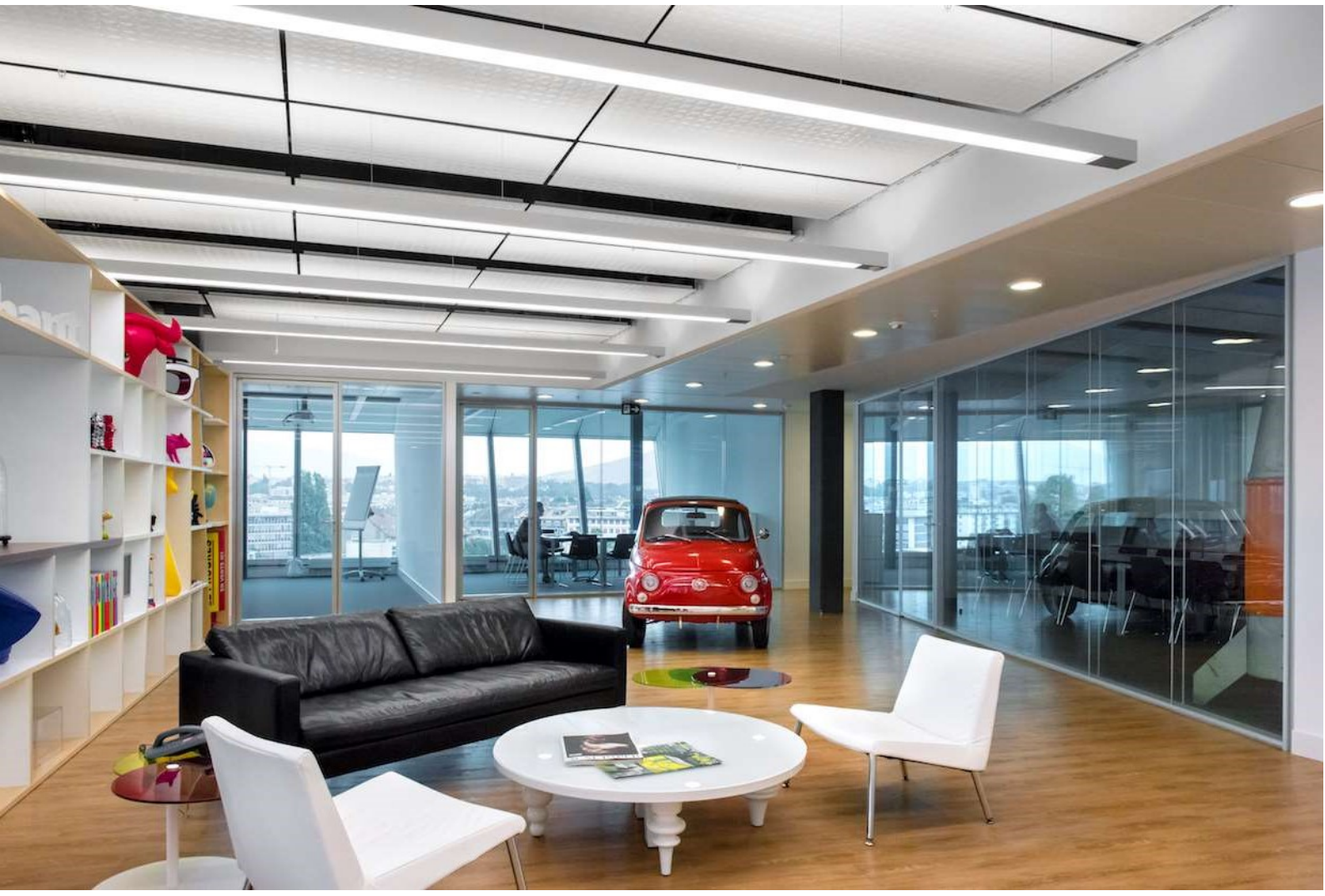
KIGO®
by SOLTOP Energie AG

KIGO STANDARD

CLIMATE PANELS AS CEILING SAIL

TECHNICAL DOCUMENTATION



1 Design 4
2 Installation types 5
2.1 Ceiling 5
2.1.1 Direct with metal studs and threaded rods 5
2.1.2 Direct with hooks and quick-set metal suspension 5
2.1.3 Indirect through a sub-construction including rails, clamps and threaded rods 5
2.1.4 Direct with cables 5
2.1.1 Indirect with cables 6
2.2 Wall 6
2.2.1 On standard structures 6
3 Materials 7
3.1 Materials for standard applications 7
3.2 Materials for specific applications 7
4 Structures and dimensions 7
4.1 Standard structures 7
4.2 Custom structures 7
4.3 Weight and content capacity 8
4.4 Hydraulic connections 8
4.5 Pressure losses in KIGO panel groups 8
5 Power of KIGO standard 9
5.1 Ceiling installation for heating 11
5.2 Ceiling installation for cooling 12
5.3 Vertical wall installation in heating and/or cooling mode 12
6 Acoustic 13
6.1 Climatic performance versus acoustic performance 13
6.2 Standard solutions 13
6.3 Custom solutions 17
7 Integration of ventilation 17
8 Lighting integration 19
9 Panel installation caution 20
9.1 Installation 20
9.2 Packaging and protection of panels 20
9.3 Handling of panels 20
9.4 Installation of panels 20
9.5 Flushing of distribution line 20
9.6 Pressure tests 21
9.7 Filling water quality (and refill water if required) 21
9.8 Circuit water quality 21
9.9 Flushing of the circuit and the climate panels 21
9.10 Post start-up operation quality control 21
10 KIGO standard technical data 23

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1 Design

The KIGO radiant panel consists in a flat exchanger providing total irrigation and integrated in stainless steel frame which provides an attractive finish and increases its rigidity. The frame also allows the panel to be suspended from a ceiling or installed against a wall.

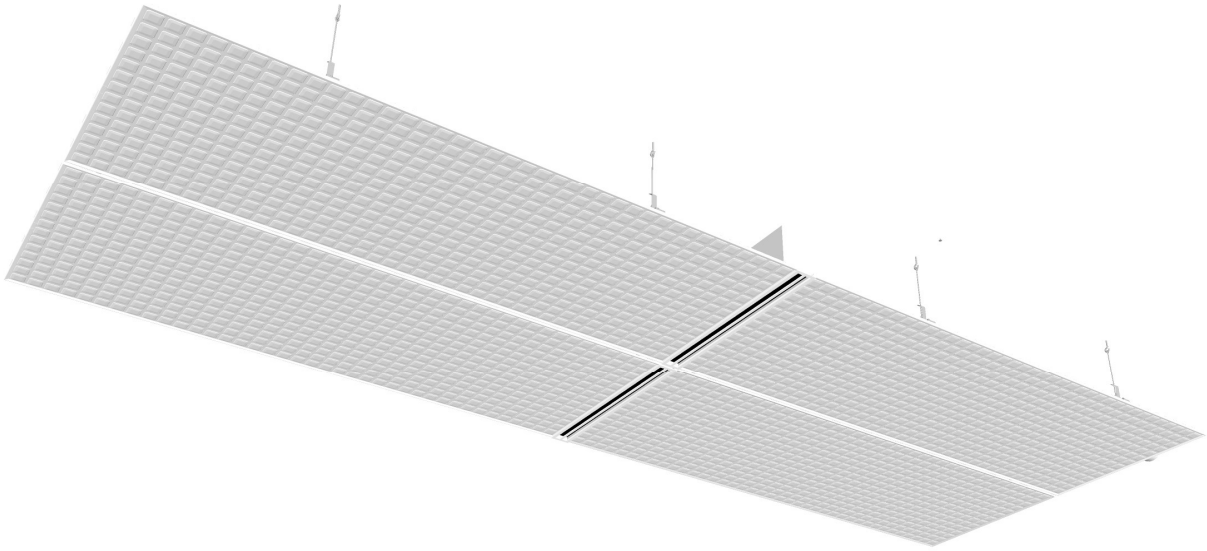

Fig. 1 – group of 4 standard KIGO climate panels (with optional integrated ventilation slits)

The whole is delivered powder coated in white or other color (RAL or NCS) to the client's choice. It is also possible to retain the galvanized steel hook by using a colorless powder coating.

