Surface water heating and cooling systems

SYSTEM **KAN-therm**

Floor heating

manual

EN 06/2015

TECHNOLOGY OF SUCCESS

ISO **9001**

About KAN

Modern water and heating solutions

KAN was established in 1990 and has been implementing state of the art technologies in heating and water distribution solutions ever since.

KAN is European recognized leader and supplier of state of the art KAN-them solutions and installations intended for indoor hot and cold tap water installations, central heating and floor heating installations, as well as fire extinguishing and technological installations. Since the beginning of its activity, KAN has been building its leading position on such values as professionalism, innovativeness, quality and development. Today, the company employs over 600 people, a great part of which are specialist engineers responsible for ensuring continuous development of the KAN-therm system, all technological processes applied and customer service. The qualifications and commitment of our personnel guarantees the highest quality of products manufactured in KAN factories.

Distribution of the KAN-therm system is performed through a network of commercial partners all over Germany, Poland, Russia, Ukraine, Belarus, Ireland, the Czech Republic, Slovakia, Hungary, Romania and in the Baltic States. Our expansion and dynamic development has proven so effective that KAN-therm labeled products are exported to 23 countries, and our distribution network assumes Europe, a great part of Asia, and a part of Africa.

The KAN-therm system is an optimal, complete multipurpose installation system consisting of state of the art, mutually complementary technical solutions for pipe water distribution installations, heating installations, as well as technological and fire extinguishing installations. It is the materialization of a vision of a universal system, the fruit of extensive experience, the passion of KAN's constructors, as well as strict quality control of our materials and final products.

TECHNOLOGY OF SUCCESS

INTRODUCTION

KAN-therm system is a collection of ready-made, complete design solutions that enable implementation of indoor and outdoor water surface heating and cooling installations.

It comprises modern, complementary solutions for installation materials and assembly techniques.

The manual "KAN-therm Designer's and Contractor's Manual" is intended for all stakeholders involved in implementing modern installations - designers, installers and supervision inspectors.

The Manual features a wide range of presented solutions and installation techniques. A single handbook contains the most modern and at the same time most popular intallation systems for contemporary construction industry, systems that together form the **KAN-therm** multisystem. As such, the handbook provides the user with an overview and comparison of systems and thus the opportunity for optimum selection, in terms of technical, economic and operational properties, of suitable installation solutions.

The content of the manual provides for currently applicablenational and EU standards as well as guidelines for surface heating and cooling systems, used in construction.

Designers using the traditional methods of dimensioning are welcomed to take advantage of a separate, attached to the Manual, set of tables containing hydraulic properties of pipes and fittings described in the Manual, with regard to typical parameters of surface installation operation. All designers, in addition to the Manual, are also offered a free of charge package of professional computer aided design software: **KAN ozc**, **KAN c.o.** and **KAN H2O**.

KAN manufacturing process, as any other KAN activity, is ISO 9001 certified.

Table of contents

1 General information

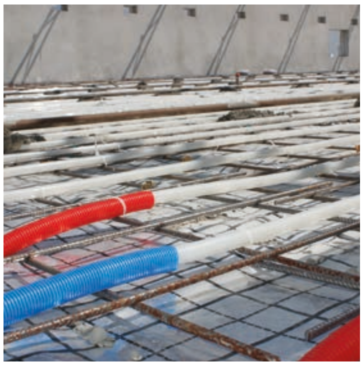
The systems of water low-temperature surface heating and cooling that make use of floor or wall surfaces as a source of heat (or cold) are becoming increasingly popular. The increase in energy prices forces users to use modern and at the same time operationally inexpensive heating installations and devices, manufactured and operated in accordance with the requirements of environmental protection.

The choice of this method of heating is primarily driven by energy efficiency and comfort. With wel designed, optimum temperature distribution, air temperature within the space can be reduced while the thermal comfort is still maintaned, resulting in reduction of the amount of heat supplied. Low supply temperature also reduces heat loss. Even 2 years is enough for full return of the investment! This way surface heating may be one of the the cheaper solutions for heating.

Other advantages are equally important. Aesthetics - surface heating is invisible, allowing for flexible interior design. It features a "pure" solution, reducing convection currents it eliminates circulation and settling of dust. And last but least - surface heating systems are reliable and durable, with heat source durability being the only constraint. Another undisputed virtue of surface heating is its low carbon footprint as a system fed by low temperature, "clean" gas boilers or other alternative heat sources (geothermal energy, solar energy, etc..).

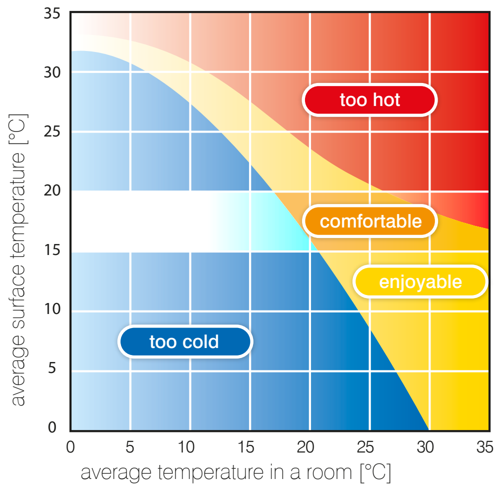
KAN-therm offers a range of modern technologies that enable construction of energy-efficient and sustainable water surface heating and cooling systems. KAN-therm makes it possible to implement virtually any, even the most unusual, floor, wall or ceiling installation as well as heating installations for outdoor surfaces. KAN-therm system is a complete system, as it contains all the elements (heating pipes, insulations, manifolds, cabinets, automation) necessary to implement an efficient and cost effective heating.






1.1 Thermal comfort

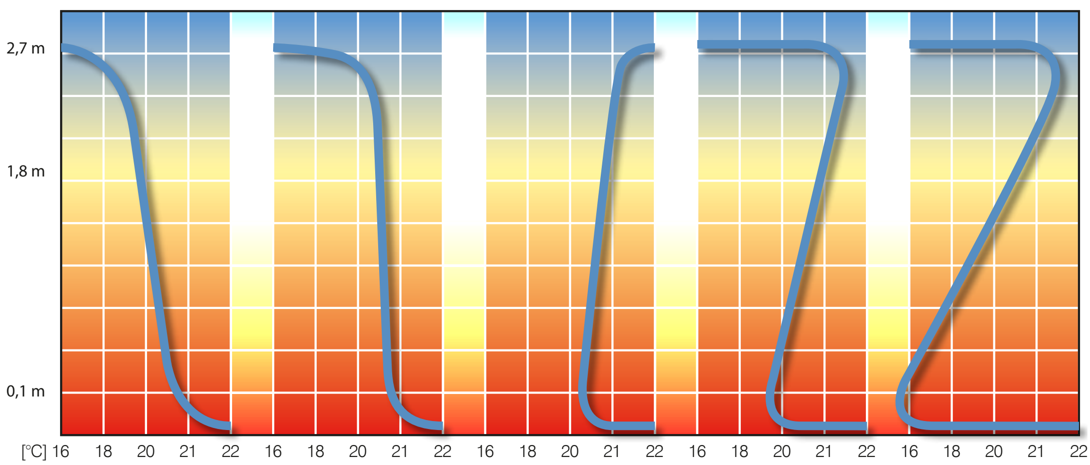
Surface heating and cooling systems substantially improve perceived thermal comfort within indoor spaces. For this heating system the majority of heat is transferred through radiation. Floors (and walls) feature elevated temperatures and as such they cease to be building partitions during the winter season (no cooling effect for feet) with no adverse impact on the so called perceived temperature (resultant air, wall and floor of an indoor space) which determines the perceived thermal comfort. The relatioship between the perceived temperature and building partition temperature as well as air temperature is described by Koenig chart.



Surface heating/cooling systems are low temperature systems. Average temperature of heating/cooling surface is only slightly higher (or lower for cooling) than the air temperature within the space. For surface heating, temperature of 20°C provides the same thermal comfort as 21- 22°C achieved with traditional radiators on convection heaters.

Surface heating, and in particular floor heating, offers the most favourable, next to ideal, temperature distribution for humans. It means pleasent warmth for feet and favourable cooling at the head level.

Fig. 1. Vertical temperature distribution for various types of heating



ISO 9001

Considerably important, in terms of surface heating comfort, is greatly reduced (compared with radiator heating systems) air convection that causes floating of allergenic dust. Furthermore, surface heating reduces growth of harmful mites due to the low relative humidity at the floor level.

Surface heating, contrary to high temperature radiator heating systems, will not cause excessive, harmful positive air ionization.

1.2 Energy efficiency

Surface heating is an energy efficient heating system. Since surface heating makes it possible to reduce indoor air temperature by 1 ÷ 2°C (compared with radiator heating systems), the resulting heat energy savings range between 5-10% (with no adverse effect on thermal comfort) as lower temperature reduces the heat loss through partitions. An additional advantage of underfloor heating is low feedwater temperature (max. 55°C). This property of the system makes it possible to use unconventional heat sources such as solar collectors, heat pumps or condensing boilers.

An underfloor heating systems radiates warmth evenly in human occupied zones. This feature is of particular importance for heating rooms with high ceilings. In case of convection heaters warm air in high rooms gathers in the upper part and more energy must be used to maintain temperature in human occupied zones.

Surface heating systems are self - adjusting. This property is due to the slight difference between the floor and indoor air temperature, at which heat exchange takes place.

Any increase in indoor air temperature (such as caused by heat gains) reduces the output of floor heating (lower temperature difference) and thus a counter reaction temperature increase. With constant flow of water in coils such counter reaction causes an increase in return water temperature and energy savings in the heat source that features automatic control of feed water temperature.

1.3 Surface heating installation heat sources and supply temperatures

Surface water heating systems (floor, wall heating) are low-temperature heating systems. In case of under floor heating the maximum temperature of feed heating water is 55 ° C (for design external temperature) and the optimum temperature drop of water in the coils is 10°C (permissible range 5÷15°C).

Typical parameters of coil feed and return water are therefore:

- 55°C/45°C
- 50°C/40°C
- 45°C/35°C
- 40°C/30°C

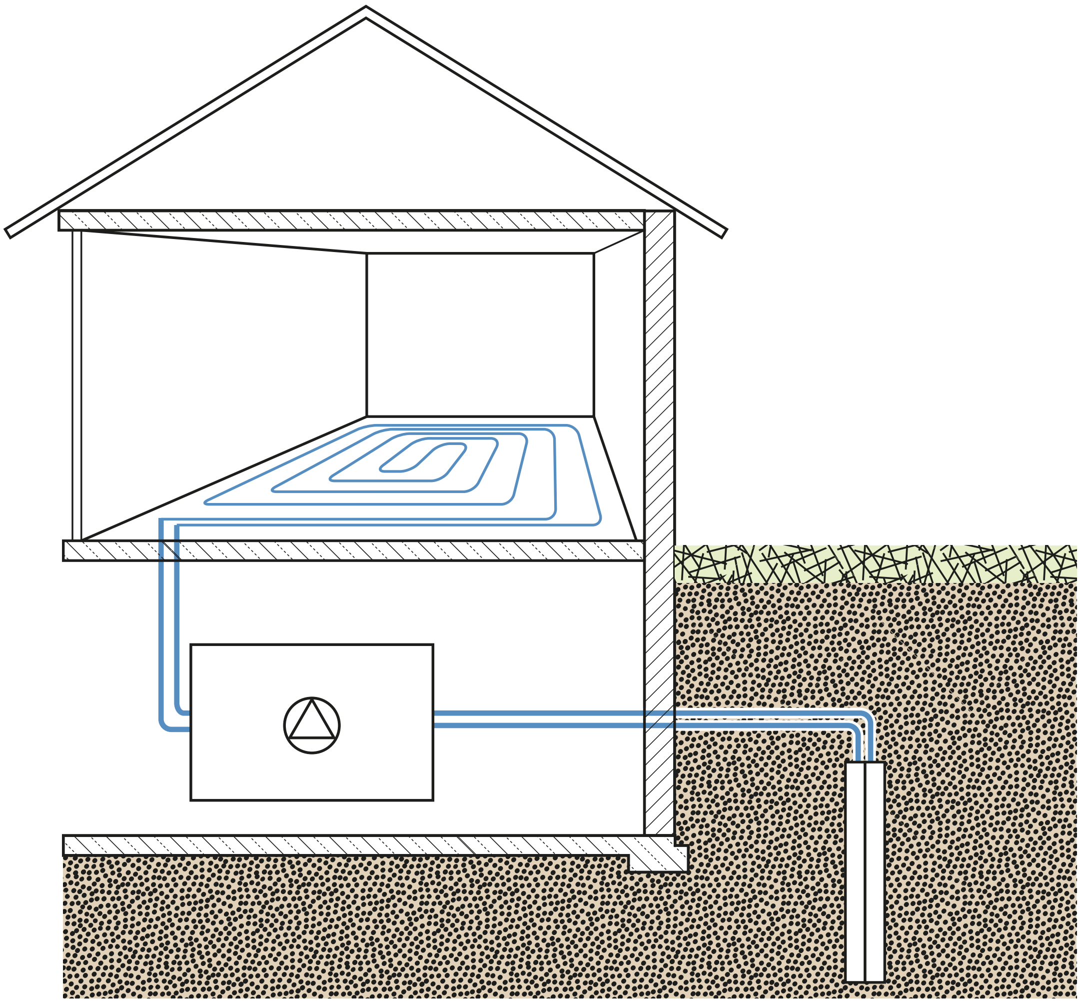
Feed and return temperature for the entire system is determined for the space with highest specific heat demand.

Heating installation can be fed directly from low-temperature heat sources (gas condensing boilers, heat pumps) **Fig. 2** or, if combined with radiator heating system, from sources of higher temperature, supplied through a system lowering temperature of heating water (such as mixing systems).

If a surface heating system is dominant in a building, the use of low temperature heat sources may result in significant reduction in operating costs. Energy savings are due to higher energy efficiency of these sources and lower heat losses of surface heating systems.

The efficiency of the energy radiated into an indoor space through the heating system should not be less than 90%.

Fig. 2. Surface heating installation supply directly from low-temperature heat source



1.4 Application areas for KAN-therm surface heating and cooling systems

Water heating and cooling systems that use building partition surfaces (floors, walls, ceilings) are becoming increasingly popular, both in residential as well as general or industrial construction.

Due to the comfort and energy efficiency of this type of heating is chosen over other systems as source of heat (increasingly also cold) for houses and apartments.

Examples of an optimum use of surface heating systems are industrial or storage facilities as well as interior of church buildongs - whereever high ceilings and large surface area rule out, for economic reasons, traditional heating systems.   Surface heating systems are also equally well suited for objects that require a uniform temperature distribution - swimming pools, bathrooms, rehabilitation and sport sites.

Yet another category are heating systems for outdoor surfaces, heated using coils with warm medium toi heat, for example, pedestrian routes or playing field turf.

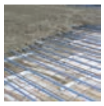
Fig. 3. Floor heating installation in single-family building, employing PE-RT Blue Floor pipes and KAN-therm Tacker system.

Fig. 4. Floor heating installation in industrial facility, employing PE-RT Blue Floor pipes and KAN-therm NET system.

Fig. 5. Heating installation of outdoor patio employing KAN-therm system PE-RT pipes.

For all above areas of application KAN-therm system offers proven technical solutions such as insulation and pipe fastening systems as well as modern devices and automation.

SYSTEM KAN-therm

Application areas	Tacker	Profil	Rail	TBS	NET
					
FLOOR HEATING AND COOLING					
Residential housing new objects	●	●	●	●	○
Residential housing, recovery		○		●	
General and public building contruction	●	●	●	●	●
Historic buildings and places of worship	●	●	●	○	●
Sports facilities - floors with point elasticity	●	●	●		
Sports facilities - floors with surface elasticity	●		●		
Sports facilities - icerinks			●		●
Heating of industrial facilities	●		○		●
Industrial cooling storages			○		●
Monolithic constructions					●
WAL AND CEILING HEATING/COOLING SYSTEMS					
Residential and public buildings - wet method			●		
Residential and public buildings - dry method				●	
FLOOR HEATING AND COOLING OF OUTDOOR SURFACES					
Pedestrain routes, driveways			●		●
Green houses					●
Sports pitch			●		
Icerinks			●		

● Recommended for use

○ suitable for use in certain conditions

2 Surface heaters design

2.1 Wall and floor heaters design

Typical floor heater is composed of the following layers:

- thermal insulation layer situated directly at the ceiling structure (with or without damp-proof insulation),
- damp-proof layer that protects the insulation,
- heat distributing layer in a form poured or dry screed,
- floor finishing layer.

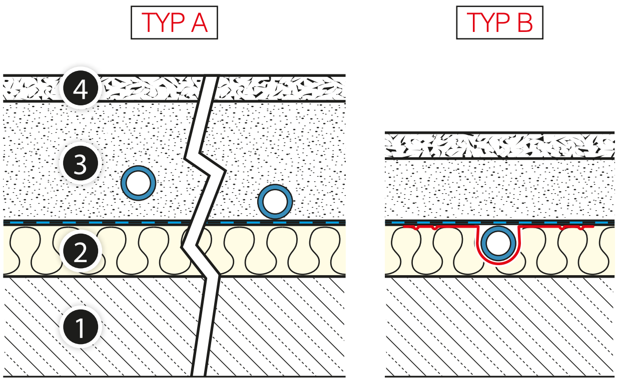
Depending on the heating pipes arrangement, the PN-EN 1264 standard distinguishes three (A, B, C) types of surface heaters design (this classification apply to both floor and wall solutions.

KAN-therm System solutions generally cover A and B type.

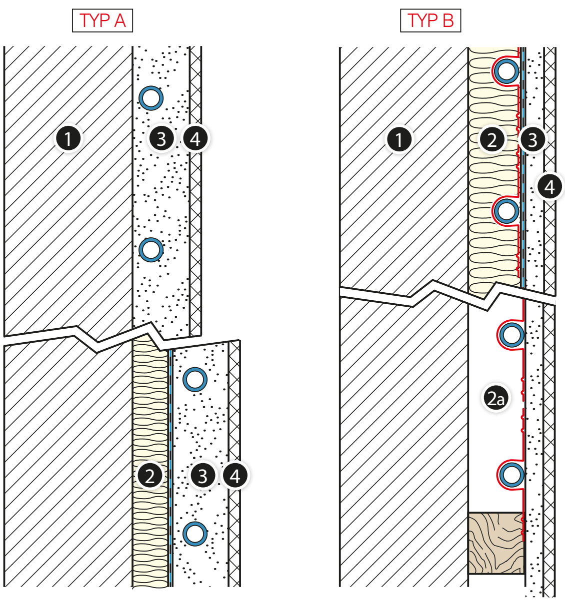
For floor heating:

- Type A - heating pipes are located on the insulation or over the insulation placed inside the screed layer.
- Type B - heating pipes are located in the upper part of the thermal insulation layer.

1. Ceiling
2. Thermal insulation layer
3. Screed layer
4. Floor covering layer



1. Ceiling
2. Thermal insulation layer (or air gap)
2a. Air gap
3. Plaster layer
4. Floor covering layer



For wall heating:

Type A – heating pipes are placed in the plaster layer.

Type B – heating pipes are placed in the upper part of thermal insulation layer or in the air gap.

2.2 Heating loops arrangement

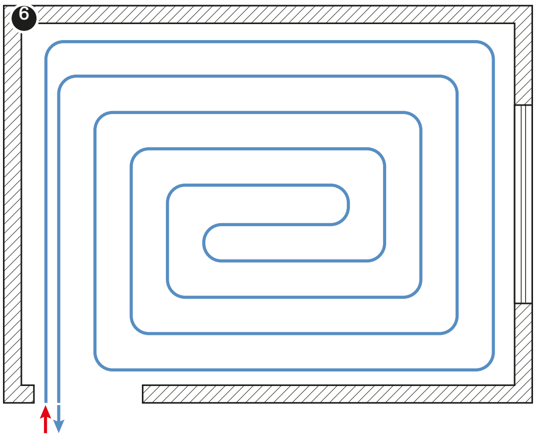
Heating pipes arrangement depends on the nature of the room (its purpose, shape), cooling partitions distribution (internal walls, windows), floor structure, as well as adopted pipes assembly technique. Two basic patterns are applied: spiral (**Fig. 6**) and series (**Fig. 7**).

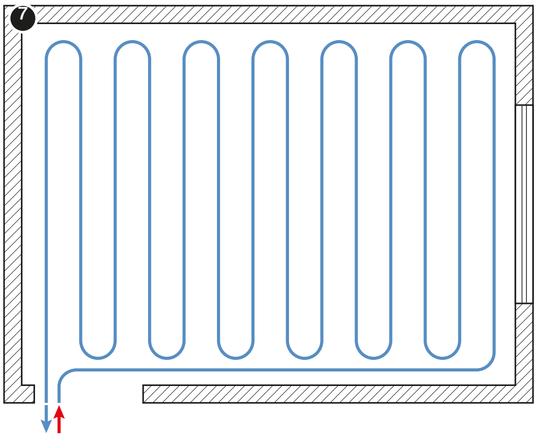
Spiral pattern ensures the most even heating surface temperature distribution, because supply and return cables are arranged next to each other alternately. In the series pattern, the medium temperature is highest at the beginning of the coil, subsequent coil series temperature, due to the cooling, becomes increasingly lower, also the heating surface temperature decreases linearly. Therefore, the beginning of series pattern coil should be arranged near the partitions with the highest heat loss (external walls, windows, terraces).

The choice of coil arrangement does not have an impact on general thermal efficiency of the surface heater in a room, but it determines the temperature distribution on its surface.

Fig. 6. Floor heating/cooling coil in spiral pattern.

Fig. 7. Floor heating/cooling coil in series pattern.

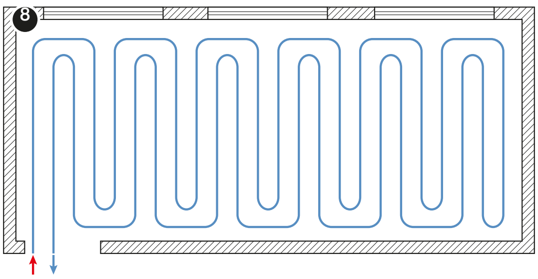


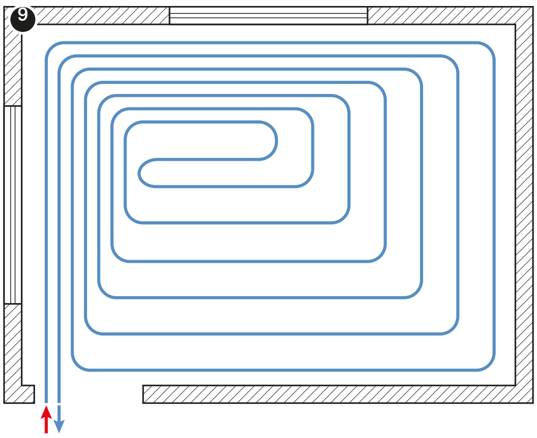


The combination of spiral and series patterns is also possible (**Fig. 8**), it ensures more balanced temperature distribution, which is suitable for areas of elongated shape.

Fig. 8. Floor heating/cooling coil in mixed arrangement: double series pattern.

Fig. 9. Floor heating/cooling coil in the spiral pattern, with an edge zone made on a single loop, arranged along the external walls or surfaces with large glazing.

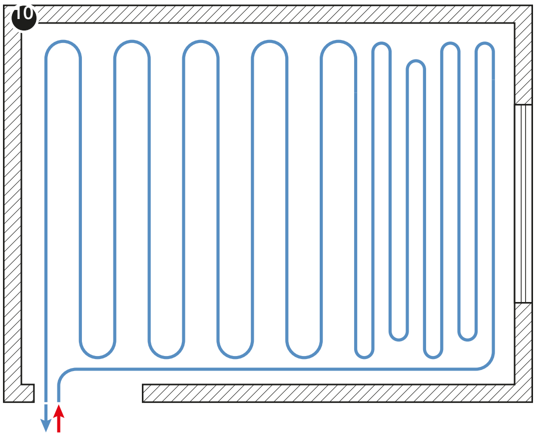


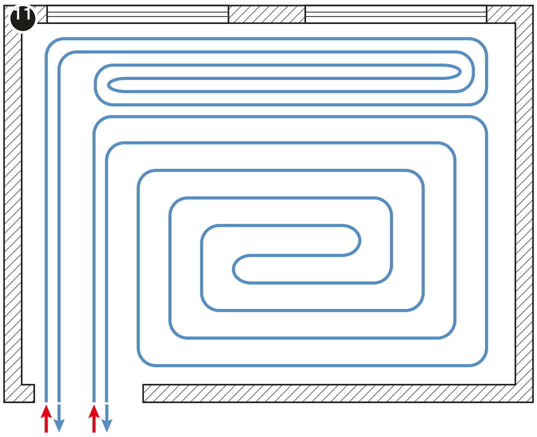


If there are places with partitions of exceptionally high heat loss in the room, e.g. near large window and terrace openings, in their proximity, the loop spacing may be compacted by creating a peripheral zone (**Fig. 4, Fig. 5, Fig. 6**). The standard width of such a zone is 1 m, with permissible floor surface temperature of 31 °C for dry rooms and 35°C for wet areas and bathrooms. The peripheral zone loops may be integrated with the standard loops of the heating field, as they have common power supply and return (**Fig. 4, Fig. 5**), they can also create a separate circuit (**Fig. 6**).

Fig. 10. Floor heating/cooling coil in the series pattern, with an edge zone made on a single loop, arranged along the external wall or surface with large glazing.

Fig. 11. Floor heating/cooling coil in the spiral pattern, with an edge zone made on a separate loop, arranged along the external wall or surface with large glazing.





The heating loops should not be arranged under the room furnishing elements, which are built-in permanently (kitchen cabinets, bathtubs etc.).

Coil heating pipes spacing is a significant parameter of a surface heater. It determines the size of thermal flux, which is radiated by a heating surface, it also has an effect on the evenness of heat distribution on the floor surface, as well as on the user's feeling of comfort.

Standard heating pipe spacing is 10, 15, 20, 25 and 30 cm. Larger spacing in typical applications is not used, due to the clearly perceived warmer and colder places on the floor surface. In the KAN-therm System, there are also non-standard spacings, which are the result of pipes mounting boards structure (16.7; 25 or 33.3 cm for TBS boards).

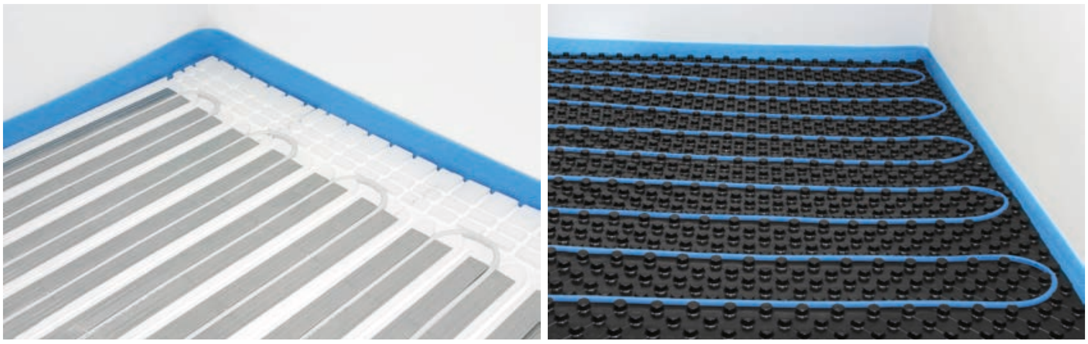
During loop arrangement (especially in the series pattern) with specified spacing, the pipes bending radius must be maintained. In case of small spacing, in order to maintain both spacing and required bending radius, the direction change arc should be "omega" letter shaped.

2.3 Dilatation in surface heatings

The dilatation solutions are applied in order to prevent the negative effects of thermal expansion of the heating pipes (floor, wall), which are subject to temperature changes. These include perimeter edge dilatations and dilatation gaps.

Insulations of perimeter dilatation, apart from the functions related to boards thermal motions, also serve as an acoustic and thermal insulation, which separate the boards from other perpendicular building partitions.

Fig. 12. Examples of edge insulation in KAN-therm floor heating.



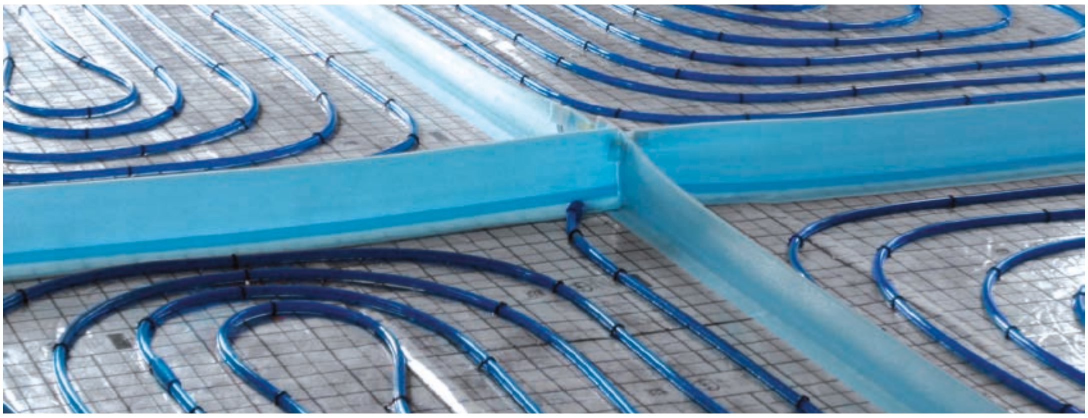
All heating plate contact points with vertical building partitions should be separated by a perimeter dilatation (spacing of at least 5 mm must be maintained). Dilatation should also be performed along the entire length of the doorway thresholds.

KAN-therm wall tape made of 8 × 150 polyethylene foam with laid out on the thermal insulation PE foil apron, which protects against the ingress of screed, should be applied as an edge insulation. The tape should be arranged from the floor support substrate, to the over the planned upper level of the covering, and after performing the spout, it should be cut to the appropriate height (in case of elastic coverings, should be flushed with the spout).

Heating plates distribution with dilatation gaps should be considered in the following cases:

- the board surface exceeds 40 m^2
- board's sides length ratio is larger than 2:1
- the length of one side exceeds 8 m
- board's surface has a complex, other than rectangular shape (e.g. types L, Z etc.).
- heating plate is covered with various types of coverings.

Fig. 13. Distribution of heating fields with dilatation gaps



Heating plates distribution should be taken into account in the technical design.

A gap (of the minimum width of 5 mm) must separate the board's screed from the entire thickness of the adjacent board, starting from the thermal insulation up to the covering layer. To perform dilatation gaps, the KAN-therm dilatation profiles with feet, allowing to stick the tape to the insulation surface, are used.

Fig. 14. Performance of dilatation gap in case of flooring made of soft covering.

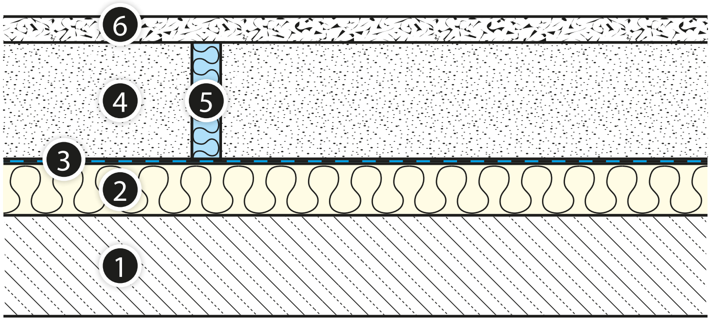
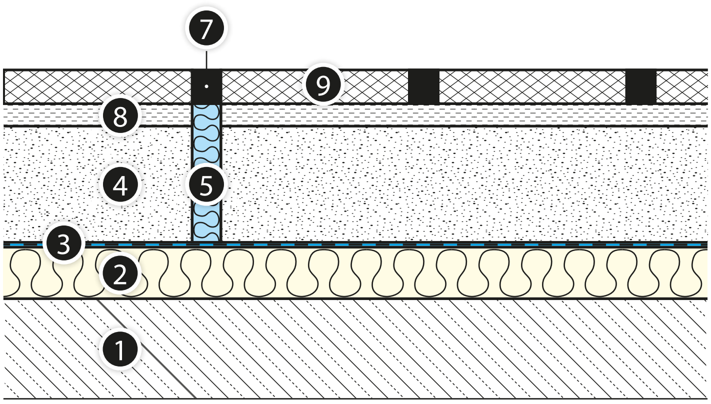


Fig. 15. Performance of dilatation gap in case of stone flooring



1. Ceiling
2. Thermal-acoustic insulation layer
3. Protective foil
4. Heating screed
5. Dilatation gap
6. Soft covering e.g. wooden
7. Joint
8. Adhesive mortar
9. Stone flooring

In case of ceramic and stone boards, the distribution of heating plates should already be adjusted to their size and arrangement at the design stage, so that the joints between the boards were located directly above the dilatation gap. Joints in those places must be made of permanently flexible material, which is resistant to elevated temperatures.

Pipes forming the heating loops cannot pass through any dilatation. Transit pipelines that supply individual coils, which have to cross the dilatation gap, should be protected from damage by placing them inside special dilatation profiles, which are made of tape of foamed PE, profiled rail and casing pipes of 40 cm length (the endings of those pipes should be protected against ingress of liquid screed).

