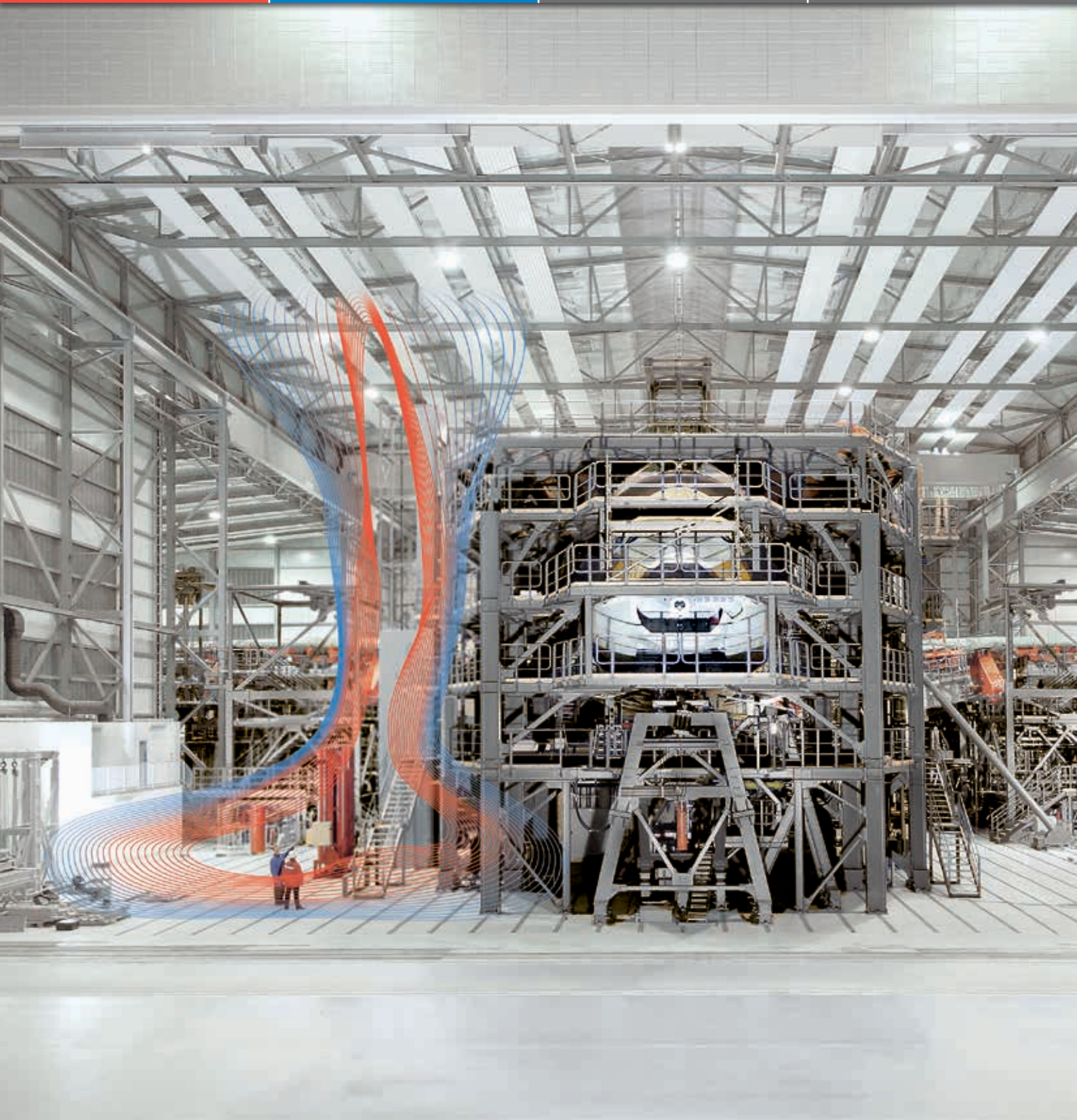
Zehnder ZBN
Heating and cooling ceiling system
Technical Catalogue

zehnder

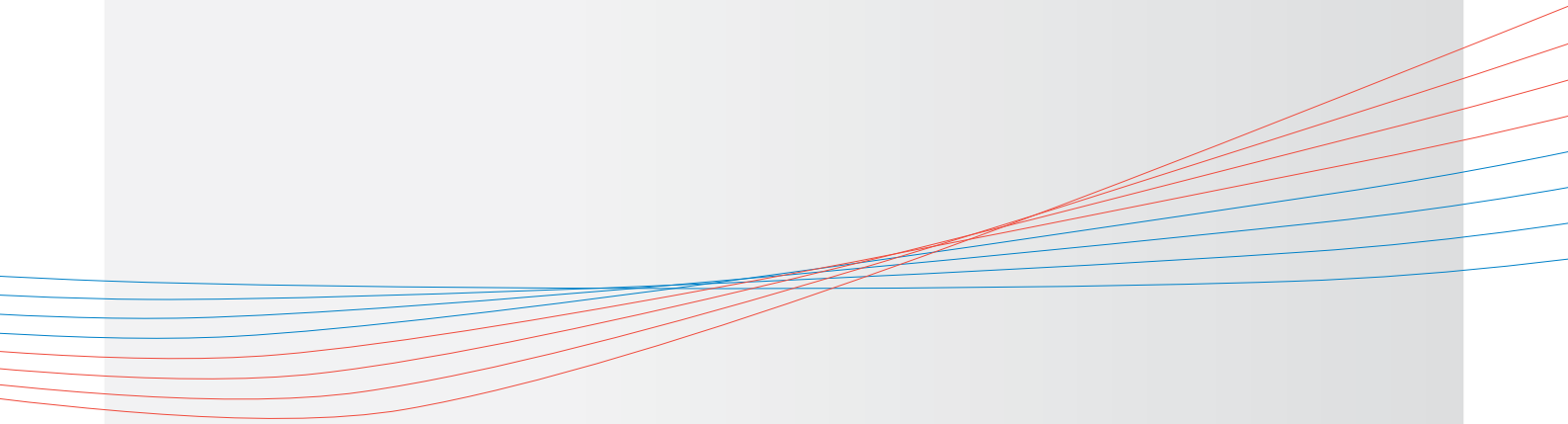
always
around you

Heating | Cooling | Fresh Air | Clean Air



Comfortable, energy-saving, flexible.

Zehnder ZBN radiant ceiling panels heat and cool a building comfortably and efficiently. They can be used in all spaces up to 50 m in height. Compared to other systems, they can achieve energy savings of over 40%. Zehnder ZBN radiant ceiling panels are made to suit the exact requirements of the installation.



Zehnder ZBN product benefits

Zehnder ZBN radiant ceiling panels are a cost-effective, efficient, environmentally friendly and energy-saving heating and cooling alternative for buildings up to a height of 30m. Here are the benefits at a glance.

1 Economic efficiency

- Possible energy savings of up to 40%
- Air temperature can be 3 K lower (heating) or 3 K higher (cooling)
- Low air temperature gradient
- Suitable for all sources of energy
- No additional electricity costs for driving circulation fans
- No maintenance or servicing costs
- High-performance radiant ceiling panels

2 Comfortable climate

- Radiant heat principle
- Even distribution of heat throughout the room
- Even distribution of temperature across the full height of the building
- Heating and cooling effect immediately noticeable
- No dust circulation
- Silent operation

3 Technology

- High heating and cooling capacity (according to EN 14037 or based on EN 14240)
- Unrestricted use of floor and wall space
- Extremely quick system response to temperature
- changes and Building Maintenance Systems (BMS)
- Easy to install; cost savings of up to 20% with an individual section lengths of 7.5 m
- Thermal insulation fitted as standard

4 Variety of products

- Seven Zehnder ZBN standard models (2 to 8 pipes) with installation depths of 300 to 1200 mm
- Length of strips up to approx. 120 m (partial length up to 7.5 m)
- High-quality powder coating in all colours
- Special solutions tailored to customer requirements
- Perforated design for acoustic absorption

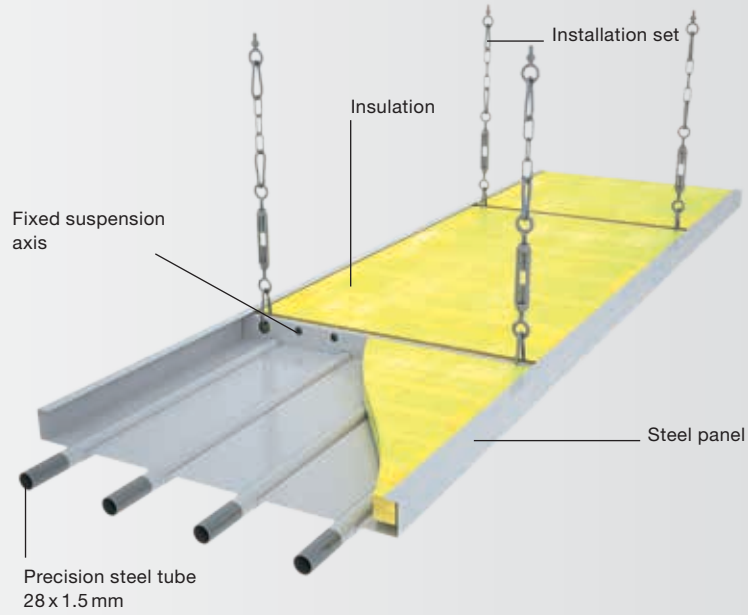
Gigelberg hall, Berlin, Germany

Zehnder ZBN: Structure and attachment

Zehnder stands for quality, functionality and design. The company is certified to ISO 9001 and 14001 and manufactures its products in accordance with the strictest quality guidelines. Zehnder ZBN radiant ceiling panels are produced and tested according to EN 14037 standard and bear the CE mark.

