. ceiling: 19 W/m<sup>2</sup>
- Heating cap. floor: 12 W/m<sup>2</sup>
- T<sub>flow, heating</sub>: +28 °C

#### Window ventilation

- Air exchange: once every 1.25 h outside air only
- T<sub>supply air, winter</sub>: variable to -14 °C
- T<sub>supply air, summer</sub>: variable up to +32.5 °C

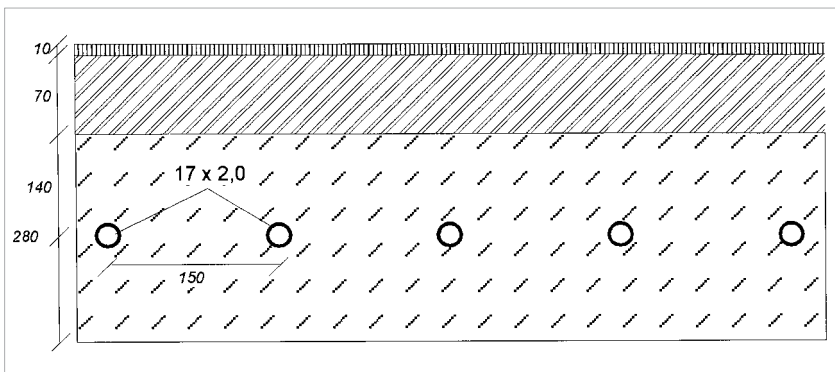


Illustration 9-41: Concrete core temperature control ceiling structure cross section

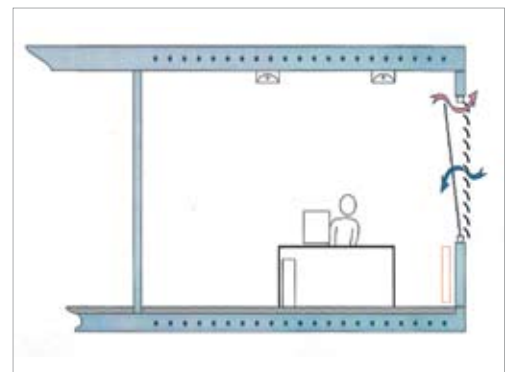


Illustration 9-40 Reference room cross section  
Internal loads: three people, three PCs at 150 W each, one printer at 50 W, illumination at 365 W, Glazing: g = 0.62  
Sun protection: z = 0.25

**Results of the thermal simulation for cooling**



- The operative room temperatures from +24 °C to +26 °C are at the upper limit of the setpoint value range during normal operation.
- The maximum operative room temperature with a load surge is +27.5 °C.
- In extreme situations, 24 hour operation of the concrete core temperature control is necessary in order to achieve the initial temperature of the following day.

**Room temperatures**

The maximum room temperatures of the first and second days of average warmth, +24.5 °C and +25.5 °C, lie within the setpoint value range.

The setpoint value according to DIN 1946, Part 2, is exceeded by 2.5 K with a load surge. The maximum room temperature of +27.5 °C lies 0.5 K over the tolerance limit of the concrete core temperature control. During normal operation on the fourth and fifth hot days of the weather period, the effects of the load surge have already abated. The maximum room temperatures, +26 °C and +27 °C, are under the permissible setpoint values.

The fixed daily initial temperature of the system of +22 °C lies at the lower limit of the setpoint value range at the beginning of the time of usage.

**Output**

The anticipative control strategy of the concrete core temperature control strives to reach the daily initial value.

To ensure comfortable initial temperatures, cooling of the concrete core during the nights of the first and second days is necessary.

The heat loads which take effect in the room over the course of a day are compensated for via extended operation of the concrete core temperature control over the operating time. The anticipative control of the concrete core temperature control deactivates the active

storage system briefly during the nights of the first and second days of average warmth to avoid under-cooling of the room at the start of the operating time.

To ensure the temperature ratios on the hot fourth and fifth days of the weather period, however, 24 hour operation of the concrete core temperature control is required.

The heat loads can only be compensated for via continuous 24 hour operation of the active storage system via the load surge on the third day and the increased outside temperatures of the fourth and fifth days. The active feedback of the system leads to varying capacity of the concrete core temperature control.

A wave-type progression of the cooling capacity of the concrete core temperature control dependent on the room temperature fluctuation is set.

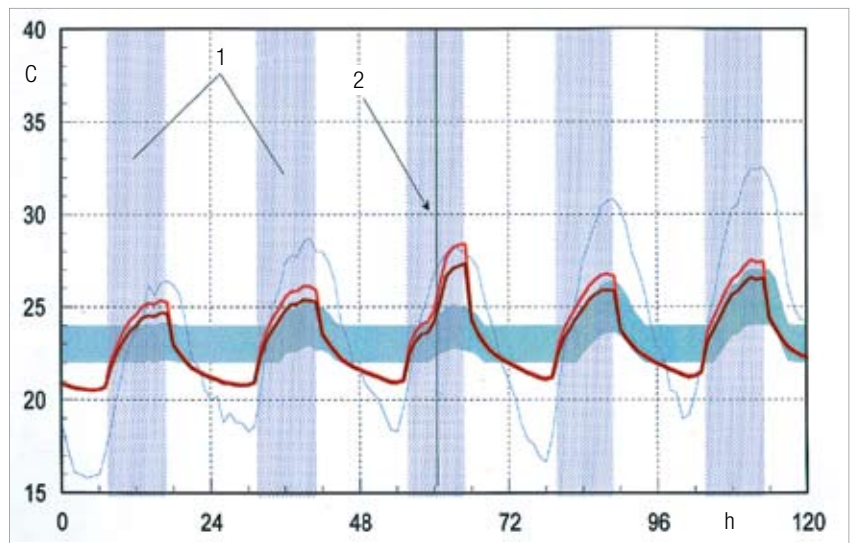


Illustration 9-42: Temperature progressions during cooling over time

- Room air
- Outside air
- Operative temperature
- Setpoint value
- 1 Operating time
- 2 Load surge



The thermal simulation for heating can be requested at a REHAU sales office in your area.

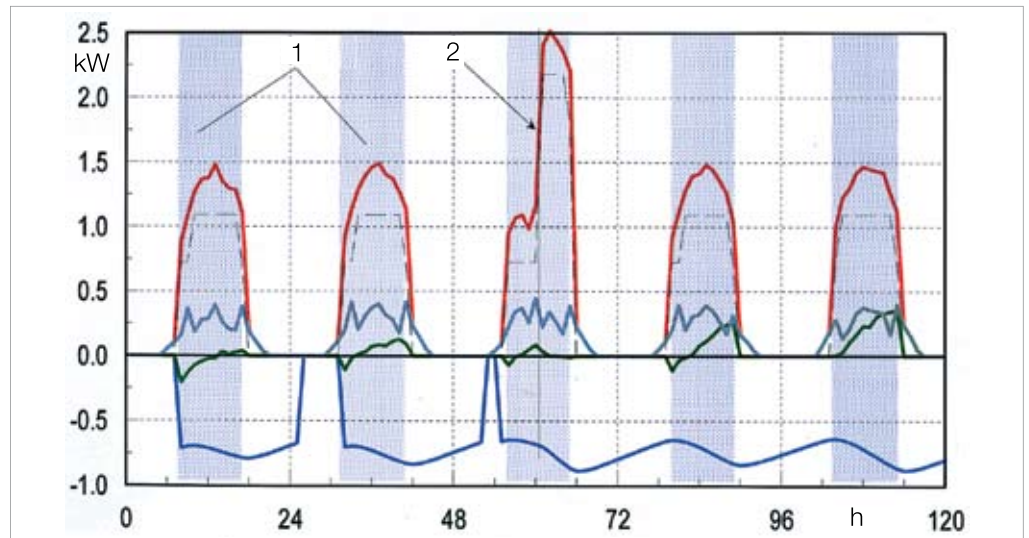


Illustration 9-43: Output progressions during cooling over time

- Sunshine
- Interior heat loads
- Sum of heat loads
- Concrete core temperature control water
- Ventilation
- 1 Operating time
- 2 Load surge

### Results of the current simulation during cooling



- The air speeds in the occupied area of  $< 0.1$  m/s fulfil the comfort criteria.
- The operative room temperatures at head height lie between  $+27$  °C and  $+29$  °C.
- A vertical room temperature gradient of 5 K is set in the occupied area.
- The humidity cannot be regulated via window ventilation.

### Room temperatures

Horizontal layers of air which are clearly separate from one another and are characteristic of draught-free underfloor heating systems are formed.

A layer of air from  $+24$  °C to  $+26$  °C forms up to approx. 7 cm above the floor.

The room air temperatures at head height, i.e. 1.35 m

above the ground, assume values of  $+28$  °C to  $+30$  °C.

The apparent temperatures at head height in the case of seated activity lie at an operative temperature between  $+27$  °C and  $+29$  °C. The setpoint value according to DIN 1946 is exceeded by 2 K in some places. From room heights of approx. 2 m, room temperatures  $> +30$  °C are set.

### Surface temperatures

The system reaches the following surface temperatures:

Floor:  $+22$  °C to  $+23$  °C

Ceiling:  $+20$  °C to  $+21$  °C

In comparison to cooling ceilings, which have surface temperatures of approx.  $+17$  °C, the risk of under-shooting the dew point is clearly lower with concrete core temperature control.

### Air speeds

The room air speeds in the occupied area up to a height of approx. 1.5 m are  $< 0.1$  m/s and lie clearly under the comfort limit of 0.3 m/s for room air speeds during cooling.

Three room air rolls caused by internal heat sources arise in the reference room.

Uncritical warm-air currents arise immediately above these heat sources to the ceiling with air speeds up to 0.35 m/s.

The influence of the opened window can be detected in the upper corner area of the reference room near the façade. Outside air with a temperature of  $+32.5$  °C flows into the room, cools at the ceiling and forms a room air roll there.

### Temperature gradient

With a vertical room temperature gradient of approx. 5.0 K in the occupied area up to a room height of approx. 1.5 m, the system does not fulfil the comfort requirements.

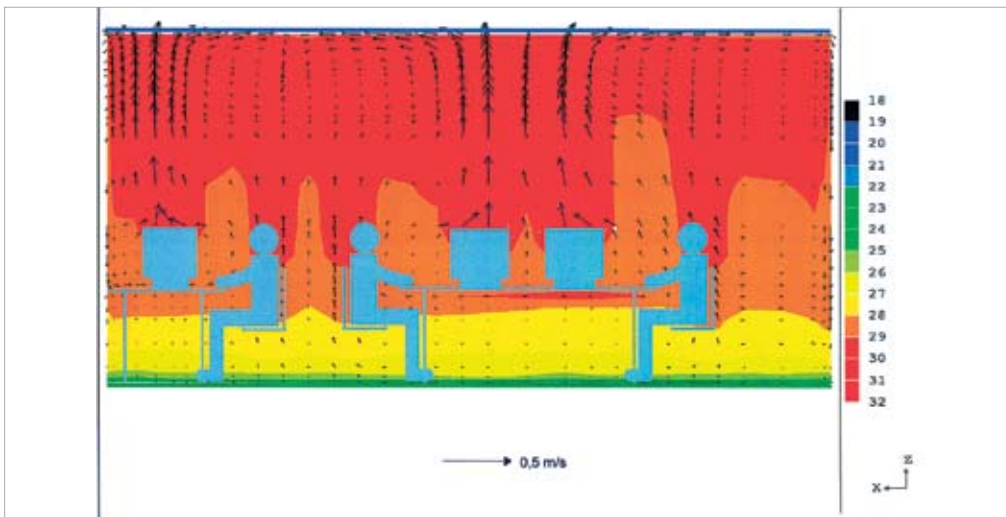


Illustration 9-44: Room air temperatures and air currents during cooling, reference room, over Y (see Illustration 9-33)

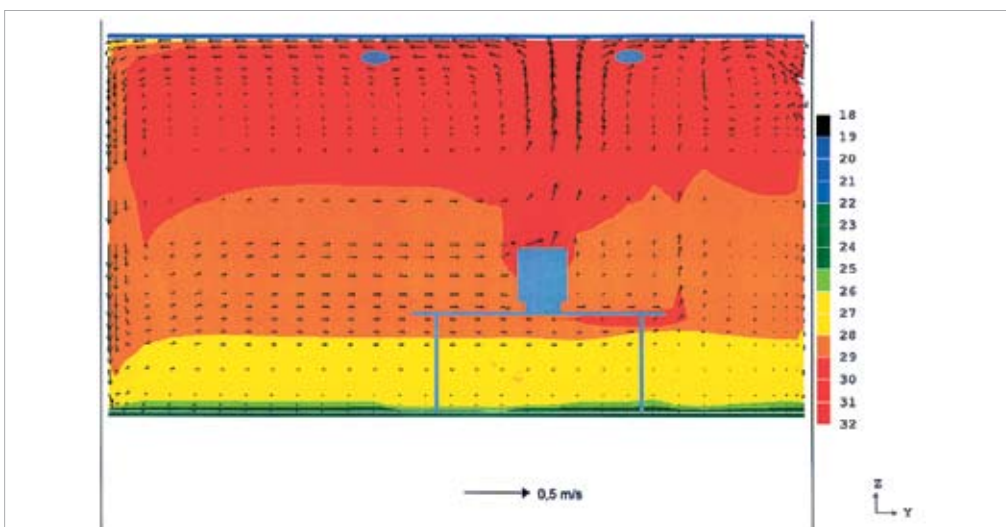


Illustration 9-45: Room air temperatures and air currents during cooling, reference room, over X2 (see Illustration 9-33)



The current simulation during heating can be requested at a REHAU sales office in your area.