Fig. 16. Dilatation profile - way of transit pipes arrangement through dilatation

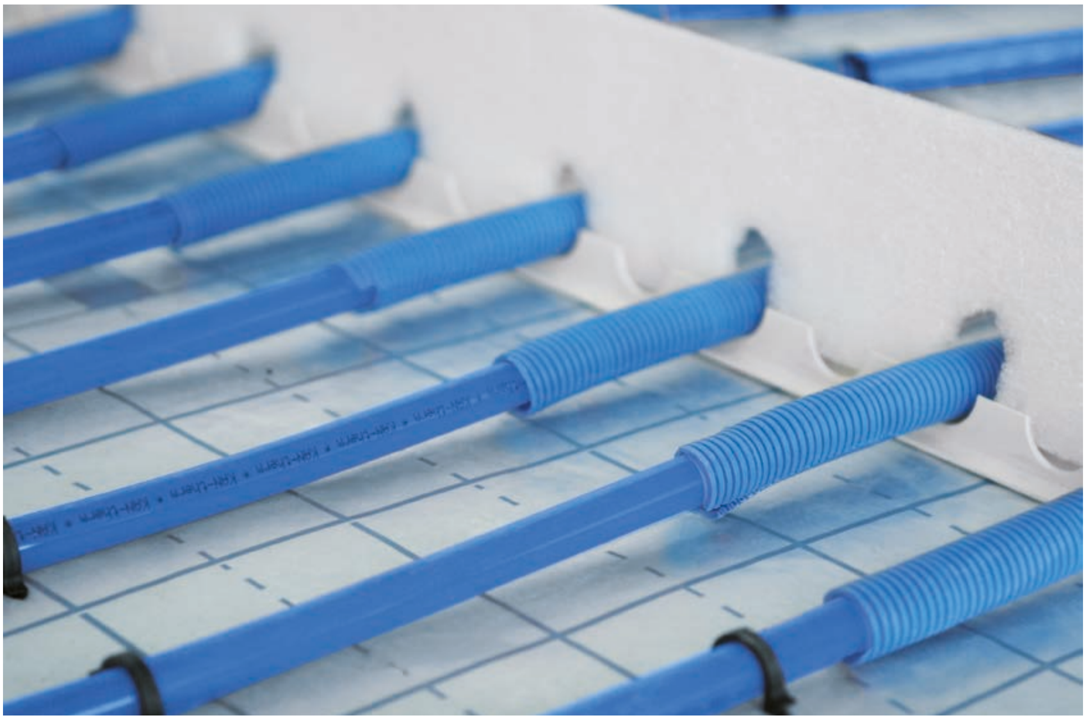


Fig. 17. Heating pipes dilatation in floor heating rules of performance

1. Wall dilatations - wall tape (edge) with apron
2. Boards dilatation - dilatation profile for transit pipes

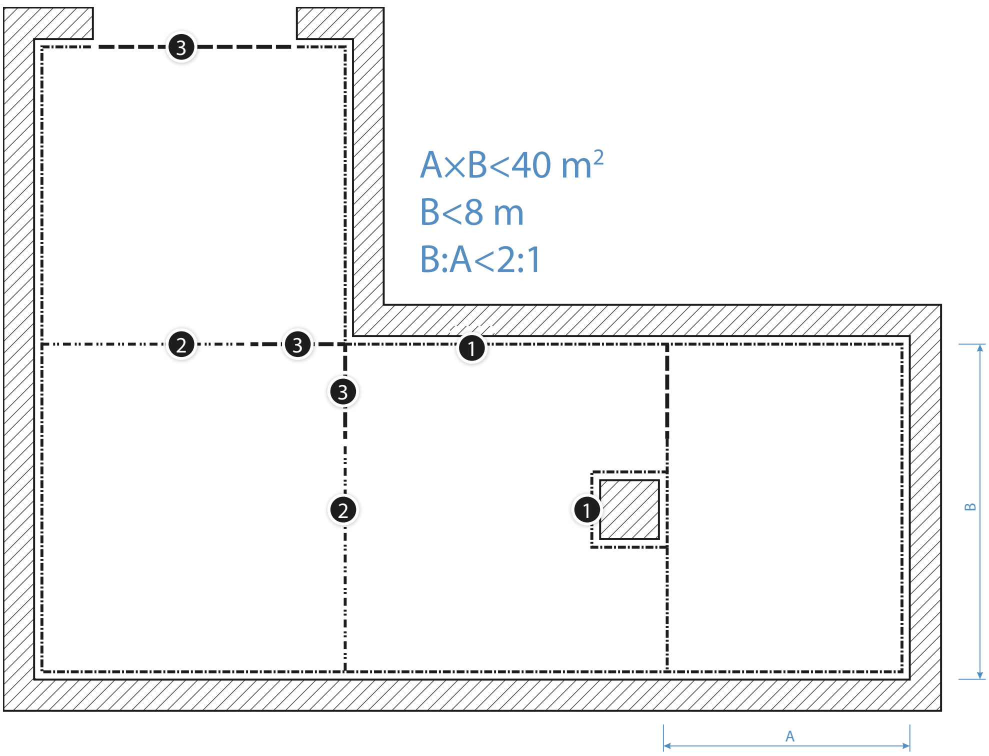
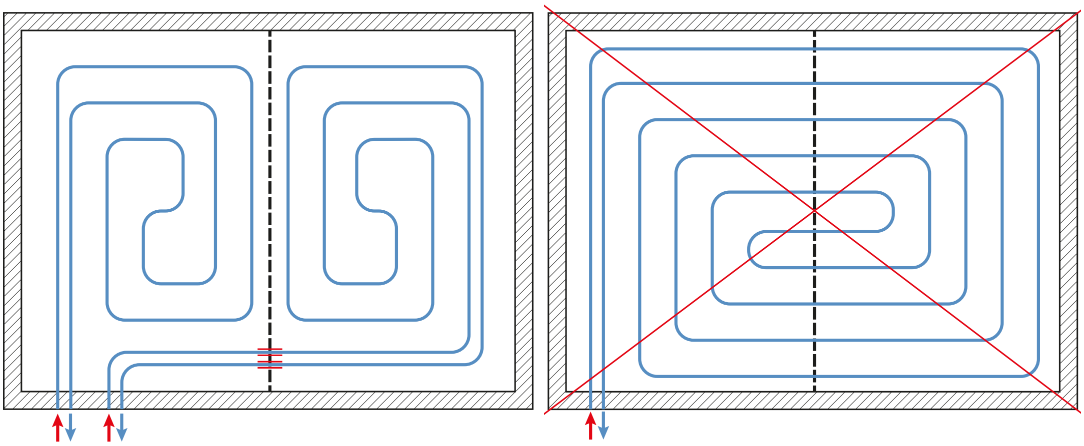


Fig. 18. Correct and incorrect distribution of heating field with a dilatation gap



2.4 Heating screeds

Screed has two functions in the surface heating/cooling: 1. is a construction element that takes on the mechanical stress, being a result of permissible loads and stresses, arising from thermal expansions (both screed and pipes) 2. serves as a layer that transfers heat or cooling to the room.

In the construction of floor heater type A (according to EN-PN 1264), performed using wet method, the screed is arranged in a plastic form (spout), based on cement or gypsum (anhydrite) mortar. In B type construction, the heating plate has a form of dry screed.

In both cases, the screed heating plate must be permanently separated from the building construction elements with a dilatation gap, forming the so called floating floor.

All types of screeds, used to perform flooring in the constructions, can be applied in floor heating. Regardless of the type of screed, every must have a proper thickness that guarantee the resistance to assumed mechanical loads, must feature low porosity and high thermal conductivity, as well as good plasticity during arrangement, which allows for a full contact of spout with heating pipes.

Arrangement and screed curing general requirements:

- in order to protect laid pipes from damage, traffic routes should be designated, by laying out gangplanks (e.g. made of wood planks).
- prior to the screed laying, perform coils pressure test, ended with a execution protocol and acceptance test (template **on page 104**),
- during screed laying, maintain pressure in pipes of min 3 bars (6 bars recommended),
- ensure that the room temperature is not lower than 5°C,
- protect against rapid change of environmental conditions (drafts, rain, sunlight),
- ensure the conditions for performing proper heating pipes dilatation, in accordance with rules described above,
- prior to the arrangement, ensure that the thermal insulation plates and dilatation protecting against liquid screed ingress are completely sealed.
- heating plate cannot have contact with building construction elements,
- ensure correct conditions for maintenance and annealing of the plate, in accordance with guidelines and procedures set forth in "Screed annealing and maintenance protocol",
- prior to the covering arrangement check the humidity of the screed (see section Floor coverings **on page 21**),
- in objects other than residential, of higher flooring permissible load, the type and thickness of screed must be agreed with the constructor of the building.

2.4.1 Cement screed

The consistency of cement screed while laying should be plastic. Ambient temperature cannot be lower than 5°C, and poured layer of screed should be seasoned for minimum 3 days in the minimum temperature of 5°C. For the next 7 days, the screed should be protected against rapid change of environmental conditions (draft, sunlight) and not burdened with heavy items.

For typical in residential constructions cement screeds of parameters: compressive strength 20 N/m^2 (class C20) and flexural strength 4 N/m^2 (class F4), the spout thickness, counted from the top of a pipe, should be less than 45 mm (approx. 65 mm from the top of thermal insulation).

It is allowed to use ready-made screeds, which are capable of producing spout of lesser thickness, while maintaining the above mentioned strength parameters, due to the application of special supplements (chemical substances or fibers).

When using ready-made or custom spouts, refer to manufacturer's recommendations.

While individually preparing a cement-based screed spout, a BETOKAN modifying admixture should be added to the cement mortar, to improve its properties through:

- reducing the amount of mixing water,
- increasing the plasticity of the mixture,
- improving screed's hydrophobicity,
- reducing the contraction of concrete board,
- improving screed's thermal conductivity by approx. 20%,
- increasing the strength of prepared board,
- reducing corrosivity in relation to steel.

Fig. 19. BETOKAN and BETOKANPlus modifying admixture

Due to the application of BETOKAN Plus admixture, it is possible to reduce the screed's thickness to 2.5 cm over the top of pipes (4.5 from the top of thermal insulation).

Note

Prior to the use of BETOKAN admixtures, read the terms of use and storage (on the packaging).

Preparing a standard screed spout of total thickness of 6.5 cm, using BETOKAN admixture

When the board is 6.5 cm thick, the average consumption of BETOKAN admixture is 1 kg per 5 m^2 of floor (3 - 3.5 kg per 1 m^3) of concrete.

Composition of cement mortar:

- CEM1 32.5 R cement (per PN-EN 197 – 1:2000) – 50 kg
- aggregate (60% sand of up to 4 mm granulation and 40% of gravel of 4 - 8 mm granulation) - 225 kg
- 16 - 18 litres of water,
- BETOKAN 0.6 kg (~1% weight of cement).

The sequence in which components should be added:

- aggregate (50 kg approx. 30 l) > cement (50 kg) > water (10 l) > BETOKAN (0.5 l) > aggregate (175 kg, approx. 110 l) > water (6 - 8 l)

Preparing a standard screed spout of total thickness of 4.5 cm, using BETOKAN Plus admixture

When the board is 4.5 cm thick, the average consumption of BETOKAN Plus admixture is 10 kg per 7.5 m^2 of floor (30 - 35 kg per 1 m^3) of concrete.

Composition of cement mortar:

- CEM1 32.5 R cement (per PN-EN 197 – 1:2000) – 50 kg
- aggregate (60% sand of up to 4 mm granulation and 40% of gravel of 4 - 8 mm granulation) - 225 kg
- 8 - 10 litres of water,
- BETOKAN Plus 5 kg (~10% weight of cement)

The sequence in which components should be added:

- aggregate (50 kg approx. 30 l) > cement (50 kg) > water (8 l) > BETOKAN (5 kg) > aggregate (175 kg, approx. 110 l) > water (6 - 8 l) (until consistency becomes plastic)

The bonding period of cement screed is 21 - 28 days, only after this time the heating can be started. Preliminary heating of screed is made when the medium temperature is approx. 20°C for 3 days, and then it is heated with maximum working temperature for the next 4 days. On thus prepared floor, ceramic and stone floor coverings can be laid.

If designed coverings (e.g. panels, parquets) require a low humidity of screed, it should be dried. The process can be started after 28 days since screed arrangement at the medium temperature of 25°C. Then, raise the temperature every 24 hours by o 10°C, until reaching temperature of 55°C. maintain this temperature until the flooring reaches the desired humidity.

Seasoning and annealing of screed should be performed in accordance with the procedure set forth in "Screed annealing and maintenance protocol".

2.4.2 Anhydrite screed (gypsum)

Anhydrite screed usually has a liquid consistency. During arrangement, the ambient temperature cannot be lower than 5°C, and poured layer of screed should be seasoned for minimum 2 days in the minimum temperature of 5°C. For the next 5 days, the screed should be protected against rapid change of environmental conditions (draft, sunlight) and not burdened with heavy items.

Gypsum screeds are sensitive to humidity, the spouts should be protected against it both during the seasoning and exploitation.

The arrangement and maintaining procedure of anhydrite screed should be performed strictly in accordance with mixture manufacturer recommendations.

2.4.3 Screed reinforcement

In typical applications (e.g. in residential construction) the reinforcement of floor screed layer is not necessary.

If higher permissible loads are expected, the screed of higher strength class should be applied (while also taking into account the thermal insulation mechanical properties).

The application of reinforcement in surface heating spouts does not significantly impact strength of the floor, it can, however, limit the contraction joints dimensions. Suitable fibers added to the mixture or fiberglass grid or steel wire may be applied for screed reinforcement. KAN offers a convenient fiberglass grid of 40 × 40 mm meshes. The grid should be arranged over the pipes in the upper part of screed layer. Reinforcement of the grid must be interrupted at the dilatation gaps zone.

2.5 Floor coverings in KAN-therm surface heating

In the KAN-therm surface heating/cooling System various types of floor coverings may be applied. But, due to their significant influence on surface heater thermal efficiency, the materials of low thermal resistance are preferred. It is assumed that this value (for covering and bonding layer) should not exceed $R = 0.15\ m^2 \times K/W$.

If at the design stage it is impossible to determine the type of covering, the value $R = 0.10\ m^2 \times K/W$ can be adopted for calculations.

Floor heating design must take into account the type of covering on the heating plate, as this layer determines the transfer of heat to the room and influences the temperature of floor surface.

Thermal efficiency for individual KAN-therm surface heating systems, which take into account the thermal resistance of coverings, are provided in separate charts, attached to the handbook.

Exemplary, indicative values of thermal conductivity resistances of various floor coverings materials.

Floor covering material	Heat conductivity λ [W/m × K]	Thickness [mm]	Heat conductivity resistance $R_{\lambda B}$ [m² K/W]
Ceramic tiles	1.05	6	0.0057
Marble	2.1	12	0.0057
Plates made of natural stone	1.2	12	0.010
Carpets	–	–	0.07 – 0.17
PVC floor lining	0.20	2.0	0.010
Mosaic parquet (oak)	0.21	8.0	0.038
Plank parquet (oak)	0.21	16.0	0.076
Laminate	0.17	9	0.053

For calculations, with sufficient precision, the following values of thermal resistance may be adopted (taking into account the bonding layer) $R_{\lambda B}$ [m² K/W]:

- ceramics, stone: 0.02,
- plastic coverings: 0.05,
- parquet of thickness up to 10 mm, carpet of thickness up to 6 mm: 0.10,
- parquet of thickness up to 15 mm, carpet of thickness up to 10 mm, floor panel with underlay: 0.15.

2.5.1 General requirements

All types of floor coverings and glues applied for laying those coverings of heating plates, cannot radiate harmful substances at elevated temperatures, for this reason they should have labelling, which authorise their use in floor heating. Those materials, especially glues, are exposed to high temperatures, which exceed 40°C at the level of glue layer.

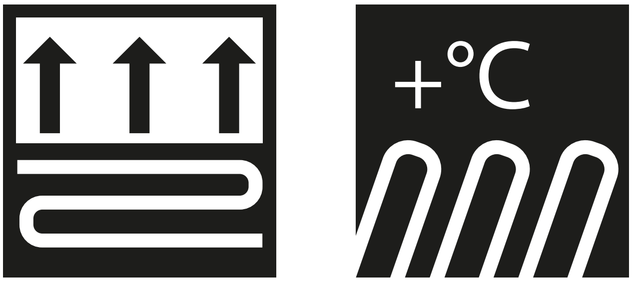


Fig. 20. Example of materials applied in floor heating labelling.

All coatings, and especially flexible plastic coverings, should be precisely glued on the whole surface, without bubbles, which unnecessarily increase covering's thermal resistance.

It is possible to lay coverings not bonded with the substrate (e.g. floor panels), but only if special floor heating substrates are applied.

Laying of external floor layer can be performed after pre-annealing of screed, at the flooring temperature of 18 - 20°C. Prior to the arrangement the humidity of the substrate should be verified. Maximum moisture content in heating screeds prior to the floor covering laying is presented in the table below. Laying of floor coverings should be performed in accordance with flooring manufacturers recommendations.

2.5.2 Ceramic and stone coverings

Glue mortars and joints, due to the differences in covering and substrate elongation, must have proper durability and elasticity. Boards joints should overlap dilatation gaps of heating fields.

2.5.3 Carpets

Carpets require higher supply temperatures. If they have the manufacturer's certification, they can be applied in floor heating. They should be sticked to the substrate along the whole surface.

2.5.4 Wooden coverings

The humidity of parquet or mosaic during laying cannot be higher than 8 - 9%. The parquet should be laid on the screed of temperature in the range of 15 – 18°C. The recommended maximum operation temperature of surface is 29°C, avoid laying parquet on thickened edge zones.

Maximum permissible moisture content in heating screeds [%]

Type of floor covering	Cement screed	Anhydrite screed
textile and elastic coverings	1.8	0.3
wooden parquet	1.8	0.3
laminated floors	1.8	0.3
ceramic tiles or natural stone and concrete products	2.0	0.3

The measurement of substrate humidity should be performed in 3 places minimum (per room or every 200 m^2).

3 KAN-therm surface heating systems

3.1 System KAN-therm Tacker

The design of surface heater composed of KAN-Therm Tacker boards is classified (according to PN-EN 1264 standard nomenclature) as type A, performed using the wet method. Heating pipes should be fixed to the insulation with plastic clips, using a special tool, so called Tacker (KAN-therm Tacker System), and then inundated with liquid screed. After binding period, followed by annealing, the floor is laid on the screed.

Application

- Floor heating in residential and general construction.

Advantages

- quick assembly using the Tacker tool,
- wide variety of thermal insulation boards,
- the possibility of mounting pipes with any spacing and in various configurations (series pattern and spiral pattern),
- manual and mechanical heating pipes mounting,
- the possibility of application for floors exposed to considerable permissible loads.

KAN-therm thermal insulations in surface heating / cooling

KAN-therm TACKER

Insulation hickness [mm]	EPS 100			EPS 200	EPS T-30
	20	30	50	30	30/32
Useful dimensions width × length [mm]	1 000 × 5 000	1 000 × 5 000	1 000 × 5 000	1 000 × 5 000	1 000 × 5 000
Usable area [m²/roll]	5	5	5	5	5
Thermal conductivity coefficient λ [W/(m × K)]	0.038	0.038	0.038	0.036	0.045
Thermal resistance R_λ [m²K/W]	0.53	0.79	1.32	0.83	0.67
Sound attenuation dB	—	—	—	—	29
Max load kg/m² (kN/m²)	3000	3000	3000	6000	400

KAN-therm Tacker system – minimum requirement for insulation thickness according to PN-EN 1264

System insulation A thickness	Supplementary insulation B thickness	Total insulation resistance R[m²K/W]	Total insulation thickness C [mm]
Required insulation thickness above the heated room R_λ=0.75 [m²K/W] Fig. 21 or Fig. 22			
Tacker EPS100 30 mm	—	0.79	30
Tacker EPS200 30 mm	—	0.83	30
Tacker EPS100 20 mm	styrofoam EPS100 20 mm	1.04	40
Required insulation thickness above the room heated to lower temperature, as well as above the room, which is not heated or a room placed on the ground R_λ=1.25 [m²K/W] Fig. 22 or Fig. 23			
Tacker EPS100 50 mm	—	1.32	50
Tacker EPS100 30 mm	styrofoam EPS100 20 mm	1.32	50
Tacker EPS100 20 mm	styrofoam EPS100 40 mm	1.58	60

System insulation A thickness	Supplementary insulation B thickness	Total insulation resistance R[m²K/W]	Total insulation thickness C [mm]
Tacker EPS200 30 mm	styrofoam EPS100 20 mm	1.30	50
Required insulation thickness for floor in contact with the outside air (Tz ≥ 0°C) Rλ=1.25 [m²K/W] (Fig. 22)			
Tacker EPS100 50 mm	—	1.32	50
Tacker EPS100 30 mm	styrofoam EPS100 20 mm	1.32	50
Tacker EPS100 20 mm	styrofoam EPS100 40 mm	1.58	60
Tacker EPS200 30 mm	styrofoam EPS100 20 mm	1.36	50
Required insulation thickness for floor in contact with the outside air (0°C > Tz ≥ -5°C) Rλ=1.50 [m²K/W] (Fig. 22)			
Tacker EPS100 50 mm	—	1.32	50
Tacker EPS100 30 mm	styrofoam EPS100 20 mm	1.32	50
Tacker EPS100 20 mm	styrofoam EPS100 40 mm	1.58	60
Tacker EPS200 30 mm	styrofoam EPS100 20 mm	1.36	50
Tacker EPS200 30 mm	styrofoam EPS100 40 mm	1.88	60
Required insulation thickness for floor in contact with the outside air (-5°C ≥ Tz ≥ -15°C) R_λ=2.00 [m²K/W] (Fig. 22)			
Tacker EPS100 50 mm	styrofoam EPS100 30 mm	2.11	80
Tacker EPS100 30 mm	styrofoam EPS100 50 mm	2.11	80
Tacker EPS100 20 mm	styrofoam EPS100 70 mm	2.37	90
Tacker EPS200 30 mm	styrofoam EPS100 50 mm	2.15	80

Note

PN-EN 1264 provides minimum requirements for thermal insulation thickness. In addition it is based on ambient temperature range -5°C ≥ Tz ≥ -15°C, while for the climate conditions in Poland, depending on climatic zone, ambient temperature falls within the range between -16°C and -24°C.

Therefore, in order to ensure energy efficiency conditions that provide for the requirements of the Ordinance of the Minister of Infrastructure dated 6 November 2008 on the technical conditions to be met by buildings and their location (Journal of Laws No. 201, item 1238: 2008), standard requirements must be extrapolated.

3.1.1 Elements of KAN-therm Tacker System floor heater

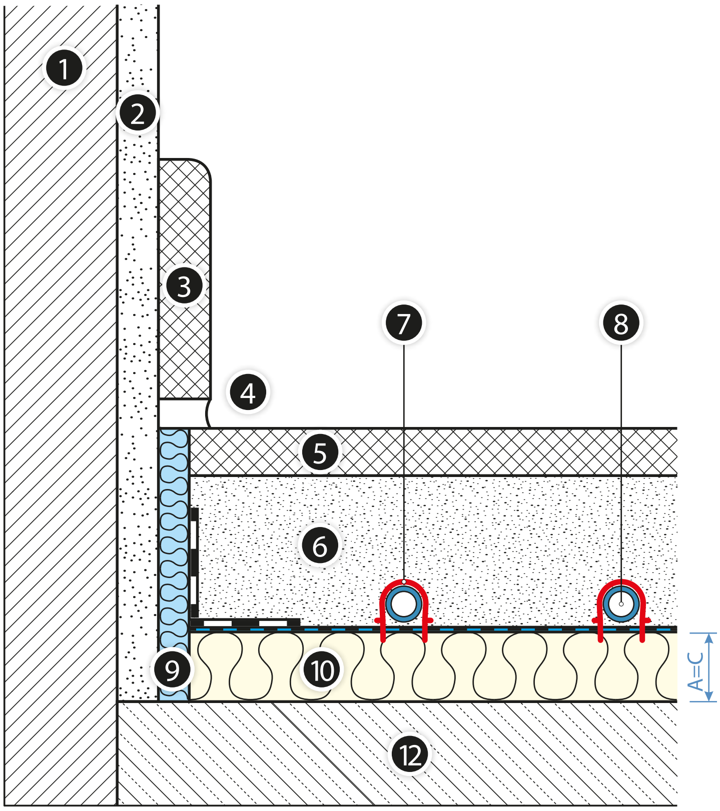


Fig. 21. Floor heater with KAN-therm Tacker System board on the ceiling above an internal room

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Screed
7. Pipe clip
8. KAN-therm heating pipe
9. Wall tape with PE protective apron
10. KAN-therm Tacker System board of thickness A with raster foil
11. Supplementary board of thickness B
12. Concrete ceiling

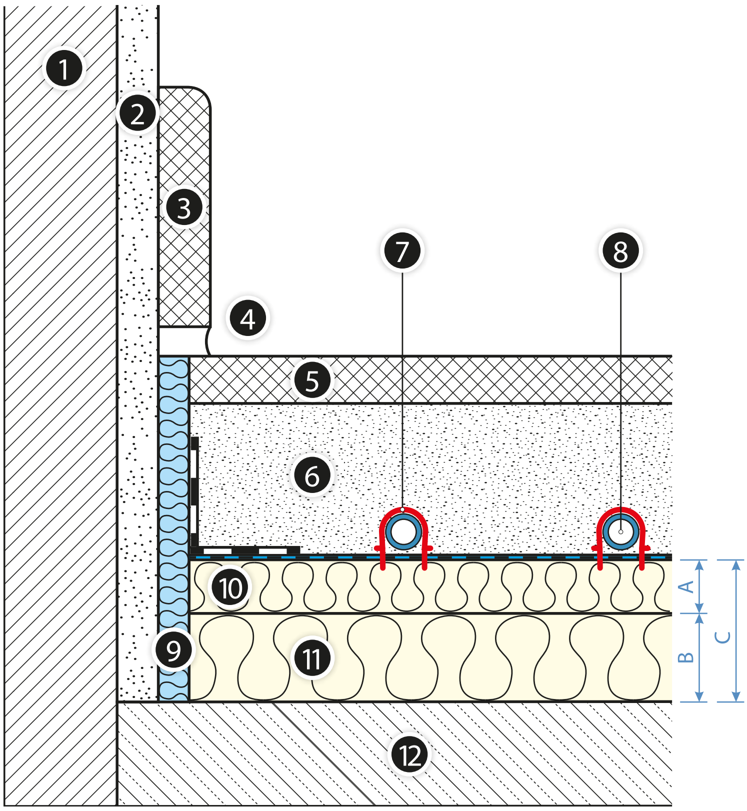
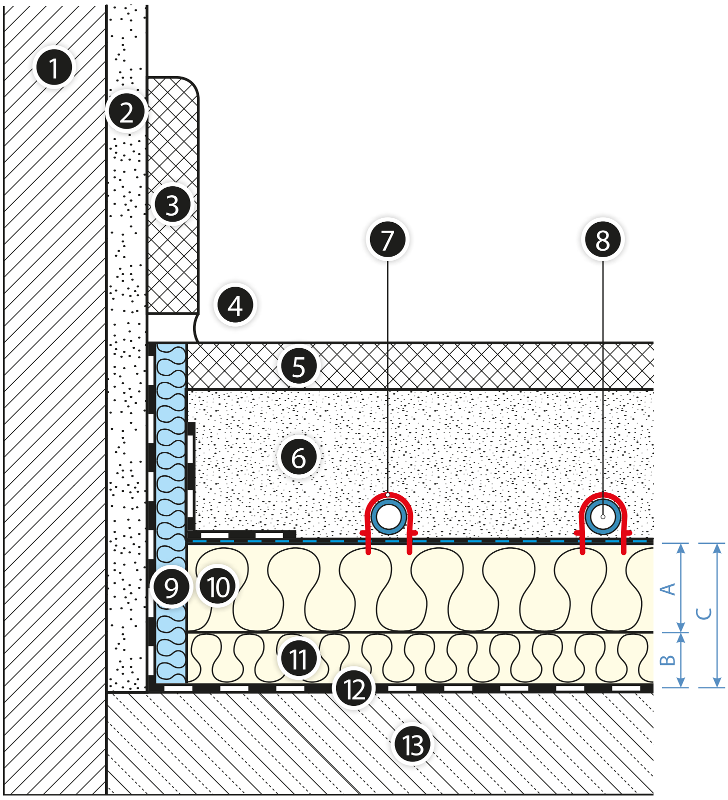


Fig. 22. Floor heater with KAN-therm Tacker System board and supplementary insulation on the ceiling above internal not heated room and on the ceiling in contact with outside air

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Screed
7. Pipe clip
8. KAN-therm heating pipe
9. Wall tape with PE protective apron
10. KAN-therm Tacker System board of thickness A with raster foil
11. Supplementary board of thickness B
12. Concrete ceiling

Fig. 23. Floor heater with KAN-therm Tacker System board and supplementary insulation and damp-proof coating on the ceiling laid out on the ground

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Screed
7. Pipe clip
8. KAN-therm heating pipe
9. Wall tape with PE protective apron
10. KAN-therm Tacker System board of thickness A with raster foil
11. Supplementary board of thickness B
12. Damp insulation (only at the ground!)
13. Concrete ceiling



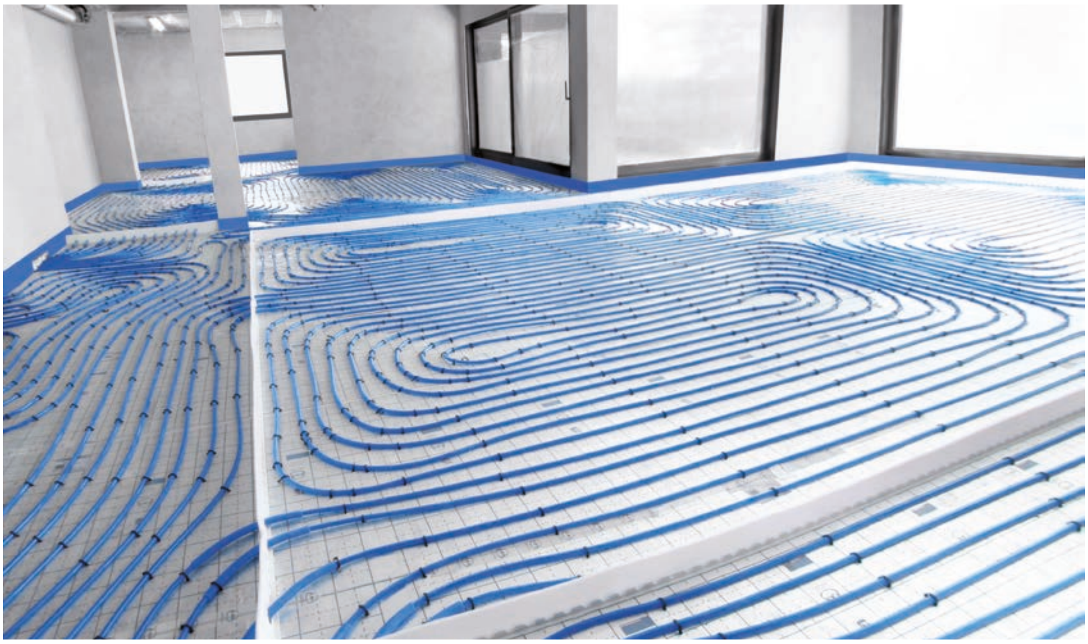
- wall tape of foamed PE, with foil apron, dimensions 8 × 150 mm,
- styrofoam board with KAN-therm Tacker EPS 100 metallised or laminated foil (20, 30 and 50 mm thickness),
- styrofoam board with KAN-therm Tacker EPS 200 metallised foil (30 mm thickness),
- styrofoam board with KAN-therm Tacker EPS T-30 metallised foil (soundproof, 35-3 mm thickness),
- additional thermal insulation in the form of ESP100 styrofoam boards, of 20, 30, 40 and 50 mm thickness,
- clips for mounting pipes of 14-20 mm diameter,
- adhesive tape,
- KAN-therm System PE-Xc and PE-RT heating pipes with diffusion barrier of 16×2, 18×2 and 20×2 diameter or KAN-therm System PE-RT/Al/PE-RT heating pipes of 14×2, 16×2 and 20×2 diameter,
- screed BETOKAN supplement.

Approximate unit consumption of materials [quantity/ m^2]

Item designation	unit	The amounts at pipe spacing [cm]				
		10	15	20	25	30
KAN-therm heating pipes	unit	10	6,3	5	4	3.3
Pipe clip	m	17	12	11	9	8
Adhesive tape	units	1	1	1	1	1
Tacker system insulation	m	1	1	1	1	1
Supplementary insulation (if present)	m^2	1	1	1	1	1
Wall tape 8×150 mm	m^2	1.2	1.2	1.2	1.2	1.2
BETOKAN supplement (at 6.5 cm screed)	kg	0.2	0.2	0.2	0.2	0.2

Tables for thermal calculation of floor heating performed in KAN-therm Tacker System are provided in separate charts, attached to this handbook.

Fig. 24. KAN-therm Tacker System floor heating



3.1.2 Assembly guidelines

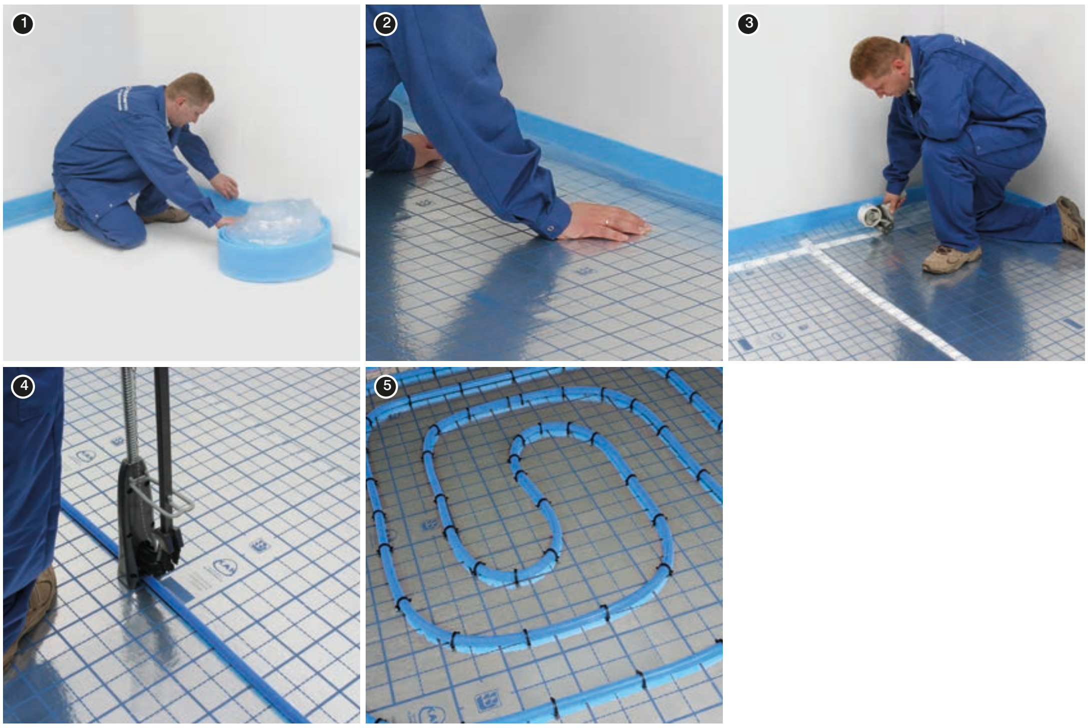
3.1.2.1 General requirements

Laying of floor heating should be preceded by window and door frames mounting and completion of plastering. Works should be performed in the temperature above +5 °C. If the floor is laid on the surface laying on the ground, the damp insulation should be executed prior to the laying of acoustic and thermal insulation.

The surface must be dry, clear, flat and even, in order to lay the system boards. Impurities should be removed and the discrepancy of levels compensated if necessary (with filler or levelling mortar). The acceptable tolerance of the support substrate unevenness for the floor heating installation is:

Distance between measuring points [m]	Surface unevenness [mm]	
	Wet system	Dry system
0.1	5	2
1	8	4
4	12	10
10	15	12
15	20	15

3.1.2.2 Assembly stages



1. Assemble the installation cabinet and heating loop manifold.

2. Expand the wall tape with a plastic apron along the walls, columns, frames, etc.(1)

3. If required, lay the acoustic insulation (does not apply to Tacker EPS T-30 boards) or additional thermal insulation on the whole surface.

   Expand the roll of KAN-therm Tacker thermal insulation with metallised or laminated foil along the wall. Subsequent strips on insulation should be laid abut expounding the protruding tabs of foil on adjacent plates. The adjacent insulation strips must be consistent with the grid lines. Contact points of all edges must be sealed with an adhesive tape as the laying of subsequent strips progresses.

   The surfaces in cavities, frames should be complemented with the unused portions of the rolls (while sealing the contact edges with a tape). Lay the PE foil apron fixed to the wall tape on the Tacker boards and seal it with an adhesive tape.

4. Proceed to the laying of heating pipes on the insulation, starting from the manifold. The assembly must be performed by two persons. Pipes can be laid in any configuration (series pattern and spiral pattern) with a spacing of 10–30 cm and increment of 5 cm, using the printing on the foil, in order to arrange them evenly. While changing direction be aware of the permissible bending radius of the pipe.

   Pipes are mounted to the insulation with plastic clips either manually or by using the tool - tacker, which significantly quickens the work.

   Pipes on the approach to the manifold must be arranged in plastic curves. To avoid the over-heating of screed at pipes congestion (close to the manifold), arrange them in casing pipes or thermal insulation.

   If the partition of hotplates with dilatation is necessary, a dilatation profile with an adhesive flange should be mounted at the line of separation. The transit pipes passing through the profile should be arranged in protective sleeves of approximate length of 40 cm.

5. Perform a pressure test of arranged coils leakage in accordance with the rules applicable for the surface heating (see section Acceptance forms). After the test, leave the pipes under pressure (min 3 bars).

   Cover the surface with arranged pipes with screed of thickness and parameters provided in the project. After screed binding proceed to screed curing (annealing) in accordance with the procedure described in the Acceptance forms section, and then, after verifying the humidity of the screed, begin the arrangement of floor lining.

3.2 KAN-therm Rail System

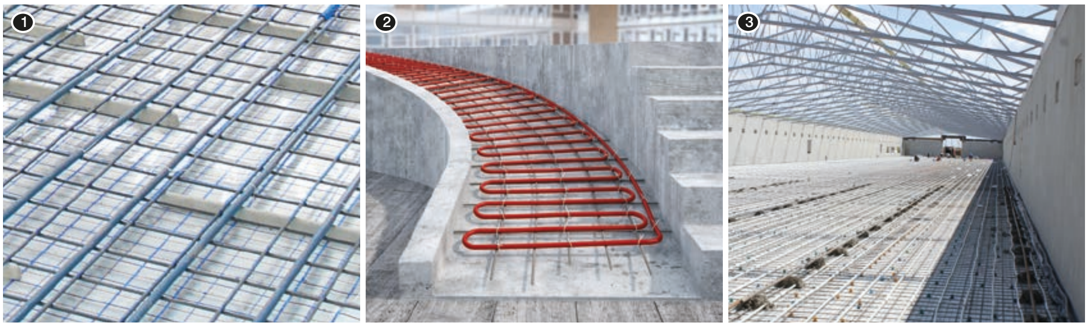
In case of heating/cooling board performance with wet method (type A), the only difference between the KAN-therm Rail System and the KAN-therm Tacker System is the method of attaching pipes to the thermal insulation. Heating pipes are arranged on the thermal insulation in Rail plastic strips, mounted to the insulation by means of metal pins, expansion plugs or adhesive type, constituting the structure of the strip.

