Passive Chilled Beams

Type PKV

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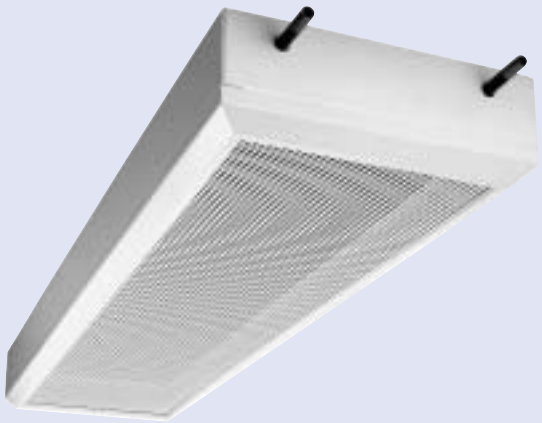
Contents · Description



Type PKV-R

Type PKV

Description

Passive chilled beams (without supply air) are used for dissipation of high internal heat loads.

The energy benefits by using water as a transport medium can in this product be fully utilised. In new buildings they offer low investment costs and high cooling capacity, and they are also the preferred option in refurbishment applications.

Depending on the design brief for the room and its ceiling, the units can be installed flush in a false ceiling or can be freely suspended.

They can be integrated with luminaires, speakers etc.
We can offer an individual solution to suit your architectural concept – contact us for particulars.

There are no moving parts within a chilled beam, so it never generates any irritating noise.

Caution!
The chilled water flow temperature should be selected so as to avoid operation below dew point.

Constructions

The type PKV passive chilled beam comprises a casing with optional frame, a cooling coil with connection flanges, and on request a perforated metal facing.

Casing without frame has hanging brackets for use when installing the unit.

When ordered with a frame (PKV-R), the unit can be supplied with nut serts or on request with adjustable height hanging brackets.

Materials

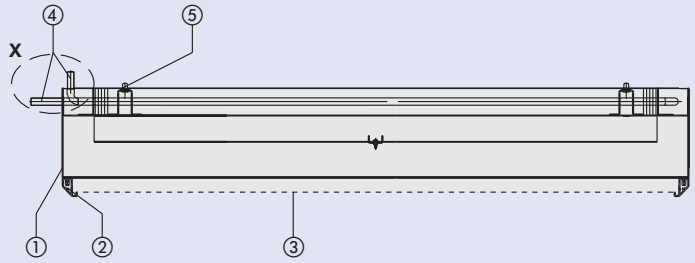
Casing and perforated metal facing are of galvanised steel sheet, frame (PKV-R) is of aluminium, cooling coil has copper tubes with formed aluminium fins and galvanised flanges.

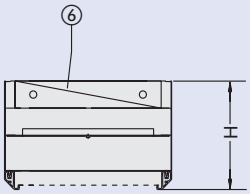
The standard surface finish of units without frames is black (RAL 9005) powder-coated. The standard surface finish of constructions with frames is pure white (RAL 9010) powder-coated. Other RAL colours can be supplied on request!

Dimensions in mm			
L (mm)	**B (mm)**	**W (mm)**	**H (mm)**
900 1200	180 320	70 210	110 200 300
1500 1800 2000	460 600	350 490	
2500 3000			

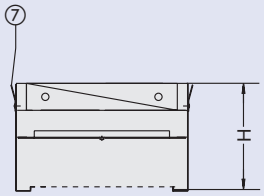
① Casing
② Aluminium frame
③ Perforated metal facing
④ Coil flow and return water connections (Ø 12 mm tube) optionally straight or bent 90° upwards
⑤ Nut serts M6 (fixed), optionally with height-adjustable hanging brackets as shown
⑥ Coil
⑦ Hanging brackets (only for construction without frames)

