WATERSTRIP

FRACCARO
RADIANT SOLUTIONS

Update on 07/2015

WATERSTRIP
HOT WATER
RADIANT PANELS

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CE

FRACCARO
RADIANT SOLUTIONS

Model number: WP2 060-090-120
WP3 030-040-060-090-120

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EN 14037-1 Ceiling mounted radiant panels

RADIANT SOLUTIONS

1.0 “WATERSTRIP” HOT WATER RADIANT PANELS

1.1 OPERATING PRINCIPLE

WATERSTRIP (hot water radiant panels) are suitable for heating large industrial and civil buildings by infrared rays. They are the best solution where low-noise operation, no air flow, and no dust circulation are required. WATERSTRIP are also suitable to heat rooms housing inflammable mixtures.
No air flow and low stratification ensure low running costs.
The power emission and the production quality are certified according to the European norm EN14037. Furthermore, the “WP” series is the result of a new patented production technology which assures the highest quality of the finished product.
In summertime, the same installation can work as a cooling plant. This is possible by using cold water as working fluid.

1.2 CONSTRUCTIVE FEATURES

WATERSTRIP consist of a set of pipes secured to an insulated shield placed on the top side. Even after several years of operation, the accurate assembly ensures a perfect contact between pipes and shield, enabling peak thermal emission values.
Side stripes can be added to reduce air circulation. A joint-cover is fitted on the welds connecting the sections. Strengthening cross-pieces are fitted on the top side, and are also used for anchoring. Fibreglass panels with aluminium foil at the top are fitted to eliminate upward radiation. The manifolds are square-sectioned, not welded to the thermal panels and can be used both with hot and cold water. The standard colour is white RAL9010. Other colours can be provided upon specific request.
WATERSTRIP panels can also work with steam: in this case special manifolds should be applied.

Key:
1 = Metal sheet panel
2 = Ø 22 mm tubes
3 = Cross-piece strengthening
4 = Top insulating panel
5 = Lateral anti-convective stripes
6 = Square manifold
7 = Joint cover

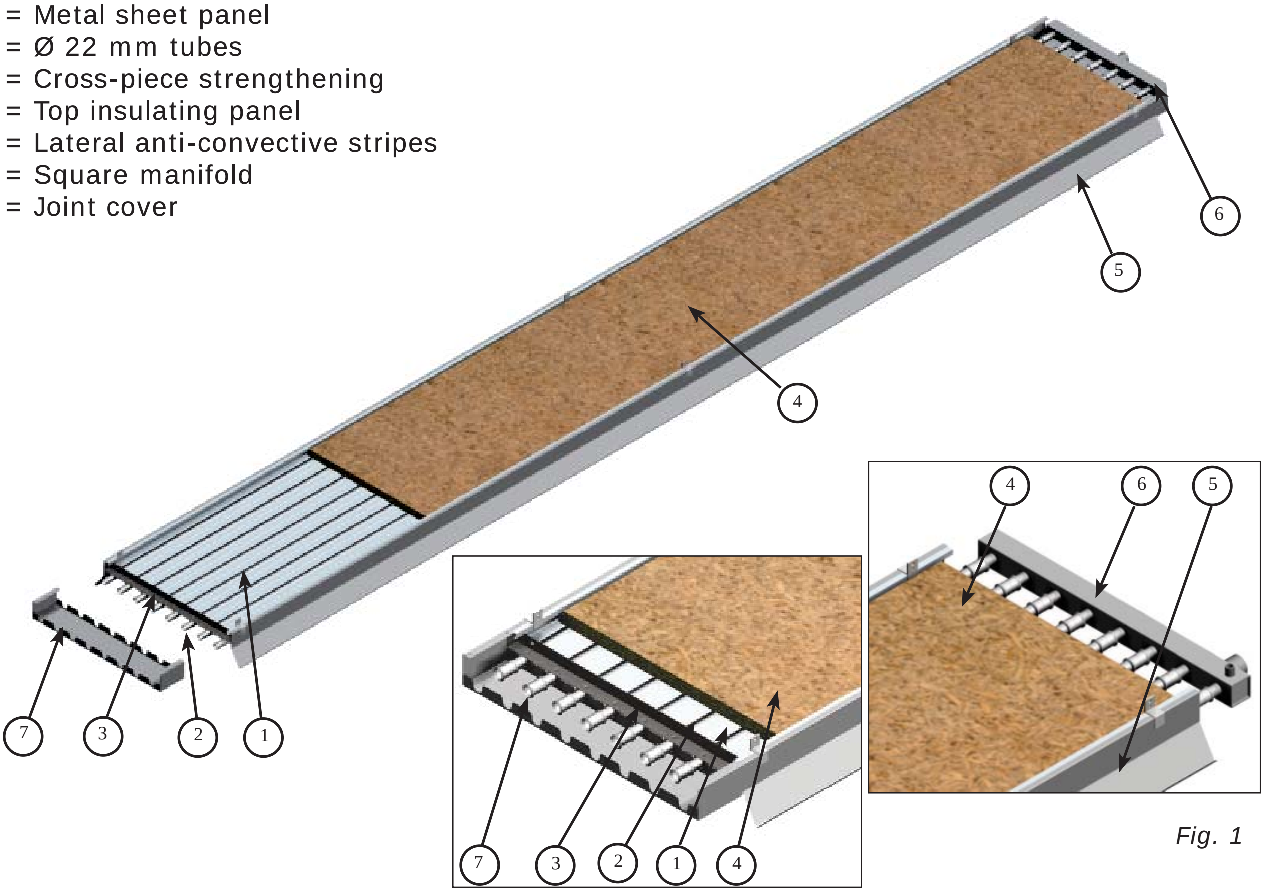


Fig. 1

1.3 WP SERIES

The “WP” series comply with the usual reliability and flexibility of Fraccaro’s products. Their main features are:

- Ø22 mm galvanised steel tube: the nominal diameter is in compliance with the international pressfitting standards;
- Radiant panel with double protection: the steel sheet is galvanised and pre-painted;
- Self-supporting panel;
- High flexibility for the installation: possibility to hook the chains to the cross-piece strengthenings (each 1,5 meters); no binds by using the sliding hooks;
- New asymmetrical manifolds which improve the balancing of water flow and allow the homogeneous distribution of the temperature into the panels.

1.4 MODELS AND SIZES
“WP” SERIES

WATERSTRIP "WP" series		WP2-060	WP2-090	WP2-120	WP3-030	WP3-040	WP3-060	WP3-090	WP3-120
Number of tubes		4	6	8	3	4	6	9	12
External tube diameter	[mm]	22			22				
Distance between tube centres	[mm]	150			100				
Water capacity	[L/m]	1,13	1,70	2,27	0,9	1,13	1,70	2,55	3,40
Panel weight without water 4 m	[Kg/pcs]	29,15	42,46	55,76	20,38	25,78	36,56	53,02	69,48
Panel weight without water 6 m	[Kg/pcs]	44,28	64,53	84,76	30,92	39,11	55,46	80,43	105,42
Panel weight with water 4 m	[Kg/pcs]	33,98	49,70	65,41	24,00	30,61	43,80	63,88	83,96
Panel weight with water 6 m	[Kg/pcs]	51,52	75,39	99,24	36,35	46,35	66,32	96,72	127,14