The KAN-therm Rail pipe assembly system is also applicable in:

- the constructions of surface heating performed using dry method with an air gap, for example floor heating systems laid on joists. See section "Sports floor heating in KAN-therm System",
- the constructions of wall heating/cooling performed using wet method (strips for pipes of 12 and 14 mm diameter). See section "Wall heating and cooling in KAN-therm System",
- outdoor surfaces heating systems, for example turf of playing fields (strips for pipes of 18, 20 and 25 mm diameter). See section "Open surfaces heating in KAN-therm System".

! **System elements - section "Pipe assembly systems in KAN-therm surface heating/cooling"**

3.3 KAN-therm NET System



KAN-therm NET is a system of heating pipes mounting on various types of surfaces (on thermal insulation, on the ground, on concrete base). The design of surface heater (or cooler) may differ depending on the applied thermal insulation (or lack thereof) and on the type and thickness of layers over the pipes.

Heating pipes are mounted on the laid on the insulation mat (grid), made of 3 mm wire with a mesh of 150×150 mm, using plastic bands or holders (clips) placed on the grid.

The wire grid can be arranged on the KAN-therm Tacker System styrofoam boards or standard EPS styrofoam boards with an unfolded PE damp-proof foil, fixed to the boards by means of plastic plugs. KAN-therm NET System may be applied for mounting of pipes in the monolithic constructions, for example thermo-active ceilings, and for arranging pipes in the outdoor surface heating systems, for example traffic routes.

Elements of the system are presented in section “Pipe assembly systems in KAN-therm surface heating/cooling”

3.4 KAN-therm Profil System

The construction of surface heater composed of KAN-therm Profil System boards may be classified as type A, performed using wet method, according to the PN-EN 1264 standard nomenclature. Heating pipes are placed, by pressing, between special tabs, profiled on the thermal insulation (styrofoam).

Application

- Floor heating in residential and general construction.

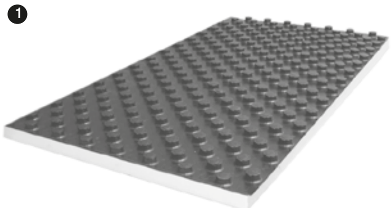
Advantages

- fast assembly due to easy fixing of heating pipes, as well as simple system boards arrangement,
- lesser consumption of screed,
- the possibility of mounting pipes with any spacing and in various configurations (series pattern and spiral pattern),
- secure mounting of heating pipes,
- the possibility of application in floors exposed to considerable permissible loads.

Thermal insulation technical specifications

	KAN-therm Profil System			
Thickness [mm]	Profil2 EPS 200 with PS foil	Profil4 EPS 200 without foil	Profil3 only profiled PS foil	Profil1 EPS T-24 with PS foil
	11	20	1	30–2
Overall thickness [mm]	31	47	20	50
Dimensions width × length [mm]	850×1450	1120×720	850×1450	850×1450
Useful dimensions width × length [mm]	800×1400	1100×700	800×1400	800×1400
Usable area [m²/board]	1.12	0.77	1.12	1.12
Thermal conductivity coefficient λ [W/(m × K)]	0.036	0.036	—	0.040
Thermal resistance R_λ [m²K/W]	0.31	0.56	—	0.75
Sound attenuation dB	—	—	—	28
Max load kg/m kg/m² (kN/m²) option	6000 (6)	6000 (6)	—	500 (5)

1. Profil1
2. Profil2
3. Profil3
4. Profil4

1


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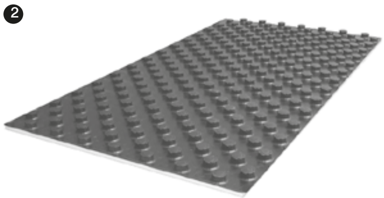

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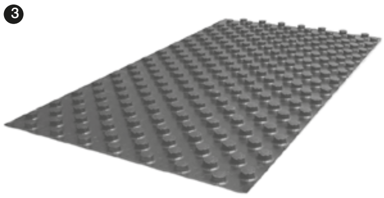


4


KAN-therm Profil system – minimum requirement for insulation thickness according to PN-EN 1264

System insulation A/Ac* thickness	Supplementary insulation B thickness	Total insulation resistance R[m²K/W]	Total insulation thickness C [mm]
Required insulation thickness above the heated room R_λ=0.75 [m²K/W] (Fig. 25 or Fig. 26)			
Profil1 30/50 mm	—	0.75	30
Profil2 11/31 mm	styrofoam EPS100 20 mm	0.84	31
Profil4 20/47 mm	styrofoam EPS100 20 mm	1.09	40
Profil3 0/20	styrofoam EPS100 30 mm	0.79	30
Required insulation thickness above the room heated to lower temperature, as well as above the room, which is not heated or a room placed on the ground R_λ=1.25 [m²K/W] (Fig. 25 or Fig. 26)			
Profil1 30/50 mm	styrofoam EPS100 20 mm	1.28	50
Profil2 11/31 mm	styrofoam EPS100 40 mm	1.36	51
Profil4 20/47 mm	styrofoam EPS100 30 mm	1.35	50
Profil3 0/20	styrofoam EPS100 50 mm	1.32	50
Required insulation thickness for floor in contact with the outside air (Tz ≥ 0°C) R_λ=1.25 [m²K/W] (Fig. 26)			
Profil1 30/50 mm	styrofoam EPS100 20 mm	1.28	50
Profil2 11/31 mm	styrofoam EPS100 40 mm	1.36	51
Profil4 20/47 mm	styrofoam EPS100 30 mm	1.35	50
Profil3 0/20	styrofoam EPS100 50 mm	1.32	50
Required insulation thickness for floor in contact with the outside air (0°C > Tz ≥? -5°C) R_λ=1.50 [m²K/W] (Fig. 26)			
Profil1 30/50 mm	styrofoam EPS100 30 mm	1.54	60
Profil2 11/31 mm	styrofoam EPS100 50 mm	1.63	61
Profil4 20/47 mm	styrofoam EPS100 40 mm	1.61	60
Profil3 0/20 mm	styrofoam EPS100 60 mm	1.58	80
Required insulation thickness for floor in contact with the outside air (-5°C ≥ Tz ≥ -15°C) R_λ=2.00 [m²K/W] (Fig. 26)			
Profil1 30/50 mm	styrofoam EPS100 50 mm	2.07	80
Profil2 11/31 mm	styrofoam EPS100 70 mm	2.15	81
Profil4 20/47 mm	styrofoam EPS100 60 mm	2.14	80
Profil3 0/20 mm	styrofoam EPS100 80 mm	2.11	100

*Ac – total height of insulation system

Note

PN-EN 1264 provides minimum requirements for thermal insulation thickness. In addition it is based on ambient temperature range -5°C ≥ Tz ≥ -15°C, while for the climate conditions in Poland, depending on climatic zone, ambient temperature falls within the range between -16°C and -24°C.

Therefore, in order to ensure energy efficiency conditions that provide for the requirements of the Ordinance of the Minister of Infrastructure dated 6 November 2008 on the technical conditions to be met by buildings and their location (Journal of Laws No. 201, item 1238: 2008), standard requirements must be extrapolated.

Fig. 25. Floor heater with KAN-therm Profil System board on the ceiling above an internal room

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Screed
7. KAN-therm heating pipe
8. Wall tape with PE protective apron
9. KAN-therm Profil System board of insulation thickness A and total height Ac
10. Supplementary board of thickness B
11. Concrete ceiling

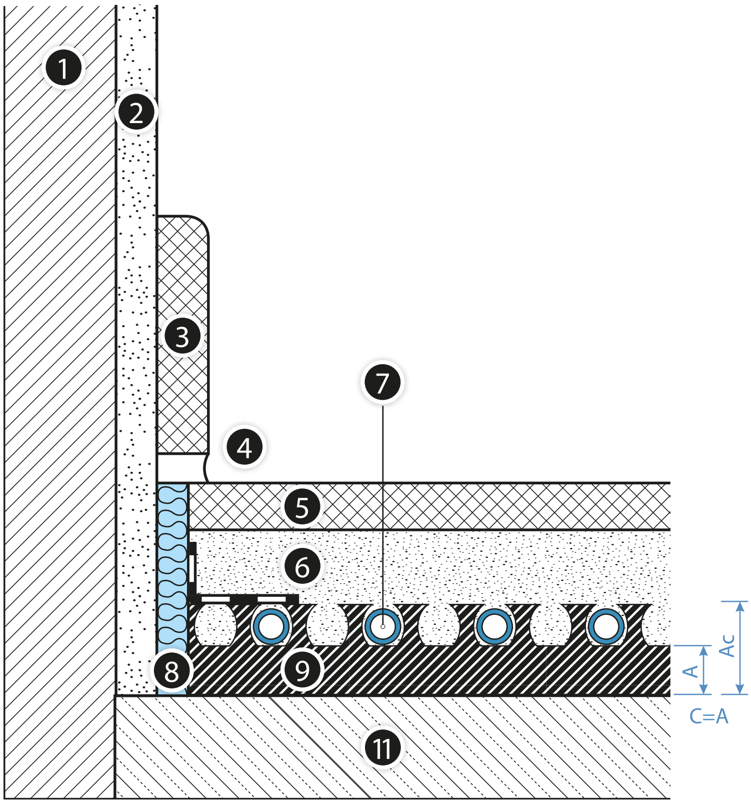


Fig. 26. Floor heater with KAN-therm Profil System board and supplementary insulation on the ceiling above internal not heated room and on the ceiling in contact with outside air

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Screed
7. KAN-therm heating pipe
8. Wall tape with PE protective apron
9. KAN-therm Profil System board of insulation thickness A and total height Ac
10. Supplementary board of thickness B
11. Concrete ceiling

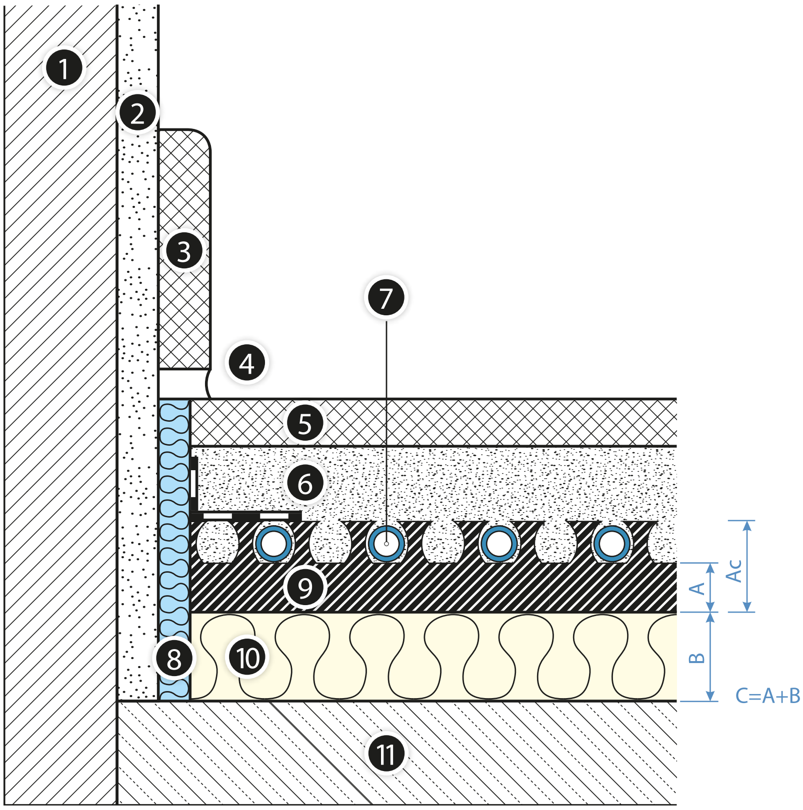


Fig. 27. Floor heater with KAN-therm Profil3 System board and supplementary insulation on the ceiling above the internal not heated room and on the ceiling laid out on the ground (damp insulation required!)

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Screed
7. KAN-therm heating pipe
8. Wall tape with PE protective apron
9. KAN-therm Profil System board of insulation thickness A and total height Ac
10. Supplementary board of thickness B
11. Concrete ceiling

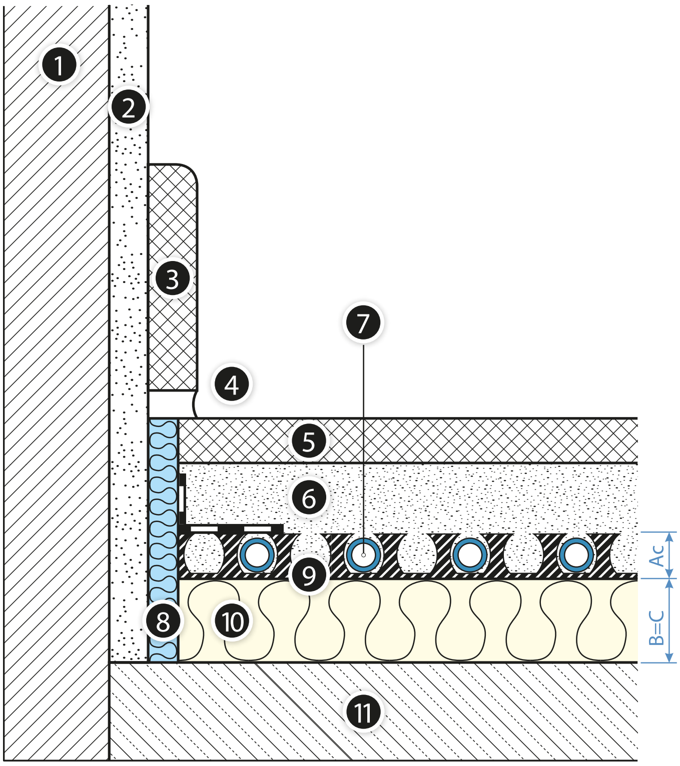
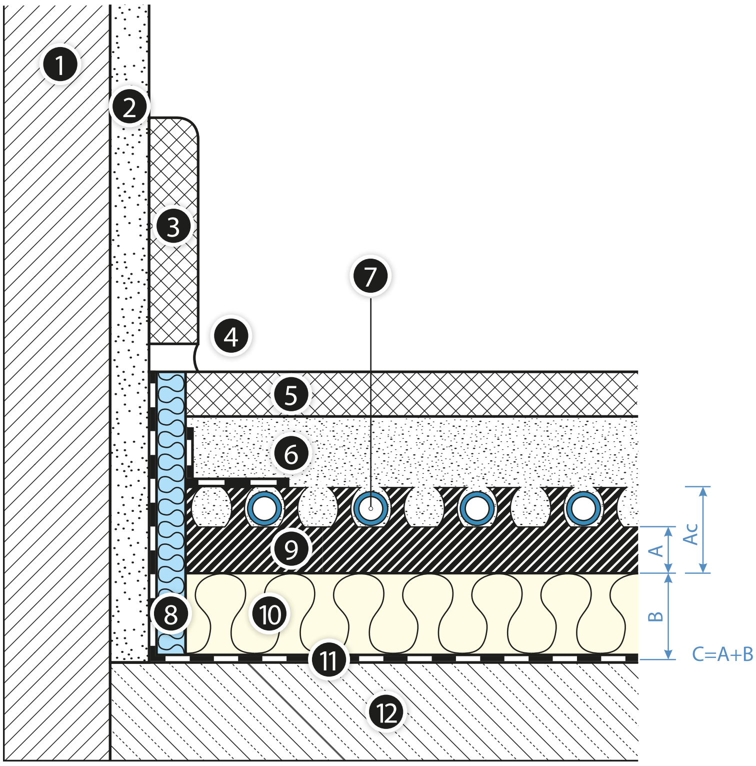


Fig. 28. Floor heater with KAN-therm Profil System board and supplementary insulation and damp-proof coating on the ceiling laid out on the ground

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Screed
7. KAN-therm heating pipe
8. Wall tape with PE protective apron
9. KAN-therm Profil System board of insulation thickness A and total height Ac
10. Supplementary board of thickness B
11. Damp insulation (only at the ground!)
12. Concrete ceiling



3.4.1 Elements of KAN-therm Profil System floor heater

- wall tape of foamed PE, with foil apron, dimensions 8 × 150 mm,
- Profil1 30mm - profiled EPS T-24 styrofoam board, with PS foil and tabs, dimensions 0.8 × 1.4 m,
- Profil2 11mm - profiled EPS200 styrofoam board, with PS foil and tabs, dimensions 0.8 × 1.4 m,
- Profil4 20mm - profiled EPS200 styrofoam board, with tabs, dimensions 1.1 × 0.7 m,

- Profil3 - profiled mat made of PS foil, with tabs, dimensions 0.8 × 1.4 m,
- additional EPS100 thermal insulation of 20, 30, 40 or 50 mm thickness,
- KAN-therm System PE-Xc and PE-RT heating pipes with diffusion barrier, of 16×2 and 18×2 diameter or KAN-therm System PE-RT/Al/PE-RT heating pipes of 16×2 diameter,
- screed BETOKAN supplement.

Approximate unit consumption of materials [quantity/ m²]

KAN-therm Profil System

Item designation	unit	The amounts at pipe spacing [cm]				
		10	15	20	25	30
KAN-therm heating pipes	m	10	6,3	5	4	3.3
Prifil system insulation	m²	1	1	1	1	1
Supplementary insulation (if present)	m²	1	1	1	1	1
Wall tape 8×150 mm	m	1.2	1.2	1.2	1.2	1.2
BETOKAN supplement (at 6.5 cm screed)	kg	0.2	0.2	0.2	0.2	0.2

3.4.2 Assembly guidelines

3.4.2.1 General requirements

Floor heating mounting should be preceded by window and door frames mounting and completion of plastering. Works should be performed in the temperature above +5°C.

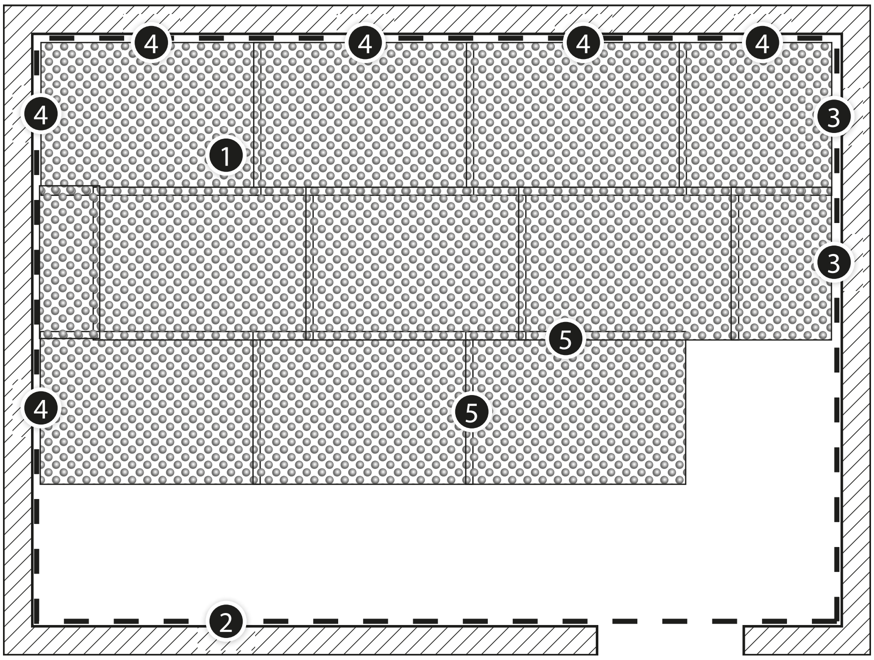
The surface must be dry, clear, flat and even, in order to lay the system boards. Impurities should be removed and the discrepancy of levels compensated if necessary (with filler or levelling mortar). The acceptable tolerance of the support substrate unevenness for the floor heating installation is:

Distance between measuring points [m]	Surface unevenness [mm]	
	Wet system	Dry system
0.1	5	2
1	8	4
4	12	10
10	15	12
15	20	15

3.4.2.2 Assembly stages

1. Mount the installation cabinet and heating loop manifold.
2. Expand the wall tape with a plastic apron along the walls, columns, frames, etc.(A)1.
3. If required, lay the acoustic insulation (does not apply to Profil 1 boards) or additional thermal insulation on the whole surface.
4. Begin the arrangement of system boards from the corner of the room. After cutting the overlaps of PS foil on the shorter and longer side, arrange system boards so to arrange their longer side along the longer wall, while applying the overlap on the first row of tabs of the preceding board. If the last board of the first strip shall be too long, it should be cut, same for the fold from the side of a wall. The remaining segment of the cut board should be used as an initial one in the subsequent row. Arrange all boards in the room in such a manner. (B).

1. KAN-therm Profil System board
2. Wall tape
3. Board cut
4. Foil overlap cutting
5. Connecting boards of foil overlaps



5 If the partition of hotplates with a dilatation is necessary, a dilatation profile with an adhesive flange should be mounted at the line of separation. The transit pipes passing through the profile should be arranged in protective sleeves of approximate length of 40 cm.

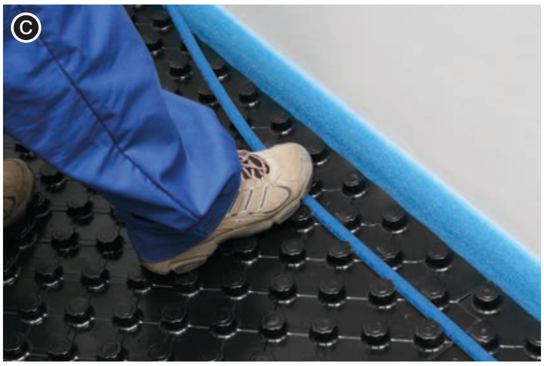
6 Put the foil wall tape apron on the arranged boards. Protect against an ingress of liquid screed between the boards and tape by pressing the apron with a round rope made of polyethylene foam, pressed linearly into extreme tabs of the boards.

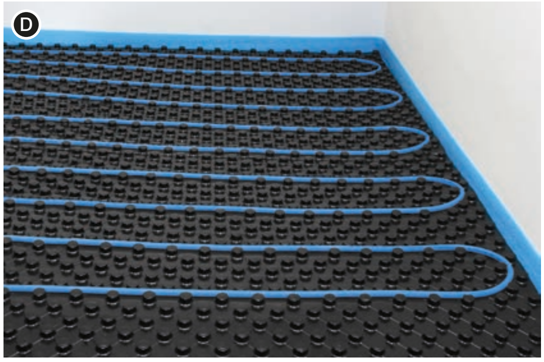
7 Connect the heating pipe to the manifold. While maintaining the designed spacing (10-30 with increment of 5 cm) and configuration (series pattern and spiral pattern), lay the pipe on the boards, by pressing it between the tabs with leg. While changing direction be aware of the permissible bending radius of the pipe.

Pipes on the approach to the manifold must be arranged in plastic profiling curves. To avoid the overheating of screed at pipes congestion (close to the manifold), arrange them in casing pipes or thermal insulation.

5 Perform a pressure test of arranged coils leakage in accordance with the rules applicable for the surface heating (see section Acceptance forms). After the test, leave the pipes under pressure.

9 Cover the so prepared surface with screed of thickness and parameters provided in the project. After screed binding proceed to screed curing (annealing) in accordance with the procedure described in the Acceptance forms section.





Tables for thermal calculation of floor heating performed in KAN-therm Profil System are provided in separate charts, attached to this handbook.

3.5 KAN-therm TBS System

Water floor heating based on the KAN-therm TBS System boards are a part of floor construction in dry system, classified according to PN-EN 1264 standard as construction type B. The heating pipes are placed in profiled, grooved styrofoam boards, and then covered with boards of dry screed of thickness depending on designed permissible load of floor surface. The heat from the heating pipes is evenly radiated to the dry screed boards through steel radiating lamellae, placed in the boards channels.

Application

- Wall and floor heating in residential and general construction.
- Wall and floor heating in renovated objects.

KAN-therm TBS System properties:

- low rise of installation,
- lightweight of the construction, which allows the mounting on ceilings with a low carrying capacity, wooden ceilings,
- fast mounting, which is a result of arrangement method and no need for screed curing,
- immediate readiness for work after the arrangement,
- possibility to apply in existing buildings and renovations,
- possibility to apply in sport facilities, in order to heat floors with point elasticity.

Technical specifications of KAN-therm TBS System thermal insulation

	TBS 16 EPS 200	TBS 14 EPS 200
Pipe spacing [mm]	167, 250, 333	125, 250, 375
Thickness [mm]		
Overall thickness [mm]	25	25
Useful dimensions width x length [mm]	500×1000	625×1000
Usable area [m²/board]	0.5	0.625
Thermal conductivity coefficient λ [W/(m × K)]	0.036	0.036
Thermal resistance R_λ [m²K/W]	0.69	0.69

KAN-therm Profil system – minimum requirement for insulation thickness according to PN-EN 1264

System insulation A/Ac* thickness	Supplementary insulation B thickness	Total insulation resistance R[m²K/W]	Total insulation thickness C [mm]
Required insulation thickness above the heated room RR$_\lambda$=0.75 [m²K/W] (pic.1)			
TBS 25 mm	styrofoam EPS100 20 mm	1.22	45
Required insulation thickness above the room heated to lower temperature, as well as above the room, which is not heated or a room placed on the ground R$_\lambda$=1.25 [m²K/W] (Fig. 29, Fig. 30)			
TBS 25 mm	styrofoam EPS100 30 mm	1.48	55
Required insulation thickness for floor in contact with the outside air (Tz ≥ 0°C) R$_\lambda$=1.25 [m²K/W] (Fig. 29)			
TBS 25 mm	styrofoam EPS100 30 mm	1.48	55
Required insulation thickness for floor in contact with the outside air (0°C > Tz ≥? -5°C) R$_\lambda$=1.50 [m²K/W] (Fig. 29)			
TBS 25 mm	styrofoam EPS100 40 mm	1.74	65
Required insulation thickness for floor in contact with the outside air (-5°C ≥ Tz ≥ -15°C) R$_\lambda$=2.00 [m²K/W] (Fig. 29)			
TBS 25 mm	styrofoam EPS100 50 mm	2.01	75

Note

PN-EN 1264 provides minimum requirements for thermal insulation thickness. In addition it is based on ambient temperature range -5°C ≥ Tz ≥ -15°C, while for the climate conditions in Poland, depending on climatic zone, ambient temperature falls within the range between -16°C and -24°C.

Therefore, in order to ensure energy efficiency conditions that provide for the requirements of the Ordinance of the Minister of Infrastructure dated 6 November 2008 on the technical conditions to be met by buildings and their location (Journal of Laws No. 201, item 1238: 2008), standard requirements must be extrapolated.

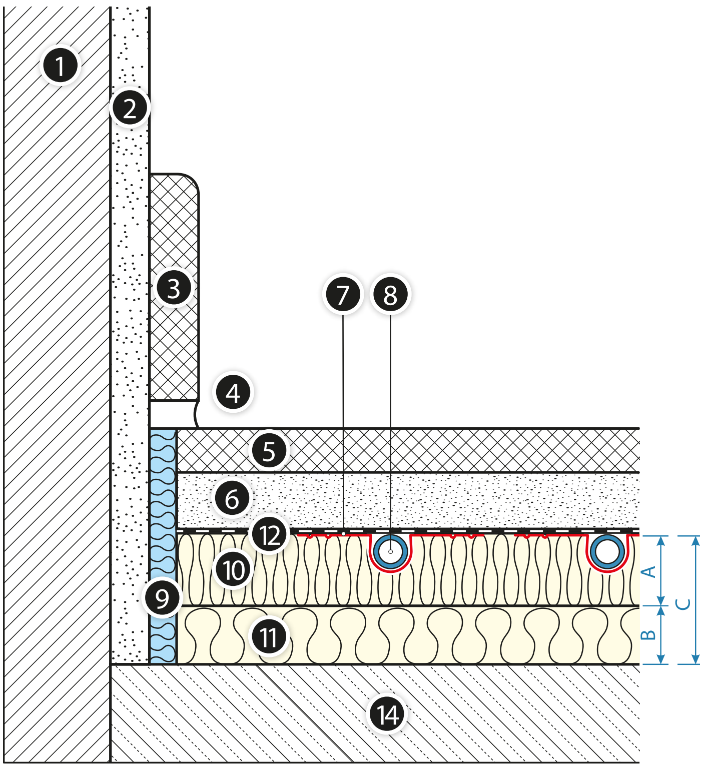
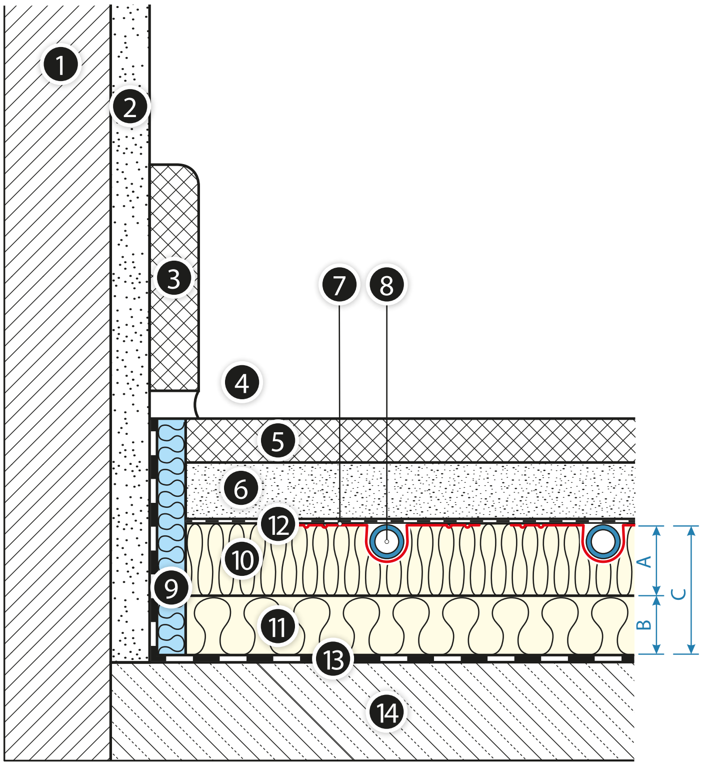


Fig. 29. Floor heater with KAN-therm TBS System board and supplementary insulation on the ceiling above internal room and on the ceiling in contact with outside air

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Dry screed
7. Steel radiator (lamella)
8. KAN-therm heating pipe
9. Wall tape
10. KAN-therm TBS System board of thickness A
11. Supplementary board of thickness B
12. PE foil
13. Damp insulation (only at the ground!)
14. Concrete ceiling

Fig. 30. Floor heater with KAN-therm TBS System board and supplementary insulation and damp-proof coating on the ceiling laid out on the ground

1. Wall
2. Plaster layer
3. Baseboard
4. Armor joint
5. Floor lining
6. Dry screed
7. Steel radiator (lamella)
8. KAN-therm heating pipe
9. Wall tape
10. KAN-therm TBS System board of thickness A
11. Supplementary board of thickness B
12. PE foil
13. Damp insulation (only at the ground!)
14. Concrete ceiling



3.5.1 Elements of KAN-therm TBS System floor heater

- wall tape of foamed PE, with foil apron, dimensions 8 × 150 mm,
- profiled TBS EPS200 styrofoam board, dimensions 0.5 × 1.0 m, for the pipes of 14 mm diameter,
- profiled TBS EPS200 styrofoam board, dimensions 0.5 × 1.0 m, for the pipes of 16 mm diameter,
- steel TBS lamellae (profiles) of 1.0 × 0.12 m dimensions, with notches every 0.25 mm, for the pipes of 14 and 16 mm diameter,
- PE foil of 0.2 mm thickness, in rolls,
- KAN-therm System PE-Xc and PE-RT heating pipes with diffusion barrier, of 14×2 and 16×2 diameter or KAN-therm System PE-RT/Al/PE-RT heating pipes of 14×2 and 16×2 diameter.

Approximate unit consumption of materials [quantity/ m²]

KAN-therm Profil System

Item designation	unit	The amounts at pipe spacing [cm]		
		16.7	25	33.3
KAN-therm heating pipes	m	6	4	3
TBS system insulation	m²	1	1	1
Supplementary insulation (if present)	m²	1	1	1
Wall tape 8×150 mm	m	1.2	1.2	1.2
PE TBS foil	m²	1.1	1.1	1.1
Metal TBS profile	units	5,1	3.4	2.5

3.5.2 Assembly guidelines

3.5.2.1 General requirements

Floor heating assembly should be preceded by window and door frames mounting and completion of plastering. Works should be performed in the temperature above +5°C.

The surface must be dry, clear, flat and even, in order to lay the system boards. Impurities should be removed and the discrepancy of levels compensated if necessary (with filler or levelling mortar). The acceptable tolerance of the support substrate unevenness for the floor heating installation is:

Distance between measuring points [m]	Surface unevenness [mm]	
	Wet system	Dry system
0.1	5	2
1	8	4
4	12	10
10	15	12
15	20	15

Due to the thermal expansion of pipes and the resulting adverse effects (sound of moving pipes), straight sections of arranged pipes should not exceed the length of 10 m, for this reason it is recommended to use KAN-therm PE-RT/Al/PE-RT multilayer pipes.

3.5.2.2 Assembly stages

1. Mount the installation cabinet and heating loop manifold.
2. Expand the wall tape with a plastic apron along the walls, columns, frames, etc.
3. If required, lay the acoustic insulation or additional thermal insulation over the entire surface.
4. Starting from the corner of the room arrange the system boards, so that their longer side was

arranged along the wall, being aware of a proper planning of board zones arrangement with the change of pipes direction. Partial boards (cut) should be put at the centre of arranged surface, not at its end.

If there are zones in the room, which are not heated by pipes, they should be filled with EPS 200 supplementary boards of 25 mm thickness.

5. Put a foil PE apron, fixed to the wall tape, on the TBS boards.

6. Place steel lamellae (radiators) in the system board channels, separating one from another by 5 mm. Lamellae feature transverse incisions (every 250 mm), which enable adjusting their length and matching with the length of the arranged boards. Arrange the lamella so that its transverse edge ends at approx. 50 mm from the change of direction of the heating pipe.

7. Starting from the manifold, arrange heating pipes in series pattern in lamellae cavities with spacing of 167 or 250 or 333 mm, changing their direction in the board zone reserved for this purpose (with transverse channels). While changing direction be aware of the permissible bending radius of the pipe.

8. Attachable pipes, which are led to the manifold inconsistently with the system board channels lay-out or laying on the supplementary board should be arranged in channels cut with a special tool - TBS cutter.

9. Cover the whole surface of so prepared floor heater with a PE foil of 0.2 mm thickness, which serves as an acoustic and damp-proof insulation. Individual foil strips should be arranged with an overlap of 20 cm.

10. Perform a pressure test of arranged coils leakage in accordance with the rules applicable for the surface heating (see section Acceptance forms). After the test, leave the pipes under pressure.

11. Proceed with the arrangement of dry screed boards in accordance with manufacturer's recommendations, after arranging the floor lining, evenly cut the protruding dilatation edge strip.

12. The installation is ready for start-up.

Tables for thermal calculation of floor heating performed in KAN-therm TBS System are provided in separate charts, attached to this handbook.

3.6 Wall heating and cooling in KAN-therm System

3.6.1 General information

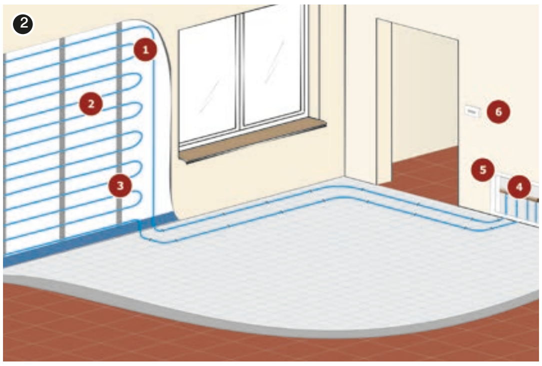
KAN-therm surface heating elements are perfectly suited for construction of heating and cooling systems of various types, mounted on vertical building envelopes. KAN-therm wall water heating has all the advantages of surface heating and additionally it features the following favourable properties:

- it can function as the only, independent room heating, or serve as a supplementary heating, in case of a lack of insufficient floor heating surface in the room. It can also support the radiator heating, while increasing the comfort in rooms (applied in cases of modernisation of a heated object),
- it ensures even, close to ideal, temperature distribution in a room, and, as a consequence, a high thermal comfort,
- vertical envelopes, due to the identical heat transfer coefficients for both heating and cooling, are ideal for the dual systems (heating/cooling),
- heat transfer takes place primarily through a comfortable radiation (approx. 90%),
- the temperature of heating surface may be higher than the temperature in the floor heating (up to 35°C), which results in a higher thermal efficiency,

- the approximate thermal efficiency 120–160 W/m^2 (provided that it does not exceed the max temperature of wall surface),
- due to the smaller thickness of heating/cooling board and low (or none) thermal resistance of external layers (linings) of the walls, the thermal inertia is lower and the control of temperature in room is easier.