## 9.6 Requirements



Effective use of the concrete core temperature control is aided by the following factors:

- Even load profile during heating and cooling
- Thermal conductivity coefficient of the window  
 $U_{\text{window}}$ : 1.0 to 1.3 W/m<sup>2</sup>K
- Sun protection admission factor  $b_{\text{Sun}}$  protection: 0.15 to 0.20
- Standard heat load  
 $\Phi_{\text{HL}}$  DIN EN 12831: 40 to 50 W/m<sup>2</sup>
- Cooling load  
 $Q_{\text{K VDI 2078}}$ : up to 60 W/m<sup>2</sup>
- Raw ceiling thickness (material: standard concrete):  
 $s_{\text{raw ceiling}}$ : 25 to 30 cm
- No suspended closed ceilings in activated zones
- Flexible room temperatures on extremely hot days are permitted
  - with system variants with supporting climate control unit up to approx. +27 °C
  - with system variants with window ventilation up to approx. +29 °C
- Homogenous usage
- consistent building user
- consistent type of usage
- No individual room control, but there is building zone division
- Operating parameters
  - $T_{\text{flow, heating}}$ : +27 °C to +29 °C
  - $T_{\text{flow, cooling}}$ : +16 °C to +19 °C

### 9.6.1 Constructional requirements

A balanced and even load profile progression during heating and cooling is a basic requirement for effective use of concrete core temperature control. Internal loads can be viewed as a constant during normal operation of an office building. The load fluctuations are caused by meteorological influences. These disturbances can be reduced considerably by optimising the building shell at the

- Windows
- Sun protection
- Transmission heat protection

A considerable contribution to the reduction of transmission heat requirement and thus smoothing of the load progression is achieved with thermal conductivity coefficients of window surfaces between 1.0 and 1.3 W/m<sup>2</sup>K due to the large amount of glazing in office buildings.

The summer disturbance of sunshine in the room can be reduced up to 85 % via outside sun protection set-ups with an average admission factor  $b$  from 0.15 to 0.20. Outside metal blinds with an aperture angle of 45° have a  $b$  factor of 0.15. With indoor sun protection measures, e.g. fabric blinds, this screening effect cannot be achieved.

By improving the transmission heat protection of outside components, a thermal requirement of modern office and administration buildings between 40 W/m<sup>2</sup> and 50

W/m<sup>2</sup> should be realised. With an average heating capacity of the concrete core temperature control of 25 W/m<sup>2</sup> to 30 W/m<sup>2</sup>, depending on the ceiling structure, the amount of coverage of the concrete core temperature control can reach up to 75 % of the thermal requirement.

Office buildings with normal usage have cooling loads of up to 60 W/m<sup>2</sup>. With an average cooling capacity of the concrete core temperature control of 35 W/m<sup>2</sup> to 50 W/m<sup>2</sup>, depending on the ceiling structure, the amount of coverage of the concrete core temperature control can reach up to 80 % of the cooling load.

The best storage effects of concrete core temperature control can be achieved with a raw ceiling thickness of 25 cm to 30 cm.

To minimise vapour diffusion in the solid component, activated concrete ceilings made of normal concrete are to be made with a density between 2.0 t/m<sup>3</sup> and 2.8 t/m<sup>3</sup> according to DIN 1045.

In areas of activated raw ceilings, the installation of suspended closed ceilings is not permissible. The assembly of open suspended ceiling grids must be scrutinised and evaluated thoroughly for each individual case.

Acoustic measures in large-size offices are recommended. Sound-absorbent suspended ceilings are not permissible in activated zones. Large-size offices and halls, in particular, must be checked to determine whether optimisation of the room acoustics is required.

### 9.6.2 Building usage

The building user must permit slipping of the operative room temperature in the occupied area during cooling on extremely hot clear days with high outside temperatures of approx. +32 °C. Optimum marginal conditions for a system concept with concrete core temperature control are a given with homogeneously uniform usage of the building structure. The uniform type of usage of a building, e.g. only sales offices or only office buildings, has a positive effect on a uniform load progression. System concepts with concrete core temperature control in buildings with different users on respective storeys can also be implemented. A well-founded explanation of the heating cost charges and the zone division is already required in the planning phase, however.

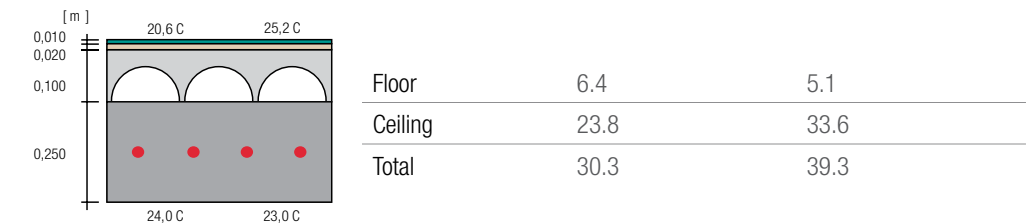
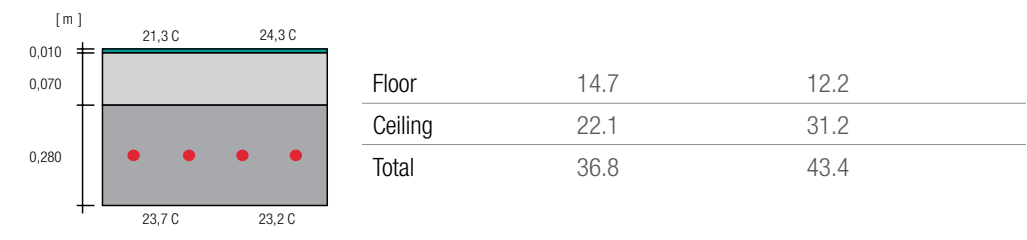
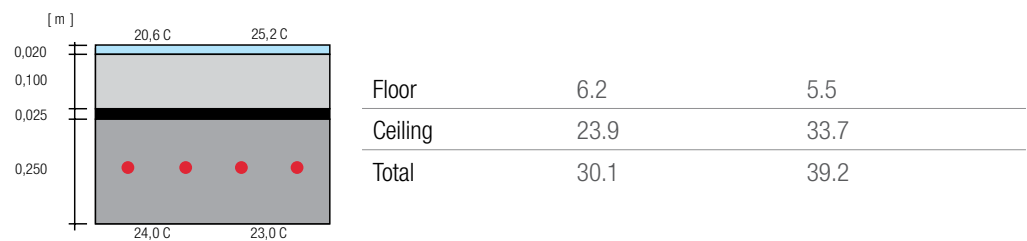
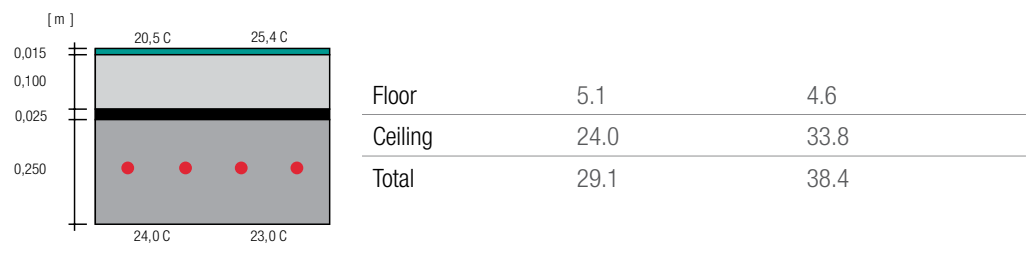
### 9.6.3 Building technology

Individual room control, as it is used with cooling ceiling systems, is not possible due to the system inactivity of concrete core temperature control. The division of the building structure in coordinated control zones with uniform load progressions is possible, however. When dividing up a building structure into north and south zones, these sections can be loaded with different flow temperatures and mass flows.

By selecting the suitable flow temperature level, major overshooting of the room temperature can be prevented during heating. To prevent the loss of condensation water on the surfaces of the activated components during cooling, the flow temperature level in summer may not be selected under +16 °C.

### 9.7 Output

Ceiling structure	Area	Heating	Cooling
		$T_{\text{room}}: 20\text{ °C}$	$T_{\text{room}}: 26\text{ °C}$
		$T_{\text{front}}: 28\text{ °C}$	$T_{\text{front}}: 18\text{ °C}$
		$T_{\text{back}}: 25\text{ °C}$	$T_{\text{back}}: 21\text{ °C}$



Average static output in  $W/m^2$  (active surfaces)

Carpet	Insulation	Concrete
Tiles	Screed	RAUTHERM S pipe 17 x 2.0 VA15
Wood panel	Double floor	

### 9.7.1 Hydraulic connection variants

**i** Hydraulic balancing of the concrete core temperature control circuits and the entire pipe network is required with each connection variant.

#### Manifold connection

The connection of the REHAU concrete core temperature control can be connected via concrete core temperature control manifold

to the pipe network of the manifold lines in the same manner as with REHAU floor heating and cooling. Ball valves and control valves are recommended for cut-off and adjustment.

- The following is to be taken into account during the design phase:
- max. pressure loss of 300 mbar per concrete core temperature control circuit
  - concrete core temperature control circuits of almost the same size

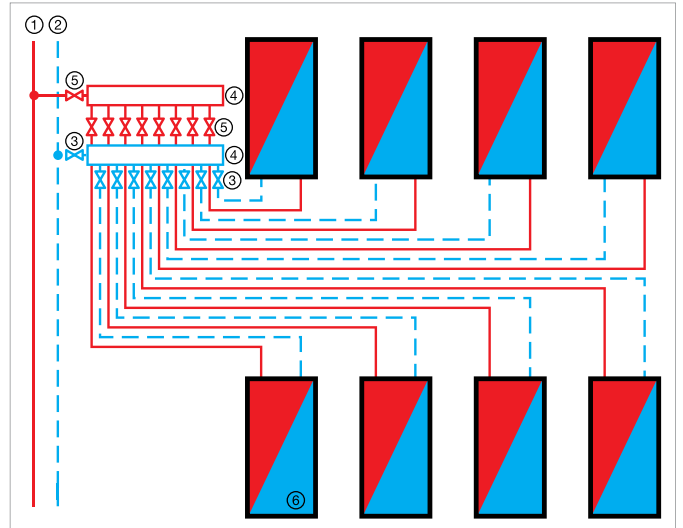


Illustration 9-46: Schematic representation of the manifold connection

- |   |                           |   |                                     |
|---|---------------------------|---|-------------------------------------|
| 1 | Flow                      | 4 | Distribution header                 |
| 2 | Return                    | 5 | Cut-off valve                       |
| 3 | Control and cut-off valve | 6 | Concrete core temp. control circuit |

#### Two-line system using the Tichelmann principle

Each concrete core temperature control circuit is connected directly to the manifold lines with a two-line system. Ball valves and control valves which can be emptied are recommended for cut-off, emptying and adjustment.

