BEKA
FÜR KLIMA-KOMFORT

Product Data Sheets
Technical Information
Calculation Programmes for
BEKA Capillary Tube Technology

www.beka-klima.de

Imprint

BEKA CD-ROM
Product binder and calculation program

Release: 04/2017

Publisher:
BeKa Heiz- und Kühlmatten GmbH
Pankstrasse 8-10 · 13127 Berlin, Germany
Phone +49(0)30 47411431
Fax +49(0)30 47411435
website: www.beka-klima.de
E-mail: info@beka-klima.de

This CD-ROM was developed according to the state of the art. For faultless work and application with the various computer types and equipment configurations, warranty can not be granted. In spite of a careful processing BeKa Heiz- und Kühlmatten GmbH do not grant any warranty.

BEKA
FÜR KLIMA-KOMFORT

New Roads in Climate Engineering
Advantages of Capillary Tube Mats

For temperature regulation in nature, water carrying capillary vessels have succeeded, so for example in the leaves of plants or beneath the human skin. Water will conduct heat 1000 times faster than air and therefore it is many times more effective.

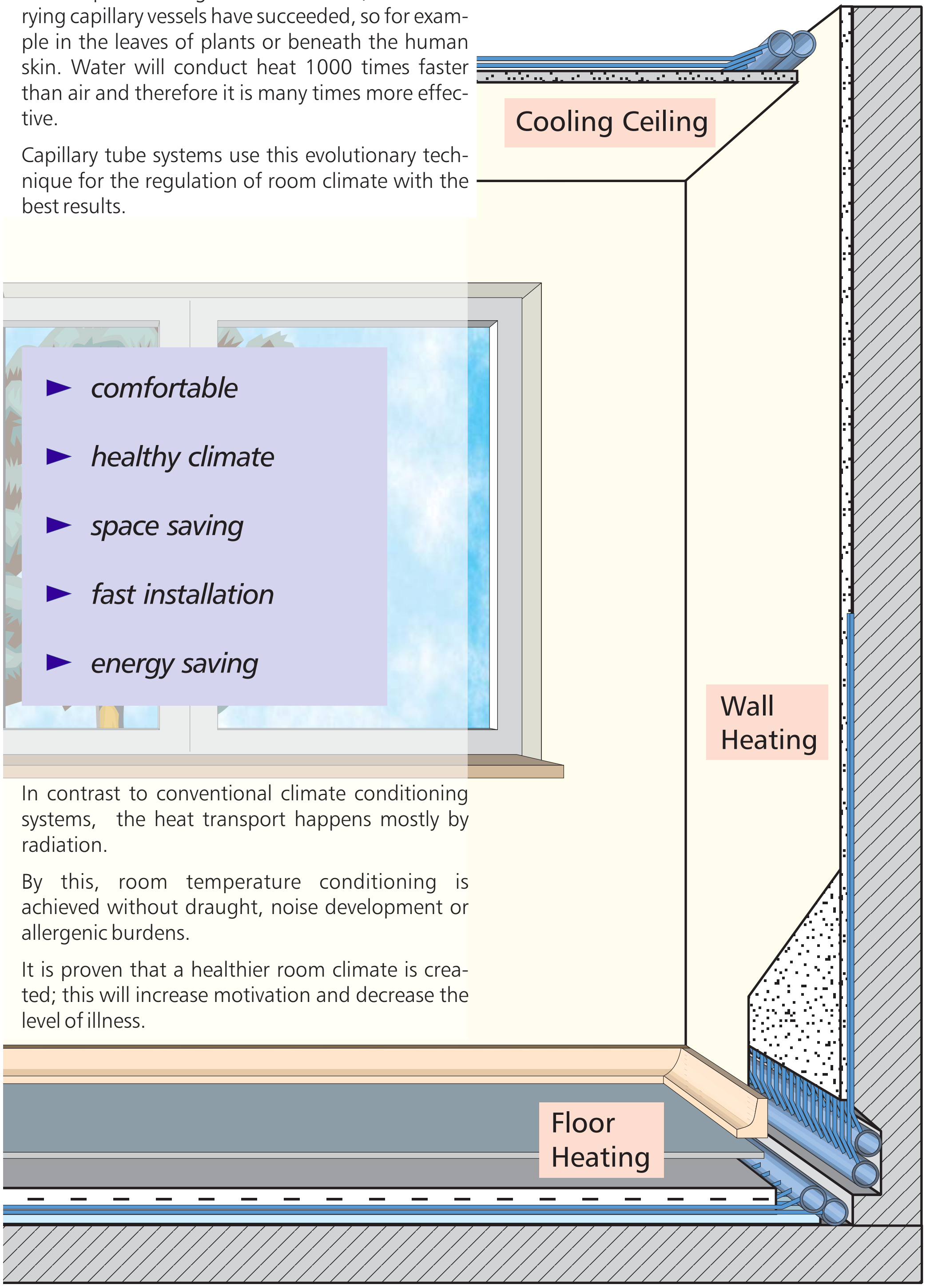
Capillary tube systems use this evolutionary technique for the regulation of room climate with the best results.

- *comfortable*
- *healthy climate*
- *space saving*
- *fast installation*
- *energy saving*

In contrast to conventional climate conditioning systems, the heat transport happens mostly by radiation.

By this, room temperature conditioning is achieved without draught, noise development or allergenic burdens.

It is proven that a healthier room climate is created; this will increase motivation and decrease the level of illness.



BEKA Capillary Tube Engineering
Heating and Cooling with Comfort

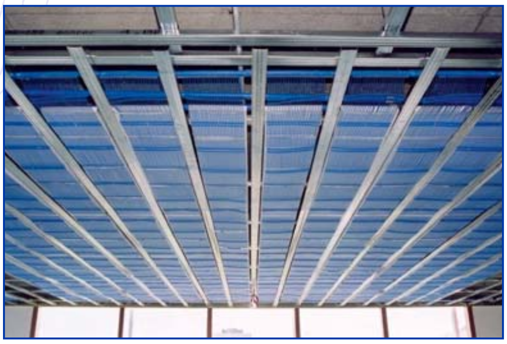
Cooling ceilings and surface heating with BEKA capillary tube mats offer a high degree of climate comfort.
Once installed beneath the plastering, dry-built boards or integrated in metal cassettes it is unobtrusive and space saving.
The obvious advantages are healthy room climate and low energy costs. But also the hidden qualities such as easy installation, high heating and cooling capacities and the flexibility of the material argue in favour of BEKA.


BEKA cooling ceiling as plaster ceiling


BEKA cooling ceiling as metal cassette ceiling


BEKA cooling ceiling with dry-built prefabricated elements


BEKA supply lines with quick-action couplings


BEKA cooling ceiling as dry-built-ceiling

Who is who?
The BEKA team is at your disposal

One of our principles:
Your project is also our project.

Therefore, we assist you from the specification to the individual offer, up to delivery , completion and beyond.
With 15 years warranty on all BEKA products we grant a maximum of security.

Albrecht Bauke, Managing Director,
Phone. +49 (0) 30 474 114 37

Jörg Siegmund, Authorised Officer (Controlling),
Phone +49 (0) 30 474 690 71

Barbara Schrekkert, Export,
Phone +49 (0) 30 474 114 36

Stephan Mölle, Authorised Officer (Engineering),
Phone +49 (0) 30 474 690 72

The Production
Quality and Delivery in Due Time

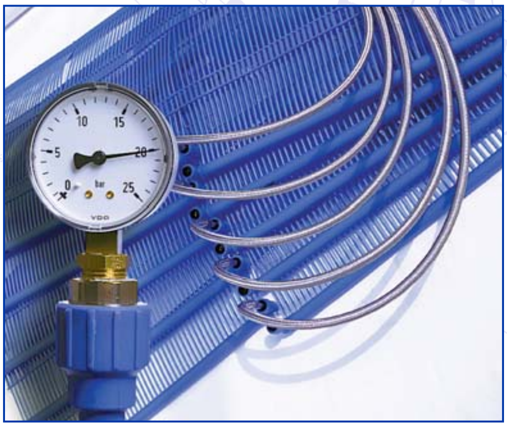
Most modern production technologies and the experienced staff guarantee production with constant high quality.
Through a just-in-time production also short term deliveries will be past on to the forwarding companies in time, transporting the BEKA products to the construction site.
With 15 years warranty on all BEKA products we pass our security on to you.

15 years warranty


Technical Hotline +49 (0) 30 474 114 -36 or by Fax -35


Production area of about 2.000 m²


Fabrication of storey stations and distributors according to plan


BEKA quality test with 20 bar


Delivery via parcel service or on pallets via carrier

BEKA
FÜR KLIMA-KOMFORT

Info 5 *General Information - Road Directory*

Your way to BEKA
We look forward to your visit

BeKa Heiz- und Kühlmatten GmbH
Pankstrasse 8-10
13127 Berlin, GERMANY
Phone +49 (0) 30 474 114 31
Fax +49 (0) 30 474 114 35

House Q · Administration House P · Production

K Capillary Tube Mats

BEKA Capillary Tube Mat type U
K.U10 · K.UM10

BEKA Capillary Tube Mat type S
K.S10 · K.SK10· K.S15

BEKA Capillary Tube Mat type G
K.G10 · K.G20 · K.GM10 · K.GK10 · K.GS10 · K.GSM10
K.GG10 · K.GT10

P Capillary Tube Mats for pressure PN20

BEKA Capillary Tube Mat type VS
P.VS10 · P.VSK10 · P.VS20 · P.VS30

BEKA Capillary Tube Mat type VG
P.VG10 · P.VG20 · P.VG30

BEKA Capillary Tube Mat type NS
P.NS15

BEKA Capillary Tube Mat type FS
P.FS20

B Pre-fabricated Units

BEKA Pre-fabricated Unit
B.GK12

BEKA Pre-fabricated Unit - Dummy sheet
B.GB12

C copper tube meander

BEKA copper tube meander
for metall panel ceilings
and gypsum plasterboard ceilings

R · Z Pipes · Supply Lines

BEKA Pipe R.R

BEKA Supply Lines
Supply Lines, single Z.E

Contents: Product Data Sheets

F Fittings

Fittings for Butt-welding
T-Connector · Elbow 90°

Fittings for Sleeve-welding
Sleeve · T-Connector · Elbow 90° · Elbow 45° · End Cap

Metal- /Plastic Fittings for Screw connection
Euro Cone Transition

Ball Valve

A Connection Technique

Quick-action Coupling Connections
Sleeve Outlet · Elbow Outlet · Plug-in Connector

Hoses · Plugs

M Measuring- and Control Engineering

Dew Point Sensor · Converter · Room Temperature Control

Thermo Actuating Drive

V Accessory Material

Adhesive · Solvent · Thermal Conductive Paste
Spacer · Adhesive Tape · Clip

Leveling out Mass · Primer

W Tools

Butt Welding Device · Sleeve Welding Device · Scissors

E Distributor

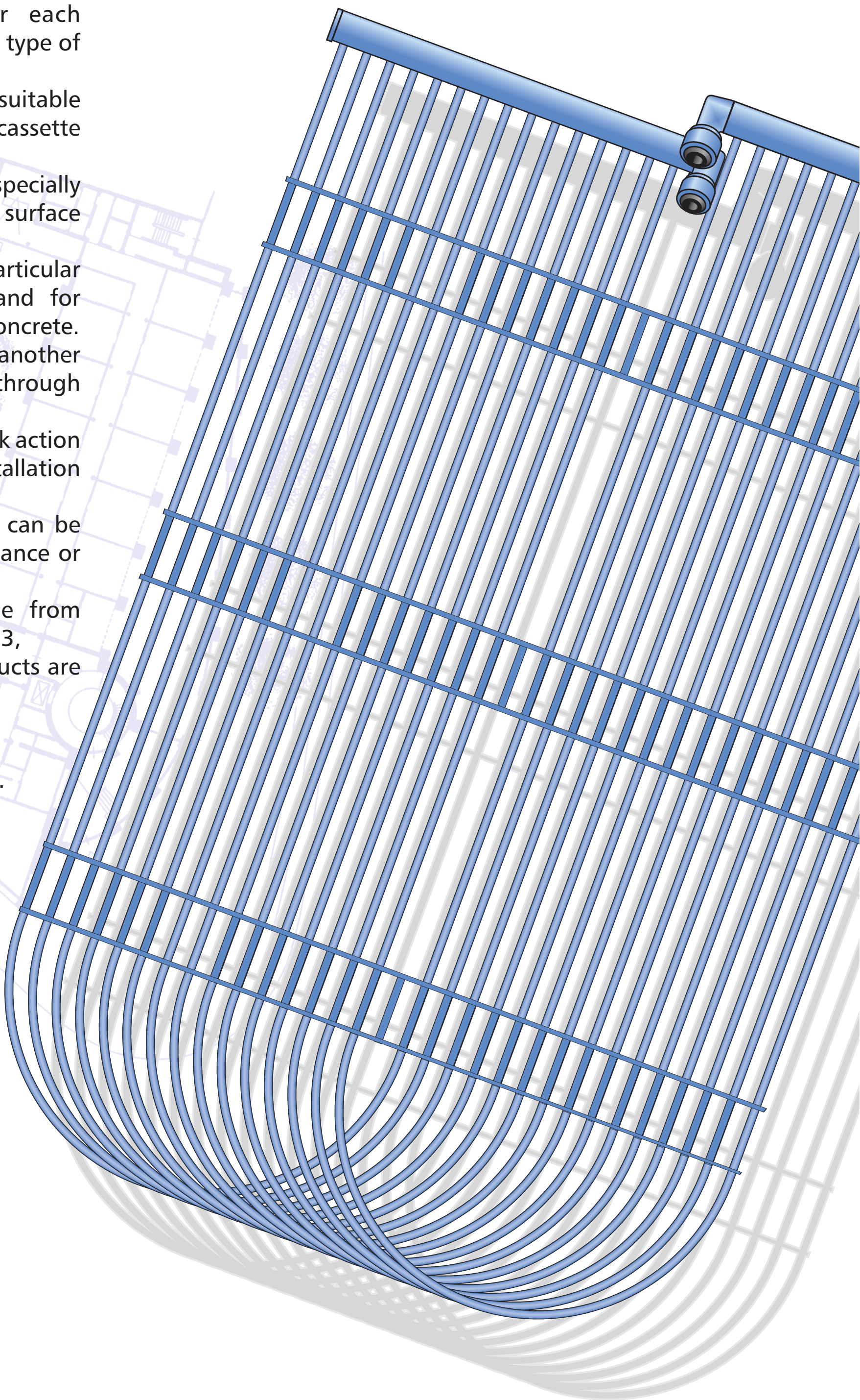
Connecting Points · Storey Distributor · Base Unit

BEKA Capillary Tube Mats
At all times the right choice

BEKA capillary tube mats are utilised for heating- and cooling mats in cooling ceilings and surface heating systems. For each application there is an optimal suitable type of mat.
The BEKA mats U10 and UM10 are suitable ideally for the application in metal cassette ceilings.
The BEKA mat K.S15 had been specially designed for plaster ceilings and surface heating systems.
The BEKA mats Type G are suitable in particular for applications on plaster boards and for numerous special-applications, e.g. in concrete.
All BEKA mats can be connected to another either by quick action couplings or through welding.
Due to the connecting system with quick action couplings and flexible hoses, the installation work is done fast and safely.
With metal ceilings the ceiling panels can be flapped down at all times for maintenance or for installation work.
The BEKA mats are exclusively made from Polypropylene Random Copolymer Type 3, DIN 8078. Consequently all BEKA products are weldable to each other.
The uniformly high quality is ensured by our 100% quality in-spection as well as a 15-year warranty on all BEKA products.

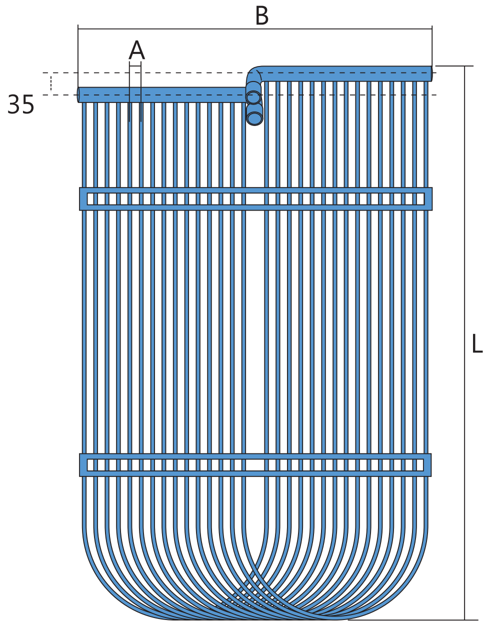
15 years warranty

BEKA



K.U10 | BEKA Capillary Tube Mat

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	600 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 160 - 1200 mm (in steps of 20 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity* Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connecting variation with quick-action couplings	11, connections middle
Operation area	Metal panel ceiling

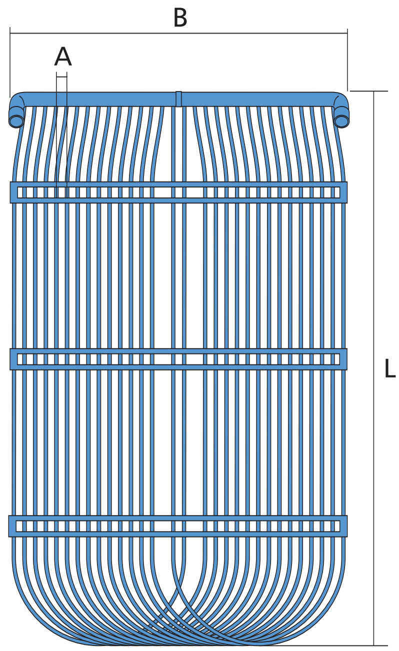


* Capacity is reached at defined conditions

Ordering example:
BEKA Capillary tube mat type K.U10, length 1350mm width 440mm, 2 connections:
K.U10.1350.0440.11

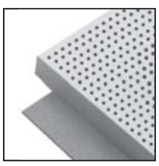
K.UM10 | BEKA Capillary Tube Mat

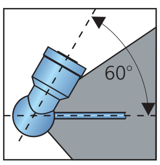
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	600 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 160 - 1200 mm (in steps of 20 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity* Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connecting variation with quick-action couplings	11, connections outside
Operation area	Metal panel ceiling



* Capacity is reached at defined conditions

Ordering example:
BEKA Capillary tube mat type K.UM10, length 1450mm width 340mm, 2 connections:
K.UM10.1450.0340.11

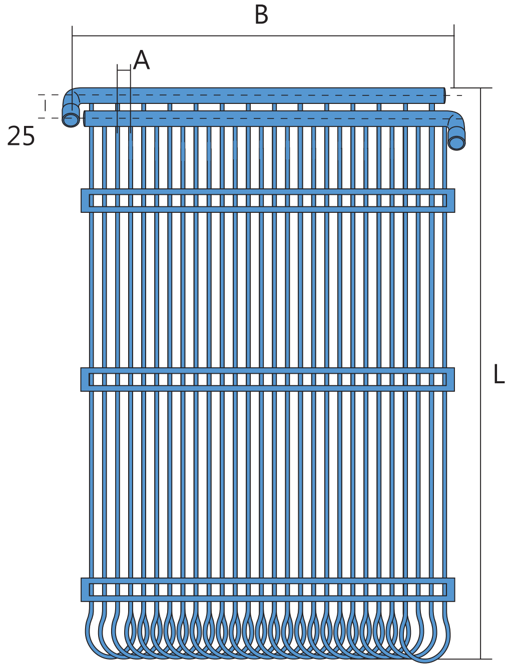




Deviations of the illustration are possible.

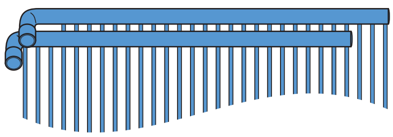
K.S10. . .11 / 20 BEKA Capillary Tube Mat

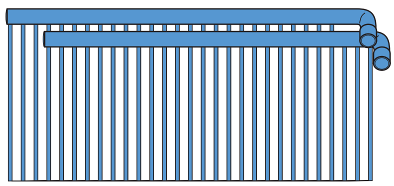
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	600 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 170 - 1210 mm (in steps of 20 mm) 175 - 1215 mm (in steps of 20 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connection variation with quick-action couplings	11, connections outside 20, connections on the left 02, connections on the right
Operation area	Special solution for: Plaster ceiling Metal panel ceiling



Connection type 00

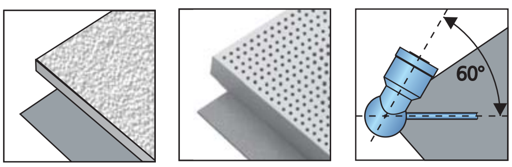
* Capacity is reached at defined conditions


Connection type 20


Connection type 02

Ordering example for variant 11:
BEKA Capillary tube mat type K.S10.11, length 1350mm width 610mm, connections outside:
K.S10.1350.0610.11

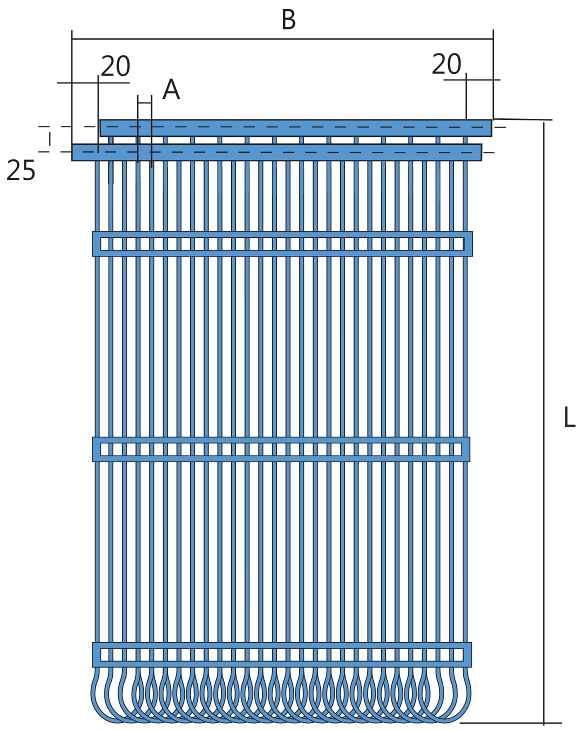
Ordering example for variant 20/02:
BEKA Capillary tube mat type K.S10.02, length 1250mm width 435mm, connections on the right:
K.S10.1250.0435.02



Deviations of the illustration are possible.

K.S10. . .00 | BEKA Capillary Tube Mat

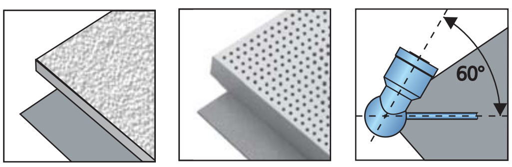
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 170 - 1210 mm (in steps of 20 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Special solutions for: Plaster ceiling Metal panel ceiling



Connection type 00

* Capacity is reached at defined conditions

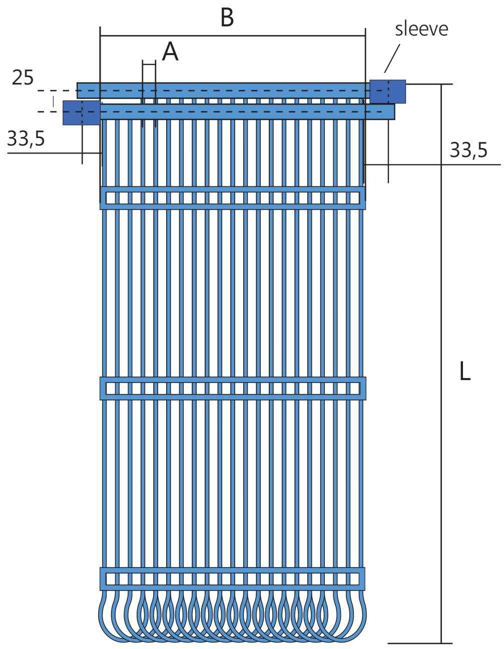
Ordering example:
BEKA Capillary tube mat type K.S10, length 5500mm width 990mm, without connections:
K.S10.5500.0990.00



Deviations of the illustration are possible.

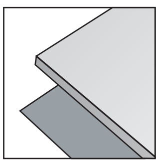
K.SK10 | BEKA Capillary Tube Mat

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 230 - 430 mm (in steps of 60 mm)
Massis filled Exchange surface Water contents	274 g/m² (without collector) 1.067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	70 W/m² 60°C 4 bar
Connection variation with quick-action couplings	00, without connections, with sleeves
Operation area	Layed on dry build sheets
Accessories	Mounting plate Plastic nails



* Capacity is reached at defined conditions

Ordering example:
BEKA Capillary tube mat type K.SK10, length 5000mm width 430mm, without connections:
K.SK10.5000.0430.00

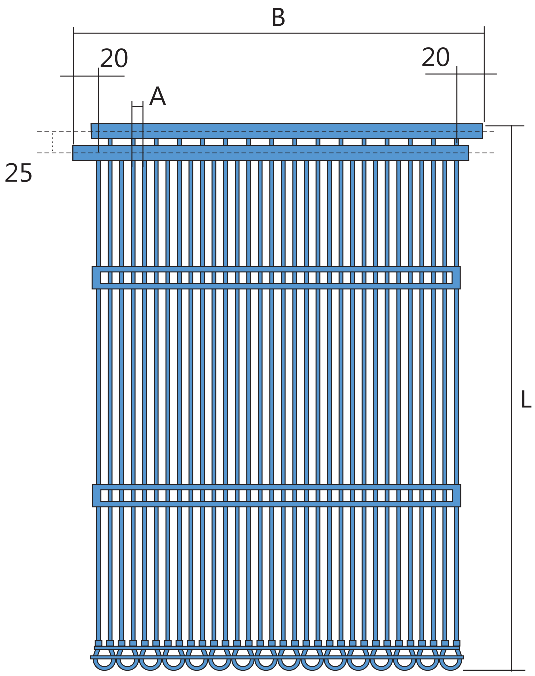


Deviations of the illustration are possible.

K.S15 | BEKA Capillary Tube Mat

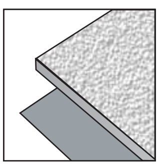
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 15 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 175 - 1195 mm (in steps of 30 mm)
Massis filled Exchange surface Water contents	562 g/m² (without collector) 0,71 m²/m² 0,27 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 60°C 4 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Plaster ceiling Surface heating in plaster or screeding

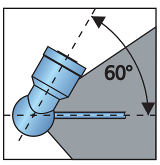
* Capacity is reached at defined conditions



Other connection types are available per your inquiry

Ordering example:
BEKA Capillary tube mat type K.S15, length 5500mm width 985mm, without connections:
K.S15.5500.0985.00

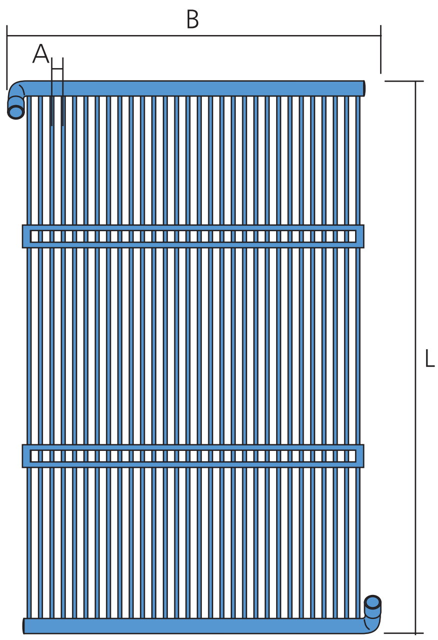




Deviations of the illustration are possible.

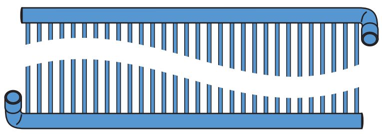
K.G10. . .11 / 20 BEKA Capillary Tube Mat

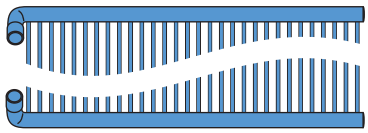
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B) - type 11 - type 00/20	600 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 155 - 1195 mm (in steps of 10 mm) 160 - 1200 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connection variation with quick-action couplings	11, connections outside on difference sides 20, connections outside on one side
Operation area	Metal panel ceiling



Connection type 11.L

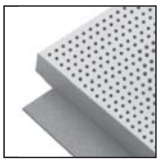
* Capacity is reached at defined conditions

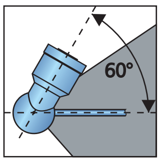

Connection type 11.R


Connection type 20/02

Ordering example:
BEKA Capillary tube mat type K.G10, length 1250mm width 625mm, connections on the right:
K.G10.1250.0625.11.R

Ordering example:
BEKA Capillary tube mat type K.G10, length 1250mm width 620mm, 2 connections outside on one side:
K.G10.1250.0620.20



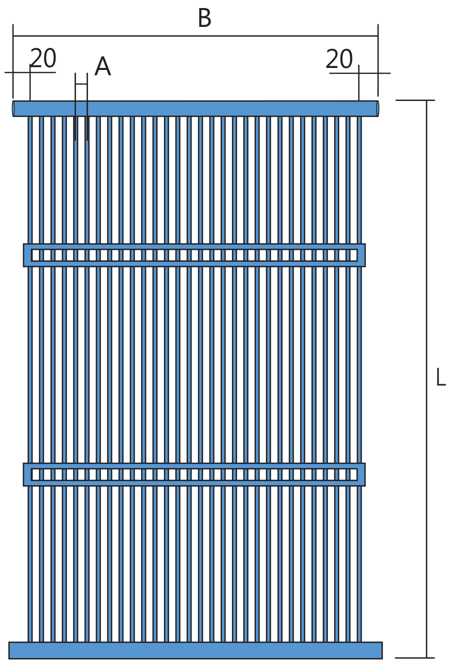


Deviations of the illustration are possible.

K.G10. . .00 | BEKA Capillary Tube Mat

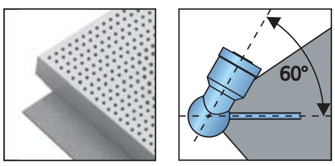
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 170 - 1200 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Metal panel ceiling

* Capacity is reached at defined conditions



Connection type 00

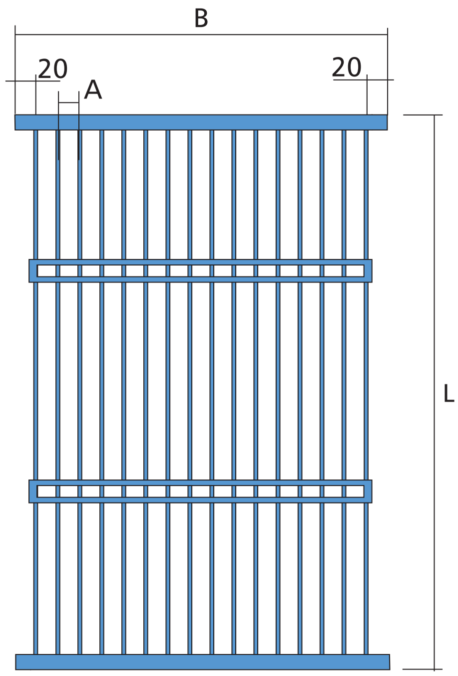
Ordering example:
BEKA Capillary tube mat type K.G10, length 6000mm width 960mm, without connections:
K.G10.6000.0960.00



Deviations of the illustration are possible.

K.G20 | BEKA Capillary Tube Mat

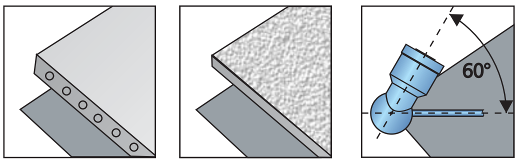
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 20 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 160 - 1200 mm (in steps of 20 mm)
Massis filled Exchange surface Water contents	412 g/m² (without collector) 0,533 m²/m² 0,19 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	45 W/m² 60°C 4 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Pre-fabricated concrete units, Plaster ceiling Surface heating in plaster or in screeding



* Capacity is reached at defined conditions

Other connection types are available per your inquiry

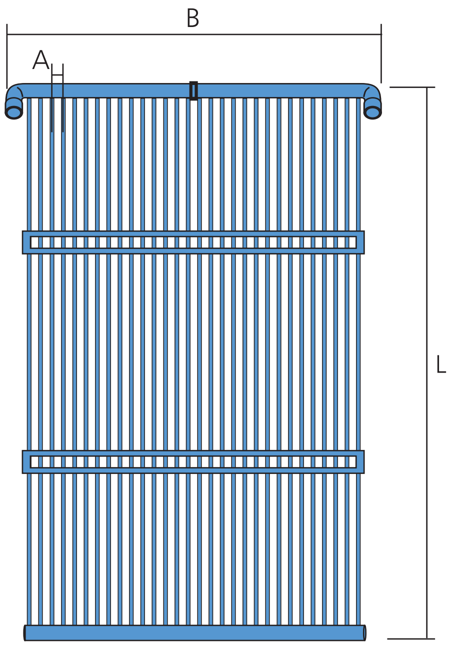
Ordering example:
BEKA Capillary tube mat type K.G20, length 5500mm width 980mm, without connections:
K.G20.5500.0980.00



Deviations of the illustration are possible.

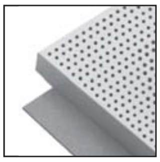
K.GM10 | BEKA Capillary Tube Mat

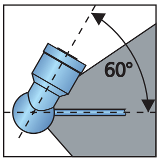
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	600 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 155 - 1195 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connection variation with quick-action couplings	
Operation area	Metal panel ceiling



* Capacity is reached at defined conditions

Ordering example:
BEKA Capillary tube mat type K.GM10, length 1450mm width 355mm, 2 connections outside:
K.GM10.1450.0355.11

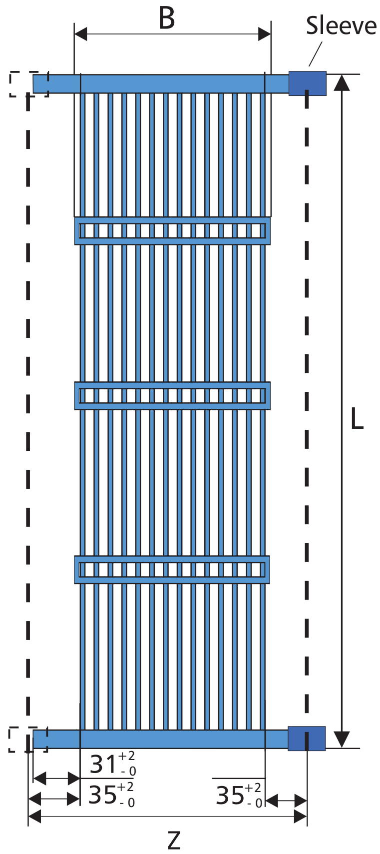




Deviations of the illustration are possible.

K.GK10 | BEKA Capillary Tube Mat

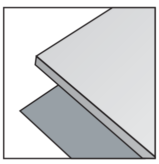
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 230 - 430 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	274 g/m² (without collector) 1.067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	70 W/m² 60°C 4 bar
Connection variation with quick-action couplings	00, without connections, with sleeves
Operation area	Layed on dry build sheets
Accessories	Mounting plate Plastic nails



* Capacity is reached at defined conditions

* Z-dimension = spacing of the ceiling substructure
* Power rating is achieved under defined conditions

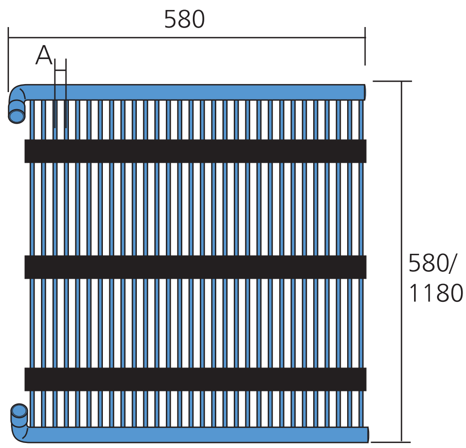
Ordering example:
BEKA Capillary tube mat type K.GK10, length 5000mm width 430mm, without connections:
K.GK10.5000.0430.00



Deviations of the illustration are possible.

K.GS10 BEKA Capillary Tube Mat

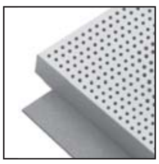
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	580 or 1180 mm 580 mm
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/ m²
Cooling capacity * Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connection variation with quick-action couplings	20, connections on the left
Operation area	Standard dimensions for metal cassettes 600 x 600 mm / 625 x 625 mm or 1200 x 600 mm / 1250 x 625 mm only in connection with pre-fabricated gluing onto metal cassettes which are provided by the customer

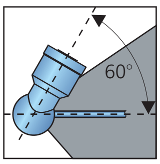


Other connection types are available per your inquiry

* Capacity is reached at defined conditions

Ordering example:
BEKA Capillary tube mat type K.GS10, length 580mm width 580mm, 2 connections on the left:
K.GS10.0580.0580.20

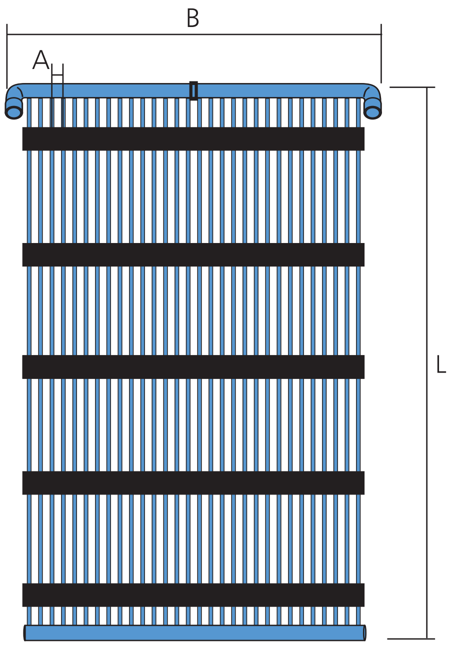




Deviations of the illustration are possible.

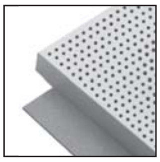
K.GSM10 BEKA Capillary Tube Mat

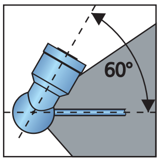
Material	Polypropylen Random-Copolymerisat Typ 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	550 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 175 - 1195 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	83 W/m² 60°C 4 bar
Connection variation with quick-action couplings	11, connections outside
Operation area	Standard dimension for factory in the hotmelt gluing process for metal ceiling panels



* Capacity is reached at defined conditions

Ordering example:
BEKA Capillary tube mat type K.GSM10, length 1450mm width 355mm, 2 connections outside:
K.GSM10.1450.0355.11

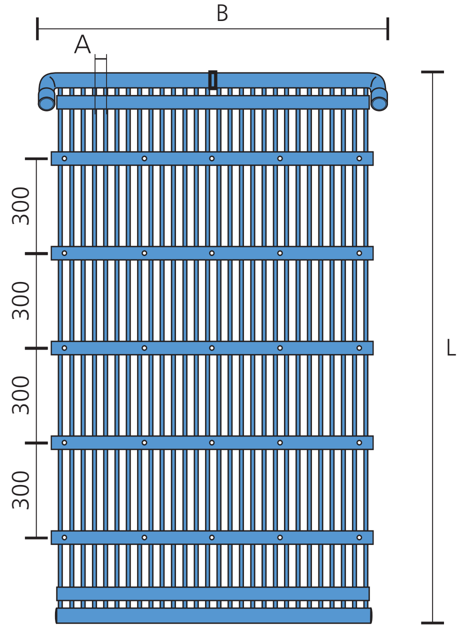




Deviations of the illustration are possible.

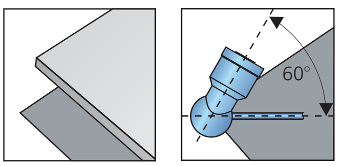
K.GG10 BEKA Capillary Tube Mat

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	600 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 155 - 1195 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/ m²
Cooling capacity * Allow. heating water temp. Operating pressure	70 W/m² as plaster board 60°C 4 bar
Connection variation with quick-action couplings	11, connections outside
Operation area	Layed on dry build sheets see TI-M05



* Capacity is reached at defined conditions

Ordering example:
BEKA Capillary tube mat type K.GG10, length 1500mm width 845mm, 2 connections:
K.GG10.1500.0845.11

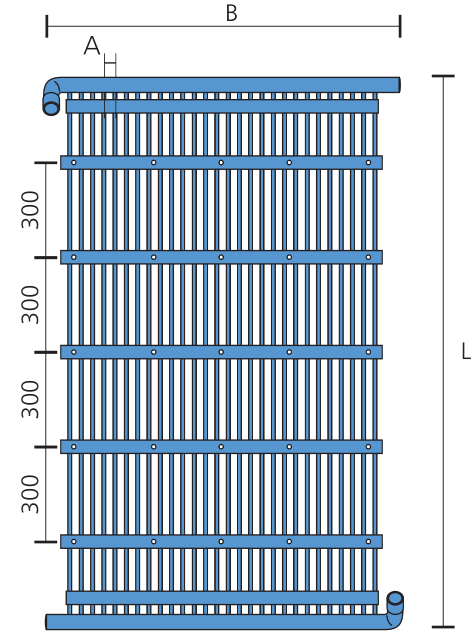


Deviations of the illustration are possible.

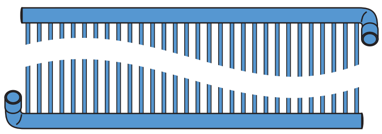
K.GT10. . .11/20 BEKA Capillary Tube Mat

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	600 - 2000 mm (in steps of 10 mm) (standard lengths in steps of 50 mm) 155 - 1195 mm (in steps of 10 mm) 160 - 1200 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	824 g/m² (without collector) 1,067 m²/m² 0,39 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	70 W/m² as plaster board 60°C 4 bar
Connection variation with quick-action couplings	11, connections outside on difference sides 20, connections outside on one side
Operation area	On dry build sheets see TI-M05

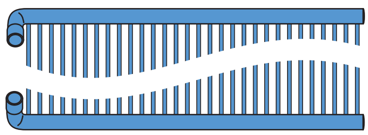
* Capacity is reached at defined conditions



Connection type 11.L



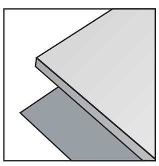
Connection type 11.R

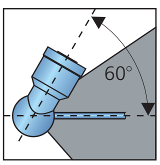


Connection type 20/02

Ordering example:
BEKA Capillary tube mat type K.GT10, length 1350mm width 615mm, connections on the left:
K.GT10.1350.0615.11.L

Ordering example:
BEKA Capillary tube mat type K.GT10, length 1350mm width 610mm, 2 connections outside on one side:
K.GT10.1350.0610.20



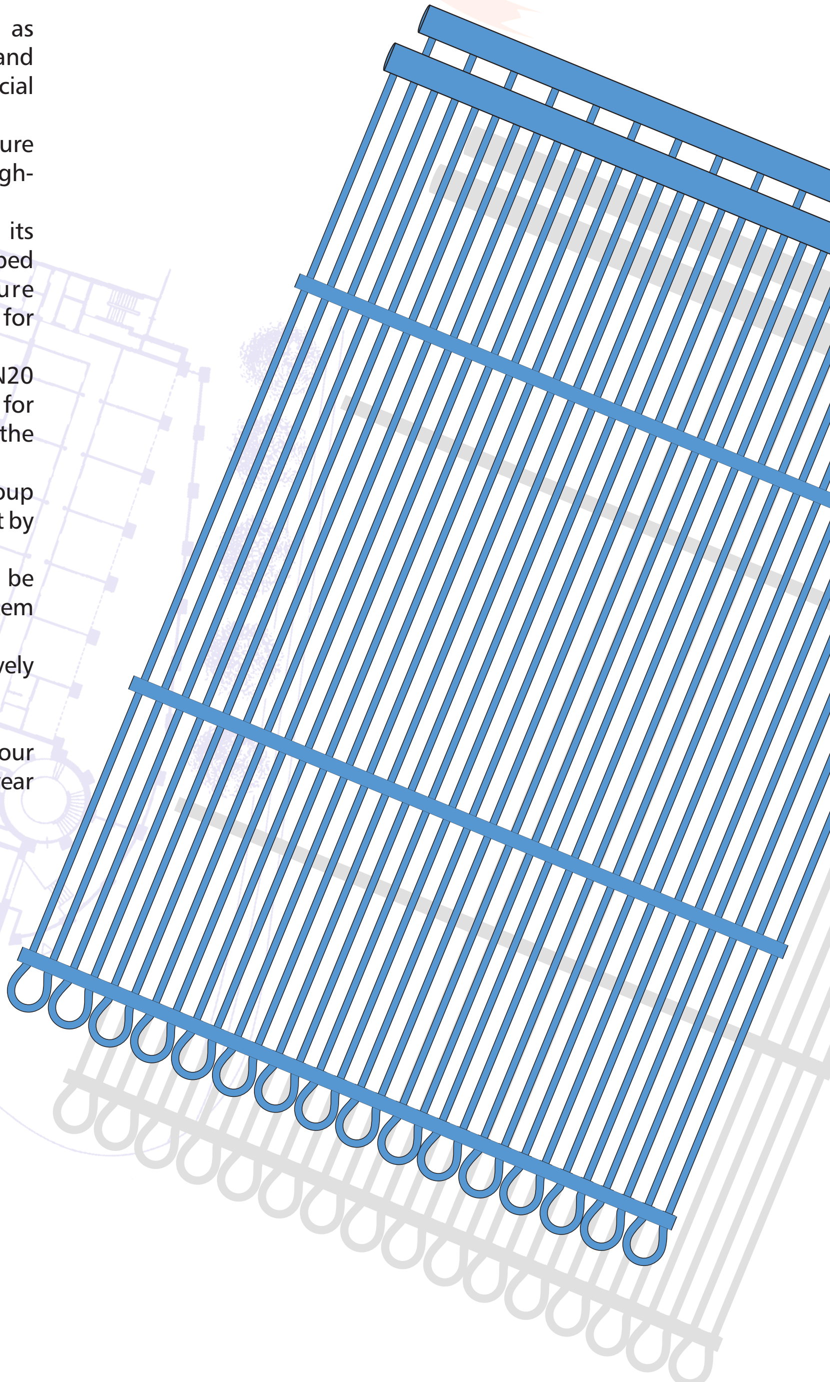


Deviations of the illustration are possible.

BEKA
FÜR KLIMA-KOMFORT

BEKA Capillary Tube Mats
At all times the right choice

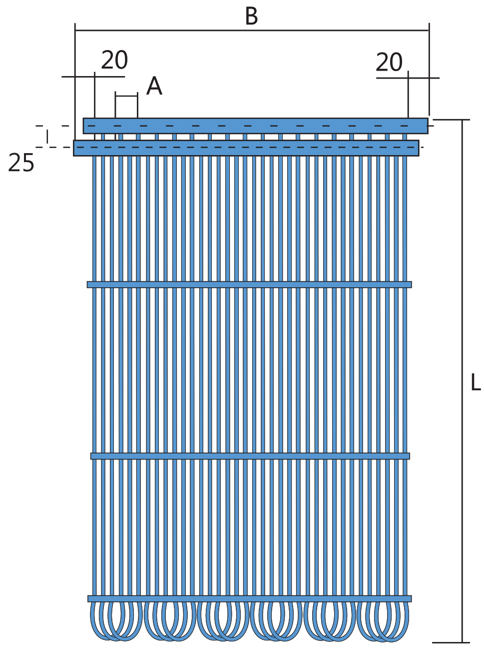
BEKA PN20 capillary tube mats are used as heating and cooling mats in cooling ceilings and concealed panel heating systems with special pressure loads.
These capillary tube mats with the PN20 pressure rating open up new areas of use in the high-pressure sector.
The BEKA PN20 capillary tube mat, with its higher compression resistance, was developed especially for use in high-temperature engineering systems, for industrial use and for systems continuously loaded with hot water.
Thanks to its higher overall stability, the PN20 capillary tube mat is particularly suited for rugged use in construction, such as the installation of floor heating.
The wide variety of the PN20 product group ensures that all your requirements can be met by selecting the optimal capillary tube mat.
The PN20 BEKA capillary tube mats can be connected to each other and to the water system by means of thermal welding.
As in all BEKA products, we use exclusively Polypropylene Random Copolymer type 3, DIN 8078.
The uniformly high quality is ensured by our 100% quality in-spection as well as a 15-year warranty on all BEKA products.



15 years warranty
BEKA

P.VS10 — BEKA Capillary Tube Mat for pressure PN20

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 10 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 260 - 990 mm (in steps of 20 mm)
Massis filled Exchange surface Water contents	1438 g/m² (without collector) 1,357 m²/m² 0,64 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Plaster ceiling Floor heating Surface heating in screeding

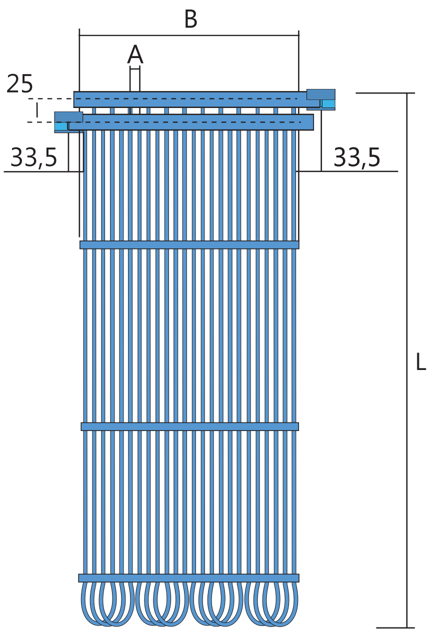


* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10)
for BEKA plug-in systems are available per your inquiry.

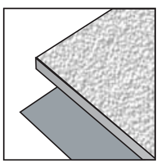
Ordering example:
BEKA Capillary tube mat type P.VS10, length 2500mm width 700mm, without connections: P.VS10.2500.0700.00

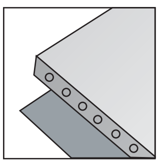
P.VSK10 — BEKA Capillary Tube Mat for pressure PN20

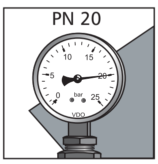
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 10 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 220 - 980 mm (in steps of von 20 mm)
Massis filled Exchange surface Water contents	479 g/m² (without collector) 0,45 m²/m² 0,21 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Plasterboard



* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10)
for BEKA plug-in systems are available per your inquiry.
Ordering example:
BEKA Capillary tube mat type P.VSK10, length 3000mm width 240mm, without connections: P.VSK10.3000.0240.00



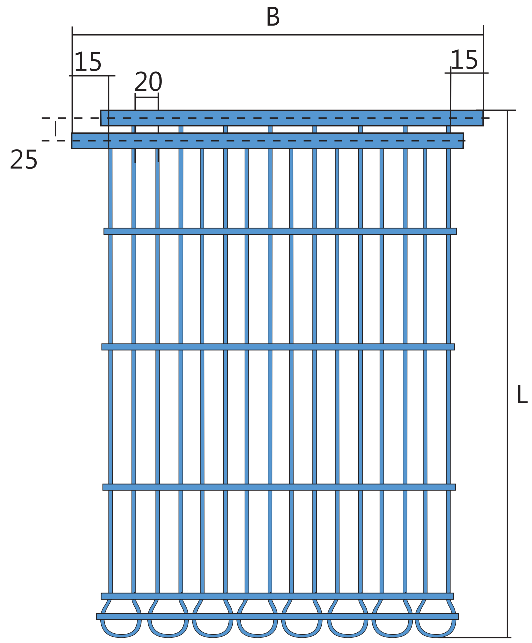




Deviations of the illustration are possible.

P.VS20 | BEKA Capillary Tube Mat for pressure PN20

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 20 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 260 - 1180 mm (in steps of 40 mm)
Massis filled Exchange surface Water contents	719 g/m² (without collector) 0,68 m²/m² 0,32 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Plaster ceiling Floor heating Surface heating in screeding

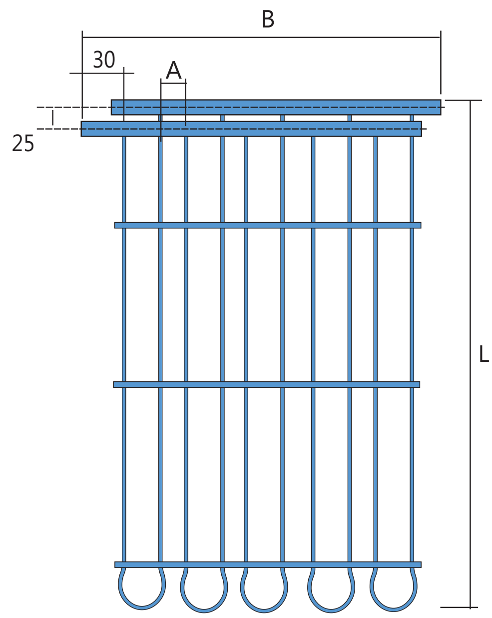


* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10 or 22x2,1)
for BEKA plug-in systems are available per your inquiry.

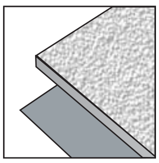
Ordering example:
BEKA Capillary tube mat type P.VS20, length 2500mm width 700mm, without connections: P.VS20.2500.0700.00

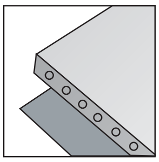
P.VS30 | BEKA Capillary Tube Mat for pressure PN20

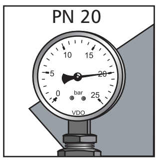
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 30 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 450 - 1170 mm (in steps of von 60 mm)
Massis filled Exchange surface Water contents	479 g/m² (without collector) 0,45 m²/m² 0,21 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Floor heating in screeding Surface heating in concrete



* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10 or 22x2,1)
for BEKA plug-in systems are available per your inquiry.
Ordering example:
BEKA Capillary tube mat type P.VS30, length 3000mm width 990mm, without connections: P.VS30.3000.0990.00



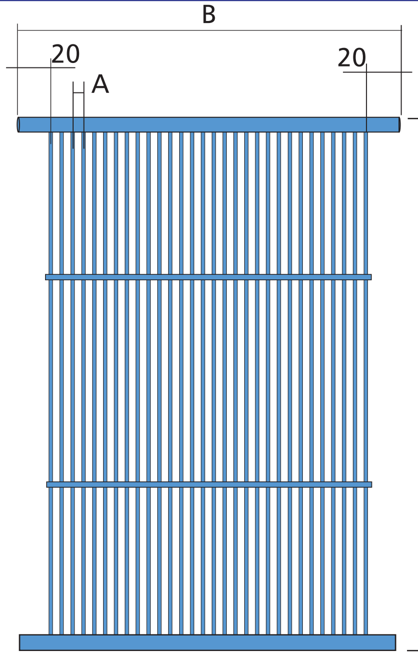




Deviations of the illustration are possible.

P.VG10 | BEKA Capillary Tube Mat for pressure PN20

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 10 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 410 - 1200 mm (in steps of 10 mm)
Massis filled Exchange surface Water contents	1438 g/m² (without collector) 1,357 m²/m² 0,64 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Earth absorber Surface heating in concrete

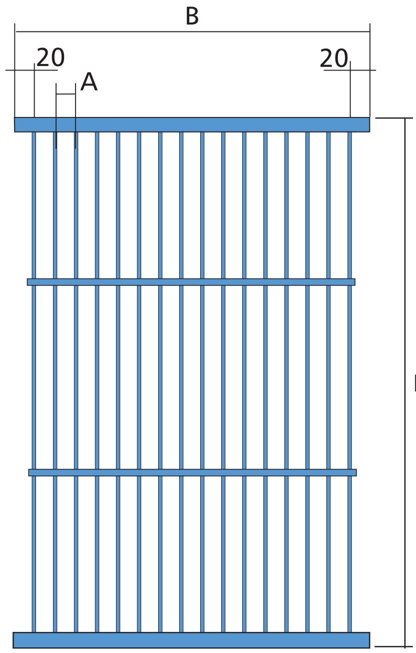


* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10 or 22x2,1)
for BEKA plug-in systems are available per your inquiry.

Ordering example:
BEKA Capillary tube mat type P.VG10, length 6000mm width 1000mm, without connections: P.VG10.6000.1000.00

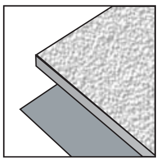
P.VG20 | BEKA Capillary Tube Mat for pressure PN20

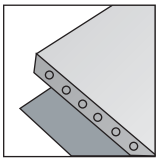
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 20 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 240 - 1200 mm (in steps of 20 mm)
Massis filled Exchange surface Water contents	719 g/m² (without collector) 0,678 m² 0,32 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Plaster ceiling Floor heating Poured in concrete

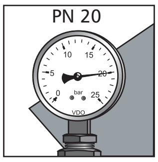


* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10 or 22x2,1)
for BEKA plug-in systems are available per your inquiry.

Ordering example:
BEKA Capillary tube mat type P.VG20, length 5000mm width 980mm, without connections: P.VG20.5000.0980.00



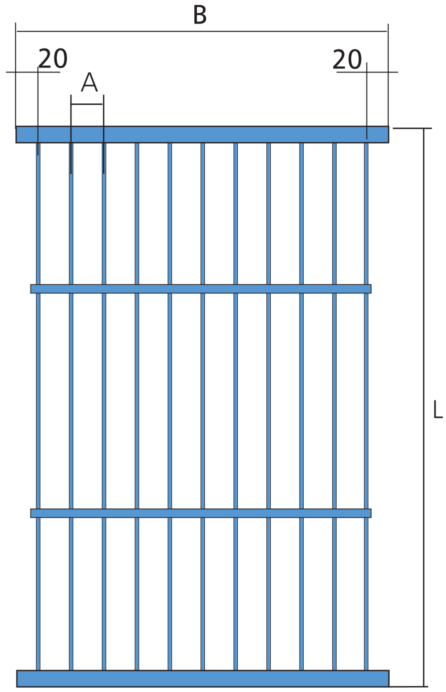




Deviations of the illustration are possible.

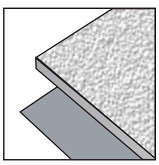
P.VG30 | BEKA Capillary Tube Mat for pressure PN20

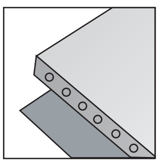
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 30 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 460 - 1210 mm (in steps of 30 mm)
Massis filled Exchange surface Water contents	479 g/m² (without collector) 0,452 m²/m² 0,211 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Surface heating in screeding Poured in concrete

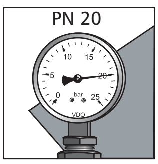


* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10 or 22x2,1)
for BEKA plug-in systems are available per your inquiry.

Ordering example:
BEKA Capillary tube mat type P.VG30, length 5000mm width 940mm, without connections:
P.VG30.5000.0940.00



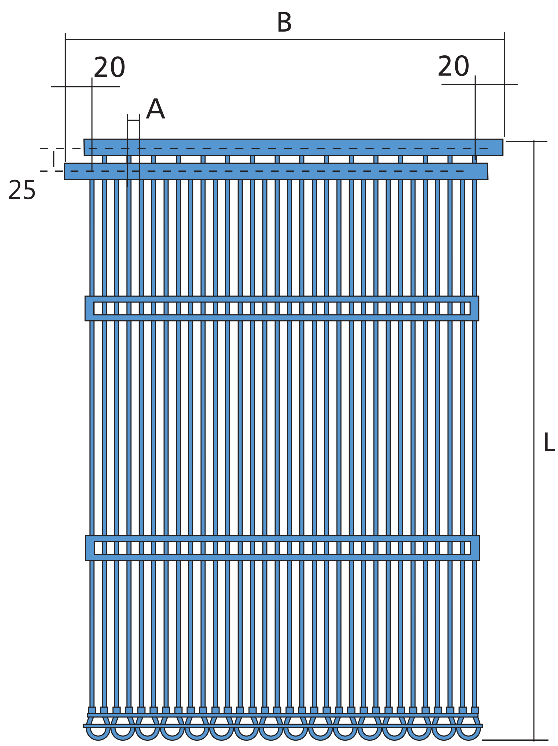




Deviations of the illustration are possible.

P.NS15 — BEKA Capillary Tube Mat for pressure PN20

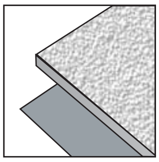
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 3,35 × 0,7 mm 15 mm
Length (L) Width (B)	750 - 6000 mm (in steps of 10 mm) 205 - 1195 mm (in steps of 30 mm)
Massis filled Exchange surface Water contents	543 g/m² (without collector) 0,68 m²/m² 0,20 l/m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	00, without connections
Operation area	Plaster ceiling Surface heating in plaster or in screeding

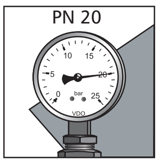


Other connection types are available per your inquiry

* Capacity is reached at defined conditions
Other collector pipe dimensions (20x2 PN10 or 22x2,1)
for BEKA plug-in systems are available per your inquiry.

Ordering example:
BEKA Capillary tube mat type P.NS15, length 4000mm width 985mm, without connections:
P.NS15.4000.0985.00

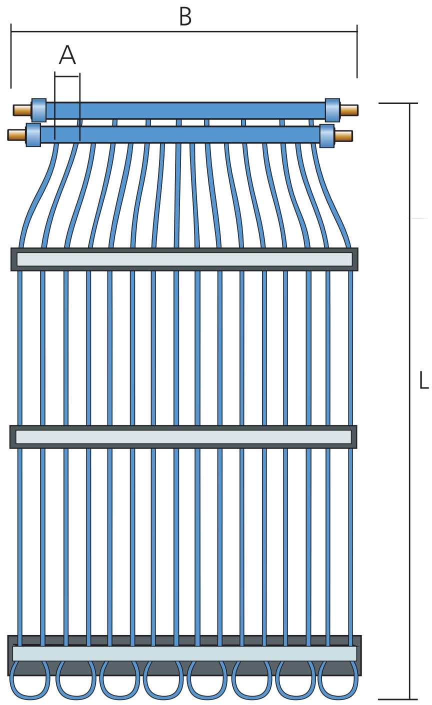




Deviations of the illustration are possible.

P.FS20 | BEKA Capillary Tube Mat foil execution for floor heating

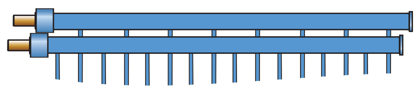
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Ø Collector pipe Ø Capillary tube Capillary tube distance (A)	20 × 3,4 mm 4,5 × 0,8 mm 20 mm
Length (L) Width (B)	1000 - 6000 mm (in steps of 200 mm) 300 or 600 mm
Massis filled Exchange surface Water contents	719 g/m² (without collector) 0,68 m²/m² 0,32 l/ m²
Cooling capacity * Allow. heating water temp. Operating pressure	80 W/m² 80°C max. 20 bar
Connection variation with quick-action couplings	4 Transitions for press and plug connection
Operation area	Floor heating
The BEKA foil mat arranged in the standard design with adhesive tape equipped for fastening of the mat at the floor	



Connection type 22

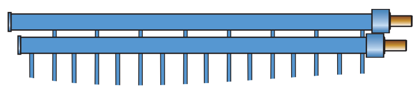
* Capacity is reached at defined conditions
Other executions with connections on one side,
end caps or without connections are available per your inquiry.

Ordering example:
BEKA Capillary tube mat type P.FS20, length 5000mm width 600mm, 4 connections:
P.FS20.5000.0600.22



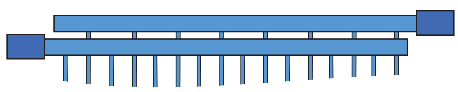
Connection type 20

Transition

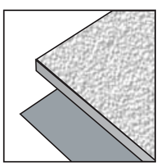


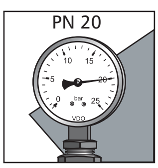
Connection type 02

Sleeve



Connection type 00

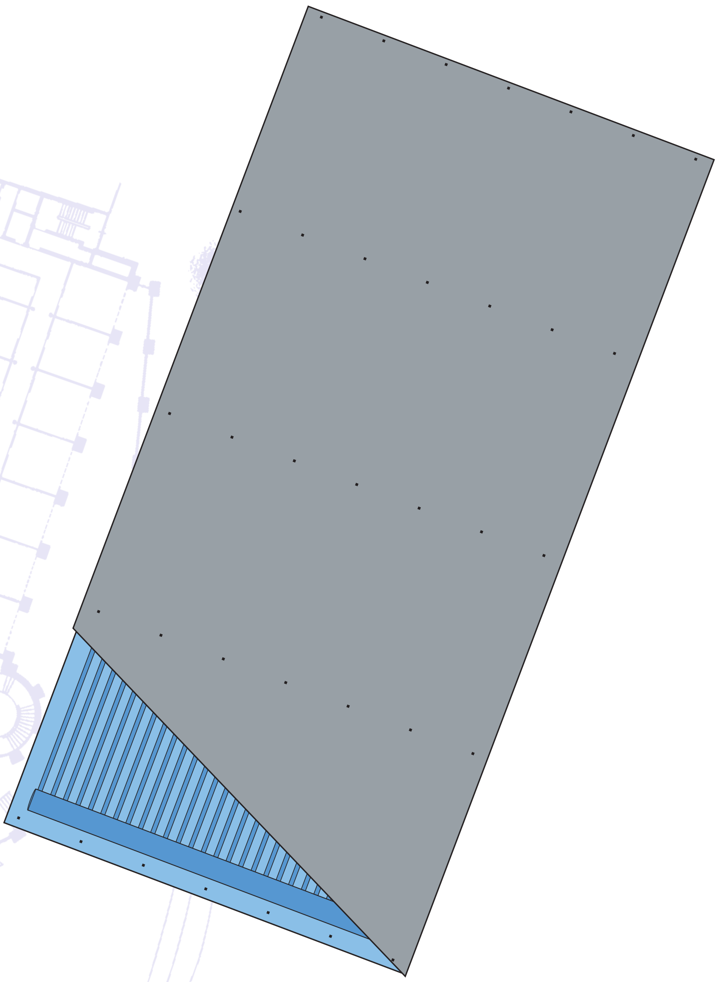




Deviations of the illustration are possible.

Pre-fabricated units from BEKA
At all times the right choice

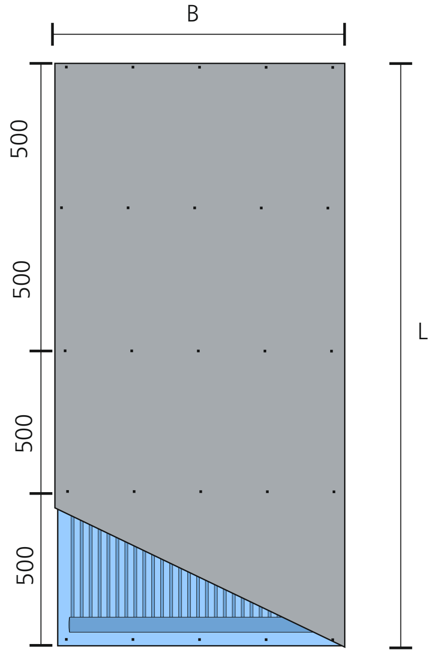
BEKA Pre-fabricated units are specially designed for the function-incorporating, dry-built products. With the installation of BEKA pre-fabricated units dry-built surfaces with cooling and heating function are practically erected in one step.
The heart of the BEKA pre-fabricated units are the approved BEKA capillary tube mats. Water is circulating in those tight capillary tubes which is not much warmer or colder than the ambient air. This type of temperature controlling follows the model of the human capillary receptacles.
Due to the patented arrangement of the capillary tube mats in the composite units, the single capillary tubes are extensively protected from external influences.
At the manufacturer the BEKA pre-fabricated units are prepared for efficient installation, so that only the usual work for the „dry-built" must be carried out.
The BEKA pre-fabricated units are simply and safely connected to the cooling/ heating circulation with flexible hoses by means of quick action couplings.
Polypropylene Random Copolymer Type 3, DIN 8078, is the exclusive material used for the BEKA capillary mats.
The uniformly high quality is ensured by our 100% quality in-spection as well as a 15-year warranty on all BEKA products.



15 years warranty

B.GK12 Pre-fabricated Unit for Ceiling

Arrangement	12,5 mm Plaster board Capillary tube mat (Polypropylene) 30 mm Extruded foam
Ø Collector pipe Ø Capillary tube Capillary tube distance	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	1500 / 2000 mm 600 mm Pre-drilled for fastening in 500 mm grid
Massis filled Active area Water contents	14 kg 1,2 m^2 0,46 l/m^2
Cooling capacity * Heating capacity * Allow. heating water temp. Operating pressure	76 W or 64 W/m^2 150 W or135 W/m^2 45°C 4 bar
Connection variation with quick-action couplings	11, Connections outside
Operation area	Dry-build heating/cooling ceiling

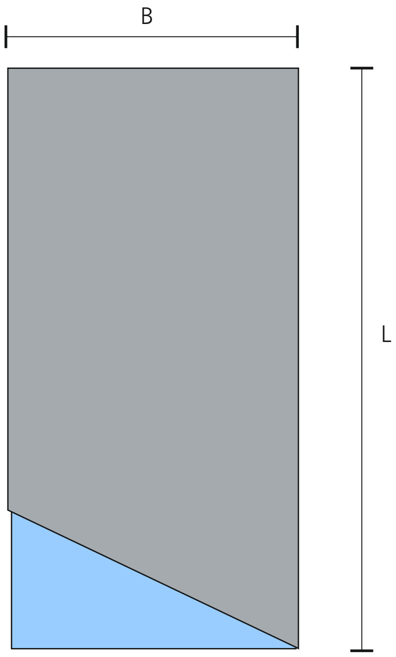


* Capacity is reached at defined conditions

Ordering example:
BEKA prefabricated panel type B.GK12 length 2000mm width 600mm, 2 connections: B.GK12.2000.0600.11
Type of mat K.G10

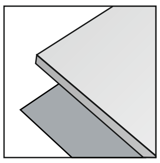
B.GB12 Pre-fabricated Unit - Dummy Sheet for Ceiling

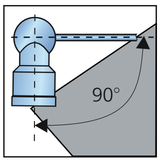
Arrangement	12,5 mm Plaster board 30 mm Extruded foam
Length (L) Width (B) Massis	500 / 2000 mm 600 mm 3.3 kg / 13,2 kg
Operation area	Tailoring sheet for cooling- and heating ceilings with the pre-fabricated unit B.GK12



Ordering example:
BEKA prefabricated dummy sheet type B.GB12 length 2000mm width 600mm:
B.GB12.2000.0600.00

The hue of the extruded foam can differ from the representation.

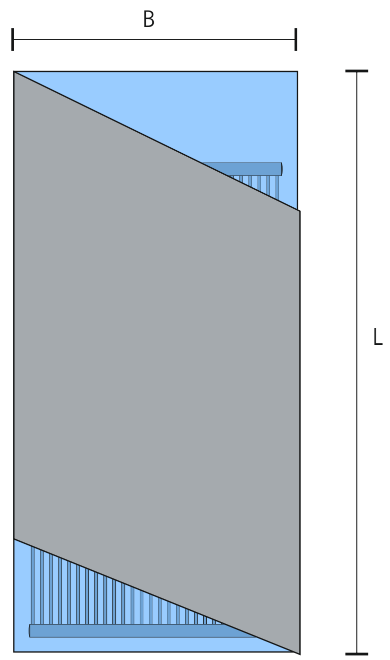




Deviations of the illustration are possible.

B.GK12 | Pre-fabricated Unit for Wall

Arrangement	12,5 mm Plaster board Capillary tube mat (PP) 30 mm Extruded foam
Ø Collector pipe Ø Capillary tube Capillary tube distance	20 × 2 mm 3,35 × 0,5 mm 10 mm
Length (L) Width (B)	2600 mm 600 mm pre-drilled for fixing on a stand
Massis filled Active area Water contents	17,8 kg 1,2 m^2 0,46 l/m^2
Cooling capacity * Heating capacity * Allow. heating water temp. Operating pressure	76 W or 49 W/m^2 150 W or 96 W/m^2 45°C 4 bar
Connection variation with quick-action couplings	11, Connections outside
Operation area	Dry-build heating/cooling walls

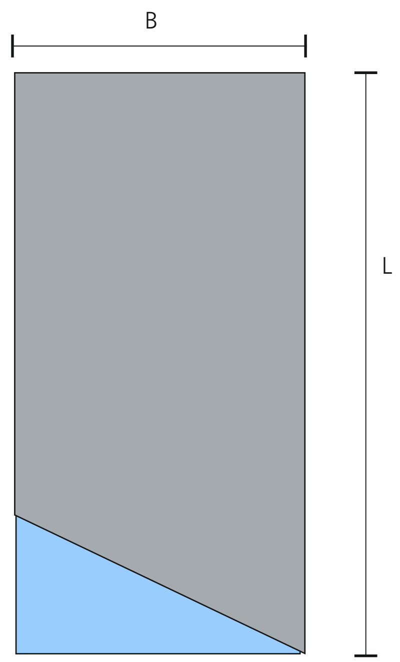


* Capacity is reached at defined conditions

Ordering example:
BEKA prefabricated panel type B.GK12 length 2600mm width 600mm, 2 connections: B.GK12.2600.0600.11
Type of mat K.G10

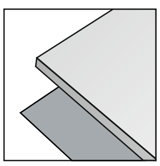
B.GB12 | Pre-fabricated Unit - Dummy Sheet for Wall

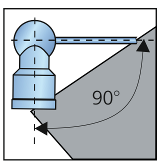
Arrangement	12,5 mm Plaster board 30 mm Extruded foam
Length (L) Width (B) Massis	2600 mm 600 mm 16,8 kg
Operation area	Tailoring sheet for heating- and cooling walls with the pre-fabricated unit B.GK12



Ordering example:
BEKA prefabricated dummy sheet type B.GB12 length 2600mm width 600mm:
B.GB12.2600.0600.00

The hue of the extruded foam can differ from the representation.





Deviations of the illustration are possible.

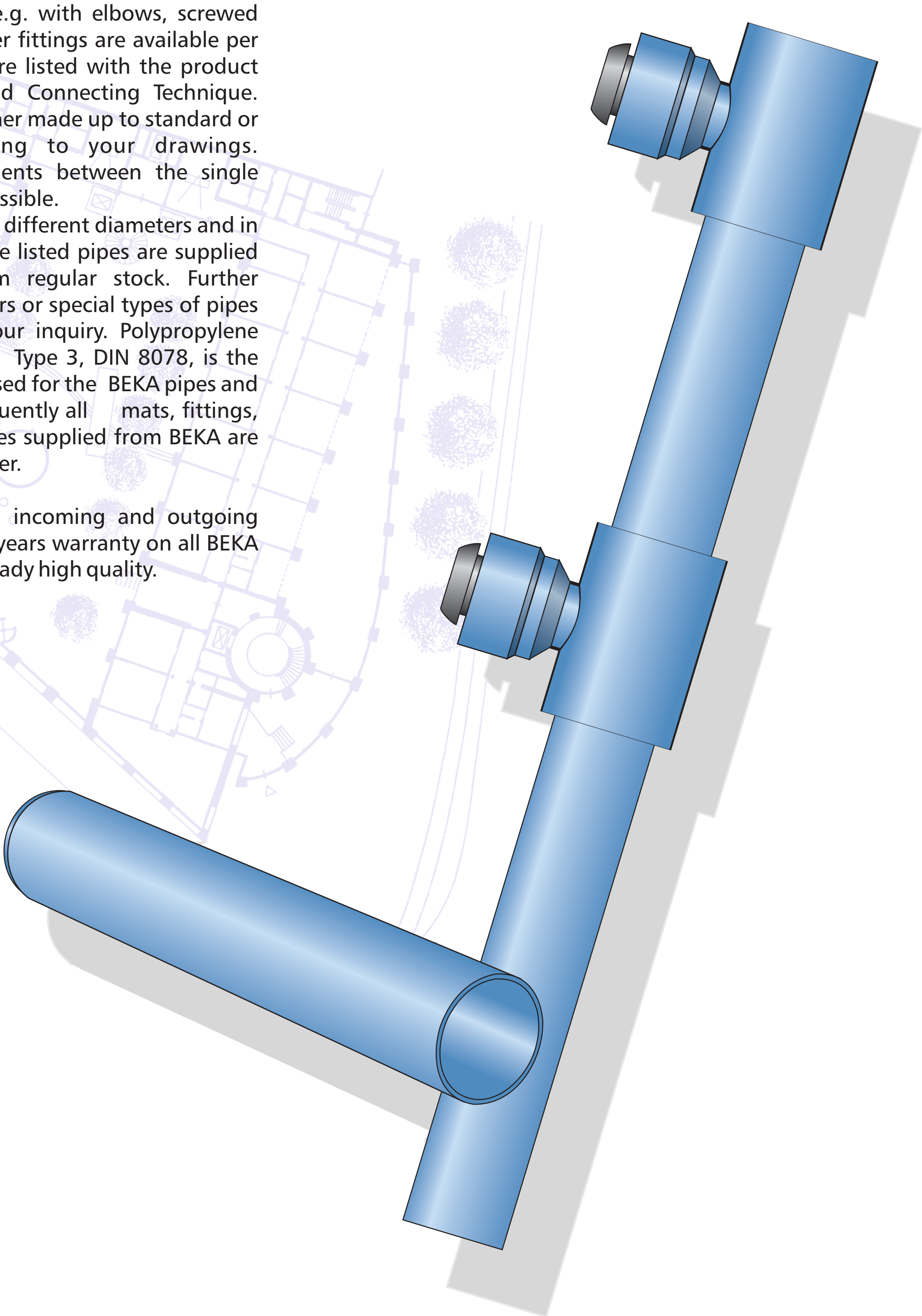
BEKA
FÜR KLIMA-KOMFORT

Pipes and Supply Lines from BEKA
At all times the right choice

BEKA pipes and supply lines are available in different variations and diameters. Also customers designs e.g. with elbows, screwed connectors and other fittings are available per your inquiry. They are listed with the product groups "Fittings and Connecting Technique. Supply lines" are either made up to standard or accurately according to your drawings. Different measurements between the single outlets are always possible.
Pipes are available in different diameters and in different colours. The listed pipes are supplied in short term from regular stock. Further diameters and colours or special types of pipes are available per your inquiry. Polypropylene Random Copolymer Type 3, DIN 8078, is the exclusive material used for the BEKA pipes and supply lines. Consequently all mats, fittings, pipes and supply lines supplied from BEKA are weldable to each other.

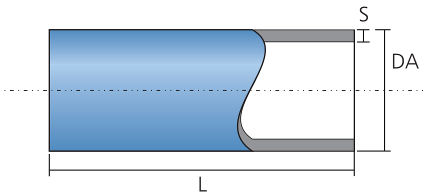
Regular controls on incoming and outgoing goods as well as 15 years warranty on all BEKA products secure a steady high quality.

15 years warranty
BEKA



R.R BEKA Pipes

Material	Polypropylene Random Copolymer Type 3, DIN 8078	
Main assortment	Ø Pipe (DA) 20 mm 25 mm	Wall thickness (S) 2,0 mm 2,3 mm
Length (L)	4000 mm	

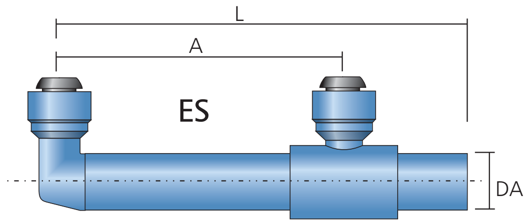


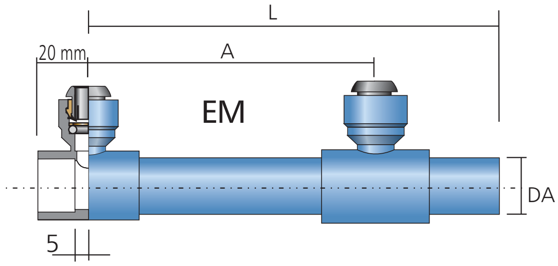
Ordering example:
PP Pipe, length 4000mm diameter 20 x 2mm:
R.R.4000.20

Other diameters, as Fiber composite pipe, are available per your inquiry.
The hue cannot correspond to the standard blue as of DA32 mm.

Z.ES · Z.EM Supply Lines, single

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Diameter (DA) Length (L) Distance outlets (A)	20 mm max. 5000 mm (other lengths on request) min. 50 mm
Description	Supply line with single outlets and quick-action couplings
Variation	Z.ES, Supply line, single with elbow outlet Z.EM, Supply line, single with welding sleeve





Ordering example:
Supply Line single with welding sleeve, length 5000mm,
5 outlets, distance between the outlets 700mm:
Z.EM.5000.0700.05

Other dimensions and special versions are available per your inquiry.

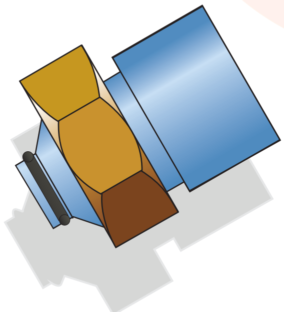
Deviations of the illustration are possible.

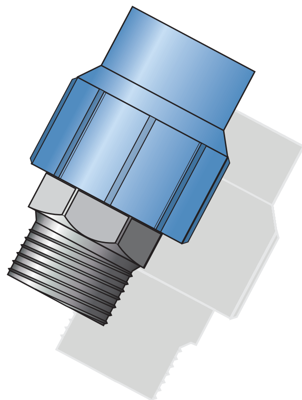
BEKA
FÜR KLIMA-KOMFORT

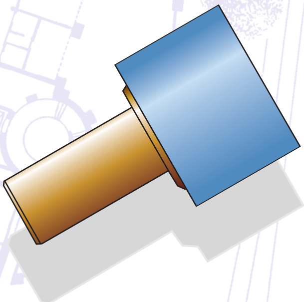
Fittings from BEKA
At all times the right choice

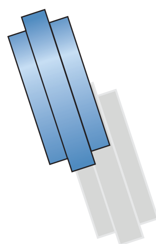
BEKA keeps an extensive program of fittings available. The assortement includes fittings for sleeve- and butt welding as well as screw connectors and plug-in connectors.
BEKA fittings are available in different diameters and different colours. The listed products are supplied in short term from regular stock. Special fittings as well as further diameters and colours are available per your inquiry.
Polypropylene Random Copolymer Type 3, DIN 8078, is the exclusive material used for BEKA fittings. Consequently all mats, fittings, tubes and supply lines supplied from BEKA are weldable to each other. Metal fittings are all stainless steel.

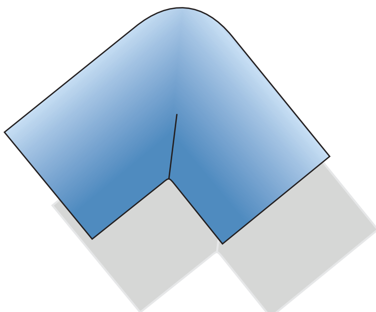
Regular controls on incoming and outgoing goods as well as 15 years warranty on all BEKA products secure a steady high quality.

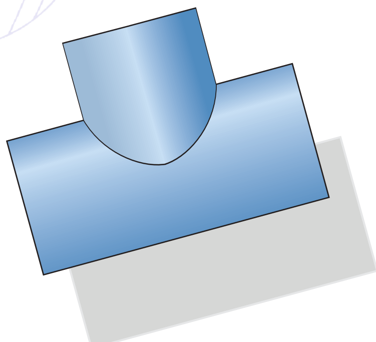












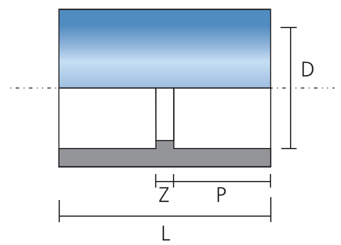
F.M Sleeve

Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D)	20 mm
Length (L)	35 mm
Design-dimension (Z)	3 mm
Welding depth (P)	16 mm

Other colours and diameters are available per your inquiry.

Description:	Welding sleeve for the connection of pipes or heating- and cooling mats

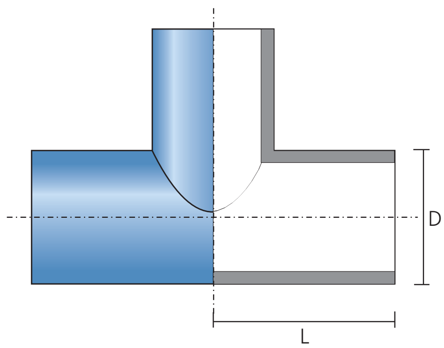
The hue cannot correspond to the standard blue as of DA25 mm.



Ordering example:
Sleeve 20mm: F.M.20

F.TS T-Connector for Butt-Welding

Material	Polypropylene Random Copolymer Type 3, DIN 8078
Diameter (D)	20 mm
Length (L)	30 mm
Description:	T-Connector for butt-weld connections of pipes or heating- and cooling mats



Ordering example:
T-Connector for butt welding 20mm: F.TS.20

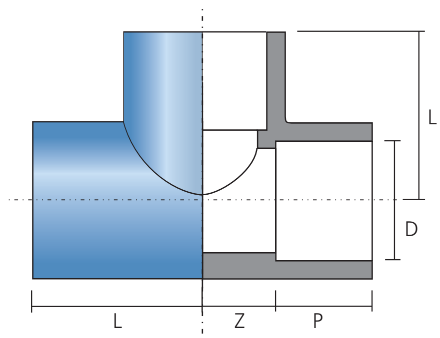
F.T T-Connector for Sleeve-Welding

Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D)	20 mm
Length (L)	27 mm
Design dimension (Z)	11 mm
Welding depth (P)	16 mm

Other colours and diameters are available per your inquiry.

Description:	T-Connector for sleeve-weld connections of pipes or heating- and cooling mats

The hue cannot correspond to the standard blue as of DA25 mm.



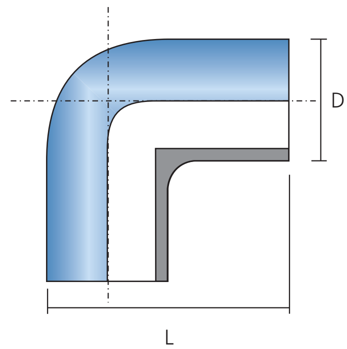
Ordering example:
T-Connector 20mm: F.T.20

Other PP form parts are available per your inquiry.

Deviation of the illustration are possible.

F.WS90 | Elbow 90° for Butt-Welding

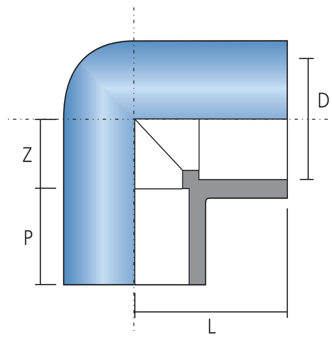
Material	Polypropylene Random Copolymer Type 3, DIN 8078
Diameter (D) Length (L)	20 mm 40 mm
Description:	Elbow for butt-weld connections of pipes or heating- and cooling mats



Ordering example:
Elbow for butt welding: F.WS90.20

F.W90 | Elbow 90° for Sleeve-Welding

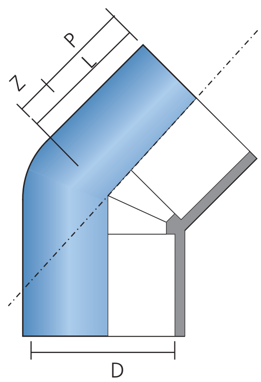
Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D) Length (L) Design dimension (Z) Welding depth (P)	20 mm 27 mm 11 mm 16 mm
Other colours and diameters are available per your inquiry.	
Description:	Elbow for sleeve-welding connections of pipes or heating- and cooling mats
The hue cannot correspond to the standard blue as of DA25 mm.	



Ordering example:
Elbow 90° 20mm: F.W90.20

F.W45 | Elbow 45° for Sleeve-Welding

Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D) Length (L) Design dimensions (Z) Welding depth (P)	20 mm 22 mm 4 mm 18 mm
Other colours and diameters are available per your inquiry.	
Description:	Elbow for sleeve-welded connections of pipes or heating- and cooling mats
The hue cannot correspond to the standard blue as of DA25 mm.	



Ordering example:
Elbow 45° 20mm: F.W45.20

Other PP form parts are available per your inquiry.

Deviation of the illustration are possible.

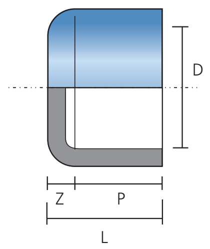
F.EM — End Cap for Sleeve-Welding

Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D)	20 mm
Length (L)	19 mm
Design dimension (Z)	5 mm
Welding depth (P)	14 mm

Other colours and diameters are available per your inquiry.

Description:	End cap for sleeve welding for locking pipes

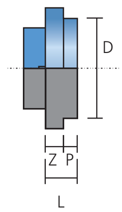
The hue cannot correspond to the standard blue as of DA25 mm.



Ordering example:
End Cap 20mm: F.EM.20

F.EIG — End Cap for Inner-Sleeve-Welding with handle

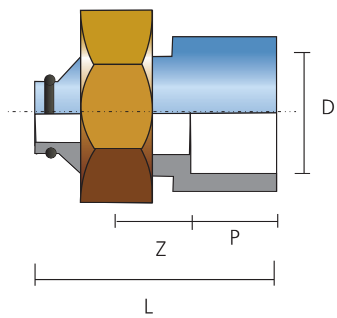
Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D)	20 mm
Length (L)	8 mm
Design dimension (Z)	4 mm
Welding depth (P)	2 mm
Description:	End cap for inner-sleeve-welding for locking pipes or heating- and cooling mats



Ordering example :
End Cap for inner-sleeve-welding 20mm: F.EIG.20

F.EK.20 — Euro Cone Transition 20 x 3/4”

Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D)	20 mm
Length (L)	47 mm
Design dimension (Z)	20 mm
Welding depth (P)	15 mm
Description:	Transition piece for the connection of PP - pipes 20 mm and form parts with euro cone and thread 3/4”



Ordering example:
Euro Cone Transition 20mm: F.EK.20

Other PP form parts are available per your inquiry.

Deviation of the illustration are possible.

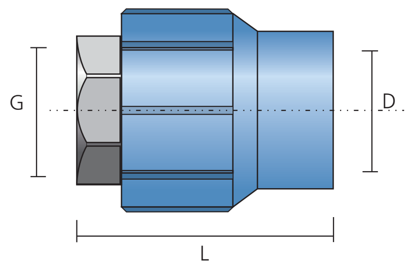
F.VIM | Screw Connector with Inside Thread

Material	Brass nickel plated, PP
Diameter (D) Length (L) Inside thread (G)	20 mm 44 mm 1/2", 3/4"

Other colours and diameters are available per your inquiry.

Description:	Connector for welded connections of plastic- and metal pipes

The hue cannot correspond to the standard blue as of DA25 mm.



Ordering example:
Screw Connector 20mm with IG 1/2'': F.VIM.2012

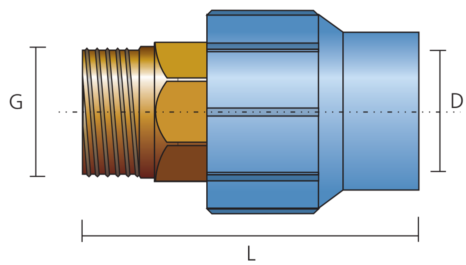
F.VAM | Screw Connector with Outside Thread

Material	Brass nickel plated, PP
Diameter (D) Length (L) Outside thread (G)	20 mm 54 mm 1/2", 3/4"

Other colours and diameters are available per your inquiry.

Description:	Connector for welded connections of plastic- and metal pipes

The hue cannot correspond to the standard blue as of DA25 mm.

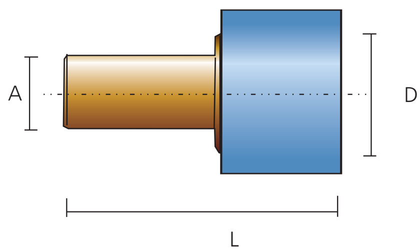


Ordering example:
Screw Connector 20mm with AG 1/2'': F.VAM.2012

F.VP | Press- and Plug Connector

Material	Polypropylen Random Copolymer Type 3, DIN 8078, Brass
Diameter (D) Length (L) Diameter (A)	20 mm 47 mm 15 mm
Description	Transition piece PP for press- and plug Connection

Press connecting parts are available per your inquiry.



Ordering example:
Press- and Plug Connector 20mm: F.VP.20

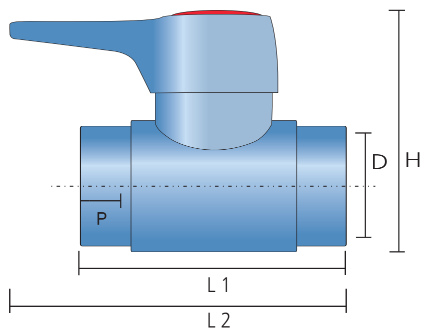
Other PP form parts are available per your inquiry.

Deviation of the illustration are possible.

F.KH.PP.20 | Ball Valve PP 20 mm

Material	Polypropylene Random Copolymer, Typ 3, DIN 8078
Diameter (D)	20 mm
Length (L 1)	68 mm
Lenght (L 2)	105 mm
Height (H)	70 mm
Welding Depth (P)	16 mm
Description	Ball valve made of Polypropylene for Welding with PP-pipes

The color may deviate from the standard blue.



Ordering example: Ball valve PP 20mm: F.KH.PP.20

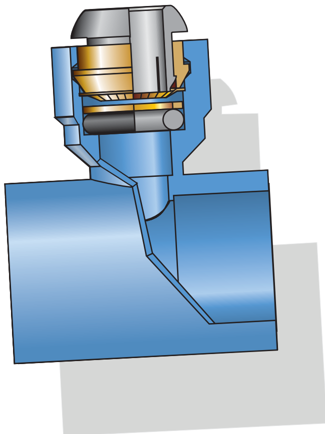
Deviations of the illustration are possible.

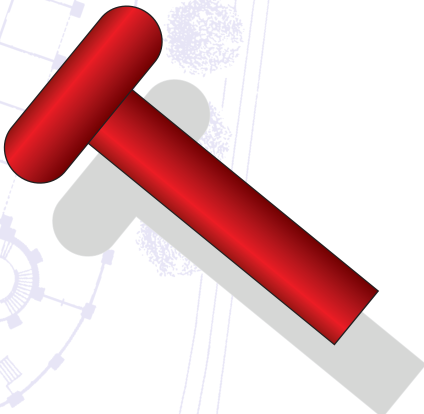
BEKA
FÜR KLIMA-KOMFORT

Connection Technique
At all times the right choice

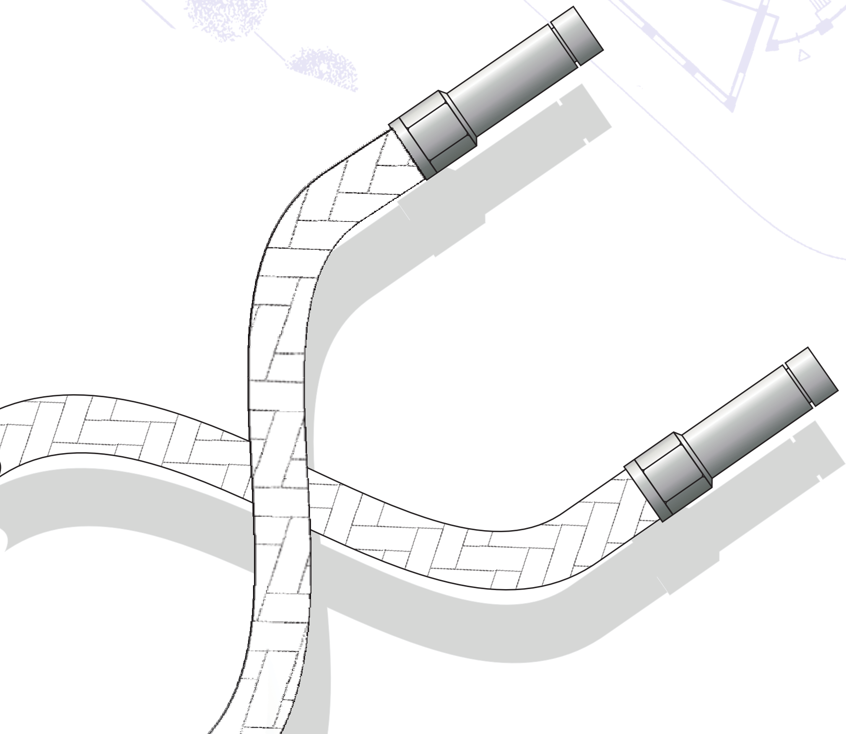
The connection technique from BEKA includes all accessories to connect BEKA mats to the supply lines with quick action couplings.
This way of connecting permits a save and fast installation, which can be disassembled at all times without damaging any of the parts. All metal parts are made from non-corrosive material.
Polypropylene Random Copolymer Type 3, DIN 8078, is the exclusive plastic material used. Consequently all from BEKA supplied connecting components can be welded to BEKA mats, fittings, pipes and supply lines.

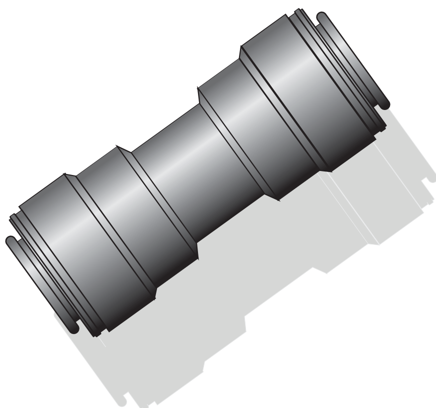
Regular controls on incoming and outgoing goods as well as 15 years warranty on all BEKA products secure a steady high quality.





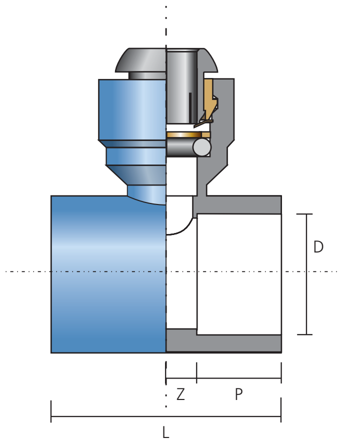
15 years warranty
BEKA





A.M.20 Sleeve Outlet

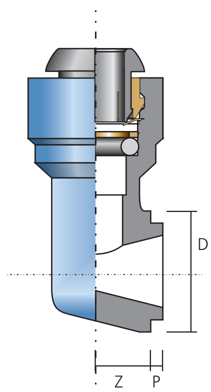
Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D)	20 mm
Length (L)	38 mm
Design dimension (Z)	5 mm
Welding depth (P)	14 mm
Description	Sleeve outlet for sleeve welding of BEKA pipes 20 mm, outlet with quick action coupling for connection hoses 10 mm



Ordering example:
Sleeve Outlet 20mm: A.M.20

A.W.20 Elbow Outlet

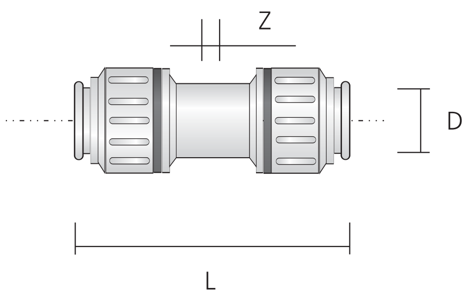
Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Diameter (D)	20 mm
Design dimension (Z)	9 mm
Welding depth (P)	2 mm
Description	Elbow outlet for sleeve welding of BEKA pipes 20 mm, outlet with quick action coupling for connection hoses 10 mm



Ordering example:
Elbow Outlet 20mm: A.W.20

A.V.10 Plug-in Connector

Material	Plastic Claw: stainless
Diameter (D)	10 mm
Length (L)	42 mm
Description	Plug-in connector for flexible connection hoses

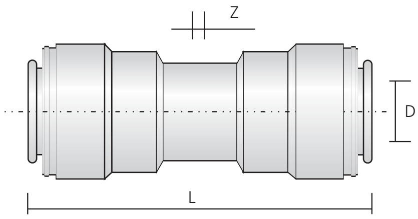


Ordering example:
Plug-in Connector 10mm: A.V.10

Deviations of the illustration are possible.

A.V.20 Plug-in Connector

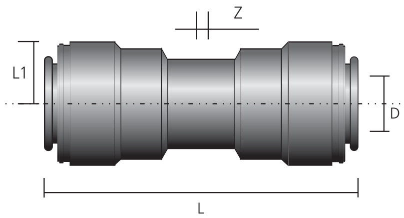
Material	Plastic, Claw: stainless
Diameter (D)	20 mm
Length (L)	68 mm
Design dimension (Z)	1 mm
insertion depth	39 mm
Description	Plug-in connector for PP-pipes with diameter of 20 mm



Ordering example:
Plug-in Connector 20mm: A.V.20

A.V.20.S Plug-in connector black

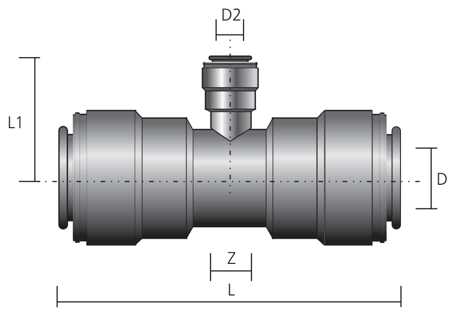
Material	Plastic, Claw: stainless
Diameter (D)	20 mm
Length (L)	67 mm
Length (L1)	17 mm
design dimension (Z)	1 mm
insertion depth	33 mm
Description	Plug-in connector for PP-pipes with diameter of 10 mm



Bestellbeispiel:
Steckverbinder 20mm: A.V.20.S

A.TV.20.10 Plug-in T-Connector, reduced

Material	Plastic, Claw: stainless
Diameter (D)	20 mm
Diameter (D2)	10 mm
Length (L)	78 mm
Length (L1)	32 mm
Design dimension (Z)	13 mm
Description	Plug-in T-connector 20 mm, with reduced outlet for 10 mm diameter

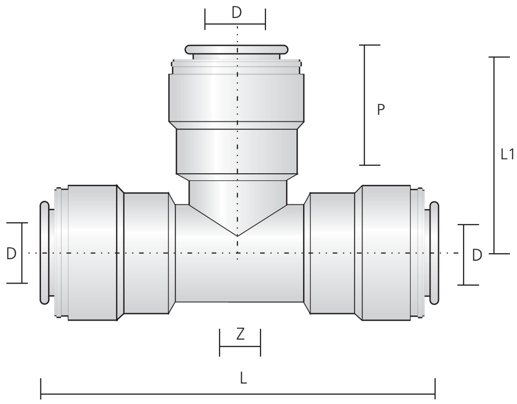


Ordering example:
Plug-in T-Connector, reduced 20mm: A.TV.20.10

Deviations of the illustration are possible.

A.TV.20 | Plug-in T-Connector

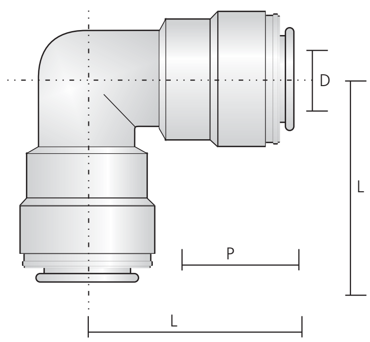
Material	Plastic, Claw: stainless
Diameter (D)	20 mm
Length (L)	88 mm
Length (L1)	45 mm
Design dimension (Z)	23 mm
Welding depth (P)	33 mm
Description	Plug-in T-connector for 20 mm diameter



Ordering example:
Plug-in T-Connector, 20mm: A.TV.20

A.WV.20 | Plug-in Connector, Elbow

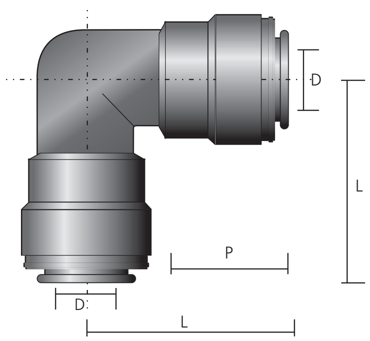
Material	Plastic, Claw: stainless
Diameter (D)	20 mm
Length (L)	45 mm
Welding depth (P)	33 mm
Description	Plug-in connector, elbow for 20 mm Diameter



Ordering example:
Plug-in Elbow 20mm: A.WV.20

A.WV.20.S | Plug-in connector elbow, black

Material	Plastic, Claw: stainless
Diameter (D)	20 mm
Length (L)	44 mm
insertion depth (P)	33 mm
Despcriotion	Plug-in connector, elbow for 20 mm

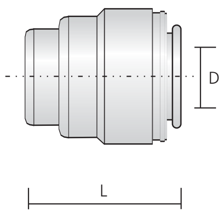


Ordering example:
Plug-in Elbow 20mm: A.WV.20.S

Deviations of the illustration are possible.

A.EE.20 Plug-in Connector, End Cap

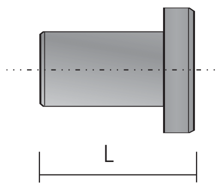
Material	Plastic, Claw: stainless
Diameter (D) Length (L)	20 mm 38 mm
Description	Plug-in connector, end cap for 20 mm diameter



Ordering example:
Plug-in End cap 20mm: A.EE.20

A.STS.20 Plug, tubular stiffener

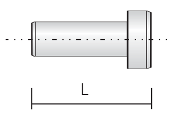
Material	Plastic, O-Ring EPDM
Length (L)	17 mm
Description	tubular stiffener for 20 mm diameter



Ordering example:
Support Sleeve for 20 mm pipe: A.STS.20

A.STS.10 Plug, tubular stiffener

Material	Plastic
Length (L)	17 mm
Description	tubular stiffener for 10mm diameter

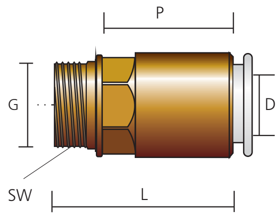


Bestellbeispiel:
tubular stiffener for pipe 10mm: A.STS.10

Deviations of the illustration are possible.

A.AGV.20 Plug-in Connector, Screw Connector AG

Material	Brass, Plastic Claw: stainless
Diameter (D)	20 mm
Length (L)	50 mm
Welding depth (P)	35 mm
Thread	3/4″
Wrench Size (SW)	32 mm
Description	Plug-in connector, screw connector for 20 mm diameter

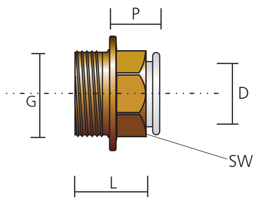


Ordering example:
Plug-in Connector 20mm 3/4'' AG: A.AGV.20

Other forms of plug-in connectors are available per your inquiry.

A.AGV.10 Plug-in connector, Screw connector AG 10 x 1/2" brass

Material	Brass, Plastic, Claw: stainless
Diameter (D)	10 mm
Length (L)	22 mm
insertion depth (P)	20 mm
Thread (G)	1/2″
Wrench Size (SW)	20 mm
Description	Plug-in connector, screw connector for 10 mm diameter



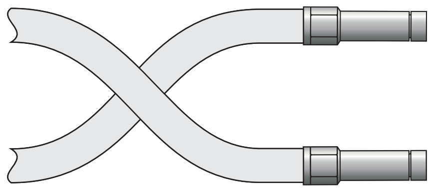
Ordering example:
Plug-in Connector 10mm 1/2" AG: A.AGV.10

Other forms of plug-in connectors are available per your inquiry.

Deviations of the illustration are possible.

A.S Connection Hose, Stainless Steel

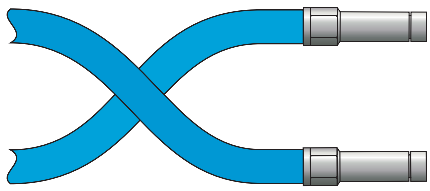
Material	Hose:	EPDM
	Outer material:	stainless steel
	Press tube:	stainless
	Grommet:	brass nickel-plates
Diameter	10 mm	
Length	300 · 500 · 800 · 1200 mm	
Description	Flexible connection hose for quick action couplings	



Ordering example:
Connection Hose with outer stainless steel material, length 300 mm, diameter 10 mm: A.S.300.10

A.SN Connection Hose, Nylon

Material	Hose:	EPDM
	Outer material:	nylon
	Press tube:	stainless
	Grommet:	brass nickel-plates
Diameter	10 mm	
Length	300 · 500 · 800 · 1200 mm	
Description	Flexible connection hose for quick action couplings	

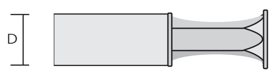


Ordering example:
Connection Hose with outer nylon material, length 300 mm, diameter 10 mm: A.SN.300.10

Flexible hoses with other lengths and connection forms are available per your inquiry.

A.BS.10 Plug

Material	Plastic
Diameter (D)	10 mm
Description	Plug for quick action couplings



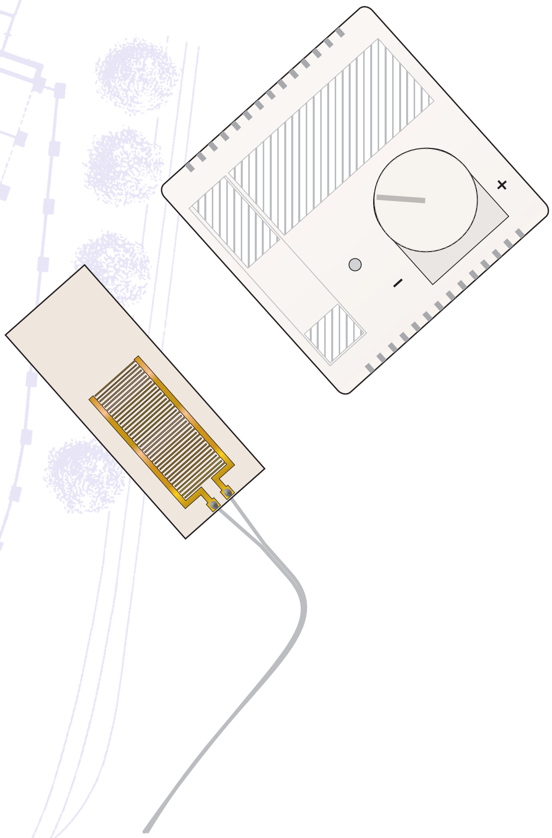
Ordering example:
Plug with 10 mm diameter: A.BS.10

Deviations of the illustration are possible.

Measuring- and Control Engineering from BEKA At all times the right choice

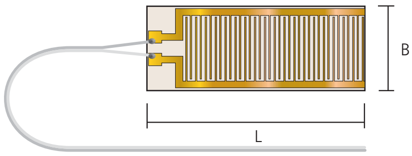
BEKA measuring- and control engineering includes all components for measuring- and control engineering which are necessary for cooling ceilings:
Dew point sensors, converter, room temperature controls and thermal actuating drives.
The listed products are supplied in short term from the regular stock, as well as special units.
Further components are available per your inquiry.
For fast and safe installation BEKA offers connecting points for feed- and return lines. These include a PP-transition connector both side, a ball faucet, a regulating valve or a tacosetter.
The materials used for the connecting points are brass, brass nickel plated and also Polypropylene Random Copolymer Type 3, DIN 8078.
Consequently all connecting points supplied from BEKA are weldable to BEKA pipes and supply lines.
Regular controls on incoming and outgoing goods as well as 15 years warranty on all BEKA products secure a steady high quality.

15 years warranty
BEKA



M.TM.2 Dew Point Sensor Metal

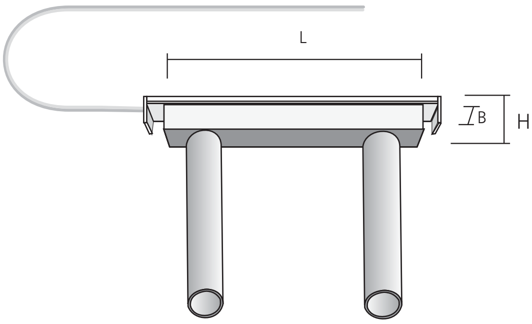
Material	Conductor plate, gold panel
Length (L)	12,35 mm
Width (B)	7,25 mm
Height (H)	1 mm
Connecting cable	2-fases, length 10 m
Description:	Dew point sensor with adhesive tape for metal ceiling sheets



Ordering example:
Dew Point Sensor for metal ceiling: M.TM.2

M.TP.2 Dew Point Sensor Plaster

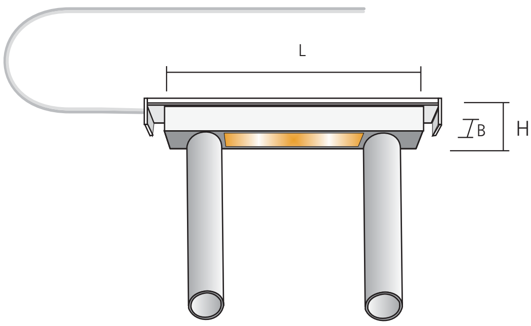
Material	Housing LLDPE Conduct panel gold plated
Length (L)	50 mm
Width (B)	22 mm
Height (H)	10 mm
Connecting cable	2-fases, length 10 m
Description:	Dew point sensor in plastic housing with snuffing tube, for plastering



Ordering example:
Dew Point Sensor for plaster ceiling: M.TP.2

M.TG.2 Dew Point Sensor Gipsum

Material	Housing LLDPE Conduct panel gold plated
Length (L)	50 mm
Width (B)	22 mm
Height (H)	10 mm
Connecting cable	2-fases, length 10 m
Description:	Dew point sensor in plastic housing with snuffing tube,

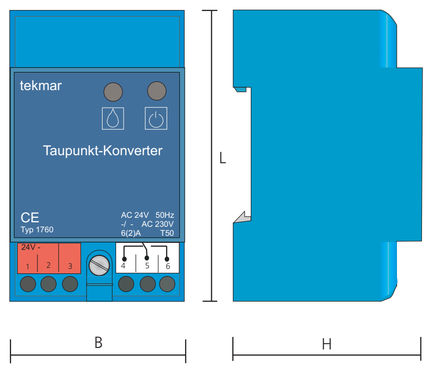


Ordering example:
Dew Point Sensor for plaster boards: M.TG.2

Deviations of the illustration are possible.