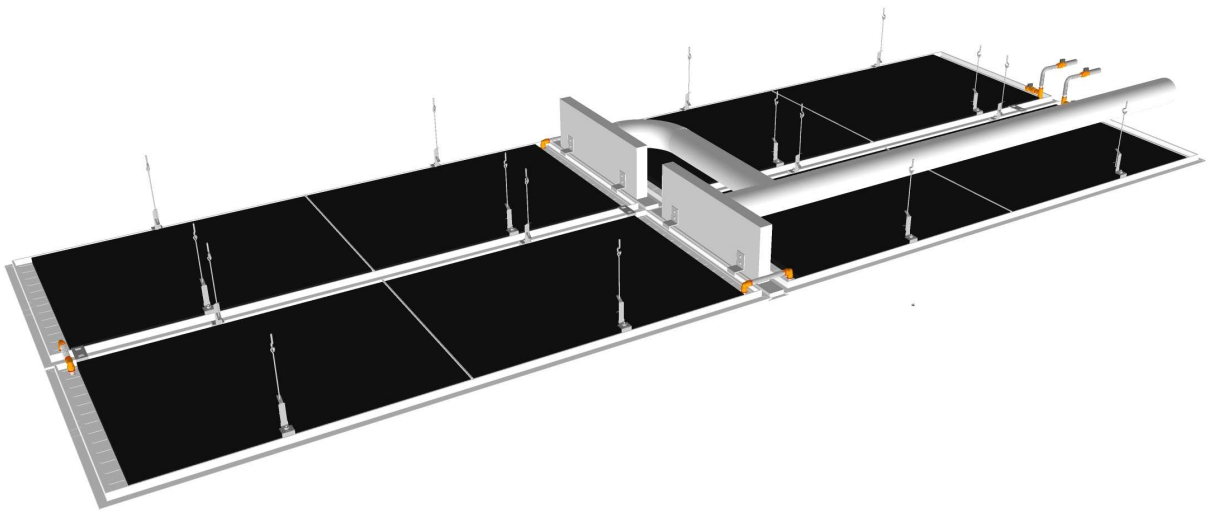

Fig. 2 – View of the hidden side of the group suspended by quick-fit mounting bracket and optional ventilation box and insulation

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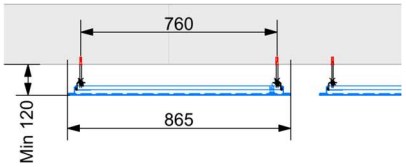
2 Installation types

2.1 Ceiling

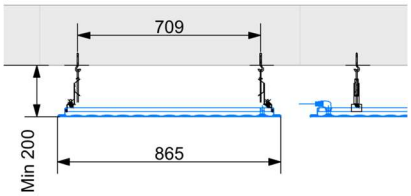
The suspension of KIGO panels can be achieved with various means. The choice may be for esthetic reasons or mandated by the maximum height of the room or, finally, by the inability to drill in the ceiling surface.

2.1.1 Direct with metal studs and threaded rods



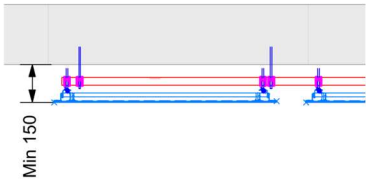
Made of a combination of metal studs, M6 threaded rods and hooks, this solution is very esthetic and compact. The assembly is simple but requires precise drilling and perfect alignment.

2.1.2 Direct with hooks and quick-set metal suspension



This variation provides a more efficient set up thanks to the use of 4 mm smooth rods and quick-set locks. Drilled holes must be must be very precise to ensure proper alignment.

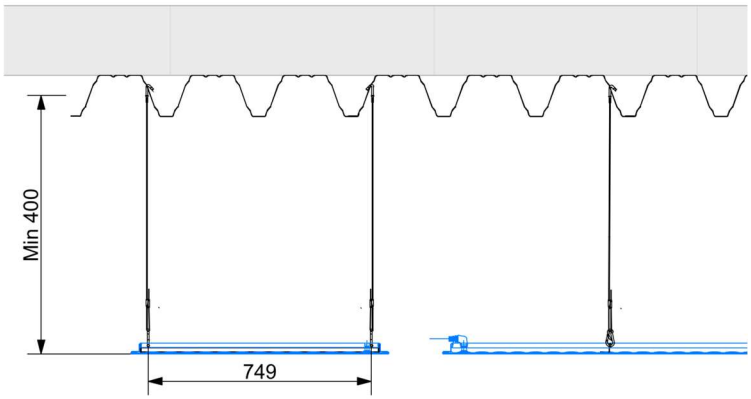
2.1.3 Indirect through a sub-construction including rails, clamps and threaded rods



A sub-construction consisting of light rails, clamps and M6 threaded rods is fixed to the ceiling surface. The panels are suspended from the rails. This solution has several advantages:

- Reduction of the number of fixing points and set up flexibility
- Levelling, perfect alignment of the panels
- Possibility to use suspension point between panels to hold, for example, the lighting system

2.1.4 Direct with cables



Setting up panels below trapezoidal ceilings may be complicated. An elegant and almost invisible solution consists in using vertical cables. One end of the cable has a special hook (to be inserted in a hole on the side of the trapeze), the other end has a carabiner and a quick-set length system.

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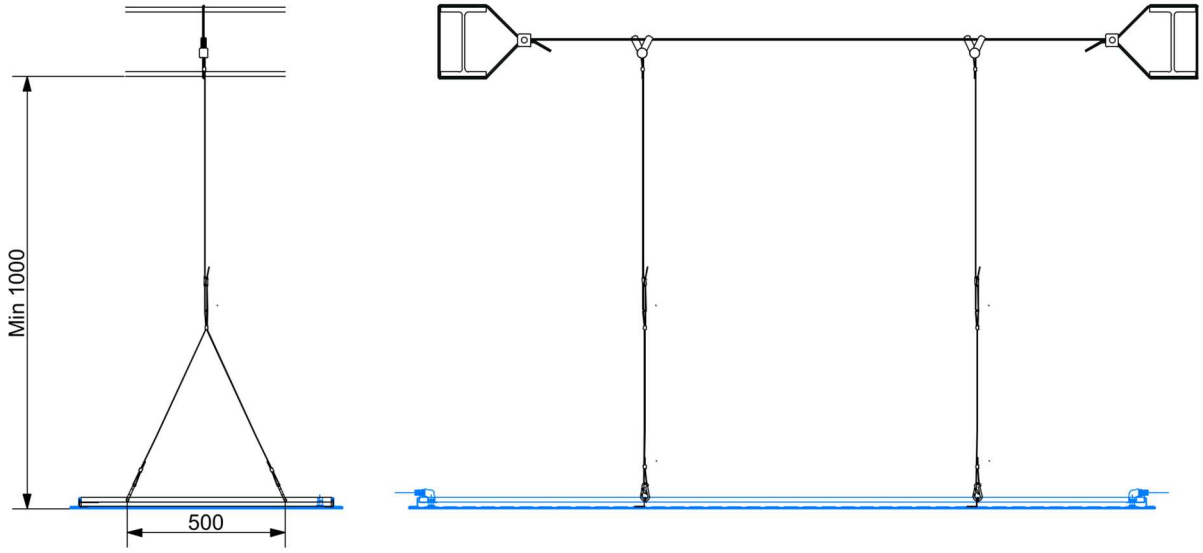
2.1.1 Indirect with cables

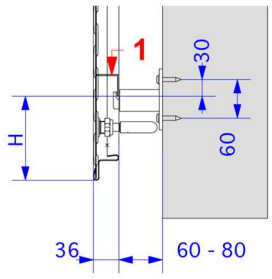
In some rooms, it may be impossible to hang the panels from the ceiling.