Almost completely uniform pressure loss is achieved via pipe installation of the manifold lines with the Tichelmann principle.

- The following is to be taken into account during the design phase:
- max. pressure loss of 300 mbar per concrete core temperature control circuit
  - concrete core temperature control circuits of almost the same size

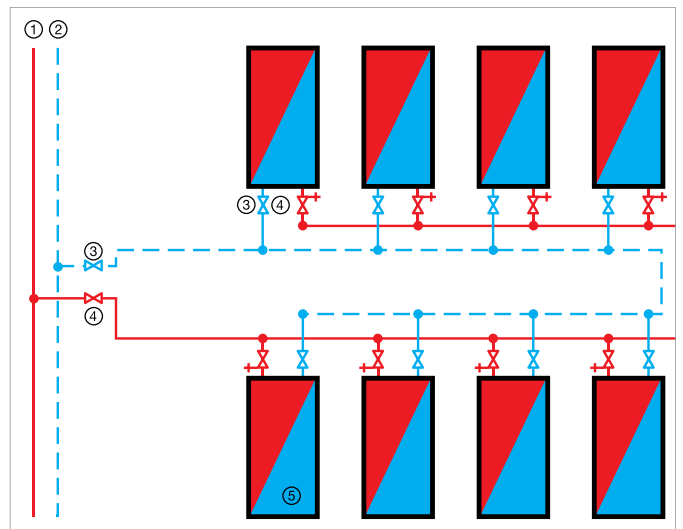


Illustration 9-47: Schematic representation of a two-line system

- |   |                           |   |                                     |
|---|---------------------------|---|-------------------------------------|
| 1 | Flow                      | 4 | Cut-off valve                       |
| 2 | Return                    | 5 | Concrete core temp. control circuit |
| 3 | Control and cut-off valve |   |                                     |



### Three-line system

To ensure greater flexibility of the concrete core temperature control depending on the required cooling and heating load, the three-line system is used. Here, you can switch between two different flow temperature levels for each concrete core temperature control with a

3-way valve. The system has a common return line.

The following is to be taken into account during the design phase:

- max. pressure loss of 300 mbar per concrete core temperature control circuit
- concrete core temperature control circuits of almost the same size

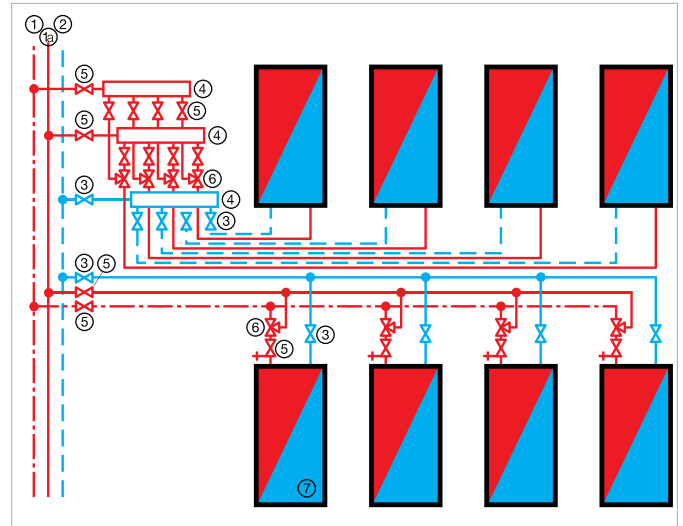


Illustration 9-48: Schematic representation of a three-line system

- |    |                           |   |                                     |
|----|---------------------------|---|-------------------------------------|
| 1  | Flow 1                    | 4 | Distribution header                 |
| 1a | Flow 2                    | 5 | Cut-off valve                       |
| 2  | Return                    | 6 | 3-way valve                         |
| 3  | Control and cut-off valve | 7 | Concrete core temp. control circuit |

### 10.1 REHAU industrial underfloor heating



- Easy and quick assembly
- Comfortably temperature-controlled floor surface
- Even temperature profile
- Minimal air speeds
- No upsetting of dust
- Optimum room arrangement flexibility
- Low operating temperatures
- Suitable for heat pump and solar power systems
- No maintenance costs

#### Components

- REHAU industrial manifold
- REHAU cable tie
- REHAU RAUFIX rail
- REHAU RAILFIX rail
- REHAU retaining pins

#### Pipe dimensions

- RAUTHERM S 20 x 2.0 mm
- RAUTHERM S 25 x 2.3 mm

#### System accessories

- REHAU pipe bend bracket

#### Description

REHAU industrial underfloor heating is assembled in a parallel formation in the concrete floor panel. In the standard solution, the heating pipes are secured to the reinforcement elements with REHAU cable ties and connected to the REHAU industrial manifold.



Illustration 10-1: Underfloor heating in an industrial hall

#### REHAU industrial manifold



Illustration 10-2: REHAU industrial manifold

Manifold and collector are made of brass pipe with bleed valve and KFE valve. Cut-off of each heating circuit is guaranteed via a ball valve (or thermostat valve) in the flow and a fine-control valve (for hydraulic balancing of each heating circuit) in the return. Assembled on robust, galvanised, sound insulated brackets.

#### REHAU cable ties

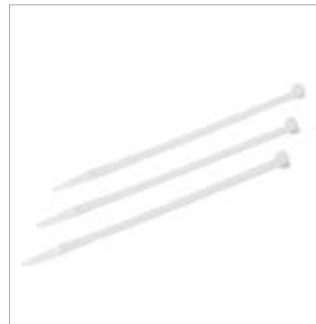


Illustration 10-3: REHAU cable ties

For protective attachment of the heating pipes to the reinforcement elements of the floor panel.

Material	Polyamide
Temperature resistance	-40 to +105 °C

### REHAU RAUFIX rail



Illustration 10-4: REHAU RAUFIX rail

Clamping rail made of polypropylene for the attachment of the RAUTHERM S pipe 20 x 2.0 mm. Moulded barbs on the bottom. Can be extended on both sides due to an integrated snap connection.

Possible installation pipe spacing	5 cm and multiples thereof
Pipe lift	5 mm

### REHAU RAILFIX rail



Illustration 10-5: REHAU RAILFIX rail

Clamping rail made of PVC for attachment of the RAUTHERM S pipe 25 x 2.3 mm.

Possible installation pipe spacing	10 cm and multiples thereof
Pipe lift	10 mm

### REHAU retaining pins



Illustration 10-6: REHAU retaining pins

For attachment of the RAUFIX or RAILFIX rail on the insulation.

Colour	Red
--------	-----

### REHAU pipe bend bracket



Illustration 10-7: REHAU pipe bend bracket

For precise redirection of the heating pipe when connecting to the manifold.

Material	Polyamide
Colour	Black

### 10.1.1 Assembly

**i** Early agreement among the workers/planners involved is necessary for trouble-free assembly!

→ Install insulation and cover with film (see "Separation and floating layers", Page 181).

→ Assemble bedding layers and lower reinforcement grids (wire grates from the construction company).

→ If a special "pipes in the neutral zone" construction (see "Floor panel", Page 180) is planned, assemble special baskets or frames.

→ Install heating pipes according to plan and connect to the manifold.

→ Flush, fill and deaerate heating circuits.

→ Perform pressure test.

→ Complete upper reinforcement.

→ Complete concreting of floor panel.

**i** We recommend that the heating installer be present during concreting.

## 10.1.2 Planning

### Floor panel

REHAU industrial underfloor heating can be installed in floor panels made of steel reinforced concrete, steel fibre-reinforced concrete and vacuum concrete (with cement as binding agent). Exceptions to this include all asphalt concrete types (cold- and hot installed). The type of use of the industrial hall and resulting traffic and usage loads do not influence the design of the REHAU industrial underfloor heating, but rather only the static dimensioning of the floor panel. For this reason, designing of the concrete floor panel (taking the above mentioned stresses into account) and the quality of the surface and the groundwater level may only be handled by a structural engineer. The structural engineer also determines the position of the heating pipes in the floor panel and the joint arrangement.

- For floor panels reinforced with steel grids, the lower reinforcement can generally be used as a pipe carrier, i.e. the heating pipes are directly attached to the grids of the lower reinforcement level with REHAU cable ties. Only then are the spacing baskets and

upper reinforcement grids assembled. This standard solution (see Illustration 10-8) has a host of advantages:

- easy assembly
  - no additional costs for pipe carrier elements
  - higher "drilling flexibility"
- If the structural engineer prefers installation of the heating pipes in the neutral position, we must return to the special solution (see Illustration 10-9). The heating pipes are assembled on the crossbars of the spacing baskets ordered as special items. These also act as spacers for the upper reinforcement grids installed afterwards.
- In steel fibre-reinforced concrete plates, the classic reinforcement of the plates (steel grids, steel bars) is replaced by the addition of steel fibres. To guarantee that the planned installation pipe spacing of the heating pipes results, additional attachment elements must be used. The easiest and repeatedly tested solution is the REHAU RAUFIX rail for the RAUTHERM S 20 x 2.0 pipes and the REHAU RAILFIX rail for the RAUTHERM S 25 x 2.3 mm pipes (see Illustration 10-10). If desired, the clamping rails can be replaced by a backer board.

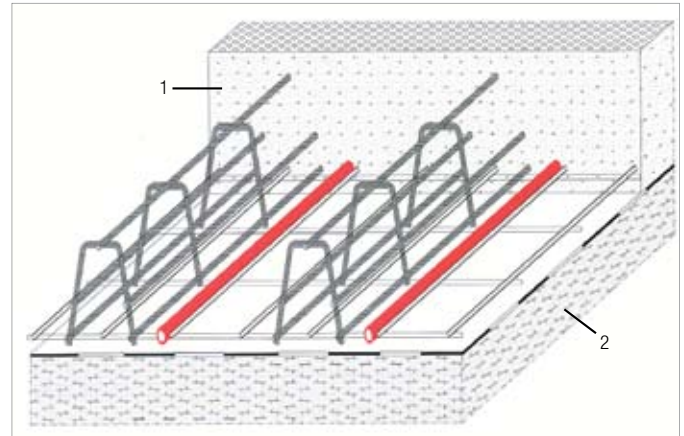


Illustration 10-8: Floor panel reinforced with steel grids; standard construction heating pipes assembled to the lower reinforcement grid

1 Concrete plate 2 Foundation

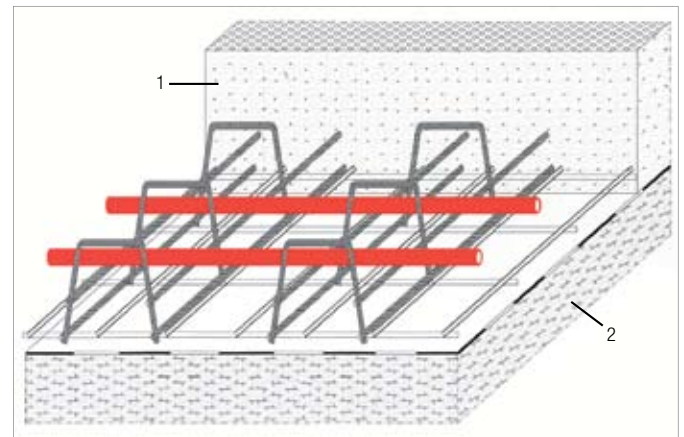


Illustration 10-9: Floor panel reinforced with steel grids; special construction heating pipes assembled at the centre of the plate

1 Concrete plate 2 Foundation

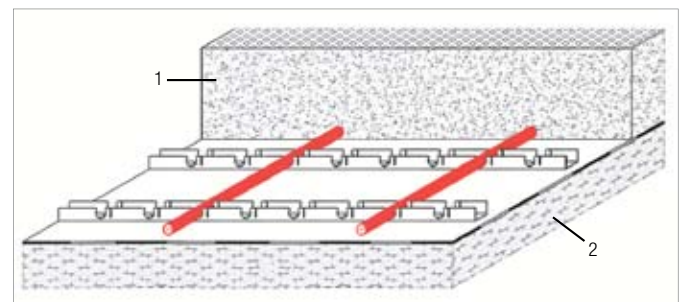


Illustration 10-10: Floor panel reinforced with steel fibres; special construction heating pipes assembled to the clamping rails

1 Concrete plate 2 Foundation

### Separation and floating layers

To prevent mixing water penetrating into the insulation layer or in the unbound bearing layer, they are covered with a separation layer (e.g. one layer of polyethylene film). To avoid friction between the floor panel and the bearing layer, so-called floating layers are used (e.g. two layers of polyethylene film). Normally, the separation and floating layers are installed by the construction company.

