COMB PANEL SYSTEM WP
TECHNICAL DESCRIPTION

APPLICATION FIELD

RETROFIT OF OLD BUILDINGS

» underfloor heating with extremely low building height.
» system can be fit upon old, but load-bearing floor boards and other floorings.
» system can be fit upon worn-out and contaminated sub-floors.
» imperfections of up to 0,2 m² per m² can be covered with the effidur floor system (for larger imperfections please contact us).
» unevenness of up to 20 mm can be balanced out by backfilling with system screed without further works.
» considerable improvement of sound insulation of the floor feasible.

INDUSTRIAL BUILDINGS

» highly load-bearing traffic areas with low heights.
» heated and chilled industrial floors / ceilings.

NEW BUILDINGS / PRE-FABRICATED BUILDINGS

» floors with comfortable sound insulation feasible in spite of lightweight construction.
» ceramic and natural stone floorings in combination with the comb panel system feasible upon nearly all kinds of sub-floors.

PUBLIC BUILDINGS / CHURCHES

» fast heat-up of temporarily used rooms (e.g. meeting rooms) easily possible.
» barrier-free building feasible (e.g. hospitals, homes for the elderly).

APPLICATION FILEDS ACC. TO LICIT AREA AND POINT LOADS

APPLICATION FIELD (EXAMPLE)			work load kN/m²	point load kN
A1	attic	non-suited for residential purposes, but accessible attic with clear height of up to 1.80 m	1,0	1,0
A2	lounge areas	rooms with sufficient lateral distribution of loads, rooms and hallways in residential buildings bed rooms in hospitals, hotel rooms incl. kitchen and bath rooms	1,5	-
A3		as A2, but without sufficient lateral distribution of loads	2,0	1,0
B1	offices, working areas, hallways	hallways in office buildings, offices, medical practice, waiting rooms, lounges incl. hallways, barns for small domestic animals	2,0	2,0
B2		hallways in hospitals, hotels, home for the elderly, boarding schools etc. kitchens, medical treatment rooms incl. operating rooms without heavy devices	3,0	3,0
B3		as B2, but with heavy devices	5,0	4,0
C1	rooms, meeting rooms and areas suited for meetings (except for categories A, B, D and E)	areas with tables e.g. class rooms, cafés, restaurants, dining halls, reading halls, entrance halls	3,0	4,0
C2		areas with firm seating, e.g. areas in churches, theatres or cinemas, convention halls, auditorium, waiting rooms	4,0	4,0
C3		freely accessible areas, e.g. museum areas, exhibition areas etc. entrance areas of public buildings and hotels, impassable yard cellar ceilings	5,0	4,0
C4		sports and play areas, e.g. dancing halls, sports halls, gymnastics and power sports areas, stages	5,0	7,0
C5		areas for large gatherings, e.g. in buildings as concert halls, terraces, entrance halls as well as tribunes with firm seating	5,0	4,0
D1	sales rooms	sales rooms up to 50 m² net area within residential or office buildings or similar	2,0	2,0
D2		areas in retail and department stores	5,0	4,0
D3		as D2, but with increased point loads due to high storage racks	5,0	7,0

excerpt from survey report of MPA Stuttgart, on the basis of DIN 1055 part 3, edition 2002

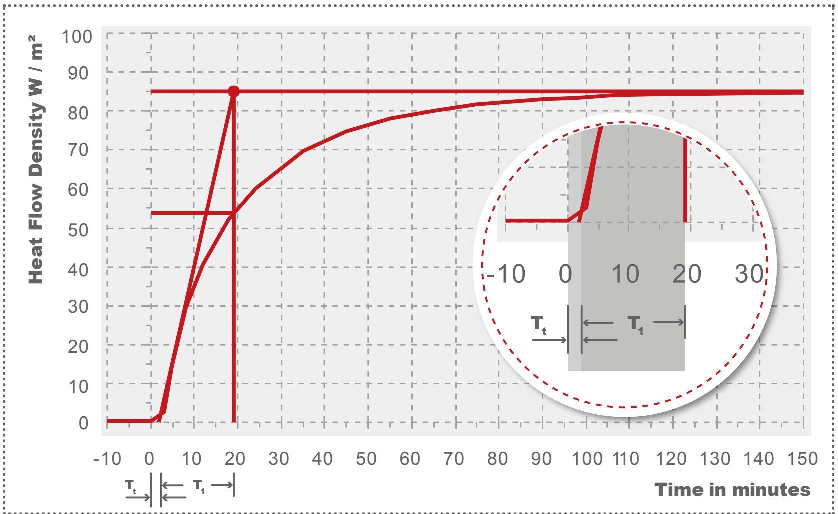
The matching especially with the according current edition of DIN EN 1991-1-1 and DIN EN 1991-1-1/NA is necessary!

