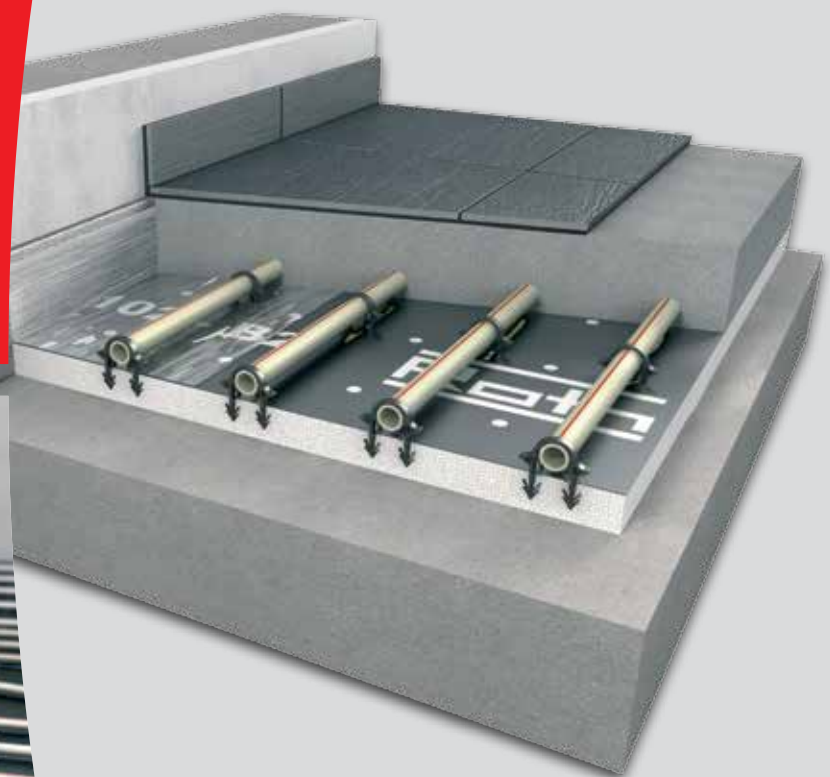


Technical Information and Assembly Instructions



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System description

System description and system benefits

The Roth Original Tacker® System is characterised by a high degree of flexibility and easy assembly, even for unusual floor plans. The heat is emitted evenly across the whole floor structure, thus creating an optimum room temperature. Because of the low system temperatures, alternative energy systems can be ideally combined with the Roth Original Tacker® System as well as conventional heat generation systems. The flooring layout designs of the Roth Original Tacker® System are determined by the requirements of German Energy Saving Directive

(Energieeinsparverordnung - EnEV) and DIN EN 1264 (surface embedded heating and cooling systems) taking into account DIN 18560 (screeds in the building industry) and DIN 4109 (sound insulation in building construction). The consistently high quality standards of the individual components, which correspond to the requirements of the respective standards, and of the overall system of the Roth Original Tacker® System are documented by a large number of testing, monitoring and quality marks.



DIN test and monitoring marks with registration number 7F083-F and 7F087-F

Possible applications

The Roth Original Tacker® System can be used in all building types envisaged in DIN EN 1264 – Residential, office, and commercial buildings, as well as other buildings used the same or at least in a similar way as residential buildings.

System description

System components

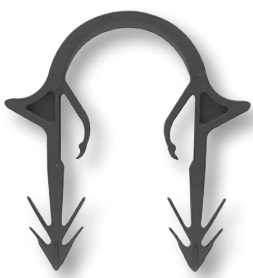


Roth System Pipes DUOPEX S5®



Roth System Pipes X-PERT S5®+, Roth System Pipe Alu-Laserflex,
Roth System Pipes PERTEX®

Technical Data			
Roth System Pipe	Pipe dimensions [Wall thickness]	Length delivered	Packaging
DUOPEX S5®	14 mm [2,2]	200 m	in a box in a box, to be laid with an unwinding reel
	17 mm [2,2]	120 m 200 m 600 m 3000 m	in a box in a box in a box, to be laid with an unwinding reel on an unwinding device, in leaf
	20 mm [2,2]	200 m 500 m 2000 m	in a box in a box, to be laid with an unwinding reel on an unwinding device, in leaf
X-PERT S5®+	14 mm [2,2]	200 m 600 m	in a box in a box, to be laid with an unwinding reel
	16 mm [2,0]	200 m 600 m	in a box in a box, to be laid with an unwinding reel
	17 mm [2,2]	200 m 600 m	in a box in a box, to be laid with an unwinding reel
	20 mm [2,2]	200 m 500 m 2000 m	in a box in a box, to be laid with an unwinding reel on an unwinding device, in leaf
Alu-Laserflex	14 mm [2,2]	100 m 200 m	in a box in a box
	16 mm [2,0]	100 m 200 m 600 m	in a box in a box in a box, to be laid with an unwinding reel
PERTEX®	17 mm [2,2]	200 m 600 m	in a box in a box, to be laid with an unwinding reel



Roth Original Tacker® E+ Clips



Roth Original Tacker® 14 - 20 mm

System description

System components



Roth system composite panel EPS-DES



Roth composite roll EPS-DES

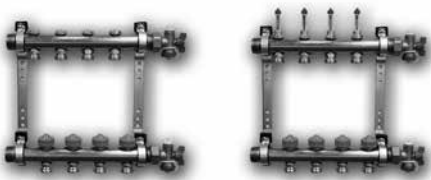
System composite panels and rolls	WLG	Insulation height	Traffic load	Impact sound reduction (min.)
EPS DES sm 25-2	045	25 mm	4,0 kN/m ²	28 dB
EPS DES sm 30-3	045	30 mm	4,0 kN/m ²	29 dB
EPS DES sm 35-3	045	35 mm	4,0 kN/m ²	30 dB
EPS DES sg 20-2	040	20 mm	5,0 kN/m ²	26 dB
EPS DES sg 30-2	040	30 mm	5,0 kN/m ²	28 dB
EPS DEO	035	26 mm	35 kN/m ²	-
EPS DES sm 25-2	032	25 mm	5,0 kN/m ²	26 dB



Roth edge insulating strips 160 mm



Roth expansion joint profile



Roth manifold with flow rate indicator, lockable / universal



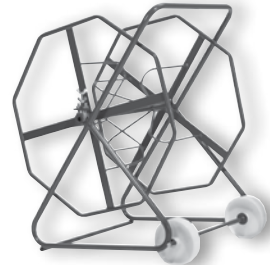
Cement screed additives/Cement screed additives Plus

System description

System components



Roth measuring point set



Roth uncoiler



Roth folding uncoiler



Roth antifreeze



Roth pipe scissors



Roth pipe cutter



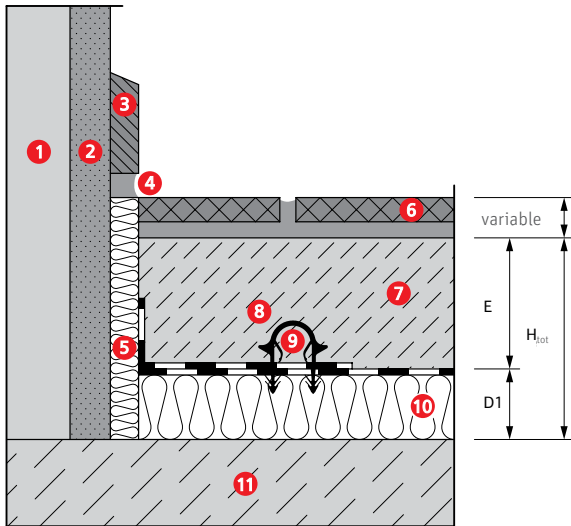
Roth knife



Roth calibration tool

Set-up and configuration

■ Cover over heated rooms



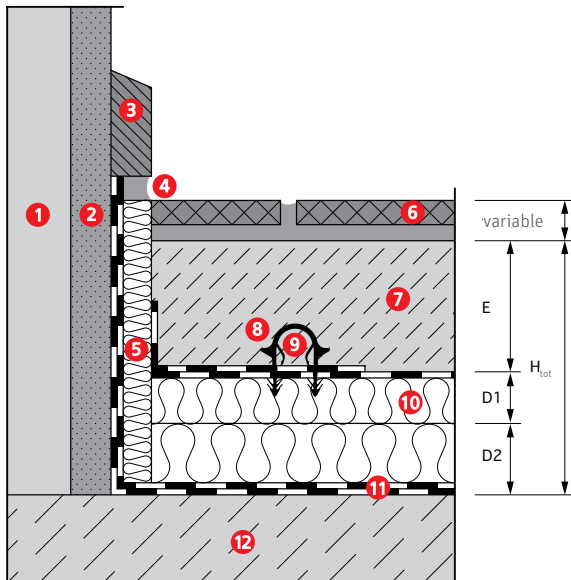
- 1 Wall
- 2 Plaster
- 3 Skirting board
- 4 Elastic grouting
- 5 Roth edge insulating strip
- 6 Surface covering
- 7 Plaster as defined in DIN 18560
- 8 Roth Pipeholder
- 9 Roth System Pipe Ø 14 - 20 mm
- 10 Roth System Composite Panel
(alternative: Roth Composite Roll)
- 11 Load-bearing subsurface

Installation height: Covers compared to equivalently heated rooms, according to DIN EN 1264, $R_{\lambda, INS} = 0,75 \text{ m}^2 \text{ K/W}$

No.	R_{λ} [m ² K/W]	D1 System composite panel or roll	D2 Additional insulation	H_{tot} with E Screed depth at 45 mm Pipe coverage [mm]	H_{tot} with E Screed depth at 30 mm Pipe coverage [mm]
1	0,78	25-2 EPS DES WLG 032	-	90	75
2	0,75	26 EPS DEO WLG 035	-	91	76
3	0,75	30-2 EPS DES WLG 040	-	95	80
4	0,77	35-3 EPS DES WLG 045	-	100	85

Set-up and configuration

Covers on unheated rooms or rooms heated at intervals, adjoining ground



- 1 Wall
- 2 Plaster
- 3 Skirting board
- 4 Elastic grouting
- 5 Roth edge insulating strip
- 6 Surface covering
- 7 Plaster as defined in DIN 18560
- 8 Roth Pipeholder
- 9 Roth System Pipe \varnothing 14 - 20 mm
- 10 Roth System Composite Panel
(alternative: Roth Composite Roll)
- 11 Sealing against ground moisture according to DIN 18195 and PE film (not required if not adjoining ground)
- 12 Load-bearing subsurface