Tab. 1

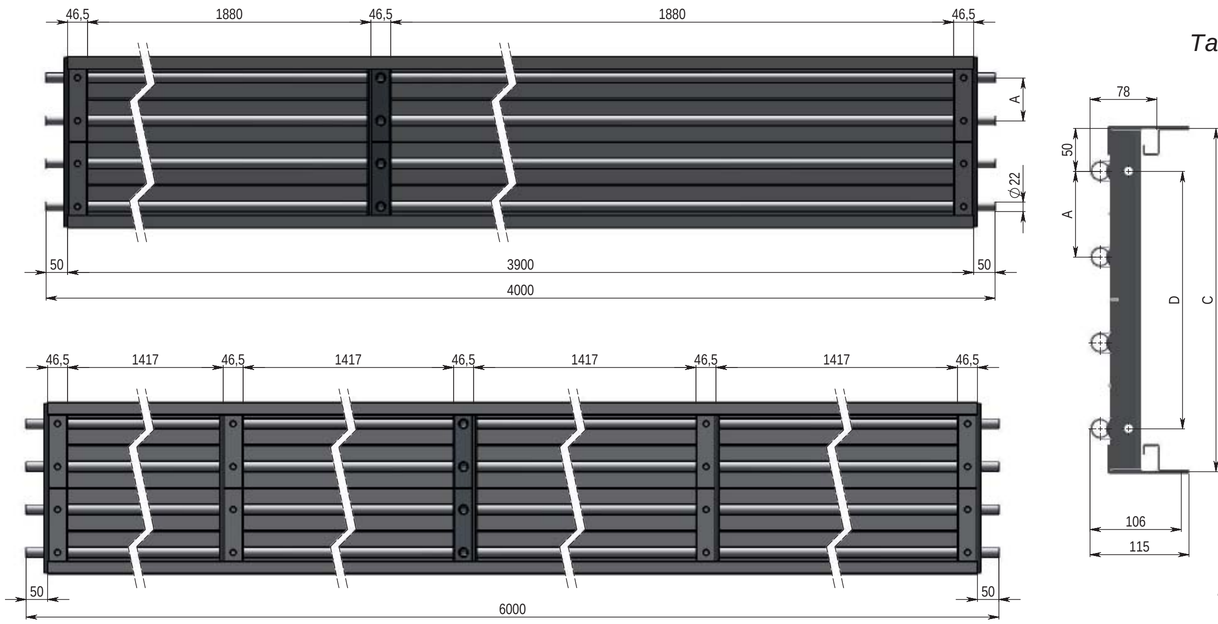


Fig. 2

Dimensions [mm]		WP2-060	WP2-090	WP2-120	WP3-030	WP3-040	WP3-060	WP3-090	WP3-120
Distance between centres of tubes	[A]	150			100				
Panel width	[B]	550	850	1150	300	400	600	900	1200
Distance between sliding hooks	[C]								
Distance between holes	[D]	450	750	750-1050	200	300	500	800	400-1100

Tab. 2

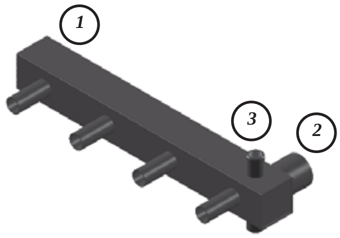
Manifold

WATERSTRIP manifold dimensions		"WP" series
Square section manifold	[mm]	50x50
Tube external diamenter	[mm]	22
Inlet connection (external thread)	[inches]	1" 1/4
Bleed (internal thread)	[inches]	3/8"

Tab. 3

“WP” series manifold

Fig. 3



Key:

1. Square section manifold
2. 1”1/4 inlet connection
3. 3/8” bleed

Manifold-hot water panel connection

The connections among hot water panels WATERSTRIP or between the hot water panel and the manifold are made by means of pressfitting couplings.
Using the pressfitting coupling, a perfect tight is guaranteed. The development of this kind of connection has been specifically based on the dimensions of the hot water panels pipes, which strictly respect the dimensional characteristics of the major pressfitting manufacturers. The standard panel is suitable for a maximum temperature of 120°C (either water or steam), with operating pressures up to 6 bars. On request, a special panel with operating pressures up to 16 bar and temperatures up to 180°C is available. Pressfittings joints can be used with operating pressures up to 16 bar with temperatures up to 95°C, or 4,5 absolute bar with temperatures up to 148°C. For special applications tube joints can be made by means of welding.

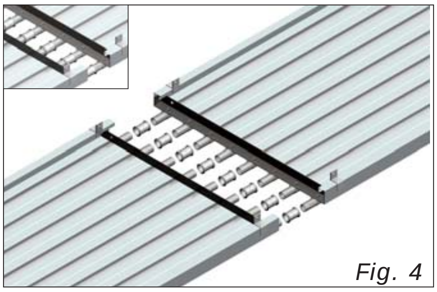


Fig. 4

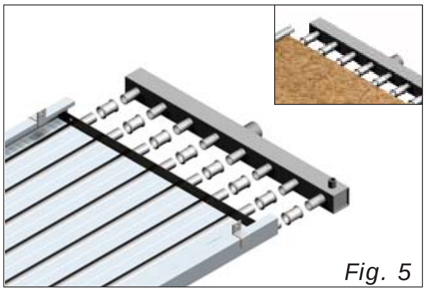
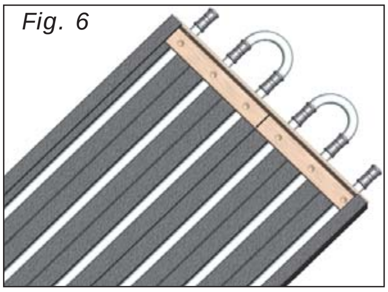


Fig. 5

Fig. 6



Installation of hot water panels

The coupling of WATERSTRIP panels to the supporting structure of the building can be realized in two different ways. They are shown in the following pictures:

Fig. 7

Fig. 8

The coupling can be made by using the two holes placed at the end of the strengthening (see position and distance between pipe centres in the dimensions of the hot water panels section). Coupling can be done by means of hooks inserted in the mentioned holes and chains anchored to the supporting structure, either by anchors (for concrete structures) or by steel strengthening.
Otherwise, when it is not possible to use the strengthening as a connection point, sliding-hooks can be used (provided by FRACCARO on request). This kind of coupling enables fastening the hot water panels everywhere the coupling to the cover is present.

Protective steel sheet for gymasium

For the installation of water panels in gymnasium or sport centres, it is possible to provide protective steel sheet installed on the top of the panel, so to avoid that any ball might remain stuck on it.

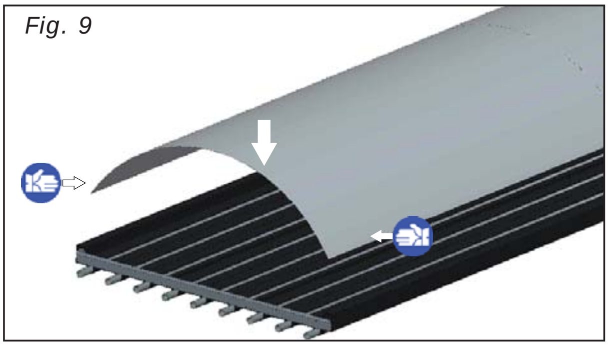


Fig. 9

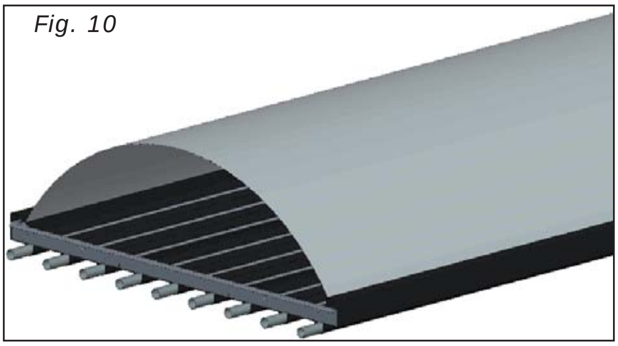


Fig. 10

Lateral stripes

Hot water panels heat mainly by radiation and partially by convection. In specific cases such as very high rooms or in presence of significant air movement, the percentage of energy transferred by convection can be higher, causing a negative outcome from the economical point of view.
In that case it is useful to mount optional lateral stripes. They act as barriers against air movements and reduce the convective effect.