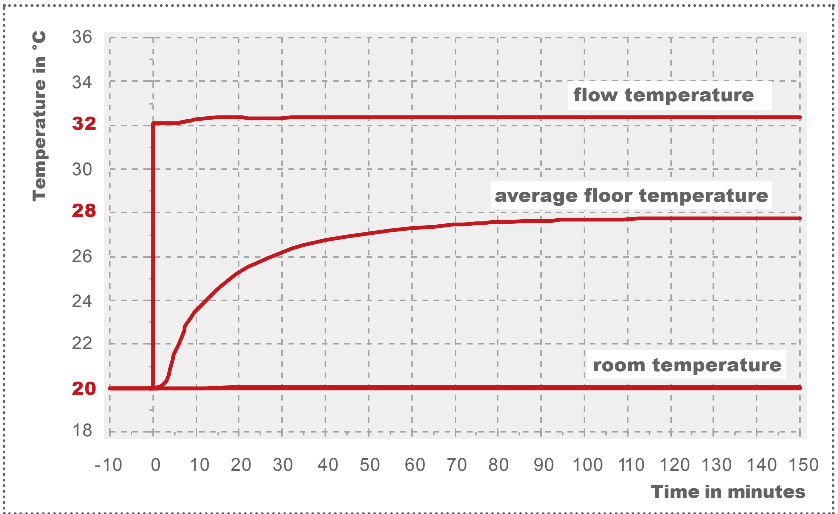
HEATING / COOLING

STANDARD PLANNING VALUES FOR FLOOR COVERINGS

FLOOR COVERING	THICKNESS (d) in mm	THERMAL RESISTIVITY ($R_{\lambda,B}$) in m^2 K/W
soft stone, e.g. marble	12	0,006
ceramic tile	13	0,012
hard stone, e.g. granite	30	0,014
carpet	4 - 10	0,05 - 0,17
PVC	2	0,010
linoleum	2,5	0,015
mosaic parquet (oak)	8	0,038
laminate	9	0,044
strip parquet (oak)	16	0,086
strip parquet (oak)	22	0,105
cork prefinished parquet	11	0,13

HEATING-UP BEHAVIOUR





In order to evaluate the time response of the effidur floor system WP 1000 a heating-up chart has been recorded showing the time dependent behaviour of the surface temperatures and the heat flow density of the underfloor heating area.

Based on a non-operating state of the effidur floor system with 20 °C, the heat water flow has been activated and the flow temperature has been increased to 32 °C in order to reach an average surface temperature of approximately 28 °C.

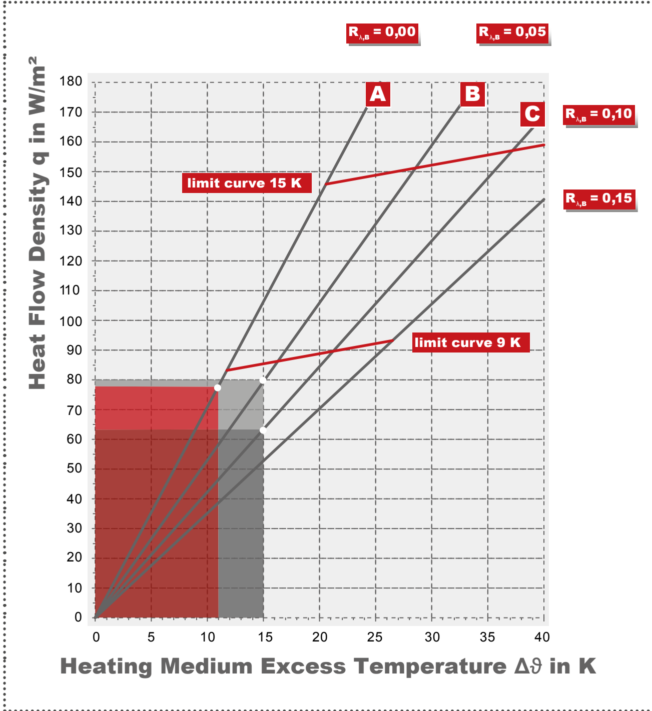
The results are shown in the charts.

It became apparent that already 19 minutes after activating the heat water flow 63.2 % of the total licit output had been reached as requested for comparing.