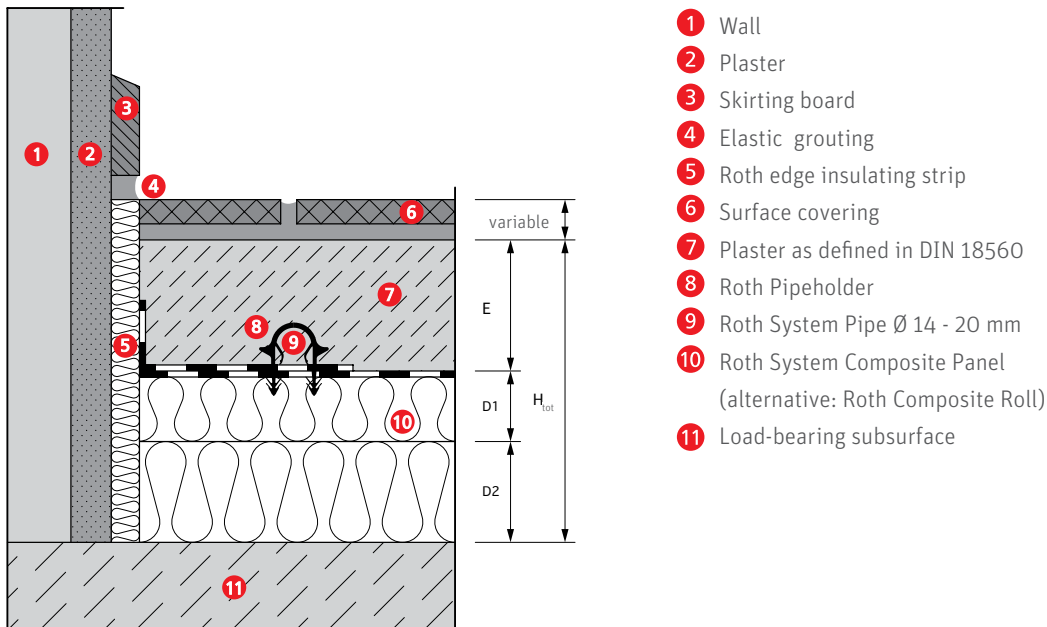
Installation height: Covers compared to unheated rooms, rooms heated at intervals or soil according to DIN EN 1264, $R_{\lambda, \text{INS}} = 1,25 \text{ m}^2 \text{ K/W}$

No.	R_{λ} [m ² K/W]	D1 System composite panel or roll	D2 Additional insulation	H_{tot} with E Screed depth at 45 mm Pipe coverage [mm]	H_{tot} with E Screed depth at 30 mm Pipe coverage [mm]
1	1,35	25-2 EPS DES WLG 032	20 EPS DEO WLG 035	110	95
2	1,32	26 EPS DEO WLG 035	20 EPS DEO WLG 035	111	96
3	1,35	20-2 EPS DES WLG 040	30 EPS DEO WLG 035	115	100
4	1,32	30-2 EPS DES WLG 040	20 EPS DEO WLG 035	115	100
5	1,41	25-2 EPS DES WLG 045	30 EPS DEO WLG 035	120	105
6	1,34	35-3 EPS DES WLG 045	20 EPS DEO WLG 035	120	105
7	1,41	30-3 EPS DES WLG 045	30 EPS DEO WLG 035	125	110

When selecting additional insulation, the minimum requirements according to DIN EN 1264 must be considered. Requirements resulting from the overall consideration of the building according to EnEV have to be prescribed by the construction planner. The entire insulation structure of the underfloor heating is tailored to the building's specific requirements.

Set-up and configuration

Covers adjoining fresh air



- 1 Wall
- 2 Plaster
- 3 Skirting board
- 4 Elastic grouting
- 5 Roth edge insulating strip
- 6 Surface covering
- 7 Plaster as defined in DIN 18560
- 8 Roth Pipeholder
- 9 Roth System Pipe \varnothing 14 - 20 mm
- 10 Roth System Composite Panel (alternative: Roth Composite Roll)
- 11 Load-bearing subsurface

Installation height: Covers against fresh air $[-5\text{ }^{\circ}\text{C} > T_d \geq -15\text{ }^{\circ}\text{C}]$, $R_{\lambda, \text{INS}} = 2,00\text{ m}^2\text{ K/W}$

No.	R_{λ} [m ² K/W]	D1 System composite panel or roll	D2 Additional insulation	H_{tot} with E Screed depth at 45 mm Pipe coverage [mm]	H_{tot} with E Screed depth at 30 mm Pipe coverage [mm]
1	2,06	25-2 EPS DES WLG 032	32 PU WLG 025	122	107
2	2,03	26 EPS DEO WLG 035	32 PU WLG 025	123	108
3	2,00	25-2 EPS DES WLG 045	36 PU WLG 025	126	111
4	2,21	25-2 EPS DES WLG 032	50 EPS DEO WLG 035	140	125
5	2,21	20-2 EPS DES WLG 040	60 EPS DEO WLG 035	145	130
6	2,18	30-2 EPS DES WLG 040	50 EPS DEO WLG 035	145	130
7	2,09	30-3 EPS DES WLG 045	50 EPS DEO WLG 035	145	130
8	2,20	35-3 EPS DES WLG 045	50 EPS DEO WLG 035	150	135

When selecting additional insulation, the minimum requirements according to DIN EN 1264 must be considered. Requirements resulting from the overall consideration of the building according to EnEV have to be prescribed by the construction planner. The entire insulation structure of the underfloor heating is tailored to the building's specific requirements.

Set-up and configuration

■ Design criteria

Room temperatures for underfloor heating

According to DIN EN 12831, the following room temperatures for heated rooms form the basis of the underfloor heating calculation:

Room type	Standard indoor temperature θ_{i} [°C]
Living rooms and bedrooms	+20
Offices, meeting rooms, exhibition rooms	+20
Hotel rooms	+20
Sales rooms, shops (general)	+20
Classrooms (general)	+20
Theatre, concert and event rooms	+20
Bath and shower rooms, swimming pools, changing rooms, any use in undressed area	+24
WC rooms	+20
Heated side rooms (corridors, stairwells)	+15

Different temperature requirements must already be provided when calculating the performance data.

Maximum temperature in the screed

The average temperature in the screed in the area of the pipes **must not exceed 55 °C**. The maximum inlet temperature of the heat generator therefore **must not be above 55 °C**, in order not to damage the screed.

The requirements of the screed manufacturers must be observed (e.g. screed heating protocols etc.).

Surface temperature with underfloor heating

For well-being, the maximum temperature difference between room temperature and surface temperature of the floor in areas where people spend time and also around the edges is limited to 9 °C and a maximum of 15 °C.

The power output is therefore limited by the limit curves for 9 K and 15 K.

Space (Room temperature)	Maximum surface temperature
Living rooms, bedrooms and offices (20 °C)	29 °C (ΔT : 9 K)
Bathroom, shower (24 °C)	33 °C (ΔT : 9 K)
Edge areas (20 °C)	39 °C (ΔT : 15 K)

Dew-point monitoring during cooling

In "Cooling" mode, it must be ensured that the dew-point temperature is not undercut. The cooling water inlet temperature may not be less than 16 °C. Condensation may form at temperatures below 16 °C.

Undercutting the dew-point temperature is prevented by appropriate control systems with dew-point monitoring.

Set-up and configuration

Floor coverings

The floor covering can also be considered in the planning project planning phase. So that an optimum set-up and use of the radiant heating is achieved, the thermal resistance of the desired floor covering ($R_{\lambda,B}$) must be applied in the calculation.

If the value is not known, the value of $R_{\lambda,B} = 0,10 \text{ m}^2\text{K/W}$ is used in the calculation.

Values of $R_{\lambda,B} > 0,15 \text{ m}^2\text{K/W}$ for the floor covering can be agreed in writing if the maximum temperatures for inlet, floor surface and screed are not exceeded.

Planning guidelines for fully adhesive floor coverings on radiant heating and cooling systems

Floor covering (Examples)	Thickness [mm]	Thermal conductivity λ [W/mK]	Thermal resistance $R_{\lambda,B}$ [$\text{m}^2\text{K/W}$]
Ceramic tiles	13	1,05	0,012
Marble	12	2,1	0,0057
Quarry tiles	12	1,2	0,010
Precast stone	12	2,1	0,0057
Carpets	variable	variable	0,07 - 0,17
Tufted floor coverings	6,5	0,54	0,12
Linoleum	2,5	0,17	0,015
Plastic covering	3,0	0,23	0,011
PVC covering without support	2,0	0,20	0,01
Mosaic parquet (oak)	8	0,21	0,038
Strip parquet (oak)	16	0,21	0,09
Multiple layer parquet	11 - 14	0,09 - 0,12	0,055 - 0,076

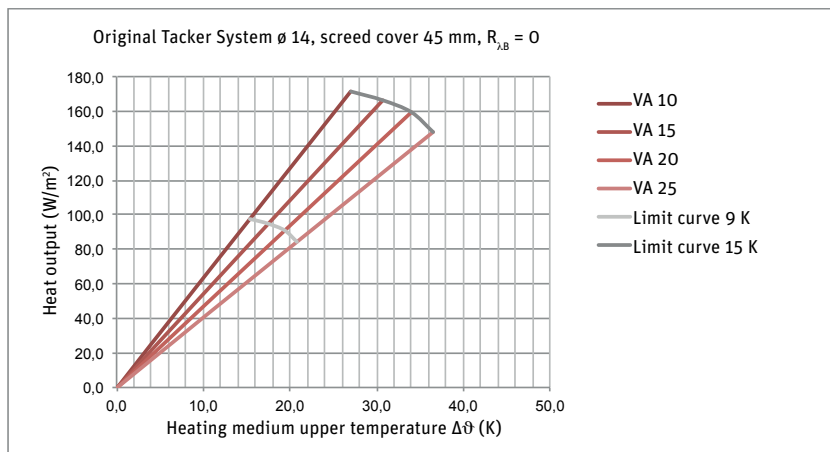
All floor coverings, as well as the adhesive used, must be suitable for radiant heating and cooling systems. The technical documents of the respective manufacturer apply to the use and processing.