A solution consists to tension supporting cables between elements of the metal framework (anchor points) and then suspending the panels with vertical cables. This system can be very effective in high ceiling hangars. The limit resides in the maximum weight of 100 kg per supporting cable (hence 3 standard panels), leading to the installation of multiple supporting cables across the ceiling surface.

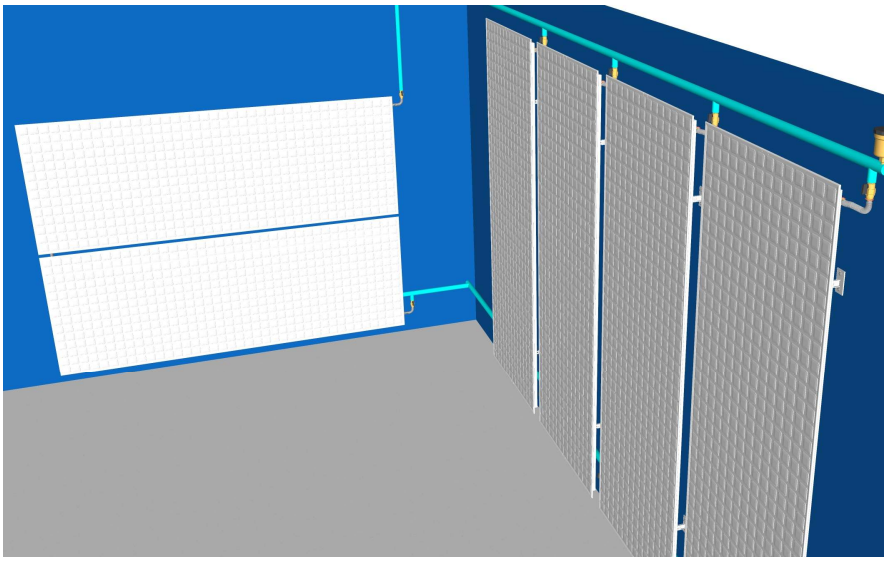


2.2 Wall

2.2.1 On standard structures



The frame of the KIGO panels, for wall installations, has additional support elements (See « 1 » on attached sketch) so standard mounting brackets can be used. These brackets will be arranged differently whether the panel installation is horizontal (landscape) or vertical (portrait).



For further information, please consult specific installation notices.

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3 Materials

3.1 Materials for standard applications

The standard panel is made of ferritic stainless steel 1.4509, the connection outlets of austenitic stainless steel 1.4301 and the frame of galvanized steel.

3.2 Materials for specific applications

For specific applications, the frame and the exchanger may be made of austenitic stainless 1.4301 (V2A), this for hygiene reasons (food applications) or technical (nonmagnetic).

4 Structures and dimensions

4.1 Standard formats

The length and width of the climate panels are 5 mm higher than those of the KIGO heat exchanger due to the frame. The standard width **B** is 865 mm. The length **L** is however adaptable to the client's needs. The maximal length is the standard length of 2'965 mm and the standard panel is 2'365 mm. Inferior lengths are possible in steps of 60 mm (2305, 2245, …).

The thickness H of the KIGO panel frame is 36 mm.

4.2 Custom formats

On request and for large orders (over 500 m2), it may be possible to reduce the width of the panels by increments of 60 mm (805, 745, 685 or 625 mm). Caution must be given as lead times can be significantly longer!

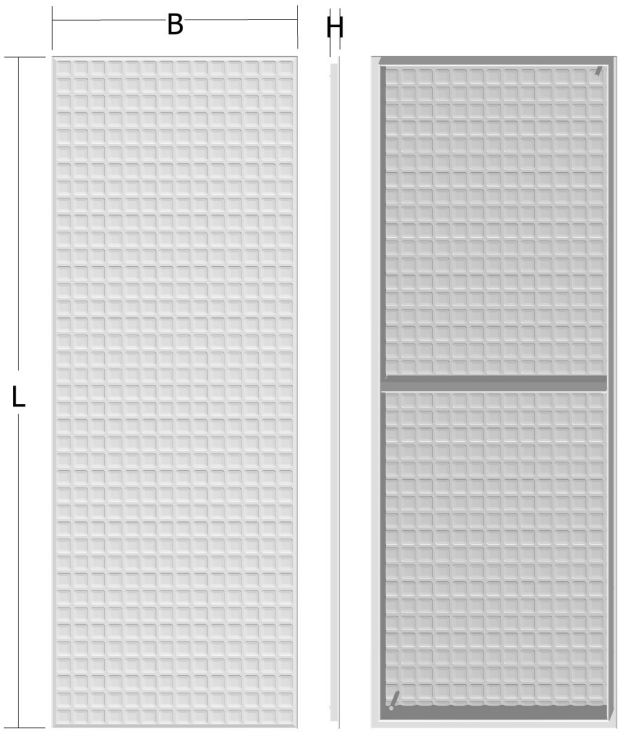

Fig. 3 – The KIGO Climate Panels and its main dimensions

KIGO PANEL SURFACE [m2]						
		WIDTH OF THE PANEL **B** [mm]				
		865[1/]	805[2/]	745[2/]	685[2/]	625[2/]
LENGTH OF THE PANEL **L** [mm]	2965	2.56	2.39	2.21	2.03	1.85
	2365[1/]	**2.05**	1.90	1.76	1.62	1.48
	2305	**1.99**	1.86	1.72	1.58	1.44
	2245	**1.94**	1.81	1.67	1.54	1.40
	2185	**1.89**	1.76	1.63	1.50	1.37
	2125	**1.84**	1.71	1.58	1.46	1.33
	2065	**1.79**	1.66	1.54	1.41	1.29
	2005	**1.73**	1.61	1.49	1.37	1.25
	1945	**1.68**	1.57	1.45	1.33	1.22
	1885	**1.63**	1.52	1.40	1.29	1.18
	1825	**1.58**	1.47	1.36	1.25	1.14
	1765	**1.53**	1.42	1.31	1.21	1.10
	1705	**1.47**	1.37	1.27	1.17	1.07

[1/] Standard dimentions

[2/] Width only on demande !

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4.3 Weight and content capacity

The tare weight of the climate panel is 13.5 kg/m2 and its capacity is 2.6 l/m2.

The standard panel is 2.05 m2 (L 2365 x B 865 mm) and weighs 27 kg empty and 32.2 kg filled.

4.4 Hydraulic connections

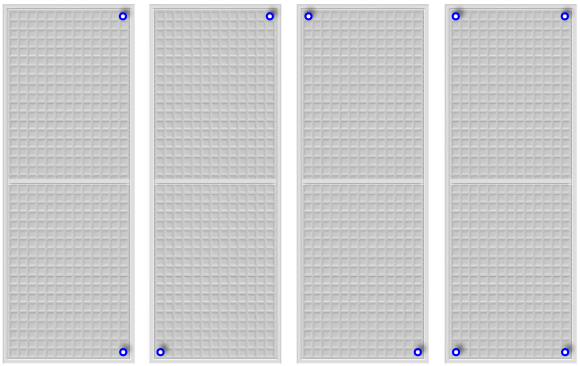

Fig. 4 – Possible positions of hydraulic connections (back side view of panel)

The climate panel can present 2 or 4 connection joints (Ø15 mm) for its hydraulic connections; either approach can be ordered. The standard panel is made with 2 parallel joints (2P).