### Heating insulation

The Energy Conservation Ordinance (EnEV), which took effect in February of 2002, differentiates (§1, Paragraphs 1 and 2) between:

- Buildings with normal interior temperatures and
- Buildings with low interior temperatures.

In **buildings with normal interior temperatures** (EnEV, §2, Paragraphs 1 and 2, i.e. with an interior temperature of 19 °C and higher, heated more than four months a year), the heat transmission resistance of the insulation under the floor panel  $R_1$  (EN 1264 Part 4) may not undershoot the following values:

- with floor panel against heated rooms:  
 $R_{min} \geq 0.75 \text{ (m}^2 \cdot \text{K)/W}$
- with floor panel against unheated rooms, intermittently heated rooms against the ground:  
 $R_{min} \geq 1.25 \text{ (m}^2 \cdot \text{K)/W}$
- with floor panel against outside air and  $-5 \text{ }^\circ\text{C} > T_d \geq -15 \text{ }^\circ\text{C}$ :  
 $R_{min} \geq 2.00 \text{ (m}^2 \cdot \text{K)/W}$

- with a groundwater level  $\geq 5 \text{ m}$ , this value should be increased.

In justified cases (unreasonable hardness), the responsible authority according to regional law can relieve you of this requirement (EnEV, §17).

In **buildings with low interior temperatures** (EnEV, §2, Paragraph 3, i.e. with an interior temperature of more than 12 °C and less than 19 °C, heated more than four months a year), there are no requirements on the part of the EnEV. The minimum values for heat transmission resistances according to DIN 4108-2 apply here. According to Table 3, Lines 7, 8 and 10, the value of the heat transmission resistance may not be less than  $0.90 \text{ (m}^2 \cdot \text{K)/W}$ , i.e.  $R_{min} \geq 0.90 \text{ (m}^2 \cdot \text{K)/W}$ .

### Building water-proofing

The building water-proofing (against ground moisture, water not under pressure or water under pressure) must be planned and executed according to DIN 18195. Normally, the building water-proofing is installed by the construction company.

### Joint arrangement

To absorb movements (e.g. heat-related expansion) of the floor panel and neutralise internal tensions, expansion and dummy joints are used. If a floor panel is cemented in several sections (depending on the capacity of the mobile concrete factory), so-called pressed joints arise.

- The expansion joints separate the floor panel from other construction elements (e.g. walls, foundations) and separate larger floor panels into smaller fields.
- The dummy joints prevent uncontrolled shifting of the floor panel.

The expansion joints can be constructed as “doweled” (freedom of movement only possible on dowel level) or “un-doweled” (freedom of movement possible in all directions). The type and position of the joints are determined by the responsible structural engineer.

**i** Only power supply cables may pass through expansion joints. Heating pipes which cross a joint must be protected.

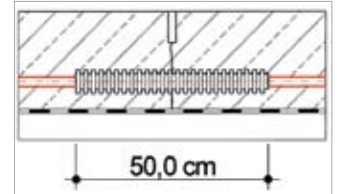


Illustration 10-13: Dummy joint, pressed joint with REHAU protective sleeve

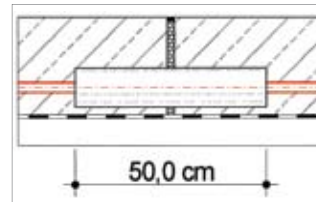


Illustration 10-11: Un-doweled expansion joint with protection via 100 % insulating tube

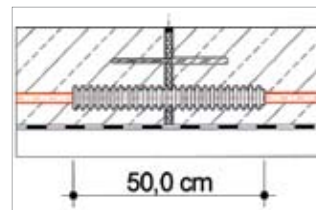


Illustration 10-12: Doweled expansion joint with REHAU protective sleeve



### Installation types

The classic reversed spiral installation type is generally not used here. Better options for adaptation (i.e. no collisions) to the course of the support baskets or support frames are offered by the meander-type installation. The drop in temperature (on the heating level and on the surface) can be compensated for via parallel installation of the flow and return lines. The heating circuits can be separated or installed in parallel, as required. Running several heating circuits in parallel forms a zone with an even surface temperature. At the same time, complex pressure balancing at the manifold is avoided, since the length of the heating circuits laid in this way is almost the same.

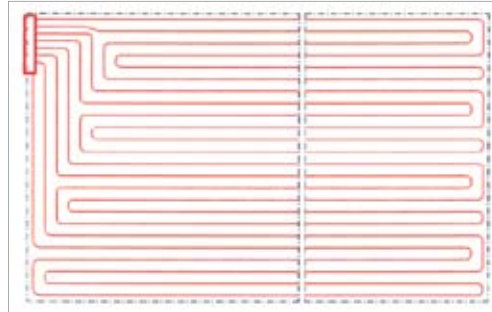


Illustration 10-14: Heating circuits separate

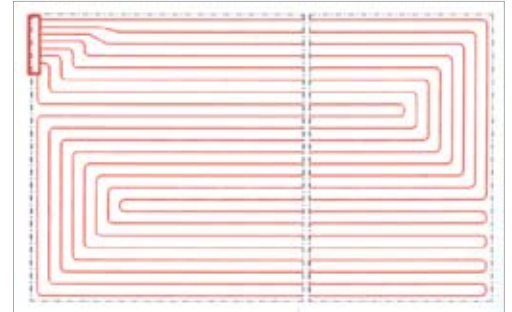


Illustration 10-15: Heating circuits run in parallel (zone formation)

### Design

The performance diagrams are used to determine the operating parameters of the industrial under-floor heating. The diagrams are calculated according to DIN 4725. The arrangement of any necessary edge zones according to the sketch shown below must be conducted differently than with subsurface heating.

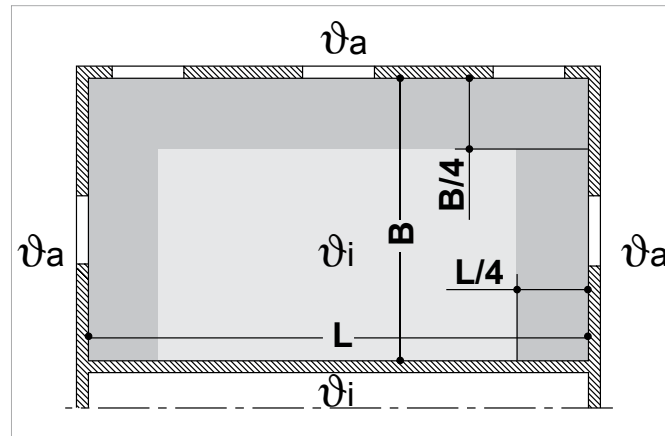


Illustration 10-16: Zone arrangement

Inner zone  
 Edge zone

## 10.2 REHAU heating system for flexible sports floors connected to standard manifold



- Quick installation
- Comfortably temperature-controlled floor surface
- Energy-saving due to a high level of radiative energy
- No upsetting of dust
- Minimal air movement
- Floor is not compromised by pipe attachment method
- Decoupling means no reduction in flexible properties of the floor
- Minimal investment costs in comparison to other heating systems

### Components

- REHAU insulation panel, pre-cut
- REHAU RAUFIX rail 16/17/20
- REHAU retaining pins

### Pipe dimensions

RAUTHERM S 20 x 2.0 mm

### Accessories

- REHAU manifold
- REHAU manifold cabinet

### REHAU retaining pins



Illustration 10-17: REHAU retaining pins

The specially shaped tips of the REHAU retaining pins make for firm seating of the REHAU RAUFIX rail on the REHAU insulation panel. The perforated floor panel of the REHAU RAUFIX rail receives the REHAU retaining pins.

### REHAU insulation panel, pre-cut



Illustration 10-19: REHAU insulation panel, pre-cut

The insulation panel consists of CFC-free, PUR hard foam which has a diffusion-proof coating (aluminium laminated) on both sides. It falls in thermal conductivity category 025 with a characteristic value of 0.025 W/mK according to DIN 4108. The panel is normally inflammable according to DIN 4102, material class B2. The REHAU insulation panel is supplied pre-cut. The grid dimensions of the floor must therefore be made known in the planning

phase. This eliminates time-consuming, laborious and imprecise cutting at the construction site.

### REHAU RAUFIX rail



Illustration 10-20: REHAU RAUFIX rail

The REHAU RAUFIX rail is an attachment element made of polypropylene with which an installation pipe spacing of 5 cm and multiples thereof are possible. Hooks on the top retaining clip of the REHAU RAUFIX rail guarantee firm seating of the pipes. Securing at the connector enables reliable and quick connection of the 1 m REHAU RAUFIX rails.



Illustration 10-18: REHAU sports floor system

Flexible floor heating makes planning and calculation much more complex. Cooperation between the architect, planner, sports hall floor installer and operator is vital for handling this added complexity. Planning always occurs separately for each construction project upon agreement with the architect and the flexible

### 10.2.1 Assembly

- Set REHAU manifold cabinet in place and install REHAU manifold.
- Install pre-cut REHAU insulation panels.
- Set REHAU RAUFIX rails in place and secure at a spacing of 40 cm with REHAU retaining pins.
- Connect RAUTHERM S pipes to REHAU manifold.
- Lay RAUTHERM S pipes in accordance with the installation plan.
- Flush, fill and deaerate heating circuits.
- Perform pressure test.

and bottom discharge valve have to be noted. Pipe installation in these areas occurs upon agreement with the flexible floor installer.