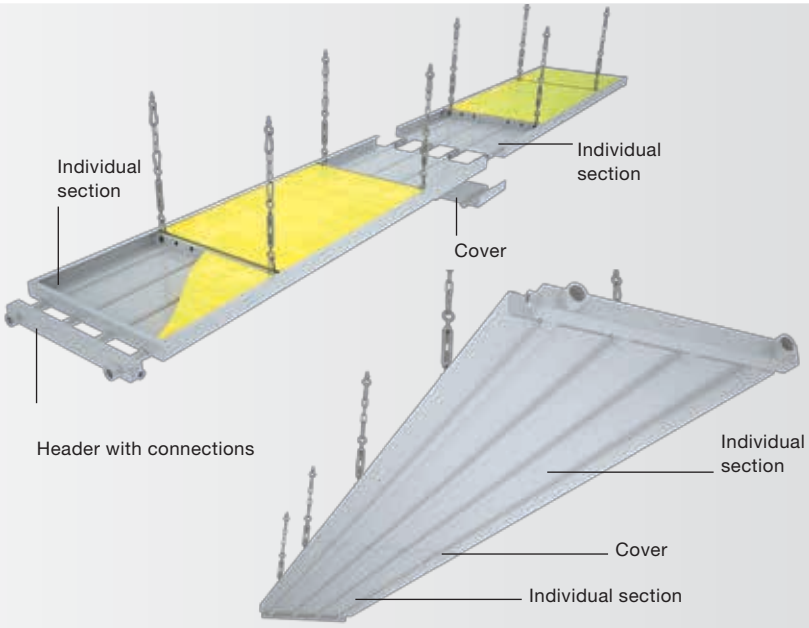
Structure of the section

Zehnder ZBN radiant ceiling panels consist of a steel panel with pre-formed channels into which the pipes are fitted ensuring maximum thermal exchange. The insulation can be installed on demand on the upper side of the panel and function as sound absorption.



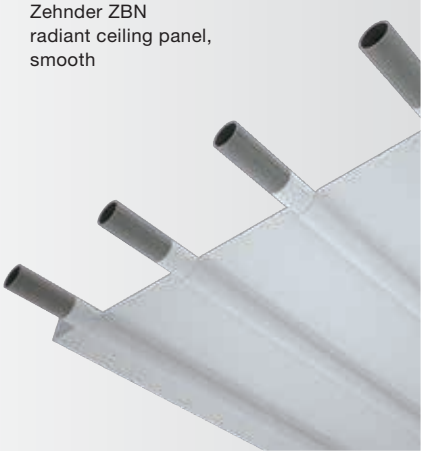
Designs

The standard installation widths are 300, 450, 600, 750, 900, 1050 and 1200 mm. Other special sizes are also available on request. A radiant ceiling panel strip can consist of several individual sections arranged in series. The individual sections are produced in lengths of up to 7.5 m.

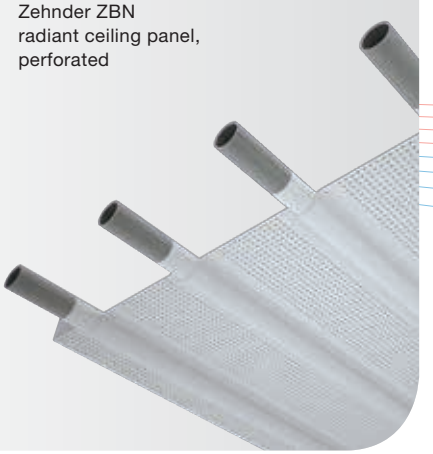


Surfaces

Zehnder ZBN radiant ceiling panels are available with a smooth or a perforated surface, depending on your requirements. The surface is coated with a high-quality powder coat finish (standard colour RAL 9016 or another colour of your choice).



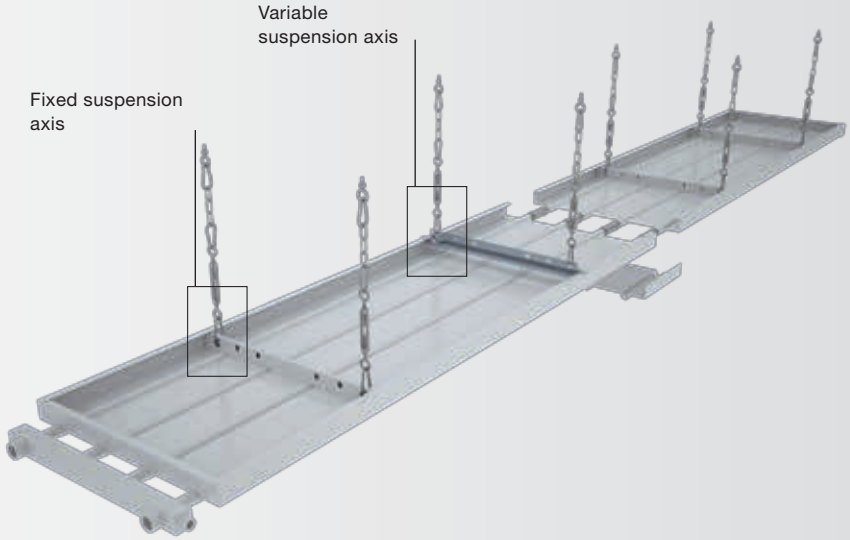
Zehnder ZBN radiant ceiling panel, smooth



Zehnder ZBN radiant ceiling panel, perforated

Suspension and attachment

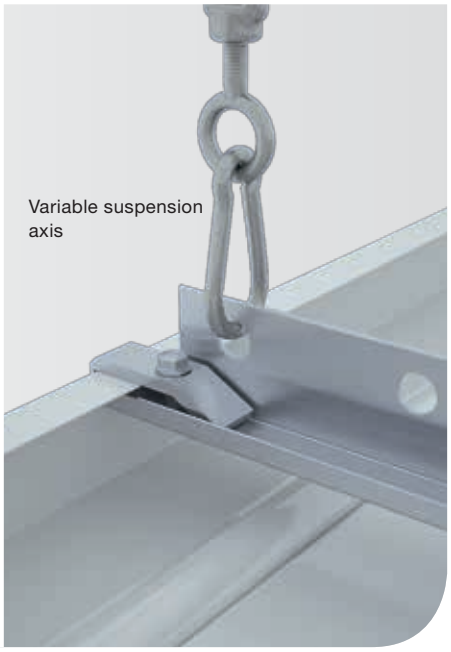
Zehnder ZBN radiant ceiling panels can be suspended in two ways: fixed and variable.



Fixed and variable suspension axes

With fixed suspension axes, the attachment points are located at fixed positions on the panel and cannot be moved. Variable suspension axes can be moved along the length of the panel, enabling them to be adjusted to best suit the conditions of the building.

Fixed suspension axis

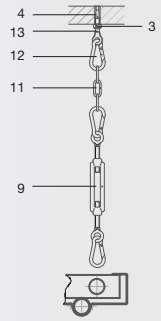


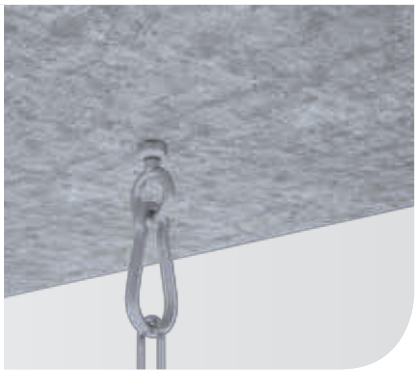
Variable suspension axis

Standard installation sets

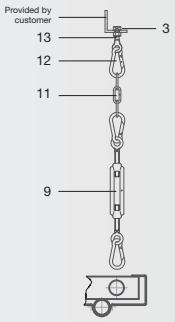
There are five standard installation sets for installing the radiant ceiling panels. In addition, Zehnder offers a number of customised solutions on request.

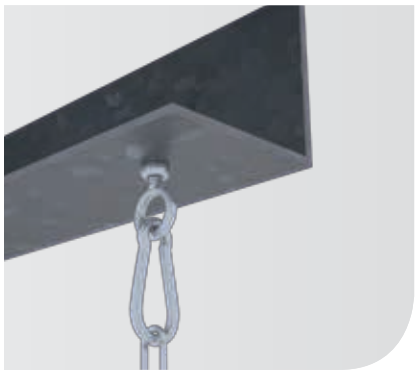
Concrete ceiling
Installation set K 33



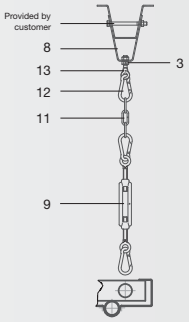


Steel profile
Installation set K 34

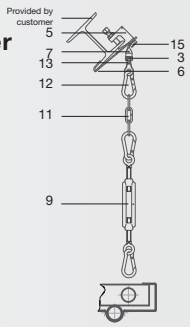


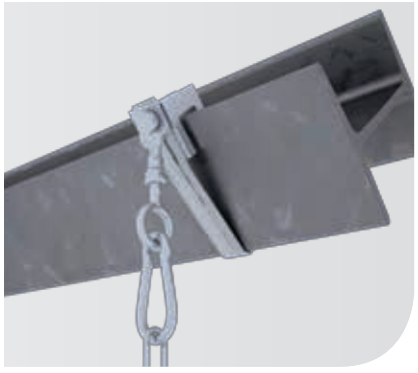


Trapezoidal steel panel
Installation set K 36

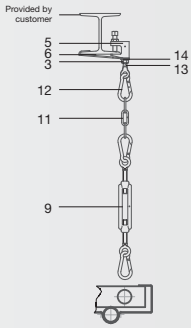


Inclined steel girder
Installation set K 37





Horizontal steel girder
Installation set K 38



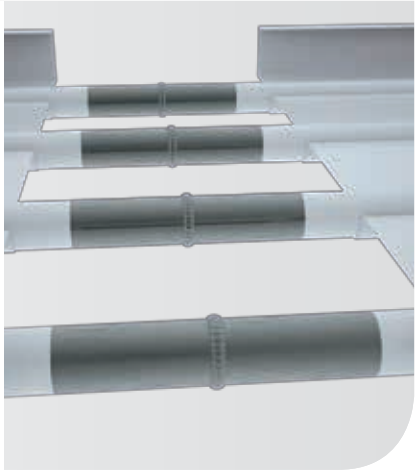
Key
3 Hexagon nut
4 Steel dowel
5 Girder clamp
6 Securing clip
7 Flat leaf screw
8 Trapezoidal hanger
9 Turnbuckle with 2 eyes
11 Link chain
12 Snap hook
13 Eyebolt
14 Washer
15 Hexagonal screw

Connector technology

If you are using two or more individual sections, they will need to be connected to one another, with the pipes joined in one of two different ways. The individual sections are assembled into the desired configuration by means of welded or press-fit connections and the joins are then hidden under a cover. So all you see is great design.