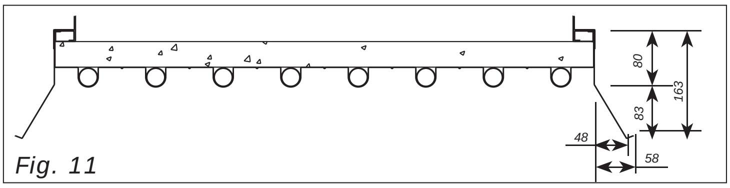
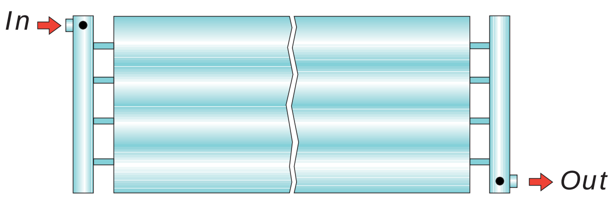


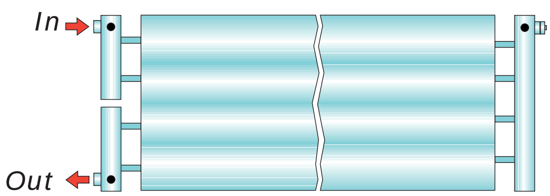
Fig. 11

Manifolds connection

Circuit TYPE B



Circuit TYPE D ***(NO WP3 - 030)***



Circuit TYPE C

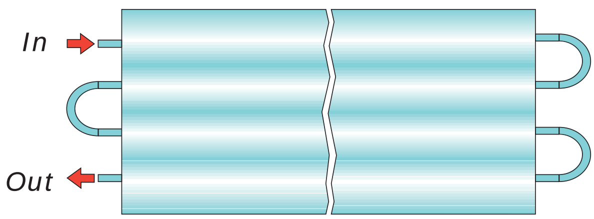


Fig. 12

2.0 WATERSTRIP INSTALLATION DESIGN

2.1 THERMAL POWER

"WP" series – thermal emissions of the panels per linear meter

	Mod. WP2 (150 mm)			Mod. WP3 (100 mm)				
	WP2-060	WP2-090	WP2-120	WP3-030	WP3-040	WP3-060	WP3-090	WP3-120
ΔTm [°K]	W/m	W/m	W/m	W/m	W/m	W/m	W/m	W/m
30	170	249	340	105	140	208	312	402
32	184	269	366	113	150	224	336	434
34	197	289	393	121	161	240	360	466
36	211	309	420	129	172	256	384	498
38	225	329	447	138	183	273	409	531
40	239	349	475	146	194	289	434	565
42	253	370	503	155	206	306	459	598
44	267	391	531	163	217	323	484	632
46	281	412	559	172	228	340	510	666
48	295	433	587	180	240	357	535	700
50	310	454	616	189	251	374	561	735
52	324	476	644	198	263	391	587	770
54	339	497	673	206	274	409	613	805
56	353	519	702	215	286	426	639	840
58	368	541	732	224	298	444	666	876
60	383	563	761	233	310	461	692	912
62	398	585	790	242	322	479	719	948
64	413	608	820	251	334	497	745	984
66	428	630	850	260	346	515	772	1021
68	443	653	880	269	358	533	799	1057
70	459	675	910	278	370	551	826	1094
72	474	698	941	287	382	569	854	1131
74	490	721	971	297	394	587	881	1168
76	505	744	1002	306	407	606	908	1206
78	521	767	1032	315	419	624	936	1243
80	536	790	1063	324	431	642	964	1281
82	552	813	1094	334	444	661	992	1319
84	568	837	1125	343	456	680	1019	1357
86	583	860	1156	353	469	698	1047	1396
88	599	884	1188	362	482	717	1075	1434
90	615	908	1219	372	494	736	1104	1473

Tab. 4

ACCESSORIES:
- hangers and mounting accessories such as chains, S hooks, ect ect
- insulating panel cut to size of the radiant

“WP” series – thermal emission for a couple of collectors

	Mod. WP2 (150 mm)			Mod. WP3 (100 mm)				
	WP2-060	WP2-090	WP2-120	WP3-030	WP3-040	WP3-060	WP3-090	WP3-120
ΔTm [°K]	W	W	W	W	W	W	W	W
30	97	146	183	40	64	95	153	198
32	105	158	198	44	69	103	165	214
34	113	170	213	47	74	111	177	231
36	122	182	228	50	80	119	190	248
38	130	195	244	54	85	127	203	265
40	139	207	260	57	91	135	215	282
42	147	220	276	60	96	144	228	299
44	156	233	292	64	102	152	241	317
46	165	246	308	67	107	160	254	335
48	174	259	325	71	113	169	268	353
50	183	272	342	74	119	178	281	371
52	192	286	358	78	125	186	294	389
54	202	299	375	81	131	195	308	408
56	211	313	392	85	136	204	321	427
58	220	327	410	89	142	213	335	445
60	230	341	427	92	148	222	349	464
62	239	355	444	96	154	231	363	484
64	249	369	462	100	161	240	377	503
66	259	383	480	103	167	249	391	522
68	268	397	498	107	173	258	405	542
70	278	412	516	111	179	268	419	561
72	288	426	534	115	185	277	433	581
74	298	441	552	119	192	287	448	601
76	308	455	570	122	198	296	462	621
78	318	470	589	126	204	306	477	642
80	329	485	607	130	211	315	491	662
82	339	500	626	134	217	325	506	682
84	349	515	645	138	224	334	521	703
86	360	530	663	142	230	344	535	723
88	370	545	682	146	237	354	550	744
90	380	560	701	150	243	364	565	765

Tab. 5

How to calculate the thermal emission

Following the norm EN 14037, the thermal emission should be calculated by this formula: $Q=K(\Delta t_m)^n$ [W/m]. The same formula should be used to calculate the thermal power of each collector.
The parameter Δt_m is the difference between the mean temperature of the hot fluid and the ambient temperature (example: hot water, input temperature: $t_i=80°C$; output temperature: $t_o=70°C$, mean temperature: $t_m=(t_i+t_o)/2=75°C$; ambient temperature: $t_a=19°C$; then: $\Delta t_m=(t_m-t_a)=56°C$. Values in the following table are calculated by considering $\Delta t_m=56°C$:

Model	Thermal power [W/m]	Model	Thermal power [W/m]
		WP3-030	194
		WP3-040	258
WP2-060	300	WP3-060	361
WP2-090	422	WP3-090	516
WP2-120	562	WP3-120	664

Tab. 6

The resulting thermal power is available in the previous tables: the values of k and n are indicated herebelow:

PANELS	Mod. WP2 (150 mm)			Mod. WP3 (100 mm)				
	WP2-060	**WP2-090**	**WP2-120**	**WP3-030**	**WP3-040**	**WP3-060**	**WP3-090**	**WP3-120**
k	3,206	4,546	6,525	2,091	2,781	4,140	6,210	7,205
n	1,168	1,177	1,162	1,151	1,151	1,151	1,151	1,182
MANIFOLDS	**Mod. WP2 (150 mm)**			**Mod. WP3 (100 mm)**				
	WP2-060	**WP2-090**	**WP2-120**	**WP3-030**	**WP3-040**	**WP3-060**	**WP3-090**	**WP3-120**
k	1,409	2,242	2,841	0,709	1,013	1,501	2,670	2,997
n	1,244	1,227	1,224	1,190	1,218	1,220	1,190	1,232

Tab. 7

Percentages of radiant and convective heating

In the table below are reported the percentages of radiant and convective emissions according to the mounting angle of the WATERSTRIP.

