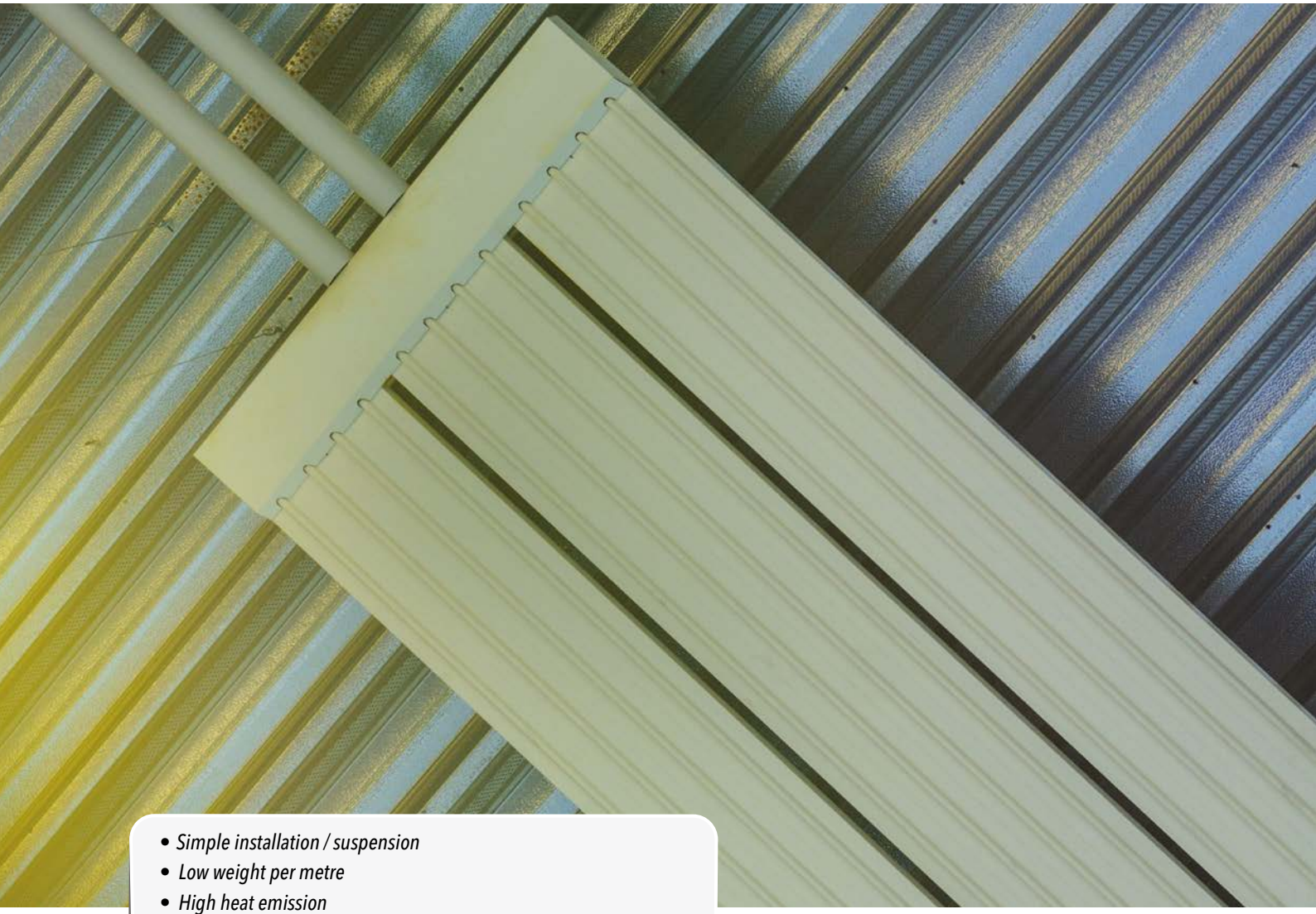
Aqua Line

Hot water radiant panels



- *Simple installation / suspension*
- *Low weight per metre*
- *High heat emission*
- *Measured and approved in accordance with BS EN 14037 1-3*
- *Ball- resistant*

Sheet thickness: 0.75mm
Material: Steel profiled panels with a polyester coating
Finish: RAL 9010 matt (other colours on request)
Fire class insulation: A2-S1
Standard panel lengths: 4m and 6m, with widths up to 1.3m wide
Application Areas: Auto showrooms, Furniture showrooms, DIY-stores, Schools, Sports/Tennis halls etc
Working pressure: Up to 8 bar

5 FIVE YEAR WARRANTY

Contents

What is radiant heating?