For additional information, please refer to the general technical documentation about KIGO heat exchangers.

4.5 Pressure losses in KIGO panel groups

The tables below indicate the pressure loss of standard dimension exchanger groups (2365 x 865 mm), connected in series with either two or four hydraulic connections of Ø 15 mm for different acceptable specific flow rates. Connection accessories such as valves, quick connect couplings and flexible hoses which induce the largest part of the pressure losses, are also included in the indicated values. For smaller panels, the values below are also applicable.

Panel with 2 openings: Total power loss (+/-5%) of the group [kPa]									
Number of panels in series	Specific flow [l/h/m2]								
	15	25	35	45	55	65		75	
2	1/	**0.5**			**0.8**	**1.3**	**1.8**	**2.4**	**3.1**
3	**0.6**	**1.4**			**2.4**	**3.8**	**5.4**	**7.3**	**9.6**
4	**1.2**	**2.9**			**5.3**	**8.4**	**12.1**	**16.5**	**21.7**
5	**2.2**	**5.4**			**9.9**	**15.7**	**22.8**	**31.3**	2/
6	**3.6**	**8.9**			**16.5**	**26.4**	2/	2/	
7	**5.5**	**13.7**			**25.6**	2/			
8	**7.9**	**20.0**			2/				

Panels with 4 openings: Total power loss (+/-5%) of the group [kPa]							
Number of panels in series	Specific flow [l/h/m2]						
	15	25	35	45	55	65	75
6	**1.3**	**3.1**	**5.7**	**9.2**	**13.4**	**18.5**	**24.3**
7	**1.8**	**4.5**	**8.5**	**13.6**	**20.0**	**27.6**	2/
8	**2.5**	**6.4**	**11.9**	**19.3**	**28.3**	2/	
9	**3.4**	**8.6**	**16.2**	**26.2**	2/		
10	**4.4**	**11.3**	**21.3**	2/			
11	**5.6**	**14.5**	**27.4**				
12	**7.0**	**18.2**	2/				

1/ insufficient flow

2/ flow exceeding 500 l/h is not tolerated by the flexible connectors (risk of vibration and resonance)

Caution: further possible pressure losses due to balancing valves are not included in the table above.

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5 Power of KIGO standard

The operating mode corresponds to the temperature conditions under which the climate panel will operate.

Hence, it depends on the heat and/or cooling sources available and the targeted comfort temperature. It corresponds to an absolute value (noted |…|) between the average temperature ™ of the water circulation through the panel and the ambient air temperature (Ta).

The average temperature gap is calculated with the following formula:

ΔTm = |Tm – Ta |= |(Ti+To)/2 – Ta| *[K]*

Where Ti=Temp. at panel entry; To=Temp. at panel exit; Ta = Ambient air temp. in the room

The average temperature gap will determine the KIGO panel specific power and required water flow.

The power is calculated using a typical formula used for heating systems, starting with the average delta of the temperature (ΔTm) and the characteristic parameters **k** and **n** of the KIGO panel.

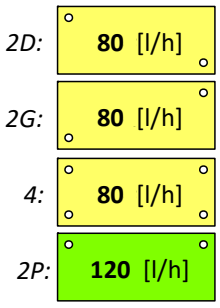
Parameter	Unit	Ceiling Installation		Wall installation
Mode	-	Heating	Cooling	Heating & Cooling
Tm	°C	0.5 x (Ti+To)		
ΔTm	K	|Tm - Ta|		
P	**W/m2**	**$P = k \times (\Delta Tm)^n$**		
Ps	W/m2/K	P / ΔTm		
ΔTw	K	|Ti-To|		
Qw	l/h/m2	P / (1.161*ΔTw) ; pour de l'eau		

The k and n coefficients will vary according to the type of installation. Please refer to the specific power tables specific to the operating conditions for various operating conditions.

The indicated power values, for ceiling installations, do not take into account the increase in power provided by the forced convection on the lower panel side by renewal air supply gates. Depending on the type of diffuser and the position relative to the climate panel the power gain can be up to 20%. For more precise date, please consult Energie Solaire SA.

The specific flow (Qw) depends directly on the power and the operating conditions.

To ensure optimal irrigation through the panel and to exploit its full power capacity, it is imperative to respect a minimum flow (Qmin) through each panel; this depends on the configuration of the connections, being either 80 l/h or 120 l/h as shown in the figure.



To address this constraint, there are two solutions available:

- To connect multiple panels in serial mode. The minimum panel surface will be the result of Smin = Qmin / Qw
- To modify the temperature set up to reduce the temperature delta ΔTw.

Caution should be given to respect the maximum flow of 500 l/h per flexible connector corresponding to 500 l/h per panel group of 2 connections (2D,2G,2P) and to 1'000 l/h for these with 4 connections.

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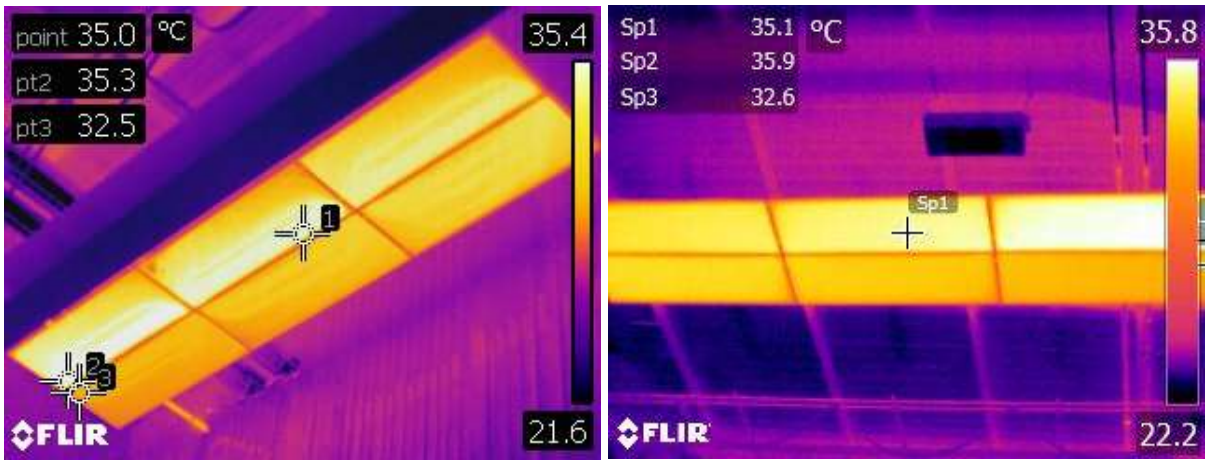

Fig. 5 – Infrared images demonstrate the effect of poor panel irrigation

The effect of insufficient flow is illustrated above. On the left, we can see that the surface is not totally irrigated while the right one (the proper flow) is totally irrigated.

The tables below provide the data about power, specific flow and minimum panel surface for various operating conditions.

