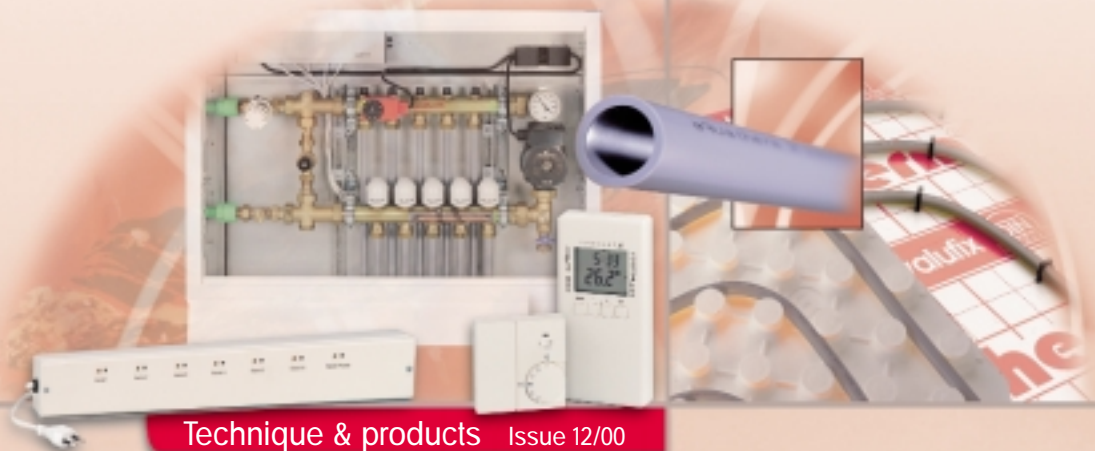


# aquatherm®

Floor heating systems



Technique & products Issue 12/00



# aquatherm®

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# Table of contents

1	Pipe material
2	Regulation
3	Heating circuit distributor
4	Floor construction
5	Planning / Design
6	Request for tender <small>Chapter 6 - A request for tender can be ordered separately under Order-no. D 90960.</small>
7	Installation instructions <small>The aquatherm®-installation instructions are added to the respective products. The instructions can also be ordered separately on request.</small>



Order-no. E 90011

## Technical Information

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## Table of contents

### Pipe material

PB-ducts

- 1.1 aquatherm®-floor heating pipes
  - operating conditions
  - handling
  - oxygen-tightness / heat exchanger
- 1.2 aquatherm®-floor heating pipes of polybutene (PB)
- 1.3 material characteristics
  - heating ducts of polybutene (PB)
    - modulus of elasticity
    - heating water additions
- 1.4
  - packing
  - supply
  - storage
  - own supervision
  - external supervision

Registration

### Regulation

Conditions

- 2.1
  - requirements
  - precontrol
  - programmable thermostat (night-lowering)
  - protection against excess temperature
  - circulating pump

Control-elements

- 2.2 aquatherm®-actuator
- 2.3 aquatherm®-room thermostat
  - with night-lowering
- 2.4 aquatherm®-timer thermostat  
aquatherm®-clock thermostat
- 2.5 aquatherm®-control distributor
- 2.6 aquatherm®-6-channel radio control unit
- 2.7 aquatherm®-radio thermostat
- 2.8 aquatherm®-mixing control
- 2.9 aquatherm®-control unit
- 2.10 aquatherm®-zone control

### Heating circuit distributor

Heating circuit distributor

- 3.1 aquatherm®-heating circuit distributor
- 3.2
  - heating circuit distributor valves
  - dimensions of the heating circuit distributor
- 3.3
  - packing
  - special accessories

Distribution cabinets

- 3.4 aquatherm®-heating circuit distribution cabinets
  - concealed design
- 3.5
  - installation dimensions concealed cabinet
  - illustration for concealed installation
- 3.6
  - surface design
- 3.7
  - installation dimensions surface cabinet
  - built-in doors

Heat distribution center

- 3.8 aquatherm®-heat distributing central system
- 3.9
  - mounting
- 3.10
  - function

### Floor construction

Preliminary conditions for installation

- 4.1
  - DIN-regulations
- 4.2
  - aquatherm®-insulation systems
  - DIN-regulations
- 4.3
  - preliminary conditions for installation
  - example of design

Accessories

- 4.4
  - impact sound insulation

System elements

- 4.6
  - aquatherm®-border insulation
- 4.8
  - aquatherm®-expansion joint profile
- 4.10
  - aquatherm®-system element valufix-74
- 4.11
  - aquatherm®-system element valufix-55
- 4.12
  - aquatherm®-system element valufix-32
- 4.13
  - aquatherm®-system element valufix-roll 38/35
- 4.14
  - aquatherm®-system element fastening plate EPS-45
- 4.15
  - summary of the aquatherm®-system elements

## Floor construction

4.16	- floor pavement	Types of floor pavement
	- cement floor / floor addition	
	- flow cement floor	
	- anhydrite floor	
4.17	- poured asphalt floor	Floor construction with cement floor
	- floor compartments	
	- edge gaps	
	- movement joints	
4.18	- dummy joints	
	- floor reinforcing	
4.19	- procedures floor covering	
	- heating of floor	
4.20	- heating protocol	Floor construction with floating floor
4.21	- Knauf-floating floor	
4.22	- advantages of floating floor	
	- insulation layers	
	- application	
	- flow temperature	
	- nominal thickness of floor	
4.23	- movement joints	
	- heating register	
	- treatment of floating floor	
	- placing of floor	
4.24	- heating protocol	
	- floor dry test	
	- covering of floor	
	- application of floating floor in humid locations	
	- floor coverings	
4.25	- heating of Knauf-floating floor: FE 80, FE 25	
4.26	- technical and building physical characteristics	
4.27	- surface coverings for Knauf-floating floor	
4.28	- floor coverings	
	- thermal resistance	
	- conditions for placing	
	- working material	
4.29	- moisture content equilibrium	
4.30	- aquatherm®-floor additive	Floor addition
4.32	- aquatherm®-floor addition special	
4.34	- cover against ground	
4.35	- cover against unheated rooms	
4.36	- cover against industrial rooms	Construction heights
4.37	- cover against heated rooms	
4.38	- examples of design	
4.39	- special applications: heating for lawns, sports floors and industrial floors	

## Planning & Design

5.1	- regulations, prescriptions, laws	Regulations
	- calculation	Basic factors
5.2	- floor surface temperature	
	- basis of design	
	- method of calculation	
5.3	- rim zone	Surface coverings
	- recreation areas	
5.4	- connection ducts	
	- floor surface coverings	
	- standard values for surface coverings	
	- symbols: "suitable for floor heating"	
5.5	- use of carpet rugs	
	- heat circuit length	
5.6	- distribution connection area	Material requirement
	- material requirement	
5.7	- thermal output as per DIN EN 1264	
5.8	- design flow temperature	
5.9	- thermal test	Thermal output
5.10	- heat insulation towards the bottom	
	- design heat flux density	
	- design heating mains	
5.11	- pressure loss diagrams	Pressure loss
	- aquatherm®-heating pipes 16 x 2,0 mm / 17 x 2,0 mm	
5.12	- heating capacity tables: 35, 40 and 45 degrees C	
	- 16 x 2,0 mm / 20 x 2,0 mm	
5.18	- presetting of the fine control valves	
	- diagram: valve adjustment / rotations	
5.19	- diaphragm expansion vessel	
5.20	- types of placing: worm-type placing	
	- types of placing: counterflow-type	Types of placing
5.21	- examples of placing: placing distance	



## aquatherm®-floor heating pipes

### Pipe material

The functionality of a floor heating system is decisively determined by the quality of the heating pipes used. The expected durability of aquatherm quality floor heating pipes can be directly deduced from the creep curves (p. 1.5) when considering the existing operating voltage and working temperature. It is clear that considerable safety reserves are given when the pipes are dimensioned according to DIN 16968.

DIN 16968

## Operating conditions

The pipes can be used for working temperatures up to 90 °C and a working pressure up to 10 bar.

90 °C / 10 bar

## Handling

The pipes can be laid without preliminary tempering simply cold from a roll. For practical reasons, the heating pipes should generally be laid with the aquatherm®-pipe hasp.

Laying

Only those pipe joints indicated by the manufacturer should be used for the respective type of pipe used. The aquatherm®-connectors and distribution union pieces correspond to the demands of the types of execution of DIN 8076 Part 1, requested in DIN 4726.

Connection systems

In the wet construction system aquatherm®-floor heating pipes are embedded directly into the heat floor. A change in length resulting from a temperature difference is avoided when embedding into the heating floor pavement. The material takes up the caused tensions so that same are uncritical.

Length extension

## Oxygen-tightness / heat exchanger

Manufacturing of the aquatherm®-floor heating pipes with an oxygen barrier layer is done according to a special developed extrusion procedure. Due to the EVOH-coating deposited on the basic pipe as an all-over compound, the pipe reaches an optimum tightness. (EVOH= ethylene-vinylalcohol copolymer)

EVOH-coating

The oxygen-tight aquatherm®-floor heating pipes are in accordance with DIN 4726. A system separation by means of a heat exchanger is not necessary as per DIN 4726 when using these pipes.

DIN 4726

## Pipe material

### Floor heating pipes of polybutene (PB)



**aquatherm®-floor heating pipes of polybutene (PB)**

art. no.	nominal size	total size	ring length
90306	16 x 2,0 mm	17 x 2,5 mm	250 m
90316	16 x 2,0 mm	17 x 2,5 mm	500 m
90307	17 x 2,0 mm	18 x 2,5 mm	250 m
90317	17 x 2,0 mm	18 x 2,5 mm	500 m
90308	20 x 2,0 mm	21 x 2,5 mm	250 m

#### Material

aquatherm®-floor heating pipes are made of the highly flexible and highly heat-resistant material polybutene. The physical and chemical characteristics are adjusted to the special interests of the heating sector.

#### Standard

aquatherm®-floor heating pipes correspond to the quality demands of DIN 16968 and DIN 4727/4726.

#### Colour

##### Colour:

grey pipe (art.-group 903.. with a transparent shimmering oxygen barrier layer).

#### Designation

##### Designation:

AQUATHERM FLOOR HEATING ELEMENT CONNECTION PIPES  
 ---- ART.-NO. 90306 ---- 16 x 2,0 MM ---- OXYGEN-TIGHT ---- PB  
 125 ---- DIN 4726 ---- DIN 16969/DIN 16968 ---- DIN CERTCO  
 3V098 PB ---- DATE OF MANUFACTURING/TIME ---- MACHINE  
 NO. ---- MTR.-MARKING ---- MADE IN GERMANY

Moreover, every ring bundle is printed continuously with the length in meters. An instruction leaflet containing the identification data is added to every ring bundle.



## Pipe material

### Heating ducts of polybutene (PB)

aquatherm®-floor heating pipes of PB (polybutene) stand out due to their e.g. high creep strength. Polybutene especially qualifies for the installation of heating ducts due to its highly heat aging stability. In the range of small-dimensioned connecting ducts polybutene convinces with its high flexibility. Other advantages of this material are:

- smooth pipe inside surface
- simple and safe installation
- low frictional loss
- corrosion-resisting

Material characteristics

Advantages

### Modulus of elasticity

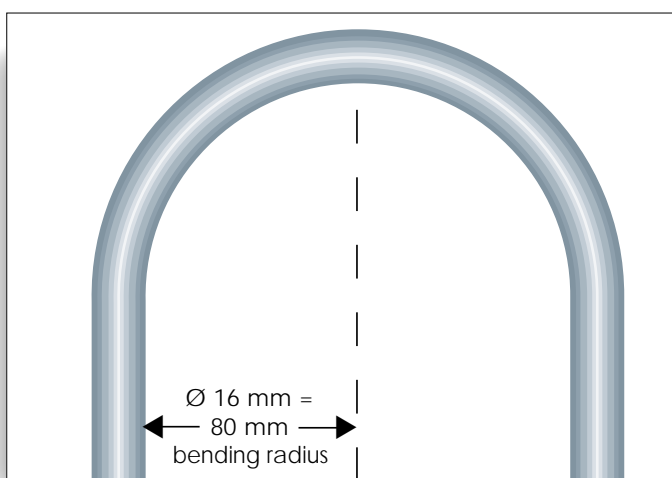
The modulus of elasticity being an important parameter of the bending resistance of pipes is for polybutene (PB) at 20 degrees C approx. 350 N/sq.mm.

Consequently is the smallest admissible

bending radius  $5 \times d$

in which  $d$  has been determined as outside diameter. For pipes with a diameter of  $16 \times 2$  mm the bending radius will be  $r = 5 \times 16 \text{ mm} = 80 \text{ mm}$ .

Bending resistance



### Heating water additions

In principle only heating water additions may be used from which the harmlessness with regard to the material polybutene (PB) has been fixed and which have been expressly released by aquatherm.

Compatibility

The application of corrosion-inhibitors is not necessary when using the oxygen-tight aquatherm®-floor heating pipes (see section oxygen-tightness).

## Pipe material

### Packing

Site-adapted  
cardboards

aquatherm®-floor heating pipes are packed in site-adapted cardboards impervious to light for protection against mechanical damage or detracton from UV-rays. The pipe bundles have to be stored in the packing till final laying. Remaining bundles have to be restored in the cardboard.

Bundle lengths

The heating pipes are supplied as a ring bundle with a length of 250 m and 500 m.  
(Other supply sizes as well as short lengths on request).

### Storage

Taking out of the  
pipes

Protective measures

aquatherm®-floor heating pipes are supplied in cardboards according to section "Packing". The pipe bundles have to be taken out of the packing only immediately before working. Unpacked pipes and remaining bundles have to be protected efficiently against UV-rays and damaging.

### Own supervision

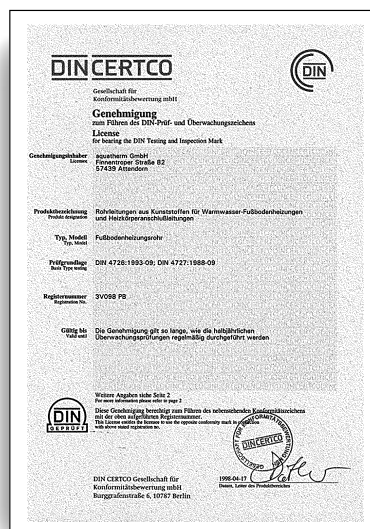
DIN 4728

aquatherm®-floor heating pipes have their own supervision in the manufacturing works according to the demands of DIN 4728.

### External supervision

DIN-CERTCO

The supervision contracts necessary in the scope of DIN-CERTCO have been concluded with the SKZ South German Plastic Center in Würzburg.



The aquatherm®-floor heating pipes have been registered under the no. 3V098 PB of the Gesellschaft für Konformitätsbewertung (DIN-CERTCO).

## Pipe material

### Behaviour under long period stressing of PB - pipes

The compression strength of plastic pipes is described with the aid of the creep internal pressure curve. Determination of these curves requires a high number of tests. Pipe sections at different temperatures have a constant internal pressure and during the test it is determined after which test duration a failure rupture will be caused (creep value).

Test

Internal pressure/  
temperature level

### Curve: Creep-internal pressure

The creep times are entered in a coordinates system with a log-log division. On the Y-axis of the coordinates system the peripheral stress caused by the internal pressure of the pipes is entered. On the X-axis the time in hours is presented. The creep internal pressure curve can be obtained by connecting the minimum creep values with each other by means of a straight line for every test temperature.

Coordinates

Creep internal pressure tests have been done for 25 years. The obtained values allow a mathematical conclusion (extrapolation) of service times of more than 50 years.

Service time  
> 50 years  
(extrapolation)

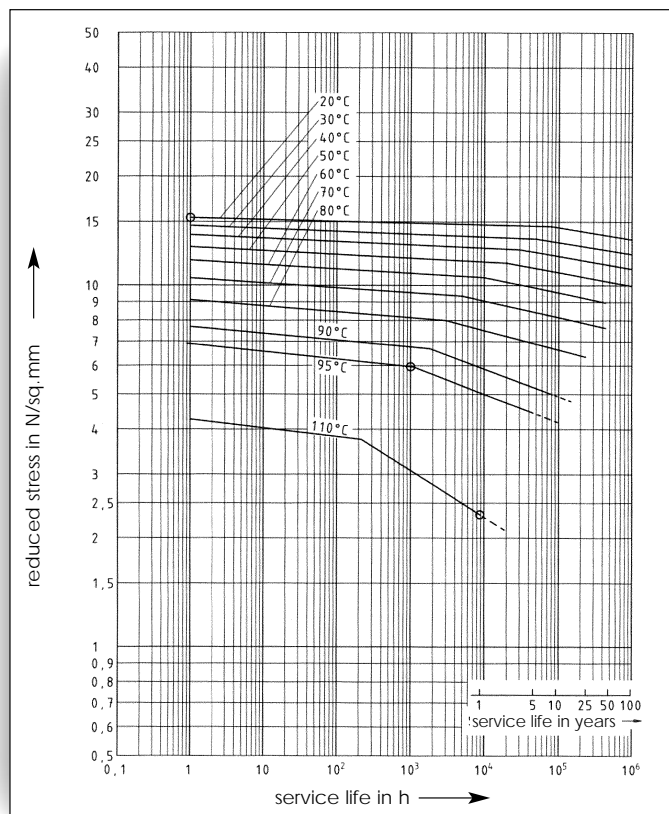
By accepting these curves in the international standard for plastic pipes they are used as a basis for dimensioning and quality supervision of plastic pipes for sanitary and heating technics.

Basis

## Pipe material

## Creep internal pressure curve

Curve:

creep internal  
pressure

### Requirements

The Decree for Energy Saving Requirements for Heating and Service Water Systems (HeizAnIV) issued on 22.3.1994 stipulates in **§ 7Control and Regulation Equipment**:

"Heating systems must be equipped with automatically-operating devices for adjusting the temperature in each room. For Groups of rooms of the same type and subjected to the same use in non-residential buildings, group regulation is permitted

Consequently, every floor heating system in residential buildings has to be provided with an individual room regulation system.

Individual room control

### Precontrol

As defined by the heating system regulation floor heating systems must be precontrolled with weather controlled regulations. In most cases this demand is fulfilled by a sliding operation of the heat generators. In case of combined systems a return addition is used so that there is an external temperature precontrol for both control loops.

Control by atmospheric conditions

### Programmable thermostat (night lowering)

A night lowering is also useful for floor heating systems. Only the lowering and heating-up times are advanced accordingly. Usually delays of approx. 1,5 - 3,0 hours have to be expected.

Delays

### Protection against excess temperature

A protection against excess temperature is absolutely necessary. Normally contact thermostats are installed disconnecting the circulation pump upon excess of the adjusted temperature or closing the mixing motor used. A gravity break or a return valve have to be topped. The excess temperature protection device should be adjusted on 60 °C.

Adjustment 60 °C

### Circulation pump

The circulation pump has to be dimensioned according to the calculated water quantity and the highest pressure loss.

Dimensioning

## Regulation

### aquatherm®-actuator

Tested actuator

The electrothermal actuator is a final control element tested by VDE with a spark protection suitable for aquatherm® heating circuit distribution valves.

Function

It has a special electrically heated expansion system and is controlled by a room thermostat. The actuator works completely soundless and keeps the valve closed in a currentless condition.



art.-no.	technical data	switching difference	colour	supply unit
94102	230 volts	–	–	1 unit
94103	24 volts	–	–	1 unit

Casing

The casing is heat resistant and made of shock-resistant plastic. The actuator is provided with a connection cable of 100 cm and especially suitable for installation into distribution cabinets due to its compact design.

Opening and closing course

The actuator shows a uniform opening and closing course. After expiration of a delay time of approx. 2-3 minutes the opening course procedure is effected by the electrical heated expansion system. The closing procedure is started after interruption of the current supply by cooling down of the expansion system.

## aquatherm®-room thermostat

The aquatherm®-room thermostat with thermal feedback controls the room temperature in connection with the aquatherm®-actuator. The base is suitable for installation to the wall and on switch boxes and fits to most plane switch combinations.

Room temperature

aquatherm®-room thermostats

- keep the selected room temperature constant
- save additional energy
- offer modern conveniences

Advantages



art.-no.	technical data	switching difference	colour	supply unit
94104	230 V - 50 HZ - 10 A	0,5 K	white	1 unit
94105	230 V - 50 HZ - 10 A	0,5 K	brown	1 unit

## Room thermostat with night-lowering

**aquatherm®-room thermostat with night lowering**  
(as described above):

Automatic night lowering

are suitable for group lowering when used with the aquatherm®-control distributor (art.-no. 94120) together with the aquatherm®-clock thermostat (art.-no. 94108).

Group lowering

art.-no.	technical data	switch difference	colour	supply unit
94107	230 V - 50 HZ - 10 A	0,5 K	white	1 unit

## Regulation

### aquatherm®-timer thermostat

Automatic lowering

The aquatherm®-timer thermostat offers all advantages of the normal room thermostat and is provided with an additional temperature lowering system.

The timer thermostat makes it very easy to programme an automatic night lowering

Advantages

- **press only one key!**



art.-no.	technical data	switching difference	colour	supply unit
94106	230 V - 50 HZ - 10 A	-	white	1 unit

### aquatherm®-clock thermostat

Daily and weekly

aquatherm®-clock thermostat is equipped with a daily and weekly program disc. By this rooms are heated resp. lowered at different times and on different days.

This alternative can be used for heating of e.g.:

Application

- bedrooms and children's rooms
- office buildings
- doctor's practices
- holiday flats



art.-no.	technical data	switching difference	colour	supply unit
94108	230 V - 50 HZ - 10 A	-	white	1 unit



### aquatherm®-control distributor

With the aquatherm®-control distributor actuators are wired problem-free and fast with room thermostats, timer thermostats or clock thermostats.

The usual cable mess in distribution boxes or cable ducts finally belongs to the past. Due to the compact design installation in aquatherm®- distribution boxes is guaranteed.

Problem-free wiring

Cable guiding

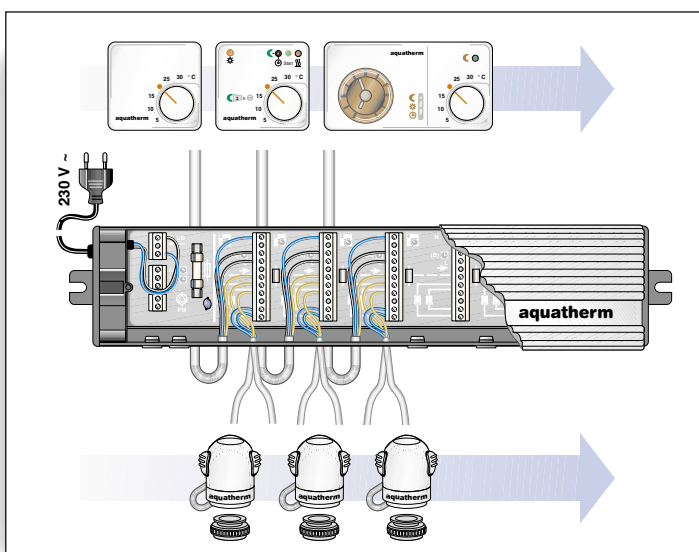


art.-no.	technical data	switching difference	colour	supply unit
94120	230 volts	–	–	1 unit

Perfect individual room control with the aquatherm®-control distributor by:

- clear allocation of the connection
- clean cable guiding
- up to 6 room thermostats connectable
- up to 12 actuators connectable
- overload protection, overvoltage protection
- switch output for pump module (extras)
- switch input for digital automatic switch (extras)
- ready to be installed into the aquatherm®-heating circuit distribution cabinet

Advantages



Detailed information about the aquatherm®-control can be gathered from the separate installation instructions (Order-no. D 91720) added to the product.

## Regulation

### aquatherm®-6-channel radio control unit

Radio signal

With the aquatherm®-6-channel radio control unit the information of the radio thermostat (transmitter) is converted into control signals for the consumer (actuators).



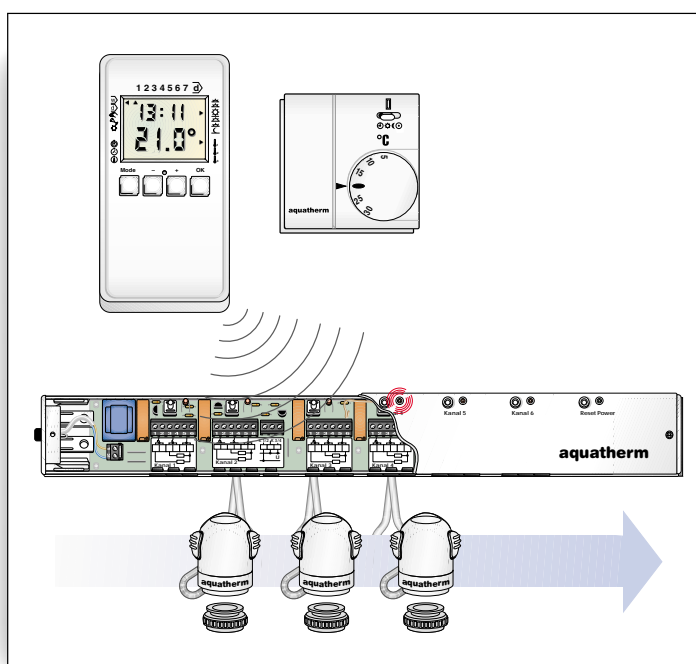
art.-no.	technical data	switching difference	colour	supply unit
94122	6 channels	–	white	1 unit

Advantages

Perfect individual room control with aquatherm®-6-channel radio control by:

- wireless drive of the actuators
- ready plugged for immediate connection to a 230 V socket
- actuator (230 V) directly connectable
- acoustic signal in case of trouble
- self-learning address setting by learning mode in the transmitter

Detailed information about the aquatherm®-6 channel radio control unit can be gathered from the separate installation instructions (Order-no. D 91750) added to the product.



**aquatherm®-radio thermostat**

The aquatherm®- radio thermostat is used for a wireless remote control of the aquatherm®-actuators.

Wireless radio control



art.-no.	technical data	switching difference	colour	supply unit
94124	with clock	–	white	1 unit
94126	without clock	–	white	1 unit

The temperature registration can be done at any place in the room. There is no cabling necessary between sender and receiver.

**aquatherm®-radio thermostat with clock:**

- three adjustable temperatures (comfort, standard, night lowering)
- six free selectable times for every day (weekly program is repeated automatically every week)
- party function
- setting of weekday and time
- frost protection

Functions

**aquatherm®-radio thermostat:**

- in connection with aquatherm®-radio thermostat with clock (art.-no. 94124) suitable for night lowering
- with frost protection

Functions

## Regulation

### aquatherm®-mixing control

#### Function

The aquatherm®-mixing control is used for a constant control of the flow temperature. It is applied e.g. in combined floor heating / radiator heating systems from which the floor heating covers a partial load of the heat demand or when a constant surface temperature is requested.

