

Zehnder ZFP

Planning document for Zehnder Flexible Panels for heating and cooling



Delivering comfort, energy-saving operation and flexibility

Zehnder ZFP radiant ceiling panels heat and cool a building comfortably and efficiently. They can be used in all rooms from approximately 2 m to 50 m in height and compared to other systems, they can achieve energy savings of up to 40%.

Zehnder ZFP radiant ceiling panels are available in many different versions. The individual elements of Zehnder ZFP are designed to form an innovative modular system and can be combined to create a solution specific to the requirements of the project.

Every project is designed according to the wishes of the customer and supplied according to the on-site workflow.

Don't hesitate to get in touch with us if you would like to discuss your requirements.

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Zehnder ZFP – flexibility and efficiency

Bespoke solutions

The flexible modular system offers the perfect heating and cooling solution for every room.

Maximum corrosion resistance

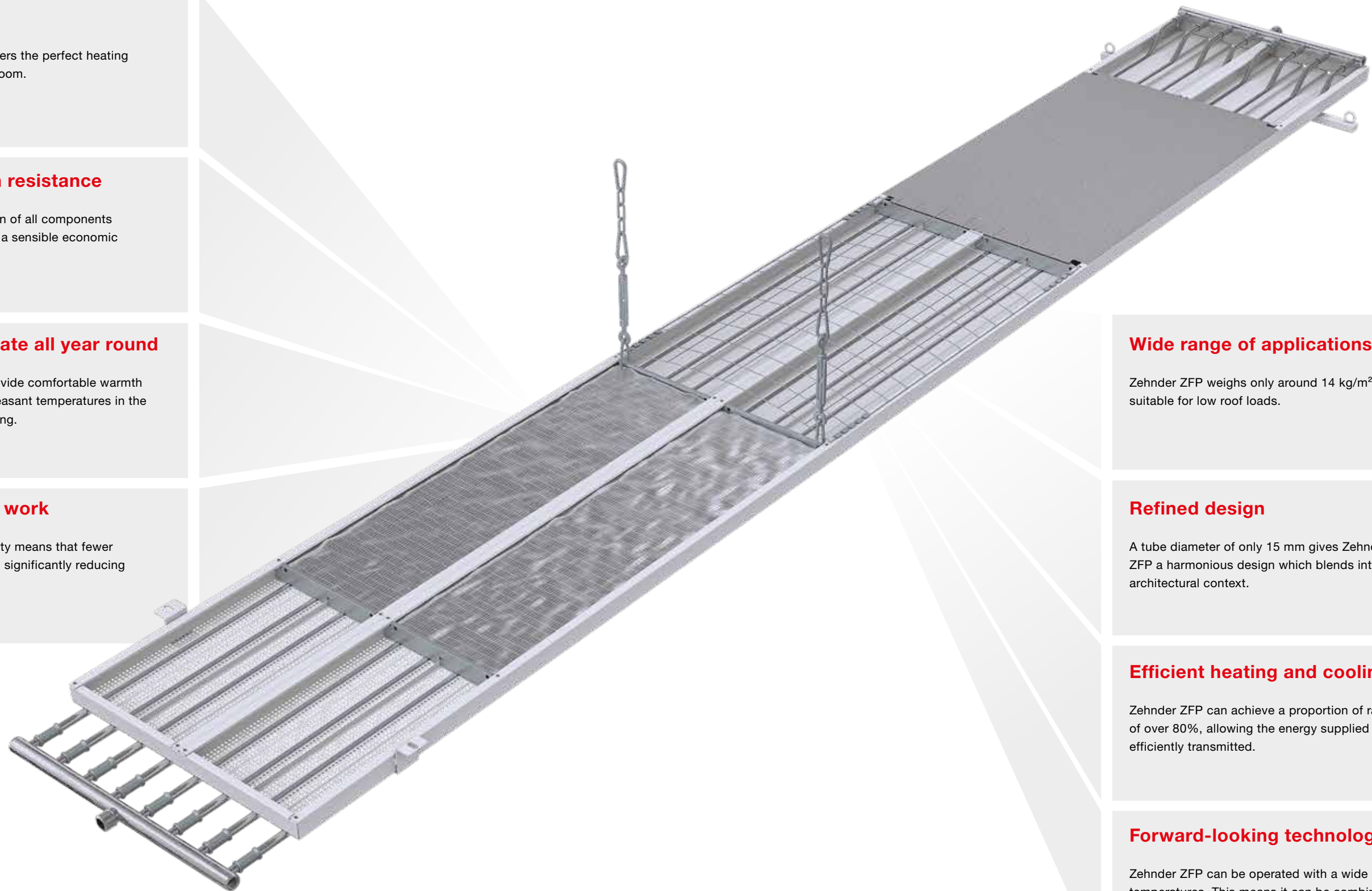
The systematic full galvanisation of all components guarantees a long service life – a sensible economic investment for the future.

Optimal indoor climate all year round

Not only does Zehnder ZFP provide comfortable warmth in the winter, it also ensures pleasant temperatures in the summer with draught-free cooling.

Minimal installation work

The modules' impressive stability means that fewer suspension points are required, significantly reducing installation time.



Wide range of applications

Zehnder ZFP weighs only around 14 kg/m², so it is even suitable for low roof loads.

Refined design

A tube diameter of only 15 mm gives Zehnder ZFP a harmonious design which blends into any architectural context.

Efficient heating and cooling

Zehnder ZFP can achieve a proportion of radiation of over 80%, allowing the energy supplied to be efficiently transmitted.

Forward-looking technology

Zehnder ZFP can be operated with a wide range of system temperatures. This means it can be combined with modern heat pumps, which have lower flow temperatures, without any issues.

Heating and cooling according to the modular principle: Zehnder ZFP

The diverse nature of contemporary projects means that customised heating and cooling solutions are required. The dimensions of the space and the way the building is used are the primary factors when it comes to designing the system layout and selecting from the various installation options. With ZFP, Zehnder has developed a modular system that offers maximum flexibility. The individual product components can be combined in different ways according to the specific project requirements.

Why not explore the wide range of options we can offer? We will be delighted to support your planning efforts.

Zehnder ZFP modular design

Product information

Performance parameters

- ▲ ■ Heating and cooling performance
- ▲ ■ Temperature limit
- ▲ ■ Minimum mass flow Inclination

Structure and dimensions

- ▲ ■ Dimensions
- ▲ ■ Connector technology

Hydraulics

- ▲ ■ Headers / collectors
- ▲ ■ Pressure loss calculation
- ▲ ■ Hydraulic balancing
- Volume flow controller

Individual solutions

Surface

- ▲ Smooth
- ■ Perforation
- ▲ Standard colour
- ■ Special colour

Thermal insulation

- ▲ Aluminium-laminated mineral wool
- Mineral wool in foil
- Acoustic insulation
- ■ Sound absorption

Ceiling fixture

- Wooden ceiling
- Concrete ceiling
- Steel profile
- Trapezoidal sheet metal
- Steel girders (angled/horizontal)
- Reinforcement axes / Variable axes
- Z-profiles
- Support tracks

Covers

- ▲ ■ Cover plate
- Ball guards
- Dust protector panel
- ■ End cover header
- ■ Raised headers

Special requirements

- Non-continuous radiant plate
- Cut-outs for fixtures
- Thermal radiation shield

Additional components

- Control system technology
- ▲ ■ LED lighting

- Example: Modular system for a sports hall
- ▲ Example: Modular system for a warehouse
- Example: Modular system for a showroom

● Example: Sports hall

Perforation and acoustic insulation

- Optimised properties for room acoustics
- Low reverberation
- Attractive look

Ball guards

- Sports activities are not affected by loss of balls
- Ball impact resistance to DIN 18032

Raised headers

- Connections not visible
- Integrated ceiling solution possible
- Uniform appearance

Special colour

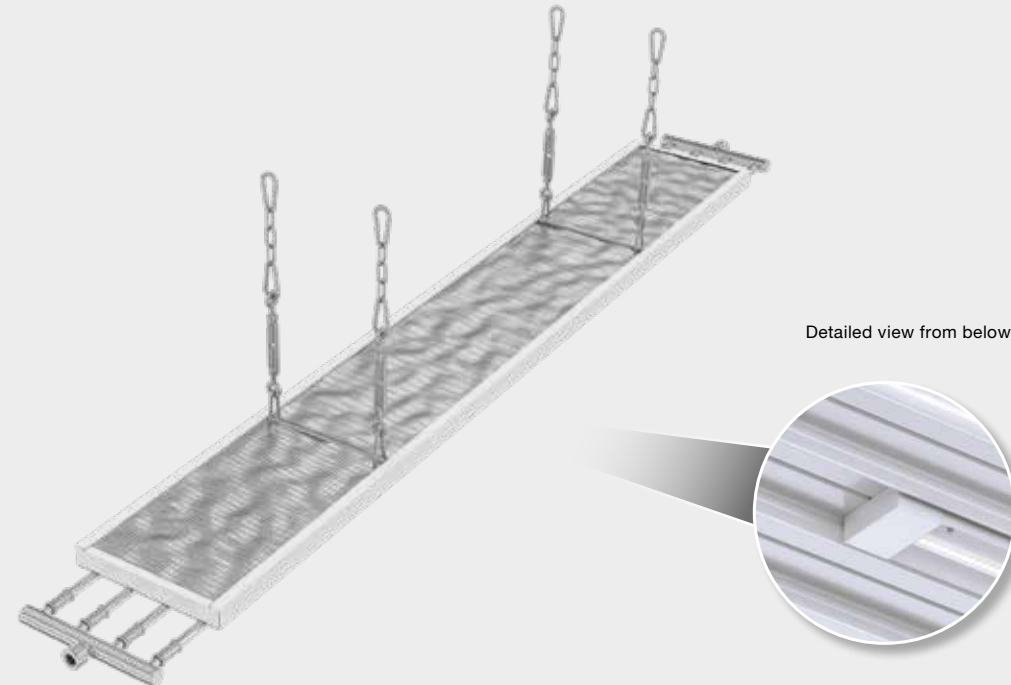
- Available in over 700 colours



▲ Example: Warehouse

⊕ Model width

- Narrow design – ideal for high-bay warehouses
- Radiant heat used according to requirements
- Can be used in combination with sprinkler systems



⊕ LED lights

- Perfect lighting for the warehouse
- Individual lighting calculations
- Lighting integrated into modules



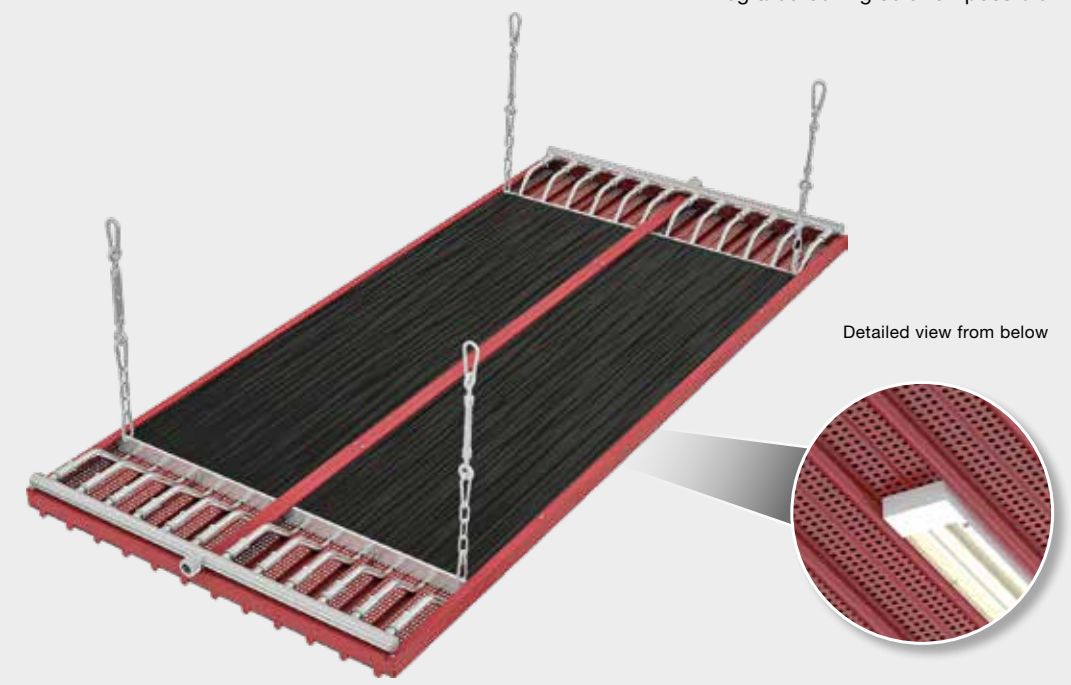
■ Example: Showroom

⊕ Perforation and acoustic insulation

- Optimised properties for room acoustics
- Low reverberation
- Attractive look

⊕ Raised headers

- Connections not visible
- Integrated ceiling solution possible



⊕ Special colour

- Available in over 700 colours

⊕ LED lights

- Perfect lighting for the showroom
- Individual lighting calculations
- Harmonious look as lighting is integrated into the radiant panel system



Heating and cooling performance

The following tables show the heating and cooling performance of the Zehnder ZFP radiant ceiling panels depending on the heating Delta T and the cooling Delta T. The thermal output values have been stated according to DIN EN 14037-3, while the measurement results for the cooling capacity are based on DIN EN 14037-4.

Note: removing the insulation has a positive effect on the cooling capacity. Removing the insulation increases the thermal output, but can lead to heat accumulation under the ceiling. Zehnder ZFP radiant ceiling panels can be used for cooling at any time, as all components are supplied in galvanised or completely galvanised versions.