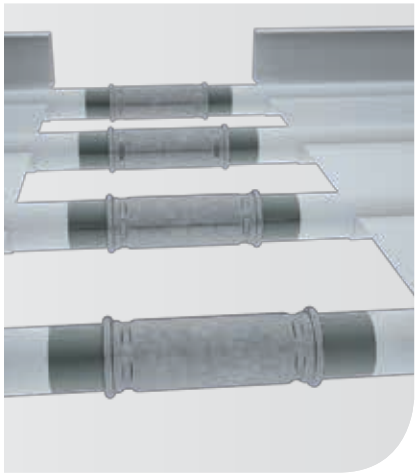
Welded connection

The welded connection can be used universally and is suitable for all temperatures, strip widths and lengths, and all types of hydraulic connection. The pipes are butt-jointed and welded on an alternating basis, starting from the outside pipes and moving towards those at the centre.



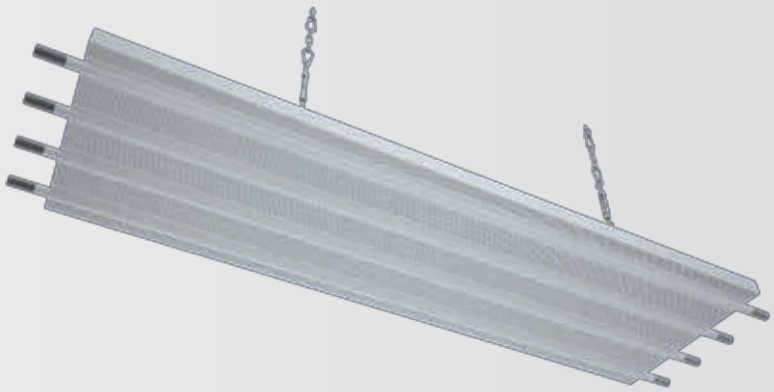
Press-fit connection

An exclusive programme has been developed to ensure press fittings can be used reliably. Zehnder uses this programme to check the configuration of the radiant ceiling panels to be installed and supplies the appropriate press fittings, thus guaranteeing that the system will remain permanently leak-tight.

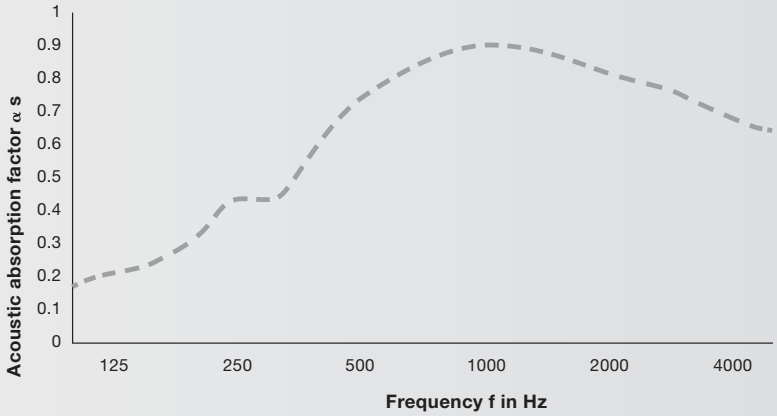


Acoustic absorption

In addition to their ability to heat and cool, perforated Zehnder radiant ceiling panels can also be used for acoustic absorption: the sound waves pass through the perforated surface of the radiant panel into the heat insulation within, where they are absorbed. This results in a significant reduction of the noise level or a reduction in the reverberation time (in gyms and sports halls, for example). Detailed information for calculating acoustics is available on request.



Zehnder ZBN acoustic absorption factor depending on frequency

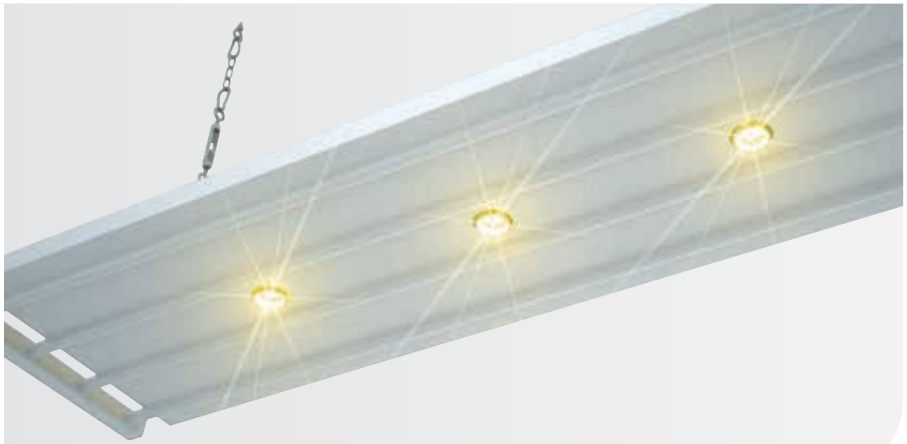


Special solutions

Zehnder ZBN radiant ceiling panels are extremely flexible: as well as the wide standard range, there are also a number of special solutions available. Therefore, whatever the room and whatever the project, we have exactly what you need.

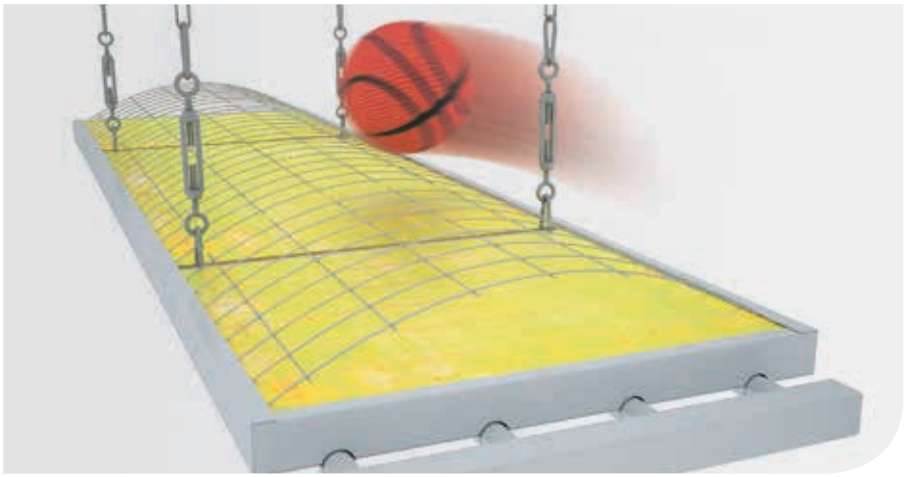
Integrated lights, etc.

The radiant panels can be provided with cut-outs for various components, such as lights, fire alarms, loudspeakers, etc.



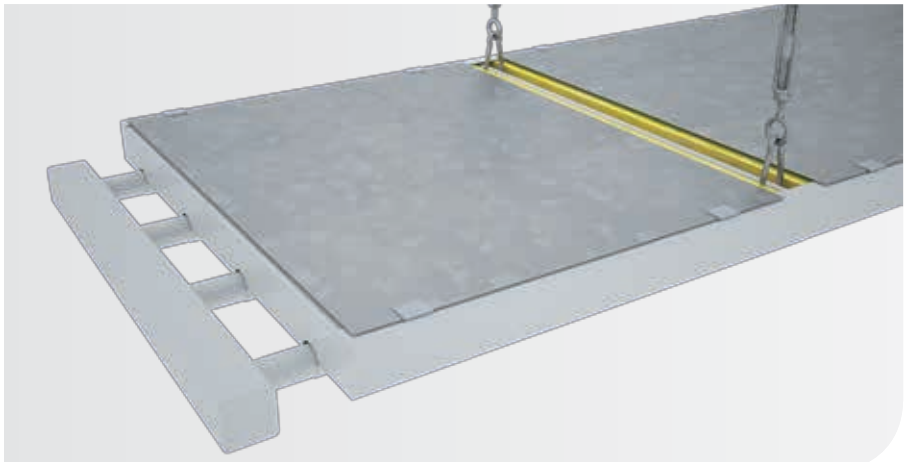
Ball deflector grid

The galvanised ball deflector grid stops balls from becoming stuck on top of the radiant ceiling panels in sports halls.



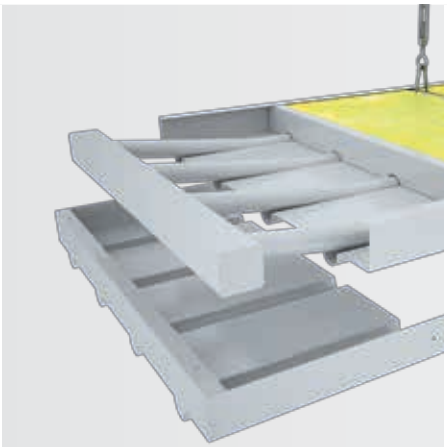
Dust protector panel

A dust protector panel can be attached if certain application areas require it for reasons of hygiene. This enables the back of the panel to be cleaned easily.



Cover

The headers are hidden behind a cover.

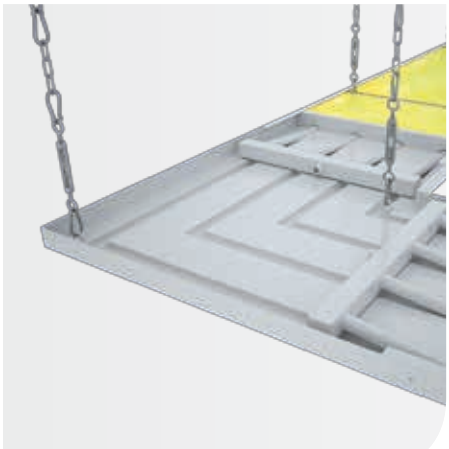


Non-continuous radiant panel

This version allows light to pass through unobstructed, for example, from skylights.

Bevelled cut-outs

Zehnder ZBN radiant ceiling panels are also available in angled versions or with bevelled cut-outs, whether you want them to fit in with the room's existing design or to make a statement all of their own.



Technical layout data

Key

t_{air}	Air temperature (°C)
t_{amb}	Ambience temperature (°C) = average surface temperature of all surfaces in the surrounding area (°C)
$t_i = t_p$	Indoor temperature (°C) = perceived temperature (°C)
t_{hf}	Heating flow temperature (°C)
t_{hr}	Heating return temperature (°C)
t_{cf}	Cooling flow temperature (°C)
t_{cr}	Cooling return temperature (°C)
Δt_{exc}	Excessive temperature (K)
Δt_{sub}	Subnormal temperature (K)
K	Constant
n	Exponent

Physical units

Degree Celsius (°C)
Kelvin (K)
Cubic metre (m^3)
Metre (m)
Millimetre (mm)
Pascal (Pa)
Kilogram (kg)

Ice rink, Küssnacht, Switzerland


Restaurant
KEK
ELVIA
züblin
INTERHOCKEY
SUBARU
SEEFELD AUTOMOBILE AG
Reebok
AIG
GARAGE ZÜRICH NORD

Heating and cooling capacity
The following tables show the Zehnder ZBN heating and cooling capacity depending on the excessive and subnormal temperatures. The heating capacity values have been measured according to EN 14037, while the measurement results for the cooling capacity are based on EN 14240.

