Plaster Ceiling with BEKA Heating and Cooling Mats

1. General

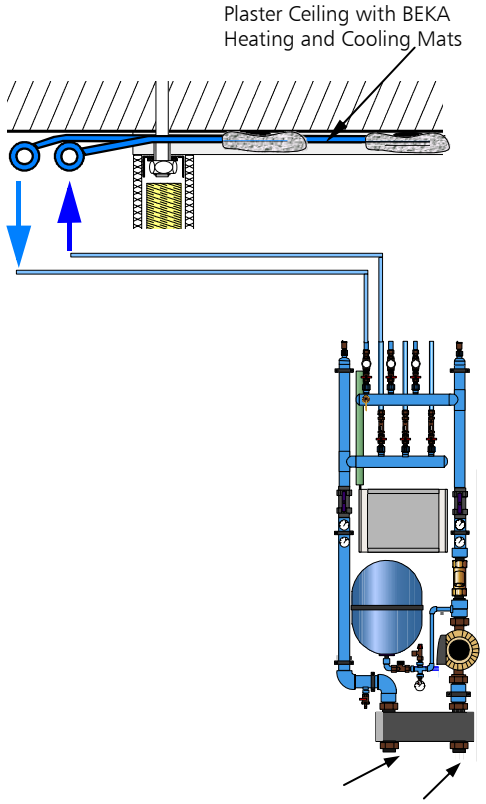
Modern office and business premises must be climate controlled almost all year through because of their high thermal insulation and internal loads from computers and office equipment. At the heating period they have comparatively low heat consumption. The energetic cost saving solution is the BEKA heating and cooling ceiling.
The BEKA heating and cooling mats can be directly fixed to the raw ceiling and then plastered. Even already suspended plasterboard ceilings can be converted very easily into economical heating and cooling ceilings. This arrangement can also be used for renovation of rooms listed for preservation. Due to the combined function of the ceiling, the investment costs for heating system installations can be minimised.

2. System description

BEKA heating and cooling mats are simply embedded into the ceiling plaster. Since the capillary tubes are positioned directly beneath the surface (the ceiling construction is thinner than 15 mm!), the surface will rapidly heat-up or cool-down. The reaction time of the ceiling is less than 15 minutes.

3. Cold water / heating water technology

The BEKA heating and cooling mats are tied up in zones to the piping as a circuit and connected to the heat or cooling source. The connection by storey-distributor is recommended.
For the cold water preparation different Techniques and systems can be used. The economical advantages of the cooling ceiling are based on the fact that the ceiling will provide already sufficient performance even with supply temperatures which are only slightly below the room temperature. This makes the utilisation of "alternative energy sources" like heat pumps or open cooling and ground water possible.
For the generation of heating water the same advantages are true as well. In connection with solar collector systems, and even with standard techniques a significant energy saving is already achieved, because essential heating performances are obtained with considerable low supply temperatures (below 40°C).



4. Installation

In general, the standard installation guidelines have to be observed. All materials used in the BEKA heating and cooling mat system must be non-corrosive. Materials to be applied can be: plastics, stainless steel, copper, brass and red brass. Use of other materials could cause sludge and lead to malfunction of the system.

5. Regulating technology

The regulating technology secures both the desired comfort and necessary system reliability.
The cooling ceiling requires: Room temperature regulation, dew point protection, and control of the supply temperature for the cold water. Supply temperatures below 16°C must be avoided because of the danger that the dew point will be reached!
For the heating ceiling, room temperature control is required, which regulates the volume of heating water as function of the desired room temperature. Supply temperatures higher than 45°C must be avoided because of the danger of excessive surface temperature of the ceiling and to prevent plaster from drying-out!

6. Dimensioning of the system

The BEKA heating and cooling mats are dimensioned according to the following layout table. The supply temperature determined in the water circuit, taken from the side of the cooling unit or heat source, is regulated with the water temperature upstream to the heat exchanger.