1. KAN-therm Rail Wall heating/ cooling performed using "wet" method

2. Basic elements of wall heating/ cooling



3.6.2 The construction of KAN-therm Wall heating/cooling

3.6.2.1 General guidelines

- The wall heating is mounted on the external walls of U ≤ 0.35 W/m^2×K transfer coefficient. If the transfer coefficient exceeds the value of 0.4 W/m^2, the wall must be further insulated. Mounting near window openings, for example under windowsills, is recommended. Mounting on the external walls is also possible.
- KAN-therm System PE-Xc or PE-RT pipes of 12×2 and 14×2 diameters and KAN-therm System PE-RT/Al/PE-RT multilayer pipes of 14×2 diameter, should be applied.
- Recommended pipe spacing - 5, 10, 15, 20, 25 cm. Apply series pattern of pipes. In case of pipe spacing of 5 and 10 cm, the pipes may be arranged in double series pattern.
- Avoid blocking heating surfaces with furniture, paintings or curtains.
- Before arranging the surface heaters all concerning installation and electrical works must be carried out.
- Minimal distances of heating pipes from the adjacent partitions and building openings are presented in **Fig. 31**.

Dilatation should be applied at the points of contact of heating walls with adjacent building partitions.

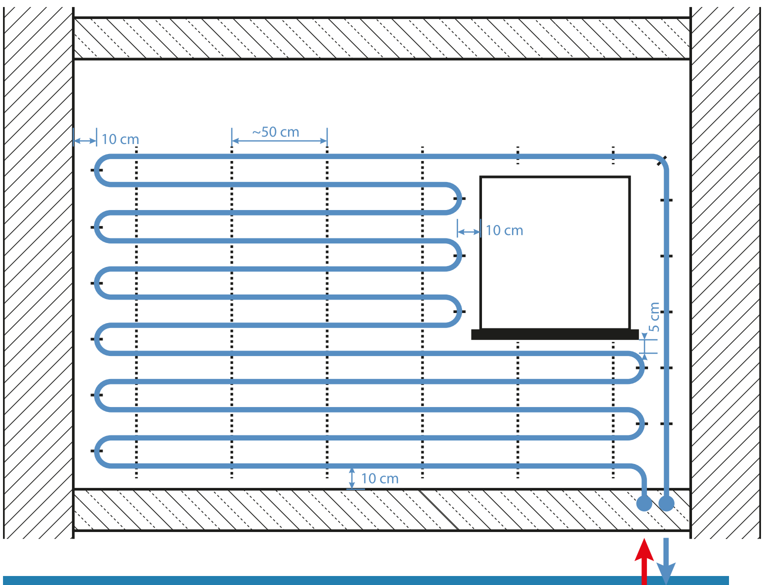
Pipes supplying the coils arranged on the floor should be arranged in insulation or protective pipe. At the transition from floor to the wall, the pipe should be carried in a 90° guide.

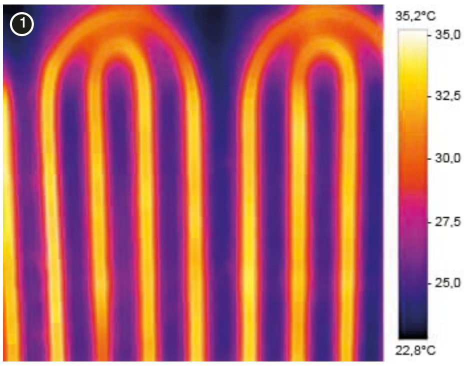
Heating loops are supplied by KAN-therm surface heating manifolds.

Coils may also be supplied in Tichelmann system, assuming that individual circuits connected to the system are of the same length.

Thermal imaging camera or special heat-sensitive foil can be used to determine the position of heating pipes in the existing wall installations.

Fig. 31. Mounting distance in wall heating





KAN-therm wall heating/cooling systems

Similarly to the floor surface heating, there are two ways of performing such an installation: "wet" and "dry" method.

3.6.2.2 KAN-therm Rail Wall "Wet" System

Fig. 32. KAN-therm TBS Rail heating/cooling structure

1. Wall lining (wallpaper, tiles
2. Plaster
3. Mounting grid 7×7 mm
4. KAN-therm heating pipe
5. Assembly rail
6. Expansion bolt
7. Wall structure
8. Thermal insulation
9. External plaster
10. Dilatations

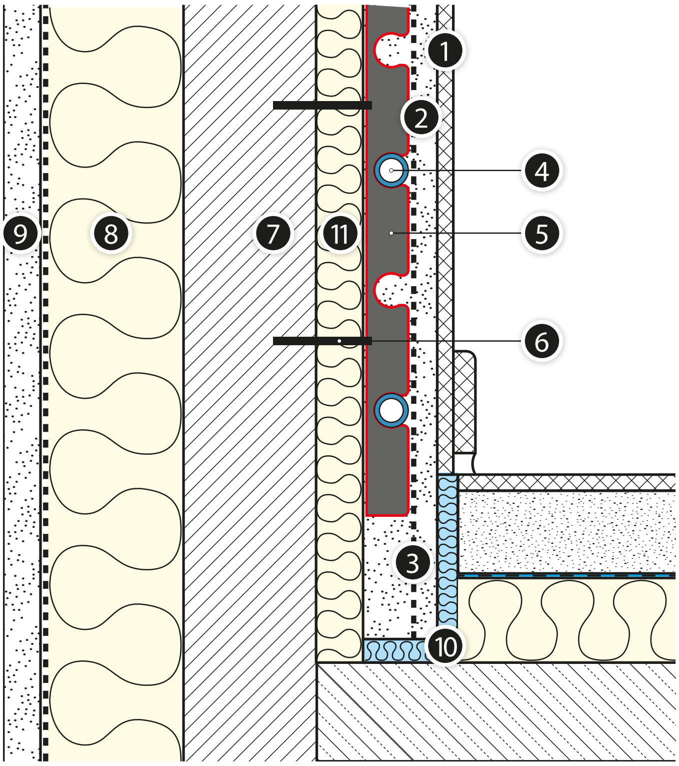
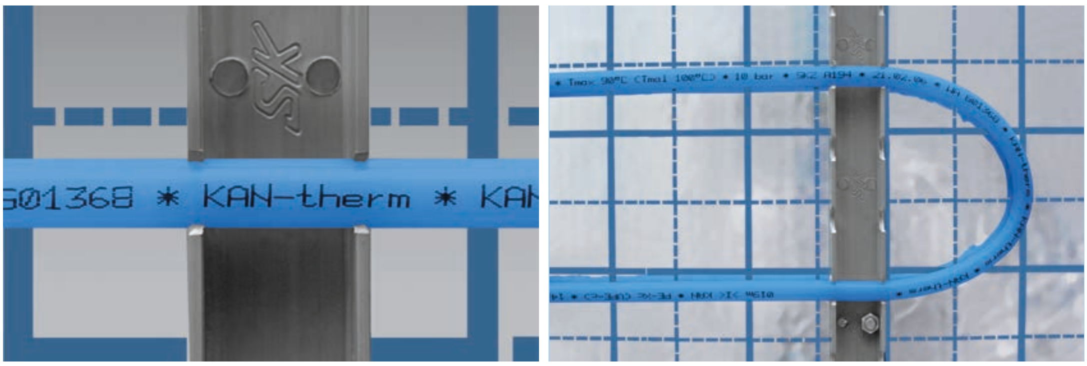


Fig. 33. KAN-therm heating pipes mounting in wall heating performed using wet method



Heating pipes of 12 or 14 mm diameter are mounted on the wall in mounting strip, and then they are covered with a plaster layer of a total thickness of approx. 30-35 mm, forming a hotplate. The minimum plaster layer thickness over the pipe surface is 10 mm.

Elements of wall heater

- KAN-therm System PE-Xc and PE-RT pipes with diffusion barrier of 12×2 and 14×2 diameters or KAN-therm System PE-RT/Al/PE-RT heating pipes of 14×2 diameter,
- KAN-therm Rail mounting strips for pipes of 12 or 14 mm diameter,
- Plastic or metal 90° guides for pipes of 12-18 mm diameter,
- Casing pipes (conduit) for pipes of 12-14 mm diameter,
- Dilatation wall tape.

Installation guidelines

- For pipe mounting use KAN-therm Rail mounting strips for diameters of 12 or 14 mm, mounted to the wall with an expansion bolt. The spacing of mounting rails is maximum 50 cm,
- Plaster of a heating plate should feature good thermal conductivity (min. 0.37 W/m × K), resistance to temperature (approx. 70 °C for cement and lime plasters, 50 °C for gypsum plasters), flexibility and small extensibility,
- The type of plaster must be adapted to the nature of the room. Cement and lime plasters, gypsum plasters, as well as clay mortars may be applied.
- Recommended prepared plasters: for example KNAUF MP-75 G/F,
- Air temperature during plastering works should not be lower than 5 °C,
- Plaster should be laid in stages: first layer of thickness of approx. 20 mm should completely cover the heating pipes. Apply fiberglass plaster mesh with 40 × 40 mm meshes on the fresh layer, and then apply a second layer of 10 - 15 mm thickness. The mesh strips must overlap each other, as well as adjacent surfaces (approx. 10 - 20 cm),
- Maximum width of a hotplate is 4 m, height up to 2 m. The plate surface should not exceed 6 m^2/heating circuit,
- During plastering the heating pipes should be filled with pressurised water (min 1.5 bar),
- Heating of a plaster can be started when it becomes dry (time specified by the plaster manufacturer - from 7 days for gypsum and up to 21 for cement plasters),
- The plaster may be painted, covered with wallpaper, paint and structural ceramic coverings.

3.6.2.3 KAN-therm TBS Wall "dry" System

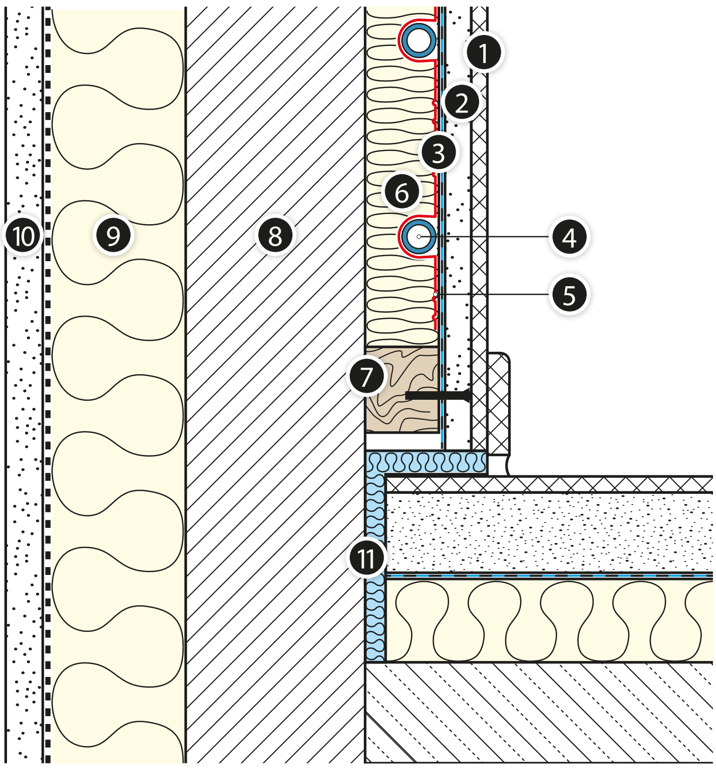


Fig. 34. KAN-therm TBS Wall heating/cooling structure

1. Wall lining (wallpaper, tiles
2. Dry plaster (g-k board)
3. PE foil
4. KAN-therm heating pipe
5. Steel profile (radiator)
6. TBS **14** System board
7. Wooden strip 25×50 mm
8. Wall structure
9. Thermal insulation
10. External plaster
11. Dilatations

Heating pipes of 12 mm diameter are placed in the channels of KAN-therm TBS 14 boards, equipped with radiators made of steel sheet. TBS 14 boards are mounted between the horizontal strips or 25 × 50 mm steel profiles, to the wall surface. On such a construction a PE foil, which serves as acoustic and damp-proof insulation, is applied, and then plasterboards are mounted to strips.

Elements of wall heater

- KAN-therm TBS 14 boards of 1020×645×25 mm dimensions, with lamellae (radiators) made of steel sheet,
- Wooden strips or 25 × 50 mm steel profiles,
- KAN-therm System PE-Xc and PE-RT pipes with diffusion barrier of 14×2 diameter and or KAN-therm System
  PE-RT/Al/PE-RT pipes of 14×2 diameter,
- PE foil of 2 m width and 0.2 mm thickness.
- Plastic or metal 90° guides for 12-18 mm diameters,
- Casing pipes (conduit) for pipes of 12-14 mm diameter,
- Dilatation wall tape,
- Dry plaster, plasterboards.

Fig. 35. KAN-therm TBS Wall heating/cooling structure

1. Layer of wall lining (tiles, structural paint, wallpaper etc.)
2. Dry plaster (g-k board)
3. PE foil
4. Steel radiator (lamella)
5. KAN-therm heating pipe
6. Wooden strips
7. KAN-therm TBS board

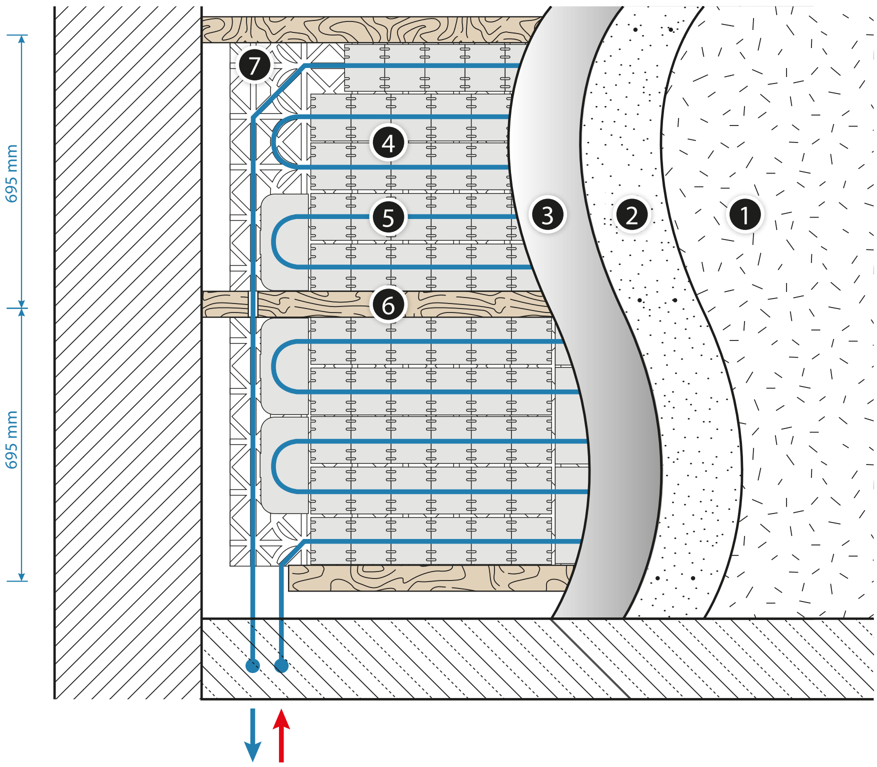
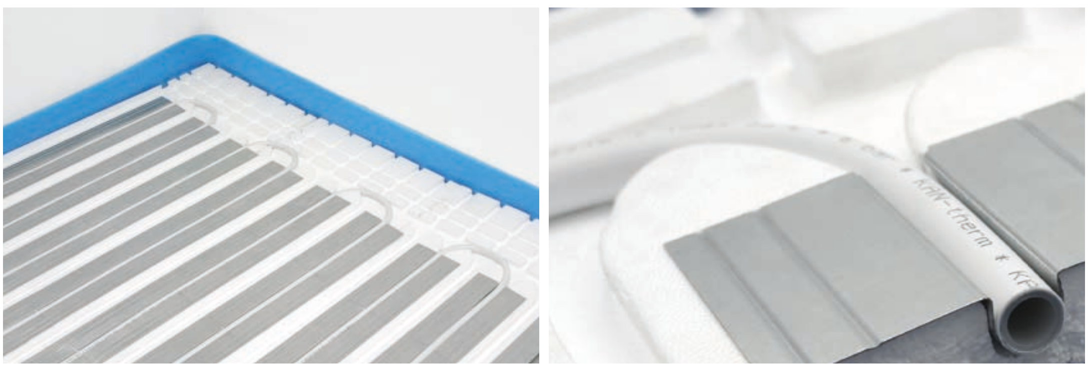


Fig. 36. KAN-therm TBS 14 board with steel radiating lamellae



Assembly guidelines

- Wall surface for heating must be clean, levelled and vertical,
- KAN-therm TBS 14 boards should be mounted to the wall surface between the strips, using proper glues for styrofoam boards mounting to buildings,
- Strips spacing is (in axes) 695 mm,
- Pipes should be laid with spacings of 125 or 250 mm,
- Apply PE foil with a 20 cm overlap,

3.6.3 Wall cooling - general rules

KAN-therm wall surface heaters can also serve as excellent cooling surfaces.

To determine the edge conditions for surface cooling operation, associated with steam condensation and comfort, use the h-x Mollier graph for humid air.

In order to prevent water vapor condensation on the cooling wall surface, the temperature of supply installation cannot drop below the dew point temperature increased by +2 K.

More information about surface cooling is presented in section "KAN-therm Surface Cooling".

3.6.4 Thermal and hydraulic dimensioning of wall surface heaters

General rules of KAN-therm wall heating/cooling design do not differ from the rules of heating and cooling dimensioning provided in the part 6 of the Handbook - KAN-therm surface heater design.

Additionally, the following criteria should also be taken into account:

- maximum wall surface temperature (heating) 35°C,
- minimum wall surface temperature (heating) 19°C,
- maximum temperature of installation supply 50°C,
- water temperature drop in pipes between 5 and 10 K,
- pipe spacing 5, 10, 15, 20 or 25 cm, arranged with series pattern (5 cm in case of double series pattern),
- minimum water velocity, responsible for the effective venting of the installation 0.2 m/s,
- approximate maximum permissible water velocity 0.8 m/s,
- approximate maximum length of heating loops: 80 m for 14 × 2 mm and 12 × 2 mm pipes (taking into account the connection segments),
- in case of external walls the thermal resistance of all wall layers counting to the heating pipe surface should not be lower than 0.75 $m^2 \times K/W$ (unless the heating of adjacent rooms is assumed).

In order to determine the thermal efficiency of wall heaters, depending on the diameter D (12 and 14 mm), pipe spacing T (10, 15, 20 and 25 cm), thickness Su, the thermal properties of plaster and average temperature $[(t_V+t_R):2]-t_i$ $\Delta\vartheta H(K)$ (tables) for plaster of 20 mm thickness (above the pipe surface) and conductivity coefficient $\lambda = 0.8$ W/mK, as well as for unit value of conduction resistance of a wall finishing layer $R_{\lambda B} = 0.00; 0.05; 0.10; 0.15$ $m^2 \times K/W$, are provided.

Tables for thermal calculation of wall heating/cooling performed in KAN-therm System are provided in separate charts, attached to the handbook.

3.6.5 Installation adjustment

The rules of hydraulic adjustment of heating/cooling installation heating circuits are the same as for KAN-therm floor heating (see section "KAN-therm surface heaters design - Installation hydraulic calculations, regulation").

Pressure loss in heating pipes may be determined using the charts of linear resistance for KAN-therm heating pipes, included in "Designer and Contractor Handbook".

For adjustment of KAN-therm wall heating and cooling installation the same elements of control and automation are applied as in the KAN-therm floor heating/cooling.

3.6.6 Leakage tests, start-up

The rules of leakage tests execution are the same as for floor heating (see section Acceptance forms).

Start-up of the installation should be performed in accordance with KAN-therm surface heating/cooling installation start-up.

3.7 Monolithic constructions

Thermal activation of construction elements means a system, which makes use of building's structural elements weight for control of temperature in the rooms. Those systems are applied for sole or supplementary heating or cooling of the rooms. They can, to a large extent, eliminate the disadvantages associated with the rooms air conditioning, based on the exchange of properly prepared air.

They are used only in the newly designed buildings, because they require the cooperation of constructors and heating and air conditioning specialists already at the stage of the building concept.

Monolithic constructions made of concrete are ideal for storing and radiating heat/cold, which is supplied by a system of pipes with cooling or heating water.

Coils made of pipes are arranged during the construction of massive ceiling or walls. Water flowing in the pipes that radiates or receives heat, thermally activates surface of the structure.

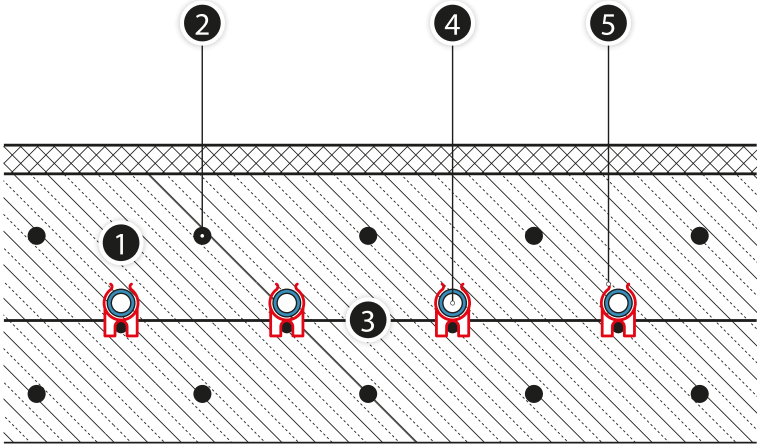
The thermo-active constructions function for the whole year - during the winter they radiate accumulated heat to the rooms, while during the summer they are primarily used to accumulate and radiate (during a day) cool to the rooms. Thus favorable conditions are provided, which ensure the high thermal and climatic comfort inside the object.

The system, due to low supply parameters (27-29°C for heating, 16–19°C for cooling) can cooperate with renewable heat sources such as various types of heat pumps.

Coils pipes of thermo-active ceiling arrangement is carried out at the construction site, during the ceiling reinforcement mounting. Pipes can be mounted to the elements of construction reinforcement or on a supplementary KAN-therm NET net, placed between the proper reinforcement of the ceiling. Pipes are mounted to the net with plastic handles or ties.

Coils are arranged with series pattern or in a double series system, with a spacing of 15 or 20 cm, most often at half the thickness of the ceiling.

1. Ceiling
2. Ceiling reinforcement
3. Assembly grid
4. KAN-therm heating pipes
5. Handles for pipes mounting in the grid



KAN-therm elements

- KAN-therm System PE-Xc and PE-RT pipes with a diffusion barrier of 16×2, 18×2 or 20×2 diameter.
- handles for pipes assembly on the NET net,
- ties for pipes mounting on the NET net,
- protective pipes for pipes of 16, 18 or 20 mm diameters.

On each floor the coils can be supplied through the connection to a heating circuits manifold, allowing the hydraulic balance of the system. They can also be supplied by the common manifold following the Tichelmann system, assuming that every circuit (coil) has the same hydraulic resistance and control valves assembled.

3.8 Sports flooring heating in KAN-therm System

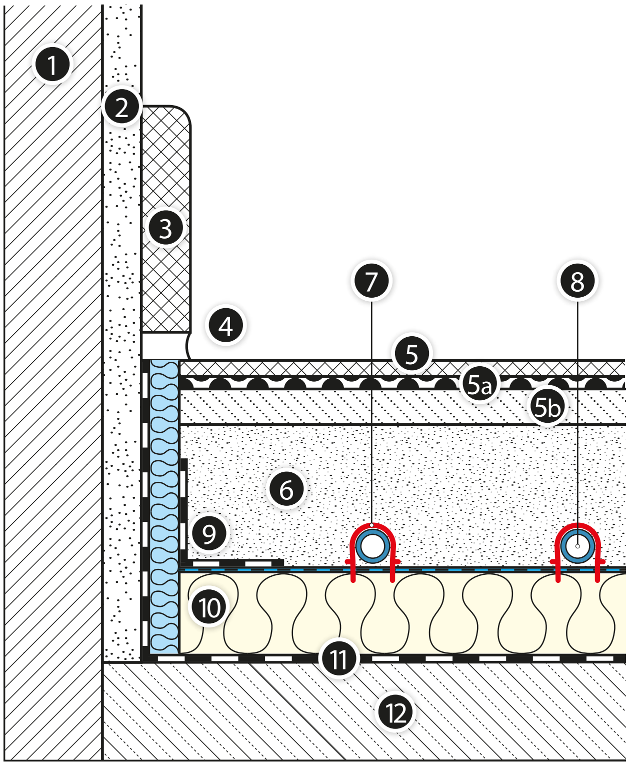
Sport halls or training and recreation rooms heating must fulfill a number of requirements, arising from their unique purpose and construction (large volume and height of the rooms, often a high degree of external walls "glazing", limited possibility of internal mounting of heating equipment due to the arrangement of rooms and user safety, the necessity to ensure a heat comfort and hygiene in the premises). In the sports and recreation objects the users are often undressed, and the uneven distribution of temperature (both vertically and horizontally, with the zones of cooler air) may cause not only colds, but injuries as well. An important aspect when choosing a heating method is also energy efficiency of the adopted system. The application of KAN-therm floor surface heating is a perfect way to ensure warmth and climate comfort in this kind of objects.

The design of KAN-therm floor heating depends on type of the floor design. In practice, there are two types of sports floors: floors with point elasticity and surface elasticity.

3.8.1 Floors with point elasticity heating

The "working" surface is evenly distributed on perpetual, flexible coating, laid on a concrete surface. Heat radiation is made through the layer of screed, inside which the heating pipes are arranged. Such a floor is perfect for, e.g. practicing indoor tennis, as well as gymnastics and athletics.

1. Wall
2. Plaster layer
3. Baseboard made of tiles
4. Armor joint
5. Sport floor lining
5a. Coating with glass fiber
5b. Elastic layer **10** mm
6. Screed
7. Pipe clip
8. KAN-therm heating pipe
9. Wall tape with PE protective apron
10. KAN-therm Tacker System board of thickness A with metallised or laminated foil
11. Damp insulation (only at the ground!)
12. Concrete ceiling



The construction of floor heater is similar to construction of heating performed using a wet method in KAN-therm Tacker System. The only difference is the construction of flooring, which is composed of 10 mm elastic layer, coating with glass fiber and proper sports flooring, made of parquet, laminate or plastic linings. Heating pipelines are arranged (in series pattern and spiral pattern) on the thermal insulation, and then covered with a screed layer of total thickness of 65 mm. All heating circuits are connected to the KAN-therm manifolds, placed in wall-mounted cabinets.

Water heating of floors with point elasticity can be performed using the dry building system. For this purpose, KAN-therm TB profiled boards with steel lamellae (radiators) and KAN-therm PE-RT and PE-Xc heating pipes with diffusion barrier or PE-RT/Al/PE-RT of 16 mm diameter should be applied. Arranged (in accordance with the guidelines on page 39) KAN-therm TBS boards with pipes, are covered with subsequent layers of sports flooring.

The course and methodology of thermal and hydraulic calculations are the same as for KAN-therm Tacker heating system in wet method or KAN-therm TBS in dry method (taking into account the thermal resistance of all sports flooring layers). While calculating the heat demand, the specificity of sports objects has to be taken into account (large volume and room height).

3.8.2 Floors with surface elasticity heating

In case of floors with surface elasticity the proper floor is spread on a special wooden elastic construction, which is composed of wooden strips based on flexible tabs (vibration carrier) and supports. Parquet or PVC lining is applied as an external layer. Airspace between thermal insulation and floor is being heated. This type of floors is especially suitable for basketball, handball and volley ball practicing.

3.8.2.1 Thermal insulation arrangement

The thermal insulation is arranged on the surface equipped with construction damp-proof insulation (in case of floors arranged on the ground). KAN-therm Tacker EPS 100 038 insulation boards of thickness depending on the localisation of the room (available thickness 20, 30, 50 mm) should be applied. The additional supplementary KAN-therm EPS 100 038 boards of 20, 30, 40 and 50 mm thickness should be applied if necessary. KAN-therm Tacker boards are covered with metallised or laminated foil, with an overprint, which makes the arrangement of heating pipes easier.

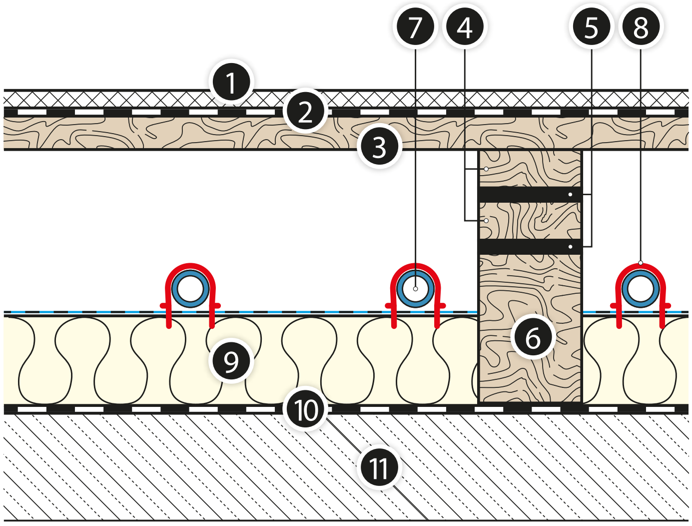


Fig. 37. Cross-section of the floor with surface elasticity, with a floor heating installation made of KAN-therm Tacker System elements.

1. Sport floor lining
2. PE foil
3. "Blind floor"
4. Double joist with flexible divider
5. Flexible washers
6. Wooden support
7. KAN-therm heating pipe
8. Pipe clip
9. KAN-therm Tacker thermal insulation with metallised or laminated foil
10. moisture insulation
11. Concrete ceiling

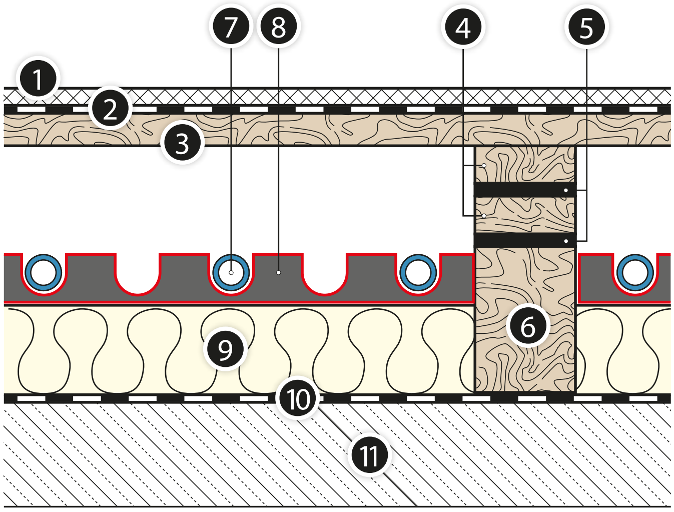


Fig. 38. Cross-section of the floor with surface elasticity, with a floor heating installation made of KAN-therm Rail System elements.

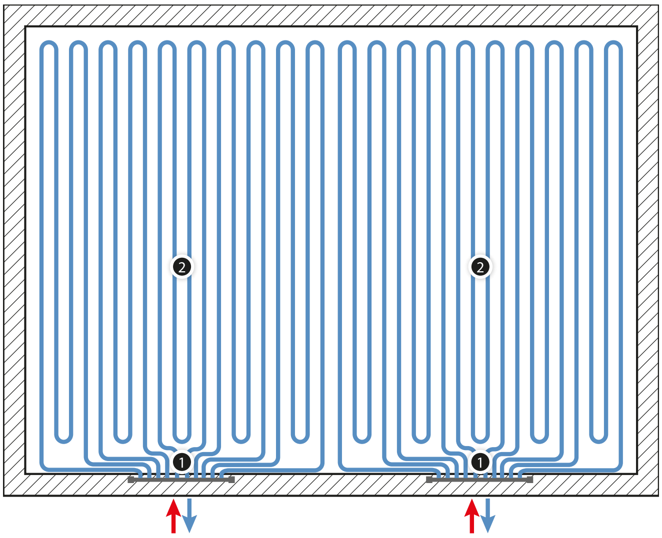
1. Sport floor lining
2. PE foil
3. "Blind floor"
4. Double joist with flexible divider
5. Flexible washers
6. Wooden support
7. KAN-therm heating pipe
8. Mounting rail for pipe fastening
9. KAN-therm Tacker thermal insulation with metallised or laminated foil
10. moisture insulation
11. Concrete ceiling

After the arrangement of thermal insulation, holes should be made in it, which shall be used for the accommodation of floor supports in accordance with the recommendations of sports floor supplier. The number of holes and spacing between them depends on the adopted type of a floor.

3.8.2.2 Pipes arrangement

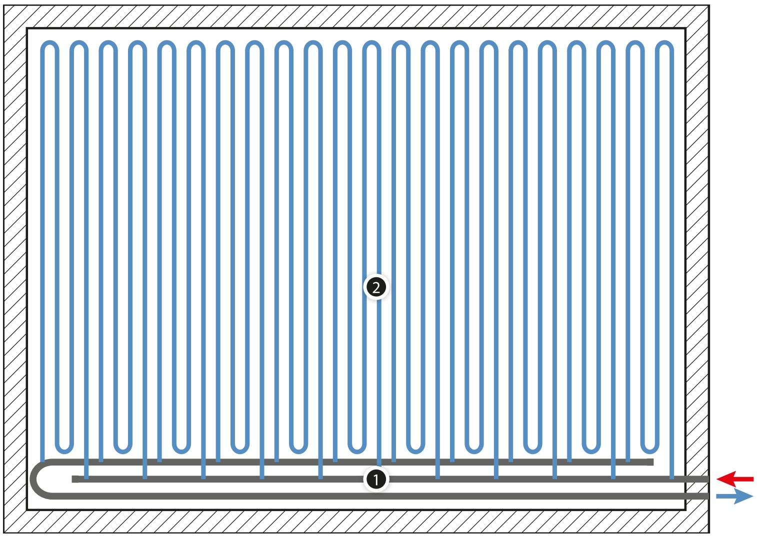
KAN-therm PE-Xc i PE-RT 16 × 2, 18 × 2 or 20 × 2 mm with diffusion barrier or PE-RT/Al/PE-RT 16 × 2 or 20 × 2 mm heating pipes are applied. Pipes are mounted using clips for pipes pressed into insulation with a tacker or by using KAN-therm Rail pipes assembly strips. Pipes are laid on the insulation in series pattern and spiral pattern in manifold arrangement or as separate, parallel loops attached to the collector header in following the Tichelmann system.

1. KAN-therm surface heater manifolds
2. KAN-therm PE-RT heating pipes with diffusion barrier



In the first case, the KAN-therm surface heating manifolds are used, which allow for a proper heat distribution and hydraulic adjustment of each circuit and heating section. Up to 12 heating circuits can be connected to a single manifold.

1. KAN-therm PE-RT/Al/PE-RT pipes and T-connections manifold KAN-therm Press or KAN-therm PP Glass pipes and PP fittings manifold
2. KAN-therm PE-RT heating pipes with diffusion barrier



In the Tichelmann system, which guaranties even pressure distribution in the installation, heating circuits are connected through a three-way adapter (or KAN-therm PP saddle joints) to the supplying and return connectors laid under the floor, along the shorter and longer sides of sports hall.

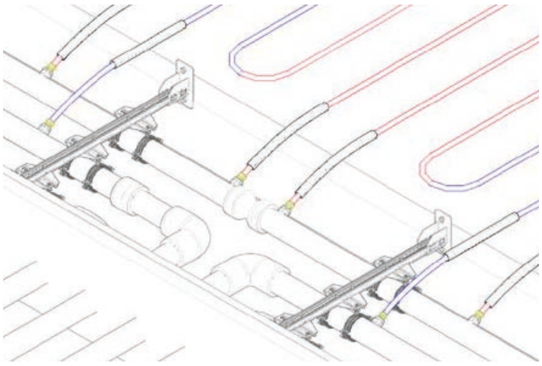
Heating loops have a shape of repeated series pattern, placed perpendicularly to the collectors ("multiplicity" of series pattern depends on heating pipes diameter and the size of a hall).

Manifold collectors are made of KAN-therm PE-RT/Al/PE-RT 40 × 3.5 multilayer pipes, connected with crimped KAN-therm Press LBP reductive three-way adapters of departure diameters of 16 × 2 or 20 × 2 mm and, for larger diameters of collectors (50 × 4 or 63 × 4,5 mm), with KAN-therm Press three-way adapters with 1" external threads.