The flow temperature in the floor heating circuit is kept constant according to the adjusted set-value by mixing of the heating water from the heat generator and the by-pass.



art.-no.	technical data	switching difference	colour	supply unit
94008	set-value control	–	–	1 unit
94018	system controlled by atmospheric conditions	–	–	1 unit

#### Control elements

The mixing control has been designed in a dimension of 1" for surfaces up to 120 sq.m. The control combines the following control elements in one unit:

- circulation pump WILO (RS 25 - 60 r)
- control valve with flow gauge
- by-pass valve with manual control flap
- safety temperature limiter
- flow and return thermometer
- differential pressure overflow valve

The mixing control can also be offered as a system controlled by atmospheric conditions equipped with the following additional elements:

- external gauge (capillary tube of 10 m) for flow temperature controlled by atmospheric conditions.

### aquatherm®-control unit

The aquatherm®-control unit is a heat circuit control depending on the outside temperatures with a PI-characteristic (PI= proportional integral).

Characteristics

It is supplied as a universal applicable heat circuit control with a subassembly ready for connection.



art.-no.	dimension	switching difference	colour	supply unit
94028	1"	-	-	1 unit

The control combines the following control elements in one unit:

Control elements

- control system weather controlled with:
  - time control and power reserve (reversible from daily to weekly program)
  - program monitoring switch
  - control knob for temperatures with normal and reduced operation
  - three-way mixer
  - mixer motor with additional set
- circulation pump WILO (RS 25 - 60 r)
- safety temperature limiter with flow gauge
- external gauge
- differential pressure overflow valve
- flow and return thermometer

## Regulation

### Connection fittings

Connection fittings

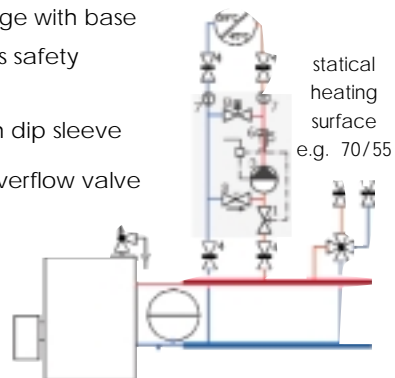
- \* The aquatherm®-mixing control as well as the aquatherm®-control unit can be equipped alternatively with different connection fittings:
- screwed connection 1 1/4" with straight seat valve for the connection of fusiotherm®-pipe ducts diameter 32 mm
- ball valve 1" with screw connection 1 1/4"

**Notice:** Connection fittings with shut-off elements have to be ordered separately.

### Functional principle

Wiring diagram  
addition control

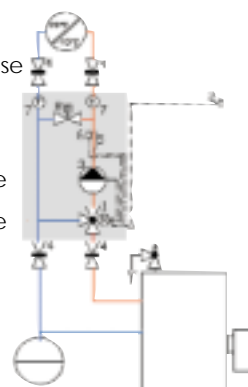
- 1 control valve with upper part thermostat
- 2 control valve as adjustable by-pass
- 3 circulation pump
- 4 shut-off unit\*
- 5 flow temperature gauge with base
- 6 contact thermostat as safety temperature limiter
- 7 dial thermometer with dip sleeve
- 8 differential pressure overflow valve



Floor heating

Wiring diagram  
control unit

- 1 three-way mixing unit with mixer motor and electronics
- 2 external temperature gauge
- 3 circulation pump
- 4 shut-off unit\*
- 5 flow temperature gauge with base
- 6 contact thermostat as safety temperature limiter
- 7 dial thermometer with dip sleeve
- 8 differential pressure overflow valve
- 9 housing space station (extra)



Floor heating

### aquatherm®-zone control

Due to electrotechnical stipulations for the control of rooms by means of thermostats and motor operators a maximum of 7 aquatherm®-actuators can be connected to a thermostat for electric circuits secured with 16 A.

Zone control



▲ aquatherm®-zone control - passage

art.-no.	dimension	switching difference	colour	supply unit
94100	1" passage	–	–	1 unit
94101	1" corner	–	–	1unit



▲ aquatherm®-zone control - corner

## Regulation

### aquatherm®-zone control

The thermostat will be connected to a zone control valve for thermostatic controlled floor heating surfaces for which more than seven heating circuits are necessary to heat a room. Consequently it is possible to control up to 12 heating circuits at the same time. In this connection the flow rates for the following  $K_v$  values have to be considered:

KV-value

Zone-value 1"	control difference [K]			$k_{vs}$ -value [cu.m/h]
	1,0	2,0	3,0	
$k_v$ -value [cu.m/h]	0,95	1,89	2,60	4,20

Installation

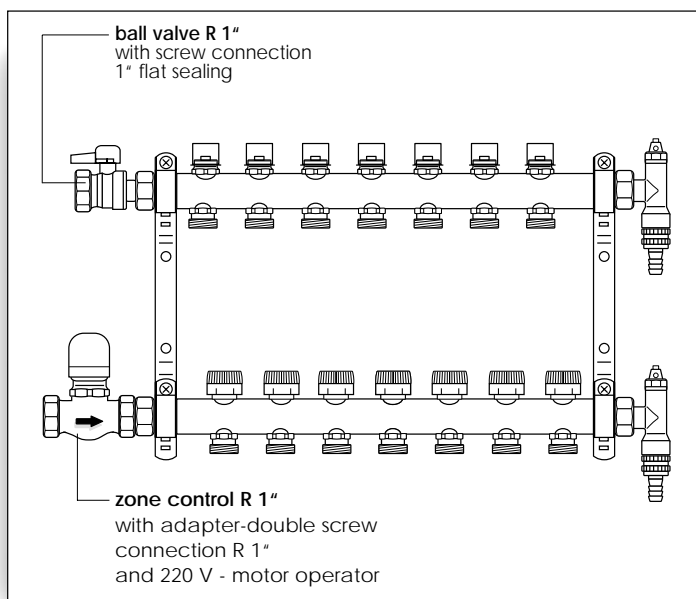
The aquatherm®-zone control valve is installed at the flow side directly to the heat circuit distributor instead of the ball valve by means of an adapter-double screw connection. The valve control is made by an actuator controlled by a room, timer or clock thermostat.

Valve control

#### aquatherm®-heating circuit distributor with zone control valve

Thermostatic control up to 12 heating circuits.

Thermostatic control



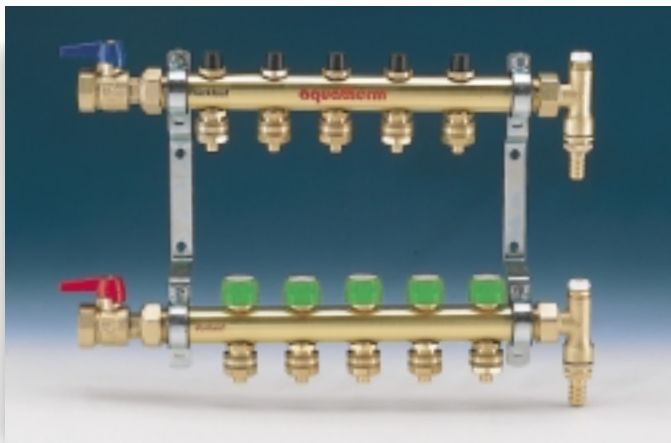


### aquatherm®-heating circuit distributor

#### consisting of:

- high-quality brass pipe MS 63
- equipped on both sides with male thread 1" for
  - high-quality brass pipe MS 63
  - end pieces with screw connection
  - feed cock and
  - ventilation valve
- has ball connection valves for flow and return
- is mounted on galvanized sound absorbing brackets as per DIN 4109
- integrated flow valve sets provided with building protection cap
- integrated return valve inserts can be shut-off
- suitable for all common clamped screw connections

Distributor elements



art.no.	dimension	heating circuits	colour	supply unit
92032	length : 295 mm	2	–	1 unit
92033	length : 350 mm	3	–	1 unit
92034	length : 405 mm	4	–	1 unit
92035	length : 460 mm	5	–	1 unit
92036	length : 515 mm	6	–	1 unit
92037	length : 570 mm	7	–	1 unit
92038	length : 625 mm	8	–	1 unit
92039	length : 680 mm	9	–	1 unit
92040	length : 735 mm	10	–	1 unit
92041	length : 790 mm	11	–	1 unit
92042	length : 845 mm	12	–	1 unit

## Heating circuit distributor

### Heating circuit distributor valves

Flow valves

The integrated flow valves enable a problem-free exchange of the manual construction protection caps against an electrothermal actuator or manual control caps. The flow valves are provided with stainless steel spindles and a double O-ring seal.

Return valves

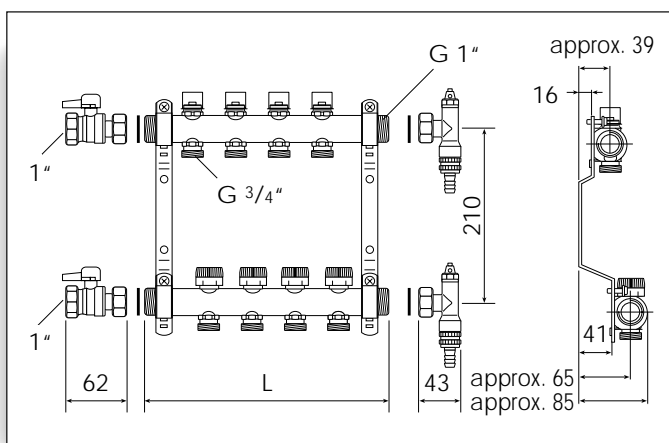
The hydraulic compensation of the heating circuits is made at the return control valve, which can be shut-off, according to the calculated values. Presetting is done by means of a commercial ventilating wrench.

**Notice:** Clamped screw connections have to be ordered separately depending on the pipe dimensions:

- Art.-no. 92106 for pipe-dia. 16 x 2,0 mm
- Art.-no. 92107 for pipe-dia. 17 x 2,0 mm
- Art.-no. 92108 for pipe-dia. 20 x 2,0 mm

### Dimensions of the heating circuit distributor

Dimensioning



exits	2	3	4	5	6	7	8	9	10	11	12
length L in mm	190	245	300	355	410	465	520	575	630	685	740
with ball valve	length L + 62 mm										
with end piece	length L + 43 mm										
total length in mm	295	350	405	460	515	570	625	680	735	790	845
max. depth	T approx. 86 mm										
total length with heat distributor centers	375	430	485	540	595	650	705	760	815	870	925

### Packing

Supply of the aquatherm®-heating circuit distributor is made in site-adapted cardboards.

A set of self-adhesive marking plates is added to every distributor. Same can be stuck on the designated fields of the manual control cap or on the actuator.

Marking plates

### Accessories

The following accessories are available for the aquatherm®-heating circuit distributor:

- clamped joints for copper or precision steel pipes
- flow measuring instrument with adapting piece for return valves
- universal mounting sets for a heat quantity counter
- connection fitting with angle and reducing ring for vertical connection of the ball valves
- manual control cap of shock-resistant plastic with +/- adjusting dial
- other accessories on request

Accessories

aquatherm offers the universal pipe system fusiotherm® with the fusiotherm®-stabi composite pipe as the optimum distribution and connection ducts

Do not abstain from the advantages of the fusiotherm®-program:

- unprecedented connection technics by means of fusion
- corrosion-resistant
- high heat aging stability
- high internal pressure creep strength
- reduced flow noise compared to metallic ducts and others

Ask for detailed technical information.

(Technical information fusiotherm®-Order-no. D 10100).

**fusiotherm®**  
Pipe System

Advantages

### aquatherm®-heating circuit distribution cabinets

The aquatherm®-universal heating circuit distribution cabinets for flush installation are made of hot-galvanized sheet steel. The distribution cabinet can be supplied in five different sizes for distribution of 2 - 12 heating circuits.

- Size I = 2 - 3 heating circuits
- Size II = 4 - 6 heating circuits
- Size III = 7 - 10 heating circuits
- Size IV = 11 - 12 heating circuits
- Size V = max. 12 heating circuits with heat quantity counter

Material

Standard sizes

Notice

Special sizes

The data are valid for a pipe-side horizontal connection of the distributor outside the flush-mounted-cabinet through the tubular feedthrough. In case of connection inside the flush-mounted-cabinet the connection fitting with reduction ring for a vertical connection of the ball valves (accessories art.-no. 92328) must be used.

When using a heat quantity counter a smaller number of heating circuits has to be considered depending on the product make.

## Heating circuit distributor

### Concealed design

aquatherm®-universal heating circuit distribution cabinet for concealed installation



#### Dimensions

art.-no.	dimension	HC <sup>1</sup>	HC <sup>1</sup> with HDC <sup>2</sup>	HC <sup>1</sup> with HDC <sup>2</sup> + OFV <sup>3</sup>	size	supply unit
93102	H: 700 - 850 mm W: 400 mm D: 110 - 150 mm	for 2 - 3	–	–	UP I size I	1 unit
93104	H: 700 - 850 mm W: 550 mm D: 110 - 150 mm	for 4 - 6	2 - 4	2	UP II size II	1 unit
93106	H: 700 - 850 mm W: 750 mm D: 110 - 150 mm	for 7 - 10	5 - 8	3 - 6	UP III size III	1 unit
93108	H: 700 - 850 mm W: 950 mm D: 110 - 150 mm	for 11 - 12	9 - 11	7 - 10	UP IV size IV	1 unit
93110	H: 700 - 850 mm W: 1150 mm D: 110 - 150 mm	for max. 12 with HQC <sup>4</sup>	–	–	UP V size V	1 unit

<sup>1</sup> = heating circuit , <sup>2</sup> = heat distribution centrals, <sup>3</sup> = overflow valve set ,  
<sup>4</sup> = heat quantity counter

#### Advantages

These are the advantages of this wall concealed installation cabinet:

- universal holding device (C-profile) (3), vertically and horizontally infinitely variable
- frame (1) with door, infinitely extractable from 110 mm - 150 mm, lacquered in white as per RAL 9010
- lower floor lining (7), adaptable to the respective height of the finished floor
- tubular feedthrough (2) pre-pressed in the lateral parts enabling an alternate pipe guidance
- bases (6), adjustable up to 60 mm of the total height and being fixed points at the same time

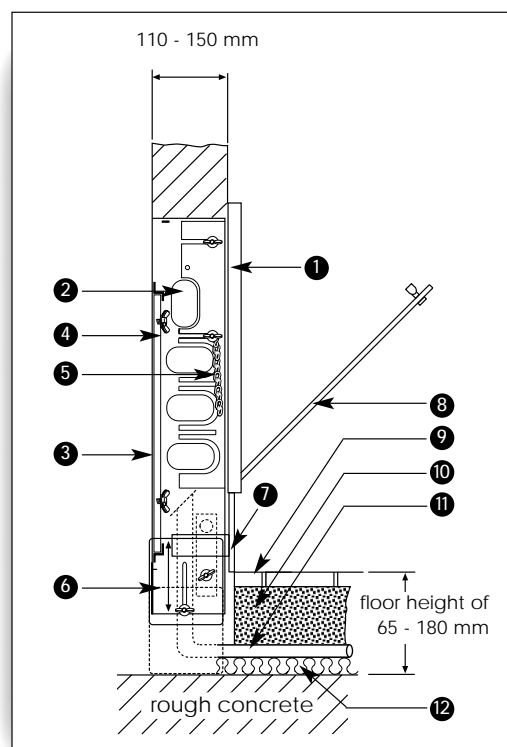
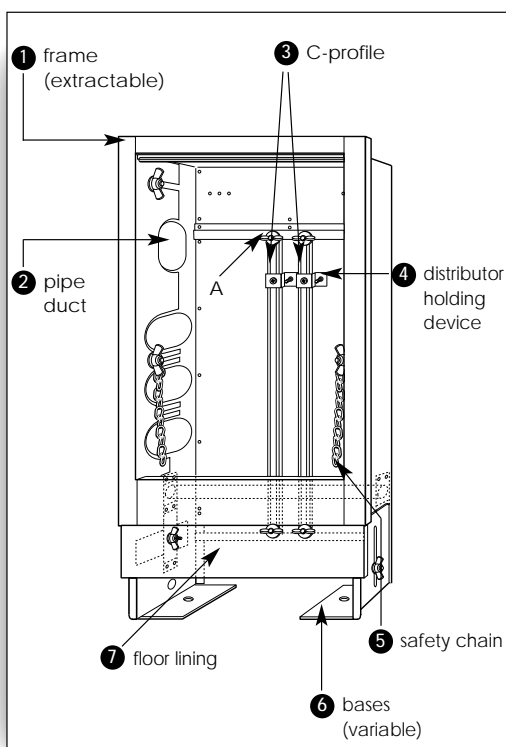
(see page 3.5: fig. concealed installation)

**Installation dimensions concealed cabinet**

Type of cabinet	UP I	UP II	UP III	UP IV	UP V
Height of cabinet inside from / mm to / mm	700 850	700 850	700 850	700 850	700 850
Width of cabinet inside mm	400	550	750	950	1150
Depth of cabinet inside from - to / mm	110 - 150				
Recess size height (unfinished state) mm	900	900	900	900	900
Recess size width (unfinished state) mm	450	600	800	1000	1200
Recess size depth (unfinished state) from - to / mm	110 - 150				

UP = concealed - mounted

**Illustration for concealed installation**



- 1 frame (extractable)
- 2 pipe duct
- 3 C-profile
- 4 distributor holding device
- 5 safety chain
- 6 bases (variable)
- 7 floor lining

- 8 insertion door
- 9 tile
- 10 floor
- 11 heating pipe
- 12 heat insulation

## Heating circuit distributor

### Surface design

aquatherm®-universal heating circuit distributor cabinet for surface installation



#### Size

art.-no.	dimension	heating circuits	size	supply unit
93012	Height : 665 mm Width : 415 mm Depth* : 128 mm	for 2 - 4	SI I size I	1 unit
93014	Height : 665 mm Width : 600 mm Depth* : 128 mm	for 5 - 7	SI II size II	1 unit
93015	Height : 665 mm Width : 765 mm Depth* : 128 mm	for 8 - 10	SI II b size II b	1 unit
93016	Height : 665 mm Width : 900 mm Depth* : 128 mm	for 11 - 12	SI III size III	1 unit

#### Advantages

The aquatherm®-surface installation cabinet is our alternative when there is no possibility for a concealed installation:

- The casing of hot galvanized sheet steel is supplied in a white lacquered design (RAL 90101) (without lacquering on request).
- The cabinet is equipped with a universal holding device enabling a vertical as well as horizontal infinitely variable installation of the distributor
- A detachable impact plate is installed as lower edge against the floor being pipe deflector at the same time.

aquatherm

## Installation dimensions surface cabinet

Type of cabinet	AP I	AP II	AP II b	AP III
Height of cabinet inside mm	665	665	665	665
Width of cabinet inside mm	415	600	765	900
Depth of cabinet inside mm	128			
Number of heating circuits *	2 - 4	5 - 7	8 - 10	11 - 12
Number of heating circuits with heat quantity counter	2	3 - 5	6 - 8	9 - 10

(external dimensions + 2 mm) AP = surface installation

\* For the installation with surface cabinets connection fittings with a reduction ring for a vertical connection of the ball valves (art.-no. 92328) are normally used. Moreover, surface cabinets are in general not suitable for heating circuit distributors with a mounted aquatherm®-heat distributor central.

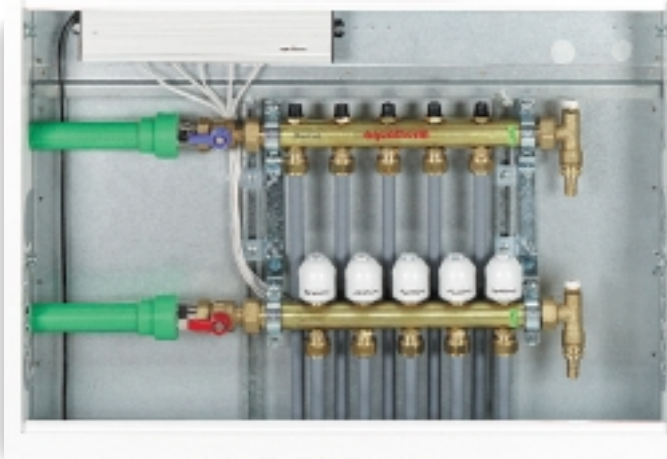
Notice

## Built-in doors

aquatherm®-wall surface installation cabinets are supplied with frame and door in a white lacquer RAL 9010 design (RAL 9010).

RAL 9010

If requested an execution with galvanized frame and door (without lacquering) can be supplied for an extra charge.



## Heating circuit distributor

### aquatherm®-heat distributing central system

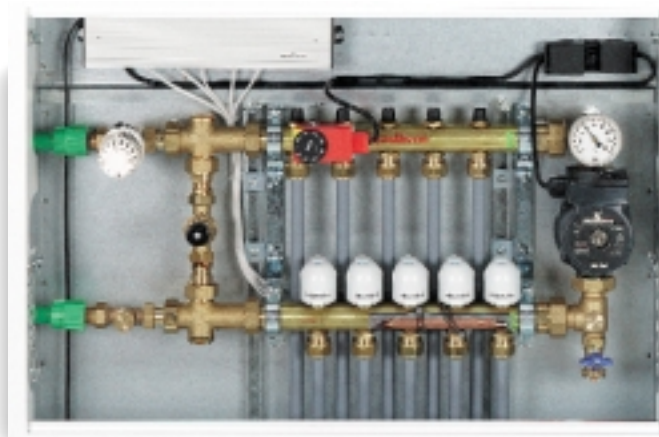
Change-over/  
extension

Control of the  
temperature level

The change-over and/or extension of an existing radiator installation with floor heating is practicable in a

- safe
- economic
- inexpensive

way by installing the aquatherm®-heat distributing central system. Only one riser on the temperature level of the heating element (e.g. 70/50 °C) is sufficient. After installation the rest will be controlled by the heat distributing central system functioning as a combination control system.



art.-no.	dimension	switching difference	colour	supply unit
92154	up to 80 sq.m heating surface	-	-	1 unit

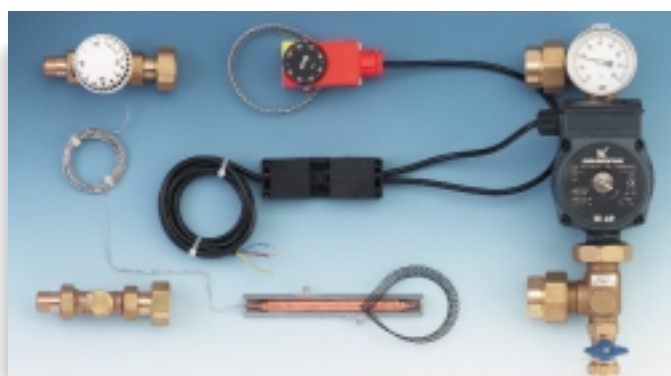
**aquatherm®-heat distributing central system (art.-no. 92154) consisting of:**

- thermostat valve with detecting element and capillary tube
- fine control valve
- circulation pump
- safety temperature limiter
- connection angle with ventilation valve
- feed cock
- thermometer
- coupling screw joints (with 4 adapter pieces)

Components



**aquatherm®-overflow valve set (art.-no. 92156)**  
suitable for installation to a heat distributing central system





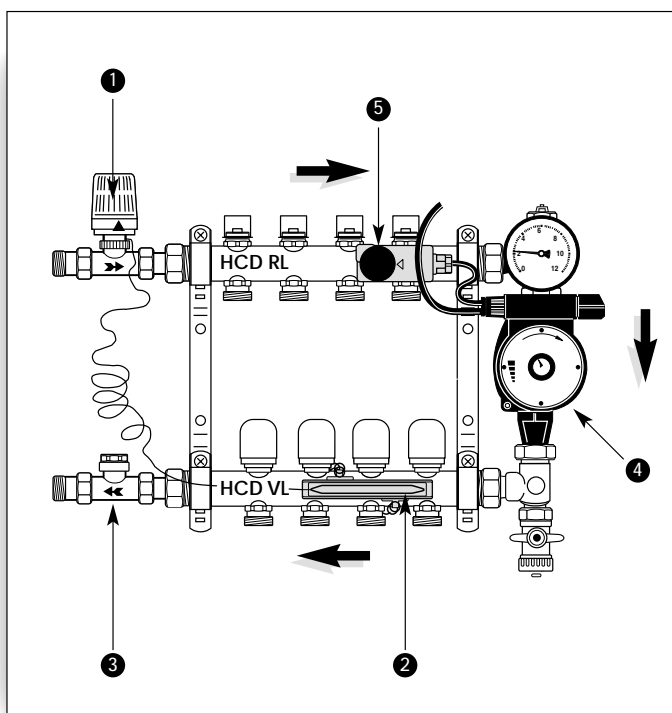
### Mounting

The heat distributing central system has been designed for the aquatherm®-heating circuit distributor.

- The **thermostat valve (1)** is fitted by means of a coupling screw joint to the exit of the distributor return pipe.
- The corresponding **detecting element (2)** with capillary tube is fixed on the flow pipe.
- The **fine control valve (3)** is mounted on the left side of the distributor flow by means of the second coupling screw joint.
- The **circulation pump (4)** has to be installed incl. connection angles, thermometer and ventilation valve to the exit of the distributor flow resp. entry of the return pipe.
- The **safety temperature limiter (5)** has to be mounted on the return pipe.

Installation

(Installation instructions with more information, Order-no. D 91740, are added to the product.)



▲ heat distributing central system at the aquatherm®-heat circuit distributor for floor heating

- ① thermostat valve
- ② detecting element
- ③ fine control valve
- ④ circulation pump
- ⑤ safety temperature limiter

## Heating circuit distributor

### Function

#### Working principle

The aquatherm®-heat distributing central system works according to the principle of the mixing control as set-value control.

#### Adjustment of flow temperature

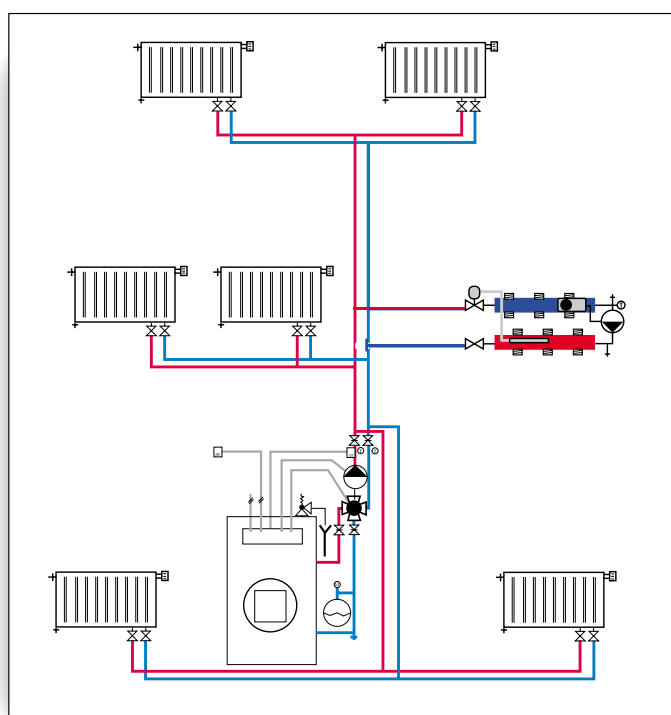
The requested flow temperature for the floor heating is adjusted with the thermostat valve. The corresponding necessary quantity of water is added from the boiler circuit (e.g. 70 °C) to the floor heating circuit.