7. Preparation for Installation

As for the connection of the BEKA heating and cooling mats, the manufacturer's instructions must be observed. Regarding the plastering, the relevant instructions of the plaster material supplier must be followed.
The raw ceiling must have a solid base, which is able to carry surface loads of at least ≥ 20 kg/m^2.
If the plaster ceiling must be applied onto a suspended ceiling, the supporting spacing and design of the suspender from the raw ceiling must bear a load of at least ≥ 30 kg/m^2.
The BEKA heating and cooling mats are offered for the different applications in widths of 1200 mm and lengths up to 6000 mm that tailoring at the building site is not necessary. Only at borders and areas, where components are to be built into the ceiling, inactive areas must be provided. The BEKA heating and cooling mats can be supplied with double-sided adhesive tape already attached in the supplier's works for the positioning of the mats at the raw ceiling.
Before starting work, a ceiling pattern and installation pattern must be drawn-up. All mats with their dimensions and direction of installation for the supply lines must be recorded. In the ceiling pattern also all areas must be marked, which will stay blank, for instance, for the installation of partition walls, light fixtures and other ceiling inserts. Also the installation position of the BEKA dew point sensor must be marked at the ceiling pattern.
The Polypropylene piping is connected by thermal welding. For execution, the welding directions DVS 2207-11 of the Deutscher Verband für Schweißtechnik e.V. are valid. (The surrounding temperature during working must not drop below 5°C. The pre-heating, welding and setting times, which depend on the pipe dimension, have to be observed according to regulation.)

8. Tools, materials

For the installation of BEKA heating and cooling mats in plaster ceilings the recommended tools and materials for the installations of Polypropylene must be used:

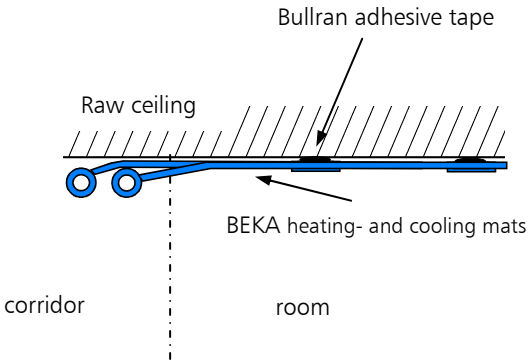
- Pipe clamps
- Dowels and screws, if necessary
- Plastic pipe clamps
- Hand-held welding device with sleeve welding adapter for plastic welding
- Plastic fittings
- Smoothening spatula
- Plaster material

Tools and materials for plastering must be provided according to the plaster manufacturer's instructions.

9. Installation Steps for the Ceiling

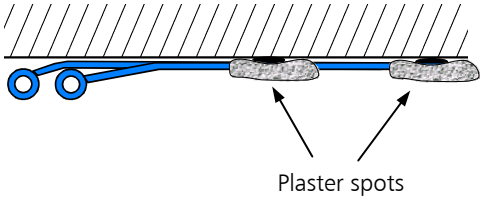
- Fasten main pipes of the mats with hose clamps to the raw ceiling or in the cavity of suspended ceilings. Later on the main pipes are located behind partition walls towards the corridor or behind cavities in the wall or mouldings.
- Connect mats to another and to the water circuit by means of thermal welding.
- Unroll the BEKA mats and position them to the raw ceiling or to the suspended ceiling by means of adhesive tape.
- Pre-test with air pressure of 10 bar for 1 hour.
- Main-test with water with 10 bar for 4 hours. Resting pressure of 3 bar must be kept-up until system is taken into operation.

I.



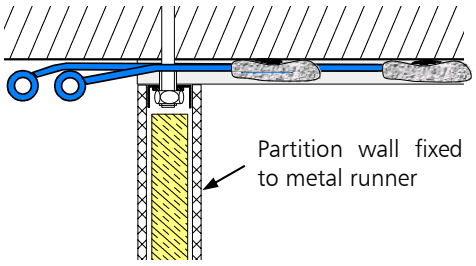
- Apply plaster spots at the spacer bars of the mats, with this the BEKA mats are held securely until plastering is done. For installation to suspended ceilings this additional fastening will not have to be done. Eventually only tacks have to be placed above the spacers of the mats, to take the tension of the mats

II.