M.K.2 Converter

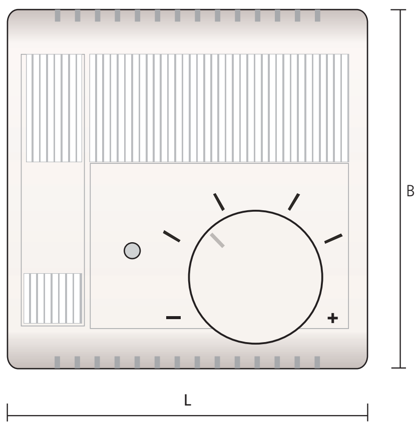
Material	Plastic housing
Length (L) Width (B) Height (H)	88 mm 50 mm 61 mm
Voltage input Switch contact load Input power allow. ambient temp.	24 V AC 230 V, 6 A max. 1 VA 5°C - 40°C
Description:	Converter for decoding of resistance of the dew point sensor with potential free switch contact. Closed housing with combination foot for bus connection in the switch box.



Ordering example:
Converter: M.K.2

M.R2/3 Room Temperature Control

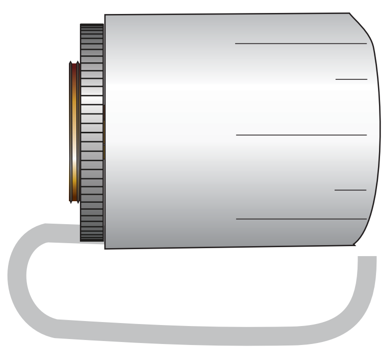
Material	Plastic housing, grey-white
Length (L) Width (B) Height (H)	74 mm 74 mm 36 mm
Operating voltage Current input Regulating range Switch hysteresis Temperature sensor Switch output	24 V ~±10%, 50 - 60 Cycle 30 m A 5°C - 40°C 1 K internal NTC TRIAC, 24V ~/ 1A, short time to 2,5 Amp
Description:	Room temperature control for heating and cooling in 2- and 3- conductor system with set point adjuster and dew point guard. LED for operating state and dew point guard. Version UP.



Ordering example:
Room Temperature Control: M.R2/3

M.TA.1 Thermo Actuating Drive

Material	Plastic housing, metal connector
Diameter Height	52 mm 72,5 mm
Standard version Electr. connection Starting current Continuous current Input power Setting force	current less closed (change possible) 24 V 250 mA 0,013 A 3 W 125 N
Description:	Actuating drive for zone valve DN15 and Dn20
Accessories	M.TAA.1 - Adapter 30 x 1,5 for MNG valve M.TAA.2 - Adapter 30 x 1,5 for SBK valve



Ordering example:
Thermo Actuating Drive: M.TA.I

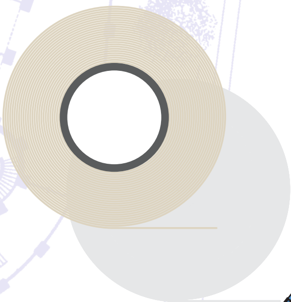
Deviations of the illustration are possible.

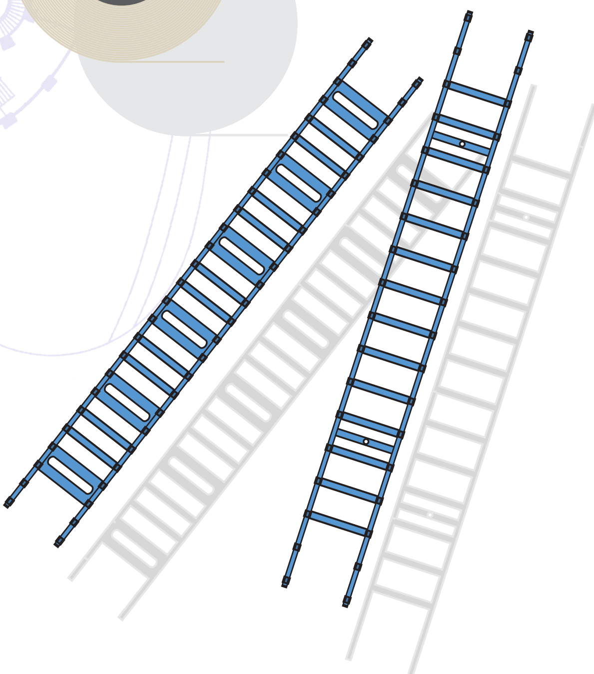
BEKA
FÜR KLIMA-KOMFORT

Installation material from BEKA
At all times the right choice

BEKA installation materials are helpful for the installation of BEKA mats.
BEKA mats are glued onto metal panel ceilings with special adhesives and solvents.
For attaching BEKA mats to dry-build boards thermal conductive paste and spacers are available.
Adhesive tape is used as an installation help for the positioning of the BEKA mats on unfinished- or dry-built ceilings, for later plastering.
Depending on the base surfaces different types are being offered.
For all types of installations BEKA provides detailed Technical Information sheets.
Please ask for the TI-M specification sheets.

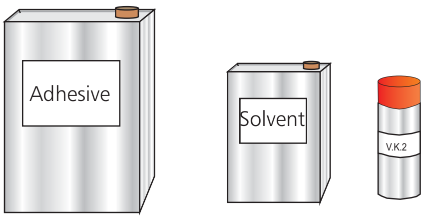
Regular controls on incoming and outgoing goods as well as 15 years warranty on all BEKA products secure a steady high quality.





V.K. · V.L. | Adhesive · Solvent

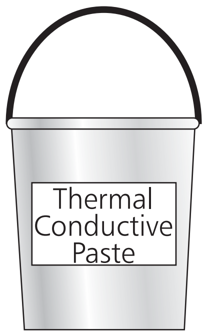
Contents	V.L.1 Solvent 9 kg V.K.1 Adhesive 22 kg V.K.2 Spray adhesive 500 ml
Range of application:	Easy sprayable contact-adhesive with long workable time to glue the BEKA-mats onto acoustic fleece in metal ceiling cassettes and onto dry-build sheets.
Processing:	see technical Information TI-M14 (Adhesive) and TI-M15 (Solvent)



Ordering example:
Adhesive: V.K.1

V.WLP.1 | Thermal Conductive Paste

Contents	Paste -25 kg
Range of application	For a thermally effective bonding of BEKA mats onto dry-build sheets (plaster boards or gypsum fibre sheets).
Processing Maturing time	see Technical Information TI-M16 20 min at norm. room temp.
Consumption	Standard value 800 g/m²

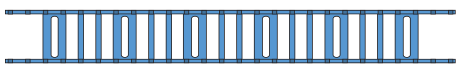


Ordering example:
Thermal Conductive Paste: V.WLP.1

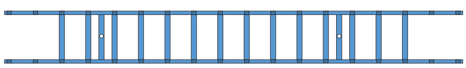
V.AG.10 · V.A.15 | Spacer

Material	Polypropylene Random Copolymer, Type 3, DIN 8078
V.AG.10 Length	Spacer for BEKA mats on dry-build sheets with a distance of the capillary tubes of 10 mm. 250 mm
Processing	see Technical Information TI-M05
V.A.15 Length	Spacer for BEKA mat type K.S15 255 mm

AG.10



A.15

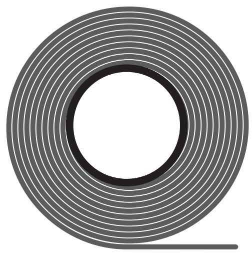


Ordering example:
Spacer: V.A.15

Deviations of the illustration are possible.

V.KB.1 Bullran Adhesive Tape

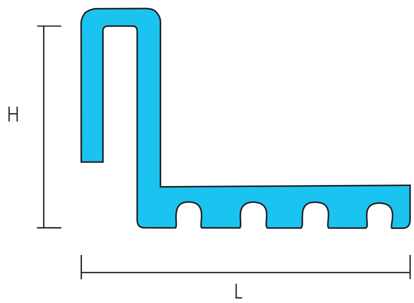
Description	Bullran adhesive tape on a roll
Range of application	Double sided adhesive to fix BEKA capillary tube mats onto raw ceilings or floors. Pre-assembled supply is possible.
Processing	see Technical Information TI-M17
Material measurement	45 x 1,0 mm
Delivery unit	1 roll contains 25 m



Ordering example:
Bullran Adhesive: V.KB.1

V.KGK.CLIP Clip

Material	Polypropylene Random Copolymer, Type 3, DIN 8078
Length	68 mm
Height	35 mm
Width	35 mm
Description	Clip for a standard CD-profile height of 27 mm
The color may deviate from the standard blue	



Ordering example: Clip: V.KGK.CLIP
Deviations of the illustration are possible.

Deviations of the illustration are possible.

V.FAN.1 · V.FAF.1 Compensation and Leveling out Mass

Material	Mixture of hydraulic binders, mineral additives and synthetic resins
Range of application	Compensation and Leveling out mass for floor heating with BEKA capillary tube mats
Processing	see Technical Information TI-M12
Contents Consumption	25 kg ca. 1,5 kg/m^2 and for each mm layer thickness

Ordering example:
Compensation Mass: V.FAF.1

V.FAP.1 Dispersion pre-Touch

Material	Neoprene dispersion pre-touch without solvent
Range of application	Pre-touch on thick and smooth, absorbent and not absorbent sub-areas before applying V.FAN.1 or V.FAF.1
Processing	see Technical Information TI-M12
Contents	1 kg VPE 5 kg are available per your inquiry
Consumption	ca. 150 g/m^2

Ordering example:
Dispersion pre-Touch: V.FAP.1

V.FAG.1 Primer

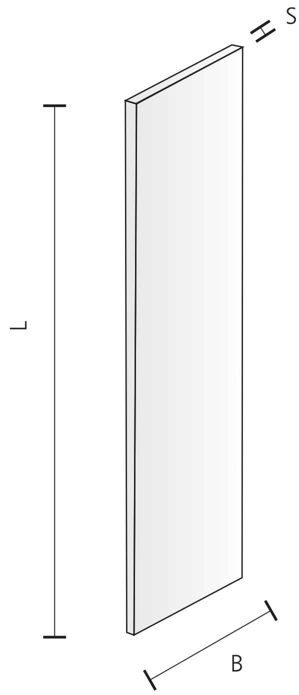
Material	without solvent, watery synthetic resin dispersion, ready for use
Range of application	priming before applying V.FAF.1 and V.FAN.1
Processing	see Technical Information TI-M12
Contents	1 kg VPE 5 kg are available per your inquiry
Consumption	ca. 150 g/m^2

Ordering example:
Primer: V.FAG.1

Deviations of the illustration are possible.

V.TK. Mounting Plate

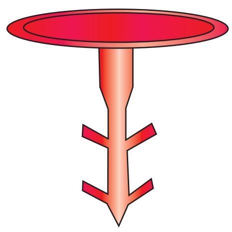
Material	Styrofoam PS40
Length (L) Width (B) Thickness (S)	2000 mm V.TK.1 - 435 mm V.TK.2 - 335 mm 22 mm
Range of application	Mounting plate for installation of BEKA mats type K.GK10 on plaster boards
Processing	see Technical Information TI-M24



Ordering example:
Mounting Plate, length 2000mm width 435mm: V.TK.1

V.NK.1 Plastic Nails

Description	Plastic Nail with claws
Head diameter Hight Range of application	35 mm 27 mm for fixing the BEKA mats K.GK10 onto the mounting plates V.TK
Processing	see Technical Information TI-M24
Delivery units	VPE 100 pieces



Ordering example:
Plastic Nails: V.NK.1

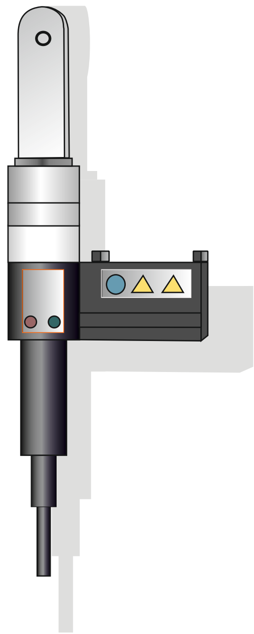
Deviation of the illustration are possible.

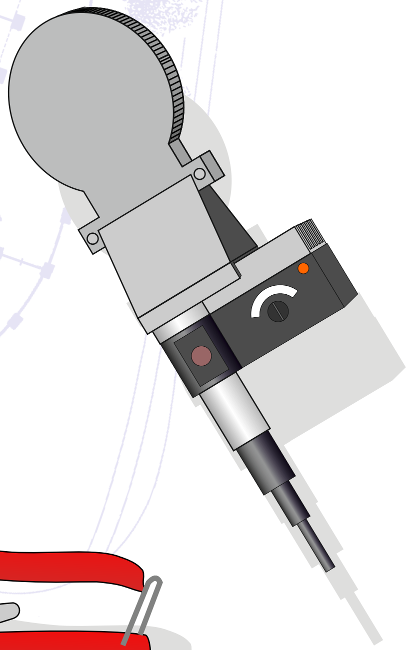
Tools from BEKA
At all times the right choice

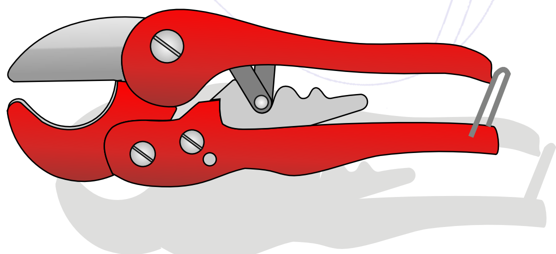
For installation BEKA offers an assortment of tools.Butt - and sleeve welding devices as well as internal sleeve welding plates are available for the different diameters.
Special scissors for BEKA pipe DA20 assure safe and accurate cuts.The above mentioned tools are available from reguler stock in short term.

Please contact us in case of further requests of tools or technical instructions. More advises and information are explained in the BEKA TI-M specification sheets.

Regular controls on incoming and outgoing goods as well as 15 years warranty on all BEKA products secure a steady high quality.

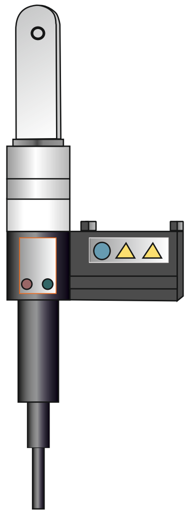






W.MSG.1 Hand Welding Device for Sleeve Welding

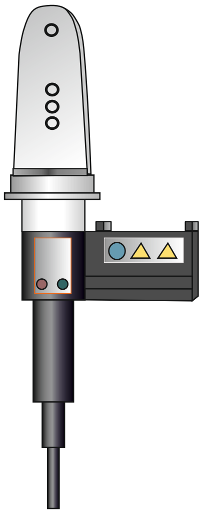
Material	Metal
Input voltage	230 V
Heating capacity	500 W
Temp. regulating range	200°C- 300°C self regulating via thermo-stat
Extent of delivery:	Sleeve welding device with holding device for table fixing.
Description:	Hand welding device with table-hold for sleeve welds. Suitable for welding adaptor from Ø20 mm up to Ø32 mm.



Ordering example:
Hand Welding Device: W.MSG.1

W.MSG.2 Hand Welding Device for Sleeve Welding

Material	Metal
Input voltage	230 V
Heating capacity	800 W
Temp. regulating range	200° C- 300°C self regulating via thermo-stat
Extent of delivery:	Sleeve welding device with holding device for table fixing.
Description:	Hand welding device with table-hold for sleeve welds. Suitable for welding adaptor from Ø20 mm up to Ø63 mm.

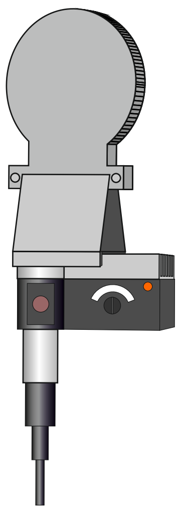


Ordering example:
Hand Welding Device: W.MSG.2

Welding devices with other capacities are available per your inquiry.

W.STSG.1 Butt-Welding Device

Material	Welding adaptor with PTFE-silver coating
Input voltage	230 V
Heating capacity	600 W
Temp. regulating range:	200°C - 300°C self-regulating via thermostat
Extent of delivery:	Butt-welding device with holding device for table fixing.
Description:	Hand welding device for butt-welds. Suitable for all BEKA pipes and mats.

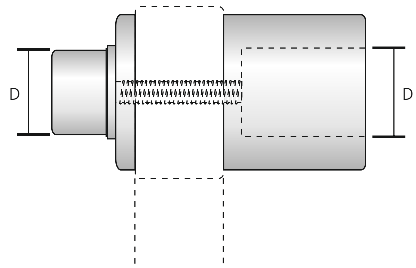


Ordering example:
Hand Welding Device for butt-welds: W.STG.1

Deviations of the illustration are possible.

W.MSE Sleeve Welding Adaptor

Material	Metal, PTFE-Silver-coated
Diameter (D)	20 mm
Description	Sleeve welding adaptor for BEKA sleeves and pipes with outer diameter of 20 mm. Accessory for sleeve welding device W.MSG

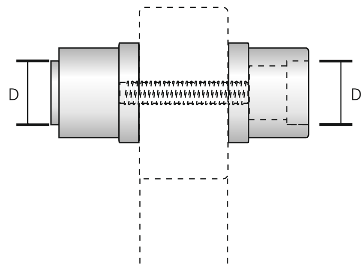


Ordering example:
Sleeve Welding Adaptor for 20mm pipe: W.MSE.20

Welding Devices for sleeve welds with bigger dimensions are available per your inquiry.

W.IMSE Inside Sleeve Welding Adaptor

Material	Metal, PTFE-Silver coated
Diameter (D)	16 mm
Description:	Inside sleeve welding adaptor for BEKA end caps and pipes with an inside diameter of 16 mm. Accessory for sleeve welding device W.MSG

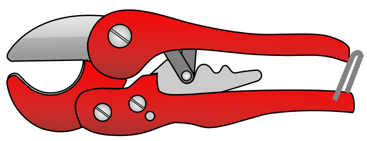


Ordering example:
Inside Sleeve Welding Adaptor for 20 mm pipe: W.IMSE.20

Welding devices for saddle welds are available per your inquiry.

W.S.20 Scissors

Material	Metal
Cutting range Colour	up to ø 26 mm red
Description:	Scissors to cut BEKA pipes up to ø 26 m



Ordering example:
Scissors: W.S.20

Special devices for welding synthetic material are available per your inquiry.

Deviations of the illustration are possible.

W.L.1 solve tool

Material	stainless steel
Diameter (D)	10 mm
Description	solve tool for removal flexible hoses in plug-in connectors

ordering example: solve tool: **W.L.1**

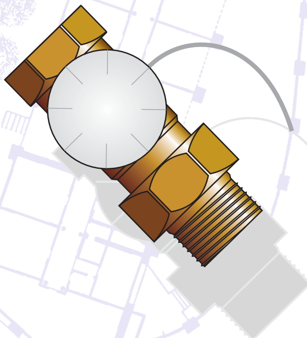
Deviations of the illustration are possible.

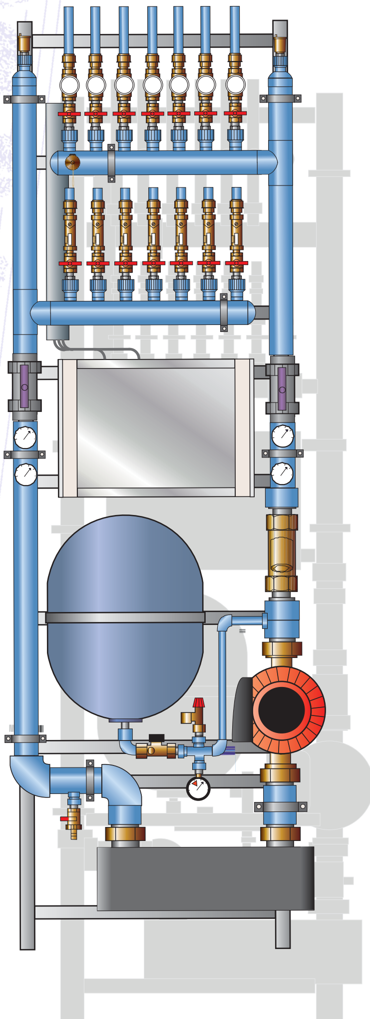
Multi-Storey Distributors from BEKA
At all times the right choice

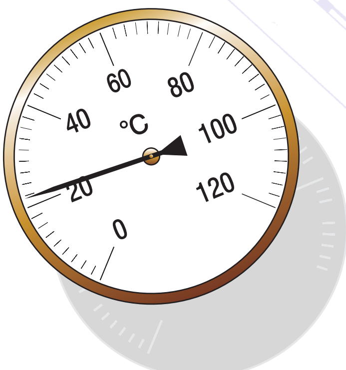
Multi-storey distributors and base units are utilised as energy transfer and splitting between the primary- and the secondary circulation consisted of BEKA mats.
All the supply lines for the cooling ceilings are fed by the base units. Cooling liquid is provided through the connecting points, through the distributor till the particular zones.

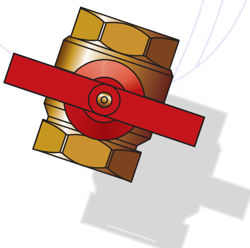
Besides Polypropylene Random Copolymer Type 3, DIN 8078, the assembled units are made up of brass and brass nickel plated.Consequently all connecting points supplied from BEKA are weldable to BEKA pipes and supply lines.

Regular controls on incoming and outgoing goods as well as 15 years warranty on all BEKA products secure a steady high quality.





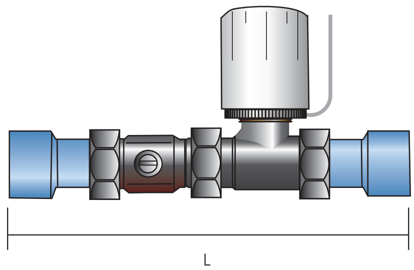




E.SAR15.1 Connecting Point Return Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA20, ball faucet, regulating valve and thermo-drive 24V AC/DC electroless closed
Versions	see table below
Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.

Dimension	Length (L) (mm)	Kvs-value
DN 15	185	1,7

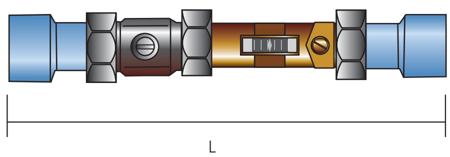


Ordering example:
Connection Point Return Pipe: E.SAR15.1

E.SAV15.1 Connecting Point Flow Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA20, ball faucet and tacosetter
Versions	see table below
Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.

Dimension	Length (L) (mm)	Kvs-Value	l/min
DN 15	250	1,8	2 - 8



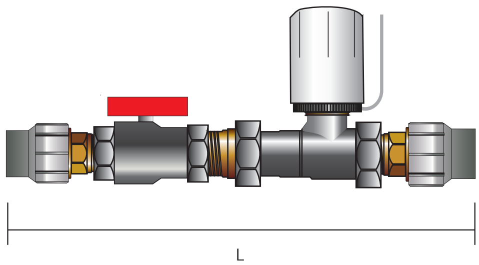
Ordering example:
Connection Point Flow Pipe: E.SAV15.1

Deviations of the illustration are possible.

E.SAR20.1 Connecting Point Return Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA25, ball faucet, regulating valve and thermo-drive 24V AC/DC electroless closed
Versions	see table below
Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.

Dimension	Length (L) (mm)	Kvs-value
DN 20	245	2,5

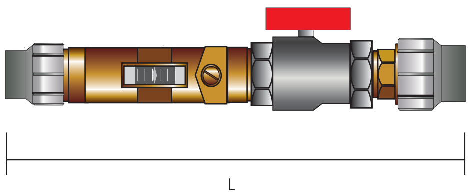


Ordering example:
Connection Point Return Pipe: E.SAR20.1

E.SAV20.1 Connecting Point Flow Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA25, ball faucet and tacosetter
Versions	see table below
Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.

Dimension	Length (L) (mm)	Kvs-Value	l/min
DN 20	295	5,0	4 - 15 8 - 30



Ordering example:
Connection Point Flow Pipe: E.SAV20.1

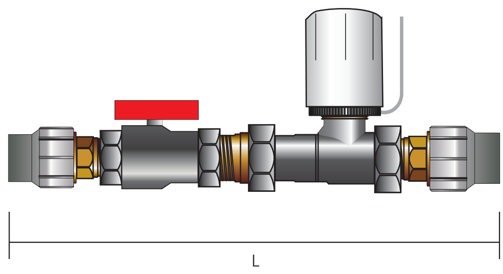
Deviations of the illustration are possible.

E.SAR25.1 Connecting Point Return Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA32, ball faucet, regulating valve and thermo-drive 24V AC/DC electroless closed
Versions	

Dimension	Length (L) (mm)	Kvs-value
DN 25	340	5,7

Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.



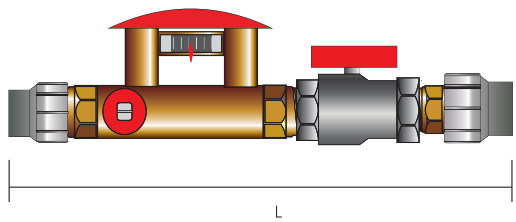
Ordering example:
Connection Point Return Pipe: E.SAR25.1

E.SAV25.1 Connecting Point Flow Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA32, ball faucet and tacosetter
Versions	

Dimension	Length (L) (mm)	Kvs-Value	l/min
DN 25	380	8,1	10 - 40

Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.



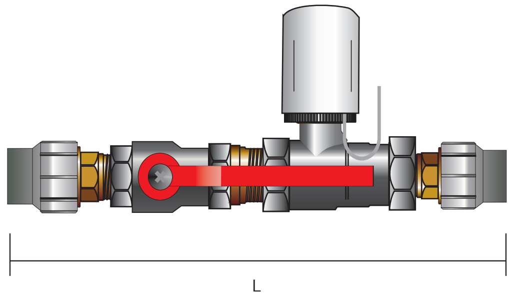
Ordering example:
Connection Point Flow Pipe: E.SAV25.1

Deviations of the illustration are possible.

E.SAR32.1 Connecting Point Return Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA40, ball faucet, regulating valve and thermo-drive 24V AC/DC electroless closed
Versions	see table
Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.

Dimension	Length (L) (mm)	Kvs-value
DN 32	345	6,7

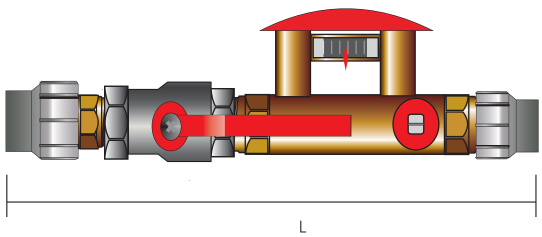


Ordering example:
Connection Point Return Pipe: E.SAR32.1

E.SAV32.1 Connecting Point Flow Pipe

Material	PP Random Copolymer, Type 3, DIN 8078 Brass and brass nickel plated
Arrangement	Transition connector PP both side DA40, ball faucet and tacosetter
Versions	see table
Description	The connection is screwed completely tight and pressure checked. The picture shows the standard version. Changed versions, for example with KFE-faucet, are available on request.

Dimension	Length (L) (mm)	Kvs-Value	l/min
DN 32	385	17,0	20 - 70



Ordering example:
Connection Point Flow Pipe: E.SAV32.1

Deviations of the illustration are possible.

E | Storey Distributor

The storey distributor EE from BEKA is utilised as energy transfer and for the splitting between the primary circulation with the refrigerating generation and the secondary circulation with the supply lines and the BEKA heating- and cooling mats

The storey distributor has a distributor in the feed- and return lines with which the particular zones of the cooling ceiling are supplied with cooling liquid.
The zones of the cooling ceiling can be dimensioned differently.

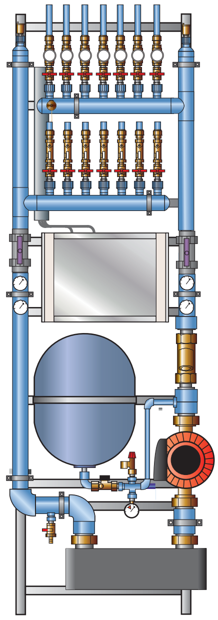
The storey distributor can be supplied either with a pressure regulated or with a non-regulated pump.

The dimensions will be fitted to the project.

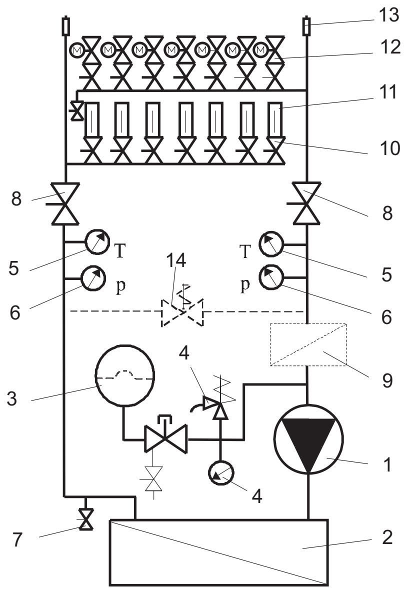
The storey distributor is fixed on a galvernised steel frame and will be pressure checked, before delivery, with 10 bar for about 3 hours

For the arrangement of the distributor the following specifications are required:
- performance in kW
- cooling liquid (partly glycol)
- primary/secondary temperatures
- possible dimensions
- quantity of zones and dimensions
- external p
- possible size of pressure expansion tank

(the nominal width will be laid out, so that a flow speed of 1,2 m/sec. will not be exceeded).



Material	Polypropylene Random Copolymerisat Type 3, DIN 8078, PVC.brass, brass nickel-plated or stainless
Composition	1 Pump pressure regulated alternative: non-regulated, with overflow valve (14) 2 Heat exchanger 3 Pressure expansion tank with cap valve 4 Safety device, consisting of: safety valve and pressure gauge 5 Thermometer 0-60°C alternative: 0-40°C 6 Pressure gauge 0-6 bar 7 Fill- and drainage faucet 8 Ball faucet 9 alternative: Dirt collector 10 Ball faucet 11 Taco setter 12 Valve with setting drive 13 automatic bleeder
Height (H) Width (B) Depth (T) Cooling capacity Operating pressure	Approx.1400 to 2000 mm * approx. 600 to 800 mm * approx. 400 mm * to 150 kW



* the dimensions can be fitted for the project

Deviations of the illustration are possible.

E | Base Unit

The base unit E.G. From BEKA is utilised as energy transfer and for the splitting between the primary circulation with the refrigeration generation and the secondary circulation with the BEKA heating- and cooling mats.

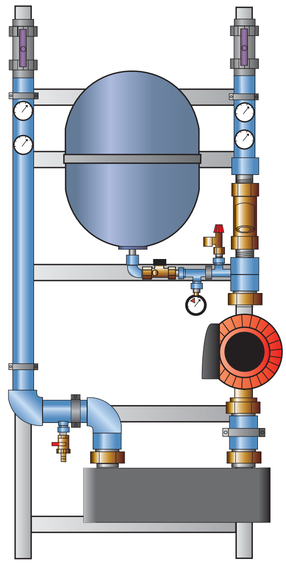
The base unit feeds the supply lines for the cooling ceiling. Via connections (M.AR and M.AV) or the distributor station (E.V) the particular zones of the cooling ceiling are provided with the cooling liquid.
The base unit is supplied with a regulated or a non-regulated pump.

The dimensions can be fitted to the requirements of the project. The base unit is fixed on a galvernised steel frame and will be pressure checked before delivery with 10 bar for about 3 hours.

For the arrangement of the station the following specifications are required:

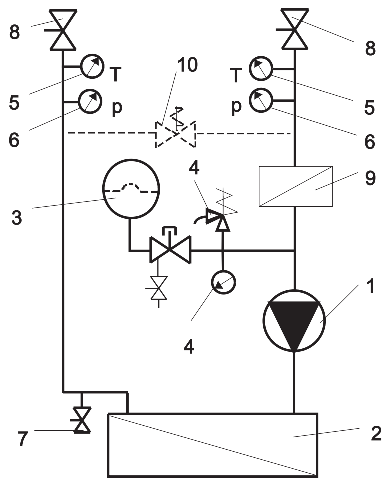
- performance (in kW)
- cooling liquid (parts per unit of glycol)
- primary/secondary temperatures
- possible dimensions
- external p
- possible size of pressure expansion tank

(The nominal width is laid out such, that the flow speed of 1,2 m/sec. will not be exceeded)



Material	Polypropylene Random Copolymere Type 3, DIN 8078, PVC. Brass, brass nickel plated or stainless
Composition	1 Pump, pressure regulated alternative: non regulated, with overflow valve (10) 2 Heat exchanger 3 Pressure expansion tank with cap valve 4 Safety device, consisting of: Safety valve and pressure gauge 5 Thermometer 0-60°C alternative: 0-40°C 6 Pressure gauge 0-6 bar 7 Filling- and drainage valve 8 Ball faucet 9 alternative: Dirt collector
Height (H)	approx. 1400 to 2000 mm *
Width (B)	approx. 600 to 800 mm *
Depth (T)	approx. 400 mm *
Cooling capacity	to 150 kW
Operating pressure	

* The dimensions can be fitted to the requirement of the project.



Deviations of the illustration are possible.

E | required data for design of base unit

In order to be able to optimally the design of the base unit some information´s are required.
Please complete the following fields and send it back to us either by fax: +49 30 474 114 35 or by E-Mail: info@beka-klima.de.

heat exchanger

capacity (kW)	
temperature primary side **in** [°C]	
temperature primary side **out**[°C]	
Medium primary side [water, glycol content] %	
temperature secondary side **in** [°C]	
temperature secondary side **out** [°C]	

Pump

delivery height / fluid quantity [m³/h] or pressure loss in the pipework (including max. heating circuit) [kPa]	

Alternative:

Max. pressure loss of the heating-cooling circuits [kPa] or sizes of heating / cooling circuits [m²] and Max. distance from the station [m]	

expansion tank (membrane-expansion tank)

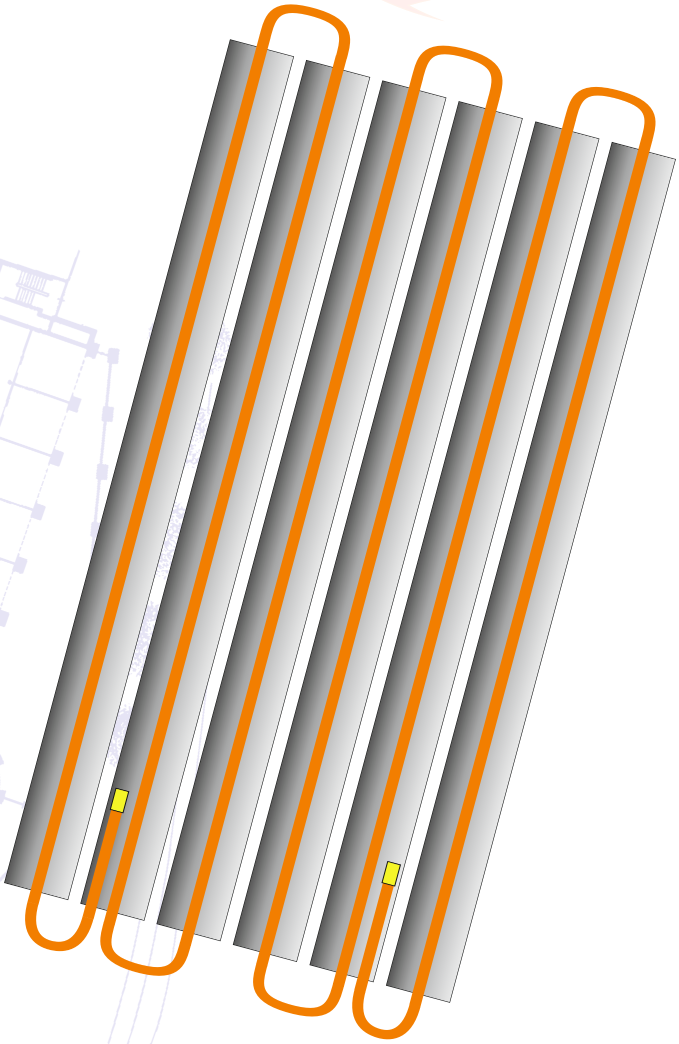
water content of the entire plant [L]	
Hydrostatic pressure (max. 13m)	

degasification line (if needed)	
Max. available space for the storey distributor [height, width, deep in cm]	

BEKA
FÜR KLIMA-KOMFORT

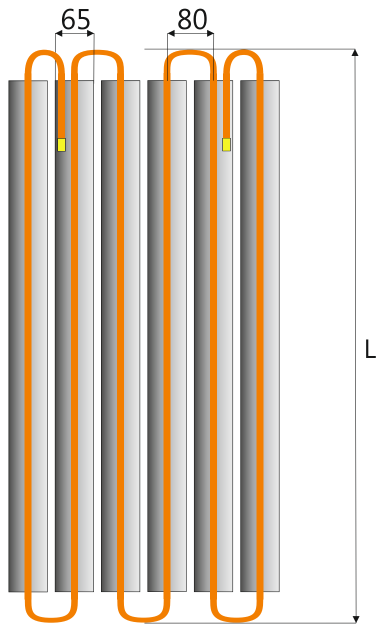
BEKA copper tube elements are the right choice in every case

BEKA copper tube elements are used as surface heat exchangers in cooling and heating ceilings.
These are conventionally used for suspended metal panel ceilings and suspended plasterboard ceilings.
The BEKA copper tube elements are manufactured with serpentine coils. To ensure efficient thermal conduction from the cooling/heating water to the outer surface of the ceiling, the copper tubes are pressed into positive-locking aluminium heat-conducting profiles. The wide range of serpentine tube dimensions, tube intervals and heat-conducting profile widths enable the thermal capacity and costs to be optimised during planning. The serpentine copper tubing is manufactured to order in the required amounts on computer-managed production lines. All BEKA copper serpentine tubes can be connected to one another by soldering, crimping connections or quick-action couplings and connected to the water system.
The product range is rounded off with flexible hoses, connector groups and fittings.
BEKA serpentine copper tubing is exclusively manufactured from Cu-DHP copper tubes as per EN 12449 standard and subjected to soft bending as per R220. The tube ends are deburred and calibrated according to the nominal dimensions of the serpentine tubes.
100% quality control and a 15-year warranty ensure the continuous high quality of all BEKA products.



C.M10.65.n.L.080.aa BEKA serpentine copper tubing

Tube material	Cu-DHP copper tubing to EN 12449, soft R220
Heat- conducting profile material crimp pressed on tube	Aluminum AlMgSi0.5 F22
Ø Cooling tube Width of heat-conducting profile Cooling tube intervals (A)	10 × 0,6 mm 65 mm 80 mm
Length (L) No. of tubes (n)	580 - 2200 mm (in 10 mm increments) min. 2 pieces max. 12 pieces
Mass when filled Water content	6.23 kg/m² 0.730 l/ m²
Cooling capacity * Operating pressure	79 W/m² 4 bar
Connection type aa (60mm tube ends)	66, straight 0° 77, straight 45° 88, 2 x 180° inwards 45° 99, 2 x 90° inwards 45°
Application area	Metal ceiling panels

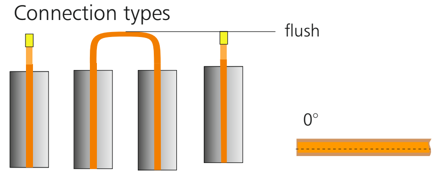


* Capacity attained under conditions defined by EN 14240

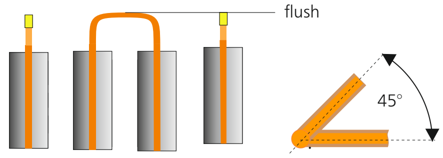
Order example:
Serpentine copper tubing, 10mm diameter,
with 65 mm-wide heat-conducting profiles,
6 tubes, 1500mm long, tubes spaced at 80mm intervalls,
both tube ends straight, 60mm
C.M10.65.6.1500.80.66

Product versions	
No heat-conducting profile	Individual further processing
With Hotmelt adhesive strip for bonding in ceiling panels	Further processing by metal ceiling manufacturer
Bonded in factory in supplied metal ceiling panels	Ceiling panels / trays up to 2200 mm long can be fitted
Customised versions with deviating tube intervals	Assembly for e.g. sprinkler installations or lamps
Individual design of connections	With respect to the free tube ends and the bending radiuses or angles

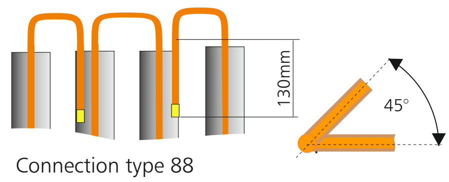
Connection types



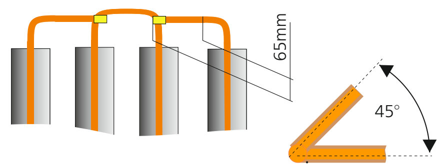
Connection type 66



Connection type 77



Connection type 88



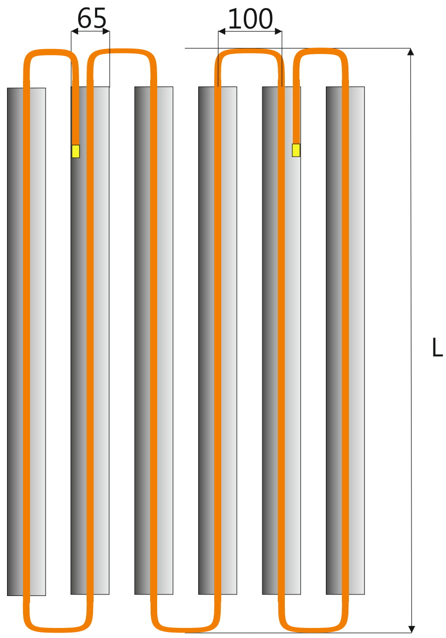
Connection type 99

Products may deviate from the illustrations

C.M10.65.n.L.100.aa BEKA serpentine copper tubing

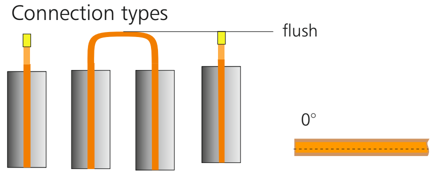
Tube material	Cu-DHP copper tubing to EN 12449, soft R220
Heat- conducting profile material crimp pressed on tube	Aluminum AlMgSi0.5 F22
Ø Cooling tube Width of heat-conducting profile Cooling tube intervals (A)	10 × 0,6 mm 65 mm 100 mm
Length (L) No. of tubes (n)	580 - 2200 mm (in 10 mm increments) min. 2 pieces max. 12 pieces
Mass when filled Water content	5.19 kg/m² 0.608 l/ m²
Cooling capacity * Operating pressure	64 W/m² 4 bar
Connection type aa (60mm tube ends)	66, straight 0° 77, straight 45° 88, 2 x 180° inwards 45° 99, 2 x 90° inwards 45°
Application area	Metal ceiling panels Plasterboard ceilings

* Capacity attained under conditions defined by EN 14240

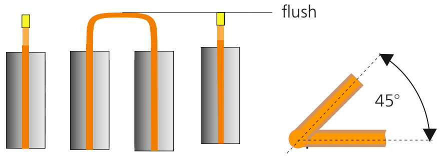


Order example:
Serpentine copper tubing, 10mm diameter,
with 65 mm-wide heat-conducting profiles,
6 tubes, 1500mm long, tubes spaced at 100mm intervalls,
both tube ends straight, 60mm
C.M10.65.6.1500.100.66

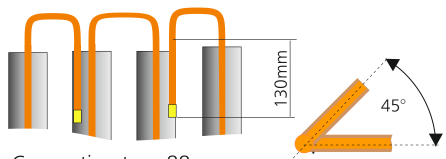
Connection types



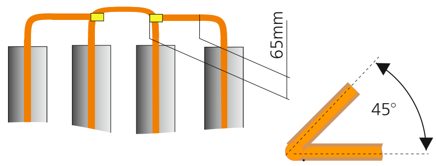
Connection type 66



Connection type 77



Connection type 88



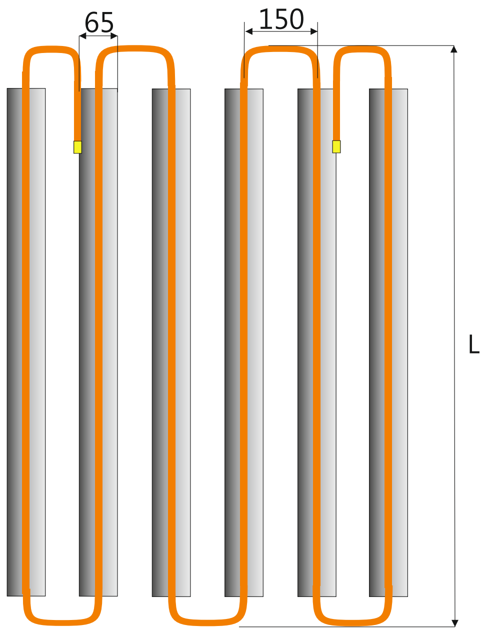
Connection type 99

Product versions	
No heat-conducting profile	Individual further processing
With Hotmelt adhesive strip for bonding in ceiling panels	Further processing by metal ceiling manufacturer
Bonded in factory in supplied metal ceiling panels	Ceiling panels / trays up to 2200 mm long can be fitted
Customised versions with deviating tube intervals	Assembly for e.g. sprinkler installations or lamps
Individual design of connections	With respect to the free tube ends and the bending radiuses or angles

C.M10.65.n.L.150.aa BEKA serpentine copper tubing

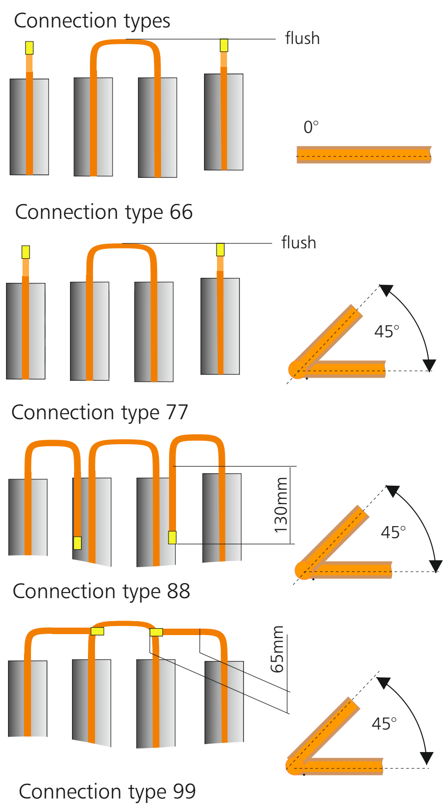
Tube material	Cu-DHP copper tubing to EN 12449, soft R220
Heat- conducting profile material crimp pressed on tube	Aluminum AlMgSi0,5 F22
Ø Cooling tube Width of heat-conducting profile Cooling tube intervals (A)	10 × 0,6 mm 65 mm 150 mm
Length (L) No. of tubes (n)	580 - 2200 mm (in 10 mm increments) min. 2 pieces max. 12 pieces
Mass when filled Water content	3,63 kg/m² 0,426 l/ m²
Cooling capacity * Operating pressure	52 W/m² 4 bar
Connection type aa (60mm tube ends)	66, straight 0° 77, straight 45° 88, 2 x 180° inwards 45° 99, 2 x 90° inwards 45°
Application area	Metal ceiling panels Plasterboard ceilings

* Capacity attained under conditions defined by EN 14240



<u>Order Example:</u>
Serpentine copper tubing, 10mm diameter,
with 65 mm-wide heat-conducting profiles,
6 tubes, 1500mm long, tubes spaced at 150mm intervalls,
both tube ends straight, 60mm

C.M10.65.6.1500.150.66

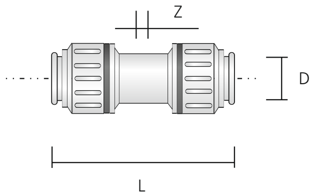


Product versions	
No heat-conducting profile	Individual further processing
With Hotmelt adhesive strip for bonding in ceiling panels	Further processing by metal ceiling manufacturer
Bonded in factory in supplied metal ceiling panels	Ceiling panels / trays up to 2200 mm long can be fitted
Customised versions with deviating tube intervals	Assembly for e.g. sprinkler installations or lamps
Individual design of connections	With respect to the free tube ends and the bending radiuses or angles

Products may deviate from the illustrations

A.V.10 | Plug-in connector

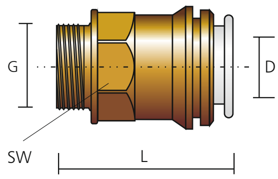
Material	Plastic Claw: Stainless steel
Diameter (D) Length (L) Z-mass	10 mm 44 mm 1 mm
Description	Plug-in connector for flexiblly hoses to serpentine copper tubes



Order example:
Plug connector 10 mm: A.V.10

A.AGV.10 | Plug-in connector, AG

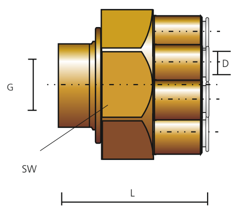
Material	Brass, Plastic, Claw: Stainless steel
Diameter (D) Length (L) Thread (G) Wrench size (SW)	10 mm 30 mm 1/2" AG 20 mm
Description	Plug-in connector as screw connection for 10mm diameter



Order example:
Plug-in connector 10mm 1/2" AG: A.AGV.10

E.UV.10.4 | Distributor arm for 10mm pipes (4 pieces)

Material	Brass, Plastic, claw: stainless
Diameter (D) Length (L) Thread Wrench size (SW)	10 mm 53 mm 1/2"IG 44 mm
Descripton	Plug-in connector as screw connection for 4 x diameter 10 mm



Order example:
Plug-in connector 10mm 1/2" IG: E.UV.10.4

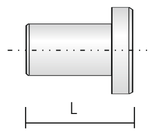
R.RR.500.10.1.1 PE-RT Pipe

Material	PE-RT 5-layer composite pipe, Oxygen-tight acc. DIN 4726 ISO 24033/22391/21003
Diameter	10 x 1,1mm
Length (L)	500 m
Application	Usually a flexible connection tube, always use with support sleeve A.STS.10

Order example:
PE-RT pipe 10 x 1,1mm: R.RR.500.10.1.1

A.STS.10 Support sleeve for 10mm PE-RT Pipe

Material	Plastic
Length (L)	17 mm
Description	Support sleeve for 10 mm diameter

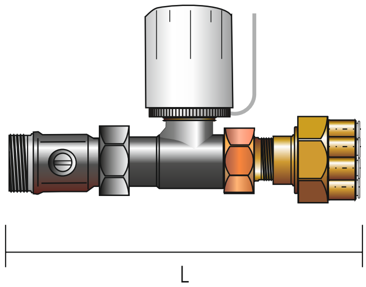


Order example:
Support sleeve for 10mm pipe: A.STS.10

E.SAR15.4 Connecting point for return pipe

Material	Brass and nickel-plated brass
Arrangement	4 x plug-in connections 10 mm Eurocone transition connector EG 3/4"; cone tap, regulation valve (thermal actuator 24V AC/DC, closed when power off
Version	Dimension / Length (L) (mm) / Kvs-value: Dn15 / 175 / 1,7
Description	The connections are screwed completely tight and pressure checked. The image shows the design. Modified designs, such as with a boiler fill- and drain-cock, are available on request.

Dimension	Length (L) (mm)	K_{vs}-value
Dn15	175	1,7

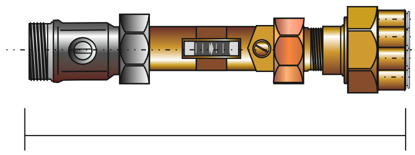


Order example:
Connection point for return pipe: E.SAR15.4

E.SAV15.4 Connecting point for flow pipe

Material	Brass and nickel-plated brass
Assembly	4 x plug-in distributor 10mm Eurocone transition AG3/4", ball valve and Tacosetter
Design	see table below
Description	The connections are screwed completely tight and pressure checked. The image shows the standard design. Modified designs, such as with a boiler fill- and drain-cock, are available on request.

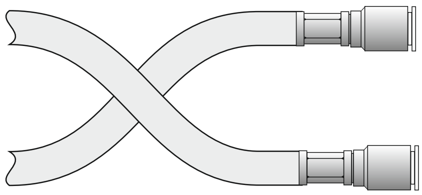
Dimension	Length (L) (mm)	K_{vs}-Wert	l/min
Dn15	200	1,8	2 - 8



Order example:
Connecting point for flow pipe: E.SAV15.4

A.KD | Connection hose with quick-action couplings

Material	Hose:	HDPE
	Sheath:	Stainless steel weave
	Sleeve:	Stainless
	Nozzle:	Nickel-plated brass
Diameter	10 mm	
Length	300 · 500 · 800 · 1200 mm	
Description	Flexible connection hose with EVOH-diffusion barrier and quick-action couplings	

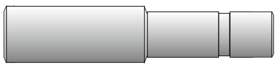


Order example:
Connection hose, stainless steel weave, 800mm length, 10mm diameter: A.KD.800.10

Flexible hoses in other lengths and connection forms can be delivered on request.

A.VST.10.12 | Connecting sleeve for flexible hoses ø 10 to ø 12 mm smooth

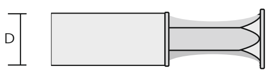
Material	Adapter:	Nickel-plated brass
Diameter	10 mm; transition piece to12 mm	
Length	55 mm	
Description	Connection sleeve for connection hoses with smooth ø 10 to ø 12 mm clogged	



Order example:
A.VST.10.12

A.BS.10 | Plug

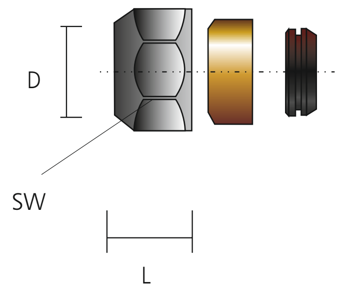
Material	Plastic
Diameter (D)	10 mm
Description	Sealing plug for quick-action couplings



Order example:
Plug diameter 10mm: A.BS.10

V.KV.CU.18 | Clamp screw connection - soft seal

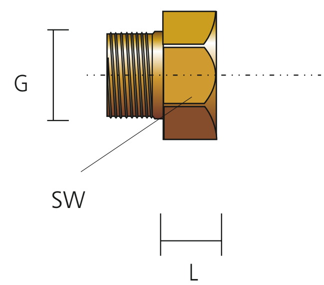
Material	Brass and nickel-plated brass
Diameter (D) Length (L) Wrench size (SW)	18mm 20mm 30 mm
Design	Union nut 3/4", compression ring, seal
Description	To connect connection points to serpentine copper tubes



Order example:
Compression fitting: V.KV.CU.18

F.VIM.AP.1 | Eurocone screw connection - soft seal

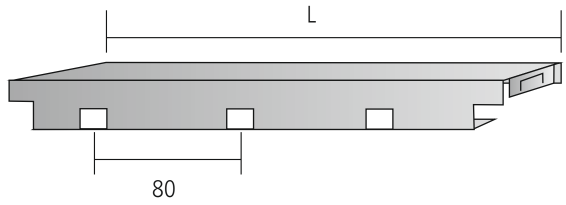
Material	Brass
Outside threads (G) Length (L) Wrench size (SW)	1/2" AG 20mm 30 mm
Design	Union nut 3/4", Eurocone, self sealing
Description	To connect connection points to connection pipes or as transition pieces



Order example:
Eurocone screw connection: F.VIM.AP.1

V.SPACER.333.80 | Spacer for 80mm intervals

Material	Galvanised steel sheeting
Nominal length Interval Division (Division depend of the nominal length)	333; 400; 500mm 80mm 3; 4; 5; 6; 7; 9
Description	Spacer for suspending serpentine copper tubing in plasterboard substructures



Order example: Spacer for 400 mm nominal length; 4 x 80mm interval: V.SPACER.333.80

Serpentine copper tubing C.M10

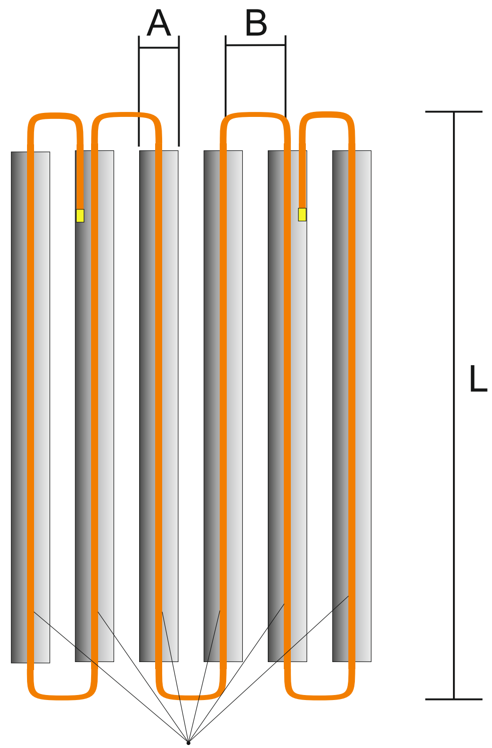
Please tick the required version

Your contact partner: ____________________

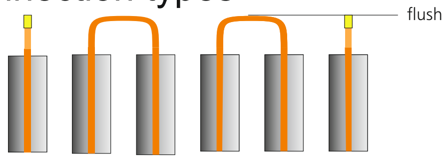
Tel. (030) 474 114 -3___ Fax (030) 474 114 35

BEKA

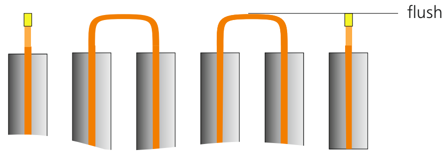
☒ Article No. C.M10



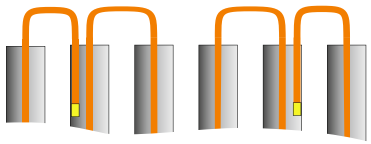
Connection types

☐ 

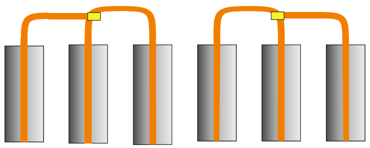
Connection type 66

☐ 

Connection type 77

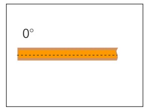
☐ 

Connection type 88

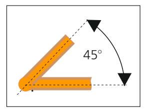
☐ 

Connection type 99

Connection angle

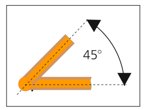
standard 

☐ Tube protrusion [ ] in 10 mm increments

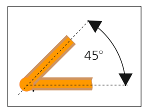
standard 

☐ other angle [ ] in 5° increments

☐ Pipe overhang [ ] in 10 mm increments

standard 

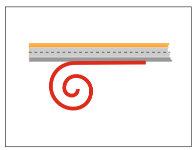
☐ other angle [ ] in 5° increments

standard 

☐ other angle [ ] in 5° increments

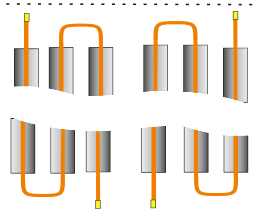
Optional for all versions

☐ Equipment



adhesive tape under AL-profile

Connection direction with uneven numbers of tubes



Connection direction

L ☐ R ☐

C.M10. [A] . [n] . [L] . [B] . [ ] . [ ]

Firm: ____________________ Employee: ____________________ Signature: ____________________

Project: ____________________ Tel: ____________________ Fax: ____________________ Date: ____________________

BEKA
FÜR KLIMA-KOMFORT

Technical Information

G Basics, General Information G

G01 Introduction into “Thermal Comfort”
G02 Humidity and Dew Point
G03 Lifetime Behaviour of Polypropylene
G04 Energy- and Cost Consideration to the BEKA Cooling Ceiling
G05 Advantages of the BEKA Capillary Tube Technique
G06 Standard BEKA Ceiling - Constructions and approx. Costing

K Short Description K

K01 Plaster Ceiling with BEKA Heating and Cooling Mats
K02 Metal Cassette Ceiling with BEKA Heating and Cooling Mats
K03 Gypsum Plasterboard Ceilings with BEKA Heating and Cooling Mats
K04 Ceiling Cooling and Ceiling Heating with BEKA Pre-fabricated Unit
K05 Wall Heating with BEKA Heating Mats
K06 Wall Heating with the BEKA Pre-fabricated Unit
K07 Floor Heating with BEKA Heating Mats
K09 Cooling and Heating Ceiling with BEKA Acoustic Metal Panel
K10 Installation with BEKA Plug-in Type Pipe System

B Calculation, Construction and Planning B

B01 Questions before lay-out of BEKA Cooling Ceilings
B02 Lay-out of BEKA Cooling Ceilings
B03 Heating with BEKA Capillary Tube Mats
B04 Calculation for the Piping of BEKA Heating- and Cooling Ceilings
B05 Control of BEKA Heating- and Cooling Ceilings
B06 Instructions for Fire Protection and to Burning Behaviour of BEKA Mats
B07 Example: Construction of a BEKA Cooling Ceiling
B08 Questions before lay-out of BEKA Floor Heating
B09 Lay-out of BEKA Floor Heating
B10 Question before lay-out of BEKA Wall Heating
B11 Lay-out of BEKA Wall Heating
B12 Requirements for the Water Quality
B13 Tolerances of BEKA Mats
B14 Technical Requirements for Basis Stations and Storey Distributors
B15 Use of calculation tools for determination of cooling and heating performance and pressure loss

M Installation M

M01 Installation Instructions for BEKA Heating- and Cooling Mats
M02 Instructions for Thermal Welding of Plastics
M03 Installation Instructions to BEKA Mats in Plaster Ceilings
M04 Installation Instructions to BEKA Mats in Metal Cassette Ceilings
M05 Installation Instructions to BEKA Mats on top of Dry-build Boards with TCP
M06 Instructions to the Installation of BEKA Dew-Point Sensor
M07 Test Instructions for BEKA Heating- and Cooling Systems
M08 Technical Data to the Converter
M09 Technical Data to the Room Temperature Control
M10 Installation Instructions to BEKA pre-fabricated dry-build units
M11 Installation Instructions to BEKA Mats between double panelled Plasterboard Ceiling
M12 Installation Instructions to BEKA Mats as Floor Heating
M14 Technical Information on BEKA Adhesive V.K.1
M15 Technical Information on BEKA Solvent V.L.1
M16 Technical Information on BEKA Thermal Conductive Paste V.WLP.1
M17 Fixing of BEKA Mats with Adhesive Tape
M19 Installation Instructions to BEKA Mats with Tacks
M20 Installation Instructions to BEKA Mats as Wall Heating
M21 Start of Operation of Basis Stations and Storey Distributors
M23 Beginning stages of BEKA floor heating systems with capillary tube mats
M24 Installation Instructions of BEKA Mats fixed on slope construction dry-build-panels
M25 Functional Heating of Ceilings with BEKA Capillary Tube Mats

T Charts and Forms T

T01 Lay-out Chart for BEKA Cooling Ceilings
T02 Lay-out Chart for BEKA Heating Ceilings
T03 Approximate Calculation of the sensible (dry) Cooling Load
T04 Identification Data for Standard Capacities of BEKA Cooling and Heating Ceilings
T05 Test Report for the final check of BEKA Heating- and Cooling Systems
T06 Combustion heat
T07 Lay-out Chart for BEKA Floor Heating
T08 Lay-out Chart for BEKA Wall Heating
T09 Quick Lay-out for Wall Heating with BEKA Prefabricated Panels
T10 Quick Lay-out for Cooling Ceilings with BEKA Prefabricated Panels
T11 Test report for beginning stages of BEKA floor heating systems
T13 Heating Protocol for BEKA Ceiling Heating

D Diagrams D

D01 Cooling Capacity for various Types of BEKA Cooling Ceilings
D02 Cooling Capacity of a BEKA Plaster Ceilings
D03 Heating Capacity for various Types of BEKA Ceilings
D04 Heating Capacity of a BEKA Plaster Ceiling
D05 Permissible Heating Capacity
D06 Permissible Heating Capacity in Dependence of the covered Ceiling sector
D07 - D08 Pressure Loss of the BEKA Mat K.U10
D09 - D10 Pressure Loss of the BEKA Mat K.G10
D11 - D12 Pressure Loss of the BEKA Mat K.S10
D13 - D14 Pressure Loss of the BEKA Mat K.S15

D15	Pressure Loss in the Connecting Hose
D16	Pressure Loss in the BEKA Pipe 20 x 2 mm
D17	Pressure Loss in a BEKA Elbow Lead-off
D18	Flow Speeds in Pipes
D19	Heat Transfer Ceiling / Room
D20	Average Surface Temperatures at the Ceiling Underside
D21	Heating Capacity of BEKA Floor Heating
D22	Pressure Loss of the BEKA Dry-built Unit B.GK12
D23	Frequency of the Dew Point
D24	Average Heat Transfer Coefficient of Buildings
D25	Basic Characteristic Curve: Cooling Capacity of an ideal Radiation Cooling Ceiling
D26	Heat Volume – Water Volume
D27	Cooling Capacity for Wall Cooling with BEKA Prefabricated Panels
D28	Heating Capacity for Wall Heating with BEKA Prefabricated Panels
D29	Heating Capacity of the BEKA Wall Heating
D30	Pressure Loss of Series Connections at BEKA Mats 600 x 600
D32-D33	Pressure Loss of the BEKA Mat P.VS
D34-D36	Pressure Loss of the BEKA Mat P.VG
D37	Pressure Loss of the BEKA Mat P.NS
D45	Pressure Loss of the BEKA Mat P.FS20

F *Formulas* *F*

A *Specifications* *A*

A01	BEKA Specification Details for BEKA Components
A02 - 1	Plaster Ceiling on Raw Concrete
A02 - 2	Plaster Ceiling on Suspended Ceiling
A02 - 3	Plaster Metal Acoustic Ceiling
A02 - 4	Pre-fabricated Units
A02 - 5	Dry-built Ceiling
A03	P-mats

Introduction into "Thermal Comfort"

1. General

Thermal comfort is a decisive criterion for good health, because the human body has permanent thermal exchange with the surroundings through radiation, convection/conduction and transpiration. If through metabolism more heat is produced than necessary, surplus heat must be passed on to the surroundings. If there is a thermal deficit, the thermal looses must be reduced and the heat production must be raised.

The thought that human beings prefer different thermal surroundings, because of their age, sex or their regional origin, and therefore well-being would only be a subjective matter, is from a scientifically point of view not the whole truth. On the contrary, comfort is depending upon factors, which influence one another. An optimal coordination of these factors to another cause that 95% of all human beings will feel comfort in the same way. These influences can be classified if they are depending upon the human being or the room they are in.

2. Influences of Thermal Comfort according ISO 7730

According to ISO 7730, the thermal comfort is calculated by means of an extensive equation. In this equation (according to investigations of Prof. Fanger [1]) the following values are considered.

Room air temperature in °C
Average radiation temperature of surrounding surfaces in °C
Relative air velocity of the room air in m/s
Partial humidity pressure of the room air in Pa
Thermal transmittance resistance of clothing in m^2 K/W
Metabolic rate in W/ m^2 for the surface of the human body

The 7^{th} parameter: The external work (in W/m^2) can be neglected, because for most of the activities it is close to zero.
As for the mentioned factors a PMV-index (predicted mean vote) is calculated. PPD-index (predicated percentage of dissatisfied) is belonging to it. The PPD-index shows the value in percentage of the probable dissatisfied people. Even at best situations there will be always 5% dissatisfied people.

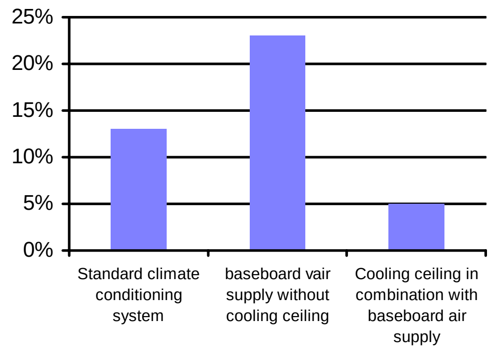


Diagram 1:
Statistical percentage of possible dissatisfied people according Prof. Fanger

[1] Prof. Ole Fanger, Copenhagen

Humidity and Dew Point

1. Generals

Humidity is the local and timely changing contents of steam in the air, which depends upon the regional climate, if not also influenced by individual usage of the rooms (kitchen, laundries etc.)
Humidity must be considered regarding comfort as well as for functioning of the system.

2. Basics

Air and steam in the atmosphere form a mixture, whose contents behave like gases. For the mixture of both the Dalton law (1820) is true „Each component *i* of a mixture of ideal gases in a definite volume *V* acts as if fills the whole volume by itself. It is under partial pressure P_i which results when the isothermal expansion of its volume V_i acts by the pressure *P* to the total volume *V*."

Example Humidity: (equation 1)

$p\ V_D = p_D\ V = m_D\ R_D\ T$ und $p\ V_L = p_L\ V = m_L\ R_L\ T$

with
$p = p_L + p_D$ und $V = V_L + V_D$

p	=	Total pressure
p_L	=	Partial pressure of the air
p_D	=	Partial pressure of the damp
V	=	Total volume
V_L	=	Volume of air
V_D	=	Volume of damp
m_D	=	Masses of damp
m_L	=	Masses of air
R_D	=	Gas resistance: damp = 461 J/kg·K
R_L	=	Gas resistance: air = 287 J/kg·K

2.1 Absolute Moisture X

The absolute moisture represents the denseness of water in the air volume.

Absolute mkoisture X (equation 2)

$X = m_D / m_L$

From equation 1 and $\rho = m/V$ follows:
$X = 0{,}622 \cdot p_D / (p - p_D)$

The total mass of 1 kg of moist air is 1+X !
For dry air X = 0, for pure damp X is infinite.

2.2 Saturation Moisture X'

Air can only take up moisture until its partial pressure p_D equals the temperature depending saturation p_S. At $p_D > p_S$ moisture will turn into water (fog).

$X' = 0{,}622 \cdot p_S / (p - p_S)$ (equation 3)

2.3 Dew Point

When air is cooled down, the damp pressure p_S and therefore, the saturation moisture reduces. The dew point is reached, when the saturation pressure p_S equals the damp pressure p_D.

Therefore:

$p_S = p_D$ or $X' = X$ (equation 4)

2.4 Relative Moisture $\varphi = X/X'$

The relative moisture prescribes how far the humidity is away from saturation or in other words, the relative moisture is the ratio between damp pressure and saturation pressure. The value is expressed in percent %.

$\varphi = p_D / p_S$ (equation 5)

3. Influence of Humidity to Comfort

Besides the temperature of the room air, surface temperature of room embracing areas and the velocity of the room air, the humidity is another magnitude, which depends on the room relating and which is of importance for the thermal comfort (see → page G01)
When the humidity in the room raises to such an extent that the portion of transpiration in the regulating mechanism of the thermal balance can not be maintained, the state of comfort can not be reached, even if other thermal quantities are floating within their limits.

4. Influence of Humidity to the System Safety

Moist air condenses at cold surfaces because of the saturation pressure being a function of the dew point temperature in dependence on the air pressure →(equation 3).
This condition influences the application of a cooling ceiling decisively. When the surface temperature is kept below the dew point, there is danger that condensation occurs.

The dew point temperature must be seen in relation to climate zones of the location. According to DIN 4710, for our latitudes a yearly average of 60 to 90 hours is assumed, where an outdoor air condition with dew point temperature above 16°C will occur.

5. Technical Solutions for Controlling the Dew Point

Basically the supply temperature should have a minimum of 16°C. Therefore the time frame, in which theoretically the humidity in the room is the same as the humidity of the outdoor air, is restricted to 4% of the yearly working hours (depending on the location).

It can be assumed though that many building materials such as gypsum, plaster, masonry, concrete, carpeting, wallpaper etc. will slow down the rise of the humidity.

To exclude this rare case, a temperature sensor is installed at the coolest spot in the room.
According to experience this spot is in the furthest corner away from the window directly next to the supply line. In case that the dew point is reached, this sensor actuates a setting valve in the return line to the closed position preventing that further water can flow into the cooling circuit (also see → B05; Regulation of BEKA heating and cooling ceilings).

This simple way of regulation is sufficient to safely avoid condensation in the normal case. At higher humidity in the room because of individual situations or at other related climate conditions, dried air must be let into the room by means of a base (board) air ventilation. The incoming air is conditioned according to the moisture, which has to be dissipated.

Long-period property of polypropylene

1. Polypropylene

BEKA heating and cooling mats are made from PP-Random-Copolymer.
This material is especially suited for water carrying pipes since the surface do not swell. PP has an extraordinary resistance against many different aggressive chemicals (→ DIN 8078 - appendix). PP can take up high temperature loads and without any problem, permanent temperatures up to 60°C. For this reason, it is successfully used for floor heating systems and drinking water supplies. Since BEKA heating and cooling systems are operated with substantially modest temperatures in comparison to conventional floor heating systems (normally, this would be up to 45°C for heating and 16°C for cooling), the actual strain on material of the BEKA pipes is clearly les.

2. Long-period property to internal pressure

Quality measure for the lifetime of plastic pipes is expressed in the "Long-period property to internal pressure" according to DIN E 8078 (1994).
This standard defines the testing mode, i.e. a number of samples of a defined plastic material is tested at different temperatures and different pressures up to the point of burst.
The statistics of the resulting measurements is evaluated in the "Long-period property to internal pressure".
The diagram below shows the long-period property of the material used in the BEKA heating and cooling mats, supply lines and pipes. The particular functions assigned to temperatures show the behaviour of the allowable reference pressure over the time until the material fails.

3. Lifetime

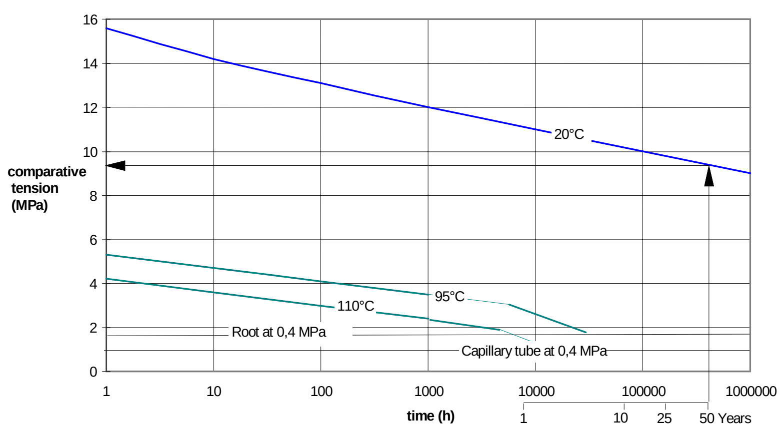
In order to express the lifetime of BEKA capillary tubes, the pressure strain in the capillary tube must be determined and compared with the allowable reference one at the actual instance.
The actual pressure strain in the tube (pressure strain in the tube wall) is determined from the tube sizes and internal pressure according to the following equation:

$$\sigma_V = p_i \cdot (d_a - s)/(2 \cdot s)$$

with
p_i - Internal pressure
d_a - Outer tube diameter
s - Wall thickness of the tubes

As for the BEKA capillary tube a pressure strain of only 1.04 MPa results from normal operating pressure of 0.4 MPa. The allowable reference pressure strain at 20°C and 50 years, on the other side, amounts still 9.4 MPa. This shows that even after 50 years there is 9-fold safety against material failures.

Allowable comparative tension PP



Energy and Cost Consideration on BEKA Cooling Ceilings

1. Generals

Modern office and business premises must be cooled nearly all year through because of their extremely good thermal insulation and the internal loads from the office and computer equipment. Considering the limitations for the permissible air velocity and the turbulences in the room, conventional air conditioning in many cases cannot sufficiently cope with the high cooling loads or only by high technical expenditure. These systems are comparatively uneconomical and have disadvantages such as molesting draft and noise. The BEKA cooling ceiling, however, creates well-being all-round while being an economical solution.

2. Cooling capacity of the BEKA cooling ceiling

BEKA radiation cooling ceilings provide 60% of the cooling through radiation and 40% through convection into the room.

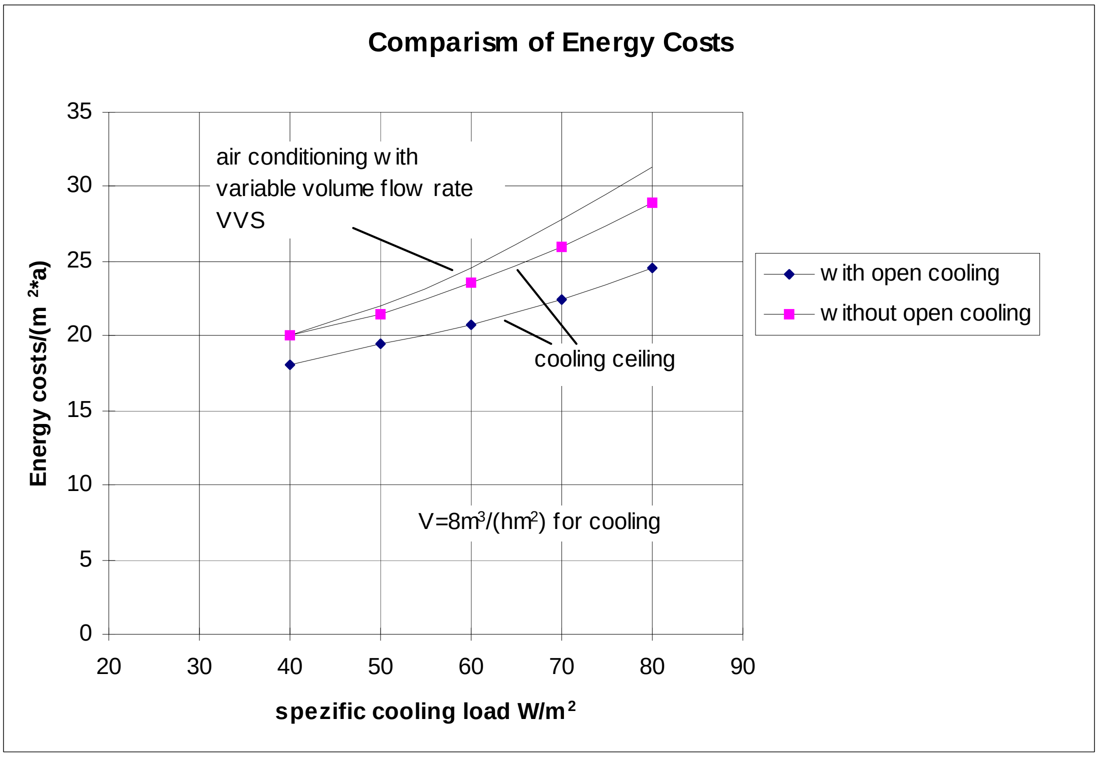
In this case, the cooling ceiling removes exclusively the sensible (dry) cooling load from the air. The necessary hygienic air exchange to vent the latent (moist) cooling load can be done in the simplest way through the open window or with a more comfortable solution, through base ventilation.
Depending upon the ceiling construction, existing intake temperature of the cooling water (for BEKA ceiling normally 16°C) and difference to the room temperature (27°C), the BEKA cooling ceiling by itself reaches a cooling capacity higher than 83 W/m². This capacity normally covers all demands on a cooling system for normally used office facilities. In the combination of cooling ceiling with a temperature controlled base or mixed ventilation, decisively higher cooling capacities can be obtained and at the same time, comfort is maintained through fresh air supply.

3. Energy consumption + energy sources with BEKA cooling ceilings

The energy consumption costs with cooling ceilings are without doubt lower than "air only systems"[1]. The energy consumption of a BEKA cooling ceiling depends mainly on the type of equipment, which is used for the cold-water preparation. In addition, only little energy is consumed for the regulating technology. The necessary cooling capacity is given by the location, the type of building and utilisation of room/building, and can be determined by a cooling load calculation.
As for the cooling water generation, different energy sources can be utilised. The particular equipment is not only distinguished by the investment costs, but mostly by the operation costs. Cooling towers are a frequently used method, which operate by open cooling, in combination with cooling units powered by electric energy. This combination secures low costs for the cold water preparation during a long period of the year and the cooling unit only goes into operation if open cooling is not possible, on very hot summer days.
BEKA cooling ceilings can be evidently utilised in reliable manner with low energy consuming technology, alternative energy sources like spring water, cooling through open waters (lakes etc.) or through earth cold. Since the BEKA cooling ceiling operates with "mild" temperatures (6°/12°C in the primary circuit of the cold water circuit), these natural energy sources can be used by relatively low technical expenditure. The cost advantage of these systems is obvious. In comparison to "air only systems", the cooling ceiling offers another substantial cost advantage [1].

The supply costs for air with conventional systems in some cases reach up to 50% of the energy costs. To convey the same amount of energy trough the medium water less than 10% of motive power is needed with BEKA ceilings.

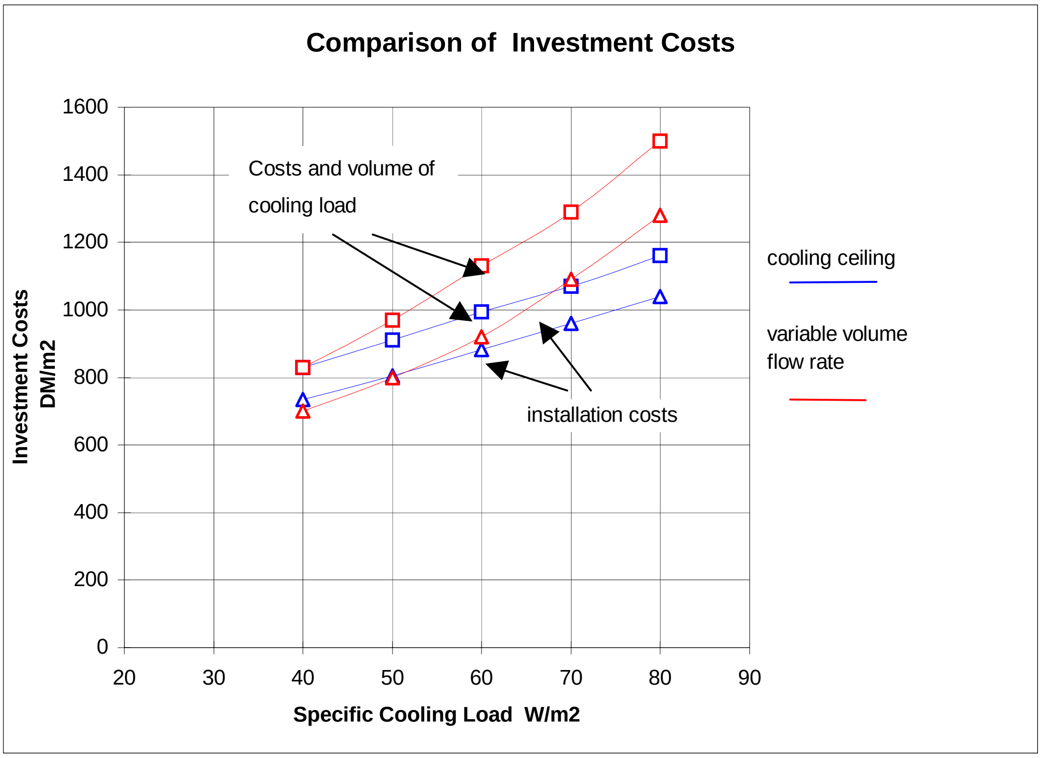
[1] Source: Magazine HLH Bd.45(1994) -„ Wirtschaftlichkeitsvergleich des Kühldeckensystems mit VVS-System", Dr.Marten Bruck, Dr. Franc Sodec



Even if the BEKA ceiling is operated in combination with baseboard ventilation for maintaining high comfort, the energy consumption is still clearly lower since exclusively the air for the hygienic air exchange must be conveyed only.

4. Investment costs

The investment costs for a cooling system are determined by the volume of the cooling load, building conditions, architectural desires, technique of the cooling system and demands for comfort.
For high cooling loads and large buildings, the BEKA cooling ceiling is the appropriate solution to provide comfortable room climate. The modest room requirements for the BEKA capillary mats and water circuit very seldom require additional space for maintenance or installation conduits. Also for this reason, BEKA cooling ceilings are outstanding for the renovation of rooms or buildings. As for new constructions, at the same height of eaves and due to the low profile of the BEKA ceilings in comparison to systems requiring an air conduit network, it is sometimes possible to gain several storeys, whereby investment costs can be saved.
BEKA heating and cooling mats can practically be installed into any type of ceiling without any problem. Without much additional expenditure it is possible to lay capillary tube mats into almost any type of ceiling. A comparison of investment costs between the BEKA cooling ceiling and a traditional air conditioning system is possible when the room and demand for comfort are accurately specified. Basically, it can be said that the combination of cooling ceiling with mechanical air ventilation with high cooling loads requires lower investment costs and lesser room than traditional air conditioning systems.


Comparison of Investment Costs
Investment Costs DM/m2
1600
1400
1200
1000
800
600
400
200
0
20
30
40
50
60
70
80
90
Specific Cooling Load W/m2
Costs and volume of cooling load
installation costs
cooling ceiling
variable volume flow rate

Advantages of the BEKA Capillary Tube Technique

1. Generals

Advantages:

- Successful since more than 15 years
- More than 750,000 m^2 of mats installed
- Healthy room climate
- Low operating costs
- Free in choice of ceiling design
- Simple and safe installation

The capillary tube technique for heating and cooling for rooms has been successful in the market for more than *15 years*. Meanwhile 750,000 m^2 of capillary tube mats have been installed for cooling ceilings or surface heating in Europe, mainly in Germany and Switzerland. For the homeowners and user of the rooms, at first the comfortable and healthy room climate along with low operating costs in comparison to standard air conditioning systems are the main reasons for choosing cooling and heating ceilings with BEKA capillary tube mats. Architects praise the nearly unrestricted possibilities of design for ceilings and implementations with the use of BEKA mats. Not the least, the BEKA technology is best suited for the installer for low costing and true time installation work because of its simple and safe connection techniques.

2. Technical principle

Advantages:

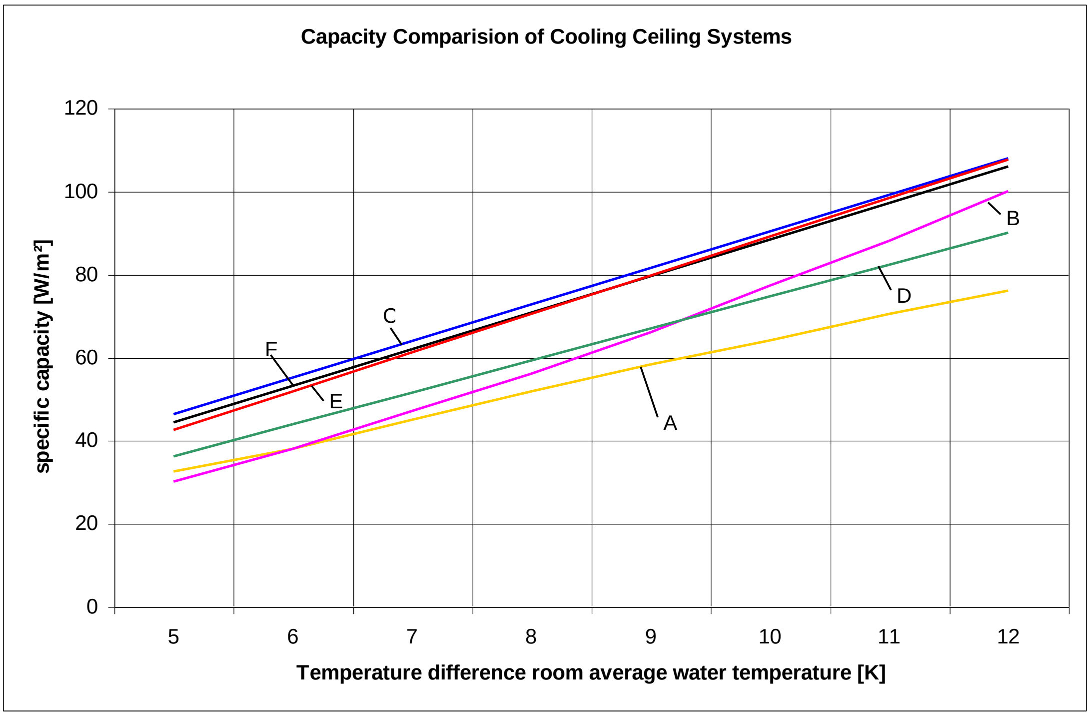
- Uniform cooling through radiation and convection
- Healthy due to barely tangible air movements
- High cooling capacity because of the capillaries laid closely beneath the surface
- With 16°C supply temperature, approximately 20°C surface temperature is reached.
- Energy savings through utilisation of alternative energy sources.
- Top in comparison with other systems.
- Little pressure loss per m^2
- Low installation expense

Similar to what blood vessels in the human body do, the water carrying BEKA capillary tubes are distributed through the room area. Thereby the water cools or heats the surfaces, which again emit the cold or heat to the room by radiation or convection. The resulting room climate is comfortable and healthy. There will be no tangible air movements and thus, dust will not be whirled up.

The capacity of a cooling ceiling is defined by the difference between operating room temperature and average ceiling surface temperature "the bigger the difference, the higher the cooling capacity". BEKA heating and cooling mats can be laid directly beneath the surface because of its little outer diameter of only 3.35 mm.

This is the decisive advantage of the capillary tube technology compared to other pipe systems, since the supply temperature of the cooling water on all systems can not be lowered to any desired temperature (in order to avoid condensation, the supply temperature normally is limited to 16°C!). Because of the narrow spacing of the capillary tubes to each another (10 mm or 15 mm), very uniform surface temperature is achieved. The BEKA system reaches an average ceiling surface temperature of approximately 20°C already with an average water temperature of 17°C. The same is true for the wall and floor heating installations.
For cooling as well as for heating, the BEKA system can therefore be operated with water temperatures, which are close to the desired room temperature.

The diagram „Capacity comparison for cooling ceiling systems", a comparison of capacity metering drawn up by an independent tester, shows clear advantages of the capillary tube system.



Source: S+G 10/93 - „Comparative capacity metering on cooling ceilings of different brands“ Author Dr. Bernd Glück- ROM

A - two in meander shape laid metal pipes, which are connected by a k-shaped crimp on the long side of the metal panel. The panels are fixed with clamps to the water carrying pipes.

B - two units with 11 inclined lamellas each. These lamellas form flow conduits wherein a convection flow is developed. Sheet metal cassettes of which approximately 20% are perforated are fixed directly beneath the units as a closed cooling ceiling.

C - Capillary tube mats spaced with 12.5 mm between the capillary tubes, glued to sheet metal panels of which 20% being perforated.

D - Copper pipes (pipe diameter = 36.7 mm^2), meander-shaped, laid onto sheet metal panels of which 20% being perforated, then covered with gypsumboard.

E – meander-shaped bent metal pipes (outer diameter 12 mm) with pipe spacing of 85 mm, with half of their circumference laid in thermal conducting profiles. The Wilhelmi-make ceiling panel with Mikropor–lamination, front faced fixed with clamp bars and with magnetic strips on the thermal conducting profile, provide the contact between panel

F - Aluminium plates with integrated water carrying conduits. These cooling plates are laid in Willhelmi-make sheets type Mikropor and fixed to the sheets with hold-down brackets and magnetic strips.

Alternative energy sources or also open cooling via outside air are sufficient for longer time periods of the year to maintain comfort. It saves energy costs and natural resources. Compared to other systems, comfort is improved, since the BEKA system reacts very fast to load changes. Continuing heat emission time through heat accumulation, as this is known from normal floor heating systems, will be very short because of the non-existing building masses above the capillary tubes.

Another advantage of the BEKA capillary tube technology, compared to the meanders made of metal pipes, is the modest pressure loss/m^2 of active ceiling surface. In the BEKA mats, the required water volume for the cooling capacity is distributed to a great number of capillaries (depending on the mat type, this could be up to 96 tubes/m width), while for the metal pipe meanders only one pipe diameter is available. Even for mat surfaces of 8 m^2 a flow rate of only 0.2 m/s is reached in the capillary tube.

In a meander made of copper tubes DN 10mm, for the same surface already a critical flow rate of 1.15 m/s is reached. Since the flow rate is entered into the formula for the pressure loss as squared term, a low flow rate, even under consideration of the substantially small diameters of the BEKA capillary tubes, results in less pressure loss. Therefore less motive power is required with the BEKA systems for the circulating pumps. Metal pipe systems avoid this possible disadvantage in most cased through the fact that smaller surfaces (seldom more than 1 m²) are installed directly to a supply line connection. But through this, however, the expense for the installation and connecting parts will be comparatively higher as with the BEKA technology.

3. Liberty of design

Advantages

- BEKA mats are flexible and fit into all building designs
- BEKA mats to be be laid on metal cassettes only
- Load per unit area only approximately 800 g/m²
- No reinforced sub-constructions required
- No impact of the capillary tubes onto the acoustic effect of perforated metal cassettes or gypsum board
- Dry-build boards to be be covered with BEKA mats only
- BEKA mats can be simply embedded in plaster
- BEKA dry-built units are available for advanced dry-built construction
- Little thermal expansion because of small temperature differences
- BEKA mats for floor heating

Due to the small dimensions of the BEKA capillary tubes the mats are very flexible and can be fit without any problem to nearly any building component. Even vaults and triangle shaped surfaces can be covered with BEKA mats.
BEKA capillary tube mats can be laid on top of *metal cassette units*, it does not matter of which brand they are. With a load per unit area of only approximately 800 g/m² (filled), the sub-construction of the ceiling units is not affected. The BEKA mat is therefore suitable for renovation of suspended metal ceilings as well.
In addition, the low weight of the cappilary tubes does not affect the acoustic function of the perforated metal cassettes, respectively, perforated gypsum boards. Comparatice tests between inactive cassettes and the ones made up from cappilary-tubes exert no impact onto the capillaries. The situation is quite different with meander-shaped cooling elements made of copper equipped with heat conducting sheet-metals. The heat conducting sheet-metals have to be perforated by expending technique to keep the impact onto the acoustic under control.
But also dry-built construction boards from plaster or fibrous plaster can be covered simply from the top with BEKA mats. The construction boards are prepared with the capillary tube mats at the building site and installed as usual. BEKA also offers a dry-built unit (a sandwich type sheet consisting of plasterboard with hart foam insulation and an integrated BEKA mat) especially for dry-built purpose. This unit is available in all construction boards standard sizes. It is particularly suited for installation of large surfaces, where the borders and the cutouts on the inactive ceiling units are just cut to size at the building site.
The embedding of BEKA- heating and cooling mats into ceiling or wall plastering can be done without any problem no matter if plaster is being applied to pre-mixed concrete, brickwork or to a plasterboard surface.
The mat itself is fixed by means of gluing, nailing, tacking or with dowels. After this a thin layer of plaster is applied. The capillaries are close beneath the surface, so that a high efficiency is reached. The main pipes which the capillary tube for supply- and return line lead into, are installed in wall slots or ceiling cavities and will then be connected to the water circuit. A danger of inadequate adhesion of the plaster, also at the state of heating, is not given since operating temperatures of the water are mostly only at 30°C (not more than 45°C) and the plaster material is not harmed and the thermal expansion of the capillaries will be taken-up by the plaster without any problem.

The use of BEKA mats for floor heating or cooling is especially suitable for renovation. The BEKA mats simply are laid on top of an a layer which is able to support load (raw concrete or floor tiles) possibly insulated to the layer below, fixed and covered with a thin layer of screed. The surface can be done with tiles or floor coverings. Different to standard floor heating systems the BEKA system leads the heat from directly beneath the surface to the room. The heating system therefore reacts very fast with water temperatures seldom higher than 28°C.

4. Easy Installation and Safety

Advantages:

- Sizes made to order
- Special mats for larger ceiling installation
- Simple installation through quick-action couplings or thermal welding
- BEKA mats supplied with adhesive tapes
- Capillary tubes self-venting
- Safety since pressure tested
- No corrosion through separated system
- Repairs of damages without any problem

BEKA heating- and cooling mats are fabricated in different versions, made to order in requested dimensions. At the building site the mats are installed according to an accurate ceiling pattern and connected to the waterlines.

Tailoring of the mats at the building site is not necessary. For larger ceiling installations like lamps, speaker boxes or air vents, BEKA offers specially manufactured mats. Small cut-outs (for light spots or sprinklers) are done simply by moving some capillaries to the side. Depending on the version the BEKA mats are connected by means of thermal welding or with flexible hoses which are supplied with quick-action couplings and can be connected to the factory prepared supply lines with the cold- or warm water circuit. BEKA mats for plaster ceilings are supplied as per request with adhesive tapes. Before plastering the installer just peels off the protective foil from the adhesive tape and glues the mat to the raw ceiling.

BEKA capillary tubes are self-venting because of their small inner diameter. Through the laminar flow in the tubes, the air is being transported out of the system even if the mats are installed with a vertical downward flow. Therefore at installations a descent must not be taken into account. Automatic vents though must be included in the supply lines of the piping.

The manufacturing of BEKA mats is covered by a strict factory quality standard. Each BEKA mat is pressure tested with 20 bars for a time of 10 minutes. According to regulation the responsible installer has to make an additional pressure test after completion of the installation.

On principle BEKA heating- and cooling mats are operated in closed circuits. The mats' circuit (secondary circuit) is connected to the circuit of the water preparation and heating unit via a stainless steel heat exchanger.

Only non-corroding components (brass, stainless steel or plastic materials) are installed in the secondary circuit. Through the system separation a reliable avoidance of sludge and clogging of the capillary tubes secured

During heating operation fall-out of water-dissolving minerals will not occur, since heating temperatures are never above 45°C. The system separation protects the system even at failures and will prevent from emptying. Should a failure occur, even with the safety measures laid out in the system and a capillary tube is damaged, the damage is only limited. Water will only drain from the damaged capillary tube until pressure equalisation with the environment is reached. For this reason the maximum possible amount of leakage is determined by the size of the expansion tank. Normally not more than 5 litres. Repairs of damaged capillary tubes are easily done through soldering/welding with a welding plate ore a soldering iron (see "Technical Information" M01). The active ceiling area and therefore a lesser performance is hardly noticeable.

BEKA heating- and cooling mats stand up to the tough building site conditions.
Wilful damages excluded, the mats can even be walked on during installation processes. The mats, pipes and supply lines can be laid at temperatures down to +5°C. Once filled with water the BEKA mats will not take damage even when freezing.

5. *Polypropylene contra Copper and Steel*

Advantages:

- Physiologically harmless
- Resistant against aggressive chemicals
- No special demands for the water quality
- Durability even at 60°C
- Duration of life more than 50 years
- Non-polluting
- No poisonous gases in case of fire
- Recycling is not a problem

BEKA capillary tube mats, pipes, supply lines and fittings are made from Random Copolymer type 3 according DIN 8078. This plastic material is a highly pure material with excellent properties regarding durability and compatibility to the environment. The polypropylene used for the BEKA mats meets the VII, Polypropylene, of the Deutschen Bundesgesundheitsamtes (BGA) (German health department) and is physiological harmless. This polypropylene can therefore also be used for cold / hot drinking water lines.

Polypropylene is resistant to a great number of chemicals, even against aggressive ones. An extensive list of chemical resistances can be found in the contents of annex 1 (add sheet) to DIN 8078. BEKA mats are filled with regular tap water, because polypropylene itself is non-corrosive. Manufacturer of copper pipe systems themselves state for their systems: „Because of differing water qualities it might be necessary to do water treatment; especially when the contents of chloride is higher than 50 mg/litre and a risk for germs exists. Generally checks of the water quality are suggested every year, for recording number of germs and amount of oxygen [1] „For copper, along with cold oxygenise water, corrosion is possible at critical conditions, which could cause pipe damages already at short operating times".[2]

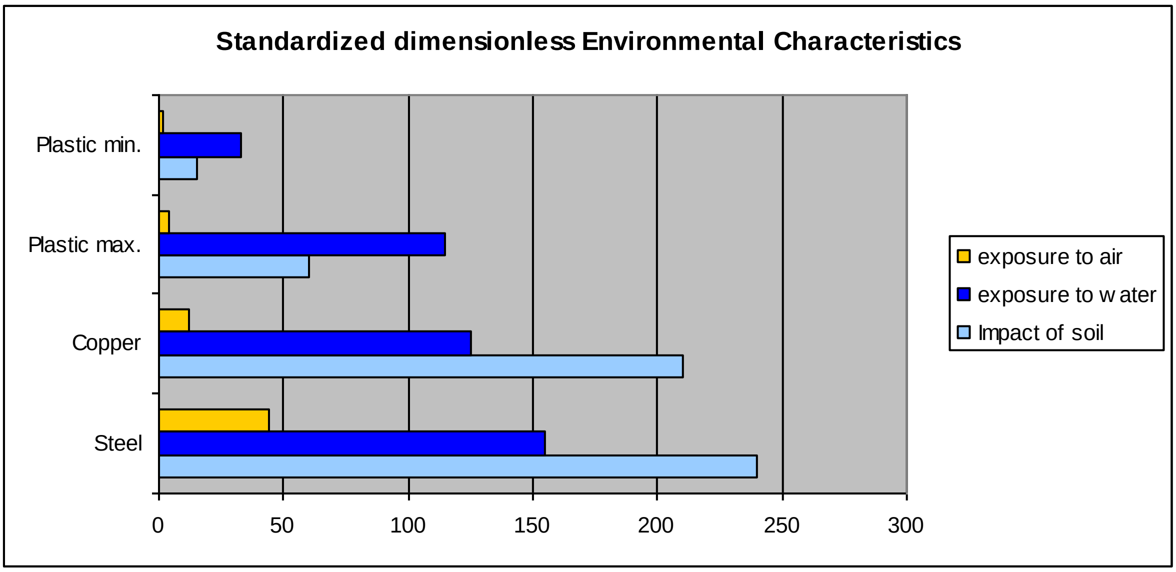
Polypropylene can be operated up to temperatures of 60°C without any problem. Quality measure for the duration of life for plastic materials generally, is the duration time internal pressure behaviour according DIN E 8078 (1994).

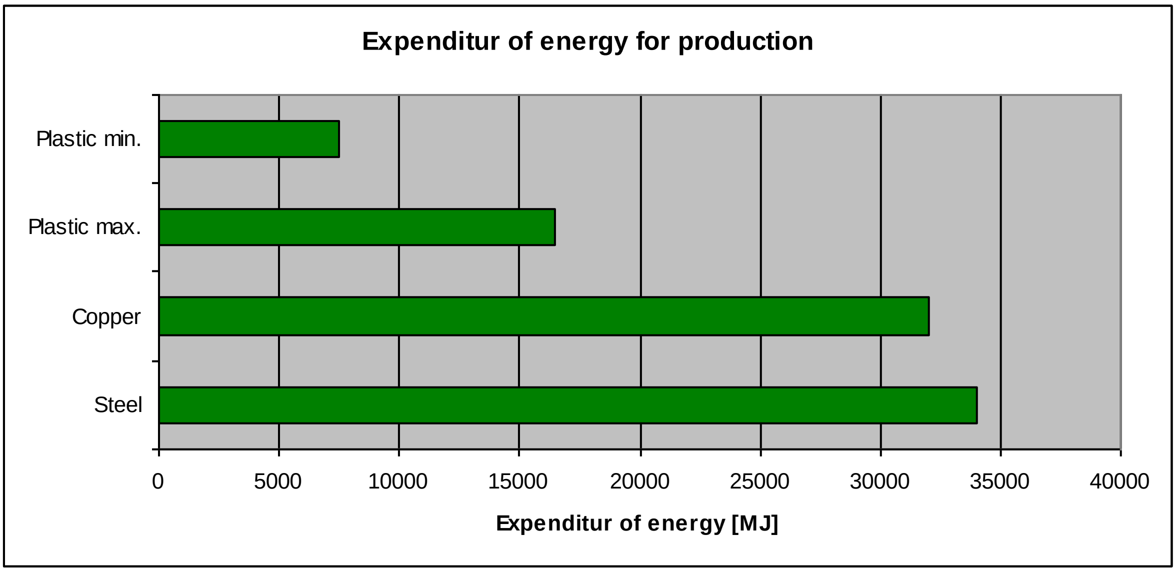
[2] Brochure Carrier Cooling Ceiling, Carrier Comfort Ceiling 56AA, 1996

According to this the duration of life for the BEKA heating- and cooling mats, pipes, supply lines and fittings are extremely (according G03 more than 50 years). Polypropylene is used for floor heating systems successfully for more than 20 years.

Against beginning resistances coming from the supplier of metal pipe systems, plastic materials dominantly succeeded in the marked. According to the magazine BmK 2/93, “the market share for copper pipes for floor heating systems, 1993 was already estimated to be below 10%”.

The environmental compatibility of plastic materials especially for polypropylene is superior to copper and steel. In an environment analysis according to the method of results oriented comparison (VENOB) of the technische Universität Berlin 1994 the pipe systems of different materials were examined. The diagrams above show the environmental behaviour in conclusion.





Polypropylene is a highly pure hydrocarbon material. With its properties this material can be classified in the group of plastic materials "minimal". The results of this study show significant advantages for the plastic materials against the standard pipe materials concerning environmental properties.
Fire behaviour of polypropylene is harmless. When Polypropylene is burned it changes to water and carbon dioxide. According DIN 4102 part 1 polypropylene belongs to the material group B2 – "normal flammable". Neither while polypropylene is burning or at the extinguishing phase, whether neither poisonous gases nor acids will be formed, as this is would be the case with PVC. Further comments to burning behaviour, as also comments to fire rating of capillary tube mats as given by the "Amtlichen Material Prüfanstalt für das Bauwesen beim Institut für Baustoffe, Massivbau und Brandschutz an der TU Braunschweig" can be found in the technical comments of B06.

BEKA capillary tube mats, supply lines and pipes, normally are not a set out to UV-light during installed situation.
Shipment of the goods will be done UV light protected in cartons or foil packaging.

Polypropylene can be totally recycled without energy waste. At BEKA, all the PP-production waste is ground-up and used again for plastic moulded parts. Large plastic material producers such as Hoechst AG are setting-up recycling systems. In the city of Knappsack, there is a recycling unit where PP-material (up to 5,000 t/year !) is recycled. Should, in any case, normal assorting of PP-material and recycling not be economical, than polypropylene can still be burned in trash burning units. Even at a trash depot, the behaviour of polypropylene is neutral. PP does not dissolve in water and therefore, does not harm underground water or ground.

Standard BEKA Ceiling - Constructions and Cost Estimate

1. Generals

The large assortment of BEKA products offers many possibilities for installation. Technical solutions and the extent of work involved are differing. Costs, which are mentioned at this point, are true for standard installation versions and should only be used for cost estimation. Costs are further influenced by the expense of cold-water preparation and the regulating technology depending on the active ceiling area. Because of so many differing offers average cost estimation can not be delivered here.

Standard installation modes of BEKA capillary tube mats.

- Embedding in metal cassette units
- Attaching of standard dry-built panels
- Usage of BEKA dry-built units (sandwich sheet made from plasterboard and insulation panel with integrated BEKA mats)
- Installation of BEKA mats in plaster (fixed to the raw concrete or to the suspended plasterboard ceiling)

2. Installation of BEKA mats on top of metal cassettes

The steps for installation are thoroughly described in "Technical Remarks" M04.

Before installation, the BEKA mats are laid into the cassettes. For perfect heat transfer, the mats should be glued-in or covered with a mineral-fibre insulating mat. In the latter case, the acoustical insulation is already pre-determined. Standard insulation thickness is mostly 40 to 60 mm. If the metal cassette is provided in the swing-down version, the insulation sheet should be secured with clamping brackets. An insulating panel increases the cooling performance in case of a totally enclosed ceiling with an additional heating source in the ceiling cavity (water carrying piping, covers for light fixtures etc.).
The supply lines are laid into the ceiling cavity. While hanging up the metal cassettes, the supply lines and mats are connected with flexible hoses.
Cutouts in the metal cassettes of up to 50 mm are possible by just bending the capillary tubes around the openings. For larger openings, BEKA offers special pre-fabricated mats with cutouts.

<u>Cooling ceilings as metal cassette type</u>

Capacity: 83 W/m² standard cooling capacity
Prices: 180,- to 450,- € /m²

(prices depend upon type and brand of the metal cassettes)

3. Attaching to standard dry-built panels

Attaching BEKA mats to the plasterboard panels is described in "Technical Remarks" M05.

BEKA mats are pre-fabricated according to the dimensions of the ceiling and supplied to the building site. The plasterboards are then covered according to the layout. For better thermal conduction, the capillary tubes are painted with a thermal conducting paste. Then the boards are pre-drilled according the layout. The construction for the suspended ceiling made from CD-profiles is fitted in 300 mm screen size according to standard dry-built regulations. The supply and return lines are installed in the ceiling cavity. The plasterboards covered with the BEKA mats are positioned at the ceiling, the supply lines connected to the waterside with flexible hoses and fixed to the suspended ceiling at the pre-drilled pattern with dry-wall screws. For larger installations non-equipped inactive plasterboards are used. Small cutouts in the ceiling are done in the same manner as with metal cassettes.

Cooling ceiling as covered dry-built panel.

Capacity 70 W/m² standard cooling capacity
Prices 150,- to 180,- € /m²

(prices depend upon type and expenditure of the dry-built ceiling)

4. Utilization of the BEKA dry-build units

Instructions for installation of BEKA dry-built units are given in the “Technical Remarks” M11.

The BEKA dry-built unit is manufactured in standard dimensions of 2000 x 600 mm.
They are suitable for installation of large linked surfaces. For the border area and for build-in components the inactive boards are tailored at the building site.

BEKA dry-built units are screwed to the CD-profiles of the suspended ceiling support construction. The supply and return lines are laid into the ceiling cavity. For the installation of the dry-built units the water connection from the base to the supply line is done with flexible hoses.

Cooling ceiling with dry-built units

Capacity 64 W/m² standard cooling capacity
Prices 150,- to 180,- € /m²

(Prices are depending upon the installation expenditure for the dry-built panels)

5. Installing BEKA mats in plaster

The installation of BEKA mats in plaster is explained in “Technical Remarks” M03.

The BEKA mat type K.S15 is fixed to the raw concrete ceiling with Butyl adhesive tape or by dowels. → M13.
A bonding layer must be applied to the raw concrete for plastering type MP75 or similar. The plaster thickness should be 12 mm – 15 mm. The main pipes for the mats are laid in wall conduits. Direct welding of the main lines with the piping makes up the connection of the mats.

Cooling ceiling embedded on the raw concrete ceiling.
Capacity 80 W/m² standard cooling capacity
Prices 65,- to 120,- € /m²

A second mode is to tack the BEKA mat type K.S15 directly to plasterboard of a ceiling suspended in the usual way. In the plasterboard surfaces slots of 150 mm are left blank. Through theses slots the collecting pipes are laid to the ceiling cavities and connected to the piping by welding. The slots then are closed with plasterboard strips. A bonding layer is applied to the ceiling surface. Finally, a layer of plaster (MP75) approx. 10 - 12 mm thick is applied.

Cooling ceiling plastered onto a dry-built panel.

Capacity 80 W/m² Standard cooling capacity
Prices 130,- to 200,- € /m²

Components up to diameter of 100 mm can be built into the ceiling by simply pulling the capillary tubes apart. For larger components to be attached the ceiling areas are kept uncovered.