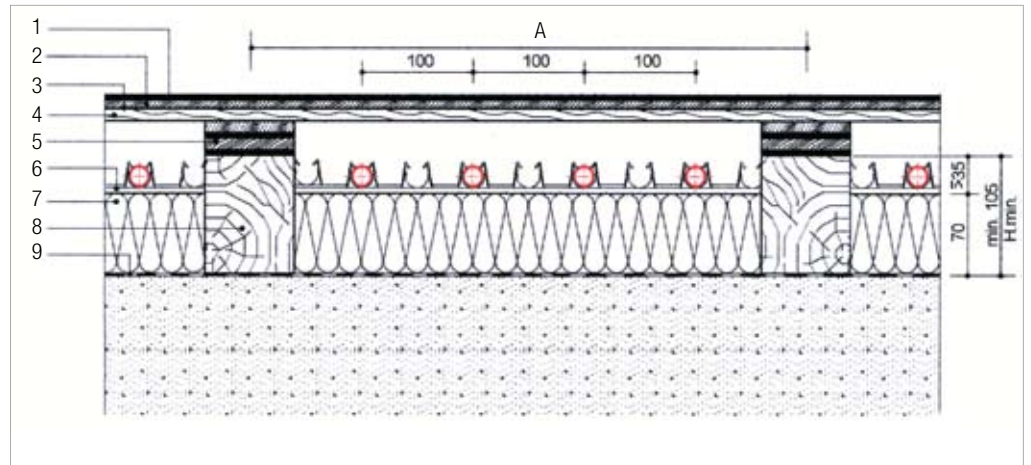


Illustration 10-21: Structure of flexible floor heating

Once the moisture barrier is installed by the customer, the installation of the pre-cut insulation panels occurs. This is performed starting with a corner determined by the flexible floor installer and then moving outward. The grid dimensions of the padding blocks is to be ensured with neighbouring REHAU insulation panels. Following this, the REHAU RAUFIX rails are secured at an installation pipe spacing of one metre using the REHAU retaining pins. The rails must be secured radially near the pipe redirection points to guarantee secure retention of the pipes. We recommend beginning with the outermost “channel” of the installation grid when installing the heating pipes. The heating pipes are pressed into the pipe guide of the rail from the roller. When installing the pipes, the anchors

- |   |   |   |   |
|---|---|---|---|
| 1 | Flooring material   | 6 | REHAU RAUFIX rail   |
| 2 | Load distribution plate (chipboard, plywood or bio-panel) | 7 | REHAU insulation panel, pre-cut                           |
| 3 | Polyethylene film   | 8 | Padding block (e.g. with 70 mm insul.: H. min. is 105 mm) |
| 4 | Subfloor  | 9 | Moisture barrier  |
| 5 | Double shock-absorption elements                          |   |   |



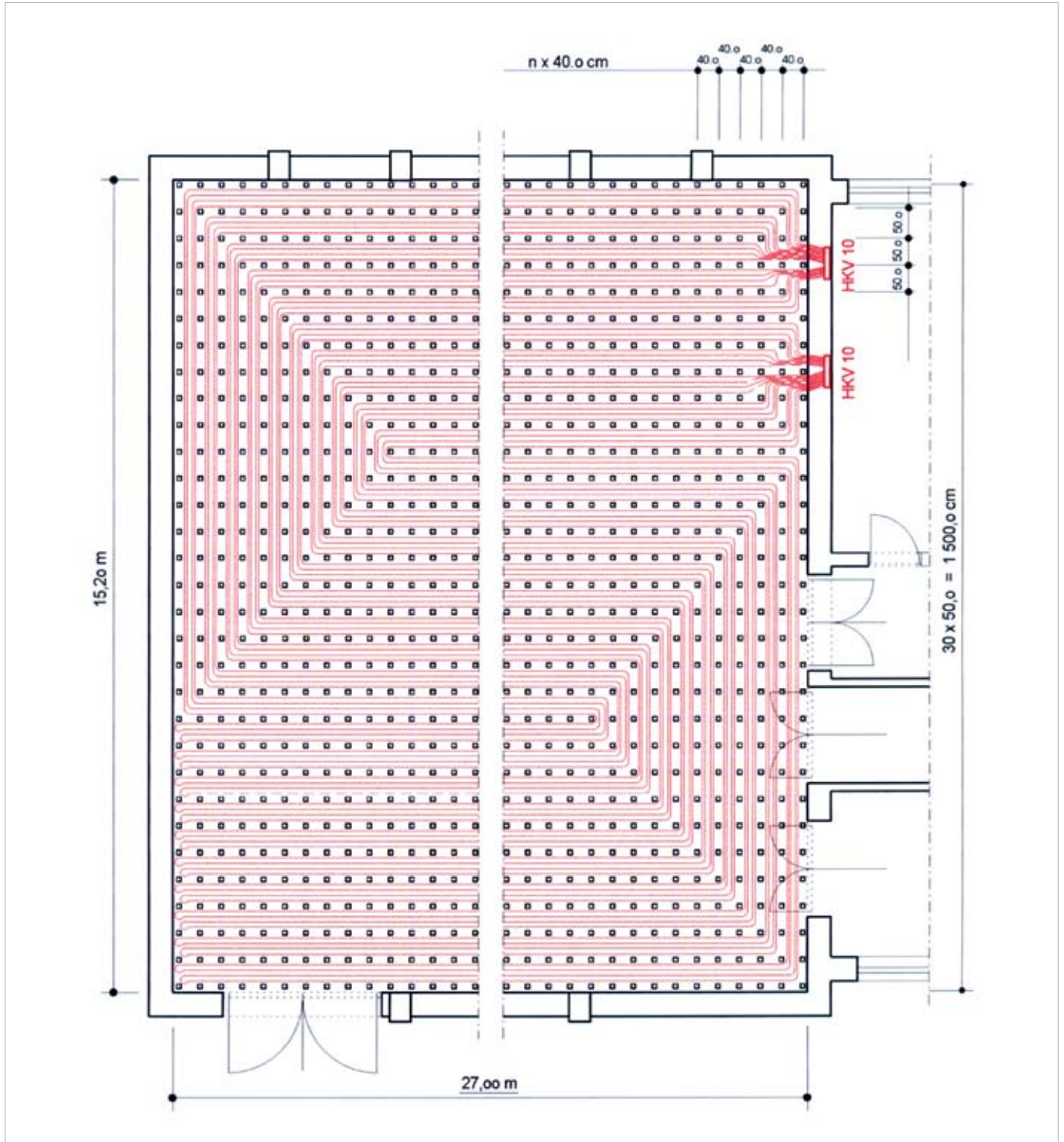


Illustration 10-22: Standard manifold of REHAU heating system for flexible floors

### 10.3 REHAU heating system for flexible sports floors connected to pipe manifold



- Quick installation
- Comfortably temperature-controlled floor surface
- Energy-saving due to a high level of radiative energy
- No upsetting of dust
- Minimal air movement
- Floor is not compromised by pipe attachment method
- Decoupling means no reduction in flexible properties of the floor
- Minimal investment costs in comparison to other heating systems

#### Components

- REHAU insulation panel, pre-cut
- REHAU RAILFIX rail
- REHAU retaining pins
- REHAU pipe manifold

#### Pipe dimensions

- RAUTHERM S 25 x 2.3 mm

#### Accessories

- REHAU manifold
- REHAU manifold cabinet

#### REHAU retaining pins



Illustration 10-23: REHAU retaining pins

The specially shaped tips of the REHAU retaining pins make for firm seating of the REHAU RAUFIX rail on the REHAU insulation panel. The perforated floor panel of the REHAU RAUFIX rail receives the REHAU retaining pins.

#### REHAU installation panel, pre-cut



Illustration 10-25: REHAU insulation panel, pre-cut

The insulation panel consists of CFC-free, PUR hard foam which has a diffusion-proof coating (aluminium laminated) on both sides. It falls in thermal conductivity category 025 with a characteristic

value of 0.025 W/mK according to DIN 4108. The panel is normally inflammable according to DIN 4102, material class B2.

The REHAU insulation panel is supplied pre-cut. The grid dimensions of the floor must therefore be made known in the planning phase. This eliminates time-consuming, laborious and imprecise cutting at the construction site.

#### REHAU RAUFIX rail



Illustration 10-26: REHAU RAILFIX rail

Flexible floor heating makes planning and calculation much more complex. Cooperation between the architect,

planner, sports hall floor installer and operator is vital for handling this added complexity. Planning

An installation pipe spacing of 10 cm and multiples thereof are possible with the REHAU RAILFIX rail. It is used as a precise pipe spacer.



Illustration 10-24: REHAU sports floor system

#### REHAU pipe manifold

The REHAU pipe manifolds are built using RAUTHERM FW pipe 40 x 3.7 mm and REHAU fittings with the compression sleeve connection technology. They are used for the connection of the RAUTHERM S pipes 25 x 2.3 mm. Assembly occurs at the construction site based on detailed drawings in accordance with the construction site conditions.

### 10.3.1 Assembly

- Install pre-cut REHAU insulation panels.
- Set REHAU RAILFIX rails in place and secure at a spacing of 40 cm with REHAU retaining pins.
- Install, align and attach REHAU pipe manifolds to one another.
- Lay RAUTHERM S pipes in accordance with the installation plan.
- Connect installed heating circuits to the REHAU pipe manifolds.
- Flush, fill and deaerate heating circuits
- Perform pressure test.

Once the moisture barrier is installed by the customer, the installation of the pre-cut insulation panels occurs. This is performed starting with a corner determined by the flexible floor installer and then moving outward. The grid dimensions of the padding blocks is to be ensured with neighbouring REHAU insulation panels. Following this, the REHAU RAILFIX rails are secured at an installation pipe spacing of one metre using the REHAU retaining pins. The rails must be secured radially near the pipe redirection points to guarantee secure retention of the pipes. When assembling the REHAU pipe manifolds, the proper sequence of manifold elements must be followed. This can be found on the detailed drawings. We recommend beginning with the outermost “channel” of the

installation grid when installing the heating pipes.

The heating pipes are pressed into the pipe guide of the rails from the roller. When installing the pipes, the anchors and bottom discharge valve have to be noted. Pipe installation in these areas occurs upon agreement with the flexible floor installer.