III.

- Apply the plaster base adhesive primer according to manufacturers instructions, through painting, roll-on or spraying.
- Apply plastering in a thin layer. Mostly 10 to 12 mm is enough. Avoid thick layers – the cooling capacity will be lowered!!!



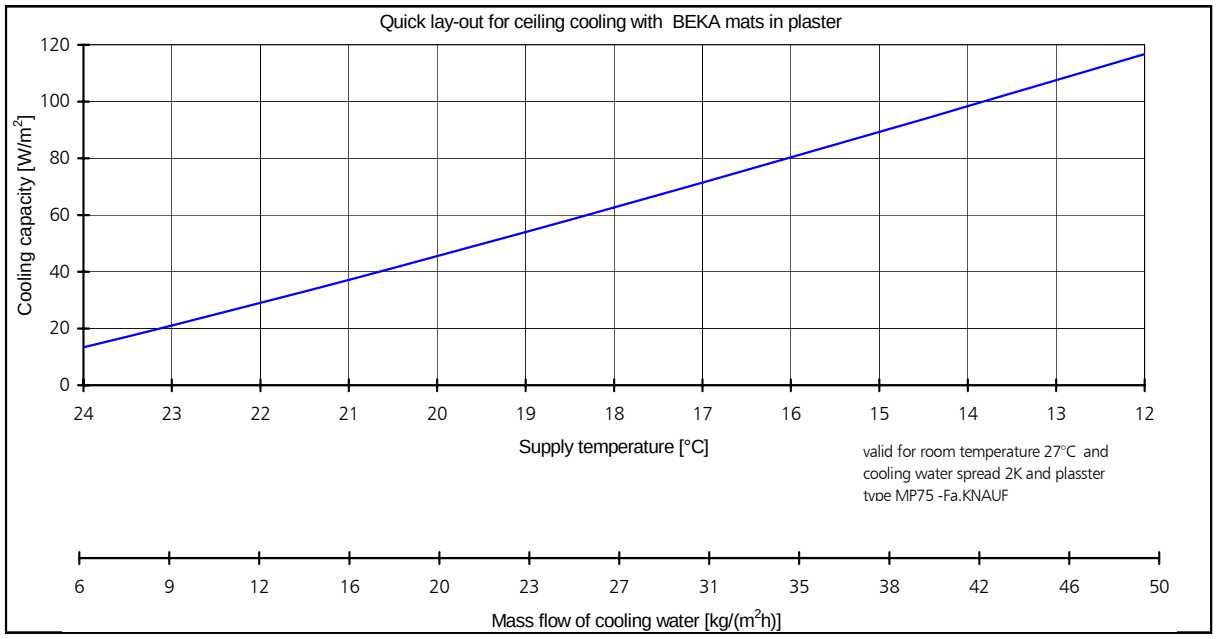
10. Lay-out of a Plaster Cooling Ceiling with BEKA Mats Type K.S15

Project :	Date
Project consultant :	Lay-out valid for 27°C room temperature and 2K cooling water spread !

Required Cooling Capacity

1	Cooling load for the room	W		from calculation of planning office
2	Planned coverage with mats	m^2		max.possible arrangement derived from room dimensions
3	Required specific cooling capacity	W/m^2		= cooling load / coverage