Note: The removal of the insulation has a positive effect on the cooling capacity (see table). However, this additional capacity can only be attributed to the room if it has an open ceiling.

Removing the insulation increases the thermal capacity, but only leads to a build-up of heat under the ceiling.

$$\text{Capacity} = K \cdot \Delta t^{n}$$

The excessive and subnormal temperatures can be calculated arithmetically:

$$t_i = t_p = \frac{(t_{amb} + t_{air})}{2}$$

$$\Delta t_{exc} = \frac{(t_{hf} + t_{hr})}{2} - t_i$$

$$\Delta t_{sub} = t_i - \frac{(t_{cf} + t_{cr})}{2}$$

Cooling capacity without insulation

	Zehnder ZBN 300/2	Zehnder ZBN 450/3	Zehnder ZBN 600/4	Zehnder ZBN 750/5	Zehnder ZBN 900/6	Zehnder ZBN 1050/7	Zehnder ZBN 1200/8
K n	3.131 1.083	4.513 1.083	5.896 1.083	7.259 1.083	8.622 1.083	9.985 1.083	11.348 1.083
Δt_{sub} (K)	W/m	W/m	W/m	W/m	W/m	W/m	W/m
15	59	85	111	136	162	188	213
14	55	79	103	127	150	174	198
13	50	73	95	117	139	161	183
12	46	67	87	107	127	147	167
11	42	61	79	97	116	134	152
10	38	55	71	88	104	121	137
9	34	49	64	78	93	108	123
8	30	43	56	69	82	95	108
7	26	37	49	60	71	82	93
6	22	31	41	51	60	70	79
5	18	26	34	41	49	57	65

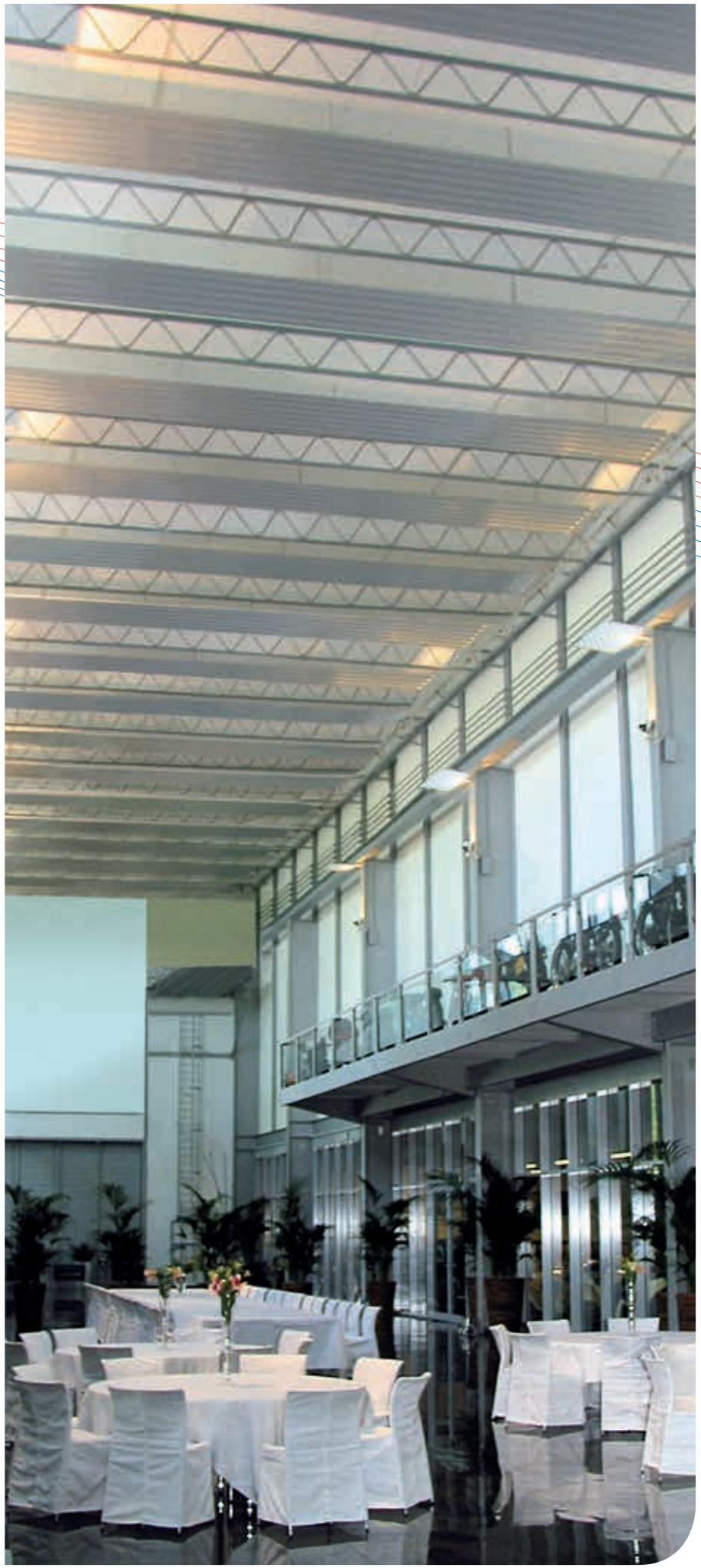
Cooling capacity with insulation

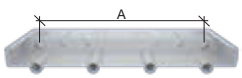
	Zehnder ZBN 300/2	Zehnder ZBN 450/3	Zehnder ZBN 600/4	Zehnder ZBN 750/5	Zehnder ZBN 900/6	Zehnder ZBN 1050/7	Zehnder ZBN 1200/8
K n	2.683 1.083	3.695 1.083	4.707 1.083	6.056 1.083	7.405 1.083	8.753 1.083	10.102 1.083
Δt_{sub} (K)	W/m	W/m	W/m	W/m	W/m	W/m	W/m
15	50	69	88	114	139	164	190
14	47	64	82	106	129	153	176
13	43	59	76	97	119	141	162
12	40	54	69	89	109	129	149
11	36	50	63	81	99	117	136
10	32	45	57	73	90	106	122
9	29	40	51	65	80	95	109
8	26	35	45	58	70	83	96
7	22	30	39	50	61	72	83
6	19	26	33	42	52	61	70
5	15	21	27	35	42	50	58

Heating capacity with insulation

	Zehnder ZBN 300/2		Zehnder ZBN 450/3		Zehnder ZBN 600/4		Zehnder ZBN 750/5		Zehnder ZBN 900/6		Zehnder ZBN 1050/7		Zehnder ZBN 1200/8	
K	1,787	0,726	2,421	1,223	3,055	1,845	3,798	2,184	4,540	2,461	5,283	2,682	6,026	2,856
n	1,176	1,199	1,177	1,167	1,177	1,134	1,177	1,154	1,177	1,174	1,177	1,194	1,176	1,213
Δt_{exc} (K)	W/m	W/col-lector pair	W/m	W/col-lector pair	W/m	W/col-lector pair	W/m	W/col-lector pair	W/m	W/col-lector pair	W/m	W/col-lector pair	W/m	W/col-lector pair
100	402	182	546	264	691	342	858	444	1025	548	1191	654	1358	763
98	392	177	533	257	675	334	838	433	1001	535	1163	639	1326	745
96	383	173	520	251	658	326	818	423	977	522	1136	623	1294	726
94	374	169	508	245	642	319	798	413	953	509	1108	608	1262	708
92	364	164	495	239	626	311	778	403	929	497	1080	592	1231	690
90	355	160	482	233	610	303	758	393	905	484	1053	577	1199	671
88	346	156	470	227	594	296	738	383	882	471	1025	562	1168	653
86	337	152	457	221	578	288	718	373	858	459	998	546	1137	635
84	327	147	445	215	563	281	699	363	835	446	970	531	1106	618
82	318	143	432	209	547	273	679	353	811	434	943	516	1075	600
80	309	139	420	203	531	266	660	343	788	421	916	501	1044	582
78	300	135	408	197	516	258	640	333	765	409	889	486	1014	564
76	291	131	395	191	500	251	621	323	742	397	863	471	983	547
74	282	127	383	185	485	243	602	313	719	385	836	457	953	530
72	273	123	371	180	469	236	583	304	696	372	810	442	923	512
70	264	119	359	174	454	228	564	294	674	360	783	427	892	495
68	255	114	347	168	439	221	545	284	651	348	757	413	863	478
66	247	110	335	162	424	213	526	275	629	336	731	398	833	461
64	238	106	323	157	409	206	507	265	606	324	705	384	803	444
62	229	102	311	151	394	199	489	256	584	312	679	370	774	427
60	220	98,5	299	145	379	192	470	246	562	301	653	356	744	411
58	212	94,6	288	140	364	184	452	237	540	289	628	341	715	394
56	203	90,7	276	134	349	177	434	227	518	277	602	327	686	378
55	**199**	**88,7**	**270**	**131**	**342**	**174**	**425**	**223**	**507**	**271**	**590**	**320**	**672**	**369**
54	195	86,8	264	128	334	170	415	218	496	266	577	314	658	361
52	186	83,0	253	123	320	163	397	209	475	254	552	300	629	345
50	178	79,2	242	117	305	156	379	199	453	243	527	286	601	329
48	170	75,4	230	112	291	149	362	190	432	231	502	272	573	313
46	161	71,6	219	107	277	142	344	181	411	220	478	259	545	297
44	153	67,9	208	101	263	135	326	172	390	209	453	246	517	282
42	145	64,2	197	95,8	249	128	309	163	369	198	429	232	489	266
40	137	60,6	186	90,5	235	121	292	154	349	187	405	219	462	251
38	129	57,0	175	85,2	221	114	275	145	328	176	382	206	435	236
36	121	53,4	164	80,0	208	107	258	136	308	165	358	193	408	221
34	113	49,8	153	74,9	194	101	241	128	288	154	335	181	382	206
32	105	46,4	143	69,7	181	93,9	224	119	268	144	312	168	355	191
30	97,5	42,9	132	64,7	167	87,3	208	111	249	133	289	155	329	177
28	89,9	39,5	122	59,7	154	80,7	192	102	229	123	266	143	304	163
26	82,4	36,1	112	54,7	141	74,2	176	93,8	210	113	244	131	278	149
24	75,0	32,8	102	49,9	129	67,8	160	85,5	191	103	222	119	253	135
22	67,7	29,6	91,9	45,0	116	61,4	144	77,3	173	92,6	201	107	229	122
20	60,5	26,4	82,2	40,3	104	55,1	129	69,3	154	82,8	179	95,8	204	108
18	53,5	23,2	72,6	35,6	91,8	48,9	114	61,3	136	73,2	158	84,5	181	95,3
16	46,6	20,2	63,2	31,1	79,9	42,8	99,3	53,5	119	63,7	138	73,4	157	82,6
14	39,8	17,2	54,0	26,6	68,3	36,8	84,8	45,9	101	54,5	118	62,6	134	70,2
12	33,2	14,3	45,1	22,2	56,9	30,9	70,7	38,4	84,5	45,5	98,3	52,1	112	58,2
10	26,8	11,5	36,4	18,0	45,9	25,1	57,1	31,1	68,2	36,7	79,3	41,9	90,5	46,7
8	20,6	8,8	28,0	13,8	35,3	19,5	43,9	24,1	52,5	28,3	61,0	32,1	69,6	35,6
6	14,7	6,2	19,9	9,9	25,2	14,1	31,3	17,3	37,4	20,2	43,5	22,8	49,6	25,1
4	9,1	3,8	12,4	6,2	15,6	8,9	19,4	10,8	23,2	12,5	27,0	14,0	30,8	15,4