Output $\dot{Q} = K \cdot \Delta T^n$

The heating Delta T and cooling Delta T can be calculated arithmetically:

$$t_i = t_p = \frac{(t_s + t_A)}{2}$$
$$\Delta T_{\text{heat}} = \frac{(t_{\text{HFT}} + t_{\text{HRT}})}{2} - t_i$$
$$\Delta T_{\text{cool}} = t_i - \frac{(t_{\text{CFT}} + t_{\text{CRT}})}{2}$$

Legend

- t_A Air temperature (°C)
- t_S Surrounding surface temperature (°C)
= average radiant temperature
= average surface temperature
of all surfaces in the surrounding area (°C)
- t_i = t_p Room temperature (°C)
= perceived temperature (°C)
- t_{HFT} Heating flow temperature (°C)
- t_{HRT} Heating return temperature (°C)
- t_{CFT} Cooling flow temperature (°C)
- t_{CRT} Cooling return temperature (°C)
- ΔT_{heat} Heating Delta T (K)
- ΔT_{cool} Cooling Delta T (K)
- K Constant
- n Exponent
- Q̇ Output
- Q̇_{TTO} Total thermal output
- s Inclination correction factor

Physical units

- Degree centigrade (°C)
- Kelvin (K)
- Cubic metre (m³)
- Metre (m)
- Millimetre (mm)
- Pascal (Pa)
- Kilogram (kg)

Cooling capacity with insulation									
	300/4	450/6	600/8	750/10	900/12	1050/14	1200/16	1350/18	1500/20
K n	2.752	4.000	5.247	6.383	7.518	8.653	9.789	11.006	12.224
	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
ΔT _{cool} (K)	W/m	W/m	W/m	W/m	W/m	W/m	W/m	W/m	W/m
15	54	79	103	126	148	170	193	216	240
14	50	73	96	116	137	158	178	201	223
13	46	67	88	107	126	145	164	185	205
12	42	62	81	98	116	133	151	169	188
11	38	56	73	89	105	121	137	154	171
10	35	50	66	80	95	109	123	139	154
9	31	45	59	72	84	97	110	123	137
8.5	29	42	55	67	79	91	103	116	129
8	27	39	52	63	74	85	96	108	120
7	23	34	45	54	64	74	83	94	104
6	20	29	38	46	54	62	70	79	88
5	16	23	31	37	44	51	57	65	72

Thermal output with insulation																		
	300/4		450/6		600/8		750/10		900/12		1050/14		1200/16		1350/18		1500/20	
K n	1.695	0.413	2.420	0.613	3.170	0.760	3.839	1.031	4.517	1.334	5.204	1.671	5.899	2.044	6.732	2.087	7.600	2.098
	1.193	1.219	1.188	1.251	1.184	1.282	1.182	1.267	1.181	1.252	1.179	1.237	1.177	1.222	1.172	1.249	1.166	1.277
ΔT _{heat} (K)	W/m	W/MP	W/m	W/MP	W/m	W/MP	W/m	W/MP	W/m	W/MP	W/m	W/MP	W/m	W/MP	W/m	W/MP	W/m	W/MP
90	363	100	508	170	652	243	784	308	916	373	1048	436	1179	498	1311	576	1443	655
88	354	97	495	166	635	236	764	300	892	362	1020	424	1148	485	1277	560	1406	637
86	344	94	482	161	618	229	743	291	868	352	993	412	1118	471	1243	544	1369	618
84	335	92	468	156	601	223	723	283	845	342	966	400	1087	458	1210	528	1331	600
82	325	89	455	152	584	216	703	274	821	332	939	389	1057	445	1176	513	1295	582
80	316	86	442	147	567	209	682	266	797	322	912	377	1026	432	1142	497	1258	564
78	306	84	429	142	551	202	662	257	774	312	885	365	996	418	1109	482	1221	546
76	297	81	416	138	534	196	642	249	751	302	858	354	966	405	1076	466	1185	528
74	288	79	403	133	517	189	622	241	727	292	832	342	936	392	1043	451	1149	510
72	278	76	390	129	501	183	603	233	704	282	805	331	907	379	1010	436	1112	493
70	269	73	377	124	485	176	583	224	681	272	779	320	877	367	977	421	1077	475
68	260	71	364	120	468	170	563	216	658	262	753	308	848	354	944	406	1041	458
66	251	68	352	116	452	163	544	208	635	253	727	297	818	341	912	391	1005	441
64	242	66	339	111	436	157	524	200	613	243	701	286	789	329	880	376	970	424
62	233	63	326	107	420	151	505	192	590	234	675	275	760	316	847	362	934	407
60	224	61	314	103	404	145	486	185	568	224	649	264	731	304	815	347	899	391
58	215	58	302	98	388	138	467	177	545	215	624	253	703	291	784	333	865	374
56	206	56	289	94	372	132	448	169	523	206	599	242	674	279	752	318	830	358
55	202	55	283	92	364	129	438	165	512	201	586	237	660	273	736	311	813	349
54	198	54	277	90	356	126	429	161	501	197	574	232	646	267	721	304	795	341
52	189	51	265	86	341	120	410	154	479	188	549	221	618	255	690	290	761	325
50	180	49	253	82	325	114	392	146	458	179	524	211	590	243	659	276	727	309
48	172	46	241	78	310	109	373	139	436	170	499	200	562	231	628	263	693	294
46	163	44	229	74	295	103	355	132	415	161	475	190	535	220	597	249	660	278
44	155	42	217	70	280	97	337	125	394	152	451	180	508	208	567	236	626	263
42	146	39	205	66	265	92	319	117	373	144	427	170	481	196	537	222	593	248
40	138	37	194	62	250	86	301	110	352	135	403	160	454	185	507	209	561	233
38	130	35	182	58	235	81	283	103	331	127	379	150	427	174	478	196	528	218
36	122	33	171	54	221	75	266	97	311	118	356	140	401	163	448	183	496	203
34	114	30	160	50	206	70	248	90	290	110	332	131	375	152	419	171	464	189
32	106	28	149	47	192	65	231	83	270	102	310	121	349	141	390	158	432	175
30	98	26	138	43	178	59	214	77	250	94	287	112	323	130	362	146	401	161
28	90	24	127	40	164	54	197	70	231	86	264	103	298	120	334	134	370	148
26	83	22	116	36	150	49	181	64	212	79	242	94	273	109	306	122	339	134
24	75	20	106	33	136	45	164	58	192	71	221	85	249	99	279	110	309	121
22	68	18	95	29	123	40	148	52	174	64	199	76	224	89	252	99	279	109
20	60	16	85	26	110	35	133	46	155	57	178	68	201	79	225	88	250	96
18	53	14	75	23	97	31	117	40	137	50	157	60	177	70	199	77	221	84
16	46	12	65	20	84	27	102	35	119	43	137	52	154	60	173	67	193	72
14	39	10	56	17	72	22	87	29	102	36	117	44	132	51	148	56	165	61
12	33	9	46	14	60	18	72	24	85	30	97	36	110	43	124	46	138	50
10	26	7	37	11	48	15	58	19	68	24	79	29	89	34	100	37	111	40

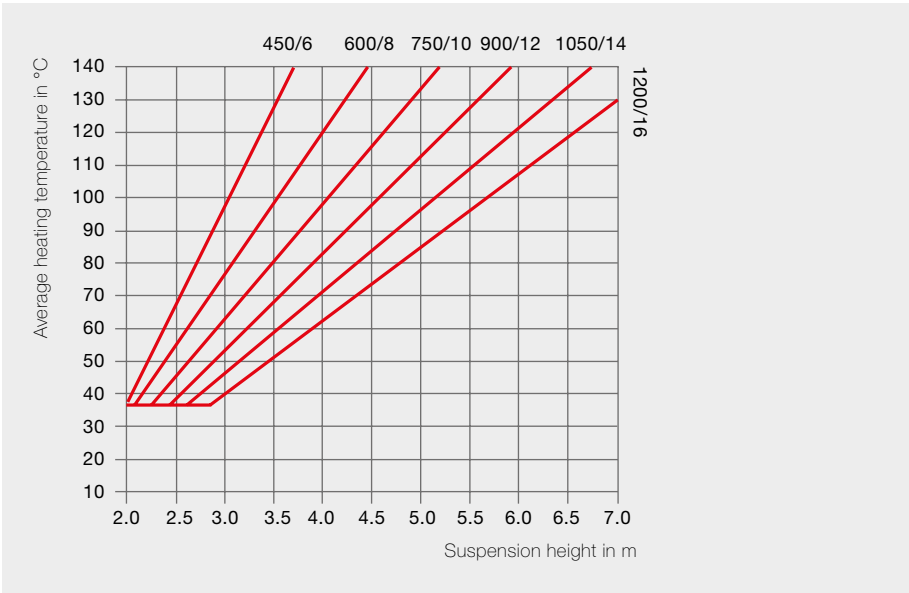
MP = manifold pair

Temperature limits

The right design temperature must be selected so that the radiant system can maintain a comfortable indoor climate. You can use the following table and graph to check this design temperature, which must be lower than the temperature limit (average heating temperature). Higher temperature limits can be used for rooms and corridors where people do not spend a great deal of time.

Temperature limits						
Height	Proportion of the ceiling surface covered by Zehnder ZFP radiant ceiling panels					
m	10%	15%	20%	25%	30%	35%
Average heating 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.

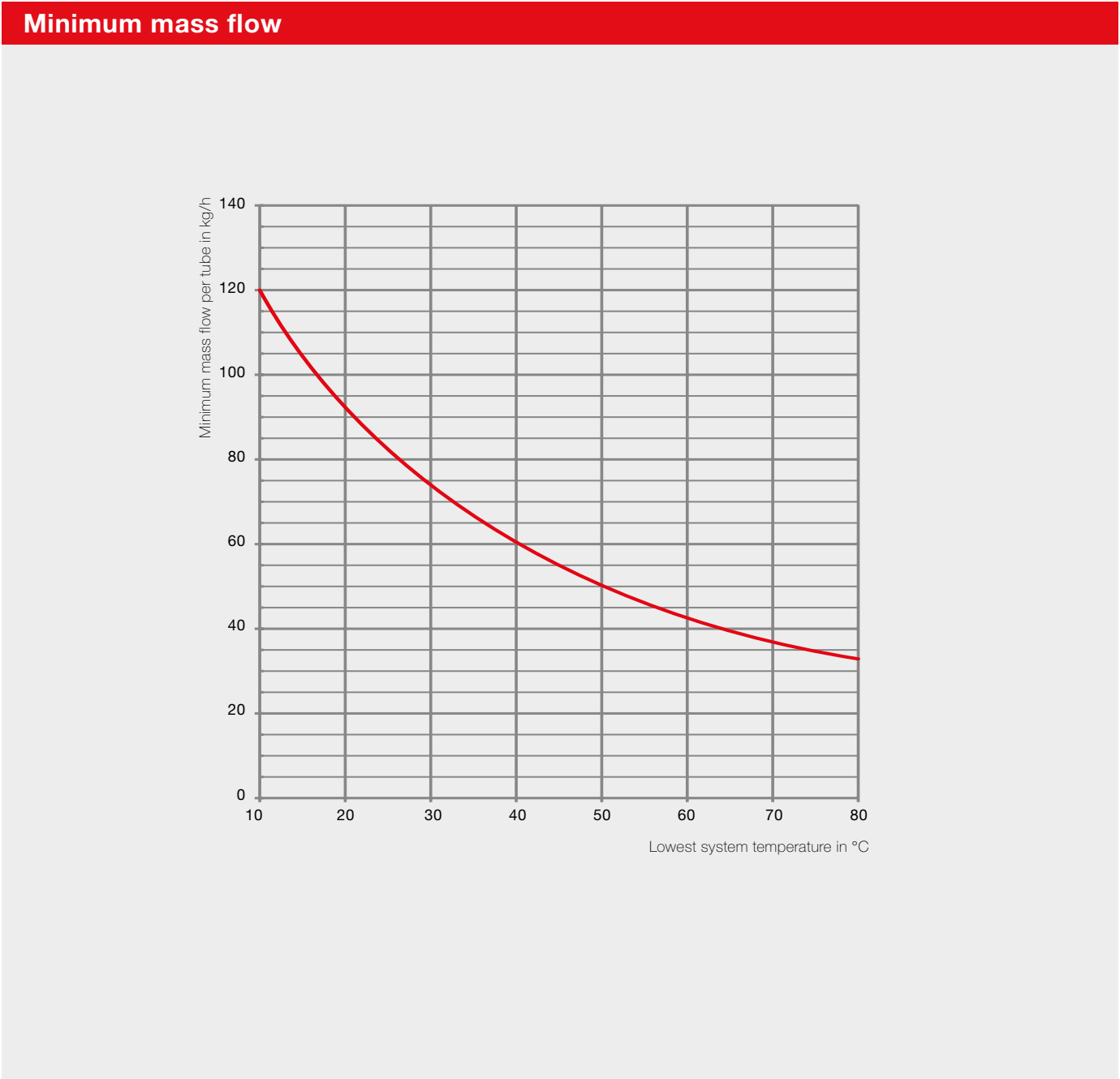


Step 2: Width of the radiant panel. The design temperature must not exceed the defined thresholds.

The specifications are approximate. A detailed calculation can be performed according to ISO 7730.

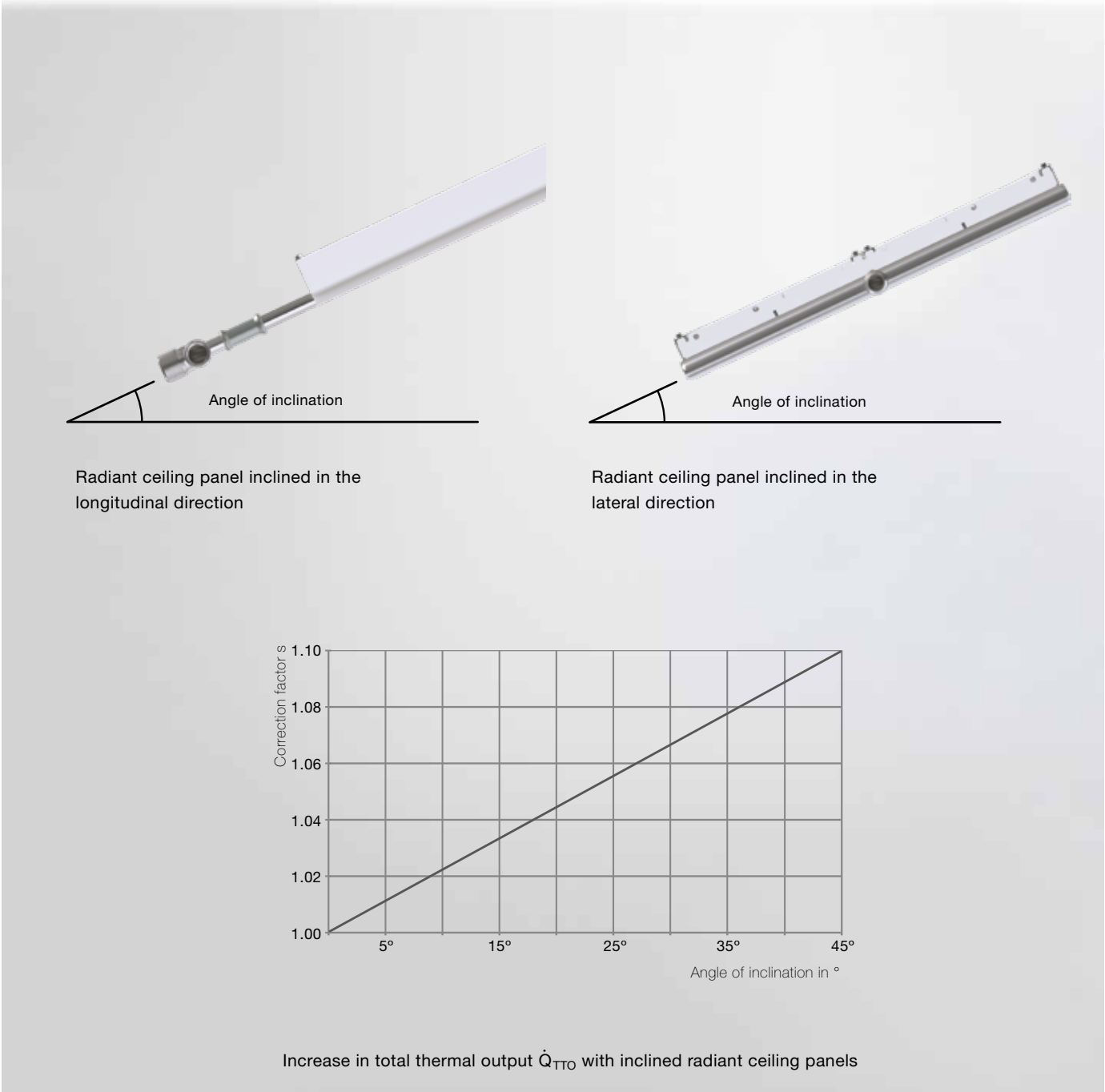
Minimum mass flow

To maintain the output shown in the table, a turbulent flow must be ensured within the tubes in the modules. The minimum mass flow required for this depends on the lowest system temperature. When heating, this corresponds to the return temperature. When cooling or in a combined cooling/heating mode, this corresponds to the cooling flow temperature. If the minimum mass flow per tube is not achieved, this can result in a drop in performance of around 15%.



Inclination

Depending on the design of the room, radiant ceiling panels can be inclined in the lateral or longitudinal direction. Inclining the radiant ceiling panel increases the output according to the formula $\dot{Q}_{TTO} = \dot{Q} \cdot s$. This increase in output must be taken into account accordingly when calculating the mass flow. The maximum permitted angles of inclination depend on the suspension technology.