The safety temperature limiter disconnects the circulation pump when exceeding the maximum temperature.

#### Control of individual rooms

Room thermostats for the control of individual rooms are urgently requested according to the heating installation regulations. As far as only one room is equipped with floor heating, the thermostat can be fitted on the circulation pump.

**Notice:** The aquatherm®-heat distributing central system is only designed for use in a pump hot-water heating installation, built according to the following plant scheme.



▲ Plant scheme: aquatherm®-heat distributing central system in PHW-heating installation

### DIN-regulations

Floor heating systems are subject to demands exactly stipulated in standards and regulations. Same have to be followed strictly especially with regard to the floor construction. In general only quality controlled and standard products may be used.

By coming into force of the amended thermal protection regulation (=WSVO) on 01.01.1995 the minimum demands to single external building components have been defined:

For surface heating systems the heat transition coefficient of the component layers between heating surface on the one hand and

- surrounding air
- ground or
- building parts with considerable lower inside temperatures on the other hand may not exceed the value of 0,35 W/sq.m K.

For buildings with a building permission granted before 01.01.1995 a heat transition coefficient of  $K = 0,45 \text{ W/sq.m K}$  is valid.

The demands for intermediate ceilings are defined in the DIN EN 1264 (hot water floor heating systems). This standard settles the minimum demand to the heat transition resistance of the heat insulation ( $R_{\lambda B} \text{ D}\ddot{a}$ ) below the heating level. It has to be distinguished between 2 types of rooms resp. of covers:

1. **Above rooms with a similar use** (e.g. intermediate storey covers in a residential building)  
 $R_{\lambda B} \text{ D}\ddot{a}_{\min} = 0,75 \text{ m}^2 \text{ K/W}$ .
2. **Above rooms with a dissimilar use** (e.g. intermediate storey covers above industrially used locations)  
 $R_{\lambda B} \text{ D}\ddot{a}_{\min} = 1,25 \text{ m}^2 \text{ K/W}$ .

Demands

WSVO  
of 01.01.95

$K = 0,35 \text{ W/sq.m K}$

$K = 0,45 \text{ W/sq.m K}$

DIN EN 1264

$R_{\lambda B} \text{ D}\ddot{a} = 0,75 \text{ W/sq.m K}$

$R_{\lambda B} \text{ D}\ddot{a} = 1,25 \text{ W/sq.m K}$

### aquatherm®-insulation systems

aquatherm offers for all mentioned applications suitable insulation systems easy to place with

- high insulation capacity
- high stability
- thermal resistance
- low apparent density.

Characteristics

Placing can be done in one layer on the rough concrete floor or separated in two layers. The single-layer insulation variant is typical for buildings with rough concrete floors on which no or nearly no disturbing electrical resp. sanitary/ heating ducts are laid.

In case of floors with "disturbing" installation ducts the separated two-layer insulation is recommended

## Floor construction

### DIN-regulations

Prescription  
and regulation

The following regulations and prescriptions have to be considered.

Regional additional decrees have not been taken into account.

#### General standards and prescriptions

- \* DIN 4102 Behaviour in fire of materials and components
- \* DIN 4108 Heat protection in high buildings
- \* DIN 4109 Sound insulation in high buildings
- \* DIN 18195 Building sealings
- \* DIN 18202 Dimensional tolerances in high buildings
- \* DIN 18336 Sealing against pressing water
- \* DIN 18337 Sealing against not-pressing water

#### Contract procedure for building works, part C

- \* DIN 18352 Tile and plate works
- \* DIN 18353 Flooring works
- \* DIN 18356 Parquetry
- \* DIN 18365 Floor covering works

#### Components of the floor construction

- \* DIN 18164 Plastic foam as insulation in the building trade parts 1 and 2
- \* DIN 18165 Fibrous insulating material in the building trade
- \* DIN 18560 Flooring in the building trade

#### Heat protection regulation

### Preliminary conditions for installation

The conditions for placing on site have to be checked prior to starting the installation.

The following preliminary conditions are necessary for perfect installation:

Walls  
and covers

- a) Walls and covers must be plastered resp. tiled or prepared in such a way that after placing of the floor heating dirt accumulation cannot occur any more.

Windows  
and outside doors

- b) Windows and outside doors have to be installed.

(The floor pavement has to be protected against draft.)

Rooms  
bordering the ground

- c) For rooms adjacent to the earth a humidity sealing as per DIN has to be installed. In case there is no sealing available the works supervisor has to be informed in order to clarify the conditions prior to the start of installation and according to the obligation of indication as per contract procedure for buildings. In case of building sealings made of bituminous material or other plasticizer separating stuff an intermediate foil has to be put before placing of the polystyrene heat-impact sound insulation. In case of polyurethane plates the intermediate foil is not necessary.

Surface

- d) The bearing ground may not have coarse unevennesses, point bumps, different levels or insufficient solid surfaces. The flatness tolerance must correspond with the demands of DIN 18202 "Tolerances in high buildings" (flatness tolerances for surfaces of covers and walls). The demands of DIN 18560 as well as DIN EN 1264 have to be considered. The rough concrete cover has to be cleaned by the customer.

Heating circuit distributor

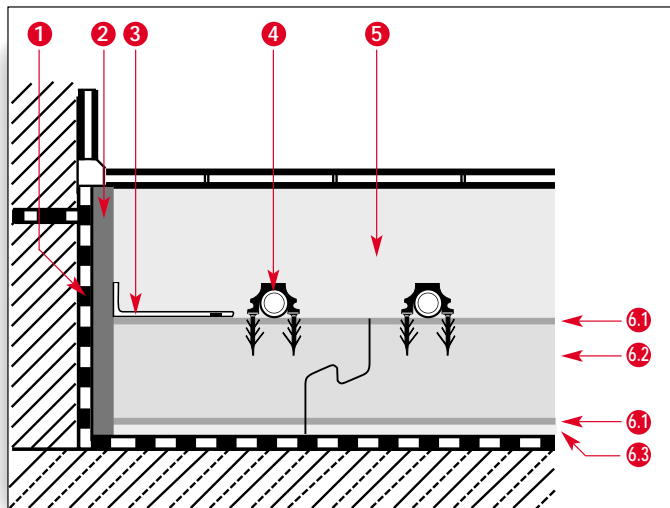
- e) The aquatherm®-heating circuit distributors are installed and tested under pressure.

Individual room control

- f) Connection ducts for individual room control are planned and laid.

## Examples of design

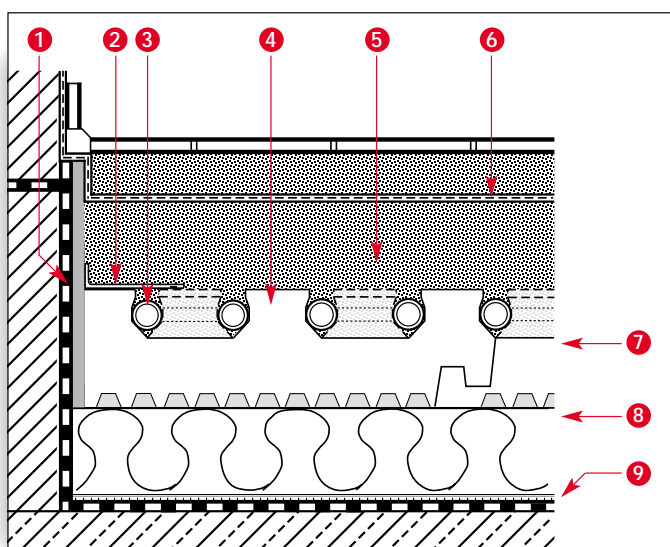
A design example of a floor construction with building sealing done by the customer as per DIN 18195 with the system element valufix - 55 resp. valufix - 74.



**Valufix system element plate**  
consisting of:  
aluminum covering  
polyurethane high-resistance  
foam  
aluminum covering  
impact sound insulation

- 1 building sealing DIN 18195
- 2 edge insulation strips (min. 8 mm thick)
- 3 welded polyethylene foil of the edge insulation strips
- 4 heating pipe
- 5 cement floor

A design example for a floor construction with a building sealing done by the customer as per DIN 18195 and an additional sealing against surface water (bath, shower, etc.) as per DIN 18337 (sealing above the heating surface) with system element fastening plate EPS-45.



**System element fastening plate EPS-45**

Additional insulation acc. to table (not necessary for valufix-55 and-74)

Intermediate foil 0,1 mm of polyethylene

(Only necessary for laying of polystyrene high resistance foam afterwards. The intermediate foil is not necessary when using polyurethane high-resistance foam).

- 6 Sealing against surface water as per DIN 18337

## Floor construction

### Impact sound insulation

Impact sound installation components

Since the appearance of DIN 4109 in November 1989, measures and demands for sound insulation have been settled. The target of this standard is e.g. to protect people in recreation rooms against unreasonable irritations of sound transmission.

In the range of floor heating the impact sound insulation is important to planners, trade and constructors.

The following components have to be considered:

- rough cement floor
- impact sound insulation
- floor pavement
- border insulation

(soft elastic floor coverings may not be considered because of the possible interchangeability).

Calculation procedure

The calculation procedure of DIN 4109 uses the following terms:

$L_n, W, eq, R$  = equivalent evaluated standard impact insulation

$\Delta L_w, R$  = impact sound improvement dimension

$L'_n, W$  = evaluated standard impact sound level

Standard impact insulation level

The equivalent standard impact sound insulation level considers the mass of the rough cover in relation to the surface (solid cover).

(DIN 4109, supplement 1, tabel 16)

Impact sound improvement dimension

With the impact sound improvement dimension the impact improvement dimension insulating effect of the cover coat (insulating material) is considered.

(DIN 4109, supplement 1, tabel 17)

Standard impact insulation level

The evaluated standard impact sound level is the demand impact sound level of DIN 4109, supplement 2, tables 2 + 3.

Sound transmission

It is distinguished according to the following criteria:

- sound transmission from a foreign residing or working area
  - a) minimum demands = **53 dB**
  - b) proposal for increased sound protection = **46 dB**
- sound transmission from an own residing or working area
  - a) minimum demand = **56 dB**
  - b) proposal for increased sound protection = **46 dB**

Correction value of 2 dB

When calculating the evaluated standard impact insulation of 2 dB  $L'_n, w, R$  a **correction value of 2 dB** has to be considered.

## Impact sound insulation

The required or requested impact sound level can be calculated with the following calculating diagram:

$L_n, w, eq,$	+	dB
$\Delta L_{w, R}$	-	dB
$L'_{n, W, R}$	=	dB
Correction value	+	dB
$L'_{n, w}$	=	dB

Calculating diagram

solid cover	thickness (cm)	12	14	16	18	20
Reinforced concrete plain sheet volume weight = 2300 kg/cu.m	mass in relation to the surface (kg/sq.m)	276	322	368	414	460
	$L_{n, w, eq, R}$ (equivalent evaluated standard impact sound level)	79	77	75	73	71
Evaluated standard impact sound level $L_{n, w, R}$ in dB as per DIN 4109 depending on the dynamic rigidity of the insulation material as per DIN 18165 (MN/cu.m)						
system elements	as footfall sound level					
valufix-74, valufix-55	$s' \leq 50, (\Delta L_{w, R} = 22)$	59	57	55	53	51
valufix-32 fastening plate EPS-45	$s' \leq 30, (\Delta L_{w, R} = 26)$	55	53	51	49	47
valufix-roll 38/35	$s' \leq 10, (\Delta L_{w, R} = 30)$	51	49	47	45	43

Table  
impact sound level

cover coat - floating floor	$\Delta L_{w, R} (VM_R)$ dB	
	with a hard cover coat	with a soft elastic cover coat <sup>1)</sup> $\Delta L_{w, R} \leq 20$ dB ( $VM_R \leq 20$ dB)
Floor pavements as per DIN 18560 part 2 <sup>2)</sup> with a mass in relation to the surface of $\leq 70$ kg/sq.m on insulation layers of insulation material as per DIN 18165 part 2 with a dynamic rigidity »s« of maximum.		
50 MN/cu.m	22	23
40 MN/cu.m	24	25
30 MN/cu.m	26	27
20 MN/cu.m	28	30
15 MN/cu.m	29	33
10 MN/cu.m	30	34

Cover coat

<sup>1)</sup> Due to the possible interchangeability of the soft elastic cover coats as per tabel 18, being subject to wear and to special requests of the residents, same may not be taken into account for the proof of demands as per DIN 4109.

<sup>2)</sup> DIN 18560 part 2, Flooring in the building trade:  
floor pavement and heating flooring on insulation layers.

In fact an increased sound protection with a demand of 46 dB normally can only be fulfilled by soft elastic cover coats. When using hard (ceramic) covers this value can only be reached through the installation of a sound insulating sub-layer.

Increased sound  
protection

## Floor construction

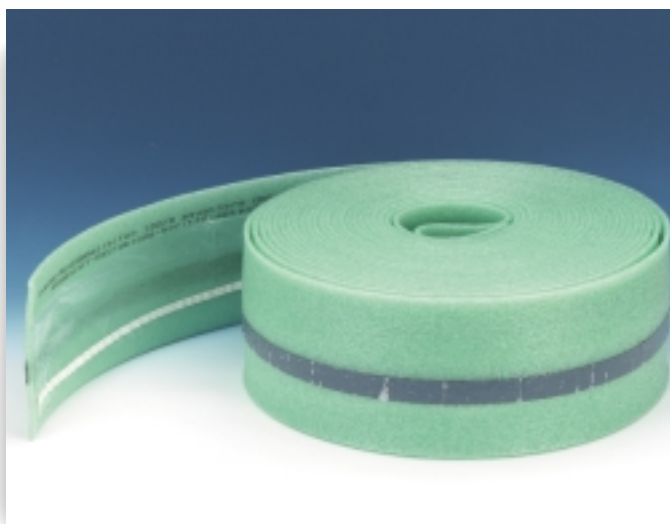
### aquatherm® - border insulation

#### Function

Border insulation fulfils several important functions between the heating flooring and the mounting components.

#### DIN 18560

The width of 5 mm as prescribed by DIN 18560 is valid for the compressed border insulation after compression of the flooring.



art.-no.	dimension	switching difference	colour	supply unit
91106	Height: 180 mm Thickness: 8 mm	–	green	25 m

#### Advantages

##### aquatherm®border insulation:

- of polyethylene foam 8 mm thick and 180 mm high
- with pre-embossed tear strip for a problem-free use with different heights of flooring
- provided with a self-adhesive welded polyethylene foil taking care that no flooring gets between the border insulation and the heat insulation plates due to conglutination on the heat impact sound insulation elements
- the aquatherm®-border insulation can also be fixed to brickwork with the gummed tape attached on the backside
- hardly inflammable

Consequently effective thermal and sound bridges are avoided.



**aquatherm®-border insulation**

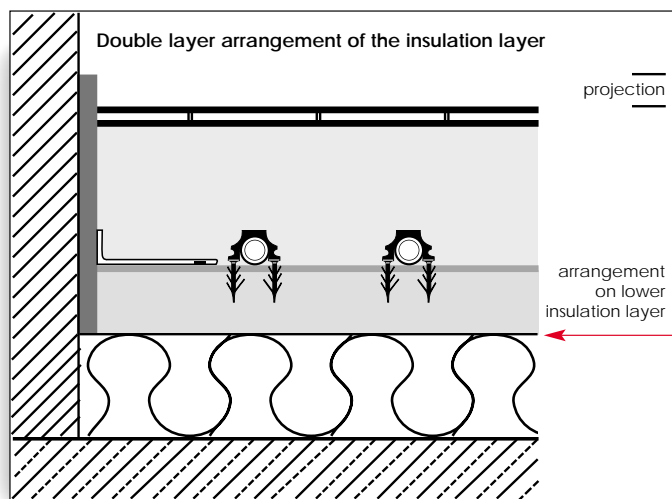
Border insulation strips are used as:

- absorption layer of the heat expansion of the heating flooring
- separation layer between heating flooring and mounting components
- impact sound insulation between components
- heating insulation layer between components

Function

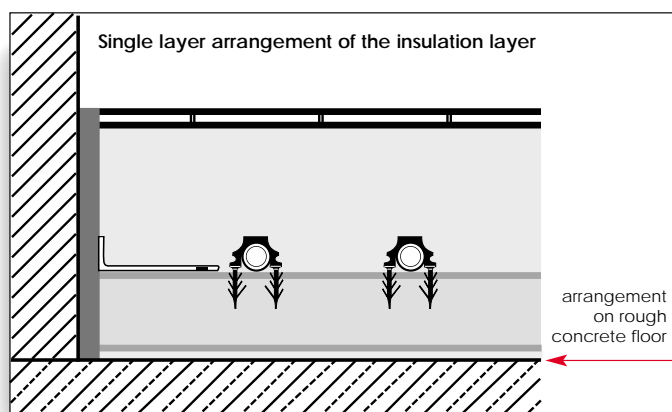
Projecting border insulation can only be removed after placing of the floor covering in accordance with the demands of DIN 18560.

Notice



Double layer insulation

- ▲ In case of a double layer arrangement of the insulation layer the border insulation is on the lower layer.



Single layer insulation

- ▲ In case of one insulation layer the border insulation is on the rough concrete floor.

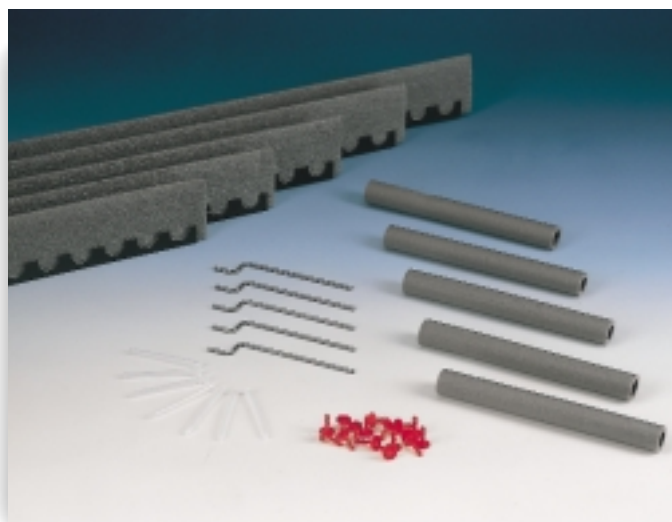
## Floor construction

### aquatherm®-expansion joint profile

Expansion  
joint

The formation of expansion joints e.g. in door areas causes considerable problems to the flooring paver as the connection ducts to the heating circuits cross the joint.

The perfect execution of an expansion joint can easily be done with the aquatherm®-expansion joint profile.



art.-no.	dimension	switching - difference	colour	supply unit
<b>91107</b>	10 units of 2,0 m	–	–	20 m

#### aquatherm®-expansion joint profile (art.-no. 91107)

consisting of:

- profile strips with polyethylene foam and punchings for heating pipe passage
- pipe guide bushes
- locking dowels
- floor pavement anchors

Components

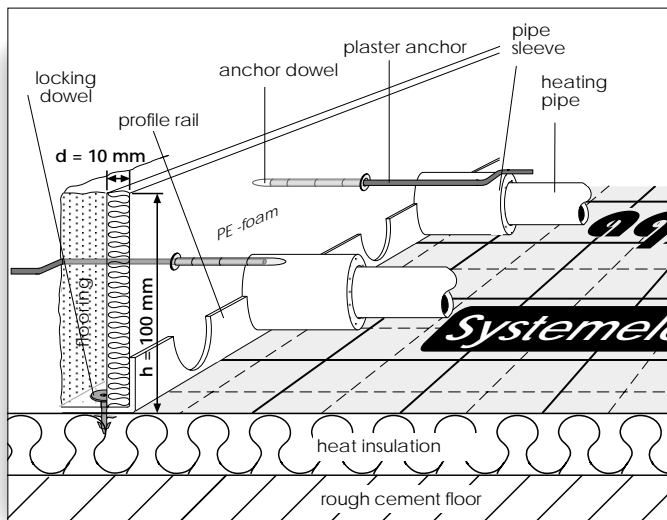
**aquatherm®-expansion joint profile**

The profile rail with joint profile is cut into a suitable length and stuck to the system element.

There are openings in the profile rail for the mostly required pipe distances starting from a spacing of 50 mm.

Profile rail

Pipe distance  
from 50 mm



The expansion strip of polyethylene foam is removed from the adhesive-active profile rail before the heating pipes are laid. After laying of the heating pipes through the profile rail the expansion strip is placed on the pipes and the passage of the heating pipes is marked with a felt-tip pencil.

The passage holes have to be punched with a diameter of approx. 35 mm. The remaining web below the punched holes is cut. The protection pipes are split pipes alongside and moved into the moving area via the heating pipe. The longitudinal slot is on the lower side and does not need to be closed additionally.

Afterwards the expansion strip is pressed over the heating pipes to the adhesive side of the profile rail.

- Larger surfaces can be divided without any problem into several partial surfaces with the expansion joint profile, when the position of the profile has been coordinated with the modular dimension of the tiles.

The codes of practice of the Central Association of the German Building Trade contain more information on the item "Joints".

**(Expansion joint profile cannot be used for the aquatherm®-system element fastening plate EPS-45).**

Laying of the  
heating pipes

Marking of the  
expansion strip

Passage holes

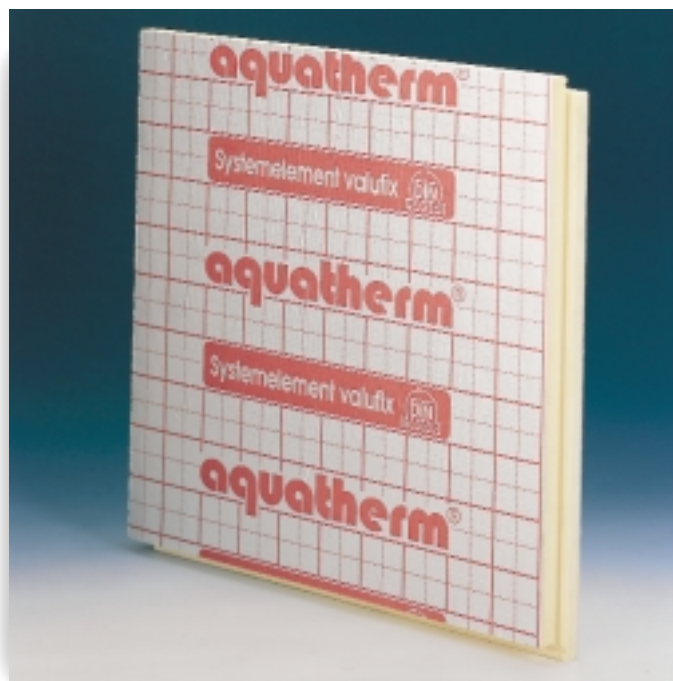
Protection pipes

Fastening of the  
expansion strip

Notice

## Floor construction

## aquatherm®-system element valufix-74



## technical data: System element valufix-74

Thermal resistance	$R_{\lambda,B} \text{ D}\ddot{\alpha} = 2,87 \text{ sq.m K/W}$
Class of building material	B 2 (normal inflammable)
Impact sound improvement dimension	$\Delta L_{W,R} = 22 \text{ dB}$
Sheet dimension	1.000 x 1.000 x 74 mm
Packing unit	7 sq.m
Article-no.	91007

The aquatherm®-system element valufix-55 is a sandwich-element sheet made of different materials.

- 1) Cover layer with a minimum thickness of 50 $\mu$  of corrosion protected aluminum foil with imprinted screen as installation aid
- 2) Core layer of CFC-free polyurethane high-resistant foam (WLG 025) as heat insulation
- 3) Aluminum coat as lower corrosion-protective layer
- 4) Impact sound insulation of polyethylene foam.

Due to this structure the heat insulating sheet valufix-74 fulfills the demands of the current heat protection regulation with small insulation material thicknesses.

The system elements valufix are provided with folding joints on all sides guaranteeing a quick placing with an entirely tight sheet composite. Consequently, an additional foil covering is unnecessary.

**Applications :**

According to the heat protection regulations (WSVO) valufix-74 is used for floors bordering to

1. outside air
2. ground or
3. building parts with considerable lower inside temperatures.

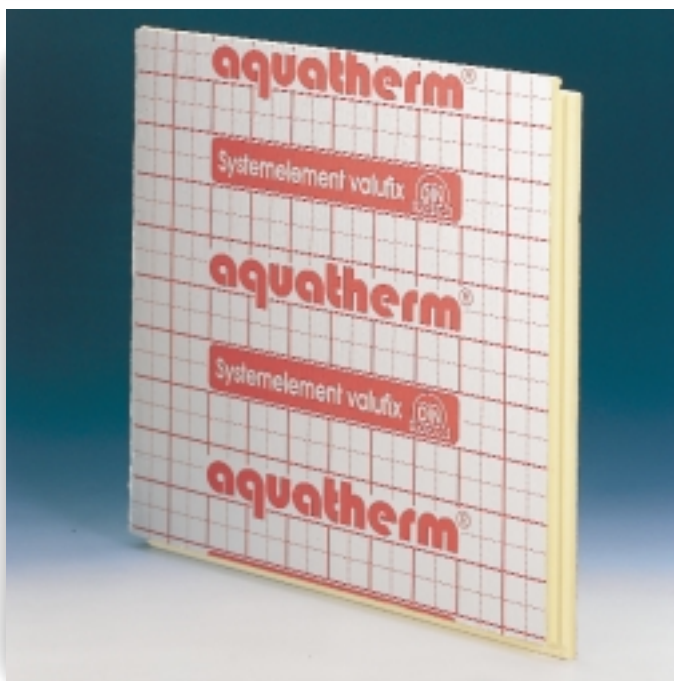


Element sheet

Material layers

WSVO

**aquatherm®-system element valufix-55**



**technical data : System element valufix-55**

Thermal resistance	$R_{\lambda,B} D\dot{a} = 2,15 \text{ sq.m K/W}$
Class of building material	B 2 (normal inflammable)
Impact sound improvement dimension	$\Delta L_{W,R} = 22 \text{ dB}$
Sheet dimension	1.000 x 1.000 x 55 mm
Packing unit	8 sq.m
Article no.:	91005

The aquatherm®-system element valufix-55 is a sandwich-element sheet made of different materials.

- 1) Cover layer with a minimum thickness of 50 $\mu$  of corrosion-protected aluminum foil with imprinted screen as installation aid
- 2) Core layer of CFC-free polyurethane high-resistant foam (WLG 025) as heat insulation
- 3) Aluminum coat as lower corrosion-protective layer
- 4) Impact sound insulation of polyethylene foam

Due to this structure the heat insulating sheet valufix-55 fulfils the demands of the previous heat protection regulations.

The system elements valufix are provided with folded joints on all sides guaranteeing a quick placing with an entirely tight sheet composite. Consequently, an additional foil covering is unnecessary.