Hereby the effidur floor system requires a two-minute initiation period (T_t) and 17 minutes pure heating-up time (T_1).

test set-up» Klima WP 1000 including 5 mm system screed (SFM) overlap, heating pipe 8 x 1,1 mm, pipe distance 120 mm

HEAT OUTPUT



thermal resistivity of flooring				
$R_{\lambda, B}$ in m² K/W	0,00	0,05	0,1	0,15
characteristic curves of floor system $q = K_H \times \Delta\vartheta$				
K_H in W/m²K	7,089	5,294	4,224	3,514
limit of specific thermal output for residential areas $\vartheta_{F,max} - \vartheta_i = 9$ K				
q_{G1} in W/m²	83,1	86,2	89,6	93,2
$\Delta\vartheta_{G1}$ in K	11,72	16,29	21,21	26,53
limit of specific thermal output for border areas $\vartheta_{F,max} - \vartheta_i = 15$ K				
q_{G2} in W/m²	145,7	151,2	157,1	163,5
$\Delta\vartheta_{G2}$ in K	20,56	28,57	37,2	46,53
heat transfer coefficient				
underfloor heating» α_F = 10,80 W/m² K				

Klima WP 1000 including 5 mm system screed (SFM) overlap, heating pipe 8 x 1,1 mm, pipe distance 120 mm

EXAMPLE CALCULATIONS» AT 20 °C ROOM TEMPERATURE

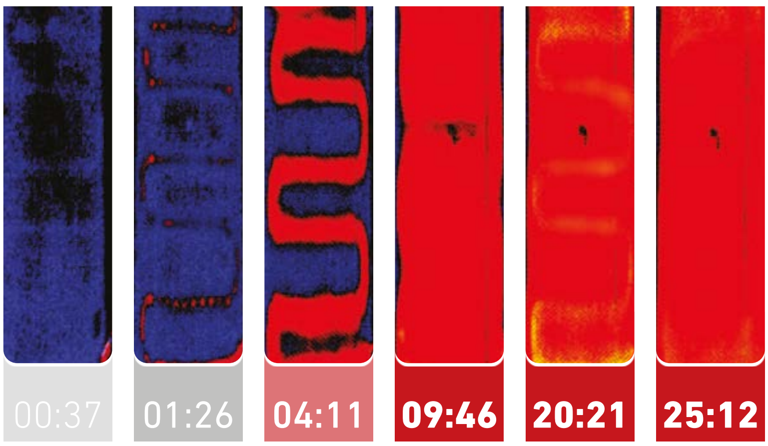
e.g.	Floor Covering	Thermal Resistivity	Average Temp. of Heating Medium	Achieved Heat Flow Density
A	tile	0,00 m² K/W	31 °C	78,0 W/m²
B	Laminate	0,05 m² K/W	35 °C	79,4 W/m²
C	strip parquet 22 mm	0,10 m² K/W	35 °C	63,4 W/m²

MAXIMUM FLOOR SURFACE TEMPERATURES ACC. TO DIN EN 1264

lounge areas»	to 29 °C	In order to avoid excessive surface temperatures,
bathrooms»	to 33 °C	the flow temperature of floor systems with integrated heating
border areas»	to 35 °C	needs to be set accordingly.

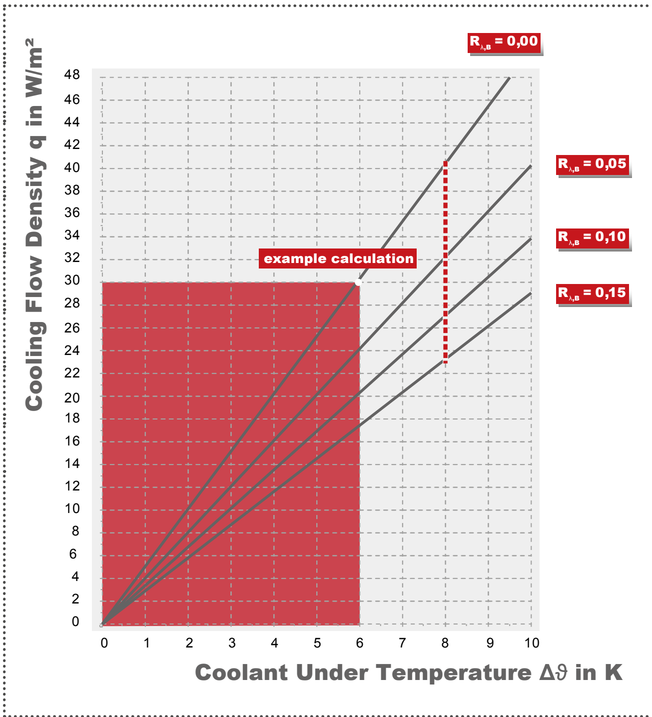
HEAT SPREADING BEHAVIOUR

Time-dependent heat spreading (data in minutes) – tested and confirmed by MFPA *[Leipzig Institute for Materials Research and Testing]*.