Panel mounting angle	WP2-060		WP2-090		WP2-120	
	Radiant emission [%]	Convective emission [%]	Radiant emission [%]	Convective emission [%]	Radiant emission [%]	Convective emission [%]
0°	65%	35%	60%	40%	71%	29%
15°	60%	40%	55%	45%	66%	34%
30°	55%	45%	50%	50%	61%	39%
45°	50%	50%	45%	55%	56%	44%
60°	45%	55%	40%	60%	51%	49%
90°	35%	65%	20%	80%	41%	59%

Panel mounting angle	WP3-030		WP3-040		WP3-060		WP3-090		WP3-120	
	Radiant emission [%]	Convective emission [%]	Radiant emission [%]	Convective emission [%]	Radiant emission [%]	Convective emission [%]	Radiant emission [%]	Convective emission [%]	Radiant emission [%]	Convective emission [%]
0°	45%	55%	55%	45%	66%	34%	70%	30%	72%	28%
15°	40%	60%	50%	50%	61%	39%	65%	35%	67%	33%
30°	35%	65%	45%	55%	56%	44%	60%	40%	62%	38%
45°	30%	70%	40%	60%	51%	49%	55%	45%	57%	43%
60°	25%	75%	35%	65%	46%	54%	50%	50%	52%	48%
90°	15%	85%	25%	75%	36%	64%	40%	60%	42%	58%

Tab. 8

2.2 WATER FLOW RATE AND FLOW RESISTANCE

On the following tables we indicate the flow resistance of every WATERSTRIP model. To consider the collectors influence, 5% of total line flow resistance should be added. It is recommended not to exceed the maximum flow rates indicated, as they involve fluid velocity greater than 2 m/s that is the limit is not exceeded or risk high noise and fast erosion in the tubes; also avoid going below the minimum flow rate to maintain the turbulent motion of the fluid: if the fluid is too slow the yield is lower by about 20%.

	Circuit type B						Circuit type C						Circuit type D				
Model	WP3-030	WP2-060 WP3-040	WP2-090 WP3-060	WP2-120	WP3-090	WP3-120	WP3-030	WP2-060 WP3-040	WP2-090 WP3-060	WP2-120	WP3-090	WP3-120	WP2-060 WP3-040	WP2-090 WP3-060	WP2-120	WP3-090	WP3-120
n° tubes	3	4	6	8	9	12	3	4	6	8	9	12	4	6	8	9	12
Water flow [l/h]	Flow resistance [Pa/m]						Flow resistance [Pa/m]						Flow resistance [Pa/m]				
Min water flow [l/h]	**200**	**260**	**400**	**540**	**620**	**820**	**65**	**65**	**65**	**65**	**65**	**65**	**130**	**200**	**270**	**310**	**410**
Max water flow [l/h]	**6000**	**8000**	**12000**	**16000**	**18000**	**24000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**4000**	**6000**	**8000**	**8000**	**12000**
65							15,8	21,0	31,5	42,0	47,3	63,1					
90							28,0	37,3	55,9	74,6	83,9	112					
110							39,8	53,1	79,6	106	119	159					
140							60,8	81,1	122	162	183	243	12,0				
170							85,6	114	171	228	257	343	16,9				
200	5,5						114	152	228	304	342	456	22,4	11,0			
225	6,8						140	187	280	374	421	561	27,6	13,9			
250	8,1	4,9					169	225	338	450	506	675	33,2	16,3	9,8		
275	9,6	5,8					200	266	399	532	599	799	39,3	19,3	11,6		
300	11,2	6,8					233	310	465	621	698	931	45,8	22,4	13,5		
350	14,7	8,9					305	407	610	814	916	1221	60,1	29,4	17,7	9,5	
400	18,6	11,2	5,5				386	515	772	1030	1158	1544	76,0	37,2	22,4	12,0	11,0
450	22,9	13,8	6,8				475	633	950	1267	1425	1900	93	45,8	27,6	14,8	13,5
500	27,6	16,6	8,1	4,9			572	762	1144	1525	1715	2287	113	55,1	33,2	17,8	16,3
550	32,6	19,6	9,6	5,8			676	902	1352	1803	2029	2705	133	65,2	39,3	21,0	19,3
600	38,0	22,9	11,2	6,8	5,5		788	1051	1576	2102	2364	3153	155	76,0	45,8	24,5	22,4
650	43,7	26,4	12,9	7,8	6,3		907	1210	1815	2420	2722	3629	179	87	52,7	28,2	25,8
700	49,8	30,0	14,7	8,9	7,2		1034	1378	2068	2757	3101	4135	203	100	60,1	32,1	29,4
750	56,3	33,9	16,6	10,0	8,1	4,9	1167	1556	2334	3113	3502	4669	230	113	67,8	36,3	33,2
800	63,0	38,0	18,6	11,2	9,1	5,5	1308	1744	2615	3487	3923	5231	257	126	76,0	40,6	37,2
900	77,6	46,7	22,9	13,8	11,2	6,8	1609	2145	3218	4290	4827	6435	317	155	93	50,0	45,8
1000	93	56,3	27,6	16,6	13,5	8,1	1937	2582	3873	5164	5810	7747	381	187	113	60,1	55,1
1100	110	66,6	32,6	19,6	16,0	9,6	2290	3054	4581	6108	6871	9161	451	221	133	71,1	65,2
1200	129	77,6	38,0	22,9	18,6	11,2	2669	3559	5339	7118	8008	10677	525	257	155	82,9	76,0
1400	169	102	49,8	30,0	24,4	14,7	3501	4668	7003	9337	10504	14005	689	338	203	108,7	100
1600	214	129	63,0	38,0	30,9	18,6	4429	5905	8858	11811	13287	17716	872	427	257	137,6	126
1800	263	158	77,6	46,7	38,0	22,9	5449	7266	10898	14531	16347	21797	1073	525	317	169,2	155
2000	316	191	93	56,3	45,7	27,6	6559	8746	13119	17492	19678	26237	1291	632	381	203,7	187

Tab. 9

Pressure drop per linear meter with CIRCUIT TYPE B

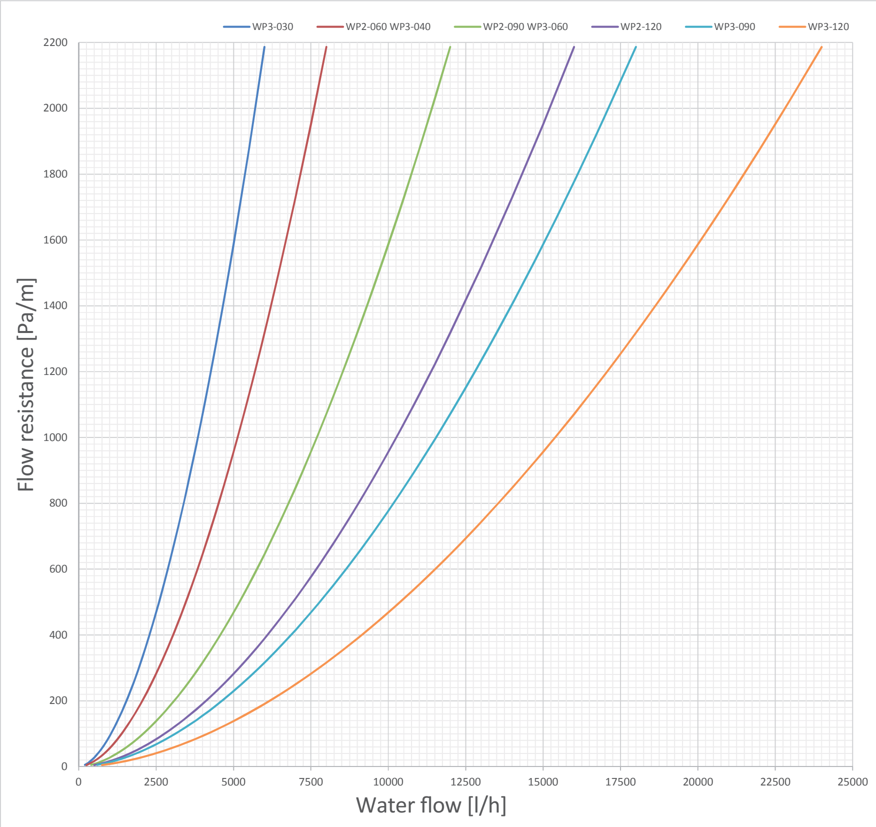
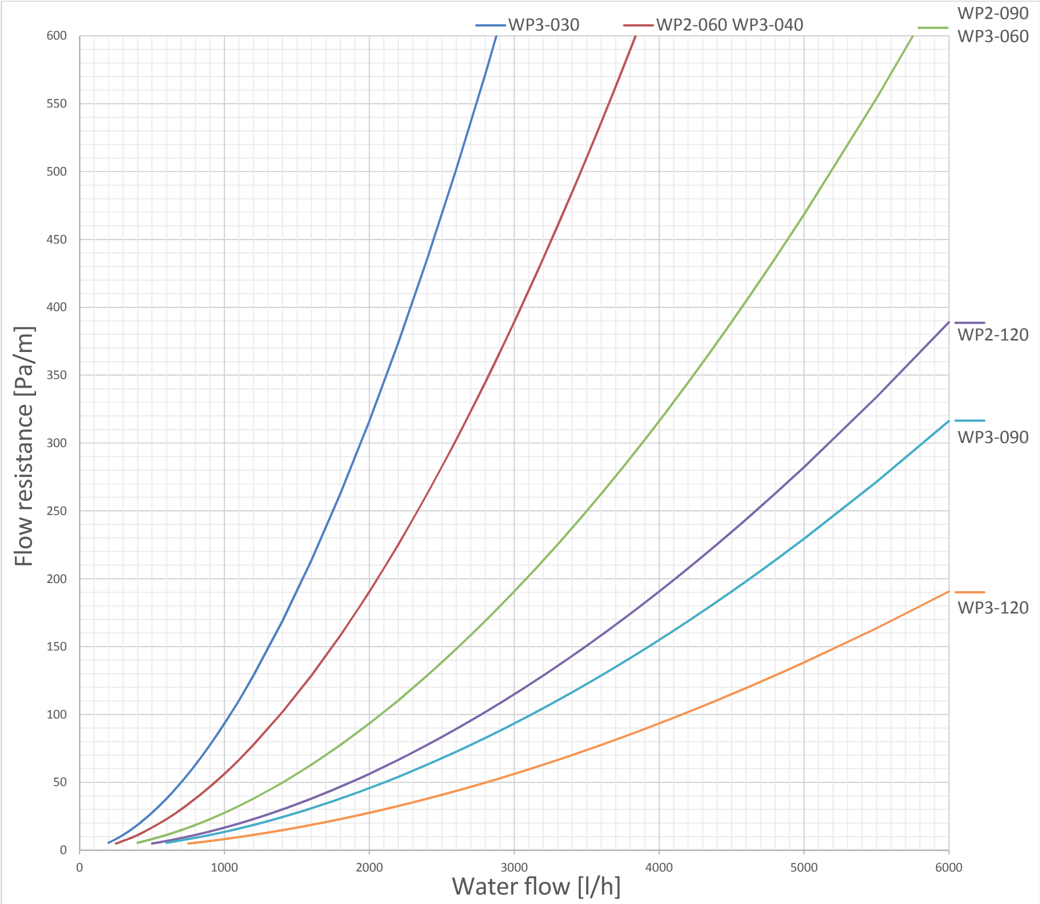