**Applications:**

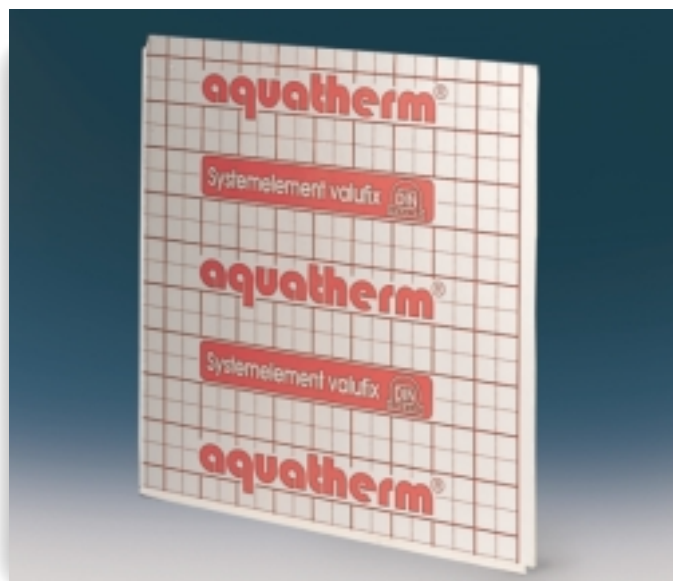
According to the previous heat protection regulations (WSVO) of 24.02.82 (valid for all building permits till 31.12.94) valufix-55 is used for floors bordering to

1. outside air
2. ground or
3. building parts with considerable lower inside temperatures.

Element sheet

Material layers

WSVO



**technical data: system element valufix-32**

Thermal resistance	$R_{\lambda,B} \text{ D}\alpha = 0,80 \text{ sq.m K/W}$
Class of building material	B 2 (normal inflammable)
Impact sound improvement dimension	$\Delta L_{w,R} = 26 \text{ dB}$
Dynamic rigidity	30 MN/cu.m
Sheet dimension	1.000 x 1.000 x 32/30 mm
Packing unit	10 sq.m
Article no.:	91036

The aquatherm®-system element valufix-32 is a combined polyurethane/polystyrene heat-impact sound insulation sheet as sandwich element.

- 1) Cover layer with a minimum thickness of 50µ of corrosion protected aluminium foil with imprinted screen as installation aid
- 2) Core layer of CFC-free polyurethane high-resistant foam (10 mm)
- 3) lower impact sound insulation layer of polystyrene high-resistant foam PST PE 22/20 mm.

The system elements valufix are provided with folded joints on all sides guaranteeing a quick placing with an entirely tight sheet composite. Consequently, an additional foil covering is unnecessary.

**Applications :**

1. According to DIN EN 1264 the system element valufix-32 is used for
  - intermediate covers above locations with a similar use (heated rooms).
2. According to the heat protection regulation (WSVO) the sheet is used above commercial polyurethane heat insulation sheets (minimum 46 mm WLG 025) on covers bordering to
  - outside air or
  - building parts with considerable lower inside temperatures.
3. According to WSVO the sheet is used over commercial polyurethane heat insulation sheets (min. 53 mm WLG 025) on covers bordering to the ground.

Polyurethane/poly-styrene element sheet

Material layers

DIN EN 1264

WSVO

**aquatherm®-system element valufix-roll 38 / 35**



**technical data: system element valufix-roll 38 / 35**

Thermal resistance	$R_{\lambda,B} D\ddot{a} = 0,75 \text{ sq.m K/W}$
Class of building material	B 2 (normal inflammable)
Impact sound improvement dimension	$\Delta L_{w,R} = 30 \text{ dB}$
Dynamic rigidity	10 MN/cu.m
Sheet dimension	10.000 x 1.000 x 38 / 35 mm
Packing unit	10 sq.m
Article-no.	91032

The aquatherm®-system element valufix-roll 38 / 35 is a quick-placing heat-impact sound insulation of PST/ SE as per DIN 18164. The valufix-roll exists of:

- 1) a cover layer of temperature-resistant plastic foil with imprinted screen to make cutting of the insulation roll and placing of the heating pipes much easier.
- 2) under-covered heat-impact0 insulation layer of polystyrene high-resistant foam PST SE 38 / 35 mm.

When placing on a flat surface the cuts of the valufix-roll will close exactly. Consequently there is a continuous insulation layer. The rolls are provided with a foil overlapping on one side. Same is sealed with the aquatherm®-gummed tape in order to reach a tight sheet composite over the whole surface.

**Applications :**

1. According to DIN EN 1264 the system element DIN EN 1264 valufix-32 is used for
  - intermediate covers above locations with a similar use (heated rooms).
2. According to the heat protection regulation (WSVO) the sheet is used above commercial polyurethane heat insulation sheets (minimum 46 mm WLG 025) on covers bordering to
  - outside air or
  - building parts with considerable lower inside temperatures.
3. According to WSVO the sheet is used over commercial polyurethane heat insulation sheets (min. 53 mm WLG 025) on covers bordering to the ground.

PST/SE  
as per DIN 1864

Material layers

DIN EN 1264

WSVO



## Floor construction

### aquatherm®-system element fastening plates EPS-45



#### technical data: system element fastening plates EPS-45

Thermal resistance	$R_{\lambda,B} D\dot{a} = 0,75 \text{ sq.m K/W}$
Class of building material	B 2 (normal inflammable)
Impact sound improvement dimension	$\Delta L_{W,R} = 26 \text{ dB}$
Dynamic rigidity	30 MN/cu.m
Sheet dimension	1.000 x 500 x 73/70 - 45 mm
Packing unit	4 sq.m
Article-no.	91000

Polystyrene  
high - resistant foam

Structure

The aquatherm®-system element fastening plate EPS-45 is a heat-impact sound insulation plate of polystyrene high-resistant foam. The plate has the following characteristics:

- knobs at a distance of 50 mm for laying of the floor heating pipes without pipe holding devices
- basic height: 45 mm, height above the knobs: 73/70 mm folded joints on all sides
- folded joints on all sides
- lower impact sound indent

especially meant for a quick floor heating placing. The indents at the lower side level slight unevennesses on the rough cement cover. The folded joints on all sides enable quick placing with a completely tight plate composite. An additional foil covering is not necessary.

#### Applications:

1. According to DIN EN 1264 the system element fastening plate is used for
  - intermediate covers above locations with a similar use (heated rooms).
2. According to the heat protection regulation (WSVO) the plate is used above commercial polyurethane heat insulation sheets (minimum 46 mm WLG 025) on covers bordering to
  - outside air or
  - building parts with considerable lower inside temperatures.
3. According to WSVO the plate is used over commercial polyurethane heat insulation sheets (min. 53 mm WLG 025) on covers bordering to the ground.

DIN EN 1264

WSVO



## Summary of the aquatherm®-system elements

Selection of the system elements and additional insulation depending on the range of application.

application range	system element	height	additional insulation	total thickness of insulation layer	thermal resistance	impact sound improvement dimension	dynamic rigidity	article no.	supply unit
		mm		mm	$R_{\lambda,B}Da = q, mK/W$	$\Delta L_{W,R} = dB$	MN/cu.m		(sq.m)
According to WSVÖ of 1.1.95 - covers against - outside air - ground - building with considerable lower inside temperatures	valufix-74	74	--	74	2,87	22	50	91007	7,0
	valufix-roll	38/35	heat insulation sheet polyurethane 46 mm	81	2,59	30	10	91032 + 91040	10,0 9,6
	valufix-roll	38/35	heat insulation sheet polyurethane 53 mm	88	2,87	30	10	91032 + 91042	10,0 9,6
	fastening plate	(73) 45	heat insulation sheet polyurethane min. 46 mm	91	2,59	26	30	91000 + by the customer	10,0 4,0
	fastening plate	(73) 45	heat insulation sheet polyurethane min. 53 mm	98	2,87	26	30	91000 + by the customer	10,0 4,0
According to WSVÖ of 24.2.82 <sup>1</sup> - covers against - outside air - ground - unheated rooms	valufix-55	55	--	55	2,15	22	50	91005	8,0
According to DIN 4725 for covers - against rooms with a dissimilar use  (e.g. industrial locations)	valufix-32	32/30	heat insulation sheet PS 20 SE 20 mm	52/50	1,30	26	30	91036 + by the customer	10,0
	valufix-roll	38/35	heat insulation sheet PS 20 SE 20 mm	55	1,25	30	10	91032 + by the customer	10,0
	fastening plate	(73) 45	heat insulation sheet PS 20 SE 20 mm	65	1,25	26	30	91000 + by the customer	4,0
According to DIN 4725 for covers - intermediate covers above locations with a similar use	valufix-32	32/30	--	32/30	0,80	26	30	91036	10,0
	valufix-roll	38/35	--	35	0,75	30	10	91032	10,0
	fastening plate	(73) 45	--	(73) 45	0,75	26	30	91000	4,0

1: according to the previous heat protection regulations (WSVO) of 24.02.92: valid for all building permits till 31.12.94

2: by the customer = commercial heat insulation sheets of polyurethane (WLG 025) resp. polystyrene PS-SE  
(see indication "additional insulation").

## Floor construction

### Floor pavement

Floor pavement is used as a load distribution and load-carrying layer. Floor pavements for floor heating must show the following characteristics:

- high temperature resistance
- high surface strength
- high thermal conduction

DIN 18560

Floor pavements on aquatherm®-floor heating systems must correspond to the demands of DIN 18560. The respective strength class is determined by the architect considering later use.

Residential buildings

For normal residential buildings cement floors of at least class ZE 20 resp. floating floors of class AE 20 up to a working load of 1,5 kN/sq.m have to be used.

Industrial buildings

For industrial buildings the strength of the heat insulation elements (WD, WS) and of the floor (ZE 30, ZE 40) are determined by the engineer engaged in the statical calculations.

### Cement floor / floor addition

Floor addition

For the aquatherm®-floor heating in connection with a cement floor, made according to DIN 18560, a floor addition "floor fix" is prescribed. This material has been tested in connection with the basic and additional materials of the floor pavement.

The floor addition "floor fix-special" is prescribed for thin-layer cement floors as per DIN 18560 (see information pages 4.30, 4.32 - 4.33)

### Flow cement floor

Composition

Placing of flow cement floors is made without large-scale compaction and distribution works. The basic materials mostly are anhydrite with an addition of solvents.

Handling/  
suitability

As these floor pavements are placed in a liquid form directly on site an all-over closed surface is necessary.

To handle flow cement floors of the make Knauf on aquatherm®-floor heatings pay attention to the notices mentioned on page 4.24.

### Anhydrite floor

Composition

Anhydrite is a floor pavement made of an anhydrite plaster, water and possibly adding of additional materials.

Handling/  
suitability

The indications of the respective manufacturer have to be considered for suitability and handling.

### Poured asphalt floor

Composition

Poured asphalt floor is a floor pavement made of bitumen and if necessary by adding of additional materials. The mixture is placed with temperatures of approx. 200 - 250 °C.

Handling/  
suitability

Poured asphalt floors are **not suitable** for aquatherm®-floor heating systems.

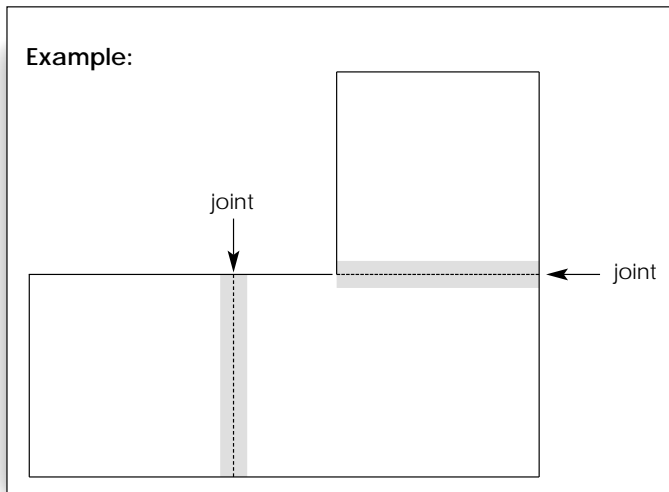
## Floor compartments

The compartment sizes for floor compartments are indicated in DIN 18560 (see section expansion joints).

In case of non-rectangular floor surfaces or surfaces with curves the necessary expansion joints have to be arranged in such a way that possibly cramped compartments result.

Compartment size

Arrangement



The thermally caused change of length of a cement floor amounts to approx. 0,012 mm/mK.

Thermal  
change of length

Taking up of pressure and tensile stress can only be achieved with correct planned and executed expansion joints and floor compartments. The planner of the building has to issue a joint plan regarding the arrangement of the joints, which has to be presented to the executing party as part of the performance description.

## Edge gaps

Edge gaps take up thermally caused changes of length of the floor pavement and the floor covering. They reduce the impact sound transmission from the floor to other components.

Function

Edge gaps must enable a movement space of at least 5 mm. The border insulation in the edge gap may only be cut after completion of the floor covering. Afterwards the edge gaps have to be filled with a permanently elastic material.

Arrangement

## Floor construction

### Movement joint

#### Surface size

In case of cement floors designated for stone or ceramic coverings with surface sizes starting from approx. 40 sq.m floor compartments have to be constructed separately by using aquatherm®-expansion joint profiles. The expansion joint profile is supplied as a complete set consisting of profile strips, proportional pipe guide bushes, locking dowels and floor pavement anchors.

#### Side ratio

The side length of single floor compartments should not exceed 8 m. The side ratio may not be larger than 1:2. Movement joints are joints in the floor pavement separating up to the insulation layer. Heating pipes may only cross those movement joints as connection ducts. In this case the pipes must be covered over a length of approx. 30 cm with the pipe guide bushes included in the set.

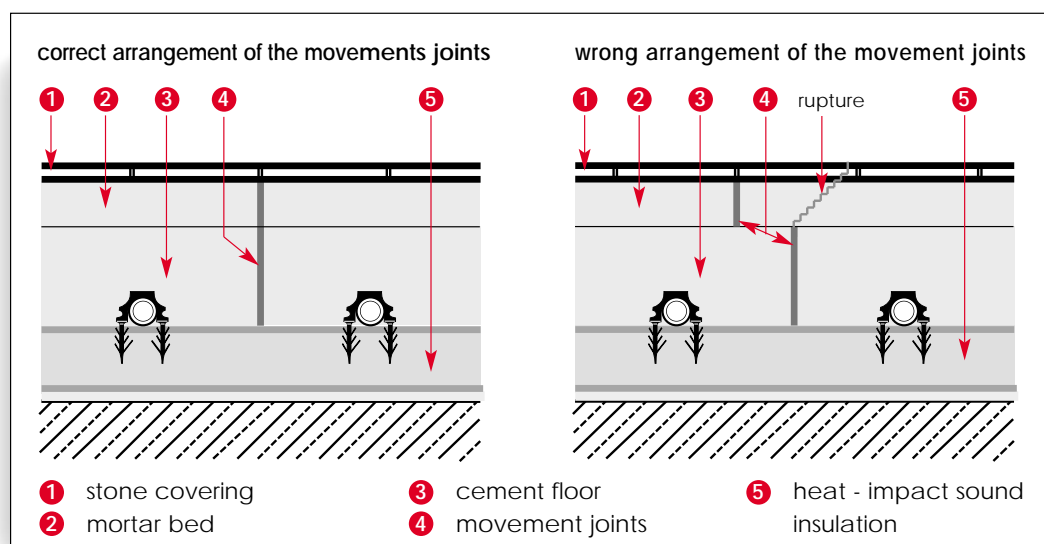
#### Heating pipes

#### Insulation layer

Movement joints must run congruently starting from the insulation layer up to the covering.

#### Joint material

On the upper side movement joints have to be closed with a permanently elastic joint material after completion of the covering.



### Dummy joints

#### Function

Dummy joints can be arranged in a cement floor as additional parting.

#### Arrangement

The indent (trowel indent) is made in fresh floor mortar. After hardening and drying up of the floor pavement they have to be closed (e.g. with synthetic resin). Dummy joints made in such a way are not considered during placing of the floor coverings, i.e. they must not be taken over congruently in the floor coverings.

#### Application

The arrangement of dummy joints is applied where movement joints are not necessary but where tensions of the floor plate should be carried off.

### Floor reinforcement

Reinforcement of floor pavements on insulation layers is generally not necessary. However, for cement floors with stone or ceramic coverings same is useful, as an enlargement of possibly resulting cracks and the displacement height of the cracked edges can be avoided.

The reinforcement has to be made with welded wire meshes with a mesh width of 150 mm x 150 mm or with welded wire meshes with the following parameters:

mesh width	diameter	rigidity
50 mm x 50 mm	2 mm	700 N/sq.m
75 mm x 75 mm	3 mm	500 N/sq.m
100 mm x 100 mm	3 mm	500 N/sq.m

The reinforcement has to be interrupted near movement joints and to be arranged in approx. the middle third of the thickness of the floor pavement. The reinforcement meshes may never be pushed through the border insulation.

Floor reinforcements must be free of edges to avoid mechanical damage of the pipes.

In principal welded wire meshes will never prevent cracking of the heating floor. When using wire welded meshes with anhydrite floors they have to be protected against corrosion.

As the professional installation of wire welded meshes with thin-layer floor pavements is rather difficult, it is recommended to add floor synthetic fibres for this kind of floor pavement (ask for product information).

Cement floor

Welded wire mesh

Mesh width

Arrangement

Notices and regulations

### Procedures floor covering

#### Thin mortar bed technique

With the thin mortar bed technique coverings are glued on the floor pavement with a suitable glue. Only products indicated by the manufacturer may be used.

#### Thick mortar bed technique

With the thick mortar bed technique the stone floors are placed in the mortar. The thickness of the mortar depends on the used stone covering. The minimum thickness is 15 mm.

#### Placing with fresh floor pavement

Large-surface stone plates can be beaten directly in the mortar bed. The advantage of this type of placing surely is the fact that a levelling of different thicknesses of the covering can be made.

The full mortar bed has to be mixed with aquatherm®-floor addition material.

Procedure

## Floor construction

### Heating of floor pavement

Anhydrite and cement floors must be heated prior to placing of floor coverings.

#### Notice

When disconnecting the floor heating after the heating phase the floor pavement has to be protected against draft and chilling.

#### Heating procedure

Differing from the method for other hot-water heating systems heating of the cement floor should be after 21 days at the earliest and of anhydrite floors according to the indications of the manufacturer, however after 7 days at the earliest. The first heating starts with a flow temperature of 25 °C and has to be kept for 3 days. Afterwards the maximum flow temperature is adjusted and kept for another 4 days.

#### Moisture contents

It is not quite guaranteed that after the described heating procedure the floor pavement has reached the moisture contents necessary to be ready for placing.

#### Remark:

The table on page 4.29 contains reference values for being ready for placing, measured with a CM-unit (moisture tester) at approx. 20 degrees C room temperature.

### Heating protocol

The protocol to be issued by the installer (see next page) must contain the following indications regarding heating:

1. Heating data with the respective flow temperatures
2. Maximum reached flow temperature
3. Operating state and external temperature upon handing over.

## Reference data

## Specialized heating installation company:

Company: \_\_\_\_\_  
 Street: \_\_\_\_\_  
 ZIP-Code: \_\_\_\_\_ Place: \_\_\_\_\_  
 Phone: ( \_\_\_\_\_ ) \_\_\_\_\_ Fax: \_\_\_\_\_

## Site:

Company: \_\_\_\_\_  
 Street: \_\_\_\_\_  
 ZIP-Code: \_\_\_\_\_ Place: \_\_\_\_\_  
 Phone: ( \_\_\_\_\_ ) \_\_\_\_\_ Fax: \_\_\_\_\_

## Specialized floor pavement company:

Company: \_\_\_\_\_  
 Street : \_\_\_\_\_  
 ZIP-Code: \_\_\_\_\_ Place: \_\_\_\_\_  
 Phone: ( \_\_\_\_\_ ) \_\_\_\_\_ Fax: \_\_\_\_\_

## Type of floor / System element

## Type of floor:

- ☐ cement floor  
☐ anhydrite floor  
☐ floating floor FE 80  
☐ floating floor FE 50  
☐ floating floor FE 25

## System element:

- ☐ valufix ( ) 74  
 ( ) 55  
 ( ) 32  
☐ valufix-roll PST 38/35  
☐ fastening plate EPS-45

**For cement floor:** (for floating floor please ask for a separate protocol).

Date of placement of the floor: \_\_\_\_\_

Date of heating: \_\_\_\_\_ heating flow temperature: \_\_\_\_\_ °C

Date max. flow temperature: \_\_\_\_\_ max. flow temperature: \_\_\_\_\_ °C

Operating state of the installation:

\_\_\_\_\_

Date of handing over : \_\_\_\_\_ External temperature handing \_\_\_\_\_ °C

## Moisture content equilibrium

- \_\_\_\_\_ % for stone and ceramic coverings (thin mortar bed technique)  
 \_\_\_\_\_ % for stone and ceramic coverings (thick mortar bed technique)  
 \_\_\_\_\_ % for textile, coverings, PVC  
 \_\_\_\_\_ % for elastic coverings  
 \_\_\_\_\_ % for parquet, laminate

\_\_\_\_\_ (Date)

\_\_\_\_\_ (Signature / Stamp)

## Floor construction

### Knauf-floating floor pavement

Composition

Mixing

Floating floor pavements of Knauf are factory-dry mortars of high-quality plaster, mineral fillers and solvents which are mixed ready for tempering. Floating floors are mixed by adding clean tap water with the suitable mixing pumps and are pumped in.

### Advantages of a floor pavement

Characteristics

- floating floors of Knauf offer an optimum heat transport from the heating pipe to the housing space thanks to their quite good thermal conduction
- due to the liquid the heating pipes laid are enclosed completely and consequently have no air influence
- floating floors of Knauf are self-levelling and therefore offer horizontal and flat surfaces which must neither be ground nor brushed
- due to small floor thicknesses above the heating pipes the total construction height is reduced
- floating floors are walkable and capable of bearing after a very short time. This offers decisive advantages for scheduled sites or prefabricated house constructions, etc.

### Insulation layers

Suitability  
with floating floors

All system elements offered by aquatherm have an excellent suitability for placing under Knauf-floating floors due to their plate composite technique.

The "tight covering" being urgently required for the application of floating floors is reached without large-scaled additional measures.

Buts of plates which are not tight enough have to be sealed with aquatherm®-gummed tape manually.

### Application ranges

Application of  
floating floors

Placing of Knauf-floating floors is suitable for all residential and object buildings at the interior.

It is suitable for e.g.

- new buildings
- rebuilding
- refurbishing

and especially at places where only low weight loads may be placed due to static problems.

### Flow temperature

max. allowed  
max. required

The maximum allowed flow temperature is 55 °C. The usually required flow temperatures normally are at 45 °C.



### Thickness of floor pavement

The nominal thickness of Knauf-floating floors FE 80 and FE 25 reaches at least 35 mm above the upper edge of the heating pipe.

35 mm  
above heating  
pipe

### Movement joints

Movement joints generally have to be built in near doors. Surfaces with a diagonal larger than 10 meters must be divided by movement joints. In case of non-rectangular floor surfaces or surfaces with cants movement joints must also be arranged and built in.

Application

In general the tape for movement joints with the T-profile offered by Knauf has to be used for T-profile. (Consider technical information of Knauff).

Notice

### Heating register

All heating registers must be laid and fixed sufficiently according to the installation instructions.

They have to be tested under pressure prior to placing the floating floor (see separate installation instructions, section: filling and commissioning).

Installation  
conditions

During placing of the floor the heating registers must be filled with water and be under pressure. In case of danger of frost the floor heating can be operated with flow temperatures of max. 20 °C when placing the floor pavement.

### Handling of floating floor pavement

Floating floors of Knauf are placed in a liquid form with suitable mixing pumps.

Advantages

The mixing pump will be fed either with bag goods or automatically from containers or silos depending on the size of the site. The site is kept free of dirt or aggregates.

Supply

Working with floating floor pavement is a clean matter.

### Placing of floor pavement

aquatherm®-system elements are generally placed as wet-laid heating systems.

Layer installation

For this reason, Knauf-floating floors are placed in two layers.

#### FE 80/FE 25

- 1<sup>st</sup> layer: pre-casting up to approx. 2/3 of the height of the heating pipe
- 2<sup>nd</sup> layer: cover casting (covering of the pipes at least 35 mm)

Notice

(Consider technical information of Knauf.)

## Floor construction

### Heating protocol

Regulation  
of the document

In any case a protocol about the heating procedure must be issued. Same must be presented to the chief of the covering placing according to the contract procedure for building works (VOB) part C floor covering works, DIN 18365.

(Printed form see separate installation instructions 7.21).

### Dry test of floor pavement

Procedure

Drying has to be tested with laid-on and at the edges sticked plastic foil (approx. 50 cm x 50 cm).

Notice

In case of a heated floor with a maximum flow temperature of 55 °C no condensation water may be formed under the foil within 12 hours.

**In case of formation of condensation water heating and ventilation should be continued.**

### Placing on the floor pavement

Procedure

Hard and steam-tight coverings (e.g. tiles, natural stone) should be placed approx. 1 - 3 days after heating/cooling. Before placing of the covering the floor pavement has to be sucked off with an industrial type vacuum cleaner before and afterwards primed with an acrylate dispersion primer.

Recommendation  
of flooring adhesives

Flooring adhesives suitable for floor heating must be used; for rigid coverings (tiles, natural stone) elastic adhesives have to be applied (see recommendation of placing).

### Use of floating floor pavement in humid rooms

Floating floors FE 80/FE 25 can be used in domestic humid areas such as kitchens and bathrooms.

Protection

The floor pavement has to be protected permanently with a hydrophobic coat (e.g. Knauf-surface-tight with surface sealing tape; consider the technical handling instructions of Knauf).

### Floor coverings

Suitability

The following types of coverings are suitable for aquatherm®-floor heating in connection with Knauf-floating floor pavement:

- ceramic tiles and plates
- natural stone ( marble etc.)
- elastic coverings (e.g. PVC-floor)
- textile coverings (carpet floor)
- parquet/laminate

DIN EN 1264

The thermal resistance for surface coverings is 0,15 sq.m K/W as per DIN EN 1264.

### Heating of Knauf-floating floor pavement FE 80

Knauf floating floor pavement FE 80 on an aquatherm®-floor heating can be heated **not earlier than 7 days** after placing of the floor pavement.

Notice

1. The flow temperature has to be adjusted on 25 °C and kept for 3 days.
2. Afterwards the flow temperature is adjusted on the maximum temperature (55 °C).
3. The maximum temperature has to be kept without night lowering till complete drying of the floor pavement has been reached.
4. Afterwards the flow temperature will be lowered again till a surface temperature of 15 - 18 °C has been reached.

Heating phases

### Heating of Knauf-floating floor pavement FE 25

Knauf floating floor pavement FE 25 on an aquatherm®-floor heating can be heated immediately after completion of the flooring works.

Notice

1. Adjust the flow temperature on 55 degrees C and start heating.
2. Heating without lowering at night, till the floor is dry.
3. It should be ventilated sufficiently.
4. The drying time for a total floor thickness of 55 mm is approx. 10 days.
5. Afterwards it must be checked if the floor dried sufficiently. (See item: Dry test of floor pavement).
6. After drying turn of the heating system or reduce the flow temperature to 15 - 18 °C.