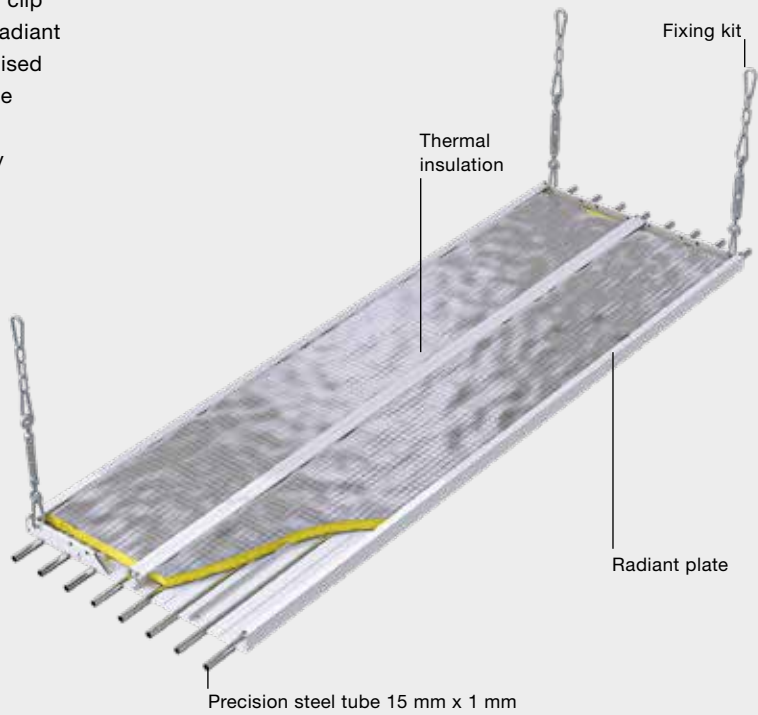


Structure and dimensions

Structure of the module

A galvanised steel sheet with Zehnder special clip profiling forms the basis of the Zehnder ZFP radiant ceiling panel. Four to twenty externally galvanised precision steel tubes, suspension axes and the top heat insulation are then embedded into it. The radiant ceiling panel is optimally statically reinforced using chamfers, special duplications, clinched joints and edgings.

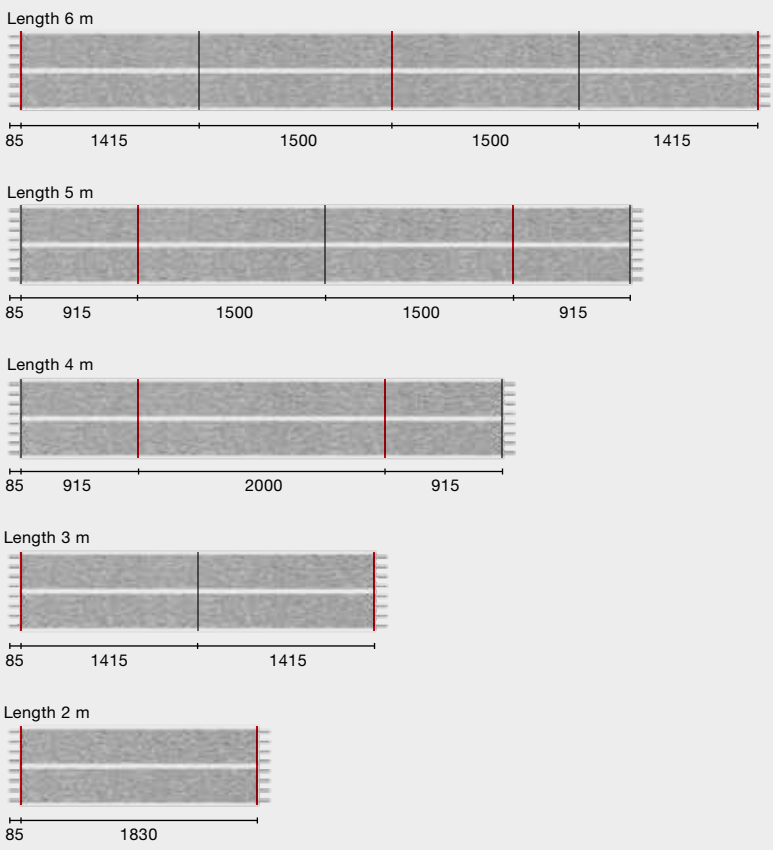
Zehnder ZFP radiant ceiling panels are supplied with a smooth or perforated design. The surface is galvanised and also coated with a high-quality polyester paint (similar to RAL 9016 matt).



Standard lengths

Zehnder ZFP modules are available in standard lengths of 2, 3, 4, 5 and 6 m. Longer strips can be created by connecting multiple modules in a row.

Special lengths are available on request.

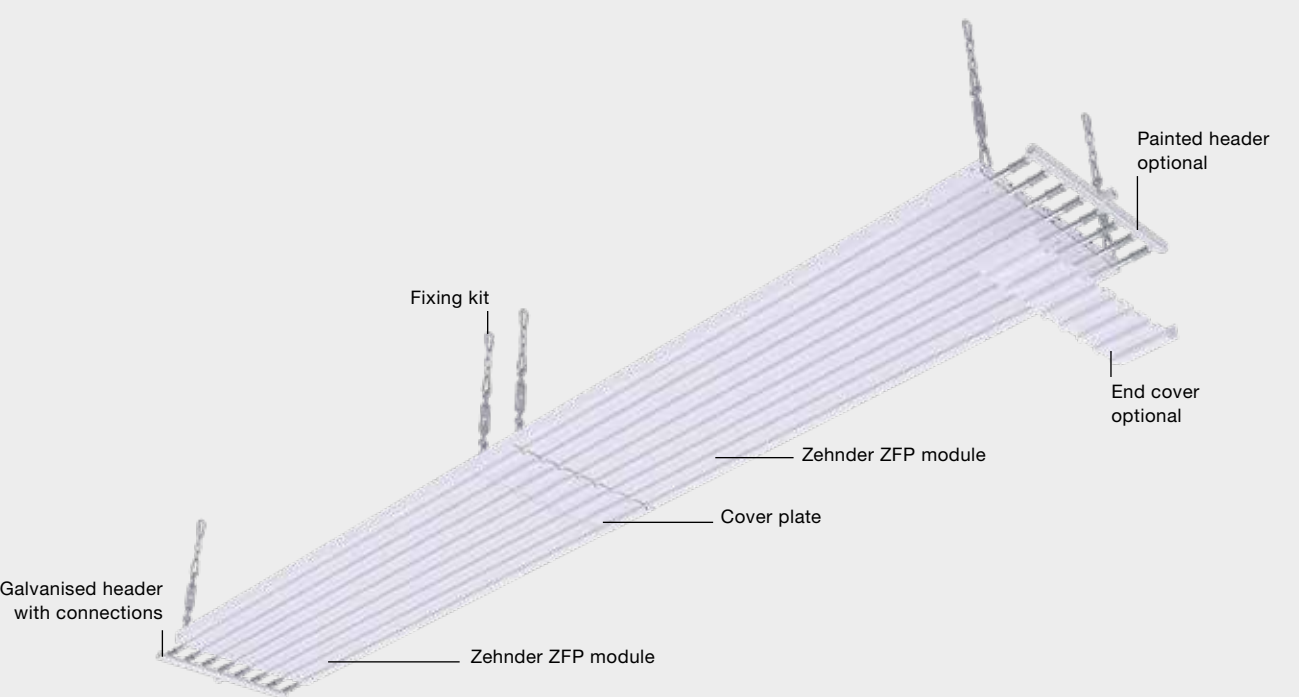
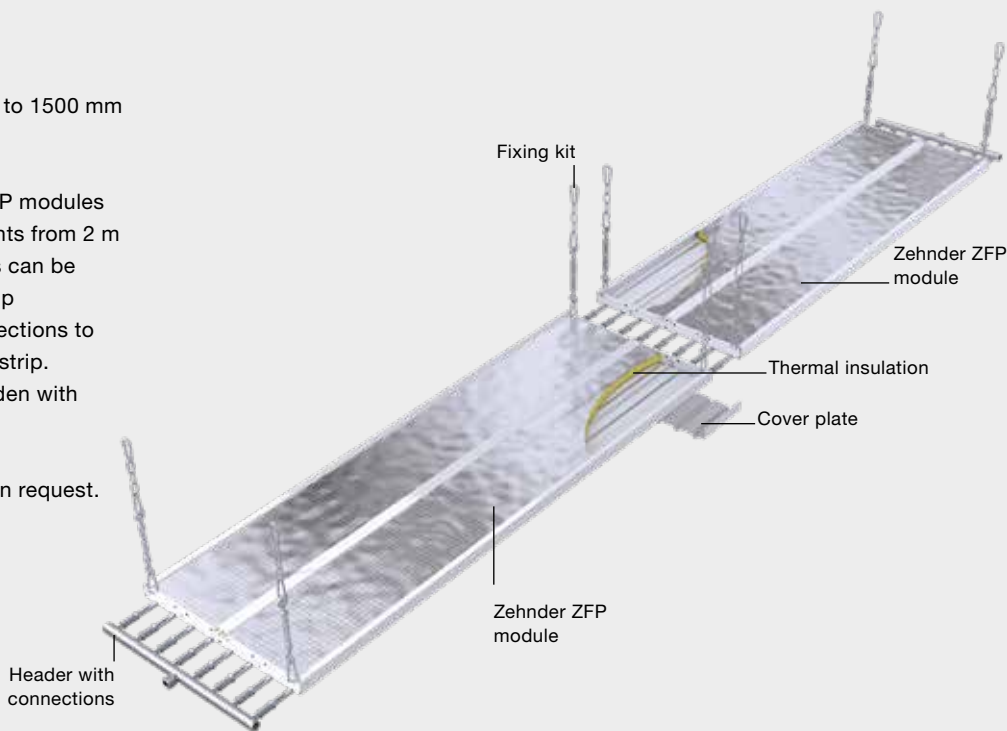


Design

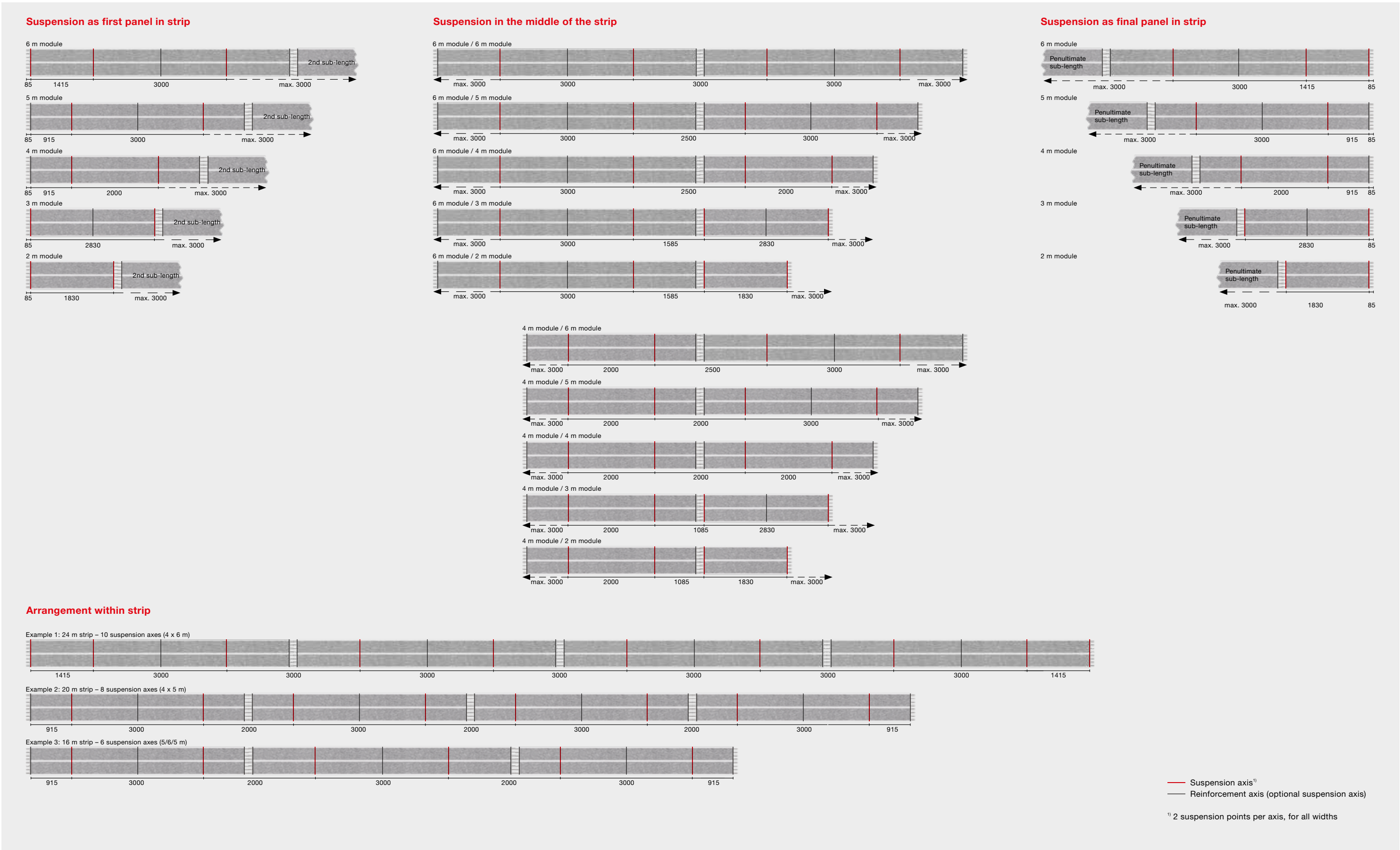
Zehnder ZFP modules are 300 to 1500 mm wide.

In terms of length, Zehnder ZFP modules are available in metre increments from 2 m to 6 m. The individual modules can be connected together using crimp connections or threaded connections to form one radiant ceiling panel strip. The connection points are hidden with cover plates.