Possible configuration of KAN-therm PE-RT 20 × 2 mm heating pipes connection to the collector made of KAN-therm PE-RT/Al/PE-RT pipes of 40 mm diameter:

KAN-therm PE-RT 20 × 2 pipe with diffusion barrier > KAN-therm Press LBP 40 × 3.5/20 × 2.0/40 × 3.5 three-way adapter >KAN-therm PE-RT/Al/PE-RT 40 × 3.5 pipe

Alternatively, it is possible to apply KAN-therm PP Glass or KAN-therm PP pipes of the diameter range between 40 - 110 mm and KAN-therm PP saddle joints with a GW½" external thread, to which, through compression fittings with an external thread, heating loops are connected.



Possible configuration of KAN-therm PE-RT 18 × 2 mm heating pipes connection to KAN-therm PP Glass collector made of pipes of diameter 50 mm:

KAN-therm PE-RT 18 × 2 pipe with diffusion barrier > 18 × 2.0/GZ½" compression fitting > KAN-therm PP 50/GW½" saddle joint > KAN-therm PP 50 × 6.9 pipe

Departure spacing (three-way adapters or saddle joints) on the collector, depends on heating loop series pattern multiplicity and pipe spacing in series pattern, which is assumed to be in the range of 15 - 30 cm.

3.8.2.3 Floor with surface elasticity assembly

Elastic sports floor is arranged subsequent to completion of installation works. Firstly, the wooden supports with elastic tabs should be placed in the holes, which were cut earlier in the insulation. Double joists (made of wooden, planed and dried strips) with an elastic divider (double vibration carrier) are mounted on those pads. Then, a so called sub floor made of wooden strips of 17 - 18 mm thickness and approx. 98 mm width, is mounted on the joists. Prior to the arrangement of proper floor, polyethylene PE foil should be loosely unfolded on the sub floor. The final stage of heated sports floor mounting is the arrangement of proper external floor in the form of PVC lining or sports parquet (18 - 20.5 mm). In case of lining (for example made of linodur), firstly a load distribution layer of several millimetres thickness is arranged on the sub floor. All wooden elements should be of highest quality, properly dried and seasoned. Linings made of plastics, as well as glues, varnishes, must possess a manufacturer's assurance that they are suitable for floor heating and have special labelling.

3.8.2.4 Heat calculations

In KAN-therm heating of floors with surface elasticity arranged on joists, the air, which is not a good heat carrier, carries the heat between heating pipes and the surface of proper floor. For this reason, in order to ensure the proper thermal efficiency of heating surface, a higher temperature of heating circuits supply is applied, which amounts to the maximum of 55–65 °C with pipes spacing of 15 - 30 mm. With such parameters, it is possible to achieve the efficiency of 40–60 W/m^2, which ensures an adequate thermal comfort in the occupied zone.

KAN-therm sports floor heating installation design must be carried out in cooperation with an architect and manufacturer of elastic floor, as well as with KAN company Technical Department.

3.9 Open areas heating in KAN-therm System

The elements of KAN-therm System water surface heating, allow for the performance of heating installation on external surfaces, which are exposed (or partially exposed) to weather factors.

Such installations are applied in order to accelerate snow and ice melting on surfaces exposed to precipitation and surface drying, as well as for maintaining constant temperature of surface and the ground.

Application:

- roads, driveways and traffic routes, landings heating,
- sports pitch heating,
- maintaining constant temperature of ground surface or flooring in any kind of buildings intended for animal husbandry or plant breeding (in gardening or agriculture).

3.9.1 General principles

As a heating elements, the KAN-therm multilayer pipes or PE-RT, PE-Xc pipes with diffusion barrier of diameters 18, 20 or 25 mm should be applied.

In order to ensure even pipe distribution, the mounting strips fixed to the surface with metal pins (System KAN-therm Rail) should be applied, and also they should be attached with ties to the mats (grids) made of wire or, for example, using special pipes handles (KAN-therm NET System).

Certified antifreeze fluids (based on glycols) are used as a heating medium, for example KAN-therm antifreeze fluid for temperatures of -20, -25 or -35 °C. The application of those fluids should be taken into account during hydraulic calculations, because their density and viscosity is higher than water's.

In case of large surfaces heating, making the dilatation of heating boards should be taken into account.

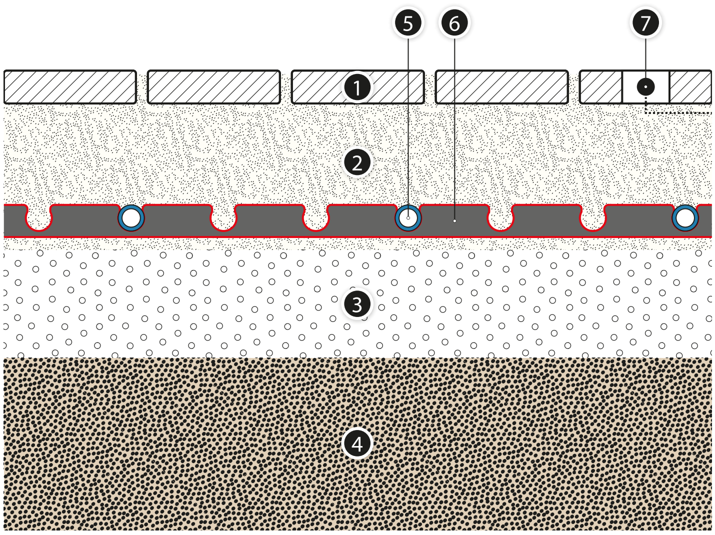
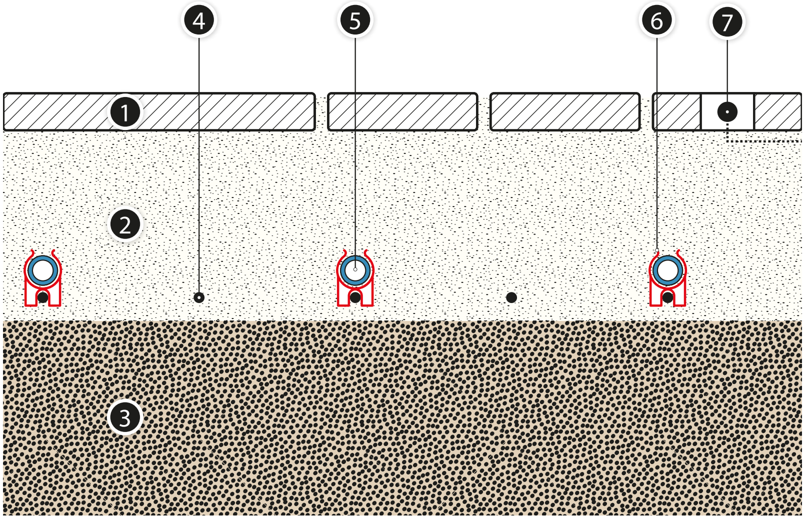


Fig. 39. External traffic routes heating (KAN-therm Rail System)

1. External flooring
2. Sand bed
3. Concentrated primer
4. Native soil
5. KAN-therm 20 mm heating pipes
6. Pipes mounting strip
7. Temperature and snow sensor

Fig. 40. External traffic routes heating (KAN-therm NET System)

1. External flooring
2. Concrete
3. Native soil
4. Steel grid for pipe mounting in meshes 150×150 mm
5. KAN-therm 20 mm heating pipes
6. Handle (clips) for pipes mounting in the grid
7. Temperature and snow sensor



3.9.2 External traffic routes heating

Heating pipes are arranged in the layer of concrete or in the layer of sand (less advantageous solution, due to the low thermal conductivity of sand), on which the external layer, for example paving stones, slabs etc., is laid. Thickness and type of those layers depend on planned heated surface load. The thickness of concrete layer above the pipes should not be less than 6 cm, while the thickness of sand layer should not exceed 10 cm.

Total thickness of heating board, counted from the top to the external surface of the pipe, is 15 - 25 cm.

The efficiency of such type of heating increases application of thermal insulation under pipes, which, however, must meet specific conditions such as damp resistance or mechanical load. In case of solution without the insulation, the huge inertia of such a surface heater should be taken into account, which, in practice, may mean its constant operation.

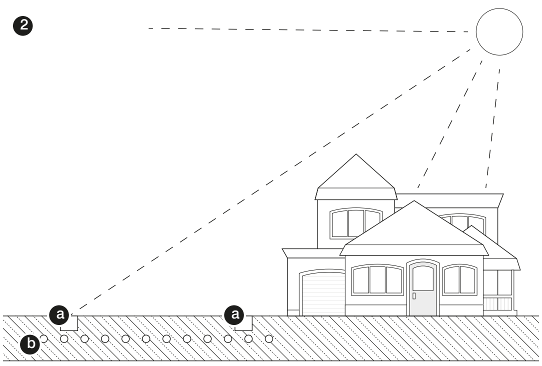
It is important that the water, which is a result of melting snow, was drained fast.

The pipes may be laid in series pattern and spiral pattern.

In order to ensure efficient and economic functioning of the installation, a proper control and adjustment of heating loop supply system must be ensured. KAN-therm ice and humidity sensors, which are connected to heated open surfaces icing controller, that drives the installation power supply system, are suited for this purpose. The controller is designed to early detect via sensors ice or snow and activate the pump interposing a heating medium into heating loops. The signal from the sensor depends on temperature and humidity of heated surface.

1. External traffic routes heating (KAN-therm Rail and NET System)
2. Controller sensors distribution

a. Sensor
b. Heating cables



There is a possibility to connect 2 ice sensors, which operation parameters (temperature and humidity) can be adjusted separately for each of them. Thus, an optimal monitoring of large or divided external surfaces or surfaces exposed to various conditions, e.g. uneven insolation of heating surface, is achieved.

If sensor detects the temperature below a critical range (0...+5 °C), the device activates heating. After short wait time, sensor detects, on the basis of power consumption, whether the environment is dry or wet. Possible occurring layer of snow is melted. At the earliest, heating shall switch off after set "minimum heating time".

Besides the upper range temperature values (0...+5 °C), also the lower range value may be set between -5… -20 °C. This is caused by the fact that at low ambient temperatures there is no water, which is a result of melting of a snow, which is light and dry at such low temperatures. Due to the fact that in such conditions the heating power is generally insufficient to completely remove the snow from the whole surface, there is a risk of undesirable formation of ice layer.

The maximum length of cable connecting sensor to controller - 50 m.

The detailed description of the functions and operation of controller and sensors can be found at en.kan-therm.com "Icing controller for open surfaces heating with snow and ice sensor" Manual.

3.9.2.1 Calculation of heating power

When setting the heating power of external surfaces heating, additional factors, which do not occur in case of indoor heating, should be taken into account: freezing temperatures, wind, ground heat loss, type of cover (snow, ice), the assumed time of ice or snow layer melting.

Therefore, the calculation methodology differs from the procedure based on PN-EN 1264 standard.

The following assumptions should be made:

- assumed surface temperature +1 °C, not higher than +5 °C,
- heating loops power supply temperature 35 – 50 °C, at the recommended temperature drops to 15 K,
- minimum temperature for efficient snow and ice removal -10°C,
- pipe spacing 15 - 25 cm,
- assumed ice or snow melting time is 1 or 2 hours,
- heating power depends on several factors (thermal resistance of layers under the pipes, ambient temperature, consideration of winds occurrence), indicative capacity range of installation used to prevent icing and remove snow is 100–250 W/m².

Fig. 41. KAN-thermExternal surfaces heating - during and after finishing of the works

3.9.3 KAN-thermSystem Football - heating of sport grounds pitch

Sport grounds pitch heating is a specific type of external surface water heating. Its purpose is to prevent the retention of snow on the grass and ice formation, which can hinder or even prevent sports games. Although the general principle of operation of such a surface heater does not differ from the principle of surface water heating operation, due to the specific features (various weather conditions, large surface, pitch sensitivity to temperature and lack of humidity, as well as the need to perform an efficient drainage), the system does not require individual design and materials collection for each installation.

KAN offers a set of elements constituting the KAN-therm Football System, which allow for the performance of effective and efficient play grounds pitch heating system.

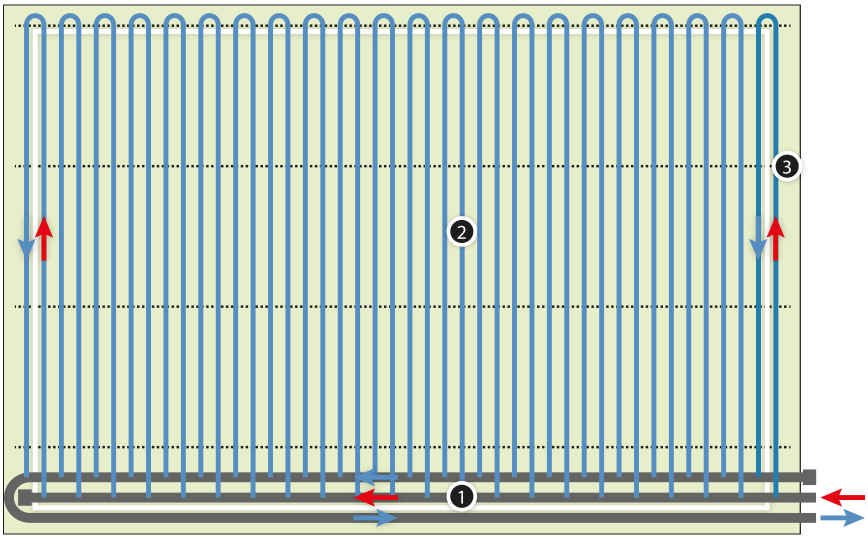


Fig. 42. KAN-therm field pitch heating installation – flowchart

1. KAN-therm Football collectors
2. KAN-therm heating pipes 25×2.3
3. Rail mounting strips

3.9.3.1 Structure and components

Heating loops made of KAN-therm PE-Xc 25 × 2.3 mm pipes, which are arranged at regular lengths along the longer or shorter side of the field, are a basic element of the installation. To ensure an even heat distribution, heating pipes are connected in counter-current Tichelmann system to the collectors laid on the excavation at the edge of the field, along the side and goal lines. Collectors are arranged approx 50 cm below the heating pipes arrangement level.

Due to the adopted heating cables power supply system (all heating circuits are the same length), the system does not require hydraulic adjustment.

Fig. 43. KAN-therm Football System elements

KAN-therm collectors are made of polyethylene pipes of diameter 160-180 mm with spigots of diameter corresponding to the heating loops pipes diameter and spacing, arising from the designed heating pipes spacing. Collector segments are connected by butt wielding, it is also possible to connected them using electric resistance fittings. The collectors are performed and delivered in accordance with an individual technical documentation.

Heating loops pipes are arranged with 20 - 35 cm spacing in KAN-therm Rail System mounting strips, fixed to the surface with steel pins, and then connected to collector spigots with KAN-therm Press LBP fittings. Strips spacing 200 cm.

Depth of loops arrangement depends on the type of pitch (natural or artificial) and amounts to approx. 25–30 cm for natural grass (necessity to protect the root zone) and approx. 10 - 20 cm for synthetic grass. Heating pipes backfill should be made with sand of suitable granulation. It is advantageous to arrange collector pipes (non-insulated) in the zone of the heated pipe - this way they can become a heating element of the system. Cable, which supply the collectors must always be thermally insulated. Please keep in mind, that while defining the heated surface of the field, the external strip of 1 m width along the side and goal lines should be taken into account.

Pitch heating process proceeds under the control of snow and air temperature sensors at the ground and sensors placed at the level of grass roots.

Heated field pitch should be equipped with an efficient rainwater drainage system, and in the case of natural grass, with an efficient sprinkler system. Heating installation arrangement should be coordinated by field pitch contractor. It is recommended that the installation was filled and under pressure during inundation of heating pipes.

Fig. 44. Play field - natural grass

1. Natural grass
2. Grass roots ~ 20 cm
3. Sand layer ~ 15 cm
4. Heating pipes KAN-therm 25 mm
5. Mounting rail for pipe fastening
6. Drainage layer (gravel)
7. Native soil
8. Draining system
9. Temperature sensor for grass roots
10. Temperature sensor of pipe surface

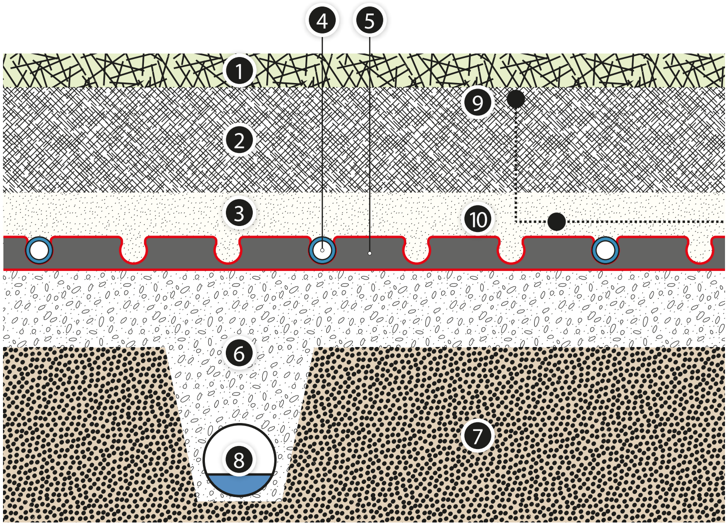
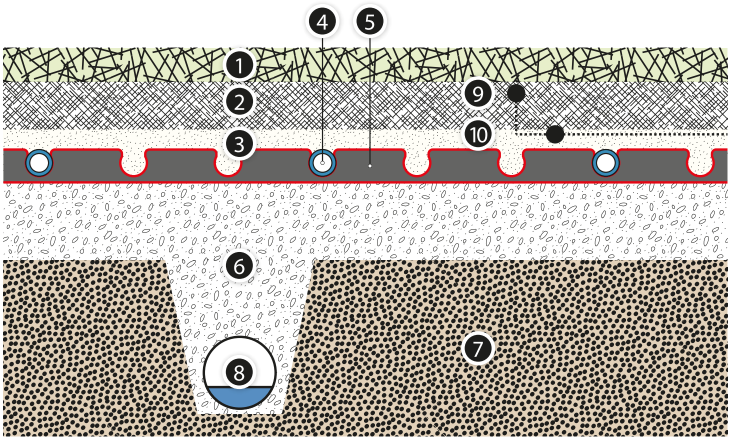


Fig. 45. Play field - artificial grass

1. Artificial grass with a substrate ~6 cm
2. Support layer ~ 5 cm
3. Sand layer ~ 6 cm
4. KAN-therm 25 mm heating pipes
5. Mounting rail for pipe fastening
6. Drainage layer (gravel)
7. Native soil
8. Draining system
9. Temperature sensor of grass substrate
10. Temperature sensor of pipe surface



3.9.3.2 Thermal and hydraulic dimensioning of the installation

The efficiency of field surface heating installations operation depends on several factors, including climatic zone, rainfall and winds intensity, in case of natural surfaces - the need to ensure optimal grass vegetation conditions.

The following assumptions should be taken into account:

- optimal temperature on the surface from +1 to +5°C,
- approximate unit thermal efficiency 120–180 W/m^2,
- maximum temperature in the root zone 8°C,
- collectors power supply temperature depends on the type of pitch surface and is within the range of 30–50°C,
- heating medium - antifreeze fluid with properties corresponding to 34% glycol solution.

4 Components of **KAN-therm** surface water heating and cooling

A KAN-therm system comprises all necessary components needed for installation of surface water heating and cooling:

- heating/cooling pipes,
- thermal insulations,
- pipe mounting systems,
- dilatation elements (dilatation tapes and profiles)
- heating circuits manifolds,
- installation cabinets,
- control and automation devices,
- screed additives.

Fig. 46. Components of KAN-therm surface heating/cooling

4.1 KAN-therm heating pipes

KAN-therm system high quality polyethylene pipes with anti-diffusion barrier and multilayer polyethylene pipes for all types of surface heating and cooling.

KAN-therm PE RT pipes are made from acetate copolymer of polyethylene with improved thermal resistance and excellent mechanical properties. Properties of the pipes and the range of their operating conditions correspond with PN EN ISO 22391-2:2010.

KAN-therm PE-Xc pipes are made from high density polyethylene subjected to the molecular electron beam crosslinking ("c" method - physical method, no chemicals involved). Such crosslinking of polyethylene structure ensures the most optimum, high resistance to thermal and mechanical loads. Degree of crosslinking> 60%. Properties of the pipes and the range of their operating conditions correspond with PN EN ISO 15875–2:2005.

Both types of pipes feature a barrier preventing ingress (diffusion) of oxygen to heating water through pipe walls. The EVOH barrier (ethylene vinyl alcohol) meets the requirements of DIN 4726, (permeability <0.10 g $O_2/m^3 \times d$).

KAN-therm multilayer pipes comprise of the following layers: an inner layer (core pipe) of PE-RT polyethylene with improved thermal resistance, a middle layer of an aluminium strip, ultrasonically butt-welded as well as an outer layer of PE-RT polyethylene with improved temperature resistance. Between aluminium and plastic layers the pipes feature an adhesive binding layer for permanent binding of the metal and plastic material.

Properties of the pipes and the range of their operating conditions correspond with PN EN ISO 21003–2:2009.

Fig. 47. Design of PE-RT and PE-Xc pipes with z anti-diffusion barrier

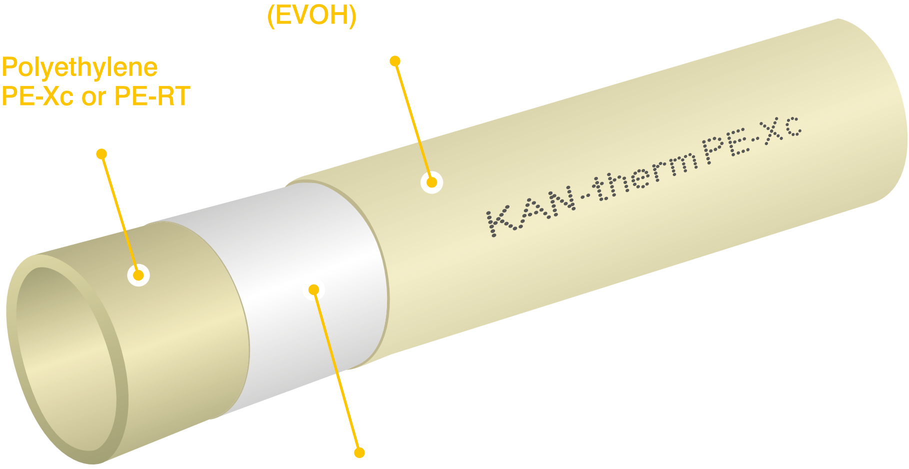
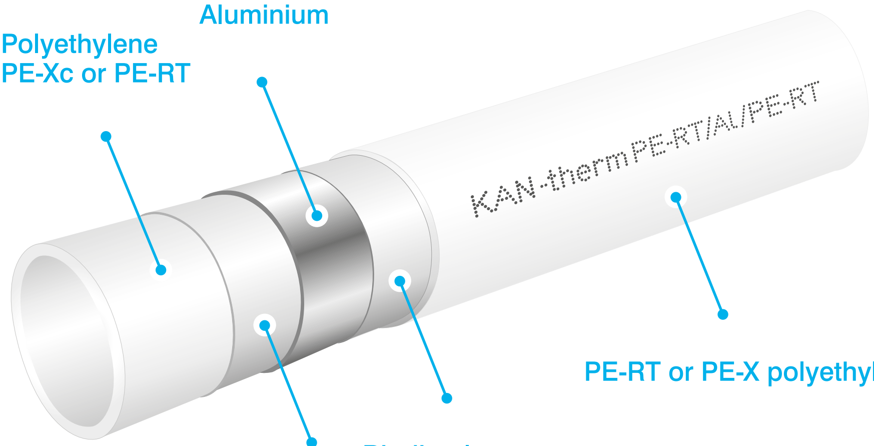


Fig. 48. Design of KAN-therm multilayer pipes



4.1.1 Properties of KAN-therm heating pipes

Property	Symbol	Unit	PE-Xc	PE-RT	PE-RT/Al/PE-RT
Linear elongation coef- ficient	α	mm/m × K	0.14 (20°C) 0.20 (100°C)	0.18	0.025
Heat conductivity	λ	W/m × K	0.35	0.41	0.43
Nominal bending radius	R_{min}		5 × D	5 × D	5 × D
External wall coarseness	k	mm	0.007	0.007	0.007
Anti-diffusion barrier			EVOH (< 0.1 g/m³ × d)	EVOH (< 0.1 g/m³ × d)	Al
Max. operating condi- tions	T_{max}/P_{max}	°C/bar	90/6	90/6	90/10

4.1.2 Parameters of KAN-therm heating pipes

DN	Outer diameter × wall thickness	Inner diameter	Unit weight	Water volume	Number in one coil	Colour
	mm × mm	mm	kg/m	l/m	m	
KAN-therm PE-RT pipes						
12	12 × 2.0	8.0	0.071	0.050	200	milky
14	14 × 2.0	10.0	0.085	0.079	200	milky
16	16 × 2.0	12.0	0.094	0.113	200. 600	milky, blue (BlueFloor)
18	18 × 2.0	14.0	0.113	0.154	200	red, blue (BlueFloor)
20	20 × 2.0	16.0	0.172	0.201	200	milky
25	25 × 3.5	18.0	0.247	0.254	50	milky
KAN-therm PE-Xc pipes						
12	12 × 2.0	8.0	0.071	0.050	200	cream-coloured
14	14 × 2.0	10.0	0.085	0.079	200	cream-cloured
16	16 × 2.0	12.0	0.094	0.113	200	cream-coloured
18	18 × 2.0	14.0	0.113	0.154	200	cream-coloured
20	20 × 2.0	16.0	0.141	0.201	200	cream-coloured
25	25 × 3.5	18.0	0.247	0.254	50	cream-coloured
KAN-therm PE-RT/Al/PE-RT pipes						
14	14 × 2.0	10	0.102	0.079	200	white
16	16 × 2.0	12	0.129	0.113	200	white
20	20 × 2.0	16	0.152	0.201	100	white
25	25 × 2.5	20	0.239	0.314	50	white
26	26 × 3.0	20	0.296	0.314	50	white

4.1.3 Heating pipe connections, repairability

As far as practical avoid connecting pipe sections in loops. Never connect pipes on bends. Any damaged of already arranged pipes (such as accidental drilling through pipes) can be repaired by removing the damaged section (perpendicularly to pipe axis) and connecting both ends with a clamp connector. To repair a pipe covered with concrete a fairly long groove must be cut out.

Permanent clamp connectors of brass or PPSU plastic are KAN-therm system recommended connections for pipe sections. Depening on the pipe type these could be brass push rings connectors (KAN-therm Push system) or KAN-therm Press LBP steel pressed ring connectors. Temporary connections (twisted) must not be used except when such connector is placed in an ispection hole.

Fig. 49. KAN-therm Push connector for PE-Xc and PE-RT pipes, diameters 12 × 2, 14 × 2, 18 × 2, 18 × 2,5, 25 × 3,5

Fig. 50. KAN-therm Push LBP connector for multilayer pipes 16 × 2, 20 × 2, 25 × 2.5

4.2 KAN-therm manifolds

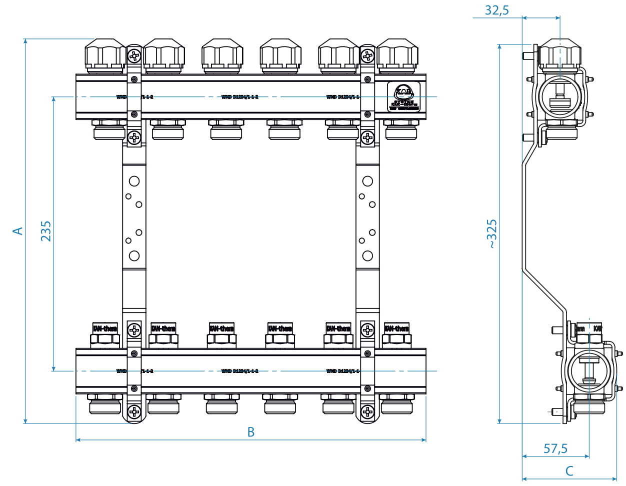
Manifolds are the elements of the system that enable distribution and control of the heating medium. KAN-therm system offers a wide range of manifolds: from simple solutions with control valves at the bottom beam (51A series) to modern manifolds with flow meters and thermostatic valves featuring thermoelectric actuators (75A series).

For smaller floor heating installations (up to several dozen tens m^2) KAN-therm system has on offer a convenient and cost effective model of heating loop manifold combined with pump mixing system (manifold series 73A and 77A). This solution is particularly useful for mixed systems, where low-temperature floor heating system works in combination with radiator heating system.

KAN-therm also offers independent pumping groups, which can be combined with any KAN-therm system floor heating manifold.

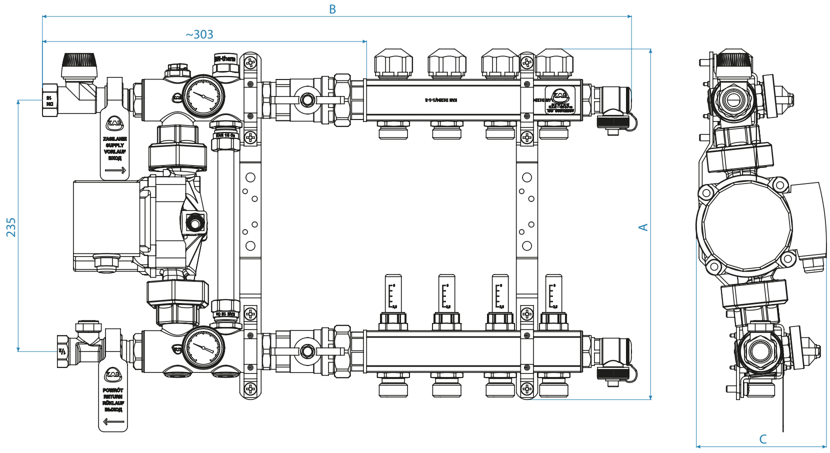
All manifolds, made of high quality brass 1" sections, feature connector pipes with ¾" external thread (Eurocone).

4.2.1 KAN-therm 7xx series monifold assembly dimensions

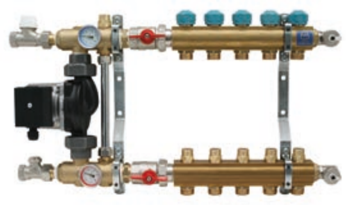
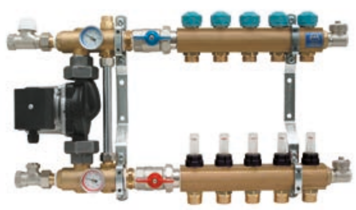


KAN-therm surface heating manifolds

Number of circuits	Series 51A	Series 55A	Series 71A	Series 75A
				
	Dimensions (h. A x w. B x d. C)			
2	326 × 100 × 80	326 × 100 × 80	326 × 100 × 80	326 × 100 × 80
3	326 × 150 × 80	326 × 150 × 80	326 × 150 × 80	326 × 150 × 80
4	326 × 200 × 80	326 × 200 × 80	326 × 200 × 80	326 × 200 × 80
5	326 × 250 × 80	326 × 250 × 80	326 × 250 × 80	326 × 250 × 80
6	326 × 300 × 80	326 × 300 × 80	326 × 300 × 80	326 × 300 × 80
7	326 × 350 × 80	326 × 350 × 80	326 × 350 × 80	326 × 350 × 80
8	326 × 400 × 80	326 × 400 × 80	326 × 400 × 80	326 × 400 × 80
9	326 × 450 × 80	326 × 450 × 80	326 × 450 × 80	326 × 450 × 80
10	326 × 500 × 80	326 × 500 × 80	326 × 500 × 80	326 × 500 × 80
11	326 × 550 × 80	326 × 550 × 80	326 × 550 × 80	326 × 550 × 80
12	326 × 600 × 80	326 × 600 × 80	326 × 600 × 80	326 × 600 × 80
	Brass profile with 1” female thread Stub pipe spacing 50 mm Manifold beam spacing 235 mm			
A full set includes:	– ¾” male thread stub pipes – control valves on bottom beam; – set of mounting brackets with vibration damping insert.	– ¾” male thread stub pipes; – control and measuring valves (flow meters) on bottom beam; – set of mounting brackets with vibration damping insert.	– ¾” male thread stub pipes – control valves on bottom beam; – shut-off valves for electric cylinders with caps; – set of mounting brackets with vibration damping insert.	– ¾” male thread stub pipes; – control and measuring valves (flow meters) on bottom beam; – shut-off valves for electric cylinders with caps; – set of mounting brackets with vibration damping insert.



KAN-therm surface heating manifolds with mixing system

Number of circuits	Series 73A	Series 77A
		
	Dimensions (h. A x w. B x d. C)	
2	410 × 451 × 123	410 × 451 × 123
3	410 × 501 × 123	410 × 501 × 123
4	410 × 551 × 123	410 × 551 × 123
5	410 × 601 × 123	410 × 601 × 123
6	410 × 651 × 123	410 × 651 × 123
7	410 × 701 × 123	410 × 701 × 123
8	410 × 751 × 123	410 × 751 × 123
9	410 × 801 × 123	410 × 801 × 123
10	410 × 851 × 123	410 × 851 × 123

Brass profile with 1" female thread
Stub pipe spacing 50 mm
Manifold beam spacing 235 mm

A full set includes:

	Series 73A	Series 77A
A full set includes:	– ¾" male thread stub pipes; – control valves on bottom beam; – shut-off valves for electric cylinders with caps; - 2 vent and drain valves; – set of mounting brackets with vibration damping insert.	– ¾" male thread stub pipes; – control and measuring valves (flow meters) on bottom beam; – shut-off valves for electric cylinders with caps; - 2 vent and drain valves; – set of mounting brackets with vibration damping insert.
	– 2 1" shut-off valves – ½" thermostatic valve – ½" control valve - 2 dial thermometers - by-pass with control valve - non-diaphragm pump RS 25/6	

KAN-therm system manifold offering also includes a wide range of accessories: plugs and adapters as well as manifold beam extension pieces, straight and angled connection valves, vents and drain valves, electric actuators as well as pipe joints for switching the heating pipes.

Discriptions and manuals of manifolds are available in separate brochures from **en.kan-therm.com**.

73A and 77A series manifold instruction manual

51A, 55A, 71A and 75A series manifold instruction manual

4.3 KAN-therm installation cabinets

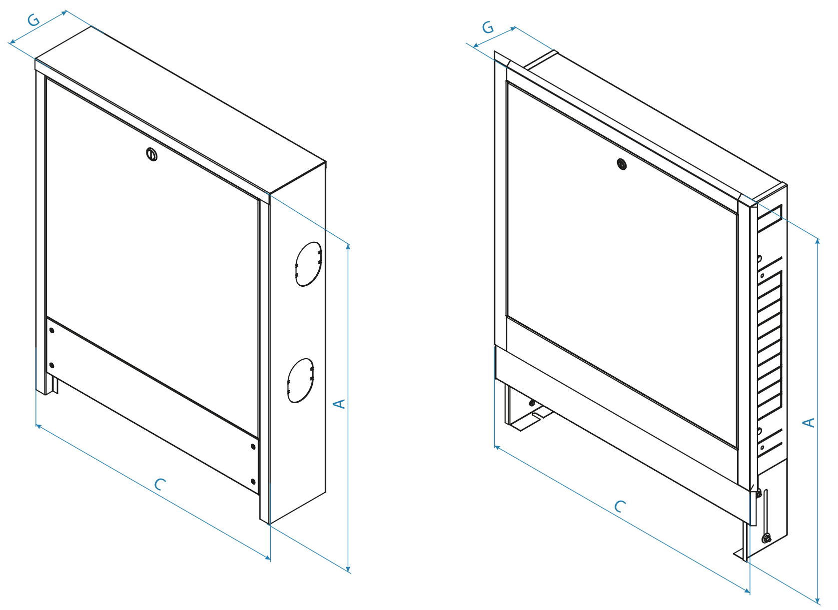
Surface heating/cooling manifolds are assembled in installation cabinets, available as SWN-OP surface mounted cabinets as well as SWP-OP and SWPG-OP flush mounted cabinets. All cabinets are made of metal sheets galvanized both sides and coated with a layer of RAL 9016 durable powder paint (white). The door of SWPG-OP can be covered with ceramic tiles.

Fig. 51. Installation cabinets: SWN-OP surface mounted, SWP-OP and SWPG-OP flush mounted

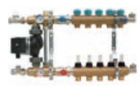
Flush mounted cabinets feature adjustable dimensions: height and width (SWP-OP) as well as depth (SWPG-OP). The design of the cabinets is also suitable for manifolds with mixing system. The cabinets feature space for terminal strips, to be fixed with screws to holes in mounting rail, provided in the upper part of the cabinet.