Heating phases

In case that the floating floor pavement FE 25 can only be heated after one or several days a gradual heating procedure is necessary.

Notice

1. 1st day: Commissioning with the flow temperature 10 °C higher than the room temperature.
2. 2nd day and following days: increase the flow temperature each time by 10 °C till the highest allowed flow temperature of 55 °C has been reached.
3. Heat without lowering at night till the floor is dry.
4. Afterwards it must be checked if the floor dried sufficiently. (See item: Dry test of floor pavement).
5. After drying turn of the heating system or reduce the flow temperature on 20 °C.

Heating phases

## Floor construction

### Technical and building physical characteristics

#### Characteristics

product	FE 80	FE 25
Use of material for 1 cm floor	approx. 18 kg/sq.m	approx. 18 kg/sq.m
Bulk density of dry material	1,6 kg/l	1,5 kg/l
Water required for 40 kg (=1 bag)	approx. 8 l	approx. 7,5 l
Flow dimension (test box of 1,3l )	max. approx. 52cm	approx. 45 cm
Reaction of the mortar	alkaline	alkaline
Volume weight dry (appar. density) wet	2,0 kg/l 2,2 kg/l	1,8 kg/l 2,0 kg/l
Yield of 100 kg material	55 l mortar	57 l mortar
Start of stiffening	approx. 90 min.	approx. 60 min.
Expansion during setting	max. 0,1 mm/m	ca. 0,5 mm/m
Walkable after Capable of bearing after	approx 24 hours approx. 3 days	approx. 3 hours approx. 8 hours
Crushing strength after 28 days	38 N/sq.mm	40 N/sq.mm
Flexural strength after 28 days	7 N/sq.mm	8 N/sq.mm
Modulus of elasticity	17.000 N/mm <sup>2</sup>	18.000 N/mm
Ready for placing (35 mm thick) after	approx. 3-6 weeks	approx. 8-10 days
Depending on site conditions, placing thickness and drying possibilities (e.g. aeration / ventilation). Residual moisture < 1 % for steam-open coverings (carpet, etc.) Residual moisture < 0,5% for steam-resistant coverings (PVC-coverings, parquet, tiles and similar).		
max. flow temperature with floor heating	55° C	55° C
Thermal conductivity (floor heating)	$\lambda_z = 1,87 \text{ W/m.K}$	$\lambda_z = 1,38 \text{ W/m.K}$
Thermal expansion (floor heating)	approx. 0,016 mm/m	approx 0,015mm/m
Material class	A1 not combustible	
Storage of dry mortar	up to 2 months	up to 3 months

## Surface coverings for Knauf-floating floors

The following data are only valid for Knauf-floating floors and fillers.

Placing recommendation on Knauf-floors				
surface covering	Pretreatment	approx. use per sq.m	cement	approx. use per sq.m
a) floor tiles in thin mortar bed			resin-hardened thin bed mortar e.g. Knauf-building and tile cement	2 kg
b) floor tiles on heating floor	acrylate dispersion priming e.g. Knauf-floor priming	0,15 - 0,2 kg	elastic thin bed mortar, resin-hardened e.g. Knauf-building and tile cement mixed with Knauf-elastic	2 kg
b) natural stone			elastic medium bed mortar	depending on thickness
Carpet coverings	acrylate dispersion priming e.g. Knauf-floor priming	0,15 - 0,2 kg	resin-dispersion cement e.g. Knauf-floor covering cement	0,3 kg
PVC-coverings	acrylate dispersion priming e.g. Knauf-floor priming  Knauf-special-flow filler 415 or cement-bound filler e.g. Knauf-flow filler 315	0,15 - 0,2 kg  1,5 kg per mm layer thickness	resin-dispersion cement e.g. Knauf-floor-covering cement	0,3 kg
Wood-parquet	priming with regard to cement	-	plastic adhesive	-
Available floor (without surface covering)	light-duty Knauf-floor priming 2 x Otherwise impregnation, sealing or coating can be done depending on use	0,2 kg	-	-

Data

## Floor construction

### Floor coverings

Type of coverings

The following floor coverings are suitable for aquatherm®-floor heating systems:

- ceramic tiles and plates
- natural stone (marble, etc.)
- elastic coverings (e.g. PVC-floors)
- textile coverings (e.g. carpet floors)
- parquet/laminate

### Thermal resistance

0.15 sq.m K/W

The allowed thermal resistance for surface coverings is 0,15 sq.m K/W as per DIN EN 1264.

Notice

The respective installation instructions, standards resp. regulations for the individual types of coverings have to be considered.

### Conditions for placing

Heating of floor

The following conditions must be fulfilled prior to placing of the selected surface covering.

Moisture content equilibrium

Edge joints and joints for movements

Mortar remains

- a) The floor has been heated according to the aquatherm®-installation instructions.
- b) The flow temperature has to be kept till the moisture content equilibrium of the table has been reached
- c) All edge joints and joints for movements have been checked on correct arrangement and execution.
- d) Remaining solid matters have been removed completely (e.g. mortar remains).

### Working material

Suitability for floor heating

Only such materials may be used as priming materials, fillers, adhesives/cement and thin bed mortar as shown by the manufacturer to be "suitable for floor heating systems". The floor heating manufacturer has to guarantee the heat aging stability.

Thin bed mortar and adhesives (cement) must be resistant to a permanent temperature up to 50 °C and compensate permanently different heat expansions of the floor pavement and the surface covering.

Textile surface coverings must be glued all-over the surface and have to be provided by the manufacturer with the supplement "suitable for floor heating systems".

(also see page 5.4: floor surface coverings).

## Moisture content equilibrium

Prior to placing of the floor covering the floor pavement must have reached the moisture content equilibrium according to the following table.

The moisture content equilibrium must be checked by the company placing the floor covering. 3 measuring points per 200 sq.m resp. per housing.

### Decisive max. moisture content of floor pavements for readiness for placing of the floor coverings

Floor covering	Moisture cement anhydrite floor	Moisture content anhydrite floor
stone and ceramic coverings in thin bed	2,0 %	0,5 %
stone and ceramic coverings in mortar bed on parting layer	2,0 %	0,5 %
stone and ceramic coverings in thick bed	4,0 %	(not suitable)
textile coverings permeable to steam	3,0 %	1,0 %
textile coverings steam-resistant	2,5 %	0,5 %
elastic floor coverings e.g. PVC, rubber, lino	2,0 %	0,5 %
parquet/laminate	2,0 %	0,5 %

Moisture content

## Floor construction

### aquatherm®-floor additive

#### ▼ aquatherm®-floor-fix and floor-fix special



art.-no.	dimension	use per sq.m	colour	supply unit
91108	–	0,15 kg	blue	10 kg

#### aquatherm®-floor additive (Art.-no. 91108)

- as floor and mortar bed additive
- to increase the floor density and the water retention value

art.-no.	dimension	use per sq.m	colour	supply unit
91110	–	1,45 kg	pink	10 kg

#### aquatherm®-floor additive special (Art.-no. 91110)

- for thin-layer cement floor
- floor-pipe covering: 30 mm

Application range

Application range



### aquatherm®-floor additive

aquatherm®-floor fix is a highly effective additive especially developed for heating floor pavements and cement-bound mortar.

Cement floors for heated floor constructions do not differ from the "normal" floating floors as per DIN 18560 part 2, with regard to their mortar technological composition, machine preparation and necessary solidity.

For heated floor constructions it must be secured to a certain extent that the standard requirement of the floor pavements installed are fulfilled. The fresh floor mortar must have characteristics guaranteeing a circumferential embedding of the heating pipes and may not have any damaging influences on the installed materials.

aquatherm®-floor-fix reduces the surface tension of the mixing water and hereby causes a better digestion of the fine-grained binding agent. A more homogeneous, good handleable floor mortar enclosing completely the heating pipes is produced. By adding the aquatherm®-floor-fix the quantity of the mixing water is reduced. A reduction of the water-cement-value - with a constant mortar consistency - means an increase of the apparent density of the hardened floor pavement.

By increasing the apparent density of the load distributing floor plate an improvement of the thermal conductivity is reached and at the same time an increase of the heat accumulation capability. The characteristics of the fresh mortar obtained by floor-fix cause an increase of the pressure-flexural resistance. The air-void content is practically not increased. With aquatherm®-floor-fix a strong water retaining value of the fresh mortar is achieved, i.e. the bleeding "water separation" at the surface of the floor is prevented and the tendency to crack due to shrinkage is reduced.

Application range

Standard requirement

Characteristics

Thermal conductivity

Crush/ flexural resistance

Water retaining value

### Dosing quantity

aquatherm®-floor-fix has to be added when preparing the floor mortar in a portion of 1 weight percentage (referring to the cement weight), this corresponds to 0,5 kg per 50 kg cement.

- floor-fix must be added immediately to the first mixing water
- the dosing quantity for a floor thickness of 6,5 cm consequently is approx. 0,2 kg/sq.m
- no other additions may be mixed to the aquatherm®-floor-fix
- the addition of floor-synthetic fibres into the fresh floor mortar as replacement for floor grid is possible.

(ask for product information).

Dosing

## Floor construction

### aquatherm®-floor additive special

Application range  
DIN 18560

aquatherm®-floor-fix special is a highly effective additive for making of thin-layer cement-bound heat floor pavements as per DIN 18560.

Minimum rigidity  
class ZE 30

This additive is used for cement floors to be placed on floor heating systems with a minimum rigidity class of ZE 30.

Minimum floor  
height: 30 mm

The nominal thickness of the heat floor pavement above the heating pipes (covering height) can be reduced to 30 mm when using floor-fix special.

Standard conform  
function

The heat floor pavement made with floor-fix special fulfils with this low thickness the standard conform function of a load distributing plate due to its good compacting willingness and its rigidity.

Flexural and crush  
resistance

aquatherm®-floor-fix special produces a considerable increase of the flexural and crush resistances. The maximum value for the deflection of 0,15 mm required by DIN 18560 T2 is reasonably lower.

Low surface tension

By adding this addition the floor mortar gets more willingly to compact - with saving of mixing water at the same time - and obtains a uniform mortar structure. These characteristics of the fresh mortar cause a better digestion of the fine-grained cement, a.o.by lowering of the surface tension. "Bleeding" of the floor surface (sanding) does not occur. Increasing of the apparent density, reached by adding aquatherm®-floor fix special also causes an increase of the thermal conductivity of the heat floor pavement.

Thermal  
conductivity

DIN 18560 part 2

Handling, composition, preparation and aftertreatment have to be done according to DIN 18560 part 2, "Floor pavements and heat floor pavements on insulation layers". The aggregate (gravel/sand 0/8 mm) must correspond to DIN 4226 "Aggregate for concrete" with regard to its structure (a.o. grain solidity) and the grain composition of the floor aggregate to DIN 1045 "Concrete and reinforced concrete". Handling does not differ from the previously known usual execution as commercial machines for mixing and transport must also be used.

## Dosing quantity

aquatherm®-floor-fix special has to be added when preparing the fresh mortar in a portion of 10 weight percentage (referring to the cement weight), this corresponds to 5 kg for every 50 kg cement

Dosing

- aquatherm®-floor-fix special must be added immediately to the first mixing water
- to make a heating floor pavement with a **rigidity class ZE 20** the following data for the required quantity of floor-fix are given in the example:

### Example:

When using	300 kg	Cement / cu.m
	2,4 - 3 kg	floor-fix special/cu.m

It corresponds for 1 sq.m heating floor pavement to approx. 2,4 - 3,0 g fix-floor per cm of floor thickness. For a floor covering of 30 mm (total thickness of the floor pavement approx. 45 mm) this corresponds to a quantity of 1,45 kg/sq.m.

- when **using "factory-fresh mortar"** the floor consistency must be stiff upon delivery. Adding of floor-fix special is made on site directly into the truck's mixer. A remixing time of approx. 10 min is necessary in any case, in order to utilize the effect of floor-fix special completely. In case that a concrete restrainer should be added to the factory-fresh mortar the consultation of aquatherm is absolutely necessary.
- **no other additives** may be added to the floor pavement. Floor mortars may not be handled under +5 degrees C according to DIN 18560 part 1.
- as the **additional competent placement** of e.g. a **floor grid** as reinforcement for thin-layer floors is rather hard to handle, it is recommended to add floor synthetic fibres to the fresh mortar (ask for product information).

Heating floor pavements must be heated before placement of floor coverings. Commissioning (heating) must be done according to the aquatherm®-installation instructions.

Commissioning

aquatherm®-floor-fix special is supplied in packing drums of 25 kg (PE-cans).

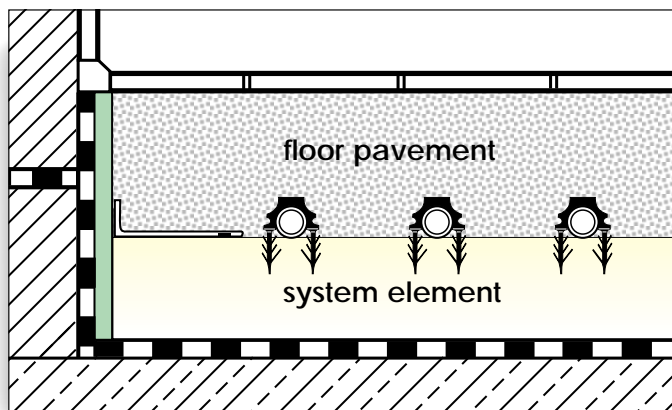
Inherent colour: pink

## Floor construction

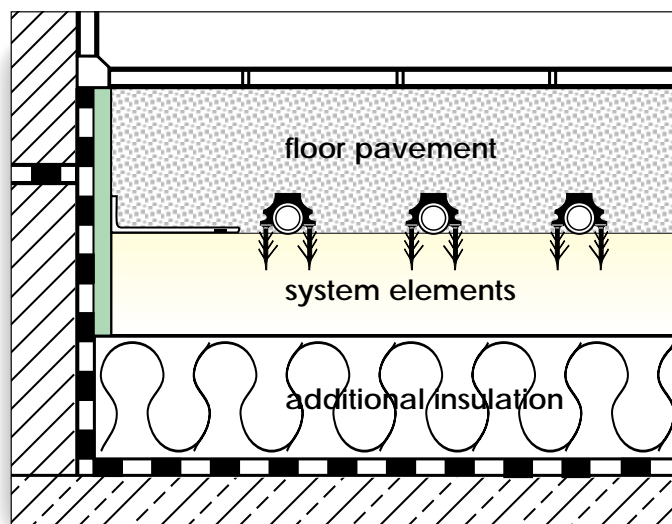
### Covers against ground

Application range: covers against

- ground
- outside air



elements			types of floor pavement		
system elements and additional insulations	height system elements (mm)	height additional insulation (mm)	cement floor ZE 20 with floor-fix	cement floor ZE 30 with floor-fix-special	Knauf-floating floor FE 80 / FE 25
			floor superstructure heights in mm		
			65 mm	46 - 47 mm	55 mm
valufix-74	74	-	139 mm	120 - 121 mm	129 mm
valufix-55 <sup>1</sup> with PS 20-SE	55	30	150 mm	131 - 132 mm	140 mm
valufix-32 <sup>2</sup> with PUR 53	32/30	53	148 mm	129 - 130 mm	138 mm
valufix-roll with PUR 53	38/35	53	153 mm	134 - 135 mm	143 mm
fastening plate with PUR 53	(73) 45	53	163 mm	144 - 145 mm	153 mm



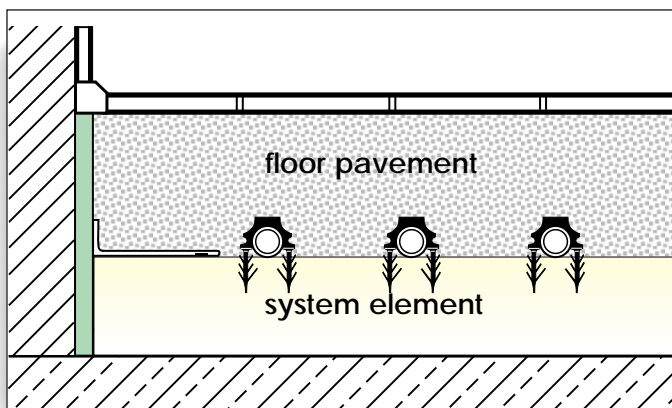
<sup>1</sup> with additional insulation: hardly inflammable polystyrene sheets (PS 20-SE) of at least 30 mm thickness

<sup>2</sup> with additional insulation: polyurethane high-resistance foam sheets (PUR) of at least 53 mm thickness (WLG 025).

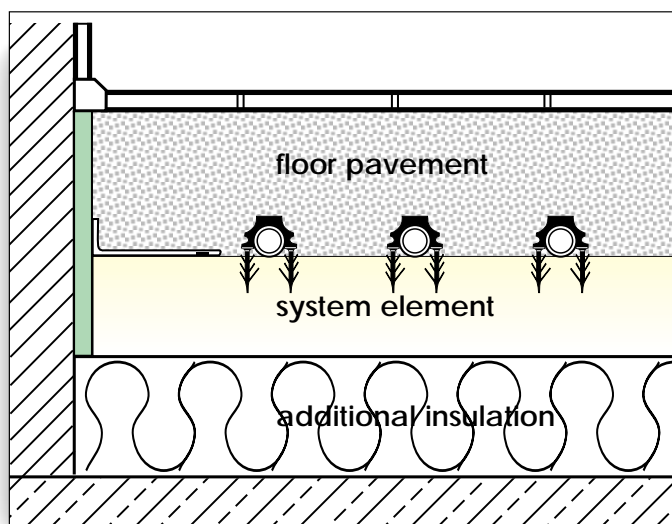
**Covers against unheated rooms**

Application range: covers against

- building part with considerable lower inside temperatures



elements			types of floor pavement		
system elements and additional insulation	height system elements (mm)	height additional insulation (mm)	cement floor ZE 20 with floor-fix	cement floor ZE 30 with floor fix special	Knauf-floating floor FE 80 / FE 25
			floor superstructure heights in mm		
			65 mm	46 - 47 mm	55 mm
valufix-74	74	–	139 mm	120 - 121 mm	129 mm
valufix-55 <sup>1</sup> with PS 20-SE	55	30	150 mm	131 - 132 mm	140 mm
valufix-32 <sup>2</sup> with PUR 46	32/30	46	141 mm	122 - 123 mm	131 mm
valufix-roll with PUR 46	38/35	46	146 mm	127 - 128 mm	136 mm
fastening plate mit PUR 46	(73) 45	46	156 mm	137 - 138 mm	146 mm



<sup>1</sup> with additional insulation: hardly inflammable polystyrene sheets (PS 20-SE) of at least 30 mm thickness

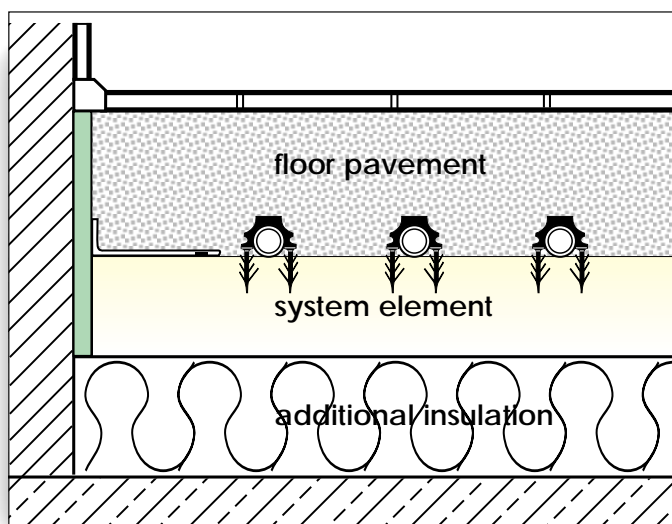
<sup>2</sup> with additional insulation: polyurethane high-resistance foam sheets (PUR) of at least 46 mm thickness (WLG 025).

## Floor construction

### Covers against industrial rooms

**Application range: covers against**

- rooms with a dissimilar use  
(e.g. industrial rooms)



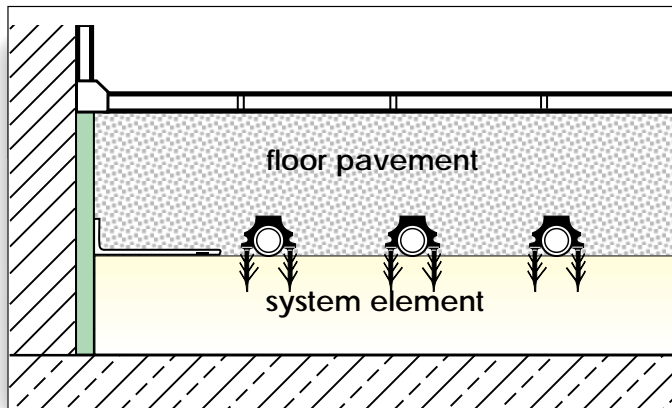
elements			types of floor pavement		
system elements and additional insulation	height system elements (mm)	height additional insulation (mm)	cement floor ZE 20 with floor-fix	cement floor ZE 30 with floor fix special	Knauf-floating floor FE 80 / FE 25
			floor superstructure in mm		
			65 mm	46 - 47 mm	55 mm
valufix-32 with PS 20 SE	32/30	20	115 mm	96 - 97 mm	105 mm
valufix-roll with PS 20 SE	38/35	20	120 mm	101 - 102 mm	110 mm
fastening plate mit PS 20 SE	(73) 45	20	130 mm	111 - 112 mm	120 mm

<sup>1</sup> with additional insulation: hardly inflammable polystyrene sheets (PE 20-SE) of at least 20 mm thickness

**Covers against heated rooms**

**Application range:**

- intermediate covers  
above rooms with a similar use



elements			types of floor pavement		
system elements and additional insulation	height system elements (mm)	height additional insulation (mm)	cement floor ZE 20 with floor-fix	cement floor ZE 30 with floor fix special	Knauf-floating floor FE 80 / FE 25
			floor superstructure in mm		
			65 mm	46 - 47 mm	55 mm
valufix-32	32/30	–	95 mm	76 - 77 mm	85 mm
valufix-roll 38/35	38/35	–	100 mm	81 - 82 mm	90 mm
fastening plate <sup>2</sup>	(73) 45	–	110 mm	91 - 92 mm	100 mm

## Floor construction

### Examples of design

Moving zone



▲ Spiral-type placement in a movement zone

Fastening plate



▲ aquatherm®-system element fastening plate EPS-45

Heating circuits



▲ Arrangement of different heating circuits



### Special applications

In addition to heating of domestic and industrial buildings aquatherm also offers uncomplicated solutions for heating of

- lawns for sporting activities,
- free spaces,
- sport and multipurpose halls
- and industrial halls.

### System lawn heating

The heating pipes are placed in a lengthwise or crosswise direction of the field according to the local conditions in order to guarantee an optimum operation of the installation in dependence of the weather conditions (e.g. shade and/or sun).

Aquatherm offers an economical installation variant for **modernization and retrofit measures** of intact fields from which the lawn will not be renewed.

The heating and irrigation ducts are placed in accordance with the pipe insertion procedure depending on the subsoil at approx. 25 to 30 cm under the lawn surface after having dugged the trenches at the outside of the field and placing of the distribution and connection ducts. The lawn surface stays almost intact.

The connection of the heating pipes with the distribution pipes laid in the trenches is made according to the socket welding procedure. The connection ducts from the distributors to the heating central system are installed with the fusiotherm®-pipe ducts system with the welding saddle technique developed by aquatherm.

Laying of the pipes for **reconstruction and sanitation measures** is made above the drainage layer by means of ground anchors or fastening rails.

Design

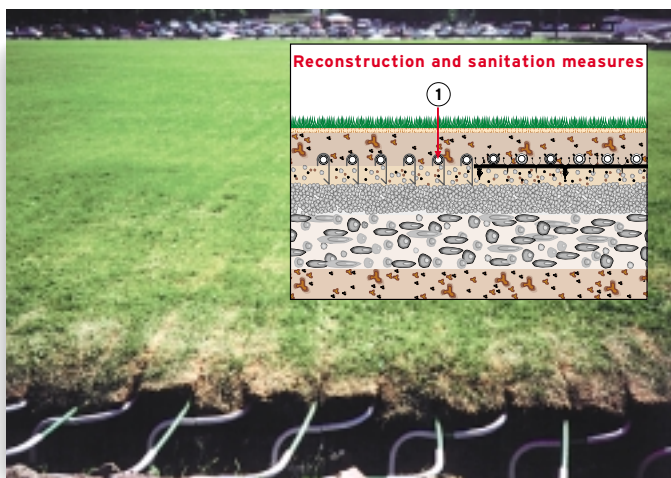
#### Inform yourself:

Ask for the detailed technical information.

Heating and irrigation technique for sports places

- lawn heating
- sprinklers
- subsurface irrigation
- swing ground heating

Order -no. D 18600



① heating ducts

Construction

▲ Modernization / retrofit measures

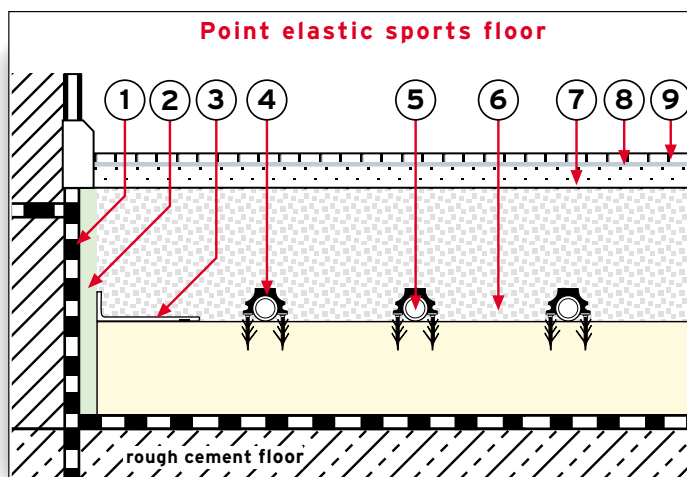
## System engineering

### System heating for sports floors

#### Construction

aquatherm offers two different systems for heating of sport floors.