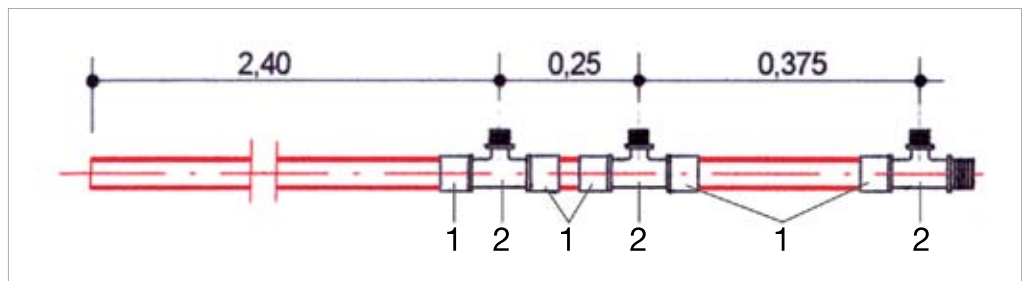


Illustration 10-27: REHAU pipe manifold

1 Compression sleeves: 40 x 3.7

2 Tees: 40 x 3.7–25 x 2.3– 40 x 3.7

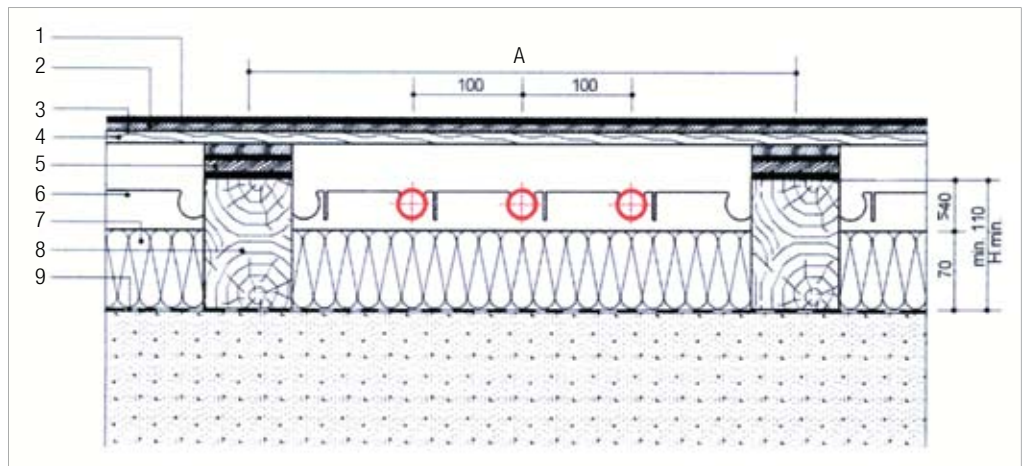


Illustration 10-28: Structure of flexible floor heating

1 Flooring material

2 Load distribution plate (chipboard, plywood or bio-panel)

3 Polyethylene film

4 Subfloor

5 Double shock-absorption elements

6 REHAU RAILFIX rail

7 REHAU insulation panel, pre-cut

8 Padding block (e.g. with 70 mm insul.: H. min. is 105 mm)

9 Moisture barrier



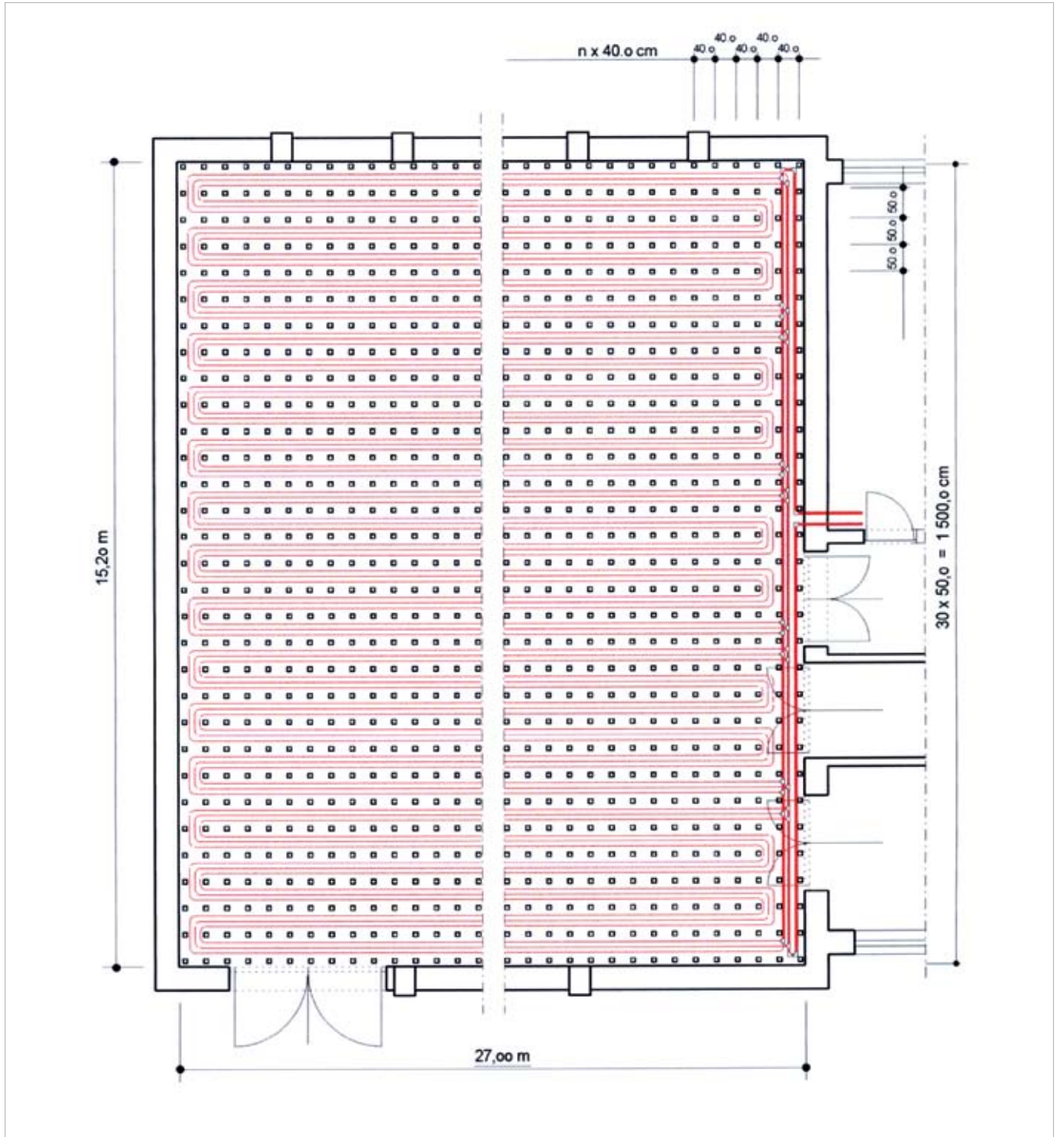


Illustration 10-29: Pipe manifold of REHAU heating system for flexible floors

## 10.4 REHAU outdoor sub-surface heating



- Easy and quick assembly
- Keep streets, car parks, garage driveways, promenades etc. free of ice and snow
- Low operating temperatures
- Suitable for heat pump and solar power systems
- No maintenance costs

### System components

- REHAU industrial manifold
- REHAU cable ties
- REHAU RAUFIX rail
- REHAU RAILFIX rail
- REHAU retaining pins

### Pipe dimensions

- RAUTHERM S 20 x 2.0 mm
- RAUTHERM S 25 x 2.3 mm

### System accessories

- REHAU pipe bend

### System description

REHAU outdoor underfloor heating is used to keep the following surfaces free of ice and snow:

- Streets and car parks
- Helicopter landing pads
- Garage driveways
- Promenades
- etc.



Illustration 10-30: REHAU outdoor underfloor heating: Heating a car park



### Caution!

#### Frost damage.

- Operate all outdoor underfloor heating systems with anti-freeze agents.



When performing the pressure-loss calculation, the influence of the antifreeze agent on the increase in pressure loss must be taken into account!

### 10.4.1 Planning

#### Floor structure

The heating pipes are predominantly assembled in parallel form in a concrete floor panel (and infrequently in a sand layer, e.g. with promenades) and connected to the

REHAU industrial manifold.

If the heating pipes are embedded in a **concrete plate**, the REHAU outdoor underfloor heating has the same structure as REHAU industrial underfloor heating. This means that the floor panel structure, the joint arrangement, use of the separation and gliding layers and the installation types and the assembling sequence are the same. Heating insulation is generally not installed under the floor panel. This increases the inactivity of the outdoor underfloor heating, which means continuous operation in day to day use.

Advantage of this solution: the heat-retention capacity of the underfloor (a heat lens is formed) is utilised.

When installing the installation

pipes in a **sand layer**, the REHAU RAUFIX or RAILFIX rail is predominantly used as a pipe spacer. The major disadvantage of this solution is the decreasing thermal conductivity of the sand when it dries out. This increases the operating temperatures and lowers the effectiveness of outdoor underfloor heating.

For this reason, the installation of the heating pipes in a sand layer under firm and packed coverings (natural stone pavement, concrete block pavement) should be avoided.

#### Design

Since the heat emission of a concrete surface in the outdoors very heavily depends on weather conditions, the performance and

the resulting operating temperatures must be determined in a material-related fashion. For quick determination of the performance of the heat station, a specific performance of the outdoor underfloor heating of  $q = 150\text{W/m}^2$  can be assumed when the surface is kept ice free.

### Installation types

As with REHAU industrial underfloor heating, parallel pipe routing and meander type installation are used.

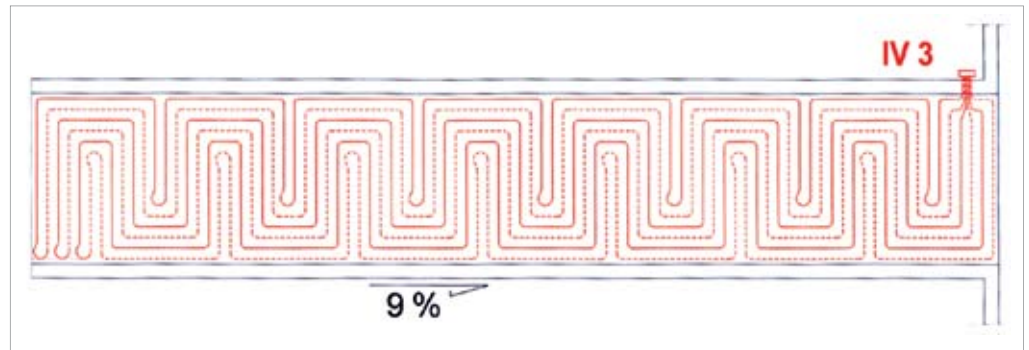


Illustration 10-31: REHAU outdoor underfloor heating: Heating a ramp (installation sketch)

### 10.4.2 Assembly

Early agreement among the workers/planners involved is necessary for trouble-free assembly!

- Install film (separation layer).
- Assemble bedding layers and lower reinforcement grids.
- i** → If a special construction (pipes in the neutral zone) is planned, assemble special baskets or frames.
- Assemble industrial manifolds at the planned locations.
- Install heating pipes according to plan and connect to the manifold.
- Flush, fill and deaerate heating circuits.
- Complete upper reinforcement.
- Concrete the floor panel.

**i** We recommend that the heating installer be present during concreting.

### 10.5 REHAU pitch heating



- Easy and quick assembly
- Keep areas free of ice and snow
- Low operating temperatures suitable for the use of heat pumps and solar power systems
- Does not disturb grass and ground vegetation
- Does not interfere with grass maintenance
- No maintenance costs

#### Components

- REHAU pipe manifold
- REHAU RAILFIX rail

#### Pipe dimensions

- RAUTHERM 25 x 2.3 mm

#### Application

REHAU pitch heating is used to keep natural and artificial grass football fields free of ice and snow.

#### System description

REHAU pitch heating is a special variant of REHAU outdoor underfloor heating.

The heating circuits made of tried and tested RAUTHERM pipe 25 x 2.3 mm are installed in parallel and connected to the manifold pipes via REHAU compression sleeve joining technology. The REHAU RAILFIX rail is used as a spacer. The REHAU manifold pipes are installed based on the individual project and are supplied as a specially tailored product. The uniform length of the heating circuits, the dimension of the manifold pipes and the connection of the manifold and the collector using the Tichelmann Principle guarantee even temperature distribution across the entire playing field.





Illustration 10-32: Installing drainage in the playing field



Illustration 10-33: Installing pitch



Illustration 10-35: Installing heating pipes



Illustration 10-34: Heated playing field



## 10.6 REHAU industrial manifold



- Manifold and collector made of 1¼" or 1½" brass pipe
- Terminating cap with KFE valve and deaerator in the flow and return
- Ball valves in the flow (thermostat valves with IVT) and fine-control valves with clamping ring or eurocone screw connections
- Assembled on galvanised, sound insulated (according to DIN 4109) brackets

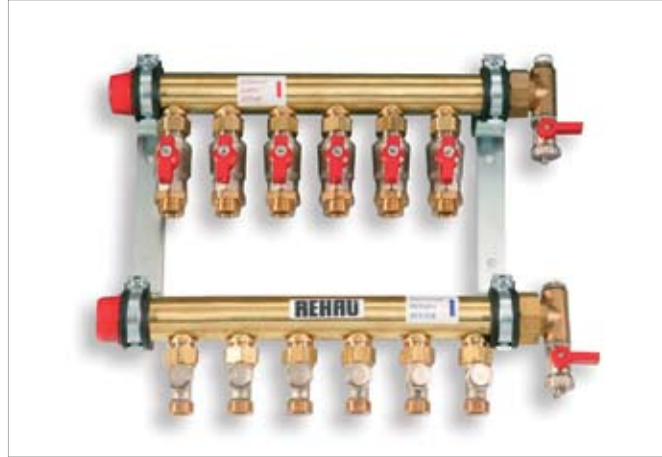


Illustration 10-36: Example: Industrial manifold 1¼"

### Overview

	Manifold 1¼"	Manifold 1½"	
Designation	IVK	IVKK	IVKE
Outlets	½"	¾"	¾"
Flow set-up	Ball valves	Ball valves	Ball valves
Return set-up	Fine-control valves	Fine-control valves	Fine-control valves
Pipe connection	RAUTHERM S 17 x 2.0/ 20 x 2.0	RAUTHERM S 25 x 2.3	RAUTHERM S 17 x 2.0/ 20 x 2.0
Screw joint	EUROCONE <sup>1)</sup>	Clamping ring screw joint	EUROCONE <sup>1)</sup>
Number of heating circuits which can be connected	2 to 12	2 to 12	2 to 12
Centre distance between the outlets	55 mm	75 mm	75 mm