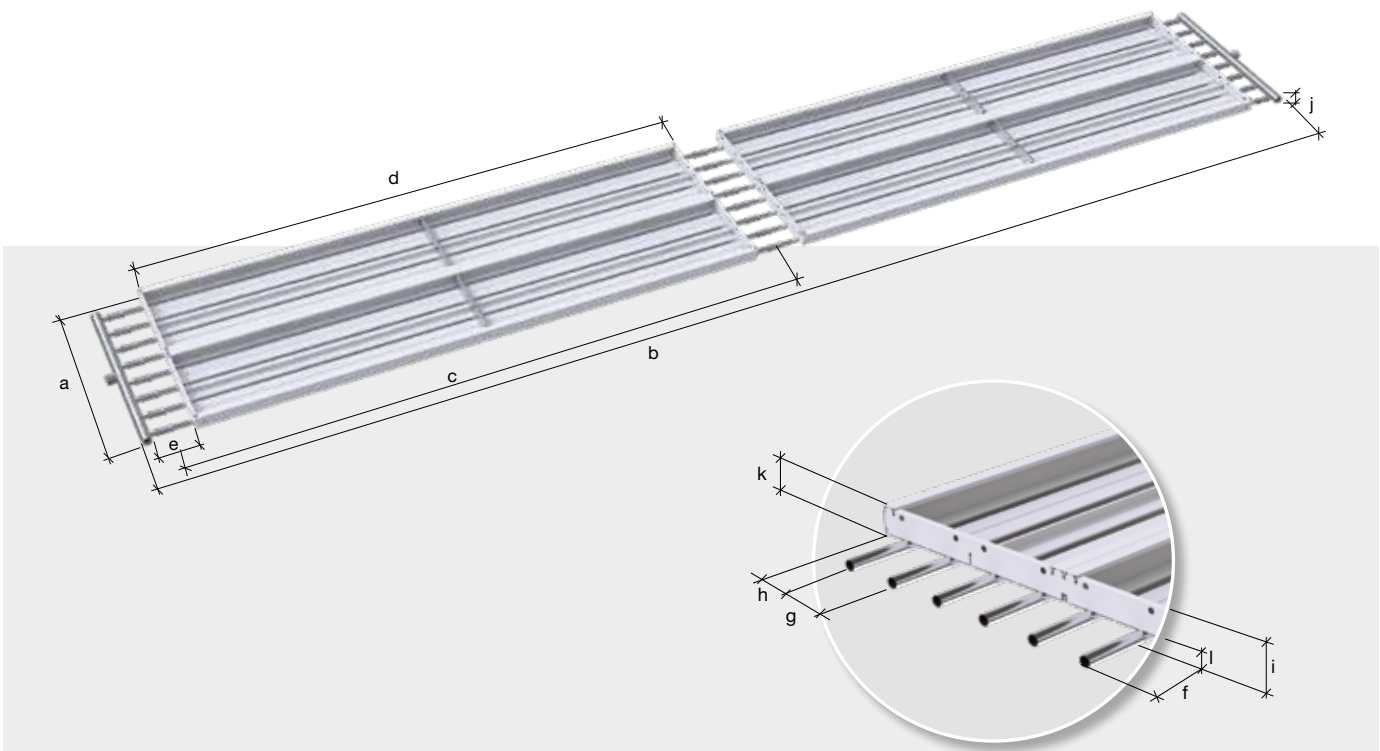
Special lengths are available on request.



Combination options



Module dimensions



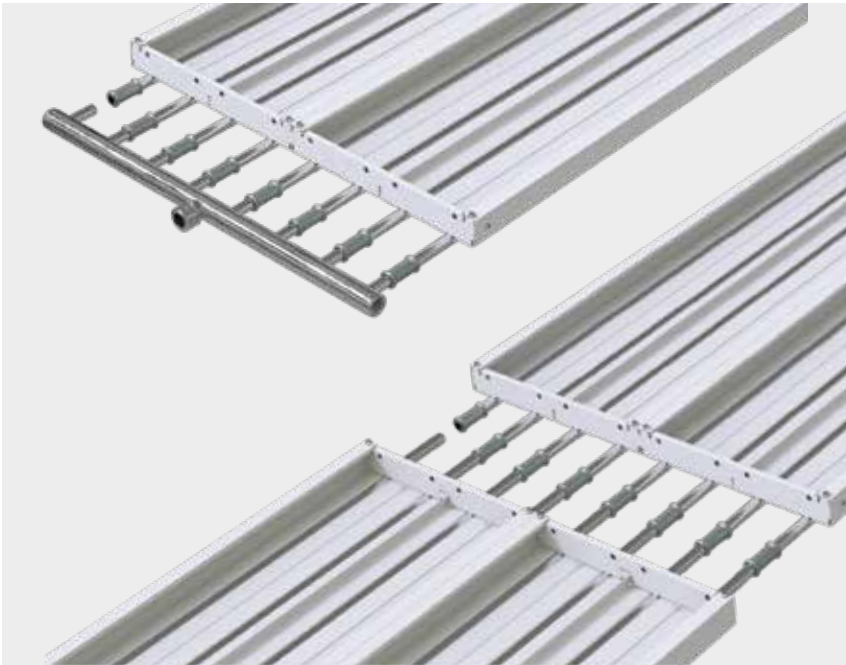
Module dimensions

Item	Description	Dimension in mm	Min. dimension in mm	Max. dimension in mm	Note
a	Overall width	Variable	300	1500	Grid size: 150 mm
b	Overall length (without connections)	Variable	2140	- 1)	Grid size: 1000 mm
c	Length of individual element / length of tube	Variable	2000	6000	Grid size: 1000 mm
d	Radiant plate length of individual section	Variable	1830	5830	Grid size: 1000 mm
e	Distance from module end to collector tube	125	-	-	-
f	Tube projection	85	-	-	-
g	Distance from tube centre to tube centre	75	-	-	-
h	Distance from tube to side lip	37.5	-	-	-
i	Overall height (without suspension)	55	-	-	-
j	Diameter of header	30	-	-	-
k	Height of side lip	42	-	-	-
l	Height of tube beading	13	-	-	-

1)The maximum possible overall length of the Zehnder ZFP strip depends on the operating conditions and the permitted pressure loss.

Connector technology

The Zehnder ZFP modules are assembled into the desired configuration by means of press-fit or threaded connections and the connection points are then hidden under a cover plate. Galvanised headers are supplied.



Crimp connection

Article no. 502280

Max. operating temperature: 120 °C
Max. operating pressure: 12 bar

Fitting length: 48 mm



Threaded connection

Article no. 633010

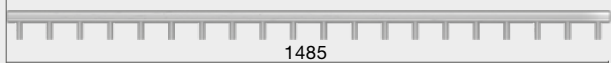
Max. operating connection: 95 °C
Max. operating pressure: 5 bar

Fitting length: 66 mm

Headers and collectors

The galvanised headers and collectors are pressed or bolted together with the externally galvanised tubes (as per DIN EN 10305-3) of the Zehnder ZFP modules.

Collector 20
Article no. 514350



Collector 18
Article no. 514340



Collector 16
Article no. 514330



Collector 14
Article no. 514320



Collector 12
Article no. 514310



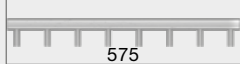
Collector 10
Article no. 514300



Collector 9
Article no. 514290



Collector 8
Article no. 514280



Collector 7
Article no. 514270



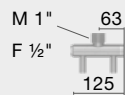
Collector 6
Article no. 514260



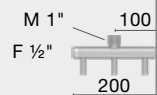
Collector 5
Article no. 514250



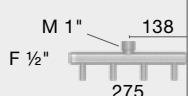
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Article no. 514240



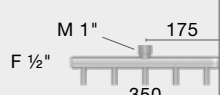
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Header 3
Article no. 514110



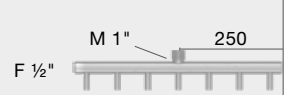
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Article no. 514120



Header 5
Article no. 514130



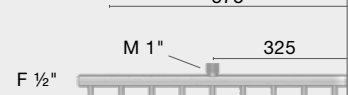
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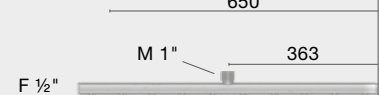
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Article no. 514150



Header 8
Article no. 514160



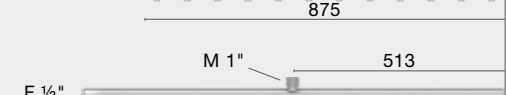
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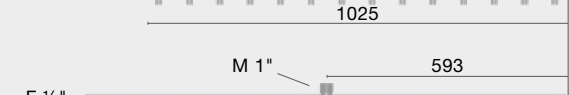
Header 10
Article no. 514180



Header 12
Article no. 514190



Header 14
Article no. 514200



Header 16
Article no. 514210



Header 18
Article no. 514220



Header 20
Article no. 514230

F = female thread
M = conical male thread
Zehnder accepts no liability for the use of other connections.

Maximum flexibility – example of water channels for model 600/8

Water channels at opposite ends



Water channels at the same end



Layout basics

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

Thermal output calculation						
Type	Length in m	Excess temperature in K	Output in W/m	Output in W/manifold pair	Quantity	Total thermal output in W
ZFP 900/12	13	55	512	201	4	27446
ZFP 900/12	44	55	512	201	4	90973
ZFP 450/6	44	55	283	92	4	50197
ZFP 300/4	44	55	202	55	2	17880
						186497 W

Example of layout and arrangement
The following example shows the layout of a sports hall.

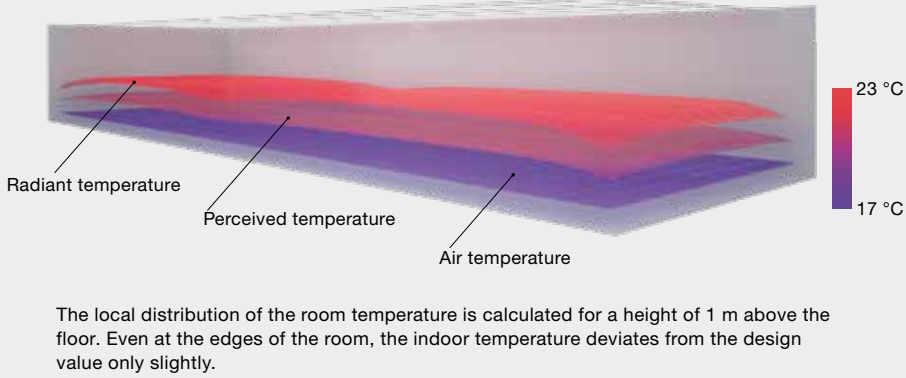
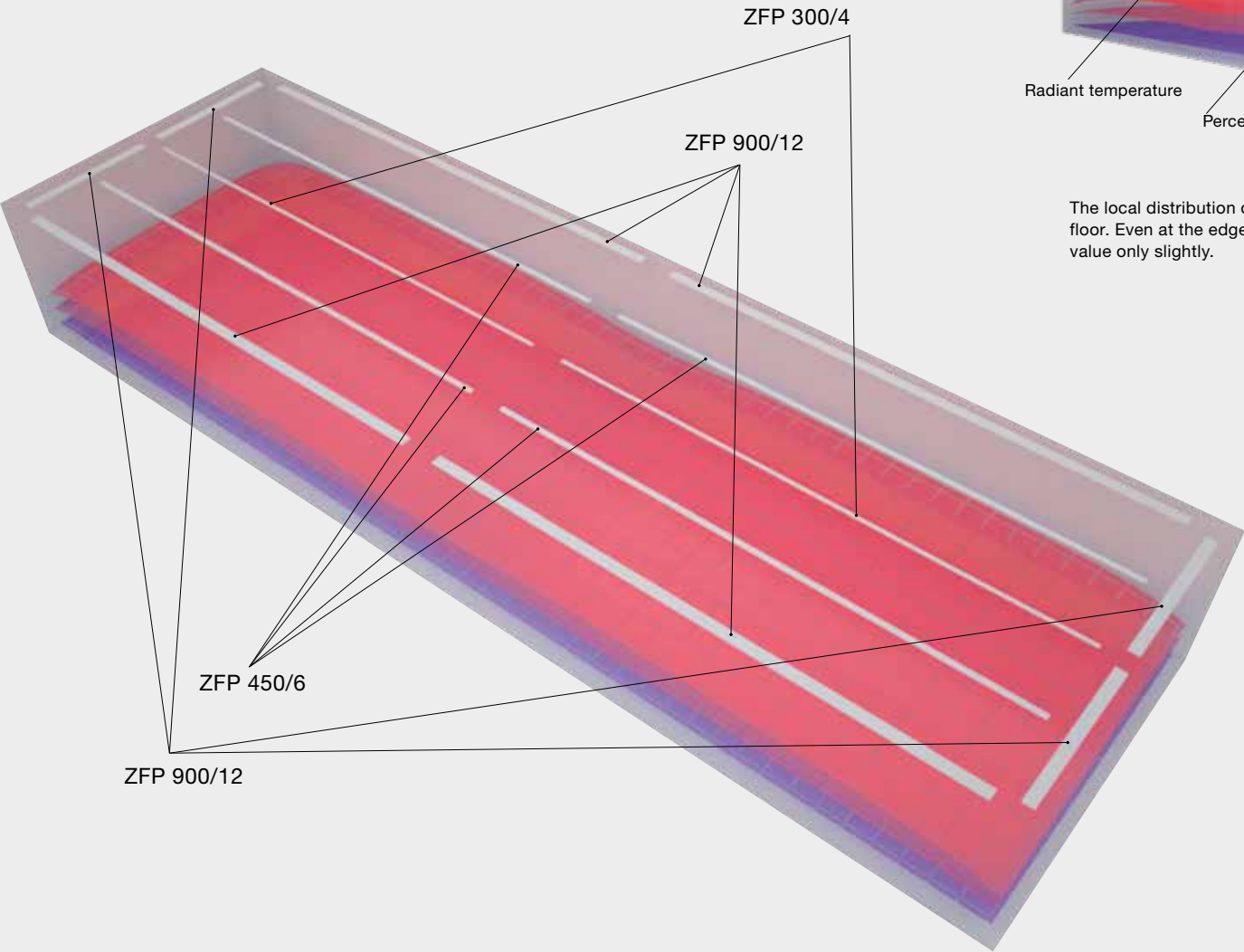
Objective
Even indoor temperature (20 °C) throughout the entire room.

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

Heat load
Design transmission heat loss: 108500 W
Design ventilation heat loss: 77260 W
Design heat loss: 185760 W

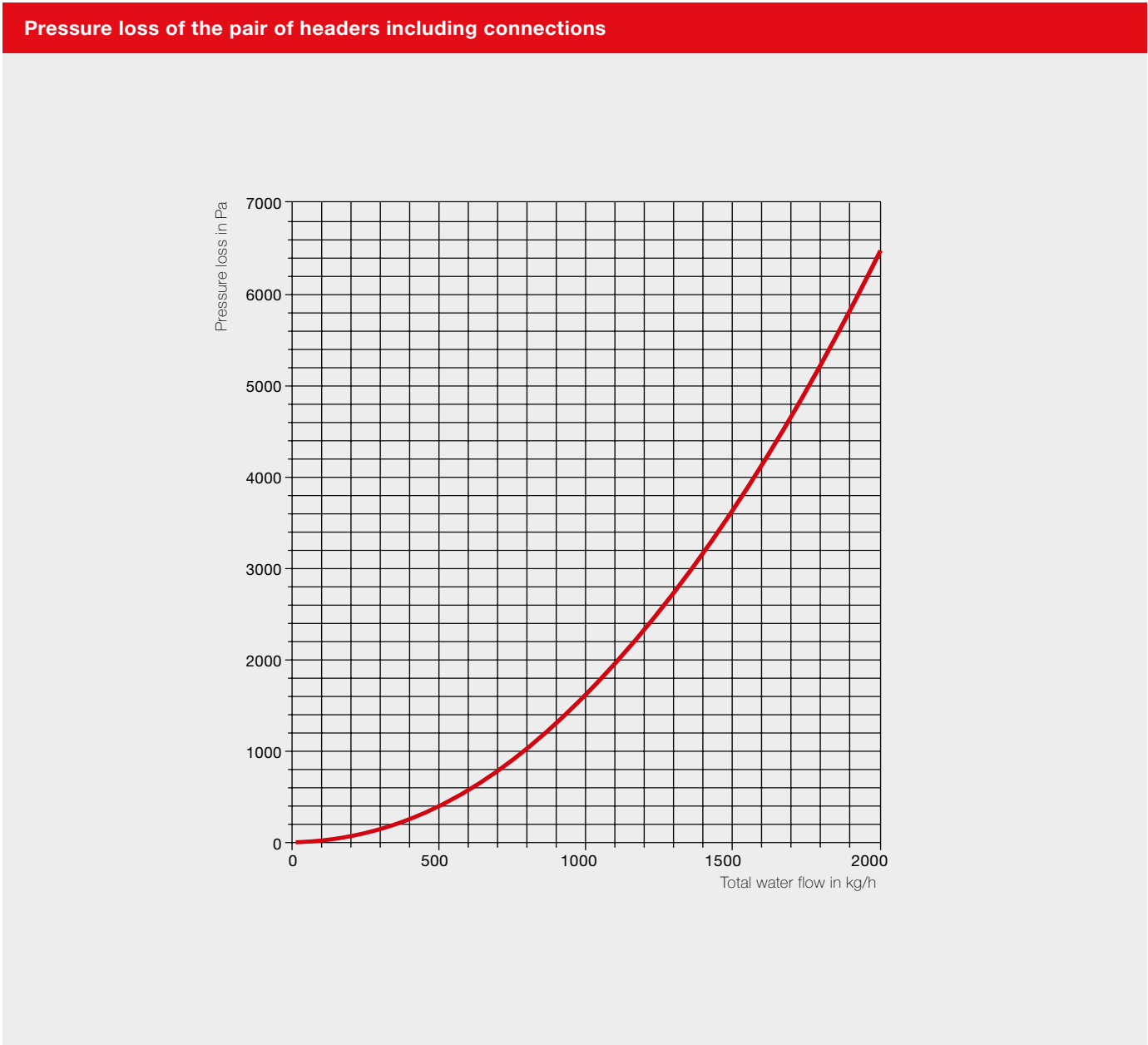
Layout of the radiant ceiling panels
Flow temperature: 80 °C
Return temperature: 70 °C

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



Pressure loss calculation

The total pressure loss for Zehnder ZFP radiant ceiling panels is calculated as a total of the pressure loss in the tube and the pressure loss in the headers. When using Zehnder volume flow controllers, the additional pressure loss incurred should be added to this.