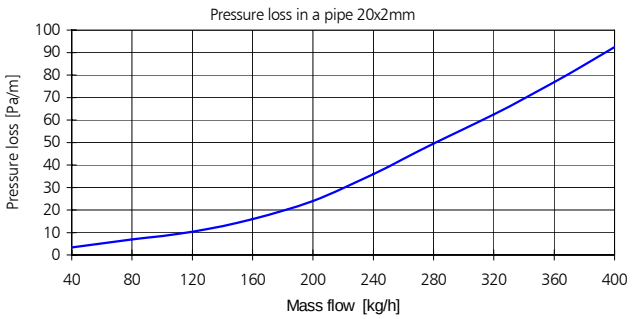
Performance Determination

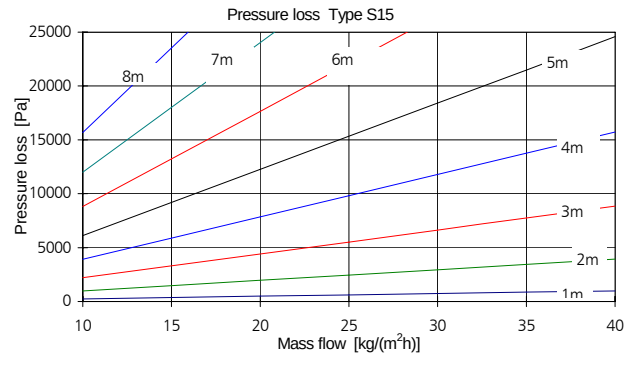


4	Supply temperature -> from diagram 1	°C	
5	Return temperature	°C	
6	Water volume of mat area	$kg/(m^2h)$	
7	Water volume per zone	l/h	

Pressure loss determination

8	Length of connecting pipe	m	
9	Resistance in the pipe -> from diagram 2	Pa/m	
10	Pressure loss in the pipe = pipe length * resistance	Pa	
11	Pressure loss of the mat -> with value of line 2 from the diagram 1	Pa	
12	Addition for pressure loss of fittings (recomm.: 30% addition to pipe)	Pa	
13	Addition for heat transfer station (recomm:for zone valves 500-1000 Pa for mains regulating valves 700 - 1500 Pa for heat exchanger approx. 4000 Pa	Pa	
14	Total pressure loss	Pa	





If BEKA heat transfer stations are utilised, the pressure determinaton can be omitted. Only the quantity of cooling circuits and the total cooling capacity is required for the selection.

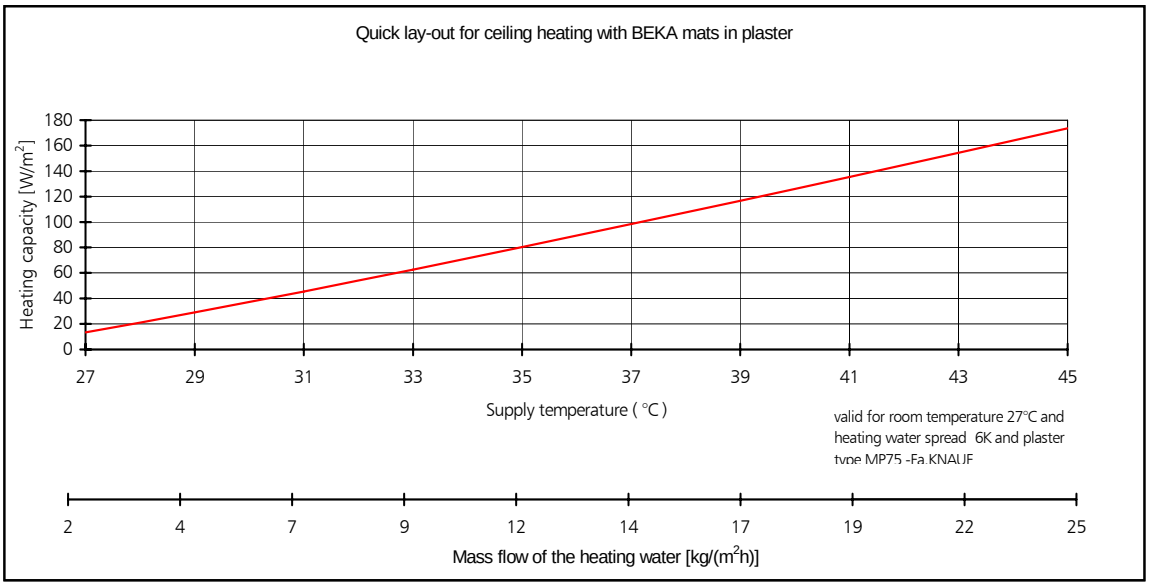
11. Lay-out of Plaster Ceiling for Ceiling Heating with BEKA Mats Type K.S15

Project :	Date
Project consultant :	Lay-out valid for 22°C room temperature and 6K Heating water spread !