Technical data at a glance



1) 

2) Higher operating temperature possible on request
3) Higher operating pressure possible on application

	Zehnder ZBN		Unit of measurement	Strip						
	Type			300/2	450/3	600/4	750/5	900/6	1050/7	1200/8
Dimensions	Installation widths		mm	300	450	600	750	900	1050	1200
	Number of pipes		piece	2	3	4	5	6	7	8
	Pipe material / dimension (Ø outer x pipe thickness)		–/mm	Precision steel tube / 28 x 1.5						
	Panel material		–	Steel						
	Pipe separation		mm	150						
	Min. installation length of individual section		mm	2000						
	Max. installation length of individual section		mm	7500						
	Suspension points per axis		piece	2	2	2	2	2	2	2
	Distance between suspension points (A)[1]		mm	200	350	500	650	800	950	1100
Parameters	Max. operating temperature[2]		°C	120						
	Max. operating overpressure[3]		bar	10						
Weights	Empty weight without water, with insulationa	Radiant panel	kg/m	6.95	9.67	12.42	15.14	17.86	22.08	24.83
		Per collector	kg	1	1.5	2	2.5	3	3.5	4
	Operating weight with water and insulation	Radiant panel	kg/m	7.94	11.14	14.38	17.59	20.8	25.52	28.76
		Per collector	kg	1.5	2.2	3	3.7	4.5	5.2	6
	Weight of insulation		kg/m	0.3	0.45	0.6	0.75	0.9	1.05	1.2
	Weight of ball deflector grid		kg/m	0.29	0.42	0.55	0.68	0.81	0.94	1.67
	Water capacity		kg/m	0.982	1.473	1.964	2.455	2.946	3.437	3.928
Heating capacity	Thermal capacity according to EN 14037 at $\Delta t = 55$ K with upper insulation		W/m	199	270	342	425	507	590	672
	Thermal capacity constant (K)		–	1.787	2.421	3.055	3.798	4.540	5.283	6.029
	Thermal capacity exponent (n)		–	1.176	1.177	1.177	1.177	1.177	1.177	1.176
Cooling capacity	Cooling capacity based on EN 14240 at $\Delta t = 10$ K with upper insulation		W/m	32	45	57	73	90	106	122
	Cooling capacity constant (K)		–	2.683	3.695	4.707	6.056	7.405	8.753	10.102
	Cooling capacity exponent (n)		–	1.083	1.083	1.083	1.083	1.083	1.083	1.083

Minimum mass flow

To maintain the capacity shown in the table, a turbulent flow must be ensured within the pipes in the panels. This minimum water flow depends on the lowest system temperature.
Where heating is concerned, this corresponds to the return temperature and when cooling or in a combined cooling/heating mode, it corresponds to the cold water flow temperature. If the minimum water flow per pipe is not achieved, this can result in a drop in performance of around 15%.

Limit temperatures

The right design temperature must be selected in order to ensure the radiant system delivers a comfortable climate throughout the room. You can use the adjacent table and graph to check this design temperature, which must be lower than the two limit temperatures. Higher limit temperatures can be used for rooms and corridors where people do not spend a great deal of time.

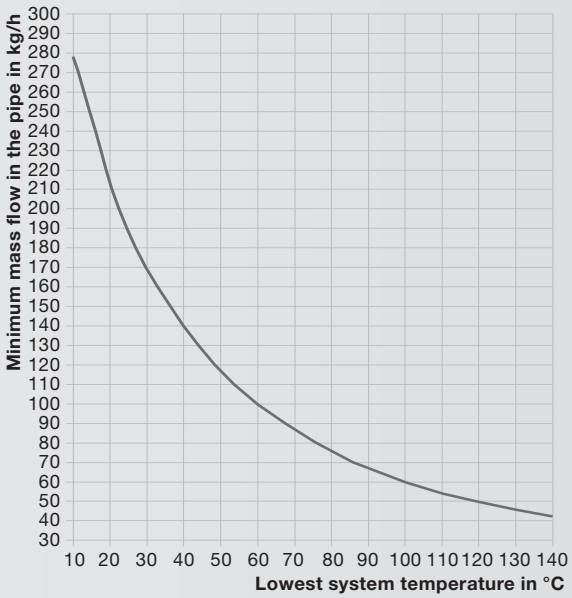
These values are only intended as a guide.
A detailed calculation can be performed according to ISO 7730.

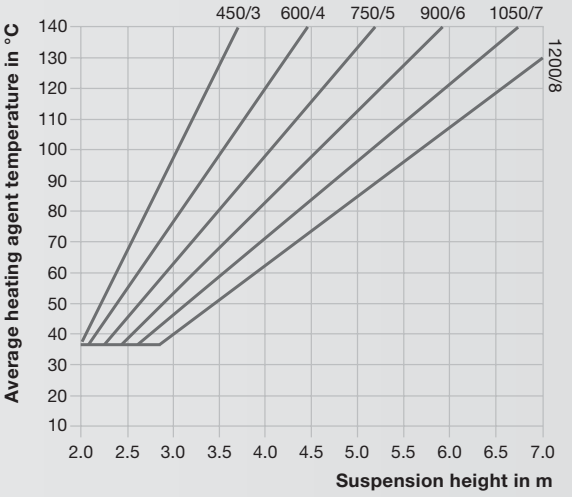
Height	Proportion of the ceiling surface covered by Zehnder ZBN radiant ceiling panels					
m	At 10%	At 15%	At 20%	At 25%	At 30%	At 35%
	Average heating agent temperature in °C					
≤3	73	71	68	64	58	56
4	115	105	91	78	67	60
5	>147	123	100	83	71	64
6		132	104	87	75	69
7		137	108	91	80	74
8		>141	112	96	86	80
9			117	101	92	87
10			122	107	98	94

Step 1: Ceiling coverage. The design temperature must not exceed the defined thresholds.

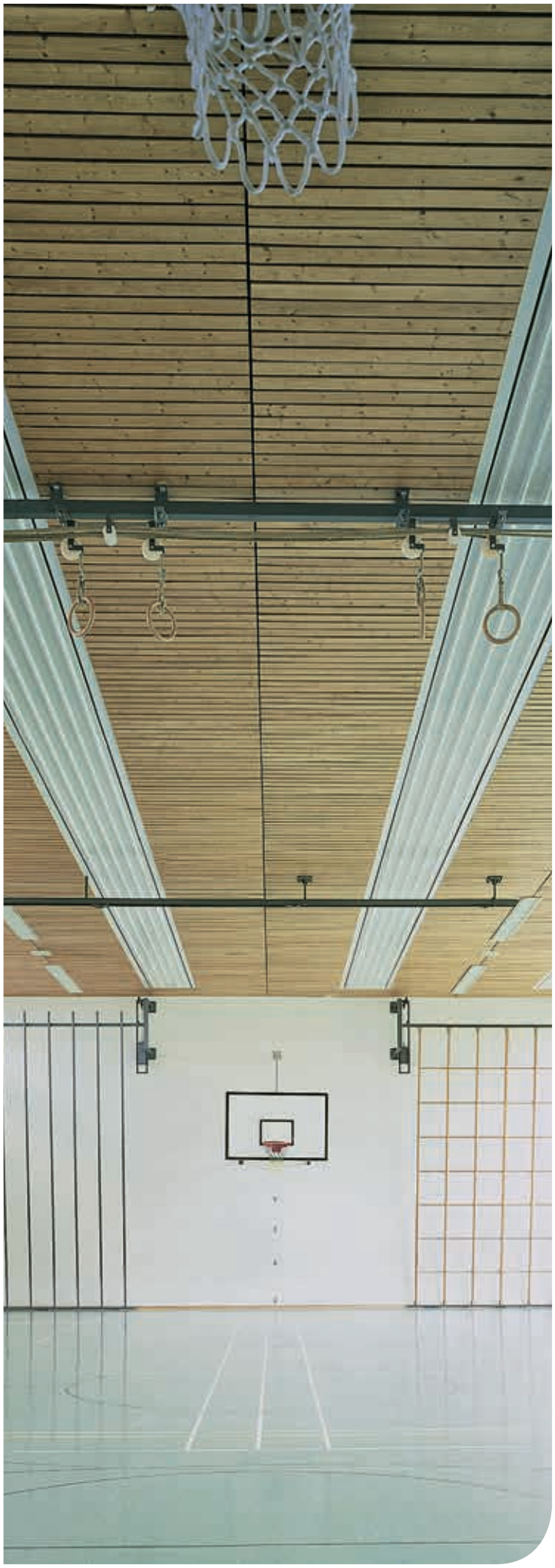
Ball impact resistance

The stability of the radiant ceiling panels is particularly important when they are used in sports halls, where they could be accidentally hit by balls, for example. This is why Zehnder ZBN radiant ceiling panels have been tested for ball impact resistance in accordance with DIN 18032, Part 3. The test was performed by the Materialprüfungsanstalt Stuttgart materials testing institute.