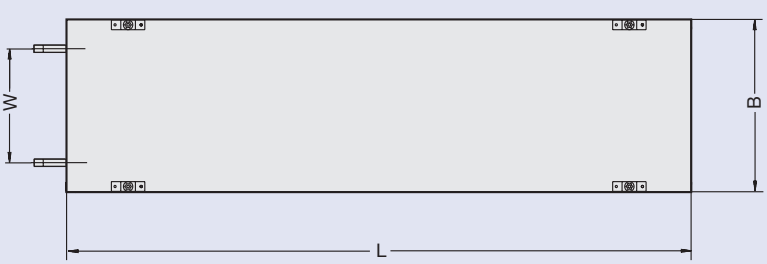
Type PKV-R
(**with** frame)





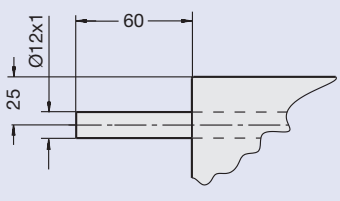
Type PKV
(**without** frame)



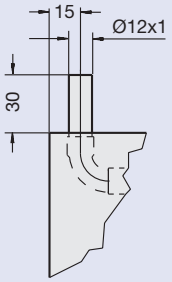


Detail **X**

straight pipe connections (G)



pipe connections bent 90° upwards (B)



Installation · Assembly

It is essential for perfect convection that the air which has to be cooled down can flow unhindered into the coil.
The best condition for this is when distance Z – lower edge of ceiling slab to upper edge of beam – is as large as possible (optimally Z ≥ B/2).

The type PKV chilled beam is suspended with hanging brackets fixed on the sides of the casing.

The type PKV-R chilled beam can be suspended either with height-adjustable hanging brackets or with fixed nut serts.

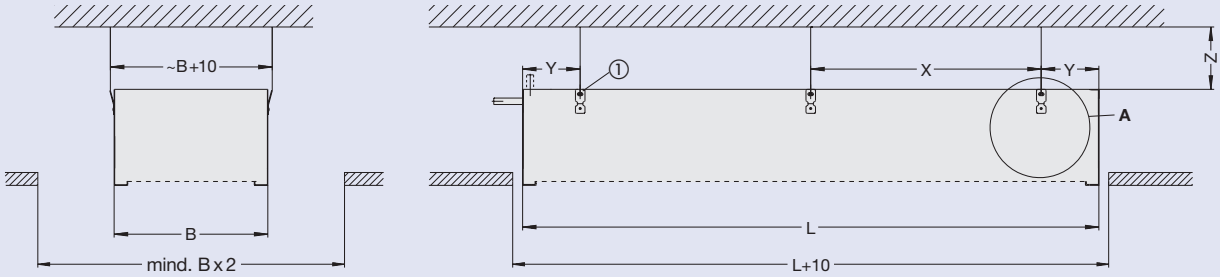
The chilled beam can be suspended from the ceiling slab with threaded rods or suspension wires.

L (mm)	X (mm)	Y (mm)	Quantity of items 1, 2, 3
900	–	120	4
1200	–	120	4
1500	–	120	4
1800	–	120	4
2000	–	120	4
2500	965	285	6
3000	1050	450	6

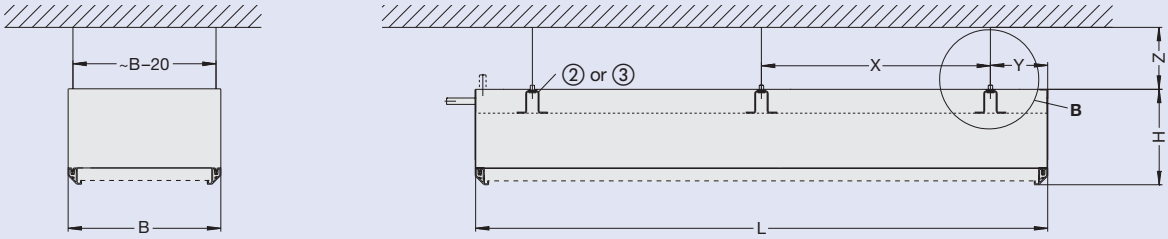
B (mm)
180
320
460
600

Z = 50 to 300 mm

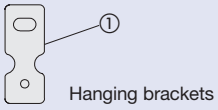
Type PKV · flush mounting



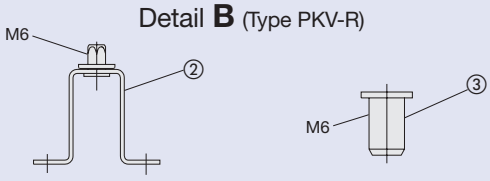
Type PKV-R · freely suspended



Detail **A** (Type PKV)