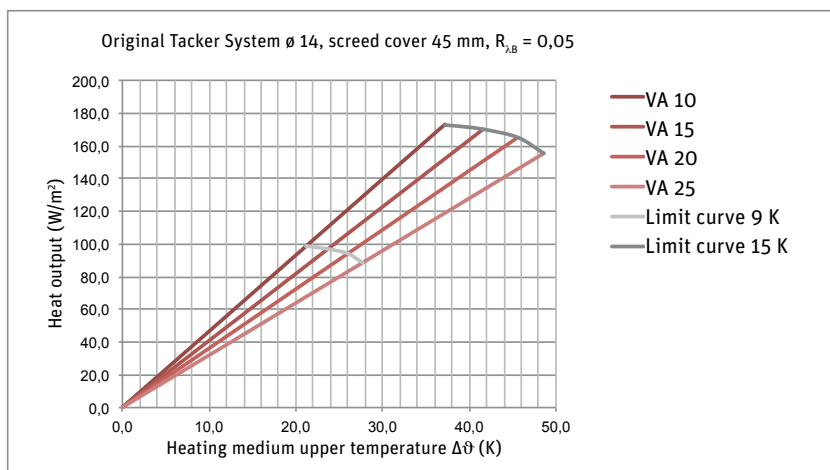
Performance data Roth Original Tacker® System Ø14, Heating

WTP test report no. 98160002 and 1011001

$R_{\lambda,B} = 0$ Ø 14	Heating	Occupied area, Ø 14 [ΔT 9 K]		Boundary zone [ΔT 15 K]	
Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10	6,3	98	15	171	27
VA 15	5,4	95	18	166	31
VA 20	4,7	91	19	159	34
VA 25	4,1	84	21	148	37



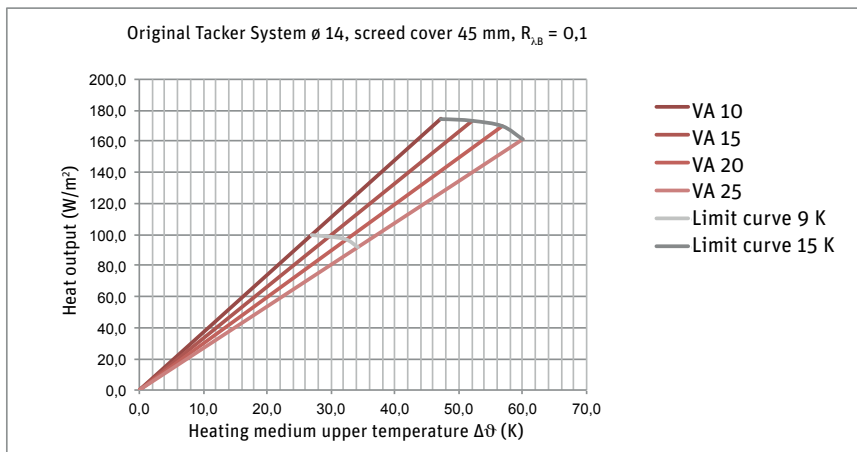
$R_{\lambda,B} = 0,05$ Ø 14	Heating	Occupied area, Ø 14 [ΔT 9 K]		Boundary zone [ΔT 15 K]	
Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10	4,7	99	21	173	37
VA 15	4,1	97	24	170	42
VA 20	3,6	94	26	165	46
VA 25	3,2	89	28	156	49



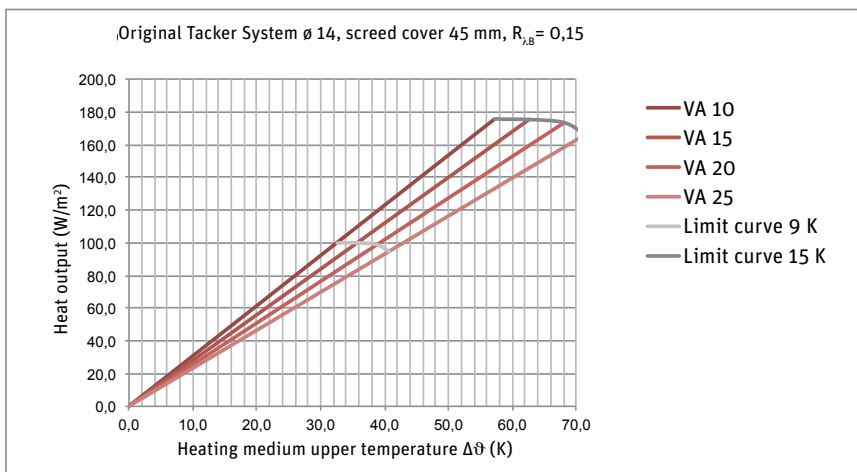
Performance data



$R_{s,B} = 0,1$ Ø 14	Heating	Occupied area, Ø 14 [ΔT 9 K]		Boundary zone [ΔT 15 K]	
Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10	3,7	100	27	175	47
VA 15	3,3	99	30	173	52
VA 20	3,0	97	32	170	57
VA 25	2,7	92	34	161	60



$R_{s,B} = 0,15$ Ø 14	Heating	Occupied area, Ø 14 [ΔT 9 K]		Boundary zone [ΔT 15 K]	
Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10	3,1	100	33	175	57
VA 15	2,8	100	36	175	63
VA 20	2,5	99	39	174	68
VA 25	2,3	95	41	166	71

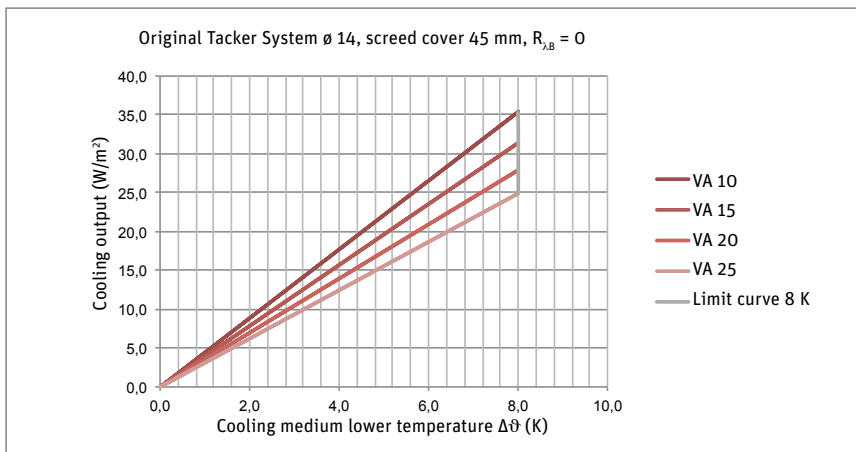


Performance data

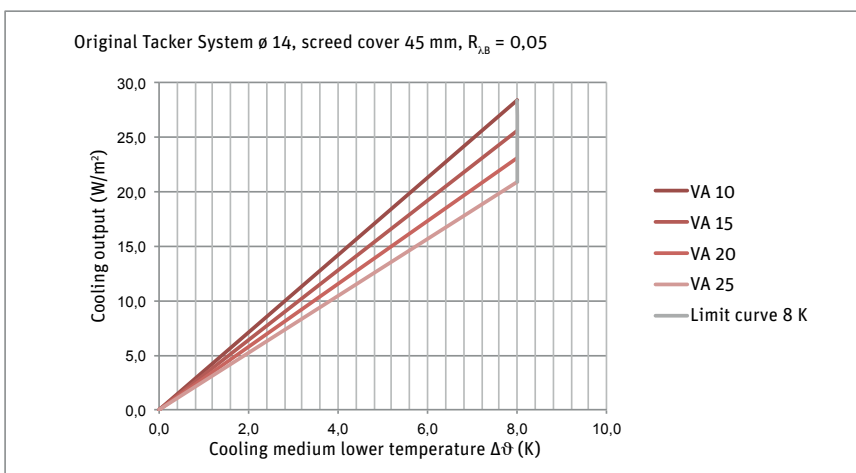


Performance data Roth Original Tacker® System Ø 14, Cooling

$R_{sB} = 0$ Ø 14	Cooling	Occupied area, Ø 14 [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	4,4	35	8
VA 15	3,9	31	8
VA 20	3,5	28	8
VA 25	3,1	25	8



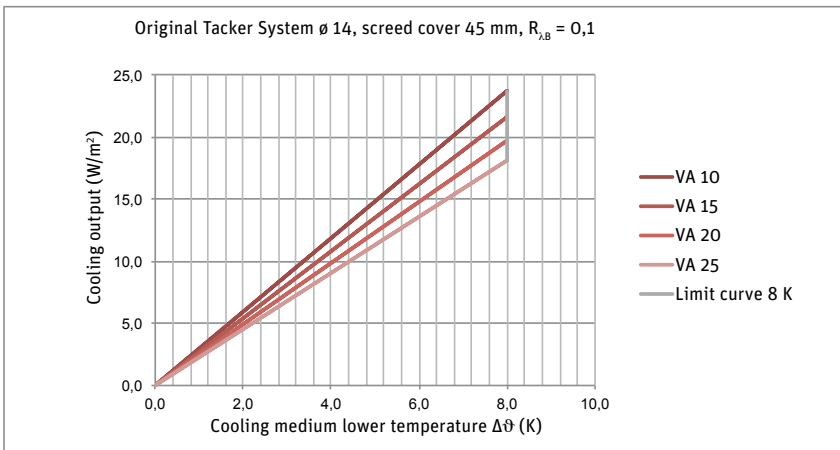
$R_{sB} = 0,05$ Ø 14	Cooling	Occupied area, Ø 14 [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	3,5	28	8
VA 15	3,2	26	8
VA 20	2,9	23	8
VA 25	2,6	21	8