Fig. 13

Detail of pressure drop per linear meter with circuit type B



Pressure drop per linear meter with CIRCUIT TYPE C

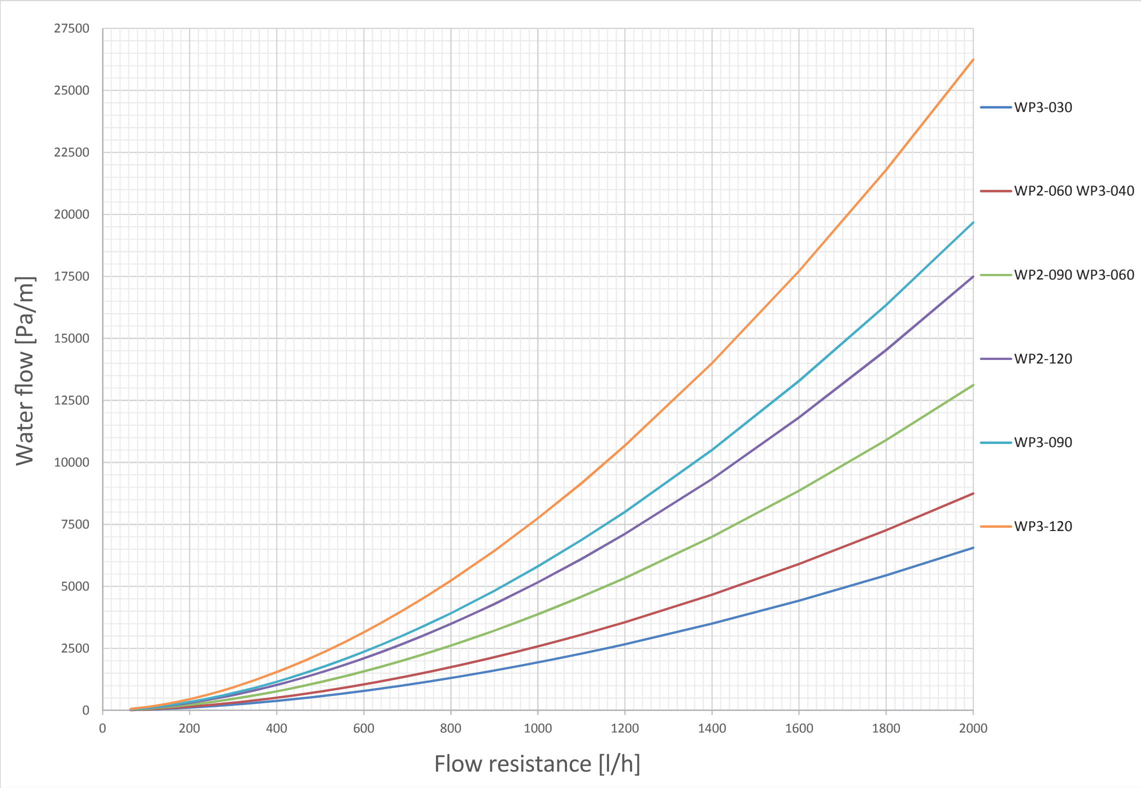


Fig. 14

Pressure drop per linear meter with CIRCUIT TYPE D

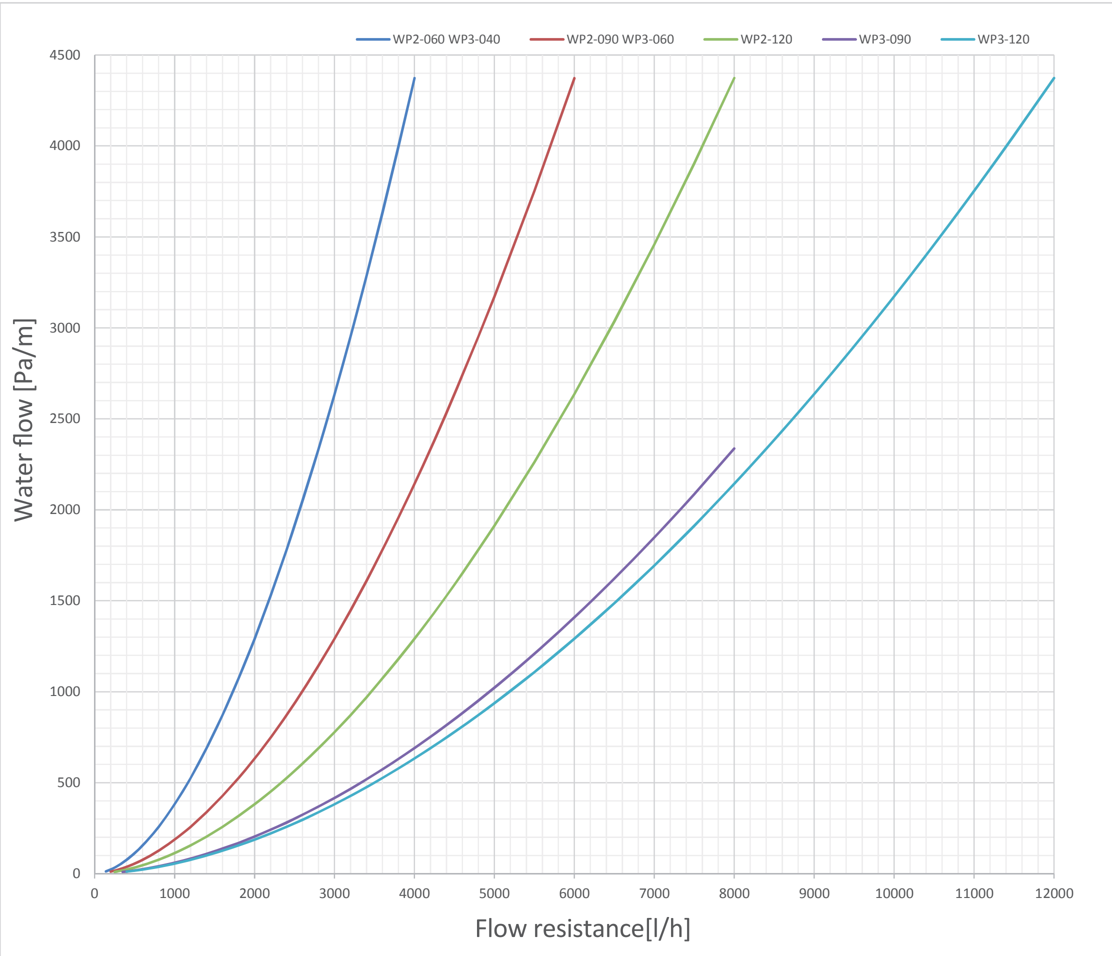


Fig. 15

2.3 MAXIMUM STANDARD LENGHT

Maximum length for circuit type C

Model	WP2-060	WP2-090	WP2-120	WP3-030	WP3-040	WP3-060	WP3-090	WP3-120
N. of pipes	4	6	8	3	4	6	9	12
Distance between the centres of the pipes [mm]		150				100		
Maximum lenghts of the single lines [mt]	28	20	14	36	28	20	18	14

Tab. 10

Maximum length for circuit type B and type D

Water temperature difference between inlet and outlet ΔT = 10° C. It's a temperature difference that involves low difference in yield between the initial section (hotter) and final stretch.
Higher temperature differences can be used, as a consequence the end part of the line (colder) will have a lower yield.
- water inlet temperature: t_i=77°C and environment temperature: t_a=18°C. Output temperature so will be t_u=67°C, average water temperature: t_m=72°C, temperature difference between panels and environment: ΔT_m=72-18=54°C.
In the tables are reported, according to the maximum length, the minimum flow rates that ensure the ΔT = 10°C for each model and the corresponding flow resistance for the whole line of that length.

In case of design conditions involving different ΔT and ΔTm, the maximum length can be derived using the formula $L_{max} = L_{max,\ std} * (F2/F1)$, using the correction factors F1 and F2 derived from appropriate tables.

Fattori correttivi F1 e F2

When F1 and F2 are used to verify the correct maximum length, the new flow resistance must be calculated using table 9.

ΔTm [°C]	F1
30	0,5
40	0,71
50	0,92
54	1
60	1,13
70	1,33

ΔT [°C]	F2
5	0,5
10	1
15	1,5
20	2
25	2,5
30	3

$$L_{max} = L_{max,std} * (F2/F1)$$

Tab. 11

Example:

With WP3-090 panels, from tab. 12 in nominal conditions: max length 52 m, flow rate 2700l/h, flow resistance 3,38 kPa.
In different conditions, input water temperature: 75,5 °C, water temperature drop: Δt= 15°C (t_u = 60,5°C), t_m=68°C and (environment temperature t_a=18°C) ΔT_m = 50, so: F1= 0,92 and F2= 1,5 and than correct maximum length will be: 52*1,5/0,92= 84 meters.
From tab.5, it can be seen that with Δt_m 50 the power output is 561 W/m, the output for all the line will be 561*84 = 47,124 kW.
For this thermal output, with Δt =5°C, the flow rate is 2700 l/h, with the maximum length of 84 meter there will be a flow resistance of 5,46 kPa.

Maximum length for circuit type B

$\Delta T = 10°C$ $\Delta T_m = 54°C$

Max length	WP3-030	WP3-060	WP3-090	WP3-120	Tot pressure drop
(m)	Flow rate l/h				Kpa
12	200	400	600	800	0,05
16	300	600	900	1200	0,14
22	400	800	1200	1600	0,33
28	500	1000	1500	2000	0,63
34	600	1200	1800	2400	1,06
40	700	1400	2100	2800	1,64
46	800	1600	2400	3200	2,41
52	900	1800	2700	3600	3,38
56	1000	2000	3000	4000	4,57
62	1100	2200	3300	4400	6,01