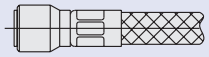
Detail **B** (Type PKV-R)



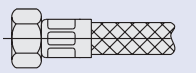
on request with adjustable height hanging brackets (…-H)

or with fixed nut serts (…-E)

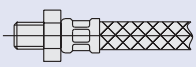
Flexible hose (FS12) for water connection Ø 12 mm (ends can be combined in any way)



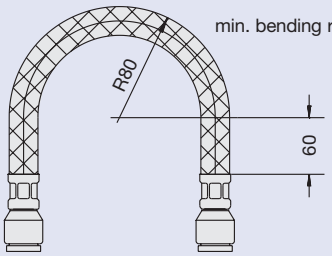
-S with push-fit connector Ø 12 mm, L = 500, 750, 1000 mm



-U with union nuts 1/2", flat sealing, L = 500, 750, 1000 mm



-A with external thread 1/2", flat sealing, L = 500, 750, 1000 mm



Possible connections	
both ends	combination
FS12-S	FS12-S/U
FS12-U	FS12-S/A
FS12-A	FS12-U/A

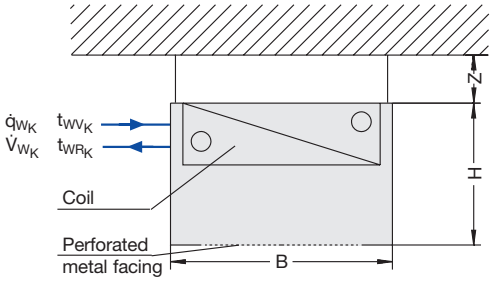
Nomenclature

$\dot{V}_{WK}$	in l/h	Water volume flow rate, cooling
$\dot{Q}_{WK}$	in W	Water cooling capacity
$\dot{q}_{WK}$	in W/m W/m²	Specific cooling capacity per m or per m²
t_{WVK}	in °C	Chilled water flow temperature
t_{WRK}	in °C	Chilled water return temperature
$t_{\bar{w}}$	in °C	Chilled water mean temperature
t_R	in °C	Max. room air temperature
Δt_W	in K	Temperature difference between water flow and return temperature
$\Delta t_{R\bar{w}}$	in K	Temperature difference between max. room air temperature and chilled water mean temperature
V_{50}	in m/s	Maximum time average air velocitiy measured approx. 1 m underneath the passive chilled beam
Δpw	in kPa/m	Water-side pressure drop
fo	in %	Free area of bottom perforated cover plate (100 % without perforated sheet metal)
$K_{Z/B}$		Correction factor for the relation Z to B
K_W		Correction factor for the water volume flow rate
K_{fo}		Correction factor for the air flow % free area
L	in mm	Length of chilled beam
B	in mm	Width of chilled beam
H	in mm	Height of chilled beam
Z	in mm	Suspension height from lower edge of ceiling slab to upper edge of chilled beam

Reference values

t_{WV_K}	= 16 °C	Chilled water flow temperature
t_{WR_K}	= 18 °C	Chilled water return temperature
t_R	= 27 °C	Room air temperature
$\dot{V}_{W_K}$	= 110 l/h	Cold water volume flow
$\Delta t_{R\bar{w}}$	= 10 K	Temperature difference between room air temperature and chilled water mean temperature

Example of a passive chilled beam



Cooling capacity (W/m) at Δt_{Rw} = 10 K according to DIN 4715 with Z/B ~0.33

H (mm)	fo =	B = 180 mm, Z = 60 mm				B = 320 mm, Z = 100 mm				B = 460 mm, Z = 150 mm				B = 600 mm, Z = 200 mm			
		20 %	34 %	50 %	100 %	20 %	34 %	50 %	100 %	20 %	34 %	50 %	100 %	20 %	34 %	50 %	100 %
110		64	75	80	84	126	149	157	165	190	223	236	247	253	297	315	330
200		79	93	99	103	156	183	195	204	235	276	293	306	313	368	388	408
300		91	108	114	119	180	212	225	235	271	319	337	353	360	423	450	470