Determining the pressure loss:

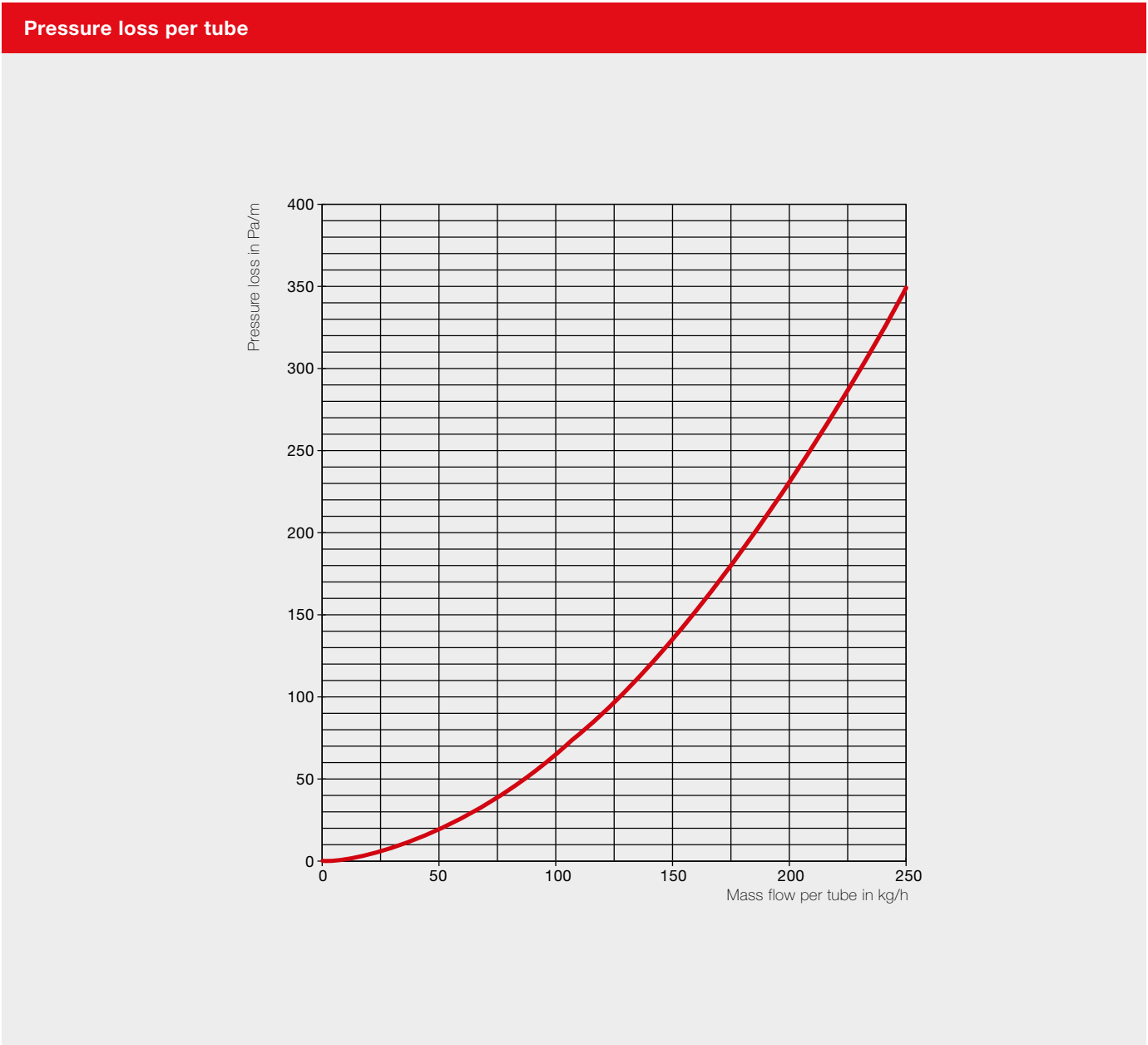


e.g. ZFP 900/12, 13 m

1. Calculate total mass flow of the radiant ceiling panel in question.

Calculation formula:
 $\dot{m} = (\dot{Q} \cdot 0.86) / \Delta T$
 $\dot{Q}$ = output (W)
 ΔT = spread (K)
 $\dot{m}$ = mass flow (kg/h)

For the example on page 24 (for a 900/12 strip, 13 m) the following therefore applies:
 $\dot{m} = (6861 \text{ W} \cdot 0.86) / 10 \text{ K} = 590 \text{ kg/h}$
2. Refer to the graph for the pressure loss of the pair of headers.
e.g. $\Delta p = 600 \text{ Pa/pair of headers}$. Since the heating water flows into and out of a header twice, the value should be multiplied by two.
3. Refer to the graph for the pressure loss of the tube. The mass flow is calculated by dividing the total mass flow by the number of tubes with parallel flow.
e.g. $590 \text{ kg/h} : 6 \text{ tubes (6 each for flow and return)} = 98 \text{ kg/h}$
 $\Delta p = 65 \text{ Pa/m} \cdot 13 \text{ m} \cdot 2$
(for flow and return) = 1690 Pa
4. The total pressure loss for the radiant ceiling panel is the sum of the individual pressure losses calculated previously.



Hydraulic balancing of radiant ceiling panels

The correct water flow distribution for the heating water flow 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 the volume flows are identical, laying pipes according to the Tichelmann system (two-pipe system with reverse return) will provide a perfect hydraulic solution. However, the third pipe results in a considerable increase in costs where space heating systems are concerned and is not advisable in many instances if panels of different sizes are used.

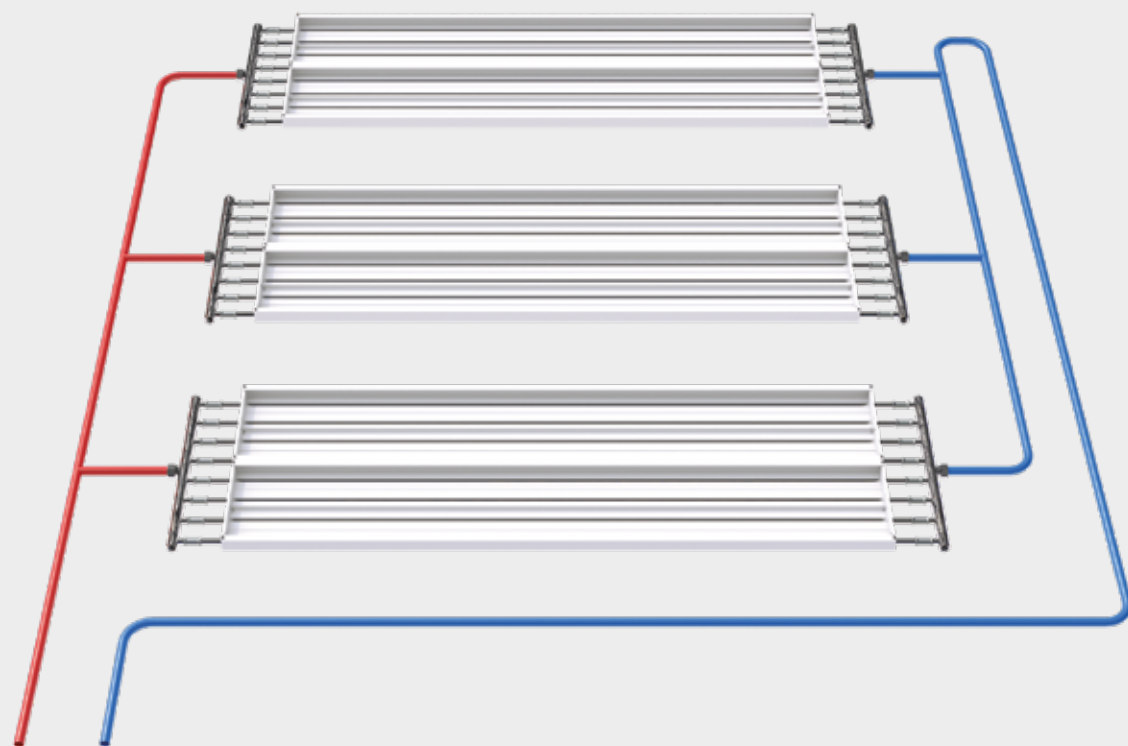


Fig. 1: Pipes laid according to the Tichelmann system (two-pipe system with reverse return)

Systems where the individual strips have different outputs must be subjected to hydraulic balancing by means of the pipework design and adjustments. This process, however, demands a large investment in terms of time and money. Hydraulic balancing is made easier with the Zehnder volume flow control combination (VSRK) (Fig. 2).

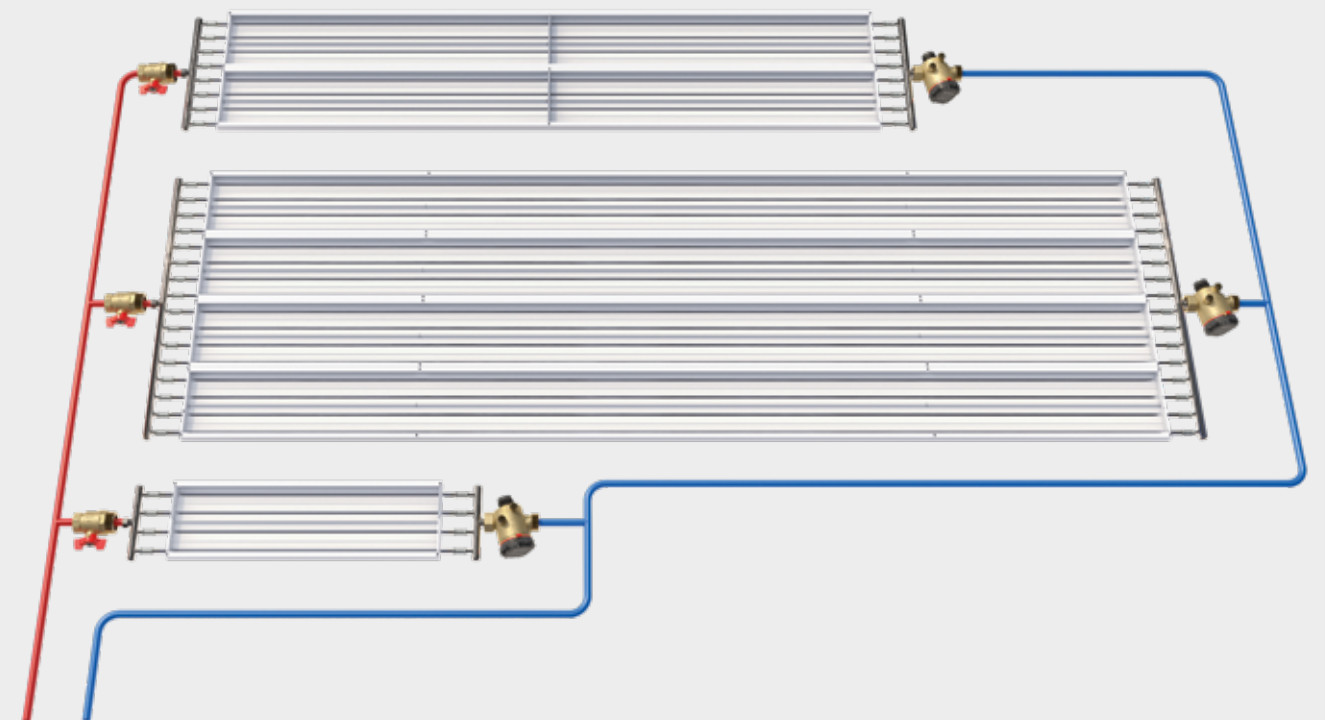


Fig. 2: Simplified pipe layout with Zehnder volume flow control combination (VSRK)

Volume flow control combination

The VSRK is a complete set consisting of a volume flow controller and ball cocks.

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

Other advantages of the VSRK:

- Constant volume flow even when there is a high differential pressure
- Hydraulic balancing even for radiant panels of different sizes

Longer radiant panel systems must have a flexible connection (armoured hose).

The Zehnder volume flow control combination is suitable for an operating temperature of -10 °C up to a maximum of 120 °C and a maximum operating pressure of 16 bar. The working condition is permitted for the following medium: Water and ethylene/propylene glycol water mix (max. 50%), pH value 6.5–10.