MFPA
Leipzig Institute for Materials Research and Testing

COOLING OUTPUT



thermal resistivity of flooring				
$R_{\lambda, B}$ in m² K/W	0,00	0,05	0,10	0,15
characteristic curves of floor system $q = K_K \times \Delta\vartheta$				
K_K in W/m² K	4,98	4,04	3,39	2,91
cooling flow densitiy bei $\Delta\vartheta$ = 8 K				
q_G in W/m²	39,9	32,3	27,1	23,3
heat transfer coefficient				
Floor cooling » $\alpha_{F,K}$ = 6,50 W/m² K				

Klima WP 1000 including 5 mm system screed (SFM) overlap, heating pipe 8 x 1,1 mm, pipe distance 120 mm

EXAMPLE CALCULATION» thermal resistivity $R_{\lambda,B}$ = 0 m² K/W; room temperature 26 °C

Floor Covering	Flow Temperature	Return Flow Temperature	Return Flow Temperature
tile	18 °C	22 °C	≈ 30 W/m²

The cooling flow density has been determined based on the basic characteristic curve according to draft DIN EN 1264-5.

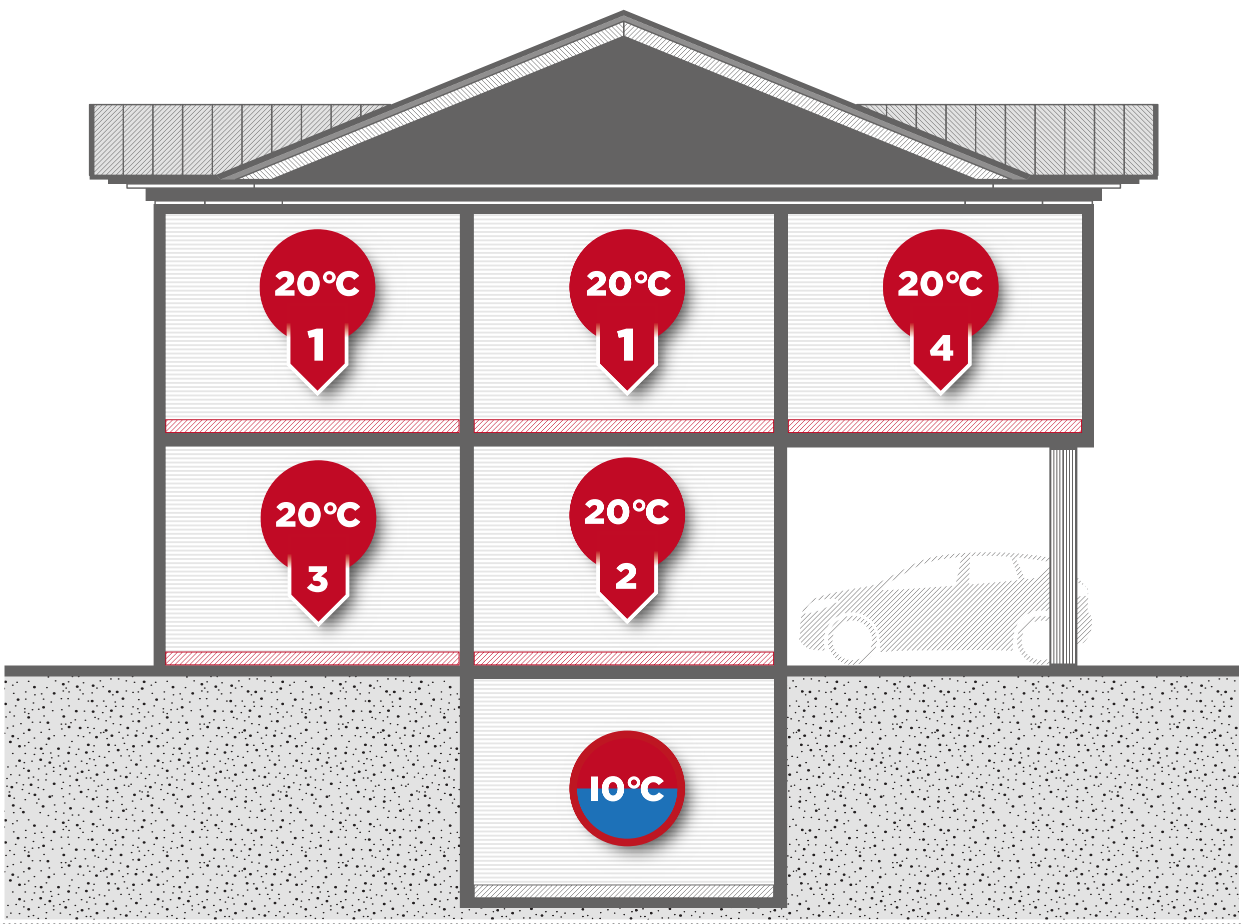
HEAT INSULATION

ADVICE

In order to limit the energy consumption within a building both for new buildings as well as for the retrofit of old buildings, amongst others the thickness of the heat insulation needs to be considered. For dimensioning the current Energy Saving Regulations are decisive. In Germany the Energy Saving Regulations EnEV 2009 respectively EnEV 2014 apply according to the date of the submitted building application until resp. after April 30th, 2014. In case the installation of the heat insulation is limited for technical reasons at the retrofit of old buildings, the requirements of the German Energy Saving Regulations are deemed to be complied with if the highest possible insulation thickness is fit according to the acknowledged rules of technology. Detailed requirements for the heat conductivity of the insulation(s) can be found at the according applicable Energy Saving Regulations. The Requirements of DIN EN 1264-4 apply for the insulation underneath an underfloor heating.