Abbreviations used in the tables below

Ta	Average ambient room temperature
Ti	Entry water temperature (entrance of water in panel)
To	Return temperature (exit of water from the panel)
ΔTw	Difference in water temperature Ti-To
ΔTm	Average temperature gap (Ti+To)/2-Ta
P	Specific power of panel $P = k*(\Delta Tm)^n$
Ps	KIGO exchange coefficient
Qw	Specific flow
Smin_80	Minimum panel surface (2 connections in diagonal or 4 connections) to get optimum irrigation of 80 l/h
Smin_120	Minimum panel surface (2 connections in parallel) in the group to get optimum irrigation of 120 l/h
HR max	Maximum relative humidity (dew point)

To determine the power for other operating conditions, please use the specific coefficients k and n shown on the tables and use the calculation formula indicated earlier on, you may also see these examples.

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5.1 Ceiling installation for heating

KIGO IN CEILING HEATING MODE - STANDARD INSULATION ON HIDDEN SURFACE								k n	7.627 1.133
Ta	Ti	To	ΔTw	ΔTm	P_{ch}	Ps	Qw	Smin_80	Smin_120
[°C]	*[°C]*	*[°C]*	*[K]*	*[K]*	*[W/m2]*	*[W/m2/K]*	*[l/h/m2]*	*[m2]*	*[m2]*
16	33.0	30.0	3.0	15.5	170	11.0	48.9	1.6	2.5
16	35.0	30.0	5.0	16.5	183	11.1	31.5	2.5	3.8
16	40.0	35.0	5.0	21.5	247	11.5	42.5	1.9	2.8
16	45.0	40.0	5.0	26.5	313	11.8	53.8	1.5	2.2
18	33.0	30.0	3.0	13.5	146	10.8	41.8	1.9	2.9
18*	**35.0**	**30.0**	**5.0**	**14.5**	**158**	**10.9**	**27.2**	**2.9**	**4.4**
18	40.0	35.0	5.0	19.5	221	11.3	38.0	2.1	3.2
18	45.0	40.0	5.0	24.5	286	11.7	49.3	1.6	2.4
20	33.0	30.0	3.0	11.5	121	10.6	34.8	2.3	3.4
20	35.0	30.0	5.0	12.5	133	10.7	23.0	3.5	5.2
20	40.0	35.0	5.0	17.5	195	11.2	33.6	2.4	3.6
20	45.0	40.0	5.0	22.5	260	11.5	44.7	1.8	2.7
22	33.0	30.0	3.0	9.5	98	10.3	28.1	2.9	4.3

*** Example:**

Operating conditions Ti=35°C To=30°C Ta=18°C (T felt = 20°C with properly insulated walls)
Tm= 0.5 x (35 + 30) = 32.5°C
ΔTm = 32.5 - 18 = 14.5 K
Power = P = 7.627 x $14.5^{1.133}$ = 158 W/m2
Exchange coefficient = 158 / 14.5 = 10.9 W/m2/K
Specific flow = 27.2 l/h/m2
Minimum required surface for 80 l/h flow = 2.9 m2 and for 120 l/h flow = 4.4 m2

KIGO IN CEILING HEATING MODE – NO INSULATION ON HIDDEN SURFACE								k n	8.918 1.120
Ta	Ti	To	ΔTw	ΔTm	P_{ch}	Ps	Qw	Smin_80	Smin_120
[°C]	*[°C]*	*[°C]*	*[K]*	*[K]*	*[W/m2]*	*[W/m2/K]*	*[l/h/m2]*	*[m2]*	*[m2]*
16	33.0	30.0	3.0	15.5	192	12.4	55.1	1.5	2.2
16	35.0	30.0	5.0	16.5	206	12.5	35.5	2.3	3.4
16	40.0	35.0	5.0	21.5	277	12.9	47.7	1.7	2.5
16	45.0	40.0	5.0	26.5	350	13.2	60.3	1.3	2.0
18	33.0	30.0	3.0	13.5	165	12.2	47.2	1.7	2.5
18	35.0	30.0	5.0	14.5	178	12.3	30.7	2.6	3.9
18	40.0	35.0	5.0	19.5	248	12.7	42.8	1.9	2.8
18	45.0	40.0	5.0	24.5	321	13.1	55.2	1.4	2.2
20	33.0	30.0	3.0	11.5	137	12.0	39.5	2.0	3.0
20	35.0	30.0	5.0	12.5	151	12.1	26.0	3.1	4.6
20	40.0	35.0	5.0	17.5	220	12.6	37.9	2.1	3.2
20	45.0	40.0	5.0	22.5	292	13.0	50.2	1.6	2.4
22	33.0	30.0	3.0	9.5	111	11.7	31.9	2.5	3.8

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5.2 Ceiling installation for cooling

KIGO CEILING COOLING MODE – STANDARD INSULATION ON HIDDEN SURFACE							k n	11.447 1.1203		
Ta	Ti	To	ΔTw	ΔTm	P_{fr}	Ps	Qw	Smin_80	Smin_120	HR max
[°C]	*[°C]*	*[°C]*	*[K]*	*[K]*	*[W/m2]*	*[W/m2/K]*	*[l/h/m2]*	*[m2]*	*[m2]*	*[%]*
24	15.0	17.0	2.0	8	118	14.7	50.6	1.6	2.4	57
24	15.0	18.0	3.0	7.5	109	14.6	31.4	2.5	3.8	57
24	16.0	19.0	3.0	6.5	93	14.3	26.8	3.0	4.5	61
26	15.0	18.0	3.0	9.5	143	15.0	40.9	2.0	2.9	51
26*	**16.0**	**19.0**	**3.0**	**8.5**	**126**	**14.8**	**36.1**	**2.2**	**3.3**	**54**
26	16.0	20.0	4.0	8	118	14.7	25.3	3.2	4.7	54
26	17.0	20.0	3.0	7.5	109	14.6	31.4	2.5	3.8	58
26	17.0	21.0	4.0	7	101	14.5	21.8	3.7	5.5	58
26	17.0	22.0	5.0	6.5	93	14.3	16.1	5.0	7.5	58
28	16.0	19.0	3.0	10.5	159	15.2	45.8	1.7	2.6	48
28	16.0	20.0	4.0	10	151	15.1	32.5	2.5	3.7	48
28	17.0	21.0	4.0	9	134	14.9	28.9	2.8	4.2	51
28	18.0	21.0	3.0	8.5	126	14.8	36.1	2.2	3.3	55