68	1200	2400	3600	4800	7,72
72	1300	2600	3900	5200	9,71
80	1400	2800	4200	5600	12,01
84	1500	3000	4500	6000	14,64
90	1600	3200	4800	6400	17,62
96	1700	3400	5100	6800	20,97

Max length	WP2-090	Tot pressure drop
(m)	Flow rate l/h	Kpa
8	400	0,04
14	600	0,12
18	800	0,27
22	1000	0,52
28	1200	0,88
32	1400	1,36
36	1600	2,00
42	1800	2,80
46	2000	3,79
50	2200	4,98
56	2400	6,40
60	2600	8,05
66	2800	9,96
70	3000	12,14
74	3200	14,61
80	3400	17,39

Max length	WP2-060	WP2-120	Tot pressure drop
(m)	Flow rate l/h		Kpa
10	300	600	0,05
14	400	800	0,12
16	500	1000	0,22
20	600	1200	0,38
24	700	1400	0,59
26	800	1600	0,86
30	900	1800	1,21
34	1000	2000	1,63
38	1100	2200	2,15
40	1200	2400	2,76
44	1300	2600	3,47
48	1400	2800	4,29
50	1500	3000	5,23
54	1600	3200	6,30
58	1700	3400	7,50
62	1800	3600	8,83
64	1900	3800	10,32
68	2000	4000	11,95
72	2100	4200	13,75
74	2200	4400	15,71

Max length	WP3-040	Tot pressure drop
(m)	Flow rate l/h	Kpa
12	300	0,06
16	400	0,14
20	500	0,27
24	600	0,46
30	700	0,72
34	800	1,06
38	900	1,48
42	1000	2,01
46	1100	2,64
50	1200	3,39
54	1300	4,26
58	1400	5,27
64	1500	6,43
68	1600	7,74
72	1700	9,21
76	1800	10,85
80	1900	12,67
84	2000	14,68
88	2100	16,89
92	2200	19,30

Tab. 12

Maximum length for circuit type D

$\Delta T = 10°C$ $\Delta T_m = 54°C$

Max length	WP3-060	WP3-090	WP3-120	Tot pressure drop
(m)	Flow rate l/h			Kpa
6	400	600	800	0,05
8	600	900	1200	0,15
12	800	1200	1600	0,34
14	1000	1500	2000	0,64
16	1200	1800	2400	1,07
20	1400	2100	2800	1,67
22	1600	2400	3200	2,45
26	1800	2700	3600	3,44
28	2000	3000	4000	4,66
30	2200	3300	4400	6,12
34	2400	3600	4800	7,86
36	2600	3900	5200	9,89
40	2800	4200	5600	12,23
42	3000	4500	6000	14,91
44	3200	4800	6400	17,94
48	3400	5100	6800	21,35

Max length	WP2-090	Tot pressure drop
(m)	Flow rate l/h	Kpa
4	400	0,04
6	600	0,12
10	800	0,28
12	1000	0,53
14	1200	0,89
16	1400	1,39
18	1600	2,03
20	1800	2,85
24	2000	3,86
26	2200	5,07
28	2400	6,51
30	2600	8,20
32	2800	10,14
34	3000	12,36
36	3200	14,87
38	3400	17,70

Max length	WP2-060	WP2-120	Tot pressure drop
(m)	Flow rate l/h		Kpa
5	300	600	0,05
6	400	800	0,12
8	500	1000	0,23
10	600	1200	0,38
12	700	1400	0,60
14	800	1600	0,88
14	900	1800	1,23
16	1000	2000	1,66
18	1100	2200	2,19
20	1200	2400	2,81
22	1300	2600	3,53
24	1400	2800	4,37
26	1500	3000	5,33
26	1600	3200	6,41
28	1700	3400	7,63
30	1800	3600	8,99
32	1900	3800	10,50
34	2000	4000	12,17
36	2100	4200	14,00
36	2200	4400	16,00

Max length	WP3-040	Tot pressure drop
(m)	Flow rate l/h	Kpa
6	300	0,06
8	400	0,15
10	500	0,28
12	600	0,47
14	700	0,73
16	800	1,08
18	900	1,51
20	1000	2,04
22	1100	2,69
24	1200	3,45
26	1300	4,34
28	1400	5,37
30	1500	6,55
32	1600	7,88
36	1700	9,37
38	1800	11,05
40	1900	12,90
42	2000	14,94
44	2100	17,19
46	2200	19,65

Tab. 13

2.4 INSTALLATION: HEIGHT AND CENTER-TO-CENTER DISTANCE

To obtain an homogeneous distribution of radiation, the maximum distance between two hot water panels has to be lower than the installation height: I max<=1,5 ÷ 2 x H.