Plaster Ceiling with BEKA Heating and Cooling Mats

1. General

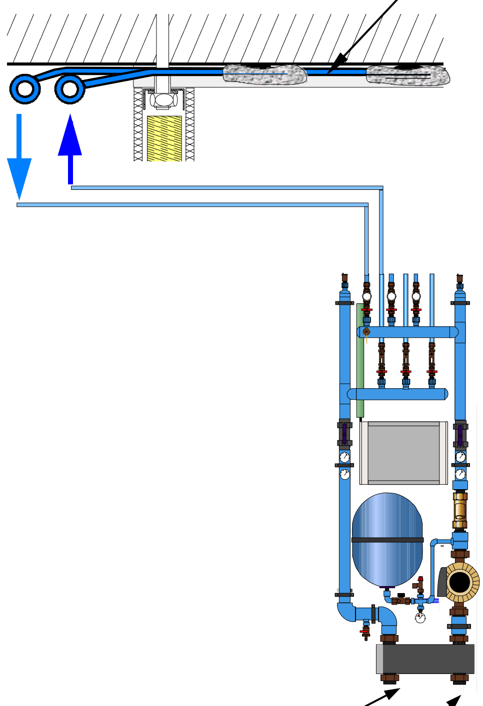
Modern office and business premises must be climate controlled almost all year through because of their high thermal insulation and internal loads from computers and office equipment. At the heating period they have comparatively low heat consumption. The energetic cost saving solution is the BEKA heating 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/m².
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/m².
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:

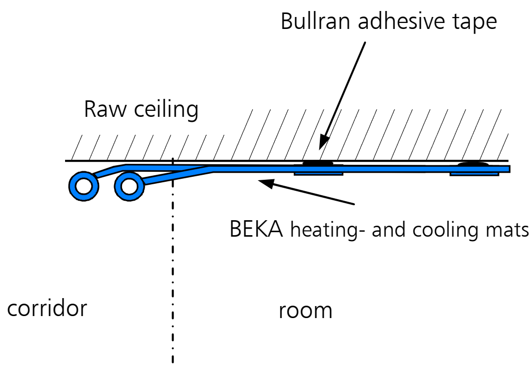
- Pipe clamps
- Dowels and screws, if necessary
- Plastic pipe clamps
- Hand-held welding device with sleeve welding adapter for plastic welding
- Plastic fittings
- Smoothening spatula
- Plaster material

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

9. Installation Steps for the Ceiling

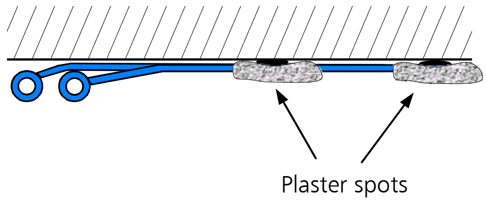
- Fasten main pipes of the mats with hose clamps to the raw ceiling or in the cavity of suspended ceilings. Later on the main pipes are located behind partition walls towards the corridor or behind cavities in the wall or mouldings.
- Connect mats to another and to the water circuit by means of thermal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



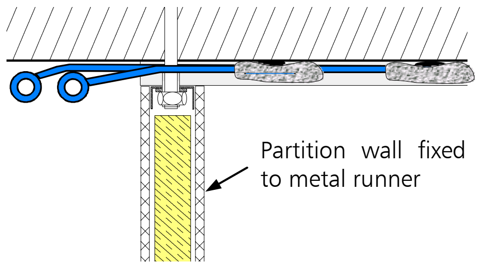
- Apply plaster spots at the spacer bars of the mats, with this the BEKA mats are held securely until plastering is done. For installation to suspended ceilings this additional fastening will not have to be done. Eventually only tacks have to be placed above the spacers of the mats, to take the tension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



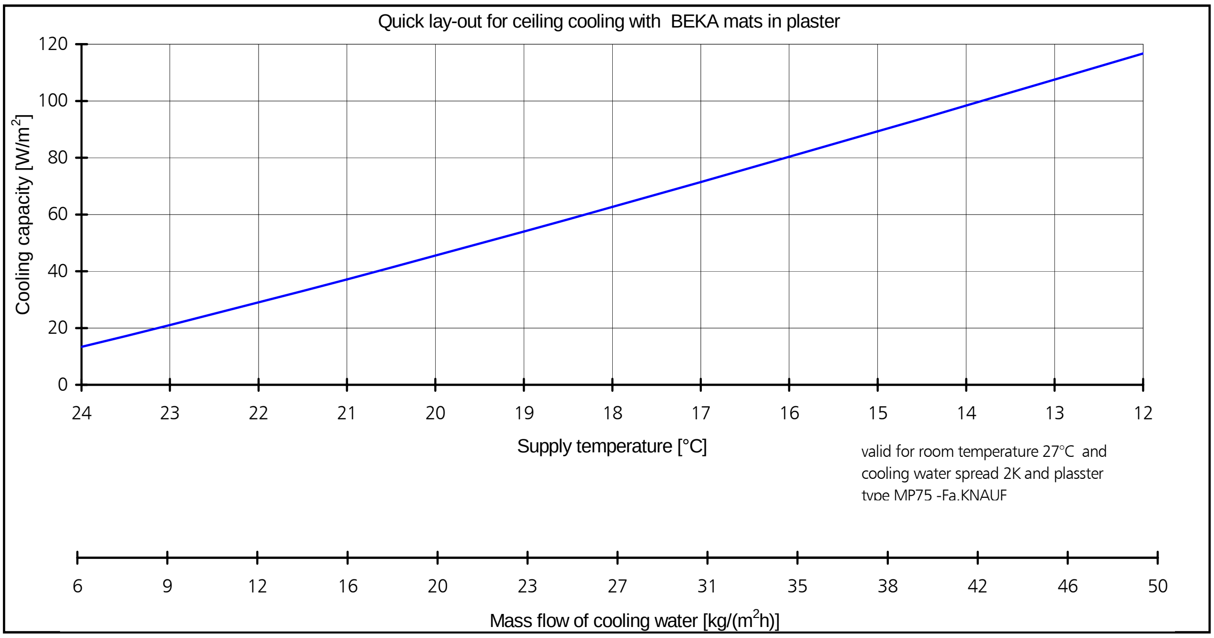
10. Lay-out of a Plaster Cooling Ceiling with BEKA Mats Type K.S15

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

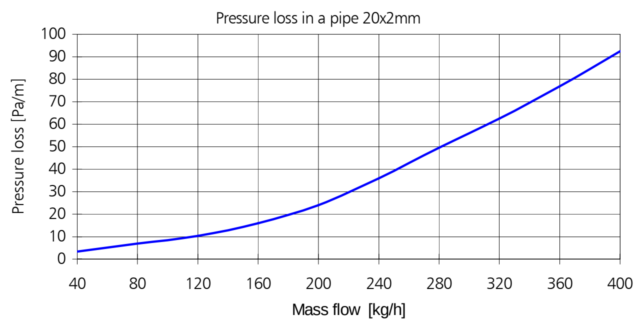
Required Cooling Capacity

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

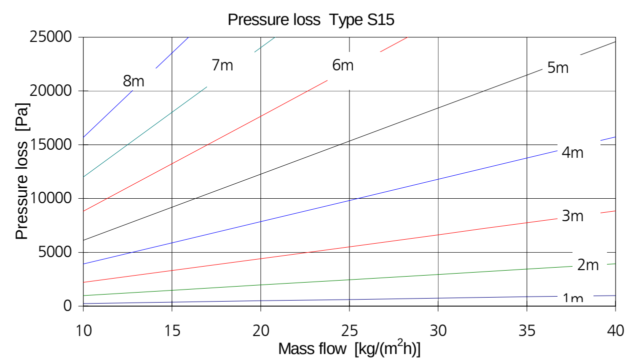


4	Supply temperature -> from diagram 1	°C	
5	Return temperature	°C	
6	Water volume of mat area	$kg/(m^2h)$	
7	Water volume per zone	l/h	



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.

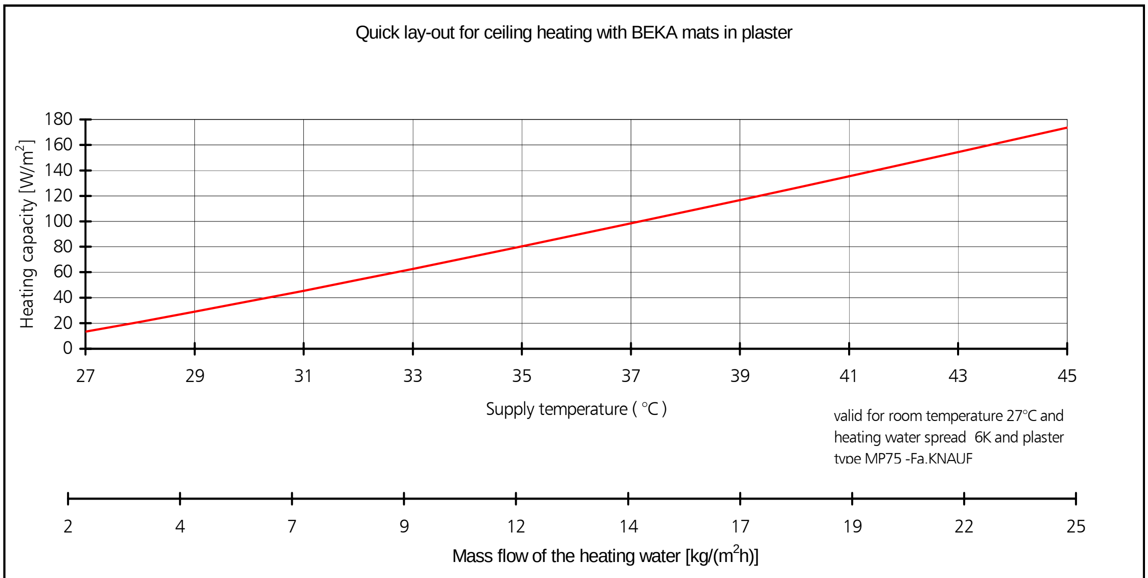
11. Lay-out of Plaster Ceiling for Ceiling Heating with BEKA Mats Type K.S15

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

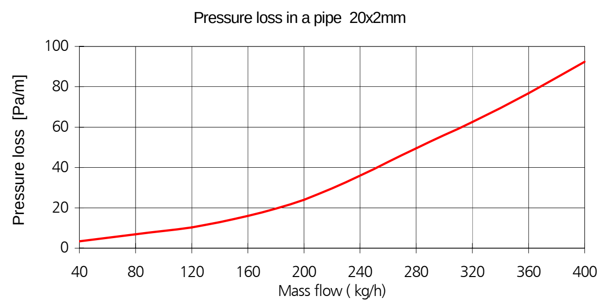
Required heating capacity

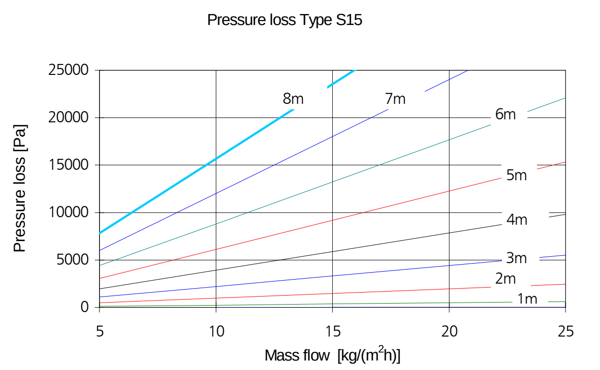
1	Heat requirement for the room	W		from calculations of the planning office
2	Planned coverage with mats	m^2		max.possible arrangement derived from the room dimensions
3	Required specific heating capacity	W/m^2		= Heat requirement / coverage

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

Metal Cassette Ceiling with BEKA Heating and Cooling Mats

1. Generals

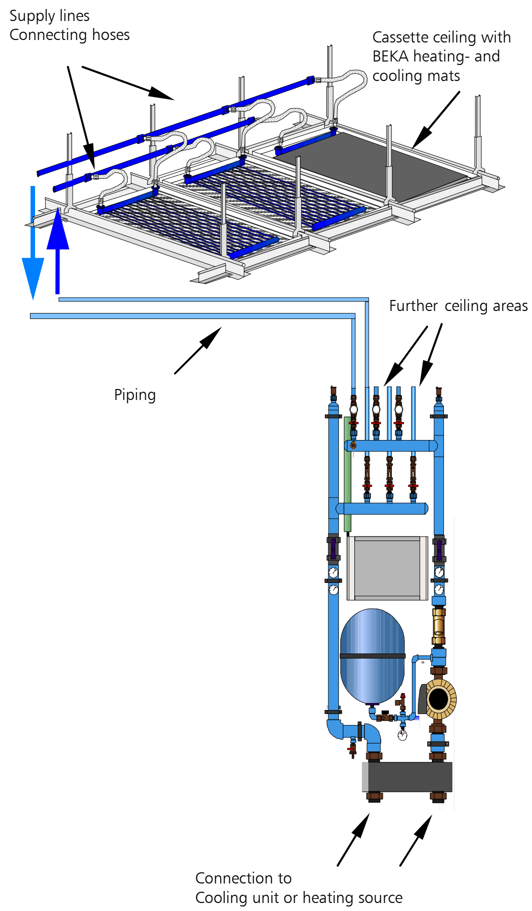
Modern office and business facilities must be cooled mostly throughout the whole year because of the internal loads generated by office and computer equipment and because of the high thermal insulation of walls and facades. During the heating period itself the rooms need comparatively little heating. Because of this the utilisation of the energetically low cost BEKA heating and cooling ceiling is possible.
The BEKA heating and cooling mats are simply laid on top of the panels of the suspended metal cassette ceiling. This way each metal cassette ceiling can be utilised very easily and economically as a heating and cooling ceiling. This setup can also be used for renovation. Because of the combined function of the ceiling the investment cost for the building installations can be minimised.

2. System description

The BEKA heating and cooling mats are simply laid on top of the metal cassettes. The capillary tubes are positioned directly on the sheet metal or thin acoustic fibre. The surface is rapidly cooled-down or heated-up. 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 heating or cooling source. The connection to a storey distributor is recommended.
For the cold-water preparation different techniques and systems can be utilised. The economical advantages of the cooling ceiling is basing on the fact that the ceiling will provide already high performances with supply temperatures, which are only slightly below the room temperature. This makes the utilisation of "alternative energy sources" such as heat pumps or open cooling and ground water possible. For the generating of heating water the same advantages are true. In connection with solar collector systems and even with standard techniques significant energy savings are achieved, because already with low supply temperatures (below 40°C) it can be heated with respectable heating performances.



4. Installation

Generally the standard installation guidelines must be obeyed. All materials used in the BEKA heating and cooling mat system must be non-corrosive. Materials to be 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 technology

The regulating technique provides for both the desired comfort and the necessary system reliability.
The cooling ceiling requires: Room temperature regulation, dew point protection and regulation of the supply temperature for the cold water. Supply temperatures below 16 °C must be avoided because of danger that the dew point could be reached!
For the heating ceilings, a room temperature control is required, which regulates the volume of heating water in dependence to the desired room temperature. In rooms higher than 3.5 m supply temperatures above 40°C must be avoided because of excessive surface temperatures!

6. Dimensioning of the installation

The BEKA heating and cooling mats are dimensioned according the dimensions of the metal cassettes. The necessary quantity of mats and temperature of the cooling water or heating water is determined according to the following layout tables. 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 upstream to the heat exchanger.

7. Preparation for installation

For the installation of the suspended metal cassette ceiling, the manufacturer's instructions must be followed.
The capillary tubes of the BEKA heating and cooling mats should have good contact to the surface of the metal cassettes so that the heat transfer is directly led to the water. If there are additional heat sources in the ceiling cavity (heat radiation from light fixtures, warm water pipes, etc.) a mineral wool mat can be laid on top of the capillary tubes for energy saving purpose. Sometimes such an installation could be required for the acoustic insulation of the ceiling. If this requirement is not set forth we recommend gluing the capillary tubes to the surfaces.
The BEKA heating and cooling mats are produced in size of the metal cassettes based on the project to avoid any tailoring work at the building site. At the border areas and areas where components are to be attached to the ceiling, inactive cassettes will be installed.
The BEKA heating and cooling mats are supplied with quick-action couplings for the connection of supply and return lines with flexible hoses.
Before starting work, a ceiling pattern and installation pattern must be drawn-up. All mats with their dimensions, direction of installation and the supply lines must be recorded.
In the ceiling pattern, all areas must be marked which will stay uncovered, i.e. for the installation of partition walls or light fixtures and other ceiling in-fills. Also the installation positions for the BEKA dew point sensor must be marked at the ceiling pattern.
The polypropylene piping is connected among each other by thermal welding.
Here the welding directions DVS 2207-11 of the Deutschen Verband für Schweisstechnik e.V. must be observed. (The ambient temperature must not drop below 5 °C. The pre-heating, welding and setting times for the individual pipe sizes are to be observed according to the relevant regulations.)

8. Tools, materials

For the installation of a metal cassette heating and cooling ceiling with BEKA capillary tube mats, standard tools and materials for ceiling constructions and installation of plastic pipes can be used, such as:

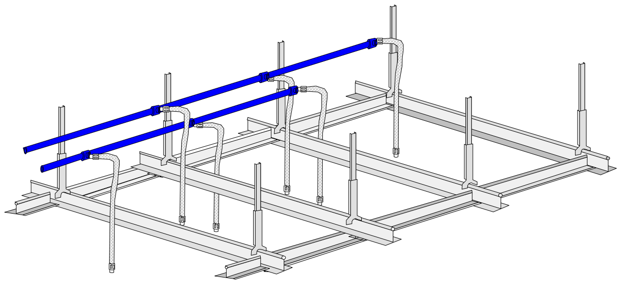
- Metal cassettes
- Suspension profiles and suspenders depending at the type of construction used for the particular ceiling.
- Dowels and screws
- Sheet metal scissors
- Mineral-wool insulating mats (if req.)
- Scissors to cut plastic piping
- Hand-held welder with sleeve welding adaptor for plastic welding
- Plastic fittings

For the connection of the supply lines to the cold water circuit a hand-held welder with sleeve welding adaptor and plastic fittings are recommended.
Alternatively compression fittings can be used.

9. Installation steps at the ceiling

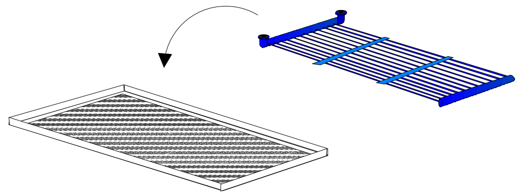
- The supporting structure is fastened and aligned to the raw ceiling with nonius hangers according to manufacturer's recommendations of the chosen ceiling brand.
- The supply lines are laid into the ceiling cavity and connected to the main supply lines (connections done either by thermal welding or with compression fittings)
- The flexible connecting hoses are plugged into the quick-action couplings of the supply lines.

I.



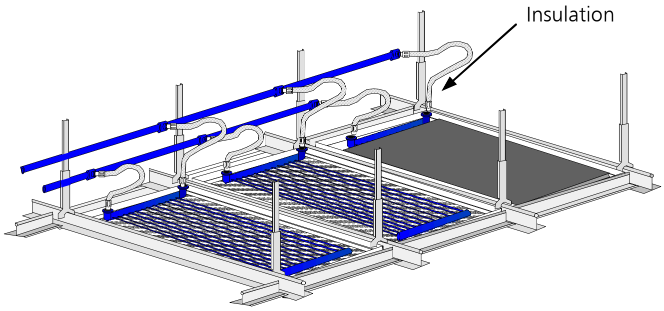
II.

- The BEKA heating and cooling mats are laid into the cassettes and if necessary, fixed with BEKA adhesive V.K.1.



III.

- Plug the flexible hoses into the quick-action couplings of the BEKA mats.
- The cassettes with the BEKA mats inserted are hung-up into the supporting structure and the joints aligned.
- If required, place insulating mats on top of it.
- Take pretest with compressed air at 10 bar for one hour.
- Take final test with water at 10 bar for 4 hours and maintain an pressure at rest of 3 bar until the system is taken into operation.



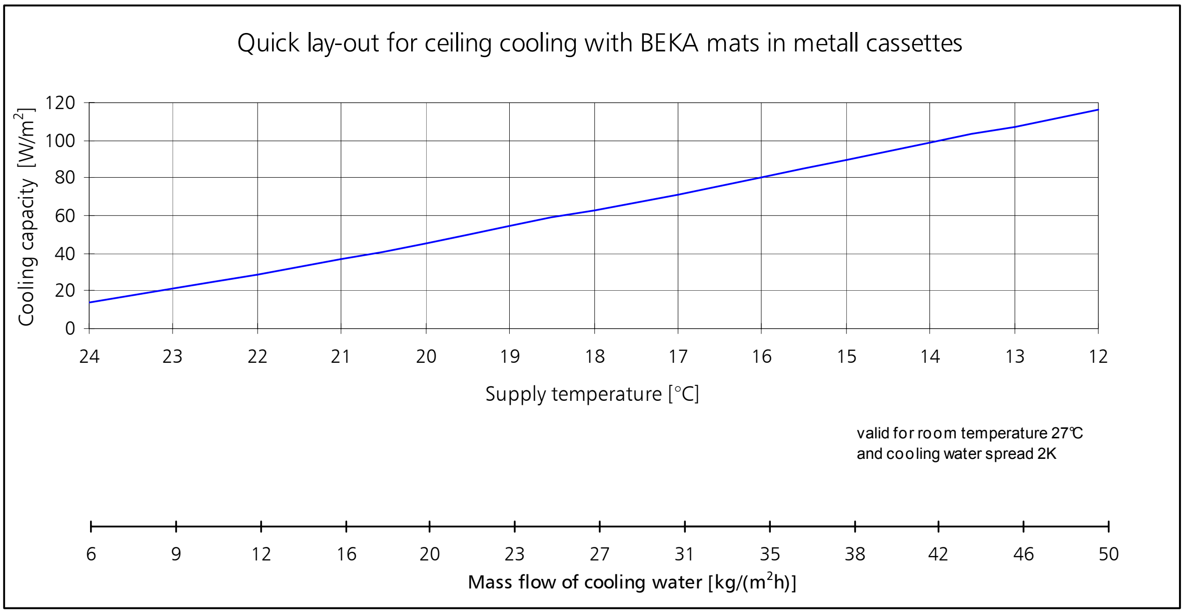
10. Layout for metal cassette cooling ceiling with BEKA capillary tube mats

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

Required cooling capacity

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

Determination of performance

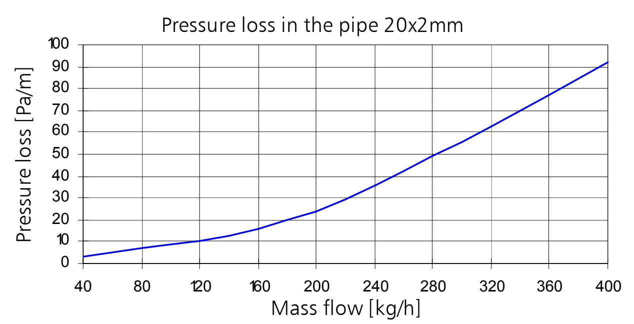


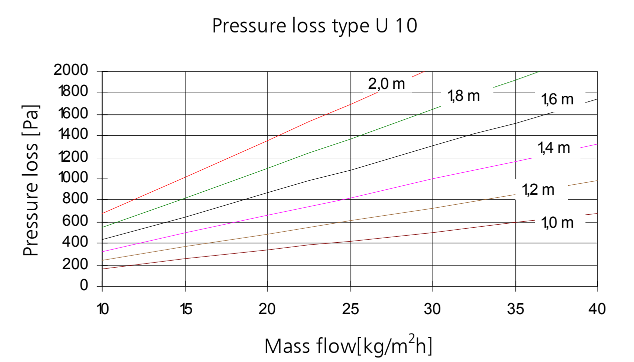
4	Supply temperature → from diagram 1	°C	
5	Return temperature	°C	
6	Water volume per mat	kg/m^2h	
7	Water volume per zone	l/h	

Pressure loss determination

8	Length of the connection pipe	m	
9	Resistance in the pipe → from diagram 2	Pa/m	
10	Pressure loss in pipe = pipe length * Resistance	Pa	
11	Pressure loss of the mat → with value of line 2 from diagram 1	Pa	
12	Addition for pressure loss through 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 determination of pressure loss can be omitted.
In this case only the quantity of cooling circuits and the total cooling capacity is required for the selection.





11. Layout for metal cassette ceiling heating with BEKA capillary tube mats

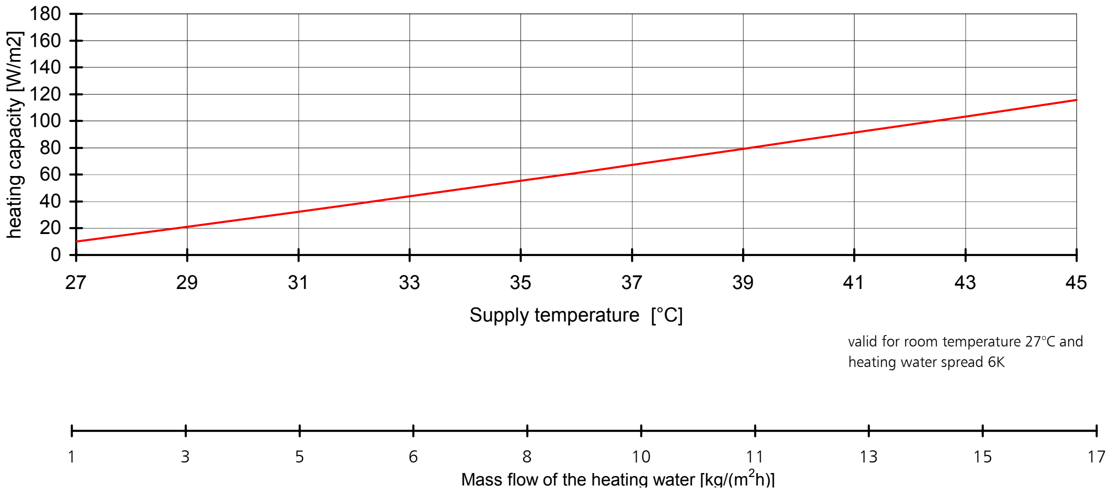
Project :	Date
Projekt consultant:	Lay-out valid for 22°C room temperature and 6K heating water spread !

Required Haeting Capacity

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

Determination of Performance

Quick lay-out for ceiling heating with BEKA mats in metal cassettes

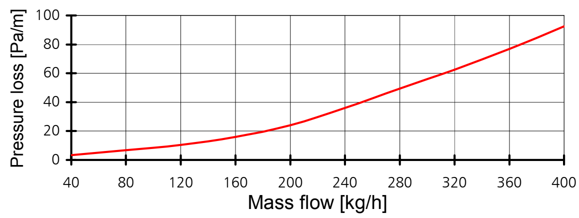


4	Supply temperature -> from diagram 1	°C	
5	Return temperature	°C	
6	Water volume per mat area	kg/(m^2h)	
7	Water volume per zone	l/h	

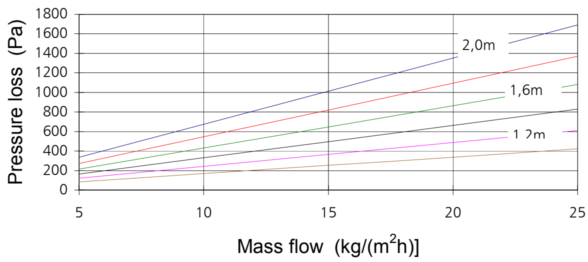
Pressure Loss Determination

8	Length of connection 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 diagram 1	Pa	
12	Addition for pressure loss through 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	

Pressure loss in a pipe 20x2mm



Pressure loss type U10



If BEKA heat transfer stations are utilised the determination of pressure losses can be omitted. Then only the quantity of heating circuits and the total heating capacity is requird for the selection !

12. Technical specification

BEKA Capillary tube mats:
Type K.U10
Type K.UM10
Type K.G10

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 spacing	10 mm
Exchange surface	1.067 m^2

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

Masses:
0.43 kg/m^2 (empty, without collector)
0.82 kg/m^2 (filled, without collector)
Water content 0.39 l/m^2

Cooling capacity:
Depending upon type
80 W/m^2 for metal cassette (DIN 4715)

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

Operating conditions:
Temperature-stable with permanent operation to 45°C
Operating pressure 3 to 4 bar
Test pressure 10 bar over 10 hours maximum

Application / mode of installation:
Cooling and heating ceilings for the installation on top of metal cassettes
Connections by quick-action coupling system

Delivery:
The mats are supplied lying flat in cartons or in one-way transport cassettes

Gypsum Plasterboard Ceilings with BEKA Heating and Cooling Mats

1. Generals

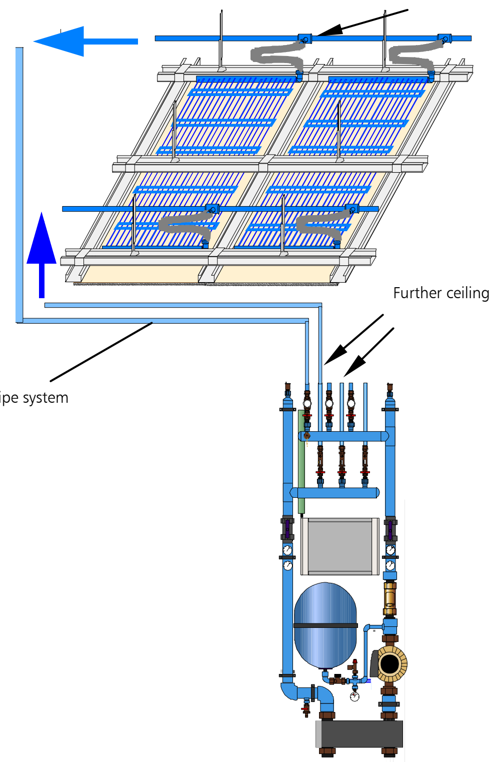
Suspended gypsum plasterboard ceilings can be very easily and economically designed as heating and cooling ceilings with BEKA heating and cooling mats. Contemporary office and computer technology combined with a high degree of thermal insulation make it necessary to air-condition offices and business premises nearly all year round. Even during periods, when heating is required, these rooms have comparatively low heat consumption. The most cost-effective solution with regard to energy is the installation of a BEKA cooling and heating ceiling. The combined functionality of the ceiling minimises the investment required for the necessary building technology.

2. System description

The BEKA capillary tube mats are simply stretched between the supporting profiles and covered with mineral wool. Afterwards, the ceiling is planked as usual - (standard cooling capacity 65 W/m^2).

3. Cold-water/hot-water technology

The BEKA heating and cooling mats are integrated in rooms/zones in a tubing network as a circulation loop and connected to a cold-water generator and heat source. We recommend that the connection is made using a BEKA single-storey distributor.
A wide variety of technologies and systems may be used for cold water generation. The economic advantages of the cooling ceiling are based primarily of the fact that the ceiling is extremely efficient even at flow temperatures which are only slightly below the room temperature. This facilitates the use of "alternative energy" (heating pumps) and natural energy (e.g. free cooling, groundwater).
The same advantages apply to hot water generation. Significant energy savings are achieved not only in combination with solar heating systems, but with conventional technology as well, since even at low flow temperatures (below 40° C), the respectable calorific output canbe used for heating.



4. Installation

As a rule, the general installation guidelines apply. All materials used in the tubing network of the BEKA capillary tube mats must be made of non-corrosive materials. Plastics, stainless steel, copper, brass and red bronze may be used. Other materials may cause the system to silt up and thus disrupt its function.

5. Regulating technology

The control technology ensures the comfort you desire and provides the necessary system safety as well.
The cooling ceiling requires: Room temperature controller, dew point protection and a controller for the initial flow temperature of the cold water. Initial flow temperatures below 16°C must be avoided due to the dew point risk!
The heating ceiling requires room temperature control. This regulates the flow of hot water depending on the desired room temperature. Initial flow temperatures more than 45°C must be avoided so that the surface temperature of the ceiling does not become too high, and the gypsum plasterboards dry out!

6. System dimensioning

The BEKA heating and cooling mats are sized according to the following design tables. The initial flow temperature in the water circulation of the BEKA mats is set by adjusting the water temperature upstream to the heat exchanger on the cold generator or heat generator side.

7. Installation preparation

The stipulations of the relevant dry construction guidelines and the regulations of the employer's liability insurance association apply to the assembly and mounting of the BEKA heating and cooling mats on gypsum plasterboard ceilings.
We recommend constructing the supporting structure using torsion-resistant steel profiles.
The specification of the effective spacing and the execution of anchoring the hangers on the bare ceiling must be designed for a load of ≤ 30 kg/m^2.
Gypsum plasterboard sheets of customary dimensions are used. The BEKA heating and cooling mats are supplied in the proper widths and lengths that cutting them to size on the building site is not necessary. Inactive areas are arranged only around the edges and in places where ceiling fittings are planned.

Before beginning work, both a ceiling pattern and installation layout must be drawn up, in which all boards with their dimensions, alignment, and supply lines must be recorded. In the ceiling pattern, all areas must be also marked, which must remain unoccupied, e.g. where partition walls, lighting and other ceiling fittings will be installed. In addition, the location where the BEKA M.TG.1 dew point sensor will be installed, has to be marked in the ceiling pattern as well.
If thermal plastic welding is being used to connect the polypropylene tubes, the welding guideline DVS 2207-11 of Deutscher Verband für Schweißtechnik e.V. (German Association of Welding Technology) applies. (The environment temperature during processing may not be lower than 5°C and the preheating, welding and holding times must be observed according to the dimensions of the tubing.)

8. Tools, materials

The conventional tools and materials used in dry construction are used for the installation of the gypsum plasterboard ceiling covered with BEKA mats:

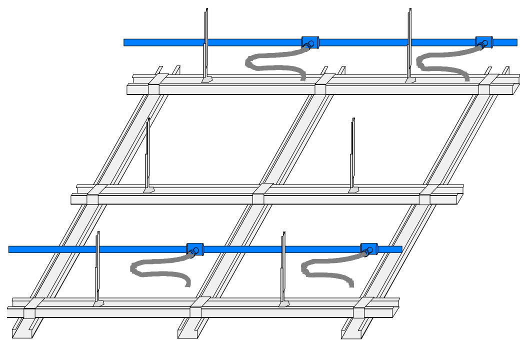
- CD profiles
- Cross links
- Nonius hangers
- Dowels and screws
- Dry-wall screws, 25mm long
- (Only version B) dry-wall screws, 40 mm long
- Angle profiles
- Possibly knife for cutting to size and an edge planer
- Screwdriver
- Spatula
- Joint filler
- Hand grinder

To connect the supply lines to the cold water circulation, a hand-held welding unit with a sleeve adaptor is used for plastic welding and the corresponding plastic fittings are required. Compression fittings may be used as alternative.

9. *Installation steps at the ceiling*

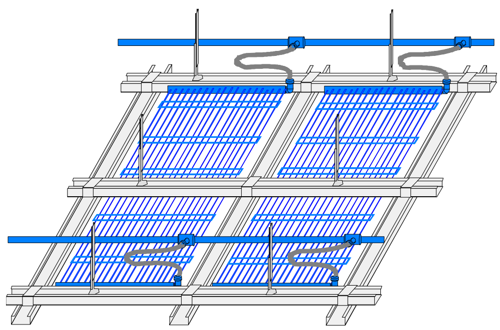
- In accordance with the manufacturer's instructions, the supporting and basic profiles are attached to the bare ceiling using nonius hangers and aligned. The spacing between the supporting profiles must be set at 40 or 50 cm. Additional supporting profiles (including the angle profile) in the area around the edge for the inactive tailored sheets are arranged according to the ceiling pattern in accordance with the dry construction guidelines.
- The supply lines are laid in the hollow cavity of the ceiling and connected to the supply lines (connection by means of thermal plastic welding or compression fittings).

I.



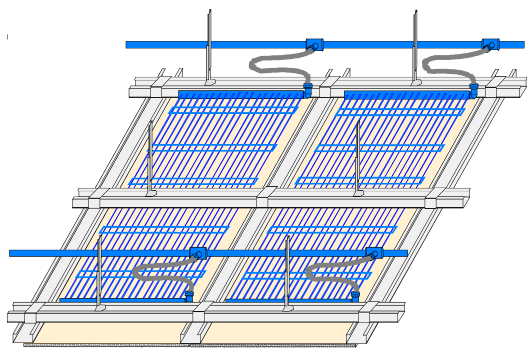
- The BEKA mats are stretched between the supporting profiles and connected to the supply lines via the flexible hoses; alternatively, the mats can be connected to each other and piping using plastic welding.
- Adhesive tapes are fastened from supporting profile to supporting profile so that the mats do not sag.
- Mineral-wool mats are laid on top of the BEKA mats from above. The mineral wool must be cut to fit as a strip into the screen of the supporting profiles. If the hollow ceiling cavity is used for the exhaust ventilator or if perforated gypsum board is used, the mineral wool must be packed in fireproof PE-foil wrapping.

II.



- The supporting structure is planked from below with gypsum board and filled.
- Preliminary test with 10 bars of compressed air for 1 hour.
- Main test with 10 bars of water for 4 hours – maintain resting pressure of 3 bar until the system is put into operation.

III.



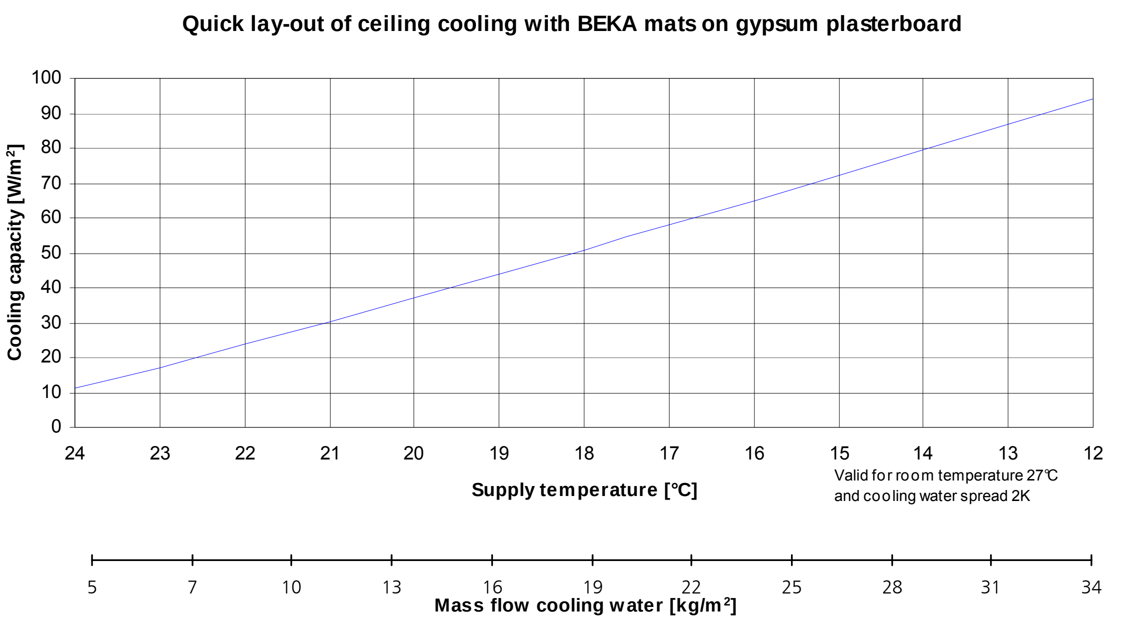
10. Layout for BEKA mats on gypsum plasterboard in cooling ceiling

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

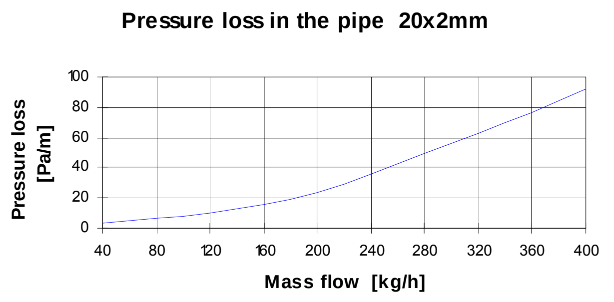
Required Cooling Capacity

1	Room cooling load	W		from calculation of the planning office
2	Planned coverage with mats	qty		Max. possible arrangement derived from the room dimensions
3	Required cooling capacity	W		= Cooling load / Coverage

Determination of Performance

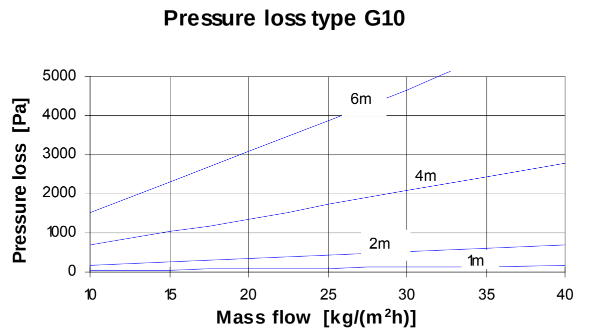


4	Supply temperature -> from diagram 1	°C	
5	Return temperature	°C	
6	Water volume per mat area	kg/m²h	
7	Water volume per zone	l/h	



Pressure loss calculation

8	Length of connecting tube	m	
9	Resistance in the tube -> from diagram 2	Pa/m	
10	Pressure loss in the tube = tube length * Resistance	Pa	
11	Pressure loss of the mat -> with value of line 2 from diagram 1	Pa	
12	Add. for pressure loss through fittings (recomm: 30% addition to tube)	Pa	
13	Add.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 loss can be omitted.
In this case only the quantity of cooling circuits and the total cooling capacity is required for the selection !

11. Layout for the BEKA mats on gypsum plasterboard in heating ceiling

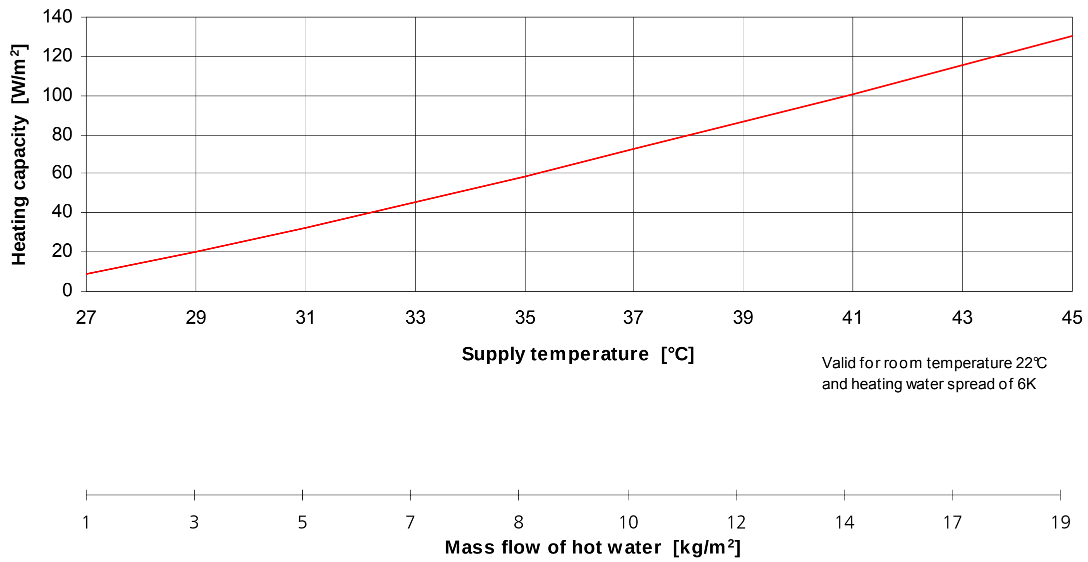
Project :	Date :
Project consultant :	Lay-out valid for 22°C -room temperature and 6 K hot spred!

Required heating capacity

1	Room heat requirement	W		from calculation of planning office
2	Planned coverage of mats	qty		max. possible arrangement derived from room dimensions
3	Required specific heat capacity	W		= Heating requirement /Coverage

Determination of Performance

Quick lay-out for ceiling heating with BEKA mats on gypsum plasterboard



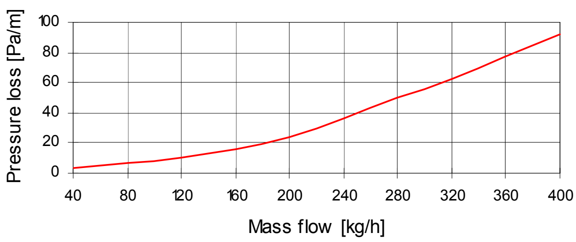
4	Supply temperature → from diagram 1	°C	
5	Return temperature	°C	
6	Water volume per mat area	kg/(m²h)	
7	Water volume per zone	l/h	

Pressure loss calculation

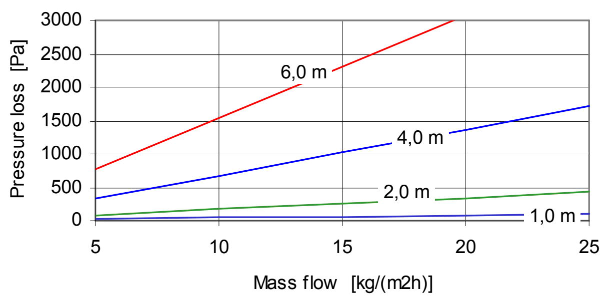
8	Length of connecting pipe	m	
9	Resistance in the pipe → from diagram 2	Pa/m	
10	Pressure loss in the pipe = Pipe length* Resistance	Pa	
11	Pressure loss of the mat → with value from line 2 in diagram 1	Pa	
12	Add.for pressure loss through fittings (recomm: 30% addition to pipe)	Pa	
13	Add.for heat 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 transfer stations are used, the pressure loss calculation is omitted. Only the number of heating circuits and the total heating capacity are required for the selection .

Pressure loss in the pipe 20 x 2 mm



Pressure loss type K.G10



12. Technical specification

BEKA capillary tube mats
Type K.G10/K.GK10

Material:
Polypropylene random copolymerisate Type 3 DIN 8078

Geometry:

Collection tube	20 x 2 mm
Capillary tube	3.35 x 0.5 mm
Capillary tube interval	10 mm
Exchange surface	1.067 m^2

Size
Length: 600 - 6000 mm (in steps of 10 mm)
Width: 230 - 430 mm (in steps of 10 mm)

Masses:
0.430 kg/m^2 (unfilled, without collector)
0.824 kg/m^2 (filled, without collector)
Water content 0.39 l/m^2

Cooling capacity:
65 W/m^2 with 10 mm gypsum plasterboard
(heat conductivity of the thermal sheet approximately 0.40 W/mK)

Heating capacity:
Up to 130 W/m^2

Operating conditions:
Temperature-stable with permanent operation up to 45°C
Operating pressure 3 to 4 bar
Test pressure 10 bar over 10 hours maximum

Application/mode of installation:
Cooling and heating ceilings in dry construction
Connection by flexible hoses and quick-coupling connectors
or through thermal plastic welding

Delivery:
The mats are rolled and delivered in cartons.

TI-K04	Short Description

Ceiling Cooling and Ceiling Heating with BEKA Pre-fabricated Units

1. Generals

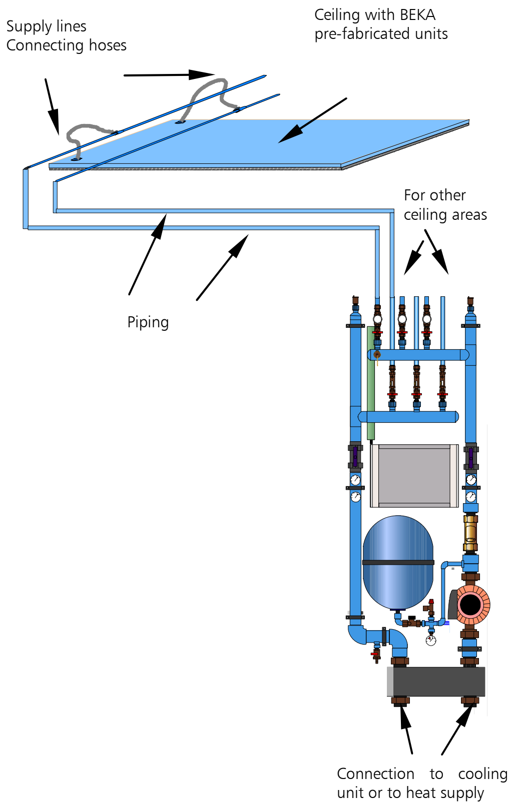
Modern office and business premises must be climate controlled nearly throughout the year because of their high thermal insulation and internal loads generated by computers and other office equipment. At the heating period, they have comparatively low heat consumption. The energetic cost saving solution is a BEKA heating and cooling ceiling.
With the BEKA pre-fabricated unit heating and cooling mats can easily and economically be utilised for dry-built construction. Due to the combined function of the ceiling, investment costs for heating system installations can be minimised.

2. System description

The BEKA pre-fabricated units are screwed to suspension ceiling construction according to dry-built construction instructions just like any standard dry-built panel. The pre-dimensioned connection lines are laid into the ceiling cavity. The pre-fabricated unit is connected with flexible hoses to the supply lines.

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 utilised. The economical advantages of cooling ceilings is based on the fact that the ceiling will already provide sufficient performance even with supply temperatures, which are only slightly below the room temperature. This makes the utilisation of "alternative energy sources" such as heat pumps or open cooling and ground water possible.
For generating of heating water the same advantages are true as well. In connection with solar collector systems and even with standard technologies, a significant energy saving is already reached, because respectable heating performances are achieved with considerably 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 used can be: plastics, stainless steel, copper, brass and red brass. Other materials in use could cause sludge and lead to a failure of the system.

5. Regulating technology

The regulating technology secures both the desired comfort and necessary system reliance.
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 above 45°C must be avoided because of danger of excessive surface temperatures of the ceiling and to avoid that the plasterboard will dry-out!

6. System dimensioning

The cooling ceiling from BEKA pre-fabricated units is dimensioned according to the following layout 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 upstream to the heat exchanger.

7. Installation instructions

For the installation of the BEKA pre-fabricated unit the standards for dry-built construction and the manufacturer's recommendations must be obeyed.
It is recommended to use torsion-resistant sheet-metal profiles for the supporting construction of the suspended ceiling. The spacing and the type of anchoring of the suspended hangers to the raw ceiling must be designed for load of ≤ 30 kg/m^2.
The pre-fabricated unit is offered in the same dimensions as the standard building panels so that tailoring work at the building site is not necessary. Only at border areas and places where components are planned to be attached to the ceiling, inactive panels are fitted. The BEKA pre-fabricated units are delivered pre-drilled for the assembly to sub-construction made from standard CD-profiles.
The screws may only be placed at these pre-determined positions, otherwise there is danger that the integrated capillary tube mats are damaged.
Before starting work, a ceiling pattern and installation pattern must be drawn-up. All cassettes with their sizes, installation direction and supply lines must marked. In the ceiling pattern, also all areas must be marked, which will stay empty for the installation of partition walls, light fixtures and other components to be attached to the ceiling. Also the installation position for the BEKA dew point sensor must be marked at the ceiling pattern.
The Polypropylene piping is connected among each other by thermal welding. For the execution, the welding directions DVS 2207-11 of the Deutschen Verband für Schweißtechnik e.V. are valid. (The surrounding temperature during working must not drop below 5°C. The pre-heating, welding and setting time for the individual pipe sizes must be observed according to the relevant regulations.)

8. Tools, materials

For the installation of the BEKA pre-fabricated units, standard tools and materials for the dry-built construction work are used:

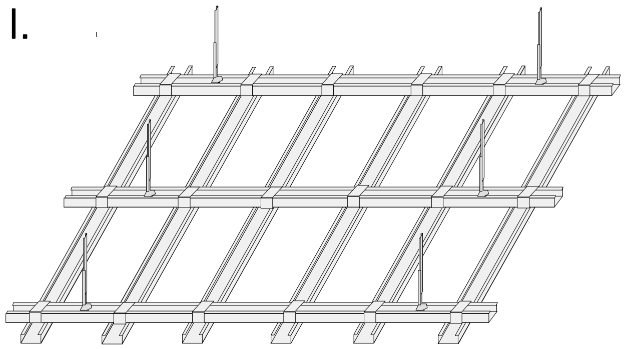
- CD - profiles
- Cross links
- Nonius hangers
- Dowels and screws
- Dry-wall screw, 55 mm long
- Angle profiles
- Knife and edge planer
- Screw driver
- Smoothening spatula
- Joint filler
- Hand-held grinder

For the connection of supply lines to the cold-water circuit, a hand held welder with sleeve adapter is recommended for the plastic welding together with plastic fittings. Alternatively compression fittings can be used.

9. Installation steps at the ceiling

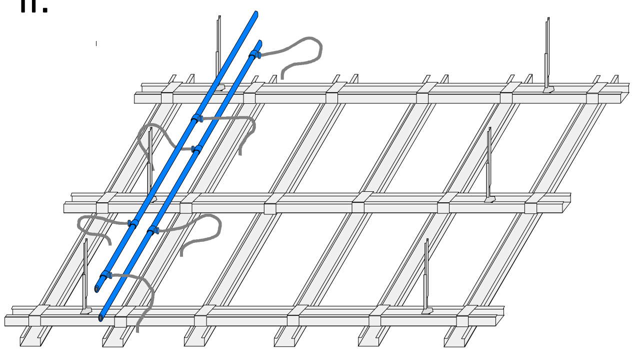
- The supporting structure is aligned and fixed at the raw ceiling with nonius hangers.
- The spacing for the supporting profiles should be 500 mm. Additional supporting profiles (also the angle profiles) at the border areas for the tailored inactive panels are positioned according to the relevant dry-built directions.

I.



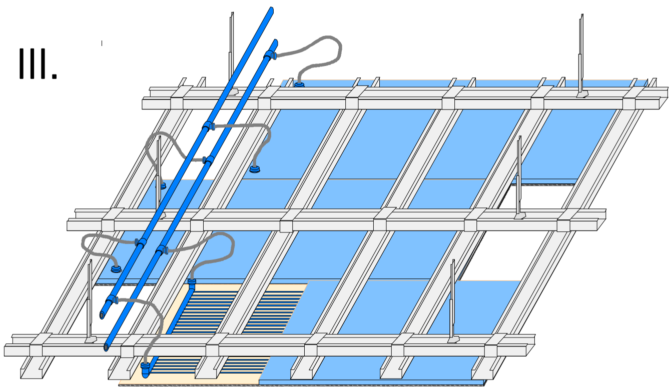
- The supply lines are laid in the ceiling cavity and connected to the main lines (connections by thermal welding or compression fittings).

II.



- The BEKA pre-fabricated units are fixed to the subconstruction according to the ceiling-pattern.
- The flexible connecting hoses are plugged into the quick-action couplings of the supply lines.
- The pre-fabricated unit are aligned at the subconstruction to the pre-drilled holes.
- The dry-wall screws are inserted through the pre-drilled holes and tightened until subconstruction securely fixed.
- Take pretest with air pressure of 10 bar for 1 hour
- Take final test with water at 10 bar for 4 hours.
- Maintain a resting pressure of 3 bar until taken into operation.

III.



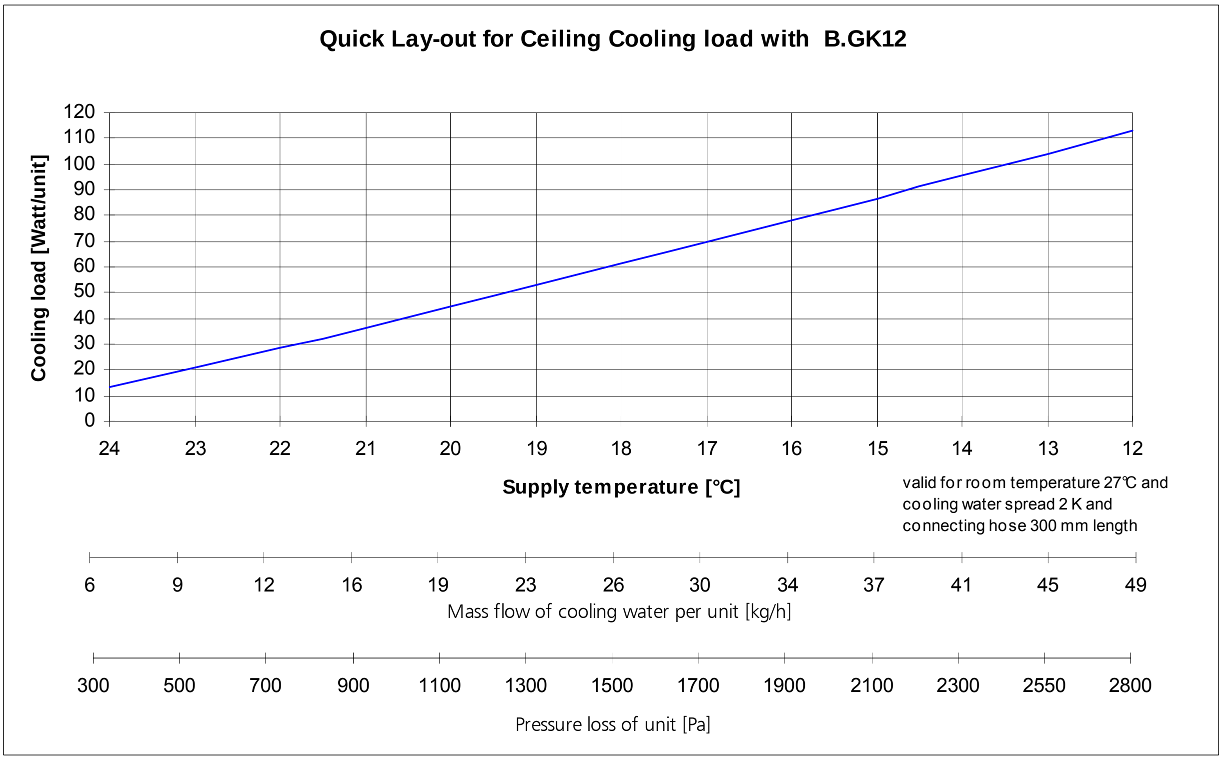
10. Lay-out of the Cooling ceiling with the BEKA Pre-fabricated Unit B.GK12

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

Required cooling capacity

1	Cooling load for the room	W		from calculation of planning office
2	Planned quantity of panels	qty		derive possible arrangement from room measurements
3	Required cooling capacity of unit	W		= cooling load / quantity of panels

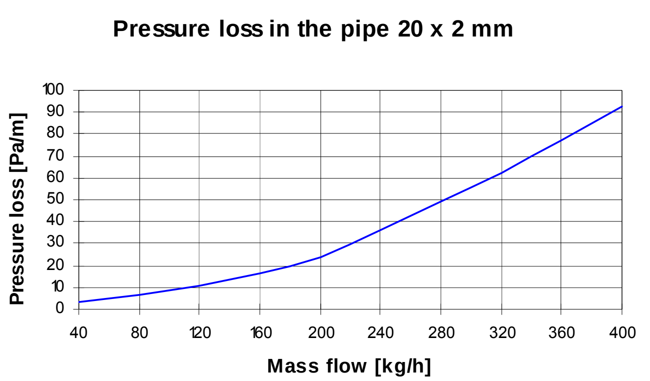
Determination of capacity



4	Supply temperature → from diagram	°C		Water volume per unit	kg/h		→ from diagram
5	Return temperature	°C		Water volume per zone	l/h		

Pressure loss determination

6	Pressure loss in the pipe = pipe length * Resistance	Pa		Length of connecting pipe Resistance in pipe → from diagram	m Pa/m		only one lead Value → from diagram
7	Pressure loss of unit → with value of line 3 from diagram	Pa					
8	Add. for pressure loss through fittings (Recomm: 30% extra for pipe)	Pa					
9	Add. 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					
10	Total pressure loss	Pa					



If BEKA transfer stations are used the determination for pressure losses can be omitted. Only the quantity of cooling circuits and total cooling capacity is required for the selection!

11. Layout for ceiling heating with the BEKA pre-fabricated unit B.GK12

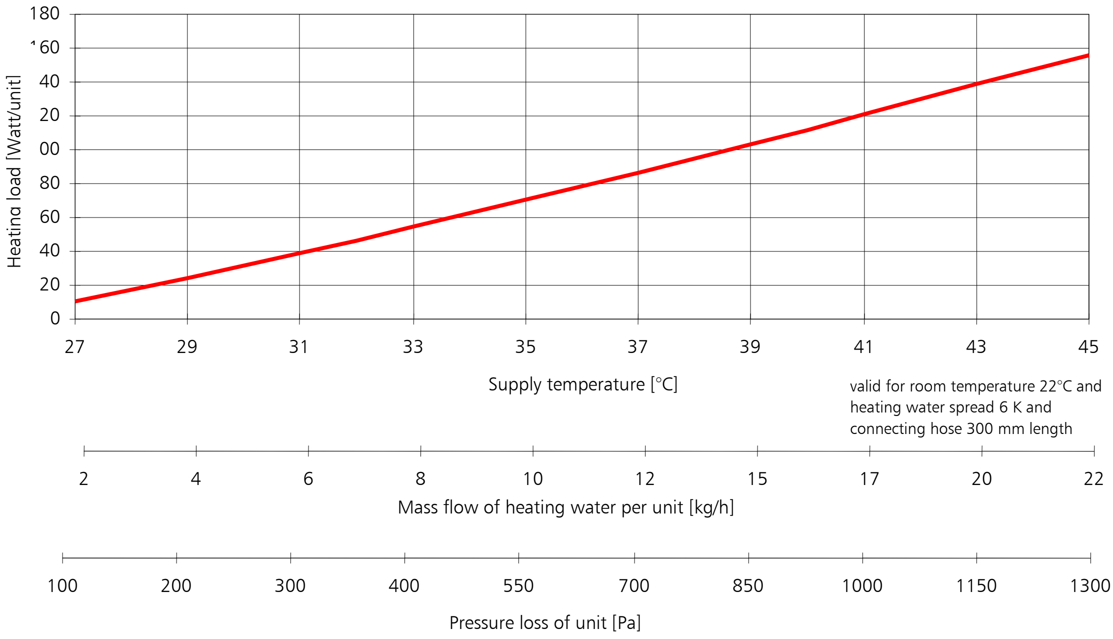
Project:	Date :
Project consultant:	Lay-out valid for 22°C - room temperature and 6 K cooling spread!

Required heating capacity

1	Heating load for the room	W		from calculation of planning office
2	Planned quantity of panels	Stück		derive possible arrangement from room measurements
3	Required heating capacity of unit	W		= heating load / quantity of panels

Determination of capacity

Quick Lay-out for Ceiling Heating load with B.GK12

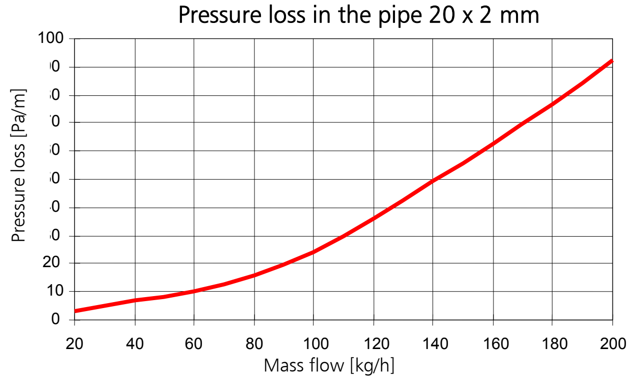


4	Supply temperature → from diagram	°C		Water volume per unit	kg/h		→ from diagram
5	Return temperature	°C		Water volume per zone	l/h		

Pressure loss determination

6	Pressure loss in the pipe = pipe length * Resistance	Pa		Length of connecting pipe Resistance in pipe → from diagram	m Pa/m		only one lead Value → from diagram
7	Pressure loss of unit → with value of line 3 from diagram	Pa					
8	Add. for pressure loss through fittings (Recomm: 30% extra for pipe)	Pa					
9	Add. 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					
10	Total pressure loss	Pa					

Pressure loss in the pipe 20 x 2 mm



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

12. Technical specification

Design:
12.5 mm Plasterboard
Capillary tube mat with capillary diameter 3.35x0.5 mm (Polypropylene)
30 mm extruded foam (thermal conductivity 0.035 W/mK; Fire rating: B1)

Masses:
11.8 kg/m^2 (empty)
12.5 kg/m^2 (filled)

Size:
Width: 600 mm
Length: 2000 mm
Pre-drilled to be screwed in 500 mm screen

Cooling capacity:
65 W/m^2 (DIN 4715)
=78 W/Unit

Heating capacity:
130 W/m^2
= 156 W/Unit

Operating conditions:
Temperature-stable with permanent operation up to 45°C
Operating pressure 3 to 4 bar
Test pressure 10 bar over 10 hours maximum

Application / mode of installation:
Cooling and heating ceilings for dry-built constructions
Connections by BEKA quick-action coupling system
Installation according to the relevant dry-built instructions

Delivery:
Finished dry-built units are delivered laid on pallets.

FÜR KLIMA-KOMFORT

Wall Heating with BEKA Heating Mats

1. Generals

Wall heating with BEKA heating mats releases the heat to the room and directly to the room occupant in a natural way through radiation. The small diameter of the capillary tubes allows the construction of wall heating with a low profile. For this reason, BEKA mats are distinguished for the renovation where wall heating is installed to a later stage. Differing to standard wall heating systems, the heat is directly beneath the wall surface. The BEKA wall heating reacts very fast and can be operated with low supply temperatures .

2. System description

In most cases, the BEKA mats are installed into the plastering of outer walls, directly beneath the surface. The outer wall must have a U-value below 0.35 W/(m²K). If this is not given, insulation of the internal wall can be utilised. Wall heating systems prevent the dew point from moving into the wall construction. The connections of the mats to each other and the connection of the mats to the piping, all the way to the heating circuit distributor, normally are thermal welded. In most cases, the mats are installed to the wall up to a height of 2 meters. This way the possibility is given to fix things (pictures etc.) to the wall above this area.

3. Heating water technology

The BEKA heating mats are connected in a circuit to the heat source through pipes to the supply and return lines, room for room or zone for zone. It is recommended to connect to BEKA storey distributor stations.
The economical advantages of BEKA wall heating systems are based on the fact, that already at supply temperatures that are barely above room temperatures, the wall releases a high efficiency. This makes it possible to utilise alternative energies (heat pumps, solar collector systems etc). But also with the standard heating a significant energy saving will be achieved, since heating with supply temperatures below 40°C is possible.

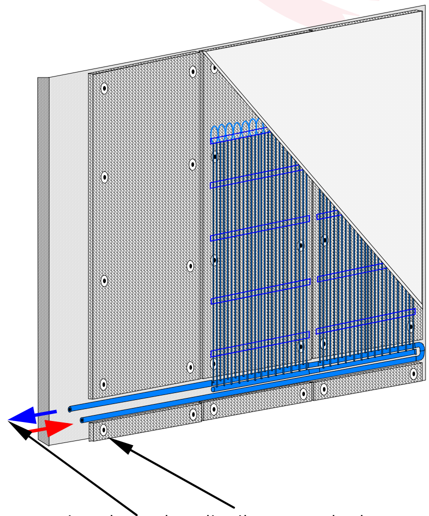


Figure 1: BEKA mats on the wall with internal insulation and insulation panels. The piping is installed according to Tichelmann

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 such as 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 technology provides for both the desired comfort and necessary system reliability.
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 above 45°C must be avoided because of danger that an excessive surface temperature will dry-out the plaster!

6. System dimensioning

The wall heating with BEKA heating 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 installation of wall heating with BEKA heating mats the installation instructions of the plaster supplier and BEKA instructions must be obeyed. The walls to be heated must have a load-bearing surface.
The BEKA heating mats are pre-fabricated to the required dimensions for each project that tailoring at the building site is not necessary. It is recommended to have the mats supplied already prepared with adhesive tape for the positioning of the mats to the raw ceiling.
A layout pattern should be prepared as orientation before work gets started. All heating mats, their seizes and direction they are facing must be marked in the pattern. All surfaces that will not be covered as for the installation of internal walls and fixing points for hanging cabinets must also be marked. The connections of the BEKA heating mats to each other and Polypropylene pipelines are performed by thermal welding. The welding directions DVS 2207-11 of the Deutschen 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 for the individual pipe sizes must be stuck to according to the relevant regulations.)

8. Tools, materials

Regarding installation of BEKA heating mats for wall heating, the usual tools and materials for plastering and installation of plastic pipes can be used, such as:

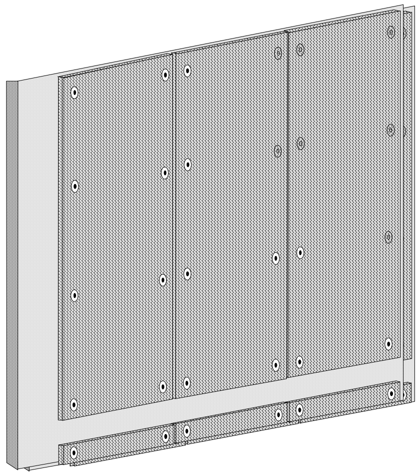
- Plastering material (suitable for wall heating systems)
- Mixer
- Smoothening spatula
- Bonding layer
- Roller or brush
- Border strip
- Possibly spreading dowels and hand drill for additional fixing of the mats to the raw ceiling
- Pair of scissors for cutting plastic piping
- Pencil

For the connection of the piping to the water circuit, a hand-held thermal welder suitable to weld sleeves of plastic fittings is required. Alternatively compression fittings can be used.

9. Installation steps at the wall (with Inside insulation

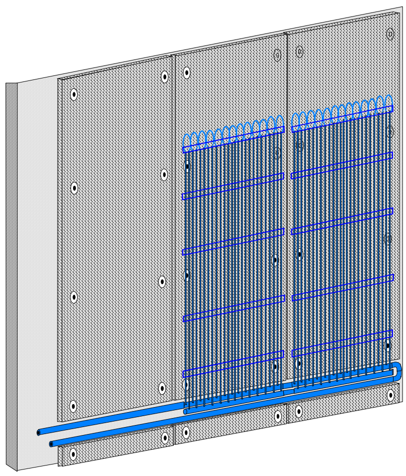
- Fix the insulation panels for a plastering base to the raw walls (with adhesive or dowels) according manufacturer's instructions.
- Cut a slot (100 x 30 mm) into insulation approximately 100 mm above the floor
- Prepare the insulation panel to be bonding layer for the plastering

I.



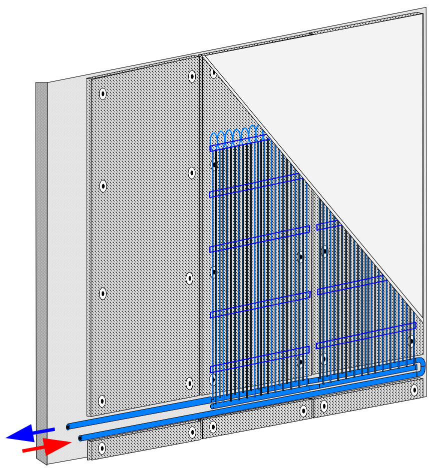
- Position the BEKA heating mats and fix them with adhesive tape.
- Possibly secure the mats with spreading dowels to the wall.
- Connect the mats to another and pipes for the supply and return lines by thermal welding.
- Take pretest with compressed air of 10 bar for 1 hour.
- Take final test with water pressure of 10 bar for 4 hours. Maintain a resting pressure of 3 bar until taking into operation.

II.



III.

- Apply a thin layer of plaster (10 mm) in one step according to manufacturer's instructions.
- Smoothen the plaster and align to the pre-drilled holes.



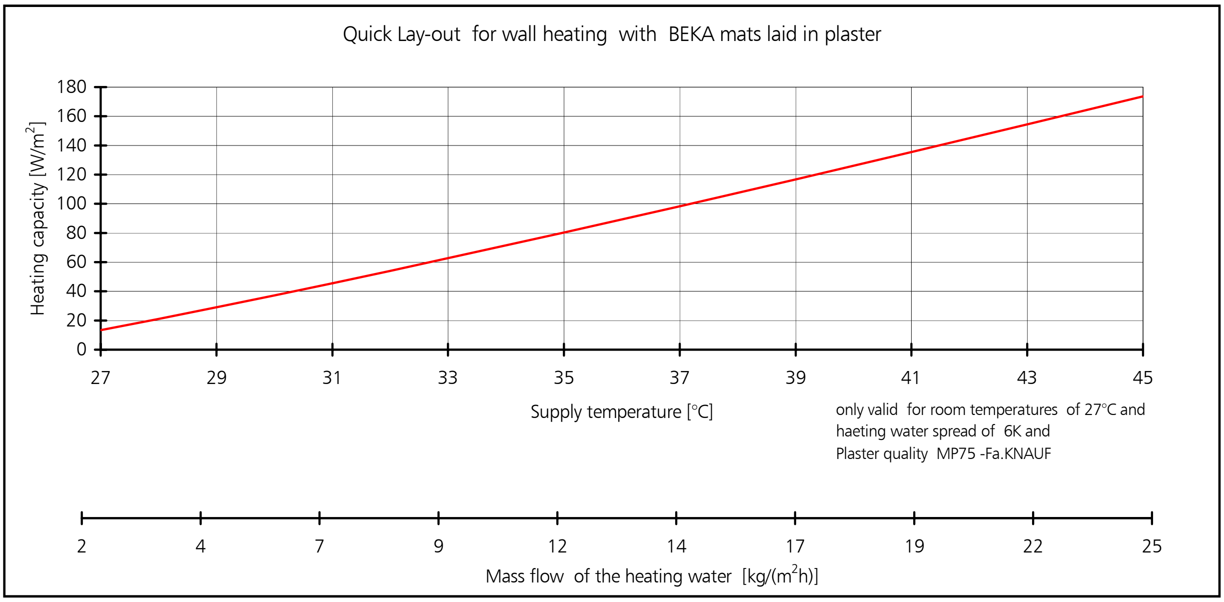
10. Layout of wall heating with BEKA heating mats

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 the calculations of the planning office
2	Planned coverage with mats	m^2		derive the maximum possible arrangement from the room measurements
3	Required specific heating capacity	W/m^2		= heat requirement/ Coverage

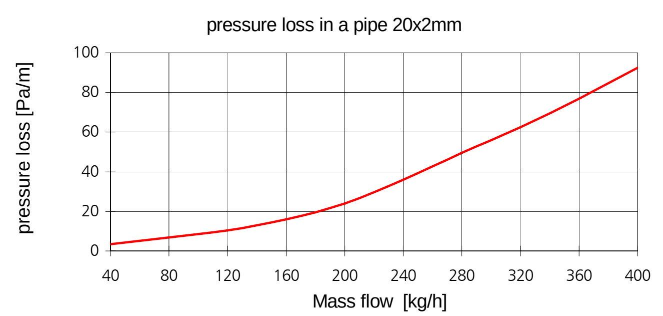
Determination of capacity

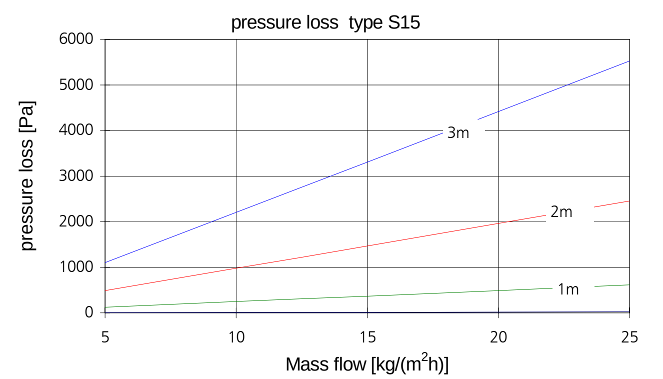


4	Supply temperature -> from diagram 1	°C	
5	Return temperature	°C	
6	Water volume per mat area	$kg/(m^2h)$	
7	Water volume per zone	l/h	

Determination of pressure loss

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 from diagram 1 (line 2)	Pa	
12	Add for pressure loss through fittings (recomm: 30% add to the pipe)	Pa	
13	Add 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 transfer stations are utilised the determination of pressure loss can be omitted, only the quantity of the heating circuits and the total heating capacity is required for the selection.

11. Technical specification

BEKA Capillary tube mats
Type K.S15

Material:
Polypropylene Random Co-polymer type 3 DIN 8078

Geometry:

Collector pipe	20 x 2 mm
Capillary tube	3.35 x 0.5 mm
Capillary tube distance	15 mm
Exchanging surface	0.71 m^2

Size:
Length: standard 600-2000 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 content 0.27 l/m^2

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

Operating conditions:
Temperature-stable with permanent operation up to 45°C
Operating pressure 3 to 4 bar
Test pressure 10 bar over 10 hours maximum

Application /mode of installation:
Wall heating for plaster walls
Connections through thermal welding

Delivery
Mats are delivered rolled-up and packed in cartons.

Wall Heating with the BEKA Pre-fabricated Unit

1 Generals

Because of the high thermal insulation of modern buildings, the offices and residential houses have comparatively low heat requirements. In many cases, they must be cooled during long periods of the year to maintain comfortable room temperatures. A low cost solution to save energy is the use of a BEKA wall heating / wall cooling system. With the use of BEKA pre-fabricated units, heating and cooling surfaces can be arranged simply and economically in the dry-built version.
Due to the combined function of the wall surface, investments for the necessary building installations can be minimized.

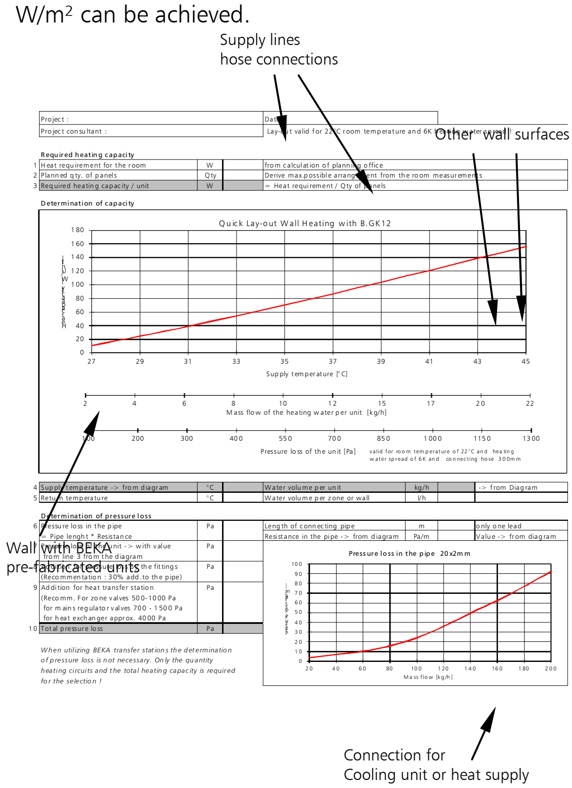
2 System description

The BEKA pre-fabricated unit is fixed to the supporting structure, like any other standard dry-built board, according to the dry-built directions. The supply lines, pre-fabricated to the required sizes are laid into the wall cavities. The pre-fabricated units are connected to the supply lines through flexible hoses.

3 Cold water / heating water technology

The BEKA pre-fabricated units are connected to the supply and return piping of the heat or cold-water source, room for room or zone for zone. Connection is recommended by BEKA storey distributor unit.
For the heating water generation, different techniques and constructions can be utilised.
The economic advantages of a cooling ceiling are influenced mostly by the fact that the wall will deliver high heating/cooling capacity already with supply temperatures, which are only slightly above / below the room temperature. This allows the use of alternative energy sources such as heat pumps or solar technologies. Even with the use of standard equipment, decisive energy saving can be achieved, since already small temperature differences in the supply temperatures compared to the ones of the room (for heating: Supply temperature below 40°C) will achieve considerable heating capacities of 110 W/m^2.

For cold-water cooling similar advantages are obtained. The supply temperatures must be restricted to minimum of 16°C to avoid condensation, in every case. At room temperature of 27°C, cooling capacities of approximately 65 W/m^2 can be achieved.



4 Installation

Basically, the standard installation instructions are valid for all installations. All components used in the piping for the BEKA pre-fabricated units must be made of non- corrosive materials. Plastic materials, copper, brass and red brass are permitted. Other materials may cause sludge and thus, malfunction of the system.

5 Regulating technology

The regulating technology secures both the desired comfort and necessary system reliance.
For the wall heating, room temperature control is required, which regulates the supply temperature of the desired room temperature. Supply temperatures above 45°C must be avoided because of danger that excessive surface temperatures could dry-out the plasterboards!
For wall cooling, room temperature regulation, dew point protection and regulation of the supply temperature of the cold water is required.
Supply temperatures below 16°C must be avoided that the dew point will not be reached!

6 System dimensioning

Wall heating/cooling ceilings with BEKA pre-fabricated units are dimensioned according to the following layout table. The supply temperature determined in the water circuit, taken at the side of the cooling unit or heat source, is regulated with the water temperature upstream to the heat exchanger.

7 Installation preparation

As for the installation of the BEKA pre-fabricated units, the standards for dry-built construction and the manufacturer's recommendations must be stuck to.
It is recommended using distortion-resistant sheet-metal profiles for the supporting construction of the suspended ceiling. The spacing of the bracing profiles to each other must amount to 600 mm.
The selected supporting profiles and mode of fixing must have to meet the dry-built specifications.
The BEKA pre-fabricated units are delivered in standard sizes of 2600 mm x 600 mm. The active surface area amounts to 1.2 m². Capillary tubes are not located above 2100 mm of height. This area serves the tailoring to length of the BEKA pre-fabricated units related to the room height. At the border area, inactive panels are fitted. The BEKA pre-fabricated units are pre-drilled for fixing to the sub-constructions.
The fixing screws may only be located at the given positions, otherwise damages may be caused to the integrated capillary mats.
Before starting work, a wall pattern must be drawn up as a working and positioning layout. All panels, their dimensions and positioning of the supply lines must be recorded. On the wall pattern, all areas must be marked, which will be left uncovered for installation purposes of inner walls, light fixtures and other wall installations. Furthermore, the installation position for the BEKA pre-fabricated units with integrated dew point sensors must be recorded.
The Polypropylene pipes are connected by thermal welding; the welding specification DVS 2207-11 of the Deutschen Verband für Schweißtechnik e.V must be obeyed. The surrounding temperature (at the time of welding) must be above 5°C. The pre-heating temperatures, welding and setting times must be kept according to specified values for the responding pipe sizes.

8 Tools , materials

For the processing of the BEKA pre-fabricated units the standard dry-built tools and materials can be used, such as:

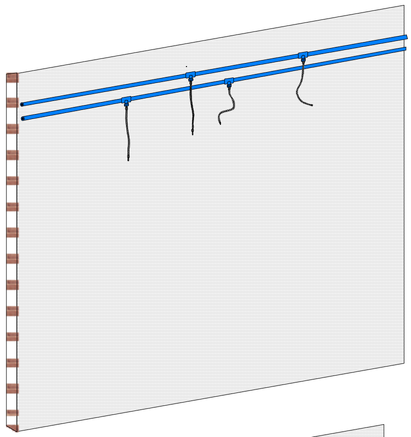
- CW profile
- UW - profile
- Sound insulation tape
- Dowels and screws
- Dry-wall screws, 55 mm long
- Knifes for tailoring and edge planer
- Screw driver
- Spatula
- Filler
- Hand-held grinder

A hand-held welding tool with a sleeve welding device is used for welding the supply lines to the cold water circuit. Alternatively, compression fittings may be used instead.

9 Installation steps at the wall

- The connection lines are installed at the raw wall at a height of approx. 2100 mm and fixed with pipe clamps according to installation instructions. The supply lines are connected by means of thermal welding or compression fittings.

I.

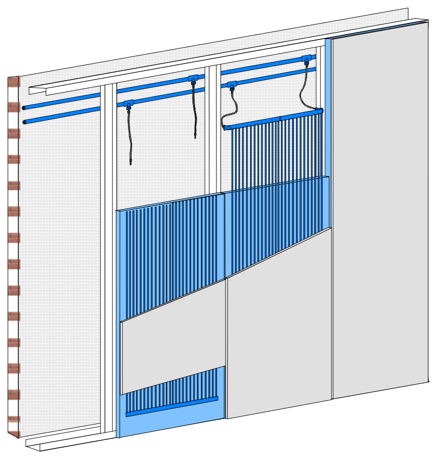


- The U- and stud profiles are aligned and fixed to the raw wall in the appropriate manner according to manufacturer's specifications. The spacing between the stud profiles is set to 600 mm. Additional stud profiles at the border area and for the inactive (tailored) panels have to be arranged to the wall pattern according to dry-built guidelines.

II.

- The BEKA pre-fabricated unit is fitted to the stud construction according to the wall pattern.
- The flexible connecting hoses are plugged into the quick-action couplings.
- The pre-fabricated unit is aligned to the stud construction according to the drilled-hole pattern
- The dry-wall screws inserted into the drilled holes and fastened until a secure fixing to the sub-construction is established.
- Take pretest with compressed air at 10 bar for 1 hour.
- Take final test with water at 10 bar for 4 hours. The pressure at rest of 3 bar must be kept until start of operation.
- Fill gaps, smoothen and grind.

III.



10. Layout for a wall cooling with the BEKA pre-fabricated unit B.GK12

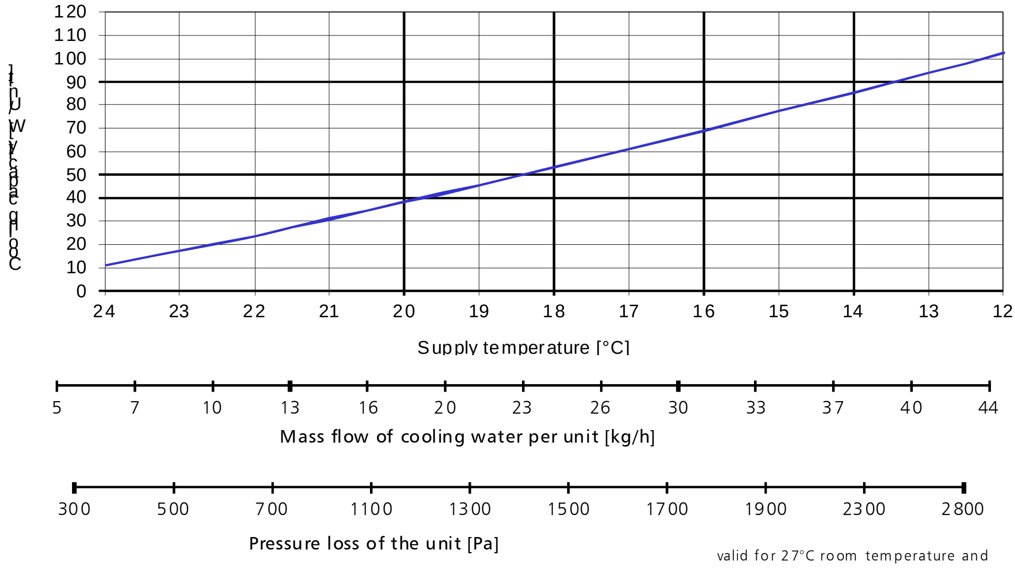
Project:	Date :
Project consultant :	Lay-out valid for room temp. of 27°C and 2K cooling water spread!

Required cooling capacity

1	Cooling load	W		Calculation from planning office
2	Planned qty of panels	Qty.		max.possible arrangement derived from room dimensions
3	Required cooling capacity per unit	W		= cooling load / qty of panels

Determination of capacity

Quick Lay-out for Wall cooling with B.GK12



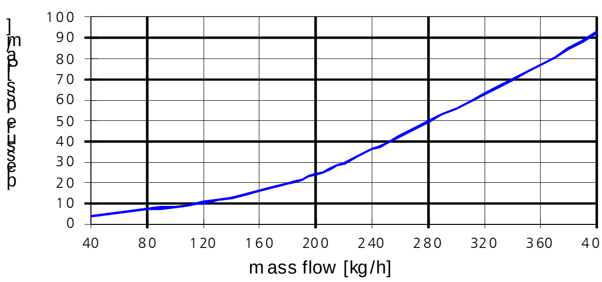
valid for 27°C room temperature and
2K cooling water spread,
connection hose of 300mm length

4	Supply temp. -> from diagram	°C		Water volume per unit	kg/h		-> from diagram
5	Return temperature	°C		Water volume per zone or wall	ltr/h		

Determination of pressure loss

6	Pressure loss in the piping = pipe length * resistance	Pa		Length of connecting pipe Resistance in pipe -> from diagram	m Pa/m		only 1 pipeline value -> diagram
7	Pressure loss of the unit -> values of line 3 from diagram	Pa					
8	Add for pressure loss through fittings (recomm: 30% addition to pipe)	Pa					
9	Add for heat exchange unit recomm: for zone valves 500-1000 Pa for mains regulator valves 700 - 1500 Pa for heat exchanger approx. 4000 Pa	Pa					
10	Total pressure loss	Pa					

pressure loss in pipe 20x2mm



If BEKA heat exchanger units are used, pressure loss determination can be omitted. Only the number of cooling circuits and the total cooling capacity is required for the selection.

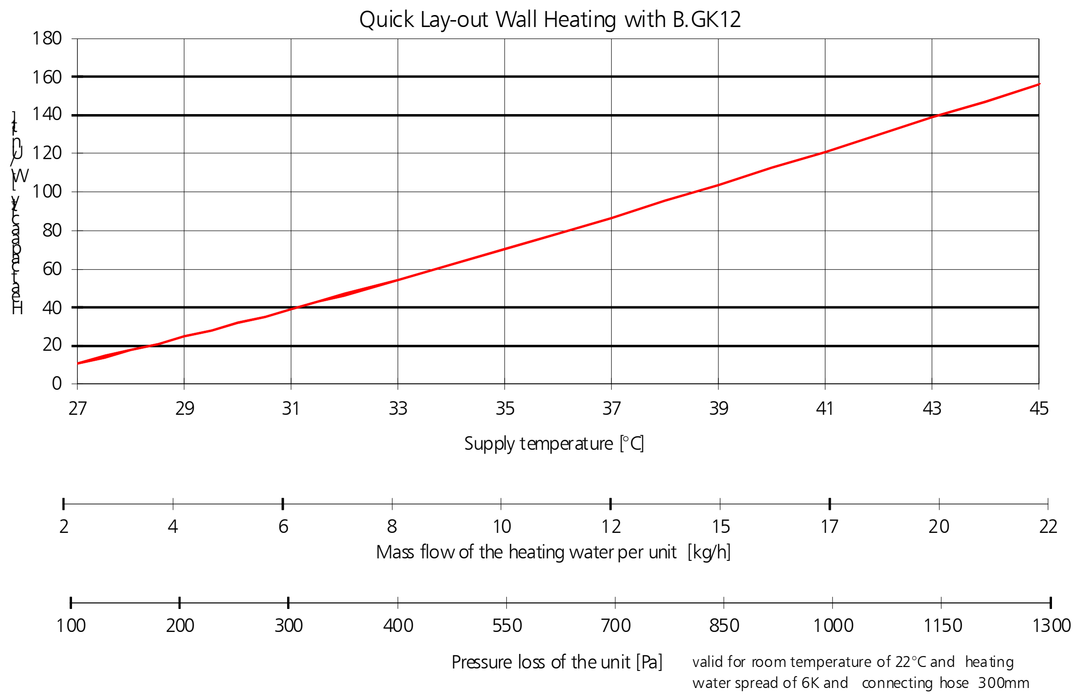
11. Layout for wall heating with BEKA pre-fabricated unit B.GK12

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 calculation of planning office
2	Planned qty. of panels	Qty		Derive max.possible arrangement from the room measurements
3	Required heating capacity / unit	W		= Heat requirement / Qty of panels

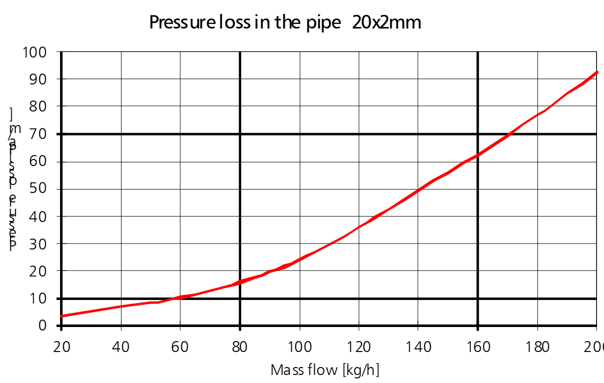
Determination of capacity



4	Supply temperature -> from diagram	°C		Water volume per unit	kg/h		-> from Diagram
5	Return temperature	°C		Water volume per zone or wall	l/h		

Determination of pressure loss

6	Pressure loss in the pipe = Pipe lenght * Resistance	Pa		Length of connecting pipe Resistance in the pipe -> from diagram	m Pa/m		only one lead Value -> from diagram
7	Pressure loss of the unit -> with value from line 3 from the diagram	Pa					
8	Addition for pressure loss by the fittings (Recommentation : 30% add.to the pipe)	Pa					
9	Addition for heat transfer station (Recomm. For zone valves 500-1000 Pa for mains regulator valves 700 - 1500 Pa for heat exchanger approx. 4000 Pa	Pa					
10	Total pressure loss	Pa					



When utilizing BEKA transfer stations the determination of pressure loss is not necessary. Only the quantity heating circuits and the total heating capacity is required for the selection !

12. Technical specification

Design:
12.5 mm plasterboard
Capillary tube mat with capillary diameter 3.35x0.5 mm (Polypropylene)
30 mm extruded foam (heat conductivity 0.035 W*K; Fire proofness class B1)

Masses:
17.8 kg/m^2 (empty)
18.4 kg/m^2 (filled)

Size:
Width: 600 mm
Length: 2600 mm
Active area 1.2 m^2
Upper tailoring area 500 mm
Pre-drilled for fixing at a stud distance of 600 mm

Cooling capacity:
58 W/m^2 (DIN 4715)
=70 W/unit

Heating capacity:
130 W/m^2
= 156 W/unit

Operating conditions:
Temperature-stable with permanent operation up to 45°C
Operation pressure 3 to 4 bar
Test pressure maximum10 bar over 10 hours

Application / mode of Installation
Cooling and heating walls, dry-built version
Connection through BEKA quick-action coupling system
Installation according to the dry-built guidelines

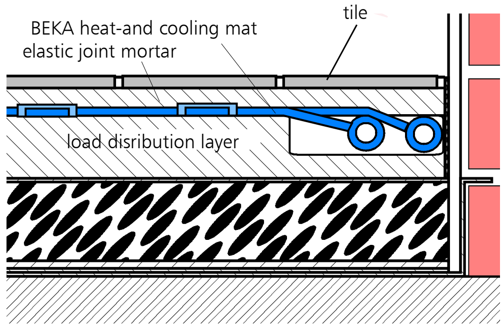
Delivery:
Finished dry-built units are delivered, lying on pallets.

TI-K07 Short Description

Floor Heating with BEKA Heating Mats

1. Generals

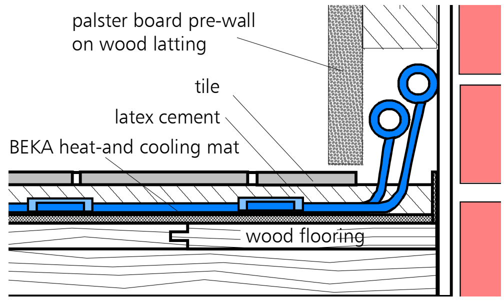
The small diameter of the capillary tubes of the BEKA mats allows a-low profile construction of the floor heating. For this reason, BEKA mats are especially useful for modernising, when floor heating is installed at a later stage. Different to the standard floor heating systems, the heat is available closely beneath the floor surface. For this reason, the BEKA floor heating reacts very rapidly and can be operated already with low supply temperatures.



Variation A: Layout for new floor construction

2. System description

The BEKA mats are laid on top of a load supporting structure, directly below the surface of the floating screed. The capillaries tubes do not weaken the load-carrying capacity of this thin layer of screed. The mats are connected between each onother, to the pipelines and up to the heating circuit distributor normally by means of thermal plastic welding.



Variation B: Layout for modernizing

3. Heating water technology

BEKA heating mats are connected room-/zonewise with the supply and return pipes in one circuit to the heat source. The connection via a BEKA storey distributor unit is recommended. The economic advantages of the BEKA floor heating are based mostly on the fact that already low supply temperatures, which are only slightly above the room temperature, will transmit high performances. This makes the utilisation of alternative energy (heat pumps and solar collectors) possible.
But even with conventional technologies a defined energy saving will be achieved, since it can be operated with temperatures below 40°C .

4. Installation

Basically, the relevant installation specifications are valid. All materials used in the BEKA heating mats must be non-corrosive.
The following materials may be used: Plastic, stainless steel, copper, brass and red brass. Other materials may cause sludge in the system, which may lead to breakdown.

5. Regulating technology

The regulating technology provides for both the desired comfort and necessary system reliance.
The floor heating requires room temperature regulation to control the supply temperature in relation to the desired room temperature. It must be observed that the surface temperature must not exceed 29°C in the room.
Depending on floor covering material and floor construction, the supply temperatures will normally not raise above 36°C. In non-occupied areas surface temperatures up to 35 °C are permissible.

6. System dimensioning

Floor heating installations with BEKA floor mats are dimensioned according to the following layout 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 upstream to the heat exchanger.

7. Preparation for installation

For the installation of the floor heating with BEKA heating mats, working and installation instructions of the floor concrete manufacturers must be observed. The floor to be heated has to be completed with a load carrying, possibly thermal insulated layer.
BEKA mats are pre-manufactured to object size that tailoring at the building site will not be required.
It is recommended having the mats supplied already prepared with adhesive tapes for better positioning at the floor.
The laidout BEKA Heating mats can be walked-on, when the floor screed has been attached. They should be protected area-wise with styrofoam plates to avoid damage of the capillary tubes.

Before starting work, a layout pattern should be prepared as working base. In this layout pattern, all heating mats with their sizes and positions as well as the supply lines should be outlined. In this pattern, also all areas must be marked which must remain uncovered as for the positioning of internal walls. BEKA heating mats are connected to each onother and to the Polypropylene piping through thermal welding. For execution, the welding directions DVS 2207-11 of the Deutschen Verband für Schweißtechnik e. V. are relevant. (The surrounding temperature during working must not drop below 5°C. The preheating, welding and setting times for the single pipe sizes must be observed according to regulations.)

8. Tools, materials

Regarding installation of BEKA heating mats for floor heating, all tools and materials normally used for floor concreting, such as screed and installation of plastic tubing, can be utilised:

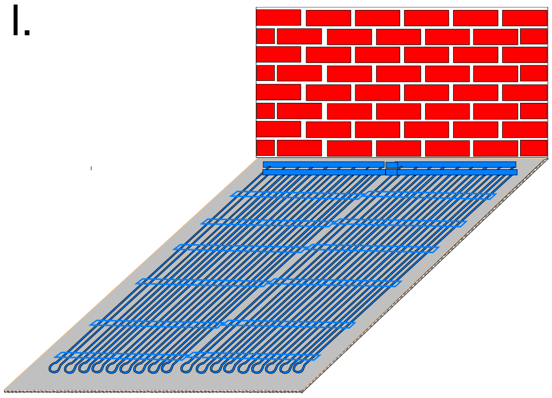
- Levelling compound (suitable for floor heating)
- Mixer
- Smoothening trowel
- Adhesive layer
- Roller or paint brush
- Border strips
- Possibly butterfly dowels and hand drill for additional fixing of the mats to the raw floor.
- Styrofoam sheets for protection of the capillary tubing when walking on them
- Scissors to cut plastic piping.
- Marker

For the connection of the supply lines to the heating circuit, a hand-held welding unit with a sleeve welding device is needed for the welding of the plastic fittings. Alternatively cutting ring connectors can also be used.

9. Installation steps for the floor, variation A

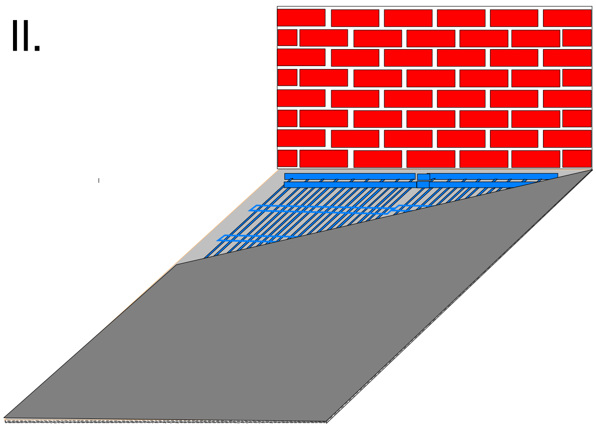
- Take BEKA heating mats out of the packaging. Mark the lay-out pattern at the primed raw floor.
- Connect the mats to the mains pipes and to the ones up to the distributor unit through thermal welding.
- Take pretest with compressed air 10 bar for 1 hour
- Take final test with water at 10 bar for 4 hours.
- Maintain a pressure at rest of 3 bar until start of operation

I.



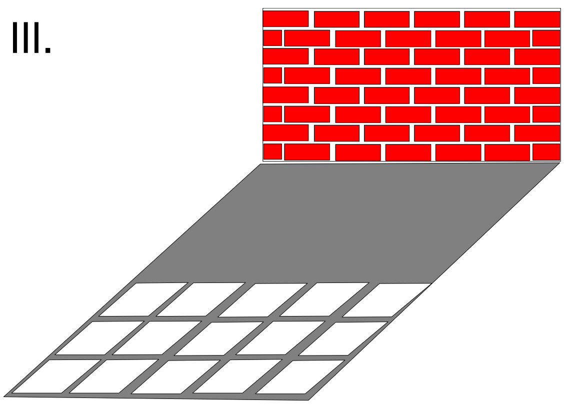
- Area-wise cover the capillary piping with Styrofoam sheets for safe walking (during application of the screed, the sheets are removed again).
- Attach levelling or flexible filling compound according to manufacturer's specification.

II.



- Finishing of the floor covering,
- (tiles etc.)

III.



The installation steps for version B are similar to the shown version A. For version B, however, the mains and mains pipe are arranged behind a dummy wall.

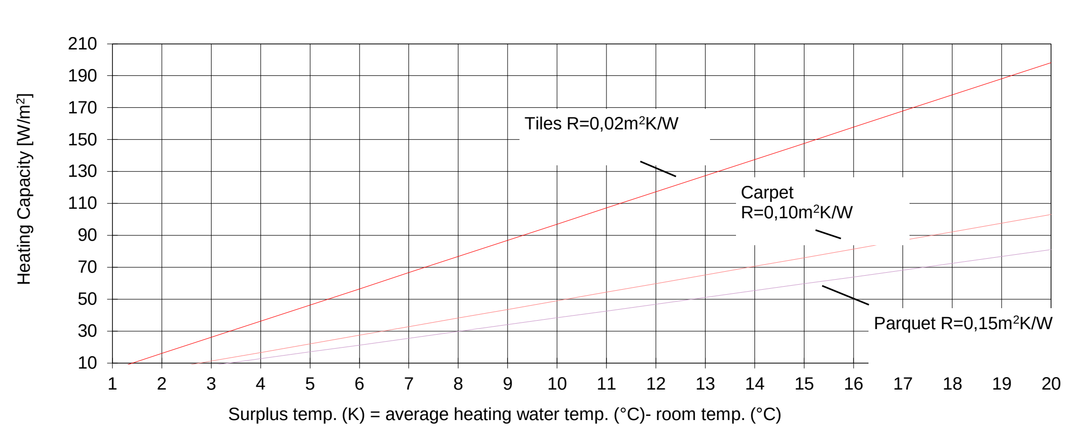
10. Layout of the floor heating with BEKA heating mats

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

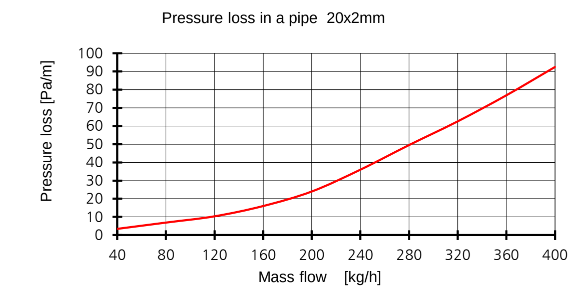
Required Heating Capacity

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

Determination of Performance

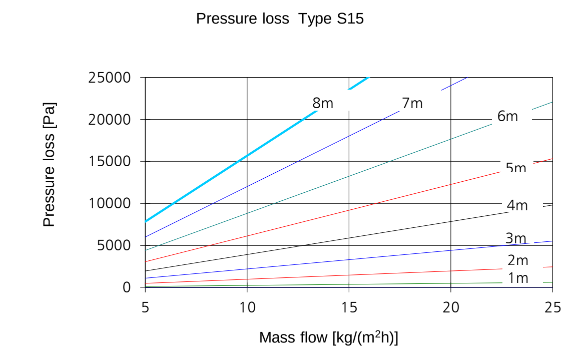


4	Room temperature	°C		average heating water temp.	°C		-> from diagram
5	Supply temp. -> from diagram	°C		return temperature	°C		
6	Spread	K					
7	Water volume per mat	kg/h		= (Heating capacity x 3600) / (Spread x 4180)			
8	Water volume per zone	ltr/h					



Determination of pressure loss

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



When using BEKA Transfer units the determination for pressure losses are obsolete. Only the qty. of heating ciruits and the total heating capacity is required for the selection.

11. Technical specification

BEKA Capillary tubes 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 pipe distance	15 mm
Exchanging area	0.71 m^2

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

Heating capacity:
Depending upon type
180 W/m^2

Operating conditions:
Temperature-stable with permanent operation up to 60°C
Operatiing pressure 3 to 4 bar
Test pressure 10 bar over 10 hours maximum

Application / mode of installation:
Floor heating with low profile
Connection by thermal welding

Delivery:
The mats are delivered rolled-up and packed in cartons

FÜR KLIMA-KOMFORT

TI-K09 **Short Description**

Cooling and Heating Ceiling with the BEKA Acoustic Metal Panel

1. Generals

In modern offices and business premises, the contemporary office and computer technology combined with increased thermal insulation of the exterior walls and façades, the rooms must be air-conditioned all year round. Even during periods when heating is required, these rooms have comparatively low heat consumption. This facilitates the use of cost-effective and energy-saving BEKA cooling and heating ceiling.
With the BEKA acoustic metal panel, any metal cassette ceiling can easily be designed as cooling and heating one. The equipment is also suitable for retrofitting. The combined functionality of the ceiling minimises investment costs required for necessary building technology.

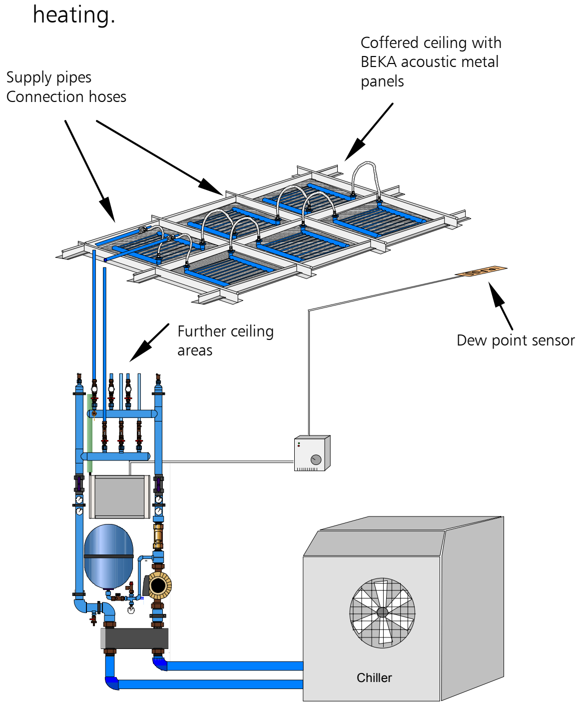
2. System description

BEKA acoustic metal panels are metal cassettes, which come completed ex works with BEKA capillary tube mat. The capillary tube mats are glued on using a hot-melt process. Like any other metal cassette, the BEKA acoustic metal panel is simply laid on top of the supporting structure. The capillary tubes lie practically directly on top of the sheet-metal that the surface is rapidly cooled or heated. The reaction time of the ceiling is less than 15 minutes.

3. Cold-water/hot-water technology

The BEKA acoustic metal panels are integrated in rooms/zones within a piping network as a circulation loop and connected to a cold-water generator and heat source. We recommend that the connection is made by using BEKA storey distributor.
A wide variety of techniques and systems may be used for cold-water generation. The economic advantages of the cooling ceiling consist primarily of the fact that the ceiling is highly efficient even at flow temperatures, which are only slightly below the room temperature. This facilitates the use of "alternative energy" (heating pumps) and natural energy sinks (e.g. free cooling, groundwater).

The same advantages apply to hot water generation. Significant energy savings are achieved not only in combination with solar heating systems, but with conventional technology as well, since even at low flow temperatures (below 40°C), the respectable thermal output can be used for heating.



4. Installation

As a rule, the general installation guidelines apply. All materials used in the tubing network of the BEKA acoustic metal panels must be made of non-corrosive materials.
Plastics, stainless steel, copper, brass and red bronze may be used. Other materials may cause the system to silt up and thus, disrupt its function.

5. Regulating technology

The control technology ensures both the comfort you desire and necessary system reliability as well.
The cooling ceiling requires room temperature control, dew point protection and control for the initial flow temperature of the cold water. Initial flow temperatures below 16°C must be avoided due to the dew point risk!
The heating ceiling requires room temperature control to regulate the flow of hot water depending on the desired room temperature. In rooms with heights of up to 3.5 metres, initial flow temperatures above 40°C must be avoided preventing the surface temperature of the ceiling to become too high!

6. System dimensioning

The BEKA acoustic metal panels are available in the standard ceiling cassette sizes of 600 x 600 mm and 625 x 625 mm. The required quantity of panels and temperature of the cooling or heating water are determined according to the layout tables shown below. The initial flow temperature in the water circulation of the BEKA acoustic metal panels is set by adjusting the water temperature upstream to the heat exchanger on the cold generator or heat source side.

7. Preparation for Assembly

The manufacturer's instructions regarding assembly of the suspended metal cassette ceiling according to the selected ceiling model have to be met.
The BEKA acoustic metal panels must be laid on a 24 mm T-profile structure. The BEKA acoustic metal panel simultaneously fulfils the acoustic requirements for the ceiling.
The BEKA acoustic metal panels are manufactured in the dimensions 600 x 600 mm and 625 x 625 mm that tailoring by cutting is not required at the construction site. Inactive cassettes are installed around the edges and in places where ceiling fittings are planned. The BEKA acoustic metal panels are equipped ex works with a plug-in coupling system for connection to flow and return pipes by means of flexible hoses.
Before beginning work, a ceiling pattern and laying plan must be drawn up, in which all cassettes including their dimensions, alignment and supply lines must be recorded. In the ceiling pattern, all areas must be also marked, which have to remain unoccupied, e.g. where partition walls, lighting and other ceiling fittings will be installed. In addition, the location where the BEKA dew point sensor will be installed must also be marked in the ceiling pattern.
If thermal plastic welding is being used to connect the polypropylene tubes, the welding guideline DVS 2207-11 of the Deutscher Verband für Schweißtechnik e.V. (German Association of Welding Technology) applies. (The environment temperature during processing may not drop below 5°C and the preheating, welding and setting times must be observed according to the actual size of the pipes.)

8. Tools, materials

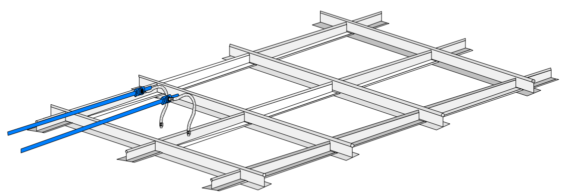
The conventional tools and materials for the installation of ceilings and plastic tubing are used for the installation of a metal cassette heating/cooling ceiling with BEKA acoustic metal panels:

- Metal cassettes
- Suspension profiles and hangers depending on the design of the selected ceiling model
- Dowels and screws
- Metal shears
- Plastic tube shears
- Hand-held welding unit with a welding sleeve device for plastic welding
- Appropriate plastic fittings and compression ones

A hand-held welding unit with a sleeve welding device appropriate for plastic welding and the adequate plastic fittings are recommended for connecting the supply lines to the cold-water circulation. Compression fittings may be used as an alternative.

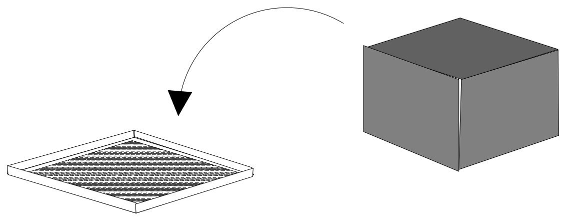
9. Steps in Assembling the Ceiling

I.



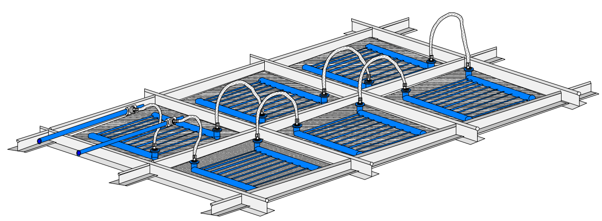
- In accordance with the manufacturer's instructions for the selected cassettes, attach the supporting structure to the bare ceiling using nonius hangers and aligned them then.
- Lai the supply lines into the ceiling cavity and connected them to the supply lines (connection through thermal plastic welding or compression fittings)
- Insert the flexible connection hoses in the plug-in couplings of the supply lines.

II.



- Remove the pre-assembled BEKA acoustic metal panel from its packaging.