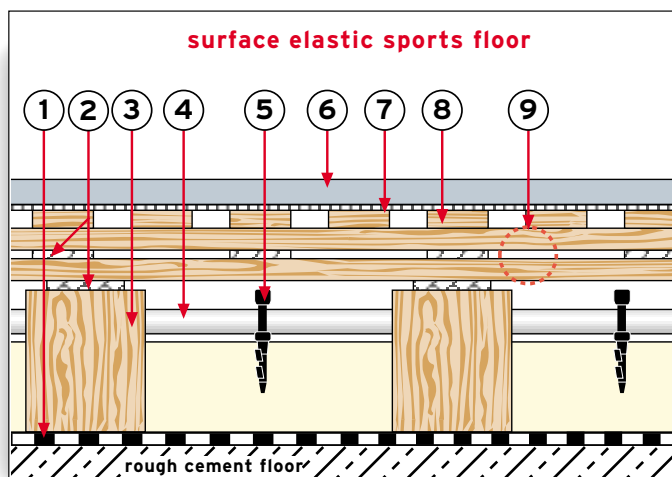
- ① building sealing
- ② aquatherm®-border insulation
- ③ welded PE-foil of the border insulation
- ④ aquatherm®-pipe clip
- ⑤ aquatherm®-heating pipe
- ⑥ floor pavement
- ⑦ elastic layer (10 mm)
- ⑧ glass fiber composite
- ⑨ free selectable surface covering



For point elastic heating systems for floors sports the heating pipes are laid in a cement or anhydrite floor. The covering existing of an elastic layer, glass fiber composite and surface floor is glued on the floor pavement.

aquatherm®-system element-valufix  
heat insulation according to WSVÖ

- ① building sealing
- ② permanent elastic spring pads
- ③ lining blocks
- ④ aquatherm®-heating pipe
- ⑤ aquatherm®-pipe clip
- ⑥ sports parquet module (18 - 20,5 mm)
- ⑦ PE-foil
- ⑧ subfloor
- ⑨ double swing bearer



The air space between the heat insulation and the sports covering is heated for heatings used for surface elastic sports floor. The construction is made of elastic layers of wood arranged on swing bearers and lining blocks.

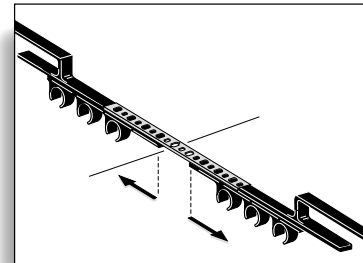
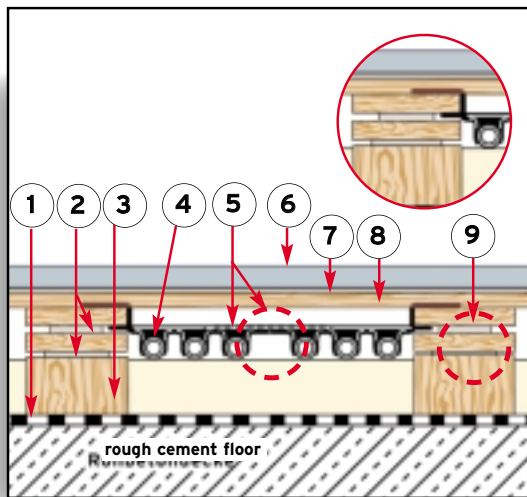
Parquet or PVC can be selected as surface covering.

**System heating for sports floors**

The design called pipe suspension rail is used with the surface elastic floors as an alternative for fastening of the heating pipes. In this case the aquatherm®-heating pipes are kept in the ventilation space of the mounting construction by means of the aquatherm®-pipe suspension rail. The pipe suspension rail is hung up securely and firmly in the double swing bearer.

The rail is lengthwise adjustable and consequently suitable for nearly all center dimensions and model constructions. All kinds of heating insulation material as boards or rolls can be selected.

Technical rules



aquatherm®-system element valufix or all other  
 kinds of heat insulation material as boards or rolls  
 heat insulation according to WSVÖ

- ① building sealing
- ② permanent elastic spring pads
- ③ lining blocks
- ④ aquatherm®-heating pipe
- ⑤ aquatherm®-pipe suspension rail
- ⑥ surface cover: e.g. sports parquet module (18 - 20,5 mm) or PVC
- ⑦ PE-foil
- ⑧ sub floor
- ⑨ double swing bearer

## System engineering

### System heating for sports floors

#### Design

The heating pipes of the aquatherm®-swing floor heating are laid in crosswise or lengthwise direction between the understructures of the swing floor.

Connection of the heating pipes is made by means of heating circuit distributors equipped with flow and return valves. By this an individual capacity adaptation of each heating circuit is possible. For hydraulic similar heating circuits a control of all connected heating circuits can be made with a central zone control system.

As an alternative, the welding saddle technique developed by aquatherm and the optimum coordinated aquatherm-system technique enable the connection of the heating pipes to a continuous distributor pipe in accordance with the Tichelmann-principle. You receive detailed technical information in a separate document - Order-no. D 18600 / (see page 4.39)



Example:

Sports- and multipurpose hall (before/afterwards)



**System heating for sports floors**

The aquatherm®-swinging floor heating achieves considerable freedom because of its invisible mounting construction integrated in the floor. Disturbing heating surfaces are eliminated and the complete hall surface can be used in an optimum way.

Cuttings in the floor required later for fastening of equipment are no problem for the plastic pipes firmly anchored in the construction but however flexible. The pipes can be adapted to the requirements even after placing.

Moreover costs following for cleaning, recoating of the heating surfaces etc. are eliminated for the aquatherm®-heating for sports floors compared with static heating surfaces. The heating pipes are integrated into the floor and are invisible and maintenance-free.

Design

## System engineering

### System industrial floor heating

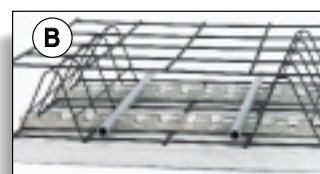
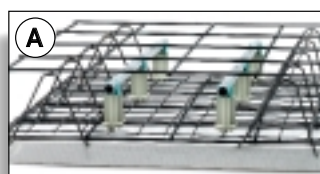
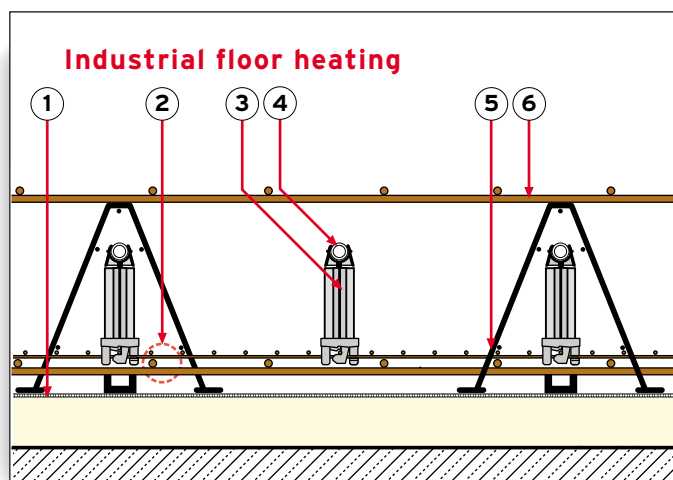
#### Construction

The lower reinforcement is placed on the insulation with PE-foil indicated by the structural engineer as per WSVÖ resp. directly on the rough cement cover. Fastening of the heating pipes can alternatively be made with the aquatherm®-masterclip or the aquatherm®-spring rail. Consequently the PB-heating pipes are safely and immovably integrated in the tension-free zone in the system.

Laying of the pipes is made at a planned laying distance according to the demands required by the customer.

- ① PE-foil
- ② lower reinforcement
- ③ aquatherm®-masterclip  
alternatively:  
aquatherm®-spring rail
- ④ aquatherm®-heating pipe
- ⑤ distance piece
- ⑥ upper reinforcement

 aquatherm®-system element valufix heat insulation according to WSVÖ



...with aquatherm®-masterclip      ...with aquatherm®-spring rail

#### Design

You receive detailed technical information in a separate document (Ord.-no. D 18610) - (compare technical design p. 4.41)



▲ Installation industrial floor heating

**aquatherm**

### Regulations, decrees, laws

The following laws, decrees, instructions and standards have to be considered for planning and execution of heating systems:

- \* energy saving law (EnEG)
- \* heating system decree (HeizAnIV)
- \* heating costs decree (Heizkosten)
- \* heat protection decree (WschuVo)

Instructions

### Heating technics

- \* DIN 196 Contract procedure for building works B and C
- \* DIN 4102 Fire protection
- \* DIN 4108 Heat protection in high buildings
- \* DIN 4109 Sound insulation in high buildings
- \* DIN 4701 Calculation of the heat requirement of buildings
- \* DIN EN 1264 Hot-water floor heating systems
- \* DIN 4726 Pipelines of plastic for hot-water floor heating systems
- \* DIN 4751 Safety equipment of hot-water heating systems
- \* DIN 18380 Heating and service water heating system

### Calculation

In general an exact heat requirement calculation as per DIN 4701 has to be made prior to the design of an aquatherm®-floor heating system. The calculation of the pipe distances is made in accordance with the performance characteristics of the single pipe partitions.

The surface covering should be known when planning. For objects for which the covering will be determined afterwards, the most unfavourable but still allowable covering should be planned. Same is also valid for rooms, in which a change of covering is to be expected later on.

For rooms with stone coverings real life showed that they will mainly be covered with rugs, carpets etc. A correction of the planning is necessary.

Heat requirement  
as per DIN 4701

### Floor surface temperature

The following floor surface temperatures should not be exceeded for physiological and medical reasons:

29 °C in recreation rooms (domestic and office buildings)

35 °C in rim zone areas

33 °C in bathrooms and swimming baths

Maximum  
temperatures

When calculating the rooms, it should be checked if the max. allowed floor temperature has been kept with the selected pipe distance.



## Planning / Design

### Floor surface temperature

Additional heating surface

For rooms in which the specific heat requirement does not guarantee the allowed surface temperature any longer, planning of additional heating surfaces should be considered.

Notice

The fact that the design-outside temperature as indicated in DIN 4701 only occurs on a few days shows that the actual floor surface temperatures considerably are below the theoretically determined values.

### Basis of design

Necessary documents

The following documents are necessary to calculate the aquatherm®-floor heating system:

- the complete constructional drawings
- the standard heat requirement calculation as per DIN 4701
- the performance characteristics of the pipe distances
- the pressure loss diagrams of the valves
- the pressure loss diagram of the heating pipes

When designing the rooms the reduced heat requirement  $Q_{Ber}$  [W] can be taken into account and is calculated as follows:

Heat requirement

$$\begin{array}{ll} Q_N & \text{standard heat requirement DIN 4701} \\ - \dot{q}_{FB} & \text{heat flow through the floor} \\ \hline = Q_{Ber} & \text{reduced heat requirement [W]} \end{array}$$

Standard heat requirement

The standard heat requirement  $Q_N$ [W] is decisive for the design of the heat generator and the calculation of the water quantity.

The reduced specific heat requirement  $q_h$  [W/sq.m] is calculated according to the following formula of calculation:

Specific heat requirement

$$q_h = \frac{Q_{Ber} \text{ reduced heat requirement [W]}}{A_R \text{ room surface [sq.m]}}$$

### Method of calculation

DIN EN 1264

The method of calculation is made as per DIN EN 1264. The surface temperature is limited in accordance with the respective design area. The return temperature is limited variably to at least  $\vartheta_i + 2^\circ\text{C}$  for every room so that a hydraulic adjustment is possible.



## Rim zone areas

Laying of the pipes in rim zone areas can be made at shorter distances as these zones are not used so frequently. The surface temperatures may be higher compared to the recreation zone.

Higher heat losses e.g. of large-surface glazings can be considered and compensated.

The width of rim zones should not exceed 1,0 m. Moreover, rim zones should be placed all-over the outside wall in which the window is arranged.

In case that the pipe distance in the recreation zone is VA 100 or VA 150 the laying distance (VA) of the rim zone should be VA 75. For a pipe distance of VA 200 to VA 300 same should be VA 100. If the rim zone has to produce extremely high heating capacities, same can also be executed with a laying distance of VA 50.

In general the rim zone should be designed as an independent heating circuit, i.e. with an own connection duct. For small rooms with a small rim zone the integrated design should be selected, i.e. rim zone area and recreation area are laid as a combined heating circuit.

Characteristics

Width and arrangement

Independent heating circuit

## Recreation zone

The recreation areas are laid in accordance with the calculated pipe distance. Pipe distances of more than 30 cm are only allowed in exceptional cases due to the high waviness of the floor surface temperatures.

### Kitchen:

As during the planning phase the covered surface is in most cases not known due to built-in furniture, a minimum VA of 150 should be planned and laid considering the max. allowed surface temperature).

Openings under built-in furniture should be avoided if possible.

### Baths:

In bathrooms, toilet areas and going round spaces of swimming pools a pipe distance of at least VA 100 mm has to be planned and constructed (considering the maximum allowed surface temperature) as a direct foot contact is quite frequently here.

Minimum distance

Notice

Minimum distance

## Planning / Design

### Connection ducts

#### Characteristics

Connection ducts are ducts running as a connection from the heating circuit distributor to the heating circuit.

Connection ducts running through another room with an independent heating circuit must show an identical pipe distance compared to the surface design. These continuous connection ducts can be executed with the same heat emission as the heating circuit design. A corresponding correction for continuous connection lengths has to be made for the determination of the water circulation quantity.

### Floor surface coverings

#### Thermal resistance

Floor surface coverings have an important influence on the heat flux density of floor heating systems. The thermal resistance of floor coverings depends on the nature of the materials.

The maximum temperature delay of floor coverings is  
 $R_{\lambda B} = 0,15 \text{ sq.m K/W}$ .

For carpets the temperature delay of the floor and the possibly used lower layer must be added.

### Standard values for surface coverings

#### Standard values

- tiles	approx. 0,01 - 0,02 sq.m K/W
- marble	approx. 0,01 - 0,025 sq.m K/W
- carpet	approx. 0,05 - 0,15 sq.m K/W
- parquet/laminate	approx. 0,035 - 0,150 sq.m K/W
- PVC, lino	approx. 0,025 - 0,075 sq.m K/W

### Symbols „suitable for floor heating systems“

#### Symbols

Carpets and elastic coverings being suitable for placing on floor heating systems are provided with a corresponding symbol from the manufacturer.



carpets



elastic coverings

## Use of carpet rugs

In case that loose carpets or carpet rugs are placed on stone floors, PVC, parquet or laminate the medium thermal resistance  $R_{\lambda B}$  has to be determined in accordance with the surface portion using the following formula.

$$R_{\lambda Bm} = \frac{A_{Ges} \cdot R_{\lambda O} + A_B \cdot R_{\lambda T}}{A_{Ges}}$$

$R_{\lambda Bm}$  = medium thermal resistance  
 $A_{Ges}$  = total surface  
 $A_B$  = surface covered with loose carpet  
 $R_{\lambda O}$  = thermal resistance surface covering  
 $R_{\lambda T}$  = thermal resistance carpet

Notice

Medium thermal resistance

### Calculation example: medium thermal resistance

#### Example:

30.0 sq.m stone tiles       $R_{\lambda O} = 0.02$  sq.m K/W  
 covered with  
 10.0 sq.m carpet       $R_{\lambda T} = 0.10$  sq.m K/W

#### Result:

$$R_{\lambda Bm} = \frac{30 \text{ sq.m} \times 0.02 \text{ sq.m K} + 10 \text{ sq.m} \times 0.1 \text{ sq.m K}}{30 \text{ sq.m}}$$

$$R_{\lambda Bm} = 0.053 \text{ sq.m K/W}$$

Calculation example

## Heating circuit length

The maximum allowed heating circuit length for aquatherm®-floor heating systems is 120 m.

Rooms from which the design requests greater pipe lengths should be divided into several heating circuits - if possible - of the same length, in order to guarantee a hydraulic compensation of the heating circuit lengths system.

It should be considered that even for heating circuits up to a length of 120 m a partition into 2 heating circuits is necessary, when the pressure loss exceeds 350 mbar.

The allowed surface for each heating circuit (without connection lengths) is:

VA 50	VA 75	VA 100	VA 150	VA 200	VA 250	VA 300
6,3 sq.m	9,6 sq.m	12,6 sq.m	19,2 sq.m	24,0 sq.m	30,0 sq.m	34,2 sq.m

Maximum heat circuit length

## Planning / Design

### Distribution connection area

Surface  
temperature

The total amount of feeding pipes in front of the heat distributor are placed at very short distances. As these connection ducts also convey heat it is possible that under some conditions a surface temperature above the allowed value results.

Notice

In this case a respective number of connection ducts should be provided with insulation materials.

### Material requirement

The determination of quantities of the aquatherm system components can be made in accordance with the following table.

Computation of  
quantities

Material requirement		VA 50	VA 75 <sup>1</sup>	VA 100	VA 150	VA 200	VA 250	VA 300
Heating pipe	m	A x 19,0	A x 12,5	A x 9,5	A x 6,25	A x 5,0	A x 4,0	A x 3,5
Heating pipe <sup>2</sup>	unit	A x 40,0	A x 25,0	A x 20,0	A x 15,0	A x 10,0	A x 8,0	A x 7,0
alternatively for pipe holder device: fastening rail <sup>3</sup>	m	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0
Edge insulation strips	m	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0
Floor additive	kg	A x 0,15	A x 0,15	A x 0,15	A x 0,15	A x 0,15	A x 0,15	A x 0,15
Floor additive-special	kg	A x 1,45	A x 1,45	A x 1,45	A x 1,45	A x 1,45	A x 1,45	A x 1,45
System elements	sq.m	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0	A x 1,0

A: heating surface [sq.m]

VA: laying distance [mm]

- <sup>1</sup> Laying distance 75 mm is not possible when using the system element fastening plate
- <sup>2</sup> Pipe holder devices are not necessary when using the system element fastening plate
- <sup>3</sup> Fastening rail is not suitable for the system element fastening plate

## Thermal output as per DIN EN 1264

Until now the selection of the laying distances has been made in accordance with the thermal output of the respective system supplier.

A comparison of suppliers with the same system constructions was nearly impossible due to different capacity data.

With DIN EN 1264 a uniform calculation procedure has been introduced enabling to determine the procedure capacity data of all floor heating systems.

Capacity differences of comparable systems with the same construction are not longer possible.

The thermal output of a floor heating system in the wet-laying procedure can be calculated based on the following formula:

$$q = B \cdot a_B \cdot a_T^{m_T} \cdot a_U^{m_U} \cdot a_D^{m_D} \cdot \Delta\vartheta_H$$

Calculation  
procedure

Thermal output  
wet-laying  
procedure

The symbols mean the following:

B	influence of the raw material, the pipe sheet thickness and a possible pipe enclosing on the flux density
$a_B$	factor of the floor covering
$a_T$	division factor (pipe distance)
$a_U$	covering factor
$a_D$	factor of the external diameter of the pipe
$\Delta\vartheta_H$	excess temperature of heating means
$m_T$	$1 - \frac{T}{0.075}$ (valid for pipe ducts $0.050 \leq T \leq 0.375$ m)
$m_U$	100 (0.045 m - Sü) valid for pipe coverings $Sü \leq 0.015$ m
$m_D$	250 (D - 0.020 m) valid for pipe diameters $0.012 \text{ m} \leq D \leq 0.030 \text{ m}$

Legend

## Planning / Design

### Thermal output as per DIN EN 1264

Floor pavement covering

aquatherm®-floor heating systems correspond to the system construction A1 as per DIN 18560, part 2.

When using an aquatherm®-heating pipe 16 x 2 mm and a cement floor of class ZE 20 a floor pavement covering of  $S_{\text{ü}} = 49 \text{ mm}$  results.

When using an aquatherm®-heating pipe 17 x 2 mm and a cement floor of class ZE 20  $S_{\text{ü}}$  will be = 48 mm.

The specific outputs for the single system constructions can be gathered from the tables on pages 5.12 - 5.14

The performance characteristic describes the connection between the heat output  $q$  and the required excess temperature of the heating means  $\Delta\vartheta_{\text{H}}$ , whereas the temperature delay for four floor coverings has been considered as well.

Excess temperature heating means

The excess temperature for the heating means  $\Delta\vartheta_{\text{H}}$  is calculated as a logarithmic means from the flow temperature  $\vartheta_{\text{V}}$ , the return temperature  $\vartheta_{\text{R}}$  and the room temperature  $\vartheta_{\text{i}}$ . Consequently the influence of the expansion has been determined.

$$\Delta\vartheta_{\text{H}} = \frac{\vartheta_{\text{V}} - \vartheta_{\text{R}}}{\text{Ln} \frac{\vartheta_{\text{V}} - \vartheta_{\text{i}}}{\vartheta_{\text{R}} - \vartheta_{\text{i}}}}$$

### Design flow temperature

Temperature delay

Upon determination of the design flow temperature a temperature delay of the floor covering of  $R_{\lambda, \text{B}} = 0.10 \text{ sq.m K/W}$  is assumed in accordance with the standards for recreation rooms.

For bath  $R_{\lambda, \text{B}} = 0.00 \text{ sq.m K/W}$

Expansion

The expansion of the heating circuit in the most unfavourable room amounts to approx. 5 K. In the other rooms larger spreads result depending on the heat requirement, pipe distance, floor covering and excess temperature of the heating means. Consequently the medium heat flow is determined as a mixed value from the medium heat flow of all heating circuits and can be calculated with a predicted spread.

Limiting values

Surface temperatures result in limiting values of the heat flux density depending on the floor covering. These limiting curves are drawn in the displays and may not be exceeded at all.

## Design flow temperature

The design flow temperature  $\vartheta_{V, \text{Ausl.}}$  is calculated as follows

$$\vartheta_{V, \text{Ausl.}} = \vartheta_i + \Delta\vartheta_{H, \text{Ausl.}} + \frac{\sigma}{2}$$

Design flow  
temperature

If the ratio  $\sigma / \Delta\vartheta_H > 0,5$  the design flow temperature has to be calculated as follows:

$$\vartheta_{V, \text{Ausl.}} = \vartheta_i + \Delta\vartheta_{H, \text{Ausl.}} + \frac{\sigma}{2} + \frac{\sigma^2}{12 \Delta\vartheta_{H, \text{Ausl.}}}$$

For all other rooms operated with the design flow temperature the respective expansions have to be calculated according to the following formula

$$\sigma_j = 2 \cdot [(\vartheta_{V, \text{Ausl.}} - \vartheta_i) - \Delta\vartheta_{Hj}]$$

as far as the ratio  $\sigma_j / \Delta\vartheta_H \leq 0,5$ . At a ratio of  $\sigma_j / \Delta\vartheta_H \leq 0,5$  the expansions are calculated as follows

$$\sigma_j = 3 \cdot \Delta\vartheta_{Hj} \left[ \sqrt{1 + \frac{4 \cdot (\vartheta_{V, \text{Ausl.}} - \Delta\vartheta_{Hj})}{3 \cdot \Delta\vartheta_{Hj}}} - 1 \right]$$

## Thermal test

The "thermal test" for hot-water floor heating systems as required by the DIN EN 1264 standard has been done by **Prof. Dr. Ing. W. Kast, Thermal process technology and heating technics, TH Darmstadt** for the aquatherm®-system "valufix" with heating pipes of 16 x 2 mm and 17 x 2 mm.

The **DGWK, Berlin** issued the approval to bear the DIN-conformity and inspection mark.

For the valufix-System with a heating pipe 16 x 2 mm:

**5 D 003**

For the valufix-System with a heating pipe 17 x 2 mm:

**5 D 024**

### Heat insulation towards the bottom

In accordance with the following table three different cases can be stated for the minimum thermal resistance below the heating level:

Minimum thermal resistance

no.	heating insulation	$R_{\lambda, D\ddot{A}, \min}$ [sq.m K/W]
I	above rooms with similar use	0,75
II	above rooms with dissimilar use <sup>1)</sup>	1,25
III	above unheated rooms (e.g. cellars) as well as outside air and ground	as per WschuVo
<sup>1)</sup> e.g. domestic locations above industrially used locations		

### Design heat flux density

The design thermal output results from the determined reduced heat requirement as per DIN 4701 divided by the heating floor surface.

The design thermal output results in accordance with DIN 4701 part 3:

Design thermal output

$$Q_H = (1 + X) Q_N$$

Normally the design supplement is  $X = 0$  when an increase of the thermal output by increasing of the heating means temperature is possible.

The design heat flux density is identical with the required heat flow necessary to cover the thermal output.

### Design heating means flow

The design heating means flow  $m_H$  of a heating circuit is calculated according to the following formula:

$$m_H = \frac{A_F \cdot q}{0 \cdot c_W} \cdot 1 + \frac{R_o}{R_u} + \frac{\vartheta_i - \vartheta_u}{q \cdot R_u}$$

The temperature delays and heat transmission resistance are determined up resp. down with the partial heat transition resistances  $R_o$  resp.  $R_u$ .