Cooling capacity (W/m) at Δt_{Rw} = 10 K according to DIN 4715 with Z/B ~0.5

H (mm)	fo =	B = 180 mm, Z = 90 mm				B = 320 mm, Z = 160 mm				B = 460 mm, Z = 230 mm				B = 600 mm, Z = 300 mm			
		20 %	34 %	50 %	100 %	20 %	34 %	50 %	100 %	20 %	34 %	50 %	100 %	20 %	34 %	50 %	100 %
110		65	76	81	85	129	152	162	169	193	229	243	253	257	304	324	338
200		80	94	100	105	160	188	200	209	240	283	300	314	319	376	399	416
300		92	109	115	121	184	217	230	240	277	335	345	361	368	433	459	480

Perforated metal plate fo = 50 % = standard construction!
fo = 100 %, construction without perforated metal plate!

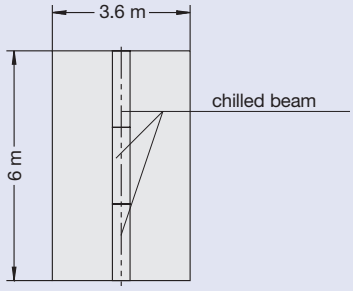
Example

Room size: 3.6 x 6 m (build module 2 x 1.8 m)
Room height: 3 m
No suspended ceiling

t_R = 26 °C
t_{WV} = 16 °C
t_{WR} = 19 °C
$\Delta t_{R\bar{w}}$ = 8.5 K
$\dot{q}_{WK}$ = 55 W/m²
$\dot{Q}_{WK}$ = 55 · 3.6 · 6 = 1188 W

The architect has selected a row of units maximum 6 m along the centre line of the room (3 x 2 m).

Room sketch



$\dot{q}$ per 2.0 m = 1188 : 3 = 396 W / PKV 2000

Diagrams I ... III (see page 6)

unit width 460 mm
unit height 200 mm
unit length 2000 mm $\dot{Q}$ = 460 W

For versions with perforated plate (50%) the correction factor is K_{fo} = 1.0, so no correction is required!

Diagrams IV and V (see page 6)

At a differential between water flow temperature and return water temperature of 3 K, the water flow rate V_W = 140 l/h.
Since the water flow rate is greater than the nominal water flow rate of 110 l/h, a correction factor K_W = 1.04 is applied to the calculated capacity $\dot{Q}$ = 460 x 1.04 = 478 W.

Diagram VI

For the desired mounting height of 100 mm between the ceiling slab and the top edge of the chilled beams (dimension Z), there is a correction factor of 0.9.

$$\frac{Z}{B} = \frac{100}{460} = 0.22$$

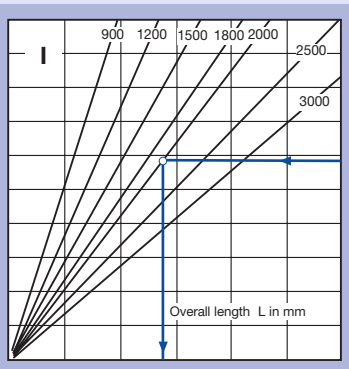
$\dot{Q}$ = 478 x 0.9 = 430 W / PKV, L = 2000 mm

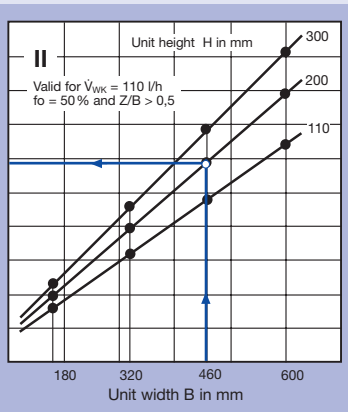
For the room as planned with 3 chilled beam units a = 2 m, the available overall cooling capacity is:

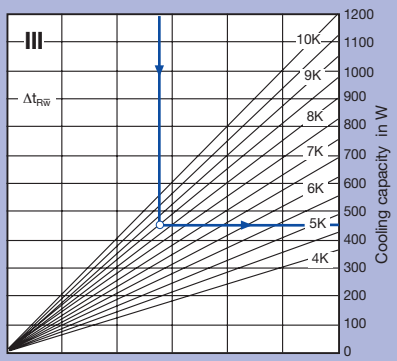
$\dot{Q}_{WK}$ = 3 x 430 = 1290 W

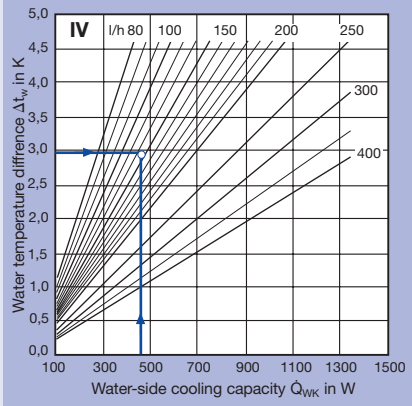
The requirement was 1188 W. *Continued on page 6!*

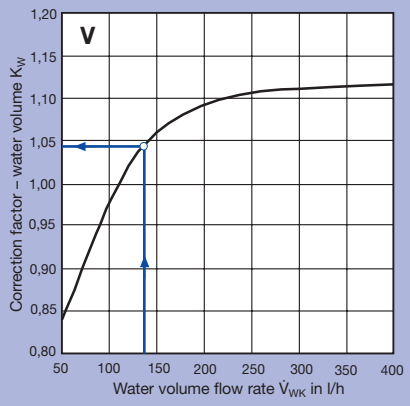
Technical data

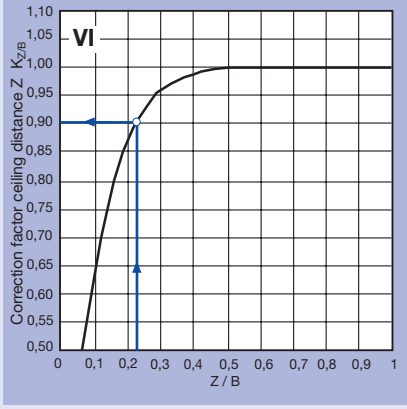


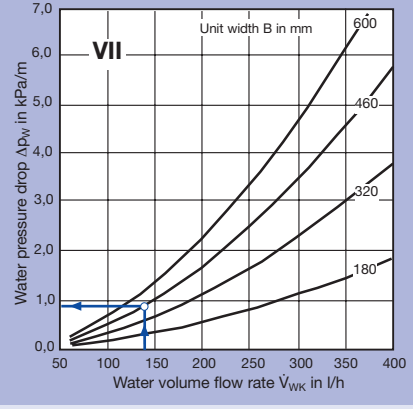












The exact match between the actual capacity and the required capacity can be achieved by adjusting the flow water temperature and / or the water flow rate.

These will change the water-side Δt_W correspondingly.

Diagram VII

Water-side pressure drop

0.9 kPa/m · 2 m = 1.8 kPa

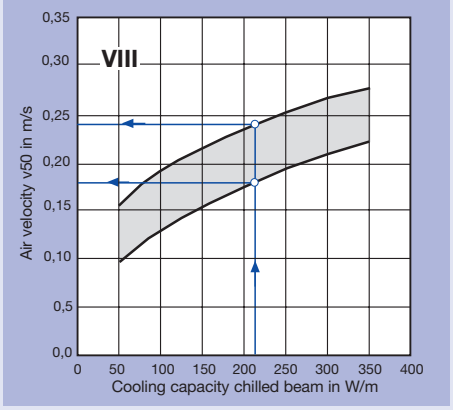
All three chilled beams will be connected separately to the flow and return water pipework.

Diagram VIII

The air velocity 1 m below the passive chilled beam will be between 0.17 and 0.23 m/s !