I max (maximum center-to-center distance)

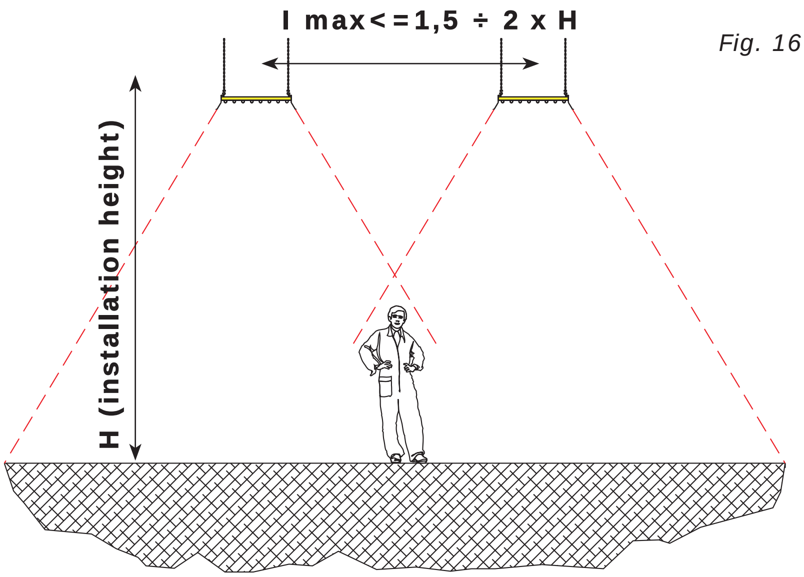


Fig. 16

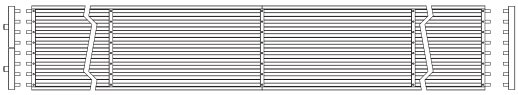
Minimum recommended installation height:

Water mean temperature [°C]	Minimum installation height				
	WP2-060 WP2-090	WP3-040 WP3-030	WP3-060 WP3-090	WP2-120	WP3-120
60	3,10	3,10	3,20	3,20	3,30
70	3,20	3,20	3,30	3,30	3,40
80	3,30	3,30	3,50	3,40	3,60
90	3,50	3,40	3,70	3,70	3,90
100	3,70	3,50	4,00	3,90	4,20
110	4,00	3,60	4,20	4,30	4,40

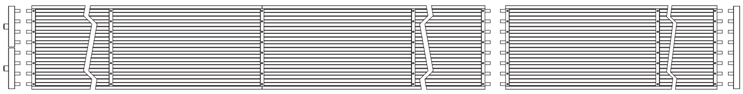
Tab. 14

2.5 EXAMPLES OF WATERSTRIP COMPOSITION

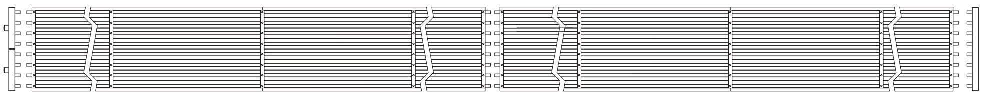
Here below are shown some examples of composition with WATERSTRIP panels.



6 m panel



6 m panel + 4 m panel = 10 m line



6 m panel + 6 m panel = 12 m line

Fig. 17

Length of lines

By means of standard 4 and 6 meter modules, it is possible to obtain every line having length with multiple of 2. The minimum length is 4 meters. In the following table find the possible lengths:

Total length [m]																								
[m]	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**32**	**34**	**36**	**38**	**40**	**42**	**44**	**46**	**48**	**50**
4 m panels	1		2	1		2	1		2	1		2	1		2	1		2	1		2	1		2
6 m panels		1		1	2	1	2	3	2	3	4	3	4	5	4	5	6	5	6	7	6	7	8	7