III.



- Insert the flexible hoses into the plug-in couplings of the BEKA acoustic metal panel.
- Hang-up the cassettes in the supporting structure and align the joints.
- Take pretest with 10 bar of compressed air for 1 hour
- Take final test with water at 10 bars for 4 hours – maintain pressure at rest of 3 bar until the system is put into operation.

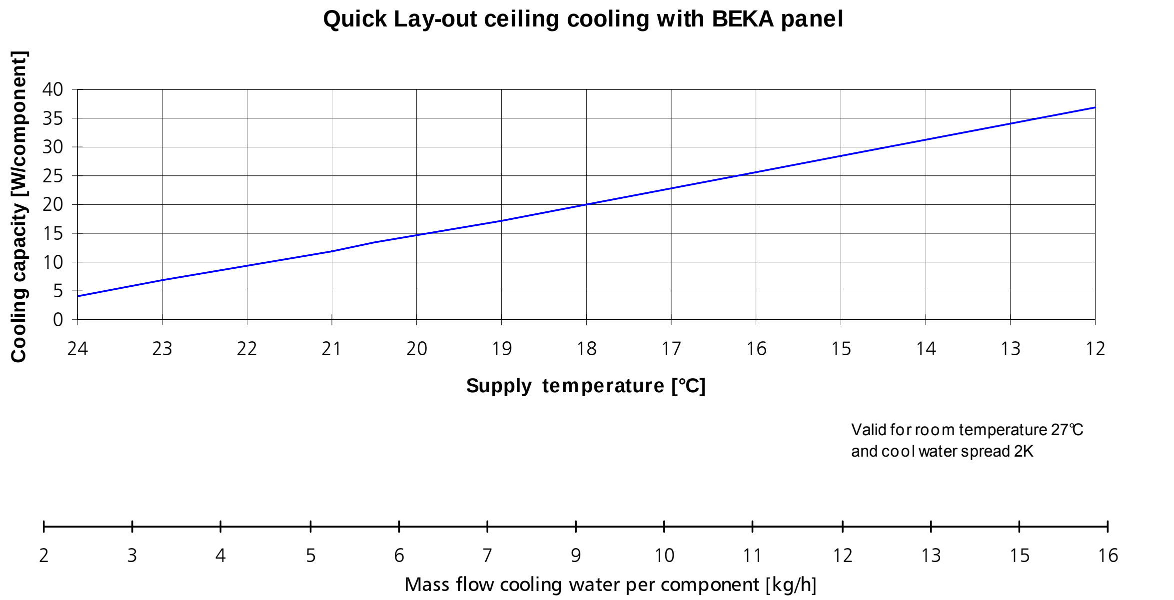
10. Layout for the BEKA acoustic metal panels in the cooling ceiling

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

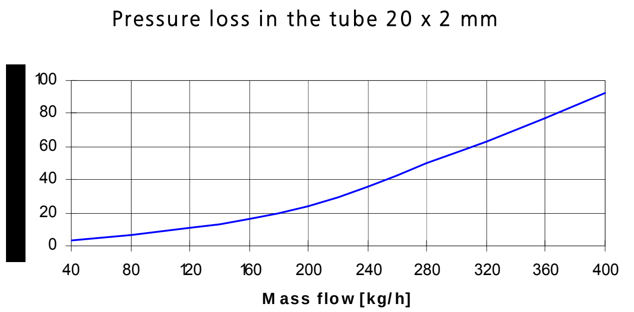
Required cooling capacity

1	Room cooling load	W		from calculations of the planning office
2	Planned component qty	m^2		Max. possible arrangement derived from room dimensions
3	Required cooling capacity	W/m^2		= Cooling load / Quantity of units

Capacity calculation

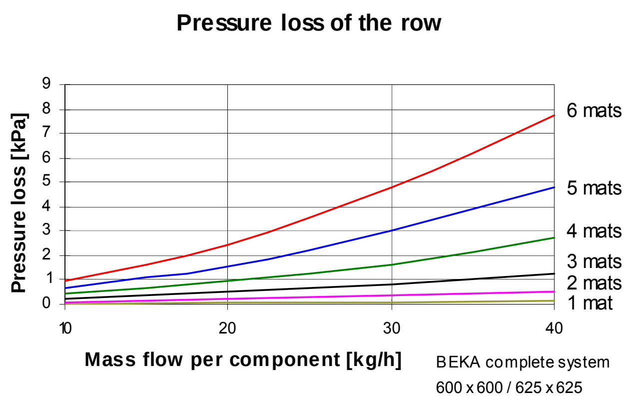


4	Supply temperature -> from diagram	°C	
5	Return temperature	°C	
6	Water qty per component	kg/h	
7	Water qty per zone	l/h	



Determination of pressure loss

8	Length of the connection tube	m	
9	Resistance in tube -> from diagram	Pa/m	
10	Pressure loss in tube = tube length * Resistance	Pa	
11	Component pressure loss → from diagram	Pa	
12	Add for pressure loss through fittings (recomm: 30% Add to pipe)	Pa	
13	Add for heat transfer station (recomm: for zone valves 500 -1000 Pa for branch control valves 700 - 1500 Pa for heat exchanger approx.. 4000 Pa)	Pa	
14	Total pressure loss	Pa	



If BEKA transfer stations are utilised the pressure losses do not have to be determined. Only the quantity of cooling circuits and the total cooling capacity is required for the selection.

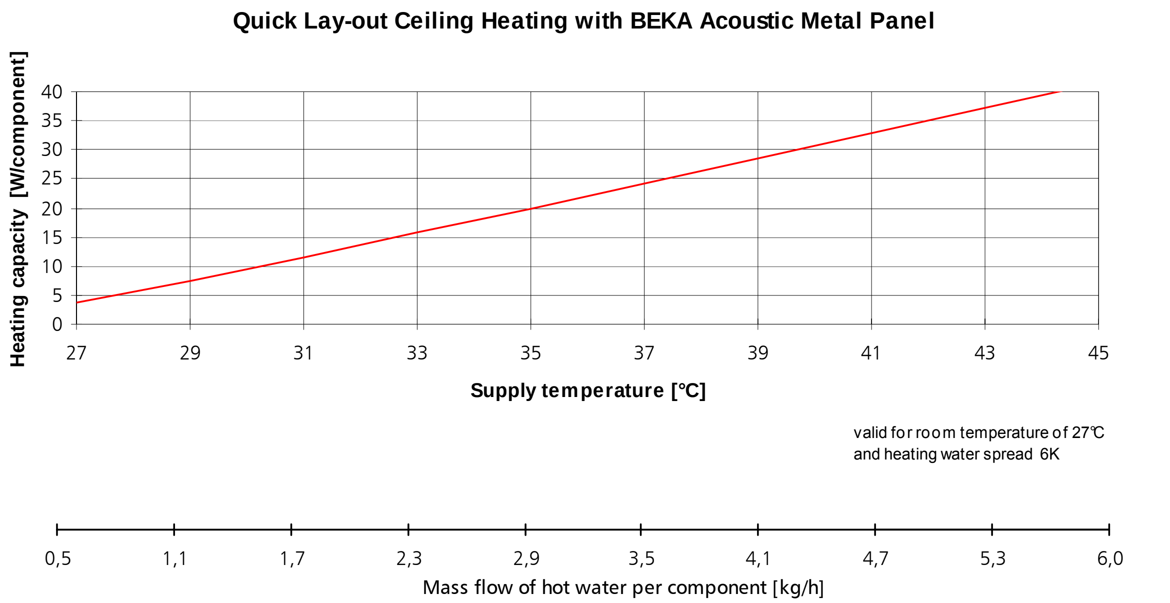
11. Layout for the BEKA acoustic metal panels in the heating ceiling

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

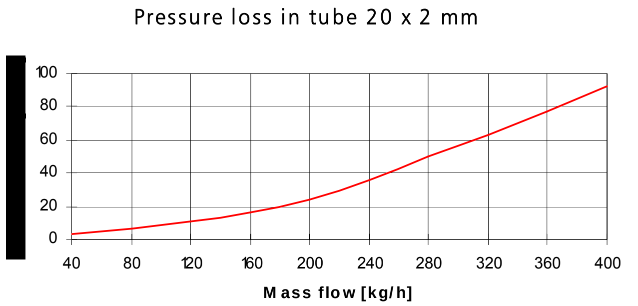
Required heating capacity

1	Planned heat requirement for the room	W		from calculations of planning offices
2	Planned component quantity	m^2		max. possible arrangement derived from room dimensions
3	Required heating capacity	W/m^2		= Heat requirement / Coverage

Capacity calculation

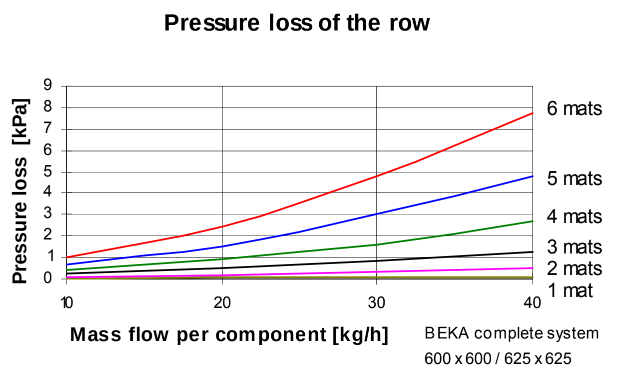


4	Supply temperature → from diagram 1	°C	
5	Return temperature	°C	
6	Water qty per component	$kg/(m^2h)$	
7	Water qty per zone	l/h	



Determination of pressure loss

8	Length of the connection tube	m	
9	Resistance in tube → from diagram 2	Pa/m	
10	Pressure loss in tube = Tube length * Resistance	Pa	
11	Component pressure loss → from diagram	Pa	
12	Add for pressure loss through fittings (recomm: 30% Add to tube)	Pa	
13	Add for heat transfer station (recomm: for zone valves 500 -1000 Pa) for branch control 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 losses do not have to be determined. Only the quantity of cooling circuits and the total heating capacity is required for the selection.

12. Technical specification

Material:
Metal cassette with acoustic fleece
Capillary tube mat with capillary diameter of 3.35 x 0.5 mm (polypropylene)
Glued through hot-melt process

Masses:
4.6 kg/m^2 (unfilled)
5.3 kg/m^2 (filled)

Size:
Width: 600 mm and 625 mm
Length: 600 mm and 625 mm

Cooling capacity:
74 W/m^2 (DIN 4715)
=29 W/component

Heating capacity:
130 W/m^2 assuming 45°C hot water/21°C room temperature
=51 W/component

Operating conditions:
Temperature-stable with permanent operation up to 45°C
Operating pressure 3 to 4 bar
Test pressure 10 bar up to a maximum of 10 hours

Application/mode of installation:
Cooling and heating ceilings in metal cassette design
Connection through BEKA quick-coupling system
Assembly according to manufacturer's instructions

Delivery:
Prefabricated acoustic metal panels are delivered in cartons.

TI-K10 **Short Description**

Installation with the BEKA Plug-in Type Pipe System

1. Generals

Up to now, the installation of a piping system for the connection of heating or cooling panels with BEKA mats/prefabricated components usually required specialised expertise in working with plastic piping, as well as special tools. The BEKA quick-coupling piping system is a cost-saving alternative. You can construct a complete piping system using only a pair of plastic pipe shears.

2. System description

The BEKA piping system with quick-action coupling contains all of the required installation materials for the piping of cooling or heating circuits, from the BEKA mat or the BEKA prefabricated component to the distribution throughout the storey. The pipe dimension of DA22 and DA20 mm are designed for cooling or heating circuits with a maximum size of 15 m^2. All quick-action coupling parts can be used with the BEKA DA22 or DA20 mm piping without additional dimensioning to assemble the heating/cooling circuits internally and to construct the connection up to the distributor. The piping length up to the distributor may be up to a maximum of 40 metres for the flow and return pipes, respectively. The pipes and the pre-formed parts are simply assembled by pushing them together. The connection between the piping and BEKA mats/prefabricated components is made by using flexible hoses. In those cases, in which the quick-action coupling system is to be used with piping or components from other systems, suitable adapters with ¾" exterior threads are available.

3. Installation

As a rule, the general installation guidelines apply. All materials used in the piping system of the BEKA mats or prefabricated components must be made of non-corrosive materials.
Plastics, stainless steel, copper, brass and red bronze may be used. Other materials may cause the system to silt up and thus, disrupt its function.

4. Preparation for Assembly

Before beginning work, a floor/ceiling pattern and laying plan must be drawn up, in which all BEKA prefabricated components (metal acoustic mat, inlaid component, prefabricated ceiling or wall) with their dimensions, alignments and supply lines must be recorded. In the specification of the piping layout within a heating/cooling circuit, the general rules must be applied that an even flow is guaranteed throughout the area. In the floor/ceiling pattern, all areas have to be marked, which must remain unpiped, e.g. where partition walls, lighting and other ceiling fittings will be installed. In addition, the location where the BEKA dew point sensor will be installed must also be marked in the floor/ceiling pattern.
All BEKA prefabricated components are equipped ex works with a quick-coupling system for connection to flow and return lines by means of flexible hoses. The individual lengths of the piping sections are determined from the floor/ceiling pattern. The pipes are fastened with conventional pipe clips in accordance with the generally applicable installation guidelines for the BEKA DA22 mm pipe with spacing of up to 800 mm maximum to the bare floor or ceiling.

5. Tools, materials

To process the quick-coupling system, the following tools and materials are required:

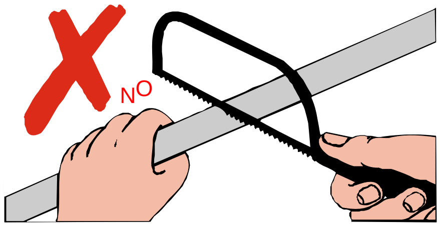
- Plastic pipe shears
- Marker
- Meter rule

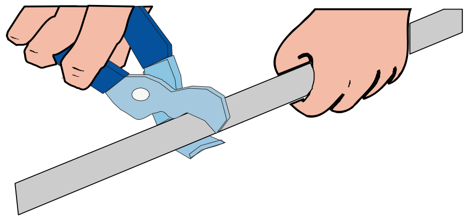
For fastening to the raw ceiling:

- Commercial 22 mm pipe clips
- Dowels and screws
- Drilling machine/hammer drill, if necessary
- Tools for mounting the pipe clips

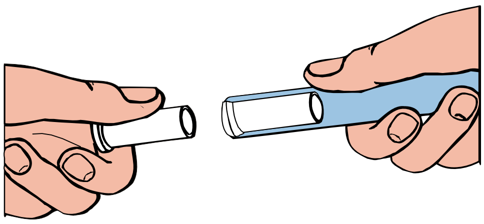
6. Assembly Steps

- Cut the tube to the required length. Use only the plastic tube shears to cut the tube (do not use a saw or similar tools!). Be careful to make the cut straight or angled as required.

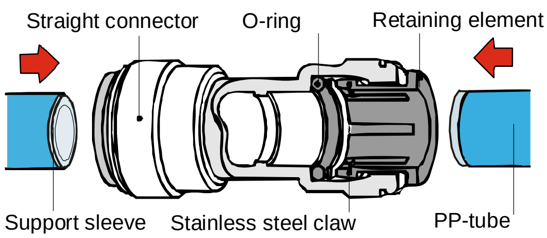




- Insert the support sleeve in the end of the tube.
(RESPECT: The Support sleeve is not necessary for BEKA pipe DA20!)



- Insert the tube with the support sleeve to the limit stop into the plug-in fitting –
- **Pressure test with 10 bars of compressed air for 10 minutes.**
Pressure relief with – 2 bars for 10 minutes.
- **and you are finished!**



7. Technical Specifications

System Components
BEKA tube, 22 x 2,1 mm or 20 x 2 mm, polypropylene, PN10
Straight connector, 22 or 20 mm
Angled plug connector, 22 or 20 mm
T plug connector 3 x 22 mm or 3 x 20 mm
Reduced T plug connector, 22 x 10 x 22 mm or 20 x 10 x 20 mm
Plug-in end cap, 22 or 20 mm
Screw connector, 22 mm x ¾" or 20 mm x ¾" exterior thread (brass)
Support sleeve for 22 mm tube, not for DA20 mm
Flexible connecting hose with stainless steel fabric casing

Operating conditions:
Temperature stability in continuous use up to 45°C
Operating pressure 3 to 4 bars
Test pressure 10 bars up to a maximum of 10 hours

Fields of application:
Cooling and heating floors/ceilings with BEKA capillary tube mats or prefabricated components
Connection via the BEKA Plug-in type pipe system
Assembly according to manufacturer's guidelines

Form of delivery:
Tubing in rods of 4 meters in length
Plug-in fittings and hoses in accordance with the quantities ordered

Questions before lay-out of BEKA Cooling Ceilings

1. Cooling load / heat requirement

The specific cooling load split to every room must be obtained from the planning or architect's office. If concrete figures cannot be specified, then the cooling loads or heat requirement for each room must be calculated by yourself, at least roughly for pre-planning. The calculation for the cooling load follows VDI 2878, as for the heat requirement according DIN 4701. The result for the cooling load, however, must be interpreted before considered in the construction of the ceiling, since the calculation procedure according to VDI 2078 will not account for the operative temperature and impact of the storage behaviour of the cooling ceiling. By establishing characteristic room figures, the radiation ratio and change in the share of convection, caused by the type of ventilation, can be considered for the expected capacity of the ceiling.

For the calculation of the cooling load the following details are required:

- Building and room dimensions
- Location of building, direction of rooms
- Type of walls, windows and door positions → U-values of the building components
- Climate conditions: High and low temperatures of the year, outside humidity through the year
- Internal room temperature variation → room temperature
- Requirements directed to air quality → pollutants, humidity
- Usage of the room, number of persons present, type of activities
- Electrical appliances → quantity and connecting loads
- Lighting → electric connection values
- Other loads → heat caused goods and substances passing through the room
- Room temperatures of adjacent rooms

A form for the (rough) calculation of the cooling load is included in the → collection of tables.
In critical areas, however, an accurate calculation of the cooling load is absolutely necessary.

2. Building / room condition

Whilst item 1 possibly can be fully prepared by the planner, the expert planning for the cooling ceiling begins from now on.
The room dimensions can be taken from the construction drawing and/or can be ascertained by inspection of the site.
It must be laid down with the planning person if separate ventilation is planned and/or if the windows will remain open able. The volume of air supply, the condition of the air (air supply, exhaust air temperature and humidity) and the type of exhaust outlets must be inquired from the planning office and/or will be laid down by considering the usage of the rooms, observing the state of the art and standards for the required air exchange rates.
Statements about air supply will be considered for the construction of the cooling ceiling and will influence the cooling load of the ceiling.
It is also important to clarify what energy can be used for the cooling water preparation.
The technique of cooling water preparation is not part of the construction for the cooling ceiling and therefore, will not be mentioned further.
At least, the cooling water temperatures and water volumes for the cooling circulation (secondary circle) must be co-ordinated with the planning specialist. From the necessary capacity of the ceiling and with the given split between water temperatures in supply and return of the secondary circuit the necessary volume of water can be calculated. The difference in temperature between the supply and return determines the capacity of the ceiling in dependence of the chosen type of ceiling.

3. Ceiling design

If it is not given anyway, the design of the ceiling must be clarified with the architect/ builder. The BEKA heating and cooling mats are suited for practically all installation variations. But next to aesthetics also the different capacities of the cooling ceiling, depending upon the ceiling type, must be considered.

Basically, it can be distinguished between the following types of installations:

The BEKA mats will be laid on top of suspended metal cassette units

The BEKA mats will be fixed to the raw ceiling from below and plastered.

The BEKA mats will be laid from below to the dry plaster boards and plastered.

The BEKA mats will be placed on top of plaster-boards.

Each of these installation details can vary depending upon the differing building materials. Nearly any variation is given. Roughly, this can also be used as basis for the expected capacities for the different type of ceilings.
For a first estimation, the maximum ceiling area to be covered with mats must be established. Built-in components such as lamps, sprinklers or speaker boxes must be considered lost for ceiling area, the same as build-in cupboards. Further, it must be clarified how much building space is provided for the piping. This can be hollow (dead) space in ceilings and floors of the above storey. If space for the piping was not planned for, it must be created in agreement with the architect.
The chosen type of ceiling is influencing the construction time schedule. Plastered ceilings require additional time for drying before they can be painted. With the installation of BEKA heating and cooling mats on top of plaster boards the rooms can be used at an earlier stage.

4. Cold water technology

The cooling water of the BEKA mats can supplied centrally from one point of each room, or from the point of cold-water preparation to the storey distributor. Variations for the cold-water distribution are possible. Which basic type or which mixed form is going to be used will depend on size and building layout, the approved installation material, the installation requirements, the state of control accuracy and the serviceability.
Basically, all mat-related parts, valves (secondary circulation) and raw materials must be non-corrosive, to avoid sludge. Also increasing a secure operation of the system by taking a storey distributor into account should be discussed.
In all cases, the position of riser conduits should be provided between storeys and eventual free spaces for sub-distributors or storey distributors.
For the cold-water preparation, many different techniques can be utilised. The economical advantages of the cooling ceiling is, that already with supply temperatures which are only slightly below the room temperature a high performance is achieved. This enables the utilisation of "alternative energies" such as solar energy for heating and ground water for cooling.

5. Control technology

The control technology secures a desired comfort and the necessary system security.
Since cooling ceilings often are operated in combination with other heating, cooling and air-conditioning systems, a general control concept is to be developed. Interactions can therefore be avoided.
The cooling ceiling by itself requires controls for room temperatures, a dew point protection and a temperature control for the supply of the cold water.

Basically, two types of supply temperature controls can be distinguished:

- constant supply temperature (not below 16° to avoid the dew point)
- floating supply temperature (the ceiling will not be switched-off at critical humidity and will continue with a partial load.)

Which variation is to be used must be decided by the demand on comfort, and by the combination with the air-conditioning (ventilation).

Lay-out BEKA Cooling Ceilings

1. Generals

To obtain a room climate to feel comfortable, it is necessary to cool modern offices because of their inner heat loads caused by office and computer equipment and through the high thermal insulation of the buildings.
The most cost-effective solution is the utilisation of BEKA cooling ceilings. High cooling loads to be dissipated exclusively by air-conditioning are not only un-economical but also the limits of the admissible speed of the room air ventilation and rate of turbulence is often exceeded.
BEKA radiation cooling ceilings achieve 60% of the cooling by radiation and 40% by convection. This is equivalent to how the human body regulates its temperature at moderate activity.

2. Capacity of the BEKA cooling ceiling

The cooling ceiling absorbs only the sensible (dry) cooling load of the room. The required air change can be achieved by simply opening the windows or in a more comfortable way, through base ventilation.
The reason for the temperature transport from the room to the ceiling is the temperature difference of the room and the average surface temperature of the ceiling. Where the temperature of the ceiling is given by the internal heat transition from the lower side of the ceiling to the cooling water.
The capacity of the BEKA cooling ceiling is determined according to DIN 4715, where a standard load is a function of undertemperature and is represented by the following equation:

With:
$q_N\ [W/m^2] = C \cdot T_U^{\,n}$

Abbreviations:
T_U – temperature difference between room temperature and average cooling water temperature
C - constant
Cn - exponent

Specific figures for "C" and "n" can be determined for each installation version of the BEKA mats.
The diagrams D01 and D02 (→ index: Diagrams) show the capacity curves of standard installation situations.
The table T04 "Standard capacity identification data" (index: Tables and Forms) shows further data about special ceiling constructions.
The following equation applies to the heat volume to be dissipated:

$Q = m \cdot c \cdot \Delta T$

Abbreviations:
m - mass flow
c - specific heat capacity
ΔT- temperature difference

The above equation is used to determine the necessary amount of water with a given temperature difference (spread) between supply and return of the cooling water. The heat volume taken from the low temperature of the ceiling must be equal to the heat volume, which is dissipated by the cooling water.

Since the standard capacity was established under test situations, a real project must be matched to the actual situation, to given loads and to the impact of ventilation. Therefore a room constant K_R is established for the correction.

3. Construction of the BEKA Cooling Ceiling

The necessary cooling load for the ceiling is determined on the dry cooling load of the room. It must be observed that air carries-off cooling load through the fact of ventilation, even if this is only a minor factor.

In principle, the BEKA cooling ceiling should only be operated with a supply temperature above 16°C, to safely avoid any condensation. At room temperatures of 27°C, depending upon the situation of installation, cooling loads above 80 W/m² will result.

It must be observed, that not the room air temperature, but the operative temperature will be used for calculation. The operative temperature represents an average from air temperature and average radiation temperature of the surrounding room surfaces including the cooling ceiling. For this reason, it is possible to have the comfortable room air temperature below cooling ceilings 2K higher than with conventional systems.

For the layout the “form” T01 “lay out table cooling ceiling” (→ tables and forms) can be used. The explanations in the form will lead through the calculation. Standard cooling capacities of the BEKA cooling ceiling can be taken from the diagrams D01 and D02, or calculated using the data for “C” and “n” from table T04.
The extra cooling capacity for heat from ceiling cavities or for warm water carrying pipelines, which the ceiling will have to produce additionally, will be equalised through the water volume.

Heating with BEKA Capillary Tube Mats

1. Generals

Next to aesthetics advantages (no visible radiators) and savings on investment costs (besides the cooling ceiling there is no other heating system necessary), the cooling ceiling also has hygienic advantages.
Air movements are not noticeable, so that transport of dust particles and other pollution is stopped. The heating surfaces themselves do not develop air movements.
The permissible temperature limits of the ceiling under side has to be observed when using BEKA mats, otherwise the radiation heat from the ceiling, which hits the human body, is too high, and the heat will not be able to be sufficiently cooled.
The comfort disrupted (see: A. Kollmar: Heat physical calculations for heating ceilings, steel sheets and infra red radiation; Ges.-Ing 1960 p65/84). The temperature limit depends upon the geometry of the room. As lower the room, as smaller is the permissible average ceiling temperature. For a room height of 3 m, this will be 35°C.
At the same time, a cold air penetration at the window front must be considered for the planning of the ceiling heating, otherwise there is the danger of air draft.
The heat requirement in adequately insulated rooms is not high anymore for most of the wintertime considering the mostly high internal heat loads. The heat requirement for typical office rooms is between 20 and 40 W/m². According to → diagram D05, the permissible heat capacity of the ceiling is most of the time sufficient for the complete heating.

2. Permissible heating capacities

The → diagram D05 shows the permissible heating capacity in relation to the room depth and room height, whereby the permissible temperature limits will just be reached with 75% of the maximum heat load.
It is suggestive to run border strip of higher temperature on the ceiling alongside the windows. Here the supply temperature should not be regulated on basis of the room temperature, but should be controlled in floating manner by the outside temperature. For the border strip also the permissible heating capacity is valid, so that the comfort is not disturbed. The diagram D06 shows the relationship to the room height.

3. Lay-out of a BEKA heating ceiling

The layout for the BEKA heating ceiling is done in analogy to the cooling ceiling.
Beginning with the calculation of the transmission heat requirement and the heat specification for joints, the necessary heating capacity for the ceiling is determined. It must be observed that the calculation for the transmission of radiator heaters besides the transmission of walls also the heat for the hygienic necessary air exchange is taken into account. The influence of it is omitted for a heating ceiling, if the heat requirement for ventilation is covered by the heat recovery of the ventilation equipment. Internal heat producers such as lamps, technical appliances etc. also reduce the actual heat requirement.

Impacts on the layout

- Heat requirement < 100 W/m - facade → Heating can be performed through the ceiling without restriction.
- W/m < Heat requirement < 250 W/m of facade → Heating can be performed by a border strip on the ceiling alongside the windows; the radiation heat will be concentrated to the windows, air drafts are avoided.
- Heat requirement < 250 W/m facade → In dependence of the activities in the room it must be checked if the ceiling by itself is sufficient for heating; otherwise an additional heat source is required alongside the window.

For the layout the form → T02 can be used. The containing explanations on the form lead through the way of calculation.

The standard capacities of the capillary tube heating ceiling can be taken from the → diagrams D03 and D04. It must be observed that heating capacity of the ceiling surface is only permissible according to → diagram D05.
The → diagram D06 delivers a fast answer for the possibilities of ceiling heating.

Calculation for the Piping of BEKA Heating- and Cooling Ceilings

1. Generals

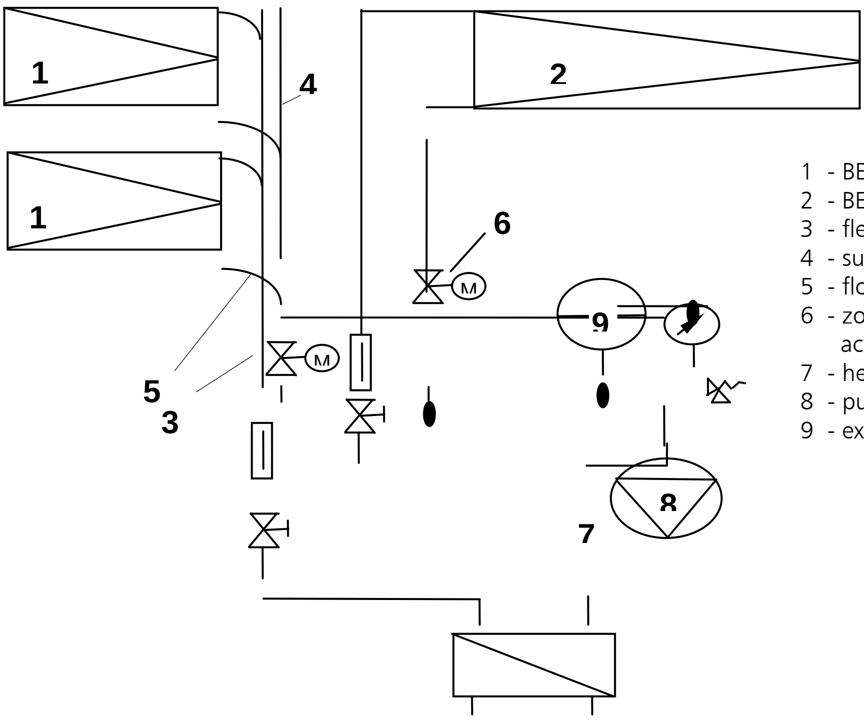
The BEKA heating and cooling ceiling works as a closed-circuit system. The cooling and heating water preparation in the primary circuit is parted by a heat exchanger from the ceiling system with BEKA mats in the secondary circuit.
All components of the secondary circuit are from non-corrosive materials and can be delivered from BEKA. Diffusion of oxygen through the plastic material, in this case, has no significance. Sludge therefore must not be suspected. With the BEKA systems, because of the typical low operation temperatures for cooling and heating, precipitation will not take place. Professionally installed, including pressure check after installation, will exclude any water damages.

If after all safety precaution, a capillary tube should leak, the damage is limited.

The mat is only filled with 0.46 litre/m² of water and the system only drains itself up to the pressure equalisation of the system-inherent pressure with the atmospheric one. The volume in the expansion tank will be the maximum possible amount of leakage, which in normal cases never exceeds 5 litres.

2. Components of the system

The schematic (below) shows the basic arrangement of each component. The units 5 to 9 can be united into a single storey station, which is also manufactured by BEKA.



1 - BEKA mat for a metal ceiling
2 - BEKA mat for a plaster ceiling
3 - flexible connecting hose
4 - supply line
5 - flow control valve
6 - zone valve with thermal actuator
7 - heat exchanger
8 - pump
9 - expansion tank

3. Layout of the tubing for the BEKA cooling ceiling

The layout of the piping system reflects the state of the art and therefore, is only outlined.
If the cold water supply is by central distributor or via storey distributors, this condition depends upon many facts, such as: Size of the total cooling area, the building situation, the hydraulic view, ease for service, system reliability etc. The distribution by storey stations enjoys preference. Herewith a high grade of service ability is reached. Regulation of the system is possible from one central point. In case of a failure, the shut-off of each separate zone is possible.
Basically, only non-corrosive materials for pipes, fittings and controls are used in the secondary circuit. Plastic materials can be used without any problems.
When using copper piping together with plastic material, a brass part must be inserted between them.
The dimensions for the pipes are calculated under consideration of the volumes and the allowable flow rates.
In civil engineering, a maximum flow rate of 1.5 m/sec is adapted to avoid circuit hydrodynamic noise. It must be considered that speed changes at intersections, especially at passes with conflux of more than 0.3 m/sec are avoided. This could lead to flow cut-offs. The total pressure loss is calculated on basis of known sizes of mats, pipes, armatures and other components of the system.
The pressure losses for BEKA heating and cooling mats can be taken from the diagrams →D07 to D14, in relationship with the mat sizes, mat type and specific water volume.

The heat exchanger and pump must be of non-corrosive material. The capacity of the heat exchanger is calculated from the total volume of water at the chosen spread. The pressure loss of the heat exchanger depends on the manufacturer, and will be calculated in a special way. Usually a pressure loss of 20 kPa set forth for the heat exchanger in the primary and secondary circuit.
The total pressure loss of the system results from the pressure loss of the piping and the one of the heat exchanger. The heat exchanger is chosen to compensate for the pump capacity and under consideration of a safety allowance.

The delivery height must be specified that the total pressure loss of the system, including a safety allowance, will be compensated for. The delivery capacity of the pump must fulfil safety allowance for the total water volume. For choosing pumps, the manufacturer's specified characteristic performance curve is used.

Control of BEKA Heating- and Cooling Ceilings

1. Generals

The control technology for the BEKA cooling ceilings must apply to the two function-appointed factors: Temperature and humidity in the room.
Basically, the expenditure of control technology can be kept relatively low, since a solid laid out cooling ceiling will not give many occasions for the control to get active for securing the safety of the system.
BEKA heating and cooling ceilings incorporate already a so-called “self control effect”. This means, only after the heat source enters in the room, the heat flow will start from the heat source towards the ceiling, and the heat load is dissipated from the room.
The capacity of the ceiling will increase as greater the loads are, and will reach its peak, at pre-set water volume flow, when the pre-set difference between water supply and return temperatures is reached.

2. Room temperature control

Normally, the room temperature is recorded with the room temperature controller. This directly actuates a zone valve with a thermal actuator when the actual temperature has fallen below the pre-set temperature, so that the cold-water circuit is interrupted. The temperature controller is installed at a spot where no direct sunlight can reach, in height of approximately 1.5 m.

3. Dew point control

To avoid condensation on or in building components the supply temperature should be set above the dew point of the room (normally 16°C is sufficient). Only in this way, a high degree of safety against condensation of outside air at our latitude can be already obtained. For additionally safety, a humidity sensor should be installed at the coolest spot of the room (from experience, this is furthest corner away from the window, directly at the supply flow).

This sensor will give a signal to the converter or room temperature controller, when the dew point is reached, which then actuates an actuator on a return line at the corresponding circuit. For seldom to be expected case, the system will be shut-off for a short period. Because of the storage effect of the cooled building surfaces, the temperature will be kept up for some time, so that the room inhabitant does not notice the shut-off.
In normal cases, this simple way of controlling is sufficient for secure resistance against condensation.
Should there be other climate situations with a higher humidity than expected, dry air can be fed into the room. The amount of incoming air is metered according the humidity, which has to be dissipated. Thereby the temperature of the incoming air and the air speed must be taken into consideration.
A floating control system is another way to run the cooling system with an optimal supply temperature regarding the dew point control. Herewith a constant supply volume flow of the cooling water is set forth and a regulator computes the dew point temperature from the measured humidity of the room and the pre-set room temperature at the controller.
Thereafter the controller compares the value with the supply temperature and sets the measure of the possibly necessary raising or lowering of the supply temperature. In order not to limit the comfort in this case, a temperature balancing control should be designated for the room through basic ventilation.

Instructions for Fire Protection and to Burning Behaviour of BEKA Mats

1. Generals

Under the construction law in Germany, fire prevention requisitions are set forth within the building codes of the Federal States, which must be stuck to. Because of Federal State Laws, there could be different requirements. Above these, there are also separate regulations and standards for special buildings (high-rise buildings, hospitals and meeting halls), which must be obeyed. Besides the demands for fire prevention, there are additional injunctions by the underwriters, which are relevant.
For numerous requisitions, regulations are defined in a general manner and based on standards.
DIN 4102 "Behaviour of building materials and components in fire" regulates nearly every case for fire prevention. The following standards and guidelines apply for the BEKA heating, cooling mats, and the installation material.

DIN 4102 – Part 1	Building materials (classification)
DIN 4102 – Part 2	Building components (fire resistance classes)
DIN 4102 – Part 3	Firewalls (non-load bearing external walls)
DIN 4102 – Part 4	Fire resistance of building materials, components and special Components Specification and application of classified materials, components and special components, whose fire resistance properties are known, respectively, standardised.
DIN 4102 – Part 11	Pipe partitioning + utility conduits
DIN 18232	Fire protection – Smoke and heat extraction, Part 1 – 3
ISO 6944	Test of pipelines
DIN 18230	Building fire protection for industrial buildings Part 1 + 2

2. Fire resistance of the BEKA heating and cooling mats, pipes, supply lines and fittings

BEKA heating and cooling mats, pipes, supply lines and fittings are made from polypropylene type 3, random co-polymer, without the use of additives. This plastic material is a high-grade material, which burns to water and carbon dioxide (H_2O und CO_2).
According DIN 4102, Part 1, polypropylene is classified in building material group: B2 normal flammable, self-extinguishing
Basically, take notice that the BEKA capillary tube mats are practically never on the surface after installation, and therefore are not directly exposed to flames. This is true especially when laid in plaster or in a composition floor. But also when laid on top of ceiling panels, the mats are mostly covered with mineral wool towards the ceiling cavity.

Furthermore, it can be assumed, that the water filled capillary tubes will cause a distinct reduction of the surface temperature and therefore a distinct reduction of an eventual ignition. This was confirmed in an assessment of fire resistance concerning capillary tube mats by "Amtlichen Materialprüfanstalt für das Bauwesen beim Institut für Baustoffe, Massivbau und Brandschutz" at the Technical University in Braunschweig/Germany.

3. Provisions for fire prevention

If BEKA pipes or supply lines are laid through fire section walls, partitioning (insulating) could be necessary.
Pipes are allowed to be covered with mineral plaster of minimum 15 mm thickness or insulating shells for heating pipes made of rockwool (minimum thickness 30 mm – building material class A, melting point above 1000 °C). In this way, the fire load is securely absorbed (certificate issued by Institute für Baustoffe, Massivbau und Brandschutz at the Technical University in Braunschweig/Germany, No. 3335/1111 – Mer – dated 01.03.2001).
Openings for pipes tube bundles through fire walls above 50 mm diameter must be insulated. Thereby the firewalls and ceilings have to be improved by using qualified fire resistance measures, so that the required fire resistance class is assured.
Standard fire blocks for openings in fire section walls are fire prevention gaskets or packing rings. Only fire blocks with approval and test certificate may be used. The manufacturer of these products must secure by self-auditing that the delivered goods is covered by the approval. Installation must be done according to manufacturer's guidelines. Certification for this must be given to the builder (owner) to be passed on to the building authority. Each fire insulation block must be permanently marked.
In the real case, the exact implementation of the fire block should be advised by the building supervision or should be set forth by an authorised person, since fire protection requisitions are covered by building state law where possibly differing regulations must be obeyed.

Example: Design of a BEKA cooling ceiling

0. Preliminary remark

Only a detailed and properly designed cooling and heating ceiling can ensure the required function of room temperature stabilisation. Consideration must be given to all thermodynamic relationships of heat flows, the performance-determining structural design of the ceiling, the active temperatures and the load effects.
For a good understanding of the theoretical basis, the reading matter of the VDI Guideline 6034 “Cooling surfaces for rooms – Planning, installation and operation” is recommended.

The example design given here can serve only as a simplified calculation procedure with the goal of quickly imparting a basic understanding.

The individual steps of the design planning are:

1. Definition of the initial conditions
2. Determination of the cooling load and heating requirement
3. Determining the system-dependent specific cooling and heating capacities
4. Planning of internal pipework for cooling and heating surfaces
5. Specific fluidic calculations
6. Sizing of the pipe installation and standard system components

The example confines itself to the design of the cooling ceiling. When used for heating, the required steps of the design planning are to be applied analogously.

1. Definition of the initial conditions

In the first step, the specific room situation is to be clarified as regards the structural design of the building shell, room usage and desired/required room temperatures.

Figure 1 of system 1 shows an example sketch of a room arrangement. Rooms 1 through 3 are to be temperature controlled/stabilised with a cooling and heating ceiling combined with displacement ventilation.

Envisaged room usage is:

Room 1 - Conference room
Room 2 - Office
Room 3 - Office

The building concerned is the ground floor of a multi-floor building. The external walls are thermally insulated and fitted with double-glazed windows with outside louvred blinds.
The prescribed ceiling design is a suspended ceiling of smooth plasterboard. The height of the suspended ceilings in all rooms is to be 3 metres.
The permissible room temperature when cooling is used is to be a maximum of 27°C for the conference room (room 1) and 25°C and 26°C respectively for the offices. The incoming air volume must meet hygiene standards.
When heating is used, a room temperature of 21°C must be maintained.

2. Cooling load and heating requirement

The cooling load and heating requirement are highly dependent on the room size and use of the rooms, geographical location and design of the building. The loads are to be determined for each room and serve as the crucial starting point of calculations for the cooling and heating ceiling.

The cooling load to be lead off from a room so that the required room temperature is maintained is nowadays normally calculated externally using standard software. Here, it should be ensured that this software takes account of the special thermodynamics of radiant heating and cooling in the calculation procedure. The calculation method of the past, which was used solely for the design of purely air driven climate control systems, indicates as a result somewhat unrealistically high demands as regards capacity requirements. Where no suitable software is available, the sensible cooling load may alternatively be determined using the calculation of Table TI-T03, Rough calculation of sensitive cooling load. In the example, this estimate of cooling load is shown for room 1. The method of calculation is self explanatory and is presented in the sample calculation (annex 2, table 1).
Various standard software is available nowadays for determining the heat requirement of the separate rooms. But this software too should take into account the particularities of room heating via radiant heating systems.

3. Determining the required specific cooling and heating capacities

The calculations of the ceiling's required specific cooling and heating capacities are in keeping with the steps presented in tables TI-T01 and TI-T02. The results of the calculations for specific cooling and heating capacities can then be collated room-wise in tables TI-T01 and TI-T02 respectively.

A rough plan of the possible thermal activation of the ceiling surface is drawn up based on the predefined/desired ceiling design.
In the example, a BEKA heating and cooling mat of type K.S15 is used for the prescribed ceiling design (suspended plasterboard with plastered over capillary tube mats). Figure 2 shows an example of a possible arrangement of the mats. The goal here should be maximum ceiling coverage. It makes sense here to earmark an unoccupied border region to even out dimensional tolerances and to lay the connecting pipes. Where customer-designated free areas for light fittings, air outlets, loudspeakers or the like are already provided (does not apply in this example!), they remain unoccupied. Smaller openings in the ceiling for sprinklers, for example, are disregarded. In these cases the capillary tubes of the BEKA mat can be routed around the opening during installation.

Standard cooling capacities, measured according to EN 14240, exist for BEKA cooling ceilings for standard installation situations. (Note: older tests according to DIN 4715 are no longer binding as evidence. Nevertheless, these tests still give indicative results. Where evidence is required though, the tests for these installation variants must be carried out afresh according to EN 14240 in an approved testing institute).
The heating capacity of ceiling heating is similarly determined based on DIN EN 14037-2 in a test room under standard conditions.
The specific cooling and heating capacities achievable with the standard tests are kept up to date for diverse ceiling structures in the BEKA design tools as Excel sheets, and can be quickly ascertained by entering the required system temperature. Use of the BEKA design tools is described in TI-B15.

As a substitute, rough estimates of the cooling and heating capacities for various ceiling designs can also be taken from diagrams D01 - D04.

Since the standard capacity is determined under test bench conditions, strictly speaking this value needs to be suitably adjusted in a specific project for the load situation and room circumstances as well as the effect of ventilation. In practice this adjustment is the responsibility of the planning engineer. He/She will compare the defined thermodynamic boundary conditions of the test bench measurement against the real conditions in the project and, if necessary, determine the actual cooling and heating capacity of the ceiling structure by a room simulation calculation.

4. Planning of the internal piping

The BEKA cooling and heating ceiling is of the radiant type that temperature-stabilised water flows through. The even distribution of the temperature stabilised water over the thermally active surface is the basic prerequisite for a perfectly functioning cooling and heating ceiling. Fulfilment of this technical task calls for orderly planning and design of the internal pipework and the correct choice and sizing of all system components.
In practice it has proven successful to divide up the entirety of required cooling and heating surfaces into smaller units – cooling or heating circuits. Here, roughly one surface of 10 - 15 m^2 per circuit is a convenient partial surface. This division makes it easier to ensure that the water volume required for capacity transfer is distributed evenly enough over the active surface. Nevertheless, care must be taken that the pressure drops of the individual components of a cooling or heating circuit do not lead to an uneven distribution of the water volume. This is ensured if the pressure drop in the separate capillary tube mats within a cooling or heating circuit is almost equal in size everywhere.
A division of the ceiling surface in circuits/zones with regard to the building grid also makes sense. When the room partitioning is subsequently altered, regulation of the temperature of the new rooms can be rearranged without difficulty.
The separate zones/circuits are connected to a sub-distributor (heating circuit manifold) or joined to the main lines via circuit control valves. This makes for trouble-free e adjustment of the required volume flow rates of the separate zones/circuits.

The BEKA cooling and heating ceiling is constructed as a closed system. It is strongly recommended that all system components in the secondary circuit of a BEKA capillary tube cooling and heating ceiling are made of non-corrosive materials. This will dispel any worries about silting up brought on by oxygen diffusion. In addition to this requirement, the advice given in TI-B12 should be consulted.

In the example a floor manifold unit is used. Here, the cold or hot water supplied by a central conditioning unit is passed on via a heat exchanger to the circuit on the floor. In the floor unit the water is then distributed to the separate circuits of the rooms/zones. The volume of water for each circuit can be adjusted via a flow regulator in the flow line. Each circuit can be controlled via a valve with a thermal actuator in the return line. On the actuator, the room temperature and dew point sensor are connected as a signal.

5. Specific fluidic calculations

The pressure drop of the BEKA heating and cooling mats is preferably determined by the BEKA calculation tool, "Calculation of pressure drops in BEKA capillary tube mats". The use of this Excel sheet is described in TI-B15. Alternatively, the values from diagrams D07 - D14 can be read off to determine the pressure drops.

In the example, the pressure drop for a BEKA mat of type K.S15 with a length of 4.30 m is calculated for a mass flow of 42.72 kg/(m^2h). The pressure drop of this mat is 19.97 kPa.

6. Sizing of the pipe installation and standard system components

The hydraulic design of the pipe network and calculation of the system's overall pressure drop is in keeping with the recognised rules of engineering. The capabilities of a standard software should be used for the pipe network calculation. By doing so, the specific pressure drops of the BEKA capillary tube mats (see section 5) as single pressure drops can be adopted into the calculation.

As an alternative to using standard software, the calculation can also be done manually with the support of the BEKA calculations, "Add-on module for pressure drops". The use of the Excel sheets is described in TI-B15.

When calculating the system's overall pressure drop, the pressure drop (pipes, mouldings and valves) of the longest sub-section as far as the floor unit (pump) is calculated taking into account the inflowing water volume from the subsequent zones. The drops in the individual pipe lengths for flow and return lines in the section under consideration are recorded as one double-length section for simplicity's sake.
The pressure drops that arise within the floor unit are also then added to this. The pressure drop in the floor unit itself is negligibly small since considerably oversized pipes are used. This ensures a lower flow rate (= less noise and an even temperature distribution). The pressure drop in the heat exchanger though has decisive influence. It is product specific. Dependent on the temperature difference between the water entry and exit in the primary and secondary circuit and total water volume, the pressure drop is to be determined according to the manufacturer's data.

The flow rate in all pipelines should not exceed 1 m/s. This will avoid flow noises and limit the pressure drop in the individual pipeline sections.

In the example, a total water volume of 2.6 m^3/h was determined for the cooling surfaces of all rooms. On the primary side a normal spread of 6°/12°C cold water temperature is set. The secondary side is run at 16°/18°C. The suitably chosen heat exchanger 9 has a pressure drop of 17 kPa.

In the example, the flow temperature in the secondary circuit is regulated via a mixer in the primary circuit. As a result, the effective total pressure drop for choosing the pump in the floor unit is composed only of the sum of the pressure drop of the longest subsection + pressure drop of the capillary tube mat in the furthermost zone + pressure loss in the heat exchanger.

With the total water volume and total pressure drop known, the choice of pump can now be made. Pressure-dependent regulated or unregulated pumps of corrosion-proof design can be used.
In the example, the appropriate pump must deliver a total water volume of 2.6 m3/h and equalise a pressure drop of at least 44.3 kPa. An unregulated pump with a delivery head of 6 mWS and 4 m^3/h delivery capacity was chosen.. The oversizing is "tuned out" by an overflow valve in the bypass of the floor unit.

The system fill volume needs to be determined to size the expansion vessel. In the example, 65 m^2 was occupied with BEKA mats of type K.S15. With a specific water content of 0.27 l/m^2 this gives a proportional volume for the BEKA mats of 17.55 l. A volume of 29.3 l was determined for the pipework including the floor unit. Therefore the system is filled with 46.85 l. Determination of the size of the expansion vessel is in accordance with the advice of the supplier. The manufacturers provide the appropriate calculation programs. At this point the special calculation of the expansion vessel is not elaborated on.

<u>Annex 1</u>

Figure 1: Room arrangement and load situation
Figure 2: Installation plan of BEKA mats
Figure 3: Connecting pipework of BEKA mats
Figure 4: Circuit schematic (Excerpt)

<u>Annex 2</u>

Table 1: Design table for cooling ceiling
Table 2: Rough calculation of the sensible (dry) cooling load

Example: Construction for a BEKA Cooling Ceiling, Attachment 1, Figure 1-4

Figure 1 : *Floor layout and load condition*

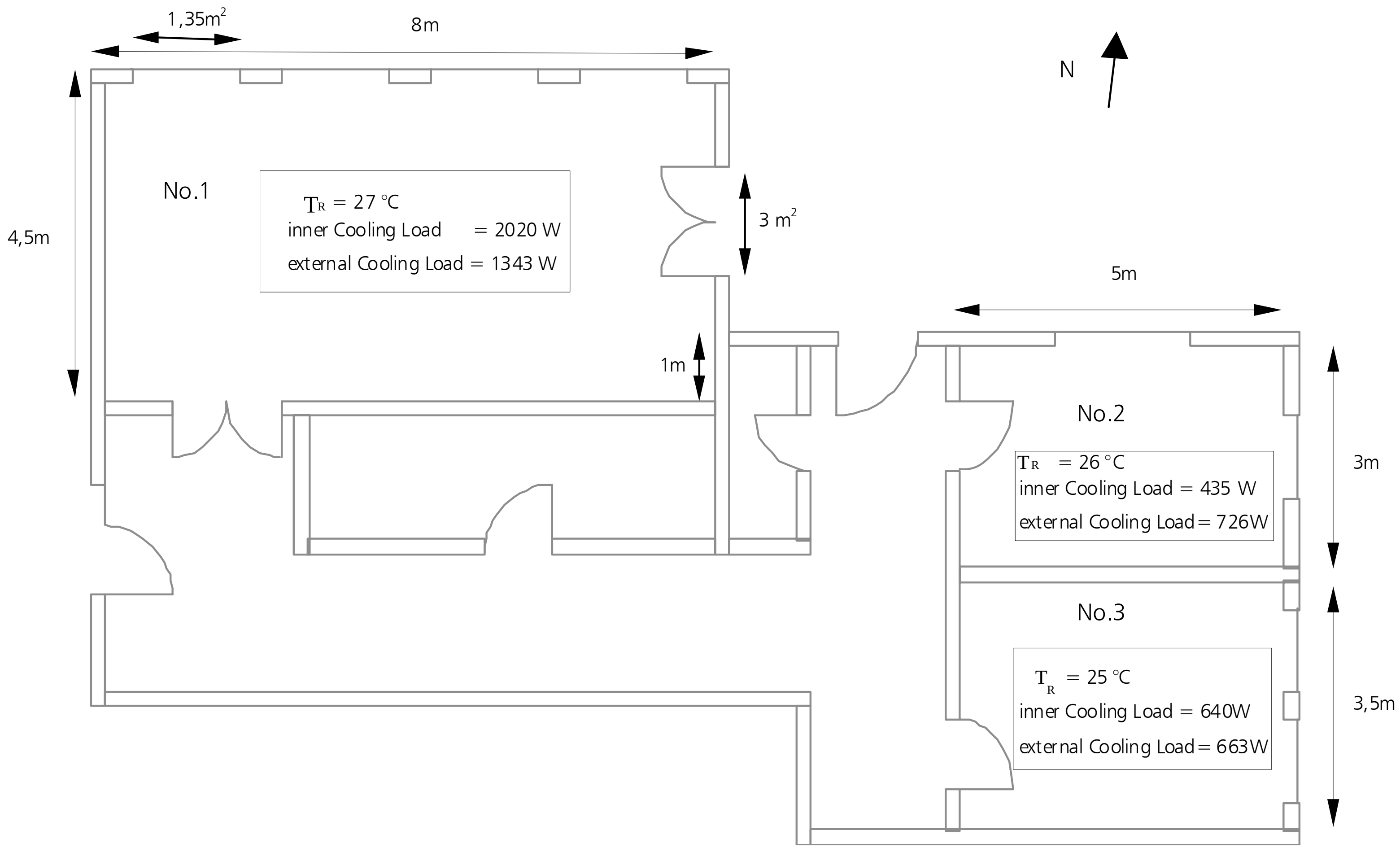


Figure 2: *Layout for BEKA mats*

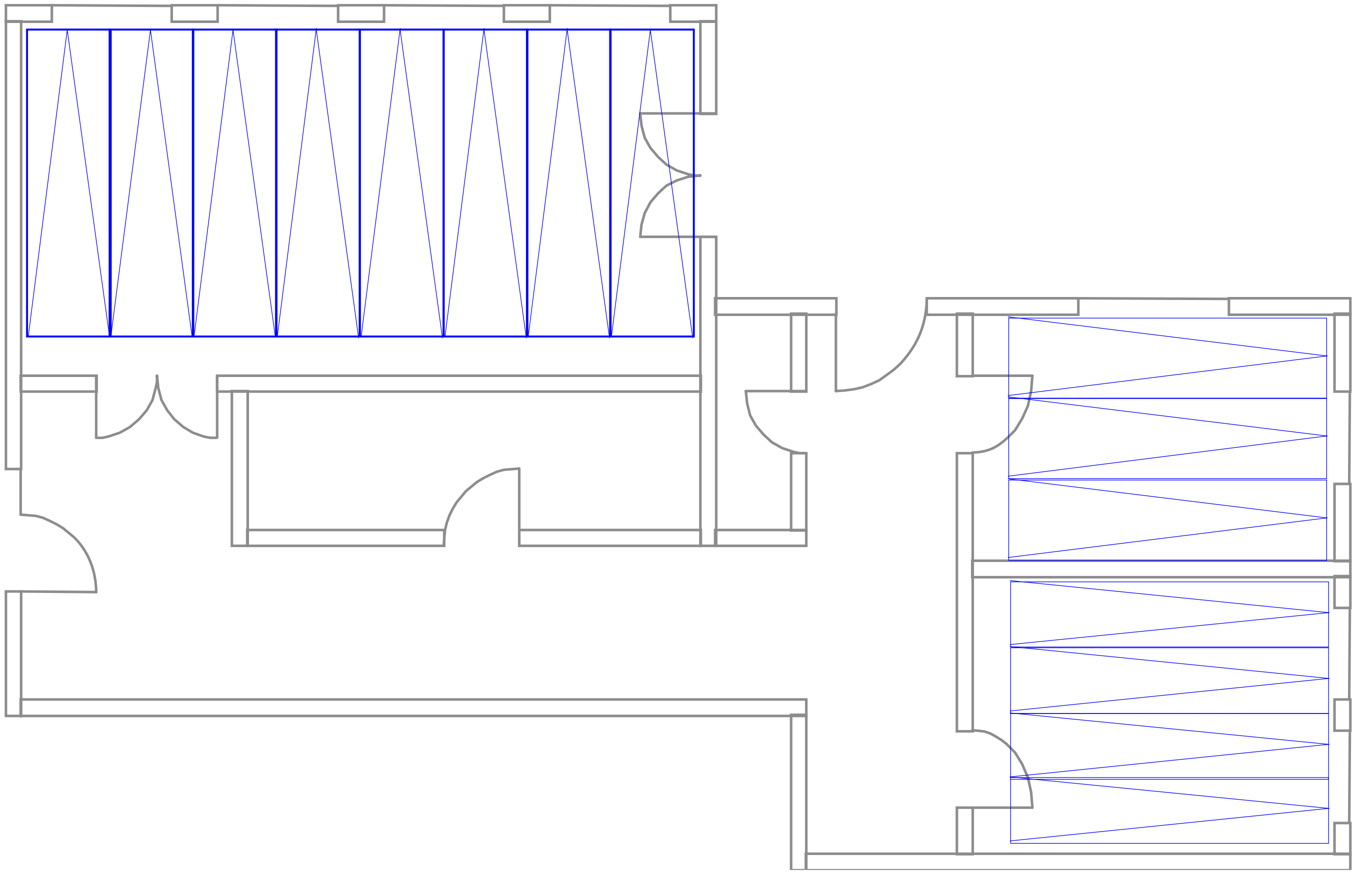


Figure 3: *Connection piping for BEKA mats*

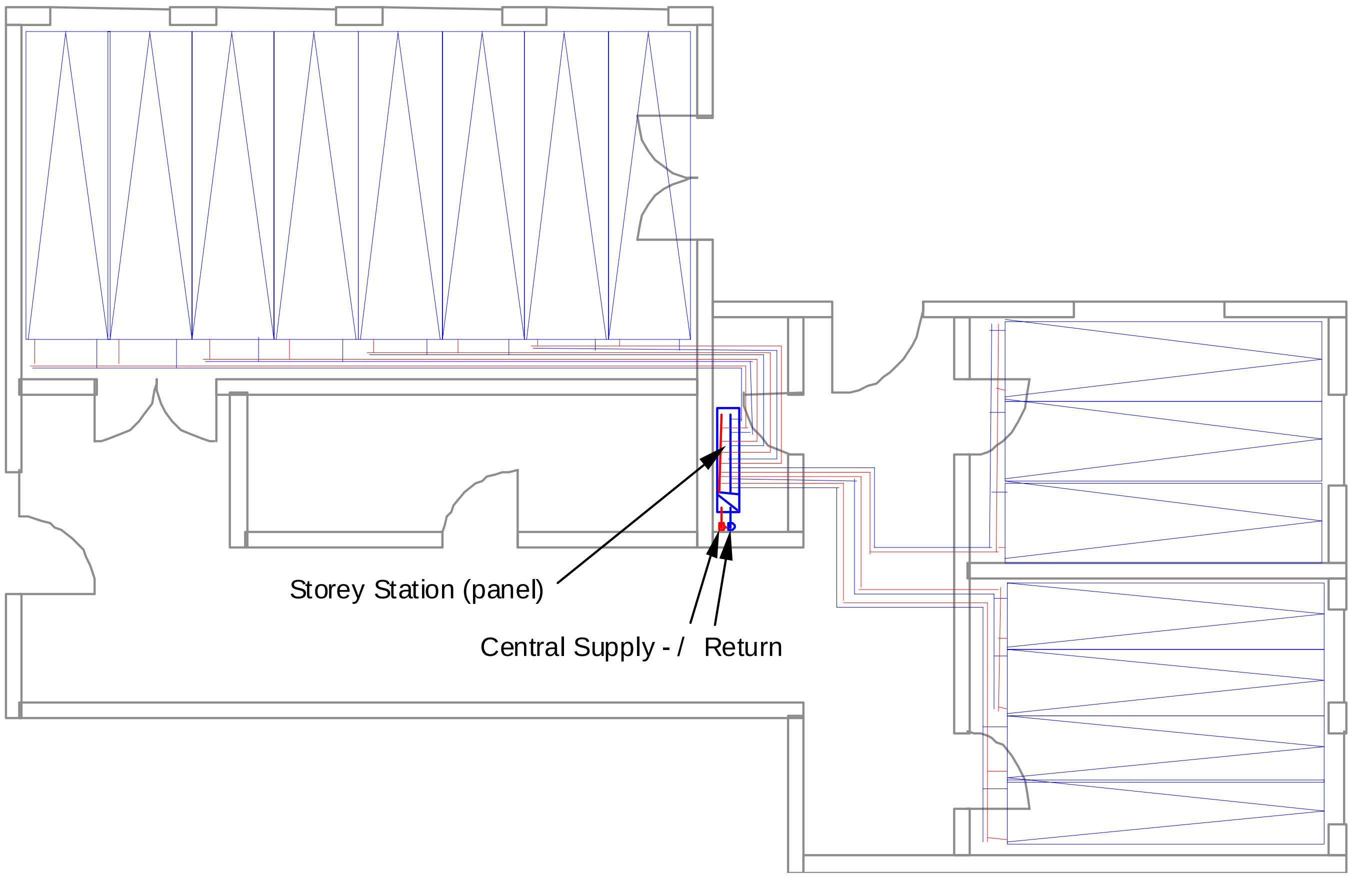
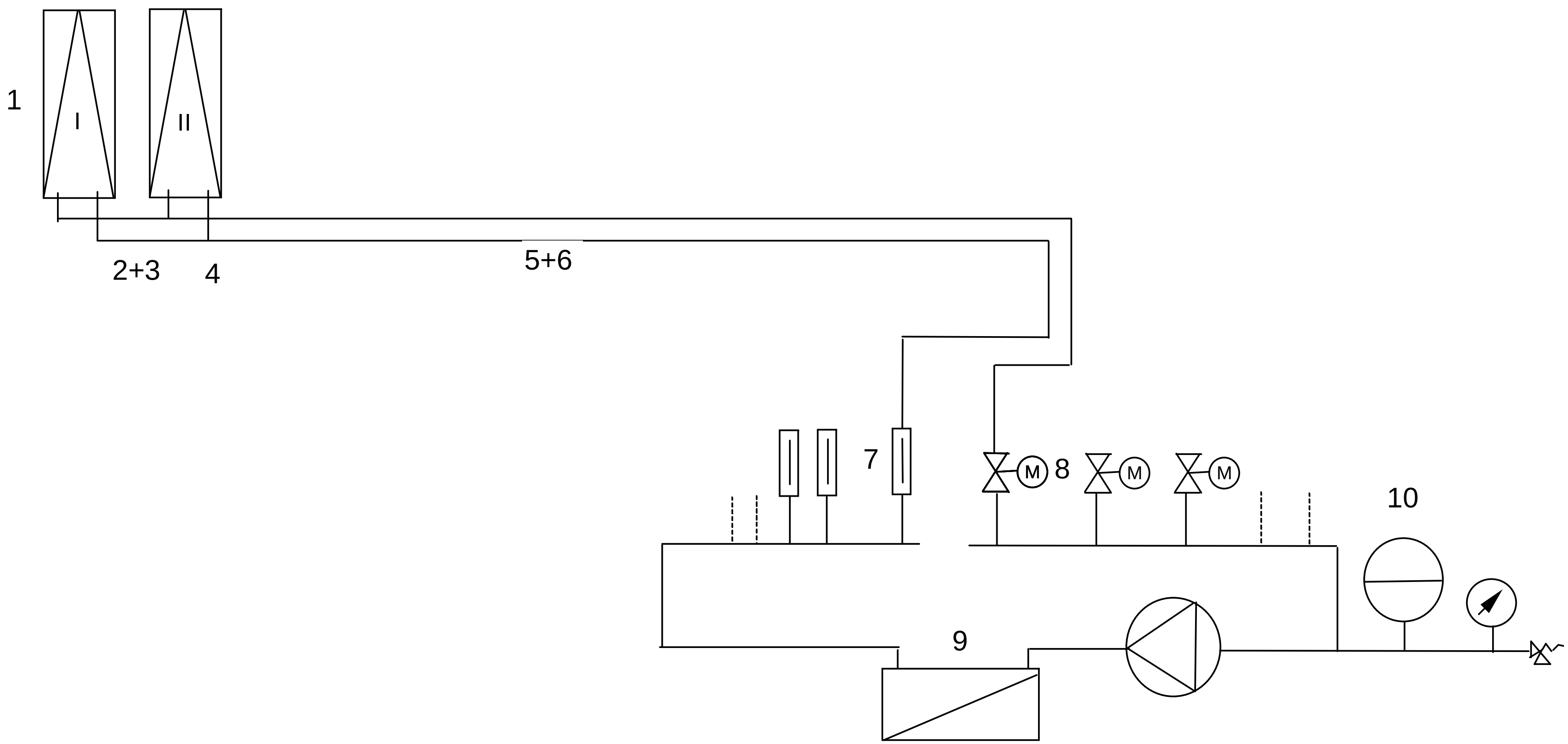


Figure 4: Line schematic (detail)



Example: Construction of a BEKA Cooling Ceiling, Attachment 2, Tables 1-2

Layout Table Cooling Ceiling

	Sample room no. 1
Project engineer:	John Doe
Date :	05.07.2017

Data

1	Room temperature	°C	27.00	
2	Room surfaces	m2	36.00	

Cooling loads

3	Total internal cooling load	W	2020	from calculation of the planning office
4	Total external cooling load	W	1211	from calculation of the planning office
5	Total cooling load based on floor space	W	3231	=(internal cooling load + external cooling load)

Ventilation

6	Air volume intake	m³/h	500.00	allow minimum of 50m³/h person
7	Temperature of intaken air	°C	25.00	
8	Exhaust temperature	°C	27.00	
9	Cooling capacity of incoming air	W	320	= air supply volume * dT * 0.32

Required cooling capacity

10	Required cooling capacity for ceiling	W	2911	= Total cooling load - cooling capacity of air intake
11	Ceiling area covered with mats	m²	33,00	→ compared with calculated value of line 21
12	Required Specific cooling capacity, ceiling	W/m2	88.21	= req. cool cap / ceiling area to cover → compared with line 16

Performance Calculation

13	Supply temperature	°C	16.00	
14	Return temperature	°C	18.00	
15	Average water temperature	°C	17.00	=(Supply temp. + return temp.) / 2
16	Specific cooling load	W/m2	97.45	→ From BEKA calculation tool → compared with line 12

Water volume

26	Cooling water spread	K	2.00	= Supply temperature - return temperature
27	Quantity of mats per room	Stck	8	
28	Length of mat	m	4.30	
29	Width of mat	m	0.96	
30	Area covered with mats	m²	33.00	= Length * width * quantity of mats → compared with calculated value from line 11
31	Mass flow of water	l/m² h	37.98 27.00	=(specific cooling capacity * 3600) / (Spread * 4180) water volume should be minimum 17 l/m² h
32	Temperature above ceiling	°C	27.00	Standard = room temperature of the room above
33	Thermal conductance factor	W/m² K	1.10	
34	Capacity to top	W/m²	11.00	= Therm. conduct. to top * (temp w/o over water temp)
35	Corrected mass flow of water	l/m² h	42.72	=((spc cooling capacity + capacity to top) * 3600) / (Spread * 4180)
36	Water volume of each zone (room)	l/min	23.49	= corrected mass flow / 60 * coverred area
		l/h	1409,76	= corrected mass flow * coverred area

Rough Calculation for the sensible (dry) Cooling load

Important note: For this calculation a temperature difference between inside and outside temperatures of 6°C to 8°C is assumed.

Room location: Sample room No.1
Prepared by: John Doe

Room dimensions:
Length: 8 m Width: 4.5 m Height: 3 m Area: 36 m² Volume: 108 m³

1. Solar radiation, windows: (Outer frame dimensions)

Window / Cardinal points	Width [m]	Height [m]	Qty.	Area [m²]	Double glazed windows without blinds	with inside blinds	with outside blinds	
South	x	x	=		x 205	x 175	x 60 =	W
South west	x	x	=		x 245	x 205	x 75 =	W
South east	x	x	=		x 250	x 205	x 75 =	W
North	1 x	1.35 x	4 =	5.4	x 60	x 50	x 20 =	108 W
North west	x	x	=		x 165	x 145	x 50 =	W
North east	x	x	=		x 155	x 140	x 50 =	W
West	x	x	=		x 255	x 215	x 75 =	W
East	x	x	=		x 250	x 210	x 75 =	W

(Use only maximum values - delete other values!)

2. Transmission energy: Windows (All windows and outside doors)

			Area		
m² +	5.4 m² +	3 m² =	8.4 m²	x 20	= 168 W

3. Transmission energy: Walls (without windows surfaces)

				Area		
Northern and inside walls	3 m² +	24 m² +	18.6 m² =	45.6 m²	x 8	= 364.8 W
All other walls	m² +	13.5 m² +	7.5 m² =	21 m²	x 10	= 210 W

4. Ceiling or roof

Ceiling to non - climate controlled rooms	= 36 m²	x 10	= 360 W
Ceiling beneath the attic, attic floor not insulated	= m²	x 17	= W
Ceiling with 50 mm thermal insulation	= m²	x 10	= W
Flat roof, not insulated	= m²	x 35	= W
Flat roof, with 50 mm thermal insulation	= m²	x 12	= W

5. Floor above non-climate controlled rooms

(omitted when basement is not heated) = / m² x 5 = / W

6. Open passages

Width	Height	Qty.	Area		
x	x	=	m²	x 100	= / W

7. No. of persons in the room

Qty.	Physical work light	average	heavy	
10	x 70	x 85	x 95	= 700 W

8. Lights

(Connection value)

Qty.	connection value		
12	x 60	W	= 720 W

9. Electrical appliances

(Connection value: Observe simultaneity)

Type	Qty	Connection value		
Overhead x	1 x	600	W	= 600 W

10. Other heat sources

Description:

= / W

External cooling load, section 1- 6	= 1211 W
Internal cooling load, section 7-10	= 2020 W
Total sensible cooling load	= 3231 W

Questions before drafting of BEKA Floor Heating

1. Place of Application

BEKA heating and cooling mats are also used for floor heating in houses and commercial buildings, where they are used as low-temperature heating system with an utmost equal floor temperature.
Installation is done on top of the floor construction. In new builds, this is done above the load-distributing layer, in renovation on top of the existing floor surface.
The energy can be supplied through any warm water heating system. Because of the only low heating water temperatures, which are required, heat pumps and solar collector heating systems can be used for the energy supply.

Floor heating constructed from BEKA heating and cooling mats fascinates because of its low construction height. Especially for renovation purpose, construction heights of only 15 – 20 mm are required. The universal application is additionally widened by the extremely short reaction times.

2. Standards and building regulations for floor construction

The following rules and regulations must be obeyed for any type of floor heating construction. Regional additional issues are not taken into account:

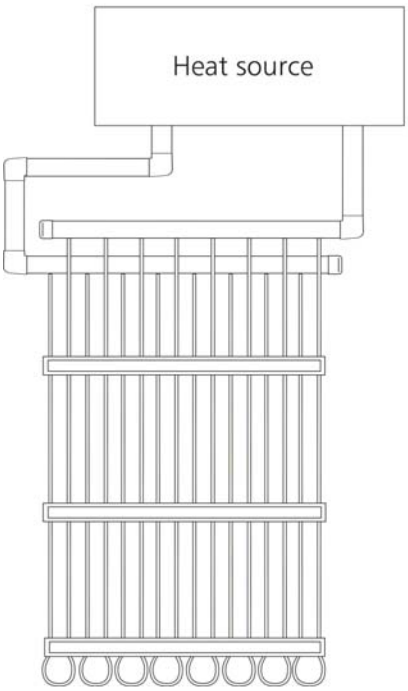
Components for the floor heating construction	
DIN 18164	Plastic foams for insulation in building practice, part 1 +2
DIN 18165	Fibre insulation materials for building practice
DIN 18560	Cement asphalt floor for building practice
VOB Contract procedure act, part C	
General technical contract stipulations for construction work	
DIN 18352	Tiles and tile laying work
DIN 18353	Concrete asphalt work
DIN 18356	Parquet work
DIN 19365	Floor covering work
Typical standards and regulations	
DIN 18195	Building sealing work
DIN 18202	Tolerances for building constructions
DIN 18336	Sealing against pressing water
DIN 18337	Sealing against non-pressing water
DIN 4102	Fire resistance of building materials and components
DIN 4108	Thermal insulation for building construction
DIN 4109	Sound insulation for the building construction
DIN 1055	Part 3, Load bearing capacities for buildings
DIN 4725	Warm water – floor heating
Energy conservation regulations	

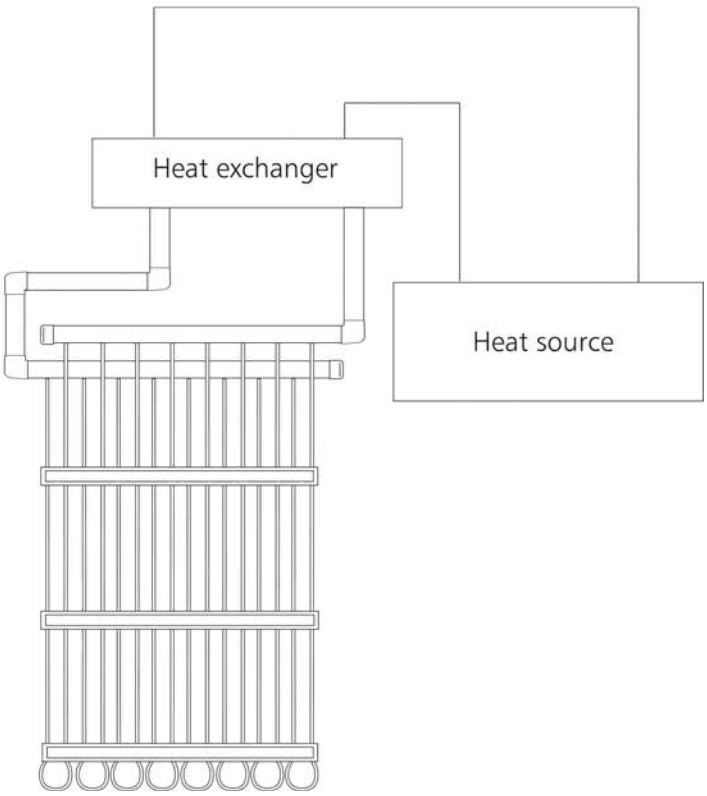
3. System Specification

Floor heating with BEKA heating and cooling mats was especially designed for fast reaction times and for low construction heights of 15 to 20 mm. The supply and return lines for heating water in the BEKA heating and cooling mats are alternatingly laid at gaps of 15 mm. This results into an equal floor temperature with a high efficiency. Low supply temperatures, normally at a maximum of 30°C, are enough for most of the cases, to achieve room comfort even at extremely low outside temperatures. In spite of the low construction profile, height will not cause a restriction to the floor bearing. BEKA heating and cooling mats are manufactured in all lengths and can be assembled to the required widths. Due to the extremely short reaction time of the heating system, BEKA heating and cooling mats are positioned directly beneath the floor surface, only the really required energy is being consumed.

For the installation of floor heating no special building materials are required. Basically, the floor construction is in accordance with the regular design. With new construction, only the asphalt concrete is laid in two steps. For renovation, the floor heating can be installed in one step.

Corrosive components are excluded from use in heating circuits. Suitable materials are all plastic materials, brass and stainless steel. Copper is only suitable with reservations. With transitions from copper to plastic materials, a brass bridge must be inserted to avoid electrochemical reactions.
If it is not possible to use only non-corrosive materials for the heating circuit, a separation must be installed by means of a heat exchanger.
The collector pipes of the BEKA mats and the connection piping can be positioned in wall slots. If the floor construction for a BEKA floor heating system is to be planned for a new building, conduits can be integrated into the load-carrying layer, which later the piping is laid into.





4. Floor Construction

4.1 New Construction

For new construction, BEKA heating and cooling mats are positioned as layer close to the floor surface, on top of the load-bearing layer. The insulation is done according to the regulations of:

- DIN 4725 part 3
- DIN 4109
- WSchV 1/95 (German energy conservation regulation)

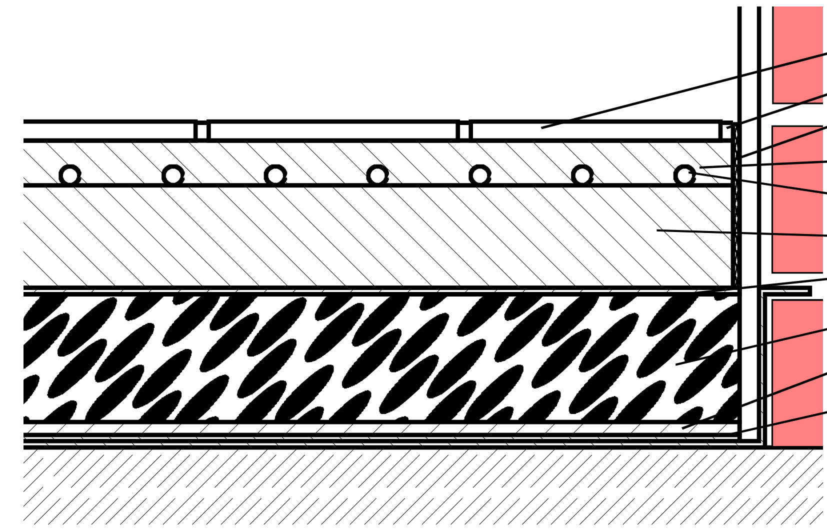
Basically, for the concrete asphalt layer the following materials are permitted for use: Dry asphalt, synthetic resin modified cement asphalt and liquid asphalt according to DIN 18560.

The load-bearing base layer, the insulation and the load distributor layer must be laid The BEKA out according the expected traffic load.

heating and cooling mats are positioned on top of the distributor layer. There after a levelling compound of 10 to 15 mm is applied. The levelling compound must be suitable for floor heating systems and the application must be done according to manufacturer's specification.

According to the relevant work directives, parquet, tiles and/or textile coverings can be laid onto the floor.

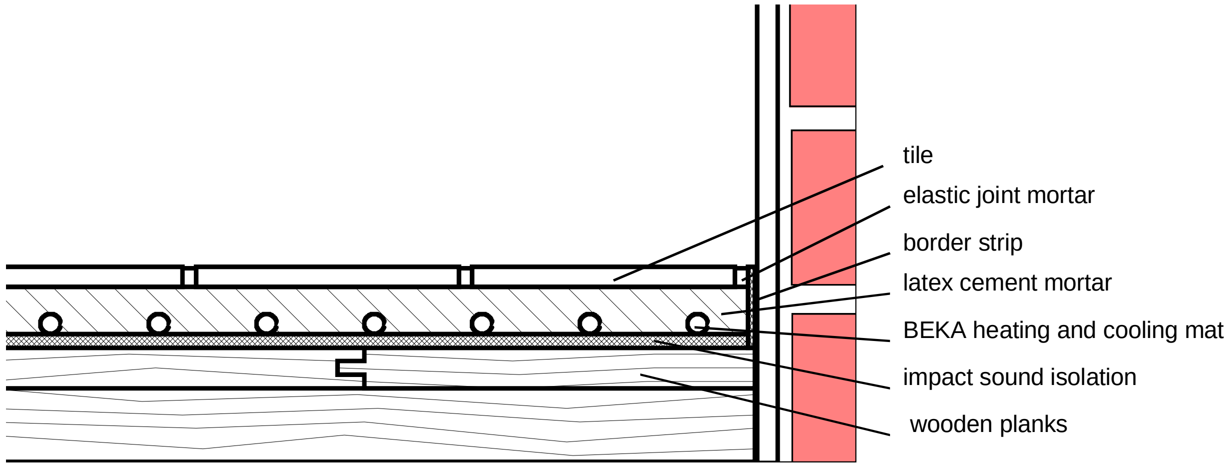
Border insulation strips, expansion joints and building construction sealing are not affected. They have to be planned as usual.



4.2 Modernising

For renovation, low construction heights prove its worth for the use in floor heating systems with BEKA heating and cooling mats.
Pre-condition for the application of a floor heating system in renovation is the existing load carrying floor base.
For boarded wood floors, the floorboards must have the necessary strength and must lie firmly supported. Defective boarded floors must be repaired or exchanged.
Concrete asphalt or tile floors must be repaired, if defect.

Only after that installation preparatory work, the floor heating system can be started with.
The BEKA heating and cooling mats are fixed to the floor base. For boarded wood floors, it is advisable to support the BEKA heating and cooling mats with a 5 mm thick impact sound insulation layer.
On top of the BEKA heating and cooling mats, a layer of (minimum 6 mm) latex concrete plaster is applied, and on top of this a layer of ceramic tiles or natural stone tiles is laid.
Border strips, expansion joints and building construction sealing are to be laid according to relevant work directives applying to the latex concrete-plaster.



Lay-out of BEKA Floor Heating

1. General

Because of the small diameter of the BEKA capillary tubes, it is possible to keep the construction heights at a minimum profile. They are perfectly suitable also for renovation for later installation of floor heating. The BEKA mats are laid on top of a load-carrying base, directly below the surface of a floating screed. The load carrying ability of this thin layer of screed is not weakened by the capillaries tubes. Differing to other floor heating systems, the heat is brought directly beneath the floor surface. For that reason the BEKA floor heating reacts very quickly and can be operated already with low supply temperatures.

2. Layout for BEKA mats as floor heating system

For floor heating the BEKA mat type K.S15 is specifically suitable. Through the close spacing of the capillary tubes of only 15 mm (conventional floor heating systems work with pipe spacing of minimum 120 mm) the supply and return temperatures are close together. On the surface of the floor, therefore a very uniform temperature is achieved and independently from the size of the sections, there will be the same surface temperature at every spot. For this reason, it is possible with BEKA floor heating to achieve the maximum possible heating capacities, which are actually possible, while maintaining the maximum allowable surface temperatures (max. 29°C at the commonly used areas, 35°C at perimeters and up to 32 °C in bathrooms) in reference to DIN 4725/26. The uniform surface temperature will be achieved even if there is a spread of 8 K and more between the supply and return temperatures. Therefore, little specific water quantities are needed.

The achievable heat capacity for a floor heating system can be taken from the standard characteristic curve, according DIN 4725.

The characteristic curve follows the function:

$$q_N\ [W/m^2] = 8.92 * T_Ü^{1,1}$$

with $T_Ü$ – Temperature difference between floor temperature and room temperature

Under consideration of the heat resistances of the floor covering, the heating capacity of the BEKA floor heating can be taken from diagram 21.

This diagram shows the heat capacity in dependence to the temperature differences of floor covering, average heating water temperature and room temperature.

The average heating water temperature is calculated by:

$$T_{WM}\ [°C] = (T_{VL} - T_{RL}) / 2$$

with T_{VL} – Supply temperature [°C]
T_{RL} – Return temperature [°C]

Based on the heat demand, which is calculated externally, now the specific heat capacity in W/m² can be calculated for the floor surface, which has to be covered with the BEKA mats (generally 80% of the room area can be covered, the rest will be covered with furniture). With this value and the chosen floor covering, the average heating water temperature can be determined with the help of diagram. By election of the spread
($sp = T_{VL} - T_{RL}$ and $T_{VL} = T_{WM} + sp/2$) the necessary supply temperature for the heating water can be easily calculated.

The water volume, which is required for the heating capacity, follows the equation:

$$Q = m * c * \Delta T$$

With m - mass flow
c - specific heat capacity
ΔT- temperature difference based on the heat requirement, which is calculated externally $T_{VL} - T_{RL}$

The mass flow should best be converted into the specific mass flow per m^2 of BEKA mats.
With this value the pressure loss can be determined in relationship to the length and type of mat referring the diagrams 7 to 14.
The pressure loss of the BEKA mat will then be used in the calculation for the hydraulic layout of the piping and for the selection of the pump. The dimensioning is done according to known standards. References are included in B04 – pipeline calculation for BEKA heating- and cooling mats.

For the layout the form T07 "Layout for BEKA floor heating" (tables and forms) can be used. The explanation in the form will lead through the calculation.

BEKA
FÜR KLIMA-KOMFORT

Questions before drafting of BEKA Wall Heating

1. Range of application

BEKA heating and cooling mats are also utilised for wall heating. It is a low temperature heating system with an extremely uniform surface temperature, used for houses and commercial buildings.
Installation is done mainly in outside walls. According to WSVO 1995 (energy conservation regulation), the wall must have U-value of maximum 0.35 W/(m²K).
For wall heating, the BEKA heating and cooling mats are mainly laid into the plastering.
The energy supply can be maintained by the warm water heating system. Because of the low supply temperatures, which are required, heat pumps, solar collector systems and calorific value burners can be used for the energy supply.
The heating circuit must not have any corrosive components. If this cannot be assured, the system must be separated with the installation of a heat exchanger, otherwise there is the danger that capillary tubes will clog up.
A wall heating system with BEKA heating and cooling mats fascinates by its uniform surface temperatures, the very good adaptation to building conditions and non-polluting energies used. The universal applications are complemented by the extremely short reaction times of the system.

2. Features of wall heating

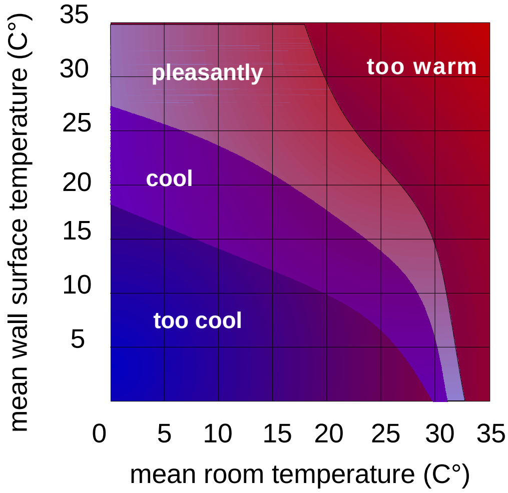
The advantages of the wall heating in general will additionally be influenced through the utilisation of the BEKA heating and cooling mats.

Characteristics of BEKA wall heating:

- High wellbeing through gentle heat radiation
- Dry building with warm walls
- Qualified for the use of solar collecting systems, calorific value burners as well the use of heat pumps
- Great comfort when lowering the room temperature (in comparison to other heating systems). ⇒ One degree less of room temperature results into 6% energy savings!
- Healthy room climate because of little air turbulences
- Short reaction times, since BEKA mats are laid closely beneath the wall surface.
- Nearly every surface can be used for the installation of BEKA mats, since the BEKA heating and cooling mats are very flexible and can be adapted to the building construction.
- Total utilisation of the wall surfaces. Height and width of the BEKA heating and cooling mats are manufactured according project requirements.
- Low construction profile
- Low flow resistance because of the parallel arrangement of the capillary tubes
- Uniform surface temperatures, since supply and return lines are laid with spacing of max. 15 mm only.

A wall heating system has the advantage that there are no radiators obstructing the room and natural cosiness is achieved. The installation of BEKA heating and cooling mats can be done without any problems in new construction and for renovation.
A further advantage is that the wall heating system can also be used for cooling in the summertime. In this case, water with a minimum temperature of 16°C (avoiding the dew point) is circulating through the BEKA heating and cooling mats. Even at the hottest days cosiness can be achieved with this solution, especially "in critical rooms" (beneath inclined roofs or in rooms facing the Southside).

In the following diagram, cosiness is shown in relationship to the temperatures between wall and room temperatures according to ISO 7730. The most pleasant feeling can be reached with lowered room temperatures and warm walls. The chosen room temperature depends on the utilisation of the room. Normally, higher temperatures than 22°C are not necessary.



The diagram shows that with room temperature of 22°C, wall temperature of approx. 28°C can still be felt as pleasant.

3. System specification

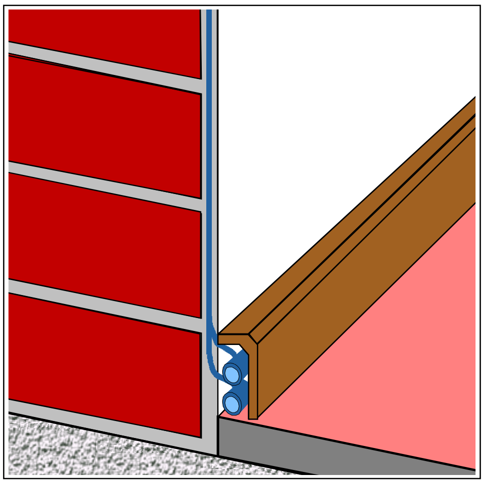
The wall heating system with BEKA heating and cooling mats was especially designed for short reaction times and for cosy living standards. With the BEKA heating and cooling mats embedded in plaster, the supply and return lines of the heating water are alternatingly spaced with 15 mm. This results in uniform surface temperature with high performance release. Low supply temperatures, normally maximum of 35°C, are sufficient for most cases, to reach cosiness inside the rooms, even at extremely low outside temperatures. For heating the rooms, normally only outside walls are used. Only in cases of exceptions, with large glazed window or door units, also inner walls can be taken into consideration.

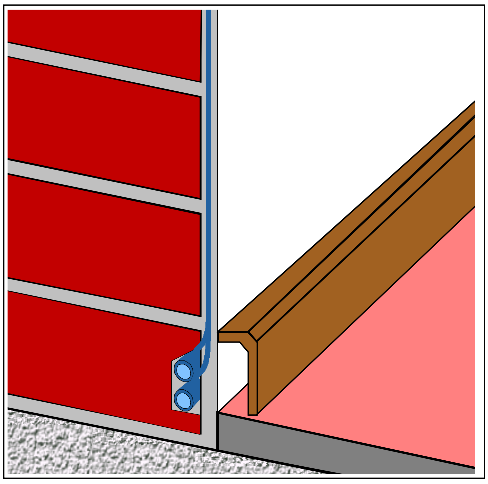
BEKA heating and cooling mats are produced in all lengths and can be matched to the requested widths. Due to the extremely short reaction times of the heating system (BEKA heating and cooling mats are positioned directly beneath the wall surface), only the really required energy would be used up.

When BEKA heating and cooling mats are embedded in the plaster of the outside walls, a layer of insulation has to be attached to minimise energy losses.
The wall heating with BEKA heating and cooling mats often are only covering the walls up to a height of 2 m. Above the mats, there is the possibility to fasten pictures, lights and other components. BEKA heating and cooling mats can be positioned very well at the parapet area below windows, because the mats can be tailored to size by the manufacturer. For wall heating, no special building materials are necessary. Essentially the wall construction is like a conventional wall. For the plaster version, the connector pipes are laid in the bottom rail or in a special- purpose wall conduit.

4. Wall construction

The BEKA heating and cooling mats are laid in the wall plaster. For the plaster, any commercial type (mineral based) can be used. Coarse-grained floating and plaster is not allowed for use, because of the danger that the capillary tubes could be damaged. The working instructions of the plaster suppliers must be obeyed. The base surface must be solid and have good bearing strength. Plaster reinforcement fabrics are not necessarily to be laid over the mats. Only above the loops of the mats and on top of the collector pipes when laid in a wall cavity reinforcing of the plaster this recommended.





Positioning of the collector pipes in the bottom rail and in the wall conduit.

If required, the insulation can be done according to DIN or WSVO. Also, an inside insulation can be used without any problem. Since the walls are heated, dew point shifts will not occur.

Lay-out of BEKA Wall Heating

1. Generals

The small diameter of the capillary tubes of the BEKA mats and the close spacing between the capillaries (only 15 mm) allow the realisation of wall heating systems with low profile and uniform surface temperatures. Also very short reaction times of the heating system are achieved. Already with very low supply temperatures the rooms can be heated. Therefore, the BEKA mats are perfectly suitable in connection with low temperature heating. The BEKA mats are laid onto a solid base surface into layer of plaster, closely beneath the surface. The plaster is not weakened.
Open shelves, interior furnishing and furniture equipped with feet and those, which are not positioned directly to the walls, do not diminish the thermal output. Large wall units, which are not equipped with air vents on top and bottom towards the heating wall, or furniture, which have room height and are directly on the wall will reduce the thermal output up to 20 % and should therefore not be planned as heating surface.

2. Construction of the BEKA mats for wall heating

For wall heating, the BEKA mat type K.S15 is especially suited. Due to the close spacing of the capillary tubes of only 15 mm the supply and return temperatures are close together. For this reason, a very uniform surface temperature is achieved on the surface of the wall. Independently from the panel size the same surface temperature will be maintained on each spot. For this reason, it is possible to achieve a high efficiency while maintaining comfortable surface temperatures (maximum 29°C in living areas, 35 °C at fringes or maximum 32 °C in bathrooms). A uniform surface temperature is achieved even at a spread of 8 K and more between the supply and return lines.
Therefore, only a small specific amount of water is required.

The thermal output, which can be achieved with a BEKA wall heating system, is taken from the characteristic curve in reference to DIN 4703/03.

This characteristic curve follows the function:

$$q_N\,[W/m^2] = C{*}Tü^{\,n}$$

with Tü – temperature difference between the average heating water temperature and room temperature

Under consideration of heat resistance of the plaster, the thermal output of the BEKA wall heating system read from the diagram 29 "Thermal output of the BEKA wall heating system".
The diagram arranges the thermal output in dependence on the plaster type and the plaster thickness to the temperature difference between the average heating water temperature and the room temperature.

The average heating water temperature is calculated from:

$$T_{WM}\,[°C] = (T_{VL} - T_{RL}) / 2$$

with T_{VL} – supply temperature [°C]
T_{RL} – return temperature [°C]

Starting from the heat demand for the room, which is being determined externally, the necessary specific thermal output (W/m²) can be calculated for the wall covered with BEKA mats (normally the walls are covered up to the height of 2 m the rest is kept for pictures and other components to be fastened there). With this value and the one for the chosen plaster as well as plaster thickness, the average heating water temperature can be taken from diagram 29. With the choice of the spread ($sp = T_{VL} - T_{RL}$ and $T_{VL} = T_{WM} + sp/2$) now the necessary supply temperature for the heating can be calculated very easily.

The amount of water necessary for the thermal output follows the relation.

$$Q = m * c * \Delta T$$

with m - mass flow
c - specific thermal output
ΔT- temperature difference
T_{VL} - T_{RL}

The mass flow should be converted to the specific mass flow per m² of BEKA mats. With this value, the pressure loss of the BEKA mat according to length and mat type, can be taken from diagrams 7 – 14. The pressure loss of the mat is considered for the hydraulic layout of the piping and for the choice of the pump. The dimensioning is done according the state of the art. Advices are found in B04 "Calculation for the piping of BEKA heating and cooling mats".

For the layout the form T11 „Layout for BEKA wall heating" (→ tables and forms) can be used. The explanations contained in the form will lead through the way of calculation.

BEKA
FÜR KLIMA-KOMFORT

Requirements for the Water Quality

1. Generals

All applicable regulations and rules for heating and cooling water are generally valid also for installations with BEKA capillary tube mats. The installer and operator of the system should especially pay regard to the VDI 2035 and the DIN 4726. In general, the installer and operator of an installation have to take all measures in order to exclude corrosion.

2. Special Advice for BEKA capillary tube technology

For the manufacturing of BEKA capillary tube mats, pipes, fittings and connection lines, polypropylene is used.
With regard to the oxygenation of cooling and heating water due to the specialties of capillary tube technology, the builder of the installation has to choose the components and heat transfer medium with regard to their corrosion resistance.
A secure measure in order to exclude corrosion is the use of a heat exchanger between the refrigeration or heat generation and the BEKA mats. After the heat exchanger, all components of the BEKA system are made from non-corrosive materials (plastic, stainless steel, brass). This separation of the systems is at the same time a hydraulic separation. Thanks to this technique, a maximum of security for the installation is reached and, at the same time, for the running of the installation clearly defined general conditions in terms of system temperatures and pressure conditions.
For this type of installation, it is usually sufficient to fill the BEKA capillary tube system with simple drinking water with the quality according to the drinking water regulations of 5.12.1990. In case that after checking the water quality a water preparation or treatment is advised, only additives should be used that are explicitly permitted for polypropylene and the other materials used within the system (DIN 8078 – chemical resistance of pipes and fittings made from polypropylene). Advisable is only the filtering of the filling water (filters 20 to 40 μm) while the system is filled.

3. No Danger through Clogging, Sediments or Rust Sludge.

Clogging through lime sediments is not possible in the BEKA system, since the BEKA system is operated as a closed system (a circuit which is similar to the radiator of an automotive engine).
In difference to the drinking water networks, no new lime is brought in once the system is filled. Furthermore, the temperatures of the cooling water are so low (16°C to 19°C) that materials dissolved in water are not yet dissolved.

Conventional water systems can clog through the rust-sludge when oxygen (dissolved in the water) gets in touch with corrosive materials. In the BEKA system, formation of rust-sludge is excluded when all components of the network are made from plastic, stainless steel or brass and when the prevailing regulations for cooling and heating water are complied with. The water in the BEKA system will stay oxygen enriched and clear, even after years.

BEKA
FÜR KLIMA-KOMFORT

Tolerances of BEKA Mats

1. Generals

Given lengths and widths of the BEKA heating and cooling mats are nominal sizes and relate to the outer dimensions of the mats. The designation of the dimensioning is given in the product sheet of the mat type in question. Depending on the mat type and manufacturing method, the actual dimensions deviate from the nominal one. The different deviations are adapted to the usual application of the particular mat type.

2. Length tolerances

The BEKA heating and cooling mats are supplied with minus tolerances to ensure that they will always fit into the existing building screen.

Length / Type	K.U10 K.UM10 K.G10 K.GM10 K.GS10 K.GK10 K.GS10 K.S10 K.S15	K.GG10 K.GT10	P.VS20 P.VS30 P.VG10 P.VG20 P.VG30 P.FS20 P.NS15
to 1000 mm	-5 -20	-5 -15	-5 -20
to 2000 mm	-5 -20	-5 -15	-5 -20
to 4000 mm	-5 -35		-5 -35
to 5000 mm	-5 -40		-5 -40
Over 6000 mm	-5 -50		-5 -50

3. Width tolerances

The widths of the BEKA heating and cooling mats are supplied with minus tolerances (0-10) to ensure that they will always fit into the existing building screen.
Depending on the type, the BEKA heating and cooling mat can only take up certain widths.

	K.G10 11 K.GM10 K.GG10 K.GT10 11	K.G10 20 K.G10 00 K.GT10 20 P.VG10	K.U10 K.UM10	K.S10 20	K.S10 11 K.S10 00 K.G20 00	K.GK10	K.SK10	K.S15
Basic widths (over connections)	155	160	160	165	170	330	330	170
Width step	10	10	20	20	20	10	20	30

	P.VG10	P.VG20	P.VG30	P.NS15	P.VS20	P.VS30	P.FS20
Basic widths (outer size)	400	230	450	200	260	450	300
Width step	10	20	30	30	40	60	300

BEKA
FÜR KLIMA-KOMFORT

Technical Requirements for Basis Stations and Storey Distributors

1. Basics

Basis stations and storey distributors are laid out and dimensioned by BEKA according to the building project. The principle construction is shown in the product sheets of the basis stations and storey stations.

On principle, only non-corrosive materials must be used for basis stations and storey ones.

All used components must have a pressure resistance of PN10.

The distributors are mounted on a galvanised frame and pressure checked with 10 bar.
Due to the use of only non-corrosive materials (stainless steel, brass, nickel-plated brass, plastic etc.) in the secondary cooling circuit, no oxygen is used-up through the anti oxidant process. No potential descent of the oxygen will result between the closed cooling circuit and surrounding air. Therefore, it is insignificant that the PP material used for the BEKA mats system is not diffusion-tight. Because of the non-existing descent of oxygen saturation, a constant oxygen saturation of the cooling fluid is taking place. Exchange of oxygen between the surrounding air and the closed circuit is not sludge-clogged.

2. Basic data

The most important basic data for the layout of the distributors are:

- efficiency in kW
- primary temperatures: 6°/12°C
- secondary temperatures: 16°/18°C
- cooling fluid (portion of Glycol included)
- possible dimensions
- number of zones and their dimensions.

The nominal sizes of the pipes, fittings and valves are designed that flow rates of 1.2 m/s are not exceeded.
Therefore, hydrodynamic noise is not expected.

3. Pressure losses

The heat exchanger has a strong impact to the pressure loss in the distributor.

The choice of the heat exchanger by BEKA is done in a way that the resistance on the secondary side will not exceed the value of 15 kPa.

If there are special demands for the resistance of the primary side, they must be specified at the time of ordering.

The selection of pump, heat exchanger, pipes, fittings and valves made by BEKA is such that a pressure of approximately 40 kPa will be available for the cooling circuit

4. Pump

Recently almost every pump installed in the distributor is pressure-regulated. These pumps have the advantage that because of the pressure regulation, the particular sections of the cooling zones can be excellently tuned without change of volume flow if zones are switched-on or switched-off. Only pumps with non-corrosive components such as bronze or stainless-steel housings may be utilised.

For choosing pumps, BEKA makes the choice that the working point of the pumps is near to the middle third of the characteristic curve of the pump. Here the pump works with its highest efficiency at lowest operating costs.

A further advantage is that the delivery height of the pump can be adjusted to the exact working point. By this measure, it is possible that only the required energy is consumed.

5. Filling, rinsing, bleeding, degassing

5.1 Basis station

Faucets are installed for filling and rinsing of the basis station and heating or cooling system.
The basis station is equipped only with one KFE-faucet. Here, within the system, more KFE-faucets must be provided. With this version, measures must be taken to bleed and degas the piping system.

5.2 Storey station

At the storey station a minimum of 3 KFE-faucets are used. Through systematic opening and closing of the ball-type faucets in each zone, the particular zones can be filled with water and rinsed afterwards. The rinsing process should be done with maximum possible water volume. With this process, possible air enclosures and installation dirt can be rinsed out.
To reach a short time for the start of operation and to fill as well as rinse each zone individually, there is a possibility to install a KFE- faucet in each zone in the supply and return line. At later operation, small air bubbles will leave the water system through the automatic vent.
Water is degassed, when the flow rate will reach very small values. A specific measure for this is the installation of an air bottle in the return line (extra costs). Through a distinctive larger dimension, such a flow rate is reached at which the degassing is taking place. The air bubbles are leaving the water system through an automatic vent. Degassing is also achieved without the installation of an air bottle, if only one zone is in operation and the flow volume will be so small that degassing begins.

6. Filters

Experience has shown that filter units are not required for closed systems. Pollution, which could have been caused by the installation, will be removed through the filling and rinsing process. Further pollution will not occur in the closed system. If a filter is being used after all, a cleaning process must be done unconditionally after start of operation. The rinsing operation contributes exclusively for the rinse-out of air bubbles when filters are in use.

7. Temperature and pressure display

A thermometer of class 1, with a display range from 0 to 60°C or 0 to 40°C should be used for temperature display. Thermometers with larger display ranges or of another accuracy class will not have given an adequate result at a spread of 2°K. The pressure gauge should have a display range of 0 to 6 bar or 0 to 10. Larger display ranges will not have the required read-out accuracy.

8. Zones

The dimensioning of the zones depends on the area, spread and capacity.
In the normal version, a flow meter, regulating valve (Tacosetter, TA-valve or similar) and ball faucet are installed in the supply line. For the return line, a ball faucet and regulating valve is used. For DN15 and DN20, a low cost thermal actuator can be used for the controlling the regulating valve. Larger than DN20, setting valves with motorised actuators are used.
At this point, the accuracy of the volume flows should be pointed out. The capacity of the heating and cooling mats is determined according DIN 4715 part 1. The capacity determination is done with the full and 50% of the volume flow. The capacity results of both volume flows will show that already with a 50% volume flow a capacity of approx. 89% of the full volume flow is reached. These findings should be utilised to positively influence the operating costs. If a volume flow of 90% is planned for each zone, the pump can be dimensioned smaller, thus resulting into lower energy costs.
The capacity of the heating and cooling ceiling will only be insignificantly lower than the standard capacity.

9. Electrical connections

Storey distributors and basis stations can be supplied with the switch panel fully connected.
The measuring and control technology supplied by BEKA works with 24 volts (see: →
M08 "Technical data of the converter M.K.1,
M09 "Technical Data of the room temperature controller M.R 2/3).
All regulating valves of the storey stations should be equipped with auxiliary contacts. The electrical circuit arrangement can be carried out such that when the last cooling circuit is switched-off, also the pump is switched-off. So the pump is treated gently and energy is saved.

The thermal actuators used by BEKA are equipped with an auxiliary contact.
They operate with 24 Volt, switch-on current of 250 mA and operational input power of 3 Watt.

Use of the BEKA calculation tool for determining the cooling and heating capacity and pressure drop

1. Area of application – General description

The *BEKA design aid* allows one to calculate the specific performance values of the different installation variants of the BEKA capillary tube mats. These calculations are based on the results of standard calculations of the cooling load and heat requirement (DIN EN 12831- Calculation of heat requirement; VDI 2078- Calculation of cooling load. (Calculations based on thermal room simulation models can also be used).
The *BEKA pressure drop calculation* for capillary tube mats is used to determine the specific pressure drops of the capillary tube mats. These results are entered into the standard calculations for pipe network calculation. The *BEKA add-on module for pressure drops* allows numerical determination of the pressure drops of individual typical components of the system (how: supply lines, piping, fittings and valves). The results of the calculations from the separate *BEKA calculation tools* can be entered into a separately managed room book. In this way, a summary of all of the data for a system can be produced.
The *BEKA calculation tools* are to be applied with appreciation for practice-oriented design.
The *BEKA calculation tools* have been produced with simple, self-explanatory menu guidance in mind. Hints are superimposed at the marked fields to aid understanding of the terminology used in the *BEKA calculation tools*. However, a basic understanding of the technical relationships that operate in radiant temperature control systems is prerequisite.

2. Restrictions

The *BEKA calculation tools* are in no way calculation software for the complete planning of an entire heating and cooling system. The *BEKA calculation tools* are also in no way theoretical calculation methods that build on material properties of the individual influencing variables.
The basis for the calculations of cooling and heating capacities are clearly defined installation situations of capillary tube mats, testing according to standards. This restriction makes the calculation easier and quickly leads to a result fit for practical use. The specification of material values, parameters and geometric values for the layer structure is not necessary, since only the standard installation situations are recorded in den BEKA calculation tool. The only values that need to be entered are the essential thermodynamic factors. Where installation situations deviate from the verified standard, the user is called upon to interpret the results critically using his/her own expertise.

3. General thermodynamic framework conditions

In all cases, it holds that a chosen surface design with predefined thermodynamically active layers has a specific power output dependent on the temperature in the room and the effective temperature in the cooling or heating water. This relationship cannot be altered. Should the transferable heating or cooling capacity of the intended surface in the desired version not meet the demands, the outstanding capacity requirement can only be met by a change in the relationships of the effective temperatures, enlarging the size of the active surface, a change to a different version of installation situation or the installation of additional components, such as fresh air conditioning.

The maximum dissipatable power of a surface at predefined temperatures of supply and return flow now gives the flow rate of the cooling or heating water which must be brought into the surface. It should be noted here that the specific design of capillary tube technology usually allows spreads in temperature between supply and return of no greater than 4K. In the case of cooling, it is often indeed necessary to limit the spread to 2K, so that high cooling capacities can be transferred whilst excluding the risk of condensation.

4. Strategy

Even if the calculation methods have the same basis, a distinction should be drawn in the calculations for a system as to whether a draft plan/design of a system or an execution plan for concrete determination of the execution and material requirements is to be drawn up. This distinction is sensible since the tasks during these planning phases have quite different freedoms as regards selectable technical needs, and therefore the diverse options of the capillary tube mat installation variants can be enlisted to optimise the system.

5. Calculations during the draft planning/design

The heating/cooling capacity requirement dependent on the building design and room usage is determined by external standard programs. This requirement is referred to the maximum envisaged surface to be activated and specified as a specific variable in the next step. The rule of thumb is that only around 65% of the surface envisaged as radiant heating and cooling can realistically be activated. There are always potential open spaces to consider that need to remain inactive. The inactive surfaces are used to secure lamps or for sun screening, sound equipment, pictures or the like. In appreciation of the energy balance, it is essential to observe that all factors which lessen the required capacity are taken into account. Should the system be equipped with air conditioning equipment, this component's contribution to cooling or heating capacity is to be taken into account in the requirements on capacity of the radiant heating and cooling.
The required room temperature has already been stipulated in the calculation of cooling load and heating requirement.
The boundary conditions for selecting the flow and return flow temperatures are already fixed by the choice of the remaining components of the system. When selecting the remaining components of the system, such as equipment for providing the heating and cooling water, the aim should be sensible energy efficiency.
Finally, architectonic designs for the ceiling structure should also be considered.

The sensible steps in the draft planning/design of a system are illustrated by way of the following example:

Step 1: Compilation of the technical framework conditions

In the example:

<u>From the cooling load calculation:</u>

Room area	= 100m^2
Cooling load	= 5,130 W
Room temperature	= 26°C
Max. area to be activated	= 65m^2
Cooling capacity component of incoming air	= 320 W
Specific required cooling capacity of ceiling	= 73 W/m^2

<u>Presets from selection of system components for the cooling water preparation:</u>

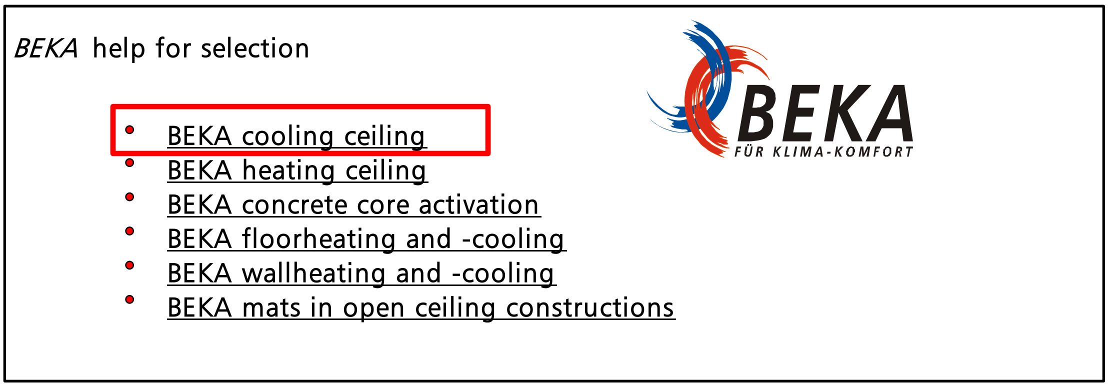
Flow temperature for cooling ceiling	= minimally 16°C
Return temperature for cooling ceiling	= minimally 18°C

<u>Architectonic requirements:</u>
Smooth ceiling surface without joints or visible proportion of holes

With the *BEKA design aid,* the decision can now be reached as to whether the capacity requirement can be met with the desired installation situation of capillary tube mats.