*** Example:**

Operating conditions Ti=16°C To=19°C Ta=26°C

Tm= 0.5 x (16 + 19) = 17.5°C

ΔTm = 26 - 17.5 = 8.5 K

Power = P = 11.447 x $8.5^{1.1203}$ = 126 W/m2

Coefficient exchange = 126 / 8.5 = 14.8 W/m2/K

Specific flow = 36.1 l/h/m2

Minimum surface for 80 l/h flow = 2.2 m2 and for 120 l/h flow = 3.3 m2

5.3 Vertical wall installation in heating and/or cooling mode

KIGO ON WALL – NO INSULATION AND SPACE BETWEEN PANEL AND WALL								k n	13.321 1.2071	
HEATING MODE										
Ta	Ti	To	ΔTw	ΔTm	P_{fr}	Ps	Qw	Smin_80	Smin_120	HR max
[°C]	*[°C]*	*[°C]*	*[K]*	*[K]*	*[W/m2]*	*[W/m2/K]*	*[l/h/m2]*	*[m2]*	*[m2]*	*[%]*
16	35.0	30.0	5.0	16.5	393	23.8	67.7	1.2	1.8	
16	40.0	30.0	10.0	19	466	24.5	40.1	2.0	3.0	
16	45.0	35.0	10.0	24	617	25.7	53.2	1.5	2.3	
18	35.0	30.0	5.0	14.5	336	23.2	57.9	1.4	2.1	
18	40.0	30.0	10.0	17	407	24.0	35.1	2.3	3.4	
18	45.0	35.0	10.0	22	556	25.3	47.9	1.7	2.5	
20	35.0	30.0	5.0	12.5	281	22.5	48.4	1.7	2.5	
20	40.0	30.0	10.0	15	350	23.3	30.2	2.7	4.0	
20	45.0	35.0	10.0	20	495	24.8	42.7	1.9	2.8	
COOLING MODE										
24	15.0	17.0	2.0	8	164	20.5	70.6	1.1	1.7	57
24	16.0	19.0	3.0	6.5	128	19.6	36.6	2.2	3.3	61
24	17.0	20.0	3.0	5.5	104	19.0	29.9	2.7	4.0	65
26	15.0	17.0	2.0	10	215	21.5	92.4	0.9	1.3	51
26	16.0	19.0	3.0	8.5	176	20.8	50.6	1.6	2.4	54
26	17.0	20.0	3.0	7.5	152	20.2	43.5	1.8	2.8	58
28	16.0	19.0	3.0	10.5	228	21.7	65.3	1.2	1.8	48
28	17.0	20.0	3.0	9.5	202	21.2	57.9	1.4	2.1	51
28	18.0	22.0	4.0	8	164	20.5	35.3	2.3	3.4	55

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6 Acoustic

Acoustic waves propagate within a room at the speed of sound (340 m/s). When they encounter a surface delimiting the room, they are partially reflected and form a diffused sound field which superimposes itself to the sound coming directly from the sound source. As the trajectory pursued by the diffused sound is longer than the straight trajectory of the direct field, they do not arrive at the same time. This phenomenon is known as reverberation time. A reverberation time too long is not comfortable.

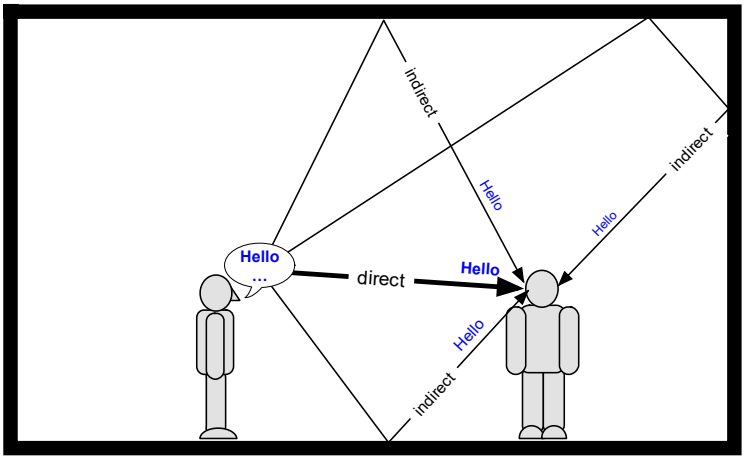

Fig. 6 – Direct and indirect sound field

The acoustic absorption factor of a material, defined by the symbol α_s, is an important component of acoustic studies of rooms. It is indicated in function of the frequency between 125 et 4'000 Hz.

The mathematical description of the acoustic absorption power was established by W.C. Sabine, who had discovered a relation between the reverberation time T_R (s), the volume of the room V_L (m3) and the equivalent acoustic absorption surface A (m2).

$A = 0.163 * V_L / T_R = \Sigma A_e$

The equivalent surface A_e of each element can also be calculated using α_s and the actual surface of the element S_e.

$A_e = \alpha_{s_e} * S_e$

6.1 Climatic performance versus acoustic performance

In addition to the climatic performance, the acoustic performance is as well essential to comfort. In most cases, we treat acoustic absorption in combination with KIGO climate panels.

Is there such a thing as an exchanger that is as efficient thermally standpoint as it is acoustically?

Unfortunately, no! A thermal exchanger requires large conducting surfaces, often metallic, this contrasting to acoustically insulating materials. One must then find a compromise.

6.2 Standard solutions

Most cooling panels available in the marketplace are made up of a perforated sheet metal to which a sound absorbing surface has been attached on the hidden side. The sound is directly absorbed by the surface not covered by fins (typically between 15 and 30% of the surface) and by the back of the panel which absorbs the waves reflected by the ceiling

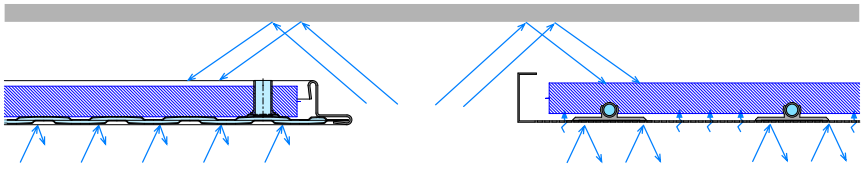

Fig. 7 – Acoustic behavior: KIGO on left and conventional on right

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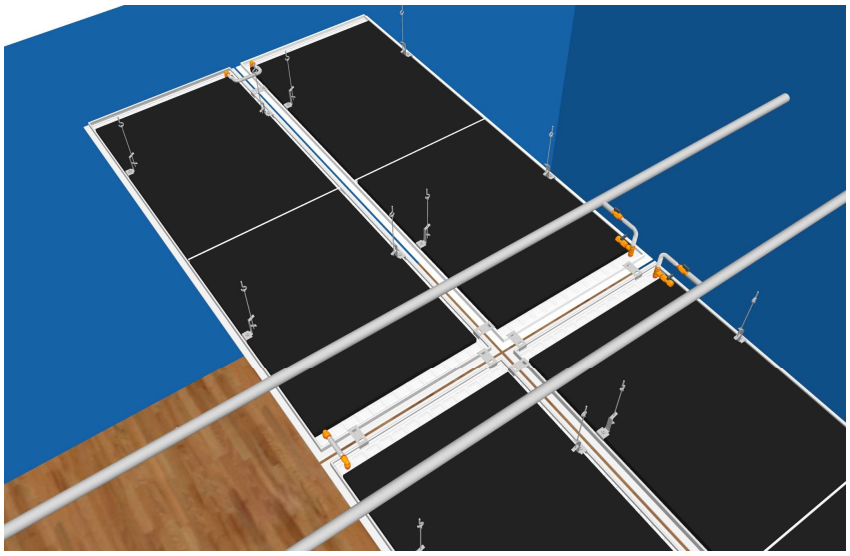
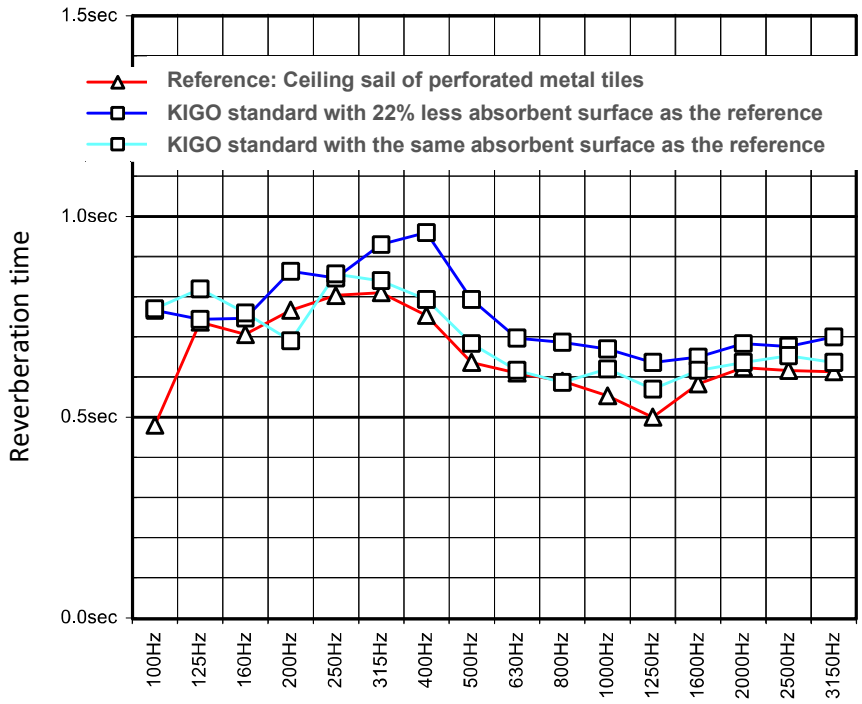
The acoustic behavior of the basic KIGO climate panel is itself comparable to the behavior of a panel in wood cork.