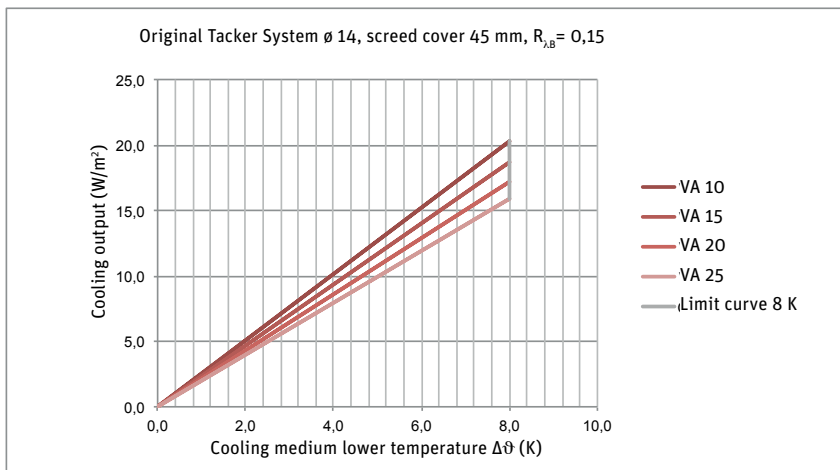
Performance data



$R_{f,B} = 0,1$ $\varnothing 14$	Cooling	Occupied area, $\varnothing 14$ [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	3,0	24	8
VA 15	2,7	22	8
VA 20	2,5	20	8
VA 25	2,3	18	8



$R_{f,B} = 0,15$ $\varnothing 14$	Cooling	Occupied area, $\varnothing 14$ [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	2,5	20	8
VA 15	2,3	19	8
VA 20	2,1	17	8
VA 25	2,0	16	8

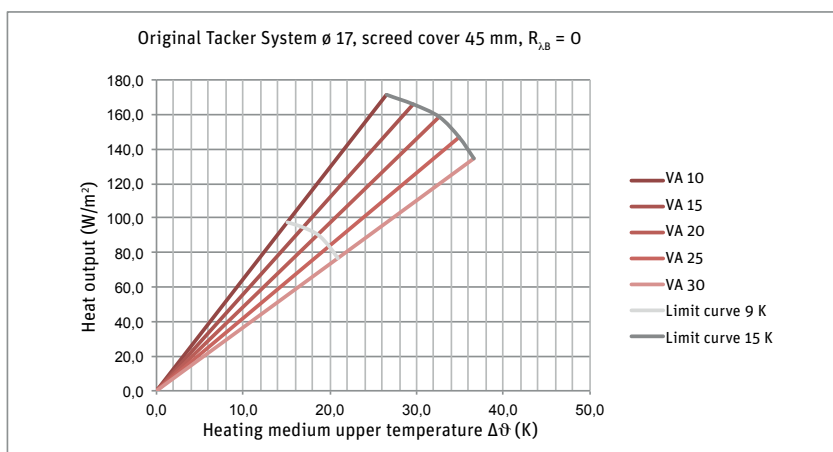




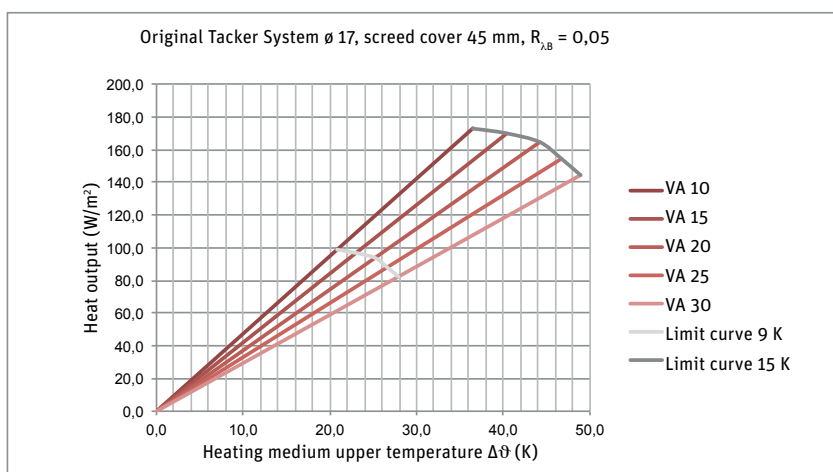
Performance data Roth Original Tacker® System Ø 17, Heating

WTP test report no. 13106004

$R_{f,B} = 0$ Ø 17	Heating	Occupied area, Ø 17 [ΔT 9 K]		Boundary zone [ΔT 15 K]	
Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10	6,5	98	15	171	27
VA 15	5,6	95	17	166	30
VA 20	4,9	90	19	159	33
VA 25	4,2	84	20	147	35
VA 30	3,7	77	21	135	37



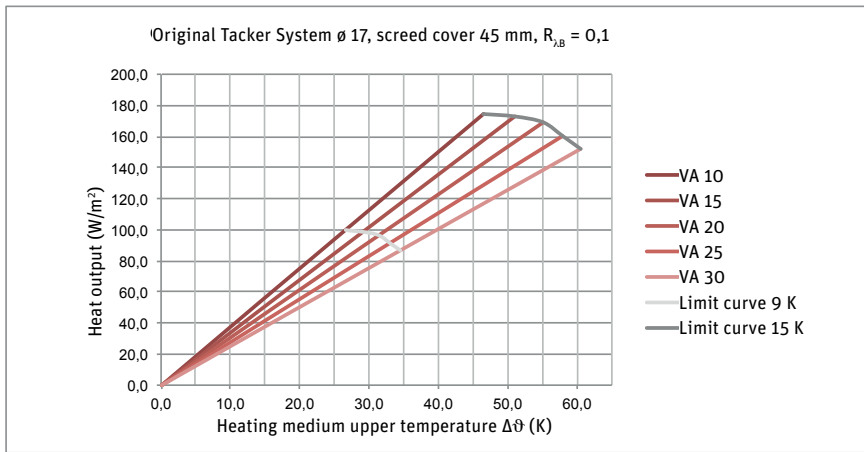
$R_{f,B} = 0,05$ Ø 17	Heating	Occupied area, Ø 17 [ΔT 9 K]		Boundary zone [ΔT 15 K]	
Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10	4,7	99	21	173	37
VA 15	4,2	97	23	170	40
VA 20	3,7	94	25	165	44
VA 25	3,3	88	27	154	47
VA 30	3,0	82	28	144	49



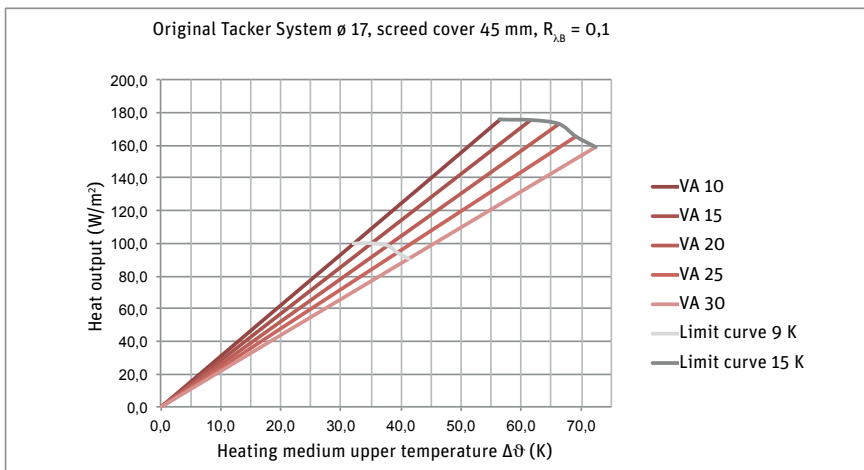
Performance data



$R_{f,B} = 0,1$ $\varnothing 17$	Heating		Occupied area, $\varnothing 17$ [ΔT 9 K]		Boundary zone [ΔT 15 K]	
	Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10		3,8	100	27	175	47
VA 15		3,4	99	29	173	51
VA 20		3,1	96	31	169	55
VA 25		2,8	91	33	160	58
VA 30		2,5	87	35	152	61



$R_{f,B} = 0,15$ $\varnothing 17$	Heating		Occupied area, $\varnothing 17$ [ΔT 9 K]		Boundary zone [ΔT 15 K]	
	Installation spacing T [mm]	Offset coefficient K_H	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]	Thermal output Q_H [W/m ²]	Heating medium upper temperature $\Delta\theta_H$ [K]
VA 10		3,1	100	32	175	56
VA 15		2,8	100	35	175	62
VA 20		2,6	99	38	173	66
VA 25		2,4	94	39	165	69
VA 30		2,2	91	41	159	72

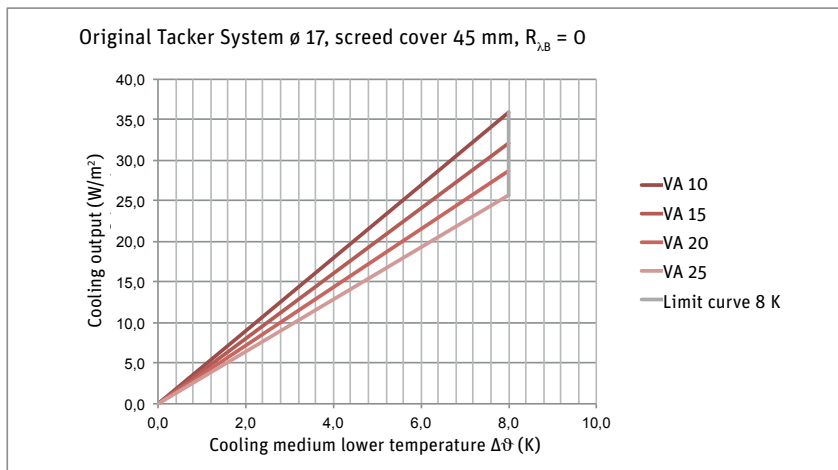


Performance data

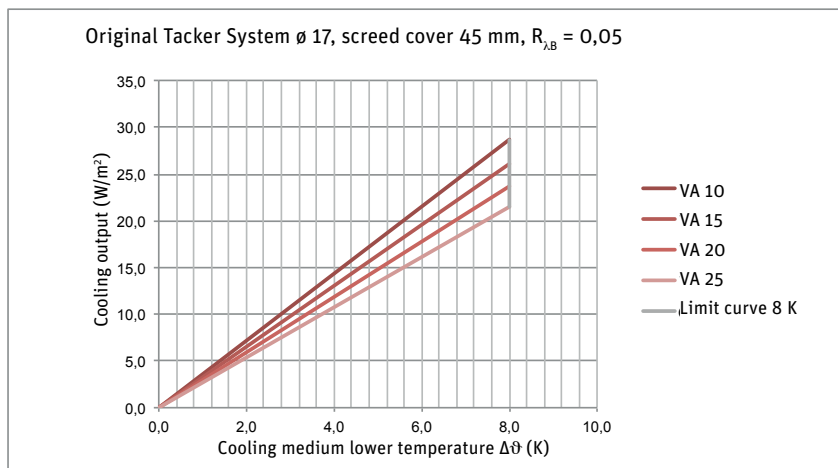


Performance data Roth Original Tacker® System Ø 17, Cooling

$R_{\lambda,B} = 0$ Ø 17	Cooling	Occupied area, Ø 17 [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	4,5	36	8
VA 15	4,0	32	8
VA 20	3,6	29	8
VA 25	3,2	26	8