Step 2: Selection of the function and surface to be activated

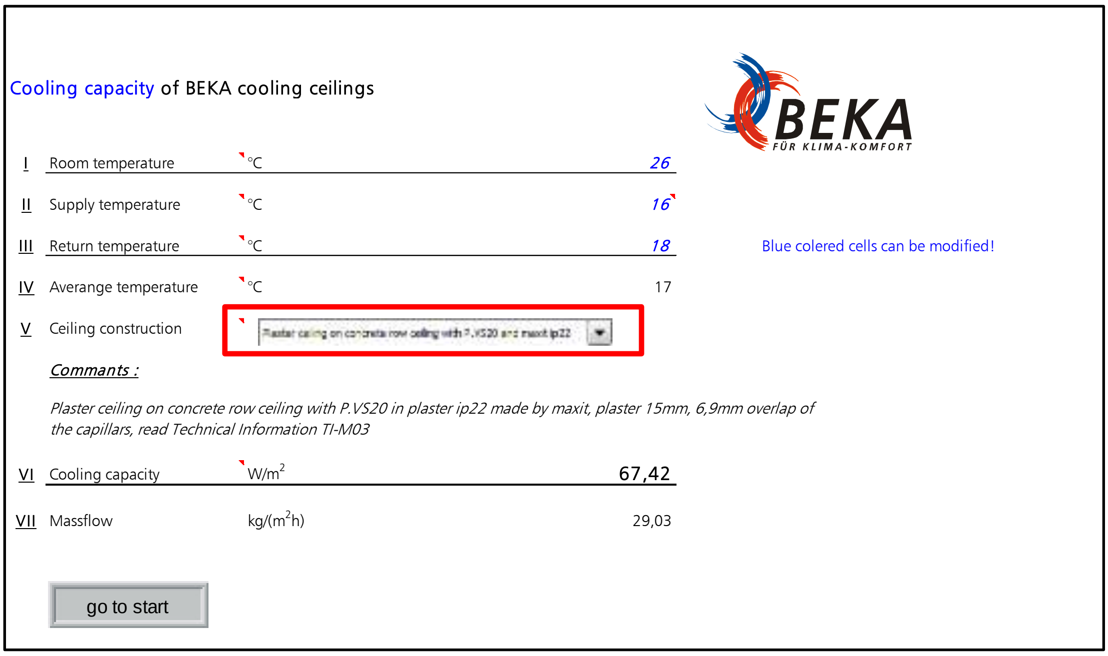
The start screen (cover page) of the *BEKA design aid* is coarsely divided into functions and surfaces. When a choice is clicked on with the mouse, the program activates the desired calculation (e.g. “BEKA cooling ceiling”)



Screen 1: Start screen

Step 3: Selection of the ceiling structure

In the “Select ceiling structure” window, the desired/intended ceiling structure can be chosen from a drop-down list. For each version stored, the corresponding test certificate can be requested from BEKA as evidence. The general description of the layer composition and materials used is already specified in the calculation sheet. (E.g. “Plaster ceiling against concrete ceiling with P.VS20 and maxit ip22“)



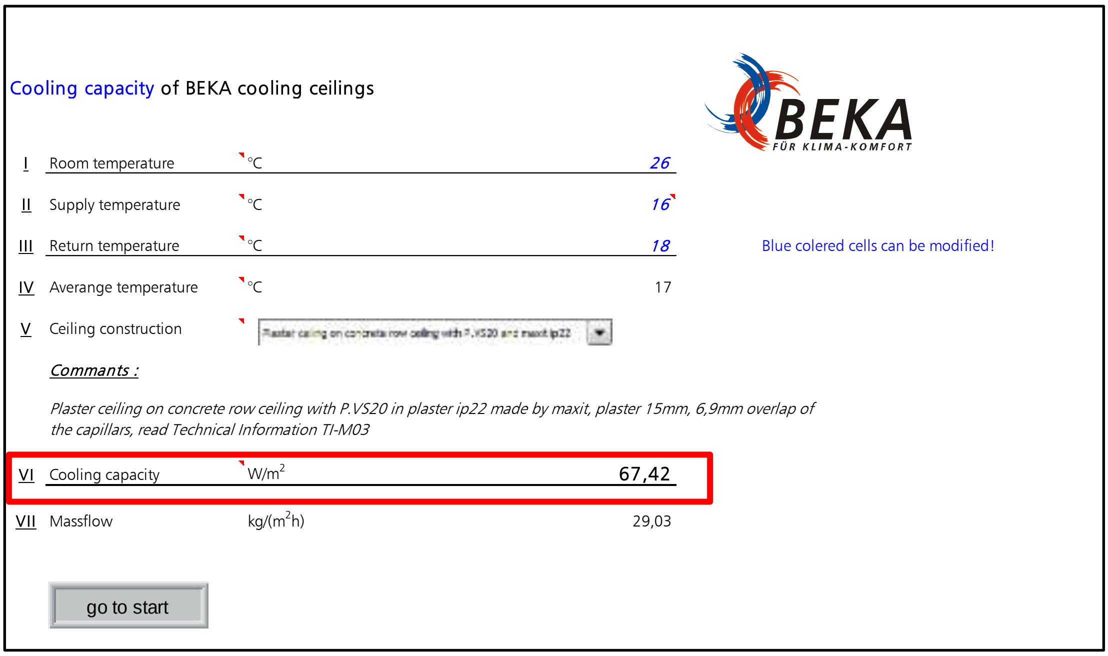
Screen 2: Select ceiling structure

Step 4: Entry of temperatures

The room temperature, flow and return temperatures are entered in the same window. The room temperature entered here matches the requirement from the cooling load calculation. The values for the flow and return temperatures are often already predetermined by the choice of equipment for the cooling water provision.
In the example: Room temperature 26°C; Flow temperature 16°C; Return temperature 18°C.

Step 5: Emission of specific cooling capacity

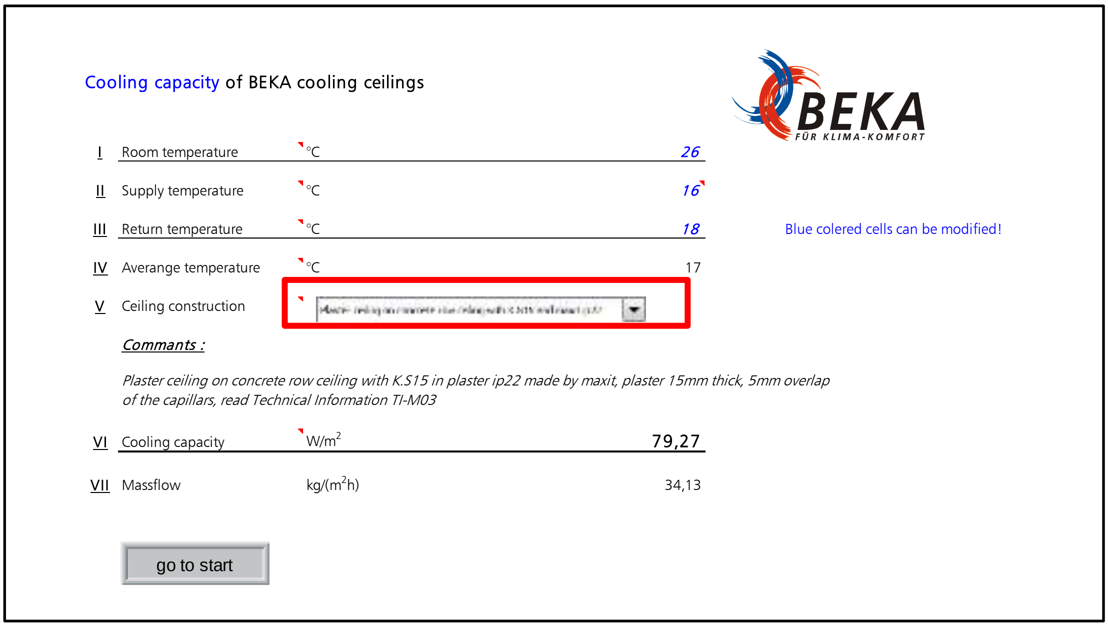
The cooling capacity for this installation situation is stated in W/m². The value relates to the specific surface, i.e. the activated surface actually planned with capillary tube mats. The result is to be compared against the requirement from the cooling load calculation. Should the target value for specific cooling capacity already be reached with the chosen installation situation, planning can continue with step 7.
In the example, a value of 67.42 W/m² is achieved. That is not enough to meet the requirement of at least 73 W/m². This calls for changes in the technical implementation.



Screen 3: Select ceiling structure

Step 6: Optimisation

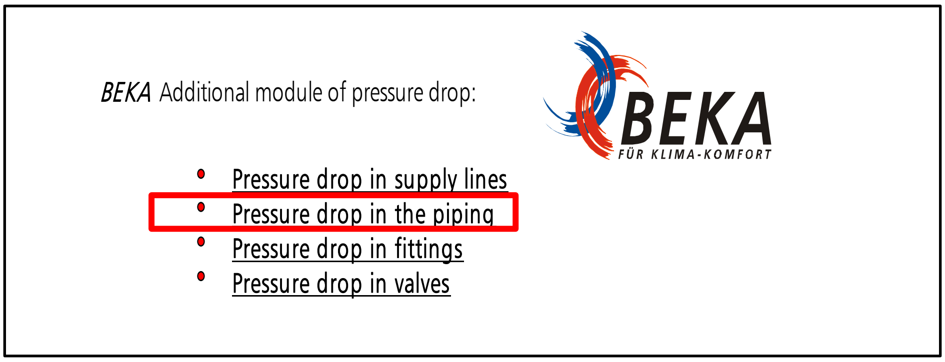
Before the technical framework parameters are altered, an attempt should be made to still meet the demands for output capacity with an installation situation more appropriate than the first one chosen. Changing the thermal specifications should be done only as a second train of thought. A change in the predefined temperatures may indeed quickly lead to the desired result, but often has a negative impact on the energy efficiency of the entire system. In any case, the architect’s approval should be sought when altering the installation variant if this will result in a totally different appearance. Changes in the cost estimate may also arise due to this.
In the example, the alternative ceiling structure “Plaster ceiling against concrete ceiling with K.S15 and maxit ip22” is chosen. A specific cooling capacity of 79.27 W/m² is achieved with this change – this fulfils the target value from the cooling load calculation.



Screen 4: Select ceiling structure, variant 2

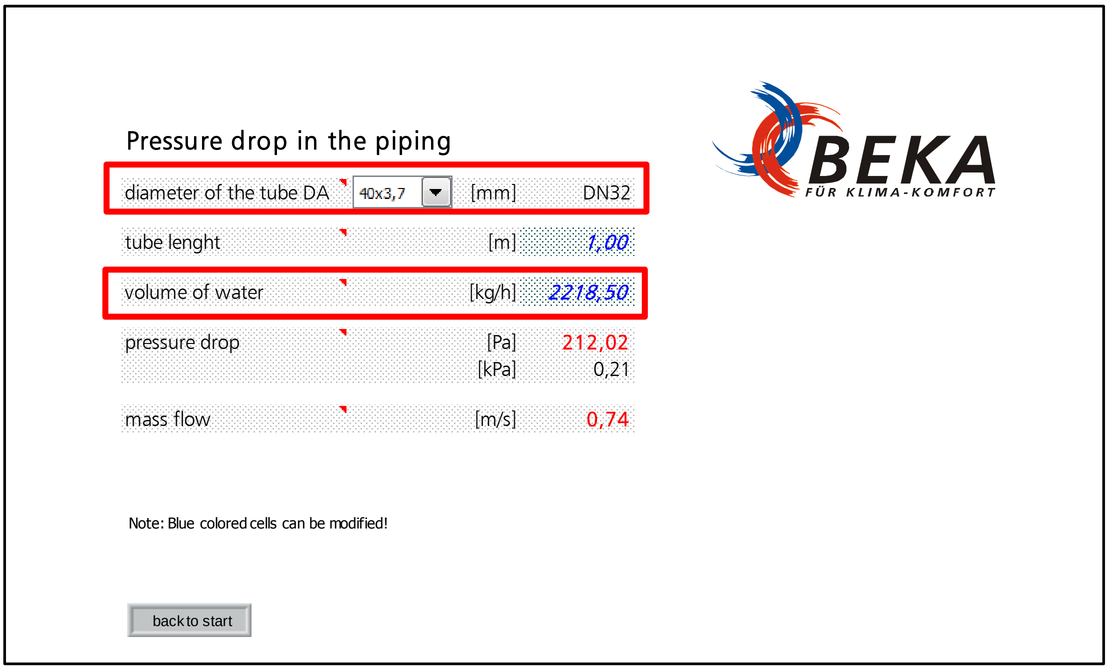
Step 7: Hydraulic sizing of the system

It must be ensured that the cooling ceiling is supplied adequately with cooling water. For this reason, the pipe sizes and pump capacity need to be estimated. The *BEKA design aid* shows the water volume required in kg/(m^{2}h) for the provision of energy. Multiplying this value by the surface intended for activation within the room or envisaged cooling zone yields the required mass flow that the pump needs to deliver for this room (or zone) alone.
To prevent flow noises in the piping, flow speeds of under 1m/s should be planned for. With the total water volume now known, a suitable size connecting pipe can now be determined with any standard software for pipe network sizing or else slightly less conveniently with the *BEKA add-on module for pressure drops*.



Screen 5: Start screen

To work out the connection size of the mat surface with the *BEKA add-on module for pressure drops*, the “Pipe network” tab is opened on the start screen.
Next, the total amount of water is entered at “Water volume”, the latter being obtained by manual adding the values of the separate mats on the surface to be supplied. Heeding the advice that the flow rate in the connecting pipe should be under 1 m/s, the appropriate connection size can now be selected in the “Ø pipe DA” drop-down list.
In the example: 79.27 W/m^2 and 34.13 kg/(m^{2}h) = 2,218.5 kg/h for 65m^2 ⇒ from e.g. the add-on module for pressure drops: Connection size DN32.



Screen 6: Pressure drop in the pipe

In the example, the 65m^2 of active surface must therefore be connected to a DN32 size pipe.

It should be noted that with large active surfaces within a room, subsequent division into smaller control areas is often sensible to allow partitioning of the room. In this case, the pipe size must be calculated for the actual active surface (then as “active room surface”) to be attached in the control area.

Step 8: Estimates of pressure drops

During the design phase, estimates of the pressure drop elements of the components in the system are usually adequate. However, should a more precise calculation be required, it is convenient to use standard software to fulfil this task.
After defining the arrangement of the mats and determining the length, width and number of mats to be used, the pressure drop attributable to the mats can be determined with the *BEKA pressure drop calculation* for capillary tube mats. This value is then entered into the calculation methodology of the standard software.

If no standard software is available, the values of individual pressure resistances from the *BEKA calculation tools, BEKA pressure drop calculation* and *BEKA add-on module for pressure drops*, can be calculated manually in sections and brought together in a separate table manually for an end result. This procedure though can only be an aid since there are far more convenient approaches using standard software.

Step 9: Compilation of the results of the draft planning

In the example:

Plaster ceiling against concrete ceiling with K.S15 and maxit ip22

Room area	= 100m²
Room temperature	= 26°C
Max. area to be activated	= 65m² (65%)
Specific required cooling capacity of ceiling	= 73 W/m²
Flow temperature for cooling ceiling	= 16°C
Return temperature for cooling ceiling	= 18°C
Connection size	= DN32

Step 10: Formulation of the performance specification

BEKA makes available drafts of suitable texts for performance specification. These texts are kept general and their content always needs to be adapted specific to the project by agreement with the other specialist services.

6. Calculations in the design planning

Up until the design planning phase, greater elaboration of the technical task is often necessary. These changes should ideally lead to an improvement in the system technology. At the time of the execution plan though, there is usually no fundamental deviation from the technology stipulated in the draft plans and defined in the performance specification. An examination of the performance values of the cooling ceiling is always necessary though, even if the construction work is to proceed as envisaged in the draft version. For this examination the *BEKA design aid* is used once again.

Step 1: Recording of the actual requirements

After only a smooth plaster ceiling was stipulated in the draft phase, now in the design phase the ceiling is to have a sound deadening effect, for example. The new task in the example is:

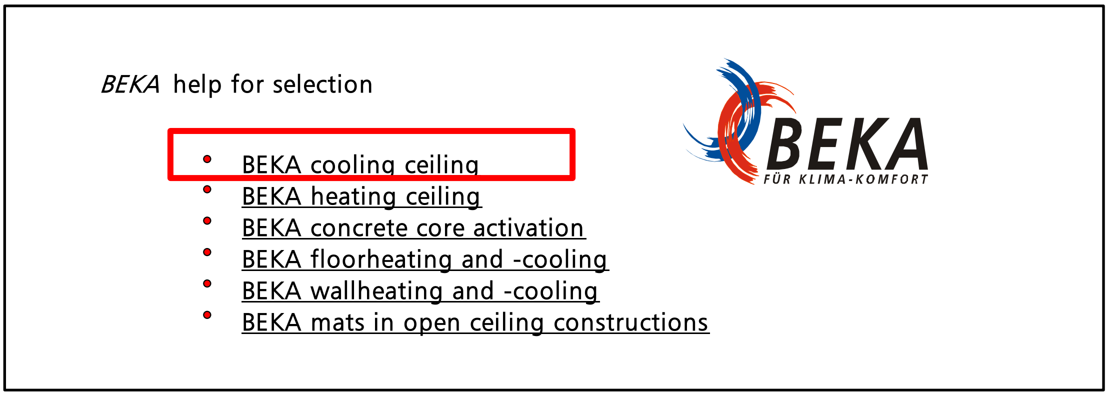
Smooth plaster ceiling against concrete ceiling with <u>acoustic requirement NCR 0.65</u>

Room area	= 100m²
Room temperature	= 26°C
Max. area to be activated	= 65m² (65%)
Specific required cooling capacity of ceiling	= 73 W/m²
Flow temperature for cooling ceiling	= 16°C
Return temperature for cooling ceiling	= 18°C
Connection size	= DN32

Alone the change in the installation situation with regard to the now newly defined acoustic requirement necessitates a new arrangement.

Step 2: Selection of the function and surface to be activated

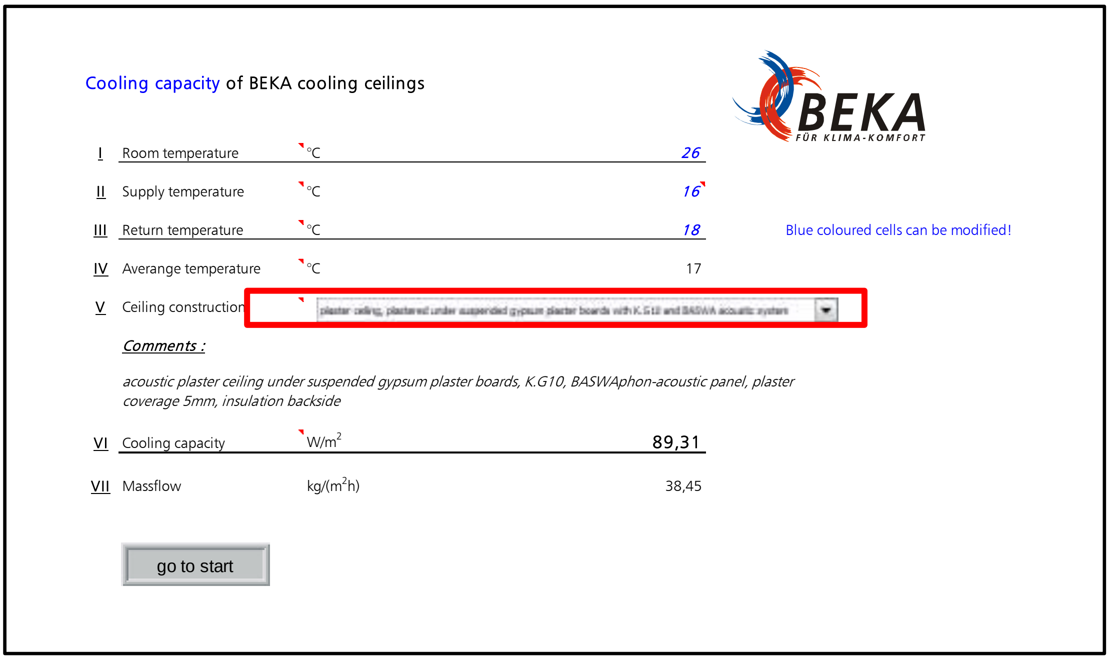
The start screen (cover page) of the *BEKA design aid* is coarsely divided into functions and surfaces. In the example a cooling ceiling is to be built. On clicking with the mouse on the "BEKA cooling ceiling" option, the program initiates the calculation.



Screen 7: Start screen

Step 3: Selection of the ceiling structure

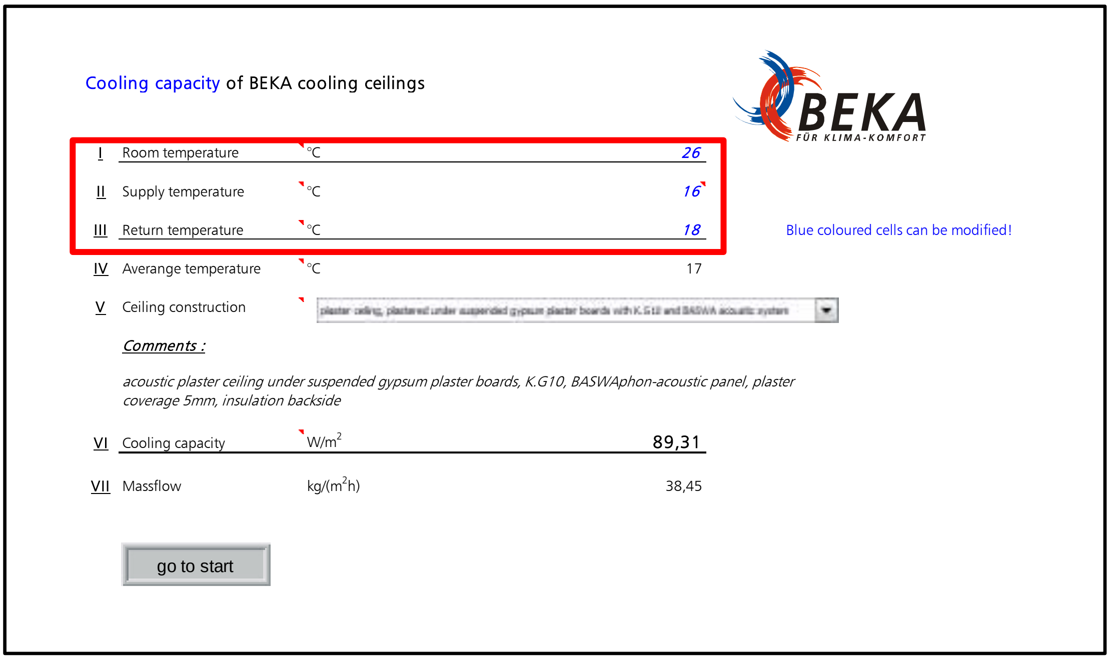
In the *Select ceiling structure* drop-down list, one can select the desired/intended ceiling structure.
In the example, a smooth ceiling with an acoustic effect is now to be installed (e.g. "plaster ceiling under GK with K.G10 and BASWA acoustic system").



Screen 8: Select ceiling structure

Step 4: Entry of temperatures

The room temperature, flow and return temperatures are entered as per the performance text.
In the example: Room temperature 26°C; Flow temperature 16°C; Return temperature 18°C.



Screen 9: Entry of temperatures

Step 5: Generated specific cooling capacity

The cooling capacity for this installation situation is stated in W/m^2. The value relates to the specific surface, i.e. the activated surface actually planned with capillary tube mats. The result is to be compared against the requirement from the performance specification. Should the target value for specific cooling capacity already be correctly reached with the chosen installation situation, planning can continue with step 7. If the value generated for cooling capacity deviates from the target value in the performance specification, the ceiling is to be optimised.
In the example, a value of 89.31 W/m^2 is reached: this is distinctly more than the 73 W/m^2 required. That is a good basis for optimising the technical implementation.

Step 6: Optimisation

If the value generated for cooling capacity does not reach the predefined value in the performance specification, the specified implementation must be discussed with the customer.

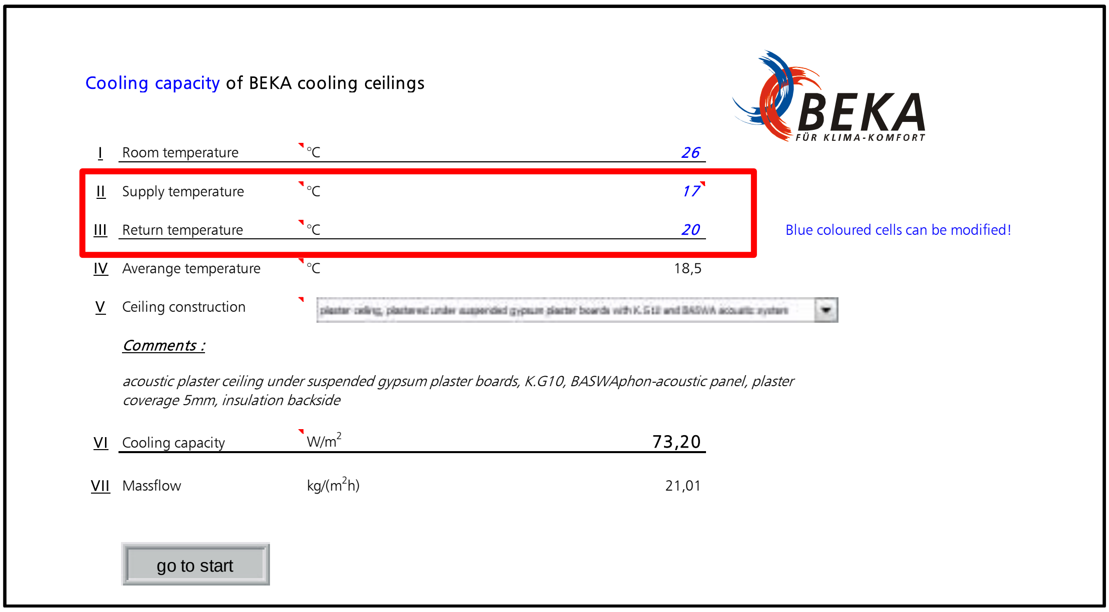
A decision can be made here:
- The shortfall in capacity is accepted (but this is seldom the case)
- More surface area can be activated – fewer ceiling fittings or walls are activated as well (the additional costs need to be clarified)
- The flow temperature or temperature spread between flow and return is lowered (poorer energy efficiency of the overall system must be accepted by the customer)
- The room temperature is increased (deterioration in comfort is accepted)
- The cooling load percentage of fresh air is increased (deterioration in energy efficiency and comfort is accepted)
- A different installation situation is defined (additional costs may need to be clarified)

If the value generated for cooling capacity reveals a higher figure than the performance specification prescribes, a decision about optimisation can be made as follows:

- The surface to be activated with capillary tube mats can be reduced (the degree of activation falls, fewer capillary tube mats are installed - a cost saving is to be expected)
- The flow and return temperatures are increased (the energy efficiency of the overall system will increase)
- The spread between flow and return is increased (the size of the connecting pipe is smaller – a cost

saving is to be expected)

All changes with respect to the performance specification should be discussed and agreed with the customer. The value added and extra costs should especially be discussed with the customer when the reason for the higher cooling capacity achievable is a higher grade style of ceiling.
In the example, the acoustically active plaster ceiling achieves 89.31 W/m^2 at the temperatures specified. At the same time though, considerable additional costs are to be expected for the now higher quality ceiling. Optimisation is achieved by increasing the spread between flow and return temperatures to 17°/20°C. The cooling capacity is 73.2 W/m^2 and meets the requirements of the performance specification. Cost savings to be expected due to the reduced connection size and lowering of the required pump output can be used to offset the additional costs of the higher quality ceiling.



Screen 10: Increase in the spread between supply- and return flow

Step 7: Arrangement of the capillary tube mats

The length and width of the capillary tube mats and orientation of the connections is to be recorded in the ceiling plan. The type of mat complies with the intended installation variant, i.e. for attachment to the ceiling, wall or floor.
The capillary tube mats are manufactured to the appropriate length and width specific to a project. The maximum width though is 1200mm. If wider mats are to be installed, the required widths are made by putting together segments at the work site. In its standard range BEKA produces capillary tube mats up to 6000mm in length. Excess lengths can be manufactured by agreement. It should be borne in mind though that the pressure drop of mats with a length of over 6000mm is high.

All further entries in the ceiling plan are made on the basis of the pipe network plan to be drawn up separately. This planning work has no specific content that is conditional on the capillary tube technology. The standard software is used here. As an alternative, the *BEKA add-on module for pressure drops* can be used. However, this program requires the calculation of individual components and the collating of values in the BEKA room book.

Step 8: Calculation of pressure drops

After defining the arrangement of the mats and determining the length, width and number of mats to be used, the pressure drop attributable to the mats can be determined using the *BEKA pressure drop calculation* for capillary tube mats.
This value is then entered into the calculation methodology of the standard software.

BEKA Additional module of pressure drop:

- Pressure drop in supply lines
- Pressure drop in the piping
- Pressure drop in fittings
- Pressure drop in valves

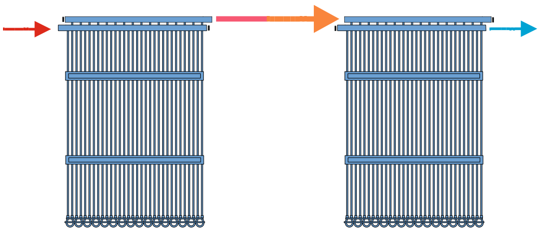
Screen 11: Start screen

Capillary tube mats can be connected individually to the connecting pipework or first interconnected to form a row. The interconnection has some influence on the pressure drop. A pressure drop of more than 30kPa should generally be avoided, otherwise the required pump output becomes very great and the cost of installing and running the system turn out high. Moreover, the flow in the capillary tube should remain laminar. The heat exchange between the cooling water and pipe wall is nevertheless good and the laminar flow assists the venting of the system.

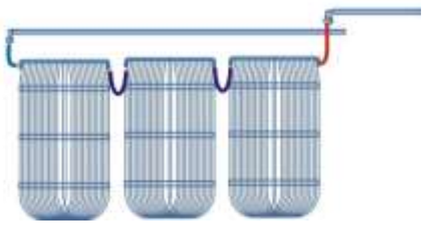
For an understanding of series and parallel connection, the analogy of wiring two or more resistances in electrical engineering helps.

The following interconnections are standard:

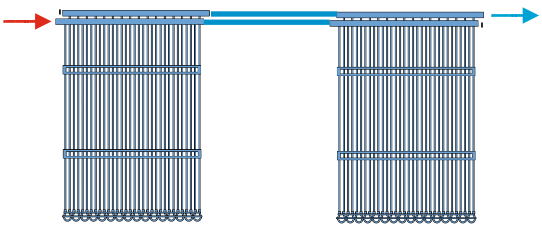
Series connection



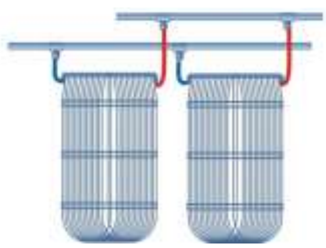
Series connection when flexible hoses are used



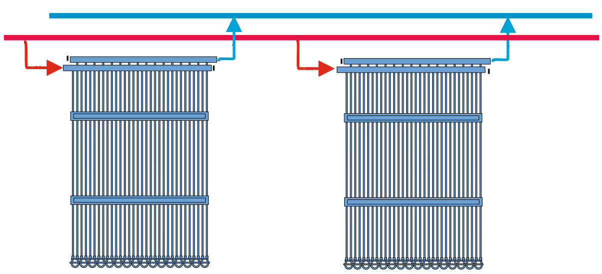
Parallel connection to „Tichelmann"



Parallel connection when flexible hoses are used

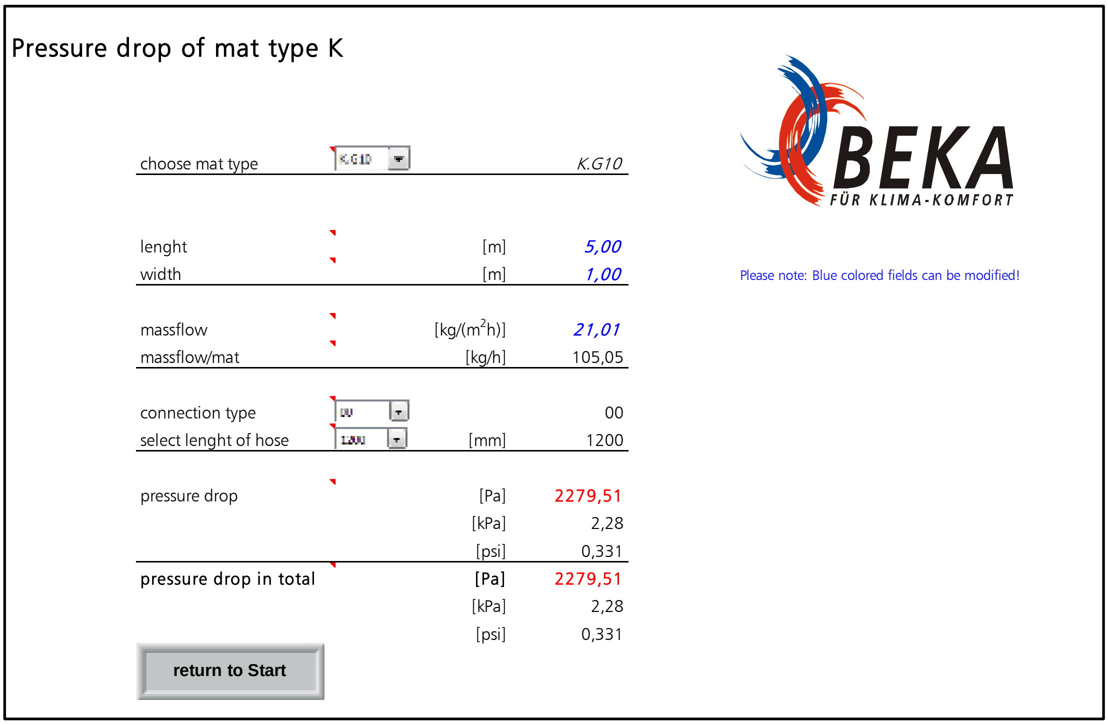


Parallel single connection to „Tichelmann"



The *BEKA pressure drops calculation tool* allows various connection variants to be calculated. If no connecting tube is used, selection of connection type “00” suffices. In this case the pressure drop in the connecting tube is not calculated. If the capillary tube mat is joined to the connection piping via connection tubes though, the length of the tubing used must be selected. The overall pressure drop then shows the value that can be entered as a single resistance for the capillary tube system in the pressure drop calculation of the current pipe network calculation software.

Capillary tube mats that are directly joined to one another on the main pipes result in a wider mat. As a rule, the pressure drop is determined primarily by the length of the capillary tube. Thus combined mats have a greater pressure drop than narrow ones only after the width exceeds 4m.

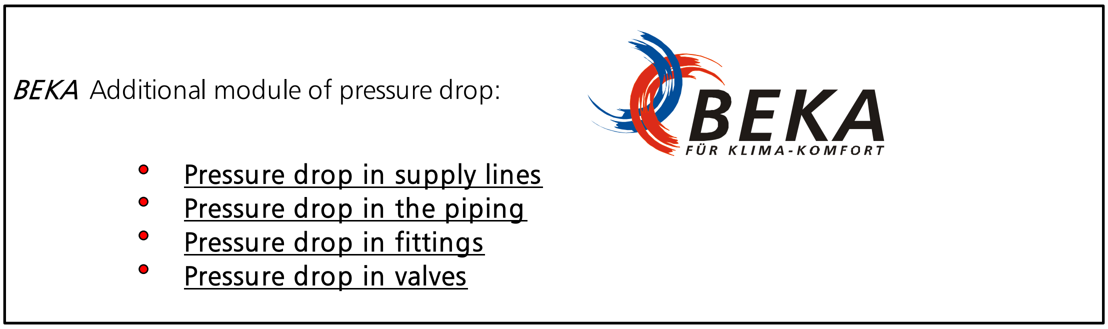


Screen 11: Start screen

In the example, the plaster ceiling with the BASWA acoustic system uses series K.G10 mats which are 5m long and 1m wide. To ensure the required cooling capacity of the ceiling at the predefined water and room temperatures, the flow rate through the individual mats must be 21.01 kg/(m^{2}h). This value is transferred manually from the *BEKA design aid* into the *BEKA pressure drop calculation*. Since the mats are directly connected to the supply lines via thermal plastic welds (no connecting tubes are used!) the pressure drop of the mat also corresponds to the overall pressure drop = 2,279.51Pa.

Step 9: Hydraulic sizing of the system

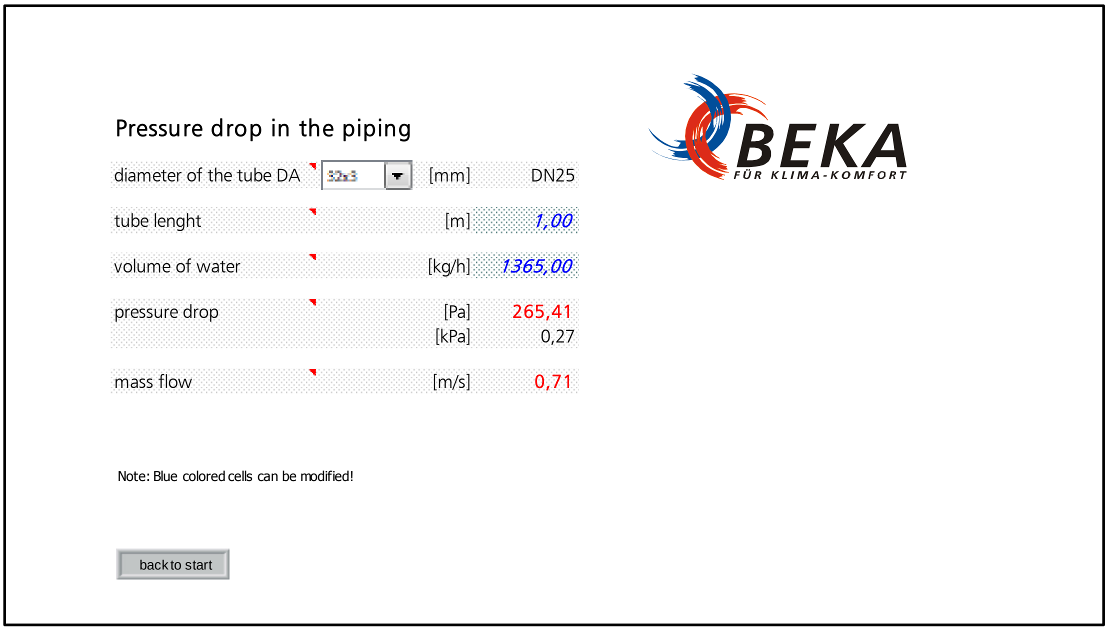
It is recommended that the calculations required for sizing the hydraulics are carried out using standard software. The pressure drops of the mats are transferred into this software manually as a single resistance.
If no standard software is available, the sizing of the entire system can also be done in sections using the *BEKA add-on module for pressure drops*. In accordance with basic hydraulic principles, the amounts of water in the respective sections are combined and these values are used to calculate the corresponding pressure drop for each component. The individual results must be recorded manually in a separately managed table and combined to give a final result. Since the systems may differ significantly in the composition of pipe circuits and components, a high level of technical competence is needed to calculate a system’s overall pressure drop. This is why BEKA has decided not to offer any guidelines for potential variants for this calculation. This is solely the task of the specialist planner or installer. Thus in the example here, only the scale of the connection size is to be calculated, influenced by the amended task for the design planning.



Screen 12: Start screen

The required pipe size can be quickly determined by entering the water volume aggregated for the size of surface to be connected and by observing the maximum desired flow rate.

In the example: 73.10 W/m^2 and 21.01 kg/(m^{2}h) = 1,365 kg/h for 65m^2 ⇒ e.g. from *add-on module for pressure drops*: Connection size DN25; the cost of all supply line components falls in comparison to the advance estimated cost according to the performance specification. The raising of the flow temperature leads to greater energy efficiency. The consumption costs in subsequent system operation will fall.



Screen 13: Pressure drop in the pipe

Step 10: Compilation of the results of the design planning

In the example:

Smooth plaster ceiling against concrete ceiling with <u>acoustic requirement NCR 0.65</u>

Room area	= 100m^2
Room temperature	= 26°C
Max. area to be activated	= 65m^2 (65%)
Specific required cooling capacity of ceiling	= 73.20 W/m^2
Flow temperature for cooling ceiling	= 17°C
Return temperature for cooling ceiling	= 20°C
Connection size	= DN25

In the example, a higher quality ceiling was rendered possible in the course of design planning while the expected extra costs were able to be moderated by a substantiated possible reduction in the connection size of all supply lines, including the required mouldings and functional elements such as zone valves, circuit control valves, expansion vessels, pumps, pipe insulation, and even a reduction in the expected installation times/costs.

Step 11: Transfer of the values into the planning documents

Once the results of the design planning have been approved by the customer, the capillary tube mats can be entered into the planned sizes in the installation plans. The resulting parts list that ensues as a secondary result is then the basis for a concrete offer request or order at BEKA.

Providing the parts list is submitted in Excel format, BEKA is able on request to mark the mats with regard to the construction stages, room numbers etc. This free-of-charge service makes it easier to clearly assign the supplied materials at the work site and to check the delivery for completeness. This leads to reduced installation times and avoids expensive misunderstandings in the construction sequence and wastage of material.

Installation Instruction for BEKA Heating- and Cooling Mats

1. Generals

The BEKA heating and cooling system is easy to install. BEKA supplies the mats in the precisely required sizes. Tailoring at the building site is not required. Only for the installation of the piping matching work is necessary. The state of the art for working with plastic material is to be applied.
In all cases, good workmanship and carefulness is required. The described guidelines must be obeyed so that proper operation and safety of the BEKA system can be assured. The BEKA heating and cooling mats are subject to laminar flow. The system is equipped with automatic vents. After complete installation, the system will be rinsed; at the same time, there will be self-bleeding. During installation, a slope for the mats is not necessary.
BEKA heating and cooling mats as well as the supply lines are normally operated at pressures between 0 and 4 bar.
The minimum room temperature for installation work is 10°C. The BEKA heating and cooling mats, pipes, supply lines and fittings must be kept protected from permanent direct UV-light.

2. Connection of BEKA heating and cooling mats and pipes

BEKA heating and cooling mats, pipes and fittings are made from Polypropylene (PP) type 3. All components can be joined to another through thermal welding or by compression fitting. For transitions from PP-pipe to another material, compression fittings are used. All materials used for the secondary circuit must be non-corrosive.
The BEKA heating and cooling mats, depending of which type, are connected either directly through thermal welding to the water pipelines or by flexible hoses, which are plugged into the quick-action couplings of the mats and supply lines.

Thermal welding of plastic material requires some training.

For thermal welding of plastic material, there are different versions:

Sleeve welding → Welding temp. 260°C

Butt-welding → Welding temp. 240°C

Electric sleeve welding → welding current

according to manufacturer's specification

While welding, it must observed that excessive heating up time and/or excessive welding pressure will not reduce the inner diameter of the tubes, since undefined and increased flow resistances will occur.
For introduction in thermal welding technique for plastic piping, BEKA offers seminars.

3. Laying the BEKA mats into metal cassette plates

By placing BEKA mats into metal cassette units, each suspended metal ceiling can be converted into a heating or cooling ceiling.
BEKA mats are simply laid from the rear side into the metal cassettes. For the mats to have full contact, they can be covered with mineral insulating mats. Additional coverings with plasterboards or sheet- metal will secure full contact to the metal cassettes. Another possibility is to glue the mats to the cassettes. For this the glue is applied to the mat with a spraying gun, than the mat is placed directly onto the metal cassette and pressed down with a (PUR-foam) roller. After spraying of the glue, no extra time for the adhesive to vent-off is required. The adhesive is transparent after setting; it has neutral odour. (acoustic fleece should be an intrinsic part of the metal panel in order to prevent defilements with glue especially with perforated metal panels. Apart from this, the glue adheres to acoustic fleece better). A further possibility is offered by BEKA to send the metal panels to the factory BEKA directly. The metal panels (acoustic fleece must be a part of the metal panels) will be equipped with BEKA capillary tube Mats and

glued onto the metal panels with hot-melt adhesive. The hot-melt adhesive is also odourless.
This variant would be advantageous both for existing buildings as well for new buildings. A further advantage of this variant is that the packaging of the metal panels can be re-used for delivery of the activated metal panels to the building site. In addition, this variant is cost-effective because the assembly-time on construction site has to be calculated only for mounting the metal panels in the intended suspended construction and for connecting them with flexible hoses to the supply lines.
As last alternative variant, instead of gluing, BEKA offers capillary tube mats with magnetic spacers. This variant saves the delivery of metal panels to the BEKA factory. The installer has only to take the assembled mats with magnetic spacers and lay them onto the metal panels. Then make use flexible hoses to make the connection between mats and supply lines.

4. BEKA heating and cooling mats in plaster

Onto any raw or suspended plasterboard ceiling, BEKA mats can be fixed from below and plastered with nearly any type of mineral plaster. Rubbing plastering, however, is not permissible because of danger that the capillaries are damaged. Plaster base preparation must be according to the state of the art.
For fastening the mats to the raw ceiling plaster, double sided Butyl adhesive tape, butterfly or plate dowels can be utilized. Fastening of BEKA mats to plaster boards or building boards is done with tacks (quality of tacks should be agreed upon with the plaster supplier). The tacks are positioned at the spacer ribbon of the mats. A suitable driving force must be adjusted at the tacker gun in order not to damage the capillary tubes
During plastering work, the capillary tube mats are filled with water and kept at normal water supply pressure. Any damage to the tubes can therefore soon be detected and be repaired.
After fastening the mats, the plaster is applied and smoothened. Plaster qualities to be used are standard types and machine plaster MP 75 or also acoustic plaster.
When the water connection to the mats has been laid into the plastering, then all connections from the mats to the pipelines must be carried out through thermal welding. If flexible hoses are used for the mat connections, then the hoses must be laid into the ceiling cavity. In no case, the flexible hoses must be laid in the plastering.

5. Pressure Test

Even that all BEKA heating and cooling mats have been factory pressure tested a new pressure test must be done after installation at the building side. For guaranty reasons the pressure tests after installation is mandatory. In all cases, the person responsible for the installation must draw up a test report.
Directly after connections of the mats to the supply lines, the mats are pre-tested with compressed air at 10 bar. With this, eventual leakages at the connections can be recognized. For the main test, the mats are filled with water zone-by-zone and tested for 10 minutes with 3 bar.
Eventual leakages must be fixed at once. After this the pressure is raised to 10 bar . After another hour, eventual pressure drops caused by the elasticity of the piping should be equalized again. If the pressure in the system will sustain for 4 hours then the pressure test has been successful.

In case that leakage had to be repaired, the pressure test must be repeated. In the report, all faults must be recorded.
At the end of the pressure test the system is brought to idle (operating) pressure of 2 to 3 bar kept in this state at best until the end of the construction work.

6. Repair of damaged BEKA Mats

The BEKA heating and cooling mats are manufactured with great care and under strict quality measures. The mats are extremely stress bearing and robust and if normally handled they can be installed at the building side without any problems.
If nevertheless, in spite of all precautions, a damage of some single capillary tube occurs, the mat must not have to be exchanged in any case. Mats can be "repaired".

The following steps must then be followed:

Separate the mat from the water

Separate the leaking tube with a pair of scissors

Close both end s of the capillary tube with the welder or a soldering iron, warm-up and press the cut surfaces together.

Repeat the pressure test

This repair is only admissible for one or two damaged capillary tube otherwise the effective heating/cooling surface will be reduced too

much.
Closing the cut ends of the capillary tubes with an open flame (cigarette lighter) is not admissible for a repairing. The open flame will burn the plastic material form the outside and carbon black particles will be in the weld, causing a weak weld strength. Furthermore the appropriate welding temperature of 240°C cannot be assured, so that a weak weld could be the result.

Instructions for Thermal Welding of Plastics

1. Generals

BEKA pipes and supply lines can be connected to another or BEKA heating and cooling mats by thermal welding.

There are different types of welding:

- Butt welding
- Sleeve welding

Complying with the following working direction, the thermal welding is a fast, uncomplicated and represents a safe connecting technique.

2. Butt welding

Cutting

- With a pair of pipe scissors the pipe is cut to the necessary length (allow approximately 3 mm for weld burn-off!)
- Pipes, fittings and welding plate must be free of dirt or grease.

Warm-up

- Heat-up the welding plate to 240 °C.
- Press both pipe ends simultaneously and rapidly with light pressure onto the welding plate until a small weld upset of 1 mm occurs.
- Warm-up the pipe ends while keeping this position for 3 seconds.

Joining

- After the warm-up time has elapsed, take away both ends from the welding plate and rapidly join the parts together, accurately with light pressure and without twisting.
- The molecules of the material join homogeneously after a few seconds. To maintain shape, hold the pipes together in a stable position. The connection can be fully stressed after 30 minutes.

Note:
Longer warm-up times and excessive joining pressure will lead to narrowing of the inner pipe diameter! Excessive joining pressure will press the weld upset away from the welding area and thus, cannot take any loads there after.

3. Sleeve welding

Cutting

- With a pipe scissors the pipe is cut to length (as for a 20 mm pipe diameter, add 5 mm - 12 mm of joining depth of the pipe into the sleeve,)
- Mark the joining depth on the pipe.
- Pipe, fitting and welding plate must be free of dirt and grease.

Warm-up

- Heat-up the welding plate to 260 °C.
- Slightly time-offset, press (first the sleeve then the pipe) on/in to the welding plate with slight pressure to the stop or the marking.
- In this position, warm-up the parts for 5 seconds.

Joining

- After the warm-up time has elapsed, pull-off the parts to be joined from the welding plate and join them together, accurately with little pressure and without twisting.
- The molecules of the material join homogeneously after a few seconds. To maintain shape, keep holding the pipes together in stable position. The connection can be fully stressed after 30 seconds.

Note:
Longer warm-up times and excessive joining pressure are to be avoided and will lead to narrowing of the inner pipe diameter!

4. *Welding property of various PP-materials*

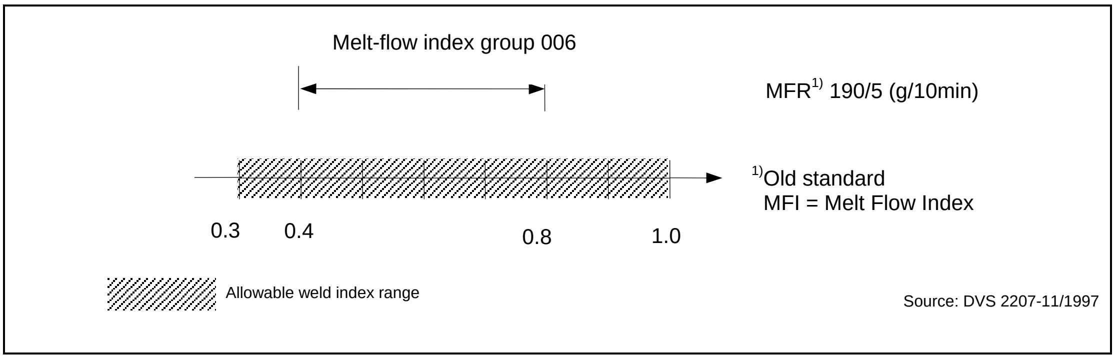
All pipes and fittings made from polypropylene, which are supplied by BEKA, can be welded to each other. The PP-materials used are all classified in *melt-flow index index group 006.* For testing the welding property, the "Richtlinie des Deutschen Verbandes für Schweißtechnik e.V. DVS 2207-11 (Entwurf August 1997) is the valid standard. Under consideration of this standard, a welding index value of MFR 190/5 0.3 to 1.0 g/10 min is appropriate. The classification of the welding-flow index groups is always to be complied with.

5. *Tools*

For thermal welding of synthetic material, the following tooling is required:

- Pipe scissors W.S.20
- Butt welding unit W.STSG.1 or sleeve welding unit WMSG1 with sleeve welding insert W.MSE.20 or inner sleeve insert IMSE.16
- Ruler
- Marker

Figure: Welding-flow index groups for PP according to DIN 16774



6. *Welding of big-size pipes*

As for welding of big-size pipes larges than DA20 follow, by principle, the above procedure and comply with the instructions of the pipe supplier.

Recommended values for sleeve welding at ambient temperature of 20°C and slow air blast:

Pipe diameter	Minimum pipe wall thickness	War-up time in sec	Adaptation time in sec	Cooling time in sec
25	2,7	7	4	2
32	3,0	8	6	4
40	3,7	12	6	4
50	4,6	18	6	4
63	3,6	24	8	6
75	4,3	30	8	6
90	5,1	40	8	6
110	6,3	50	10	8

Installation Instruction to BEKA Mats in Plaster Ceilings

1. Generals

BEKA mats can be fixed to the underside of any raw ceiling or suspended plasterboard ceiling and plastered with nearly any mineral plaster material. Rubbing plastering though is not allowed because of danger that the capillaries could be damaged. Standard-type plaster to be used is machine applied plaster, type MP 75 or IP 22 and acoustic plaster as well.
The small diameter of BEKA capillary tubes allows for thin layers of plaster (approx. 10 mm), through which high cooling capacities are reached. The supply lines and the mains of the mats are normally laid in the in wall conduits or in-wall (this could be baseboards or stepped plaster endings).
At beginning of the work, a ceiling pattern completed with the layout for the mats positions and supply lines must be drawn up. In this pattern, all areas, which will remain uncovered, must be marked (positions of inner walls, light fixtures and other ceiling in-lays). The position of the dew point sensor has to be outlined at the ceiling pattern.

2. Installation steps at the raw ceiling

Preparation of the raw ceiling

- The raw ceiling must be dry and free of separating substances (observe cleaning directions).
- Close holes, smoothen uneven surface areas.
- Define the position of mats.
- Fix pipe clamps for the supply lines and collector pipes.
- Pre-drill dowel holes into the ceiling for fastening the mats.
- Install cable for smoke detector or lamps and fix the fasteners by means of wall bolt (protect thread with tapes).

Connect BEKA mats to water lines, and perform a pressure test

- Install the supply lines.
- Connect the BEKA mats to the supply lines (see → M02 – Instructions for thermal welding of plastics)
- Take pressure test of the installed system. (see → M07 – Test instructions for BEKA heating and cooling systems)
- Set the pressure at rest to 3 bar (mats stay under 3 bar pressure for entire time of installation).
  - Compressed air is recommended.

Fixing mats to the raw ceiling

- Fix BEKA mats to raw ceiling by means of:
  - Disc-dowels or plug-dowels
  - Butyl adhesive-tape and application of gypsum pads (see instruction M17)
- Align the mats and stretch the capillary tubes.
- Fix and electrically connect the BEKA dew point sensor for the plaster (see → M06 Instructions to the installation of BEKA dew point sensors)

Apply plaster and smoothen (comply with manufacturer's instructions!)

- Apply primer for the plaster.
- Apply plaster – assure that only a minimal plaster thickness is applied; normally 10 mm (the plaster thickness influences the expected cooling capacity decisively!)
- Smoothen plaster –avoid any damage to the capillaries by all means.
- Damage must be repaired at once (warm-up ends of damaged tubes with welding unit or soldering iron and press the end of the tubes together, if necessary replace the whole mat).

Ceiling finish

- Apply layer of paint.

Trim the snifter pipe of the sensor flush with the ceiling surface, mark its location (dirt must be kept away from the snifter pipe openings to avoid malfunction of the sensor!).

3. Installation Steps for the Suspended Plasterboard Ceiling

Prepare the sub-construction

- Arrange the connection piping for the BEKA mats at the ceiling according to the layout plan
- Fix the CD – profiles firmly to the nonius hangers according to manufacturer's instructions. The sub-constructions must be installed in such a way that the supply and return lines of the BEKA mats are on top of the plasterboards. Consider an additional load of nearly 15.5 kg/m^2.

Connection of BEKA mats to water lines and pressure test

- Hang-up BEKA mats with the mains according to the layout plan into the sub-construction; the mats are then hanging down into the room. If the mats are too long, they are rolled-up loosely and held together with wires.
- Connect the BEKA mats to the supply lines inside the ceiling cavity (see → M02 - Instructions for thermal welding of plastics).
- Take pressure test of the installed system (see → M07 – Test instructions for BEKA heating and cooling systems).
- Set pressure at rest to 3 bar (this pressure remains in the mats for the entire time of installation until start of operation!). Use compressed air is recommended.

Installation of plasterboards

- Fix plasterboards with dry-wall screws to the sub-construction according to manufacturer's instructions – push the plasterboards gaps of approximately 10 mm.

from both sides to the BEKA mats to form

Fixing mats to the sub-ceiling

- Align the BEKA mats at the sub-ceiling, fix with double-sided adhesive tape – stretch the capillary tube mats.
  Alternative: Fix with staples; double check if the staples quality complies with the requirements set out by the plaster manufacturer (see → M19 Installation instructions to BEKA mats with staples).
- Install and electrically connect the BEKA dew point sensor (see → M06 Instruction for the installation of the BEKA dew point sensor).

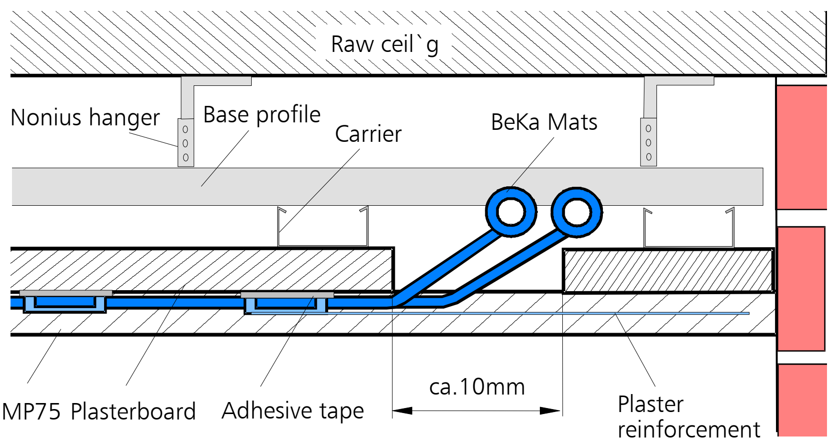
Apply plaster and smoothen (meet manufacturer's instructions!)

- Close installation conduits with joint filling material by adding fibre cloth strengtheners into the plaster.
- Apply primer for the plaster.
- Apply plaster – assure only a minimal plaster thickness: Normally 10 mm (the plaster thickness influences the expected cooling performance decisively!)
- Smoothen the plaster - definitively avoid any damage of the capillaries by all means; damage must be repaired at once. If necessary, replace the whole mat.

Ceiling finish

- Apply paint.
- Trim snifter pipe of the dew point sensor flush with the surface of the ceiling. (Dirt must be kept away from the snifter pipe to avoid malfunction of the sensor!).

Principle of a BEKA mat positioned below a plasterboard ceiling imbedded in plaster



4. Alternative Installation of BEKA Mats through embedding directly into Plaster*

ATTENTION! This installation is only possible when the installation work is closely coordinated between the installer and the plasterer. Instructions and special advice for plastering are to be obtained from the plaster producer.

Preparation of the raw ceiling

- The raw ceiling must be dry and free of separating substances (observe cleaning directions).
- Close holes, smoothen the uneven surface areas.
- Apply plaster base.
- Define the position of mats.
- Fix pipe clamps for the supply lines and collector pipes.
- Pre-drill dowel holes into the ceiling for fastening the mats.
- Install cables for smoke detector or lamps and fix the fasteners by means of wall bolts (protect thread with tape).

Connection of BEKA mats to waterlines and pressure test

- Install the supply lines.
- Connect BEKA mats to the supply lines inside the ceiling cavity (see → M02 - Instructions for thermal welding of plastics) – the mats should hang loosely rolled up, even better though, straight down from the ceiling
- Take pressure test of the installed system (see → M07 – Test instructions).
- Drain the system.
- Set pressure at rest to 3 bar (this pressure remains in the mats for the entire time of installation until start of operation!)
- Place the cable of dew point sensor loosely into pre-determined position.

Apply plaster and smoothen (fulfil manufacturer's instructions[1]*)

- Apply plaster in thin serpentines in the width of the mats, over the total length – DO NOT SMOOTHEN YET! - apply in sections! Set plaster to a sturdy consistency!
- Unroll the BEKA mats below the ceiling and stretch the capillary tubs along installation direction.
- Do not push the capillary tubes into the moist plaster - DO NOT PLANE THE PLASTER! DO NOT USE SHARP - EDGED TOOLS! (similar to embedding reinforcement fabric).
- Afterwards (within 15 minutes after first application) attach a second thin layer of plaster (normally 10 mm is enough) (the plaster thickness influences the expected cooling performance decisively!) - Set plaster to the usual consistency!
- Position the dew point sensor above the capillary tubes in the moist plaster.
- Embedding the reinforcement fabric 80 x 80 mm at the mats ends and in critical spots is recommended.
- After settling smoothen the plaster - avoid any damage of the capillaries by all means; damage must be repaired at once (warm-up ends of damaged tubes by welding unit or soldering iron and press ends of tubes together, if necessary, replace the whole mat)
- Smoothen the plaster - avoid any damage to the capillary tubes by all means.

Ceiling finish

- Apply paint.
- Trim snifter pipe of the dew point sensor flush with the surface of the ceiling. (Dirt must be kept away from the snifter pipe to avoid malfunction of the sensor!)

[1] *The installation steps have been coordinated with the Firm:
Maxit Baustoff- und Kalkwerk Mathis GmbH

Installation Instruction to BEKA Mats in Metal Cassette Ceiling

1. Generals

By laying the BEKA mats into the metal cassettes, any suspended ceiling construction can be converted in a heating or cooling ceiling. Therefore, the BEKA mats are simply laid into the cassette from the back. To provide for sufficient contact of the mat, the only thing to do is to place a mineral insulation mat on top of it. Additional coverings with plasterboards or sheet-metal will assure good contact of the mats to the metal cassettes. It is also possible to glue-in the BEKA mats. The BEKA adhesive is simply applied by spraying gun onto the mat. After the mat is placed into the cassette and pressed-onto it by PU-roller. Drying time is not required for the adhesive. The glue is transparent after setting; it has a neutral odour. Only full contact of the mat will secure maximum cooling capacity.
Before beginning work, a pattern has to be drawn–up as a work and positioning reference. All dimensions for positioning, direction and supply lines must be recorded. In the pattern, all areas, which will have to remain uncovered (for internal walls, light fixtures and other components to be attached to the ceiling), must be marked. Furthermore, the position of the dew point sensor has to be marked on the pattern.

2. Installation steps

Hanging-up the suspended ceiling

- The carrier- and basic profiles are aligned and fixed to the raw ceiling with nonius hangers according to manufacturer's specification.

Installation of the BEKA supply lines

- The supply lines are installed inside the ceiling cavity and connected to the mains (see → M02 – Instructions for thermal welding of plastics).

Laying the BEKA mats into the metal cassettes

- Full surface contact of the BEKA mats in the ceiling cassettes is achieved by:
  - Covering with mineral fibre mats, additional bracing of the mineral fibre mats with the sheet metal covering, sheet metal braces, plasterboards or similar
  - Bonding of the mats with BEKA adhesive
- Connect the flexible hoses to the quick-action couplings on the BEKA mats.

Laying the ceiling boards

- The ceiling boards together with the mats are laid into the row-type screen structure.
- While installing the ceiling mats the flexible connecting hoses are plugged into the quick-action couplings of the supply lines.
- Installation of the BEKA dew point sensor for metal ceilings (see → M06 – Instructions for the installation of the BEKA dew point sensor)

Pressure test (see → M07 – Test Procedure)

- Take pretest with compressed air at 10 bar for 1 hour´.
- Take final test with water at 10 bar for 10 hours.
- Maintain a pressure at rest of 3 bar until start of operation.

Installation Instruction to BEKA Mats on top of Dry-build Boards with TCP

1. Generals

BEKA mats can be laid onto the back of dry-built boards without any problem. In this way, cooling ceiling units can be made out of plaster-boards or from fibre plaster boards, which can be installed in dry-built version. BEKA manufactures also special capillary tube mats just for the use with dry-built boards. Lengths and widths are tailored to the dry-built standard boards. In areas, where they are screwed to the ceiling and/or wall construction, special spacers are provided. The distance between the spacers is 300 mm. The spacers determine the gap of the profiles at the wooden or metal sub-construction.

Illustration of the BEKA heating and cooling mat for dry-built boards:

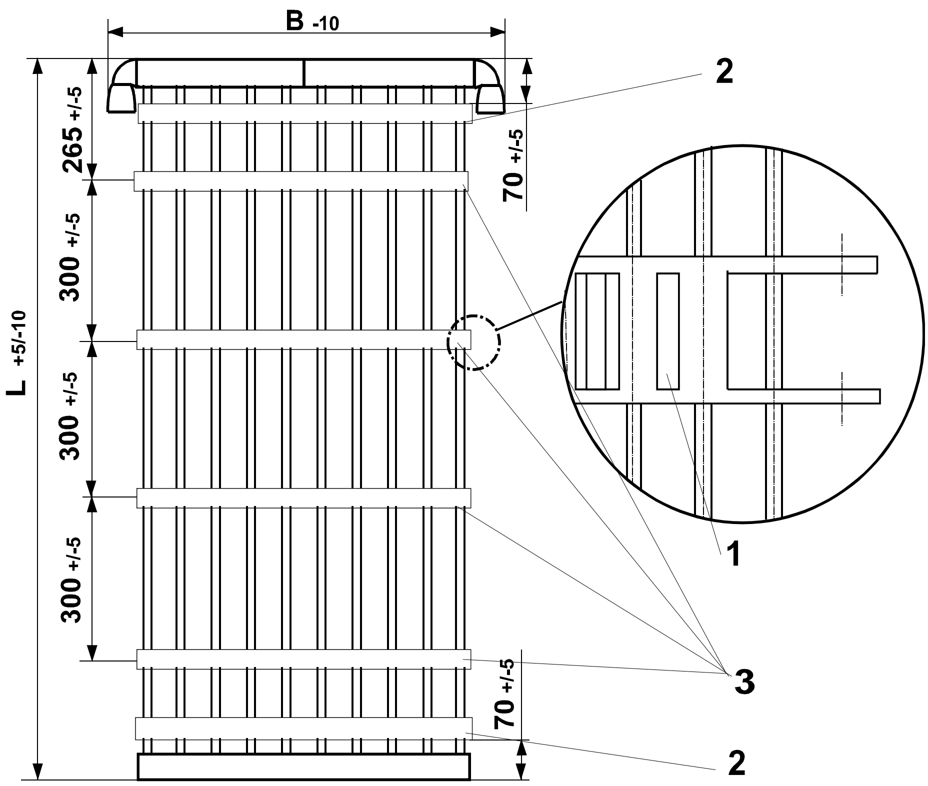
Illustration of BEKA capillary tube mats for heating and cooling

1 Oblong hole for fixing screws
2 Spacer for the initial fixing
3 Spacer for the ceiling profile

2. Installation steps

A working place where the dry-built board can be fully laid-out is necessary for the installation.

a) Installation of the additional spacers at the front end. On the installation table, the dry-built board is laid with its side to be equipped facing up. The additional supplied spacers, which are supplied with the BEKA heating and cooling mats are tacked to the front-end side.



b) Fastening the BEKA heating and cooling mats with tacks.
The heating and cooling mat is aligned and positioned between the spacers (described in point 1). In this position, the spacers located closely to the collector pipes (marked with 2 in illustration 1) are tacked to both sides of the heating and cooling mats. Then the heating and cooling mats are pulled flush through pulling on the collector pipes. The distances of the other spacers to each other is measured and corrected, if required. Then the spacers are fastened with tacks.

c) Application of thermal conductive paste
Apply the thermal conductive paste (approx. 800g/m^2) by paint roller, pouring or other suitable measures. After the paste has been applied between the spacers, it will be brushed in the direction of the capillary tubes towards the base narrow brush. At normal temperatures, the thermal conductive paste dries within 20 minutes that the ceiling boards can be installed. The spacers, which have contact to the ceiling profile, are smoothened with a spatula or other appropriate tools, in case that paste had been applied there.

d) Drilling of holes for the fixing screws:
Before drilling, the heating- and cooling mats are put under air pressure of 8 to 10 bar. If there are any injuries to the tubes, they can be detected then. The spacers have oblong holes (every 40 mm) (see figure 1, marked with 2). These oblong holes are used for pre-drilling with a ∅ 2.5 mm for the fixing screws. The drilling pattern (spacing of the holes to another in diagonal direction to the heating and cooling mats) depends upon the installation instructions of the dry-built board manufacturer.

e) Finishing
After the pressure test, the quick-action couplings are closed again with cover caps, then.

f) Installation modes
If the installation is executed by more than one person or if work is carried out in working steps, then the working step 3 is recommended to be last one.

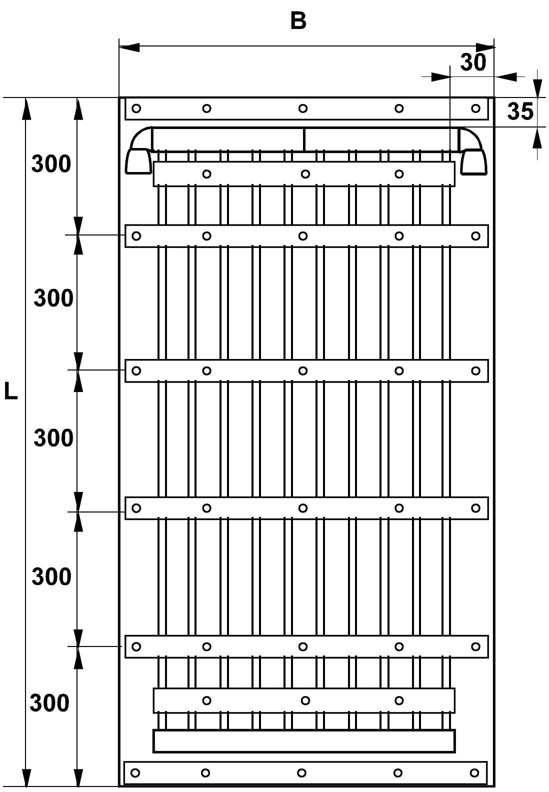
3. Tools

As for attaching the dry-built board to the heating and cooling mat G.10.X, the following tools are required:

- Installation table
- Scissors to cut plastic material
- Power drill
- Drill ∅ 2.5 mm
- Tackler
- Tacks
- Paint roller
- Narrow brush
- Rule
- Spatula
- Compressed air connection

Note:
With long, narrow and thin dry-built boards, the impact of moisture from the thermal conductive paste can lead to momentarily small reduction of strength of the dry-built boards. Careful handling of the boards is then necessary.

Picture of an equipped dry-build board



Instruction to the Installation of BEKA Dew-Point Sensor

1. Generals

The dew point sensor is built into the cooling ceiling to avoid condensation. Its principle is based on changing resistances of an electrical conductor, which is printed on as thin layer. With danger of condensation, the resistance drops rapidly. The changing resistance is computed by the converter M.K.2 or room temperature controller M.R2/3 and transmitted as command. The command can be used to switch-off the cooling ceiling or to start an alarm signal.
Up to 5 dew point sensors can be connected to the converter M.K.2.
3 dew point sensors can be connected to the room temperature controller.

3 types of dew point sensors are available:

1. Dew point sensor for metal ceiling boards
   → M.TM.1
2. Dew point sensor for plaster ceilings
   → M.TP.2
3. Dew point sensor for plasterboards
   → M.TG.2

The connecting cable for the dew point sensor may be extended up to 100 m without problem (minimum cross-section of 2x0.14 mm^2). The kind of connection of the extension has to assure proper conductibility (soldering or securely clamped).

2. BEKA Dew point sensor for metal ceilings

The dew point sensor M.TM.1 is equipped with a gold-plated circuit board at one side and adhesive surface on the other side. The soldered connecting cable is 10 m long.

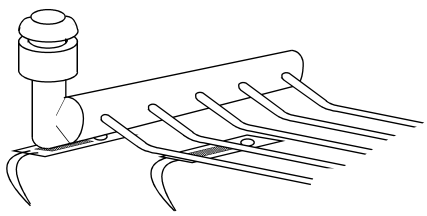
2.1 Installation

The dew point sensor is positioned at the coolest spot on the ceiling. The position of the dew point sensor must be near to the supply side of the capillary tube mats. The dew point sensor can be positioned best directly below the collector pipe or between the collector pipe and the first row of the spacers diagonally to the capillary tubes (see illustration). The dew point sensor is connected with its connecting cable to the converter M.K.2 or room temperature controller M.R2/3. The connecting cable can be installed in the ceiling cavity, in plaster or in electrical tubing.

Installation steps
The dew point sensor M.TM.1 is electrically connected and placed closely to the final installation position. Until the final positioning the dew point sensors is kept in its protective cover.

The dew point sensor can be assembled together with the installation of the supply lines (Z.EM or Z.ES).
Along the arrangement of the ceiling boards with the applied BEKA heating- and cooling mats to the hanger of the row-type screen profile, the dew point sensors are fixed as well. The dew point sensors are best positioned directly below the collector pipe or between the collector pipe and the first row of the spacers diagonally to the capillary tubes. The protecting cover is removed from the circuit board, the protective foil for the adhesive pulled off and the dew point sensor glued to its pre-determined installation position.

Illustration:
Location of the dew point sensor for metal ceilings below the BEKA heating and cooling mat



3. BEKA Dew point sensor for plaster ceilings

The dew point sensor for plaster ceilings M.TP.2 consists of a gold-plated circuit board and is glued to a plastic housing. A snifter hose is connected to the plastic housing. A connecting cable (length 10 m) is soldered to the circuit board.

3.1 Installation

The dew point sensor is installed at the coolest spot of the cooling ceiling. The dew point sensor is best positioned between the collecting pipe and first row of the spacers diagonally to the capillary tubes (see illustration).

The dew point sensor M.TP.2 is fixed to its position before plastering! The sensor is connected to the converter or room temperature controller with its connecting cable. The 10 m long connecting cable can be installed in the ceiling cavity, plaster or in electric tubing.

Installation steps

1. The dew point sensor M.TP.2 is electrically connected and placed closely near to its final position. Until its final positioning the dew point sensor is kept in its protective cover.

2. After fixing of the BEKA mat at the raw ceiling a plaster spot or another appropriate means of fastening is placed at the installation position of the dew point sensor (see illustration)

3. The self-sticking backside of the gold plated circuit board of the dew point sensor for plaster ceilings is positioned diagonal to the capillary tubes. Then the ceiling is plastered

4. After paintwork is done the sniffing hose is shortened even to the ceiling surface. Care must be taken, that the openings of the snifter hose will not closed.

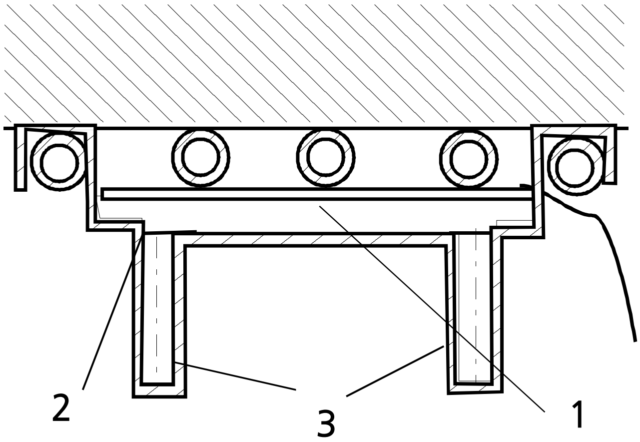


Illustration 1: Positioning of the Dew point Sensor :
1 Gold-plated circuit board
2 Plastic housing
3 Snuffing hose

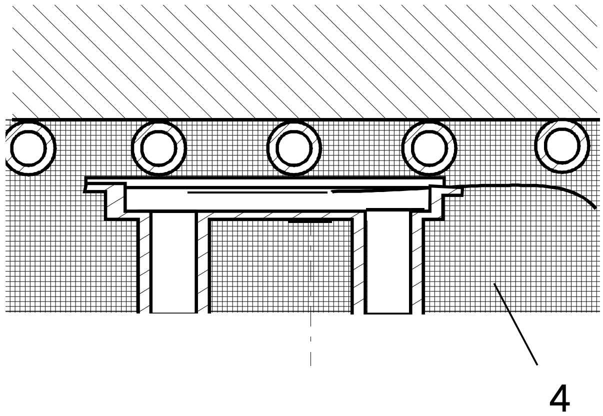


Illustration 2: Plastered dew point sensor
4 Plaster

4. BEKA Dew point sensor for plaster ceilings

The dew point sensor M.TG.2 for plaster ceilings consists of a gold-plated circuit board, which is glued to a plastic housing. A snifter hose is connected with the circuit board. A cable of 10 m length is soldered to the circuit board.

4.1 Installation

The dew point sensor is located at the coolest spot at the ceiling. The dew point sensor is best positioned between the collector pipe and the first row of spacers diagonally to the capillary tubes. Depending on the type of ceiling cavities, various dew point sensors are utilised.

Open ceiling cavity

With open ceiling cavities, these are ceiling cavities, which are in connection with the room air, the dew point sensor M.TM.1 for metal ceilings is used.

The dew point sensor is positioned best between the collector pipe and the first row of the spacers diagonally to the capillary tubes.

Installation steps

The dew point sensor is electrically connected and positioned closely to its final working position. Until final positioning, the dew point sensor is kept in its protective cover.

The dew point sensor can be installed together with the supply lines (parts: Z.EM or Z.ES).

Together with the arrangement of the plasterboard ceiling in the ceiling construction, the dew point sensor is fixed. The dew point sensor is best located between the collector pipe and the first row of the spacer diagonally to the capillary tubes. The protective cover is taken from the circuit board and the protective foil from the dew point sensor and then glued to the predetermined installation position.

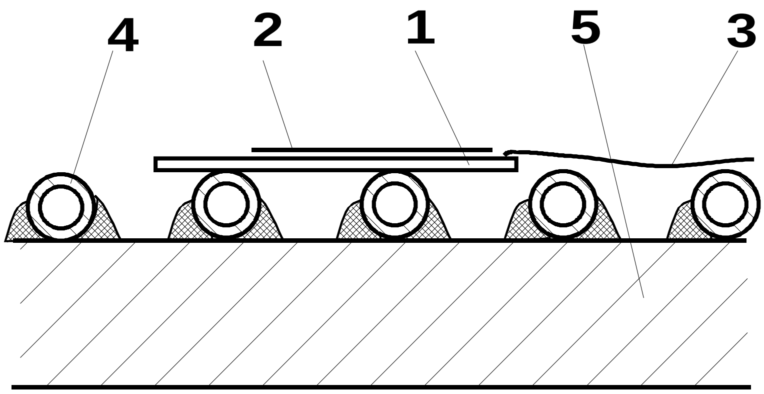


Illustration 4: Arrangement of the dew point sensor inside the open ceiling cavity

1 Dew point sensor
2 Circuit board
3 Supply line
4 Capillary tube
5 Plaster board ceiling

Closed ceiling cavity

With closed ceiling cavities, these are ceiling cavities, which have no air connection to the room, the dew point sensor M.TG.2 for plasterboards is used. The dew point sensor is best positioned between the collector pipe and the first row of spacers diagonally to the capillary.

Installation steps

The dew point sensor is electrically connected and positioned near the final working position. Until final positioning, the dew point sensor is kept in its protection cover.

The dew point sensor can be installed with the supply lines (parts: Z.EM or Z.ES).

Drilling the hole for the snifter hose. For the preparation of the final installation position of the dew point sensor, a hole of ∅ 6 mm must be drilled for the snifter hose.

Together with the fixing of the plaster board ceiling, the dew point sensor is fixed as well. The dew point sensor is best positioned between the connecting pipe and the first row of spacers diagonally to the capillary tubes. The adhesive protection tape for circuit board is taken off and the dew point sensor installed in its final position.

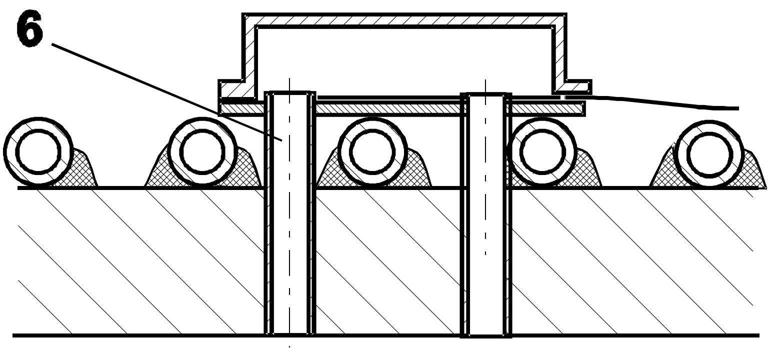


Illustration 5: Location of the dew point sensor in a closed ceiling cavity

6 Snuffing hose shortened to be flush with the ceiling surface.

Test Instructions for BEKA Heating- and Cooling Systems

1. General statements and remarks

BEKA heating and cooling ceilings as well as the supply lines are normally operated between 0 and 4 bar.
A pretest with compressed air of 10 bar is recommended to assure tightness of the heating and cooling mats as well as supply lines, which where installed at the building site.
Before start of operation and after bleeding, the water system must be tested for tightness with pressure of 10 bar.
Take care that gauges, whose allowable nominal pressure stays below the maximum test pressure, are not installed during the time of pressure testing. All BEKA fittings und armatures of ∅ 10 and ∅ 20 mm can be short time tested with 16 bar and remain for 24 hours pressurised under 10 bar.
Until finishing all work at the construction site up to the start of operation, the system should be kept under a pressure at rest of 2 to 3 bar. Damage, which is caused by other work groups after installation is finished, can be recognised soon and be repaired immediately.

2. Test procedure

A thorough test report must be prepared by the responsible person (see → test report T05) and be handed to the project manager.

The fully completed test report is the basic requirement for the 15 year warranty of BEKA granted to material.

On principle, the common rules for the pressure tests of water-carrying systems are valid. These include also the following items:

- Proceed section by section. The sections should only be that big that it can be kept under control when pressure tested.
- Never take pressure test with the connection opened to the urban water system, because of danger that the urban water will keep on running without being detected.
  Use pressure test pumps only.
- All lines, which later are not accessible, must be pressure tested successfully with 10 bar before the final closing.

Directly after connecting the BEKA mats to the supply lines test the mats with pressure applying compressed air at 10 bar. The pressure is to be maintained for 1 hour. Possible leakages at the connections can be detected at once.

For the final test, the mats have to be filled with water section by section, then bled and pressure tested for 10 minutes with a pressure of 3 bar. Possible leakages must be sealed at once.

For the final test, the mats have to be filled with water section by section, then bled and pressure tested for 10 minutes with a pressure of 3 bar. Possible leakages must be

Thereafter, the pressure is raised to 10 bar. After 1 hour the possible pressure loss, caused by the elastic expansion of the piping, must be compensated for.

If the systems will hold constant the pressure of 10 bar for 4 hours, the pressure test had been successful.

If leakages had to be sealed, the pressure test must be repeated. In the report all failures have to be recorded.

At the end of the pressure test, the system is depressurised to a normal pressure of 2 to 3 bar and must remain so until all the construction work is finished.

Technical Data to the Converter

1. Product description

The converter evaluates the existing resistance of the dew point sensor. A relay in the dew point sensor is switched when the resistance rapidly lowers. A neutral switching contact is available.
The circuit board of the converter is accommodated in a housing with a combined base prepared for bus connection in a switchbox. The operation status: "operating" or "danger of dew point" is signalled by pilot lamps.

2. Specification

L x W x H (mm):	88 x 50 x 61
Supply voltage	24 V AC / DC
Switching contact load [1]:	230 V, 6 A
Power max.	Max. 1 VA
Allowable ambient temp.	5....40 °C

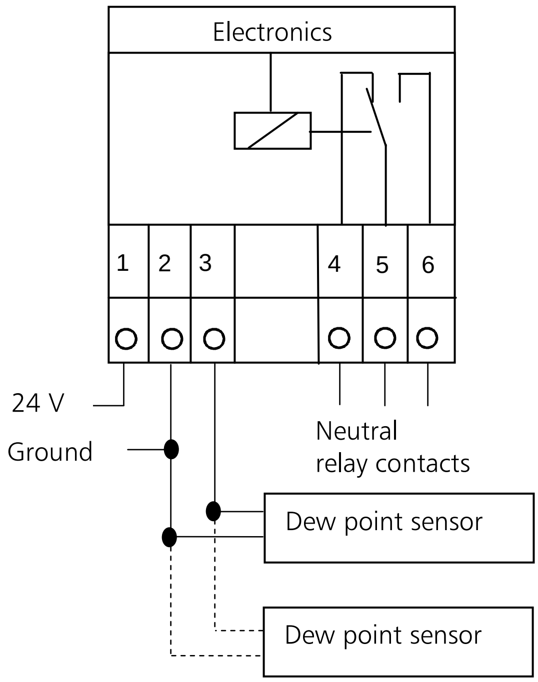
[1] For the control of relays, contactors etc. with co- sinus φ <0.3, installation of a RC-module in parallel to the coil is recommended. This will lessen the contacts burn-off and avoid high-frequency interference impulses.

Up to 5 dew point sensors can be connected.

3. Functional description

In the normal state, there is no danger to reach the dew point. The detected relative humidity at the measuring spot is less than 80%. A cooler can be switched on or a message sent to the DDC, respectively, GLT via the neutral relay contacts (terminals 4 and 5 are closed, the internal relay is not energised). The right-hand LED lights green.
When the dew point sensor detects humidity greater than 80%-85%, then the relay contacts switch over (terminals 5 and 6+ closed, the internal relay is energised). The cooler can be switched off, valve closed or a message can be sent to the DDC, respectively, GLT. The left-hand LED lights yellow.

4. Electrical connection



Technical Data of the Room Temperature Controller

Room temperature controller M.R2/3 for cooling ceilings with dew point control and heating regulation.

1. Description of function

The room temperature controller with dew point control of type M.R2/3 is especially suited for the control of heating and cooling systems, where the formation of condensation (for example: at cooling ceilings) is detected early and reliably that cooling can be shut-off (to avoid condensation).
With the adjusting knob at the front side the desired temperature is set. The set temperature can also be changed by means of an external remote controller. LEDs of different colours inform of the operating state:

Operating state of the room temperature controller
Red: = "Heating"
-> Drop below the set temperature
Green: = "Cooling"
-> Exceeding the set temperature
Yellow; = "Cooling OFF"
-> Due to possible condensation.

The controllers are completed with in-wall distributors, which fit into switch boxes according to DIN 49073 and switch frames of size 70.5 x 70.5 mm. The installation depth amounts to 28 mm.

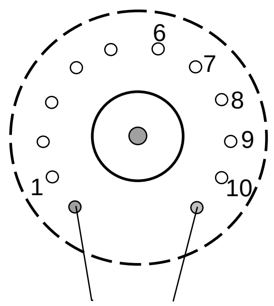
2. Converter versions

Through changing over the converter-internal switch J1, the converter can be set to two or three-wire system (factory setting is J1 open = three-wire system.).

DIP-switch opened	Controller set for three-wire system with two valve-control outputs to govern heating or cooling.
DIP-switch closed	Controller set for two-wire system with <u>one</u> valve-control output, which can be changed over to heating and cooling (summer/winter mode) by external control.

3. Control range

The room temperature can be set in the range from 5° to 30°C, whilst the adjustments can be limited mechanically with increments of 2.3 K. The limits are set by pins, which are plugged underneath the adjusting knob into the respectively marked boreholes.



Delivery condition:
Limits: 5°C and 30°C

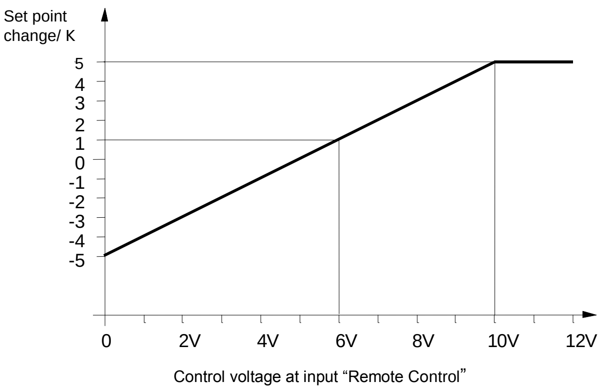
4. Dew point detection

When the sensor during cooling mode detects humidity, cooling is interrupted. This state is indicated by the yellow LED. Up to 3 dew point sensors can be connected to the controller.

5. Set point remote control

With a DC-voltage of 2...10 V at the control input "Remote Control", the set value can be linearly shifted by maximum ±5K (see illustration 1). For example: With DC-voltage of 6 V applied, the set room temperature will be raised by approximately 1K. If the control input is not supplied with a signal, then the set point is not changed.

Illustration 1: Characteristic curve for set-point with remote control



6. Summer / winter mode

Changeover between summer / winter mode is only required with the two-wire system (J1 closed).
Energising the input "Heating / cooling" (terminals 1 and 5) the mode is changed.
As for the 2-wire system, factory setting is to winter mode, that means, the terminals 1 and 5 are not jumped.

7. Switching behaviour, hysteresis

When set room temperature drops below the set point, the heating system will be activated (with M.R2 only in winter mode), which will be signalled by the red LED.

If the room temperature is exceeded, however, the cooling system will be activated (with M.R2 only in summer mode), which will be signalled by the green LED.

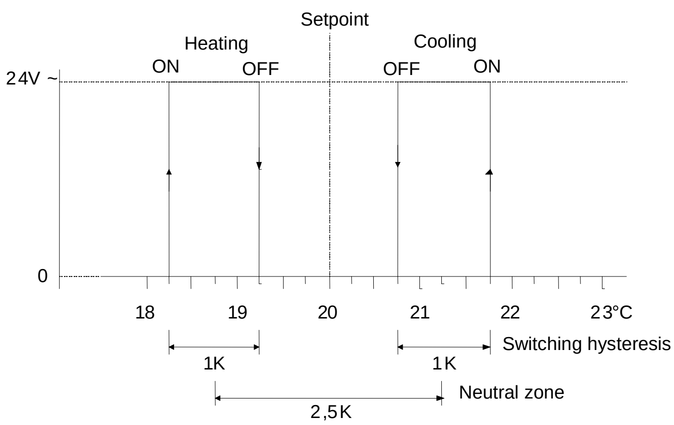


Illustration 2: Switching behaviour, hysteresis

Summer: When the input is closed, the controller switches the valve to cooling, when the set temperature is exceeded.

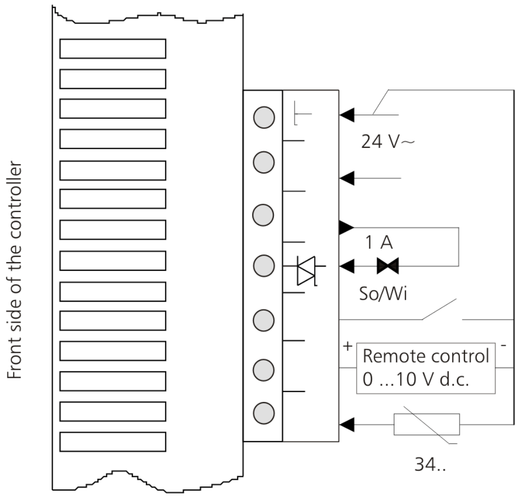
Winter: When the input is open, the controller switches the valve to heating, when the set room temperature has dropped below the set point.

8. Terminal assignment

M.R2 (two-wire system)

Terminal Assignment

1 Operating voltage, neutral potential of the dew point sensor, remote controller (-) & summer winter switch
2 Operating voltage, 24 V a.c.
3 24 V a.c. valve outputs
4 Switching output heating / cooling valve
5 Switch-over input for heating / cooling mode
6 Remote control input
7 Dew point sensor input



Also a 24 volt a.c. auxiliary relay can be connected to the switching outputs for the heating / cooling valve, if the maximum load does not exceed 1 amp.

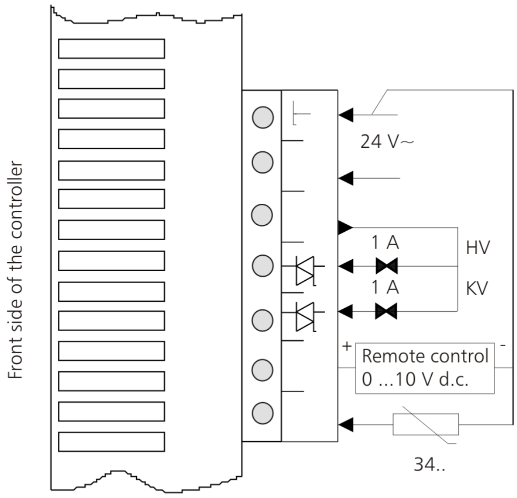
9. Technical specification

Operation voltage:	24V a.c. ±10%, 50...60 Hz
Power consumption:	30 mA (w/o output load)
Outputs:	Triac-outputs; Heating /cooling not neutral
Switching capacity:	1 A / 24V~ [short-time (1 min) approximately .2.5A]
Control range:	5...30°C
Switch hysterics:	1 K
Neutral zone:	2.5 K
Temp. sensor:	built-in NTC
Ambient temp.:	0...+40°C
Protection class	IP 40
Protection class:	III
Size (WxHxD):	74 x 74 x (23) mm
Colour:	grey/white

M.R3 (three-wire system)

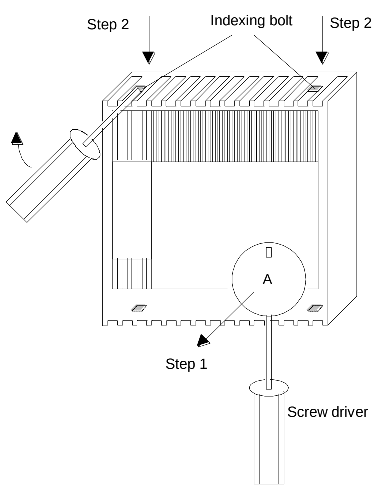
Terminal Assignment

1 Operating voltage, neutral
2 Operating voltage, 24 V a.c.
3 24 V a.c. valve outputs
4 Switching output to heating valve
5 Switching output to cooling valve
6 Remote control input
7 Dew point sensor input



10. Installation instruction

For dismantling, take the steps 1 and 2 according to the sketch. Assemble in reversed order. For mounting the controller on the wall box, use the attached screws.



Installation instructions to BEKA pre-fabricated dry-build units

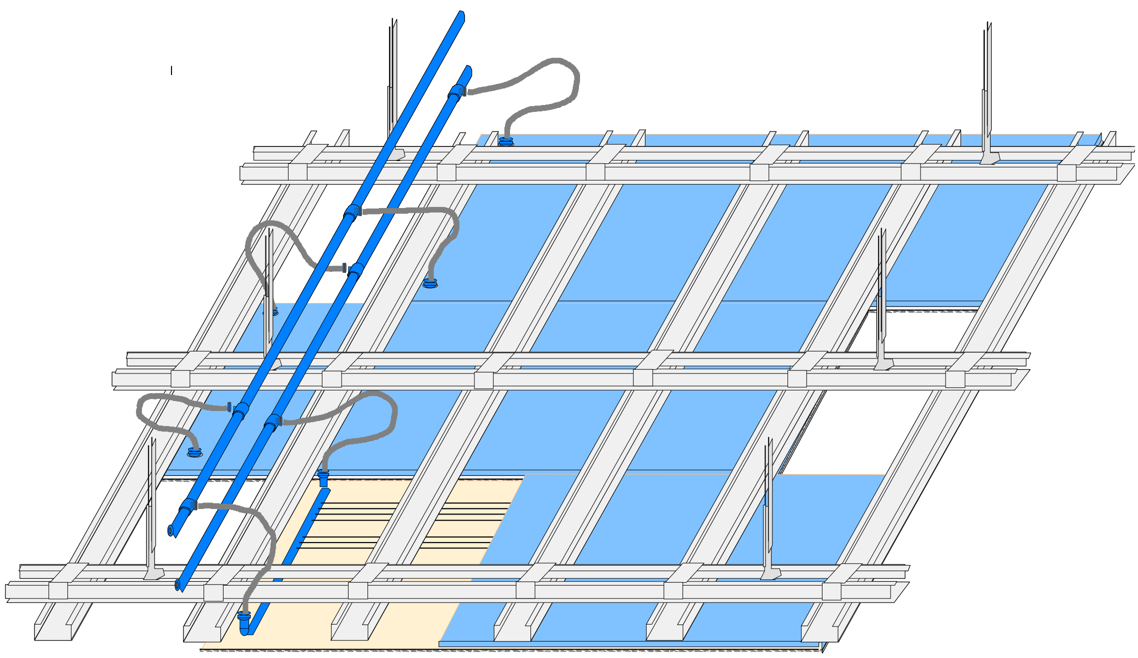
1. Generals

The BEKA dry-built units are sandwich boards made out of building board (plasterboard, Fermacell or similar) and hard foam insulation (Styrofoam) with integrated capillary tube mat, suitable for the installation in dry-built constructions, similar to the commercial dry-built boards. In this way, a heating or cooling ceiling is produced for dry-built construction.

The dry-built units are supplied in standard sizes of building boards that tailoring at the building site is not required. Only at border area and places, where components are to be built in the ceiling, inactive boards are fitted. The dry-built unit is supplied, pre-drilled for dry-wall screws, for the installation to a sub-construction made from standard CD-sheet Metal profiles.

The dry-wall screws must only be positioned at these places otherwise there is danger that the integrated capillary tube mats are damaged.
Before beginning work, a layout pattern must be drawn up as reference. All mats with its sizes and laying direction including the supply lines are to be defined in that pattern. In the ceiling pattern, also all areas must be marked, which will not be covered, for instance: Erection of internal walls, positioning of light fixtures and other components to be built into the ceiling. Furthermore, the installation position of the BEKA dry-built unit with the integrated dew point sensor must be indicated in the ceiling pattern.

Illustration: Layout of a suspended ceiling with BEKA dry-built units.



2. Installation steps

1. Suspension of the CD - profiles

   The supporting and basic profiles are fixed and aligned to the raw ceiling with nonius hangers according to manufacturer's instructions. The spacing of the supporting profiles is fixed to 500 mm. Additional supporting profiles (also the border angle profiles) at the border area and for the inactive tailored boards are positioned according the ceiling pattern. The dry-built construction guidelines must be met.

2. Installation of the BEKA supply lines.

   The supply lines are laid into the ceiling cavity and connected to the main supply lines (see M02 – Thermal welding for plastic materials).

3. Preparation of the BEKA dry-built units

   Remove the dust protection covers from the plug-in couplings on the unit.

   Plug-in the flexible connection hoses into the quick-action couplings of the BEKA dry-built unit.

4. Fasten the dry-built unit to the sub-construction

   Place the dry-built unit according ceiling pattern to the sub-construction.
   Plug-in the flexible connection hoses to the quick-action couplings of the supply lines.

   Align the dry-built unit to the pre-drilled holes at the sub-construction.
   Insert dry-wall screws into the pre-drilled holes to firmly fasten the unit on the sub-construction Make sure that the screw head has sunk in 1 mm deep. (Set the torque of the power tool !!)

5. Pressure test (see M07 – Test instructions)

   Take pretest with compressed air of 10 bar for 1 hour.

   Take final test with water of 10 bar for 10 hours. .

   Keep-up a pressure at rest of 3 bar until start of operation.

6. Connection of the BEKA dew point sensor

   Unroll the connecting cable of the dew point sensor and lead to the BEKA room temperature controller M.R2/3. Connect to the room temperature controller according to the connection schematic.

7. Ceiling finish

   Cut in-active boards for the border area and close the ceiling area completely.
   Fill the board-joint gaps, smoothen and grind even.
   Apply ceiling paint.

   Trim the snifter tube by knife to be flush with the ceiling.

3. Tools, materials

For the application of the BEKA dry-built units, standard tools and materials, commonly used for dry-built construction, can be utilised:

- CD profiles
- Cross links
- Nonius hangers
- Dowels and screws
- Dry-wall screws, length 55 mm
- Border angle profiles
- Knife for tailoring and edge planer
- Power screw driver
- Spatula
- Joint filler
- Hand-held grinder

For connection of the supply lines to the cold water circuit, a hand-held welding unit with sleeve welding device is required (see M03).

Installation Instructions for BEKA Mats between Double-panelled Plasterboard Ceiling

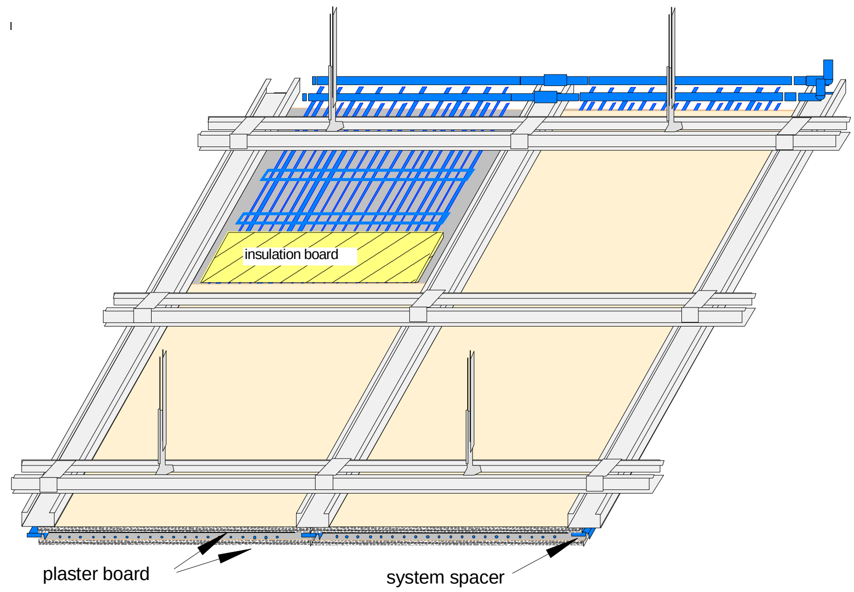
1. Generals

The installing mode of the BEKA mats according to the system Wedel is the arrangement of capillary tubes between two dry-built boards. BEKA cooling ceilings are manufactured in real dry-built construction. The applied procedure is protected by a "registered model". The advantage of this solution is based on the fact that the whole ceiling can be assembled in real dry-built construction by using standard dry-built boards (mostly plasterboards) and the work can be easily coordinated with other construction works.

As for the Wedel system, special BEKA mats of type K.S15 can be offered. The mains lines of the mats are placed in the suspended ceiling made from CD-profiles and piped in the cavity of the ceiling.

After connecting the mats to the water side through thermal welding, the pressure test according regulation M07 - Test instruction – Has to be carried out. Thereafter the first layer of plasterboards is screwed to the suspended ceiling. To enable mats to be taken from the ceiling cavity a gap must be left free. Then the mats are fixed with double-sided adhesive tape to the, of course not visible but by the position of the screws noticeable supporting profiles, under the ceiling. BEKA manufactures mats in widths equal to the spacing between the supporting profiles. The room dimensions determine the length of the mats. The system-spacers are glued under the "invisible" supporting profiles. In the last step, the second layer of plasterboard is fixed (screwed through the system spacer on to the supporting profiles). The following gap filling, smoothening and grinding is done according to the standards of the dry-built construction technique.
To achieve respectable cooling performances for this ceiling construction, Styrofoam insulation boards should be laid in sections under the capillary tube mats.

Illustration: Arrangement of BEKA mats according to the Wedel system.



2. Installation Steps

1. Suspension of the CD - Profiles

The supporting and basic profiles are connected and aligned to the raw ceiling according to the manufacturer's specification, normally by means of nonius hangers. The spacing between the supporting profiles according standards is set to 600 mm and 500 mm.

2. Installation of the supply lines.

The supply lines for supply and return are laid into the ceiling cavity according to hydraulic layout. The connecting points for the mats must be aligned exactly to the suspension ceiling construction

3. Hanging-up of the BEKA mats

Fastening of the mains lines for the mats to the basic profiles with cable ties. .

Connection of the mats with the supply lines (see M02 - Thermal welding of plastic materials).

4. Pressure test (see M07 -Test Instructions)

Pre-test with compressed air at 10 for 1 hour.

Take final test with water of 10 bar for 10 hours.

Pressure at rest with 3 bar to be maintained until start of operation.

5. Installation of the first layer of dry-built boards

Screw-on the plasterboards according to the dry-built construction specification.

6. Attaching (gluing) the BEKA mats

Unroll the mat, align and glue-on with adhesive tape to the first layer of dry-built boards between the supporting profiles. If wanted, insulation sheets can be placed under the mats.
Glue system spacers under the supporting profiles.

7. Installation of the second layer of dry-built boards

Screw-on the plasterboards according to the dry-built construction specification through the system spacer onto the supporting profile.

Install the BEKA dew point sensor and connect: Roll-out the connecting cable of the dew point sensor and lead to the room temperature controller M.R2/3. Connect the sensor to the room temperature controller according to the connection schematic. Insert a snifter tube of the sensor through a pre-drilled hole of the plasterboard.

8. Ceiling finish

Fill joints between boards, smoothen and grind even.

Apply ceiling paint.

Trim the snifter tube with knife to be flush with the ceiling.

3. Tools, materials

For the application of the BEKA pre-fabricated units commercial standard tools and materials for dry-built construction can be utilised.

- CD profile
- Cross links
- Nonius hangers
- Dowels and screws
- Dry-wall screws
- Corner angle profiles
- Knife for tailoring and Edge planer
- Power screw driver
- Spatula
- Joint filler
- Hand-held grinder

For the connection of the supply lines to the cold water circuit, a hand-held welder with sleeve welding device is utilised (see M03).

Installation Instructions for BEKA Mats as Floor Heating

1. Generals

The BEKA floor heating system can be installed onto nearly any base surface.

The floor must be constructed according to the valid standards for impact sound and heat insulation and able to carry the required passage volume.

-> Information on the Building Specifications is to be found in B08 „Questions before construction of BEKA-floor heating„

In contrast to other floor heating systems, the BEKA floor heating is not embedded into the load-carrying concrete. The capillaries are laid on top of an already load carrying base and only covered with a thin covering layer as well as the desired floor covering. The appropriate floor covering must be chosen according to the existing floor base. The application should be executed according to the manufacturer's working instructions. Basically, the thickness of the layer should only be as thick as necessary.
The thickness is affecting the reaction time of the BEKA floor heating (small thickness of layer = quick reaction!).

The supply lines and the collector pipes of the mats are commonly laid in wall slots or hidden conduits in the floor.

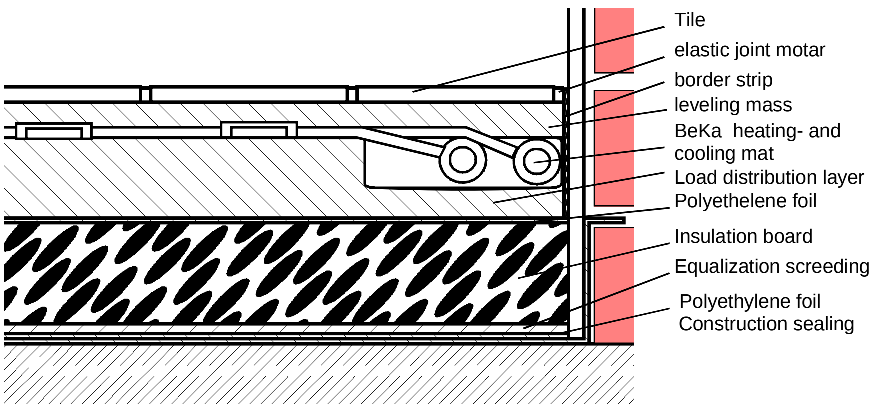
In the layout pattern also all areas must be indicated, which have to be kept free of tube mats, for instance, where internal walls will be set up. Areas for wall units and permanently fixed furniture should not be covered with tube mats, because heating is not required in these areas. For the application of the BEKA mats for floor heating, the mats must be fixed to the raw floor temporarily until the load distributing layer has been produced. For this the BEKA heating and cooling mats can be supplied with Butyl adhesive strip. After removal of the protective tape from the Butyl strips, the mats can simply be positioned on the raw floor. On a dry screed floor base, the mats can also be tacked-on.

2. Arrangement of the connecting lines and collector pipes

For a new construction of the floor, the collector and supply pipes can be laid in hidden conduits. These conduits are simply integrated into the load distributing layer (temporarily wooden (roof) batten are laid-out). After the concrete has been solidified, they can be removed and in this way, conduits are created.

Illustration 1: Cross-section of the floor with the layout of collecting pipes in the floor conduits

Before starting work, a layout pattern must be drawn up as work reference. All mats with their sizes, direction they have to be laid along and supply lines must be indicated.

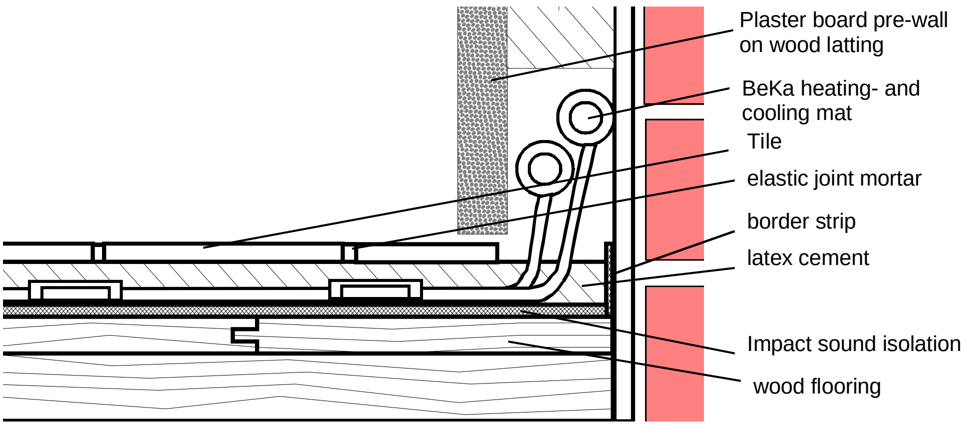


If chipboards are used for the load-distributing layer, two layers should be chosen. At places, where conduits have to be formed, then one layer is simply omitted.

The load-carrying capacity of the load-distributing layer will be recovered again, when the conduits are poured with levelling compound.

In renovation cases, it is possible to make free-cuts in the floorboard in longitudinal direction of the beams. In these cases, the load-carrying capacity must be restored again by an appropriate wood sub-construction.

Illustration2: Arrangement of the collector pipes behind the cover wall



The collector pipes and the connection lines can also be laid in wall slots. Before the chiselling out, it is necessary to check if the stability of the wall construction is sufficient. If the stability of the wall is not strong enough, installation slots can be created by mounting a cover (plaster-boards on lath).

3. Installation steps

Take BEKA mats out of the packaging and roll them out on a flat and clean surface, to keep them down apply some (flat) weights at the loop-ribbon side. Up to 15 mats can be staggered one over the other. Before continuing work, the mats should rest for one day for stress relieving.

1. Preparation of the raw floor
- Smoothen unevenness.
- Apply primer.
- Draw up a mat pattern to lay the mats on the floor.
- Fix the clamps to fasten the supply and collector lines.

2. Connect and pressure test BEKA mats to the waterside.
- Install the supply lines.
- Connect the BEKA mats to the supply lines (see → M02 – Instructions for thermal welding of plastic materials).
- Take pressure test of the completely installed system. (see → M07 – Test instruction for BEKA heating and cooling systems)
- Set a pressure at rest to 3 bar (the mats will remain under that pressure during the total time of installation until start of operation!)

3. Fasten the mats on the raw floor
- Fasten the BEKA mats on the load-distributing layer by
- Butly adhesive tape
- StecPlug-type dowel double clamps (Supplier: Hilti – Type: EDD 4-12)
- Tack with non-corrosives staples (use only in for application on dry-screed floor base!).The staples are positioned above the braces of the spacer-ribbon. The driving force and length of staples chosen should be fit to hold the mats firmly in place, the spacer should not be damaged.
- Align the mats and stretch the capillary tubes

4. Apply covering layer and smoothen. (observe manufacturer's instructions!)
- Apply a self-levelling compound – consider minimal thickness, normally 10 to 15 mm.
- In case capillaries are damaged, repair at once by closing tube ends by soldering iron, or if required, replace damaged mat. →TI.M01.

4. Product-specific installation instructions for floor heating with BEKA mats on wooden ans dry-built units

Ground	**Chipboard V 100 E 1 OSB-boards** floating	**Chipboard V 100 E 1 OSB-boards** screwed on supporting timber	**Wooden boards**	**Gypsum fibre or plasterboards**
1. Ground preparation	Grinding and extracting	Grinding and extracting	Grinding and extracting	Grinding and extracting
2. Ground priming	**ARDAGRUND EP** Epoxy resin subcoat	**ARDAPREN** Neoprene precoat	**ARDAPREN** Neoprene precoat	**ARDAL** **Ground sealer** 2 hours drying time
3. BEKA mats fixing	Glue on ground with double-sided adhesive strip or staple	Glue on ground with double-sided adhesive strip or staple	Glue on ground with double-sided adhesive strip or staple	Glue on ground with double-sided adhesive strip or staple
4. BEKA mats embed ding	**ARDALAN FLEX** minimum 3 mm over upper edge of tube Total height: 15 mm	**ARDALAN FLEX** minimum 3 mm over upper edge of tube Total height: 15 mm	**ARDALAN FLEX** minimum 3 mm over upper edge of tube Total height: 15 mm	**ARDALAN FLEX** minimum 3 mm over upper edge of tube Total height: 15 mm
5. Heating (functional heating)	Start heating 72 hours after attaching the fibre-laminated equalizer compound. Start with 20°C and increase every day by 5°C until reaching the maximum supply temperature. After reaching the maximum supply temperature, maintain that level for 24 hours.			

Working instruction: Laying of floor coverings after functional heating	
Parquet Consult the parquet manufacturer for compatibility of the parquet with floor heating.	**NIBOFLOOR PK Elastic** Mosaic and small-size elements, B3 serration / ready-to-lay parquet and long-size wooden boards with B5 serration
Ceramic covering	**ARDAL FLOORFLEX** Serration to match to the tile size Joints to be filled after 24 hours with **ARDAL FLEXFUGE**
Textile covering	**BOSTIK POWER TEX** Minimum serration B1 (consider sufficient wetting of the back of the covering, if necessary, use coarser serration). Basic rule: Needle fleece with serration B2.

5. Product-specific installation for floor heating with BEKA mats on mineral grounds

Ground	Cement screed	Anhydrite (floating) screed	Dry concrete ceiling
1. Ground preparation	cleaning	Grinding and extracting	Grinding and extracting
2. Grundieren des Untergrundes	ARDAL Grundfestiger 2 Std. Trockenzeit	ARDAL Grundfestiger 24 Std. Trockenzeit	ARDAL Grundfestiger 2 Std. Trockenzeit
3. BEKA mats fixing	ARDAFLEX RAPID	ARDAFLEX RAPID e	ARDAFLEX RAPID
4. BEKA mats embedding	ARDALAN FLEX minimum 3 mm over upper edge of tube Total height: 10 mm	ARDALAN FLEX minimum 3 mm over upper edge of tube Total height: 10 mm	ARDALAN FLEX minimum 3 mm over upper edge of tube Total height: 10 mm
5. Heating (functional heating)	Start heating 72 hours after attaching the fibre-laminated equalizer compound. Start with 20°C and increase every day by 5°C until reaching the maximum supply temperature. After reaching the maximum supply temperature, maintain that level for 24 hours.		