Thanks to standard insulation, made of fiberglass wrapped in black PE robe, installed on the back of the panel. The acoustic properties are significantly improved.

Fig. 8 – Group of radiant panels with standard insulation on the back side

This graph shows the result of comparative measurements of reverberation time in a room in function of the panel type installed. The reverberation time of the KIGO standard solution is slightly higher than the time observed with a typical perforated metal ceiling since the absorbent surface is lower due to the higher KIGO power. For an identical absorbing surface, the reverberation time is almost equivalent.



The table below indicates the acoustic absorption factors of the KIGO panels surfaces and metal perforated bins.

	α_s					
Frequency [Hz]	**125**	**250**	**500**	**1000**	**2000**	**4000**
KiIGO bottom face	0.06	0.06	0.04	0.03	0.05	0.10
KIGO hidden face with 25 mm insulation	0.12	0.51	1.03	0.97	0.93	0.58

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6.3 Custom solutions

The spaces between the climate panels and in periphery may participate very efficiently to the direct acoustic absorption. The angles of the room play a key role in the acoustic performance.

Various technical solutions are possible, such as ceilings or walls use of stretch canvas which can combine harmoniously with the KIGO panels.

7 Integration of ventilation

The diffusion of the renewal air requires a discretely integration with the climate panels. The distribution ducts can easily be dissimulated between the slab and the KIGO panels and the diffuser slots, of the same color and width as the panels, find an ideal place between the panels. The boxes can be easily attached to the panel frames, ensuring a quick installation and a perfect alignment.

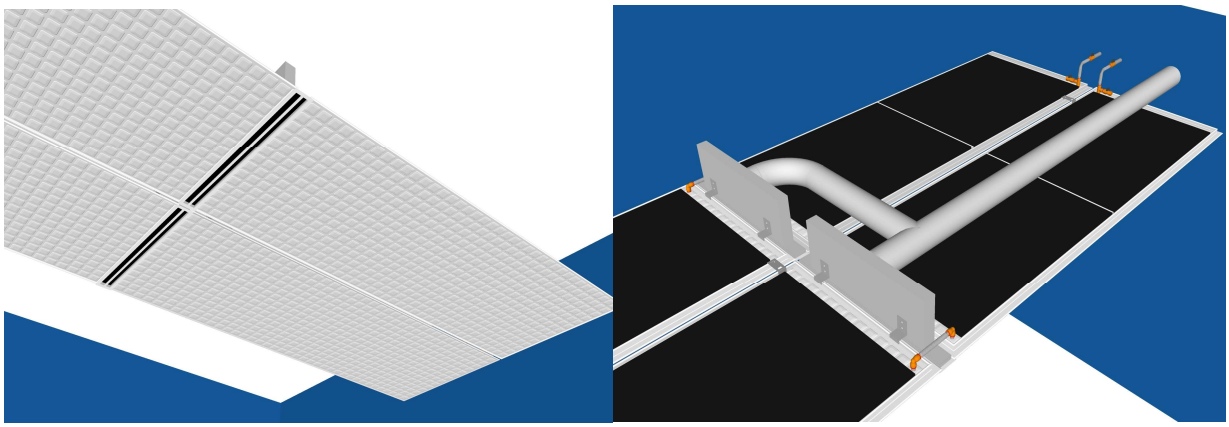

Fig. 9 – Integrated air distribution box in a group of KIGO climate panels

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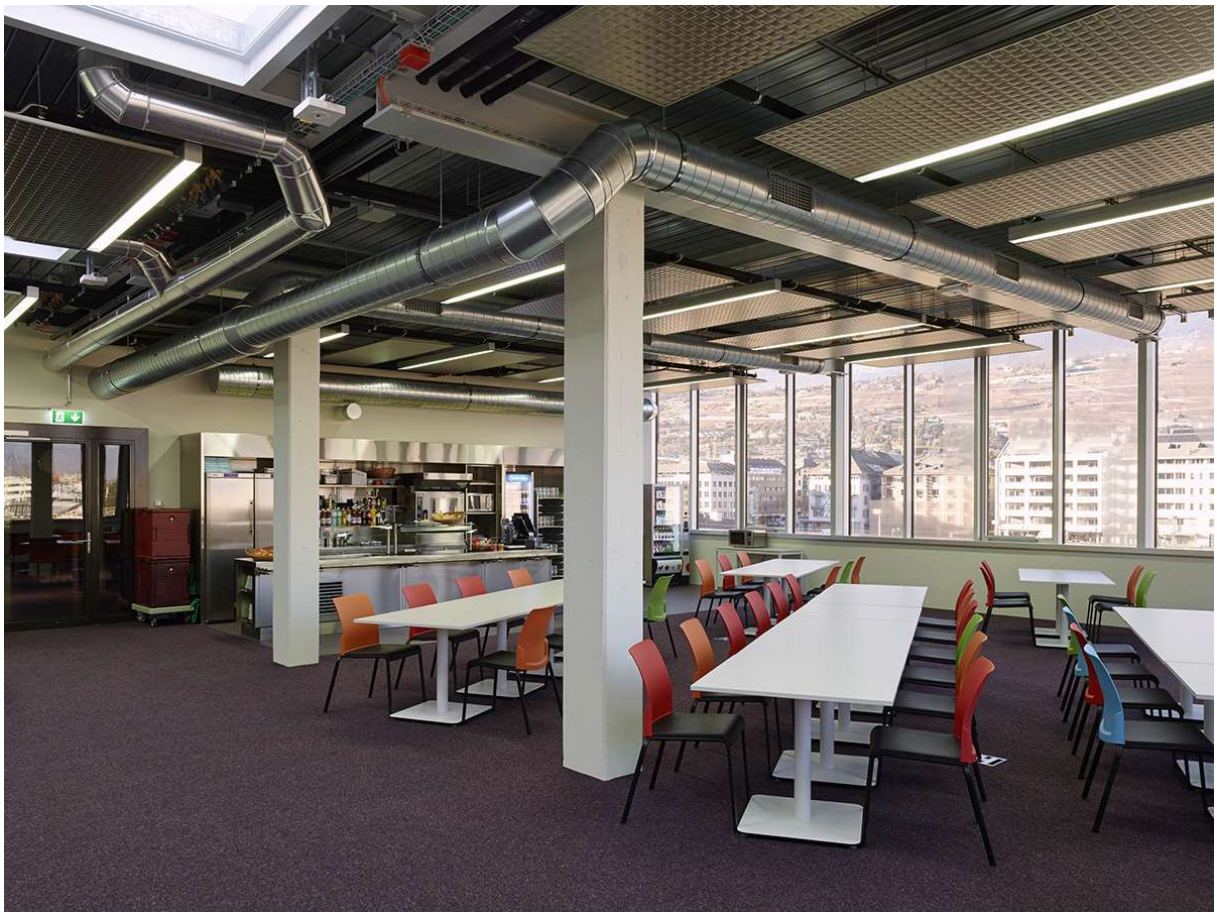
8 Lighting integration

The luminaires find a privileged place between the climate panels. Depending on the mounting system, they benefit from the panel structural support system, helping at the same time their installation and alignment.