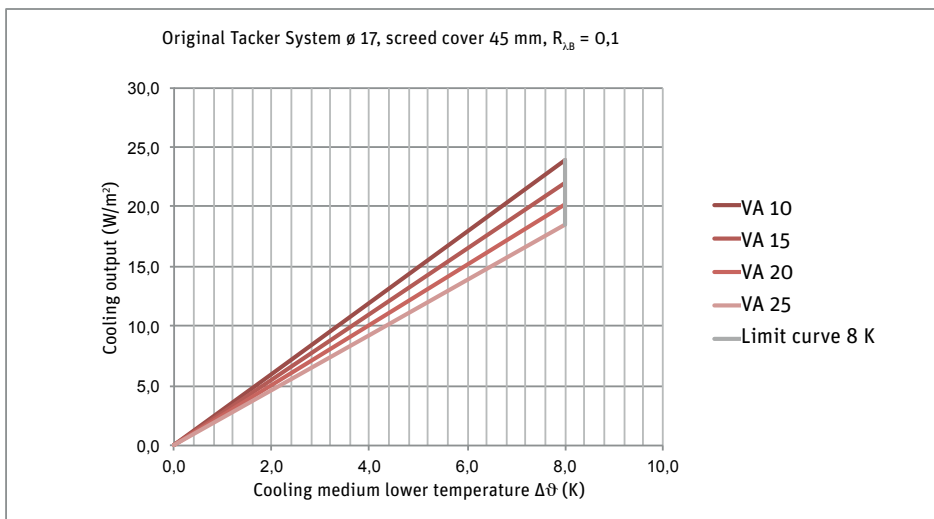
$R_{\lambda,B} = 0,05$ Ø 17	Cooling	Occupied area, Ø 17 [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	3,6	29	8
VA 15	3,3	26	8
VA 20	3,0	24	8
VA 25	2,7	22	8



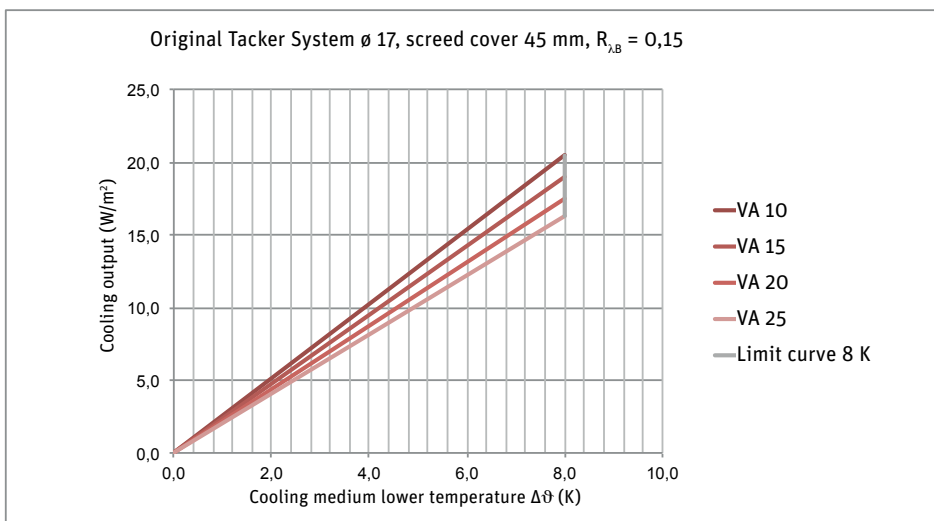
Performance data



$R_{f,B} = 0,1$ Ø 17	Cooling	Occupied area, Ø 17 [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	3,0	24	8
VA 15	2,7	22	8
VA 20	2,5	20	8
VA 25	2,3	19	8



$R_{f,B} = 0,15$ Ø 17	Cooling	Occupied area, Ø 17 [ΔT 8 K]	
Installation spacing T [mm]	Offset coefficient K_c	Cooling output Q_c [W/m ²]	Cooling medium lower temperature $\Delta\theta_{CN}$ [K]
VA 10	2,6	21	8
VA 15	2,4	19	8
VA 20	2,2	18	8
VA 25	2,0	16	8





Determining the performance data

The performance data for the heating and cooling surfaces on the floor has been calculated according to DIN EN 1264 and registered with and monitored by DIN CERTCO.

DIN CERTCO registration number: 7F087-F and 7F083-F

Heating:

Thermal output (q) = Heating medium upper temperature ($\Delta\vartheta_H$) * offset coefficient (K_H)

q: Thermal output of floor heating systems divided by effective surface [W/m²]
 $\Delta\vartheta_H$: Heating medium upper temperature: Difference between heating medium temperature and inside temperature [K] (temperature difference between heating medium and room)
 K_H : offset coefficient (equivalent thermal transmission coefficient) [W/m²K]
Heating medium or coolant: Water

Heating medium upper temperature

Logarithmically determined (precisely):

$$\Delta\vartheta_H = \frac{\vartheta_V - \vartheta_R}{\ln \frac{\vartheta_V - \vartheta_i}{\vartheta_R - \vartheta_i}}$$

ϑ_V : Inlet temperature
 ϑ_R : Return temperature
 ϑ_i : Room temperature

Simplified:

$$\Delta\vartheta_H = \frac{\vartheta_V - \vartheta_R}{2} - \vartheta_i$$

Cooling:

Cooling output (q_c) = Cooling medium lower temperature ($\Delta\vartheta_C$) * offset coefficient (K_C)

q_c: Specific standard cooling output of integrated cooling systems [W/m²]
 $\Delta\vartheta_C$: Temperature difference between room and coolant for cooling systems (cooling medium lower temperature) [K]
K_c: Increase in characteristic curve (cooling) [W/m²K]

Cooling medium lower temperature:

$$\Delta\vartheta_C = \frac{\vartheta_{C,out} - \vartheta_{C,in}}{\ln \frac{\vartheta_{C,in} - \vartheta_i}{\vartheta_{C,out} - \vartheta_i}}$$

$\vartheta_{C,out}$: Outlet temperature of the cooling water (return)
 $\vartheta_{C,in}$: Inlet temperature of the cooling water (inlet)
 ϑ_i : (Standard) inside temperature ($\vartheta_{in} = 26$ °C)

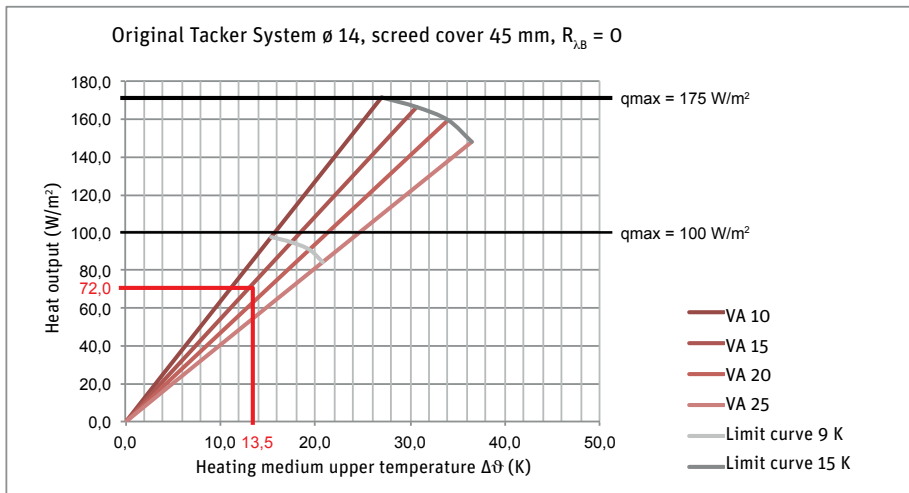
Performance data



Example – Performance calculation, heating

Example, heating – Performance calculation with diagram:

ϑ_V :	Inlet temperature	40 °C [K]
ϑ_R :	Return temperature	35 °C [K]
ϑ_i :	Bathroom temperature	24 °C [K]
$R_{\lambda,B}$:	Thermal resistance	0 m ² K/W
VA:	Planned installation spacing	15 cm
$\Delta\vartheta_H$:	Heating medium upper temperature	calculated from formula (precisely): 13,34 K, simplified: 13,5 K
q:	Power output	72 W/m ² (read)



Example, heating – Performance calculation with formula:

Thermal output (q) = Heating medium upper temperature ($\Delta\vartheta_H$) * offset coefficient (K_H)

ϑ_V :	Inlet temperature	40 °C [K]
ϑ_R :	Return temperature	35 °C [K]
ϑ_i :	Bathroom temperature	24 °C [K]
$R_{\lambda,B}$:	Thermal resistance	0 m ² K/W
VA:	Planned installation spacing	15 cm
$\Delta\vartheta_H$:	Heating medium upper temperature	calculated from formula (precisely): 13,34 K, simplified: 13,5 K
K_H :	Offset coefficient	5,4 (from table)
q:	Power output	5,4 x 13,34 = 72,04 W/m ² , simplified: 72,90 W/m²

$R_{\lambda,B} = 0$ \varnothing 14	Heating
Installation spacing T [mm]	Offset coefficient K_H
VA 10	6,3
VA 15	5,4
VA 20	4,7