Working instruction: Laying of floor coverings after functional heating	
Parquet Consult the parquet manufacturer for compatibility of the parquet with floor heating.	**NIBOFLOOR PK Elastic** mosaic and small-size elements, B3 serration / ready-to-lay parquet and long-size wooden boards with B5 serration
Ceramic covering	ARDAL FLOORFLEX Serration to match to the tile size Joints to be filled after 24 hours with **ARDAL FLEXFUGE**
Textile covering	**BOSTIK POWER TEX** Minimum serration B1 (consider sufficient wetting of the back of the covering, if necessary, use coarser serration). Basic rule: Needle fleece with serration B2.

Technical Information on BEKA Adhesive V.K.1

1. Range of application

For gluing the capillary tube mats to acoustic fibre mats, in metal ceiling sheets and to dry-built boards.

2. Characteristics

The BEKA Adhesive V.K.1 is an adhesive, which is suited for spray-application with a setting time. For stress- free application on absorbent materials, it is possible to work with a one-sided layer of adhesive. The adhesive forms an elastic, permanent and colourless adhesive joint.

3. Processing guidelines

For gluing into metal ceiling sheets, the BEKA adhesive V.K.1 is thinned with BEKA solvent V.L.1 in the proportion up to max. 5:1 before applying. The adhesive, dosed economically, is sprayed onto the mats. The mat is then laid immediately in the cassette and rolled-onto the surface.
As guideline for the amount of usage: 80 g/m2.

4. Technical data

Raw material base:	SBS -caoutchouc
Solid base contents:	ca. 43%
Density:	ca. 0.83 g/ml
Viscosity:	ca. 200 mPas (Brookfield)
Colour:	natural
Application of adhesive:	with spraying gun
Nozzle size:	1.5 – 2.5 mm
Spraying pressure:	2 - 6 bar
Flashtime:	ca. 0.5 – 3.0 minutes, depending on layer thickness, material and temperature
Setting time:	for double sited application: approximately 120 minutes for one sided application: approximately 15 minutes
Cleaning agent:	solvent V.L.1
Storage time:	at +15°C to 20°C approximately 6 months
Storage temperature:	not below +10°C, affected by frost
Application temperature:	Material, room and adhesive temperatures Not below +15°C and not above +25°C; best application temperature is +18°C to +22°C

Identification code according to
GefStoffV (regulation for dangerous materials): Flame symbol, F, highly inflammable

Marking according VbF:	A I

Technical Information on BEKA Solvent V.L.1

1. Range of application

Universal solvent and cleaner for BEKA adhesive V.K.1

2. Working guidelines

For gluing into metal ceiling sheets, the BEKA V.K.1 adhesive is thinned with BEKA solvent V.L.1 in proportions up to max. 5:1. The adhesive, dosed economically, is sprayed onto the mats. The mat is laid into the cassette immediately and rolled-onto the surface.
A guideline for the amount of usage is: 80 g/m2.
In case of the usage of thinning solvents for better viscosity, it must be observed that there is still enough adhesive left, which ensures sufficient adhesive film after application, otherwise it could cause insufficient adhesion.

3. Technical data

Storage temperature:	Cool storage; not affected by frost
Storage time:	unlimited, if kept in tightly closed container
Application temperature:	Material, room and adhesive temperature not below +15°C and not above +25°C; best application temperature at +18°C to +22°C
Identification code According to GefStoffV:	Flame symbol, F, highly inflammable

Identification code according to VbF:A I

Technical Information on BEKA Thermal Conductive Paste V.WLP.1

1. Range of application

For thermally effective embedding of capillary tube mats onto dry-built construction sheets, such as plaster boards or gypsum wallboards.

2. Characteristics

The BEKA thermal conductive paste V.WLP.1 is a highly elastic, solvent-free liquid foil with a long setting time. The thermal conductive paste is made ready for application. After binding, the paste forms an elastic, aging-resistant, thermally conductive and grey joint.

3. Application guidelines

The thermal conductive paste is applied by a roller, pouring or other applying method (ca. 800g/m^2). After the paste has been applied all over between the spacers, it is then distributed through narrow long brush moved in parallel to the capillary tubes. This will form a bridge between the air gap, base of the capillary tube and surface of the plate. At normal temperatures, the thermal conductive paste will bind within 20 minutes that the ceiling boards can be installed. The spacers, which have contact with the ceiling profile, are smoothened by spatula or another suitable tool from the possibly applied thermal conductive paste.

4. Technical data

Raw material base:	plastic water-based, modified
Colour:	grey
Density:	ca. 0.83 g/ml
Consistence:	highly viscous, non dripping
Joint coverage:	up to 2.1 mm
Tensile strength:	1.5 N/mm^2
Elongation at tear:	ca. 400%
Application of paste:	by brush
Setting time:	ca. 120 minutes
Cleaning agent:	just applied, with water
Storage time:	at +15°C to 20°C approximately 6 months
Storage temperature:	free of frost
Application temperature:	not below +5°C

Fixing of BEKA Mats with Adhesive Tape

1. Generals

BEKA mats can be installed below suspended ceilings laid in plaster. For this purpose, the mats must be temporarily fixed in a suitable way to the underside of the plaster board ceiling until the final plastering. The BEKA heating and cooling mats can be supplied equipped with adhesive tape. After the protective tape has been pulled from the adhesive tape, the mats a simply fixed to the underside of the ceiling.

2. Application conditions for gluing with adhesive tape

2.1 Conditions of the ground

The best ground is plane plasterboard. Joints between boards and screw heads must be filled and smoothened. The ground must have load-carrying capacity and be dry, free of dirt, grease, oil and dust.

The adhesive primer must not be applied at this time!

Application and storage temperatures

+15°C to +28°C

2. Application time

The fixing of the BEKA mats with adhesive tape to the plasterboards is only laid out as an installation aid before plastering. The mats can only be held with the adhesive tape to the ceiling up to a time period of 3 days. In case of longer interruption of work, the capillary tube mats must be fixed to the ceiling by additional means.

3. Installation steps

- Take the BEKA mats out of the packaging and rollout onto a flat surface and if necessary, place some (flat) weights onto the loop-ribbon side. The mats can be stacked up to 15 layers. Before work is started, the mats should be left for stress relieving for the time of one day.
- Position and fasten the main pipes of the BEKA mats to pre-fixed clamps. Depending upon their length, the mats can be loosely rolled-up again for easier handling.
- Install the water connection to the main pipes. → see working direction TI-M02
- Take pressure test after installation according to TI-M07.
- Rollout the mat and fix to the ceiling with adhesive tape. Therefore, peel off the protective foil from the adhesive tape and press the mat onto the ceiling with little but equal pressure. The mats should be stretched that they are even with the ceiling. Single sagging capillaries can be stretched by pulling them into direction of the loops.
- If necessary, fasten the mats additionally with staples.
- Prepare the surface of the ground for plastering. Suitable adhesive primer is Beto Kontakt 90 from Knauf or other similar materials.
- Apply the plaster to the BEKA mats. Put the BEKA mats under pressure with compressed air of 3 bar and retain this pressure during the total time when the plaster is applied (possibly occurring leakages will be detected by air bubbles, it can be repaired immediately without drainage of the water from the mats. →TI-M01).

Flow pressure and consistence of the plaster should be such that the mats are not drawn from the ceiling when the plaster is applied!

Mounting instructions for BEKA mats on drywall boards under concrete ceilings

1. General advice

Concrete ceilings can be easily upgraded to a heating and cooling ceiling by directly mounting a dry-lined ceiling from below. The BEKA capillary tube mats are simply placed from above onto suspended drywall boards (usually plain or fibre-reinforced plasterboards). Wooden battens are attached by dowels under the concrete ceiling as a supporting structure for the drywall boards.

System description

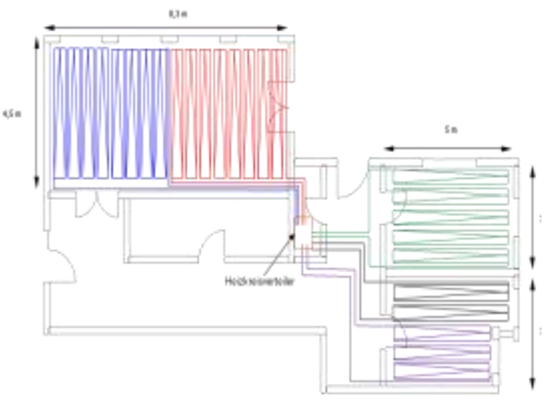
The BEKA heating and cooling ceiling in its dry-lining variant is connected to the customer's existing or to be installed heating or cooling system. So that besides the advantages of BEKA ceilings in terms of comfort, the beneficial effects of improved energy efficiency also become apparent, the BEKA ceiling is preferably to be combined with heating and cooling equipment based on low-temperature technology. Heat pumps or solar heating systems are very favourable for this.
The system solution of the BEKA heating and cooling ceiling in its dry-lining variant comprises the capillary tube system including the necessary plug-in connectors for building heating circuits. All customary materials for the installation of heating systems and dry-lined ceilings are not a component of BEKA's scope of supply.
All installation and dry-lining work calls for a thorough understanding of this technical field. Within the scope of advice on a system solution, no further information is given about this work. If necessary, please obtain this from the respective manufacturers of these materials.

Stipulation of the ceiling supporting structure

Use wooden battens with an edge size of at least 35mm(H) x 60mm(W). The height (H) subsequently gives the overall construction height of the ceiling structure. When customary 12.5 mm thick plasterboard is used, the heating and cooling ceiling subsequently builds up to only 47.5mm.

2. Technical preparation

It makes sense to create a construction/ceiling plan before the material is ordered and installation begins. The plan specifies the arrangement of the capillary tube mats in the separate rooms and from this the required mat lengths are defined. The length of mat is determined via the room size. However, for flow property reasons the maximum length should not exceed 8 metres. Also to be recorded in the plan is the arrangement of the wooden battens for the ceiling's supporting structure. The wooden battens are attached by dowels directly to the raw concrete ceiling at a spacing of 500mm. The capillary tube mats are later stretched between the wooden battens. The pipework for the supply lines is also laid in the future ceiling cavity.



An example installation plan

Division into control zones

Each room is a separate control zone as regards room temperature.
Only capillary tube mats of identical length and in a maximum overall area of 15m² are to be installed in a control zone. If the active area of a room exceeds 15m², please divide the area into 2 hydraulic control zones, each of which is connected to the heating circuit manifold. If the geometry of a ceiling area is unsuitable for arranging solely mats of identical length in a control zone, divide the ceiling area into subareas of identical length. Each subarea is then a hydraulic control circuit that is connected to the heating circuit manifold.

3. Installation steps

1. Securing the wooden battens

The 35x60mm wooden battens are fixed to the concrete ceiling by dowels on the wide side (W).

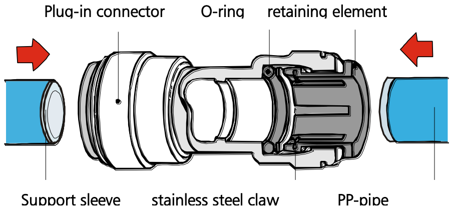
A terminating strip is installed right round along all the walls.
The wooden battens running lengthways to the installation direction of the capillary tube mats are shortened in length by around 150mm. The connecting pipes of the capillary tube mats and supply lines to the heating circuit manifolds later lie in the supply zone that results from this.
The centre spacing between the wooden battens is 500mm. This distance must be adhered to very accurately. If may be advisable to make a gauge for strict adherence to this measurement. To make a gauge, simply use a leftover piece of the existing wooden battens. Any unevenness in the concrete ceiling must be rectified by placing equalising wooden wedges underneath.

The wooden battens must subsequently exhibit a smooth level surface on the underside. Use a spirit level or laser measuring device to check this.

2. Preparing the plug-in connections

Insert the support sleeve up to the stop in all four ends of the connecting pipes of the capillary tube mats. Never use the plug-in coupling without a support sleeve fitted. The plug-in connections may later become leaky.

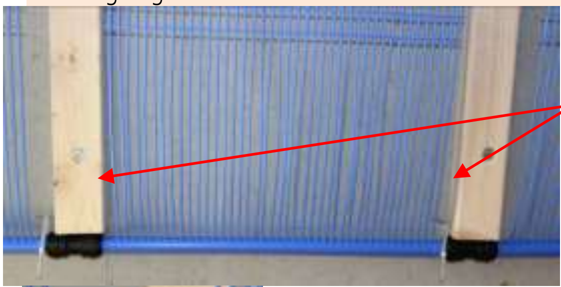
The plug-in coupling is simply pushed on. If the connection needs to be released at some time. Please release the coupling by pressing down on the securing ring and then simply pull off the coupling.



3. Joining the mats to one another

Now simply plug the adjacent mats of a control zone together. So that the mats hang suspended in the structure, simply keep the mats' connecting pipes or couplings secured to the ceiling by suitable means.
(In the example shown, cable ties were fastened to the side of the wooden batten).

4. Aligning the mat structure



Now arrange the mats over the width by moving the entire mat structure laterally.

Potential mishandling!

The lateral capillary tubes must not lie on a wooden batten.

They must also not be kinked by the wooden batten.

5. Fixing the mat structure in place

Route the capillary tubes neatly along the batten structure. No capillary tubes must lie on the batten. To achieve an improved heating and cooling capacity with this ceiling structure, insulating boards (35 – 40mm thick) of mineral fibre or the like can be mounted between the wooden battens before the capillary tube mats are installed. These should not be pressure resistant so the capillary tubes are not squashed later on. The insulating boards are normally packed in PE foil to avoid fibre dust.

If the mats sag too much over the length, simply fix the mats with adhesive tape or some other suitable retaining material that arranges them crossways to the battens. Please ensure that the retaining devices have only a minimal mounting height so that subsequently no dislocation is caused to the ceiling surface when the drywall boards are installed.

6. Connecting the supply lines

The separate mat arrays / heating circuits are connected as per the Tichelmann system.

To connect the separate heating circuits to the heating circuit manifold, use raw materials and connection accessories obtainable from your regional commercial outlets Make sure though that the pipes are of corrosion-resistant material. No steel pipes or mouldings or items of galvanised steel must be used. Instead, use preferably plastic pipes. Corrodible materials will quickly corrode and put the system out of action.

7. Connection to the heating circuit manifold

Next, route all supply lines to the heating circuit manifold. If need be, secure the pipes in suitable pipe brackets or pipe retaining clips. When routing pipework through wall ducts, please observe noise protection and, where applicable, fire prevention requirements.

Connect the flow and return lines for each heating circuit to the heating circuit manifold. Use a suitable heating circuit manifold. Please consider a corrosion-resistant design here as well.

7. Filling the system

Example product: Solarcheck Mobilcenter P80 KOMPAKT
Producer: ZUWA-Zumpe GmbH, www.zuwa.de

The heating water must meet the requirements of the VDI 2035 directive. Please consult a specialist water treatment firm about the use of hot water treatment or corrosion inhibitor in the heating water. The capillary tube mats are not diffusion-proof. To fill, preferably use a filling and flushing device. These devices are available from retailers. They are usually used to fill solar heating systems. With this equipment you will quickly expel the air from the capillary tube mats.
Should any leaks occur, please deal with the cause straight away. Vent the system.

8. Carrying out the pressure test


Standard commercial pressure test pump

The entire installation must be pressure tested before it is put into service.
Pressurise, section by section, individual heating circuits of the system. During the main test, the mats are to be subjected to a pressure of 3 bar for 10 minutes. Any leaks that occur must be fixed straight away.
The pressure is then increased to 10 bar. After 1 hour the pressure drop due to elastic stretching of the pipe network may need to be compensated for.
If the system maintains the pressure of 10 bar for 4 hours thereafter, the pressure test is deemed successful.
If leaks had to be fixed, the pressure test has to be repeated. Keep a log of the progress of the test.
At the end of the pressure test, the system pressure is lowered to the normal 2 - 3 bar and remains in this state until the end of the building activities.

9. Installing the drywall boards

As the final installation step, mount the drywall boards on the wooden battens. Make sure a capillary tube is not inadvertently lying between the wooden batten and drywall board. The capillary tubes must not be squashed. Should a capillary tube have been damaged, it must be separated and shrunk done at both ends. The instructions for shrinking down can be found in section 3

10. Putting the system into service

Put the system into service. Observe all of the manufacturer's instructions about the individual components of the system and all of the recognised codes of practice.
Hydraulic balancing of the separate heating circuits on the heating circuit manifold is the prerequisite for the system to work and heat up the ceiling surface evenly. Influencing of the heating capacity is more effectively achieved by altering the flow temperature than by altering the mass flow at the heating circuit manifold. Moreover, lowering the flow temperature of your heating system is usually also more energy efficient. The BEKA heating ceiling is a radiant heating system. Radiation temperatures that are too high disturb comfort and must be avoided. Adjust the system such that the surface temperature of the ceiling is not higher than 30°C. This value is achieved when the flow temperature is around 36°C. The return flow should not be lowered by more than 3°C so that the ceiling temperature is kept as uniform as possible. With a surface temperature of around 30°C the BEKA ceiling has a heat output of about 60W/m². In rooms of up to 2.75m in height, that is the maximum heat output that is still perceived as comfortable.
If you are also using the ceiling for cooling, please avoid flow temperatures below 16°C. Otherwise your ceiling may suffer condensation during damp weather. We recommend the use of a BEKA dew point sensor. This sends a control signal to the BEKA room temperature regulator or BEKA converter if there is a risk of condensation. Both evaluation units promptly switch the system off if there is a risk of condensation.

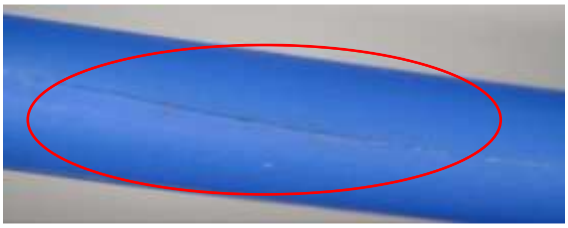
4. Potential faults on the capillary tubes and advice on fixing leaks

Rough mechanical influences can damage the capillary tubes and shorten the service life of the mat. For reliable recognition of potential damage spots on the capillary tube, we refer to some typical symptoms of damage illustrated below:

The capillary tube was squashed by mechanical influences (e.g. it lay between the wooden batten and drywall board). Besides the deformation of the capillary tube diameter, a thin white stroke is noticeable along the squashed region

The capillary tube was kinked.

The welding of the capillary tube to the connecting pipe was deformed



The capillary tube was deformed by an applied blow temporarily. A tear can be clearly seen along the pipe wall.

The defective places must therefore be removed. If only some capillary tubes are affected, the entire mat does not need to be replaced. In this case just the capillary tubes affected can be shrunk down. For this, the capillary tube is completely cut through and the damaged section is cut out. After this, the two open ends of the capillary tube are sealed by thermal plastic welding. Although the capillary tube affected is then no longer in operation, the perceptible effects on the cooling and heating capacity are negligible.

The work steps involved in shrinking down capillary tubes

Cut the damaged capillary tube so that two ends are created and remove the damaged portion of tube generously.

Heat up each end of the capillary tube until it begins to melt.
CAUTION: Plastic is combustible! Therefore work swiftly and protect the surroundings from a fire starting.

The use of an electrical welding iron is non hazardous. You should preferably use this method.

Press the molten ends of the capillary tube together boldly and allow it to cool down. After this you need to repeat the pressure test.

5. Tools, Materials

The usual tools and materials for pipe installation and dry lining are used to install the BEKA heating ceiling in its dry-lined variant:

For the supporting structure

- Wooden battens 34 (40) x 60mm
- Dowels and screws to secure the wooden battens
- Power drill
- Saw for cutting the battens
- Spirit level, laser measuring device, measuring tape, possibly a spacing gauge

For the mat installation

- Capillary tube mats in numbers and sizes as per the installation plan
- Quick couplings and supporting sleeves
- Transition fittings of the quick couplings and for the connecting pipe
- Means of securing the connecting pipes of the capillary tube mats (e.g. Cable ties, pipe brackets or similar)
- Pipeline of corrosion-resistant material (plastic, stainless steel) and mouldings suitable for the installation of supply lines to the heating circuit manifold
- Heating circuit manifold of corrosion-resistant material
- Heating and refrigeration technology of corrosion-resistant material or interposed heat exchanger with separating unit
- Possibly adhesive tape or similar to fix the capillary tube mats to the ceiling structure
- Tools for working on and installation of the connecting pipework

For putting into service

- Filling and flushing device

For the pressure test/ leakproofness test

- Pressure test pump

For installation of the dry-lined ceiling

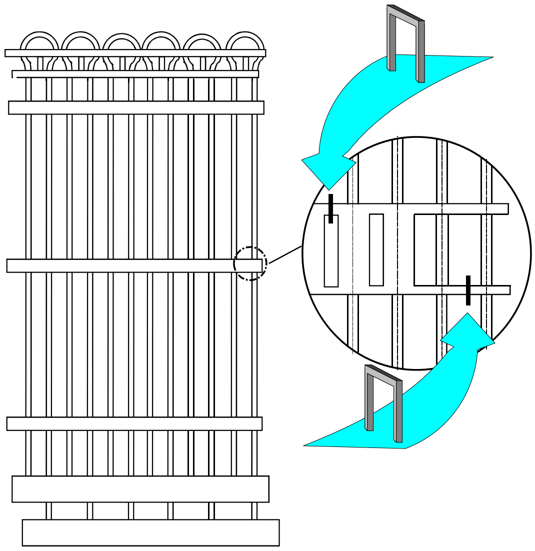
- Drywall boards (plain or fibre-reinforced plasterboards)
- If necessary, knife to cut to size and chamfer plane
- Dry wall screws
- Screwdriver
- Spatula
- Joint filler
- Hand-held grinder

Installation Instructions for BEKA Mats with Tacks

1. Generals

When BEKA mats are fixed to suspended plasterboard ceilings from above or from below, very often the fastening technique of tacking is used. Because of the possibility that capillaries can get damaged, staples should only be used if gluing with adhesive tape (→TI-M17) cannot be utilised.
The installation depends on the type of ceiling construction. For plaster ceilings (→TI-M03), the piping for the supply lines has been laid into the future cavity of the ceiling. For dry-built construction boards (→TI-M05), the supply lines are connected to flexible hoses during the time of installation.

Attention!	It must be made sure that before tacking all capillaries, which might have slipped out of the spacers, will be clipped back properly into the spacer bar.



2. Installation steps

2.1 Plaster ceiling

When installing, the collector pipes of the mats must be fixed properly. After connecting the mats to the water lines according to the instructions TI-M07 – Test instructions for BEKA heating and cooling systems, a pressure tests must be performed. Then the capillary tube mats will have to stand a pressure at rest of 3 bar over the entire time of installation until start of operation.
Long BEKA mats are hang up to the ceiling, already connected, and rolled-up until the actual tacking is performed.

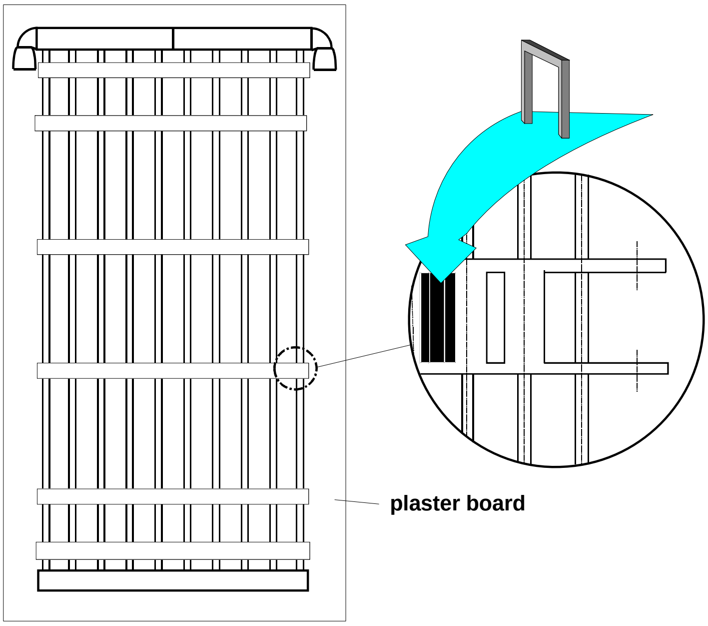
The covering of the ceiling with plasterboards and the following joint filling, smoothening and grinding is done according to the dry-built construction specifications. The BEKA mats are tacked to the plaster board ceiling. Doing so the tacks will be positioned alternately to both sides to the flanges.
The staples are placed first at the side of the collector pipes. The BEKA mat is rolled-off during the work in progress. The stacks are placed in such positions that the side flanges of the spacers are bridged. The driving force for the tacker must be set to such a degree that the side flanges of the spacers will not deform or in exceptional cases, will not deform more than 1 mm. (Side flanges and tacks should be of same height). The length of the tacks should be maximum 15 mm.

2.2 Dry-built construction board

The BEKA mat is positioned on the dry-built construction board (plasterboard or fibre plasterboard) by placing the spacers to their predetermined positions. Then they are tacked to the boards.

While tacking, the BEKA mat is fixed on the plasterboard or fibre plasterboard by tacks.
First both the outer spacer rows are fastened. The spacers are especially shaped that staples can be set to determined areas. The cross-connections between the side flanges are laid deeper to have direct contact to the plasterboards. The driving force set for tacking must be such that the flange in the spacer will only be deformed to a miner degree. The length of the staples should be not more than 12 mm.
Maximum 15 mm must be the length of the staples when the side flanges of the spacers are used according to the point 2.1 (Plaster ceiling).

The flat-wire staples are suitable for all types or plasterboards. If staples are used where the legs are tightly located (narrow-back staples of 4 mm) then the legs effect like one wide piece. With fibre plasterboards, the use of those staples can cause damage. The rigidity in these areas is damaged because of the local load. Often the fibre material is pressed through the fibre plasterboard and rests as build-up to the opposite side. Often the fibre material is separated from the fibre plasterboard.
The stapler must be adjusted to such a force that the staples will hardly, or in exceptional cases deform the plastic material of the spacer by not more than 1 mm (side flange and staples will make up same height).



3. Tools, materials

Best results will be achieved with flat wire or surface-improved staples. These staples are available for all staple guns.
The lengths of the staples for tacking the side flange of the spacers should be maximum 15 mm (see point 2.1. and 2.2). A maximum staple length of 13 mm can be utilised, when the brace of the spacers are stapled.

Installation Instructions for BEKA Mats as Wall Heating

1. Generals

The BEKA wall heating can be installed to nearly any load-carrying wall surface. If the installation is at an outer wall, then the U-value of the wall must be better than 0.35 W / (m^2K). Occasionally an additional layer of insulation might be necessary. General explanations can be read in → TI-B10 – Questions before drafting of BEKA wall heating. For wall heating the BEKA heating and cooling mats are mostly embedded directly into the plastering.

For the installation of wall heating, special building materials are not required. Fundamentally, the wall construction can be of any standard-type wall. After fastening the BEKA heating and cooling mats to the raw wall, the mats can be plastered with all types of mineral plaster. Coarse-grain rubbing plaster is not permissible because of danger that the capillaries could get damaged. Common plaster types and qualities would be: Machine plaster type MP75 GF. Basically, the thickness of the plaster should be chosen only as thick as necessary. Normally a thickness of 12 to 15 mm is sufficient. The thickness of this layer affects the reaction time of the BEKA wall heating (thin layer thickness = fast reaction time!). The ground is to be pre-treated according to manufacturer's guidelines.

Before starting work, a layout pattern for the arrangement of the mats must be drawn up as work reference. In it, all mats with their sizes, direction of arrangement and supply lines must be lined out. In the pattern all areas, which will be kept empty, as for inner walls or for wall units and permanently fixed furniture should not be covered, since there is no heating required in those areas. For the utilisation of BEKA mats for wall heating, the mats must be positioned and fixed to the raw wall in appropriate manner until plastering.

Therefore the mats are supplied with Butyl adhesive tape already attached to it. After the protective foil is peeled-off, the mats are simply fixed to the raw ceiling by means of the adhesive tapes. The mats can also be staple-fixed if dry-built construction boards are used as wall base.

2. Arrangement of the connecting lines and of the collecting pipes

The collecting pipes and supply lines for the BEKA wall heating, plastering version, are placed into the base board or special wall slot. Explanation for this version is given in the technical information TI-B10.

It could be the case that building regulations prohibit positioning collector pipes in wall slots, because of possibly changes in the building statics. Normally, slot depths of 15 to 20 mm are sufficient. The possible weakening of the wall must be clarified prior to the changes.
For renovation purposes, the old layer of plaster, if still load-carrying, can remain. In this case, it is sufficient to mill slots into the plaster for later accommodation of the collector pipes.

If inner wall insulation is required or desired, then the insulation panels can get cut-outs for the reception of the collector pipes. The insulation panels are to be fixed to the raw wall according to manufacturer's installation guidelines. For the accommodation of the main pipes, the panels are simply fixed in spaces to each other.

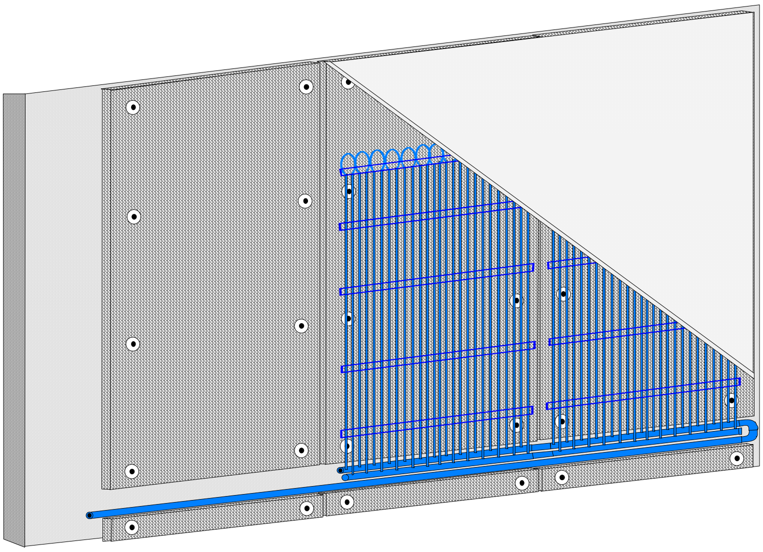


Figure 1 Arrangement of the collector pipes and piping according to “Tichelmann” by utilisation of insulation sheets for the formation of installation slots.

3. Installation steps

Take the BEKA mats out of the package, roll them out onto a clean flat surface and load the loop side with a flat weight. The mats can be stored up to 15 layers one over the other. Before further processing, the mats should be stress-relived for one day.

1. Preparation of the raw wall
   Smoothen unevenness.

   Apply primer.

   Draw up the arrangement of the mats on the wall and fix temporarily.

   Attach clamps for reception of supply lines and collector pipes.

2. Connect the BEKA mats to the water line and make pressure test.

   Install the supply lines.

   Connect the BEKA mats to the supply lines (→ TI-M02 – Instruction for thermal welding of plastics).

   Take pressure test of the finally installed system (→ TI-M07 – Test instructions for BEKA- heating- and cooling systems).

   Set a pressure at rest of 3 bar and maintain this pressure during the time of installation until start of operation!

3. Fasten the mats to the raw wall with:

   - Adhesive tape → TI-M17
   - Plug-in dowels – double dowel clamps from Hilti – type: EDD 4-12
   - Fasten with staples made of non-corrosive steel (valid for the fixing to plasterboards!) The staples are to be positioned over the braces of the spacer-strips. The driving force and lengths of the staples should be chosen that the mats are fastened securely, but the spacers not torn. → TI-M19.

   Align the mats.
   Tighten the capillary tubes.

4. Apply plaster and smoothen (meet th manufacturer’s instructions!)

   Apply plaster - minimal thickness, normally 10 to 15 mm are sufficient.

   If capillaries are damaged, repair by soldering the tube ends. If required, exchange the whole mat → TI-M01.

Start of Operation of Basic Stations and Storey Distributors

1. Delivery and transport

The story distributors and basis stations are supplied lying on palettes. To protect them from dirt, the goods are wrapped in shrinking foil.

When the goods are received from the forwarder, a check for possible transport damages.

If damages are obvious, recorded them in the delivery bills and report to the forwarder.

The storey distributors and basis stations are always installed on a zinc coated frame. Questions on dimensioning and arrangement are answered in TI-B14 (Technical requirements for basis stations and storey distributors).

During transport, all forces may only have an effect on the zinc-coated frame. For handling (loading and unloading) the pumps, pipes vents and valves must not be touched!

After installing and fastening of the storey distributors and basis stations at their appointed position, connect them to the primary and secondary circuits. The electric lines can also be connected.

Each storey distributor and each basis station had been tested with a pressure of 10 bar and checked for leakage before shipment. A further pressure test of 10 bar at the building site is not permissible since the pressure control valve will respond to a lower pressure, this could cause damage to the pressure gauge; if possibly by-pass the pressure control valve because of its quick respond.

As for the pressure test with 10 bar, the maximum
Pressure-relieving valve must be closed at the drainage side, the pressure gauge de-installed and the threaded connection closed and the cap valve towards the compensating tank as well.
After the pressure test, the state of supply must be re-established.

2. Filling, rinsing and pressure relief

For filling and rinsing, the KFE faucets of the storey distributor and the basis station are provided. Filling and rinsing of the basis stations must be only carried out with the connecting lines installed.
As for the storey distributor, the working sequence should be that at best each cooling circuit is filled and rinsed separately. Thereby one KFE-faucet is used for filling and at the other one a hose is connected, which is leading to a deposit.
The filling is performed with low water pressure only until water is emerges from the second KFE-faucet. Then the rinsing process starts with maximum water pressure, so to rinse-out possible air and installation dirt, which has been trapped in the circuit. After some time the water is draining smoothly without any air encapsulated. The filling and rinsing process is finished. After rinsing with
cold water, condensation can occur at the supply lines and capillary tube mats.
Condensation can be avoided when lukewarm, clean water is used for rinsing or a portable rinsing unit is being used.
With the KFE faucet, the system is adjusted to the required operating pressure.
Make sure that the cap valve to the pressure expansion tank is open and the correct gas precharge pressure has been set.
Any air bubbles left will be let out of the system through the automatic bleeding valve.
If there is not enough water pressure for the elimination of air bubbles available, then rinsing can also be done by using the pump, which is installed in the system. For this purpose, the pump must be set to its maximum capacity.
After filling and first rinsing with the existing water pressure, each separate cooling zone will be flushed through with water by directed opening of the zone valves. Any air bubbles left will be let out of the system through the automatic bleeding valve.
Due to the air leaving the system, the operating pressure could drop, it must be corrected to its required pressure by refilling.

An automated refilling can be arranged by means of an adequate refilling setup. Without such a setup, the first control must take place in the first week after the system was taken into operation. After some monthly controls, the checking is due after every 6 months.

3. Setting the flow rate for each zone

For setting the flow rate at the storey distributor for the separate zones, it should be started with the zone having the highest flow resistance. Here the flow-control and regulating valve is set to its maximum opening. Through reducing the pressure at the overflow valve or reduction of the speed (rpm) at the pressure-controlled pump, the desired volume flow can be adjusted. Thereafter the single zones can be set to the flow rate. This is done with the volume flow-control and regulating valve.
Due to the steady pressure of the overflow-valve or through matching the speed of the pressure regulated pump, each single zone can be adjusted without that one zone to interfere with another one.

TA-valves cannot be adjusted according to the described method with the control- and setting computer. For this purpose, the pump must be set to constant flow rate that the computer can read the adequate values of the valves.
At this point, the necessary accuracy of the flow rates must be pointed out.
The required flow rates for each zone are specified by the planning or engineers office. Measurements according to DIN4715, part 1, have revealed that with 50% of the flow rate 89% of the nominal capacity is achieved (→ TI-B14 Technical Requirements for Basis Stations and Storey Distributors).
From this result it can be derived that at a slightly lower flow rate there will be no remarkable capacity reductions with BEKA heating and cooling ceilings

4. Electrical connections

Storey distributors and basis stations can be supplied including electric wiring and control panel.
The measuring and controlling technology supplied by BEKA is operated by 24 V a.c. (→ TI-M08 Technical data of the converter M.K.2; TI-M09 Technical data on the room temperature controller M.R 2/3). The schematic is included in the storey distributor or basis stations. The regulating valves of the storey distributors should be equipped with auxiliary contacts. The electrical circuit arrangement can then be laid-out for gentle treatment and energy saving purposes that with the switching-off of the last cooling circuit also the pump is shut-off.

Attention :
After initiation, the thermal actuator has an opening time of approximately 2.5 minutes. Only after this time the auxiliary contact and thus, the pump is actuated.
After the shut-off of the thermal actuator, a closing time of approximately 2.5 minutes must be accounted for .Only after this time, after the last zone has been switched-off, the pump can be shut off as well.

The thermal actuators supplied by BEKA possess an auxiliary contact, they are operated with 24 V a.c. The peak starting current amounts to 250 mA and power consumption of 3 watt at operation. The auxiliary contact disposes of a load capacity of 2 amps and 230 volt.

5. Filters

In case that filters are utilised, they must be cleaned after start of operation.
The rinsing operation with installed filters is exclusively for bleeding of air bubbles.

6. Generals

Pump manufacturer's instructions for the operation of the pump are given in the operating manual.
Pay attention to the proper sense of rotation of the pumps.
Electrical work may only be performed through appropriate trade staff.

BEKA
FÜR KLIMA-KOMFORT

Functional Heating of Floor Heatings with BEKA Capillary Tube Mats

1. Generals

BEKA capillary tube mats can be applied as floor heating in various floor structures.
They are distinguished in

- BEKA capillary tube mats in screed layer (cement screed or calcium sulphate screed)

and

- BEKA capillary tube mats on solid base in balancing layer (fibre-reinforced balancing layer, for example, Ardalan Flex from ARDAL).

Functional heating does not replace the pressure test of the installation according to the testing instruction TI-M07. After pressure test, the installation is to be kept pressurized while the screed is laid. During that period the installation is NOT HEATED!

These instructions are considered supplement to the general rules of technology, current regulations as well as manufacturer's guidelines. The standards DIN 18560, DIN 4725, DIN EN 1264, DIN 68771, guidelines of the association TDB "Ceramic tiles and plates, natural stone and concrete stones on heated cement-based floor structures" as well as information sheets of the association BVF "Control and regulation of warm-water floor heatings" and "Interface coordination with heated floor structures" are to be complied with.

2. Functional Heating

Cement screeds are permitted to be heated after 21 days only, at the earliest. As for calcium sulphate screeds, the waiting time amounts to minimum 7 days. The manufacturer's guidelines are to be complied with, in every case.

First heating starts with a supply temperature of 25°C to be kept for three days, followed by the maximum possible supply temperature to be maintained for another 4 days.
Do not cover the heated area with construction material and covers of any kind.
After termination of functional heating, protect the screed from rapid cooling. Avoid any draught!

When the BEKA capillary tube mats are laid on a solid base in a balancing layer (fibre-reinforced balancing layer, for example, Ardalan from ARDAL), heating is not required. Functional heating is only caused to check the functioning. The area is allowed to be heated after complete setting of the balancing layer after about 3-5 days only. The manufacturer's guidelines are to be complied with, in every case.

Functional heating is to be recorded in the respective protocol, see TI-T11.

Independently of functional heating, check the humidity content before attaching the floor covering.
Consider the manufacturer's specification for residual humidity!

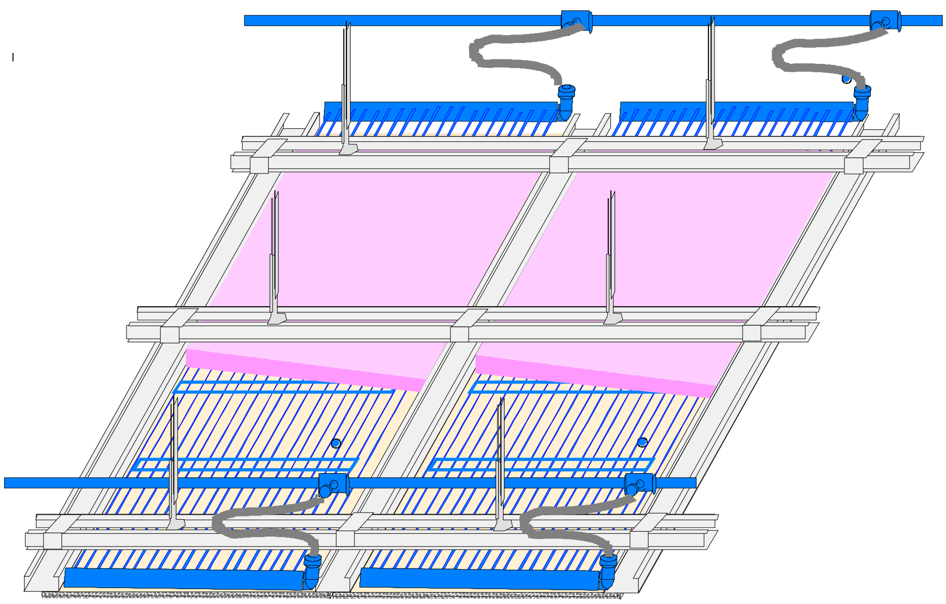
Installation Instructions of BEKA mats fixed on slope construction with dry-build panels

1. Generals

Cooling ceilings can be easily constructed in dry-built technique by attaching BEKA mats from top on suspended plaster board ceilings. For that purpose, before planking the ceiling with plaster boards, prefabricated insulating boards are screwed on the basic profiles of the CD-profiles between the supporting profiles of the suspension structure. Then the BEKA mats are fastened to the insulating boards. The insulating boards as well as the BEKA mats are produced in those widths that fit into the spacing of the supporting profiles. The mat length is determined by the room dimensions. The maximum length, however, should not exceed 8 metres for reason of flow property.
The collector pipes of the mats are fixed on the basic profiles in suitable manner (for example, cable ties, or the like). Before doing that, the piping of the supply lines has to be laid already in the future ceiling cavity. The mats are stretched only so far that they slightly sag to bottom. In case of long mats, fix the mats with plastic nails to the insulating boards to prevent the mats from sagging too much. Alternatively BEKA offers a special tool V.KGK.CLIP (cliphook).

The cliphooks are hooked into the support profile and the capillaries of the mat are clicked into the Omega-openings. The cliphooks ensures a planar contact of capillaries when the dry-build panels are later screwed up. After connecting the mats to the water supply by flexible hoses, take pressure test according to instruction M07 – test instruction. Planking with plaster boards and subsequent smoothening as well as grinding are to be performed according to the relevant guidelines of dry-build technique.
The insulating boards serve to fix the supporting profiles among each other and at the same time, as fastening plane for the capillary tube mats. In addition, the insulating boards increase the thermal resistance towards the ceiling cavity and in this way assure a respectable cooling performance of the ceiling construction.

Alternatively to the connecting version of the BEKA mats by flexible hoses, the mats can be connected to each other above the supporting profiles with the collector pipes by thermal welding. For that kind of construction, BEKA delivers the mat type K.GK10, which is already equipped ex works with sleeves and extended collector pipe ends.



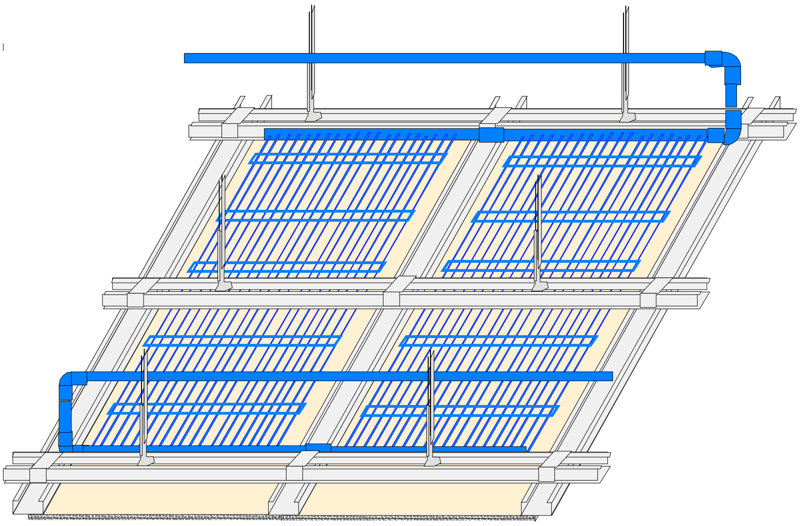


Illustration 1: Arrangement of the BEKA mats on the dry-built ceiling with insulating boards, connected through flexible hoses.

Take the pre-test with compressed air of 10 bar over 1 hour. Perform the final test with water of 10 bar over 10 hours. Maintain the pressure at rest of 3 bar until start of operation.

Illustration 2: Alternative: Connection of the mats according to Tichelmann, here without insulating boards.

2. Sequence of installation operations

1. Suspending the CD-profiles

Fasten the supporting and basic profiles according to the manufacturer's guidelines on the raw ceiling with nonius hangers and align them. Determine the spacing of the supporting profiles according to relevant standard. If necessary, attach additional basic profiles ac-cording to the layout of the mats to fix the mains.

2. Laying the BEKA supply lines

Lay the supply lines in the ceiling cavity and connect them to the main pipes (see M02 – Thermal welding).

3. Assembling the insulating boards

Screw the insulating boards to the basic profiles.

4. Stretching the BEKA mats

Fix the collector pipes of the mats to the basic profiles with, for example, cable ties. Fasten the mat over its length on the insulating board to limit sagging. Plug the flexible connecting hoses into the plug-in couplings of the supply lines.

5. Pressure testing (see M07 – Testing instruction)

6. Arranging the dry-built boards

Screw the plaster boards according to the dry-built guidelines.
Install and connect the dew-point sensor. For that purpose, roll off the connecting cable of the dew-point sensor and lay that cable to the BEKA room temperature controller M.R2/3 (see M06 – Installation instructions). Connect the dew-point sensor to the room temperature controller via the terminals. While doing that consider the connecting scheme. Insert the snifter pipe of the sensor into the already drilled hole in the plaster board.

7. Ceiling finish

Fill the board joints and grind them even, then apply ceiling paint. Cut the snifter pipe to be flush with surface by knife.

3. Tools, materials

In order to install the BEKA dry-built ceiling, make use of the common tools and materials as they are utilised for dry-building:

Functional Heating of Ceilings with BEKA Capillary Tube Mats

1. Generals

BEKA capillary tube mats can be applied as ceiling heating in various ceiling structures.

If necessary, the proper quality of the plaster and specifications for treatment of the plaster have to be agreed with the manufacturer of the plaster. The specifications given here refer to the plaster product MP75 by KNAUF.

Functional heating does not replace the pressure test of the installation according to the testing instruction TI-M07. After pressure test, the installation is to be kept pressurised while the plaster is laid. During that period the installation is NOT HEATED!

These instructions are considered supplement to the general rules of technology, current regulations as well as manufacturer's guidelines. Considering the technical closeness of ceiling heating and floor heating, the standards DIN 18560, DIN 4725, DIN EN 1264, DIN 68771, guidelines of the association TDB "Ceramic tiles and plates, natural stone and concrete stones on heated cement-based floor structures" as well as information sheets of the association BVF "Control and regulation of warm-water floor heatings" and "Interface coordination with heated floor structures" are to be complied with.

2. Functional Heating

Plaster ceilings are permitted to be heated after 7 days only, at the earliest. The manufacturer's guidelines are to be complied with, in every case.

First heating starts with a supply temperature of 25°C to be kept for three days, followed by the maximum possible supply temperature to be maintained for another 4 days.
Do not cover the heated area with construction material and covers of any kind.
After termination of functional heating, protect the plaster from rapid cooling. Avoid any draught!

Functional heating is to be recorded in the respective protocol, see TI-T13.

Independently of functional heating, check the humidity content before attaching surface coating to the ceiling.
Consider the manufacturer's specification for residual humidity!

Lay-out Chart for BEKA Cooling Ceilings

Project:
Project consultant:
Date:

Room Data

1	Room temperature	°C		
2	Surface area of the room	m^2		

Cooling Loads

3	Internal total cooling load	W		Calculation from planning office
4	Externnal total cooling load	W		Calculation from planning office
5	Total cooling load based on surface area	W/m^2		=(internal + external load) / surface area

Proportion of Ventilation

6	Intake air volume	m^3/h		minimum 50 m^3/h per person
7	Intake air temperature	°C		
8	Exhaust air temperature	°C		
9	Cooling capacity of intake-air	W/m^2		=intake air volume flow * dT * 0,32 / surface area

Required Cooling Capacity

10	Cooling capacity ceiling	W		=total cooling load – cooling capacity of air intake
11	With mats coverable ceiling area	m^2		→ compared with calculated value from line 21
12	Required specific cooling capacity for ceiling	W/m^2		=req. cooling capacity. / factor of ceiling coverage → compared with line 16

Calculation of Capacity

13	Supply temperature	°C		
14	Return temperature	°C		
15	Average temperature	°C		=(supply temperature + return temperature) / 2
16	Specific cooling capacity	W/m^2		=from BEKA calculation tool → compared with line 12

Water Volume

17	Cooling water spread	K		=supply temperature – return temperature
18	Quantity Of mats per zone	Qty		
19	Length of mat	m		
20	Width of mat	m		
21	Surface area covered with mats	m^2		=length * width * Quantity Of mats → compared with calculated value from line 11
22	Mass flow water	$l/m^2\,h$		=(spezial cooling capacity * 3600) / (spread * 4180) Water volume should be minimum 17 l / m^2 h
23	Temperature above ceiling	°C		Normally it is equal to the room temperature above
24	Thermal conductance factor to top	$W/m^2\,K$		
25	Capacity to top	W/m^2		=Thermal conductance to top. * (Temp. Top- aver. Water temp.)
26	Corrected mass flow water	$l/m^2\,h$		=((spec. Cooling capacity + capacity to top) * 3600) / (spread * 4180)
27	Water volume per zone	l/min		=corrected mass flow / 60 * covered surface area
		l/h		=corrected mass flow * covered surface area

Lay-out Chart for BEKA Heating Ceilings

Project:
Project consultant:
Date :

Room Data

1	Room temperature	°C		
2	Surface area of the room	m^2		
3	Room height	m		

Heat Requirement

4	Transmission heat requirement	W		calculation from planning office
5	Effective joint-ventilation heat requirement	W		calculation from planning office (open ventilation)
6	Total heat requirement	W		=Transmission + joint-ventilation heat requirement

Proportion of Ventilation

7	Intake air volume	m^3/h		Account for a minimum of 50 m^3/h per person
8	Intake air temperature	°C		
9	Exhaust air temperature	°C		
10	Heat-/cool capacity of air intake	W		=intake air volume flow * dT * 0,32

Required Heating Capacity

11	Required heat capacity for ceiling	W		=total heat requirement. – heat capacity of air intake + cooling capacity of air intake
12	With mats coverable ceiling surface area	m^2		→ compare with calculated of line 24
13	Estimated value: required heating capac. ceiling	W/m^2		=req. heat capac. / possible ceiling coverage → compared with line 18
14	Permissible heating capacity	W/m^2		→ from diagram must be greater than value from line 13

Calculation of Capacity

15	Supply temperature	°C		
16	Return temperature	°C		
17	Average temperature	°C		=(Supply temperature + return temperature) / 2
18	Specific heat capacity	W/m^2		→ value from BEKA calculation tool → ltr./m^2 h compared with value from line 13 =((req. heat capac. + capac. top) * 3600)

Water Volume

19	Heating water spread	K		=supply temperature – return temperature
20	Qt. of mats per zone	Pc.		
21	Length of mat	m		
22	Width of mat	m		
23	Occupied area with mats per zone	m^2		Length* width * qt. of mats → compared with value from line 12
24	mass flow water	l/m^2 h		=((req. heat capac. + capac. top) * 3600) / (spread * 4180) amount of water should be at least 17 l / m^2 h
25	Temperature above ceiling	°C		Temperature inside of ceiling cavity
26	Heat conductivity upwards	W/m^2K		=corrected mass flow * covered ceiling surface
27	Capacity upwards	W/m^2		=heat conductivity upwards * (Temperature upwards – average Water temperature)
29	Corrected mass flow water	l/m^2 h		=((req. heat capacity + capacity upwards) *3600) / (spread * 4180)
29	Water volume per zone	l/m^2 h		=corrected mass flow / 60 * occupied ceiling area
		l/h		=corrected mass flow * occupied ceiling area

Estimate calculation of the sensible (dry) cooling load

Important Remark: The calculation is based on a temperature difference between room- and outside temperature of 6 to 8°C

Room:
Person responsible:

Room measurements

Length: Width: Height: Area: Volume:

1. Solar radiation windows

(windows measurements include frame)

Windows	Width	Height	Qty	Area	Double glazed window			
	[m]	[m]		[m²]	without	with	with	
Direction					blinds	inner blinds	outer blinds	
South	x	x	=		x 205	x 175	x 60 =	W
South-West	x	x	=		x 245	x 205	x 75 =	W
South-East	x	x	=		x 250	x 205	x 75 =	W
North	x	x	=		x 60	x 50	x 20 =	W
North-West	x	x	=		x 165	x 145	x 50 =	W
North-East	x	x	=		x 155	x 140	x 50 =	W
West	x	x	=		x 255	x 215	x 75 =	W
East	x	x	=		x 250	x 210	x 75 =	W

(use only maximum values; disregard other values !)

2. Transmission-heat windows

(All windows and outer doors)

Area

m²+ m²+ m² = m² x 20 = W

3. Transmission-heat walls

(minus window surface)

				Area		
Nord- and internal walls	m²+	m²+	m²=	m²	x 8	= W
All other walls	m²+	m²+	m²=	m²	x 10	= W

4. Ceiling or Roof

Ceiling to non temperature conditioned rooms	= m²	x 10	= W
Ceiling below roof, non-insulated	= m²	x 17	= W
Ceiling with 50mm thermal insulation	= m²	x 10	= W
Flat roof, non insulated	= m²	x 35	= W
Flat roof, with 50 thermal insulation	= m²	x 12	= W

5. Floor above non-temperature conditioned

(not applicated if un-heated cellar) = m² x 5 = W

6. Open walkthrough

Width	Height	Qty	Area		
x	x	=	m²	x 100	= W

7. Qty of persons in room

Qty	Physical work light	average	heavy	
	x 70	x 85	x 95	= W

8. Light

(connected load)

Qty connected load

x W x = W

9. Electrical Applications

(connected load; observe similarity) Type Qty connected load

x x W x = W

10. Other heat source

(material put-though) Description

= W

External cooling load Field 1 to 6 = W
Internal cooling load Field 7 to 10 = W
Sensible total cooling load = W

Final Pressure Test Report for BEKA Heating and Cooling systems

Construction project:	
Project-No.:	

Section*		Pressure	Date	Time	Remarks	Signature
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					
	Begin					
	End					

*) Room- or mains identification

Additional remarks:

Hereby I confirm, that a pressure test fort he above mentioned sections has been successfully performed According to the BEKA installation instruction M07.
The system was filled with water, air bladed and with a testing pump set to 10 bar.
The pressure loss caused by elastic expansion has been compensated for..
The water pressure of 10 bar was maintained for 4 hours.
Thereafter the system was lowered to an idle pressure of 3 bar.

Name of person testing

Date Signature

Combustion Heat

1. Combustion Heat of PP- Random- Copolymert

Source: Statement of the company Borealis

H = 42.23 MJ / kg = 42.23 * 10^6 Ws / kg = 11.73 kWh / kg

2. Combustion Heat of PP - Pipe PN10

Outer Diameter d_a [mm]	Nominal sizze DN	Wall thickness s [mm]	Combustion Heat H [kWh/m]
16.0	12	1.6	0.76
20.0	15	1.8	1.09
25.0	20	2.3	1.73
32.0	25	3.0	2.89
40.0	32	3.7	4.45
50.0	40	4.6	6.93
63.0	50	5.8	11.00
75.0	63	6.9	15.59
90.0	75	8.2	22.25
110.0	90	10.0	33.17
125.0	100	11.4	42.95
140.0	110	12.8	54.00

3. Combustion Heat of BeKa Heating- and Cooling Mats

(without mains)

BEKA mat type	Combustion Heat H [kWh/m^2]
K.S15	3.21
K.S10 · K.U10 · K.G10	4.99

Lay-out for BEKA Floor Hearting System

Project:	
Project consultant:	
Date:	

Room Data

1	Room temperature	°C		
2	Width of room	m		
3	Length of room	m		
4	Surface area of the room	m^2		
5	Heat requirement for room	W		Calculation from planning office

Required Heat Capacity

6	Planed coverage	m^2		Estimate value → compare with calculated value of line 18
7	Required specific heat capacity	W/m^2		=heat requirement / planned coverage

Perfomance Calculation

8	Heat resistance of the floor covering	m^2K/W		From external calculation or estimate value
9	Effective excess temp. heating water	°C		→ with values from line 7 and 8 from diagram 21
10	Standard-heating capacity	W/m^2		→ from diagram 21
11	Spread	K		Customary are values between 6 to 12 K
12	Supply temperature	°C		=Room temperature + excess temperature + Spread / 2
13	Return temperature	°C		=Supply temperature - Spread
14	Average water temperature	°C		=(Supply temperature – return temperature) / 2

Selection of BEKA Mats

15	Qty of mats per zone	Qty		
16	Length of mat	m		
17	Width of mat	m		
18	With mats covered area	m^2		=length * width * Qty of mats
19	Real heating capacity of the floor	W		=Standard heat capacity * covered floor area → compare with required heat capacity from line 5; possibly the average water temperature must be raised

Water Volume

20	Heating water spread	K		=Supply temperature – return temperature
21	Mass flow water	$ltr./m^2$ h		=(required heat capacity * 3600) / (spread * 4180)
22	Temperature below the floor	°C		Temperature below the floor
23	Thermal conductance factor to bottom	W/m^2 K		From external calculation
24	Capacity to the bottom	W/m^2		=Thermal conductive fact to bottom * (aver water temp. - temp.)
25	Corrected mass flow of water	$ltr./m^2$ h		=((req heat capac + capac to bottom) * 3600) / (spread * 4180)
26	Water volume per zone	ltr./min		=corrected mass flow / 60 * covered floor area
		ltr./h		=corrected mass flow * covered floor area

Lay-out for BEKA Wall Heating System

Project:
Project consultant:
Date:

Room Data

1	Room temperature	°C		
2	Length of wall	m		
3	Height of wall	m		
4	Heat requirement of room	W		from calculation of the planning offices

Required Heat Capacity

5	Planned coverage of wall	m^2		Estimate value → compare with calc value from line 18
6	Required specific heat capacity	W/m^2		=Heat requirement / planned coverage

Proformance Calculation

7	Plaster quality			
8	Thermal conductive factor	W/mK		
9	Plaster thickness above the mat	mm		
10	Resistance characteristic value			→ from chart / diagram 29
11	Effective excess temp. heating water	°C		→ with values from line 6 and 10 from diagram 29
12	Standard heating capacity	W/m^2		→ from diagram 29
13	Spread	K		customary are values between 6 to 12 K
14	Supply temperature	°C		=Room temperature + excess temperature + Spread / 2
15	Return temperature	°C		=Supply temperature - Spread
16	Average water temperature	°C		=(supply temperature – return temperature) / 2

Selection of the BEKA Mats

17	Qty of mats per zone / wall	Qty		
18	Length of mat	m		
19	Width of mat	m		
20	With mats covered wall area	m^2		=lenth * width * Qty of mats
21	Real heating capacity of wall	W		=Standard – heating capacity * covered wall area → compare with required heat capac from line 6; possible the average water temperature must be raised

Wter Volume

22	Heating water spread	K		=supply temperature – return temperature
23	Mass flow of water	ltr./m^2 h		=(required heating capac * 3600) / (spread * 4180)
24	Water volume per zone / wall	ltr./min		=mass flow / 60 * covered wall area
		ltr./h		=mass flow * covered wall area

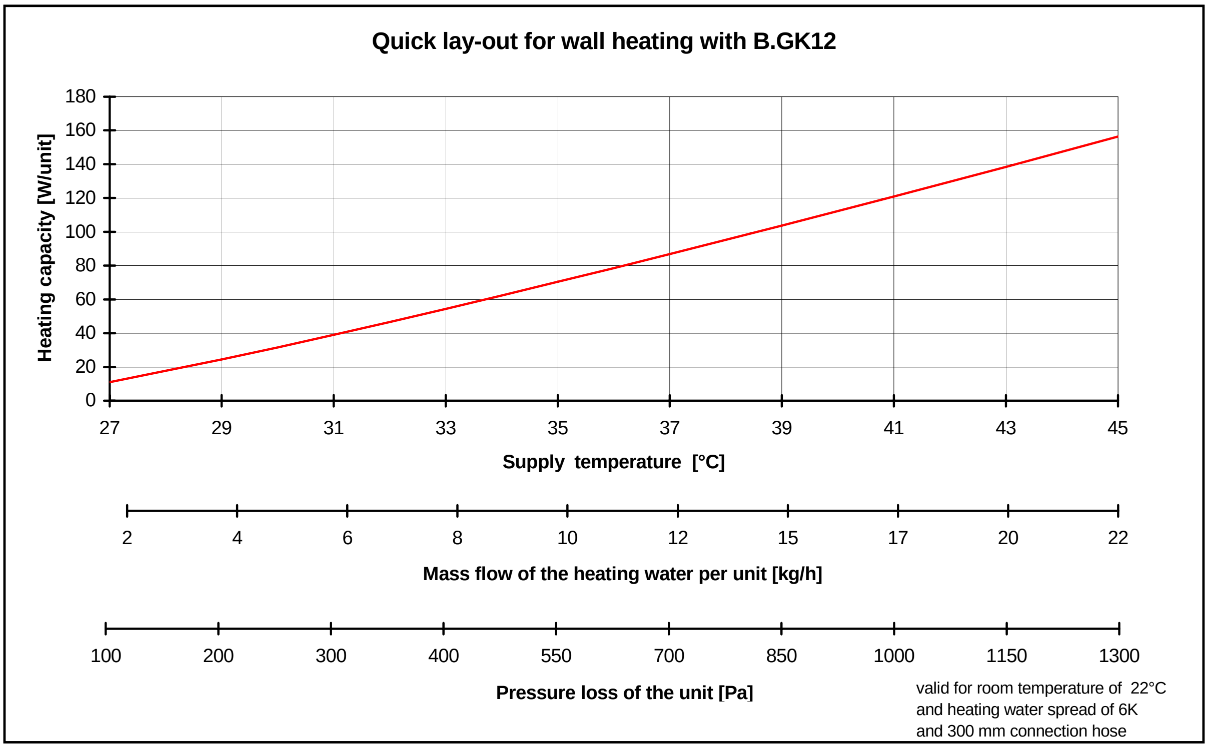
Quick Lay-out for Wall Heating with BEKA Prefabricated Panels

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

Required Heating Capacity

1	Heat requirement for room	W		from calculation of planning offices
2	Planned qty of units	Qty		max.possible arrangement derived from room measurements
3	Required heating capacity per unit	W		= heat requirement / qty of units

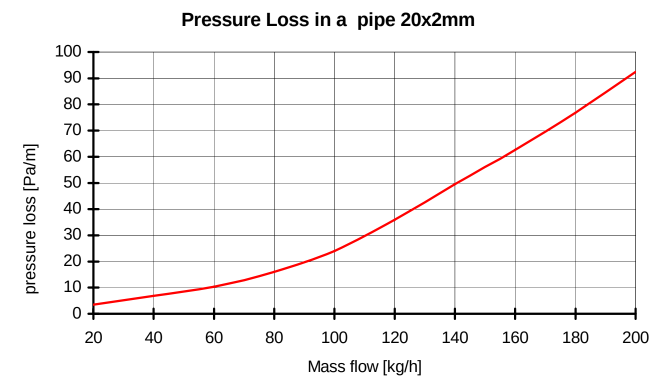
Capacity Determination



4	Supply temperature -> from diagram	°C		Water volume per unit	kg/h		-> from diagram
5	Return temperature	°C		Water volume per zone or wall	l/h		

Pressure loss determination

6	Pressure loss in pipe = pipe length * resistance	Pa		length of connection pipe resistance in the pipe - from diagram	m Pa/m		only one line path value - from diagram
7	Pressure loss of the unit -> with value of line 3 from diagram	Pa					
8	Addition for pressure loss by fittings (recomm. 30% additions to pipe)	Pa					
9	Additions for heat transfer station (recomm:for zone valves 500 to 1000 Pa for mains regulating valves 700 to 1500 Pa for heat exchanger appox. 4000 Pa	Pa					
10	Total Pressure Los	Pa					



When using the BEKA transfer stations the pressure loss deterination can be ommitted. Only the quantity of the heating circuits and the total capacity is required for the selection.

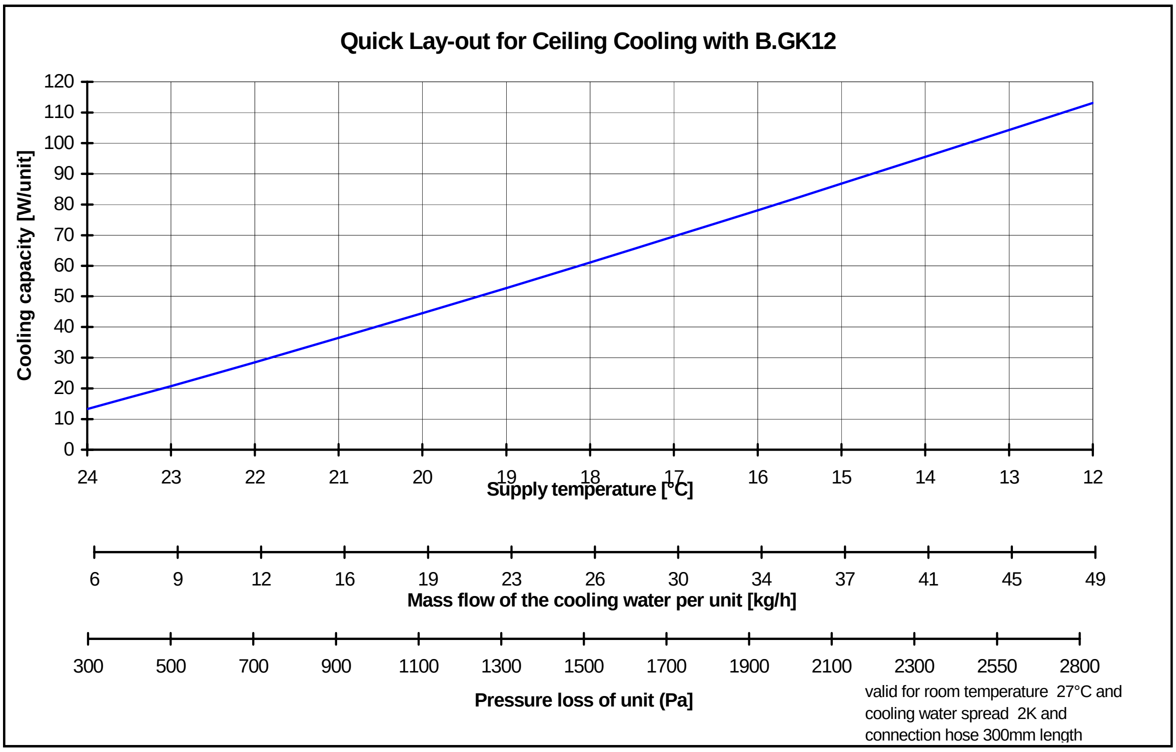
Quick Lay-out for Cooling Ceilings with BEKA Prefabricated Panels

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

Required cooling load

1	Cooling load for the room	W		from calculations of planning office
2	Planned quantity units	Qty		max. possible arrangement derived from room dimensions
3	Required cooling capacity per unit	W		= cooling load / Quantity of units

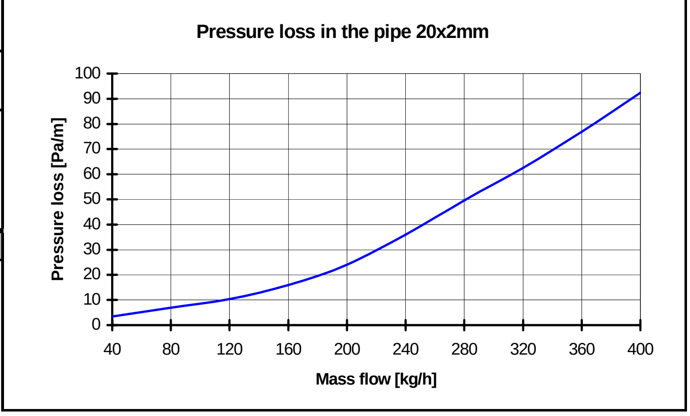
Performance determination



4	Supply temperature -> from diagram	°C		Water volume per unit	kg/h		-> from diagram
5	Return temperature	°C		Water volume per zone or wall	ltr./h		

Pressure Loss Determination

6	Pressure loss in pipe = pipe length * resistance	Pa		Length of connection pipe resistance in the pipe -> from diagram	m Pa/m		only one line path value -> from diagram
7	Pressure loss of the unit -> with value of line 3 from diagram	Pa					
8	Addition for pressure loss through fittings (recomm: 30% addition to pipe)	Pa					
9	Additions 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					
10	Total Pressure Loss	Pa					



By using the BEKA transfer stations the pressure loss determinaion can be ommited.Only the quantity of the cooling circuits and the total cooling capacity is required for the selection !

Heating Protocol for BEKA Floor Heating

The installation was tested for tightness according to TI-M07 and documented. After the pressure test and during screeding the installation was kept pressurized with 1-3 bar.

Note: As for functional heating, observe the generally valid regulations and instructions according to TI-M23! The heating protocol is valid in connection with the technical instruction TI-M23 only!

Project:	
Project no.:	

Type of screed, make	
Applied bond	
End of screed work	
Start of heating (functional heating) with constant supply temperature of 25°C (manual control)	
Start of heating with maximum supply temperature (installation temperature of °C (maximum 60°C, when anhydrite or calcium sulphate screed is applied, maximum 55°C, respectively, according to manufacturer's instruction.	
End of heating	
Heating was interrupted? YES ☐ / NO ☐	If yes: from _________ until __________
The heated area was uncovered	YES ☐ / NO ☐
The rooms were aerated without draught and after switching off the heating all doors as well as windows were closed.	YES ☐ / NO ☐
The installation was approved at an outdoor temperature of _____°C for further building activities.	☐The installation was out of operation ☐The floor was heated with a temperature of ______°C

WARNING: Independently of functional heating, check the humidity content before laying the floor covering. Meet the manufacturer's instructions regarding admissible residual humidity!

Additional comments:	

Building owner / customer

Builder's manager

Contractor

Date/ signature / stamp

Date/ signature / stamp

Date/ signature / stamp

Heating Protocol for BEKA Ceiling Heating

The installation was tested for tightness according to TI-M07 and documented. After the pressure test and during plastering the installation was kept pressurized with 1-3 bar.

Note: As for functional heating, observe the generally valid regulations and instructions according to TI-M25! The heating protocol is valid in connection with the technical instruction TI-M25 only!

Project:	
Project no.:	

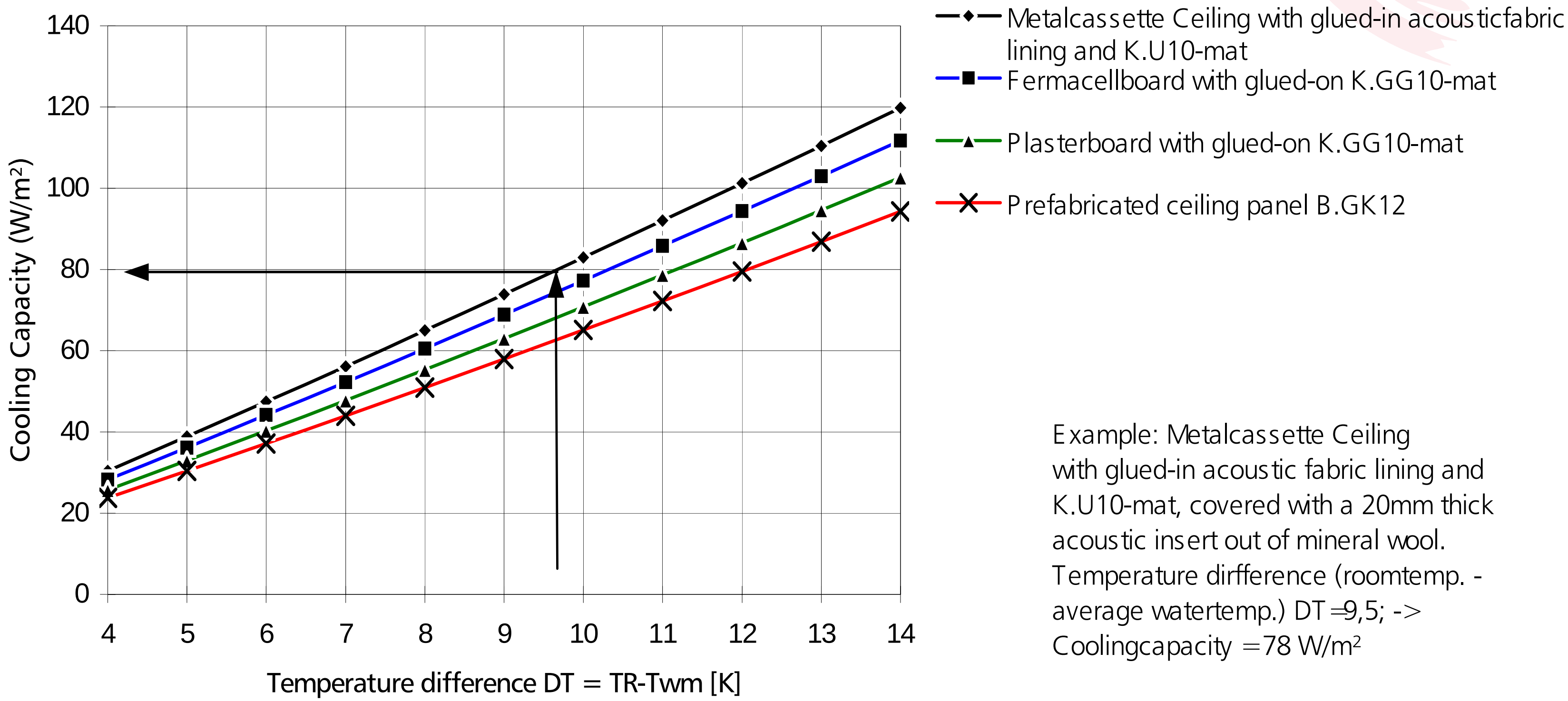
Type of plaster, make	
Applied bond	
End of plaster work	
Start of heating (functional heating) with constant supply temperature of 25°C (manual control)	
Start of heating with maximum supply temperature (installation temperature of °C (maximum 60°C, when anhydrite or calcium sulphate screed is applied, maximum 55°C, respectively, according to manufacturer's instruction.	
End of heating	
Heating was interrupted? YES ☐ / NO ☐	If yes: from _________ until __________
The heated area was uncovered	YES ☐ / NO ☐
The rooms were aerated without draught and after switching off the heating all doors as well as windows were closed.	YES ☐ / NO ☐
The installation was approved at an outdoor temperature of _____°C for further building activities.	☐The installation was out of operation ☐The ceiling was heated with a temperature of ______°C

WARNING: Independently of functional heating, check the humidity content before laying the floor covering. Meet the manufacturer's instructions regarding admissible residual humidity!

Additional comments:	

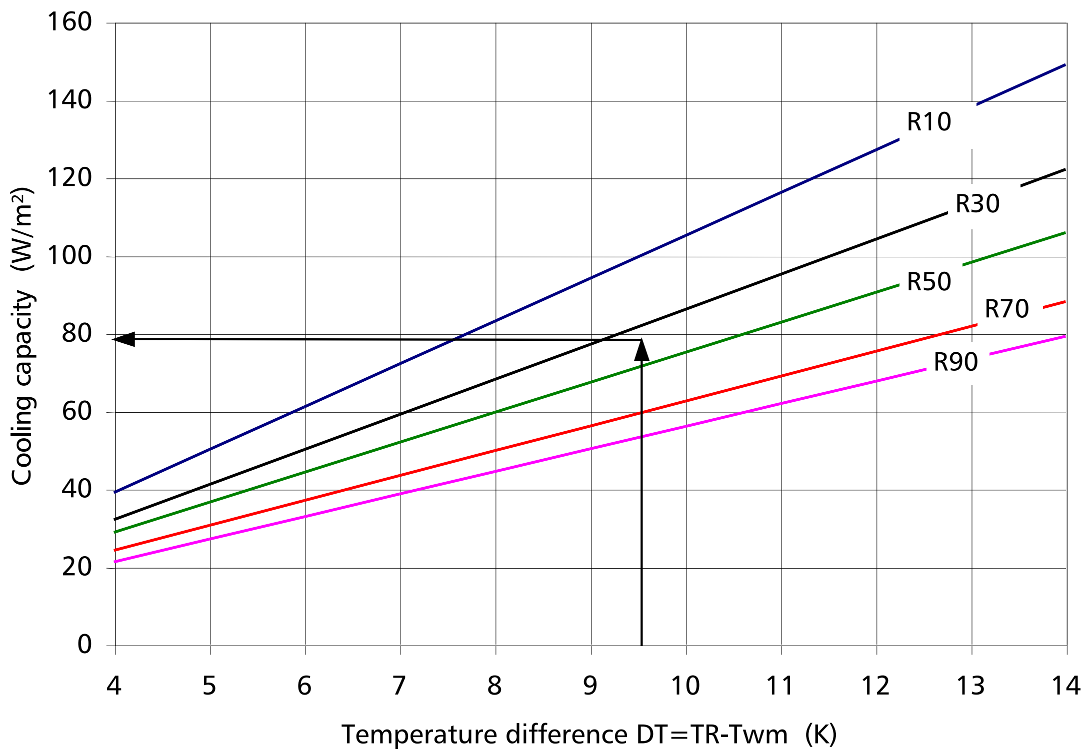
Building owner / customer	Builder's manager	Contractor
Date/ signature / stamp	Date/ signature / stamp	Date/ signature / stamp

Cooling Capacity for various Types of BEKA Cooling Ceilings



Example: Metalcassette Ceiling with glued-in acoustic fabric lining and K.U10-mat, covered with a 20mm thick acoustic insert out of mineral wool. Temperature dirfference (roomtemp. - average watertemp.) DT =9,5; -> Coolingcapacity =78 W/m²

Cooling Capacity of BEKA Plaster Ceilings

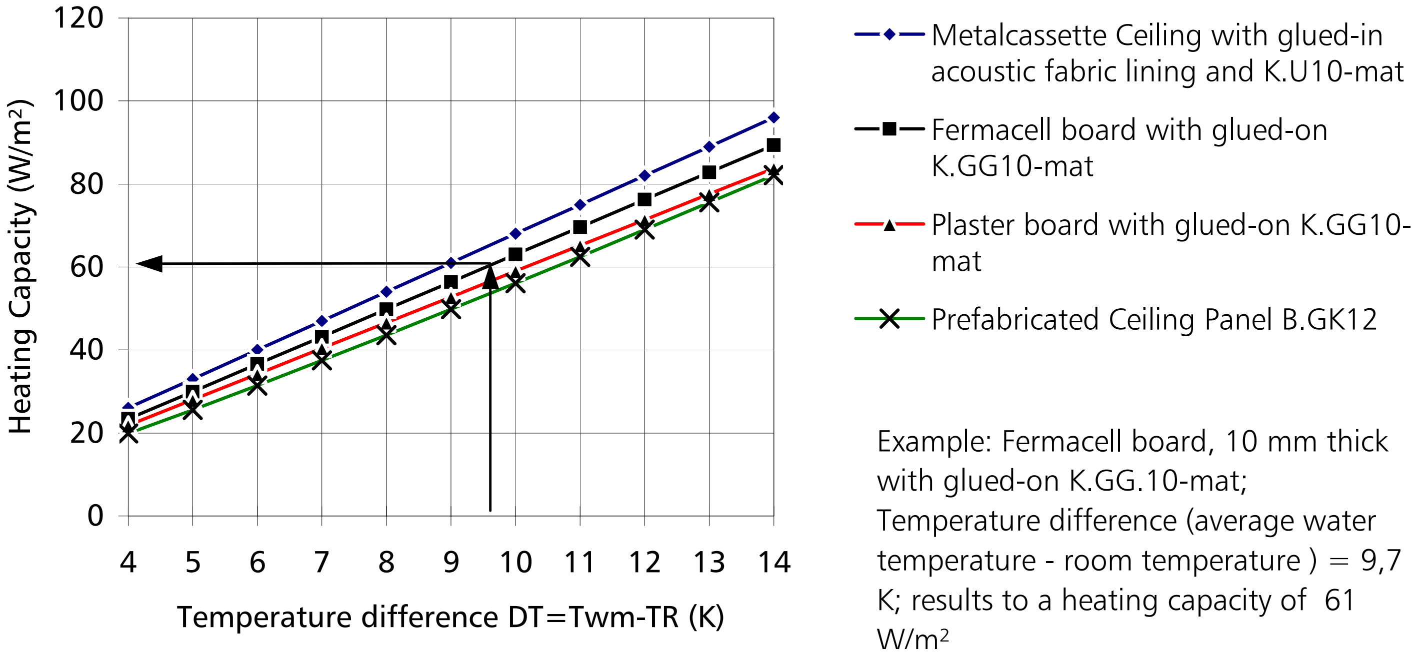


Type of plaster	Thermal conductivity for plaster in W/m K	Plaster thickness above mats in mm	Characteristic Line
Gypsum plaster	0,45	5	R21
Gypsum plaster	0,45	10	R32
Gypsum plaster	0,45	15	R41
Gypsum plaster	0,45	20	R70
Gypsum plaster	0,35	5	R24
Gypsum plaster	0,35	10	R38
Gypsum plaster	0,35	15	R52
Gypsum plaster	0,35	20	R90
Lime plaster	0,87	5	R12
Lime Plaster	0,87	10	R18
Lime plaster	0,87	15	R23
Lime plaster	0,87	20	R38
Concrete plaster	1,50	5	R10
Concrete p.	1,50	10	R13
Concrete p.	1,50	15	R15
Concrete p.	1,50	20	R24
Acoustic p.	0,12	2	R39
Acoustic p.	0,12	4	R55
Acoustic p.	0,12	6	R72

Example: Plaster ceiling with embedded capillary tube mat; Gypsum plaster 10 mm thick over capillary tube (R32); Temperature difference (room temperature – average water temperature) DT=9,5 K; results to a cooling capacity of 78 W/m².

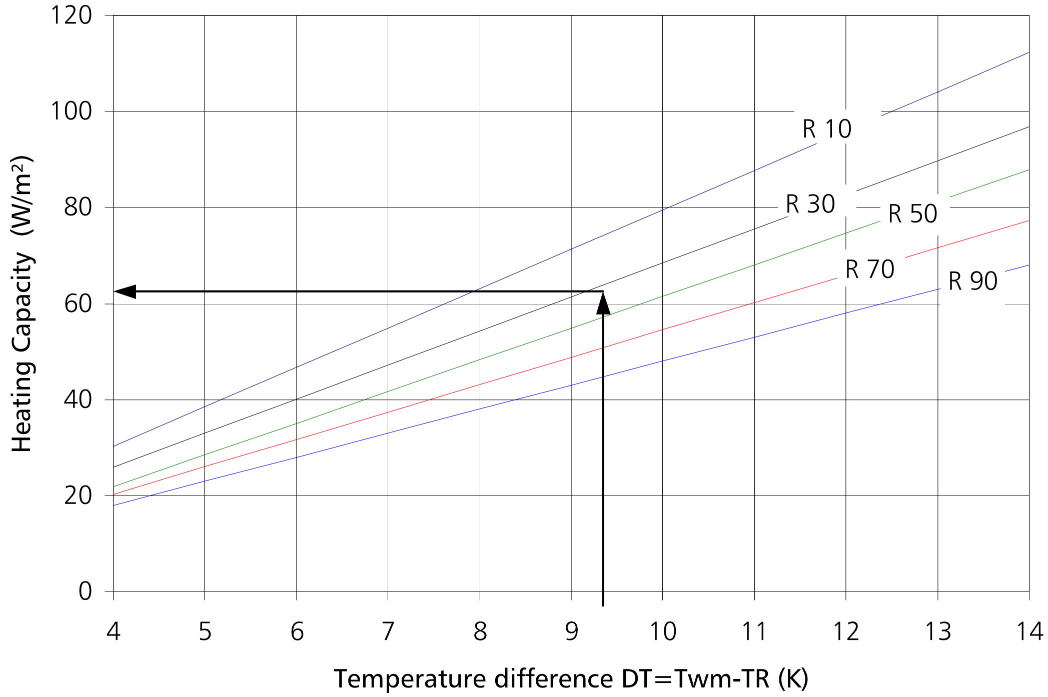
TI-D03 Diagram

Heating Capacity for various Types of BEKA Ceilings



Example: Fermacell board, 10 mm thick with glued-on K.GG.10-mat; Temperature difference (average water temperature - room temperature) = 9,7 K; results to a heating capacity of 61 W/m²

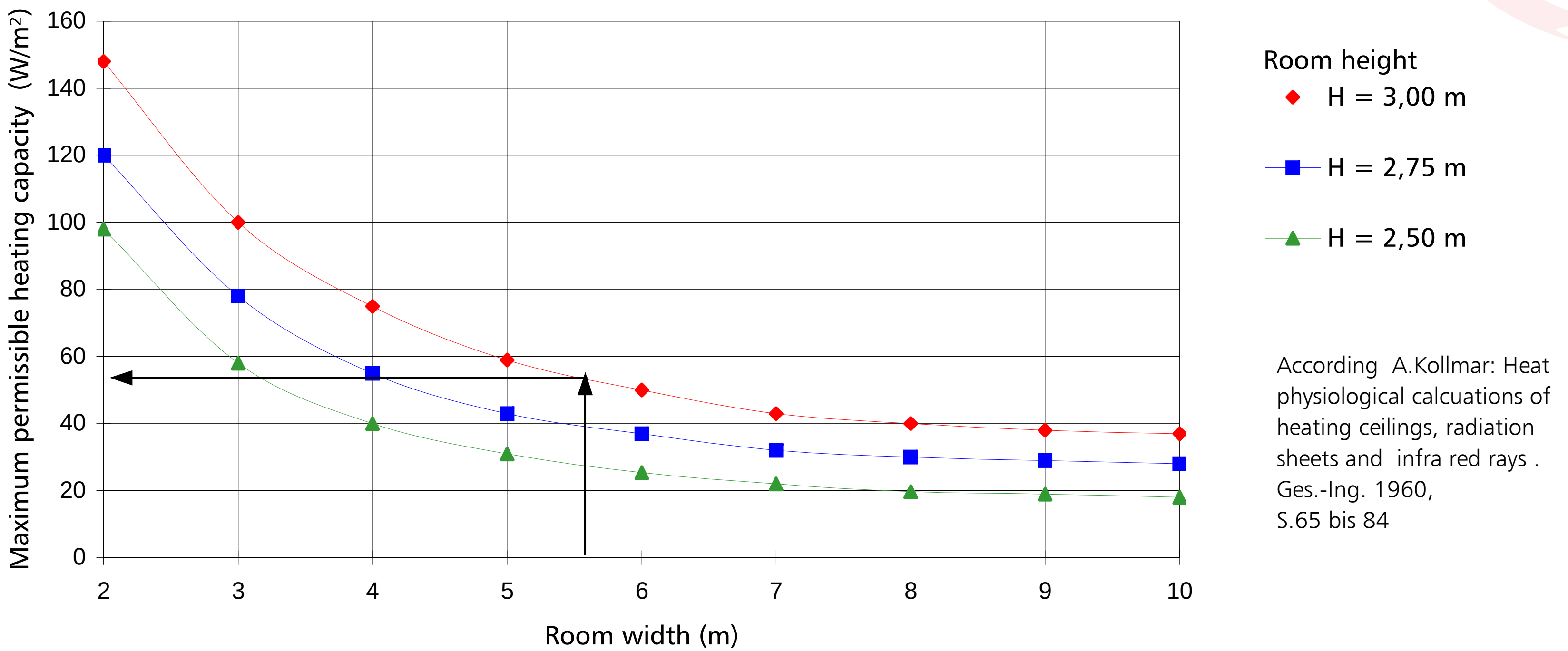
Heating Capacity of BEKA Plaster Ceiling



Type of plaster	Thermal conductivity factor for plaster in W/m K	Plaster ceiling above mat in mm	Characteristic curve
Gypsum	0,45	5	R21
Gypsum	0,45	10	R32
Gypsum	0,45	15	R41
Gypsum	0,45	20	R70
Gypsum	0,35	5	R24
Gypsum	0,35	10	R38
Gypsum	0,35	15	R52
Gypsum	0,35	20	R90
Lime	0,87	5	R12
Lime	0,87	10	R18
Lime	0,87	15	R23
Lime	0,87	20	R38
Lime	1,50	5	R10
Concrete	1,50	10	R13
Concrete	1,50	15	R15
Concrete	1,50	20	R24
Acoustic	0,12	2	R39
Acoustic	0,12	4	R55
Acoustic	0,12	6	R72

Example: Plaster ceiling with embedded capillary tube mat; Gypsum plaster 15 mm thick over capillary tubes (R41); Temperature difference (average water - temperature – room temperature) DT=9,3 K; results to a heating capacity of 63 W/m².

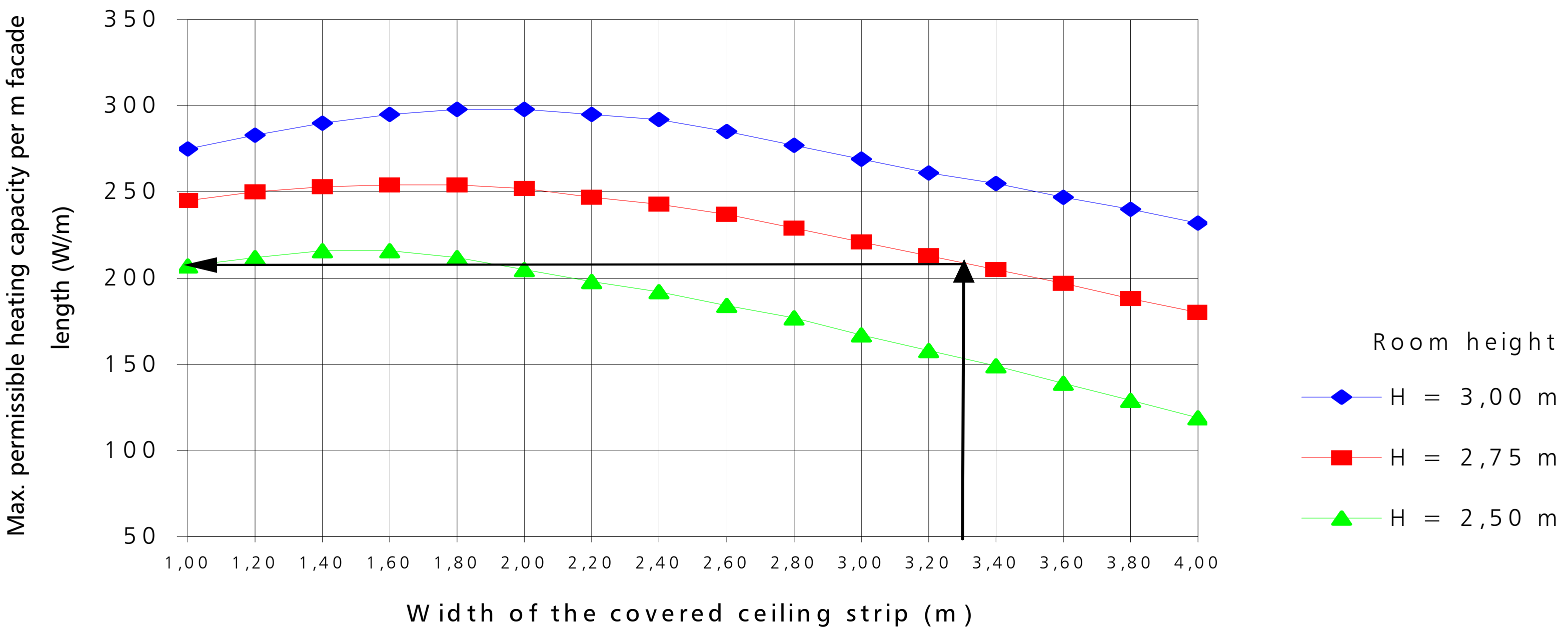
Permissible Heating Capacity



According A.Kollmar: Heat physiological calcuations of heating ceilings, radiation sheets and infra red rays . Ges.-Ing. 1960, S.65 bis 84

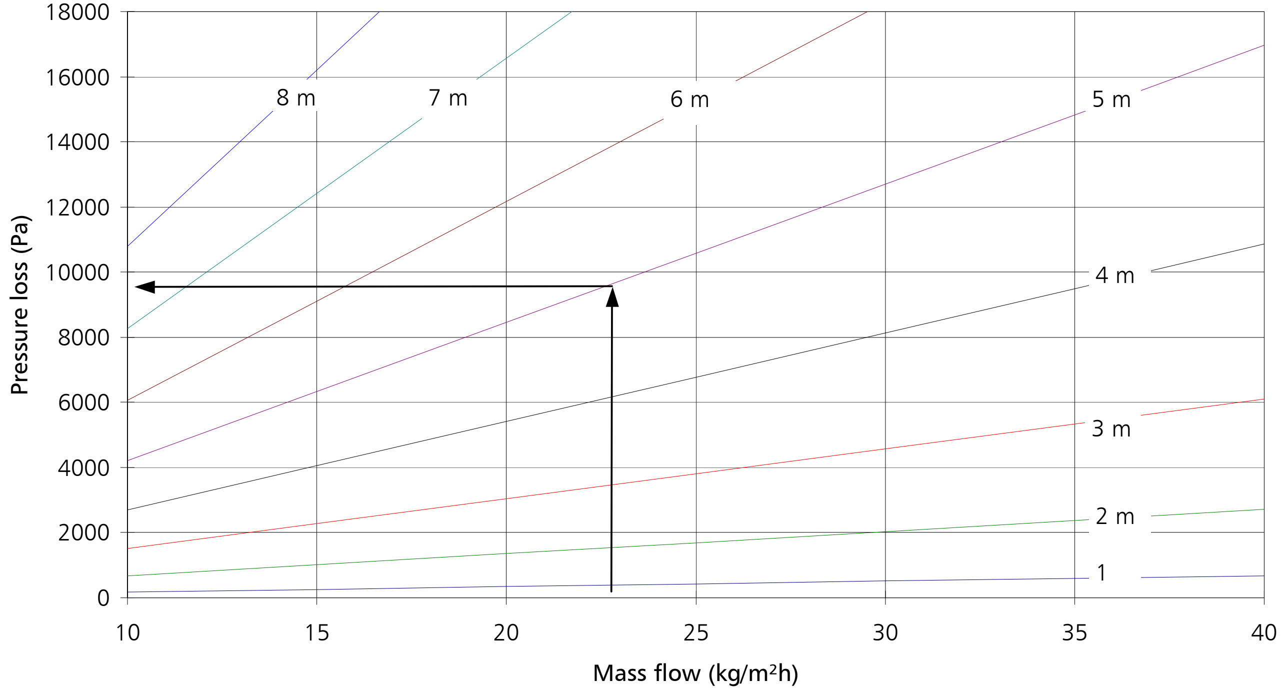
Example: In a 3,0 m high and 5,5 m wide room the permissible heating capacity is maximum 57 W/m²

Permissible Heating Capacity in Dependence of the covered Ceiling sector



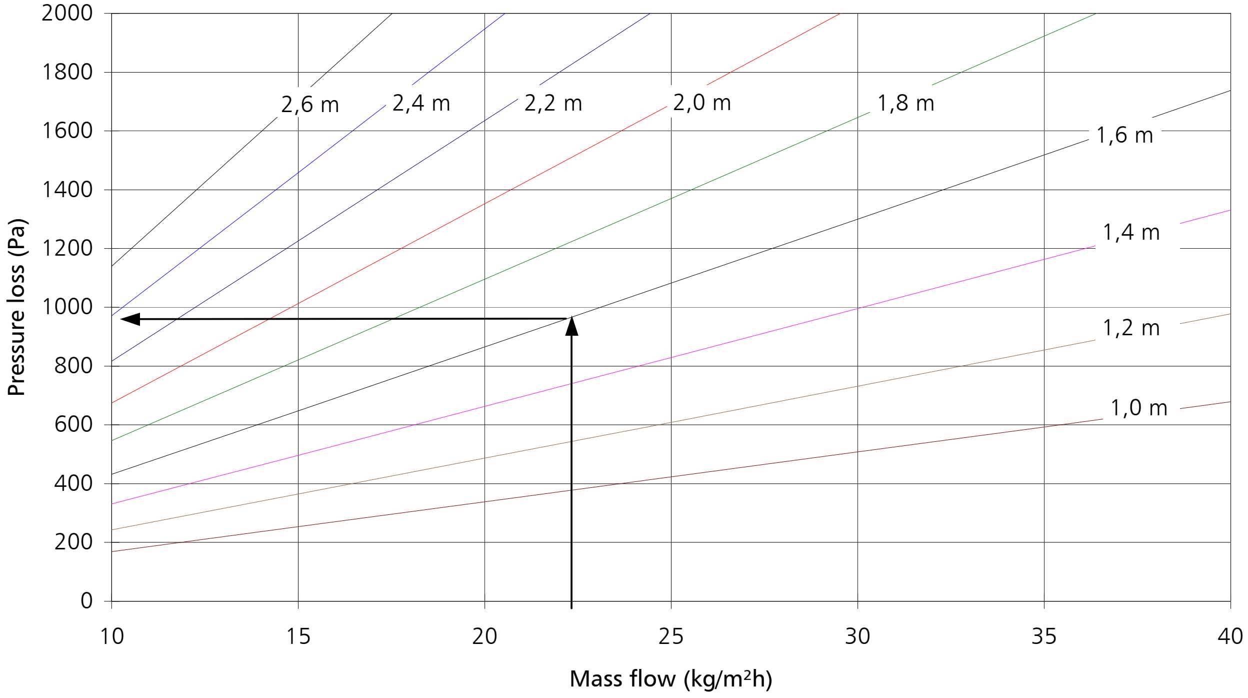
Example: In a 2,75 m high room with the width of the covered ceiling strips of 3,3 m the permissible heating capacity may be maximum 210 W/m²

Pressure Loss of the BEKA Mat K.U10 (Length from 1,0m to 8,0m)



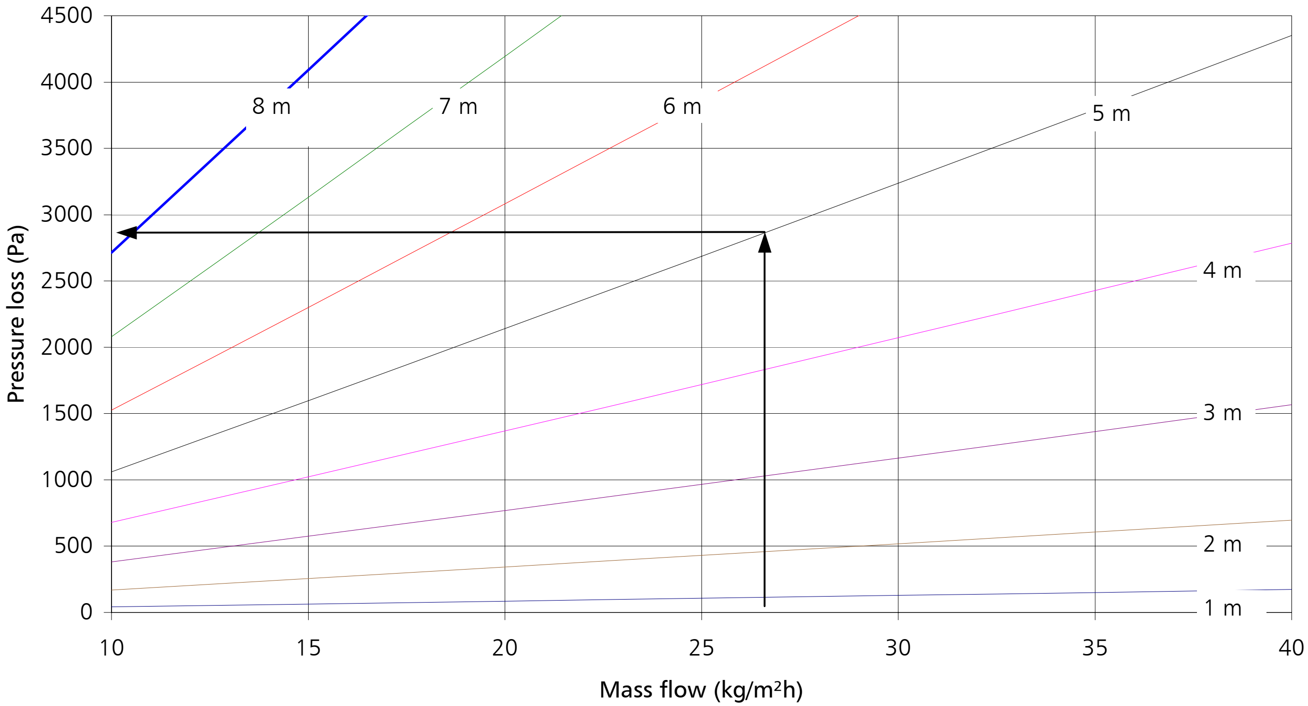
Example: Mass flow water = 23 kg/m²h; length of mat = 5 m; results to a pressure loss of = 9500 Pa

Pressure Loss of BEKA Mat K.U10 (Length from 1,0 to 2,6m)



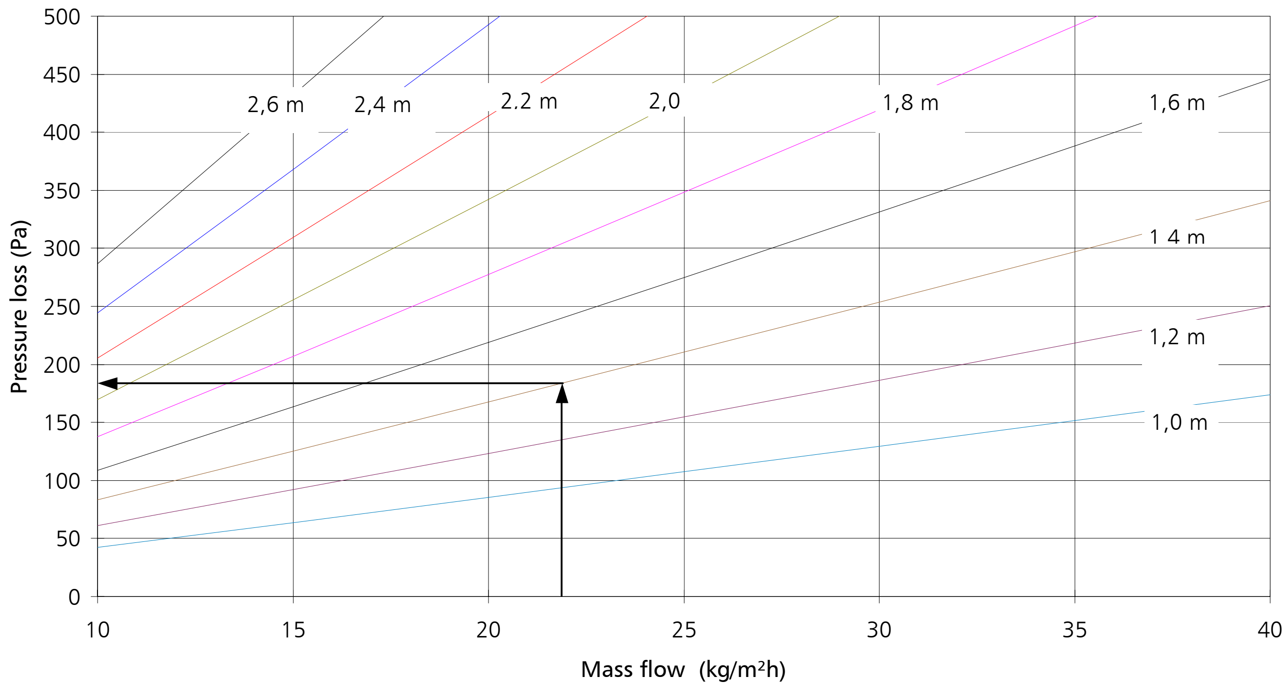
Example: Mass flow water = 23 kg/m²h; length of mat = 1,6 m; results to a pressure loss of = 950 Pa

Pressure Loss of the BEKA Mat K.G10 (Length from 1,0m to 8,0m)



Example : Mass flow water = 27 kg/m²h; length of mat = 5 m; results to a pressure loss of = 2900 Pa

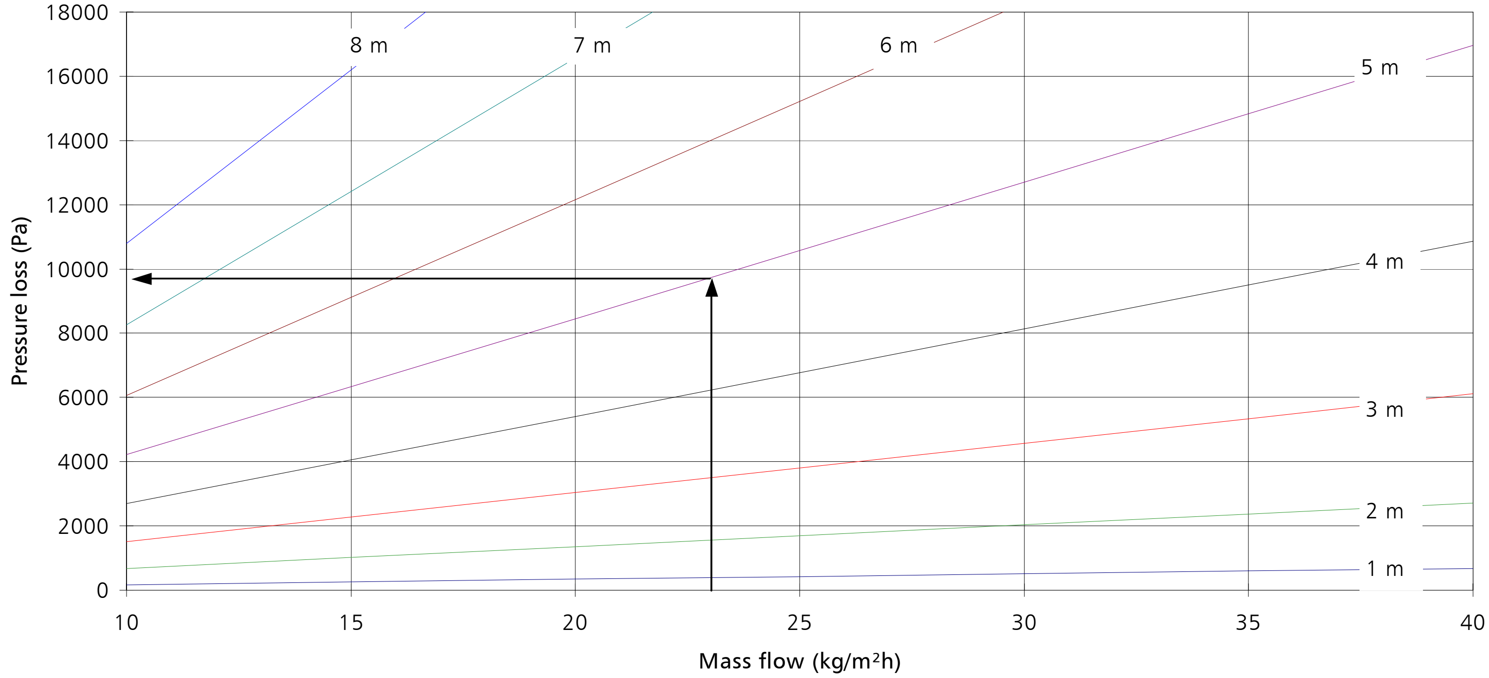
Pressure Loss of the BEKA Mat K.G10 (Length from 1,0m to 2,6m)



Example: Mass flow water = 22 kg/m²h; Length of mat = 1,4 m; results to a pressure loss of = 180 Pa

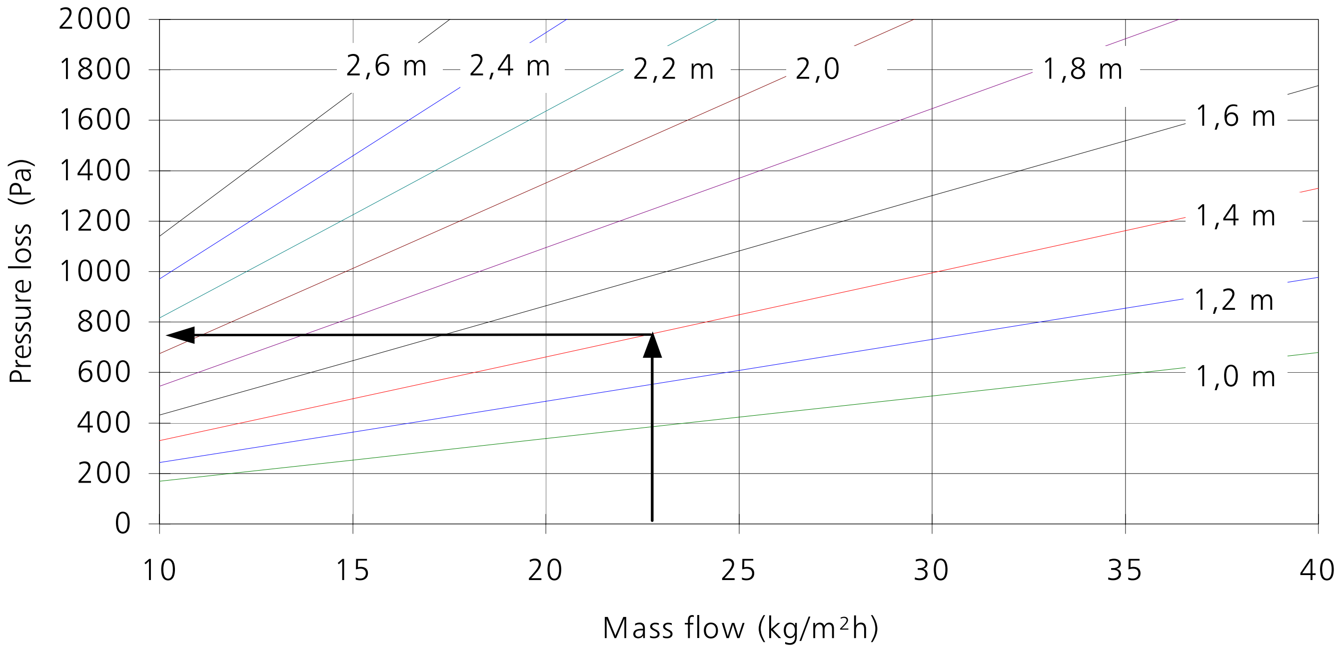
TI-D11 **Diagrams**

Pressure Loss of the BEKA Mat K.S10 (Length from 1,0 to 8,0m)



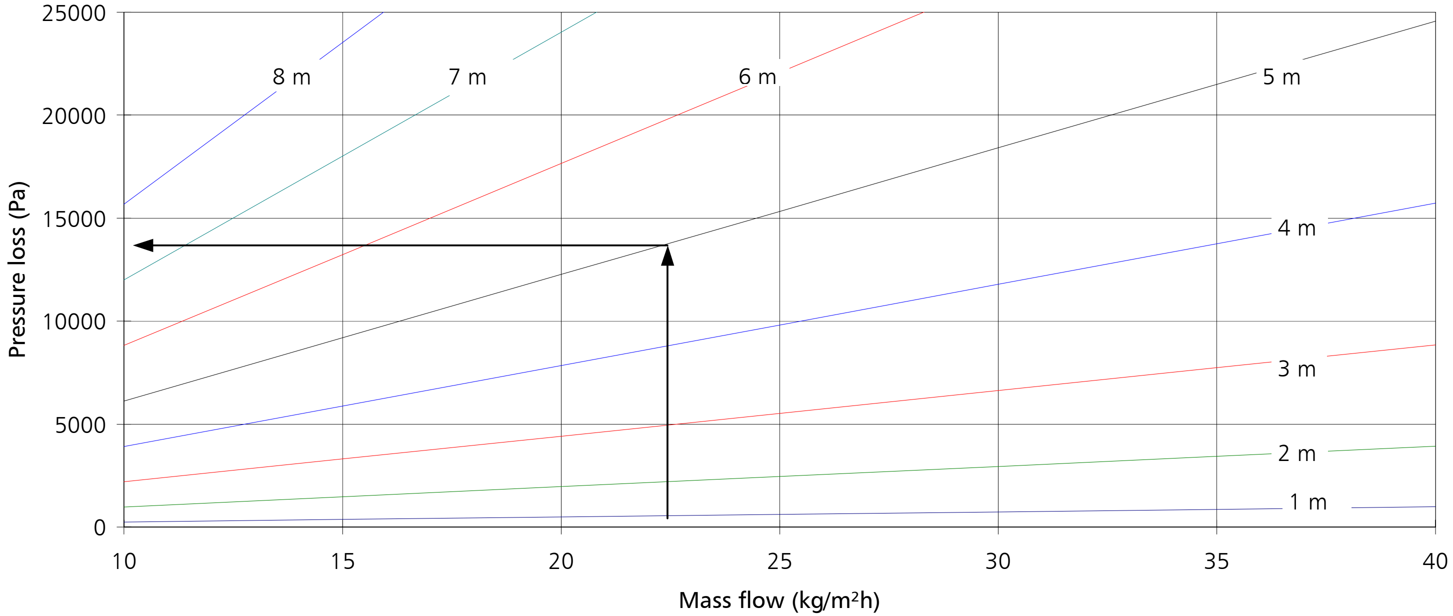
Example: Mass flow water = 23 kg/m²h; Length of mat = 5 m; results to a pressure loss of = 9500 Pa