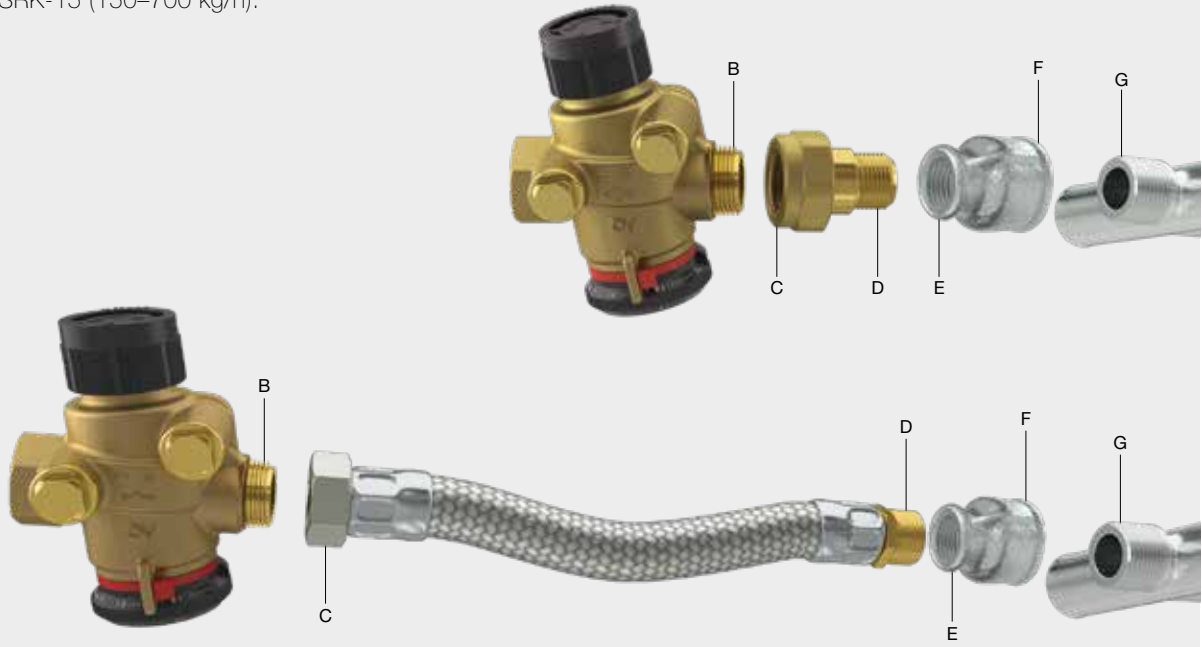
Article numbers:

VSRK-15 combination, 30–210 kg/h	513800
VSRK-15 combination, 150–700 kg/h	513810
VSRK-25 combination, 300–2000 kg/h	513820
VSRK-32 combination, 600–3600 kg/h	513830
VSRK Special 15/15/15, 30–210 kg/h	513840
VSRK Special 15/15/15, 150–700 kg/h	513850
VSRK Special 25/15/15, 300–2000 kg/h	513860
VSRK Special 25/25/25, 300–2000 kg/h	513870
VSRK Special 32/25/25, 600–3600 kg/h	513880
VSRK Special 32/32/32, 600–3600 kg/h	513890
Controller, separate DN15, 30–210 kg/h	513900
Controller, separate DN15, 150–700 kg/h	513910
Controller, separate DN25, 300–2000 kg/h	513920
Controller, separate DN32, 600–3600 kg/h	513930
Flow, separate DN15	513940
Flow, separate DN25	513950
Flow, separate DN32	513960
Armoured hose DN15	509260 / 513430
Armoured hose DN25	509280 / 513440
Armoured hose DN32	509310 / 513450
Reducing sleeve 1" x ½"	501170
Sleeve 1"	501190
Reducing sleeve ¾" x 1"	501180
Coupler screw connection ¾" x ½"	514000

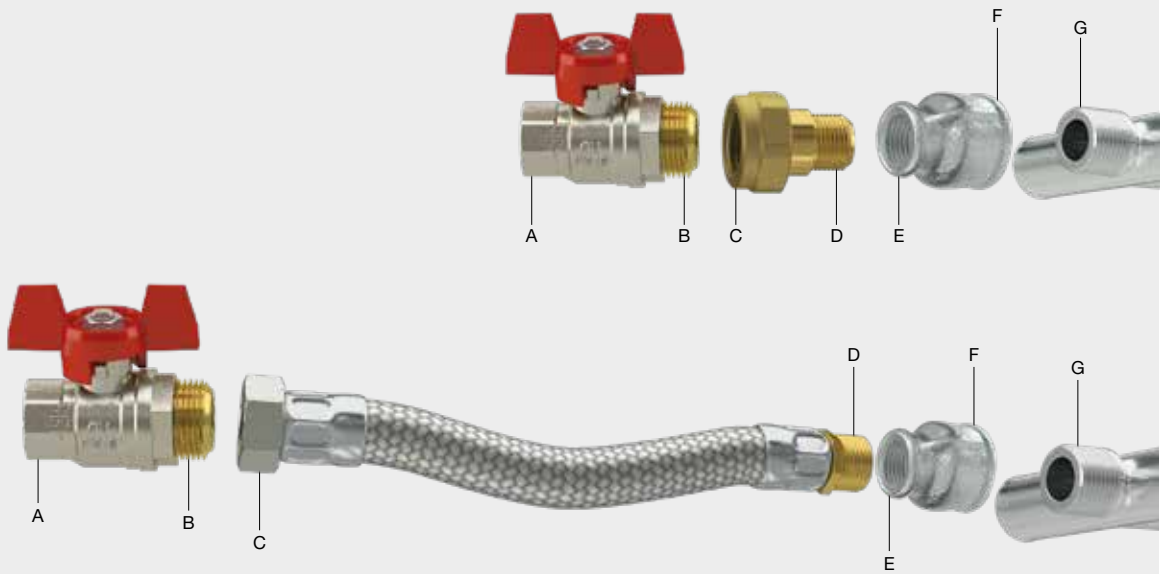
DN15				DN25		DN32	
30–210 kg/h		150–700 kg/h		300–2000 kg/h		600–3600 kg/h	
Mass flow (kg/h)	Minimum differential pressure (kPa)	Mass flow (kg/h)	Minimum differential pressure (kPa)	Mass flow (kg/h)	Minimum differential pressure (kPa)	Mass flow (kg/h)	Minimum differential pressure (kPa)
30	10.0	150	13.0	300	15.0	600	15.0
60	10.8	200	13.5	350	15.3	700	15.3
90	11.7	250	13.9	400	15.6	800	15.7
120	12.5	300	14.4	450	15.9	900	16.0
150	13.3	350	14.8	500	16.2	1000	16.3
180	14.2	400	15.3	550	16.5	1100	16.7
210	15.0	450	15.7	600	16.8	1200	17.0
		500	16.2	650	17.1	1300	17.3
		550	16.6	700	17.4	1400	17.7
		600	17.1	750	17.6	1500	18.0
		650	17.5	800	17.9	1600	18.3
		700	18.0	850	18.2	1700	18.7
				900	18.5	1800	19.0
				950	18.8	1900	19.3
				1000	19.1	2000	19.7
				1050	19.4	2100	20.0
				1100	19.7	2200	20.3
				1150	20.0	2300	20.7
				1200	20.3	2400	21.0
				1250	20.6	2500	21.3
				1300	20.9	2600	21.7
				1350	21.2	2700	22.0
				1400	21.5	2800	22.3
				1450	21.8	2900	22.7
				1500	22.1	3000	23.0
				1550	22.4	3100	23.3
				1600	22.6	3200	23.7
				1650	22.9	3300	24.0
				1700	23.2	3400	24.3
				1750	23.5	3500	24.7
				1800	23.8	3600	25.0
				1850	24.1		
				1900	24.4		
				1950	24.7		
				2000	25.0		

Connection size for Zehnder volume flow control combinations							
VSRK dimensions	Controller or ball valve		Flat-sealing coupler screw connection	Hose, male thread	Sleeve, female thread	Sleeve, female thread	Header, conical male thread
	A	B	C	D	E	F	G
DN15 (30–210 kg/h)	Rp ½"	G ¾"	Rp ¾"	R ½"	Rp ½"	R 1"	R 1"
DN15 (150–700 kg/h)	Rp ½"	G ¾"	Rp ¾"	R ½"	Rp ½"	R 1"	R 1"
DN25 (300–2000 kg/h)	Rp 1"	G 1 ¼"	Rp 1 ¼"	R 1"	Rp 1"	R 1"	R 1"
DN32 (600–3600 kg/h)	Rp 1 ¼"	G 1 ½"	Rp 1 ½"	R 1 ¼"	Rp 1 ¼"	R 1"	R 1"

Example of VSRK-15 (150–700 kg/h):
Return



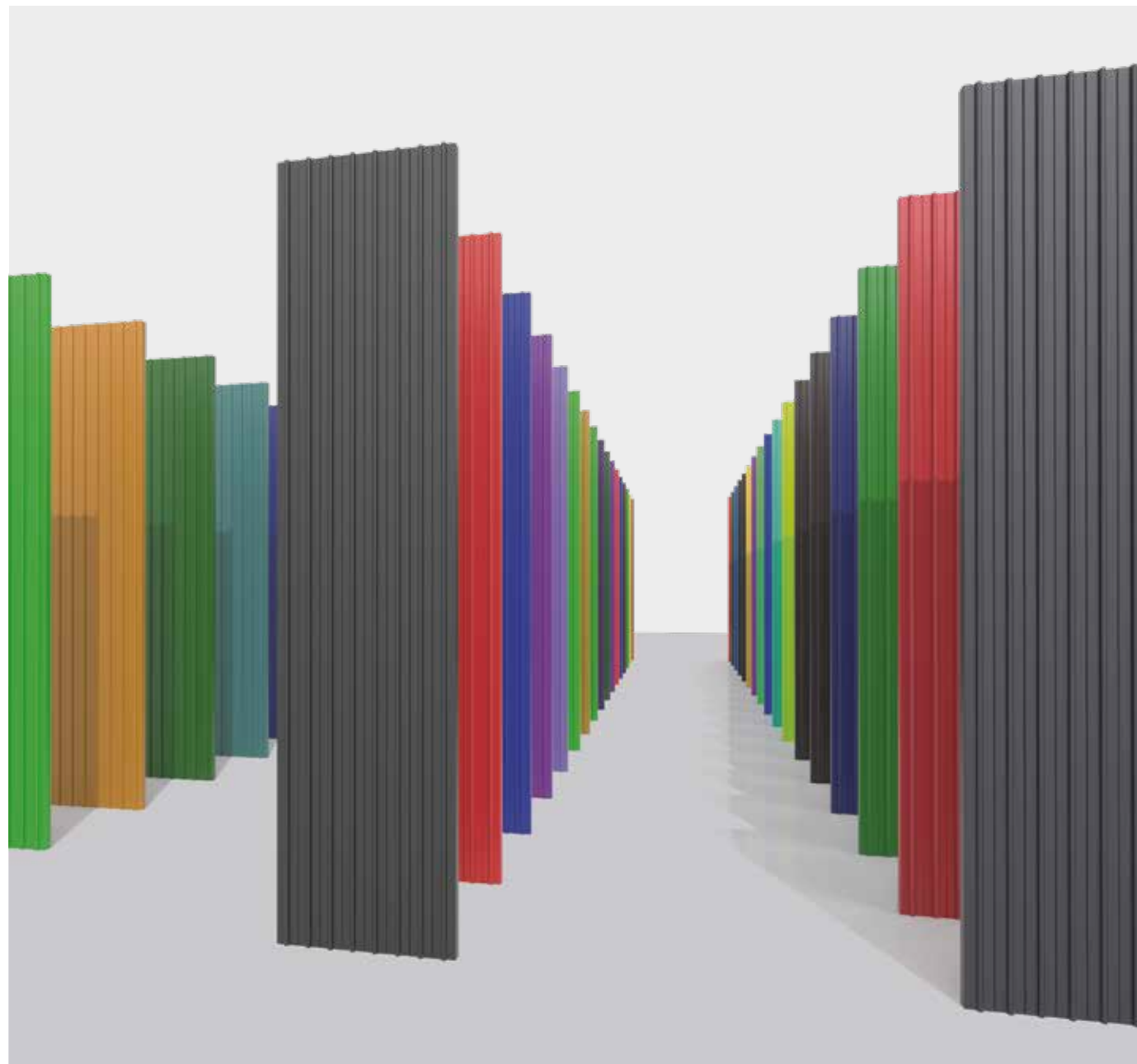
Example of VSRK-15 (150–700 kg/h):
Flow



Standard colour / special colour

The surfaces of Zehnder heating and cooling ceiling modules are coated with a high-quality powder coat finish. Our standard Zehnder ZFP radiant ceiling panels are similar to RAL 9016 matt. Alternatively, you can choose from over 700 colours.

We would be delighted to review your enquiry – please get in touch.



Types of insulation

When radiant ceiling panels are used, insulation on top of the panels is recommended. Zehnder offers a suitable option for every application – fitted ex works. This saves valuable time during on-site installation.

Aluminium-laminated mineral wool

Application:
Zehnder ZFP for heating, smooth version

Mineral wool exempt according to EU directive 97/69 (note Q);
lined with aluminium grille on one side
 $\lambda = 0.038 \text{ W/mK}$, thickness 40 mm



Mineral wool wrapped in foil

Application:
Zehnder ZFP for heating and cooling, smooth and perforated versions

Mineral wool exempt according to EU directive 97/69 (note Q),
lined with black fleece and wrapped in LDPE foil
 $\lambda = 0.040 \text{ W/mK}$, thickness 40 mm



Acoustic insulation

Application:
Zehnder ZFP for heating, perforated version

Mineral wool, coated with glass mat on both sides
(one side white/one side black)
 $\lambda = 0.035 \text{ W/mK}$, thickness 40 mm

Available
in 2020



Standard fixing kits

There are six standard fixing kits for installing the radiant ceiling panels on the ceiling. In addition, Zehnder offers a number of customised solutions on request.

WOODEN CEILING



KN 52*
Minimum suspension height without link chain: 154 mm
Article number: 513520

KN 82*
Minimum suspension height without link chain: 392 mm
Article number: 513530

CONCRETE CEILING



KN 53
Minimum suspension height without link chain: 141 mm
Article number: 505160

KN 83
Minimum suspension height without link chain: 379 mm
Article number: 505260

STEEL PROFILE



KN 54
Minimum suspension height without link chain: 141 mm
Article number: 505170

Provided by customer

KN 84
Minimum suspension height without link chain: 379 mm
Article number: 505270

Provided by customer

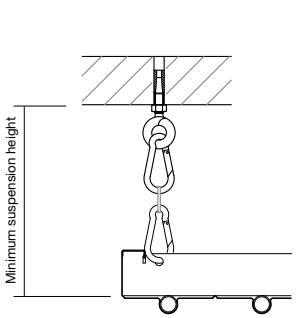
*Screws for ceiling mounting brackets must be purchased by the customer

TRAPEZOIDAL SHEET METAL



KN 56
Minimum suspension height without link chain: 183 mm
Article number: 505210

KN 86
Minimum suspension height without link chain: 421 mm
Article number: 505280



Key	Article number:
1 Hexagon nut M8	506080
2 Steel dowel M8	961120
3 Girder clamp M8	506030
4 Retaining cord	506100
5 Flat leaf screw M8	506050
6 Trapezoidal hanger M8	506020
7 Link chain 4 mm	509960
8 Carabiner hook 5 x 50	506010
9 Eyelet screw M8	506040
10 M8 washer	959020
11 M8 x 40 hexagon screw	506070
12 M8 x 110 hexagon screw	501500
13 Turnbuckle M6 x 110	506120
14 Support plate M8	513500

INCLINED STEEL GIRDER



KN 57
Minimum suspension height without link chain: 172 mm
Article number: 505220

Provided by customer

KN 87
Minimum suspension height without link chain: 410 mm
Article number: 505290

Provided by customer

HORIZONTAL STEEL GIRDER



KN 58
Minimum suspension height without link chain: 151 mm
Article number: 505230

