# Plaster Ceiling with BEKA Heating and Cooling Mats

## 1. General

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

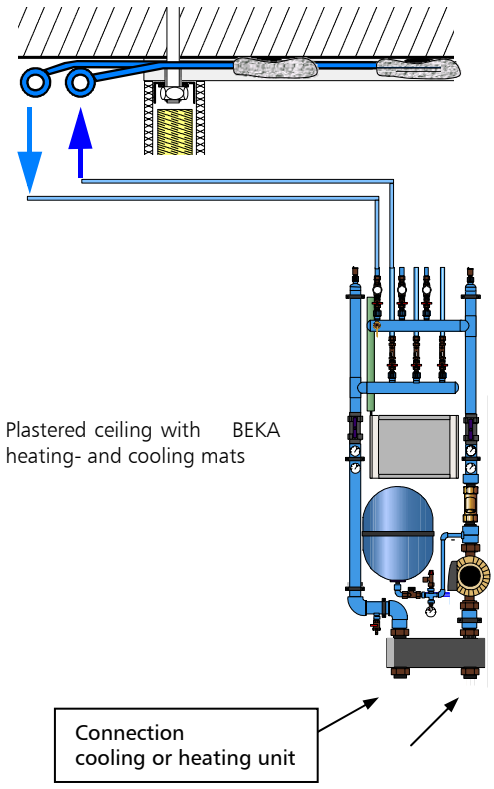
## 2. System Description

The 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 heat-up or cool-down fast. The time reaction of the ceiling is less than 15 minutes.

## 3. Cold Water- / Heating Water Technique

The BEKA heating- and cooling mats are tied up in zones to the piping as a circuit and connected to the heat- or cooling supplier. The connection via a storey-distributor is recommended.

For the cold water preparation different techniques and systems can be utilised. The economical advantages of the cooling ceiling exist because 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. In connection with solar collector systems, and even with standard techniques a significant energy saving is already reached, because respectable heating performances are achieved with considerable low supply temperatures (below 40°C).




Plastered ceiling with BEKA heating- and cooling mats

## 4. Installation

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

## 5. Regulating Technique

The regulating technique secures, first the desired comfort, second the necessary system reliance.
The cooling ceiling requires: a room temperature regulation, a dew point guard, and a 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 is reached!
For the heating ceiling a room temperature control is required, which regulates the volume of heating water in dependence to the desired room temperature. Supply temperatures higher than 45°C must be avoided because of the danger of an 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 lay-out table. The supply temperature determined in the water circuit, taken at the side of the cooling unit or heat generator, is regulated with the water temperature before the heat exchanger.

## 7. Preparation for Installation

For the connection of the BEKA heating- and cooling mats the manufacturers instructions must be obeyed. For the plastering 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 distances 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 uses in widths of 1200 mm and lengths up to 6000 mm, so that tailoring at the building site is not necessary. Only at borders and at areas where ceiling in-builds are planned, inactive areas must be provided. The BEKA heating- and cooling mats can be supplied with readily attached double sided adhesive tape, for the positioning of the mats at the raw ceiling.
Before starting work a ceiling pattern and an installation pattern must be drawn-up. All mats with its dimensions and direction of installation for the supply lines must recorded. In the ceiling pattern also all areas must be marked, which will stay empty for instance for the installation of partition walls, for light fixtures and for other ceiling in-fills. Also the installation position of the dew point BEKA-sensor must be marked at the ceiling pattern.
The connection of the Polypropylene piping is done by thermal welding. For the execution the welding directions DVS 2207-11 of the Deutscher Verband für Schweißtechnik e.V. are valid. (The surrounding temperature during working must not be below 5°C. The pre-heating,- welding and setting time must be according to regulations.)

## 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:

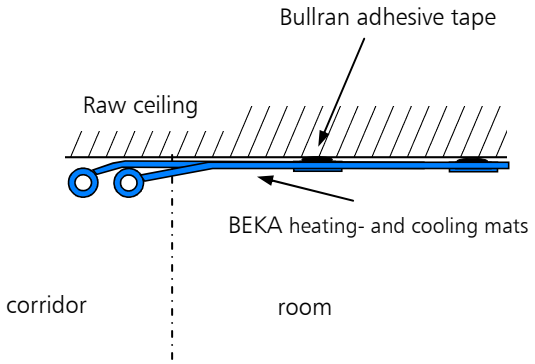
- Pipe clamps
- Dowels and screws, if necessary
- Plastic pipe clamps
- Hand held welding device with sleeve welding adapter for plastic welding
- Plastic fittings
- Smoothening spatula
- Plaster material

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

## 9. Installation Steps for the Ceiling

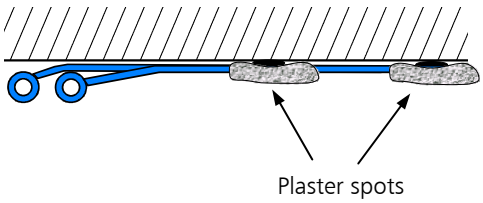
- Fasten main pipes of the mats with hose clamps to the raw ceiling or in the cavity of suspended ceilings. Later on the main pipes are located behind partition walls towards the corridor or behind cavities in the wall or mouldings.
- Connect mats to another and to the water circuit by means of thermal 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.