Pressure Loss of the BEKA Mat K.S10 (Length from 1,0m to 2,6m)



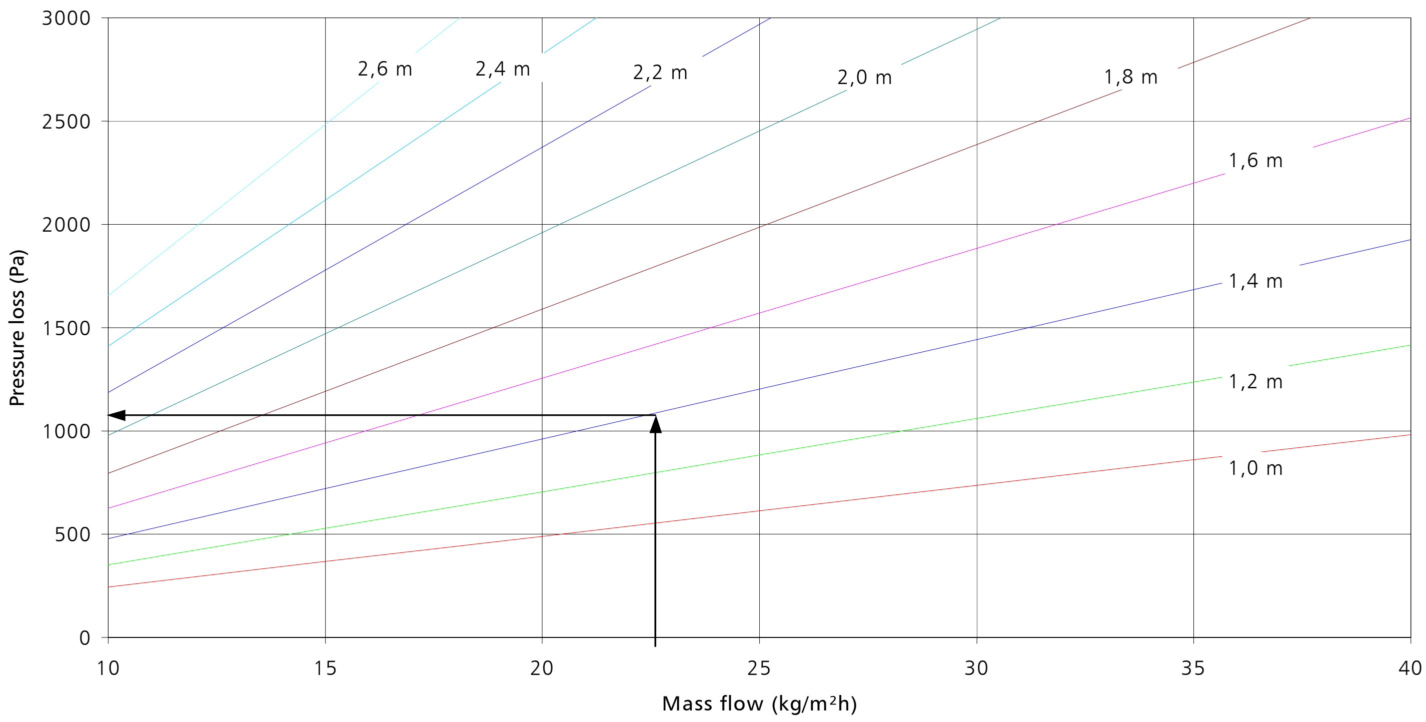
Example: Mass flow water = 23 kg/ m^2h; Length of mat = 1,4 m; result to a pressure loss of = 750 Pa

Pressure Loss of BEKA Mat K.S15 (Length from 1,0 m to 8,0 m)



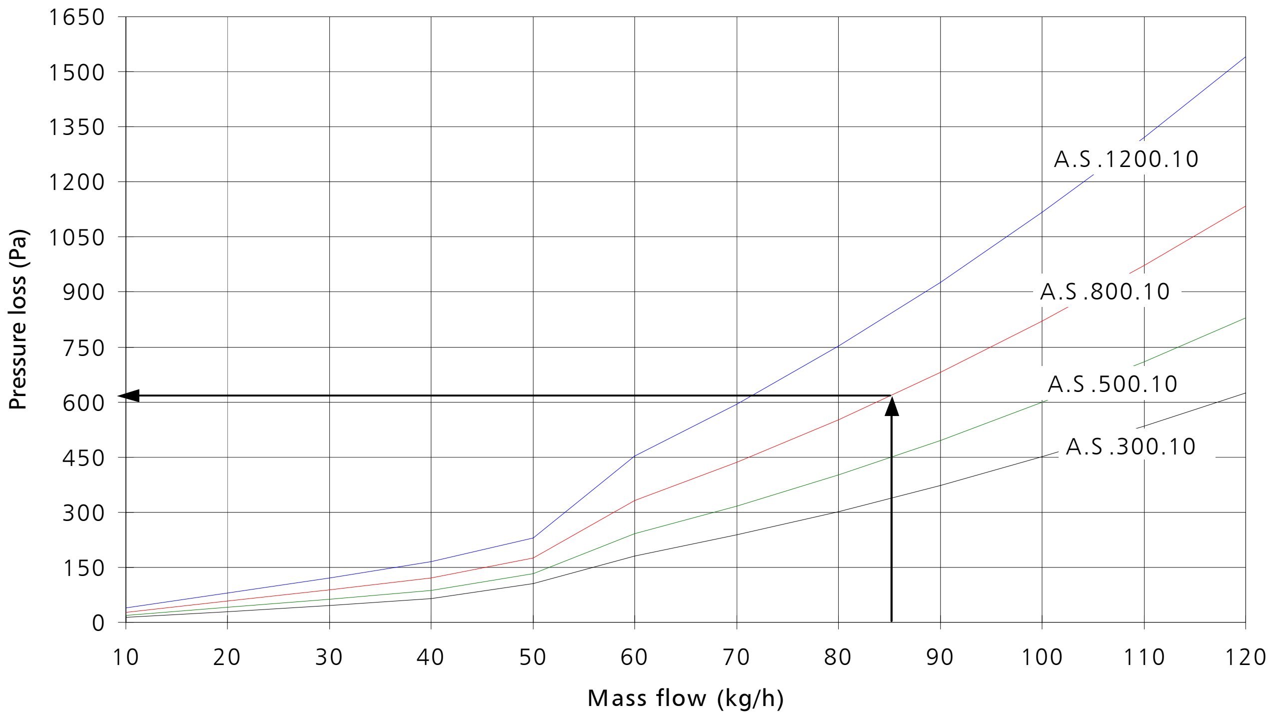
Example: Mass flow water = 23 kg/m²h; Length of mat = 5 m; result to a pressure loss of = 14000 Pa

Pressure Loss of the BEKA Mat K.S15 (Length from 1,0 m to 2,6 m)



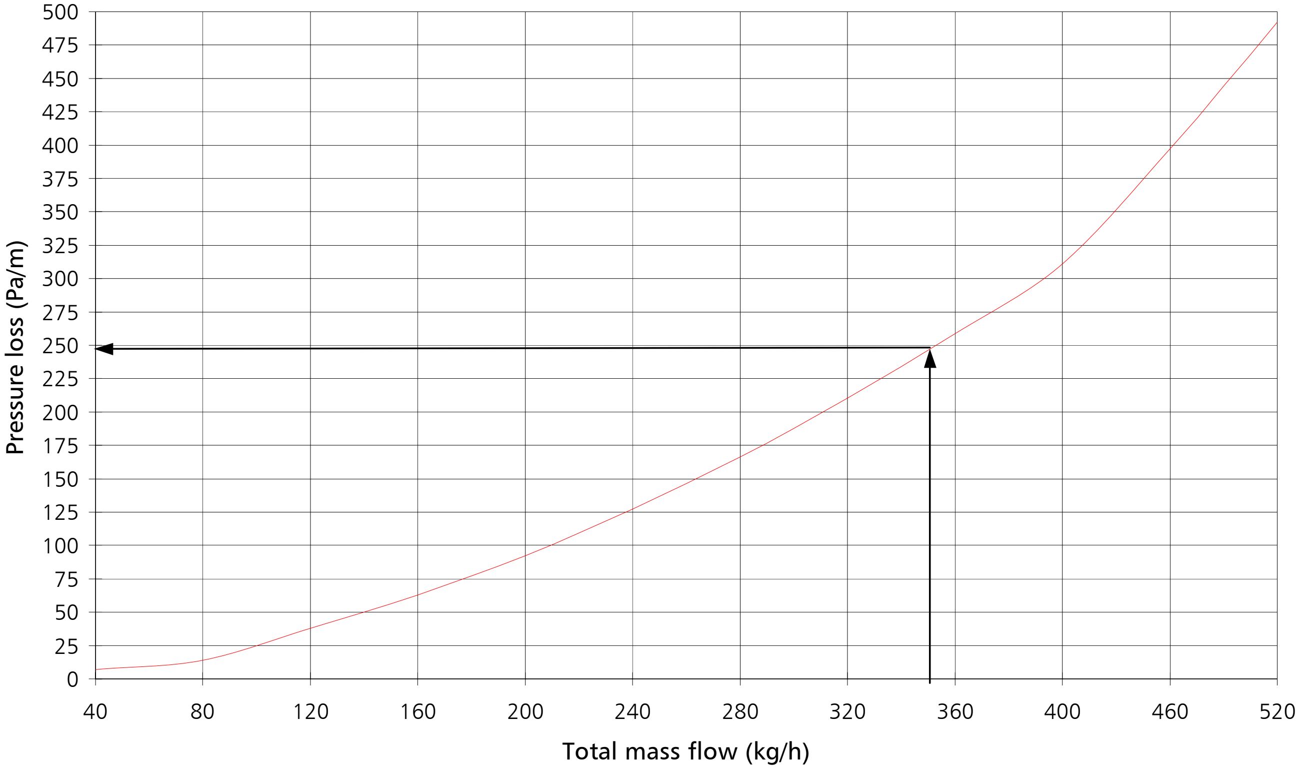
Example: Mass flow water = 23 kg/m²h; Length of mat = 1,4 m; results to a pressure loss of = 1150 Pa

Pressure Loss in the Connecting Hose



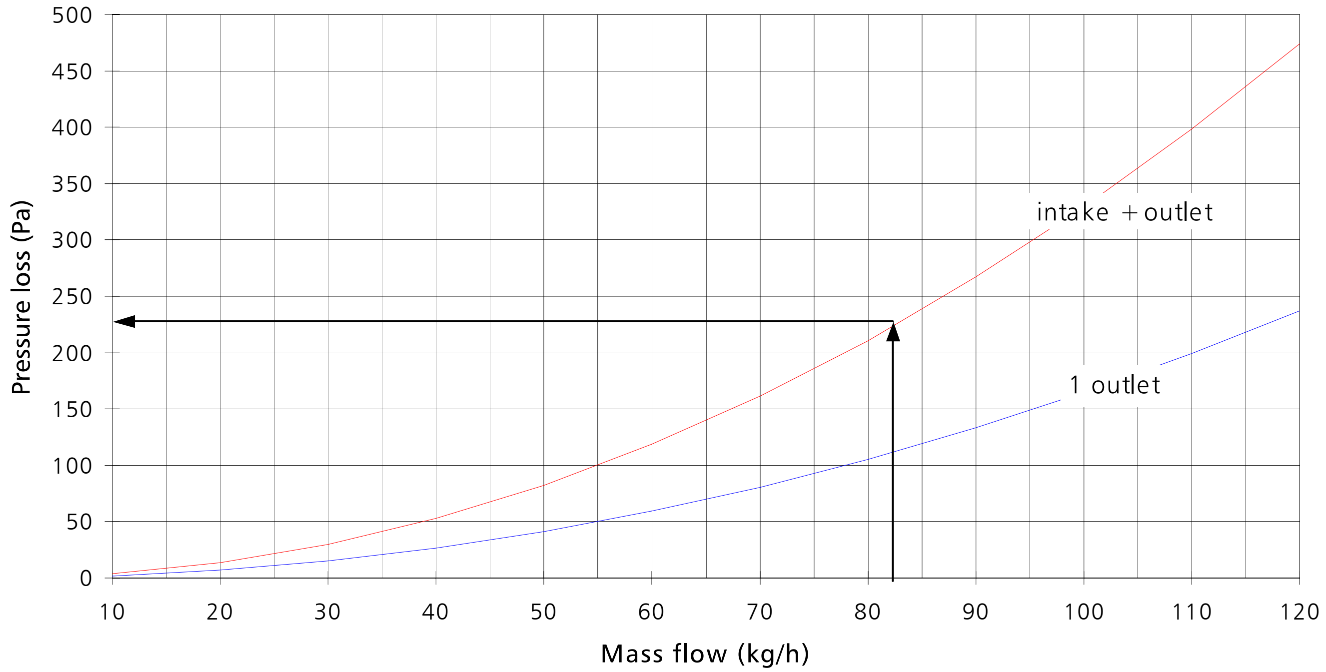
Example: Mass flow water = 85 kg/h results to a pressure loss of = 615 Pa in a 800 mm long connecting hose

Pressure Loss in the Pipe (20x2mm)



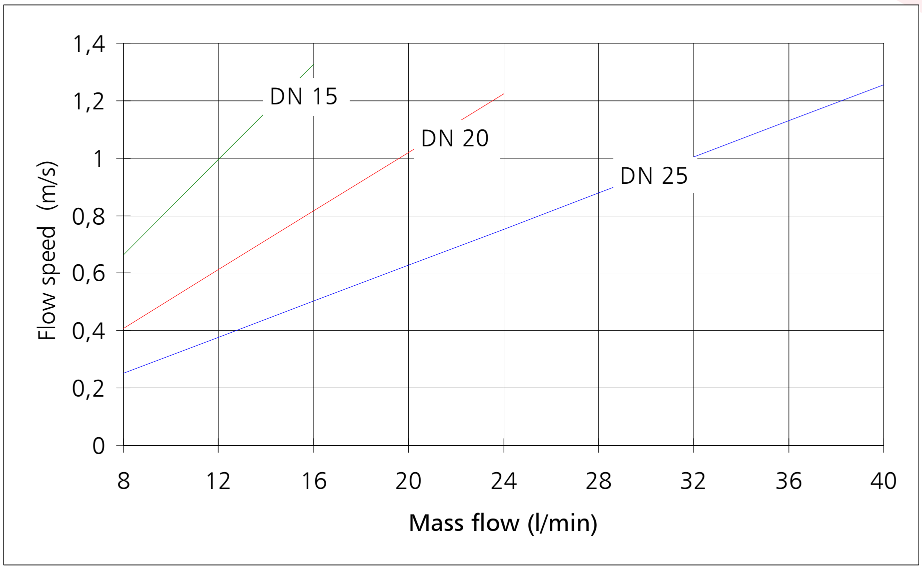
Example: Through a pipe of 6 m length 350 kg/h should be flowing through. The pressure loss per 1 m is 250 Pa.
This results to a total pressure loss in the pipe of: 6 m x 250 Pa/m = 1500 Pa

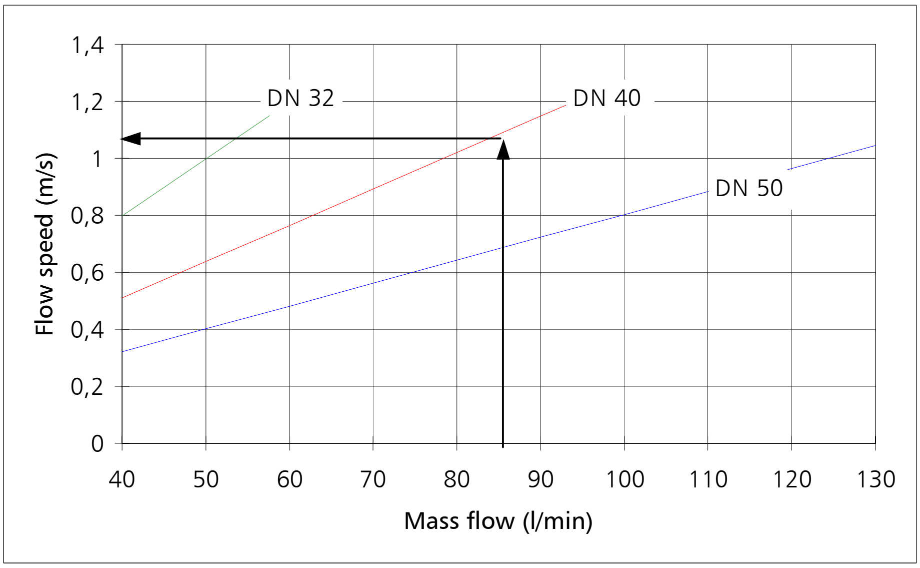
Pressure Loss in the Elbow Outgoing



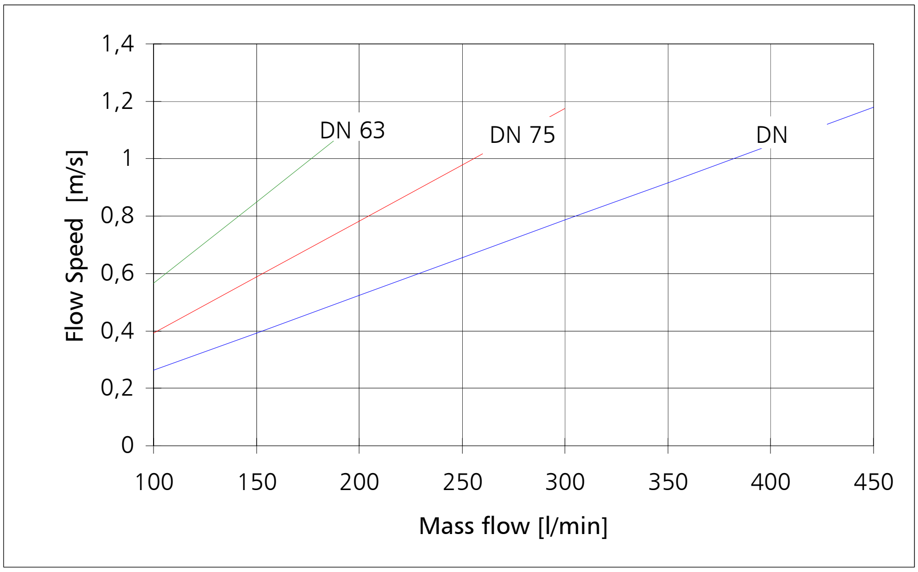
Example: Mass flow water = 83 kg/h ; in both elbows outgoing there will be a pressure loss of 230 Pa

Flow Speeds in Pipes

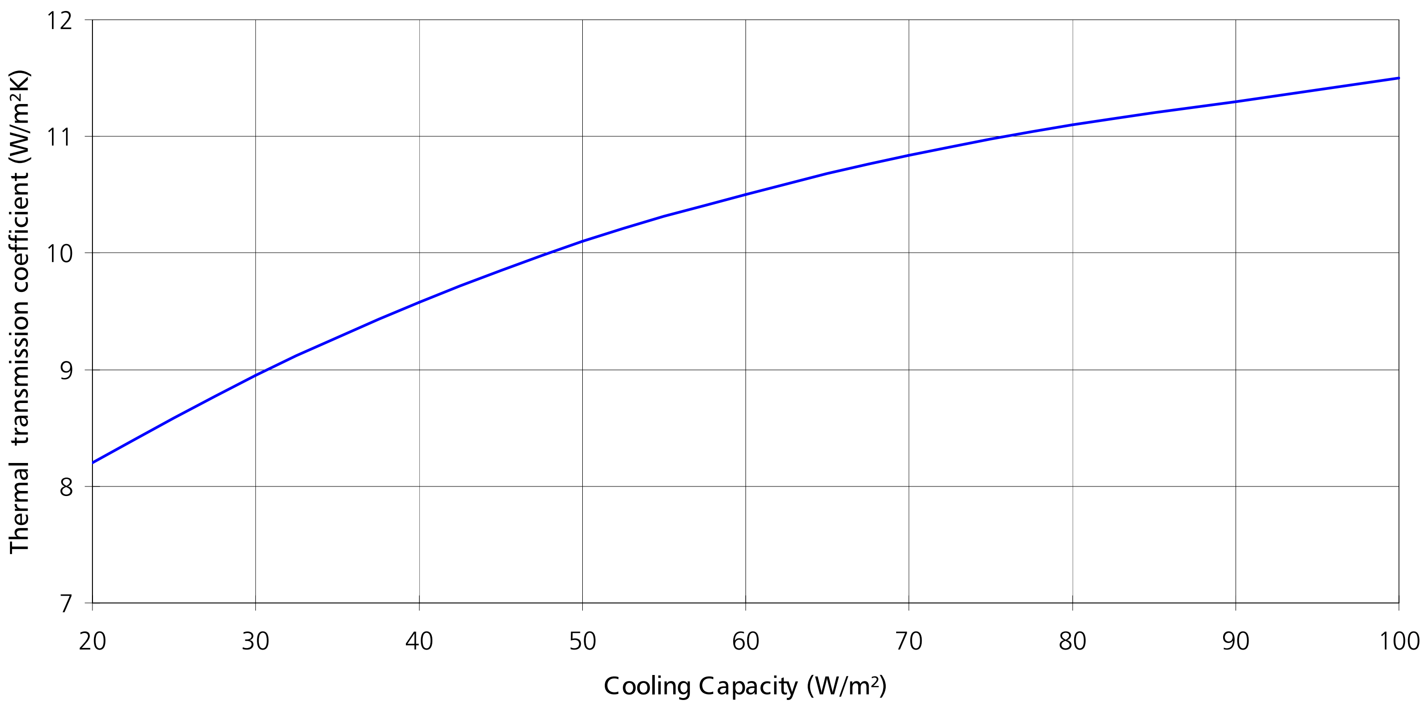




Example: 85 l/min are flowing through a pipe DN 40 with a flow speed of approx. 1,08 m/s


1,4
1,2
1
0,8
0,6
0,4
0,2
0
Flow Speed [m/s]
DN 63
DN 75
DN
100
150
200
250
300
350
400
450
Mass flow [l/min]

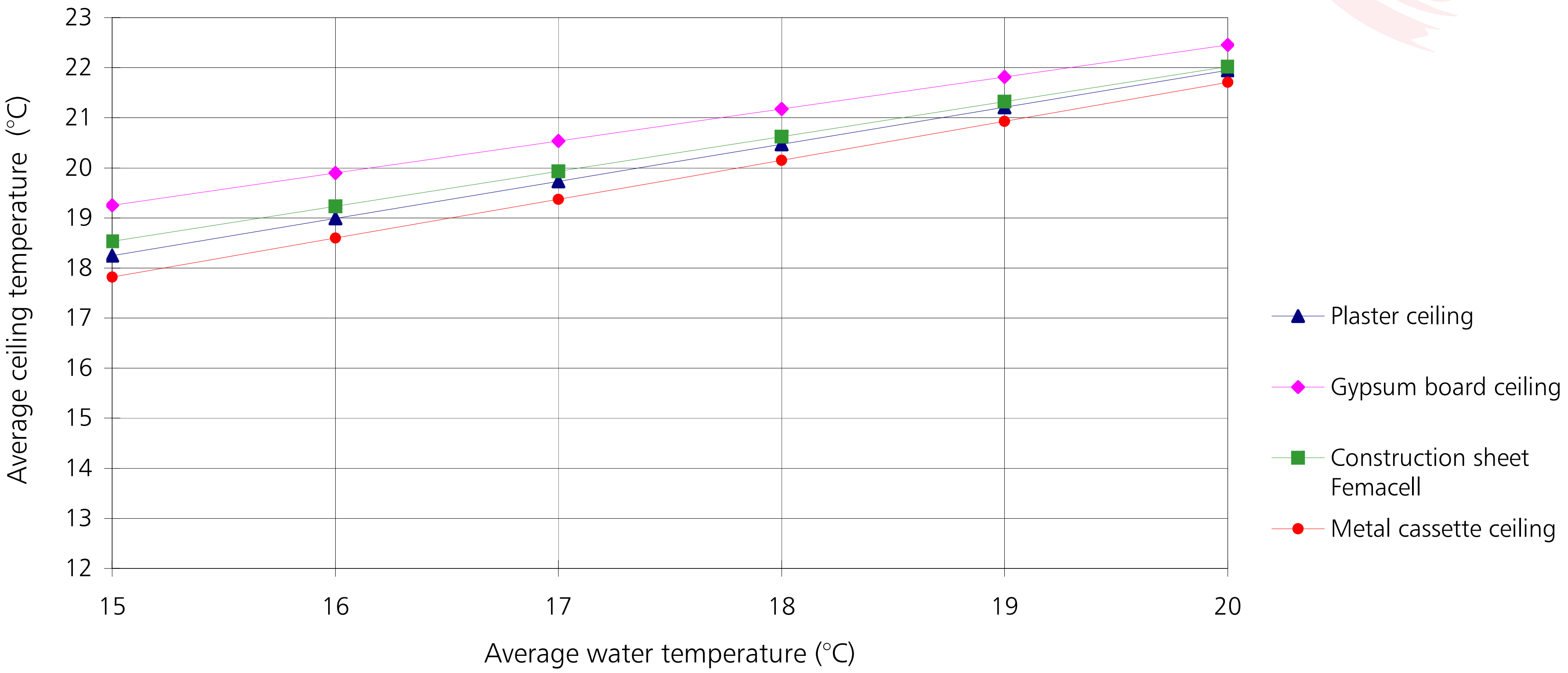
Heat Transfer Ceiling / Room



Source: Praxis hand book Haustechnik ATGA, Wien, 1995

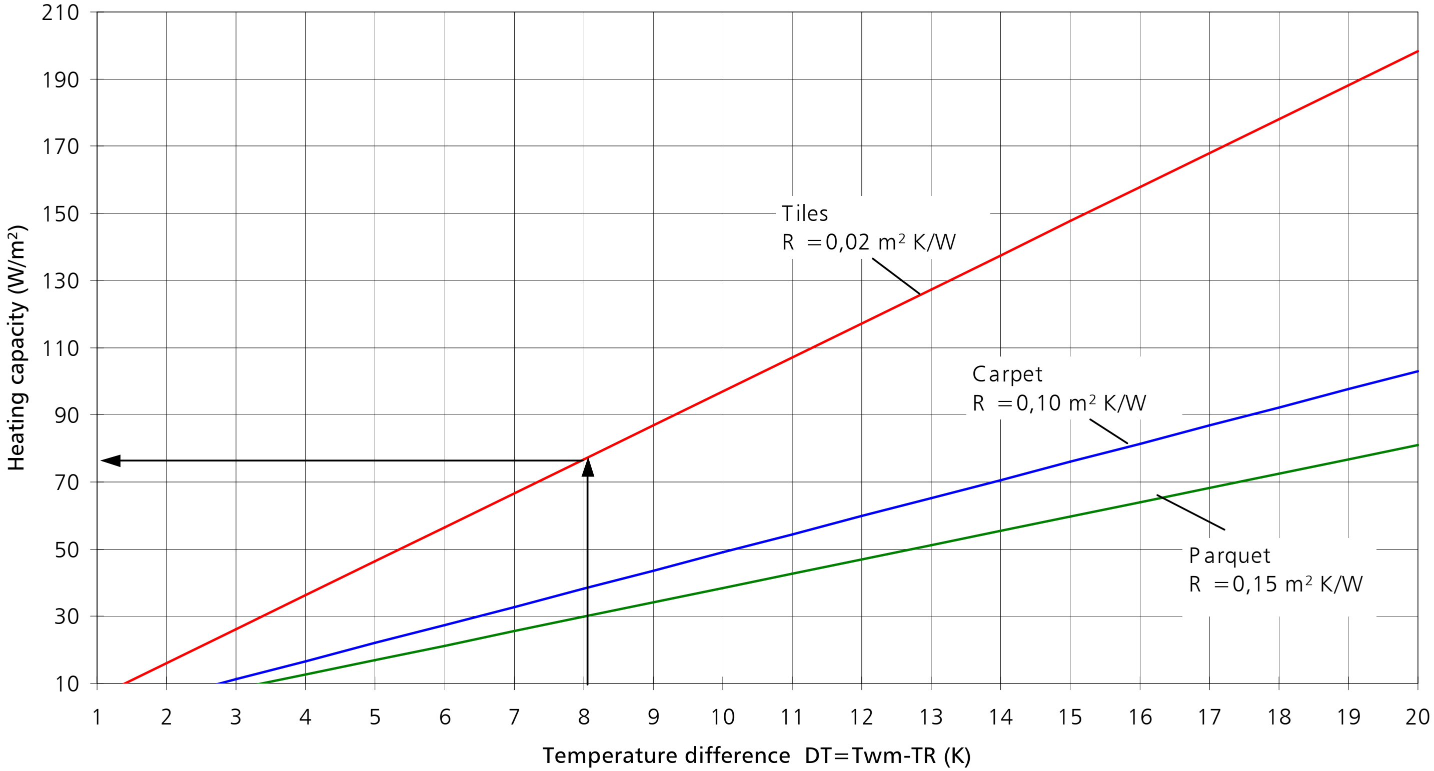
TI-D20 | Diagrams

Average Surface Temperature at the Ceiling Underside



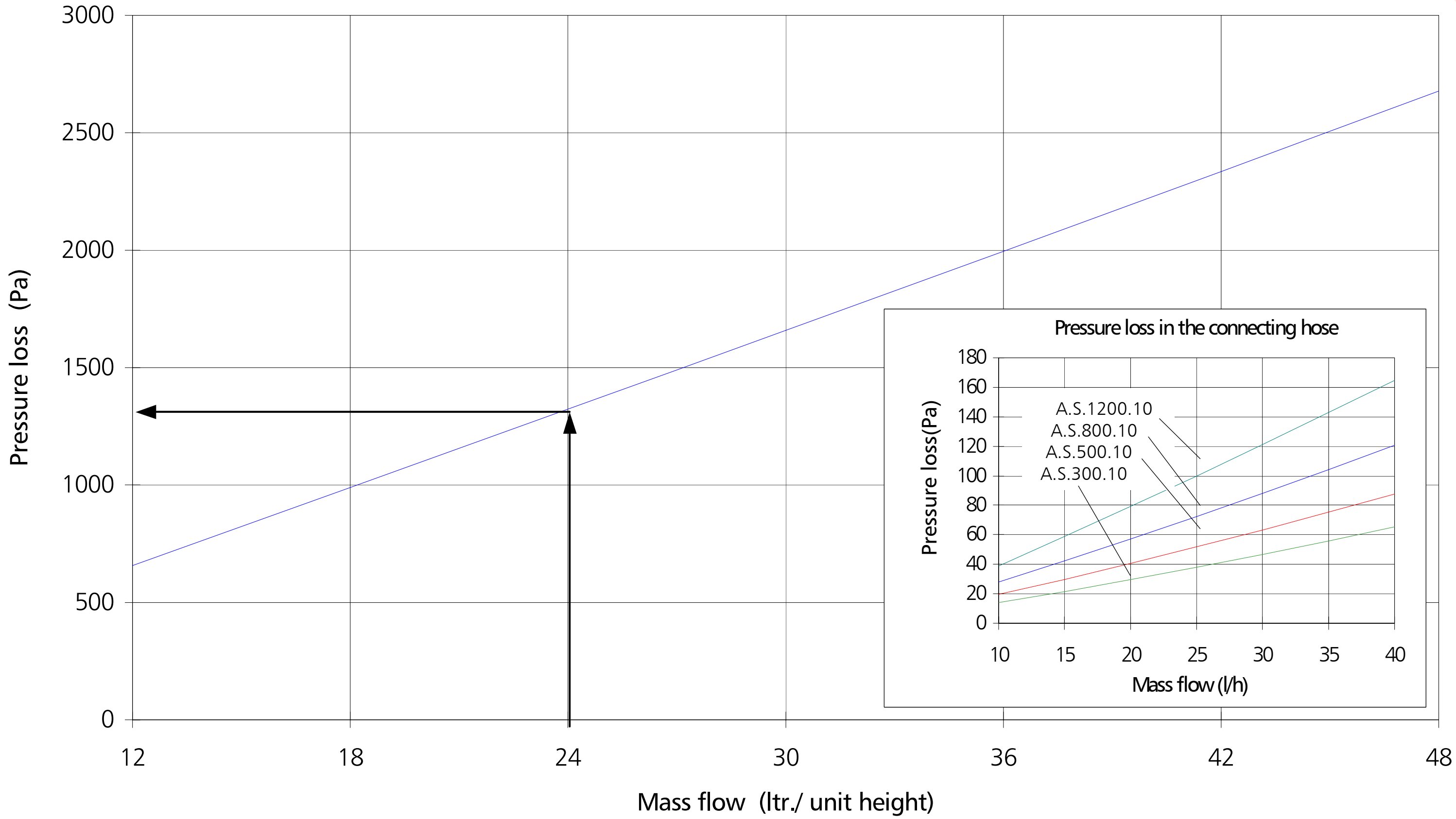
Average ceiling temperature at the bottom surface in °C at a basis- room temperature of 26°C

Heating Capacity of BEKA Floor Heating



Example: BEKA floor heating covered by tiles; temp difference (average water temp – room temp) DT = 8 K; results to a heating capacity of 78 W/m²

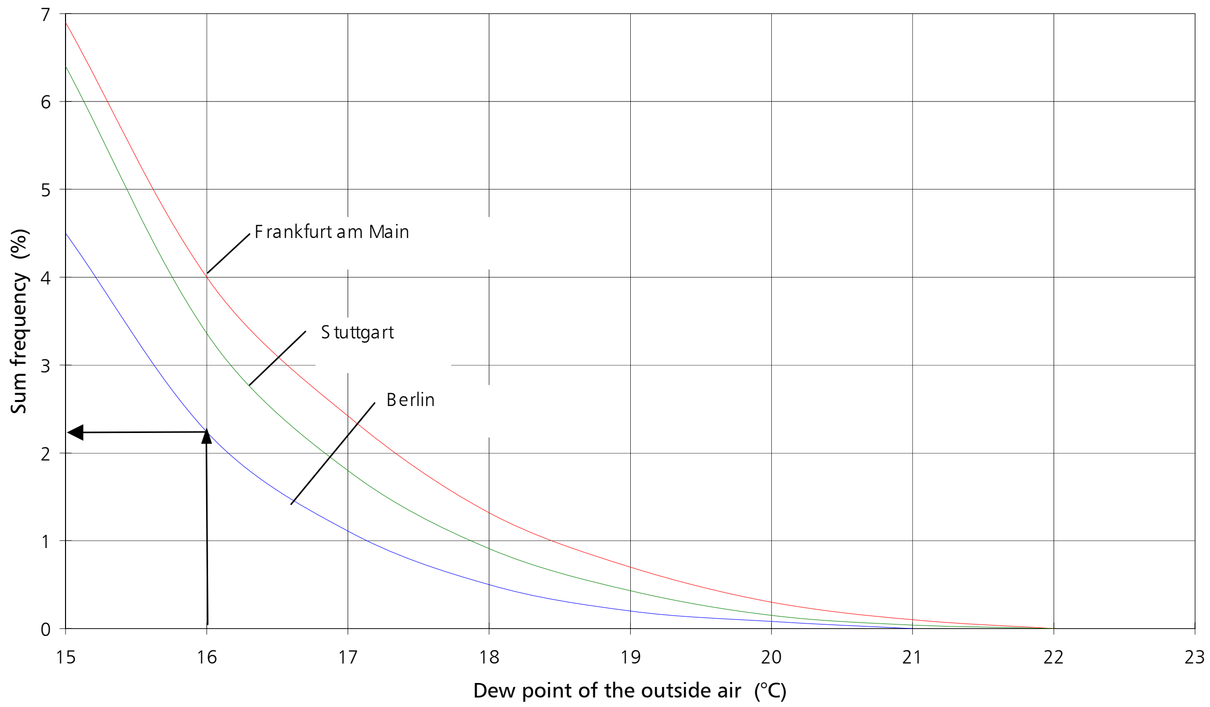
Pressure Loss of the BEKA Dry-built Unit B.GK12



Example: Mass flow water = 24 l / unit height; results to a pressure loss of = 1300 Pa

Frequency of the Dew Point

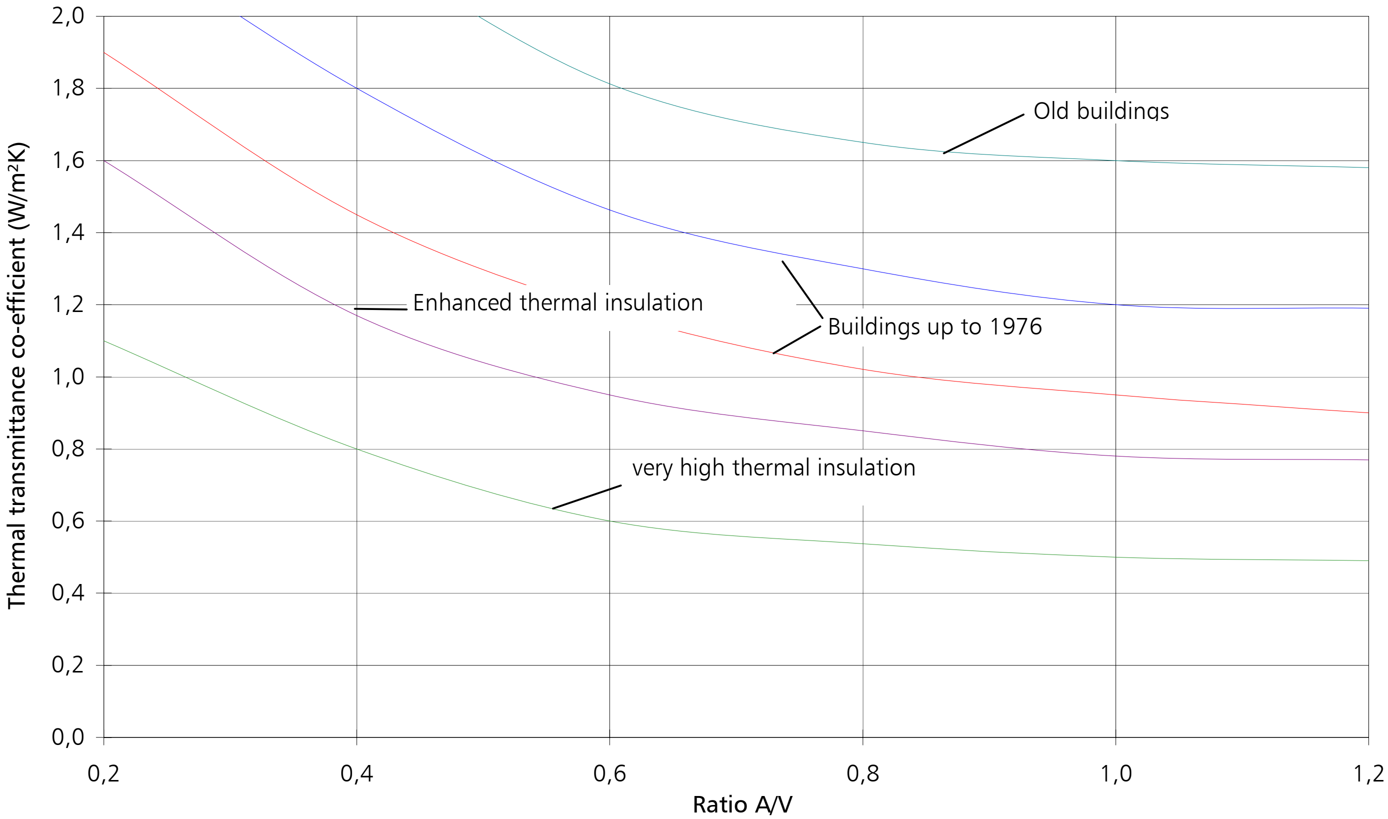
Above the permissible Value with 12 Operating hours



Example : Outside temperature for Berlin 16° C , Frequency of Dew Point = 2,1%

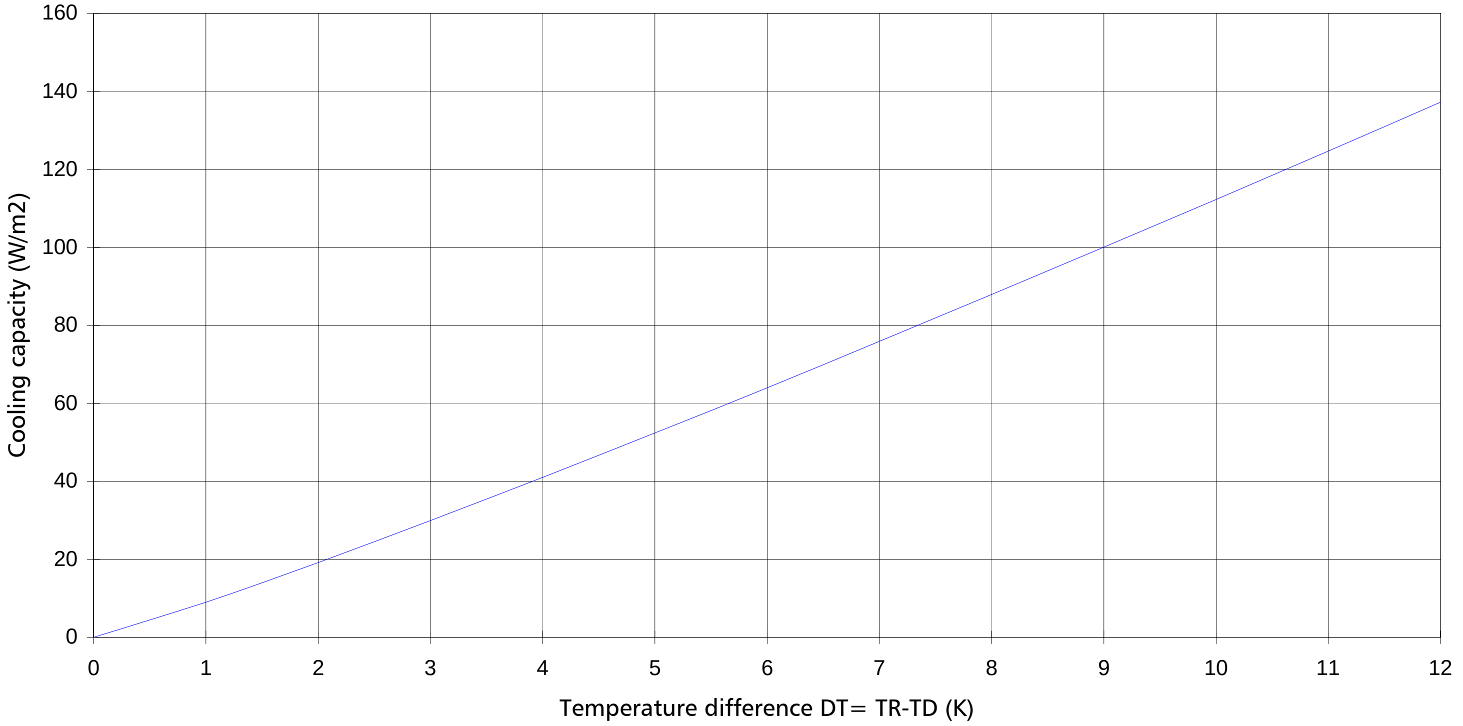
TI-D24 **Diagrams**

Average Heat Transfer Coefficient of Buildings



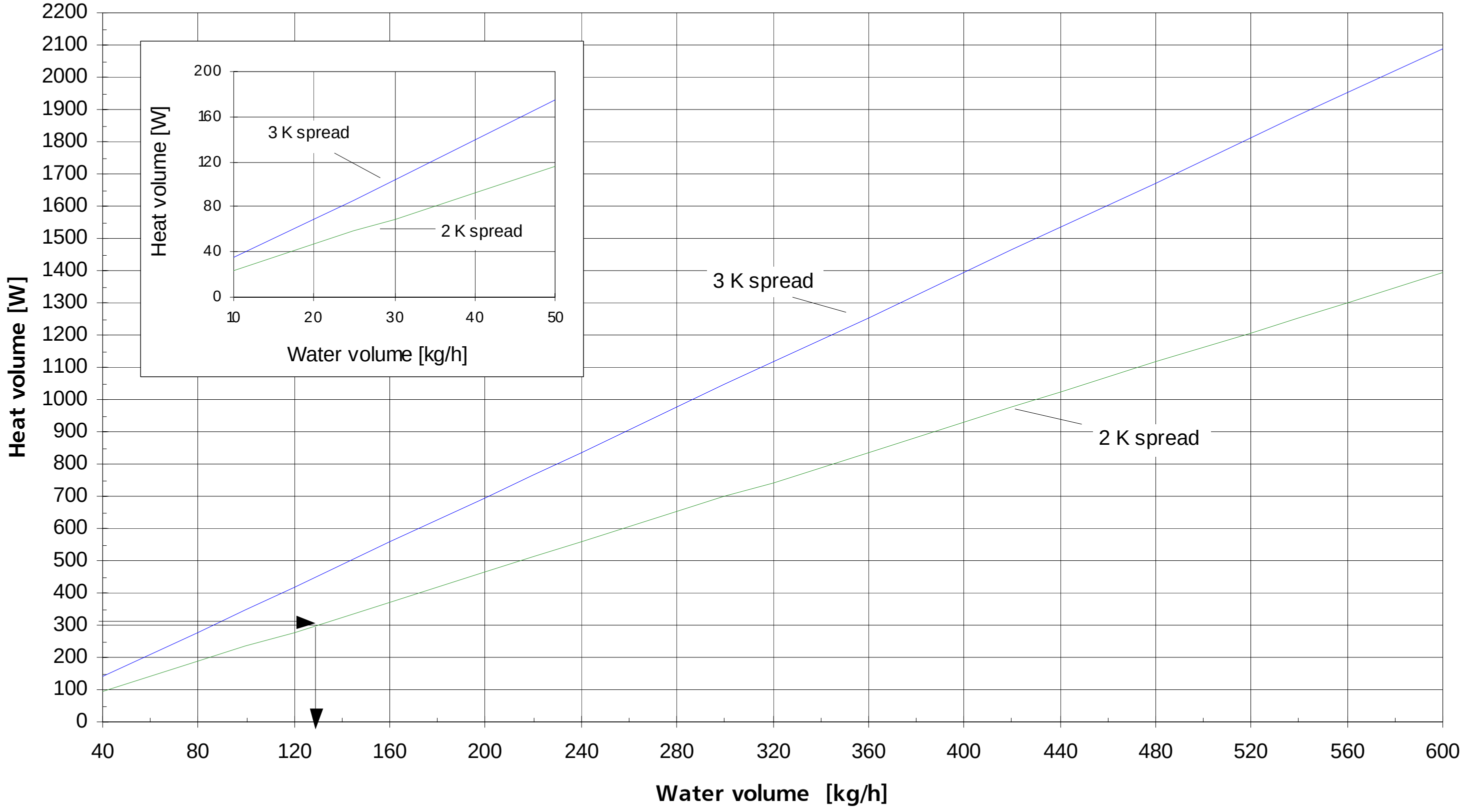
A = total enclosed area in m² V = total building volume in m³

Basic Characteristic Curve: Cooling Capacity of an ideal Radiation Cooling Ceiling



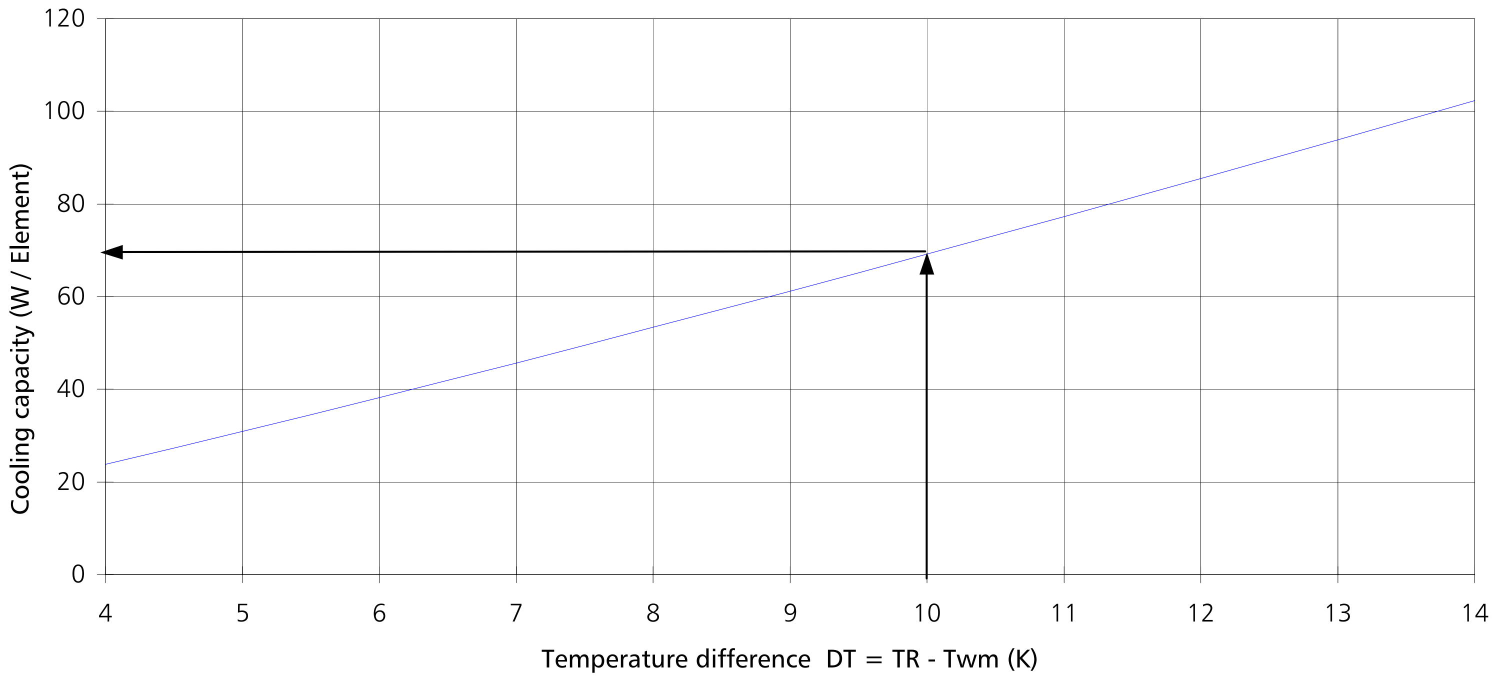
TR = room temperature TD = average ceiling temperature at the underside

Heat Volume - Water Volume



Example: For a required heat volume of 305 Watt there are 130 kg/h water necessary with a spread of 2 K.

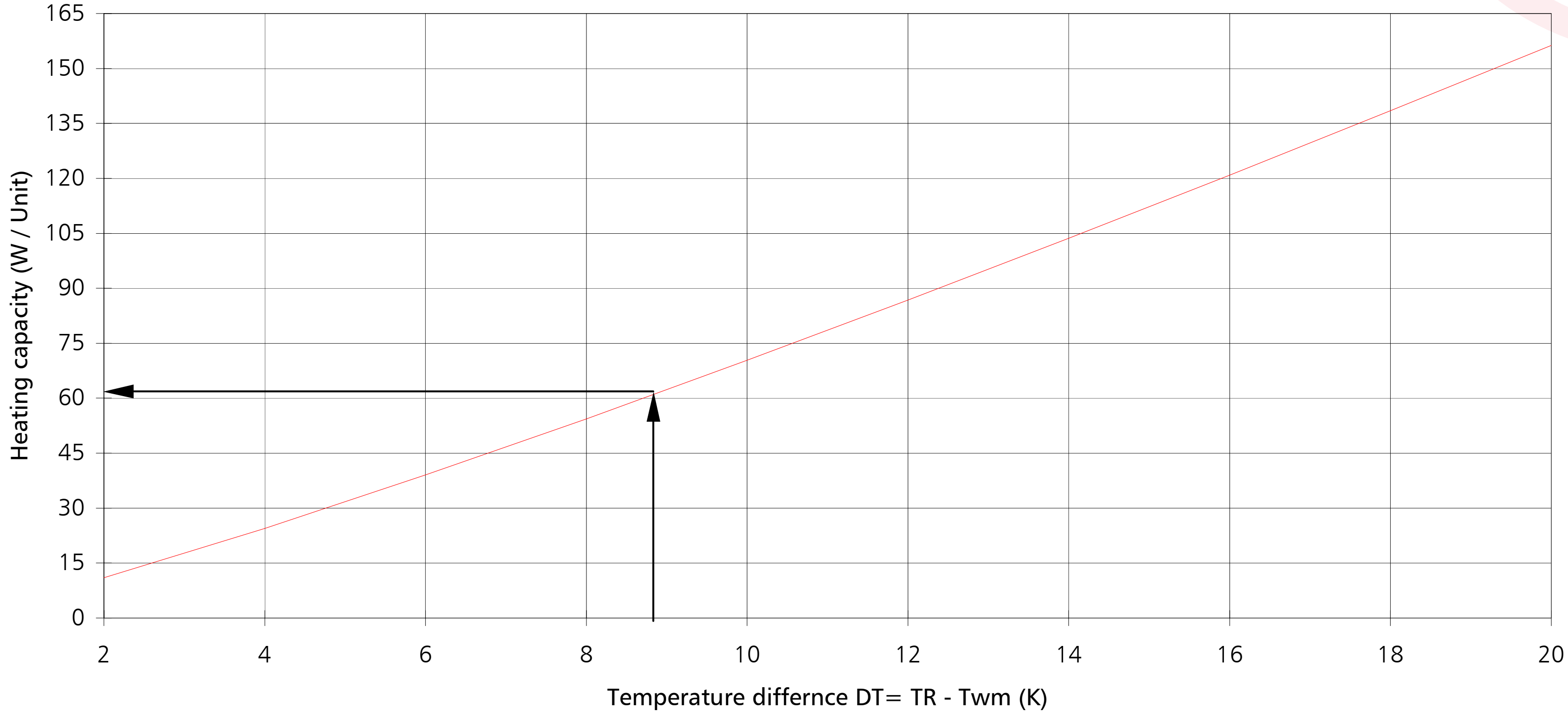
Cooling Capacity for Wall Cooling with BEKA Prefabricted Panels



Example: The BEKA dry-build construction unit B.GK.12, at a temp. difference (room temp. – average water temp.) DT = 10 K, achieves a cooling capacity of 69 W.

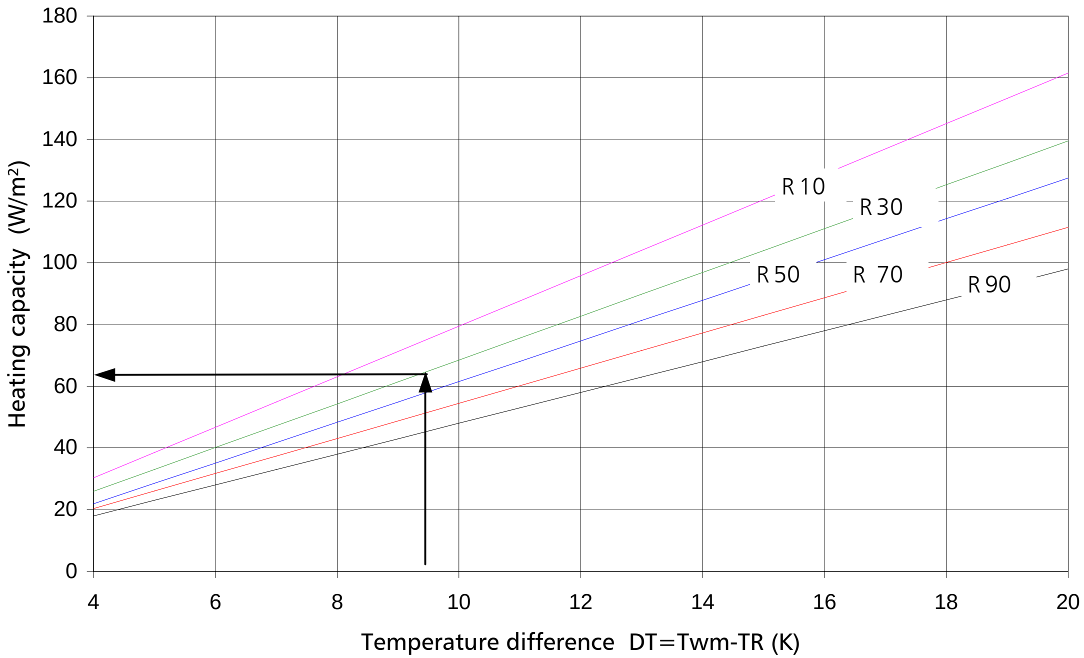
TI-D28	Diagrams

Heating Capacity for Wall Heating with BEKA Prefabricated Panels



Example: The dry-build unit B.GK.12, at a temperature difference (average water temp.- room temp.) DT = 9 K, will reach a heating capacity of 62 W.

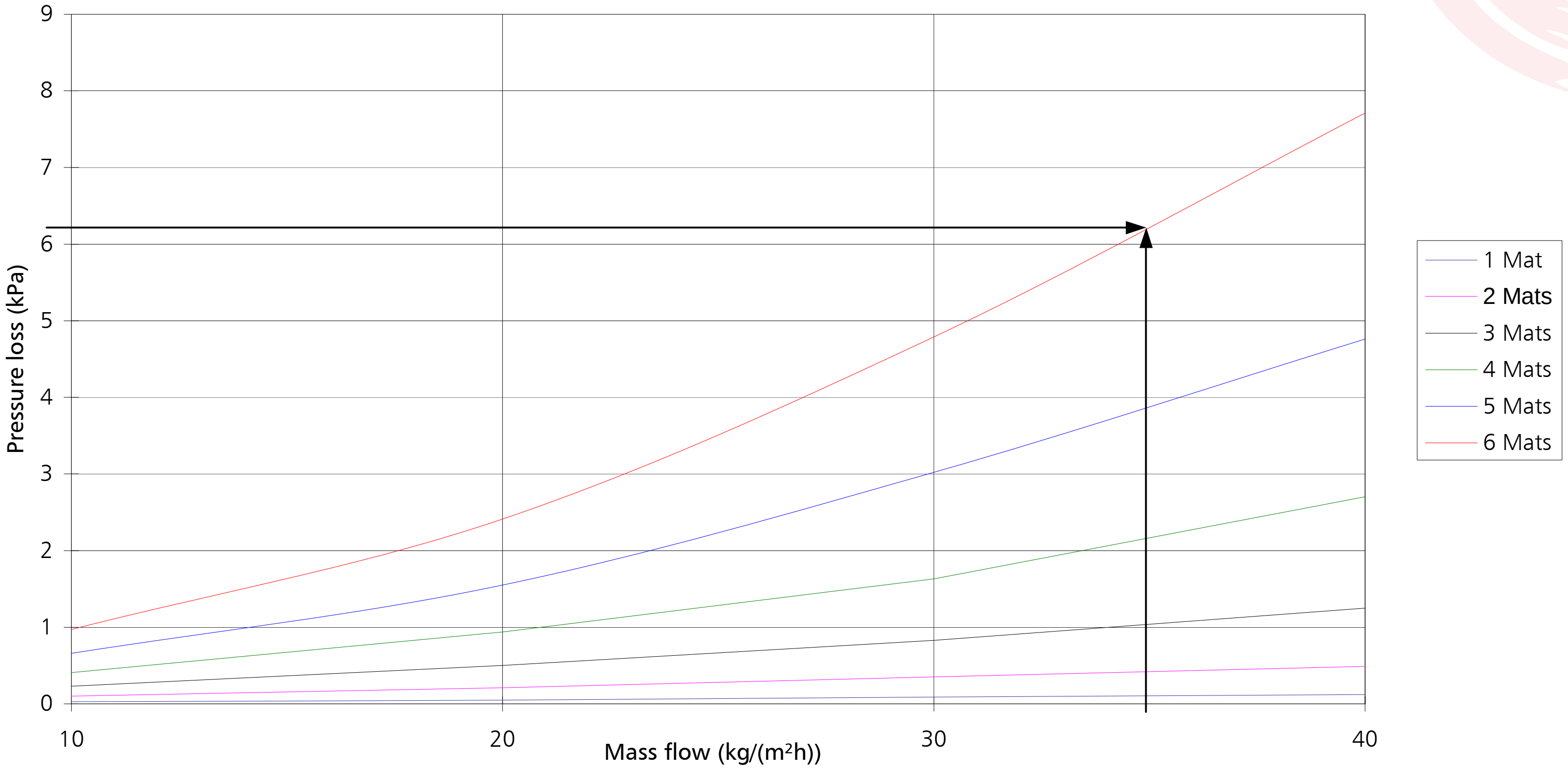
Heating Capacity of the BEKA Wall Heating



Type of Plaster	Thermal conductivity factor for plaster in W/m K	Plaster thickness over mats in mm	Characteristic curve
Gypsum	0,45	10	R32
Gypsum	0,45	15	R41
Gypsum	0,45	20	R70
Gypsum	0,35	10	R38
Gypsum	0,35	15	R52
Gypsum	0,35	20	R90
Lime	0,87	10	R18
Lime	0,87	15	R23
Lime	0,87	20	R38
Concrete	1,50	10	R13
Concrete	1,50	15	R15
concrete	1,50	20	R24

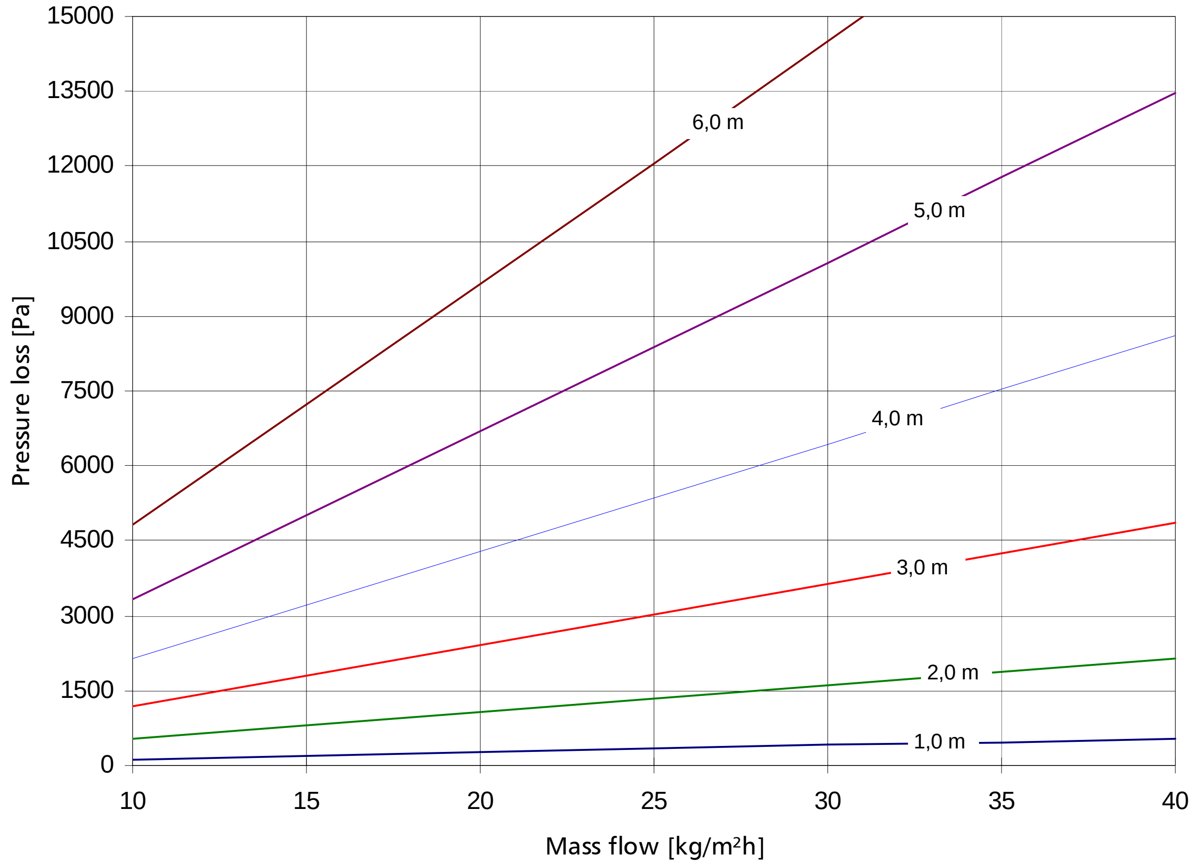
Example: Wall heating with embedded capillary tube mat; gypsum plaster, 15 mm thick, over the capillaries (R41); Temperature difference (average water temp – room temp) DT=9,3 K; results to a heating capacity of 63 W/m².

Pressure Loss of Series Connections at BEKA-Mats 600x600mm

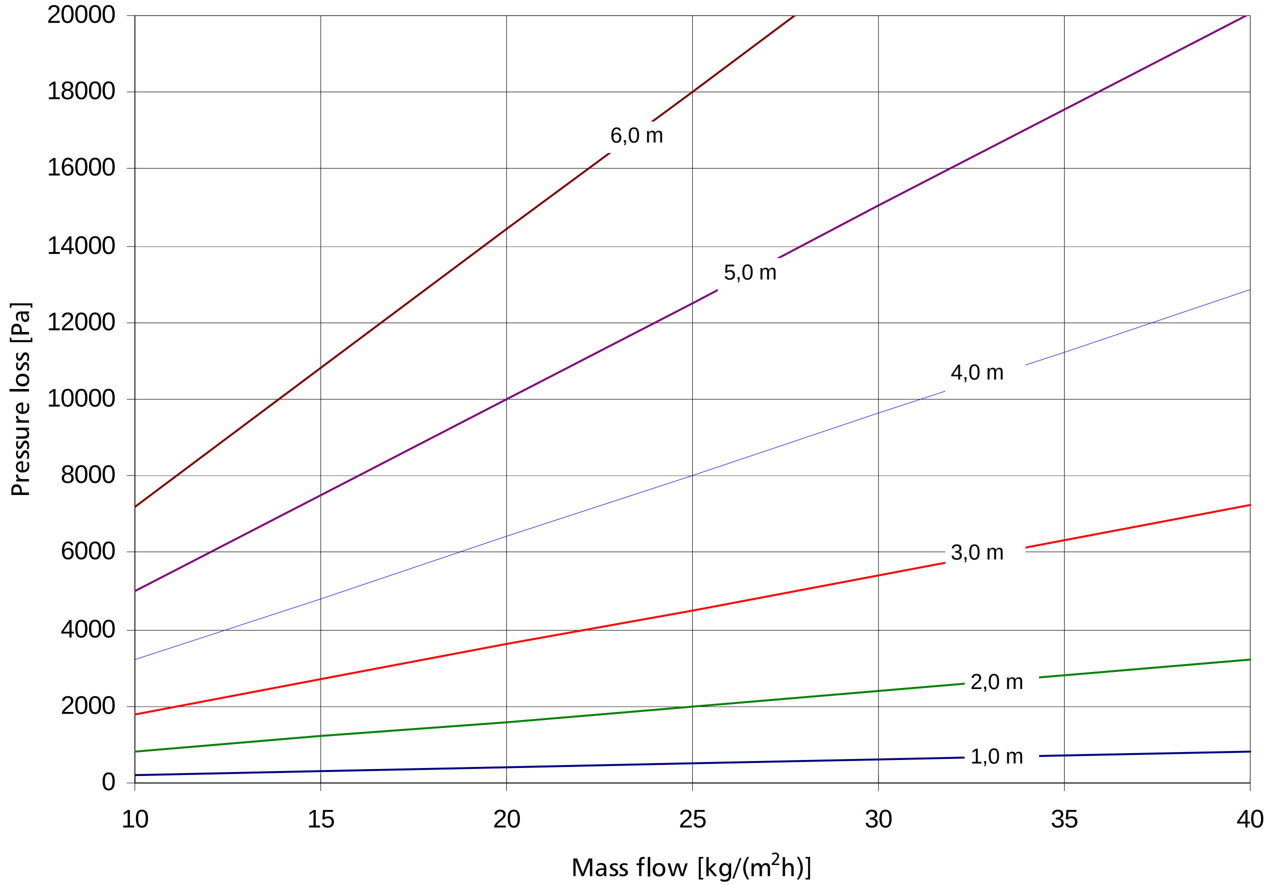


Example: For BEKA mats K.G10.0600.0600.20 in one row, a mass flow of 35 kg/(m²h) will result to a pressure loss of 6,13 Pa.

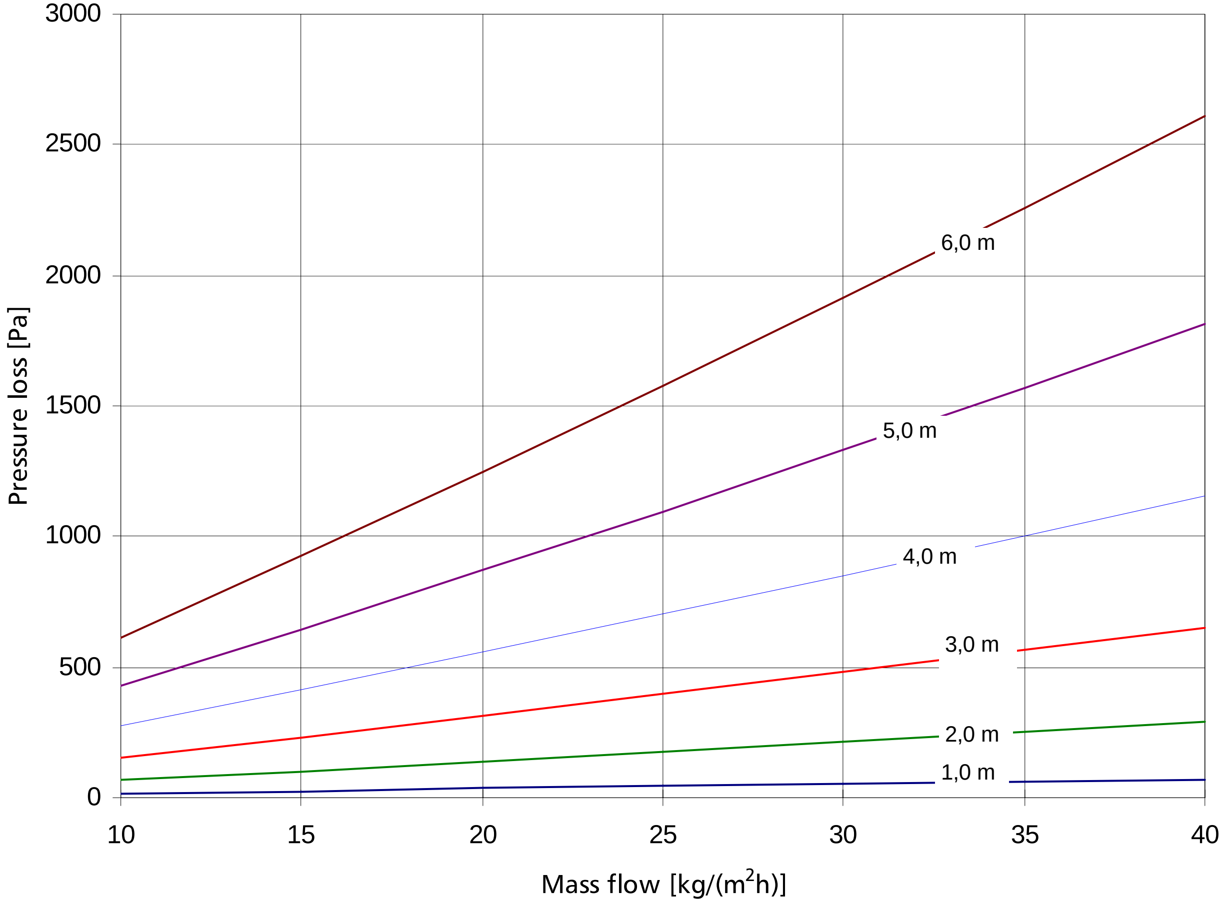
Pressure Loss of BEKA Mats P.VS20 (Length from 1,0m to 6,0m)



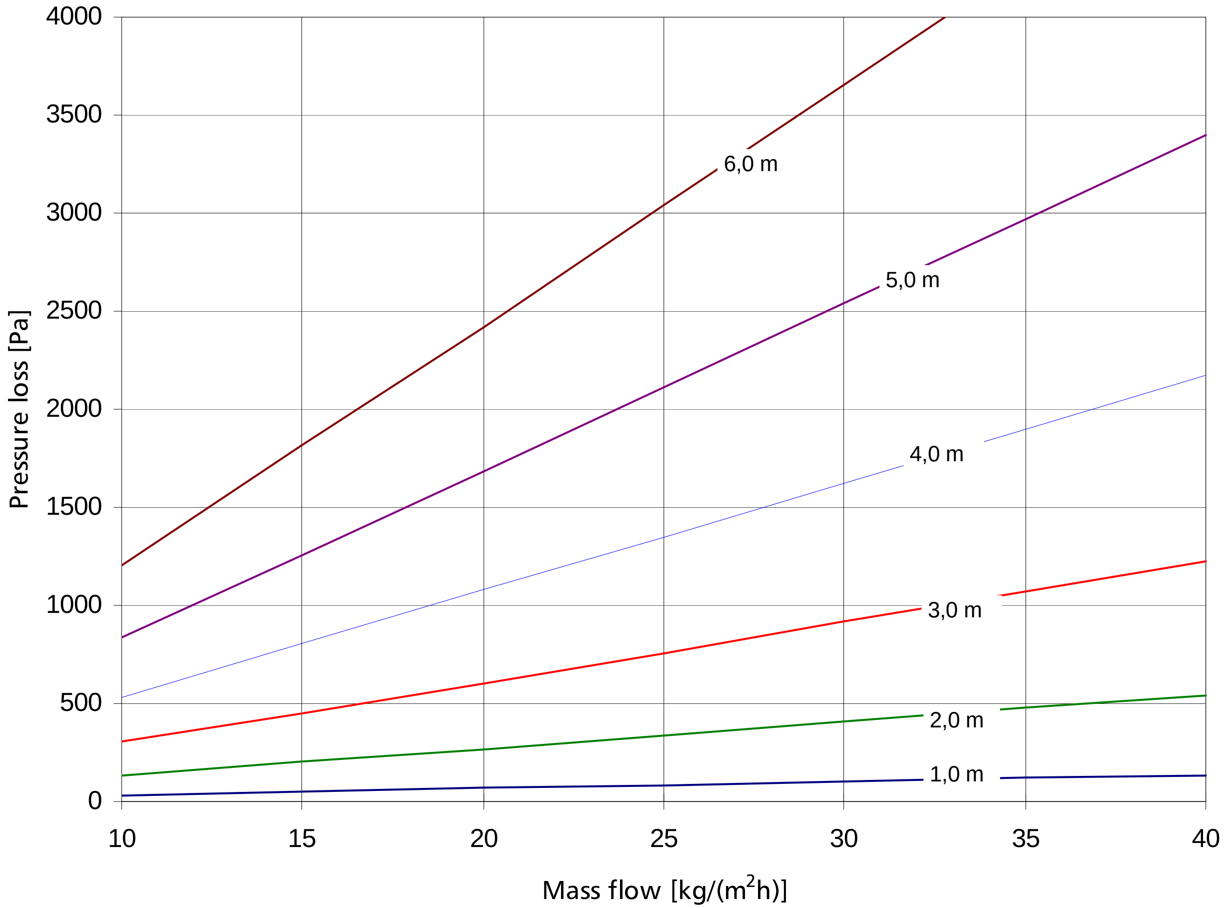
Pressure Loss of BEKA Mats P.VS30 (Length from 1,0m to 6,0m)



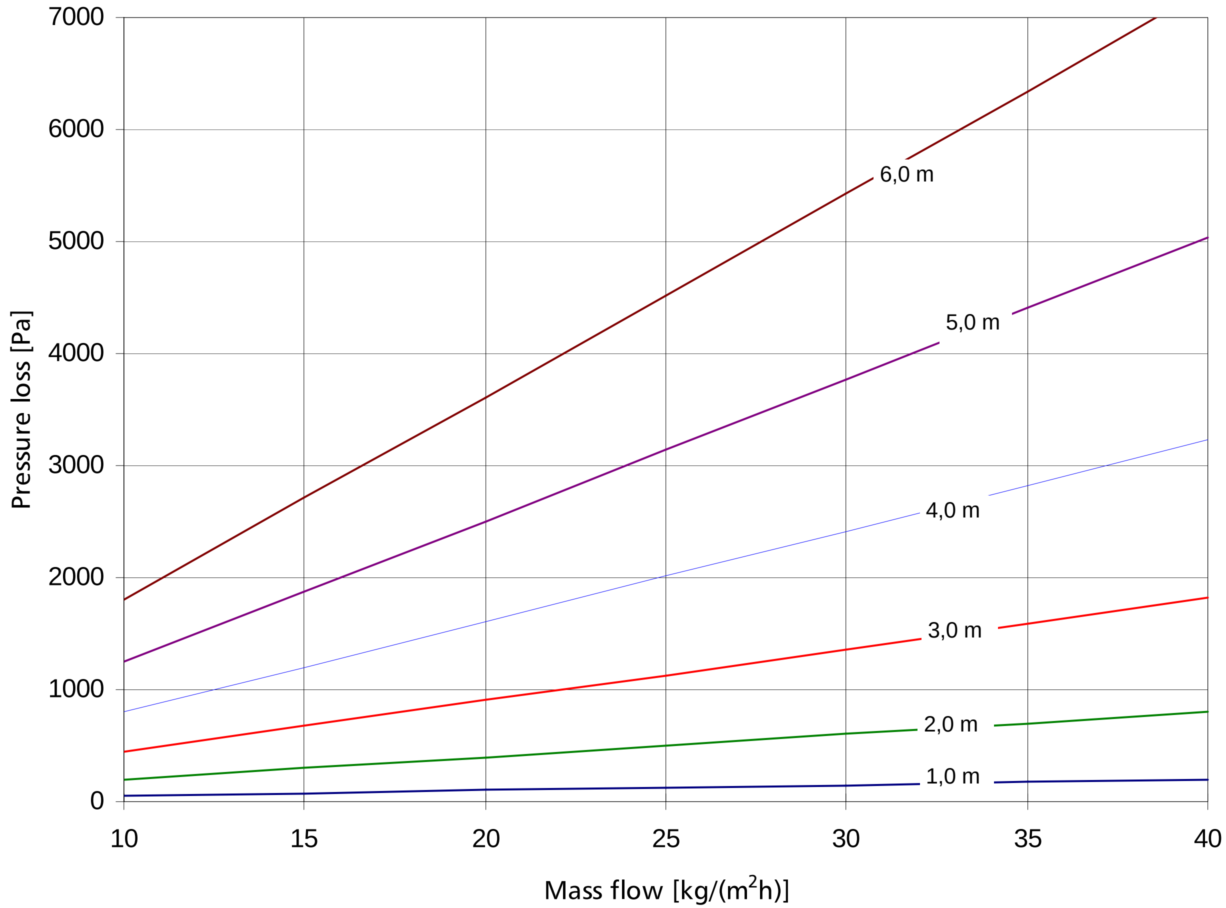
Pressure Loss of BEKA Mats P.VG10 (Length from 1,0m to 6,0m)



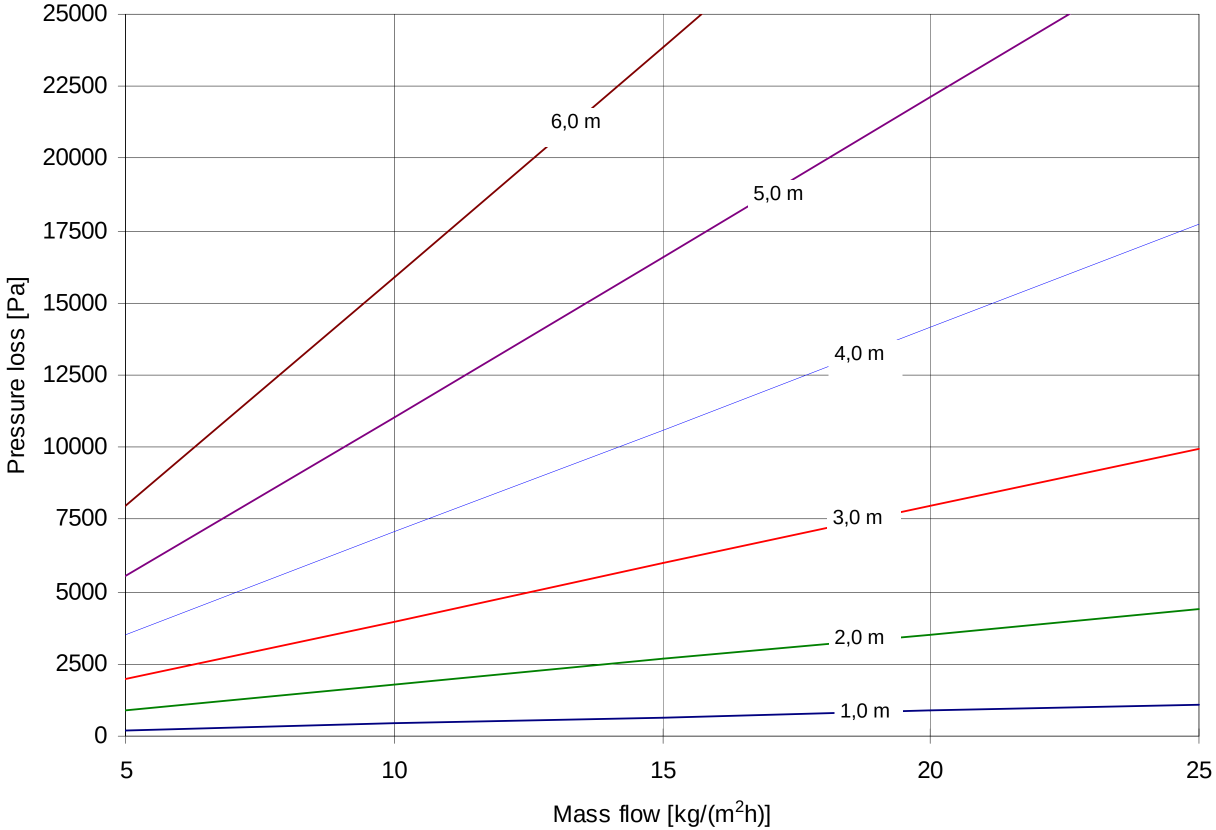
Pressure Loss of BEKA Mats P.VG20 (Length from 1,0m to 6,0m)



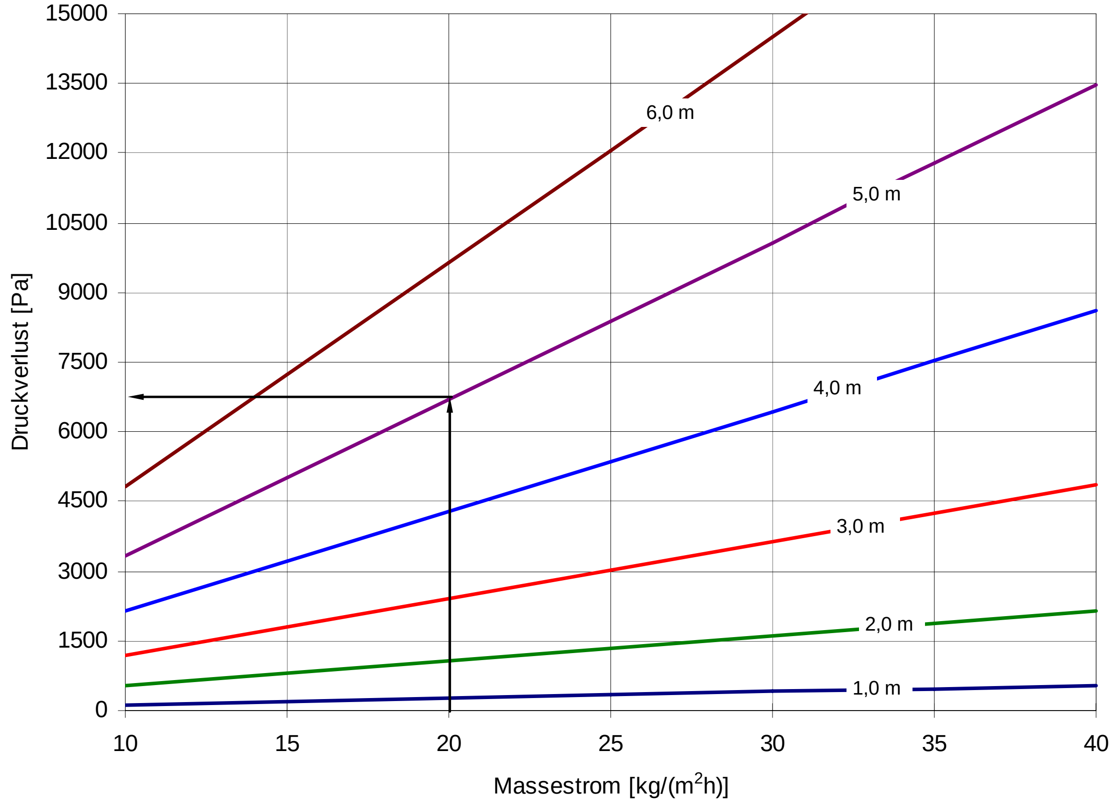
Pressure Loss of BEKA Mats P.VG30 (Length from 1,0m to 6,0m)



Pressure Loss of BEKA Mats P.NS15 (Length from 1,0m to 6,0m)



Pressure Loss of BEKA Mats P.FS20 (Length from 1,0 m to 6,0 m)



Exemple: Mass flow water = 20 kg/m²h; length of mat = 5,0 m; results to a pressure loss of = 6700 Pa = 6,7 kPa

Formulas

Building identification data

Height factor K_H (1)

$K_H = 1.117 - 0.045 \cdot H$ [m]
with: H - room height

valid for $2.5m < H < 5m$

Load factor K_K (2)

$K_K = (q_{iL} + q_{eL}) / (q_{iL} + q_{eL}/2)$

with:
q_{iL} - internal specific cooling load [W/m²]
q_{eL} - external specific cooling load [W/m²]

K_K maximum = 1.2 permissible

Ventilation

Specific cooling load of draft q_L (3)

q_L [W/m²] = $v_L \cdot \Delta T_L \cdot c_L \cdot \rho_L$

with:
v_L - specific air intake volume flow [m³/hm²]
ΔT_L- temperature difference exhaust-intake [K]
c_L - specific heat capacity of the air = 1004 J/kgK
ρ_L - density of the air = 1.14 kg/m³

or (4)

q_L [W/m²] = $0.32 \cdot v_L \cdot \Delta T$

Ventilation factor K_L (5)

Ventilation system	Ventilation factor K_L
Basic airflow	1.00
Climate convector	1.08
Ceiling slot outlet	1.10
Ceiling spin outlet	1.13

Ceiling Construction

Degree of ceiling coverage D_G (6)

$D_G = A_D / A_B$

with:
A_D - ceiling area covered with mats [m²]
A_B - floor area of room [m²]

Factor of coverage K_B (7)

$K_B = 1.21 - 0.3 \cdot D_G$

valid for $0.3 < D_G < 1{,}0$

Room constant K_R (8)

$K_R = K_H \cdot K_K \cdot K_L \cdot K_B$

Cooling Ceiling Capacity

Average water temperature T_{WM} (9)

T_{WM} [°C] = $(T_{VL} + T_{RL}) / 2$

with;
T_{VL} - supply temperature [°C]
T_{RL} - return temperature [°C]

Effective under temperature T_U (10)

T_U [°C] = $T_R - T_{WM}$

with
T_R – room air temperature [°C]

Required specific capacity for cooling ceiling q_{ERF} (11)

q_{ERF} [W/m²] = $q_{GA} - q_L$

with
q_{GA} - total cooling load in reference to floor area [W/m²]

Specific standard cooling capacity q_N according DIN 4715 (12)

q_N [W/m²] = $C \cdot T_U^{\,n}$

with

C – constant
n - exponent → see enclosure

Real specific cooling capacity to bottom qT (13)

q_T [W/m²] = $K_R \cdot q_N$

Specific capacity to top q_O (14)

q_O [W/m²] = $k_O \cdot (T_Ü - T_{WM})$

with
k_O – Thermal conductivity factor to top [W/m²K]
$T_Ü$ – Temperature above the ceiling [°C]

Heat flow density (basis characteristic curve) q_i (15)

qi [W/m²] = $8.92 \cdot (T_i - T_D)^{1,1}$

with
T_i - room temperature [°C]
T_D – average ceiling temp. at bottom side [°C]

Internal thermal transfer coefficient κ (16)

κ [W/m²K] = $q_i / (t_D - T_{WM})$

with
T_{WM} – average cooling water temperature [°C]

for capillary tube mats $\kappa \approx 20 - 30$ W/m²K

Mass flow

Cooling water spread S_P (17)

S_P [K] = $T_{VL} - T_{RL}$

Specific mass flow water m_W (18)

m_W [kg/m²h] = $3600 \cdot q_N / (c_W \cdot S_P)$

with
c_W - specific heat capacity of water = 4180 J/kgK

or (19)

m_W [kg/m²h] = $0.861 \cdot q_N / S_P$

Corrected specific water mass flow m_{KW} (20)

m_{KW} [kg/m²h] = $0.861 \cdot (q_N + q_O) / S_P$

Flow / pressure Loss

Flow rate w (21)

w [m/s] = V / A_S

with
V – flow [m³/s]
A_S – Flow cross-section [m²]

or (22)

w [m/s] = $21.22 \cdot m / d_i^2$

with
m – water volume [l/min]
d_i - internal pipe diameter [mm]

Pressure loss in the pipe Δp_R (23)

Δp_R [Pa] = $\lambda \cdot L / (d_i \cdot 10^{-3}) \cdot \rho/2 \cdot w^2$

with
λ - pressure loss coefficient
L - length of pipe [m]
ρ - density [kg/m³]

or (24)

Δp_R [Pa] = $499200 \cdot \lambda \cdot L / d_i \cdot w^2$

with
ρ_W – density of water = 998.4 kg/m³

Pressure loss at fittings and transitions Δp_F (25)

Δp_F [Pa] = $\xi \cdot w^2 \cdot \rho/2$

with
ξ - Resistance coefficient according to chart

Type of Fitting	*ξ - Value*
Sleeve connector	0.0
Elbow, wide	0.5
Elbow, narrow	0.3
Expansion	0.5
T-junction, separation	1.5
T-junction, union	1.0
T-passage, separation	0.0
T-passage, union	0.5
T-counter current	3.0

Pressure loss at valves Δp_V (26)

Δp_V [Pa] = $(m_a / k_{VS})^2 \cdot 10^{-1}$

with
m_a – actual mass flow [kg/h]
k_{VS} – value according manufacturer [m^3/h]

Pressure loss in the capillary tube mat Δp_M[1] (27)

Δp_M [Pa] =
$V^2 \cdot 8 \cdot \rho / \pi^2 \cdot 1/ \left(n_K \cdot \sqrt{d_K^5 / (\zeta \cdot d_K + \lambda_K \cdot L_M)} \right)^2 + (\lambda_S \cdot B/d_S + \xi \cdot n_K)\, w_S^2 \cdot \rho/2$

with
V - Flow [m^3/s]
n_K - Number of capillary tubes
d_K - Inner diameter of capillary tube [m]
λ_K - Friction factor of capillary tube
L_M - Extended length of capillary tube mat [m]
λ_S - Friction factor of collecting tube
B - Length of collecting tube or width of mat [m]
d_S - Inner diameter of collecting tube [m]
ξ - Resistance coefficient for junction = 0.04
w_S - Flow rate in the collecting tubes [m/s]

Reynolds number Re (28)

$Re = (w \cdot d_i) / \nu$

or
$Re = w \cdot d_i \cdot 10^3$

with
ν – Kinematic viscosity for water [10^{-6} m^2/s]
w – Flow rate [m/s]
d_i – Inner diameter [mm]

Pressure loss coefficient λ (29) and (30)

for Re < 2300
$\lambda = 64 / Re$

for 2300< Re< 10^5
$\lambda = 0.3164/ Re^{0,25}$

Comfort

Windchill factor[2] ϑ_{res} (31)

ϑ_{res} [°C] = $a \cdot \vartheta_a + (1- a) \cdot \vartheta_{mrt}$
where $a = 0.5 + 0.25 \cdot v$

with
ϑ_a - air temperature [°C]
ϑ_{mrt} - average radiation temperature [°C]
v - air velocity [m/s]

or for v< 0.1 m/s (32)

$\vartheta_{res} = (\vartheta_a + \vartheta_{mrt})/ 2$

Average radiation temperature[2] ϑ_{mrt} (33)

ϑ_{mrt} [°C] = $(\Sigma\, \vartheta_i \cdot A_i) / \Sigma A_i$

with
ϑ_i - surface temperature of the area A_i

Valid when the emission coefficients of the particular surfaces are almost equal (standard case); Is not valid if in the room in question infra red reflective layers have been installed!

Required air exchange[2] V_{LW} (34)

V_{LW} [m^3/h] = $V_{CO2} / (C_{CO2I} - C_{CO2A})$

with
V_{CO2} - CO_2 – Emission in the room [l/h]
C_{CO2I} - CO_{2I} – Concentration in room air [l/m^3]
C_{CO2A} - CO_{2A} – Concentration in outside air [l/m^3]

Stability

Reference pressure σ_V (35)

σ_V [MPa]= $p_i \cdot (d_a - s)/ (2 \cdot s)$

with
p_i - inside pressure [MPa]
d_a - outer diameter of pipe [mm]
s - wall thickness of pipe [mm]

Heat flow / Heat transfer

Heat flow through a surface / wall Q (36)

Q [W] = $k \cdot A \cdot \Delta T$

with
k - overall heat transfer coefficient [W/m^2K]
A - area of component [m^2]
ΔT- temperature difference between

[1] Vogel Fachbuch: Wagner - Strömung und Druckverlust, Vogel Buchverlag Würzburg 1992
[2] Source: Praxishandbuch Haustechnik. Akademie für technische Gebäudeausrüstung. Wien 1995

ouside/inside [K]

$k\,[W/m^2K] = 1 / (1/\alpha_i + 1/\alpha_a + \Sigma s_i / \lambda_i)$

with

α_i - inner thermal transfer coefficient [W/m²K]
inner thermal transfer resistance
$R_i = 1 / \alpha_i = 0.13\ m^2K/W$

α_a - outer thermal transfer coefficient W/m²K]
outer thermal transfer resistance
$R_a = 1 / \alpha_a = 0.04\ m^2K/W$

s_i - layer thickness [m]

λ_i - thermal conductivity of the layer [W/mK]

Average k-value k_m (38)

$k_m\,[W/m^2K] = (k_W \cdot A_W + 0.8 \cdot k_D \cdot A_D + 0.5 \cdot k_B \cdot A_B + k_F \cdot A_F) / A_{ges}$

with

$k_{W.D.B.F}$ - k-value for wall; ceiling; floor; window (W/m²K]

$A_{W;D;B;F}$ - area of wall; ceiling; floor; window [W/m²K]

A_{ges} - total embracing area [m²]

k-Value k (37)

Heating

Approximate heat requirement Q_W (39)

$Q_W\,[W] = (k_m \cdot A_o/V + 0.34 \cdot n_W) \cdot V_o \cdot \Delta T$

with

k_m - average overall heat transfer coefficient W/m²K]

A_o - total embracing area [m²]

V_o - total building volume [m³]

n_W - rate of hourly air exchange=0.5 to 1.0 [h^{-1}]

ΔT - temperature difference outside/inside [K]

Attachments to the: collection of formulas

Conversion table for pressure units

units	bar	mbar	Pa	kPa	daPa	kp/cm² atü	mmWs kp/m²	mmHg Torr	atm	psi lb/in²
1 bar =	1	1000	100 000	100	10 000	1.01972	10197	750.062	0.986923	14.5038
1 mbar =	0.001	1	100	0.1	10	1.01972 x10^{-3}	10.197	0.750062	0.986923 x10^{-3}	0.014504
1 Pa = 1 N/m² =	10^{-5}	0.01	1	0.001	0.1	1.01972 x10-5	0.10197	0.007501	9.86923 x10^{-6}	1.45038
1 kPa =	0.01	10	1000	1	100	0.010197	101.97	7.501	9.86923 x10^{-3}	0.145038
1 daPa =	10-4	0.1	10	0.01	1	1.0197 x10^{-4}	1.0197	0.075	0.987 x10^{-4}	0.00145
1kp/cm² = 1 atü =	0.9807	980.7	98066.5	98.0665	9806.6	1	10 000	735.56	0.9678	14.2233
1mmWs=	0.9807 x10^{-4}	0.0981	9.80665	98.0665 x10^{-4}	0.981	0.0001	1	0.0736	0.9678 x10^{-4}	0.001242
1 Torr = 1mmHg =	1.33322 x10^{-3}	1.33322	133.322	0.133322	13.3322	1.35951 x10^{-3}	13.5951	1	1.31579 x10^{-3}	0.019337
1 atm =	1.01325	1013.25	101325	101.325	10132.5	1.03323	10332.3	760	1	14.6959
1 psi = 1 lb/in² =	0.06895	68.9576	6894.76	6.89476	689.746	0.070307	703.07	51.7149	0.068046	1

Units and abbreviations used in formulas

Abbreviations	Contents	Units
A	Area, generally	m^2
A_B	Floor area of a room	m^2
A_D	Ceiling area covered with mats	m^2
A_o	Total embraced area of a room	m^2
A_S	Square area of flow	m^2
B	Width of mat e.g. length of mains	m
C	Coefficient for DIN-standard capacity	
c_L	Specific heat capacity of air = 1004 J/kgK	J/kgK
c_W	Specific heat capacity of water =4180 J/kgK	J/kgK
d_a	Outer diameter of a pipe	mm
D_G	Degree of ceiling coverage – correction factor cooling load	
d_i	Pipe inner diameter	mm
d_K	Inner diameter of capillary tube	m
H	Room height	m
k	Overall heat transfer coefficient - k-value	W/m^2K
K_B	Degree of coverage – correction value: cooling load	
K_H	Height factor – correction value: cooling load	
K_K	Load factor – correction value: cooling load	
K_L	Ventilation factor – correction value: cooling load	
k_m	Average k-value	W/m^2K
k_O	k- value to top (above)	W/m^2K
K_R	Room constant factor – correction value cooling load	
k_{VS}	Specific flow rate – according to manufacturer	m^3/h
L	Length, generally	m
L_M	Length of mat	m
m	Volume of water	l/min
m_a	Queued-up mass flow	kg/h
m_{KW}	Corrected specific water mass flow	kg/m^2h
m_W	Specific mass flow water	kg/m^2h
n	Exponential function for DIN-standard capacity	
n_K	Quantity of capillary tubes at the mains of a mat	
p_i	Internal pressure of a pipe	MPa
q_{eL}	Specific external cooling load	W/m^2
q_{ERF}	Required specific capacity of a cooling ceiling	W/m^2
q_{GA}	Specific total cooling load	W/m^2
qi	Heat flow density	W/m^2
q_{iL}	Specific internal cooling load	W/m^2
q_L	Specific cooling load for air intake	W/m^2
q_N	Standard cooling capacity according DIN 4715	W/m^2
q_O	Specific cooling capacity to top (above)	W/m^2
q_T	Actual specific cooling capacity	W/m^2
Q	Heat flow, generally	W
Q_W	Estimated heat requirement	W
Re	Reynolds number	
s	Wall thickness of a pipe	mm
s_i	Layer thickness	m
S_P	Cooling water spread	K
T_D	Average ceiling temperature at the bottom (side)	°C
T_i	Room temperature	°C
T_R	Room air temperature	°C
T_{RL}	Return temperature of the cooling water	°C
T_U	Effective under temperature	°C
$T_{Ü}$	Temperature above the ceiling	°C
T_{VL}	Supply temperature of the cooling water	°C
T_{WM}	Average water temperature	K

v	Air velocity	m/s
V	Volume flow	m^3/s
v_L	Specific air intake flow	m^3/hm^2
V_{LW}	Required air exchange rate	m^3/h
V_o	Total building (or) room volume	m^3
w	Velocity of flow	m/s
w_S	Velocity of flow in the mains	m/s
α_a	Outer, thermal transition coefficient	W/m^2K
α_i	Inner, thermal transition coefficient	W/m^2K
λ	Pressure loss coefficient	
λ_i	Thermal conductivity of a layer	W/mK
λ_K	Pressure loss coefficient in the capillary tube	
λ_S	Pressure loss coefficient in the mains	
κ	Inner thermal transition coefficient	W/m^2K
Δp_F	Pressure loss at the fitting	Pa
Δp_M	Pressure loss of the mat	Pa
Δp_R	Pressure loss of the pipe	Pa
Δp_V	Pressure loss at the valve	Pa
ΔT_L	Temperature difference air intake – exhaust air	K
ρ_L	Density of air = 1.14 kg/m^3	kg/m^3
ρ_W	Density of water = 998.4 kg/m^3	kg/m^3
ϑ_a	Air temperature	°C
ϑ_i	Surface temperature of an area	°C
ϑ_{mrt}	Average radiation temperature of an area	°C
ϑ_{res}	Percept temperature	°C
σ_V	Comparative tension	MPa
ξ	Resistance coefficient	

Specifications

Enclosed specifications describe some standard details.

The advantage of the capillary tube technique is the possibility to individually design arrangements for the planned project.

Please contact us for the preparation of your specification. We will be pleased to prepare the wording especially for your planned building.

Specification of BEKA-Components

BEKA Heating- and Cooling Mats

.... of

BEKA Heating and cooling mats
Type K.S15 00

Suitable for installation in mineral plaster, in modular form, consisting of: Capillary tubes arranged in parallel and positioned by spacer braces, each leading into a collector pipe for supply and return lines. The collector pipes are unilaterally arranged in parallel to the longitudinal side of the mat. They are open on both sides to be connected to the water-carrying pipelines made from polypropylene by thermal-butt or sleeve welding.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	15 mm	
Length:	________mm	
Width:	________mm	
Material costs:	Unit price	Total price.................

.... of

BEKA Heating and cooling mats
Type K.S15 .... 20/11/02

Suitable for installation in mineral plaster, modular design. Consisting of capillary tubes arranged in parallel and positioned by spacer braces, which lead into collector pipes for the supply and return lines. The collector pipes are unilaterally arranged in parallel to the longitudinal side of the mat. They are closed on one end with an end cap. At the other end, there is a plug-type outlet arranged at a 60° angle to the surface of the mat. They will be connected to the supply lines by means of flexible hoses and plug-type couplings.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	15 mm	
Length:	________mm	
Width:	________mm	
Material costs:	Unit price	Total price.................

.... of	BEKA High-efficiency heating and cooling mats Type K.S10 00

Suitable for installation in mineral plaster, modular design. Consisting of capillary tubes arranged in parallel and positioned by spacer braces, leading into collector pipes for the supply and return lines. The collector pipes are unilaterally arranged in parallel to the longitudinal side of the mat. They are open on both sides and will be butt or sleeve welded (thermal) to the water carrying pipelines made from polypropylene.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	10 mm	
Length:	________mm	
Width:	________mm	
Material costs	Unit price	Total price.................

.... of	BEKA High-efficiency heating and cooling mats Type K.S10 .... 20/11/02

Suitable for installation in mineral plaster, modular design. Consisting of capillary tubes arranged in parallel and positioned by spacer braces, leading into collector pipes for the supply and return lines. The collector pipes are unilaterally arranged in parallel to the longitudinal side of the mat. They are closed on one end with an end cap. At the other end is a plug-type outlet, arranged at a 60° angle to the surface of the mat. They will be connected to the supply lines by means of flexible hoses and plug-type couplings.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	10 mm	
Length:	________mm	
Width:	________mm	
Material costs	Unit price	Total price.................

.... of	BEKA High-efficiency heating and cooling mats Type K.G10 00

Suitable for installation in mineral plaster, modular design. Consisting of capillary tubes arranged in parallel and positioned by spacer braces, leading into collector pipes for the supply and return lines. The collector pipes are arranged in parallel to the longitudinal side of the mat. They are open on both sides and will be thermal-butt or sleeve welded to the water carrying pipelines made from polypropylene.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	10 mm	
Length:	________mm	
Width:	________ mm	
Material costs	Unit price	Total price.................

.... of

BEKA High-efficiency heating and cooling mats
Type K.G10 .... 20/11/02

Suitable for installation in metal cassette units, modular design. Consisting of capillary tubes arranged in parallel and positioned by spacer braces, leading into collector pipes for the supply and return lines. The collector pipes are arranged in parallel to the longitudinal side of the mat. They are closed on one end with an end cap. At the other end is a plug-type outlet arranged at a 60° angle to the surface of the mat. They will be connected to the supply lines by means of flexible hoses and plug-type couplings.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	10 mm	
Length:	________mm	
Width:	________mm	
Material costs	Unit price	Total price.................

.... of

BEKA Heating and cooling mats
Type K.U10 11

Suitable for installation in metal cassette units, modular design. Consisting of capillary tubes arranged in parallel and positioned by spacer braces, leading into collector pipes for the supply and return lines. The collector pipes are unilaterally arranged next to each other, staggered at the longitudinal side of the mat. They are closed on one end with an end cap. At the inner end is a plug-type outlet, arranged at a 60° angle to the surface of the mat. They will be connected to the supply lines by means of flexible hoses and plug-type couplings.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	10 mm	
Length:	________mm	
Width:	________mm	
Material costs	Unit price	Total price.................

.... of

BEKA Heating and cooling mats
Type K.UM10 11

Suitable for installation in metal cassette units, modular design. Consisting of capillary tubes arranged in parallel and positioned by spacer braces, leading into collector pipes for the supply and return lines. The collector pipe is unilaterally arranged and split in two chambers at the longitudinal side of the mat. On the outer end, there is a plug-type outlet arranged at a 60° angle to the surface of the mat. They will be connected to the supply lines by means of flexible hoses and plug-type couplings.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
Capillary tube spacing:	10 mm	
Length:	________mm	
Width:	________mm	
Material costs	Unit price	Total price.................

BEKA Supply Lines

.... of	BEKA Supply line Type Z.EM		
	With unilaterally arranged connections for the heating and cooling mats to the water side by means of flexible hoses and plug-type couplings. The supply line will be joined to the pipeline by thermal welding. Therefore, one end is prepared with a sleeve for welding, the other end with a pipe 20 x 2 mm.		
	Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
	Colour:	blue	
	Number of outlets:	________	
	Total length:	________ mm	
	Partition:	_________ mm	
	Material costs:	Unit price	Total price.................

.... of	BEKA Supply line Type Z.EE		
	With unilaterally arranged connections for the heating and cooling mats to the water side by means of flexible hoses and plug-type couplings. One end of the supply line is closed with an end cap the other end with a tube 20 x 2 mm by which the supply line will be connected to the tubing through thermal welding.		
	Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
	Colour:	blue	
	Number of outlets:	_______	
	Total length:	_______ mm	
	Partition:	_______ mm	
	Material costs:	Unit price	Total price.................

.... of	BEKA Supply line Type Z.DM		
	With connections on both sides for the heating and cooling mats to the water side by means of flexible hoses and plug-type couplings. The supply line will be connected to the pipeline through thermal welding, therefore, one end is prepared with a sleeve for welding, the other end with a pipe 20 x 2 mm.		
	Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
	Colour:	blue	
	Number of outlets:	___	
	Total length:	_______ mm	
	Partition:	_______ mm	
	Material costs:	Unit price	Total price.................

.... of BEKA Supply line
Type Z.DE .. . .

With connections on both sides for the heating and cooling mats to the water side by means of flexible hoses and plug-type couplings. One end of the supply line is closed with an end cap, the other end has a pipe 20 x 2 mm by which the supply line will be connected to the tubing through thermal welding.

Material:	Polypropylene (PP), random copolymer Type 3 DIN 8078	
Colour:	blue	
pc(s). of outlets:	_______	
Total length:	_______ mm	
Partition:	_______ mm	
Material costs:	Unit price	Total price.................

BEKA Connecting Hoses

.... of BEKA Connecting hose
Type A.S.0800.10

For watertight connection of the heating and cooling mats to the supply lines by means of plug-type couplings.
The crimped sockets on both ends of the hose will seal-off by means of O-rings in its circumference after they are plugged into the plug-type couplings of the mats and the supply line, secured against pullout by a self-locking retaining mechanism.

Material hose:	EPDM	
Material jacket:	Stainless steel fabric	
Material crimped sockets:	Brass, nickel-plated	
Total length:	800 mm	
Material costs:	Unit price	Total price.................

.... of BEKA Connecting hose
Type A.S.1200.10

For watertight connection of the heating and cooling mats to the supply lines by means of plug-type couplings.
The crimped sockets on both ends of the hose will seal-off by means of O-rings in its circumference after they are plugged into the plug-type couplings of the mats and the supply line, secured against pullout by a self-locking retaining mechanism.

Material hose:	EPDM	
Material jacket:	Stainless steel fabric	
Material crimped sockets:	Brass, nickel-plated	
Total length:	1200 mm	
Material costs:	Unit price	Total price..............

BEKA Control

.... of BEKA Room temperature controller
Type M.R2/3

Room temperature control unit for 2-wire and 3-wire systems with set-point regulation and dew-point protection.
The plastic housing of the room temperature controller is suitable for surface mounting. The room temperature can be individually set by an adjuster. A LED display separately shows the operating condition "heating/cooling" and "dew point protection".
The control unit is pre-set by the manufacturer for the 2-wire system (central switchover "heating/cooling") and can be changed over to the 3-wire system (sequence switchover, heating/cooling) by means of 2 DIP-switches.

Size:	74 x 74 x 36 mm	
Colour:	white	
Voltage:	24 Volt AC ± 10%, 50 - 60 Hz	
Power input:	30 mA	
Range of adjustment	5 - 30 °C	
Switch hysteresis:	1 K	
Temperature sensor:	internal NTC	
Switch output:	TRIAC, 24 V AC/ 1 A, short-term to 2.5 A	
Material costs:	Unit price	Total price..............

.... of BEKA Dew point sensor for metal ceilings
Type M.TM.1

This sensor registers the condensation of humidity and transfers this information to the room temperature controller or converter.
On the back of the sensor, there is an adhesive foil tape with which the sensor can be attached on top of the metal cassette at the main supply pipe beneath the first capillary tubes.

Size:	12,35 x 7,25 x 1 mm	
Circuit card:	Gold-plated	
Supply line:	2-phases, length 10 metre	
Material costs:	Unit price	Total price..............

.... of BEKA Dew point sensor for plaster ceilings
Type M.TP.1

This sensor registers the condensation of humidity and transfers this information to the room temperature controller or converter.
The sensor is installed in a plastic housing with sniffing pipe.
The dew point sensor has to be placed into the plaster in such a way that the first capillary tubes at the main supply pipe will touch the sensor.

Size:	43 x 12 x 10 mm	
Circuit card:	Gold-plated	
Supply line:	2-phases, length 10 metre	
Material costs:	Unit price	Total price..............

.... of

BEKA Dew point sensor for gypsum ceiling panels
Type M.TG.1

This sensor registers the condensation of humidity and transfers this information to the room temperature controller or converter.
The sensor is installed in a plastic housing with sniffing pipe.
The dew point sensor has to be placed on top of the gypsum panels in such a way that the first capillary tubes at the main supply pipe will touch the sensor.

Size:	43 x 12 x 10 mm	
Circuit card:	Gold-plated	
Supply line:	2-phases, length 10 metre	
Material costs:	Unit price	Total price..............

.... of

BEKA Converter
Type M.K.1

For conversion of signals from the dew point sensor into a potential-free switching contact. In a closed housing, prepared for installation with snap-fastener on a DIN terminal bar.

Size:	47 x 45 x 47 mm	
Supply voltage:	24 Volt, AC	
Switch-over contact load:	230 Volt, 8 A	
Intake power:	max. 1 V/A	
Allowable ambient temp.:	5° C - 40° C	
Material costs:	Unit price	Total price..............