Provided by customer

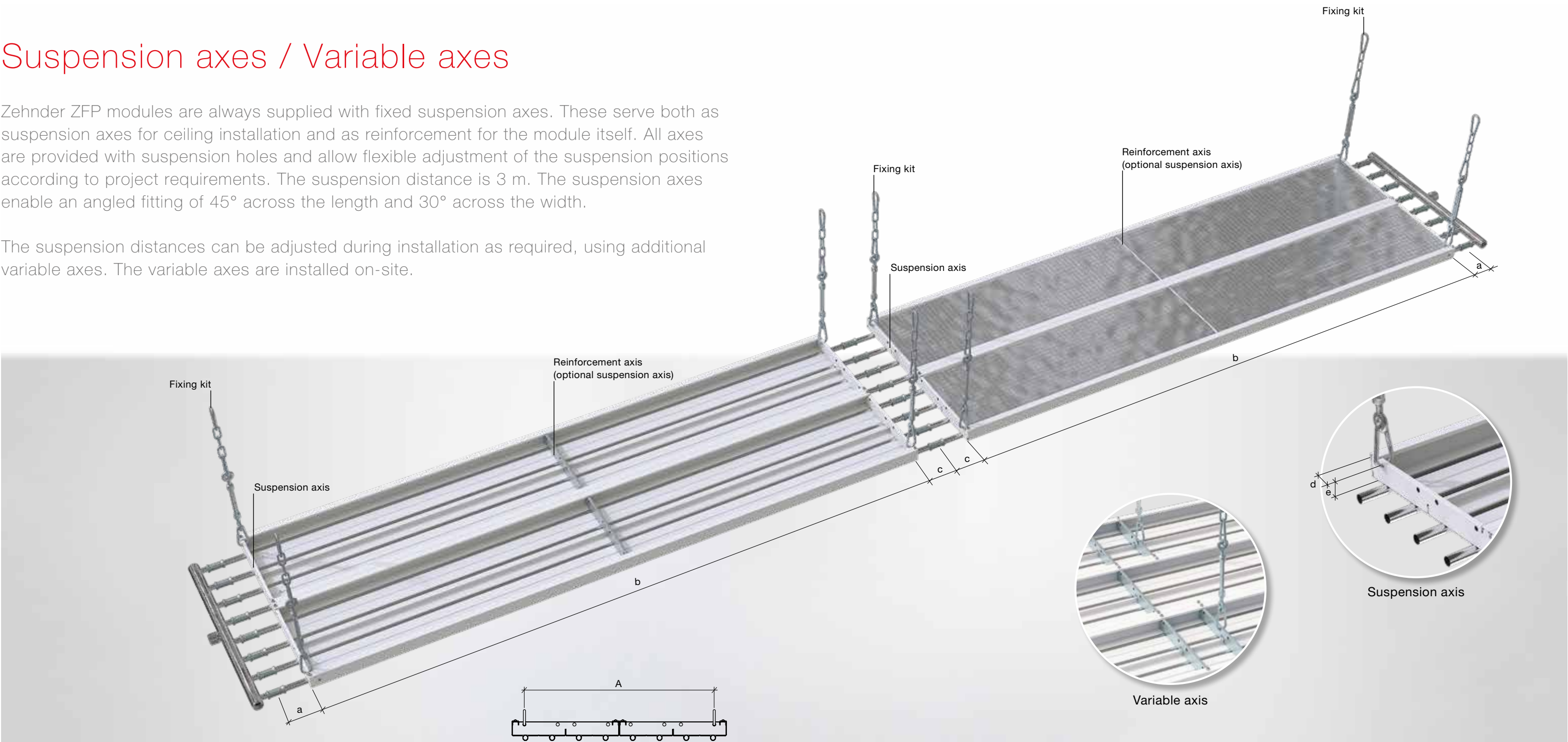
KN 88
Minimum suspension height without link chain: 389 mm
Article number: 505340

Provided by customer

Suspension axes / Variable axes

Zehnder ZFP modules are always supplied with fixed suspension axes. These serve both as suspension axes for ceiling installation and as reinforcement for the module itself. All axes are provided with suspension holes and allow flexible adjustment of the suspension positions according to project requirements. The suspension distance is 3 m. The suspension axes enable an angled fitting of 45° across the length and 30° across the width.

The suspension distances can be adjusted during installation as required, using additional variable axes. The variable axes are installed on-site.



Article numbers			
Article number	Description	Model	A
514910	Variable axis ZFP 300/4	300/4	236
514920	Variable axis ZFP 450/6	450/6	386
514930	Variable axis ZFP 600/8	600/8	536
514940	Variable axis ZFP 750/10	750/10	686
514950	Variable axis ZFP 900/12	900/12	647
514960	Variable axis ZFP 1050/14	1050/14	703
514970	Variable axis ZFP 1200/16	1200/16	553
514980	Variable axis ZFP 1350/18	1350/18	703
514990	Variable axis ZFP 1500/20	1500/20	647

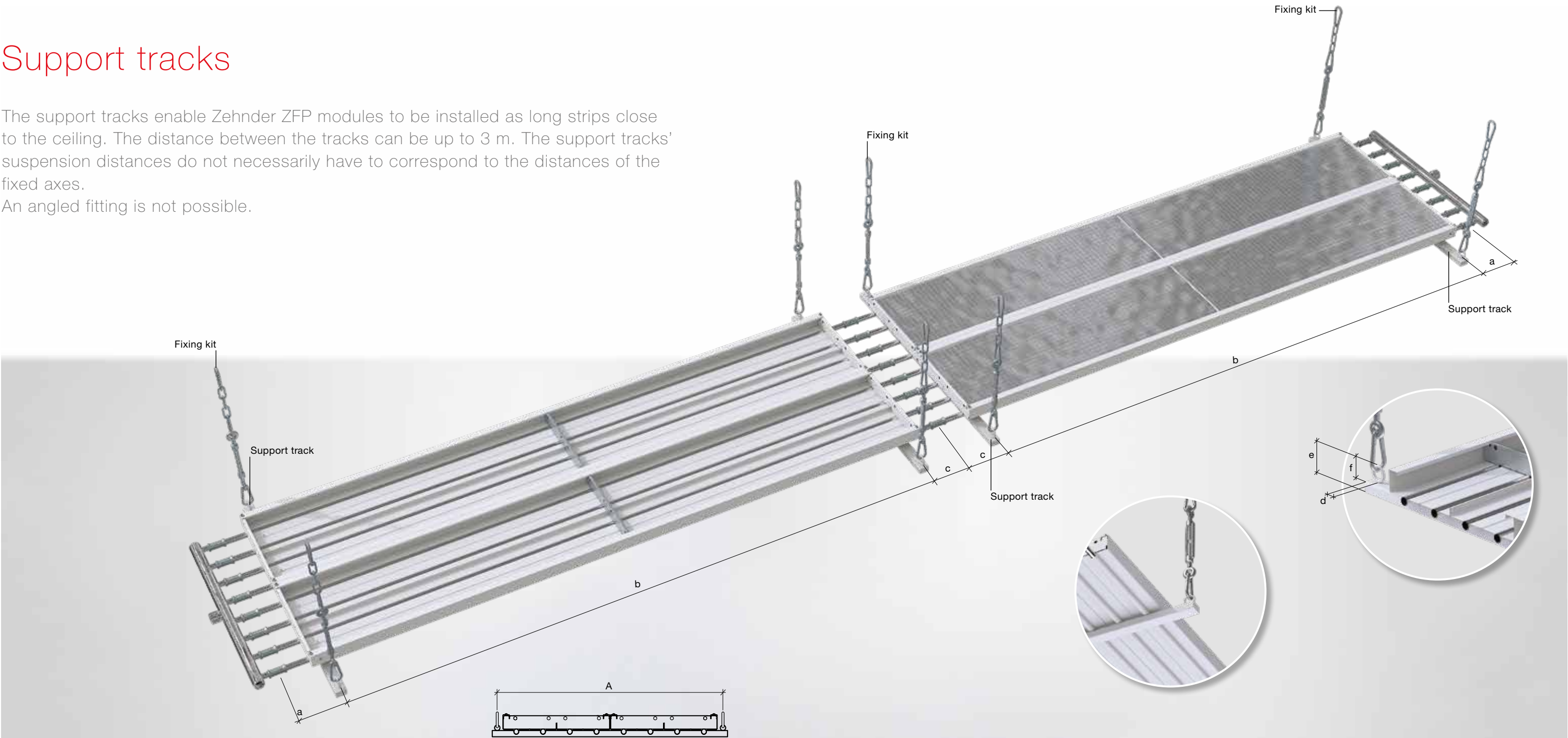
Recommended number of suspension axes per module	
Module length	Quantity
2000 mm	2
3000 mm	2
4000 mm	2
5000 mm	2
6000 mm	2

Dimensions				
Item	Description	Dimension in mm	Min. dimension in mm	Max. dimension in mm
a	Header – first suspension axis	85	-	-
b	Suspension axis – suspension axis	Variable	1000	3000
c	Suspension axis – connection point	Variable	85	3000
d	Outer edge of module – centre of 1st suspension point	Variable	32	428
e	Bottom edge of radiant plate – upper edge of suspension point	37	-	-

Minimum suspension heights with fixing kits – see specifications on page 38/39

Support tracks

The support tracks enable Zehnder ZFP modules to be installed as long strips close to the ceiling. The distance between the tracks can be up to 3 m. The support tracks' suspension distances do not necessarily have to correspond to the distances of the fixed axes. An angled fitting is not possible.



Article numbers			
Article number	Description	Model	A
515010	Support track 300/4	300/4	362 mm
515020	Support track 450/6	450/6	512 mm
515030	Support track 600/8	600/8	662 mm
515040	Support track 750/10	750/10	812 mm
515050	Support track 900/12	900/12	962 mm
515060	Support track 1050/14	1050/14	1112 mm
515070	Support track 1200/16	1200/16	1262 mm

Recommended number of support tracks per module	
Module length	Quantity
2000 mm	2
3000 mm	2
4000 mm	2
5000 mm	2
6000 mm	2

Dimensions				
Item	Description	Dimension in mm	Min. dimension in mm	Max. dimension in mm
a	Header – support track	85	-	-
b	Support track – support track	Variable	1000	3000
c	Support track – connection point	Variable	100	3000
d	Outer edge of module – centre of suspension point	21	-	-
e	Bottom edge of support track – upper edge of suspension point	34	-	-
f	Bottom edge of radiant plate – upper edge of suspension point	14	-	-

Minimum suspension height			
Descrip-tion	Dimension in mm	Description	Dimension in mm
KN52	146	KN82	384
KN53	133	KN83	371
KN54	133	KN84	371
KN56	175	KN86	413
KN57	164	KN87	402
KN58	143	KN88	381

Covers for individual space situations

Zehnder ZFP radiant ceiling panels are extremely flexible: in addition to 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 and will be happy to advise you.

BALL GUARDS/BALL IMPACT RESISTANCE

A practical solution for sports halls: the arched, galvanised grid prevents stray shots from getting caught in the radiant ceiling panels. Ball guards can be used with strips of Zehnder ZFP of any width.

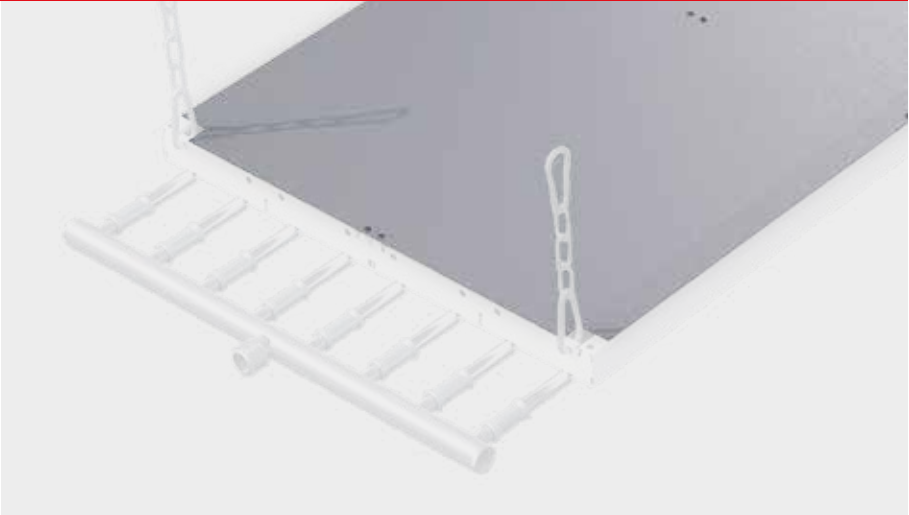
Furthermore, Zehnder ZFP radiant ceiling panels have successfully passed testing for ball impact resistance to DIN 18032 by the Stuttgart Materials Testing Institute.



DUST PROTECTOR PANEL

Zehnder ZFP radiant ceiling panels can be sealed with a dust protector panel if required. An easy-care, hygienic solution that is ideal for rooms with high dust levels.

Available
in 2020



RAISED HEADERS

The headers finish above the radiant panel sheet and therefore cannot be seen from below.

This is the ideal solution for integrating Zehnder ZFP into a suspended ceiling.



COVER PLATE

The joints of the Zehnder ZFP modules are concealed by cover plates. These are contoured to be close-fitting (with channels) and ensure an attractive appearance.

The cover plates are supplied in the desired colour. To guarantee the best possible heating and cooling performance, the joints are insulated.



END COVER

End covers are offered as an option for Zehnder ZFP. These cover the points where the headers are connected to the modules. In combination with a header that is painted as well as galvanised, this creates a colour-coordinated appearance. All components that are visible from below are powder-coated with the same colour as the radiant ceiling panels.

Available
in 2020



Special requirements

Further solutions designed for specific applications round off the ZFP modular system.

NON-CONTINUOUS RADIANT PLATE

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

The length of the radiant plate interruption can be up to 3 m.

This special solution is designed by Zehnder's internal planning department.



CUT-OUTS FOR FIXTURES

Zehnder ZFP offers the option of including cut-outs for fixtures. This can be achieved with cut-outs in the radiant plate of the modules or, for large fixtures, through integration into additional intermediate panels. Why not get in touch? We would be delighted to review your enquiry and design an individual solution.