Temperatures / delay heat transmission resistance

$$R_o = \frac{1}{a} + R_{\lambda, B} + \frac{S_{\ddot{u}}}{\lambda_{\ddot{u}}} \quad \text{with} \quad \frac{1}{a} = 0,093 \frac{\text{sq.m K}}{\text{W}}$$

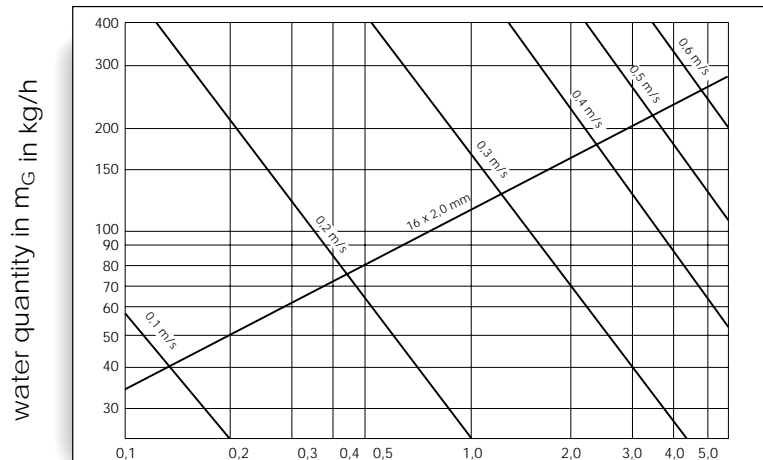
$$R_u = R_{\lambda, \text{insulation}} + R_{\lambda, \text{cover}} + R_{\lambda, \text{plaster}} + R_{a, \text{cover}}$$

with  $R_{a, \text{cover}} = 0,17 \text{ sq.m K/W}$



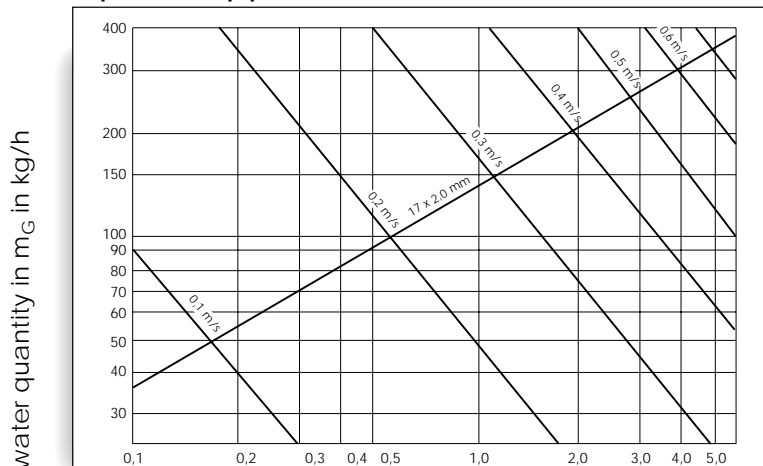
**Pressure loss diagram: 16 x 2,0 mm**

aquatherm®-pipes with dimensions 16 x 2,0 mm



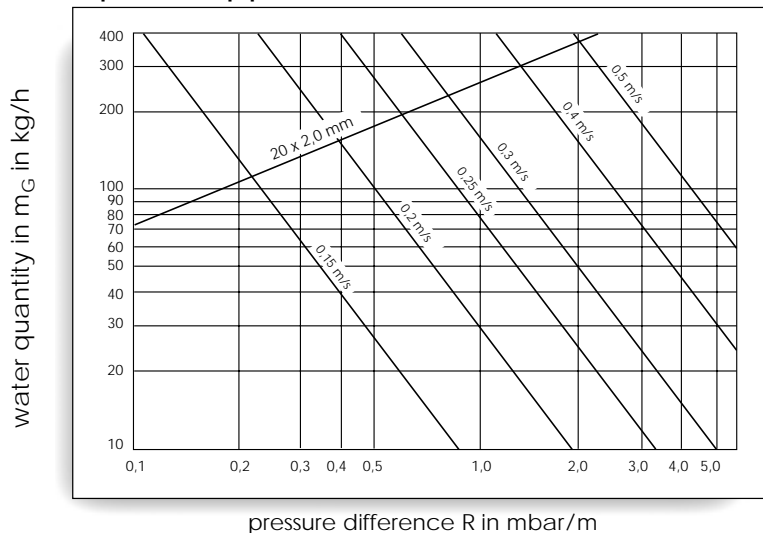
**Pressure loss diagram: 17 x 2,0 mm**

aquatherm®-pipes with dimensions 17 x 2,0 mm



**Pressure loss diagram: 20 x 2,0 mm**

aquatherm®-pipes with dimensions 20 x 2,0 mm



### Heating capacity table with pipes with a dimension of 16 x 2,0 mm

			VA 50		VA 75 <sup>3</sup>		VA 100		VA 150		VA 200		VA 250		VA 300	
<sup>1</sup> t <sub>1</sub>	Surface covering	R <sub>λB</sub> =	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>
°C		sq.m · K W	<u>W</u> m <sup>2</sup>	°C	<u>W</u> m <sup>2</sup>	°C	<u>W</u> m <sup>2</sup>	°C	<u>W</u> m <sup>2</sup>	°C	<u>W</u> m <sup>2</sup>	°C	<u>W</u> m <sup>2</sup>	°C	<u>W</u> m <sup>2</sup>	°C
24°	without covering	0,00	78	32,1	71	30,6	65	30,1	55	29,2	48	28,6	42	28,1	37	27,6
	floor tiles ≤ 15 mm	0,015	72	30,7	64	30,0	59	29,6	50	28,8	45	28,4	40	27,9	34	27,4
	floor tiles ≤ 25 mm	0,030	64	30,0	58	29,5	54	29,1	46	28,4	42	28,1	36	27,6	32	27,4
	parquet 10 mm	0,05	57	29,4	52	29,0	49	28,7	42	28,1	39	27,8	34	27,4	30	27,0
	carpet	0,10	45	28,4	42	28,1	39	27,8	34	27,4	31	27,1	28	26,8	25	26,6
	carpet	0,15	38	27,7	34	27,4	32	27,2	30	27,0	28	26,8	25	26,6	22	26,3
22°	without covering	0,0	90	30,2	84	29,7	78	29,2	65	28,1	58	27,5	49	26,7	42	26,1
	floor tiles ≤ 15 mm	0,015	85	29,8	78	29,2	75	28,7	60	27,7	53	27,1	46	26,4	40	26,0
	floor tiles ≤ 25 mm	0,030	76	29,0	71	28,6	65	28,1	55	27,2	49	26,7	42	26,1	38	25,7
	parquet 10 mm	0,05	68	28,3	64	28,0	58	27,5	50	26,8	45	26,4	39	25,8	36	25,6
	carpet	0,10	52	27,0	49	26,7	45	26,4	41	26,0	38	25,7	33	25,3	31	25,1
	carpet	0,15	44	26,3	41	26,0	38	25,7	35	25,5	32	25,2	29	24,9	28	24,8
20°	without covering	0,0	105	29,4	98	28,8	89	28,1	75	27,0	65	26,1	57	25,4	50	24,8
	floor tiles ≤ 15 mm	0,015	97	28,8	89	28,1	82	27,5	69	26,4	60	25,7	52	25,0	46	24,5
	floor tiles ≤ 25 mm	0,030	85	27,8	80	27,3	75	27,0	64	26,0	56	25,3	49	24,7	43	24,2
	parquet 10 mm	0,05	76	27,0	72	26,7	68	26,3	59	25,6	51	24,9	45	24,4	40	24,0
	carpet	0,10	60	25,7	57	25,4	52	25,0	48	24,6	42	24,1	38	23,7	35	23,5
	carpet	0,15	50	24,4	48	24,6	44	24,2	40	24,0	38	23,7	33	23,3	31	23,1
18°	without covering	0,0	120	28,6	110	27,8	101	27,1	88	26,0	75	24,9	63	23,9	58	23,5
	floor tiles ≤ 15 mm	0,015	110	27,8	100	27,0	92	26,3	82	25,5	69	24,4	59	23,6	54	23,1
	floor tiles ≤ 25 mm	0,030	98	26,8	90	26,2	84	25,7	75	24,9	64	24,0	55	23,2	51	22,9
	parquet 10 mm	0,05	87	25,9	80	25,3	76	25,0	68	24,3	59	23,6	52	23,0	48	22,6
	carpet	0,10	68	24,3	64	24,0	60	23,7	55	23,2	50	22,8	44	22,3	40	21,9
	carpet	0,15	57	23,4	52	23,0	50	22,8	48	22,6	43	22,2	38	21,7	35	21,5
15°	without covering	0,0	141	27,3	129	26,3	120	25,6	102	24,2	88	23,0	75	21,9	65	21,1
	floor tiles ≤ 15 mm	0,015	131	26,5	117	25,4	110	24,8	94	23,5	82	22,5	70	21,5	61	20,7
	floor tiles ≤ 25 mm	0,030	118	25,5	106	24,5	100	24,0	87	22,9	75	21,9	65	21,1	57	20,4
	parquet 10 mm	0,05	103	24,3	95	23,6	90	23,2	79	22,3	69	21,4	60	20,7	53	20,1
	carpet	0,10	80	22,4	75	22,0	71	21,6	63	21,0	58	20,5	52	20,0	47	19,5
	carpet	0,15	67	21,3	62	20,8	60	20,7	53	20,1	50	19,8	44	19,3	41	19,0

The capacity data are valid for a system construction with a heating pipe of 16 x 2 mm and a floor pavement covering S<sub>u</sub> = 49 mm

- <sup>1</sup>t<sub>1</sub> = room temperature
- <sup>2</sup>t<sub>fm</sub> = medium floor heating surface temperature
- q = specific thermal output
- R<sub>λB</sub> = temperature delay of the floor covering
- VA = laying distance of the heating pipes
- <sup>3</sup> = laying distance 75 mm is not valid for system element fastening plate EPS-45



Register / type  
no.  
5 D 003

## Medium heating water temperature 40 °C

Heating capacity table with pipes with a dimension of 16 x 2,0 mm

			VA 50		VA 75 <sup>3</sup>		VA 100		VA 150		VA 200		VA 250		VA 300	
<sup>1</sup> t <sub>1</sub>	Surface covering	R <sub>λB</sub> =	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>
°C		$\frac{\text{sq.m} \cdot \text{K}}{\text{W}}$	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C
24°	without covering	0,0	113	34,1	105	33,4	97	32,8	83	31,6	71	30,6	60	32,2	53	29,1
	floor tiles ≤ 15 mm	0,015	105	33,4	96	32,7	88	32,0	75	30,9	65	30,1	57	29,4	49	28,7
	floor tiles ≤ 25 mm	0,030	92	32,3	87	31,9	80	31,4	69	30,4	60	29,7	52	29,0	46	28,4
	parquet 10 mm	0,05	82	31,5	78	31,2	72	30,7	63	29,9	55	29,2	48	28,6	43	28,2
	carpet	0,10	64	30,0	61	29,7	58	29,5	52	29,0	46	28,4	41	28,0	38	27,7
	carpet	0,15	53	29,1	51	28,9	48	28,6	43	28,2	40	27,9	36	27,6	33	27,3
22°	without covering	0,0	128	33,3	120	32,6	110	31,8	94	30,5	81	29,4	69	28,4	60	27,7
	floor tiles ≤ 15 mm	0,015	118	32,5	109	31,7	100	31,0	85	29,8	75	28,9	63	27,9	56	27,3
	floor tiles ≤ 25 mm	0,030	104	31,3	99	30,9	91	30,3	78	29,2	69	28,4	59	27,6	53	27,1
	parquet 10 mm	0,05	91	30,3	89	30,1	82	29,5	71	28,6	63	27,9	55	27,2	50	26,8
	carpet	0,10	71	28,6	69	28,4	65	28,1	59	27,6	52	27,0	47	26,5	42	26,1
	carpet	0,15	59	27,6	58	27,5	55	27,2	50	26,8	47	26,5	40	25,9	38	25,7
20°	without covering	0,0	141	32,3	129	31,3	120	30,6	102	29,2	88	28,0	75	26,9	65	26,1
	floor tiles ≤ 15 mm	0,015	131	31,5	117	30,4	110	29,8	94	28,5	82	27,5	70	26,5	61	25,7
	floor tiles ≤ 25 mm	0,030	118	30,5	106	29,5	100	29,0	87	27,9	75	26,9	65	26,1	57	25,4
	parquet 10 mm	0,05	103	29,2	95	28,6	90	28,2	79	27,3	69	26,4	60	25,7	53	25,1
	carpet	0,10	80	27,3	75	26,9	71	26,6	63	25,9	58	25,5	52	25,0	47	24,5
	carpet	0,15	67	26,3	62	25,8	60	25,7	53	25,1	50	24,8	44	24,3	41	24,0
18°	without covering	0,0	154	31,3	145	30,6	133	29,7	114	28,1	98	26,8	82	25,5	72	24,7
	floor tiles ≤ 15 mm	0,015	143	30,5	132	29,6	122	28,8	105	27,4	90	26,2	78	25,2	68	24,3
	floor tiles ≤ 25 mm	0,030	128	29,3	120	28,6	111	27,9	96	26,7	84	25,7	72	24,7	64	24,0
	parquet 10 mm	0,05	111	27,9	108	27,7	100	27,0	88	26,0	78	25,2	66	24,2	60	23,7
	carpet	0,10	88	26,0	84	25,7	80	25,3	71	24,6	63	23,9	57	23,4	51	22,9
	carpet	0,15	72	24,7	70	24,5	68	24,3	61	23,7	54	23,1	49	22,7	47	22,5
15°	without covering	0,0	178	30,2	162	29,0	150	28,0	128	26,3	110	24,8	95	23,6	82	22,5
	floor tiles ≤ 15 mm	0,015	165	29,2	148	27,9	137	27,0	118	25,5	101	24,1	88	23,0	77	22,1
	floor tiles ≤ 25 mm	0,030	148	27,9	134	26,7	124	26,0	108	24,7	93	23,4	82	22,5	72	21,7
	parquet 10 mm	0,05	129	26,3	120	25,6	111	24,9	98	23,8	85	22,8	76	22,0	67	21,3
	carpet	0,10	100	24,0	95	23,4	90	23,2	80	22,3	71	21,6	64	21,0	58	20,5
	carpet	0,15	82	22,5	78	22,2	74	21,8	69	21,4	61	20,7	57	20,4	51	19,0

The capacity data are valid for a system construction with a heating pipe of 16 x 2 mm and a floor pavement covering Sü = 49 mm

- <sup>1</sup>t<sub>1</sub> = room temperature  
<sup>2</sup>t<sub>fm</sub> = medium floor heating surface temperature  
q = specific thermal output  
R<sub>λB</sub> = temperature delay of the floor covering  
VA = laying distance of the heating pipes  
<sup>3</sup> = laying distance 75 mm is not valid for system element fastening plate EPS-45



Register / type  
no.  
5 D 003

Heating capacity table with a dimension of 16 x 2,0 mm

			VA 50		VA 75 <sup>3</sup>		VA 100		VA 150		VA 200		VA 250		VA 300	
<sup>1</sup> t <sub>1</sub>	Surface covering	R <sub>λB</sub> =	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>
°C		sq.m · K W	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C
24°	without covering	0,0	149	36,9	137	36,0	127	35,2	108	33,7	93	32,4	79	31,3	69	30,4
	floor tiles ≤ 15 mm	0,015	139	36,1	125	35,0	117	34,2	100	33,0	86	31,8	73	30,8	65	30,1
	floor tiles ≤ 25 mm	0,030	122	34,8	114	34,1	106	33,5	92	32,3	80	31,3	68	30,3	60	29,7
	parquet 10 mm	0,05	108	33,7	102	33,2	95	32,6	84	31,7	74	30,8	63	29,9	57	29,4
	carpet	0,10	85	31,8	80	31,3	76	31,0	67	30,2	61	29,7	53	29,1	49	28,7
	carpet	0,15	70	30,5	66	30,2	64	30,0	57	29,4	52	29,0	47	28,5	44	28,3
22°	without covering	0,0	163	36,0	152	35,2	141	34,3	120	32,6	102	31,2	88	30,0	75	28,9
	floor tiles ≤ 15 mm	0,015	152	35,2	138	34,1	129	33,3	110	31,8	94	30,5	81	29,4	71	28,6
	floor tiles ≤ 25 mm	0,030	135	33,8	125	33,0	117	32,4	101	31,1	87	29,9	76	29,0	67	28,3
	parquet 10 mm	0,05	119	32,5	112	32,0	105	31,4	92	30,3	80	29,3	70	28,5	63	27,9
	carpet	0,10	92	30,3	89	30,1	84	29,7	75	28,9	68	28,3	59	27,6	53	27,1
	carpet	0,15	77	29,1	73	28,8	70	28,5	63	27,9	58	27,5	52	27,0	48	26,6
20°	without covering	0,0	178	35,5	162	34,0	150	33,0	128	31,3	110	29,8	95	28,6	82	27,5
	floor tiles ≤ 15 mm	0,015	165	34,2	148	32,9	137	32,0	118	30,5	101	29,1	88	28,0	77	27,1
	floor tiles ≤ 25 mm	0,030	148	32,9	134	31,7	124	30,9	108	29,7	93	28,4	82	27,5	72	26,7
	parquet 10 mm	0,05	129	31,3	120	30,6	111	29,9	98	28,8	85	27,8	76	27,0	67	26,3
	carpet	0,10	100	29,0	95	28,6	90	28,2	80	27,3	71	26,6	64	26,0	58	25,5
	carpet	0,15	82	27,5	78	27,2	74	26,8	69	26,4	61	25,7	57	25,4	51	24,9
18°	without covering	0,0	192	34,3	179	33,3	165	32,2	139	30,1	119	28,5	102	27,2	89	26,1
	floor tiles ≤ 15 mm	0,015	179	33,3	162	32,0	150	31,0	128	29,3	110	27,8	95	26,6	83	25,6
	floor tiles ≤ 25 mm	0,030	158	31,6	147	30,8	136	29,9	117	28,4	101	27,1	88	26,0	77	25,1
	parquet 10 mm	0,05	139	30,1	132	29,6	122	28,8	107	27,6	93	26,4	82	25,5	72	24,7
	carpet	0,10	109	27,7	105	27,4	97	26,8	87	25,9	78	25,2	69	24,4	63	23,9
	carpet	0,15	89	26,1	86	25,8	82	25,5	73	24,8	68	24,3	60	23,7	55	23,2
15°	without covering	0,0	213	32,9	195	31,5	180	30,4	153	28,2	131	26,5	113	25,1	99	23,9
	floor tiles ≤ 15 mm	0,015	198	31,7	177	30,1	164	29,1	141	27,3	122	25,8	105	24,4	92	23,3
	floor tiles ≤ 25 mm	0,030	175	30,0	160	28,8	149	27,9	130	26,4	112	25,0	98	23,8	86	22,8
	parquet 10 mm	0,05	154	28,3	143	27,5	134	26,7	118	25,5	102	24,2	91	23,3	80	22,3
	carpet	0,10	120	25,6	114	25,1	107	24,6	96	23,7	86	22,8	78	22,2	70	21,5
	carpet	0,15	100	24,0	95	23,6	90	23,2	81	22,4	73	21,8	68	21,3	61	20,7

The capacity data are valid for a system construction with a heating pipe of 16 x 2 mm and a floor pavement covering S<sub>u</sub> = 49 mm

- <sup>1</sup>t<sub>1</sub> = room temperature  
<sup>2</sup>t<sub>fm</sub> = medium floor heating surface temperature  
q = specific thermal output  
R<sub>λB</sub> = temperature delay of the floor covering  
VA = laying distance of the heating pipes  
<sup>3</sup> = laying distance 75 mm is not valid for system element fastening plate EPS-45



Register / type  
no.  
5 D 003

## Medium heating water temperature 35 °C

Heating capacity table with pipes with a dimension of 20 x 2,0 mm

			VA 50		VA 75 <sup>3</sup>		VA 100		VA 150		VA 200		VA 250		VA 300	
<sup>1</sup> t <sub>1</sub>	Surface covering	R <sub>λB</sub> =	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>
°C		$\frac{\text{sq.m} \cdot \text{K}}{\text{W}}$	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C
24°	without covering	0,00	–	–	78	31,2	70	30,5	60	29,7	55	29,2	48	28,6	42	28,1
	floor tiles ≤ 15 mm	0,015	–	–	68	30,3	65	30,1	54	29,1	49	28,7	45	28,4	39	27,8
	floor tiles ≤ 25 mm	0,030	–	–	61	29,7	59	29,6	48	28,6	42	28,1	40	27,9	36	27,6
	parquet 10 mm	0,05	–	–	56	29,3	52	29,0	45	28,4	41	28,0	39	27,8	35	27,5
	carpet	0,10	–	–	44	28,3	41	28,0	37	27,6	34	27,4	32	27,1	29	26,8
	carpet	0,15	–	–	36	27,6	33	27,2	31	27,0	29	26,8	28	26,8	26	26,6
22°	without covering	0,0	–	–	89	30,1	82	29,5	70	28,5	65	28,0	58	27,5	49	26,7
	floor tiles ≤ 15 mm	0,015	–	–	80	29,3	74	28,7	62	27,8	59	27,6	51	26,9	45	26,4
	floor tiles ≤ 25 mm	0,030	–	–	71	28,6	67	28,3	58	27,5	52	27,0	47	26,5	41	26,0
	parquet 10 mm	0,05	–	–	65	28,0	61	27,7	52	27,0	50	26,8	46	26,4	40	25,9
	carpet	0,10	–	–	51	26,9	49	26,7	42	26,0	40	25,9	38	25,7	33	25,3
	carpet	0,15	–	–	42	26,0	40	25,9	37	25,6	35	25,5	33	25,3	29	24,8
20°	without covering	0,0	–	–	103	29,2	95	28,6	80	27,3	70	26,5	65	26,1	55	25,2
	floor tiles ≤ 15 mm	0,015	–	–	93	28,4	85	27,8	71	26,6	65	26,1	60	25,7	50	24,8
	floor tiles ≤ 25 mm	0,030	–	–	82	27,5	77	27,1	65	26,1	59	25,6	54	25,1	46	24,4
	parquet 10 mm	0,05	–	–	75	26,9	70	26,5	61	25,7	56	25,3	51	24,9	45	24,2
	carpet	0,10	–	–	58	25,4	55	25,2	49	24,6	46	24,4	44	24,3	39	23,7
	carpet	0,15	–	–	48	24,6	45	24,2	41	24,0	39	23,7	38	23,7	34	23,4
18°	without covering	0,0	–	–	117	28,4	109	27,7	94	26,5	81	25,4	70	24,5	60	23,7
	floor tiles ≤ 15 mm	0,015	–	–	105	27,4	97	26,8	83	25,5	74	24,8	65	24,1	56	23,3
	floor tiles ≤ 25 mm	0,030	–	–	92	26,3	87	25,9	75	24,9	68	24,3	59	23,6	53	23,1
	parquet 10 mm	0,05	–	–	86	25,8	80	25,3	70	24,5	64	24,0	56	23,3	50	22,8
	carpet	0,10	–	–	79	25,3	62	23,8	58	23,5	53	23,1	47	22,5	42	22,1
	carpet	0,15	–	–	55	23,2	51	22,8	48	22,6	45	22,4	40	21,9	38	21,7
15°	without covering	0,0	–	–	137	27,0	128	26,3	110	24,8	96	23,7	81	22,4	70	21,5
	floor tiles ≤ 15 mm	0,015	–	–	123	25,9	115	25,2	98	23,8	88	23,0	75	21,9	65	21,1
	floor tiles ≤ 25 mm	0,030	–	–	109	24,7	101	24,0	89	23,1	79	22,3	69	21,4	60	20,7
	parquet 10 mm	0,05	–	–	100	24,0	93	23,4	83	22,6	75	21,9	66	21,2	59	20,6
	carpet	0,10	–	–	78	22,2	74	21,8	77	22,1	60	20,7	55	20,2	50	19,8
	carpet	0,15	–	–	64	21,0	61	20,7	57	20,4	52	20,0	47	19,5	44	19,3

The capacity data are valid for a system construction with a heating pipe of 20 x 2 mm and a floor pavement covering Sü = 45 mm

- <sup>1</sup>t<sub>1</sub> = room temperature  
<sup>2</sup>t<sub>fm</sub> = medium floor heating surface temperature  
q = specific thermal output  
R<sub>λB</sub> = temperature delay of the floor covering  
VA = laying distance of the heating pipes  
<sup>3</sup> = laying distance 75 mm is not valid for system element fastening plate EPS-45



Register / type  
no.  
5 D 003

Heating capacity table with pipes with a dimension of 20 x 2,0 mm

			VA 50		VA 75 <sup>3</sup>		VA 100		VA 150		VA 200		VA 250		VA 300	
<sup>1</sup> t <sub>1</sub>	Surface covering	R <sub>λB</sub> =	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>
°C		sq.m · K W	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C	$\frac{W}{m^2}$	°C
24°	without covering	0,00	–	–	109	33,7	101	33,1	88	32,0	77	31,1	69	30,4	58	29,5
	floor tiles ≤ 15 mm	0,015	–	–	99	32,9	91	32,3	79	31,3	69	30,4	62	29,8	53	29,1
	floor tiles ≤ 25 mm	0,030	–	–	88	31,9	81	31,4	70	30,4	61	29,7	57	29,4	49	28,7
	parquet 10 mm	0,05	–	–	80	31,3	76	31,0	66	30,2	59	29,6	55	29,2	47	28,5
	carpet	0,10	–	–	63	29,9	60	29,7	52	29,0	50	28,8	45	28,4	40	27,9
	carpet	0,15	–	–	52	28,9	50	28,8	44	28,2	41	27,9	39	27,8	35	27,5
22°	without covering	0,0	–	–	123	32,9	118	32,5	100	31,0	89	30,1	75	28,9	65	28,1
	floor tiles ≤ 15 mm	0,015	–	–	111	31,9	105	31,4	98	30,8	80	29,3	69	28,4	59	27,6
	floor tiles ≤ 25 mm	0,030	–	–	98	30,9	93	30,4	80	29,3	72	28,7	63	27,9	55	27,2
	parquet 10 mm	0,05	–	–	90	20,1	87	29,9	77	29,1	69	28,4	60	27,7	53	27,1
	carpet	0,10	–	–	71	28,6	69	28,4	61	27,7	57	27,4	50	26,8	46	26,4
	carpet	0,15	–	–	59	27,5	56	27,2	50	26,8	49	26,7	44	26,3	40	25,9
20°	without covering	0,0	–	–	137	32,0	128	31,3	110	29,8	96	28,7	80	27,3	71	26,6
	floor tiles ≤ 15 mm	0,015	–	–	123	30,9	115	30,2	98	28,8	86	27,8	75	26,9	65	26,1
	floor tiles ≤ 25 mm	0,030	–	–	109	29,7	102	29,2	89	28,1	79	27,3	69	26,4	60	25,7
	parquet 10 mm	0,05	–	–	100	29,0	94	28,5	83	27,6	73	26,8	66	26,2	59	25,6
	carpet	0,10	–	–	78	28,2	74	26,8	77	27,1	61	25,7	55	25,2	50	24,8
	carpet	0,15	–	–	64	27,2	61	25,7	57	25,4	52	25,0	47	24,5	44	24,3
18°	without covering	0,0	–	–	149	30,9	140	30,2	119	28,5	104	27,3	90	26,2	79	25,3
	floor tiles ≤ 15 mm	0,015	–	–	134	29,7	127	29,2	106	27,4	94	26,5	83	25,6	71	24,6
	floor tiles ≤ 25 mm	0,030	–	–	119	28,6	111	27,9	96	20,7	86	25,8	76	25,0	67	24,3
	parquet 10 mm	0,05	–	–	108	27,7	102	27,2	90	26,2	81	25,4	71	24,6	64	24,0
	carpet	0,10	–	–	85	25,7	81	25,3	73	24,8	79	25,3	60	23,7	55	22,8
	carpet	0,15	–	–	70	24,5	68	24,3	61	23,7	58	23,5	52	23,0	49	22,7
15°	without covering	0,0	–	–	173	29,8	160	28,8	138	27,1	120	25,6	104	24,3	90	23,2
	floor tiles ≤ 15 mm	0,015	–	–	157	28,6	144	27,5	121	25,7	109	24,7	96	23,7	84	22,7
	floor tiles ≤ 25 mm	0,030	–	–	138	27,1	128	26,3	110	24,8	99	23,9	88	23,0	79	22,3
	parquet 10 mm	0,05	–	–	126	26,1	118	25,5	103	24,2	95	23,6	82	22,5	75	21,9
	carpet	0,10	–	–	99	23,9	94	23,5	84	22,7	78	22,2	70	21,5	64	21,0
	carpet	0,15	–	–	81	22,4	78	22,2	70	21,4	67	21,3	60	20,7	56	20,3

The capacity data are valid for a system construction with a heating pipe of 20 x 2 mm and a floor pavement covering S<sub>u</sub> = 45 mm

- <sup>1</sup>t<sub>1</sub> = room temperature  
<sup>2</sup>t<sub>fm</sub> = medium floor heating surface temperature  
q = specific thermal output  
R<sub>λB</sub> = temperature delay of the floor covering  
VA = laying distance of the heating pipes  
<sup>3</sup> = laying distance 75 mm is not valid for system element fastening plate EPS-45