[please see other side for grafic of room situation]		REQUIRED MINIMUM THICKNESS IN mm			
What is underneath?	thermal resistivity $R_{\lambda, FB}$ in m²K/W lt. DIN EN 1264-4	wood fibre λ_D = 0,040 W/mK	foamed polystyrene (EPS) λ_D = 0,035 W/mK	polyurethane (PUR) double aluminium foil λ_D = 0,025 W/mK	VIP vacuum insulation λ_D = 0,008 W/mK
case 1 » heated room	0,75	30	26	19	6
case 2 and 3 » unheated / temporarily heated room / ground spoil	1,25	50	44	31	10
case 4 » design temperature T ≥ 0 °C	1,25	50	44	31	10
case 4 » design temperature 0 °C > T ≥ -5 °C	1,50	60	53	38	12
case 4 » design temperature -5 °C > T ≥ -15 °C	2,00	80	70	50	16

HEAT INSULATION» CHART OF ROOM SITUATION



HEATING PIPE

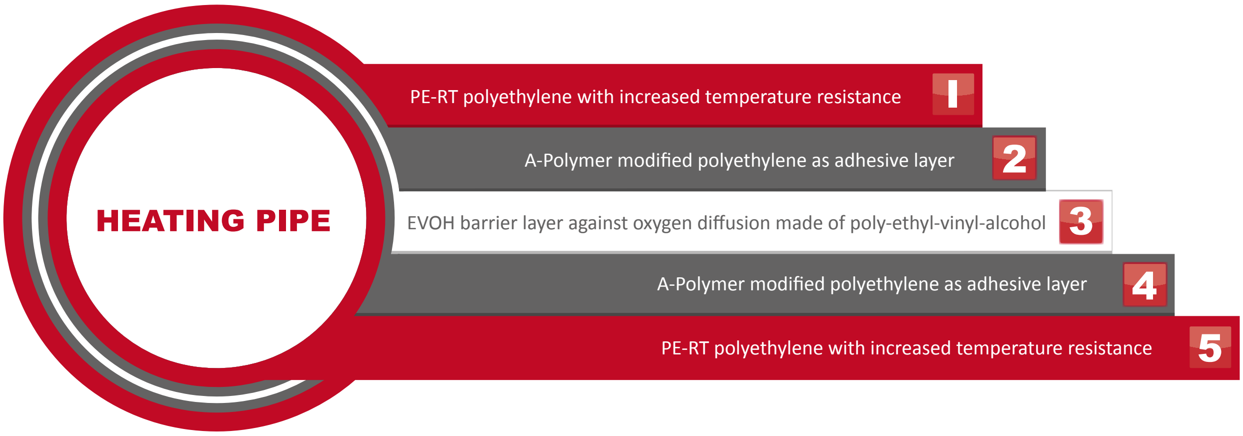
SET-UP & COMPONENTS

- Basic material and protection layer are made of PE-RT DOWLEX 2344.
- innovative synthetic, that does not require cross-linking; excellent features at high pressures and temperatures; extremely aging resistant.
- highly flexible and easy to handle.

FUNCTION OF THE PE-RT LAYERS

- protection of the oxygen barrier from mechanical damage, humidity and other environmental influences.
- protection of the oxygen barrier from aging.Increase of the resistence to internal pressure - with the effidur heating pipe the oxygen barrier improves the pipe stability (EVOH has excellent mechanical strength properties).
- Shrinkage is avoided; effidur pipes hardly show shrinkage (< 1,5 %; shrinkage known from PE-X does not occur).
- ideal for press fittings: protection of the oxygen barrier from ripping.

Flexible fully synthetic 5-layer compound pipe made of PE-RT 80 (Dowlex 2344) according to DIN 16833 and application standard DIN 4726. Oxygen impermeable according to DIN 4726 oxygen barrier protected between two PE-layers. The pipe is approved as PEOC-SYSTEM with the corresponding fittings through DIN CERTCO, approval mark 3V217 PE-RT. The effidur heating pipe meets the requirements of ISO 10508: category 4 (underfloor heating, 6 bar).