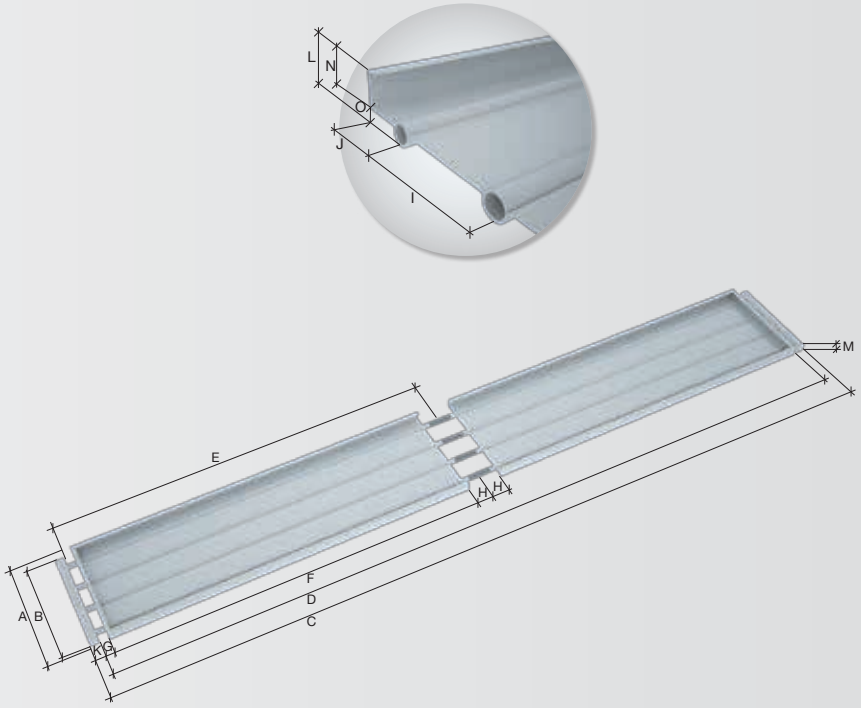
Step 2: Width of the radiant panel. The design temperature must not exceed the defined thresholds.



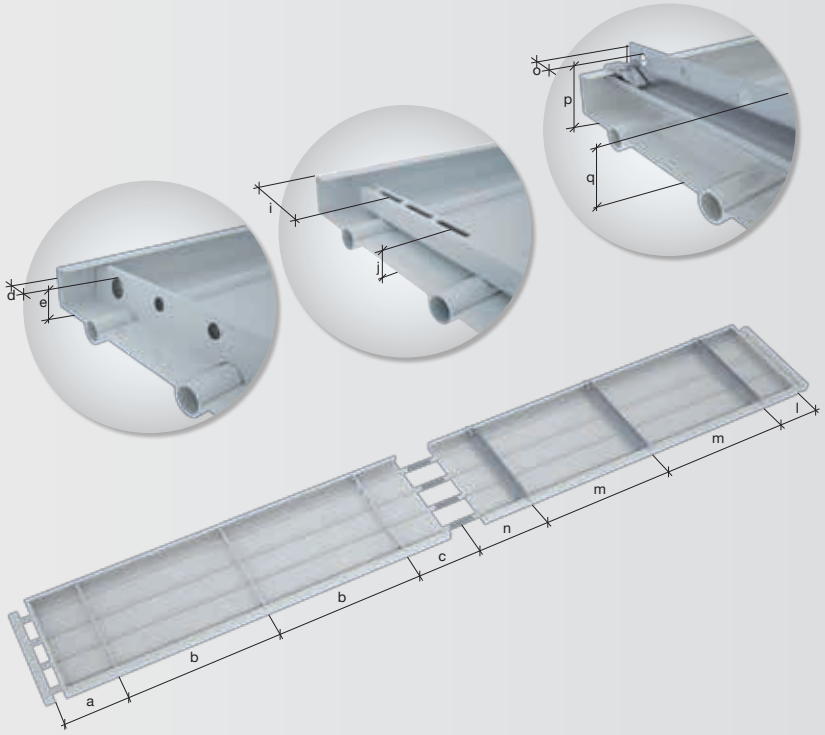
Dreifach-Sporthalle sports hall, Munich, Germany

Dimensions

Module dimensions



Attachment dimensions



Module dimensions

Item	Description	Dimension in mm	Min. dimension in mm	Max. dimension in mm	Note
A	Overall width	Variable	300	1200	Grid width 150 mm
B	Width of header	Variable	250	1150	Grid width 150 mm
C	Overall length (without connections)	Variable	2090	120090	
D	Length of pipe	Variable	2000	120000	
E	Length of individual section	Variable	2000	7500	
F	Lengtha of radiant panel for individual section	Variable	1900	7400	
G	Pipe overlap to header	Variable	50	2000	Standard 50 mm
H	Pipe overlap to connector piece	Variable	100	2000	Standard 100 mm
I	Distance between two pipes	150	–	–	
J	Distance from pipe – side lip	75	–	–	
K	Length of header	45	–	–	
L	Overall height (without suspension)	69	–	–	
M	Height of header	45	–	–	
N	Height of side lip	50	–	–	
O	Height of pipe beading	19	–	–	

Attachment dimensions

Item	Description	Dimension in mm	Min. dimension in mm	Max. dimension in mm	Note
Fixed axes panel type 300-900					
a	Header – centre of axis (fixed)	Variable	50	1000	Standard dimension 500 mm
b	Centre of axis (fixed) – centre of axis (fixed)	Variable	50	3250	Standard dimension 3250 mm
c	Centre of axis (fixed) – join	Variable	100	3150	Standard dimension 800 mm
d	Outer edge of module – centre of 1st suspension point	50	–	–	
e	Bottom edge of radiant panel – Top edge of suspension point	39	–	–	
Fixed axes panel type 1050-1200					
a	Header – centre of axis (fixed)	Variable	50	1000	Standard dimension 500 mm
b	Centre of axis (fixed) – centre of axis (fixed)	Variable	50	3250	Standard dimension 3250 mm
c	Centre of axis (fixed) – join	Variable	100	3150	Standard dimension 800 mm
i	Outer edge of module – centre of 1st suspension point	50	–	–	
j	Bottom edge of radiant panel – Top edge of suspension point	35	–	–	
Movable axes panel type 300-1200					
l	Header – centre of axis (movable)	Variable	90	750	
m	Centre of axis (movable) – centre of axis (movable)	Variable	60	3000	
n	Centre of axis (movable) – join	Variable	190	2810	
o	Outer edge of module – centre of 1st suspension point	50	–	–	
p	Bottom edge of radiant panel – Top edge of suspension point	74	–	–	Panel width 1050 and higher; 77 mm
q	Bottom edge of radiant panel – Top edge of suspension axis	82	–	–	Panel width 1050 and higher; 94 mm

Connection options

Asymmetrical and symmetrical connections
With freely suspended strips, an asymmetrical water connection can be used. If the system is being installed in a suspended ceiling, a symmetrical connection is advisable in order to ensure even expansion.

Connection at one end or both ends
The position of the connection is usually determined by the conditions of the particular building.

Varying number of pipes laid in parallel
The number of pipes depends on the minimum water flow required for the strip.

	Asymmetrical connection	Symmetrical connection
Connection on one side	 Single pipe layout  Two pipe layout  Multiple pipe layout	 Two pipe layout  Multiple pipe layout
Connection on both sides	 Single pipe layout  Two pipe layout  Multiple pipe layout	 Two pipe layout  Multiple pipe layout

Geschwister Scholl sports hall, Offenburg, Germany

Dimensioning example

Dimensioning basics
The heating load of the room is calculated according to the applicable standard. If the conducted heat lost through the roof is over 30% of the overall heating load, this indicates that significant heat loss is occurring in the ceiling area. If the roof's insulation cannot be improved, the heat insulation on top of the radiant ceiling panels can be removed instead, thus compensating for the considerable amount of conducted heat lost through the roof. If the air exchange rate of a room is above the usual level achieved with gap ventilation (max. 1/h), particularly with extraction systems, the air fed in to the room must be pre-heated. Radiant heating systems alone cannot prevent cold air from entering the room at gates or loading areas. Strip curtains or air curtains, for example, must be used to help rectify this situation.

Example of dimensioning and arrangement
The following example shows how a hall is dimensioned.

Goal
To achieve an even indoor temperature (20°C) throughout the entire room.

Specifications
Free-standing hall:
length 100 m, width 30 m,
height 8 m
Air exchange rate: 0.3 1/h
Outdoor temperature: -12°C