Register / type  
no.  
5 D 003

## Medium heating water temperature 45 °C

Heating capacity table with a dimension of 20 x 2,0 mm

			VA 50		VA 75 <sup>3</sup>		VA 100		VA 150		VA 200		VA 250		VA 300	
<sup>1</sup> t <sub>1</sub>	Surface covering	R <sub>λB</sub> =	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>	q	<sup>2</sup> t <sub>fm</sub>
°C		$\frac{\text{sq.m} \cdot \text{K}}{\text{W}}$	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C	$\frac{\text{W}}{\text{m}^2}$	°C
24°	without covering	0,0	–	–	144	36,5	140	36,2	112	34,0	100	33,0	85	31,8	75	30,9
	floor tiles ≤ 15 mm	0,015	–	–	130	35,4	126	35,1	100	33,0	90	32,2	79	31,3	69	30,4
	floor tiles ≤ 25 mm	0,030	–	–	115	34,1	110	33,8	91	32,0	82	31,5	72	30,7	63	29,9
	parquet 10 mm	0,05	–	–	105	33,4	100	33,0	86	31,8	78	31,2	69	30,4	60	29,7
	carpet	0,10	–	–	83	31,6	79	31,3	69	30,4	63	29,9	58	29,5	52	29,0
	carpet	0,15	–	–	69	30,4	65	30,0	59	29,6	55	29,2	49	28,7	45	28,3
22°	without covering	0,0	–	–	158	35,6	146	34,7	125	33,0	110	31,8	94	30,5	82	29,5
	floor tiles ≤ 15 mm	0,015	–	–	141	34,3	132	33,6	111	31,8	100	31,0	86	29,8	76	29,0
	floor tiles ≤ 25 mm	0,030	–	–	125	33,0	119	32,5	100	31,1	90	30,2	79	29,3	70	28,5
	parquet 10 mm	0,05	–	–	115	32,2	109	31,7	96	30,7	87	29,9	76	29,0	68	28,3
	carpet	0,10	–	–	90	30,1	86	29,8	77	29,1	71	28,6	64	28,0	58	27,5
	carpet	0,15	–	–	74	28,8	70	28,8	65	28,1	60	27,7	54	27,1	50	26,8
20°	without covering	0,0	–	–	174	34,9	160	33,8	138	32,1	121	30,7	104	29,3	90	28,2
	floor tiles ≤ 15 mm	0,015	–	–	168	34,4	144	32,5	121	30,7	109	29,7	96	28,7	84	27,7
	floor tiles ≤ 25 mm	0,030	–	–	139	32,1	128	31,3	110	29,8	99	28,9	88	28,0	79	27,3
	parquet 10 mm	0,05	–	–	128	31,3	119	30,5	104	29,3	95	28,6	82	27,5	75	26,9
	carpet	0,10	–	–	100	29,0	92	28,3	84	27,7	78	27,2	70	26,5	64	26,0
	carpet	0,15	–	–	81	27,4	79	27,3	70	26,4	66	26,2	60	25,7	56	25,3
18°	without covering	0,0	–	–	208	35,5	170	32,6	145	30,6	128	29,3	110	27,8	98	26,8
	floor tiles ≤ 15 mm	0,015	–	–	169	32,5	153	31,2	129	29,3	114	28,1	101	27,1	89	26,1
	floor tiles ≤ 25 mm	0,030	–	–	149	30,9	138	30,1	117	28,3	103	27,2	93	26,4	83	25,6
	parquet 10 mm	0,05	–	–	136	29,9	128	29,3	110	27,8	99	26,9	88	26,0	79	25,3
	carpet	0,10	–	–	108	27,7	100	27,0	90	26,2	82	25,5	75	24,9	68	24,3
	carpet	0,15	–	–	88	26,0	84	25,7	75	24,9	70	24,5	65	24,1	60	23,7
15°	without covering	0,0	–	–	208	32,5	190	31,1	163	29,0	144	27,5	126	26,1	109	24,7
	floor tiles ≤ 15 mm	0,015	–	–	185	30,7	171	29,7	146	27,7	129	26,3	115	25,2	99	23,9
	floor tiles ≤ 25 mm	0,030	–	–	162	29,0	151	28,1	131	26,4	118	25,5	105	24,4	91	23,3
	parquet 10 mm	0,05	–	–	150	28,0	140	27,2	125	26,0	111	24,9	100	24,0	88	23,0
	carpet	0,10	–	–	118	25,5	110	24,8	101	24,1	93	23,4	84	22,7	75	21,9
	carpet	0,15	–	–	98	23,8	91	23,2	85	22,8	79	22,3	72	21,7	66	21,2

The capacity data are valid for a system construction with a heating pipe of 20 x 2 mm and a floor pavement covering Sü = 45 mm

- <sup>1</sup>t<sub>1</sub> = room temperature  
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 q = specific thermal output  
 R<sub>λB</sub> = temperature delay of the floor covering  
 VA = laying distance of the heating pipes  
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Register / type  
no.  
5 D 003



### Presetting of the fine adjusting valves

Pressure difference

The various heating circuits show different pressure losses due to unequal lengths and utilization.

The pressure difference to the heating circuit with the highest pressure loss has to be throttled with the fine control valve.

#### Examples:

Pressure loss of the most unfavourable heating circuit

$$\Delta p_u = 225 \text{ mbar}$$

Pressure loss of the heating circuit to be controlled

$$\Delta p_{HK} = 50 \text{ mbar}$$

Pressure difference to be throttled

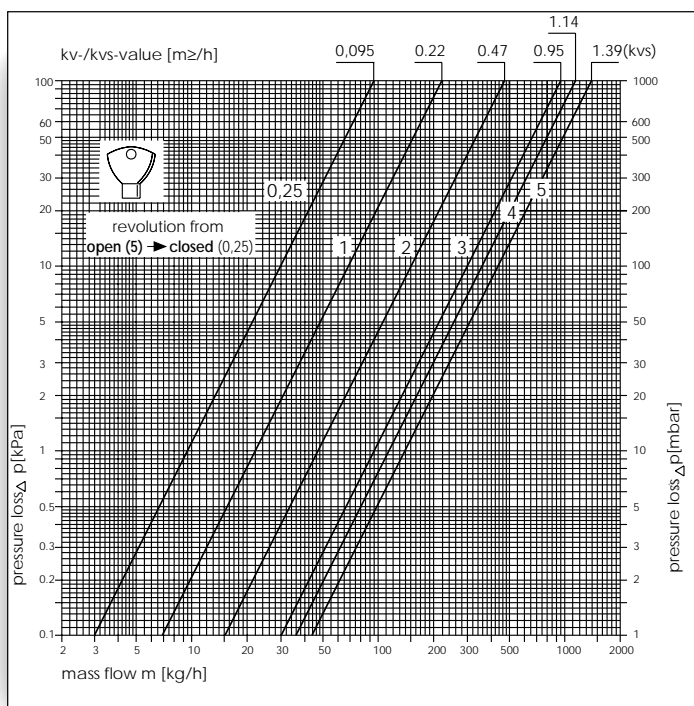
$$\Delta p = 175 \text{ mbar}$$

Circulating quantity of water:

$$m_G = 75 \text{ kg / h}$$

### Diagram: Setting of valve revolution

Pressure loss/  
mass flow





## Membrane expansion vessel

Special care should be taken when designing the membrane expansion vessel for floor heating systems. It has to be assumed that even with a "tight" installation leak-ages exist on a small scale enabling the heating water to evaporate unnoticed.

A pressure expansion vessel which has been correctly designed and integrated into the heating installation fulfils the following functions:

Function

- taking-up of the expansion volume during the heating phase
- storage of a water supply being fed into the system when needed e.g. upon cooling or loss of leakages
- maintaining of a minimum excess pressure in the system (pressure keeping)

The following terms are necessary for a correct dimensioning:

Legend

n	= expansion coefficient for water in % (s. table)
h	= static height
p <sub>SV</sub>	= response pressure of the safety valve
Δp <sub>A</sub>	= working pressure difference (response tolerance of sv)
D <sub>f</sub>	= pressure factor
V <sub>H</sub>	= nominal size
V <sub>e</sub>	= expansion volume
V <sub>A</sub>	= water capacity of the installation
V <sub>N</sub>	= nominal volume of the expansion vessel
V <sub>V</sub>	= water recipient
p <sub>a</sub>	= initial pressure in bar absolute
p <sub>e</sub>	= final pressure in bar absolute
ϑ <sub>V</sub>	= max. flow temperature

### Expansion coefficients for water with and without the addition of antifreezing compounds

Expansion

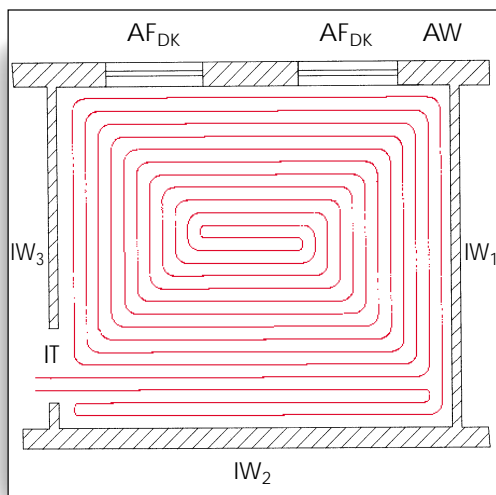
temperature °C	without addition	addition of 10 %	addition of 20 %	addition of 30 %	addition of 40 %	addition of 50 %
10	0,04	0,32	0,64	0,96	1,28	1,60
20	0,18	0,50	0,82	1,14	1,46	1,78
30	0,44	0,76	1,08	1,40	1,72	2,04
40	0,79	1,11	1,43	1,75	2,07	2,39
50	1,21	1,53	1,85	2,17	2,49	2,81
60	1,71	2,03	2,35	2,67	2,99	3,31
70	2,28	2,60	2,92	3,24	3,56	3,88
80	2,90	3,22	3,54	3,86	4,18	4,50
85	3,21	3,57	3,89	4,21	4,53	4,85
90	3,59	3,91	4,23	4,55	4,87	5,19
95	3,96	4,29	4,61	4,93	5,25	5,57
100	4,35	4,67	4,99	5,31	5,63	5,95
105	4,74	5,07	5,33	5,71	6,01	6,35
107	4,91	5,23	5,55	5,87	6,19	6,51
110	5,15	5,47	5,79	6,11	6,43	6,75
120	6,03	6,35	6,67	6,99	7,31	7,63
130	6,97	7,29	7,61	7,93	8,25	8,57

## Planning / Design

### Types of placing: spiral-type placing

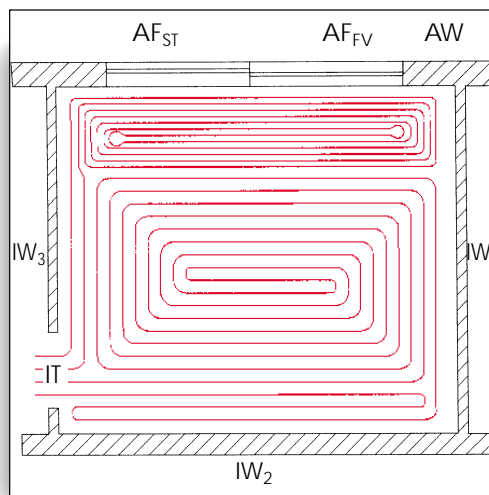
Example of placing A:

- spiral type placing



Example of placing B:

- spiral type placing with separate rim zone



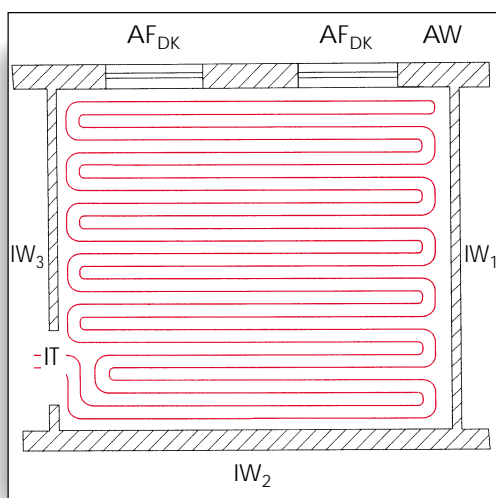
$AF_{DK}$  = outside window pivoted/pivat-hung design,  $AW$  = outside wall,  $IW_{1-3}$  = inside walls,  $IT$  = inside door

## Planning / Design

### Types of placing: counterflow-type

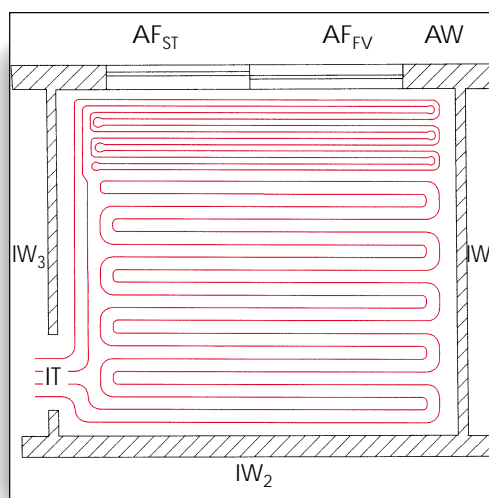
Example of placing C:

- counterflow-type

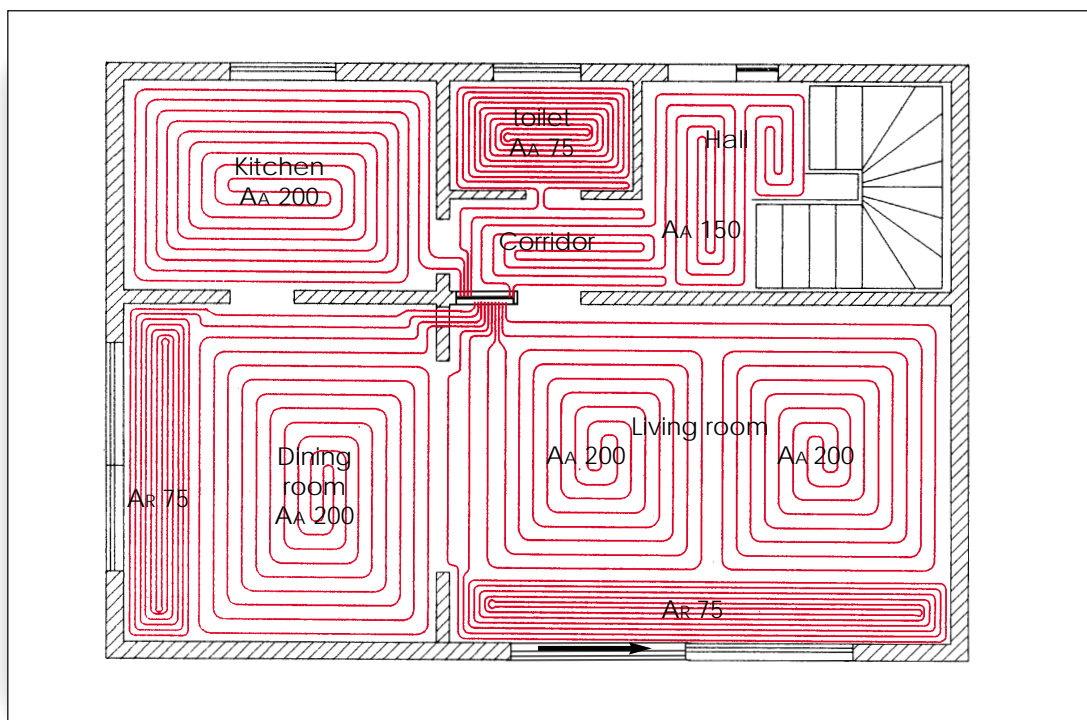


Example of placing D:

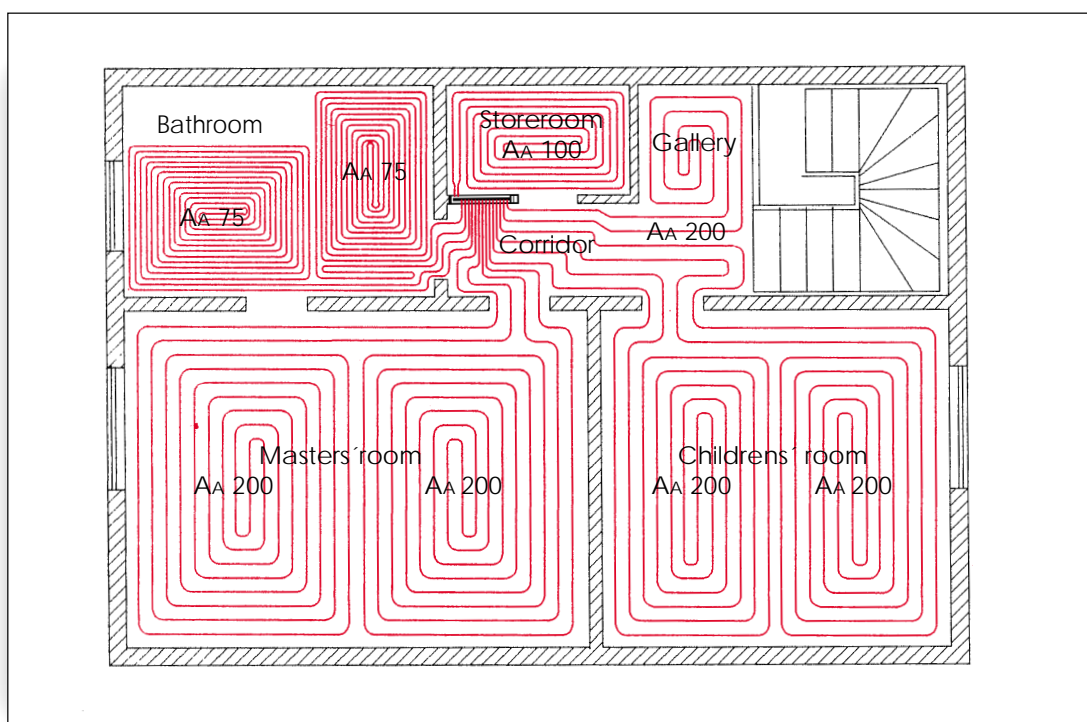
- counterflow type with separate rim zone



Types of placing: spiral-type placing



▲ ground floor



▲ upper floor

The grid area contains a faint, large-scale watermark of the aquatherm logo and the word 'aquatherm' in the bottom right corner.

## Conditions of sale, guarantee and supply

### I. Applicability:

The following conditions are decisive for each supply to be executed by the supplier. Verbal additional arrangements are only effective when confirmed in written by the supplier. These conditions are considered as accepted in all parts by placing an order. If the counterconfirmation of the buyer contains different conditions, same are only valid when they are accepted in written by the supplier. In case of a continuous business connection these conditions of supply and payment are valid for every single order, even when the conditions are not explicitly added to every single order confirmation or when it has not been referred to them.

### II. Conditions of supply:

- Our quotations are without engagement. Type samples are not binding, they show the general character of the goods, however not their single characteristics. We reserve all technical improvements. Charging of the goods is made at our prices valid on the day of supply. In case that prices increase between the confirmation of order and supply due to an increase of raw material costs, wages and transport costs or for reasons for which we are not responsible, the costs will be negotiated again by the parties. If there is no agreement within 14 days after receipt of a request for modification, every party can withdraw from the contract.
- Conclusions made by our field service or telephone arrangements need our written confirmation to become effective.
- In case of strikes or lockouts in our works or in a factory working for us, lack of energy, traffic troubles, official orders and self-supply not in due time, if and as far as these circumstances could not be foreseen objectively by us or in cases of force majeure we are not bound to agreed dates of supply and performance. In these cases the date of supply will be extended by the period of the delay. In case that supply or performance will be impossible due to these circumstances, we will be free of the supply obligation. Incidentally, we are liable for intention or culpable negligence. We will inform the buyer as soon as possible of any delay in supply or impossibility of supply. The buyer is entitled to withdraw from the contract, after he has given us an extension of 14 days for supply and threatened with the withdrawal at the same time. In case of a delayed or omitted supply he cannot make any claims for damages, unless we or our accomplices are accused of intention or culpable negligence.
- The goods travel at the receiver's risk, even for carriage free supplies. The risk of an accidental loss or deterioration passes to the buyer when handing over to the carrier - even upon supply free destination. Upon dispatch with our own vehicles the risk passes to the receiver upon ending of loading.

### III. Freight charges :

From a value of DM 2.000 supply is made **free station** within the Federal Republic of Germany. Supply abroad free border Federal Republic of Germany is made under the same conditions. In case of supply under the indicated quantities resp. values all freight costs are to be paid by the buyer.

### IV. Conditions of payments:

- As far as no other arrangements are made, payment is due 30 days after issuing of the invoice net without cash discount. Upon payment within 10 days a cash discount of 2 % is given. Contrary conditions need in any case our written confirmation.
- Giving of a cash discount is subject to payment of all due payment obligations of previous supplies. Payments will be first credited to interest claims and afterwards to the eldest payment debts.
- In case that own or foreign acceptances are given, all bill of exchange fees and discount expenses are charged to the buyer. Payments made with a bill of exchange are not considered as cash payments and have no right to a cash discount. In any case we reserve the right to accept own or foreign bills of exchange.
- Bills of exchange and cheques are only credited subject to cashing. We do not take on any guarantee for presentation in due time or making of protests. Our claims of all still existing bills - own or foreign acceptances - become due immediately in case of a protest of a bill either of an own acceptance of the customer or upon a not direct settlement of a protested foreign acceptance.
- We reserve the right to the assessment of credits and the cancellation of granted credits, even after receipt of an order. At any time, we are entitled to request according to our judgement sufficient securities. Our claims become due immediately when the guarantee is not effected upon such a request.
- In case of claims resulting from several supplies resp. performances clearance of money receipts on one or the other debt is up to the supplier. The buyer is not entitled to stop or refuse payments because of any claims, even when they are laid because of complaints. Neither is he entitled to set off against any counterclaims, unless same are indisputable or legally established.
- Payments are only legally effective when they are made directly with us. Employees or representatives may only accept payments with a special power of authority.
- Supply to other countries is made - as far as they are no special arrangements - against previous cash, bank transfer or payments upon handing over of the bill of lading (Letter of Credit).
- In any case, all claims of the supplier become due when the buyer falls behind with fulfilment of another obligation of the supplier. Same is also valid when he stops payments, is heavily in debts or insolvency or bankruptcy proceedings have been instituted over his property, or when the institution of such a proceeding has been refused for lack of assets, or when circumstances become known warranting justified doubts about the creditworthiness of the buyer.
- In case of default in payment of the buyer, the supplier is entitled - upon his choice - to depend further supplies or performances on advance payments or sureties, to demand for compensation because of non-fulfilment or to withdraw from the contract. Same is not valid when the buyer has complained the supply and moreover the supplier can return accepted bills of exchange prior to expiry and ask for a direct cash payment.

### V. Guarantee

- The buyer is obliged to examine the goods after receipt of the consignment and to notify to the seller any faults, shortages or wrong supplies within 4 days and to reprimand in written. The goods complained may only be installed or consumed with the agreement of the seller.
- Damages caused during the rail transport or during transport with trucks of the railway company have to be stated immediately by the officials of the railway company upon arrival of the consignment resp. unloading. Fractures and shortages have to be acknowledged on the consignment note by the railway company.
- Hidden faults have to be notified in written within 4 days after being detected.
- If a complaint is proven to be justified a replacement free of charge or a repair will be effected. If replacement supplies resp. repairs go wrong or require a disproportionate expenditure, only a reduction in the purchase price can be requested.
- In case that the goods complained do not come from the storage supplies of the supplier, he is only required to transmit the complaint to the delivery factory or the delivery company and to transfer the existing complaints to the buyer. There are no other claims.
- All guarantee and contractual damage claims are limited to a period of 6 months.

### VI. Liability

Other claims especially through faults upon conclusion of the contract, a positive breach of contract and tort (e.g. producer's liability) are explicitly excluded, unless they are justified with intent or culpable negligence and become a burden on the supplier, his legal representative or one of his executives, or due to lack of an expressly confirmed characteristic.

### VII. Warranty:

The aquatherm GmbH gives a guarantee of 10 years for all plastic pipes and fittings made or distributed by the company. In the scope of this warranty, they will provide compensation for damages to property of third parties and for damages resulting from this or expenditures from third parties to remove, disassemble, inspect or expose faulty products and to install, put up, lay products free of faults.

In the scope of the existing product liability insurance the aquatherm GmbH will provide compensation for damages to property up to a covering amount of 5 Mio. DM. Other claims - no matter for which legal reasons - do not exist.

Assumption for the liability is consideration of the general recognized rules of technics, especially the instructions for installation of the system.

Within the guarantee period of 10 years, aquatherm GmbH will provide a replacement free of charge for pipes and fittings when damages result which are proven to be caused by material defects. However, in case of damage, the aquatherm GmbH must have the possibility to check the damage resp. remove the damage within 8 days, before same will be repaired by a fitter and charged to them.

As far as other products as the aquatherm®/fusiotherm®-products are used (pipes as well as fittings) the above mentioned guarantee terms lose their validity.

### VIII. Reservation of proprietary:

The supplied goods stay in the possession of the supplier till complete payment of the purchase price as well as till payment of all goods supplied in the past within the business connection - including all supplementary claims. Up to that point the buyer is not entitled to pawn or to transfer the goods to a third party as security. In case of pawning by a third party, the buyer has to inform the supplier immediately. In case that the goods are consumed and the goods supplied under reservation of proprietary rights are considered to be a not insignificant part of the new article of property, the buyer will transfer already now to the supplier the property rights of the new article of property as security of the mentioned claim of the supplier agreeing at the same time that the buyer will keep this article for the supplier. The buyer is entitled to dispose of the goods resp. the make produced of it in accordance with the rules of sales. The claims resulting from the resale amounting to the original invoice amounts are transferred to the supplier to be on the safe side, without the need of a special arrangement in individual cases. The buyer is authorized to withdraw these claims for invoices of the supplier as long as he duly fulfils his payment obligations to the supplier. However, the supplier is entitled to inform the third party to be named upon his request about the transfer and to give him instructions.

### IX. Court of jurisdiction and place of fulfilment:

- Place of fulfilment and court of jurisdiction - even for claims of bills of exchange and checks - are the headquarters of the delivery company. However, the aquatherm GmbH is also entitled to call the court competent for the headquarters of the buyer.

### X.

In case that one of the above mentioned single requirements should not be valid for one or the other reason, the validity of the other requirements will not be concerned.

### XI. Validity for non-specialists

For legal transactions concerning neither conducting a trade of a businessman nor a legal entity of public law or special property under public law these terms of business are valid on the following condition:

- Clause II paragraph 1 is only valid on the condition that the supplier is entitled to charge the prices valid on the day of delivery if supply or performance is later than 4 months after conclusion of the contract.
- Clause IV paragraph 6 - sentence 2 ("The buyer is not ... complaints.") is not valid.
- Clause IV paragraph 10 is only valid if an extension of 14 days has been granted prior to compensation because of non-fulfilment or withdrawal.
- The obligation to notify under clause V paragraph 1 is only valid for obvious faults, shortages or wrong deliveries.
- Clause V paragraph 3 is not valid for non-businessmen. The limitation period of the legal claims for guarantee are valid for notification of hidden faults.
- Under Clause V paragraph 4 - sentence 2 the non-businessman can also ask for withdrawal of the purchase contract, unless withdrawal is only possible for real reasons or on aggravating conditions.
- Clause IX is only valid as far as allowed by § 38 ZPO (German code of civil procedure).

# aquatherm

We set high standards  
in quality and reliability.



## aquatherm GmbH

Kunststoff - Extrusions-  
und Spritzgießtechnik

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