Table 10-1: Overview of REHAU industrial manifold

<sup>1)</sup> Clamping ring screw joints must be ordered separately

### 10.6.1 REHAU industrial manifold 1¼" IVK

- Ball valves in the flow
- EUROCONE 17×2.0/20×2.0 mm

Type	Article No.	B [mm]	M [kg]
IVK 2	246609-001	220	4.12
IVK 3	246619-001	275	4.96
IVK 4	246629-001	330	5.81
IVK 5	246639-001	385	6.65
IVK 6	246649-001	440	7.50
IVK 7	246659-001	495	8.34
IVK 8	246669-001	550	9.19
IVK 9	246679-001	605	10.03
IVK 10	246689-001	660	10.88
IVK 11	246699-001	715	11.72
IVK 12	246709-001	770	12.57

Table 10-2: Construction lengths B and weights M

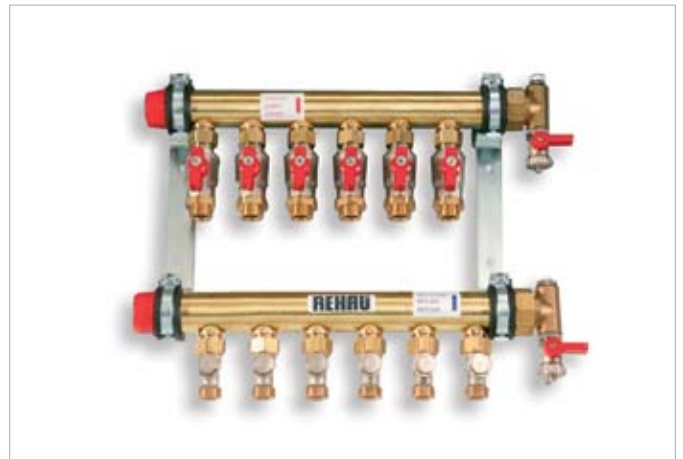


Illustration 10-37: Industrial manifold 1¼" IVK

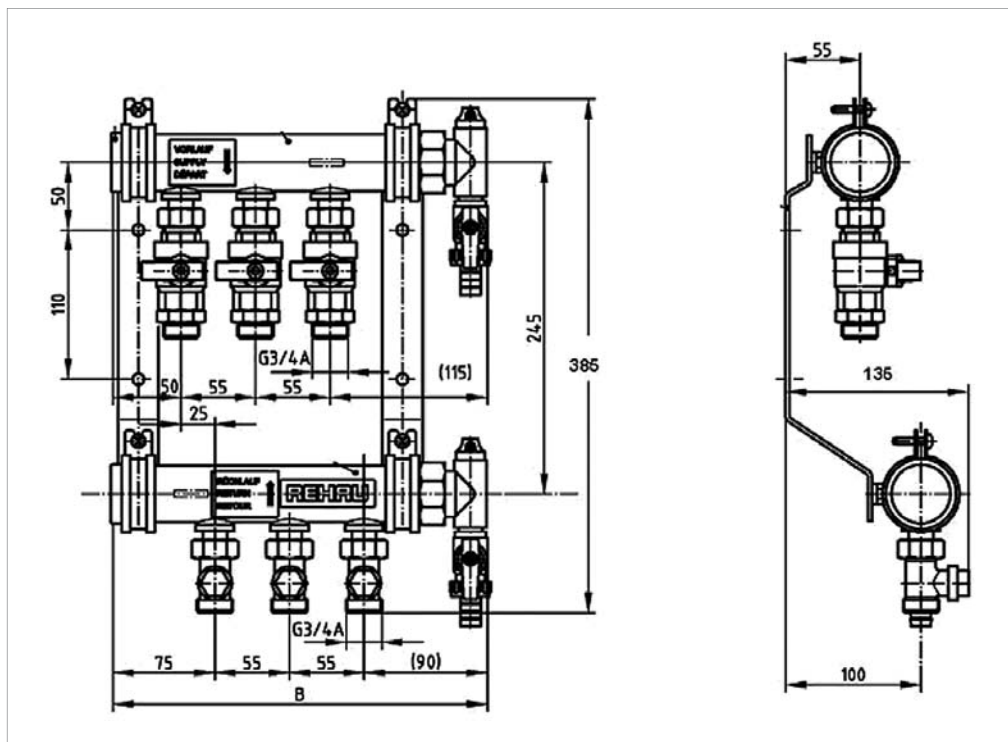


Illustration 10-38: Sizes

### 10.6.2 REHAU industrial manifold 1½" IVKE

- Ball valves in the flow
- EUROCONE 17×2.0/20×2.0 mm

Type	Article No.	B [mm]	M [kg]
IVKE 2	248760-001	285	5.6
IVKE 3	248770-001	360	7.2
IVKE 4	248780-001	435	8.8
IVKE 5	248790-001	510	10.4
IVKE 6	248800-001	585	12.0
IVKE 7	248810-001	660	13.6
IVKE 8	248820-001	735	15.2
IVKE 9	248830-001	810	16.8
IVKE 10	248840-001	885	18.4
IVKE 11	248850-001	960	20.0
IVKE 12	248860-001	1035	21.6

Table 10-3: Construction lengths B and weights M



Illustration 10-39: Industrial manifold 1½" IVKE

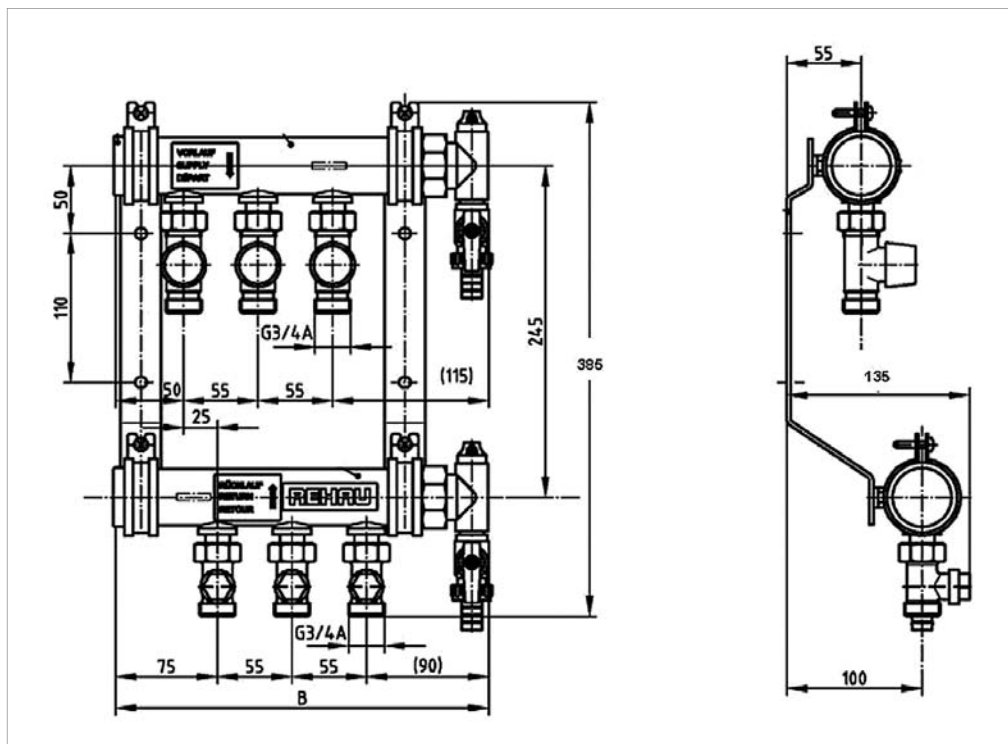


Illustration 10-40: Sizes

SPECIAL APPLICATIONS

### 10.6.3 REHAU industrial manifold 1½" IVKK

- Ball valves in the flow
- Clamping ring screw joint 25×2.3 mm

Type	Article No.	B [mm]	M [kg]
IVKK 2	248870-001	285	5.6
IVKK 3	248880-001	360	7.2
IVKK 4	248890-001	435	8.8
IVKK 5	248900-001	510	10.4
IVKK 6	248910-001	585	12.0
IVKK 7	248920-001	660	13.6
IVKK 8	248930-001	735	15.2
IVKK 9	248940-001	810	16.8
IVKK 10	248950-001	885	18.4
IVKK 11	248960-001	960	20.0
IVKK 12	248970-001	1035	21.6

Table 10-4: Construction lengths B and weights M

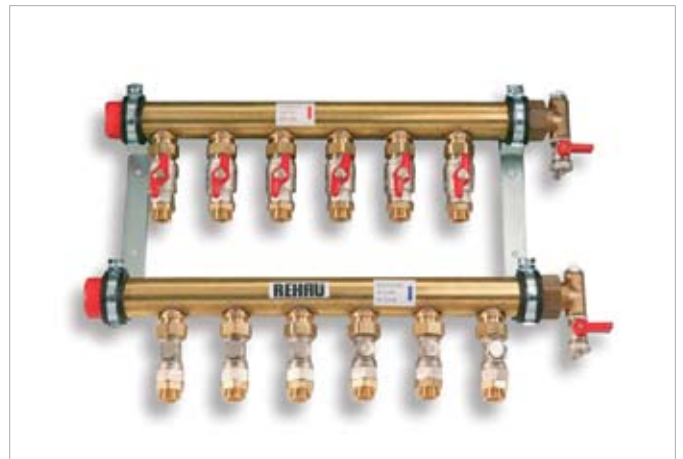


Illustration 10-41: Industrial manifold 1½" IVKK

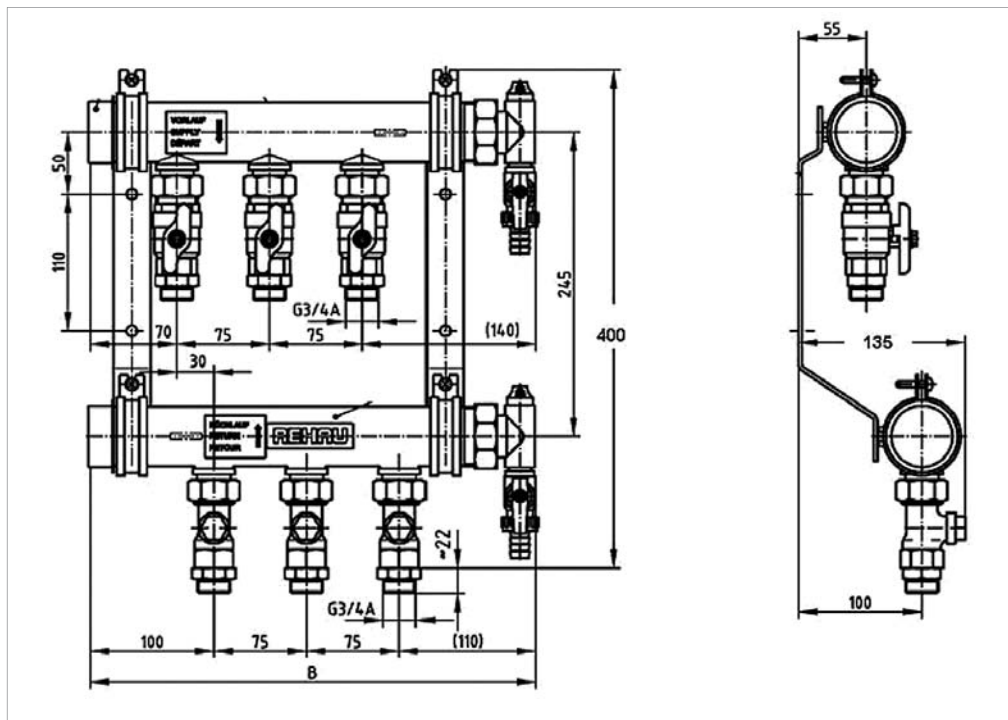


Illustration 10-42: Sizes

# 11. PROJECT PLANNING

We offer comprehensive project planning services for underfloor heating/cooling systems and provide support with our information on planning and design on the Internet and the REHAU planning software RAUCAD/RAUWIN.

## 11.1 Internet



Detailed information on project planning can be found on the Internet on our website [www.rehau.de/gebaeudetechnik](http://www.rehau.de/gebaeudetechnik) in the underfloor heating/cooling section.