OXYGEN BARRIER EVOH

» high-barrier material poly-ethyl-vinyl-alcohol (EVOH).
» firmly affiliated to one unit with the pipe material PE-RT.
» avoiding oxygen diffusion until + 80 °C (requirement of DIN 4726 only until + 40 °C)
» oxygen permeability of approximately 0,1 mg / m²d (many times better than required by DIN 4726).

SILTING OF THE HEATING PIPE - NO WORRIES!

The service life of a heating facility is essentially determined by the service life of the used metallic and non-metallic materials. The service life of metals is significantly distinguished by generating and preserving a thin protection layer of metal oxides. This surface layer inhibits corrosion so that a service life according to VDI 2067 is achieved. Nevertheless, chemical and physical processes can damage the protection layer.

For a long time the diffusion of oxygen through the pipes used in an underfloor heating was deemed negligible in comparison to other input possibilities. Experience shows that this factor shouldn't be underestimated. The diffusing oxygen enhances the corrosion of the used metal parts that could lead to unintentional deposits within the heating system. This way the efficiency and functionality of the facility is lowered.

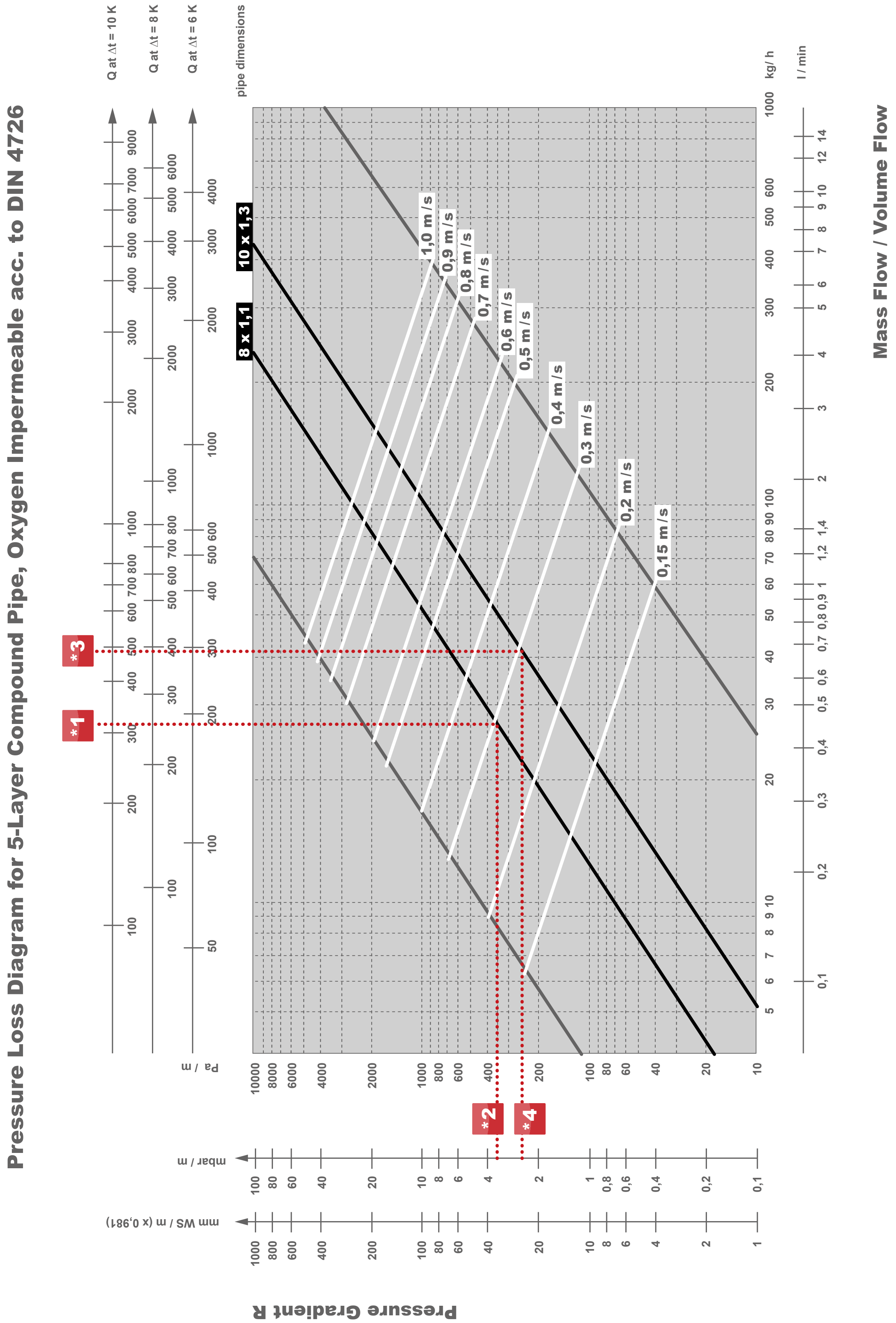
Therefore, the use of oxygen impermeable pipe, in the case of synthetic pipe with a reliably protected oxygen barrier, is indispensible in closed, technically gas proof heating systems. This also requires the regulation VDI 2035 sheet 2.