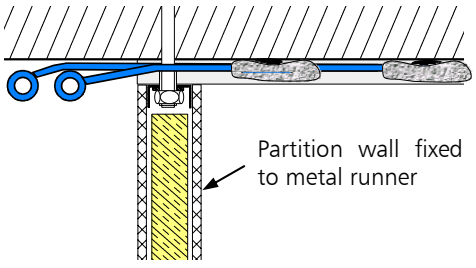

- Apply plaster spots at the spacer bars of the mats, with this the BEKA mats are held securely until plastering is done. For installation to suspended ceilings this additional fastening will not have to be done. Eventually only tacks have to be placed above the spacers of the mats, to take the tension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



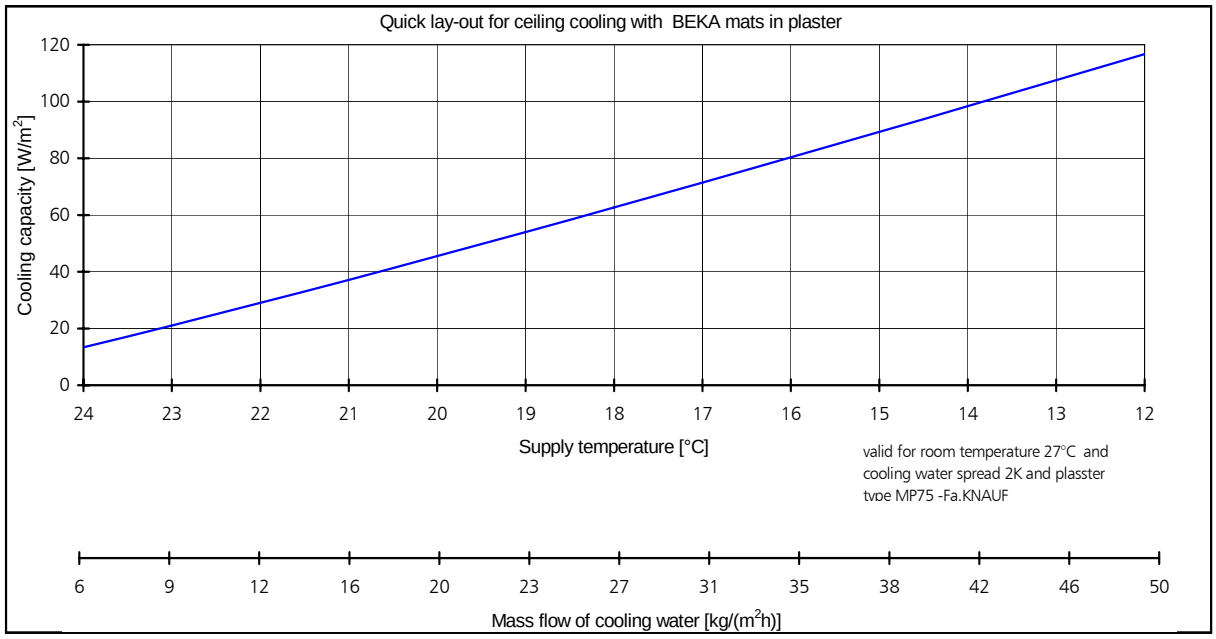
## 10. Lay-out of a Plaster Cooling Ceiling with BEKA Mats Type K.S15

| | |
|---|---|
| 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 |

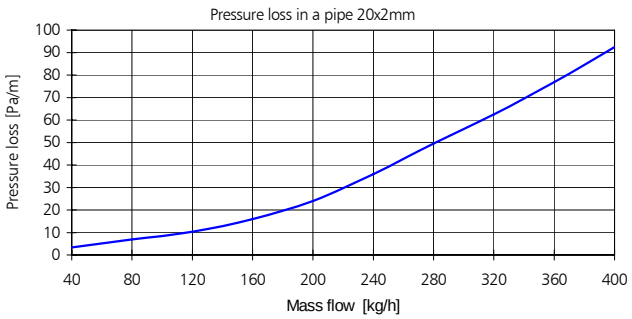
Performance Determination

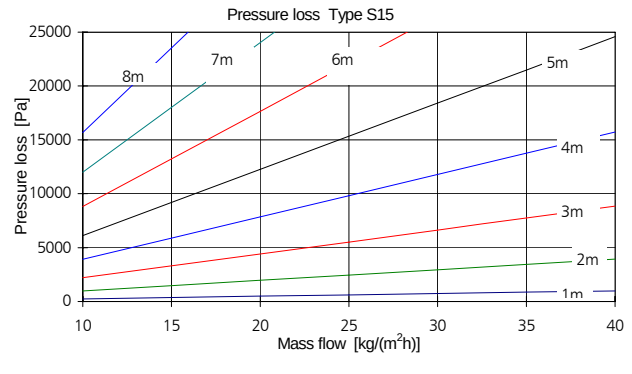



| | | | |
|---|---|---|---|
| 4 | Supply temperature -> from diagram 1 | °C | |
| 5 | Return temperature | °C | |
| 6 | Water volume of mat area | $kg/(m^2h)$ | |
| 7 | Water volume per zone | l/h | |