Dimensions and selection of cabinets based on the type of manifold, basic accessories and the method of connection can be found in the table.

Fig. 52. KAN-therm installation cabinet dimensions



Dimensions and selection of cabinets based on the type of manifold, basic accessories and the method of connection

Selection of installation cabinets								
						Number of manifold circuits		
Type od installation	Photo	Cabinet type	Height A [mm]	Width B [mm]	Depth G [mm]	OP manifold	OP manifold + Set- P/Set-K	OP manifold with mixing system
								
Additional accessories								
Surface mounted		SWN-OP – 10/3	710	580	140	2–10	2–7/2–6	2–3
		SWN-OP – 13/7	710	780	140	11–13	8–11/7–10	4–7
		SWN-OP – 15/10	710	930	140	14–15	12–14/11-13	8–10
Flush mounted		SWP-OP –10/3	750–850	580	110–165	2–10	2–7/2–6	2–3
		SWP-OP – 13/7	750–850	780	110–165	11–13	8–11/7–10	4–7
		SWP-OP – 15/10	750–850	930	110–165	14–15	12–14/11-13	8–10
		SWPG-OP – 10/3	570	580	110–165	2–10	2–7/2–6	2–3
		SWPG-OP – 13/7	570	780	110–165	11–13	8–11/7–10	4–7
		SWPG-OP – 15/10	570	930	110–165	14–15	12–14/11-13	8–10

4.4 Pipe mounting systems in KAN-therm surface heating/cooling

KAN-therm system features a wide choice of heating pipes connection methods that help implement various types of floor and wall heaters, performed using both by the wet and the dry method.

4.4.1 System KAN-therm Tacker

Pipes are fastened directly, manually or with a dedicated tool, to KAN-therm Tracker thermal insulation using plastic clips - Tackers (two versions, depending on the clip length). The top layer of insulation is reinforced with a composite film layer to ensure better grip of clips and to separate the insulation from the screed layer. The system is used in the wet method.

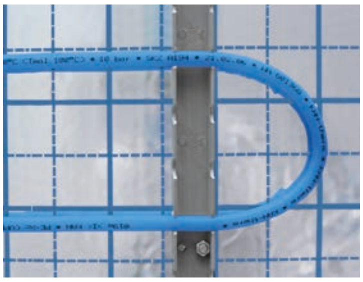
Fastening elements

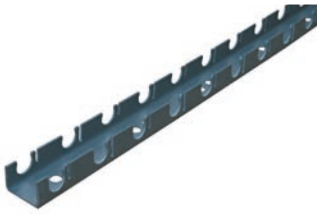
— clips for mounting pipes of 14 - 18 mm and 14-20 mm diameter.

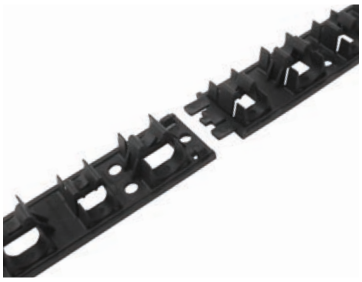
Note! With 20 mm thick insulation mount the pipes using short clips as well as the dedicated tool (tacker) to be used with this type of clips.

4.4.2 System KAN-therm Rail

Pipes are placed in profiled plastic strips (spaced every 5 cm). Strips are attached to the insulation layer by means of pins or dowels to the building partition (in case of wall heating). For insulation use KAN-therm Tracker system insulation boards with metallised or laminated foil. Rail strip used in the wet and dry (heating of joist floors). Rail strips are also used for mounting pipes in heating systems for outdoor surfaces (by mounting the stips to the ground substrate).







Fastening elements

— plastic strips (troughs) for pipes with diameters of:
16 mm - 2 m long
18 mm - 2 m long
20 mm - 3 m long
25 mm - 3 m long.

— Plastic modular strips for pipes with diameters of:
12 - 17 mm - 0.2 m long
16 - 17 mm - 0.5 m long
12 - 22 mm - 1 m long.

4.4.3 System KAN-therm Profil

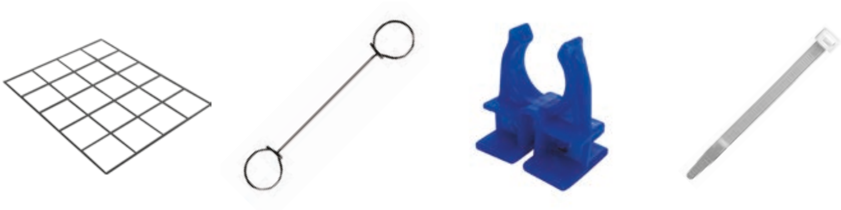
Heating pipes are placed, by pressing, between special tabs, profiled on the thermal insulation (KAN-therm Profil system styrofoam sheets).

4.4.4 System KAN-therm TBS

Heating pipes are placed in profiled, grooved insulation boards that are covered with dry screed plates. The heat from the heating pipes is evenly radiated to the dry screed boards through steel radiating lamellae, placed in the board channels.

4.4.5 System KAN-therm NET

Heating pipes are mounted on a mat (grid) laid on the insulation, made of 3 mm wire, using plastic bands or holders laced on the grid (holders are used for 16, 18 and 20 mm diameter pipes). Holders provide 17 mm gap between the pipes and insulation. The NET grid is 1,2 m x 2,1 m in dimension with 150 x 50 mm mesh. Grids are connected together using wire lacing.



Range of application of individual pipe mounting systems

System	Outer pipe diameters	Pipe spacing/pitch	Insulation	Pipe arrangement	Methods
KAN-therm Tacker	14, 16, 18, 20	10 – 30/5	KAN-therm Profil styrofoam sheets	series pattern, spiral pattern	wet
KAN-therm Profil	16, 18	5 – 30/5	KAN-therm Profil styrofoam sheets	series pattern, spiral pattern	wet
KAN-therm Rail	12, 14, 16, 18, 20, 25, 26	10 – 30/5	KAN-therm Tracker styrofoam sheets or without insulation (wall heating, external surfaces)	series pattern, spiral pattern	wet or dry, pipes mounted on ground substrate
KAN-therm TBS	14, 16	167, 250, 333	KAN-therm TBS styrofoam sheets with metal lamellae	series pattern of pipes	dry
KAN-therm NET	16, 18, 20, 25, 26	any	KAN-therm Tracker styrofoam sheets or EPS standard styrofoam sheets + damp-proof foil No insulation for monolithic structures or outdoor surfaces.	series pattern, spiral pattern	wet

Irrespective of the pipe mounting system used, while changing pipe direction be aware of the permissible bending radius of the pipe.

4.5 Dilatation tapes and profiles

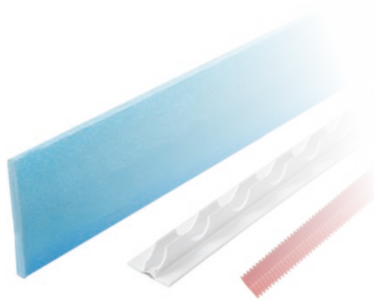
KAN-therm system offers proven components that provide proper dilatation of heating surfaces as well as separation from building envelope elements and structural elements.

KAN-therm wall tapes

Made of polyethylene foam with 8 mm thick and 150 high, to be arranged along alls, pillars, at the edge of heating plate. Effective dilatation for floor thermal movements, also feature as thermal insulation, reduce heat losses through walls. Notched to adjust the height after after laying the concrete slab. Tapes with apron prevent penetration of liquid screed underneath thermal insulation.

KAN-therm Profil dilatation profiles

To be mounted in dilatation gaps provided during installation. Also available notched tapes of polyethylene foam and dimension of 10 × 150 mm. Transit coil pipes cutting through profiles should be placed in casing pipes (conduit) 0,4 m long. Profile sets, comprising PE dilatation tape, mounting rail and casing pipe sections also available.



4.6 Other elements.

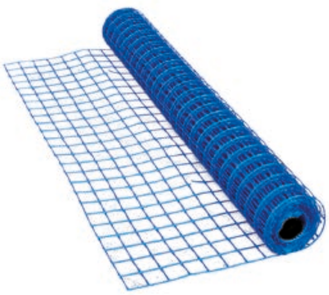
Concrete plasticizers BETOKAN and BETOKAN Plus

Used to improve workability and strength properties of screed flooring and to increase their thermal conductivity. Available in packs of 5 and 10 kg (BETOKAN) and 10 kg BETOKAN Plus. BETOKAN Plus helps reduce the thickness of concrete slab above insulation (6,5 cm) to 4,5 cm.

See chapter "Surface heater design - Cement screed" for tips on using conrete plasticizers.

Fiberglass grid for reinforcement of floors

Used for reinforcement of concrete slabs. Delivered in rolls of 1 × 50 m. Grid thickness 1,7 mm, mesh size of 40 × 40 mm. Used in combination with BETOKAN or BETOKAN Plus concrete plasticizers to increase flexibility of flooring and as the ideal protection against formation of cracks and faults.



5 KAN-therm adjustment and automation

5.1 General information

Water surface heating/cooling systems feature large heating inertia and relatively low heating systems supply temperature. Those factors determine the means of systems control. The adjustment of heating systems is responsible for ensuring thermal comfort in heated/cooled rooms, with an optimal energy consumption. In order to maintain the above mentioned requirements in changing environmental conditions (change of external temperature, insolation, changes in the method of use), the parameters of water supplying the coils should be properly controlled - its temperature (quality adjustment) or its flow (quantity adjustment). The adjustment can be done manually or in automatic mode, using proper sensors, regulators and drivers.

The temperature control in the rooms may be done centrally, at the level of heat source (boiler or a system supplying heat to surface heaters in the whole object). The temperature may also be individually adjusted in each room through thermostatic valves with actuators, placed in heating circuits manifolds (local adjustment). The best effect for comfort and energy saving is achieved through connection of local and central adjustment, which reacts to the external temperature.

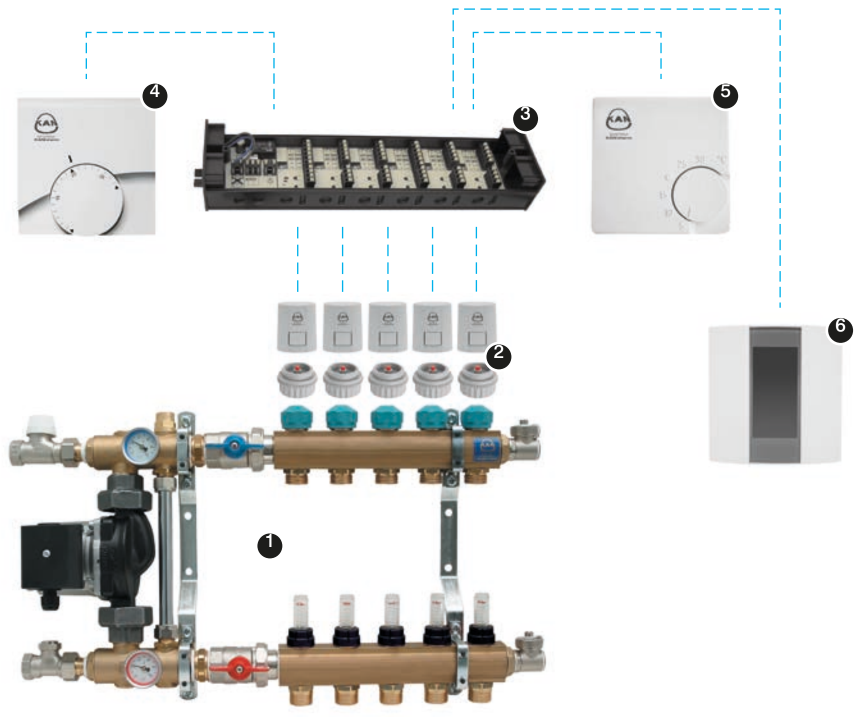


Fig. 53. Example configuration of local, wired KAN-therm surface heating automatics

1. KAN-therm manifold with a mixing pump system
2. KAN-therm Smart electric actuators
3. Basic 230V electrical terminal block
4. Basic 230V electronic thermostat
5. Basic 24V/230V bimetallic thermostat
6. 230V week electric thermostat

The operation of adjustment devices supports, typical for surface heaters, self-adjustment effect. Self-adjustment properties are due to relatively small temperature differences Δt between the temperature of heating surface (floor, wall) and the temperature in the room. Even small change of air temperature in the room causes significant (in comparison with high-temperature radiators) change of temperature difference Δt, which determines the level of heat flux given off by a heating surface. If in a room, due to periodic insolation, the air temperature increases by 1K (from 20 to 21), the heat flux given off by the floor of surface temperature 23°C shall decrease by 1/3.

Fig. 54. KAN-therm Smart wireless temperature adjustment elements

5.2 Adjustment and automation elements

KAN-therm System offers a vast variety of modern devices that allow for supplying heating to coils of the medium of proper parameters and efficient control of surface heating/cooling systems, both in manual and automatic mode. Adjustment systems are available in 230V or 24V cable versions, as well as versions operating in wireless technology (radio automatics).

5.2.1 KAN-therm mixing systems

Water surface heaters require lower supply temperature than radiator heating. The maximum temperature of supplying water should not exceed 55°C. Therefore, in case of a common with radiator heating thermal source, the solutions, which lower the temperature of power supply, should be applied. The systems based on mixing the heating water flowing from the heating source with radiator installation return water are available in KAN-therm System.

KAN-therm surface heating can also be directly supplied from low-temperature heat sources, such as condensing boilers or heat pumps.

Central mixing systems, supplying all surface heaters in the object, distributed at different levels, as well as local mixing systems, which supply heating circuits with a heating medium within a single manifold, can be distinguished in relation to the mixing system range.

5.2.1.1 Central mixing systems

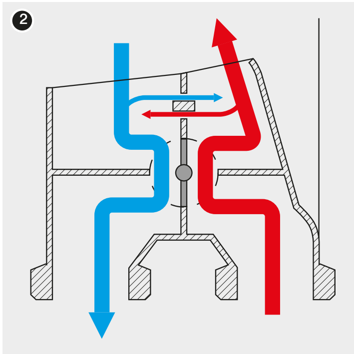
Central mixing system is based on the KAN-Bloc mixer with 4-way valve and provides two options of central preparation of heating medium - with automatic and semi-automatic adjustment.

KAN-Block T40 mixing and pumping unit in a compact construction includes: 4-way mixing valve, pressure relief valve, safety valve, three-drive pump (U35 and U55) and two thermometers on the supply and return of surface heating circuit.

All spigots of the device (of 90 mm spacing) are equipped with fittings with GW1". The mixing degree is set manually or in an automatic mode through SM4 actuator.

4-way mixer is equipped with regulated by-pass damper, located between low-temperature installation heating water supply and return. This by-pass is responsible for protecting the installation against excessive temperature on the power supply.

1. KAN-therm Bloc mixer provided with 4-way valve with thermo-insulated housing
2. Operation principle of 4-way valve in KAN-bloc mixer



KAN-Block is delivered in an insulation housing, protecting against heat loss.

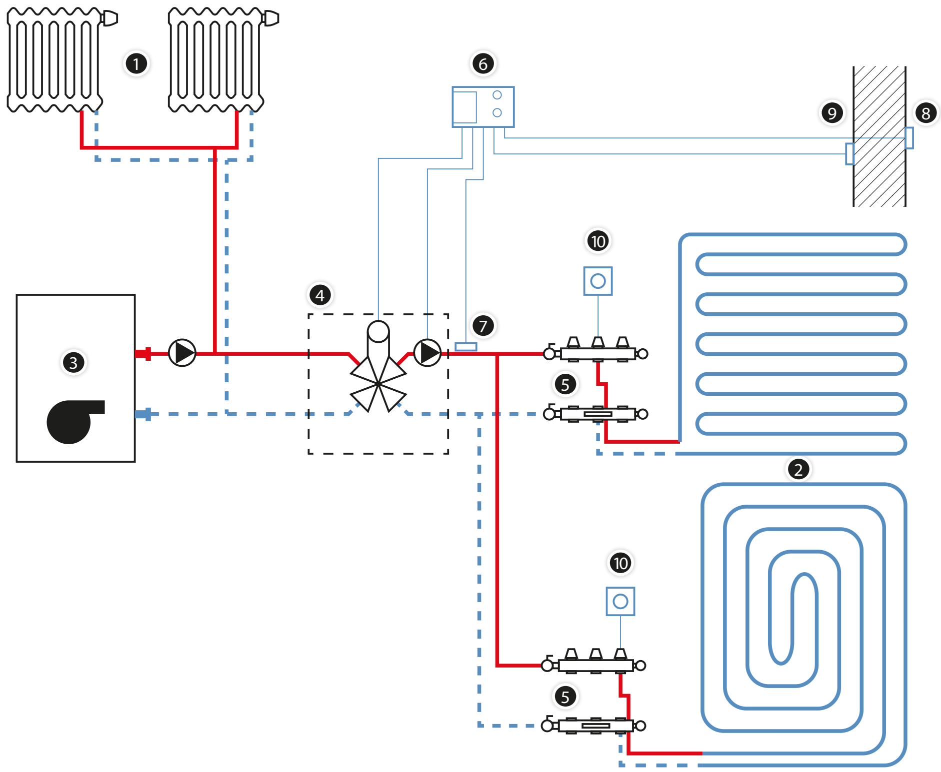
"KAN-Bloc mixing and pumping units" manual

System with automatic adjustment

Is composed of KAN-Bloc mixing unit, equipped with SM4 actuator, which is controlled by Lago Basic weather regulator that contains external temperature sensor and heating installation supply temperature contact sensor. Additionally, the system may be supplemented with internal temperature sensor (remote control system), placed in the representative room of the object.

Fig. 55. Central mixing system with automatic adjustment diagram

1. High-temperature heating
2. Floor/wall heating
3. Heat source
4. Mixer with KAN-Bloc 4-way valve provided with SM4 actuator
5. KAN-therm surface heater manifolds
6. KAN-therm weather regulator
7. Surface installation supply temperature sensor
8. Outside temperature sensor
9. Room temperature sensor with a remote control
10. Room thermostats



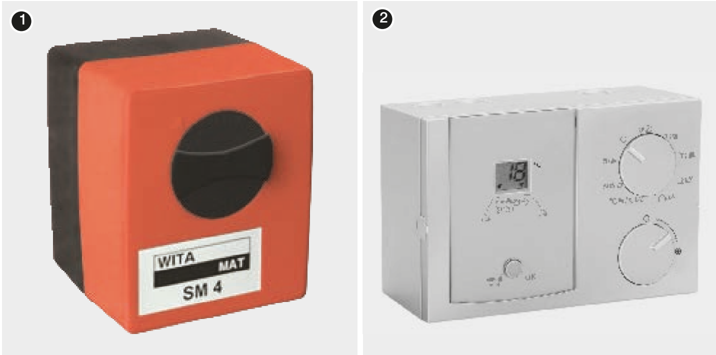


Fig. 56. Control elements of KAN-therm central mixing system (SM4 actuator (1) and weather regulator(2))

The weather regulator sets the low-temperature installation power supply temperature, depending on the external temperature, in accordance with heating curve.

The system implements quality adjustment with variable supply temperature at a constant flow of heating medium. Such configuration is not suitable for condensing boilers.

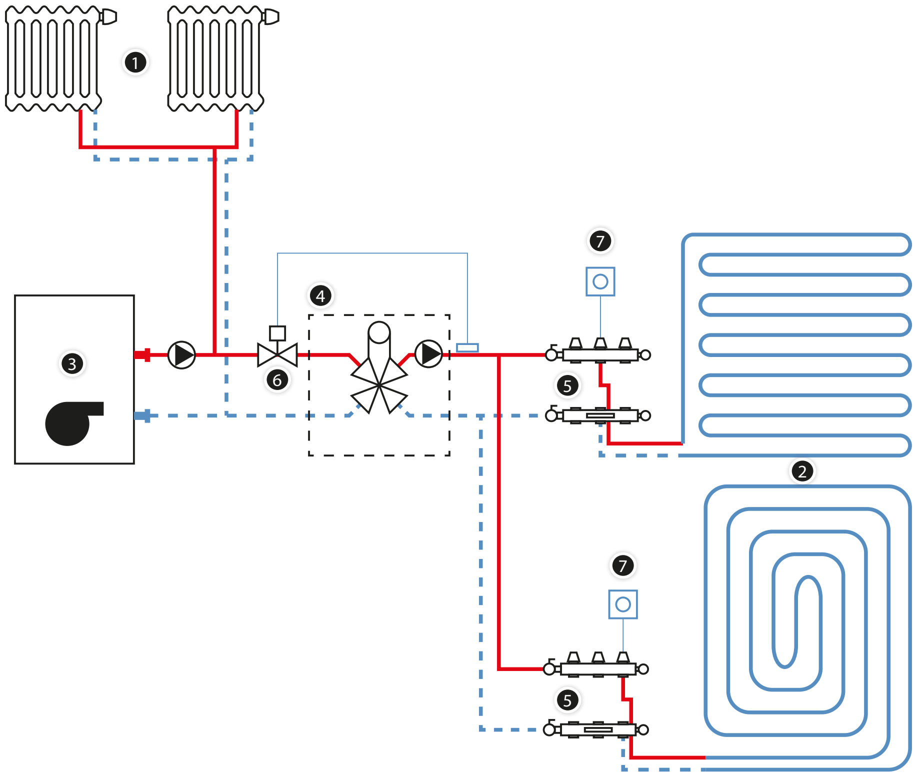


Fig. 57. Central mixing system with semi-automatic adjustment diagram

1. High-temperature heating
2. Floor/wall heating
3. Heat source
4. KAN-Bloc mixer provided with 4-way valve
5. KAN-therm surface heater manifolds
6. Valve provided with thermostatic heading with capillary and contact sensor
7. Room thermostats

The assembly of devices and sensors should be performed in accordance with available manuals.

System **with semi-automatic adjustment**

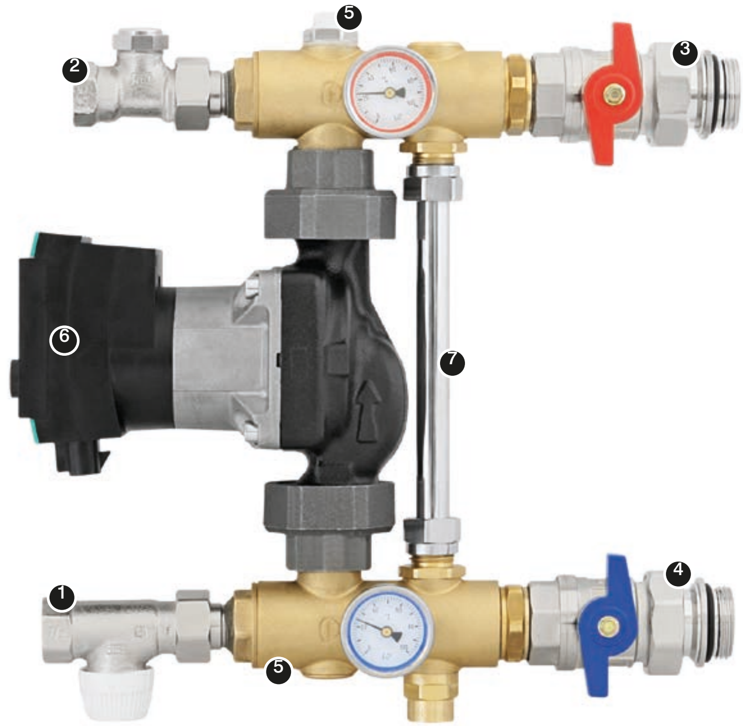
Is composed of KAN-Bloc mixing assembly with mounted on the supply, from the boiler side, thermostatic valve, equipped with a heading (actuator) with a remote (on capillary) contact sensor. This valve is responsible for maintaining constant surface heating installation supply temperature.

5.2.1.2 KAN-therm local mixing systems

KAN-therm local mixing systems are applied in high-temperature installations (radiator) when there is a need to ensure a heating medium of lower parameters for a coil unit, supported by a single manifold. Lowering the supply temperature to the values proper for surface heatings takes place on the basis of pumping mixing. It is a system of constant temperature, implemented through quantity adjustment.

Fig. 58. KAN-therm pump unit design

1. ZT GW½" thermostatic valve
2. ZR GW½" control valve
3. G1" cut-off valve of the supplying beam
4. G1" cut-off valve of the return beam
5. dial thermometers
6. Wilo-Yonos PARA glandless pump
7. by-pass with control valve

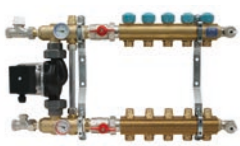
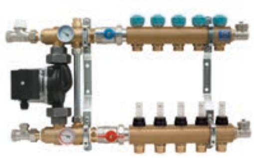


Mixing system is composed of a pump (three-stage or stepless depending on a version), ZR control valve, regulated by-pass, ZT thermostatic valve, 1" terminals to manifold and high-temperature installation, as well as 2 thermostats.

There are two device options available: individual pump units, cooperating with any surface heating manifolds and interlocked pump units with KAN-therm manifolds.

Construction, mounting, start-up and operation of individual mixing systems versions are included in the manuals. The manuals contain charts with pump and ZR control valve properties.

KAN-therm pump mixing systems properties

Mixing set type		Pump	Manifold
Pump group with a 73A series manifold		RS25/6 three-speed 4 m³/h – 6 m	included in the set, 2 - 10 circuits with control valves Included in the set 2 drain valves
Pump group with a 77A series manifold		RS25/6 three-speed 4 m³/h – 6 m	included in the set, 2 - 10 circuits with flowmeters Included in the set 2 drain valves
Pump group K-803000		RS25/4 Three-speed 3.5 m3/h – 4 m	—

Mixing set type		Pump	Manifold
Pump group K-803001		RS25/6 three-speed 4 m3/h – 6 m	—
Pump group K-803002		Wilo-Yonos PARA stepless, electronic 2.5 m3/h – 4 m	—
All versions include: pump, G½" thermostatic valve, G½" control valve, by-pass with control valve, 2 1" switching valves, 2 dial thermometers			
Pump group K-803003		Wilo-Yonos PARA stepless, electronic 2.5 m3/h – 4 m	—
Includes: a pump, G1" three-way thermostatic valve, 2 1" attachable fittings, 2 dial thermometers			

KAN-therm local pump mixing system operation

The system operates on the principle of mixing heating water from the heating source with the water from coils return. The mixing pump directs some of the water, which has the temperature proper for surface heating, to the coils supplying manifold, and some, through the ZR control valve, to the system supplying installation return pipeline. The proper degree of water mixing is achieved by adjusting the ZR control valve.

Before mixing, the water supplied to the system flows through ZT thermostatic valve, which can be controlled by a heading with contact sensor, placed on coils supplying manifold beam. It is possible to manually set a constant surface heating supply temperature value on the valve.

The adjustment of surface heater power is made through, located at the manifold's beam, thermostatic valves, controlled by electric actuators, connected with room thermostats.

Embedded in the set by-bass with a control valve, protects the pump in case of simultaneous closing of all valves on the supplying manifold and cutting off of all coils (e.g. at simultaneous closing of all actuators on manifold thermostatic valves).

Those systems shall not function properly with low-temperature heating sources, e.g. condensing boilers.

Note

Connection places of supplying and return pipelines in mixing sets of 73A and 75A series, are different than connections for pump assemblies of K-80300x series (connection places and flow directions are presented on the diagrams below).

Fig. 59. Local mixing system

1. High-temperature heating
2. Floor/wall heating
3. Heat source
4. KAN-therm mixing system, pump, with a control valve with thermostatic heading with capillary and contact sensor
5. Room thermostats

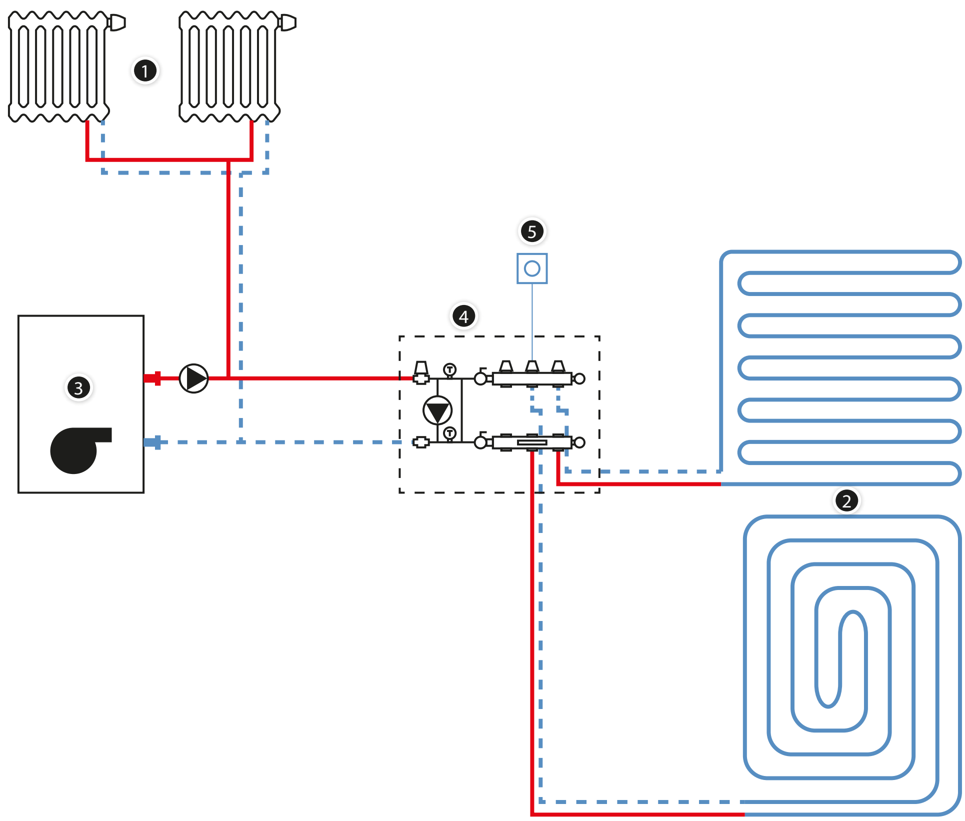


Fig. 60. Manifold provided with 77A (or 73A) mixing system

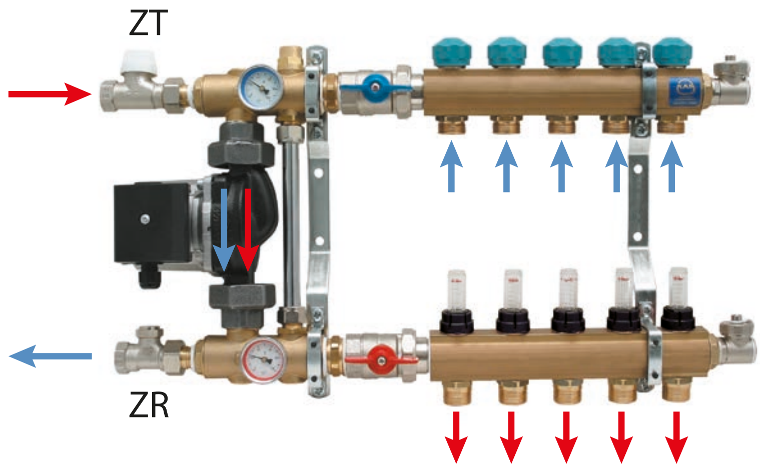
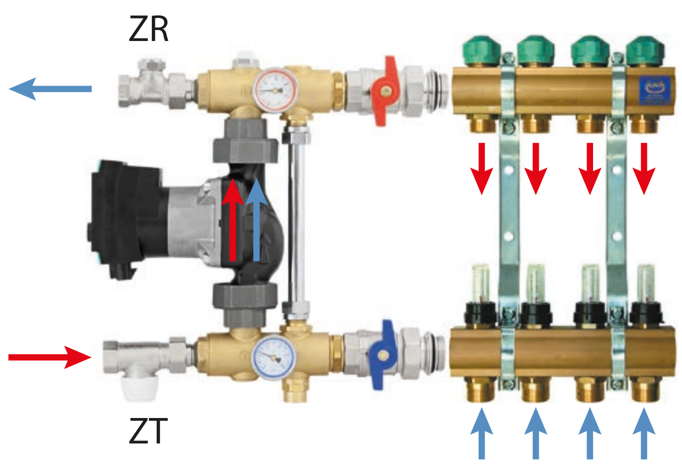


Fig. 61. K-803003 (or K-803000, K-803001) pump group with 75A (or 71A, 55A, 51A) manifold - flow directions



5.2.2 KAN-therm thermostats and regulators

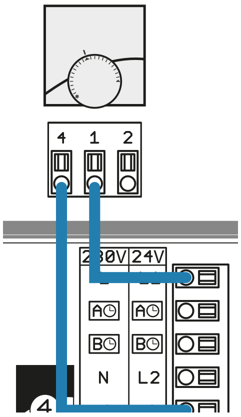
KAN-therm System provides a wide variety of room thermostats and more complex week regulators. Those devices are available in 230 and 24 V versions, as well as wireless and radio versions. 24V devices should be applied in the places, where safe voltage is required (e.g. rooms of high humidity), as well as in buildings, in which the electric installation is not equipped with shock protection.

5.2.2.1 KAN-therm cable thermostats

230V/24V bimetallic room thermostat

Basic bimetallic room thermostat is responsible for controlling executive elements - electric actuators in KAN-therm surface heating and allows for individual adjustment of temperature in room. The thermostat can be mounted inside flush-mounted box or directly on a wall. The device can operate in both 24V and 230V installation.

Fig. 62. Clamps and 24 – 230V (0.6107) bimetallic thermostat connection to the Basic electrical terminal block diagram



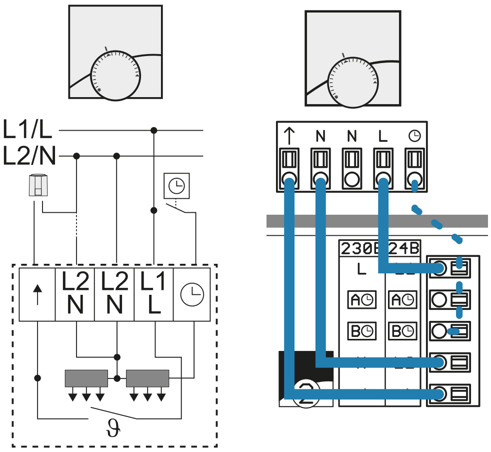
Basic 230V or 24V room thermostat

Basic electric room thermostat is responsible for controlling executive elements - electric actuators in KAN-therm surface heating and allows for individual regulation of temperature in a room. The thermostat can be mounted inside flush-mounted box or directly on a wall. It is available in 24V and 230V versions.

Thermostat features:

- adjustment of temperature setting - from 2K up to 2K,
- lowering of temperature by 4K, controlled by an external clock,
- operation signalling (heating) with LED diode,
- temperature setting range limiter,
- protection against electronic system overload,

Fig. 63. Clamps and Basic 230 or 24V thermostat connection to Basic electrical terminal blocks diagram (with an option of periodic temperature lowering through connection of a clock)



“Basic 230V/24V K room thermostat - 800100/800101” manual

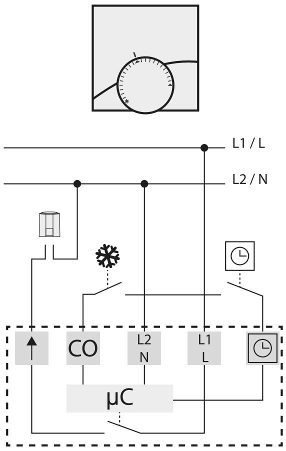
Basic 230V or 24V heating/cooling room thermostat

Basic heating/cooling electronic room thermostat is responsible for controlling executive elements - electric actuators in KAN-therm surface heating and allows for individual adjustment of temperature in a room. The thermostat can be mounted inside flush-mounted box or directly on a wall. It is available in 24V and 230V versions.