In addition to information on planning and design, you will also receive general and technical information on the systems. You will find checklists, forums, logs and texts for invitation of tenders for download. Datanorm texts, contact options and tips and tricks for frequently asked questions supplement the Internet offer.

## 11.2 REHAU planning software

REHAU product lines can handle all of your needs and enable you to implement all plans and calculations for heating and plumbing

quickly, easily and in a user-friendly way.

We have developed three modular programs to meet your needs:

- RAUWIN
  - Heating load calculation
  - Radiator design
  - Design of REHAU underfloor heating
- RAUCAD/RAUCADplus
  - Ground plot and scheme planning
  - Graphical pipe network calculation for heating, drinking water and sewage
- RAUCAD as an application for AutoCAD
- RAUCADplus including AutoCAD-OEM



Detailed information on the software can be found on the Internet on our website

[www.REHAU.de/RAUCAD](http://www.REHAU.de/RAUCAD)

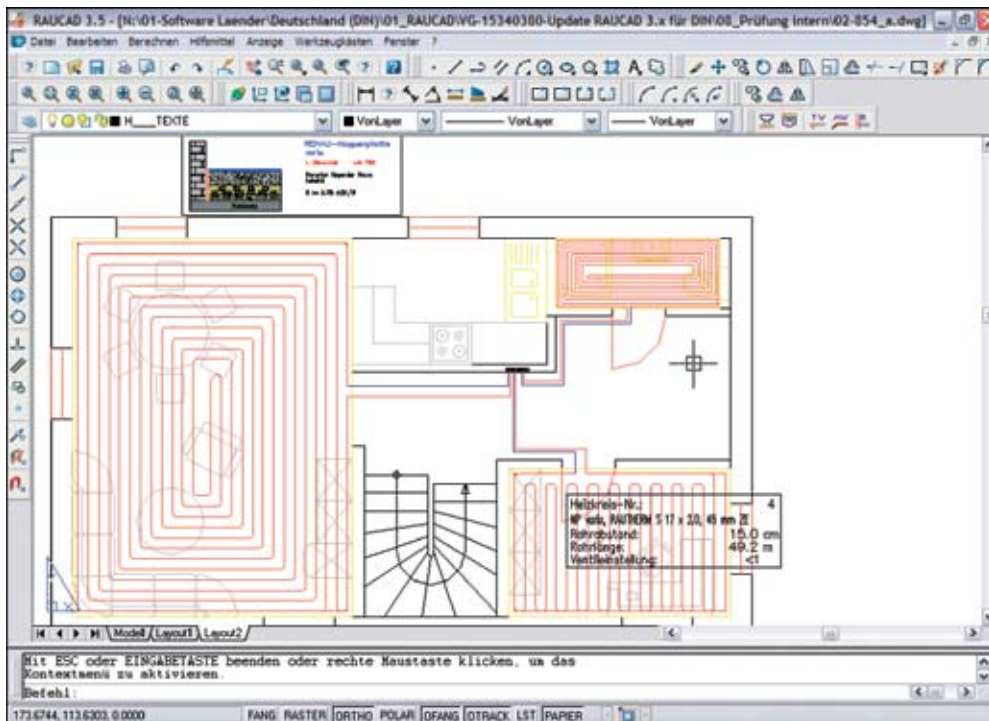


Illustration 11-1: Example for project planning of a REHAU underfloor heating system with the REHAU RAUCAD planning software.

## Pressure-test log for REHAU underfloor heating/cooling

### 1. System data

Capacity of boiler/chiller: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Installation site: \_\_\_\_\_

Max. operating pressure: \_\_\_\_\_

Max. operating temperature: \_\_\_\_\_

### 2. Pressure test

- |   |                          |
|---|--------------------------|
|   | Completed                |
| a. Close ball valve at manifold   | <input type="checkbox"/> |
| b. Fill and flush heating circuits individually one after another   | <input type="checkbox"/> |
| c. Deaerate system  | <input type="checkbox"/> |
| d. Apply test pressure: 2 x operating pressure, but no less than 6 bar (according to DIN EN 1264 Part 4)  | <input type="checkbox"/> |
| e. Reapply pressure after 2 hours, as the pressure may drop due to expansion of the pipes   | <input type="checkbox"/> |
| f. Test time of 12 hours  | <input type="checkbox"/> |
| g. The pressure test has been passed if water does not exit from any point of the pipeline and the test pressure has not dropped more than 0.1 bar per hour | <input type="checkbox"/> |

Note:

When installing the screed, the maximum operating pressure must be applied so that leaks can be detected straight away.

### 3. Confirmation

The leakage test was performed properly. Here, no leaks occurred and no components permanently distorted.

\_\_\_\_\_  
Town/city Date

\_\_\_\_\_  
Customer Contractor

---

### Functional heating log for underfloor heating/cooling

According to DIN EN 1264, Part 4, anhydrite and cement screeds must be heated before the floor coverings are installed. This should not occur until at least 21 days after the cement screed is installed, or, in the case of anhydrite screed, at least 7 days, according to the specifications from the manufacturer.

**Shortening the above listed drying times and/or changing the heat-up sequence described below (temperature, number and duration of the heating steps) requires written approval by the screed manufacturer and/or the screed installer before starting with the heat-up phase.**

Planned construction: \_\_\_\_\_

Heating construction company: \_\_\_\_\_

Screed installation company: \_\_\_\_\_

REHAU installation system: \_\_\_\_\_

REHAU pipe (type/nominal size/installation pipe spacing): \_\_\_\_\_

Screed type:  Cement screed      cm thick       Anhydrite screed      cm thick

Date of screed installation: \_\_\_\_\_

Outside temperature before beginning functional heating: \_\_\_\_\_

Room temperature before beginning functional heating: \_\_\_\_\_

1. Initial flow temperature of 20–25 °C is set and kept constant for 3 days:  
Started on: \_\_\_\_\_ Completed on: \_\_\_\_\_

2. Set the maximum permissible design temperature and maintain it for 4 days (without dropping at night):  
Started on: \_\_\_\_\_ Completed on: \_\_\_\_\_

In case of problems: \_\_\_\_\_ Heating-up interrupted on: \_\_\_\_\_

Defects found: \_\_\_\_\_

Functional heating performed without any problems:  Yes  No

Customer: \_\_\_\_\_ Town/city, date \_\_\_\_\_ Signature \_\_\_\_\_

Contractor: \_\_\_\_\_ Town/city, date \_\_\_\_\_ Signature \_\_\_\_\_

Note: After completing functional heating, it is not ensured that the screed has reached the degree of moisture required before it can be covered. The readiness for covering of the screed must be determined by the floor installer.



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### Commissioning log for wall heating/cooling

Developer: \_\_\_\_\_

Planned construction: \_\_\_\_\_

Construction step: \_\_\_\_\_

Performer: \_\_\_\_\_

Customer: \_\_\_\_\_

#### 1. Pressure test

The leak test of the wall heating/cooling circuits is provided immediately before beginning the plastering work or before beginning with the fine spackle work with the REHAU climate element system via a water pressure test. The level of the test pressure is 1.3 x the maximum permissible operating pressure, or at least 5 bar. Test time at least 12 hours. After completion of the leak test, the operating pressure is **set and maintained**.

Maximum permissible operating pressure: \_\_\_\_\_ bar

Set test pressure: \_\_\_\_\_ bar

Pressure at the end of the test duration: \_\_\_\_\_ bar

**No leakages has been ensured and no permanent distortion and leaks of any components were found.**

Confirmation from the company performing the pressure test (date, seal, signature): \_\_\_\_\_

---

---

## 2. Functional heating for cement or gypsum-bound plasters, spackles or loam plasters

Functional heating serves to check the functioning of the heated wall. Functional heating may begin no earlier than 21 days after application of the plaster/spackle. The specifications from the plaster manufacturer for the plaster type/spackle used have to be observed and complied with. Functional heating begins with a flow temperature of 25 °C, which is to be maintained for 3 days. The maximum flow temperature is then set and maintained for 4 days.

Plaster manufacturer: \_\_\_\_\_

Plaster type/spackle: \_\_\_\_\_

Functional heating occurred  before  during  after the plastering work \_\_\_\_\_

Start of plastering work: \_\_\_\_\_ (Date)

Completion of plastering work on: \_\_\_\_\_ (Date)

Start of functional heating: \_\_\_\_\_ (Date)

Initial flow temperature of \_\_\_\_\_ °C maintained until: \_\_\_\_\_ (Date)

Flow temperature increased in increments of \_\_\_\_\_ (Kelvin)

Maximum flow temperature: \_\_\_\_\_ °C reached on: \_\_\_\_\_ (Date)

Maximum flow temperature maintained until \_\_\_\_\_ (Date)

Functional heating was completed on: \_\_\_\_\_ (Date)

Functional heating was interrupted: \_\_\_\_\_ from \_\_\_\_\_ to \_\_\_\_\_ (Date)

Functional heating was not interrupted  (please tick if applicable)

**The wall heating system was turned over with a set flow temperature of \_\_\_\_\_ °C with an outside temperature of \_\_\_\_\_ °C for permanent operation.**

Confirmation (date, stamp, signature) \_\_\_\_\_

Customer: \_\_\_\_\_

Contractor: \_\_\_\_\_

---

## Pressure-test log for REHAU concrete core temperature control / 1. Pressure test

Planned construction: \_\_\_\_\_

Street: \_\_\_\_\_

Town/city/postcode: \_\_\_\_\_

### 1. Visual inspection

The inspection of the BKT modules/BKT circuits listed in the table includes the following criteria:

- 1.) Securing and position of the forms using valid assembly plans
- 2.) Module and pipe installation using valid assembly plans
- 3.) Securing and installation of the connection lines and their complete insertion into the forms
- 4.) No visible damage or leaks whatsoever on the BKT modules/BKT circuits

### 2. Pressure test

The pressure test refers to the BKT modules/BKT circuits listed in the table

- a. Apply test medium (the test pressure must be 2 x the operating pressure or at least 6 bar).
- b. Reapply pressure after 2 hours, as the pressure may drop due to expansion of the pipes.
- c. Test time of 12 hours
- d. The set-up is sealed properly if test medium has not leaked from the pipelines at any point and the test pressure has not dropped more than 1.5 bar.

Note: During the entire cementing process, the BKT modules/BKT circuits must be subjected to the test pressure so that leaks can be detected.

Circuit No.	Building section	Storey	Module type	Length (m)	Width (m)	Installation position of BKT module/ BKT circuit	Tested pressure (bar)	Notes

**3. Confirmation**

The visual inspection and leak test have to be performed properly in accordance with a test log.

Town/city: \_\_\_\_\_ Date: \_\_\_\_\_

Performing company for BKT: \_\_\_\_\_

Site management for TGA/customer: \_\_\_\_\_

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## Pressure-test log for REHAU concrete core temperature control / 2. Pressure test

Planned construction:

Street:

Town/city/postcode:

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### 1. Visual inspection

Inspection of the forms listed in the table encompasses the following criteria:

- 1.) Condition of the connection lines in the form/mould
- 2.) Condition of the pressure-test equipment

### 2. Pressure test

The pressure test refers to the BKT modules/BKT circuits listed in the table

- a. Checking of the test pressure set up from the first pressure test.
- b. The set-up is sealed properly if test medium has not leaked from the pipelines at any point and the test pressure from the first pressure test has not dropped more than 1.5 bar.
- c. If the test pressure has dropped more than 1.5 bar, the first pressure test is to be repeated.

Circuit No.	Building section	Storey	Module type	Length (m)	Width (m)	Installation position of BKT module/ BKT circuit	Tested pressure (bar)	Notes

### 3. Confirmation

The visual inspection and leak test have to be performed properly in accordance with a test log.

Town/city: \_\_\_\_\_ Date: \_\_\_\_\_

Performing company for BKT: \_\_\_\_\_

Site management for TGA/customer: \_\_\_\_\_





Construction



Automotive



Industry



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