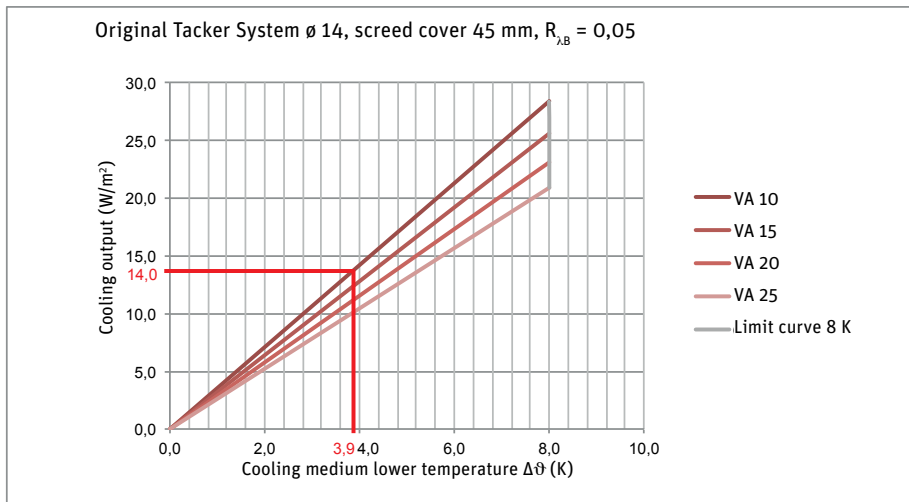
Performance data



Example – Performance calculation, cooling

Example, cooling – Performance calculation with diagram:

- $\vartheta_{C,out}$: Outlet temperature of the cooling water 22 °C
- $\vartheta_{C,in}$: Inlet temperature of the cooling water 17 °C
- ϑ_i : Room temperature 24 °C
- VA: Planned installation spacing 10 cm
- $\Delta\vartheta_c$: Cooling medium lower temperature calculated from formula (precisely): 3,991 K
- q_c : Power output **14 W/m²**



Example, cooling – Performance calculation with formula:

Cooling output (q_c) = Cooling medium lower temperature ($\Delta\vartheta_c$) * offset coefficient (K_c)

- $\vartheta_{C,out}$: Outlet temperature of the cooling water 22 °C
- $\vartheta_{C,in}$: Inlet temperature of the cooling water 17 °C
- ϑ_i : Room temperature 24 °C
- VA: Planned installation spacing 10 cm
- $\Delta\vartheta_c$: Cooling medium lower temperature calculated from formula (precisely): 3,991 K
- K_c : Offset coefficient 3,5 K ($R_{\lambda,B} = 0,05$ from the table)
- q_c : Power output **$3,5 \times 3,991 = 13,97 \text{ W/m}^2$**

$R_{\lambda,B} = 0,05$ \varnothing 14	Cooling
Installation spacing T [mm]	Offset coefficient K_c
VA 10	3,5
VA 15	3,2
VA 20	2,9

Installation requirements

The rooms must be free from frost, closed and the interior plasterwork finished.

■ Subsurface

The supporting subsurface must be dry and clean-swept before installing the Roth Original Tacker® System.

In the case of flooring areas touching the ground, or areas where rising damp is anticipated, seals against ground moisture and non-pressurised water in accordance with DIN 18195 are provided. The specifications of the construction planner apply here.

If seals made of PVC or bitumen are laid on the unfinished floor, these must be covered with a suitable separating layer or film.

The supporting subsurface must satisfy the structural requirements for bearing the flooring construction and the intended traffic load.

The height and evenness of the surface of the supporting subsurface must correspond at least to the requirements of DIN 18202 "Tolerances in building construction" Table 3 line 2.

Uneven areas or pipes installed on the unfinished covering are compensated by installing a levelling insulation, laying a levelling screed or a levelling compound in accordance with DIN 18560 in order to produce a horizontal and even surface to accommodate the system insulation.

Evenness tolerances					
Measuring points distance (m)	0,1	1,0	4,0	10,0	15,0
Evenness tolerances in (mm)	5	8	12	15	20

The subsurface must be very carefully levelled so that the insulate panels has full contact.

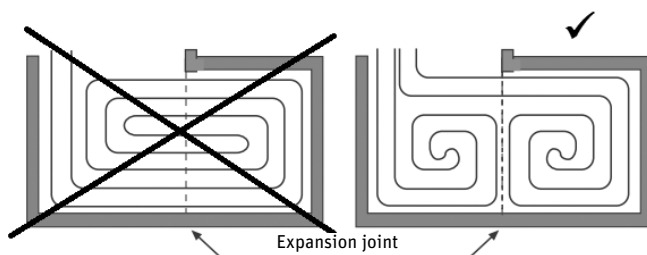
Grainy, loose materials are not suitable for levelling.

■ Joints

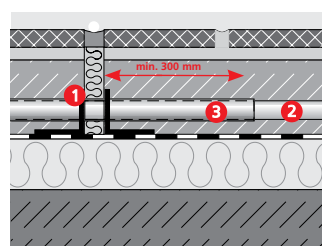
Construction joints from the supporting surface must be adopted in the flooring design.

Expansion joints on top of construction joints must not be crossed by connecting pipes. The heating circuit allocation is adjusted by the installation of additional manifolds.

Expansion joints are designed corresponding to the recognised rules of technology for screeds.



The heating circuits must be designed such that the expansion joints are not exceeded. Connecting pipes, which cross expansion joints, must be jacketed with a PE protective pipe (illustration).



- 1 Roth expansion joint profile
- 2 Roth System Pipe
- 3 Roth PE protective pipe at least 300 mm on both sides of the joint

Installation requirements

■ Edge insulating strips

The Roth edge insulation strip is attached all the way round to all rising components, walls, frames, supports and steps, before installation of the Roth system composite panels or rolls.

It must be ensured here that the PE film affixed to the edge insulating strips is fitted without tension across the system composite panels and that, for calcium-sulphate tile screeds, adhesive tape is not used. As a result, the penetration of water and screed into the insulation is prevented and direct contact between screed and wall is prevented, so that sound bridges cannot be formed.

For multiple-layer insulation layers, the Roth edge insulating strip is only fitted after the lower layers have been laid, so that the impact sound insulating layer is fully separated from the rising components.

The PE film affixed to the Roth edge insulating strip covers the joint between edge insulating strip and composite panel or roll. Particular care is required when using tile screeds. It must be ensured here that the insulating layer cover including the edge connections is watertight.

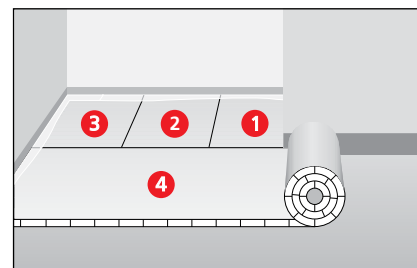
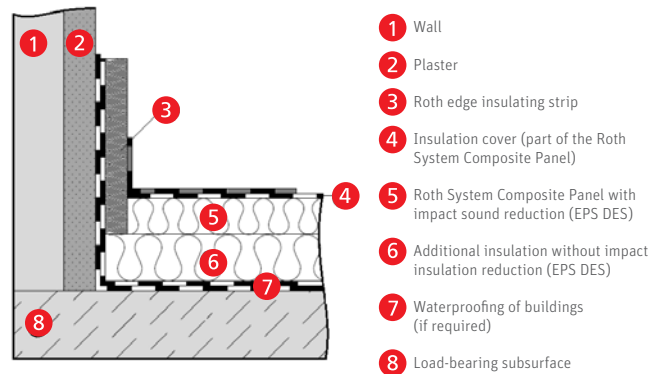
■ Insulation

In addition to DIN EN 1264 “For surface embedded heating and cooling systems”, the respective applicable directives of EnEV and the requirements of DIN 4109 on impact sound insulation must be observed.

The overlapping edges on have to be cut off from both sides of the Roth system composite panels or rolls of the first row of a room. As a result, the composite panels or rolls can be placed directly on the Roth edge insulating strip. This prevents the formation of hollows between composite panel or roll and edge insulating strip.

When installing the Roth system composite panels or rolls, work is always started at the narrow side of the areas from right to left. The advantage of this is that the self-adhesive overlapping edges of the subsequent panels can already be placed on the fitted panels without them having to be lifted and displaced (figure).

Edge insulating strips with multiple-layer insulation



Installation sequence

For double-layer installation, ensure that the top layer is installed with offset joints to the bottom layer. If installation or electrical cables are laid on the bare floor, the first layer must be adjusted such that a full-surface and completely closed surface is created for the second layer (Roth system composite panel or roll).

Installation requirements

■ Pipes

The optimum installation temperature for the system composite panels and pipes is $> 10\text{ }^{\circ}\text{C}$.

For improved installation, pipes and system panels should already be stored in the rooms in order to prevent large temperature differences.

When installing the Roth System Pipes, it must be ensured that the smallest bend radius permitted according to DIN 4726 of $5 \times d_a$ (external diameter) of the system pipe is not exceeded. When installing the Roth System Pipe Alu-Laserflex, it must be ensured that a minimum bend radius of $3 \times d_a$ is not undercut, for Roth bending spring, and $5 \times d_a$ without Roth bending spring.

The Roth System Pipes must not be installed on subsurfaces with sharp edges. The system pipes should therefore be secured with the PE sheath, e.g. when passing through wall and ceiling areas.

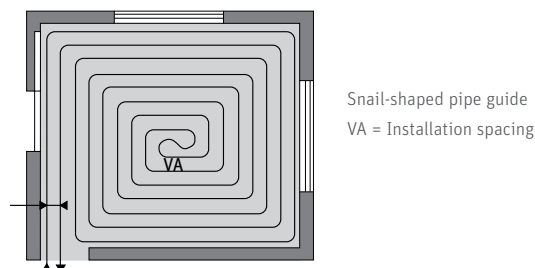
The installation of the Roth System Pipes starts with the connection of the heating circuit flow to the Roth heating circuit manifold. We recommend snail-shaped installation, in which installation takes place at twice the required installation spacing according to the plan until the turning loop is reached (illustration). The calculated installation distance is achieved by installing the heating circuit return.

When connecting the Roth System Pipes to the Roth heating circuit manifold, pipe guide bends should always be used to protect the pipes in the deflection area.

■ Tools

We recommend using the following tools when installing the Roth Original Tacker® System:

- > Tape measure or folding ruler
- > Open-end spanner SW 30 mm for connecting Roth system pipes to the Roth manifold
- > Open-end spanner SW 38 mm and 46 mm for assembling the Roth ball valve 1"
- > Open-end spanner SW 27 mm and 30 mm if using the Roth brass fitting 14 mm, 16 mm, 17 mm or 20 mm



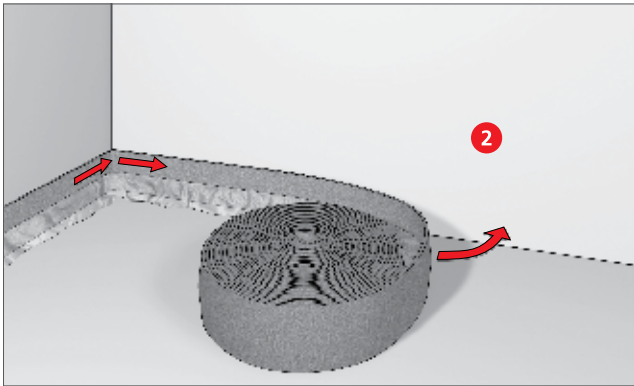
Heating circuits are installed with continuous system pipes. Connections in the screen must be avoided. If it becomes necessary, however, to install a Roth MS or Roth KU coupling in case of repair, it must be ensured that these are fitted in an unbent pipe length. The position of the coupling is measured and recorded in a diagram. The couplings have to be protected against contact with the screed by construction in the building.