Material costs Unit price……… Total price………

Specification of BEKA-Standard Ceilings

1 Plaster Ceiling with BEKA Heating and Cooling Mats on Raw Concrete

1.1 Cooling ceiling

1.1.10 Cooling ceiling system as plaster ceiling beneath the raw ceiling as closed cooling radiator one for the transmission of sensible heat loads, approximately 60% by radiation and approximately 40% by convection, which consist of:
Self-venting plastic tube mats, suitable for installation in mineral plaster, modular design, with capillary tubes arranged in parallel, positioned by spacer braces, which lead into supply and return collector pipes, completely made from polypropylene (PP), random copolymer, type 3 DIN 8078.
The collector pipes are arranged one-sided in parallel to the longitudinal side of the mat. They are open on both the ends to be connected through thermal welding (butt or sleeve welding) to the water-carrying pipes made of polypropylene and joined to room-control groups. The mats are pre-fabricated in length and width to the required dimensions. The mats are fastened to the raw ceiling by double-sided adhesive tape or dowels according to the working guidelines agreed upon with the plaster manufacturer.

Brand:	BEKA / K.S15
Offered brand/type:	....

Bonding layer for plaster on organic base with quartz sand filling. Plaster base surface: Reinforced concrete. Application with roller or spraying gun according to the plaster manufacturer's working guidelines.

Brand:	Knauf / Betokontakt or equivalent
Offered brand/type:	....

Ceiling plaster, single-layer, gun-applied plaster, pre-mixed, according to DIN 1168 and mortar group P IVa according to DIN 18550

Grain size:	Up to 1.2 mm
Thermal conductivity:	0.50 W/mK
Plaster thickness:	approximately 12-15 mm

To be applied to the raw ceiling and pre-fixed plastic tube mats, then distributed, followed by straightening as well as smoothening the surface. Flatness tolerance according to DIN 18202, including all required wall and facade connectors in sliding design with parting strips as well as cutting off the parting strips after plastering.

Brand:	Knauf / MP 75 G/F or equivalent
Offered brand/type	....

Cooling ceiling system with the following technical specification:

Cooling capacity to be dissipated For 1m² of office area:	max. .... W/m²
Specific cooling capacity, active:	83 W/m²
Coverage ratio:	approximately ....%
Room temperature (operative temperature):	27°C
Cold water supply temperature:	16°C

Cold water return temperature: 18°C
Mat width: ....mm
Mat length: ....mm
Height to the ceiling base: ....metre above raw floor

Complete cooling ceiling system including internal piping of the mat zones up to the connecting points for supply and return lines, all fastening and moulded parts according to manufacturer's installation instruction, provision of necessary installation scaffolding, required pressure tests for each section and pressure retention over the entire time of installation until start of operation.

(Note: Specified mass indications refer to the room ceiling area, but not to the effective mat area).

...........m^2 Unit price................ Total price................

1.1.20 Storey station

High-grade plastic design using non-corrosive components only, which consists of:
- Stainless steel-plate heat-exchanger with thermal insulation and flexible connecting hoses …….. kW
  Water temperature, primary side 6°/12°C
  Water temperature, secondary side 16°/18°C
- Pressure-controlled circulation pump with:
  Delivery capacity ....m^3/h
  Water column, delivery height ....m
- Expansion tank including safety unit
- .... off Pressure gauge
- .... off Thermometer 0-60°C, class 1
- 2 Ball-type shut-off faucets
- Dirt collector
- Main distributor for supply and return lines covering .... off of control zones with DN15, each equipped with:
    - Zone valve including thermal actuator
    - Main line regulating valve
    - Ball-type shut-off valves
- ...... off Bleeding valve
- ...... off Filling and drainage faucet,
  mounted on galvanised steel frame, complete with control box ....off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price................

Alternative to 1.1.20 Transfer and distributing station

High-grade plastic design using non-corrosive components only, which consists of:
- Stainless steel-plate heat-exchanger with thermal insulation and flexible connecting hose ….. kW

Water temperature, primary side 6°/12°C
Water temperature, secondary side 16°/18°C
- Pressure-controlled circulation pump with:

Delivery capacity ....m^3/h
Water column, delivery height ....m
- Expansion tank of 18 litres capacity including safety unit
- .... off Pressure gauge
- .... off Thermometer 0-60°C, class 1
- 2 Ball-type shut-off faucets
- Dirt collector
- Main distributor for supply and return lines as legs ...... off for sections with DN…, each equipped with:
- Zone valve including thermal actuator
- Main line regulating valve
- Ball-type shut-off valves

...... off Bleeding valve

...... off Filling and drainage faucet, ...off

Brand BEKA
Offered brand/type: ....

Unit price................ Total price................

1.1.21 Connecting points of mat zones
for supply and return lines with DN15, which consist of:
- Zone valve with thermal actuator
- Leg regulating valve, measuring range: 4-8 litre/min.
- Ball-type shut-off faucet, each
- Two-sided adapters to PP–pipe each.

................off
Brand: BEKA
Offered brand/type: ....

Unit price............... Total price................

1.1.22 Internal piping
Between the cooling mat zone and storey stations, PP–pipes according to DIN 8077 including all non-corrosive connecting and moulded parts, joined by butt and sleeve welding, installed according to manufacturer's guidelines, including fastening material.

Size: PP-pipe OD 20 x 2 mm

Brand: BEKA / R.R.4000.20
Offered brand/type: ....

............m Unit price................ Total price................

Alternative
to 1.1.22 Connecting piping
Between the connecting points of the cooling mat zones and leg piping made of PP–pipes according to DIN 8077, type 3 including all non-corrosive connecting and moulded parts, joined by butt and sleeve welding, installed according to manufacturer's guidelines, including fastening material.

Size: PP-pipe OD 20 x 2 mm

Brand: BEKA / R.R.4000.20
Offered brand/type: ....

............m Unit price................ Total price................

Leg piping
Between the connecting piping of the cooling mat zones made of PP–pipes according to DIN 8077, type 3 and transfer station including all non-corrosive connecting and moulded parts, joined by butt and sleeve welding, installed according to manufacturer's guidelines, including fastening material.

Size: PP-pipe OD 25 x 2.3 mm
OD 32 x 3.0 mm
OD 40 x 3.7 mm
OD 50 x 4.6 mm
OD 63 x 5.8 mm
OD 75 x 6.9 mm
OD 90 x 8.2 mm

Brand:	BEKA
Offered brand/type:	....

............m Unit price................
Total price................

1.1.30 Wall and facade connection
in sliding version with parting strip as supplement to the specified cooling ceiling system including the cutting-off of the parting strips after plastering.

............m Unit price................ Total price................

1.1.40 Cutouts in the cooling ceiling system
left for electrical cables to suspending lighting gears and their holders, components to be built in such as aerating fan or loudspeakers, etc. as supplement to the specified cooling ceiling system.

............m Unit price................ Total price................

1.1.50 Humidity sensor as dew-point pick-up
which detects and registers the condensation of humidity and transmits this information to the room temperature controller or converter, attached to the supply-line connecting piping for each zone and installed according to manufacturer's guidelines.

Size:	50 x 22 x 10 mm
Circuit board:	Gold-plated
Connecting cable:	2-phases, length: 10 metre

.................off

Brand:	BEKA /M.TP.1
Offered brand/type:	....

Unit price................ Total price................

1.1.60 Room temperature controller for heating and cooling in 2- and 3-wire system with remote set-point regulation and dew-point protection.
The plastic housing of the room temperature controller is suitable for on-wall mounting.
The room temperature can be individually set by an adjuster.
A LED-display shows separately the working condition “Heating/cooling” and the “dew-point protection”.
The controller has been pre-set by the manufacturer to:
2-wire system (central switch-over “Heating/cooling”), which can be changed over to the 3-wire system (sequence switch-over “heating/cooling”)
by means of 2 DIP-switches.
Installation according to the manufacturer’s guidelines, including electrical connection of the controller and humidity sensors to be installed.

Size:	74 x 74 x 36 mm
Colour:	White
Voltage:	24 Volt AC ± 10%, 50 - 60 Hz
Power input:	30 mA
Adjusting range:	5 - 30 °C
Switch hysteresis:	1 K
Temperature sensor:	Internal NTC
Switch output:	TRIAC, 24 V AC/ 1 A, short-time to 2.5 A

................off

Brand:	BEKA /M.R2/3
Offered brand/type:	....

Unit price............. Total price................

Alternative
to 1.1.60 Signal converter

converting signals from the humidity sensor into a neutral switching contact, accommodated in closed housing, prepared for installation with snap-fastener to DIN top hat rail including fasteners. Installation in a switch cabinet made available at the construction site and electrical connection of the converter to the 24 V supply and humidity sensor to be installed are to be carried out by control technicians.

Dimensions:	80 x 50 x 61 mm
Voltage:	24 Volt AC
Change-over contact load:	230 Volt, 8 A
Power intake:	max. 1 VA
Allowable ambient temperature:	5°C - 40°C

................off

Brand: BEKA / M.K.2
Offered brand/type: ....

Unit price............. Total price................

1.1.70 Hydraulic adjustment

of the individual zones according to the specified setpoints and documentation of the adjusted water volumes

Unit price............. Total price................

1.1.80 Marking

Of the leg piping for supply and return lines by attaching wear-resistant labels indicating both the leg and flow direction

Unit price............. Total price................

1.1.90 Documentation for later revision

As spare parts lists, operating and maintenance manuals of all functional components of the cooling ceiling, including documentation of the arrangement of the cooling mats and setting values.

Four copies Unit price............. Total price................

Specification of BEKA-Standard Ceilings

2 Plaster Ceiling with BEKA Heating and Cooling mats on Suspended Ceiling

2.1 Cooling ceiling

2.1.10 Cooling ceiling system as a plaster ceiling beneath the suspended one made of plaster carrying sheets as closed cooling radiator ceiling for the transmission of sensible heat loads, appr. 60% by radiation and appr. 40% by convection consisting of:
Plastic tube mats, self-venting, suitable for installation in mineral plaster, modular design, made from parallel arranged capillary tubes, positioned by spacer braces, supply and return lines leading into collector pipes. Material: Polypropylene (PP), random copolymer, type 3, DIN 8078.
The collector pipes are arranged one-sided, parallel at the longitudinal side of the mat. They are open on both sides to be connected through thermal welding (butt or sleeve welding) to the water-carrying pipelines made from polypropylene and joined to room-control groups. The mats are pre-fabricated in length and width to the necessary dimensions. The mats are fastened to the raw ceiling by double-sided adhesive tape or staples. Piping and connection of the mats runs inside the ceiling cavity.
The collector pipes of the mats are fixed to the carrier profiles of the supporting construction.

Brand:	BEKA / K.S15
Offered brand/type:	....

The bonding layer for plaster is made from organic base with quartz sand filling.
Plaster base surfaces are the plaster-carrying sheets.
Application with roller or spray gun.

Brand:	KNAUF / Betokontakt 90 or equivalent
Offered brand/type:	....

Ceiling plaster, single-layer, spray-gun applied plaster and pre-mixed according to DIN 1168 as well as mortar group P IVa according to DIN 18550,

Grain size:	Up to 1.2 mm
Thermal conductivity:	0.35 W/mK
Plaster thickness:	Appr. 12-15 mm

To be applied to the raw ceiling and fastened capillary tube mats, then distributed, followed by straightening and smoothening the surface.
Tolerance according to DIN 18202.

Brand:	KNAUF/MP75 or equivalent
Offered brand/type	....

Cooling ceiling system with the following technical standards:
Transmission of cooling load

For 1m² of office space:	max. .... W/m²
Special cooling capacity, active:	80 W/m²
Coverage:	Appr. 75%
Room temp. (operative temp.):	27°C
Cold water supply temperature:	16°C
Cold water return temperature:	18°C
Mat width:	..........mm
Mat length:	..........mm

Height to the ceiling base: ....metre above raw floor

Complete cooling ceiling system including internal piping of the mat zone up to the connecting points for supply and return lines as well as all fastening and moulded parts according to manufacturer's installation instruction. Including construction of suspended ceiling consisting of C-profiles mounted to the ceiling by means of vernier suspension bars. Sheeting: Plaster carrier panels.
Construction according to dry-build guidelines DIN 18168 and DIN 18181.
Sheets butt joined. Smoothen gaps and unravelled capillary tubes and if necessary, strengthen with reinforcement fabric. Including necessary installation scaffolding, required sectional pressure tests and pressure retaining over the total time of installation until start of operation.
(Note: Specified quantities refer to the room ceiling area, but not to the effective mat area.)

............m^2 Unit price................ Total price................

2.1.21 Connection points of the mat zones
For supply and return according to DN15 consisting of:
- Zone valve with thermal actuating drive
- Main line regulating valve, measuring range: 4-8-l/min
- Ball-type shut-off faucet, each
- Two-sided connecting adapters to PP–pipe
each

................off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price................

Alternative
to 2.1.20 Storey station
High-grade plastic version using non-corrosive components only consisting of:
- Stainless steel-plate heat exchanger with thermal insulation and flexible connecting hoses
- Pressure-regulated circulation pump with: .... m^3/h of delivery capacity
  Water column delivery height .... m
- Expansion tank including safety sub-assembly
- ....off Pressure gauge
- ....off Thermometer 0-60°C, class 1
- 2 Ball-type shut-off faucets
- Dirt collector
- Main distributor for supply and return lines for: ....off control zones in DN15 with:
  - Zone valve with thermal actuating drive,
  - Main line regulating valve and ball-type shut-off faucets
  each
- ......off Venting valve
- ......off Filling and draining faucet

mounted on galvanised steel frame completed with control panel

................off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price................

2.1.21a Internal piping
between the cooling mat zones and storey stations made from PP-pipes according to DIN 8077, including non-corroding connecting and moulded parts.
Connections through butt or sleeve welding.
Installation according to manufacturer's guidelines
Including fastening material

Dimensions:	PP-pipe DA 20 x 2 mm
Brand:	BEKA / R.R.5000.20
Offered brand/type:	....

............m Unit price................ Total price................

2.1.30 Wall and facade connection
Sliding version with parting strip as supplement to the specified cooling ceiling system including the trimming of parting strips after plastering.

............m Unit price................ Total price................

2.1.40 Blank spaces in the cooling ceiling system
For electric lines, to connect lowered lighting gears and their fasteners, ceiling installations or speakers, etc. As supplement to the specified cooling ceiling system.

............m Unit price............... Total price................

2.1.50 Humidity sensor as dew-point pick-up
which registers the condensation of humidity and transfers this information to the room temperature controller or converter.
Accommodated in a plastic housing with sniffing pipe to be embedded into the ceiling plaster.
Installation according to manufacturer's specification, including trimming the sniffing pipe flush with the ceiling after plastering and painting work has been finished.

Size:	43 x 12 x 10 mm
Conducting plate:	Gold plated
Connecting cable:	2-phases, length: 10 metre
	.................off
Brand:	BEKA /M.TP.1
Offered brand/type:	....

Unit price................ Total price................

1.1.60.1 Room temperature controller for 2- and 3-wire systems with set-point regulation and dew-point protection.
The plastic housing of the room temperature controller is suitable for surface mounting.
The room temperature can be individually set with an adjuster. A LED-display shows separately the working condition "heating/cooling" and the "dew-point protection".
he controller has been pre-set by the manufacturer for: 2-wire system (central switch-over heating/cooling") and can be changed over to the 3-wire system (sequence: Heating/cooling) by means of 2 DIP-switches.
Installation according to manufacturer guidelines including electrical connection of controller and humidity sensors.

Dimensions:	74 x 74 x 36 mm
Colour :	White
Voltage:	24 Volt AC ± 10%, 50 - 60 Hz
Power input:	30 mAmps
Adjusting range:	5 - 30 °C
Switch hysteresis:	1 K
Temperature sensor:	Internal NTC
Switch output:	TRIAC, 24 V AC/ 1 amp, short-term to 2.5 amps

................off

Brand:	BEKA /M.R2/3
Offered brand/type:	....

Unit price........... Total price................

Alternative
to 2.1.60 Converter

to convert signals from the humidity sensor into a potential-free switch contact, accommodated in a closed housing, prepared for installation with snap-fastener to DIN top hat rail, including fasteners for the control panel (control panel supplied by contractors) and electrical connection of the converter and humidity sensors.

Size:	75 x 45 x 47 mm
Voltage:	24 Volt AC
Switch-over contact load:	230 Volt, 8 Amp.
Power intake:	max. 1 Volt Amp
Allowable ambient temperature:	5°C - 40°C

.......off

Brand:	BEKA / M.K.1
Offered brand/type:	....

Unit price............. Total price................

Specification of BEKA-Standard Ceilings

3 Metal Acoustic Ceiling with BEKA Heating and Cooling Mats

3.1 Cooling ceiling

3.1.10 Cooling ceiling system, version: Suspended metal cassettes. Closed cooling radiation ceiling for the transmission of sensible heat loads, appr. 60% by radiation and appr. 40% by convection, which consists of:
Plastic tube mats, self-venting, suitable to be glued or laid into metal cassettes.
Modular design, made of parallel arranged capillary tubes, positioned by spacer braces, supply and return lines leading into collector pipes. Completely made from polypropylene (PP), random copolymer, type 3, DIN 8078. The collector pipes are arranged one-sided along the longitudinal side of the mats. One side is closed by an end cap, at the inner end there is a plug-type outlet under a 60° angle to the surface of the mat. The mats will be connected to the supply lines by means of flexible hoses and plug-type couplings.

Brand: BEKA / K.U10 or K.UM10 or K.G10
Offered brand/type: ....

Supply line for supply and return flows made of polypropylene (PP), random copolymer, type 3, DIN 8078 with connectors, for connection of heating and cooling mats by flexible hoses and plug-type connections from the water-feeding end. The supply line is connected to the tubing system by thermal welding, therefore, one end is prepared with a weld sleeve, whilst the other end features a pipe 20 x 2 mm.

Brand: BEKA / Z.EM. or equivalent
Offered brand/type: ....

Flexible EPDM-connecting hose, shielded with a stainless steel fabric for the connection of the heating and cooling mats to the supply lines by means of plug-type couplings.
The crimp sleeves made from nickel-plated brass on both ends of the hoses are sealed by O-rings. They are secured against pull-out by a self-locking retaining mechanism.

Brand: BEKA / A.S.
Offered brand/type: ....

Suspended acoustically effective ceiling panelling made of metal cassettes such as long-panel coffers or similar, perforated version with 20% of the section area free of perforation, with 2.8 mm perforation diameter and all-round, appr. 6 to 8 mm wide perforation-free border, including 20 mm thick acoustic insert made of mineral wool, one-sided with black trickling fleece; insert according to DIN 4102, non-flammable. Each panel swivel-mount (downwards), with hidden supporting structure.
Brand: DIPLING or equivalent
Offered brand/type: ....

Possible item: SBS-rubber base adhesive mixed with solvent to affix the capillary tube mats, ready-made to be sprayed onto the capillary tube mats.

Brand: BEKA / V.K.1
Offered brand/type: ....

Cooling ceiling system with the following technical specifications:

Transmission of cooling capacity for 1m² of office space:	max. .... W/m²
Special cooling capacity, active:	80 W/m²
Coverage:	appr. 75%
Room temp. (operative temp.):	27°C
Cold water supply temperature:	16°C
Cold water return temperature:	18°C
Mat width:	..........mm
Mat length:	..........mm
Height to the ceiling base:	..........metre above raw floor

Complete cooling ceiling system, including internal piping of the mat zone up to the connecting points for supply and return lines, including all fastening and moulded parts. Including installation of suspended ceilings, which consists of supporting structure fixed to the raw ceiling, for example, by vernier suspension bars using approved fasteners and connection of the metal cassettes according to manufacturer's installation instruction. Also provision of installation scaffolding including the required sectional pressure tests and pressure retention over the total time of installation until start of operation.
(Note: Specified quantities refer to the surface of the room ceiling,
but not the effective mat area.)

............m² Unit price................ Total price................

3.1.20 Connecting points of the mat zones
for supply and return lines according to DN15 consisting of:
- Zone valve with thermal actuating drive
- Main line regulating valve, measuring range: 4-8-l/min
- Ball-type shut-off faucet, each
- Two sided connecting adapters to PP–pipe
each

................off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price................

Alternative
to 3.1.20 Storey station
High-grade plastic version, using non-corrosive components only consisting of:
- Stainless steel-plate heat exchanger with thermal insulation and flexible connecting hoses
- Pressure-regulated circulation pump with: .... m³/h of delivery capacity
  Water column delivery height .... m
- Expansion tank including safety sub-assembly
- ....off Pressure gauge
- ....off Thermometer 0-60°C, class 1
- 2 ball-type shut-off faucets
- Dirt collector
- Main distributor for supply and return lines for: ....off control zones in DN15 covering:
  - Zone valve with thermal actuating drive,
  - Main line regulating valve
  - Ball-type shut-off faucets
- ......off Venting valve
- ......off Filling and draining faucet

each, all mounted on galvanised steel frame completed with control panel

................off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price................

3.1.21a Internal piping
between the cooling mat zones and storey stations, made of PP-pipes according to DIN 8077, including non-corroding connecting and moulded parts.
Connections made through butt or sleeve welding.
Installation according to manufacturer's guidelines,
including fastening material.

Size:	PP-pipe DA 20 x 2 mm	
Brand:	BEKA / R.R.5000.20	
Offered brand/type:	....	
............m	Unit price................	Total price................

3.1.30 Wall- and facade connection
Sliding version with parting strips as supplement to the specified cooling ceiling system, including the trimming of parting strips after plastering.

............m	Unit price................	Total price................

3.1.40 Blank spaces in the cooling ceiling system
For electric lines, to connect lowered lighting gears and their fasteners, ceiling installations or speakers, etc. As supplement to the specified cooling ceiling system.

............m	Unit price..............	Total price................

3.1.50 Humidity sensor as dew-point pick-up
which registers the condensation of humidity and transfers this information to the room temperature controller or converter.
Accommodated in a plastic housing with sniffing pipe to be embedded into the ceiling plaster.
Installation according to manufacturer's specification, including trimming the sniffing pipe flush with the ceiling after plastering and painting work has been finished.

Size:	12,35 x 7,25 x 10 mm	
Conducting plate:	Gold plated	
Connecting cable:	2-phases, length: 10 metre	
	.................off	
Brand:	BEKA /M.TP.1	
Offered brand/type:	....	
	Unit price................	Total price................

3.1.60.1.1 Room temperature controller for 2- and 3-wire systems with set-point regulation and dew-point protection.
The plastic housing of the room temperature controller is suitable for surface mounting.
he room temperature can be individually set with an adjuster. A LED-display separately shows the working condition “heating/cooling” and the “dew-point protection”.
he controller has been pre-set by the manufacturer to the 2-wire system (central switch-over “heating/cooling”) and can be changed over to the 3-wire system (sequence: Heating/cooling) by means of 2 DIP-switches.
Installation according manufacturer's guidelines, including electrical connection of the controller and humidity sensors.

Dimensions:	74 x 74 x 36 mm
Colour :	White
Voltage:	24 Volt AC ± 10%, 50 - 60 Hz
Power input:	30 mAmps
Adjusting range:	5 - 30 °C
Switch hysteresis:	1 K
Temperature sensor:	Internal NTC
Switch output:	TRIAC, 24 V AC/ 1 amp, short-term to 2.5 amps

	................off	
Brand:	BEKA /M.R2/3	
Offered brand/type:	....	
	Unit price............	Total price................

Alternative
to 3.1.60 Converter

to convert signals from the humidity sensor into a potential-free switch contact, accommodated in a closed housing, prepared for installation with snap-fasteners to DIN top hat rail, including fasteners for the control panel (control panel supplied by contractors) and the electrical connection of the converter and humidity sensors.

Dimensions:	75 x 45 x 47 mm	
Voltage:	24 Volt AC	
Switch-over contact load:	230 Volt, 8 Amp.	
Power intake:	max. 1 VoltAmp	
Allowable ambient temperature:	5°C - 40°C	
	.......off	
Brand:	BEKA / M.K.1	
Offered brand/type:	....	
	Unit price.............	Total price................

Specification of BEKA-Standard Ceilings

4 Installation Ceiling Using BEKA Prefabricated Units

4.1 Cooling ceiling

4.1.10 Cooling ceiling system, version: Suspended dry-build ceiling. Closed cooling radiation ceiling for the transmission of sensible heat loads, of which is appr. 60% by radiation and appr. 40% by convection, which consists of:
Pre-fabricated unit as composite panel from 12.5 mm plasterboard and 30 mm styrofoam polystyrene extruded foam with embedded plastic tube mats, self-venting, modular design, made of parallel arranged capillary tubes, supply and return lines leading into collector pipes. Completely made from polypropylene (PP), random copolymer, type 3, DIN 8078. The collector pipes are arranged one-sided along the longitudinal side of the mats.
On the outer ends there is an outlet with plug-type coupling. The connections project from the insulation sheet. The pre-fabricated unit is connected with flexible hoses and plug-type couplings.

Brand:	BEKA / B.GK12
Offered brand/type:	....

Pipeline for supply and return made of polypropylene (PP), random copolymer, type 3, DIN 8078 with connectors, for connection of heating and cooling mats by flexible hoses and plug-type connections to the water-supply end. The supply line will be connected to the tubing system by thermal welding, therefore, one end is prepared with a weld sleeve, whilst the other end features a pipe 20 x 2 mm.

Brand:	BEKA / Z.EM. or equivalent
Offered brand/type:	....

Flexible EPDM connecting hose shielded with stainless steel fabric for the connection of heating and cooling mats to the supply lines at the water-supply end by means of plug-type couplings. The crimp sleeves from nickel-plated brass on both ends of the hoses are sealed by means of O-rings after they have been put into the plug-type couplings of the mats and supply lines. Secured against pull-out by a self-locking retaining mechanism .

Brand:	BEKA / A.S.
Offered brand/type:	....

Cooling ceiling system with the following technical specifications:

Transmission of cooling load for 1m^2 of office space:	max. .... W/m^2
Special cooling capacity, active:	65 W/m^2
Coverage:	appr. 75%
Room temp. (operative temp.):	27°C
Cold water supply temperature:	16°C
Cold water return temperature:	18°C
Mat width:	600 mm
Mat length:	2000 mm
Height to the ceiling base:	..........metre above raw floor

Complete cooling ceiling system including internal piping of the mat zones up to the connecting points for supply and return lines as well as all fastening and moulded parts. Including installation of suspended ceiling consisting of a supporting structure by C-profiles, fixed to the raw ceiling, for example, with vernier suspension bars, using approved fasteners, and connection of the pre-fabricated units according to dry-built instruction, DIN 18168 and DIN 18181. Including provision of installation scaffolding and required sectional pressure tests as well as pressure retention over the total time of installation until start of operation.

(Note: Specified quantities refer to the room ceiling area, but not the effective mat area.)

...........m^2 Unit price................ Total price................

4.1.20 Connecting points of mat zones for supply and return lines in DN15 consisting of:
- Zone valve with thermal actuating drive
- Mains regulating valve, measuring range: 4-8-l/min
- Ball-type shut-off faucet, each
- Two-sided connecting adapters to PP–pipe, each

................off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price................

Alternative
to 4.1.20 Storey station
High-grade plastic version, using non-corrosive components only consisting of:
- Stainless steel-plate heat exchanger with thermal insulation and flexible connecting hoses
- Pressure-regulated circulation pump with: .... m^3/h of delivery capacity
  Water column delivery height .... m
- Expansion tank including safety sub-assembly
- ....off Pressure gauge
- ......off Thermometer 0-60°C, class 1
- 2 Ball-type shut-off faucets
- Dirt collector
- Main distributor for supply and return lines for: ....off control zones in DN15 with:
  - 1 zone valve with thermal actuating drive,
  - Main line regulating valve
  - Ball-type shut-off faucets
    each.
- .... off Venting valve
- .... off Filling and draining faucet,

all mounted on galvanised steel frame, completed with control panel

................off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price.........

4.1.21a Internal piping
between the cooling mat zones and storey stations made of PP-pipes according to DIN 8077, including non-corroding connecting and moulded parts.
Connections through butt or sleeve welding.
Installation according to manufacturer's guidelines.
Including fastening material.
Size: PP-pipe DA 20 x 2 mm

Brand: BEKA / R.R.5000.20
Offered brand/type: ....

...........m Unit price................ Total price................

4.1.30 Wall- and facade connection
Sliding version with parting strips as supplement to the specified cooling ceiling system, including the trimming of parting strips after plastering.

............m Unit price................ Total price................

4.1.40.1.1 Blank spaces in the cooling ceiling system
for electric lines, to connect lowered lighting gears and their fasteners, ceiling installations or speakers, etc. As supplement to the specified cooling ceiling system.

............m Unit price............... Total price................

4.1.50 Humidity sensor as dew-point pick-up
which registers the condensation of humidity and transfers this information to the room temperature controller or converter.
Accommodated in a plastic housing with sniffing pipe to be embedded into the ceiling plaster.
Installation according to manufacturer's specification, including the trimming of the sniffing pipe flush with the ceiling after plastering and painting work has been finished.

Dimensions:	43 x 12 x 10 mm
Conducting plate:	Gold plated
Connecting cable:	2-phases, length: 10 metre
	..................off
Brand:	BEKA /M.TP.1
Offered brand/type:	....

Unit price................ Total price................

4.1.60.1 Room temperature controller for 2- and 3-wire systems with set-point regulation and dew-point protection.
The plastic housing of the room temperature controller is suitable for surface mounting.
The room temperature can be individually set with an adjuster. A LED-display separately shows the working condition “heating/cooling” and the “dew-point protection”.
The controller has been pre-set by the manufacturer to the 2-wire system (central switch-over “heating/cooling”) and can be changed over to the 3-wire system (sequence: Heating/cooling) by means of 2 DIP-switches.
Installation according to manufacturer's guidelines including electrical connection of the control unit and humidity sensors.

Dimensions:	74 x 74 x 36 mm
Colour :	White
Voltage:	24 Volt AC ± 10%, 50 - 60 Hz
Power input:	30 mAmps
Adjusting range:	5 - 30 °C
Switch hysteresis:	1 K
Temperature sensor:	Internal NTC
Switch output:	TRIAC, 24 V AC/ 1 amp, short-term to 2,5 amps
	................off
Brand:	BEKA /M.R2/3
Offered brand/type:	....

Unit price............ Total price................

Alternative
to 4.1.60 Converter

to convert signals from the humidity sensor into a potential-free switch contact, accommodated in a closed housing, prepared for installation with snap-fastener to DIN top hat rail, including fasteners for the control panel (control panel supplied by contractors) and the electrical connection of the converter and humidity sensors.

Dimensions:	75 x 45 x 47 mm
Voltage:	24 Volt AC
Switch-over contact load:	230 Volt, 8 Amp.
Power intake:	max. 1 VoltAmp
Allowable ambient temperature:	5°C - 40°C
	.......off
Brand:	BEKA / M.K.1
Offered brand/type:	....

Unit price............. Total price................

Specification of BEKA-Standard Ceilings

5. Dry-built Ceiling with Attached BEKA Heating and Cooling Mats

5.1 Cooling ceiling

5.1.10 Cooling ceiling system, version: Suspended plaster-board ceiling. Closed-circuit cooling radiation ceiling for the transmission of sensible heat loads, approximately 60% by radiation and approximately 40% by convection, which consists of:
Plastic tube mats, self-venting, suitable to be glued or laid into metal cassettes.
Modular design, made of capillary tubes arranged in parallel, positioned by spacer braces, supply and return lines leading into collector pipes. Made entirely from polypropylene (PP), random co-polymer, type 3, DIN 8078.
The collector pipes are arranged one-sided in parallel to the longitudinal side of the mat. They are open on both the ends to be connected through thermal welding (butt or sleeve welding) to the water-carrying pipes made of polypropylene and joined to room-control groups. The mats are pre-fabricated in length and width to the required dimensions.

Brand:	BEKA / K.GK10
Offered brand/type:	....

Supporting structure by CD-60 profiles for both basic and carrying profiles, fixed to the raw ceiling by nonius hangers and approved fasteners. The heating and cooling mats are stretched between the rails of the carrying structure and covered with mineral wool cut to size and welded in PE-foils according to the manufacturer's guidelines.
Alternatively it is recommended to hang the capillary tube mats with BEKA cliphooks (V.KGK.CLIP) in the carrying profiles in order to ensure that the mat is placed flat on the plaster board which is screwed up later.

Mineral wool	WLG40 – 40 mm

Plaster boards/ thermal boards, non-perforated, even, single layer

Thermal conductivity:	0.40 W/mK
Thickness of the plaster board:	10 mm

Brand:	KNAUF or equivalent
Offered brand/type:	....

Cooling ceiling system with the following technical specifications:

Cooling capacity to be dissipated for 1m² of office space:	max. 50 W/m²
Specific cooling capacity, active:	70 W/m²
Coverage ratio:	approximately 70%
Room temp. (operative temp.):	26°C
Cold water supply temperature:	15°C
Cold water return temperature:	17°C
Mat width:	200…400 mm
Mat length:	2000…4500.mm
Height to the ceiling base:	..........metre above raw floor

Complete cooling ceiling system, including internal piping of the mat zone up to the connecting points for supply and return lines, including all fastening and moulded parts. Including installation of suspended ceilings, which consists of supporting structure fixed to the raw ceiling, for example, by nonius hangers using approved fasteners and connection of the metal cassettes according to manufacturer's installation instruction. Also provision of installation scaffolding including the required sectional pressure tests and pressure retention over the total time of installation until start of operation.
(Note: Specified quantities refer to the surface of the room ceiling, but not the effective mat area.)

...........m^2 Unit price................ Total price................

5.1.20 Storey station
High-grade plastic design using non-corrosive components only, which consists of:
- Stainless steel-plate heat-exchanger with thermal insulation and flexible connecting hoses
  …….. kW
  Water temperature, primary side 6°/12°C
  Water temperature, secondary side 16°/18°C
- Pressure-controlled circulation pump with:
  Delivery capacity ....m^3/h
  Water column, delivery height ....m
- Expansion tank including safety unit
- .... off Pressure gauge
- .... off Thermometer 0-60°C, class 1
- 2 Ball-type shut-off faucets
- Dirt collector
- Main distributor for supply and return lines covering .... off of control zones with DN15, each equipped with:
- Zone valve including thermal actuator
- Main line regulating valve
- Ball-type shut-off valves
- ...... off Bleeding valve
- ...... off Filling and drainage faucet,
- mounted on galvanised steel frame, complete with control box

................off

Brand: BEKA
Offered brand/type: ....

Unit price................ Total price................

Alternative
to 5.1.20 Transfer and distributing station
High-grade plastic design using non-corrosive components only, which consists of:
- Stainless steel-plate heat-exchanger with thermal insulation and flexible connecting hoses
  ……..kW
  Water temperature, primary side 6°/12°C
  Water temperature, secondary side 16°/18°C
- Pressure-controlled circulation pump with:
  Delivery capacity ....m^3/h
  Water column, delivery height ....m
- Expansion tank of 18 litres capacity including safety unit
- .... off Pressure gauge
- .... off Thermometer 0-60°C, class 1
- 2 Ball-type shut-off faucets
- Dirt collector
- Main distributor for supply and return lines as legs .... off for sections with DN…, each equipped with:

- Zone valve including thermal actuator
- Main line regulating valve
- Ball-type shut-off valves

...... off Bleeding valve
...... off Filling and drainage faucet,

................off

Brand	BEKA
Offered brand/type:	....

Unit price................ Total price................

5.1.21 Connecting points of mat zones
for supply and return lines with DN15, which consist of:
- Zone valve with thermal actuator
- Leg regulating valve, measuring range: 4-8 litre/min.
- Ball-type shut-off faucet, each
- Two-sided adapters to PP–pipe each.

................off

Brand:	BEKA
Offered brand/type:	....

Unit price................ Total price................

5.1.22 Internal piping
Between the cooling mat zone and storey stations, PP–pipes according to DIN 8077 including all non-corrosive connecting and moulded parts, joined by butt and sleeve welding, installed according to manufacturer's guidelines, including fastening material.

Size:	PP-pipe OD 20 x 2 mm
Brand:	BEKA / R.R.4000.20
Offered brand/type:	....

............m Unit price................ Total price................

Alternative
to 5.1.22 Connecting piping
Between the connecting points of the cooling mat zones and leg piping made of PP–pipes according to DIN 8077, type 3 including all non-corrosive connecting and moulded parts, joined by butt and sleeve welding, installed according to manufacturer's guidelines, including fastening material.

Size:	PP-pipe OD 20 x 2 mm
Brand:	BEKA / R.R.4000.20
Offered brand/type:	....

............m Unit price................ Total price................

Leg piping
Between the connecting piping of the cooling mat zones made of PP–pipes according to DIN 8077, type 3 and transfer station including all non-corrosive connecting and moulded parts, joined by butt and sleeve welding, installed according to manufacturer's guidelines, including fastening material.

Size:	PP-pipe	OD 25 x 2.3 mm
		OD 32 x 3.0 mm
		OD 40 x 3.7 mm
		OD 50 x 4.6 mm
		OD 63 x 5.8 mm

OD 75 x 6.9 mm
OD 90 x 8.2 mm

Brand:	BEKA
Offered brand/type:	....

............m Unit price................ Total price................

5.1.30 Wall and facade connection
in sliding version with parting strip as supplement to the specified cooling ceiling system including the cutting-off of the parting strips after plastering.

............m Unit price................ Total price................

5.1.40 Cutouts in the cooling ceiling system
left for electrical cables to suspending lighting gears and their holders, components to be built in such as aerating fan or loudspeakers, etc. as supplement to the specified cooling ceiling system.

............m Unit price................ Total price................

5.1.50 Humidity sensor as dew-point pick-up
which detects and registers the condensation of humidity and transmits this information to the room temperature controller or converter, attached to the supply-line connecting piping for each zone and installed according to manufacturer's guidelines.

Size:	50 x 22 x 10 mm
Circuit board:	Gold-plated
Connecting cable:	2-phases, length: 10 metre

……..............off

Brand:	BEKA /M.TP.1
Offered brand/type:	……................................

Unit price…............. Total price…..............

5.1.60 Room temperature controller for heating and cooling in 2- and 3-wire system with remote set-point regulation and dew-point protection.
The plastic housing of the room temperature controller is suitable for on-wall mounting.
The room temperature can be individually set by an adjuster.
A LED-display shows separately the working condition "Heating/cooling" and the "dew-point protection".
The controller has been pre-set by the manufacturer to:
2-wire system (central switch-over "Heating/cooling"), which can be changed over to the 3-wire system (sequence switch-over "heating/cooling")
by means of 2 DIP-switches.
Installation according to the manufacturer's guidelines, including electrical connection of the controller and humidity sensors to be installed.

Size:	74 x 74 x 36 mm
Colour:	White
Voltage:	24 Volt AC ± 10%, 50 - 60 Hz
Power input:	30 mA
Adjusting range:	5 - 30 °C
Switch hysteresis:	1 K
Temperature sensor:	Internal NTC
Switch output:	TRIAC, 24 V AC/ 1 A, short-time to 2.5 A

................off

Brand:	BEKA /M.R2/3
Offered brand/type:	....

Unit price............. Total price................

Alternative
to 5.1.60 Signal converter

converting signals from the humidity sensor into a neutral switching contact, accommodated in closed housing, prepared for installation with snap-fastener to DIN top hat rail including fasteners. Installation in a switch cabinet made available at the construction site and electrical connection of the converter to the 24 V supply and humidity sensor to be installed are to be carried out by control technicians.

Dimensions:	80 x 50 x 61 mm	
Voltage:	24 Volt AC	
Change-over contact load:	230 Volt, 8 A	
Power intake:	max. 1 VA	
Allowable ambient temperature:	5°C - 40°C	
	................off	
Brand:	BEKA / M.K.2	
Offered brand/type:	....	
	Unit price.............	Total price................

5.1.70 Hydraulic adjustment

of the individual zones according to the specified setpoints and documentation of the adjusted water volumes

…………………	Unit price………….	Total price…………….

5.1.80 Marking

Of the leg piping for supply and return lines by attaching wear-resistant labels indicating both the leg and flow direction

…………………	Unit price.............	Total price................

5.1.90 Documentation for later revision

As spare parts lists, operating and maintenance manuals of all functional components of the cooling ceiling, including documentation of the arrangement of the cooling mats and setting values.

Four copies	Unit price.............	Total price................

Specification of BEKA-Components

BEKA Heating and Cooling Mats, Pressure Stage PN20

.... of

BEKA Heating and cooling mat
Type P.FS20..........00

As version for the installation as floor heating in thin-layer technique, suitable for application under rough construction conditions, in moulded form, made from capillaries arranged in parallel, which lead into one collector pipe each for supply and return. They are fixed by foil spacing braces. The collector pipes are laid one-sided in parallel to the longitudinal side of the mat. They are equipped at both the ends with adapters to receive crimp or plug-in connectors. The mats are linked to the water-carrying pipes made from non-corrosive material by commercial connectors. The mats are equipped on the foil spacing braces with adhesive strips for easy fixing on the primed raw floor.

Material	Polypropylene (PP), random copolymerisate, Type 3, DIN 8078	
Colour	Blue	
Pressure stage	PN 20	
Capillary tube diameter	4.5 x 0.8 mm	
Capillary tube spacing	20 mm	
Main pipe diameter	20 x 3.4 mm	
Length	.... mm	
Width	.... mm	
Material costs	Unit price.........	Total prce.........

.... of

BEKA Heating and cooling mat
Type P.VS20..........00

As version for high-pressure installations working up to 20 bar and in the high-temperature field up to 60°C, suitable for application under rough construction conditions, to be laid as floor heating in thin-mortar bed technique or as wall heating in mineral plaster, in moulded form, made from capillaries arranged in parallel, which lead into one collector pipe each for supply and return. They are fixed by foil spacing braces. The collector pipes are laid one-sided in parallel to the longitudinal side of the mat. They are open at both the ends and are connected to the water-carrying pipes made from polypropylene by thermal butt or sleeve welding.

Material	Polypropylene (PP), random copolymerisate, Type 3, DIN 8078	
Colour	Blue	
Pressure stage	PN 20	
Capillary tube diameter	4.5 x 0.8 mm	
Capillary tube spacing	20 mm	
Main pipe diameter	20 x 3.4 mm	
Length	.... mm	
Width	.... mm	
Material costs	Unit price.........	Total price.........

.... off

BEKA Heating and cooling mat
Type P.VS30 00

As version for high-pressure installations working up to 20 bar and in the high-temperature field up to 60°C, suitable for application under rough construction conditions, to be laid as floor heating in thin-mortar bed technique or as wall heating in mineral plaster, in moulded form, made from capillaries arranged in parallel, which lead into one collector pipe each for supply and return. They are fixed by foil spacing braces. The collector pipes are laid one-sided in parallel to the longitudinal side of the mat. They are open at both the ends and connected to the water-carrying pipes made from polypropylene by thermal butt or sleeve welding.

Material	Polypropylene (PP), random copolymerisate, Type 3, DIN 8078	
Colour	Blue	
Pressure stage	PN 20	
Capillary tube diameter	4.5 x 0.8 mm	
Capillary tube spacing	30 mm	
Main pipe diameter	20 x 3.4 mm	
Length	.... mm	
Width	.... mm	
Material costs	Unit price.........	Total price.........

.... off

BEKA Heating and cooling mat
Type P.VG10 00

As version for high-pressure installations working up to 20 bar and in the high-temperature field up to 60°C, suitable for application under rough construction conditions, to be laid openly as heat exchanging area in the room or as ground collector or as wall heating in mineral plaster, in moulded form, made from capillaries arranged in parallel, which lead into one collector pipe each for supply and return. They are fixed by foil spacing braces. The collector pipes are laid two-sided in parallel to the longitudinal side of the mat. They are open at both the ends and connected to the water-carrying pipes made from polypropylene by thermal butt or sleeve welding.

Material	Polypropylene (PP), random copolymerisate, Type 3, DIN 8078	
Colour	Blue	
Pressure stage	PN 20	
Capillary tube diameter	4.5 x 0.8 mm	
Capillary tube spacing	10 mm	
Main pipe diameter	20 x 3.4 mm	
Length	.... mm	
Width	.... mm	
Material costs	Unit price.........	Total price.........

.... off

BEKA Heating and cooling mat
Type P.VG20 00

As version for high-pressure installations working up to 20 bar and in the high-temperature field up to 60°C, suitable for application under rough construction conditions, to be laid openly as heat exchanging area in the room or as ground collector, in moulded form, made from capillaries arranged in parallel, which lead into one collector pipe each for supply and return. They are fixed by foil spacing braces. The collector pipes are laid two-sided in parallel to the longitudinal side of the mat. They are open at both the ends and connected to the water-carrying pipes made from polypropylene by thermal butt or sleeve welding.

Material	Polypropylene (PP), random copolymerisate, Type 3, DIN 8078	
Colour	Blue	
Pressure stage	PN 20	
Capillary tube diameter	4.5 x 0.8 mm	
Capillary tube spacing	20 mm	
Main pipe diameter	20 x 3.4 mm	
Length	.... mm	
Width	.... mm	
Material costs	Unit price.........	Total price.........

.... off

BEKA Heating and cooling mat
Type P.VG30 00

As version for high-pressure installations working up to 20 bar and in the high-temperature field up to 60°C, suitable for application under rough construction conditions, to be laid as component temperature control close to the surface in concrete or as floor heating in concrete screed, in moulded form, made from capillaries arranged in parallel, which lead into one collector pipe each for supply and return. They are fixed by foil spacing braces. The collector pipes are laid two-sided in parallel to the longitudinal side of the mat. They are open at both the ends and connected to the water-carrying pipes made from polypropylene by thermal butt or sleeve welding.

Material	Polypropylene (PP), random copolymerisate, Type 3, DIN 8078	
Colour	Blue	
Pressure stage	PN 20	
Capillary tube diameter	4.5 x 0.8 mm	
Capillary tube spacing	30 mm	
Main pipe diameter	20 x 3.4 mm	
Length	.... mm	
Width	.... mm	
Material costs	Unit price.........	Total price.........

.... off

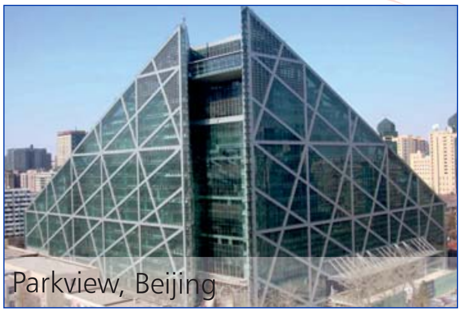
BE BEKA Heating and cooling mat KA Heiz- und Kühlmatte
Type P.NS15 00

As version for both ends and in the high-temperature field up to 60°C, suitable for application under rough construction conditions, to be laid as floor heating in thin-mortar screed beds or as cooling ceiling or wall heating in mineral plaster, in moulded form, made from capillaries arranged in parallel, which lead into one collector pipe each for supply and return. They are fixed by foil spacing braces. The collector pipes are laid one-sided in parallel to the longitudinal side of the mat. They are open at both the ends and connected to the water-carrying pipes made from polypropylene by thermal butt or sleeve welding.

Material	Polypropylene (PP), random copolymerisate, Type 3, DIN 8078	
Colour	Blue	
Pressure stage	PN 20	
Capillary tube diameter	4.5 x 0.8 mm	
Capillary tube spacing	15 mm	
Main pipe diameter	20 x 3.4 mm	
Length	……….. mm	
Width	……….. mm	
Material costs	Unit price………	Total price………

Ref *Some references from BEKA*

Federal Ministry of the Interior, Berlin



Parkview, Beijing

German Heart Institute, Berlin

Twin Tower, Vienna

Porsche, Lithuania

Olympic Village, Vancouver

IGN / Météo France, Saint-Mandé

Survey of References

Germany

Office & Business building Three George	Düsseldorf	2016
Ed. Züblin AG Headquarters	Stuttgart	2016
Auswärtiges Amt	Berlin	2015
Klinikum Chemnitz	Chemnitz	2015
HumboldtHafenEins	Berlin	2014
Ministries of Social Affairs and of Environment	Potsdam	2014
ThyssenKrupp, Q6, Q8, Q10	Essen	2013
Fasanenstraße	Berlin	2013
Phönix Logistikzentrum	Heddesheim	2012
Ategris	Mühlheim an der Ruhr	2012
IG Metall Educational Centre	Sprockhövel	2011
DTB Gymakademie	Frankfurt / Main	2011
Abgeordnetenhaus (House of Representatives)	Berlin	2010
Klinikum Brandenburg (municipal hospital)	Brandenburg an der Havel	2010
Überseequartier	Hamburg	2010
Westfalentower	Dortmund	2009
Sky Office	Düsseldorf	2009
Federal Environment Ministry	Berlin	2009
Q-Cells	Thalheim	2008
Jacobs, Technology Park	Cologne	2008
Red Square	Neu Isenburg	2007
Stadtsparkasse	Oberhausen	2007
Korean Embassy	Berlin	2006
Chinese Cultural Center	Berlin	2006
Hasso Plattner Institute	Potsdam	2006
Opern Carrée	Berlin	2006
Dekra Real Estate	Frankfurt / Main	2005
Oberbaumcity	Berlin	2005
C & A	Düsseldorf	2005
Canadian Embassy	Berlin	2004
Verdi	Berlin	2004
Tectum 10	Frankfurt / Main	2003
Office MK 3	Munich	2002
Forum Köln	Cologne	2001
Spreepalais	Berlin	2001
DG Bank	Munich	2000
Victoria Insurance	Frankfurt / Main	1999
Treptowers, Allianz Headquarters	Berlin	1997
Samsung Headquarter of Germany	Schwalbach	1996

France

Hopital Marchant	Toulouse	2015
MAPA	Staint-Jean-D´Angely	2014
Hôpital Jossigny	Lagny	2012
IGN / Météo France	Saint Mandé	2011
Green Office Bouygues	Meudon	2010
SAS Le Vaisseau	Paris	2009
Chateau Montrose	Médoc	2008
Hopital Lenval	Nice	2007
CNIT	Paris	2007
OPAC	Paris	2007
CHS	Sevrey	2006
Polyclinique de Blois	Notre Dame D´Oe	2005
Maison de Région	Alsace	2004
ETS Jaffre Briant	Trégunc	2003
CCI	Annecy	2002
Villas	Côte D'Azur	2001
Immeuble le Peletier	Paris	2000
Les Toleries de la Deule	Quesnoy sur Deule	1999
France Télévision	Paris	1997

Netherlands / Belgium / Luxembourg

Kramp	Varsseveld, NL	2016
Stadsschouwburg	Utrecht, NL	2015
Rabobank Spoorlaan	Tilburg, NL	2014
Rabobank Land van Cuijk & Maasduinen	Boxmeer, NL	2013
Rabobank Financial advice center	Apeldoorn, NL	2010
Aegon	The Hague, NL	2009
Achmea	Leeuwarden, NL	2009
ABP Headquarters	Heerlen, NL	2008
De Mandemakers Groep (DMG)	Waalwijk, NL	2008
Eureko Headquarters	Zeist, NL	2008
Politie/Brandweer	Apeldoorn, NL	2007
P22 Schiphol	Amsterdam, NL	2007
Shell Siep	Rijswijk, NL	2006
Office R.-Cube	Luxembourg, L	2006
NS Stationslocatie	Maastricht, NL	2005
Drosbach	Luxembourg, L	2005
FMO de Groene Schenk	The Hague, NL	2002
Meetkundige Dienst	Delft, NL	2001
Oranje Nassau	Heerleen, NL	2000
British Telecom	Amsterdam, NL	1999
UCB Pharma	Brussels, B	1998

BEKA
FÜR KLIMA-KOMFORT

Ref | Survey

Austria / Switzerland

IMP Building	Vienna, A	2016
Rathaus Wien	Vienna, A	2015
BTV (Bank for Tyrol and Vorarlberg)	Innsbruck, A	2014
Wagner GmbH	Nüziders, A	2014
University of Vienna (Rossauer Lände)	Vienna, A	2013
Illwerke (Montafon Centre)	Vandans, A	2013
Gottwald	Melk, A	2012
ÖGB	Innsbruck, A	2011
ÖWG Wohnbau	Graz, A	2010
Raiffeisenbank	Lenzburg, CH	2010
Faculty Library	Innsbruck, A	2009
Technology Center	Tulln, A	2008
Volksbank	Bregenz, A	2008
Sparkasse	Linz, A	2007
Mohren Brewery	Dornbirn, A	2006
Emergency Hospital	Graz, A	2006
Senebier	Geneva, CH	2006
Conference Building	Innsbruck, A	2005
Eos	Lausanne, CH	2005
IMB Headquarter	Geneva, CH	2005
IBM Forum	Vienna, A	2004
Joop	Vienna, A	2003
Uniqua Tower	Vienna, A	2003
Generali Insurance	Geneva, CH	2003
Cartier	Geneva, CH	2002
UBS	Geneva, CH	2001
Twin Tower	Vienna, A	2000/2001
Academy of Science	Vienna, A	1999
IBM Management	Geneva	1997

Italy

Le Querce	Treviso	2016
Martinengo	Milano	2015
Pauletti	Verona	2014
Bariani	Pavia	2013
Jeweller's Shop Biscontin	Pordenone	2008
Fagioli	Parma	2007
Ecological Village	Preganziol	2006
Residence Debbiano Scandicci	Florence	2005
Hotel Adler Thermae	Bagno Vignoni	2004
Nursery	Novara	2003
Hospital	Santarcangelo di Romagna	2002
Hotel Euroterme	Bagno di Romagna	2000

BEKA
FÜR KLIMA-KOMFORT

Spain / Andorra / Portugal

Viviendas General Mitre	Barcelona, E	2016
Vivienda en Calle Genil	Madrid, E	2016
Restaurant Alcalá 44	Madrid, E	2015
Convento de Jesus	Setúbal, P	2014
Vivienda Zurbano	Madrid, E	2014
Plaza del Marqués de Salamanca	Madrid, E	2013
Gamesa	Pamplona, E	2012
Conservatorio Profesional de Música	Pamplona, E	2011
Museo das peregrinacións e de Santiago	Santiago de Compostela, E	2011
Offices Heracles	Andorra, AND	2010
Banca Privada d'Andorra, S.A.	Andorra, AND	2009
Vivenda Tudela	Tudela, E	2008
Infant School Toninaina	Inca (Mallorca), E	2008
Banco Credit Centre	Andorra, AND	2008
Hospital de la Santa Creu	Vic, E	2007
Edificio de Sanidad	Bilbao, E	2007
Dynamobel Headquarters	Navarra, E	2007
Residencia Amma	Horta, P	2006
Hotel Acosta Centro	Almendralejo, E	2006
Hospital of Vouzela	Viseu (Vouzela), P	2006
Hospital MAZ	Zaragoza, E	2005
Hotel La Joyosa Guarda	Navarra, E	2005
Casa das Mudas	Madeira, P	2004
CITIB Office	Mallorca, E	2003
Pau Queimado	Lisbon, P	2003
Alvaro Siza	Lisbon, P	2003
Hospital Vic	Barcelona, E	2002
Nordoeste 32	Algarve, P	2002
Residencia Fustinana	Navarra, E	2001
Bodega Arinzano	Navarra, E	1999

Greece

Aretousas 10-Plaka	Athen	2016
Xatzopoulos	Athen	2015
Plaka	Athen	2014
Elianto	Athens	2010
Alexopoulos	Athens	2009
EFG Eurobank	Athens	2008
E.C.C. Office	Athens	2008
Villa	Kos	2007
Museum of the Lesbos Island	Lesbos	2006
Bioclimatic Offices	Athens	2005

Poland / Czech Republic / Slovakia

PBS Bank	Janów Lubelski, PL	2016
Hotel Bajkal	Františkovy Lázne, CZ	2016
Villa Sophia	Prague, CZ	2014
Altec	Vsetin, CZ	2014
Mateo	Zywiec, PL	2014
Neografia	Marin, SK	2013
Business Center Plus	Bratislava, SK	2012
HIT	Litomerice, CZ	2010
TV Nova	Prague, CZ	2009
Castle	Tonkovce, SK	2007
Residential Building	Ceska Lipa, CZ	2007
Science Institute	Prague, CZ	2006
G-TERM Center	Plana ned Luznici, CZ	2006
Airport	Pribram, CZ	2005
Polyfunctional House	Ústi nad Labem, CZ	2004

Hungary / Montenegro / Ukraine

Bugát Pál Kórház (Hospital)	Gyöngyös, H	2014
Hotel President	Budapest, H	2009
Dialysis Centre Péterfy Sándor Hospital	Budapest, H	2009
Model apartment	Dnepropetrovsk, Ukraine	2009
Korányi Hospital	Budakeszi, H	2008
Apartments Zsombor	Budapest, H	2008
Zalabau	Zalaegerszeg, H	2007
Hunguest Hotel Sun Resort	Herceg-Novi, MNE	2006
Hotel Anna Grand	Balatonfüred, H	2006
Duna-Pest Residences	Budapest, H	2005
Anjou House	Budapest, H	2003

Scandinavia / United Kingdom / Baltic States / Russia

Office Tenko Baltic	Vilnius, Litauen	2016
Office Mashkova Str.	Moskau, Russia	2016
Klinik Medea	Utena, Litauen	2015
Bogorodskoye	Moskau, Russia	2014
SEB Bank	Vilnius, Lithuania	2013
Wildwood Road	London, UK	2010
Police station	Copenhagen, Denmark	2009
Grecinieku Street	Riga, Latvia	2009
Villa	Vilnius, Lithuania	2008
Family home	Trondheim, Norway	2006

North and South America

Apartment Elm St.	Tucson, USA	2016
Cuneo Hall	Chicago, USA	2012
Perkins + Will Atlanta Office	Atlanta, USA	2010/11
Secretaría de Seguridad Pública	Mexico	2009
Asociación Chilena de Seguridad (ACHS)	Santiago, Chile	2009
Delta Hospice	Vancouver, Canada	2009
Oberlin College	Chicago, USA	2009
Olympic Village	Vancouver, Canada	2008
Flat Iron Penthouse	Vancouver, Canada	2007
Casa Quintanilla	Mexico	2007
Illinois Institute of Technology	Chicago, USA	2007

Asia and Oceania / Africa

Yi Zhuang Jin Mao Yue 85	Beijing, China	2016
Wanke Ruyuan	Beijing, China	2016
Airport Wuhan	Wuhan, China	2016
DanGuiYuan	Nanjing, China	2015
Djenane Sfari	Draria, Algerien	2014
Jinmaofu	Beijing, China	2012-14
Ziweiyuan Park, Nanjing Olympic City	Nanjing, China	2013
Tiantai-Meijia	Qingdao, China	2013
Royal Nanjing	Nanjing, China	2011
Fushuiyifang Apartment	Tianjin, China	2010
Villa	Algier, Algeria	2010
Parkview	Beijing, China	2009
Xiangxitingyuan (Villa)	Quingdao, China	2009
Port villa	Sydney, Australia	2009
Nanjing Fengshang	Nanjing, China	2008
Office Building Zhaoshangdichan	Shenzhen, China	2008
Olympic Village	Beijing, China	2007
Chinese Restaurant	Gunsan, Korea	2006
Jingzue Building	Changchun, China	2005
Science & Technology Commitee	Beijing, China	2005

BEKA FÜR KLIMA-KOMFORT

Ref *BMI, D - Berlin*

Federal Ministry of the Interior, Berlin

Project:	Federal Ministry of the Interior
Place:	Berlin
Architect:	Müller Reimann Architekten, Berlin
Planning:	Winter Ingenieure, Berlin
Time:	2011-14
Use:	Government
Area:	20.000 m²
Type:	Plaster ceiling for heating and cooling

The heating supply of the new building is under use of geothermal energy, exhaust heat utilization and district heating. For optimal, energy efficient heat distribution all over the office ceiling heaters provide with BEKA capillary tube mats, which act in the summer as a cooling ceiling.

The newly built Ministry is in the government quarter near of the chancellery and Central Station. With the new location are aggregated of costs as safety reasons all existing Berlin sites of BMI. The energetic quality of the building is detected in a total energy concept. Since spring 2015, the modern building is place of work for up to 1,400 employees of the Federal Ministry of the Interior.

BEKA
FÜR KLIMA-KOMFORT

Porsche, Vilnius

Project:	Porsche Showroom
Place:	Vilnius, Lithuania
Architect:	DO architects, Vilnius
Time:	2015
Use:	Trade
Area:	200 m²
Type:	Heating and cooling ceiling in open construction

The heating and cooling ceiling of the Porsche showroom was planned as an open construction. In order to avoid irritation by the standard blue of the mats, BEKA produced uncolored capillary tube mats for this project. The comfort ceiling works exclusively by geothermal energy.

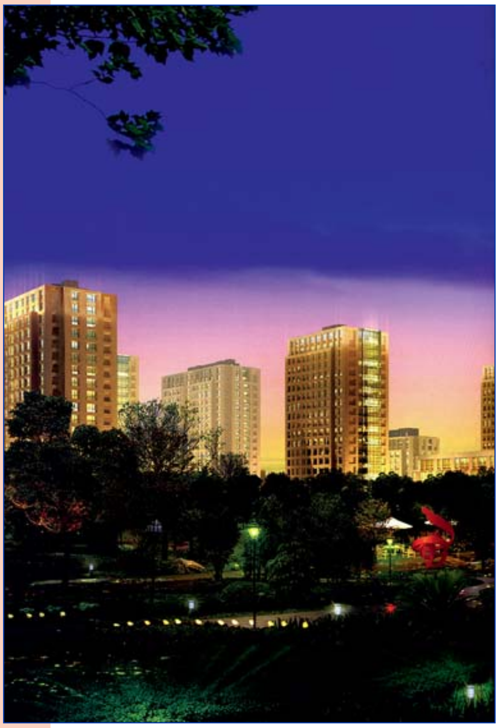
Nearly invisible: uncolored capillary tube mats unite with the open ceiling construction

Pictures: Tenko

Jin Mao Palace, Peking

Project:	Jin Mao Palace
Place:	Peking, China
Time:	2011 & 2014
Use:	Residential
Area:	230.000 m^2
Type:	Plaster ceiling
	for heating and cooling

This high-end residential area in the main business center of Beijing consists of several residential towers and spacious parks.
The investors demanded living comfort and green technology. Consequently, BEKA capillary tube mats provide ecological heating and cooling and pleasant temperatures in all apartments.



Model of the residential area

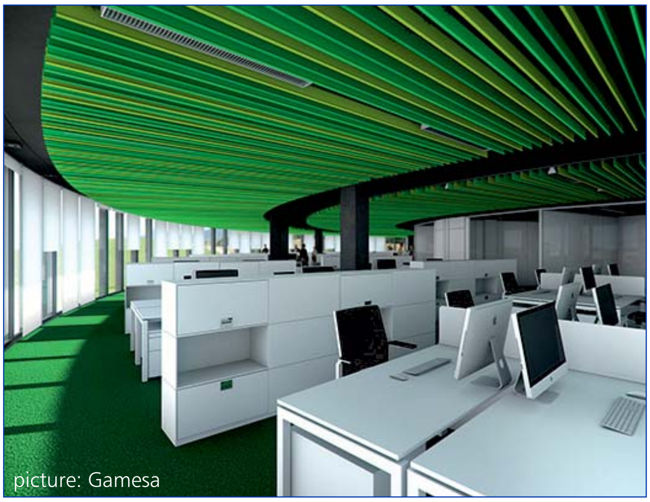
Gamesa, Pamplona

Project:	Gamesa Corporación Tecnológica
Place:	Pamplona-Sarriguren, Spanien
Architects:	Vaillo + Irigaray
Time:	März - August 2012
Use:	Bürogebäude
Area:	6.000 m² heating and cooling ceiling
Type:	Plaster ceiling

The cylindrical form of this project in Spain reduces the cladding surface by 35%, which, together with the BEKA capillary tube mats, optimizes energy efficiency.

picture: Gamesa

picture: dynamobel climatización



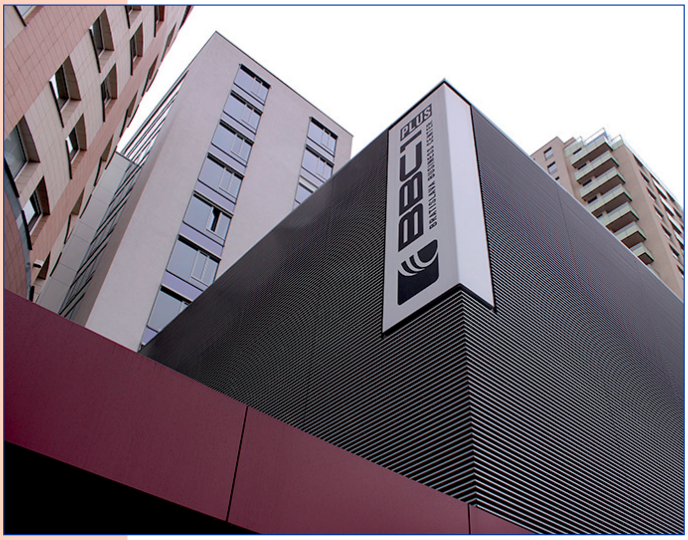
picture: Gamesa

BEKA
FÜR KLIMA-KOMFORT

Ref *Business Center Plus , SK - Bratislava*

Business Center Plus, Bratislava

Project:	Bratislava Business Center BBC 1 Plus
Place:	Bratislava, Slovakia
Architects:	Bogár, Králik & Urban
Time:	2012
Use:	Offices
Area:	10,000 m² cooling ceiling
Type:	Metal Cassette Ceiling



From the beginning, BEKA capillary tube technology was an integral part of the planning for the Business Center Plus in Bratislava, in order to reach LEED building standard Gold for this project.

At the BEKA production, the metal cassettes were fitted in hot-melt procedure with capillary tube mats. In order to ensure high efficiency, a 20 mm insulation was applied to the back of the capillary tube mats.

Ref | Solmser Schloss, D - Butzbach

Solmser Schloss, Butzbach (Castle Solms)

Project:	Solmser Schloss (Castle Solms)
Place:	Butzbach (Hessia), Germany
Architects:	P. Gronych und Y. Dollega
Planning:	GEFGA Energiesysteme
Time:	2009-2012
Use:	Cultural, Medical, Service
Area:	1,200 m²
Type:	Plaster and Plaster-bord, wall, ceiling and underfloor heating and cooling

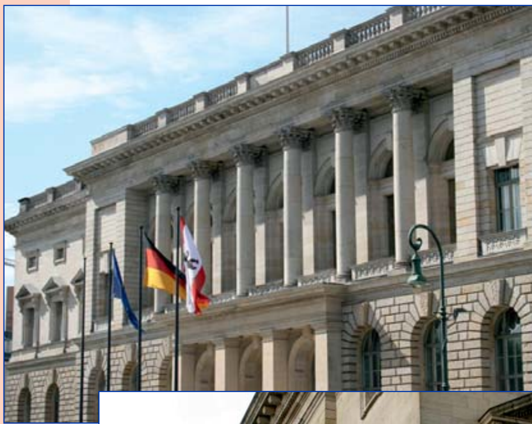
pictures: Konbau

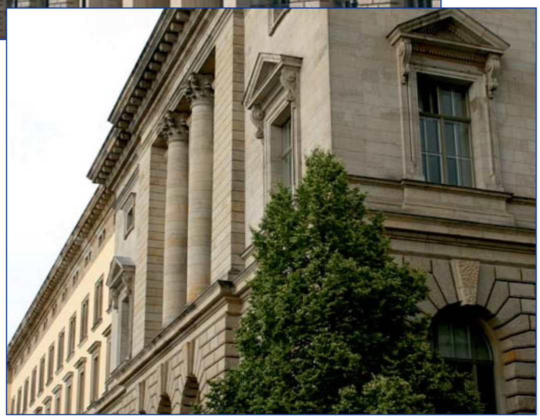
Castle Solms, a listed Renaissance building, was retrofitted in 2012. Surface heating and cooling with capillary tube mats was installed because the thin capillary tubes of the BEKA mats enable comparatively low construction heights. Thereby, the interior design with window arches could be kept in fabric and character. Today, the revitalised castle offers space amongst others for a doctor's practice and cultural use .

Abgeordnetenhaus von Berlin (House of Representatives), Berlin

Project:	Abgeordnetenhaus von Berlin (House of Representatives)
Place:	Berlin
Time:	Juli-August 2010
Use:	Parliament (offices)
Area:	2,500 m^2
Type:	Plaster ceiling, wall cooling
Function:	Cooling

In order to avoid disturbance of the parliamentary work of the State Parliament of Berlin, the installation had to be done during summer recess. In only six weeks, energy saving radiant cooling with BEKA capillary tube mats where installed in all the top floor offices.





The building was erected according to plans of Friedrich Schulze between 1892 and 1899 as Preussischer Landtag (Prussian State Assembly). The neo-Renaissance style building is situated in the city centre near Potsdamer Platz. In 1993 it became seat of the State Parliament of Berlin.

Image: Abgeordnetenhaus von Berlin

Municipal Hospital, Brandenburg

Project:	Municipal Hospital,
	2nd construction phase
Place:	Brandenburg an der Havel
Architect:	Heinle, Wischer und Partner
Time:	2010-11
Use:	Hospital
Area:	4,000 m²
Type:	Plaster ceiling

Capillary tube mats produce a healthy and agreeable room temperature in the patients' rooms. In addition, they save about 30% energy consumption in comparison to cooling by conventional air-conditioning.

Green Office, Meudon

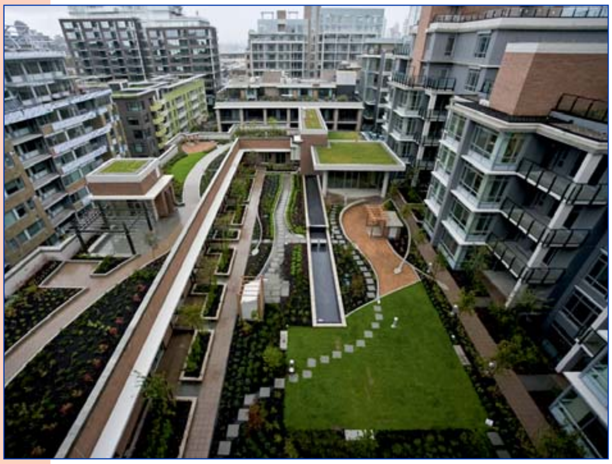
Project:	Green Office
Place:	Meudon-la-Forêt, France
Architect:	Ateliers 115 Architectes, Ion Enescu
Time:	2010
Use:	Office
Area:	4,400 m²
Type:	Metall cassette ceiling for heating and cooling

This building is the first positive energy tertiary building in France to be certified HQE and BREEAM ‚Excellent'. Per year, 64 kW/m² of energy is produced, whereas only 61 kW/m² of energy is consumed.

Picture: Ateliers 115 Architectes, Ion Enescu

Olympic Village, Vancouver

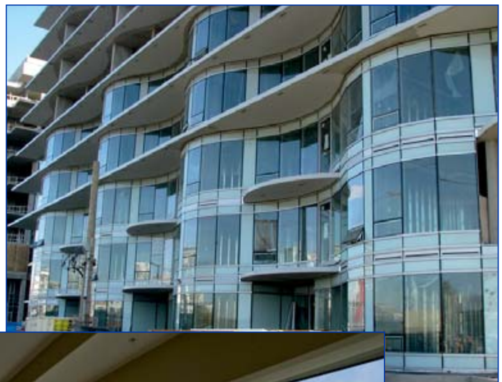
Project:	Olympic and Paralympic Village
Place:	Vancouver, (British Columbia) Canada
Architects:	Merrick Architecture, gBL Architects
Time:	2009
Use:	Residential
Area:	60,000 m² cooling & heating ceiling
Type:	Plasterboard ceiling


Aerial view of the Olympic Village

BEKA mats in large-scale projects

This large and high prestige object had to be realised in comparatively short time. A precise preparation as well as room specific production and packaging by the manufacturer BEKA made a quick and smooth installation possible.

During the Winter Olympic and Paralympic Games 2010, the buildings are used by about 2,800 athletes and officials. Afterwards, the majority of the upmarket apartments are sold, another part is rented as affordable housing. The so called Millennium Water Project is North America's first truly sustainable neighbourhood and will certify to LEED Gold standard.




Model apartment

Hospital de la Santa Creu, Vic

Project:	Hospital de la Santa Creu
Place:	Vic (Barcelona), Spain
Architect:	Jaime Ylla Vilarrubia
Time:	2002-04
Use:	Hospital, nursing home
Area:	3,000 m²
Type:	Plater-bord ceiling

The delicate state of health of the patients requires silent and draught-free air conditioning. BEKA capillary tube mats are used for cooling and heating in sickrooms, corridors and common rooms of the geriatric hospital.
In 2007, installations in further areas like the Alzheimer station followed.

BEKA
FÜR KLIMA-KOMFORT

Villa Pueblo, Colorado

Project:	Villa in Pueblo
Place:	Pueblo (Colorado), USA
Time:	2007
Use:	Private House
Area:	500 m^2
Type:	Dry-wall Construction

Large windows and hot climate make high demands on climatisation. Thus, a cooling ceiling with BEKA capillary tube mats was installed in this modern villa.
Even with outside temperatures of 40°C, the house remains pleasantly cool - without draught. Uniform temperatures and low energy costs please the house owner .

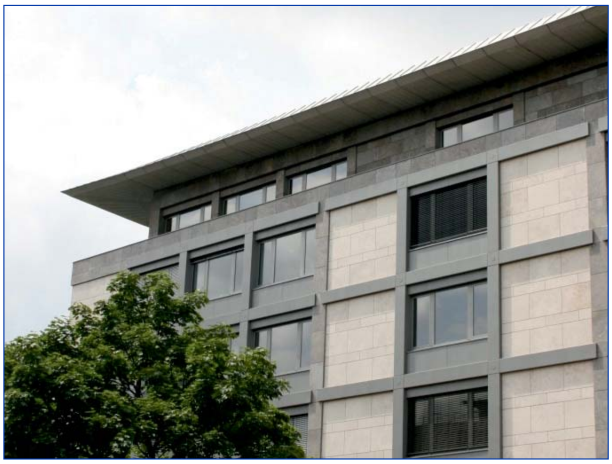
BEKA
FÜR KLIMA-KOMFORT

Korean Embassy, Berlin

Project:	Embassy of the Republic of Korea
Place:	Berlin, Germany
Architects:	Braun und Schlockermann
Time:	2006
Use:	Representation
Area:	4,500 sqm
Type:	Plaster Ceiling

The architecture firm Braun und Schlockermann designed this five-storey representative building.
A combined cooling and heating system with BEKA capillary tube mats provides pleasant temperatures around the year.

As part of the TRIUM near the Tiergarten, the Korean Embassy shows traditional Korean architectural style in a modern interpretation.



BEKA
FÜR KLIMA-KOMFORT

Treptowers, Berlin

Project:	Treptowers
Place:	Berlin, Germany
Scop:	Tower and retrofitted buildings
Time:	March - October 1997
Use:	Offices
Area:	10,500 sqm
Type:	Metal Cassette Ceiling

Special ceiling panels with BEKA capillary tube mats provide an increased cooling capacity in the fully glazed skyscraper.

Photo: Allianz Real Estate Germany GmbH

Model office of the company WINI Büromöbel (photos: WINI)

Wanke RuYuan, Peking

Project::	Wanke RuYuan
Place:	Peking, China
Time:	2016
Use:	Residential
Area:	50.000 m^2
Type:	Plaster ceiling and wall
Function:	heating and cooling

During the planning phase of the luxurious Apartment buildings the focus were not only on comfortable living, but also on efficient room temperature in summer and winter.

BEKA
FÜR KLIMA-KOMFORT

Ref *Ministry, D - Potsdam*

Ministry of Labor and Environment, Potsdam

Project:	Ministry of Labor and Environment
Place:	Potsdam
Architect:	Gössler Kinz Kerber Kreienbaum Architekten BDA GbR
Time:	2014/15
Use:	Government, Administration
Area:	10.000 m²
Type:	Plaster and drywall ceiling
Function:	Heating and Cooling

The Installation of the capillary tube mats was carried out as a standard ceiling installation which creates open space that allows a free room design.

With a public and private partnership this centrally located complex was built for two state ministries. Due to state-of-the-art building technology with capillary tube cooling ceilings, solar power system and ventilation system, the building achieves a low primary energy requirement of only 50 kWh/m² per year. The supply and return temperatures of the capillary tube mats are 31 ° / 28 ° C for heating and 18 ° / 21 ° C for cooling.

ThyssenKrupp Quartier, Essen

Project:	ThyssenKrupp Quartier, Stage 2
Place:	Essen
Architects:	Chaix & Morel et Associés, Paris and JSWD Architekten, Köln
Planner:	ECE Projektmanagement GmbH, Hamburg
Time:	2013
Use:	Office Building
Area:	12.000 m² Cooling and Heating
Type:	Plaster ceiling

The ThyssenKrupp Quartier sets standards in minimizing energy consumption and is certified by the DGNB with the gold standard award. In the second construction phase (Q6, Q8 and Q10) workstations was created for around 1,000 employees.


Foto: Zent-Frenger


Foto: JSWD Architekten / Chaix et Morel

Mat type K.GG10.11

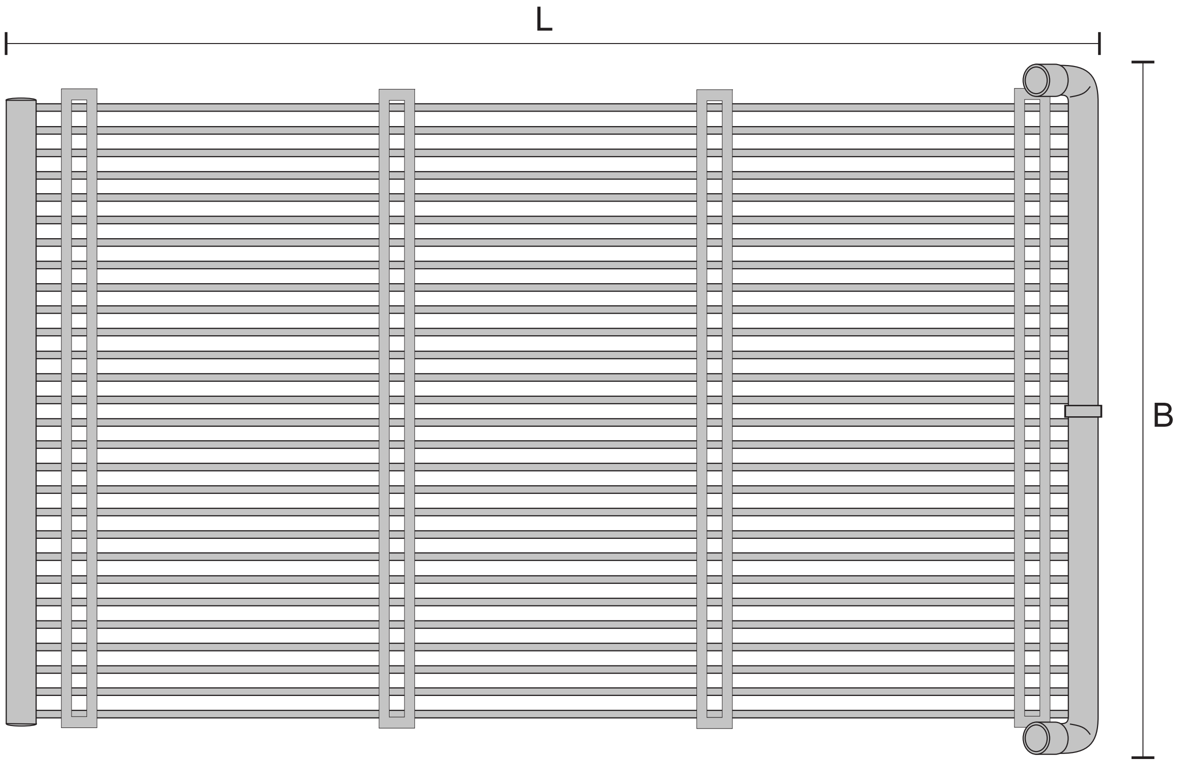
Tick desired version, please

Your contact: ____________________

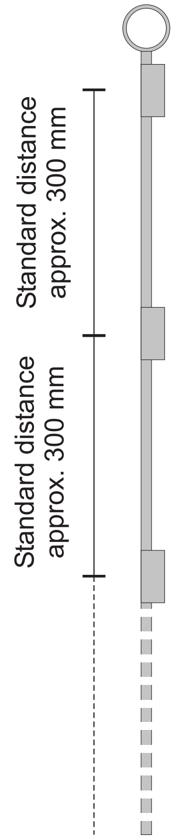
Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

BEKA

☐ Part number K.GG10.11

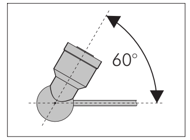


Spacers

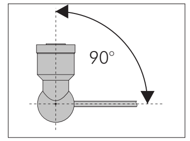


Connection angle

☐ standard



☐



☐ other angle [_ _ _] in 5° -steps

Connection version

☐ 11

Desired approximte-dimensions of spacers in case of deviation:

[_ _ _]

K.GG10. [L: _ _ _ _] . [B: _ _ _ _] .11

Firm: ____________________ Drawn up: ____________________ Signature: ____________________

Project: ____________________ Phone ____________________ Fax: ____________________ Date: ____________________

Mat type K.G10

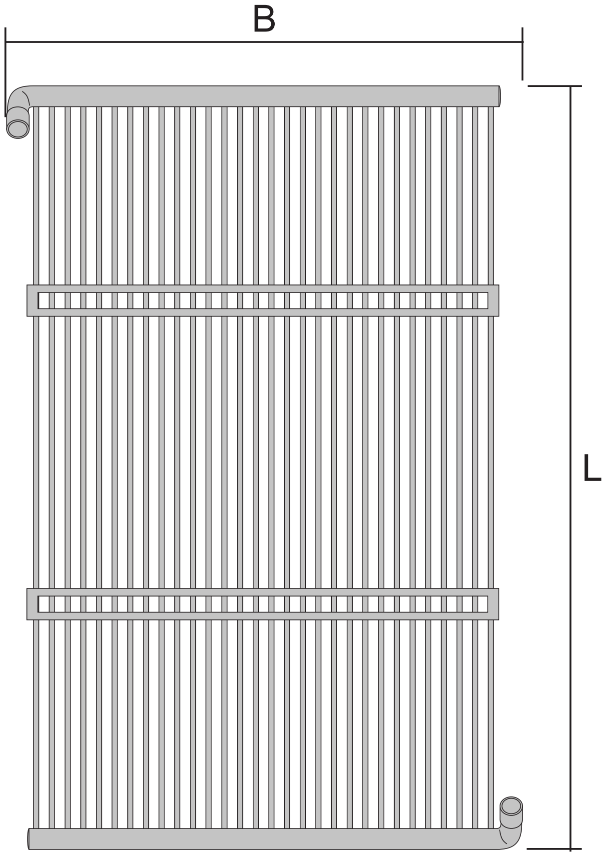
Tick desired version, please

Your contact: ______

Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

BEKA

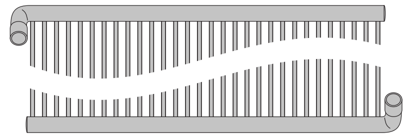
☐ Part number K.G10



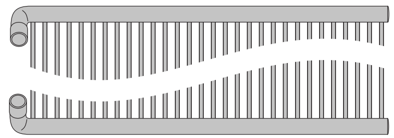
K.G10. [_ _ _] . [_ _ _] . [_ _]
(L) (B)

Connection versions

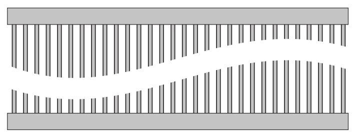
☐ Connection type 11.L



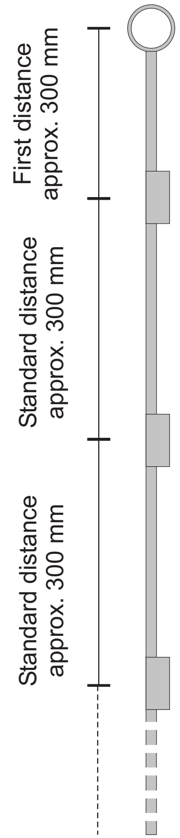
☐ Connection type 20 / 02 (identical)



☐ Connection type 00

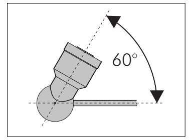


Spacers

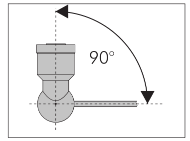


Connection angle

☐ standard



☐



☐ other angle [_ _ _] in 5° - steps

Desired approximte-dimensions of spacers in case of deviation:

[_ _ _]

Firm: ______ Drawn up: ______ Signature: ______

Project: ______ Phone ______ Fax: ______ Date: ______

Mat type K.S10

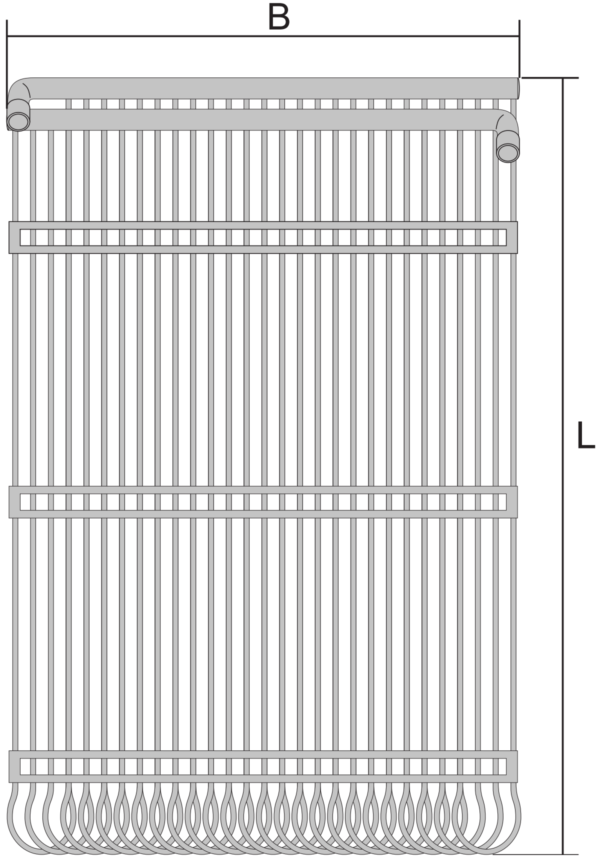
Tick desired version, please

Your contact: ______________________

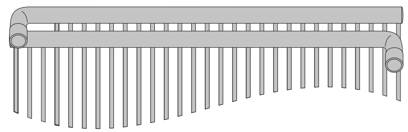
Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

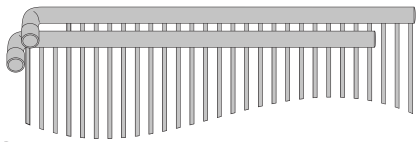
BEKA

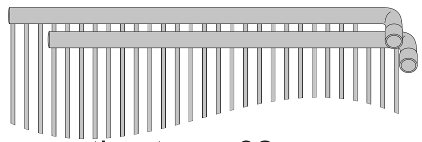
☐ Part number K.S10

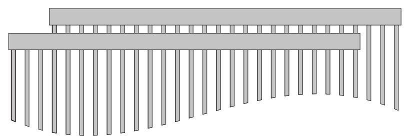


Connection versions

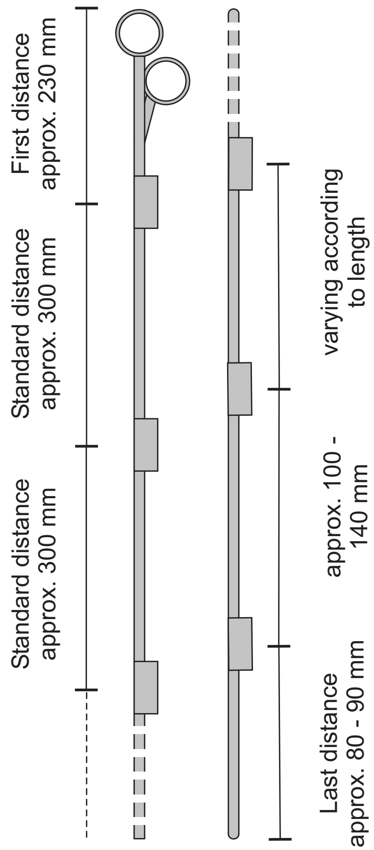
☐

Connection type 11.L

☐

Connection type 20

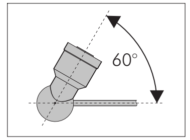
☐

Connection type 02

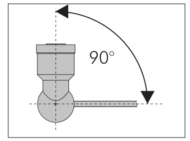
☐

Connection type 00

Spacers



Connection angle

☐ standard


☐


☐ other angle ☐☐☐ in 5° - steps

Desired approximte-dimensions of spacers in case of deviation: ☐☐☐

K.S10. [L: ☐☐☐☐] . [B: ☐☐☐☐] . [☐☐]

knot structure on page 2

Firm: ______________________ Drawn up: ______________________ Signature: ______________________

Project: ______________________ Phone ______________________ Fax: ______________________ Date: ______________________

Mat type K.S10

Tick desired version, please

Your contact: ______________________

Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

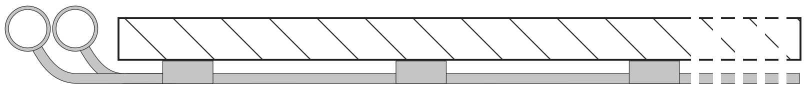
BEKA

How are the mats fixed?

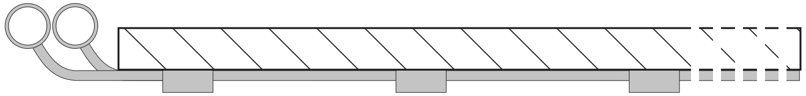
On the suspended ceiling

☐ Spacers tied from front, installation with tacks

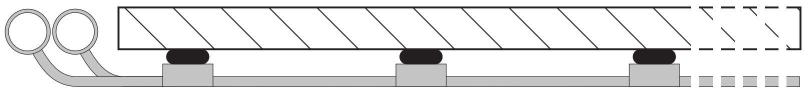
standard



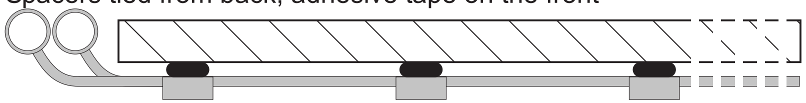
☐ Spacers tied from back, installation with tacks



☐ Spacers tied from front, adhesive tape on the front



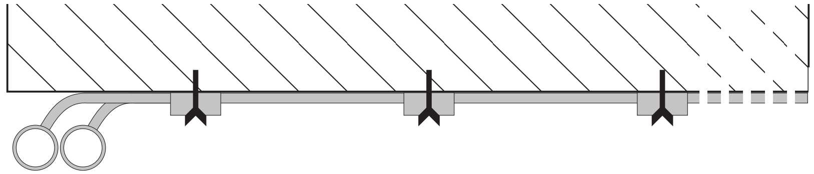
☐ Spacers tied from back, adhesive tape on the front



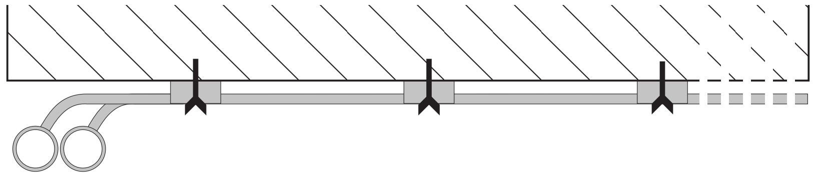
On the raw ceiling

☐ Spacers tied from the front, installation with dowels

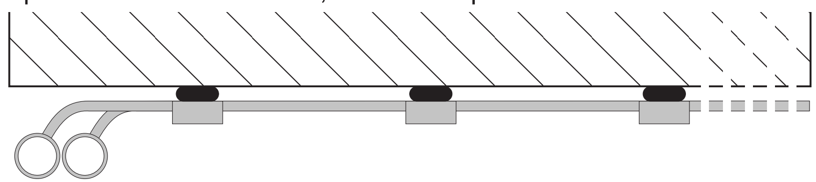
standard



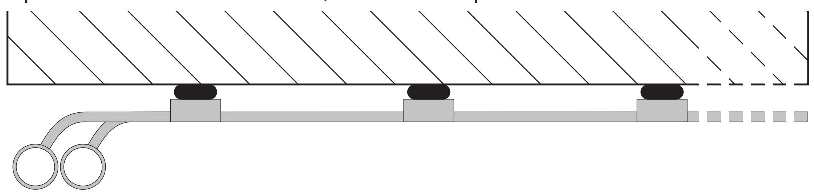
☐ Spacers tied from the back, installation with dowels



☐ Spacers tied from the front, adhesive tape from the back



☐ Spacers tied from the back, adhesive tape from the back



Firm: ______________________ Drawn up: ______________________ Signature: ______________________

Project: ______________________ Phone ______________________ Fax: ______________________ Date: ______________________

Mat type K.S15

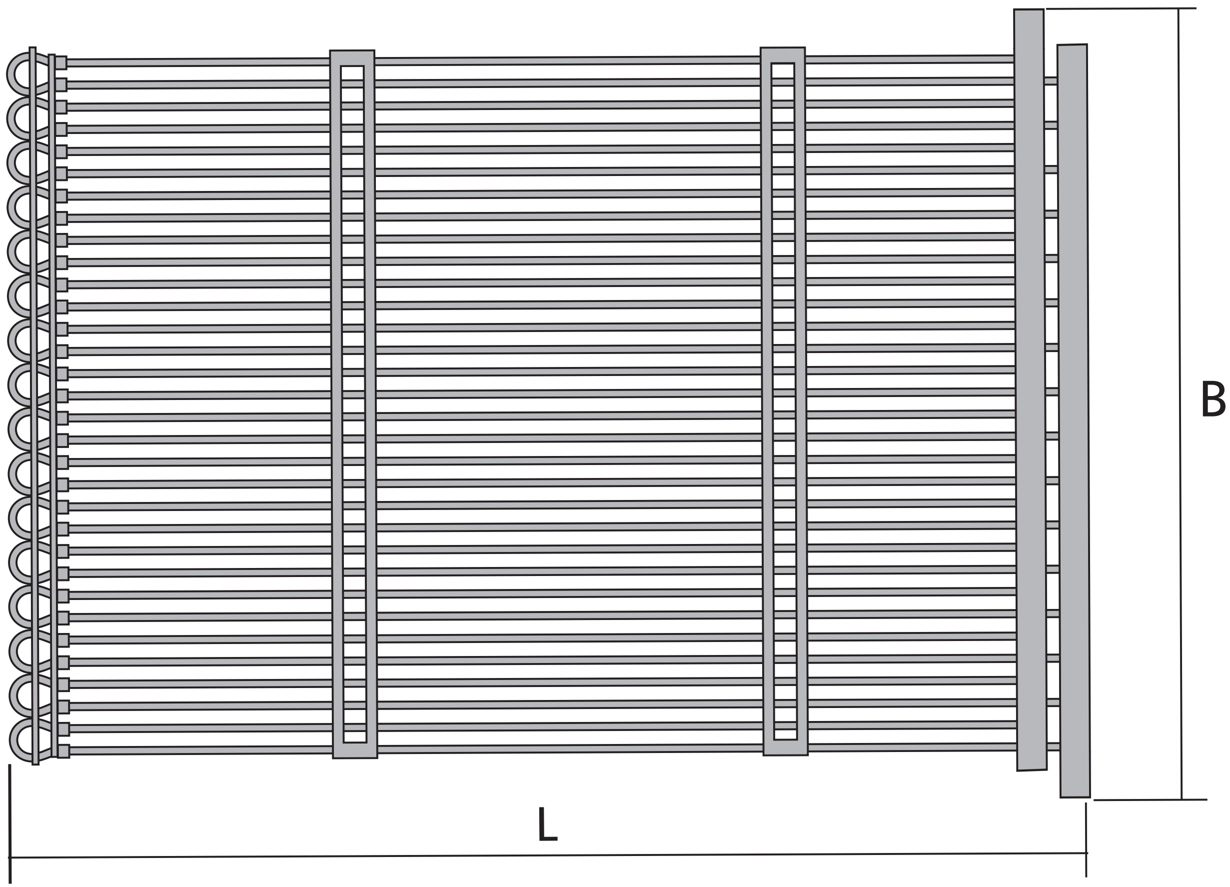
Tick desired version, please

Your contact: ______________________

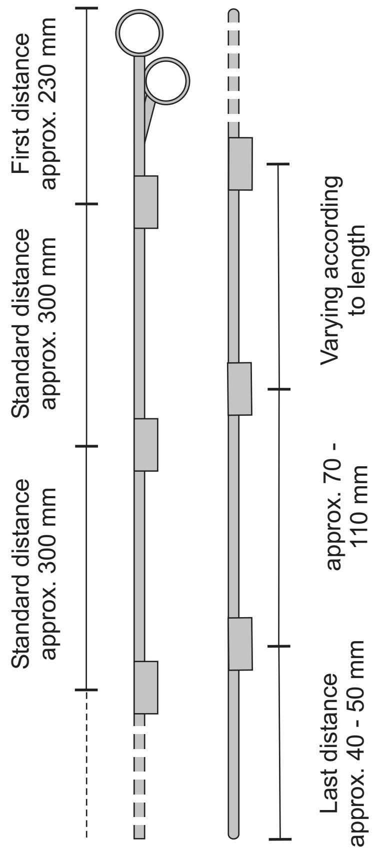
Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

BEKA

☐ Part number K.S15.00

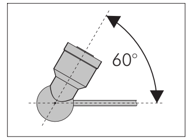


Spacers

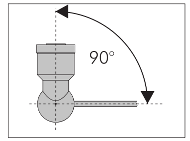


Connection angle

☐ standard



☐



☐ other angle [_ _] in 5° -steps

Desired approximte-dimensions of spacers in case of deviation: [_ _]

K.S15.[L: _ _ _ _].[B: _ _ _ _].00

knot structure on page 2

Firm: ______________________ Drawn up: ______________________ Signature: ______________________

Project: ______________________ Phone ______________________ Fax: ______________________ Date: ______________________

Mat type K.S15

Tick desired version, please

Your contact: ____________________

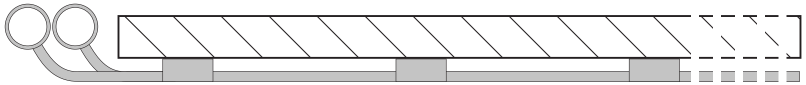
Phone (030) 474 114 -3 ____ Fax (030) 474 114 35

How are the mats fixed?

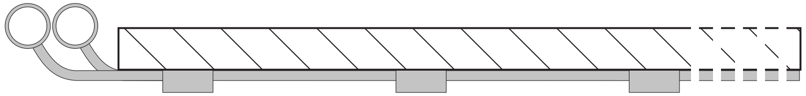
On the suspended ceiling

☐ Spacers tied from the front, installation with tacks

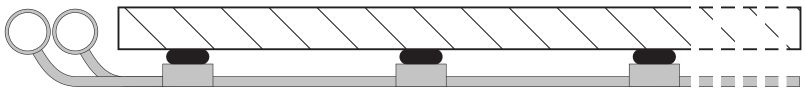
standard



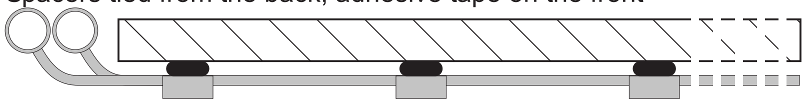
☐ Spacers tied from the back, installation with tacks



☐ Spacers tied from the front, adhesive tape on the front



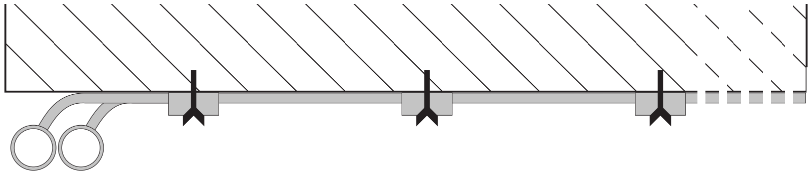
☐ Spacers tied from the back, adhesive tape on the front



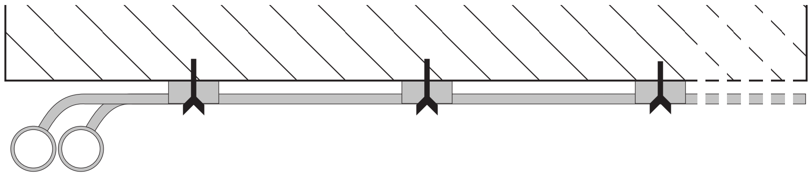
On the raw ceiling

☐ Spacers tied from the front, installation with dowels

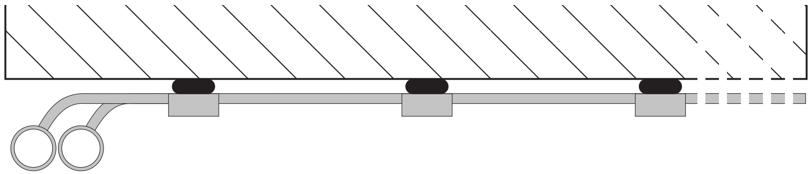
standard



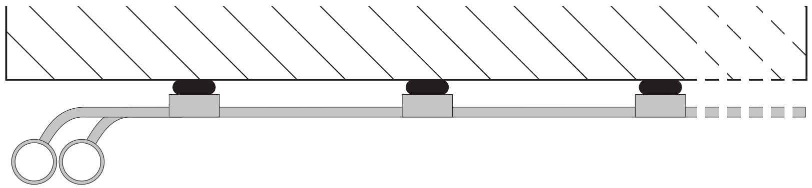
☐ Spacers tied from the back, installation with dowels



☐ Spacers tied from the front, adhesive tape on the back



☐ Spacers tied from the back, adhesive tape on the back



Firm: ____________________ Drawn up: ____________________ Signature: ____________________

Project: ____________________ Phone ____________________ Fax: ____________________ Date: ____________________

Mat type K.U

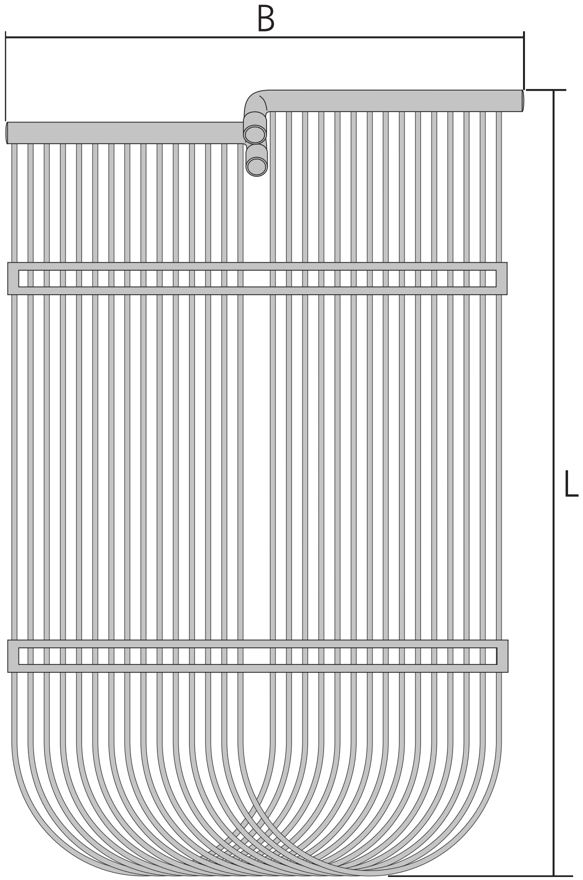
Tick desired version, please

Your contact: ____________________

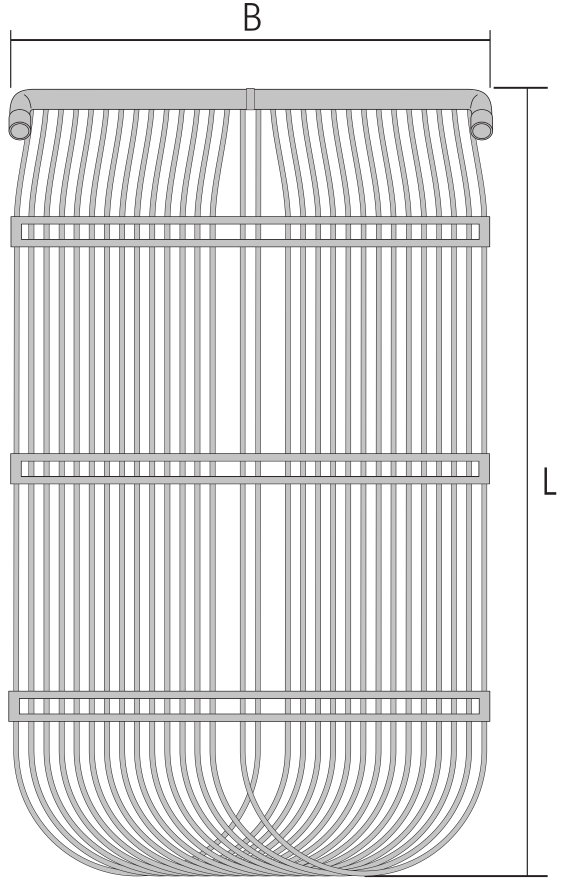
Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

BEKA

☐ Part number K.U10.11



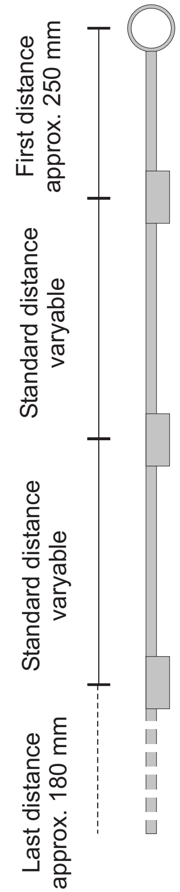
☐ Part number K.UM10.11



K.U10. [L] . [B] .11

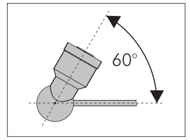
K.UM10. [L] . [B] .11

Spacers

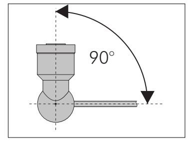


Connection angle

☐ standard



☐



☐ other angle [ ] in 5° -steps

Connection version

☐ 11

Desired approximte-dimensions of spacers in case of deviation: [ ]

Firm: ____________ Drawn up: ____________ Signature: ____________

Project: ____________ Phone ____________ Fax: ____________ Date: ____________

Mat type P.FS20

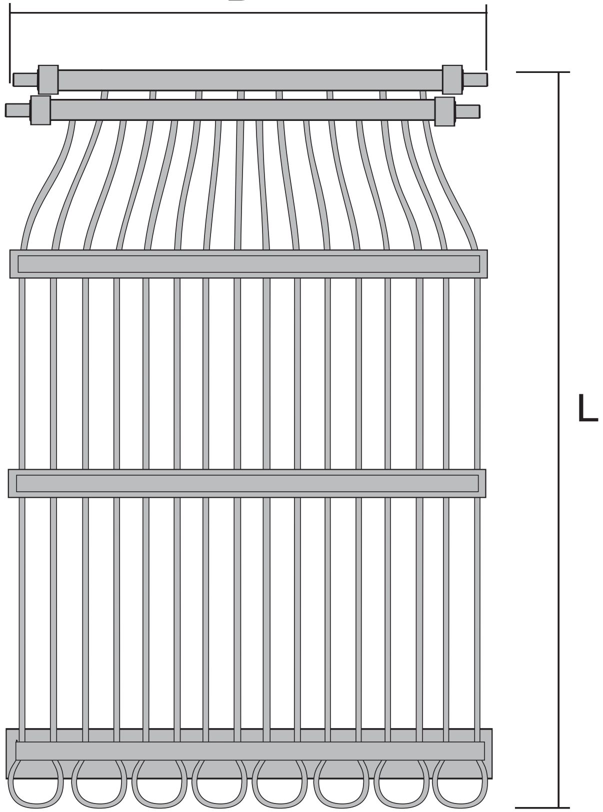
Tick desired version, please

Your contact: ______________________

Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

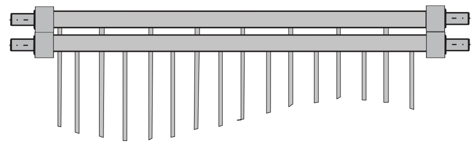
BEKA

☒ Part number P.FS20



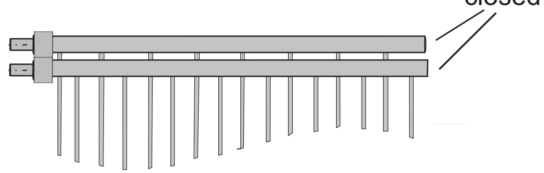
Connection versions

☐



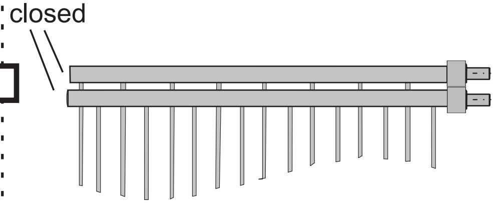
Connection type 22

☐



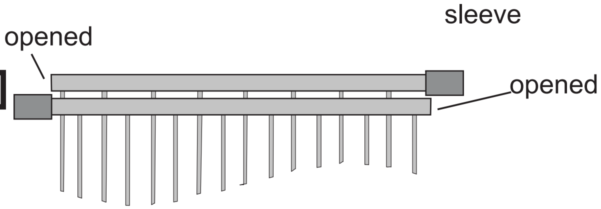
Connection type 20

☐



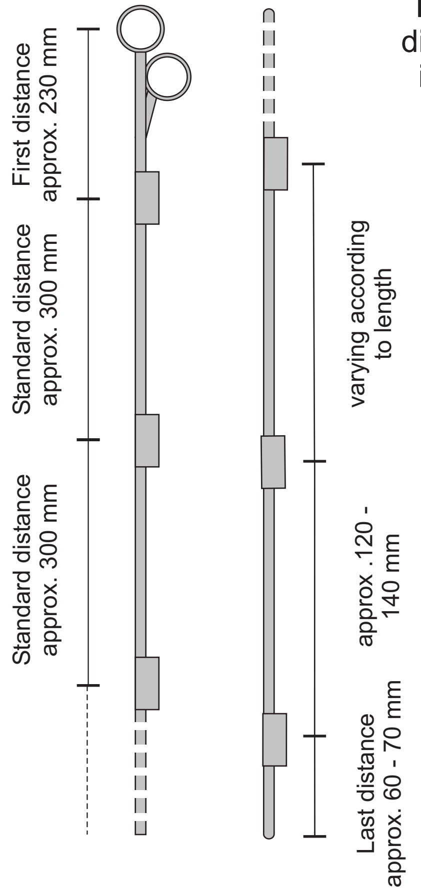
Connection type 02

☐



Connection type 00

Spacers



Desired approximte-dimensions of spacers in case of deviation: [ ]

L B

P.FS20. [ ] . [ ] . [ ]

knot structure on page 2

Firm: ______________________ Drawn up: ______________________ Signature: ______________________

Project: ______________________ Phone ______________________ Fax: ______________________ Date: ______________________

Mat type P.FS20

Tick desired version, please

Your contact: ______________________________

Phone (030) 474 114 -3 ___ Fax (030) 474 114 35

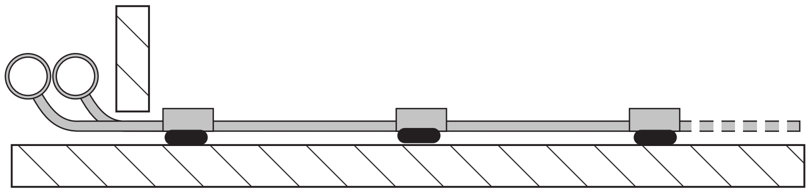
How are the mats fixed?

Collection pipes on the wall

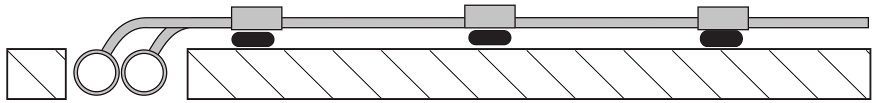
Collection pipes in floor duct

☐ Spacers tied from the front, adhesive tape from the back

standard



☐ Spacers tied from the back, adhesive tape from the front



Firm: ______________________ Drawn up: ______________________ Signature: ______________________

Project: ______________________ Phone ______________________ Fax: ______________________ Date: ______________________

WARRANTY

for BeKa Heiz- und Kühlmatten GmbH products

- BEKA products are made from high-grade materials and are subject to strict controls on purchase, during manufacture and on delivery.
- Quality controls are performed on all BEKA products as part of the production process in accordance with operating standards.
- BeKa Heiz- und Kühlmatten GmbH offers a warranty on all its products, provided these have been professionally installed, of

15 years

from the risk transfer date.

Public liability insurance cover has been taken out with a German insurance company with a sum assured of

5 million euro

per insured event for personal injury and damage to property. This insurance cover also includes claims due to damage caused by defective products and services provided by our company.

Berlin, 1 April 2015

Albrecht Bauke, Managing Director

BeKa Heiz- und Kühlmatten GmbH
Pankstraße 8–10
13127 Berlin, Germany

Tel.: **+49 30 4741 1431**
Fax: **+49 30 4741 1435**

E-mail: **info@beka-klima.de**
Website: **www.beka-klima.de**