Required heating capacity

1	Heat requirement for the room	W		from calculations of the planning office
2	Planned coverage with mats	m^2		max.possible arrangement derived from the room dimensions
3	Required specific heating capacity	W/m^2		= Heat requirement / coverage

Performance Determination

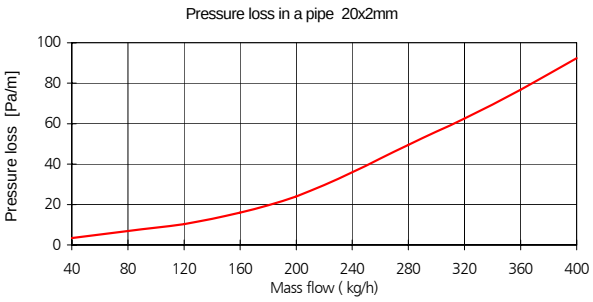


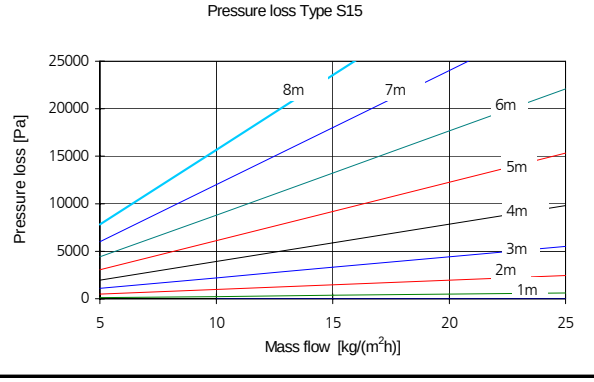
4	Supply temperature -> from diagram 1	°C	
5	Return temperature	°C	
6	Water volume per mat area	kg/(m^2h)	
7	Water volume per zone	l/h	

Pressure Loss Determination

8	Length of connecting pipe	m	
9	Resistance in the pipe -> from diagram 2	Pa/m	
10	Pressure loss in the pipe = pipe length * resistance	Pa	
11	Pressure loss of the pipe -> with value of line 2 from diagram 1	Pa	
12	Addition for pressure loss of fittings (recomm: 30% Addition to pipe)	Pa	
13	Addition for heat transfer stations (recomm:for zone valves 500-1000 Pa for mains regulating valves 700 - 1500 Pa for heat exchanger approx. 4000 Pa	Pa	
14	Total Pressure Loss	Pa	

If BEKA heat transfer stations are utilised, the determination of pressure losses can be omitted. Only the quantity of heating circuits and the total heating capacity is required for the selection.





12. Technical Details

BEKA capillary tube mats
Type K.S15

Material
Polypropylene Random-Copolymer Type 3 DIN 8078

Geometry

Collector pipe	20 x 2 mm
Capillary tube	3,35 x 0,5 mm
Capillary tube distance	15 mm
Exchange surface	0,71 m^2

Size
Length: 600-6000 mm (in increments of 10 mm)
Width: 150-1200 mm (in increments of 30 mm)

Masses
0,44 kg/m^2 (empty, without collector)
0,71 kg/m^2 (filled, without collector)
Water contents 0,27 l/m^2

Cooling capacity:
Depending upon the type
80 W/m^2 with 10 mm Plaster MP 75 (DIN 4715)

Heating capacity:
Depending upon the type
to 150 W/m^2

Operation condition:
Temperature stable at long term use up to 45°C
Operation pressure 3 to 4 bar
Test pressure 10 bar max. 10 hours

Utilisation / type of installation:
Cooling- and heating ceilings, plaster-version
Connection by thermal welding

Type of delivery:
The mats are supplied rolled-up, packed in cartons