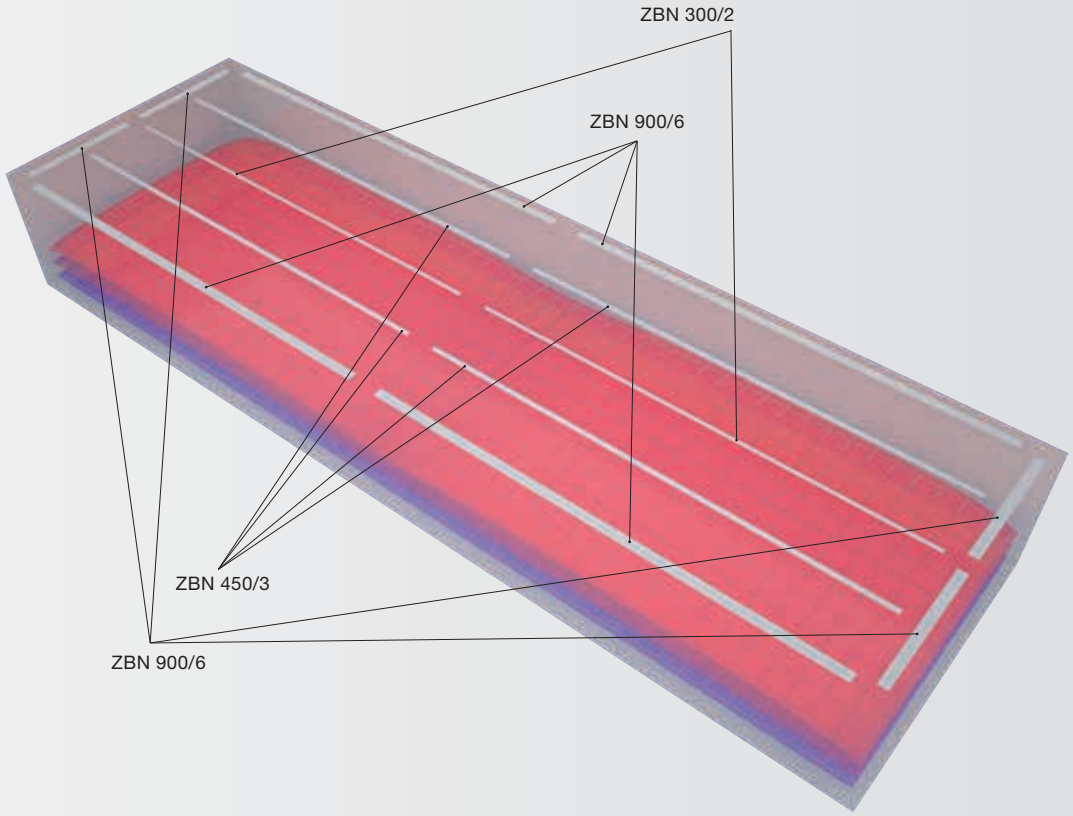
Heating load

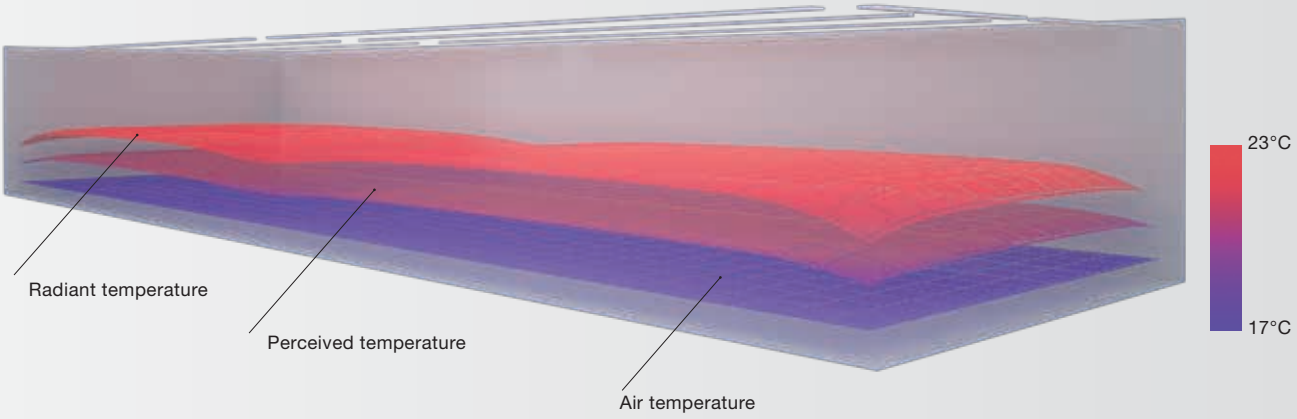
Standard conducted heat loss:	108500 W
Standard air infiltration heat loss:	77260 W
Standard heat loss:	185760 W

Dimensioning of the radiant ceiling panels
Flow temperature: 80°C
Return temperature: 70°C

Type	Installation length	Excessive temperature	Thermal capacity		Quantity	Overall thermal capacity
	m	K	W/m	W/collector pair		W
ZBN 900/6	12.5	55	507	271	4	26434
ZBN 900/6	45	55	507	271	4	92344
ZBN 450/3	45	55	270	131	4	49124
ZBN 300/2	45	55	199	88.7	2	18087
						185989

Arrangement
- 5 radiant panel strips arranged lengthwise, divided into sections in the centre, uniform centre-to-centre distance of 7.2 m, outer strips dimensioned greater than inner ones
- 1 strip at each face end, divided into sections; distance from strips to outer walls 1.5 m.



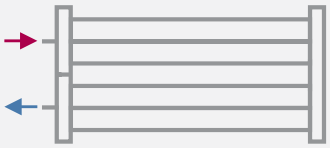


The local distribution of the indoor temperature is calculated for a height of 1 m above the floor. Even at the edges of the room, the indoor temperature deviates from the design value only slightly.

Pressure loss calculation

The overall pressure results of pressure losses from headers and tubes.

Determining the pressure loss:



E. g. ZBN 900/6; 20 m; connection 1"

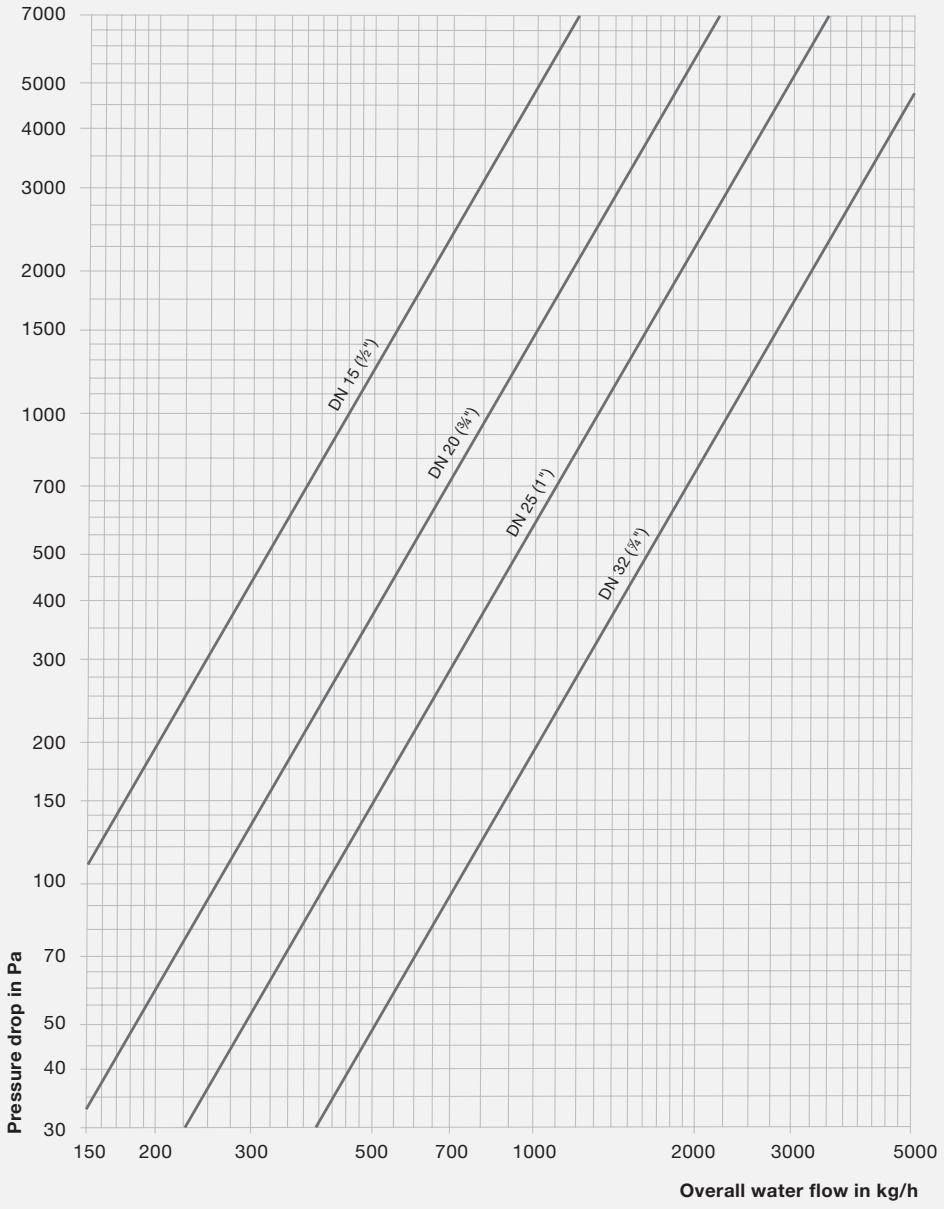
1. Determine the overall mass flow of the radiant ceiling panel concerned. For example, $\dot{m} = 600$ kg/h

2. Refer to the graph for the pressure loss of the header pair. For example, $\Delta p_{\text{header pair}} = 210$ Pa/ header pair, at 600 kg/h and 1" pipe connection

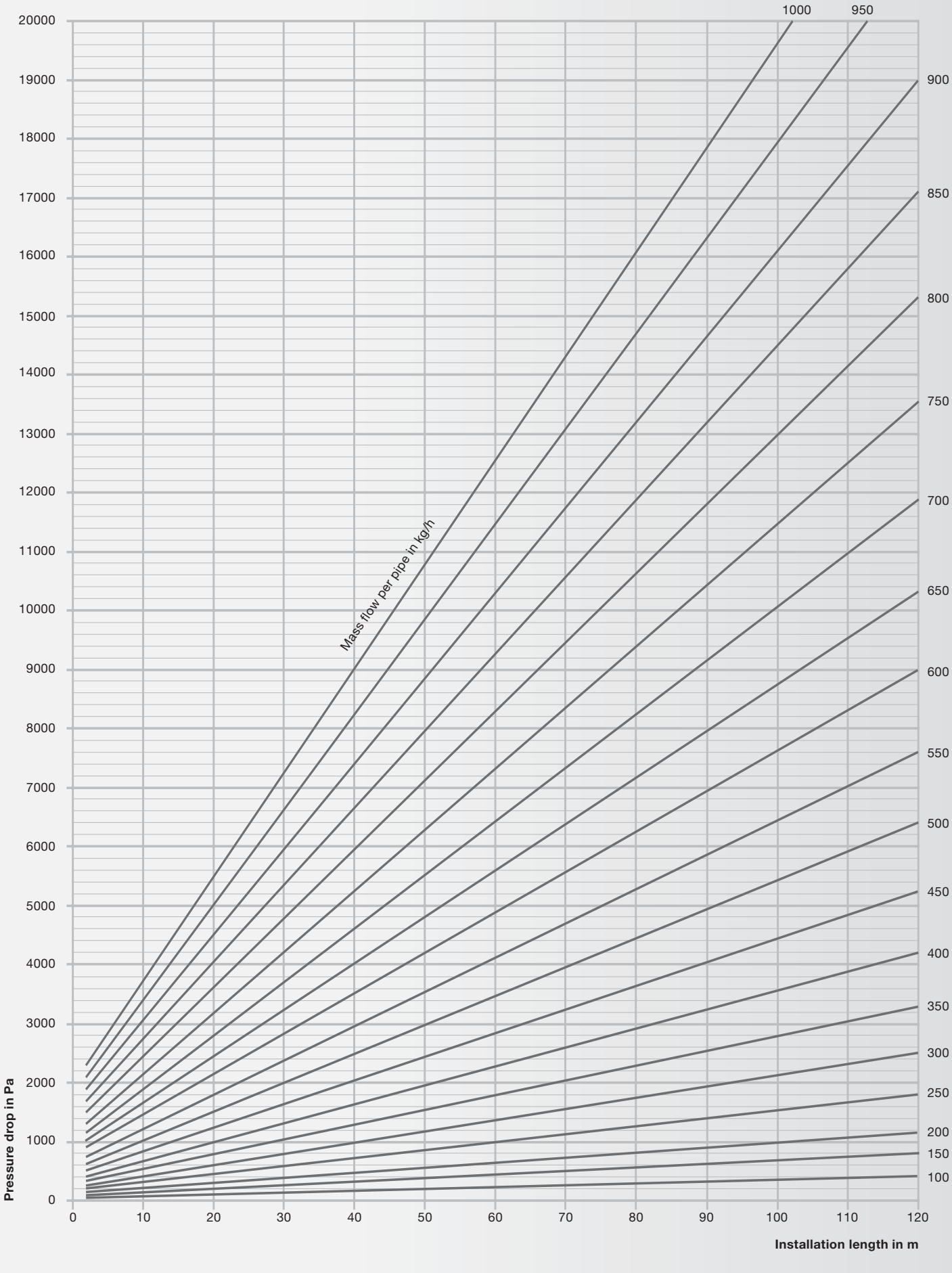
3. Refer to the graph for the pressure loss of the pipe. The mass flow is determined by dividing the overall mass flow by the number of parallel pipes through which water is flowing. For example, 600 kg/h : 3 rows of pipes = 200 kg/h
   $\Delta p_{\text{pipe}} = 300$ Pa · 2 (for flow and return) = 600 Pa