Perforated plate correction factor K_{fo}	
free area fo in %	K_{fo}
20	0.80
34	0.94
50	1
100	1.05

measured approx. 1 m below the passive chilled beam.



Specification text

Type PKV passive chilled beam is used to dissipate high internal heat loads.

It comprises a casing, on request with aluminium frame for freely suspended installation, on request with perforated plate as front cover, and the cooling coil with flanges and aluminium fins.

Depending on the construction selected, suspension of the unit on site can be by hanging brackets, fixed nut serts or height-adjustable brackets.

Materials

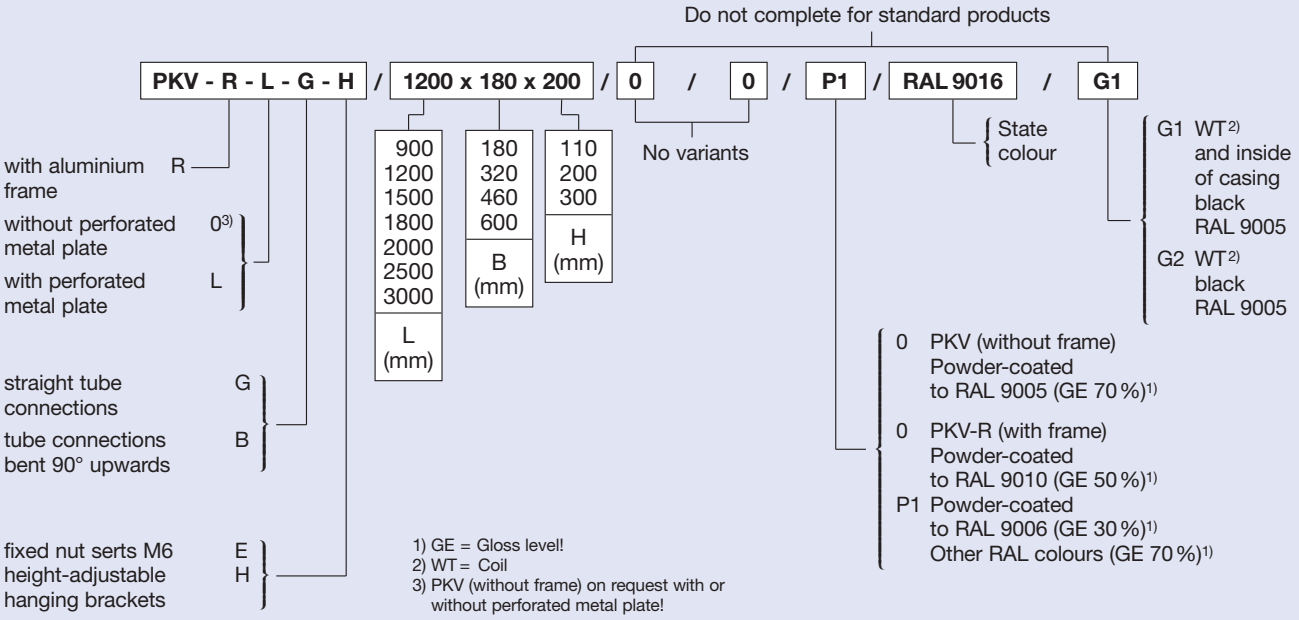
Casing and perforated metal facing are of galvanised steel sheet, frame (PKV-R) is of aluminium, cooling coil has copper tubes with formed aluminium fins and galvanised flanges.

The standard surface finish of units without frames is black (RAL 9005) powder-coated. The standard surface finish of versions with frames is pure white (RAL 9010) powder-coated.

On request, passive chilled beams can be powder-coated in a different RAL colour.

The flexible hose is available as an accessory and made of special plastic with a stainless steel sheathing.

Order code



Accessoires: Flexible hose (FS12) (see page 4)		
Possible connections		
both ends	combination	Length in mm
FS12-S	FS12-S/U	500, 750, 1000
FS12-U	FS12-S/A	
FS12-A	FS12-U/A	

Order example

Manufacture: TROX
Type: PKV-R-L-G-H / 1200 x 180 x 200 / P1 / RAL 9016 / G1