Effidur heating pipes have an organic oxygen barrier (EVOH) that limits the oxygen diffusion to approximately 0,1 mg / (m²d) and so undercuts the requirements of DIN 4726 (0,32 mg / (m²d)) many times.

The oxygen barrier is reliably protected from damage and humidity by the internal structure of the 5-layer compound pipe. Therefore externally sealing fittings can be used without problems.

When integrating an effidur floor heating or cooling system into an existing heating facility we recommend a hydraulic decoupling or the use of suited conditioning systems for the heating water (protection from lime and corrosion according to VDI 2035). The use of a flow filter additionally protects the heating system.

PRESSURE LOSS CHART FOR COMPOUND PIPE (PE)



PRESSURE LOSS CALCULATION - EXAMPLE »

Pressure loss determination for an underfloor heating in order to calculate the required pump performance when connecting to an existing heating system. Since all heating loops are installed parallel and have the same length, the pressure loss for one loop per sub-manifold needs to be determined.

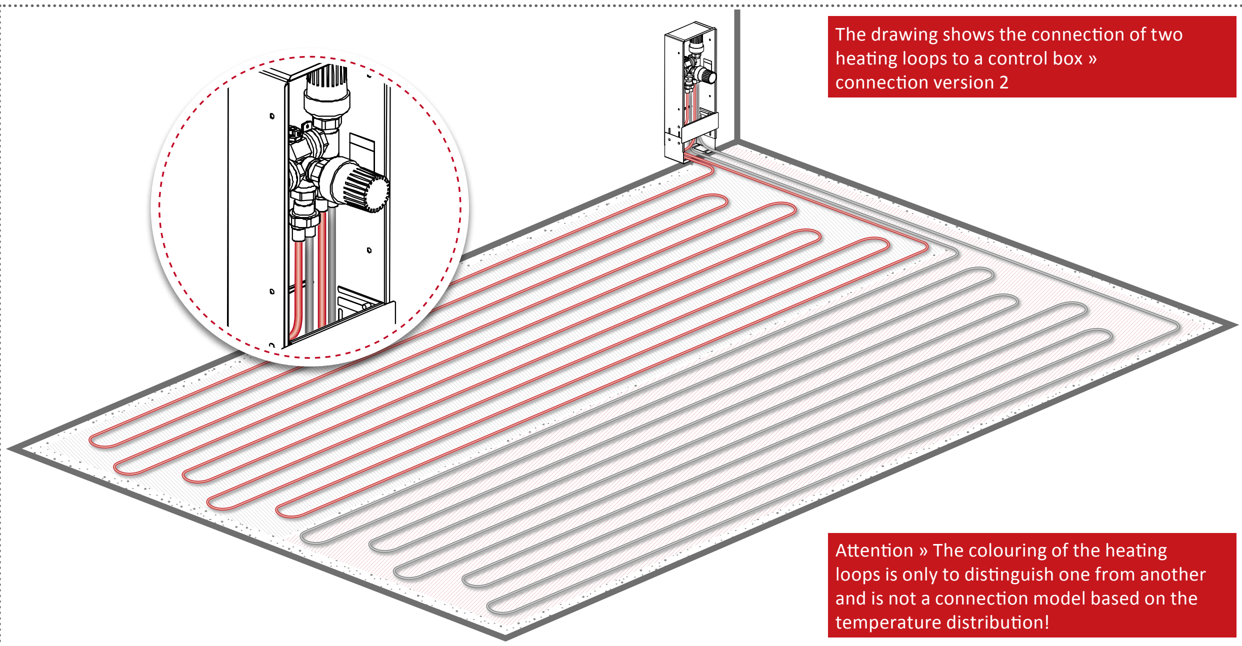
		heating pipe ø 8 x 1,1 mm	heating pipe ø 10 x 1,3 mm
LOCAL CONDITIONS	room size	16 m²	16 m²
	pipe length per heating loop	34 m	68 m
	area per heating loop	4 m²	8 m²
	number of heating loops	4	2
	manifolds for flow and return flow	2x UV 4-8	2x UV 2-10
	further components	thermostatic valve (flow), return temperature limiter (return flow)	thermostatic valve (flow), return temperature limiter (return flow)
	required heat flow density	80 W/m²	60 W/m²
	total heat output per heating loop (*1 resp. *3 at chart)	80 W/m² x 4 m² = 320 W	60 W/m² x 8 m² = 480 W
	temperature difference (flow - return flow)	10 K	10 K
PRESSURE LOSS PIPE	single value (*2 resp. *4 at chart)	3,5 mbar / m	2,5 mbar / m
	total value per heating loop (single value x length of heating loop)	119 mbar	170 mbar
PRESSURE LOSS SUB-MANIFOLD	value see chart "pressure loss of sub-manifold"	2 x 5 mbar = 10 mbar	2 x 5 mbar = 10 mbar
PRESSURE LOSS COMPONENTS	1 x thermostatic valve standard angled form at a mass flow rate of 110 resp. 82,5 kg/h	100 mbar	75 mbar
	1 x return temperature limiter standard angled form at a mass flow rate of 110 resp. 82,5 kg/h	22 mbar	17 mbar
PRESSURE LOSS TOTAL	sum of pressure losses pipe + manifolds + components	251 mbar ≈ 0,25 bar	272 mbar ≈ 0,27 bar