Thermostat features:

- adjustment of temperature setting - from 2K up to 2K,
- lowering of temperature by 4K, controlled by an external clock,
- temperature setting range limiter,
- protection against electronic system overload,

Fig. 64. Clamps and Basic 230 or 24V heating/cooling thermostat connection diagram (with an option of periodic temperature lowering by connecting a clock)

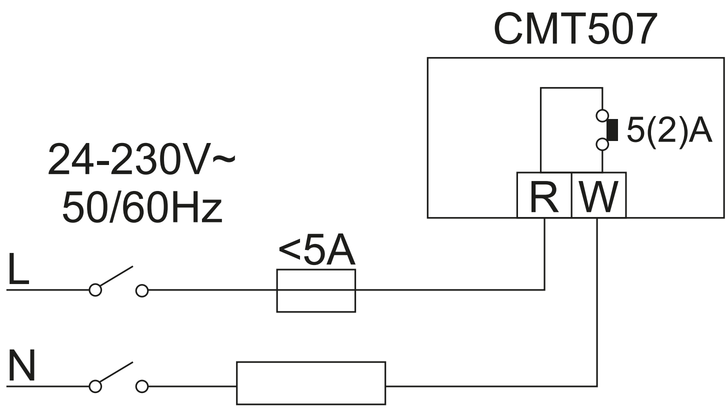


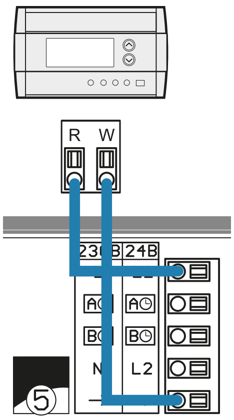
"Basic 230V/24V heating/cooling thermostat K-800035/800036" manual

24/230V week regulator

Electronic thermostat with a display, used to regulate temperature in a room with a function of weekly programming. It allows temperature adjustment in manual and automatic modes. Cooperates with Basic 230V or 24V electrical terminal blocks.

Fig. 65. Clamps and 24 – 230V week regulator connection to Basic electrical terminal block diagram





“Programmable CM 507 regulator K-800201” manual

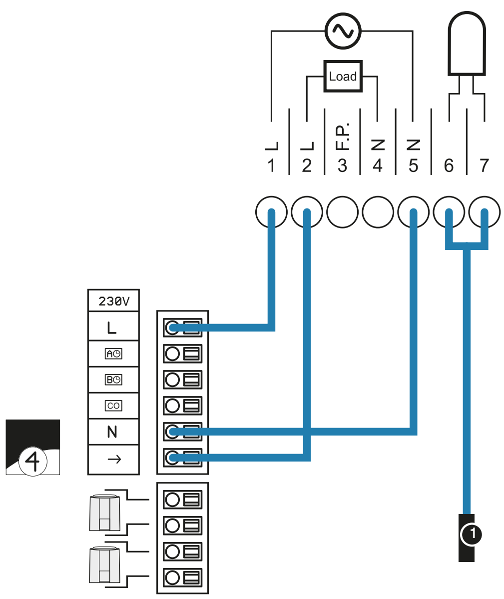
Week regulator with 230V floor sensor

This thermostat allows for individual adjustment of a room temperature with a function of weekly programming, it provides a possibility to set 4 times during a day. It is equipped with a floor temperature sensor. Operates in 3 adjustment modes: A - air temperature in a room, F - floor temperature, AF - air and floor temperature. Thermostat has a manual and automatic adjustment option, with comfort or economic temperature settings. It can cooperate with Basic electrical terminal blocks version 230V.

“Programmable thermostat TH232-AF-230” manual

Fig. 66. Clamps and TH232-AF week thermostat connection diagram

1. Floor temperature sensor



The list of basic technical parameters and 230V or 24V thermostats functions

230V KAN-therm thermostats and cable regulators

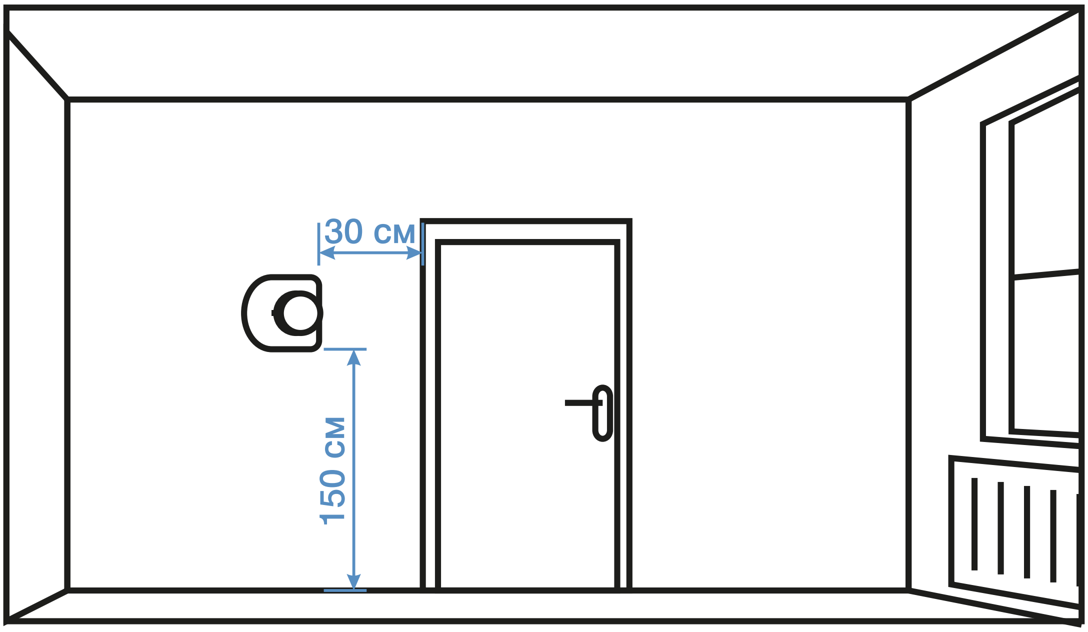
Type/model		Features and functions						Cooperation
		Max number of actuators	Cooling	Programming	Adjustment range °C	Temperature reduction	Rate setting adjustment	LE Electric terminal blocks
Bimetallic room thermostat		10	—	—	5–30			LE Basic 230V
Room thermostat (with a diode), electronic Basic		10	—	—	10–28	4K	+/-2K	LE Basic 230V LE Basic with 230V pump module
Room thermostat (heating/cooling), electronic Basic		10/3W	yes	—	10–28	4K	+/-2K	LE Basic 230V LE Basic 230V heating/cooling
Week regulator		10	—	7-day with 24 changes daily at two levels of temperature	5 - 28	-	+/- 0.5K	LE Basic 230V
Week thermostat with a floor sensor		15	—	7-day with 4 changes daily	air: 5 - 30 floor: 5 - 40	-	-	LE Basic 230V

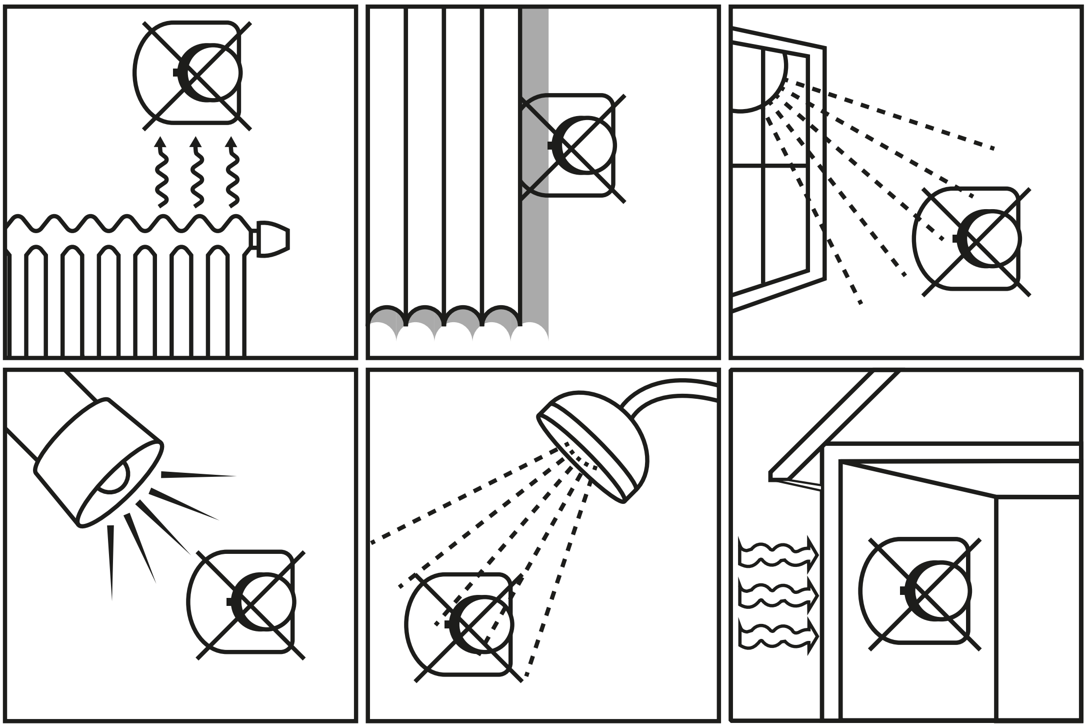
24V KAN-therm thermostats and cable regulators

Type/model		Features and functions						Cooperation
		Max number of actuators	Cooling	Programming	Adjustment range °C	Temperature reduction	Rate setting adjustment	LE Electric terminal blocks
Bimetallic room thermostat		10	—	—	5–30			LE Basic 24V
Room thermostat (with a diode), electronic Basic		10	—	—	10–28	4K	+/-2K	LE Basic 24V LE Basic with 24V pump module
Room thermostat (heating/cooling), electronic Basic		10/3W	yes	—	10–28	4K	+/-2K	LE Basic 24V heating/cooling
Week regulator		10	—	7-day with 24 changes daily at two levels of temperature	5–28	-	+/- 0.5K	LE Basic 24V

Installation guidelines for KAN-therm thermostats

Guidelines concerning the installation of thermostats are presented on the pictures.





Thermostats mounting should be performed in accordance with the manuals, attached to the product.

All manuals are available for download at en.kan-therm.com

The number of electric cables cores and their cross-sections should be accordant with the information included in the manual of each product.

All works related to electrical installations must be carried out by a qualified personnel.

5.2.3 KAN-therm wired electrical terminal blocks

KAN-therm connection electrical terminal blocks allow for a quick and convenient connection of actuators, thermostats, control clocks and power supply connection (230 or 24V) in a single place (e.g. installation cabinet above the manifold). Some terminal block models have a pump module, which controls the mixing system pump operation. All terminal blocks versions cooperate with reliable KAN-therm Smart thermoelectric actuators, adapted to the voltage of 230V or 24V.

5.2.3.1 Basic 230V or 24V electrical terminal block

In the version with built-in pump module or without the pump module, they allow for connection of max 6 thermostats and 12 actuators. The terminal block implements the heating function.

Fig. 67. Basic 230V or 24V electrical terminal blocks

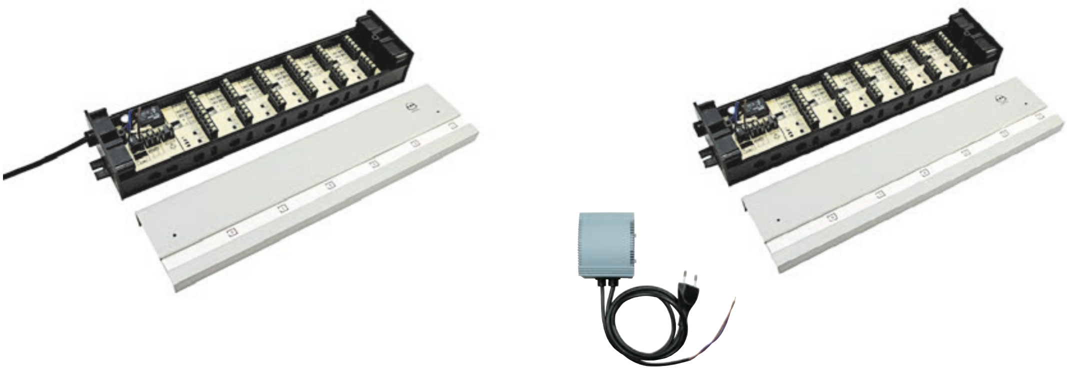
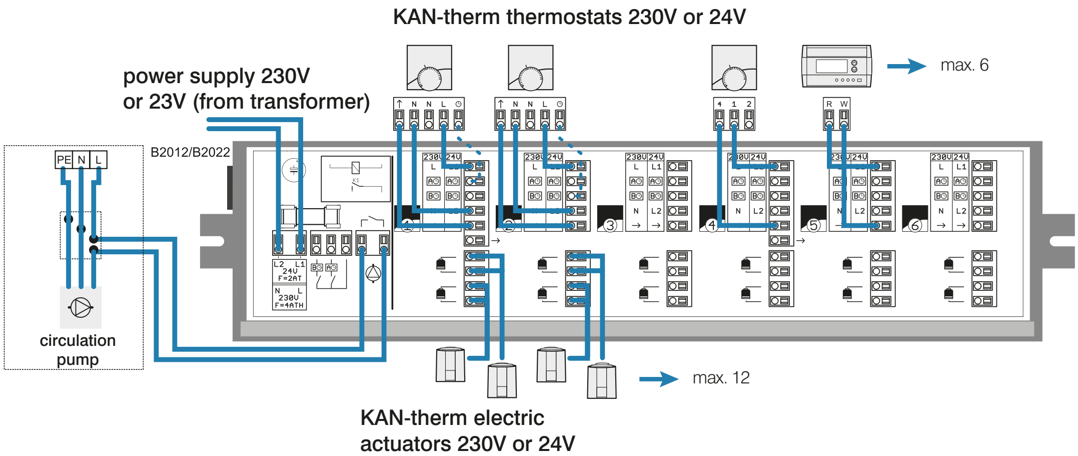
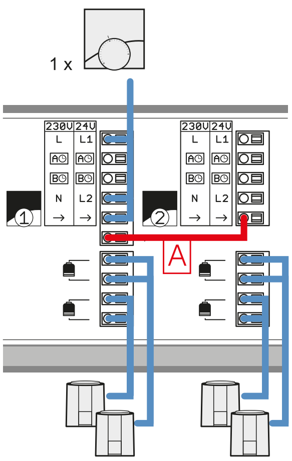


Fig. 68. Basic 240V or 24V electrical terminal block with pump module configuration



Normally one thermostat can control one or two actuators. If a jumper (A) is used, one thermostat can control 3 or 4 actuators.

Fig. 69. 3 or 4 controlled by single thermostat actuators connection



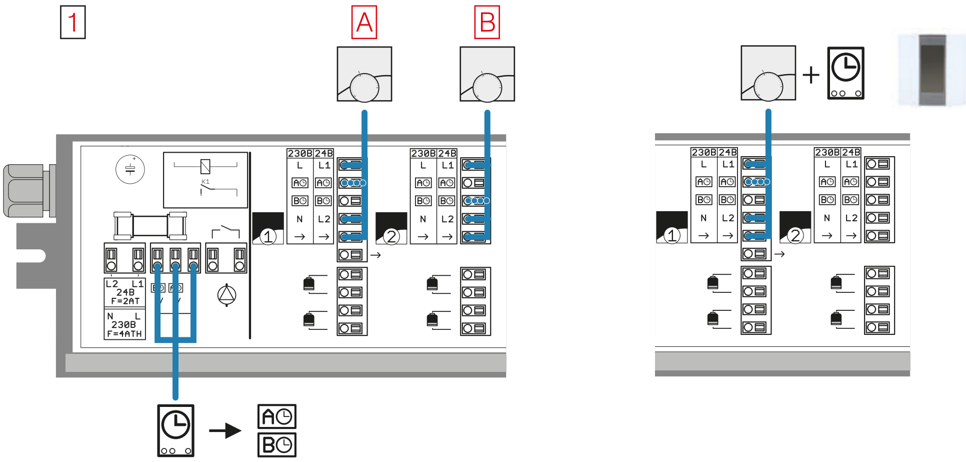


Fig. 70. Time control devices connection

ℹ **Terminal block mounting and configuration presented in “Basic 230/24V electrical terminal block” manual**

5.2.3.2 Basic 230V or 24V heating and cooling electrical terminal block

It has built-in pump module, it can control maximum of 6 thermostat and 12 actuators. The terminal block allows for the connection of external time regulator (e.g. Basic dual channel digital control clock), with which a periodic attenuation of heating for all connected to the terminal block cables or two automatic A and B circuits can be set. Terminal block normally performs a heating function, by using heating/cooling thermostats it is possible to implement the function of cooling.

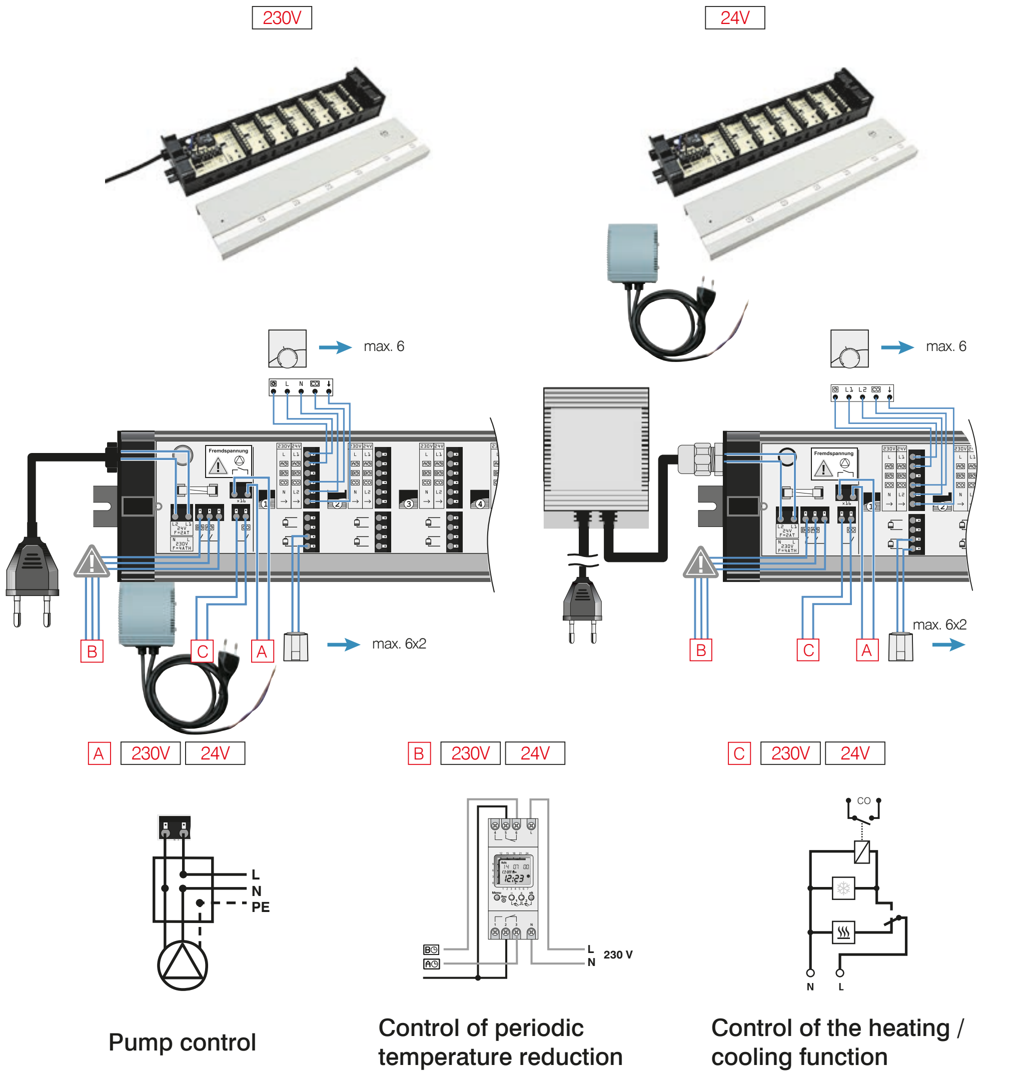


Fig. 71. Basic 230V or 24V heating/cooling electrical terminal block with pump module configuration

❗ Terminal block mounting and configuration in the “Basic 230/24V electrical terminal block for heating/cooling with a pump module” manual

5.2.3.3 The list of basic technical parameters and functions of 230V, 24V wired electrical terminal blocks

KAN-therm Basic 230V electrical terminal blocks (LE)

Type/model		Features and functions					Cooperation
		Max number of thermostats	Max number of actuators	Pump connection	Daily clock connection	Heating/cooling	TP room thermostats
LE 230V Basic		6	12	—	yes 2 programmes	—	TP Basic 230V
LE 230V with pomp module. Basic		6	12	yes	yes 2 programmes	—	TP Basic 230V
LE 230V heat./cool.Basic		6	12	yes	yes 2 programmes	yes	TP Basic heat./cool. 230V

The terminal blocks cooperate with 230V KAN-therm Smart actuators.

KAN-therm 24V electrical terminal blocks (LE)

Type/model		Features and functions					Cooperation
		Max number of thermostats	Max number of actuators	Pump connection	Daily clock connection	Heating/cooling	TP room thermostats
LE 24V Basic		6	12	—	yes 2 programmes	—	TP Basic 24V
LE 24V Basic with pomp module. Basic		6	12	yes	yes 2 programmes	—	TP Basic 24V
LE 24V heat./cool. Basic		6	12	yes	yes 2 programmes	yes	TP Basic heat./cool. 24V
	24V converter for all Basic terminal blocks						

Terminal blocks mounting should be performed in accordance with the manuals, attached to the product.

All manuals are available for download at en.kan-therm.com

The way of preparing the electric cables terminals, their mounting in electric clamps, as well as cables cross-sections should be accordant with the information included in the manual of each product.

All works related to electrical installation must be carried out by a qualified personnel.

5.2.4 KAN-therm Smart Wireless automatics system

5.2.4.1 General information

KAN-therm Smart System devices is a new generation of control automatics elements group, which offers unprecedented possibilities of operation and service. It is responsible for a wireless control and adjustment of temperature, as well as other heating and cooling system parameters, determining the feeling of comfort in rooms. The system also provides a selection of advanced supplementary functions, which make the heating system operation and service highly effective, energy efficient and user-friendly.

The system includes:

- multifunctional, wireless electrical terminal blocks, with the Internet connection and microSD slots.
- elegant and intuitive wireless room thermostats with a large LCD,
- reliable, energy-efficient thermoelectric actuators.

Fig. 72. KAN-therm Smart wireless adjustment system elements

KAN-therm Smart System is a multifunctional system, implementing, apart from temperature control and adjustment in various heating zones, among others, heating/cooling modes switching, heating source and pump operation control, air humidity in cooling mode control. The system terminal blocks also allow for the connection of temperature limiter and external control clock. The functions of pump and valves protection (periodic activation in the periods of longer stops), protection against frost and excessive critical temperatures are also implemented.

Due to the radio technology, in case of larger installations with an application of 2 or 3 KAN-therm Smart electrical terminal blocks, there is a possibility of coupling them into a single system, which allows for a mutual wireless communication.

KAN-therm SMART wireless electrical terminal blocks with LAN connection

- Wireless technology 868 MHz bidirectional,
- 230V and 24V versions (with converter),
- The possibility to connect max 12 thermostats and max 18 actuators,
- The function of heating and cooling as a standard,
- Pump and manifold valves protection functions, protection against frost function, safe temperature limiter, safe mode,
- Actuators operation mode function: NC (normally closed) or NO (normally open),
- MicroSD card reader,
- RJ 45 Ethernet port (for Internet connection),
- The possibility to connect supplementary devices: pump module, dew point sensor, external clock, supplementary heating sources,
- A clear indication of work status with LED diodes,
- Coverage 25 m indoor,
- „Start SMART" function - the possibility to commence an automatic system adaptation to the conditions in the room/building.
- Configuration using microSD card, through program interface in a network version and from the operation level of wireless thermostat,
- The possibility of easy and simple system development and quick update of settings (by network or microSD card).

Fig. 73. Wireless terminal block view (230V version)

Fig. 74. Transparent and clear signalisation of terminal block work status, simple and secure connection of actuators to external devices

KAN-therm Smart wireless terminal blocks technical data

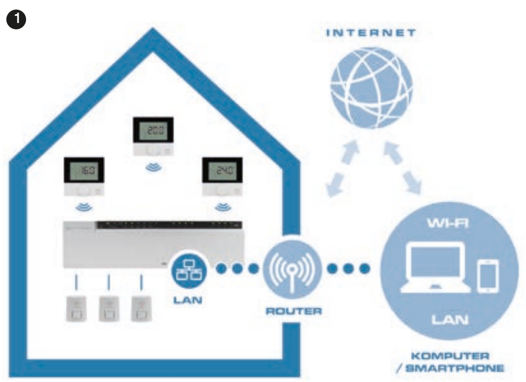
	230V terminal blocks			24V terminal blocks		
Number of heating zones (thermostats)	4	8	12	4	8	12
Number of actuators	2×2+2×1	4×2+4×1	6×2+6×1	2×2+2×1	4×2+4×1	6×2+6×1
Max. nominal load of all actuators	24 W					
Working voltage	230 V / ±15% / 50 Hz			24 V / ±20% / 50 Hz		
Network connector	Connector terminals NYM 3 × 1.5 mm²			System converter with a network plug		
Dimensions	225×52×75 mm	290×52×75 mm	355×52×75 mm	305×52×75 mm	370×52×75 mm	435×52×75 mm
Wireless technology	868 MHz, bidirectional					
Coverage	25 m indoor / 250 m outdoor					

System configuration

The electrical terminal blocks are equipped with RJ45 connector and integrated web server, which allow for system control and configuration using computer and the Internet. Thus, the device can be connected to a home network or directly to the computer, using network cable. The terminal block also features a microSD memory card slot, which allows for uploading software updates and individual system settings performing. The system configuration can be executed in several ways:

- Configuration using microSD card: By using a computer and an intuitive software, the KAN-therm EZR Manager creates individual configuration settings, which through a remote microSD memory are transfered to the terminal block, equipped with a card reader.
- Remote configuration of a terminal block directly connected to the Internet or home network through KAN-therm EZR Manager software interface.
- Direct configuration from the level of operation of KAN-therm Smart wireless thermostat (with a use of LCD).

1. KAN-therm Smart System - settings configuration via the Internet or home network
2. Settings configuration using remote microSD memory card



In any case, the configuration and operation of the system is friendly for both engineer and user, many processes are made automatically, and the settings on thermostat or in the KAN-therm EZR Manager software are intuitive. Also the development of the system and quick update of terminal block settings do not cause any trouble.

Configuration procedure in all of the above mentioned cases is described in the Terminal blocks manual.

Terminal block mounting and configuration is presented in “LAN KAN-therm Smart 230/24V wireless electrical terminal block” Manual.

5.2.4.3 KAN-therm Smart wireless room thermostat

Wireless room thermostat with LCD is a device, which controls the KAN-therm Smart electrical terminal block (24 V or 230V) via radio waves. It is used to record the temperature in a room and to set desire temperature, in a heating zone assign to it.

- Modern and elegant design, high quality material, resistant to scratches,
- Small dimensions 85 × 85 × 22 mm,
- Large (60×40 mm), clear LCD with illumination,
- Communication system based on icons and the rotary knob ensure intuitive and easy service.
- Very low energy consumption - battery of over two years life,
- The ability to connect floor temperature sensor,
- Bidirectional radio data transmission, 25 m coverage,
- Convenient and safe use guaranteed by a three-level MENU layout: user functions, user settings parameters, installer settings (service),
- Many useful features, among others: device adult lock, standby mode, day/night or auto operation modes, “Party” and “Vacation” functions,
- A number of possible settings of parameters - temperature (heating/cooling, temperatures drop), time, programmes,
- Operation via knob.

Fig. 75. Clear and intuitive indications of messages and functions

User functions
User settings
Installer settings
Error signal
Lock e.g. child lock
Low battery
Turn-off
Wireless

AUTO Automatic
Operation day
Operation night
Dew point
Cooling
Heating
Presence in the home
Acceptance
Vacation function

KAN-therm LCD Smart wireless thermostat technical data

Power supply	2 x LR03/AAA
Wireless technology	868 MHz, bidirectional
Coverage	25 m indoor
Dimensions	86 x 86 x 26,5 mm
Preset temperature setting range	5 to 30°C
Preset temperature resolution	0.2 K
Measuring range of actual temp.	0 to 40°C (indoor sensors)

Mounting and operation of thermostat are described in “KAN-therm LCD Smart wireless thermostat” Manual

Rules of mounting and localisation of KAN-therm Smart wireless room thermostats are the same as in the case of wired thermostats (see section KAN-therm thermostats).

5.2.5 KAN-therm Smart 230V or 24V electric actuators

KAN-therm Smart are modern thermoelectric drives, responsible for opening and closing of surface heating and cooling system valves. They cooperate, through electrical terminal blocks, with thermostats regulating the temperature in rooms. They are mounted on cut-off valves (thermostatic) in KAN-therm System underfloor heating 71A, 75A, 73A, 77A series manifolds. The actuator can also be mounted on thermostatic valve, located on pump mixing system supply. Then it acts as a valve executive element (through regulator - thermostat), which controls all circuits connected to the manifold - a system applied, when all heating circuits are located in the same, single room.

- 230V or 24V versions.
- „First Open" function, which makes the actuator mounting and execution of pressure test easier,
- Possibility to chose an actuator operating in NC or NO mode,
- Quick assembly using KAN-therm M28×1.5 or M30×1.5 adapters,
- Secure fastening with three-point locking system,
- Actuator calibration - automatic adjustment to the valve,
- Visualization of actuator operation status,
- Actuator assembly in any position,
- 100% secured against water and humidity,
- Energy efficient - only 1W energy consumption.

Actuators are mounted on valves through KAN-therm M28×1.5 or M30×1.5 plastic adapters (depending on the valve's thread size).

1. M28×1.5 adapter to electric actuator - applied to thermostatic valves on 71A, 75A, 73A and 77A manifold beams
2. M30×1.5 adapter to electric actuator (grey colour) - applied to thermostatic valve, e.g. on series 73A and 77A mixing system supply or a group mixing at the heat circuits group control..

Note

KAN-therm Smart actuators are fully compatible with previously used KAN-therm actuators in terms of mounting method.

KAN-therm Smart actuators technical parameters

Version	De-energised closed (NC)		De-energised open (NO)	
Voltage	230 V AC 50/60 Hz	24 V AC/DC 60 Hz	230 V AC 50/60 Hz	24 V AC/DC 60 Hz
Drive power	1.0 W			
Max. activation current	< 550 mA for max 100 ms	< 300 mA for max 2 min	< 550 mA for max 100 ms	< 300 mA for max 2 min
Positioning force	100 N +/- 5%	100 N +/- 5%		
Closing and opening time	approximately 6 min	approximately 6 min		
Setting route (indicator jump)	4 mm	4 mm		
Storage temperature	from -25 to 60°C	from -25 to 60°C		
Ambient temperature	from 0 to +60°C	from 0 to 60°C		
Protection degree / class	IP 54	IP 54		
Connection cable / cable length	2 × 0,75 mm 2 / 1 m			

The mounting and exploitation of actuators should be performed in accordance with KAN-therm manuals.

“KAN-therm Smart 230 V electric actuator” Manual
“KAN-therm Smart 24 V electric actuator” Manual

Note!

KAN-therm actuator in NC version is delivered partially opened (the function of first opening - “First Open”). It allows the execution of installation leakage test and heating of a building in raw unfinished condition, even when the electrical wiring of individual rooms is not ready. During later activation, by applying operating voltage (for longer than 6 minutes), the function of the first opening unlocks automatically and the drive is fully operational. After initial activation the KAN-therm NC actuators in de-energised condition are closed.

KAN-therm Smart actuators, regardless of type (NC/NO), cooperate with the KAN-therm Smart wireless electrical terminal blocks (in 230V and 24V versions respectively).

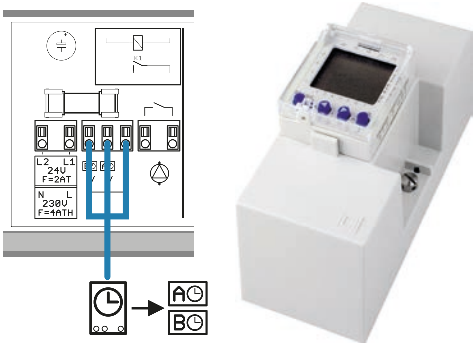
In case of cable automatics application, KAN-therm Smart type NC actuators cooperate with all KAN-therm wired terminal blocks.

5.2.6 Other elements of control and automatics

5.2.6.1 Digital control clock, 2 channel

It is used for programming of temperature control time system for two heating zones in a specified room or a group of rooms. It allows for periodical (in the absence or during the night) lowering of rooms temperature, improving the energy efficiency of a heating system. The clock can cooperate with BASIC 230V and 24V terminal blocks.

Fig. 76. Clock to Basic terminal block connection diagram



Note

Controlling 2 channel clock is not available in the KAN-therm System offer.

5.2.6.2 Contact thermostat for pump activation

The thermostat is used as a protection against exceeding of the preset temperature in the radiator or floor heating installations. The device is mounted directly on the supplying or return pipe - depending on the needs. In case of reaching temperature value set on the thermostat, the device automatically turns off the circulating pump. Temperature presetting range 50 – 95°C.

5.2.6.3 Icing controller for open surfaces icing with a snow and ice sensor

The regulator operating in cooperation with the heating system in automatic mode protects against icing and accumulation of snow on external traffic routes (stairs, sidewalks, driveways).

The heating system turns on only when there is a risk of snowfall, freezing rain or ice. After they melt, it turns off automatically. Thus, contrary to only thermostat-controlled systems, it is possible to save up to 80% of energy.

Regulator standard settings allow for heating system operation in temperature and humidity values controlling mode. Heating is enabled, if the temperature drops below 3 °C, and humidity exceeds level 3 (in 0 - 8 scale). The regulator determines an optimal time for a switch off, in order to prevent the formation of ice early enough. If the surface temperature falls below the set in menu basic value of -5 °C, heating enables regardless of humidity level and remains enabled, until the temperature rises above –5°C. If the additional heating function is activated, heating shall remain enabled, until the set time elapses.

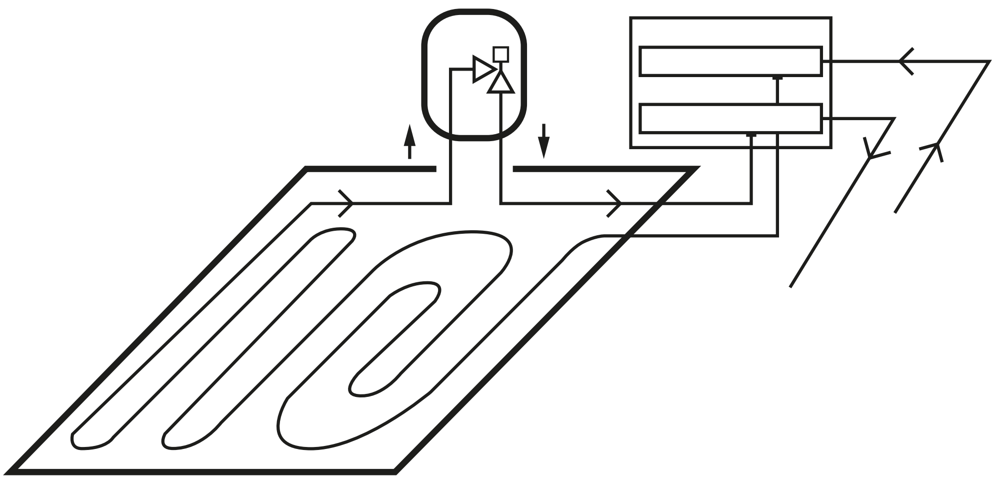
Snow and ice sensor is equipped with a 15 meters long cable (may be extended to 50 m).

“The regulator of open surfaces heating with snow and ice sensor” Manual.

5.2.6.4 Surface heating unit with vent and thermostatic valve

The device controlling temperature in a room regulates the flow of medium through single floor heating circuit, without additional heaters, depending on ambient temperature. Room set can be mounted both on the supply and return in floor heating circuit. Thermostat receives the ambient temperature and properly regulates the flow of water in a heating circuit.

Fig. 77. Operation scheme - unit located at the return



“Surface heating unit with vent and thermostatic valve” Manual

6 Designing KAN-therm surface heaters

6.1 Dimensioning of heating systems – assumptions

Designing of floor (and wall) heaters in the KAN-therm System is based on the methodology defined in PN-EN 1264: "Water based surface embedded heating and cooling systems". It adopts the following assumptions:

- the basis for calculating the density of heat flux emitted into the room is the log mean temperature difference between the temperature of the heating medium and the air temperature in the room,
- no additional heat sources are embedded in the floor,
- lateral heat transfer is ignored,
- floor heater without the finish layer emits downwards 10% of the heat flux emitted upwards.