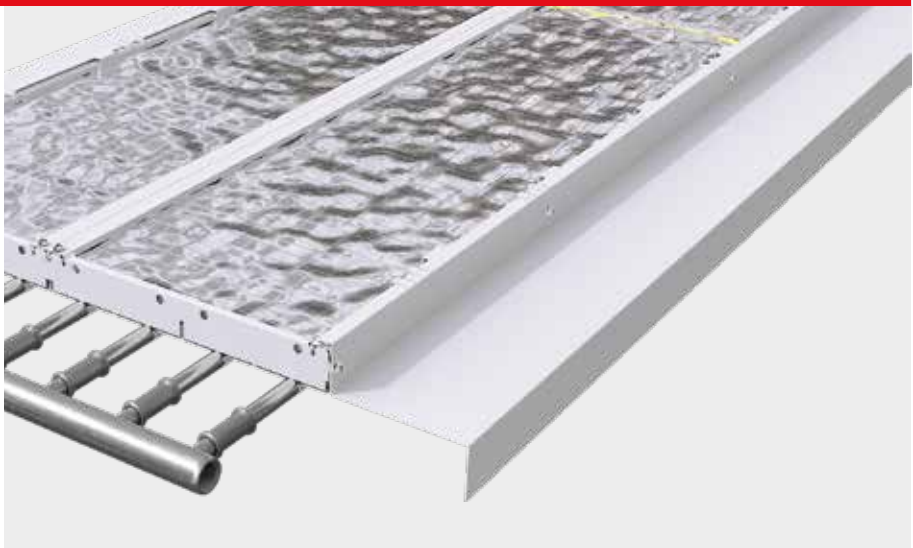
Available
in 2020



THERMAL RADIATION SHIELD

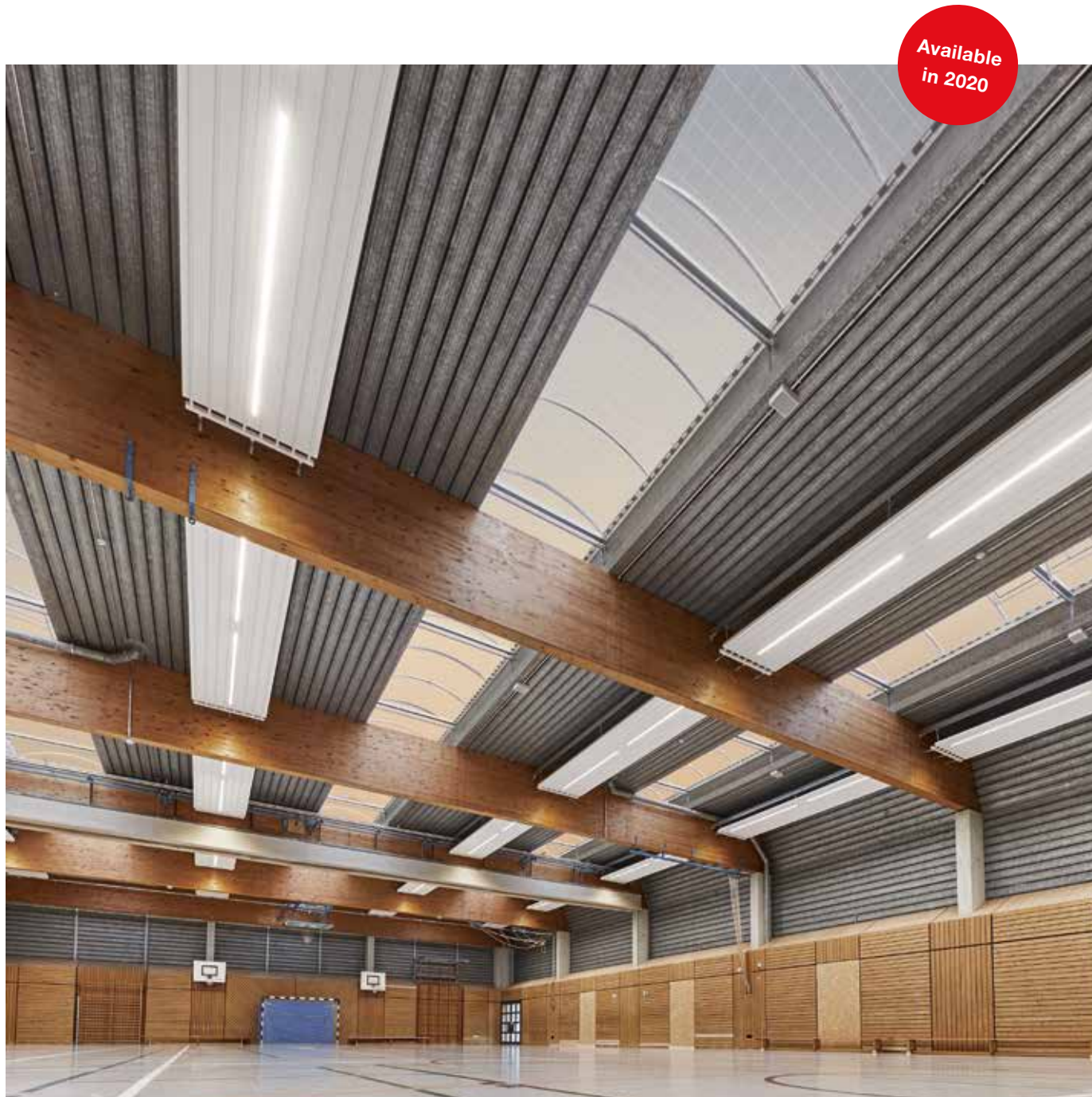
To increase the effectiveness of Zehnder ZFP's thermal radiation even further, a double-sided thermal radiation shield can be fitted. This enables a proportion of radiation of up to 88% for the output.

Available
in 2020



Recessed LED light fixtures: tasteful design and innovative lighting technology

High-quality, decorative recessed LED light fixtures are the perfect way of adapting Zehnder radiant ceiling panels to suit every application – without compromising on heating and cooling performance. With a wide variety of LED lenses available, you are guaranteed to find exactly the right type of lighting for your space – whatever the building situation. Our complete solution means that very little design work is required and makes the planning process more reliable.



Notes

[illegible]

Dimensions, operating parameters and output										
Feature	Unit of measurement	300/4	450/6	600/8	750/10	900/12	1050/14	1200/16	1350/18	1500/20
Number of tubes	Piece(s)	4	6	8	10	12	14	16	18	20
Tube material	–	Precision steel tube 15 x 1 mm, welded, external galvanisation in line with EN 10305-3								
Radiant plate	–	Fully galvanised, coated sheet steel								

Dimensions

Widths	mm	300	450	600	750	900	1050	1200	1350	1500
Tube spacing	mm	75								
Minimum module length	mm	2000								
Maximum module length	mm	6000								
Suspension points per axis	Piece(s)	2								
Transverse distance between suspension points (A) ¹⁾	mm	236	386	536	686	647	703	553	703	647

Operating parameters ²⁾

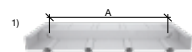
Max. operating temperature	°C	120 ³⁾ / 95 ⁴⁾
Max. operating pressure	bar	12 ³⁾ / 5 ⁴⁾

Weight⁵⁾

Empty weight without water content, with insulation	Radiant panel	kg/m	3.9	5.4	7.6	9.2	10.7	13.0	14.6	16.1	18.4
	Per manifold	kg	0.7	0.9	1.2	1.5	1.7	2.0	2.3	2.5	2.8
Insulation weight		kg/m	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.2
Water content		l/m	0.5	0.8	1.0	1.3	1.6	1.9	2.1	2.4	2.6
Operating weight with water content, with insulation	Radiant panel	kg/m	4.4	6.2	8.6	10.5	12.3	14.9	16.7	18.5	21.0
	Per manifold	kg	0.8	1.2	1.6	1.9	2.3	2.7	3.0	3.4	3.8
Weight of ball guards		kg/m	0.3	0.4	0.6	0.7	0.8	0.9	1.7	2.9	3.2
Weight of dust protector panel		kg/m	1.0	1.6	2.0	2.6	3.1	3.6	4.1	4.7	5.2

Dimensions, operating parameters and output										
Feature	Unit of measurement	300/4	450/6	600/8	750/10	900/12	1050/14	1200/16	1350/18	1500/20
Thermal output										
Thermal output according to EN 14037-3 at $\Delta T = 55\text{ K}$ with insulation	W/m	202	283	364	438	512	586	660	736	813
Thermal output constant (K)	–	1.695	2.420	3.170	3.839	4.517	5.204	5.899	6.732	7.600
Thermal output exponent (n)	–	1.193	1.188	1.184	1.182	1.181	1.179	1.177	1.172	1.166

Cooling capacity

[illegible]

When installing on suspension axes

²⁾ Water quality in accordance with VDI 2035

³⁾ Crimp connection

4) Threaded connection

⁴⁵⁾ The actual load on the supporting structure must be determined during the planning phase. The horizontal and vertical forces created by the installation conditions on-site must be taken into account.

Tender specifications

Zehnder ZFP fully galvanised radiant ceiling panel tested in accordance with DIN EN 14037, all components fully galvanised at the factory. Corrosion resistance proven in accordance with DIN EN ISO 6270-2. Operating weight of radiant panel (standard version) is 14 kg/m², suitable for low roof loads.

Zehnder ZFP radiant ceiling panels feature a proportion of radiation of up to 88%, depending on their design.

Operating temperature up to max. 120 °C, operating pressure up to max. 12 bar.
0.45 mm thick, fully galvanised radiant plate design, protective lacquer on the back and polyester coating on the front, smooth or perforated as preferred.

Zehnder special clip profile to hold externally galvanised precision steel tubes with an external diameter of 15 mm according to DIN EN 10305-3. Radiant plate statically self-bearing due to lateral and upper chamfers; chamfers to integrate and hold down the thermal insulation; two galvanised and painted end front plates on end of radiant plate.

For structural reasons, flat radiant panel systems without pipe beading or surfaces with profiles at the top are not permitted. Uneven radiant plates which deviate from the horizontal plane are excluded.
Suspension axes for fastening mounted ex works; the position of the axes can be moved as required; mounting distance of three metres without additional securing structures or carrier systems is ensured to enable optimum adaptability to structural engineering.

Radiant ceiling panels delivered in modules; modules connected on-site using galvanised crimp/sliding couplings or galvanised screw connections.

Thermal insulation installed at the factory, consisting of mineral wool in accordance with EU directive 97/69 (note Q), lined on one side with aluminium grille, thickness 40 mm, lambda = 0.038 W/mK.

Manifolds consisting of a round tube (external diameter of 30 mm) with R1" male thread connectors (DIN EN 10266), blind cover and ½" sleeve for venting/drainage. Manifolds (headers) supplied separately for on-site connection to the radiant ceiling panels using galvanised crimp/sliding couplings or galvanised screw connections.

Zehnder ZFP radiant ceiling panels tested for ball impact resistance in accordance with DIN 18032

Water quality in accordance with VDI 2035.

Brand: Zehnder
Type: ZFP radiant ceiling panel

Thermal insulation
Aluminium-laminated mineral wool
Mineral wool exempt according to EU directive 97/69 (note Q); lined with aluminium grille on one side
λ = 0.038 W/mK, thickness 40 mm

Mineral wool shrink-wrapped in foil
Mineral wool exempt according to EU directive 97/69 (note Q), lined with black fleece and shrink-wrapped in LDPE foil
λ = 0.040 W/mK, thickness 40 mm

Acoustic insulation
Mineral wool, coated with glass mat on both sides (natural/black)
λ = 0.035 W/mK, thickness 40 mm

Operating parameters
Heating medium /°C
Room temperature /°C
Operating pressure bar
Thermal output (overall) W
Module length (overall) m

Crimp connection (article no. 502280)
Galvanised crimp connection 15 mm Piece(s)

Threaded connection (article no. 633010)
Galvanised clamping ring screw connection 15 mm Piece(s)

Cover plates
Made of 0.45 mm thick sheet steel, galvanised on both sides, coated externally with polyester paint similar to RAL 9016, used to cover the crimp or threaded connections at the connection points and on the headers

Upper covers
Dust protector panel
Galvanised upper plate cover (thickness 0.63 mm) incl. fixing clamps and screws – delivered loose

Ball guards
Galvanised metal grill cover incl. fixing clips and screws for use in sports facilities – delivered loose

Fastening system
Fixing kit KN 52 (article no.: 513520)
for fixing to wooden ceilings piece(s)

Fixing kit KN 53 (article no.: 505160)
for fixing to concrete ceilings piece(s)

Fixing kit KN 54 (article no. 505170)
for fixing to steel profile piece(s)

Fixing kit KN 56 (article no. 505210)
for fixing to trapezoidal sheet metal piece(s)

Fixing kit KN 57 (article no. 505220)
for fixing to inclined steel girders piece(s)

Fixing kit KN 58 (article no. 505230)
for fixing to horizontal steel girders piece(s)

Fixing kit KN 82 (article no. 513530)
for fixing to wooden ceilings piece(s)

Fixing kit KN 83 (article no. 505260)
for fixing to concrete ceilings piece(s)

Fixing kit KN 84 (article no. 505270)
for fixing to steel profile piece(s)

Fixing kit KN 86 (article no. 505280)
for fixing to trapezoidal sheet metal piece(s)

Fixing kit KN 87 (article no. 505290)
for fixing to inclined steel girders piece(s)

Fixing kit KN 88 (article no. 505340)
for fixing to horizontal steel girders piece(s)

Volume flow controller
VSRK-15 (article no.: 513810)
Zehnder VSRK-15 (150–700 l/h) volume flow control combination consisting of a volume flow controller and a ball valve.
The volume flow controller is a valve combination which consists of an automatic flow rate controller (with a factory-set nominal value) and an actuator head. The actuator head can be equipped with an actuator (threaded connection M30 x 1.5).
The volume flow controller is used for hydraulic balancing of radiant ceiling panels.

Technical specifications:
Dimensions: DN15
Max. operating temperature ts: 120 °C
Min. operating temperature ts: -10 °C
Max. operating pressure ps: 16 bar (1600 kPa)
Max. differential pressure: 4 bar (400 kPa)

Medium: Water or ethylene/propylene glycol water mix (max. 50%), pH value 6.5–10
Housing made of dezincification-resistant brass, seals made of EPDM or PTFE, valve spindle made of stainless steel.

Article numbers:		
VSRK-15 combination, 30–210 kg/h		513800
VSRK-15 combination, 150–700 kg/h		513810
VSRK-25 combination, 300–2000 kg/h		513820
VSRK-32 combination, 600–3600 kg/h		513830
VSRK Special 15/15/15, 30–210 kg/h		513840
VSRK Special 15/15/15, 150–700 kg/h		513850
VSRK Special 25/15/15, 300–2000 kg/h		513860
VSRK Special 25/25/25, 300–2000 kg/h		513870
VSRK Special 32/25/25, 600–3600 kg/h		513880
VSRK Special 32/32/32, 600–3600 kg/h		513890
Controller, separate DN15, 30–210 kg/h		513900
Controller, separate DN15, 150–700 kg/h		513910
Controller, separate DN25, 300–2000 kg/h		513920
Controller, separate DN32, 600–3600 kg/h		513930
Flow, separate DN15		513940
Flow, separate DN25		513950
Flow, separate DN32		513960

Armoured hose
Zehnder armoured hose for heating systems, consisting of temperature-resistant and age-resistant EPDM with stainless-steel braided sleeve.

DN15 hose (article no.: 513430)
Inner installation dimension: 500 mm
Hose length: 540 mm
Permissible operating pressure: 12 bar
Operating temperature range: 90 °C
Connections: Male thread R ½"
Coupler Rp ¾"

Article numbers:		
Armoured hose DN15		509260 / 513430
Armoured hose DN25		509280 / 513440
Armoured hose DN32		509310 / 513450
Reducing sleeve 1" x ½"		501170
Sleeve 1"		501190
Reducing sleeve 5/4" x 1"		501180
Coupler screw connection ¾" x ½"		514000

ALWAYS THE BEST CLIMATE

“We strive to improve the quality of life by providing the finest indoor climate solutions.”



Excellent team
Every day we combine passion, expert knowledge and commitment to give you the best results.

Great solutions, products and services
Great products and unique service for an energy-efficient, healthy and comfortable indoor climate.

First choice for customers
Always close to the needs of our customers, to grow with you and overcome all challenges together.

INNOVATION OVER 4 GENERATIONS

MANUFACTURER OF THE WORLD'S

1st

STEEL AND BATHROOM RADIATORS

REPRESENTED IN MORE THAN

70

COUNTRIES

AROUND

3,500

EMPLOYEES

16

OF OUR OWN PRODUCTION PLANTS IN EUROPE, NORTH AMERICA AND CHINA

INNOVATION SINCE

1895

1,200

PATENTS AND DESIGN RIGHTS THROUGHOUT THE WORLD

AROUND

20,000

TRAINED CUSTOMERS PER YEAR

WE ARE THE SPECIALISTS FOR A HEALTHY, COMFORTABLE AND ENERGY-EFFICIENT INDOOR CLIMATE

The broad and clearly structured portfolio from the Zehnder Group is split into four product lines. Consequently, we can provide our customers with the right product, perfect system and matching service for all types of projects – from new build to renovations, single or multi-occupancy homes, as well as commercial projects. This variety ensures that our wealth of experience is continuously expanding, providing tangible added value to our customers on a daily basis.



Decorative radiators
Our individual decorative radiators for living and bathrooms make a home not only warmer but also more attractive. Created by renowned designers, they impress with excellent functionality.



Comfortable indoor ventilation
Our comfortable indoor ventilation is energy-efficient and provides a healthy indoor climate. It promotes the wellbeing of the occupants and increases the value of the property.



Heating and cooling ceiling systems
Zehnder ceiling systems are convenient and energy-efficient for heating and cooling. They are perfectly attuned to the relevant environment.



Clean air solutions
Clean air systems from Zehnder reduce the level of dust in the air, create a healthier working environment and reduce the amount of cleaning required.

OUR BRANDS REPRESENT INNOVATION, QUALITY AND DESIGN



The Zehnder brand offers excellent indoor climate solutions within the product lines of decorative radiators, comfortable indoor ventilation, heating and cooling ceiling systems and clean air solutions.



The Runtal brand develops and manufactures exclusive radiators combining innovative technologies with unique designs.

BEST QUALITY CERTIFICATES

Zehnder Group products are frequently awarded prizes for design and innovative technology.



For in-depth advice on products and support
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