The foldable Roth uncoiler is an ideal tool for pipe lengths of up to 600 m or the Roth uncoiler can be used for all pipe lengths and sizes.

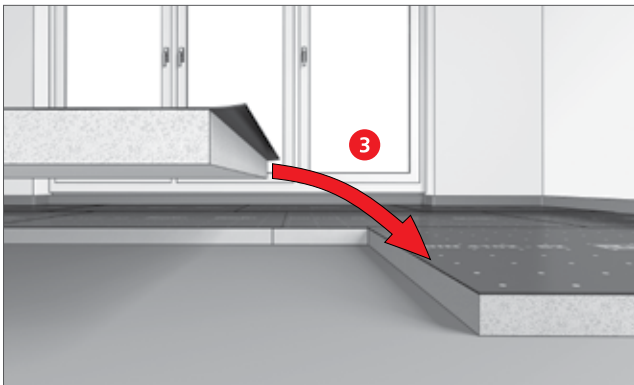
Moisture measurement points are part of an underfloor heating system and must be provided by the heating engineer. Fitting: At least 1 per accommodation unit and/or 3 per 200 m².

Only components from the Roth radiant heating range are registered for manufacturing all connections.

Assembly Instructions



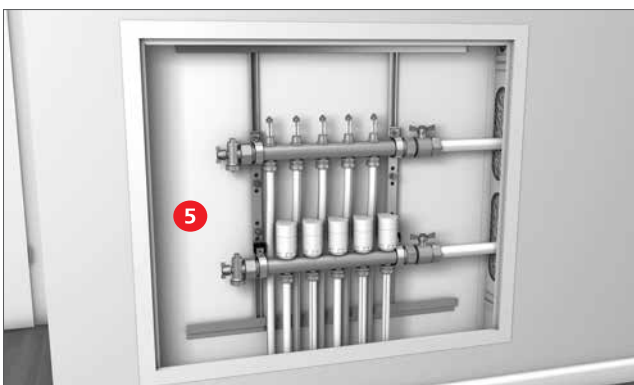
1. Check the installation requirements.
2. Lay the Roth edge insulating strip 160 mm.



3. Lay the Roth system composite panels or rolls.
The Roth expansion joint profiles are fitted at the places specified by the designer.



4. Lay the Roth System Pipes in the prescribed installation spacing.



5. Connect the Roth System Pipes to the inlet and return of the Roth manifold.

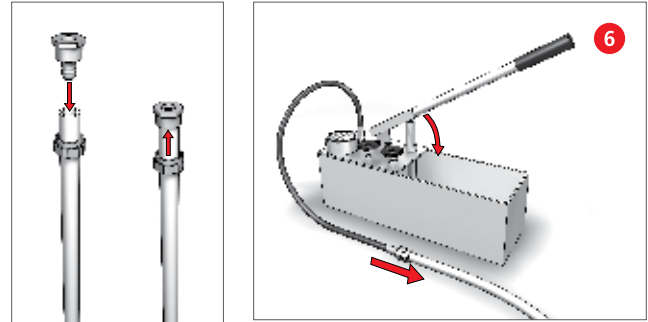
 **Heating fill-up water according to VDI 2035 (desalinated).**

Assembly Instructions

- 6. Leak test for radiant heating and cooling system according to DIN 1264 Part 4.

Procedure:

The heating or cooling circuits of the Original Tacker® System are checked for leaks by pressure testing. Tightness must be ensured immediately before and during installation of the load distribution layer.



See chapter Leak test protocol

- 7. Measurement points required.
The points are arranged in the centre of the room; there must be no pipes installed at these points.

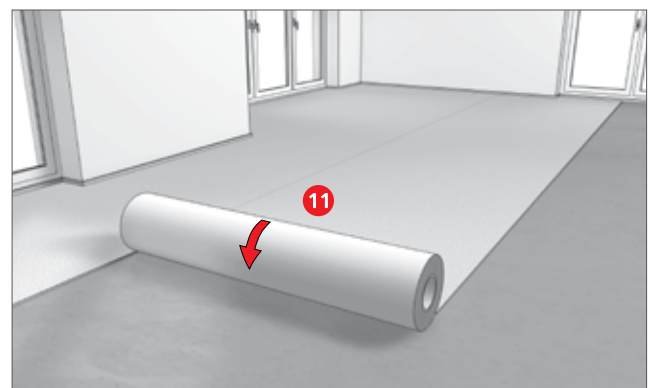
- 8. Apply screed.

- 9. Functional heating according to heating protocol.

- 10. If applicable, curing (in consultation with the floor layer).



- 11. Lay the upper layer.



Commissioning

■ Load distribution layer

Screed should be laid only at temperatures above +5 °C. The temperatures should be kept at the same level as much as possible for the entire curing time. The impact of drafts on the curing screed must be prevented.

The laying of anhydrite-bonded screeds as a load-distribution layer of the Roth Original Tacker® System is also possible. The processing guidelines from the various suppliers must be noted in this case.

■ Functional heating

Heating: (see form in chapter Heating protocol)
The heating of the load-distribution layer made of cement or anhydrite screed, the process has to be carried out according to DIN EN 1264 and recorded in writing.

It may be necessary, depending on the floor covering selected, to heat the screed again in order to achieve the permitted screed residual moisture in readiness for covering.

■ Floor coverings

Before starting laying the floor coverings, the screed is checked for readiness for covering. The foorer can check the moisture content with a CM measurement at the prescribed points.

The screed's maximum permitted moisture content in %, determined with the CM device			
Floor coverings	Cement screed target		Calcium sulphate screed target
elastic floor coverings, textile floor coverings	vapour-tight	1,8	0,3
	vapour-permeable	3,0	1,0
Parquet/cork	-	1,8	0,3
Laminate flooring			
Ceramic tiles or natural/concrete stone	Thick bed	3,0	-
	Thin bed	2,0	0,3

(Technical information service surface heating BVF, interface coordination for heated floor constructions).

■ Control technology

In order to fulfil the requirements defined in the EnEV for control technology for surface heating (single room controls and water

precontrols), all control components in the area of the Roth radiant heating and cooling systems can be used.

Leak test protocol

**with a view to conducting a leak test on radiant heating and cooling systems
in accordance with DIN EN 1264, Part 4**

Building project: _____

Client: _____

Contractor: _____

The following Roth radiant heating and cooling system has been installed as part of the above-mentioned building project:

System

- Roth Original Tacker® System
- Roth Knob System
- Roth ClimaComfort® Dry Construction System
- Roth Pipefix System
- Roth ClimaComfort® Panel System
- Roth ClimaComfort® Compact System
- Roth industrial radiant heating/
Non-residential property
- Roth sport and sprung floor heating
- Roth structural temperature control
- Roth outdoor panel heating
- Roth Flipfix Tacker System
- Roth Quick Energy® Tacker System

Pipe type

- | | |
|--|-------------------------------|
| <input type="checkbox"/> Roth DUOPEX S5® | <input type="checkbox"/> ø 14 |
| | <input type="checkbox"/> ø 17 |
| | <input type="checkbox"/> ø 20 |
| | <input type="checkbox"/> ø 25 |
| | <input type="checkbox"/> ø 32 |
| <input type="checkbox"/> Roth X-PERT S5®+ | <input type="checkbox"/> ø 14 |
| | <input type="checkbox"/> ø 16 |
| | <input type="checkbox"/> ø 17 |
| | <input type="checkbox"/> ø 20 |
| <input type="checkbox"/> Roth Alu-Laserflex | <input type="checkbox"/> ø 14 |
| | <input type="checkbox"/> ø 16 |
| <input type="checkbox"/> Roth ClimaComfort® S5 | <input type="checkbox"/> ø 11 |
| <input type="checkbox"/> Roth PERTEX® S5 | <input type="checkbox"/> ø 17 |

The leak test can be performed using water, compressed air or inert gas.

The heating circuits have been checked for leaks before fitting the load-distribution layer.

All pipelines are sealed with metal plugs, caps, etc. Any apparatus, pressure containers or fittings not suitable for the pressure test have been removed.

Ambient temperature: _____ °C

Temperature of testing medium: _____ °C

Leak test protocol

Testing medium, compressed air or inert gas:

Oil-free pressurised air Nitrogen Carbon dioxide

All pipe connections have been visually inspected to check they have been properly executed.

Test pressure: _____ **150 mbar**

Test period (up to pipework volume of 100 l) **120 min**
For every additional 100 l _____ **+ 20 min**

Once temperatures have been calibrated and a steady state attained for plastic materials, the test period then commences.

Pipework volume: _____ l **Test period:** _____ min

- No drop in pressure has been detected during the test period.
- There is no evidence of leaks.
- The test criteria have been satisfied.

Load testing at increased pressure

Test pressure $\varnothing \leq 63$ mm: _____ bar **(max. 3 bar)**
Test period: _____ min **(at least 10 min)**
For every additional 100 l _____ **+ 10 min**

Once temperatures have been calibrated and a steady state attained for plastic materials, the test period then commences.

- No drop in pressure has been detected during the test period.
- There is no evidence of leaks.
- The test criteria have been satisfied.

Town/City: _____

Date: _____

Developer/Client
Stamp/Signature

Construction Manager/Architect
Stamp/Signature

Heating engineering company/Installer
Stamp/Signature

Leak test protocol

Testing medium, water:

The test pressure must **not be less than 4 bar** and **not more than 6 bar**.

- The fill-up water has been adjusted and filtered acc. to VDI 2035-2. Heating circuits are fully vented.
- The temperature difference between the fill-up water and the environment does not exceed 10 °C.