4. The overall pressure loss of the radiant ceiling panel is simply the sum of the individual pressure losses calculated thus far. For example, 210 Pa + 600 Pa = 810 Pa

Pressure loss of the header pair incl. connections



Pressure loss of the pipe



Hydraulic balancing of radiant ceiling panels

Distributing the flow of heating water correctly is important for operating any branched heating or cooling system efficiently.
(It must also be possible to fill, shut off and empty all radiant ceiling panel strips separately.)

For systems where the radiant ceiling panels – and, therefore, the volume flows – are identical, laying pipes according to the Tichelmann system (two-pipe system with reverse return, see **Fig. 1**) will provide a solution with no hydraulic complications. However, the third pipe results in a considerable increase in costs where hall heating systems are concerned and is not advisable in many instances if panels of different sizes are used.

Systems where the individual panels have different outputs must be subjected to hydraulic balancing by means of piping calculations and adjustments. This process, however, demands a significant investment in terms of time and money.

Hydraulic balancing is made much easier with the Zehnder volume flow control combination (VSRK) (**Fig. 2**).

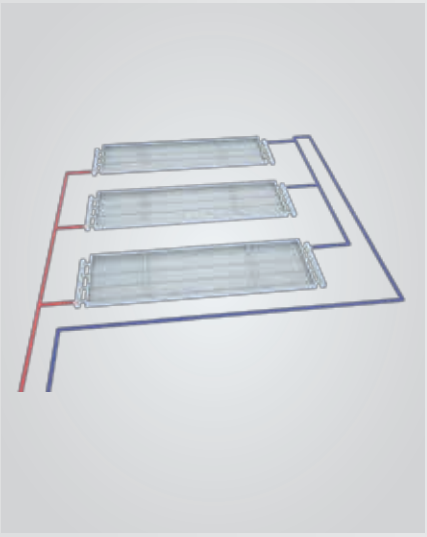


Fig. 1: Pipes laid according to the Tichelmann system (two-pipe system with reverse return)

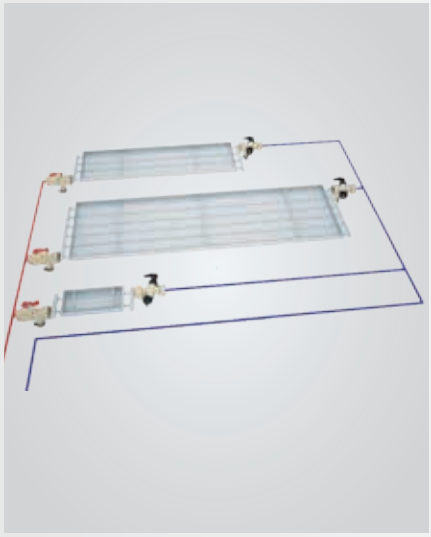


Fig. 2: Simpler pipe layout with Zehnder volume flow control combination (VSRK)

For more information and descriptions:
www.zehnder-systems.com

The Zehnder volume flow control combination VSRK

The VSRK is a complete set consisting of a volume flow controller, shut-off ball valves and filling and emptying ball valves. The headers for the radiant panels can be fitted with appropriate connections on request, so the VSRK can be attached to them directly.

The controller (**Fig. 3**) is set to the volume flow of the strip ex works. This removes the need for any time-consuming adjustment work on site.

Other benefits of the VSRK: constant heating agent flow even when there is a high differential pressure, hydraulic balancing even for radiant panels of different sizes

Volume flow controller DN 25	
Heating water flow (kg/h)	Overall pressure loss (kPa)
150	20.1
180	21.3
210	22.5
240	23.6
270	24.7
300	25.7
330	26.7
360	27.7
390	28.6
420	29.5
450	30.4
480	31.2
510	32.0
540	32.7
570	33.4
600	34.1
630	34.8
660	35.4
690	36.0
720	36.6
750	37.2
780	37.7
810	38.3
840	38.8
870	39.3
900	39.7
930	40.2
960	40.6
990	41.1
1020	41.5
1050	41.9

Volume flow controller DN 32	
Heating water flow (kg/h)	Overall pressure loss (kPa)
600	15.0
700	15.3
800	15.7
900	16.0
1000	16.3
1100	16.7
1200	17.0
1300	17.3
1400	17.7
1500	18.0
1600	18.3
1700	18.7
1800	19.0
1900	19.3
2000	19.7
2100	20.0
2200	20.3
2300	20.7
2400	21.0
2500	21.3
2600	21.7
2700	22.0
2800	22.3
2900	22.7
3000	23.0
3100	23.3
3200	23.7
3300	24.0
3400	24.3
3500	24.7
3600	25.0

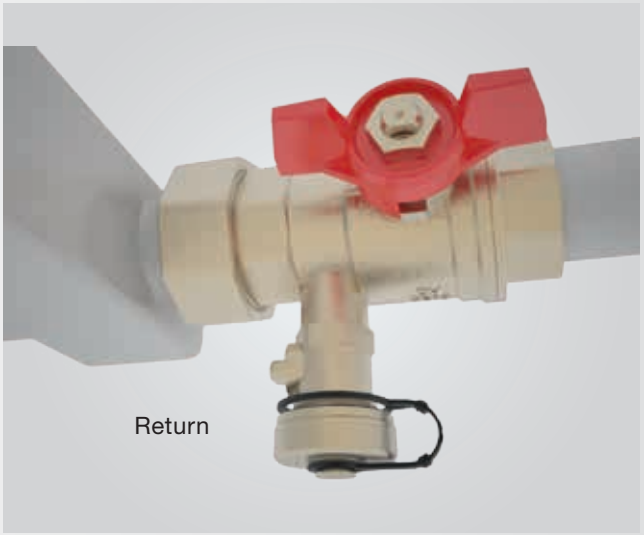


Fig. 3: Zehnder volume flow control combination. The dimensions depend on the welding nozzles used.a

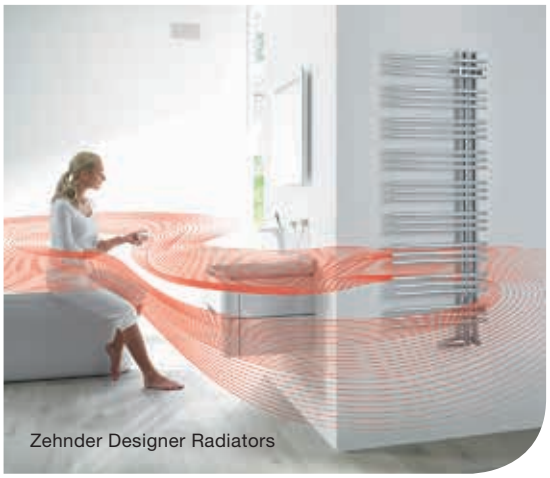
Zehnder – everything you need for comfortable, healthy and energy-efficient indoor living

Heating, cooling, fresh and clean air: at Zehnder, you will find everything you need for comfortable, healthy and energy-efficient indoor living. Zehnder's wide and clearly structured portfolio can offer the right product for any project, be it private, public or commercial, new build or renovation. And where service is also concerned, you'll find that Zehnder is "always around you".

Heating

At Zehnder, Heating doesn't just come in the form of designer radiators. We offer solutions in all shapes and sizes, from radiant ceiling panels to heat pumps with integrated ventilation devices.

- Designer radiators
- Compact energy station with integrated heat pump
- Heating and cooling ceiling systems
- Comfortable indoor ventilation with heat recovery



Zehnder Designer Radiators

Cooling

Zehnder also offers sophisticated solutions for indoor Cooling. These range from cooling ceiling systems to comfortable indoor ventilation with a supply of pre-cooled fresh air.

- Heating and cooling ceiling systems
- Compact energy station with heat pump and brine pipe
- Comfortable indoor ventilation with geothermal heat exchanger for fresh air pre-cooling

Zehnder Heating and Cooling Ceiling Systems

Fresh Air

Fresh Air – a product range with a long tradition at Zehnder. Zehnder Comfosystems provides products and solutions for comfortable indoor ventilation with heat recovery for houses and apartments, for new builds and for renovation projects.

- Comfortable indoor ventilation
- Compact energy station with integrated ventilation device

Zehnder Comfosystems

Clean Air

Zehnder Clean Air Solutions provide Clean Air in buildings which are particularly prone to dust. In residential applications, the comfortable indoor ventilation provided by Zehnder Comfosystems filters external pollutants out of the air.

- Comfortable indoor ventilation with integrated fresh-air filter
- Compact energy station with integrated fresh-air filter
- Systems for clean air

Zehnder Clean Air Solutions

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