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<br>= pipe length * resistance | Pa | |
| 11 | Pressure loss of the mat<br>-> with value of line 2 from the diagram 1 | Pa | |
| 12 | Addition for pressure loss of fittings<br>(recomm.: 30% addition to pipe) | Pa | |
| 13 | Addition for heat transfer station<br>(recomm:for zone valves 500-1000 Pa<br>for mains regulating valves 700 - 1500 Pa<br>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.*

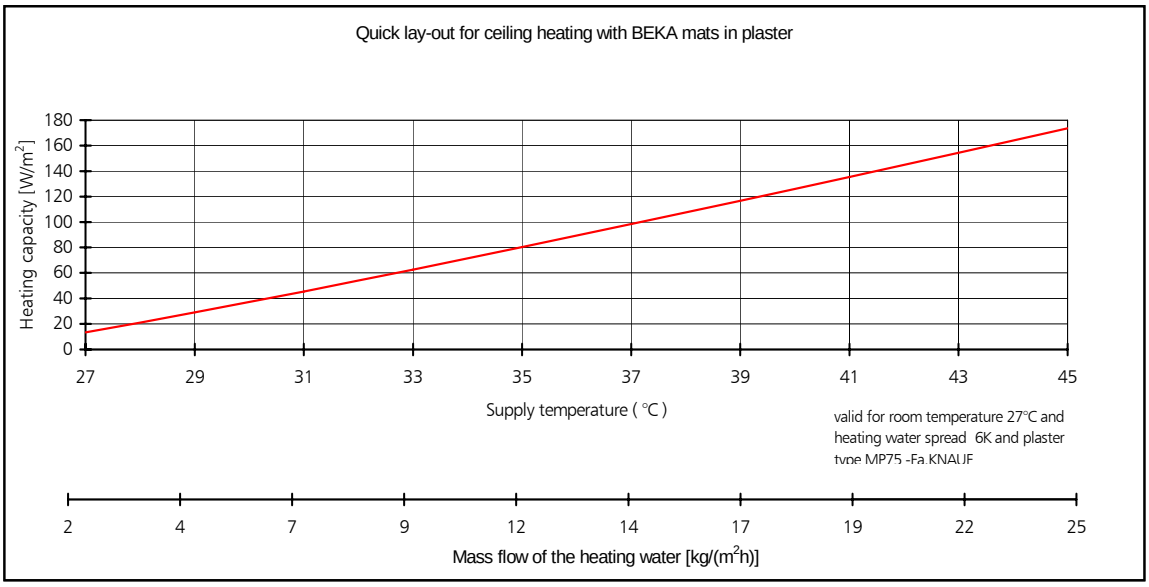
## 11. Lay-out of Plaster Ceiling for Ceiling Heating with BEKA Mats Type K.S15

| | |
|---|---|
| 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

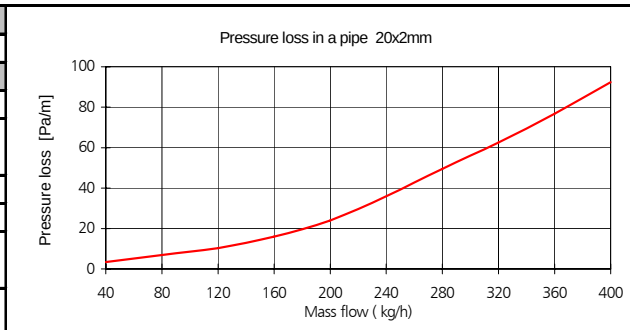


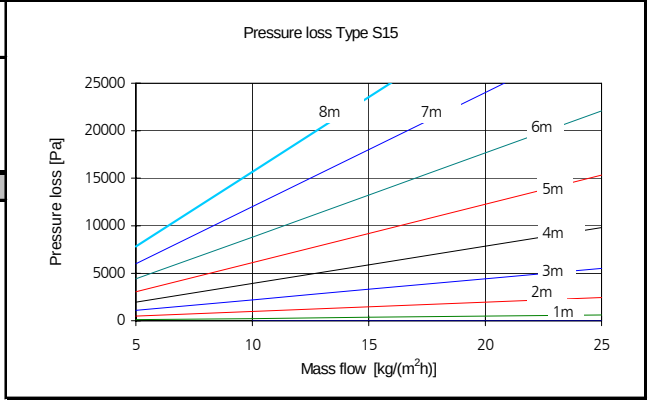

| | | | |
|---|---|---|---|
| 4 | Supply temperature -> from diagram 1 | °C | |
| 5 | Return temperature | °C | |
| 6 | Water volume per mat area | kg/(m²h) | |
| 7 | Water volume per zone | l/h | |

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