Main test for smaller installations (e.g. on each floor) or preliminary test for large systems
Test period: 60 min

1. Permissible test pressure

$$P_{\text{test}} = 1,5 \times P_{\text{operation}} \qquad P_{\text{test}} \text{ Test pressure applied: } \underline{\hspace{2cm}} \text{ bar}$$

2 x P_{test} in 30 min Test pressure generated twice within 30 min.
 Time intervals between tests 10 min

2. Permissible pressure drop in 30 min

Max. 0,6 bar (0,1 bar/5 min)

$$P_{\text{min}} = P_{\text{test}} - 0,6 \text{ bar} \qquad P_{\text{actual}} \geq P_{\text{min}} \text{ (after 30 min): } \underline{\hspace{2cm}} \text{ bar}$$

- There is no evidence of leaks.
- The test criteria have been satisfied.

Main test for large objects (if required)
Test period 120 min

Permissible pressure drop: max 0,2 bar

$$P_{\text{min}} = P_{\text{test}} - 0,2 \text{ bar} \qquad P_{\text{actual}} \geq P_{\text{min}} \text{ (after 120 min): } \underline{\hspace{2cm}} \text{ bar}$$

- There is no evidence of leaks.
- The test criteria have been satisfied.

Suitable measures need to be taken if there is a risk of frost. These include using antifreeze and temperature equalisation of the building. When the system starts normal operation, any antifreeze can be drained and disposed of in accordance with national occupational health and safety requirements. The system then needs to be flushed through three times with clean water.

Town/City: _____

Date: _____

 Developer/Client
 Stamp/Signature

 Construction Manager/Architect
 Stamp/Signature

 Heating engineering company/Installer
 Stamp/Signature

Functional heating/cooling protocol

for radiant heating and cooling systems, Roth Original Tacker® System

Building project: _____

Client: _____

Construction stage: _____

Component: _____

Requirements

Functional heating should be performed to test whether the heated or cooled floor, wall, or ceiling structures are working properly.

With dry systems, functional heating should only be performed once any smoothing over or adhesive work is complete.

The smoothing agent or adhesive must be allowed to harden over. Any manufacturer's instructions must be followed. It is important to observe the maximum specified inlet temperature (usually up to 45 °C) for 1 day.

If there is a risk of frost, the installation should then be left running accordingly. Any manufacturer specifications which deviate from the standard or this protocol should be observed and logged as well.

Wall Ceiling Panel Ø 14 Roth Pipefix Ø 11 Roth Pipefix Ø 14

Documentation

Type of heat distribution layer (if necessary, the actual product): _____

Bonding agent used: _____

End of work on heat distribution layer (date): _____

Start of functional heating (date): _____

At constant max. specified inlet temperature $t_v =$ _____ °C (if necessary, using manual control)

End of functional heating (date): _____

Suitable protective measures need to be adopted if there is a risk of frost (e.g. frost protection mode).

The rooms were ventilated without draughts and all windows and outer doors closed after the radiant heating and cooling system was switched off.

Yes No

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

The installation was not in use at the time.

The heat distribution layer was heated to an inlet temperature of _____ °C.

Caution: When switching off the radiant heating after the heating up period, the heating surface needs to be protected from draughts and from cooling down too quickly until it is completely cold.

Confirmation:

Developer/Client
Stamp/Signature

Construction Manager/Architect
Stamp/Signature

Heating engineering company/Installer
Stamp/Signature

Standards and directives

The following laws, directives, guidelines, and standards need to be taken into account when planning and creating a heating installation:

- > German Energy Conservation Act (Energieeinsparungsgesetz - EnEG)
 - > German Energy Saving Directive (Energieeinsparverordnung - EnEV)
 - > German Heating Costs Directive (Heizkostenverordnung - HeizkostenV)
 - > The individual administrative instructions from the various German states regarding the EnEG
- Standards, guidelines, and German Contract Procedures for Building Works (Verdingungsordnung für Bauleistungen - VOB)**
- > DIN 1168 Building plasters
 - > DIN 4108 Thermal insulation and energy saving in buildings
 - > DIN 4109 Sound insulation in buildings
 - > DIN 4701 Part 10 Energy efficiency assessment of heating, hot water and ventilation systems in buildings
 - > DIN 4726 Warm water surface heating systems and radiator connecting systems - Plastics piping systems and multilayer piping systems
 - > DIN 18195 Water-proofing of buildings
 - > DIN 18202 Tolerances in building construction - Structures
 - > DIN 18336 VOB, Part C: Waterproofing
 - > DIN 18340 VOB, Part C: Dry lining and partitioning work
 - > DIN 18350 VOB, Part C: Plastering and rendering
 - > DIN 18352 VOB, Part C: Wall and floor tiling
 - > DIN 18380 VOB, Part C: Installation of central heating systems and hot water supply systems
 - > DIN 18382 Electrical cable and wiring system in buildings
 - > DIN 18560 Floor screeds in building construction
 - > DIN V 18599 Energy efficiency assessment of buildings – Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting
 - > DIN EN 1264 Water based surface embedded heating and cooling systems
 - > DIN EN 1991-1-1 Actions on structures
 - > DIN EN 12831 Heating systems in buildings – Method for calculation of the design heat load
 - > DIN EN 13162 – DIN EN 13171 Thermal insulation products for buildings
 - > DIN EN 13501 Fire classification of construction products and building elements
 - > DIN EN 13813 Screed material and floor screeds - Screed materials - Properties and requirements
 - > DIN EN 13914 Design, preparation and application of external rendering and internal plastering
 - > VDI 2035 Part 2 Prevention of damage in water heating installations - Water-side corrosion

Guarantee

The guarantees and warranty conditions apply to the Roth Original Tacker® System according to the warranty certificates enclosed with the products.

CERTIFICATE OF GUARANTEE

Roth Floor Heating and Cooling Systems

Roth Pipe Installation Systems

1. Within a 10 years following installation, although no longer than 10 1/2 years following delivery of the system components, we will provide, in accordance with our preference, either free-of-charge product replacement or repair and damage replacement in the event that damage appears in the system components which we have supplied which were caused by faults in materials or production.

Excluded from this are mechanical moving parts and products as well as electrical and electrically-powered parts and products for which we have provided the guarantee services in the event of faults in materials or production listed above within a time period of 12 months following installation.

2. Prerequisites for this guarantee are:
 - a. exclusive use and installation of all system components belonging to the respective Roth Floor Heating System/Pipe Installation System,
 - b. documented adherence to the planning, installation and operating instructions respectively valid at the time of the installation,
 - c. adherence to the standards and regulations valid for this work type and for the relevant adjacent work types in connection with the respective Roth Floor Heating System/Roth Pipe Installation System,
 - d. that the installation company and the companies carrying out the construction/finishing work types are respectively recognised and authorised specialist companies and that these companies have verified their confirmations with names and signatures on this certification document,
 - e. that a completely filled out copy of this guarantee certificate is sent back to us without delay,
 - f. that damages are immediately reported to us with simultaneous forwarding of the guarantee certificate,
 - g. that claims are made within the guarantee period.

We are insured against claims made in this agreement under an extended company and product liability insurance policy with a coverage amount of **5.000.000 Euros** per occurrence for personal and property injuries.

The stipulations contained in consumer protection laws are unaffected by this guarantee.

The preceding guarantee bond affects the following:

Object of construction: _____

Building contractor: _____

Radiant Heating and Cooling Systems:

- | | | |
|--|---|---|
| <input type="checkbox"/> Roth Original Tacker System | <input type="checkbox"/> Roth ClimaComfort Panel System | <input type="checkbox"/> Roth Sport Floor Heating System |
| <input type="checkbox"/> Roth Flipfix Tacker System | <input type="checkbox"/> Roth ClimaComfort Compact System | <input type="checkbox"/> Roth Isocore Concrete Core Temperature Control |
| <input type="checkbox"/> Roth Quick-Energy Tacker System | <input type="checkbox"/> Roth Pipe Fixing System | |
| <input type="checkbox"/> Roth Knob System | <input type="checkbox"/> Roth Industrial Radiant Heating System | |
| <input type="checkbox"/> Roth ClimaComfort dry Construction System | <input type="checkbox"/> Roth Outdoor Area Heating System | |

Roth Pipe installation systems:

- | | |
|--|---|
| <input type="checkbox"/> Roth Radiator Connection System | <input type="checkbox"/> Roth Domestic Hot Water System |
|--|---|

The system components belonging to the respective Roth Floor Heating System and/or the respective Roth Pipe Installation System were delivered and installed completely on the respective date of installation.

Floor Heating System: Area laid ____ m²

Radiator Connection System: Number of radiator connections ____ pieces

Domestic Hot Water System: Number of borrow area connections ____ pieces

Specialist heating company:

Signature _____ Stamp _____ Date of installation _____

Construction/
finishing work types:

Signature _____ Stamp _____ Date of completion _____

Commissioning:

Signature _____ Stamp _____ Date of completion _____

Signature _____ Stamp _____ Date of the commissioning _____



ROTH WERKE GMBH
Am Seerain 2 · 35232 Dautphetal · Phone + 49(0)6466/922-0 · Fax +49(0)6466/922-100
Technical Support + 49(0)6466/922-266 · E-Mail service@roth-werke.de · www.roth-werke.de

Our strengths

Your benefits

Innovation

- > Early identification of market requirements
- > In-house materials research and development
- > In-house engineering

Service

- > Extensive field network of qualified sales professionals
- > Hotline and project planning service
- > Factory training courses, planning and product seminars
- > Fast availability of all Roth brand product ranges throughout Europe
- > Comprehensive warranty and extended liability agreements

Products

- > Complete range of easy-to-install product systems
- > Manufacturing expertise for the complete product range within the Roth Industries group of companies
- > All products and product systems are certified in accordance with DIN EN ISO 9001:2008





Roth Energy and Sanitary Systems

Generation

- > Solar Systems
- > Heat pump systems
- > Solar heat pump systems

Storage

- Storage systems for
- > Domestic and heating water
 - > Combustibles and biofuels
 - > Rainwater and waste water

Application

- > Radiant heating and cooling systems
- > Pipe installation systems
- > Shower Systems



ROTH WERKE GMBH
 Am Seerain 2
 35232 Dautphetal, Germany
 Telephone: +49 (0)6466/922-0
 Fax: +49 (0)6466/922-100
 E-mail: service@roth-werke.de
www.roth-werke.de