Tab. 15

2.6 EXAMPLES OF INSTALLATION

Circuit type D

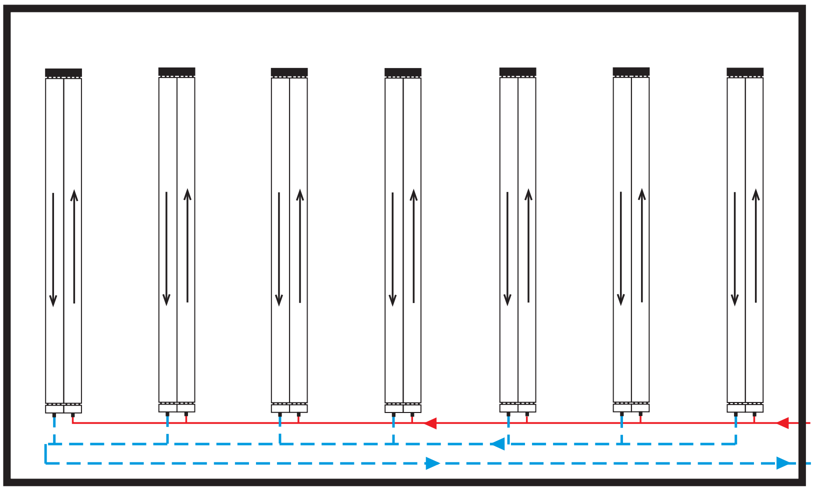


Fig. 18

Circuit type B

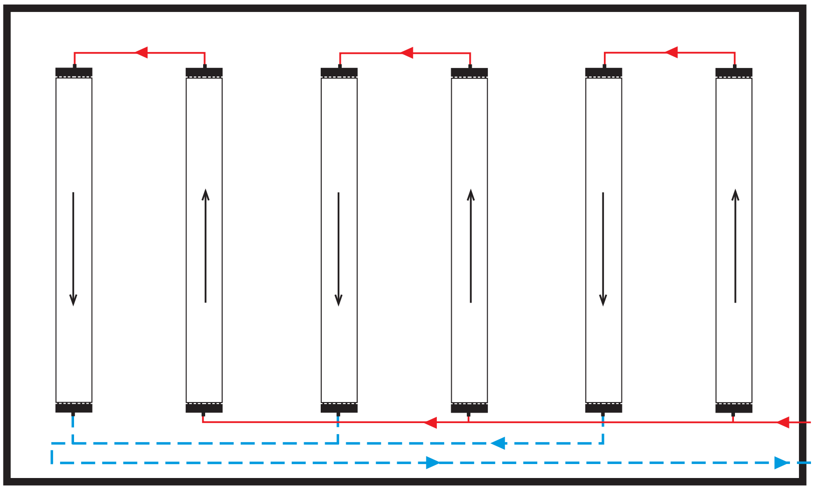


Fig. 19

Circuit type D

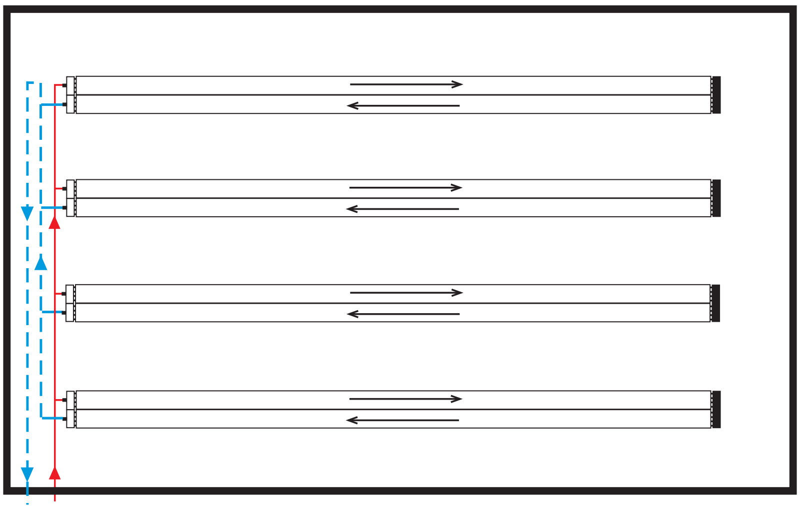


Fig. 20

Thermoregulation and balancing of the plant

To optimize the heating plant and its efficiency, the water flow of different lines should be adjusted to the same value. Three-way modulating valve at every line inlet can be applied to that purpose.
If the lines have the same length, the hydraulic plant could be balanced by adopting a simple three-tube configuration on the return pipe. If the plant has more different lines, it is advisable to install the automatic water flow stabilizer on the return pipe of each line.
In order to obtain the best control of the temperature, one or more temperature globe-probes should be used. Some examples of balanced circuits are in the following pictures.

Heating plant with external temperature probe and input water temperature regulation

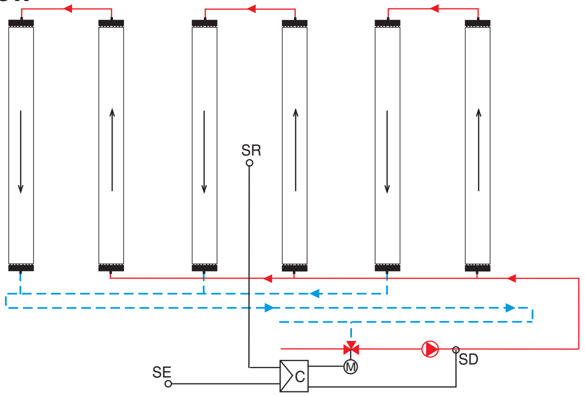


Fig. 21

Key:

- CP: Main controller
- CZ: Zone controller
- M: Motorized three-way valve
- SD: Water input temperature probe
- SE: External temperature probe
- SR: Ambient temperature probe
- A: In
- R: Out

Spot heating

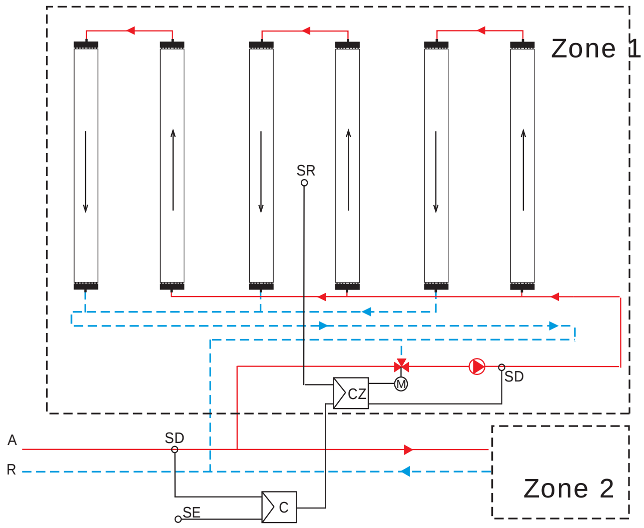


Fig. 22

Circuit with water flow stabilizer

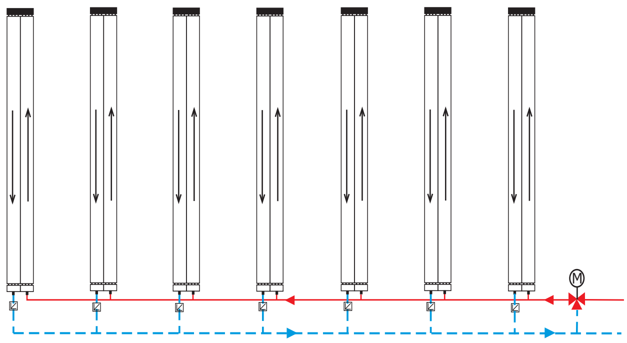


Fig. 23

Temperature globe probe and digital on/off thermostat

Fig. 24

3.0 COOLING

In summertime, the heating plant with WATERSTRIP panels could be used as a cooling system in order to improve the thermal comfort.
The application of the same plant for both heating and cooling purposes leads to fast recovery of the investment.
If we compare the radiant panel system to the traditional cold air systems, we can find out some important advantages:

- By considering the same comfort condition, the air temperature is higher;
- Noiselessness;
- No air movement;
- Better condition for the human health;
- Low installation and running costs;
- Low electrical consumption.

Like the application for heating purposes in winter time, in summer this system allows to save energy because it cools the surfaces without cooling the volume of air in between. The thermal comfort depends on the operative temperature:
Top = (Ta+Tw)/2 (Ta= air temperature; Tw= temperature of walls and floor)
If we assume Top=25 °C, this temperature can be obtained with a traditional system when Ta=23 °C and Tw=27 °C.
The same result can be obtained with the WATERSTRIP radiant system when Ta =27°C and Tw = 23°C.
The higher air temperature allows to reduce the nominal power of the heating system and to reduce the energy consumption. If we consider that a cooling plant with the radiant panel WATERSTRIP has a low electrical energy consumption and it needs little maintenance, the overall running costs of this plant is much lower than those of a standard one.
In order to avoid the condensation of atmospheric humidity, the temperature of the panel surface should be higher than the dew-point temperature. To this purpose, the best result could be obtained by adding a dehumidifying system to the radiant cooling plant.
For any further information about the application of radiant cooling systems please contact our commercial department.

Traditional air cooling system

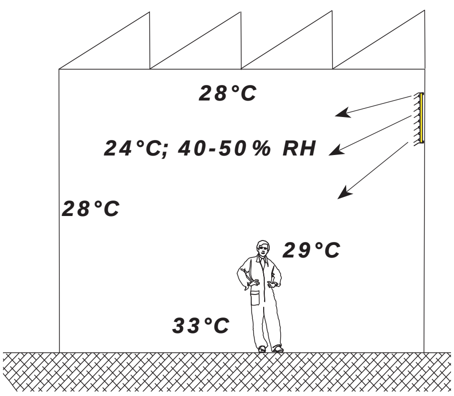


Fig. 22

Comfort diseases because of temperature differences and air flow

Radiant cooling system

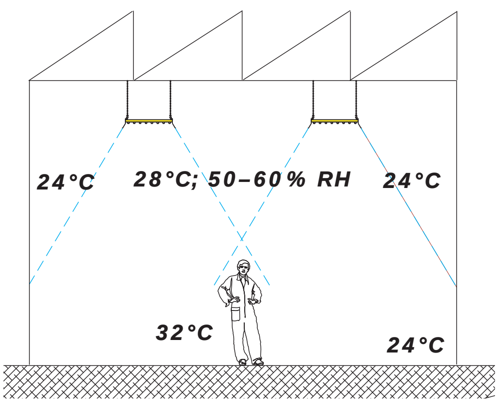


Fig. 25

Comfort condition (homogeneous distribution of temperatures)

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Refer to quality manual for details of applications to ISO 9001:2008 requirements

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Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

La validità del certificato è subordinata a sorveglianza annuale e riesame completo del Sistema di Gestione con periodicità triennale
The validity of the certificate is submitted to annual audit and a reassessment of the entire Management System within three years

RADIANT SOLUTIONS

NOTES

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Sistema di gestione ambientale ISO 14001

Sistema di gestione per la Salute e Sicurezza sul Lavoro BS OHSAS 18001

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