According to PN EN 1264 the heat flux density q transferred by a surface heater is given by the formula:

$$q = K_H \cdot \Delta\vartheta_H \quad [W/m^2]$$

where:
$\Delta\vartheta_H$ – is the log mean temperature difference [K],

K_H – constant composed of the following factors resulting from the design of the floor heater:

- composite factor dependent on the type of flour heating and the design of heating pipe,
- factor dependent on the type of finish layer,
- factor dependent on the spacing of pipes,
- factor dependent of the screed thickness over the pipes,
- factor dependent on the inner diameter of pipes.

The log mean temperature difference $\Delta\vartheta_H$ is calculated based on:

$$\Delta\vartheta_H = \frac{\vartheta_z - \vartheta_p}{\ln\left[\dfrac{\vartheta_z - \vartheta_i}{\vartheta_p - \vartheta_i}\right]}$$

where:
ϑ_Z – is the supply temperature of floor heater, [°C],

ϑ_P – heating medium return temperature, [°C],

ϑ_i – air temperature in the room [°C]

In order to facilitate calculations the above relationship is presented in tables (developed for various temperatures of heating medium and air).

Based on the $\Delta\vartheta_H$ values provided in the table as well as the parameters of the surface heater design (screed thickness over the pipe, diameter and spacing of pipes, type of floor covering) it is possible to determine the value of the heat flux emitted to the space within the scope of the project.

K_H coefficient values for Tacker, Profil, Rail and NET system, depending on pipe diameter ϕ, pipe spacing T and pipe thickness s_U as well as floor finish $R_{\lambda B}$

ϕ	$R_{\lambda B}$	0.00				0.05				0.10				0.15			
	s_U	0.025	0.045	0.065	0.085	0.025	0.045	0.065	0.085	0.025	0.045	0.065	0.085	0.025	0.045	0.065	0.085
	T	K_H															
12×2.0	0.10	8.03	7.10	6.29	5.56	5.67	5.14	4.66	4.23	4.35	4.03	3.73	3.46	3.52	3.30	3.09	2.89
	0.15	7.10	6.35	5.69	5.09	5.13	4.68	4.28	3.91	3.99	3.72	3.48	3.24	3.27	3.08	2.90	2.73
	0.20	6.20	5.62	5.08	4.60	4.59	4.24	3.91	3.61	3.65	3.43	3.22	3.03	3.03	2.87	2.72	2.58
	0.25	5.39	4.94	4.52	4.14	4.10	3.82	3.56	3.31	3.33	3.15	2.98	2.81	2.80	2.67	2.55	2.43
	0.30	4.68	4.33	4.01	3.71	3.66	3.44	3.24	3.05	3.03	2.89	2.75	2.63	2.59	2.48	2.38	2.29
14×2.0	0.10	8.14	7.21	6.38	5.64	5.74	5.20	4.72	4.28	4.40	4.08	3.77	3.50	3.56	3.33	3.12	2.92
	0.15	7.24	6.48	5.80	5.19	5.21	4.76	4.35	3.98	4.05	3.78	3.53	3.29	3.31	3.12	2.93	2.76
	0.20	6.34	5.74	5.20	4.71	4.68	4.32	3.99	3.68	3.71	3.49	3.28	3.08	3.08	2.92	2.76	2.62
	0.25	5.53	5.06	4.63	4.24	4.19	3.90	3.64	3.39	3.39	3.21	3.03	2.87	2.85	2.72	2.59	2.47
	0.30	4.80	4.45	4.11	3.81	3.75	3.52	3.32	3.12	3.09	2.95	2.81	2.68	2.64	2.53	2.43	2.33
16×2.0	0.10	8.26	7.31	6.47	5.72	5.81	5.27	4.78	4.34	4.45	4.12	3.82	3.54	3.59	3.36	3.15	2.94
	0.15	7.38	6.61	5.92	5.29	5.30	4.84	4.43	4.05	4.10	3.83	3.58	3.34	3.35	3.15	2.97	2.80
	0.20	6.49	5.81	5.32	4.81	4.78	4.41	4.07	3.75	3.78	3.55	3.34	3.14	3.12	2.96	2.80	2.66
	0.25	5.66	5.19	4.75	4.35	4.28	3.99	3.72	3.46	3.46	3.27	3.09	2.92	2.90	2.76	2.63	2.51
	0.30	4.93	4.56	4.22	3.91	3.84	3.61	3.40	3.19	3.16	3.02	2.88	2.74	2.69	2.58	2.48	2.37
18×2.0	0.10	8.38	7.41	6.56	5.81	5.88	5.33	4.84	4.39	4.50	4.16	3.86	3.57	3.62	3.39	3.17	2.97
	0.15	7.53	6.74	6.03	5.40	5.39	4.93	4.50	4.11	4.16	3.89	3.63	3.39	3.39	3.19	3.01	2.83
	0.20	6.64	6.01	5.44	4.92	4.87	4.49	4.15	3.83	3.84	3.61	3.39	3.19	3.17	3.00	2.85	2.70
	0.25	5.80	5.31	4.87	4.46	4.37	4.08	3.80	3.54	3.53	3.34	3.15	2.98	2.95	2.81	2.68	2.55
	0.30	5.06	4.68	4.33	4.01	3.93	3.70	3.48	3.27	3.23	3.08	2.94	2.80	2.74	2.63	2.52	2.42
20×2.0	0.10	8.50	7.52	6.66	5.89	5.95	5.40	4.90	4.44	4.55	4.21	3.90	3.61	3.65	3.42	3.20	3.00
	0.15	7.68	6.87	6.15	5.51	5.48	5.01	4.58	4.18	4.22	3.94	3.68	3.43	3.43	3.23	3.04	2.86
	0.20	6.79	6.14	5.56	5.04	4.97	4.58	4.23	3.90	3.91	3.67	3.45	3.24	3.22	3.05	2.89	2.74
	0.25	5.95	5.44	4.99	4.57	4.47	4.17	3.88	3.62	3.60	3.40	3.21	3.04	3.00	2.86	2.72	2.60
	0.30	5.19	4.80	4.45	4.11	4.02	3.79	3.56	3.35	3.30	3.15	3.00	2.86	2.79	2.68	2.57	2.47

K_H coefficient values for TBS system, depending on pipe diameter ϕ, pipe spacing T and pipe thickness s_U as well as floor finish $R_{\lambda B}$

ϕ	$R_{\lambda B}$	0.00				0.05				0.10				0.15			
	s_u	0.018	0.023	0.025	0.043	0.018	0.023	0.025	0.043	0.018	0.023	0.025	0.043	0.018	0.023	0.025	0.043
	T	K_H															
16×2.0	0.166	6.04	5.81	5.72	5.23	4.45	4.33	4.28	4.00	3.53	3.45	3.42	3.23	2.92	2.87	2.84	2.72
	0.250	4.44	4.28	4.22	3.99	3.50	3.39	3.35	3.21	2.88	2.81	2.78	2.68	2.45	2.40	2.38	2.30
	0.333	3.15	3.03	2.99	2.64	2.63	2.55	2.52	2.26	2.26	2.20	2.17	1.98	1.98	1.93	1.91	1.76

$R_{\lambda B} = 0{,}00$ [m²K/W] – ceramic tiling, thickness up to 12 mm and stone tiling, thickness up to 25 mm

$R_{\lambda B} = 0{,}05$ [m²K/W] – floor covering of plastic and resins up to 6 mm

$R_{\lambda B} = 0{,}10$ [m²K/W] – floor panels, thickness up to 10 mm and carpets, thickness up to 6 mm

$R_{\lambda B} = 0{,}15$ [m²K/W] – wooden panels and wood flooring, thickness up to 15 mm and carpets, thickness up to 10 mm

Values of the log mean temperature difference $\Delta\vartheta_H$ depending on the feed temperature t_V and return temperature ϑ_R of the medium and indoor air temperature ϑ_i

ϑ_V [°C]	ϑ_R [°C]	ϑ_i [°C] 5	8	10	12	16	18	20	22	24
30	25	22.4	19.4	17.4	15.4	11.3	9.3	7.2	5.1	2.8
	20	19.6	16.5	14.4	12.3	8.0	5.6			
	15	16.4	13.1	10,8	8.4					
35	30	27.4	24.4	22.4	20.4	16.4	14.4	12.3	10,3	8.2
	25	24.7	21.6	19.6	17.5	13.4	11.3	9.1	6.8	4.2
	20	21.6	18.5	16.4	14.2	9.6	7.0			
40	35	32.4	29.4	27.4	25.4	21.4	19.4	17.4	15.4	13,3
	30	29.7	26.7	24.7	22.6	18.6	16.5	14.4	12.3	10.2
	25	26.8	23.7	21.6	19.6	15.3	13.1	10,8	8.4	5.4
45	40	37.4	34.4	32.4	30.4	26.4	24.4	22.4	20.4	18.4
	35	34.8	31.7	29.7	27.7	23.6	21.6	19.6	17.5	15.5
	30	31.9	28.9	26.8	24.7	20.6	18,5	16.4	14.2	12.0
50	45	42.5	39.4	37.4	35.4	31.4	29.4	27.4	25.4	23.4
	40	39.8	36.8	34.8	32.7	28.7	26.7	24.7	22.6	20.6
	35	37.0	33.9	31.9	29.9	25.8	23.7	21.6	19.6	17.4
55	50	47.5	44.5	42.5	40.4	36.4	34.4	32.4	30.4	28.4
	45	44.8	41.8	39.8	37.8	33.8	31.7	29.7	27.7	25.7
	40	42.1	39.0	37.0	35.0	30.9	28.9	26.8	24.7	22.7

6.1.1 Maximum temperature of floor surface

In terms of human thermal comfort, the most favourable temperature of the surface of heated floor is app. 26°C. Since the heat output of a floor heater may often be insufficient at this temperature, it is assumed (in accordance with PN EN 1264) that the maximum temperature may reach the following values:

29°C for human occupied zones (air temperature ϑ_i=20°C)

33°C for bathrooms (ϑ_i=24°C)

35°C for edge zones (most vulnerable to heat loss) (ϑ_i=20°C)

Maintaining these maximum temperatures reduces the thermal efficiency of floors (heat flux density) to the limiting values of q_{max} 100 W/m² for human occupied zones and bathrooms and of 175 W/m² for edge zones (assuming the design temperatures of these zones is maintaned).

For wall heating systems the permissible surface temperature of walls may be higher, reaching 35-40°C.

If the heat loss is higher than the values resulting from the maximum performance of surface heaters, additional heaters or zones featuring higher thermal efficiency should be provided for (edge zones with narrower pipe spacing). If possible, a wall heating system, supplementing floor heating, could also be designed.

6.1.2 Edges

In order to increase the heat output and to obtain more even temperature distribution a room with "cold" partitions (such as glazed exterior walls) may feature zones, 1 m wide, along such partitions, of narrower pipe spacing - the edge zones. Floor surface temperature in such zone will be higher but should not exceed 35°C.

The coil of such zone can be integrated with heating pipes arranged in zone permanently occupied by humans but it must be supplied first and heat fluxes for both zones must be calculated separately. For higher heat losses it is preferable to add a zone with a dedicated circuit. Drawings of edge zones on **Fig. 9, Fig. 10, Fig. 11** of the chapter "Surface heaters design".

For spaces with edge zones, in order to determine the thermal power for zones permanently occupied by humans, the thermal power generated by the edge zone must be deducted from the total heat requirement $\mathbf{Q_B = q_R \times A_R}$ [W],

where:

q_R – heat flux of the edge zone resulting from narrower pipe spacing [W/m²]

A_R – edge zone surface area [m²]

The intended use of edge zones should not be modified during operation to, for example, zones permanently occupied by humans by rearranging the interior. Edge zone should not be covered with wooden linings.

6.1.3 Surface heating installation supply temperatures.

Surface heating systems (floor, wall heating) are low-temperature heating systems. In case of under floor heating the maximum temperature of feed heating water should not exceed 55 ° C (for design external temperature) and the optimum temperature drop of water in the coils is app. 10°C (permissible range 5÷15°C).

Typical parameters of coil feed and return water (ϑ_z/ϑ_p) are therefore:

- 55°C/45°C
- 50°C/40°C
- 45°C/35°C
- 40°C/30°C

Feed and return temperature for the entire system is determined for the space with highest specific heat demand.

6.2 Hydraulic calculations for the installation, adjustments

The flux of water mass m_H flowing through the heating circuit with can be calculated, with sufficient accuracy (assuming minimum thermal insulation resistance underneath the heating pipes) using the following formula:

$$m_H = A_F \times q/\sigma \times C_W \text{ [kg/s]}$$

where:

A_F – surface area of the surface heater [m²]

q – heat flux transferred by the floor heater to the heated space [W/m²]

σ – temperature drop of the heating medium [K]

c_W – specific heat of water =4190 J/(kg × K)

Total pressure drop in the heating circuit Δp (selection of the pump should be based on the least performing circuit) involves linear resistance over over the length of the coil Δp_L and the combination of local resistance at manifold valves - Δp_V and Δp_R.

$$\Delta p = \Delta p_L + \Delta p_v + \Delta p_R \text{ [Pa]}$$

Coil linear losses ΔpL can be determined using tables of specific linear resistance of KAN-therm pipes, assuming minimum flow rate at v_{min} =0.15 m/s.

The overall length of the heating circuit is made up of the heating field pipes' length plus the length of the supply and return pipes (transit pipes - from the manifold to the heating field). The approximate length of the coil can be determined from the following relationship:

$$l = A_F / T \ [m]$$

where T is the spacing of the heating pipes [m].

Unit [m/m²] pipe consumption is also provided in the tables, see the chapter on individual fastening systems for KAN-therm pipes.

The values of local losses on the manifold can be determined based on the properties of valves embedded in KAN-therm manifolds.

Total pressure drop in the heating circuit should not exceed 20 kPa.

The approximate maximum length of heating circuits (including feed and return pipes) of KAN-therm pipes:

- 12×2 – 80 m
- 14×2 – 80 m
- 16×2 – 100 m
- 18×2 – 120 m
- 20×2 – 150 m
- 25×2,5 – 160 m

Once the pressure losses have been determined for the least performing circuit, adjust the remaining circuits of the manifold by determining relevant set values measured by the number of turns of the valve head, based on parameters of control valves (for adjustment procedure see Instructions for KAN-therm manifolds).

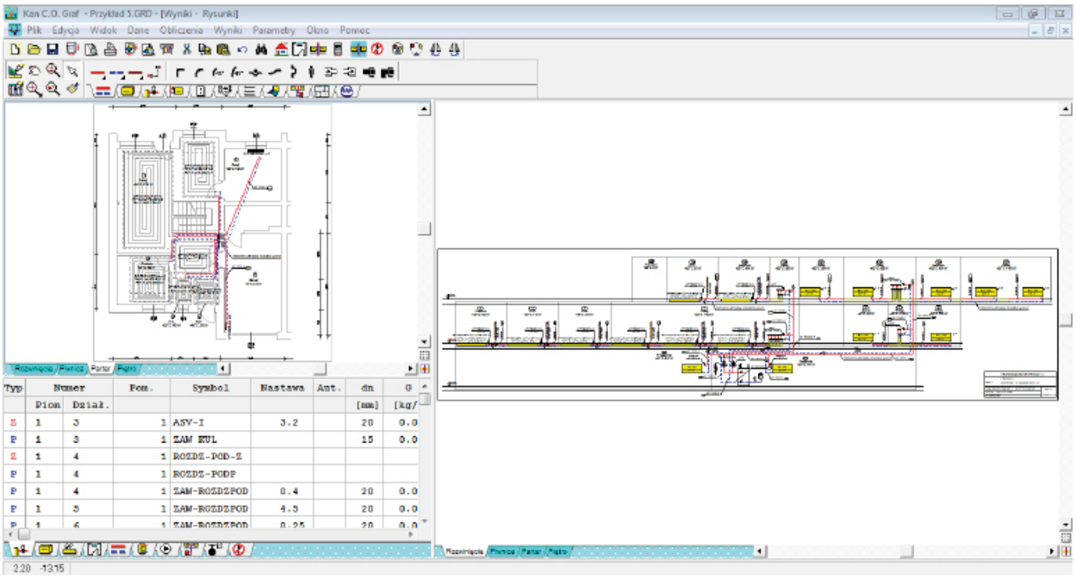
Manifolds with flow meters are adjusted by setting the flow rate for each flow meter, calculated for its corresponding heating circuit.

6.3 Computer aided design KAN software packages

Principles of KAN-therm surface heaters' design are not different from generally applicable rules, based on current standards and guidelines for installation dimensioning. To streamline calculations for an installation of this kind, KAN recommends free, proprietary computer aided design software packages.

6.3.1 KAN C.O Graf.

KAN C.O. Graf package is designed for graphic-aided design and adjustment of new heating systems, including underfloor heating as well as adjustment of existing installations (such as in insulated buildings). The package is designed to work along with the KAN OZC package, which it uses to retrieve space information.



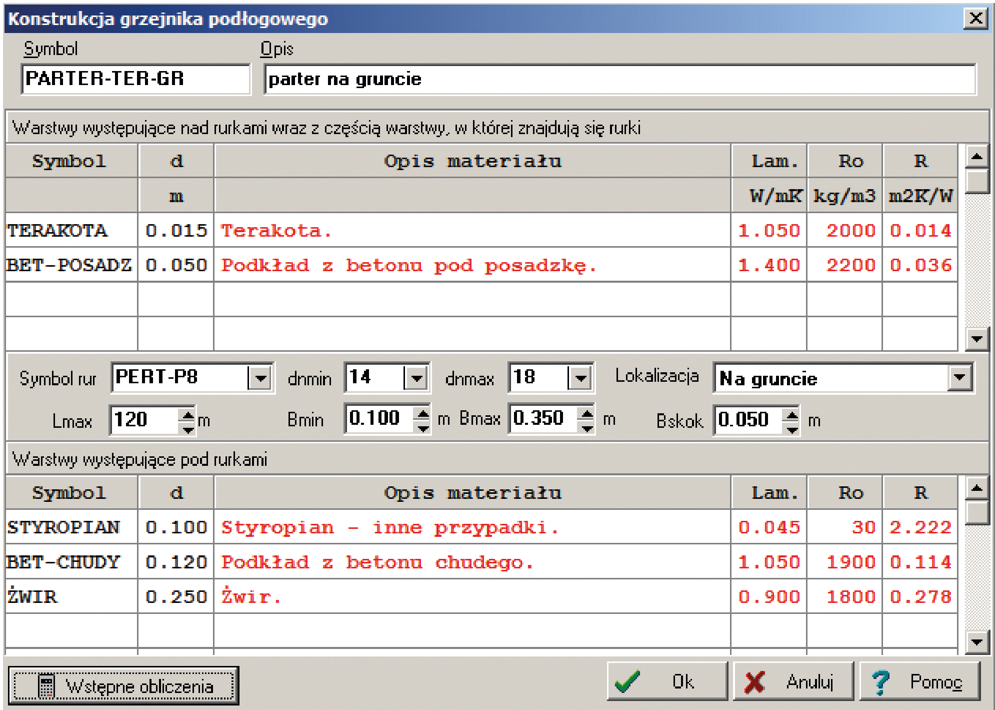
KAN C.O. Graf enables complete thermal and hydraulic calculations of installations:

- It will determine heat gains from installation pipes and calculate the cooling of the heating medium in the pipes,
- It will calculate the required size of heaters for predetermined thermal power demand,
- It will design underfloor heaters,
- It will provide for the effect of water cooling in pipes on gravitational pressure in individual circuits, as well as on thermal power of heat receivers,
- It will determine pipe diameters, hydraulic resistance of individual circuits, calculate total pressure losses in the system,
- It will reduce excess pressure in circuits by determining initial set points or orifices,
- It will provide for adequate hydraulic resistance of the plot with heat receiver,
- It will determine set points for differential pressure controllers installed in locations selected by the designer,
- It will automatically provide for authorities of thermostatic valves,
- It will select pumps and pumping group,
- It will prepare BOMs.

6.3.1.1 Floor heating design in KAN C.O. Graf software package

The package features an embedded module for designing floor heaters. It constitutes an integrated part of graphic software package for designing central heating installations. The initial stage of floor heater design is to define the design of the ceiling in which the coil is embedded (Fig. 1). The package may develop a full catalogue of the most common ceiling designs, which could then be used in other projects.

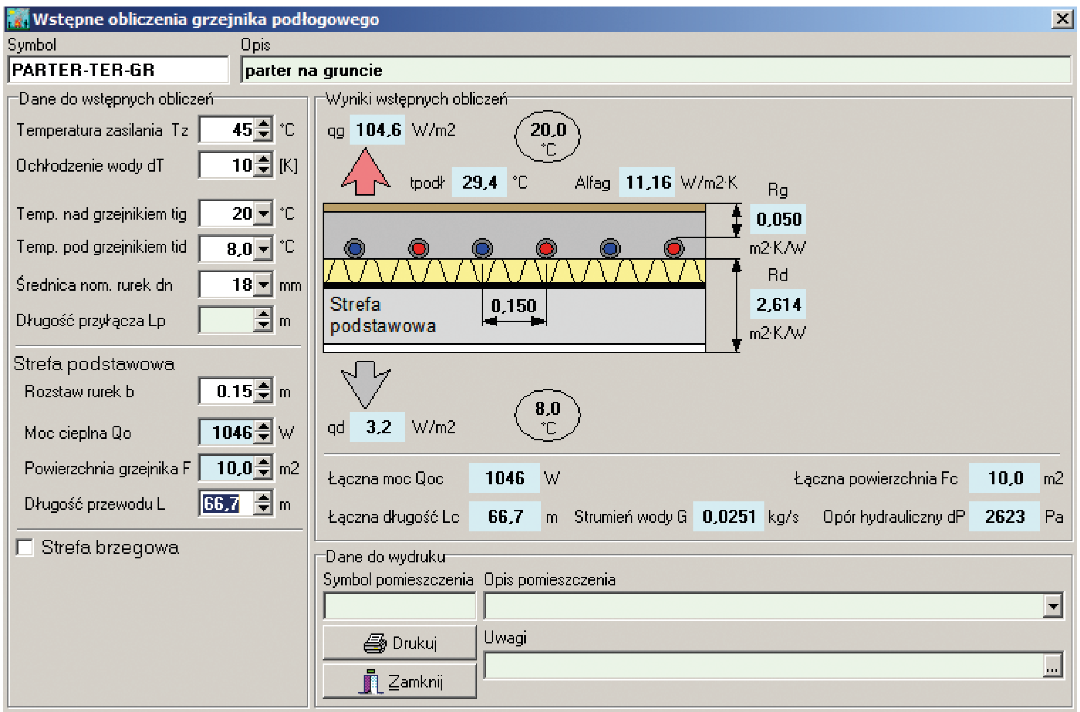
Fig. 78. Surface heater design



Once the floor heater design is entered, initial calculation of the heater output can be calculated forthwith (**Fig. 78**). This will enable an approximate determination of heater thermal efficiency, floor surface temperature and other parameters. The results may prove very helpful for designing heaters in specific premises.

When introducing floor heaters to a developed view of installation all it takes is to provide heater type information, its share in thermal power and the surface area of the floor in which the heater is to be installed. Performing calculations the software will automatically determine spacing of pipes in the coil, the actual surface area of the heater as well as the coil length.

Fig. 79. Initial calculations of floor heater output



With such solutions, designing central heating systems with floor heaters should not be that much troublesome. In addition, the software features a detailed control system of the correctness of heaters' design.

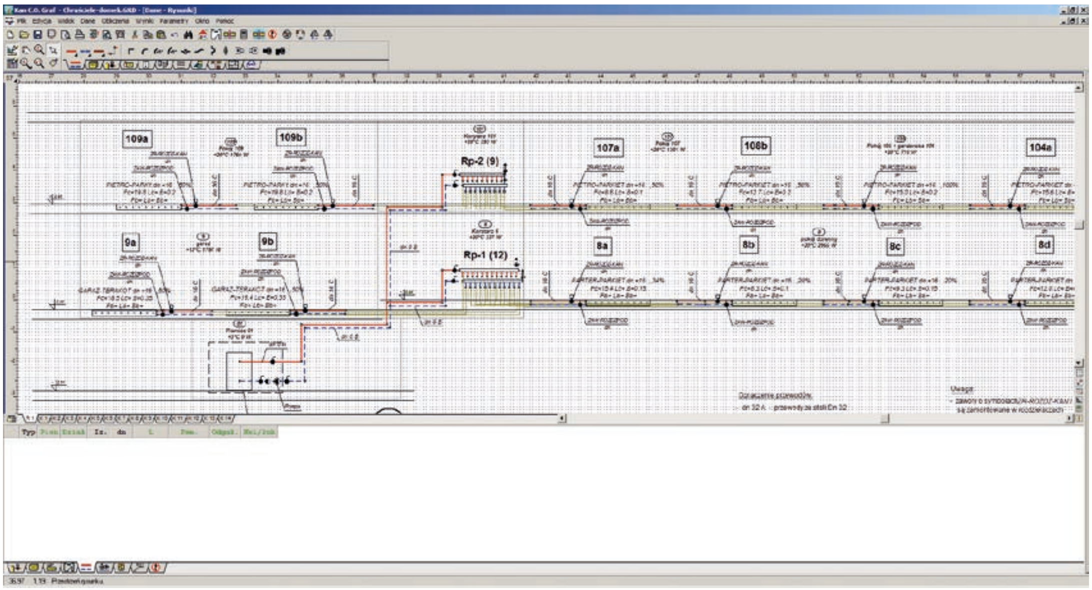


Fig. 80. Developed view of installation with floor heater.

KAN C.O. Graf enables projecting the results of calculations onto floor plans (**Fig. 81**). To do this, draw a floor plan and then project heaters, pipes and other system components onto the plan. For simple shapes the software will draws underfloor heating coils. Once the calculations are complete, the software will describe the size of the heater and draw them to scale, it will provide pipe diameters and valve settings.

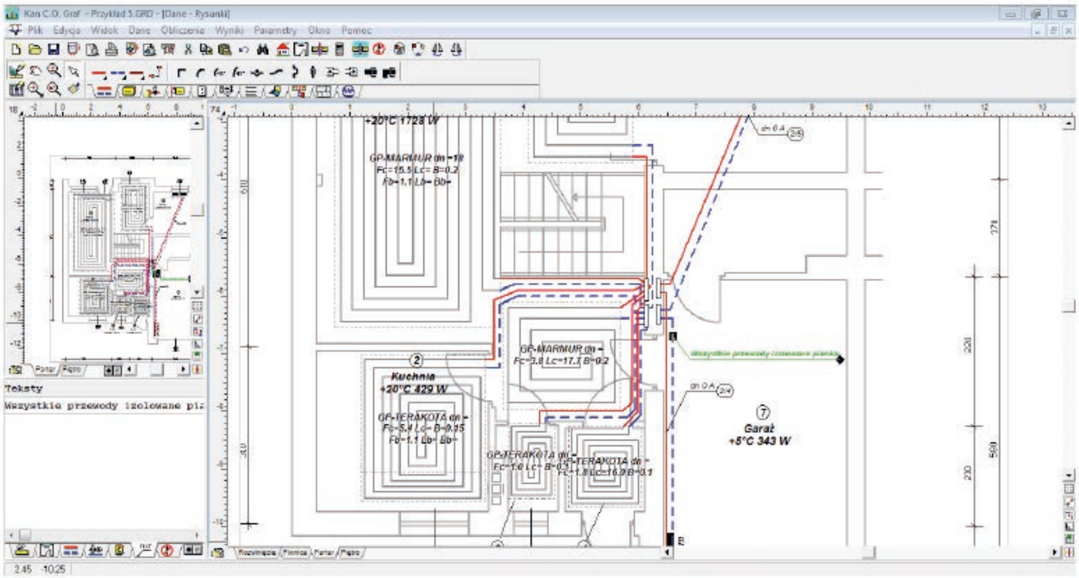


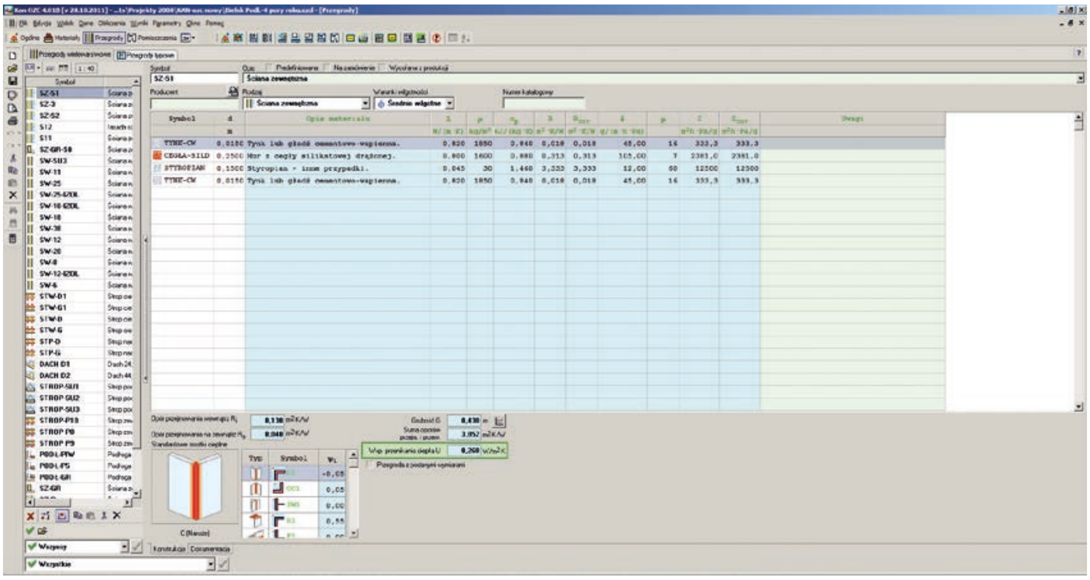
Fig. 81. Floor plan with projected floor heaters.

If the designer has floor plans drawn using software that generate WMF, DXF or DWG files (AutoCAD, CorelDRAW, MS Word, etc..), such files can be uploaded into KAN C.O. Graf. This give heating installations' architect and designer an opportunity for close cooperation and contributes towards a significant reduction of the design process duration.

KAN C.O. Graf features a great number of intended to facilitate and streamline the work:

- Graphical data entry process and graphic presentation of results on the developed viiew,
- Enhanced contextual help system and installation tips,
- Simple co-operation with a printer and plotter with print preview function and plotting function,
- Extensive error diagnostics and functions of automatic error search,
- Quick access to catalogue data for pipes, heaters and valves.

6.3.2 KAN HDC



A software package that supports calculations of thermal power demand as well as seasonal heat demand for heating of buildings. Works with the KAN C.O. Graf package.
The package enables:

- calculations of heat transfer coefficient for walls, floors, roofs and flat roofs,
- heat demand calculations for individual spaces,
- thermal power calculations for entire buildings,
- calculations of seasonal heat demand for heating of buildings
- calculation of indicators for seasonal thermal power demand.

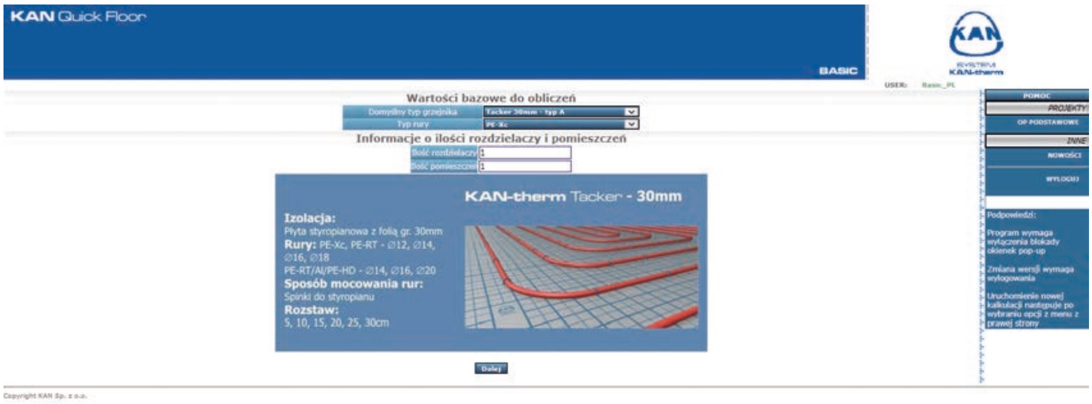
The **Extended** version of KAN ozc, in addition to performing calculations of thermal power and calculations for energy audit, can also be used to prepare Energy Certificates for buildings and their parts.

6.3.3 KAN QuickFloor

KAN provides a user friendly tool to investors, installers and designers for quick calculation of floor heating (in accordance with PN EN 1264) - the KAN Quick Floor software package, available on line on the company's website.

The package performs thermal and hydraulic calculations for floor heating implemented in wet and dry method: it will select heat output of surface heaters, required spacing of pipes, number of heating circuits per space, it will calculate pressure drops in heating circuits, verify the thermal comfort conditions in rooms.

Once the calculations are complete, the package will provide specification of materials for the calculated heating along with costs. The package enables to extend the offer it generates to include elements of other KAN-therm installations in the designed building. It means a comprehensive offer that includes a full set of installations in the building. The offer can be printed, along with photos of all elements.



The **Basic** version of the package features the calculation of required materials and their cost.

The **Extended** version makes it possible for more advanced users to modify a number of calculation parameters.

7 Acceptance forms

In this section, we present acceptance forms templates:

- Installation pressure test protocol
- Screed heating protocol
- Hydraulic adjustment execution protocol

7.1 Installation pressure test protocol

PROTOCOL

KAN-therm System surface heating/cooling installation leakage test

SYSTEM KAN-therm

Investor:

Investment/address:

Installation contractor:

Storey/room: | Total area:

KAN-therm assembly system:

KAN-therm pipe type/diameter: | running meter:

KAN-therm manifolds:

Floor heating surface, after laying and connecting to manifold, should be tested with pressurised water or air for leaks. Cables must remain under pressure also during screed laying. Test pressure must be at least 1.5 value of maximum permissible exploitation pressure, however, it cannot be less than 4 bars and more than 6 bars. The test must be performed in two stages: Preliminary **test I** - duration **60 min.**, permissible pressure drop 0.6 bar. General **test II** - duration **120 min.**, permissible pressure drop 0.2 bar.

LEAKAGE TEST COURSE

Date of test execution: | Ambient temperature: | Test pressure:

Duration of preliminary test: | pressure drop: | Duration of general test: | pressure drop:

Test result POSITIVE ☐ NEGATIVE ☐

Remarks: ....

....

....

....

....

....

Place and date	Ordering party signature	Contractor signature

7.2 Screed heating protocol

PROTOCOL

KAN-therm System surface heating/
cooling screed heating

SYSTEM
KAN-therm

Investor:

Investment/address:

Installation contractor:

Storey/room: Total area:

KAN-therm assembly system:

Screed type: Thickness [mm]:

Supplement applied to screed: Completion date of screed laying:

Remarks:

Heating screed (gypsum or cement) in accordance with PN-EN 1264 standard must be heated prior to the floor covering arrangement, In case of cement screed, heating can be executed after 21 days at the earliest, in case of gypsum, 7 days after the completion of screed laying.
For the first 3 days the supply temperature should be maintained at 25°C. For the 4 subsequent days, it should be heated with the maximum permissible supply temperature. In case of custom screeds, the heating should be performed in accordance with manufacturer's instructions.
After the heating process, screed humidity test should be executed, which shall confirm whether the screed is ready for floor covering laying.

SCREED HEATING COURSE

	DAY	DATE	TIME	TEMPERATURE	REMARKS
A	1				heating with a constant temperature of 25°C
	2				
	3				
B	1				heating with a maximum permissible installation supply temperature (3 days after A at the earliest)
	2				
	3				
	4				
C					completion of heating (4 days after B at the earliest)

Heating of screed was performed without interv YES ☐ NO ☐ intervals from ☐ to ☐

Place and date

Ordering party signature

Contractor signature

7.3 Hydraulic adjustment execution protocol

PROTOCOL

Hydraulic adjustment execution

SYSTEM KAN-therm

Investor::

Investment/address:

KAN-therm heating circuit manifold:

Manifold location:

CIRCUIT	LABELLING	CONTROL VALVE NUMBER OF TURNS N	FLOW RATE[L/MIN]
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Place and date

Ordering party signature

Contractor signature

All forms are available on our web site in the section: „Downloads”.

SYSTEM **KAN-therm**

Optimal, complete multipurpose installation system consisting of state of the art, mutually complementary technical solutions for pipe water distribution installations, heating installations, as well as technological and fire extinguishing installations.

It is the materialization of a vision of a universal system, the fruit of extensive experience, the passion of KAN's constructors, strict quality control of our materials and final products, and vast knowledge of the market of installations to meet the requirements of energy efficient, sustainable construction.

Push Platinum

Push

Press LBP

PP

Steel

Inox

Sprinkler

Underfloor heating
and automation

Football
Stadium installations

Cabinets and manifolds

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