If the luminaires are combined type, with direct and indirect lightning, the KIGO panels offer a perfect surface for the diffusion of light.

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9 Panel installation caution

9.1 Installation

For detailed instructions, please consult specific installation notes.

9.2 Packaging and protection of panels

KIGO panels are delivered in a specifically designed package to ensure maximum protection during their transport and at reception at the installation site.

Caution should be taken that the packaging does not protect against rain and other inclement weather. In case of storms during the unloading and reception of the panels at the installation site, the use of a waterproof tarp is required.

It is also forbidden to store the climate panels outdoors. They must, at a minimum, be covered by a fixed roof, offering total protection against severe weather.

Any damage caused by a lack of compliance to the instructions above are not covered by the warranty.

9.3 Handling of panels

When panels are delivered in crates, it is necessary to lean each crate slightly and to lean it (side with nails) against a wall or a support system before opening the crate (side with screws).

Panels must be handled with care and with gloves in order not to damage the thermo-plated surface. If the panels will be stored ahead of their installation, it is strongly recommended to keep them in their original package and in a dust free area. If it is not possible to keep the panels in their original package, it is certainly not acceptable to lie them down directly on the floor without any protection. Place, at a minimum, two wooden slats find a solid support against a wall or vertical beam. Place the panels face against face with at least a separation cardboard piece between the faces, leaning them slightly to ensure they will not slide to the floor.

Any damage resulting from not adhering to these instructions will not be covered by the warranty.

9.4 Installation of panels

The KIGO climate panels installation instructions must be read before beginning the installation process and these must be followed carefully. Ensure in every case that the support to which the panels will be attached is in decent shape and able to sustain the additional load.

Adapt the personal protection equipment as well in relation to the installation environment, such as the height for example.

9.5 Flushing of distribution line

A serious flushing effort of the distribution lines must be completed according to norms and standards (SIA, SICC, VDI), including the connection between the groups of panels to these distribution lines before opening the isolation valves of each group.

Care must be given to the disposal of ferrous metal residues since these are susceptible of initiating corrosion through contamination of the stainless steel which the climate panels exchangers are made of.

Damage due to internal corrosion is not covered by the warranty.

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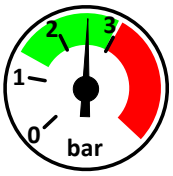
9.6 Pressure tests

The maximum pressure acceptable for KIGO climate panels is 3.0 bar.



If the pressure tests require a superior pressure level of the lines, the isolation valves of each group of climate panels must be shut down imperatively.

Any damage due to over pressurization will not be covered by the warranty.

9.7 Filling water quality (and refill water if required)

The filling water quality, and the refill water as well (if required), must respect values indicated below, these coming from the following standard SICC BT102-01

Des.	*Description*	*Target*	*Unit*	*Des.*	*Description*	*Target*	*Unit*
GH	*Total hardness*	*< 10 **	*mg/l $CaCO_3$*	*LF*	*Conductivity*	*< 100*	*µS/cm*
GH	*Total hardness*	*< 1.0 **	*°f*	*pH*	*pH level*	*6.0 à 8.5*	*-*

- *Filling and refill water must be demineralized.*

In case of any doubt about the quality of the available water, it is most imperative to consult a specialist before filling the installed line.

9.8 Circuit water quality

The circuit water quality, after a few weeks of usage post installation and, later, as part of an annual control, must respect the values indicated below, derived from the standard SICC BT102-01:

Des.	*Description*	*Target*	*Unit*	*Des.*	*Description*	*Target*	*Unit*
GH	*Total hardness*	*< 50*	*mg/l $CaCO_3$*	*SO_4^{2-}*	*Sulfates*	*< 50*	*mg/l*
GH	*Total hardness*	*< 5.0*	*°f*	*O_2*	*Oxygen*	*< 0.1*	*mg/l*
LF	*Conductivity*	*< 200*	*µS/cm*	*Fe*	*Dissolved iron*	*< 0.5*	*mg/l*
pH	*pH value*	*8.2 à 10*	*-*	*TOC*	*Total organic carbon value*	*< 30*	*mg/l*
Cl^-	***Chlorides***	***< 30***	***mg/l***				

In case of any discrepancy, it is imperative to contact a specialist to discuss how to address the situation and correct the water quality.

9.9 Flushing of the circuit and the climate panels

The presence of air in the circuit increases the risk of corrosion and the formation of mud. In addition, a poor flushing effort of the system will lead to poor efficiency in the usage of the climate panels. It is, hence, imperative to properly flush the circuit and to push out ay air imprisoned by ensuring a flow superior to 100 gl/h (500 l/h) in each group until total evacuation of air and the absence of any dripping noise.

It is necessary, for this operation, to operate the circulation pump at full speed, completely opening the balancing valves and closing the isolation valves of some groups to increase the flow in other groups. After completing air evacuation, close one group and then open the subsequent group until all groups have been all purged.

Proceed then to the set-up of the balancing valves and to the commission of the system for operational usage.

9.10 Post start-up operation quality control

As soon as the installation has been completed and that the panels are in operation for heating and cooling, it is strongly recommended to run a quality control test with a thermo-graphic camera. This will assure that all panels are properly irrigated and that there is no air left in the panels.

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12

10 KIGO standard technical data

Materials - standard applications	Exchanger: Stainless steel 1.4509 Frame: Galvanized steel
Materials - custom applications	Exchanger: Stainless steel 1.4301 Frame: Stainless steel 1.4301
Dimensions	Standard: 2365 x 865mm Maximum: 2965 x 865mm Other dimensions may be available – consult Factory
Panel thickness	36 mm
Suspension height	Min. 120mm for direct suspension with threaded rods Min. 150mm for indirect suspension with rods and rails Min. 200mm avec suspension cables (distance between ceiling and the bottom of the climate panels)
Color	Standard: RAL 9010 Other RAL & NCS colors: available at an additional fee
Tare weight	13.5 kg/m^2
Filled weight	16.1 kg/m^2
Water volume content	2,6 l/m^2
Exchanger	Exchanger with complete irrigation (95 %) based on specific geometry. Panels are spot welded.
Pressure though system	max. 3.0 bar
Max operation temperature	90°C
Power in heating for ΔTm of 15K	Ceiling island: 164 W/m2 with standard insulation Ceiling island: 185 W/m2 without insulation Wall set-up: 350 W/m2 with free back space of 10cm
Power in cooling for ΔTm of 8K	Ceiling island: 118 W/m2 with standard insulation Wall set-up: 164 W/m2 with free back space of 10cm
Hydraulic connection to and from panel	2 smooth tubes exit openings Ø 15.0 x 1.0 mm with groove. 4 openings (2 entrance / 2 exit) available per request (reducing power losses).
Hydraulic flexible connection	Stainless steel flexible connectors, 100% air tight, equipped with two quick connect couplings with double « O-Ring » and safety ring. Connection to main distribution line through ball valves and quick connect coupling and threaded connector 1/2.
Power losses through a panel network with typical flow of 35 l/h/m2	4 panels with 2 openings: 5.3 kPa 8 panels with 4 openings: 11.9 kPa Flexible connectors, quick connect couplings and valves included
Filling water quality	Switzerland: Respect SICC BT 102 01 (SICC/SWKI) specs Rest of world: Respect VDI 2035 standard. DO NOT use any water containing chore based components.
Fire resistance	Fire resistance test completed according to NBN 713.020 spec.

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