PRESSURE LOSS OF SUB-MANIFOLDS

	MODEL	PRESSURE LOSS
SINGLE PLUG CONNECTOR	STA AG-8 / STA IG-8 / STA IG-10	approx. 5 mbar
SUB-MANIFOLD 2-PORT / 4-PORT	UV2-8 / UV 2-10	approx. 5 mbar
	UV 4-8 / UV 4-10	approx. 5 mbar
MANIFOLD UNIT (≙ manifold bars)	VBG 4	approx.10 mbar
	VBG 6	approx. 10 mbar

CONNECTION OF THE HEATING PIPES

The heating pipes can be connected through effidur single plug connectors, 2-port or 4-port sub-manifolds or with effidur multi-port manifold units. These manifolds can individually be equipped with control elements. You find a wide range of manifolds and pre-assembled control units at the chapter COMPONENTS/SUB-DISTRIBUTION resp. COMPONENTS/CONTROL UNIT.
All manifolds of the effidur floor system have push connections with the John Guest principle. The manifolds might be installed in a wall recess or behind a dry wall in a distribution box. Pay attention to keep a minimum height of 200 mm between the distribution box and the floor.



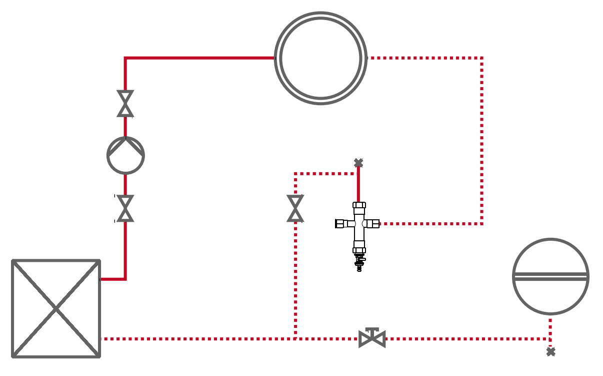
The drawing shows the connection of two heating loops to a control box » connection version 2

Attention » The colouring of the heating loops is only to distinguish one from another and is not a connection model based on the temperature distribution!

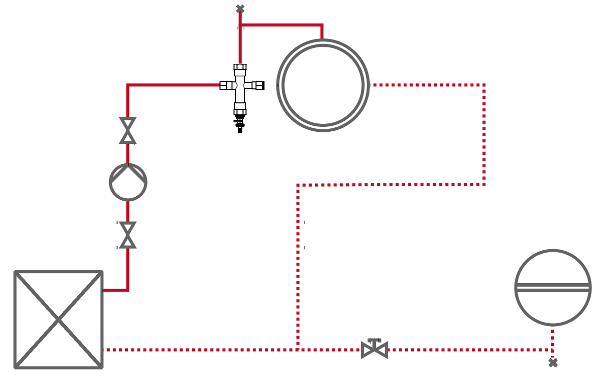
SYSTEM SEPARATION

When connecting the underfloor heating to an existing heating system we recommend the use of a flow filter or sludge collector for the entire heating system or for the underfloor heating only. Depending on the project it might be more favorable to install the filter or sludge collector directly at the flow (example 2) instead of shown in our example 1. This way contaminations of the existing facility from the installation, dirt or similar can't get into the loops of the underfloor heating. Pay attention to the manufacturer's instructions.

For existing heating facilities it might be useful for hydraulic reasons to separate the underfloor heating from the existing radiator heating. The underfloor heating needs then to be hydraulically separated from the rest of the facility through a heat exchanger. This way the underfloor heating can ideally be run with a separate pump. Pay attention to the manufacturer's instructions.



FLOW FILTER INSTALLATION EXAMPLE 1



FLOW FILTER INSTALLATION EXAMPLE 2

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