Radiant Heat Transfer is the transfer of energy between regions of temperature produced by electromagnetic waves. Radiant energy is converted to heat when it impinges on the receiving body and is absorbed.

The transfer of radiant energy does not depend upon a material to transfer the energy as in the case of conduction and convection.

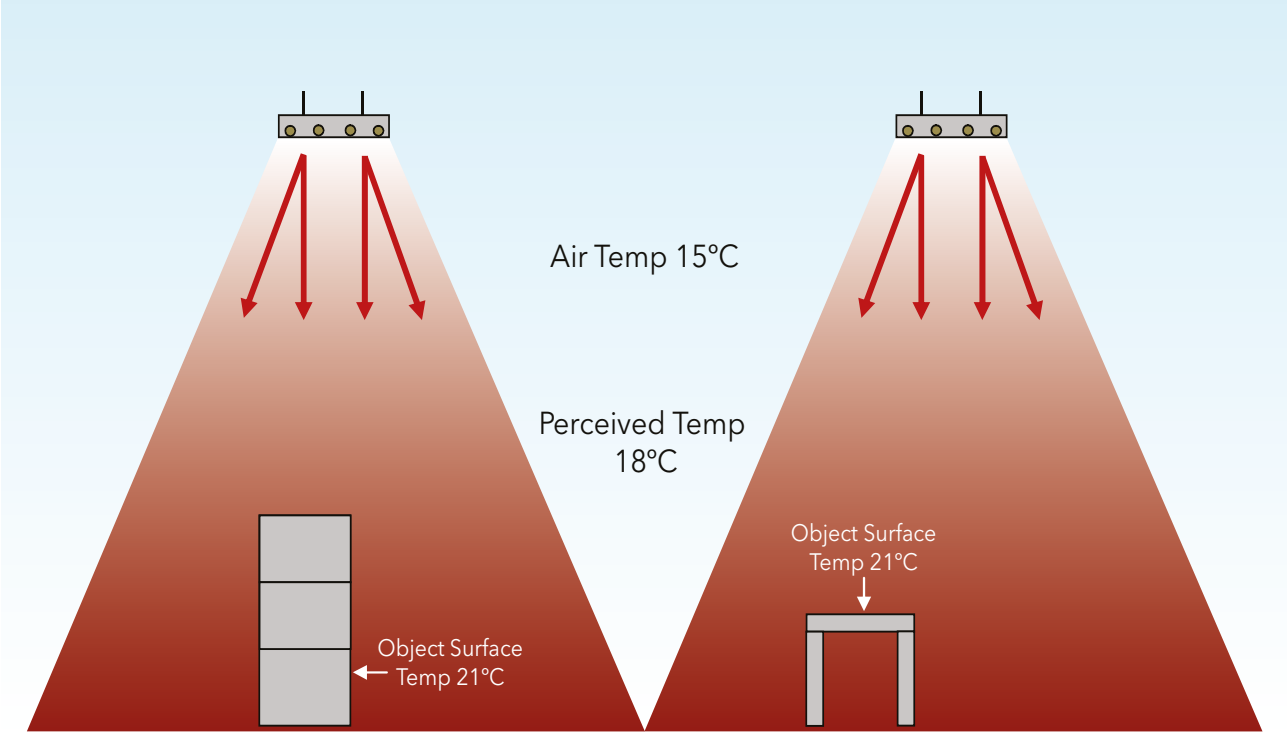
The factors determining the amount and the rate at which this is transferred to a hot body and to a cold body will depend upon the following:

- The distance between the two bodies "Hot" and "Cold".
- The difference in absolute temperature.
- The nature of the emitting and receiving bodies
- Even temperature distribution across whole room
- Rapid response warm up times
- Radiant panels operate at lower room temperatures (thus reducing costs and valuable energy)

Comfort

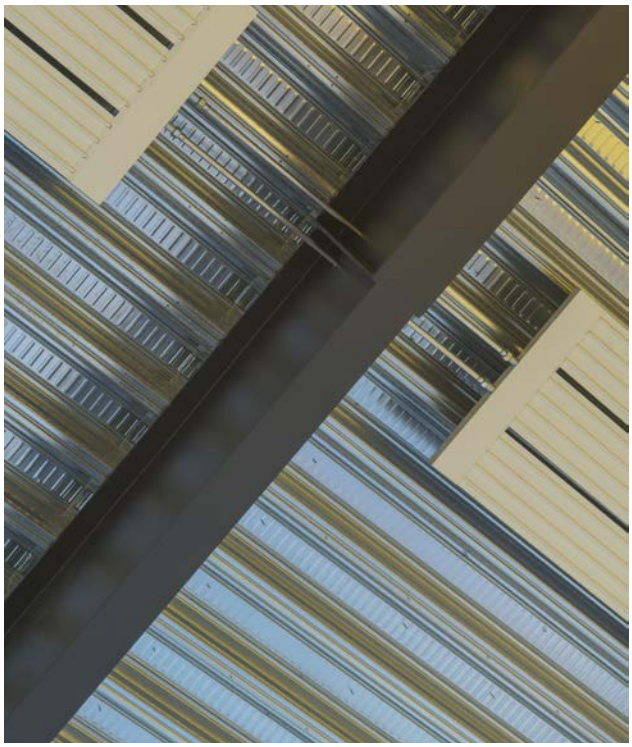
Radiant heat from overhead provides greater comfort than space heating, as they can be directed to the interior of the space. This reduces, and in some instances, eliminates excessive temperatures on outer walls and ceilings, ensuring heat is delivered directly to those areas where it is required.

Energy consumption is also reduced because radiant heating systems generally operate at lower airspace temperatures (typically some 3°C lower temperature than convective systems) without loss of comfort.



Specifications

- MHS radiant panels consisting of water-pipes. Pipe distance standard 75mm.
- Standard black tube. Galvanised pipe is available on request. Suspension profile include two mounting holes for immediate suspension or carabiners.
- Supplied with loose delivered collectors, consisting of profiled tube 40 x 30 x 2.5mm at the ends provided with welded end plates. Collectors are galvanised. Collectors are equipped with the necessary connector fittings: 1/2 ".
- Steel profiled panels, visible side foreseen with a polyester coating, RAL 9010 matt. Temperature up to 120°C. Sheet thickness 0.75mm. Pipes are held in place by means of suspension profiles.
- Optimised mineral insulation covered with reinforced aluminum foil. Heat conductivity 0,045 W/(m • k) at 60°C.
- Fire class A2-S1.
- Covered with reinforced double-layer aluminum.
- Suitable for cooling according to EN 14240.
- Aqua Line is available in Revit (3D), please contact MHS for more information.
- The panels are supplied with mounting kits consisting of a mounting bracket and two carabiners per panel in order to keep an equal distance between the panels.
- Between the panels are metal covers with a width of 150mm x 306mm, equipped with slotted holes 3mm x 9mm for fixing. Standard colour is RAL 9010
- Metal end cap, width 100mm, colour RAL 9010. Applied after mounting to finish the collector.
- Standard panel lengths of 4m and 6m, with widths up to 1.3m wide.
- Standard range of four types, with lengths of 4m up to 80m.
- Packing: panels are wrapped in foil and packed on a robust pallet equipped with lifting points.
- Panels are supplied in maximum lengths of 6m, to be assembled into the desired track length by the installer on site.
- Brackets between the suspension profile and the roof are optional. See page 18.
- Working pressure up to 8 bar.



Aqua Line radiant panel

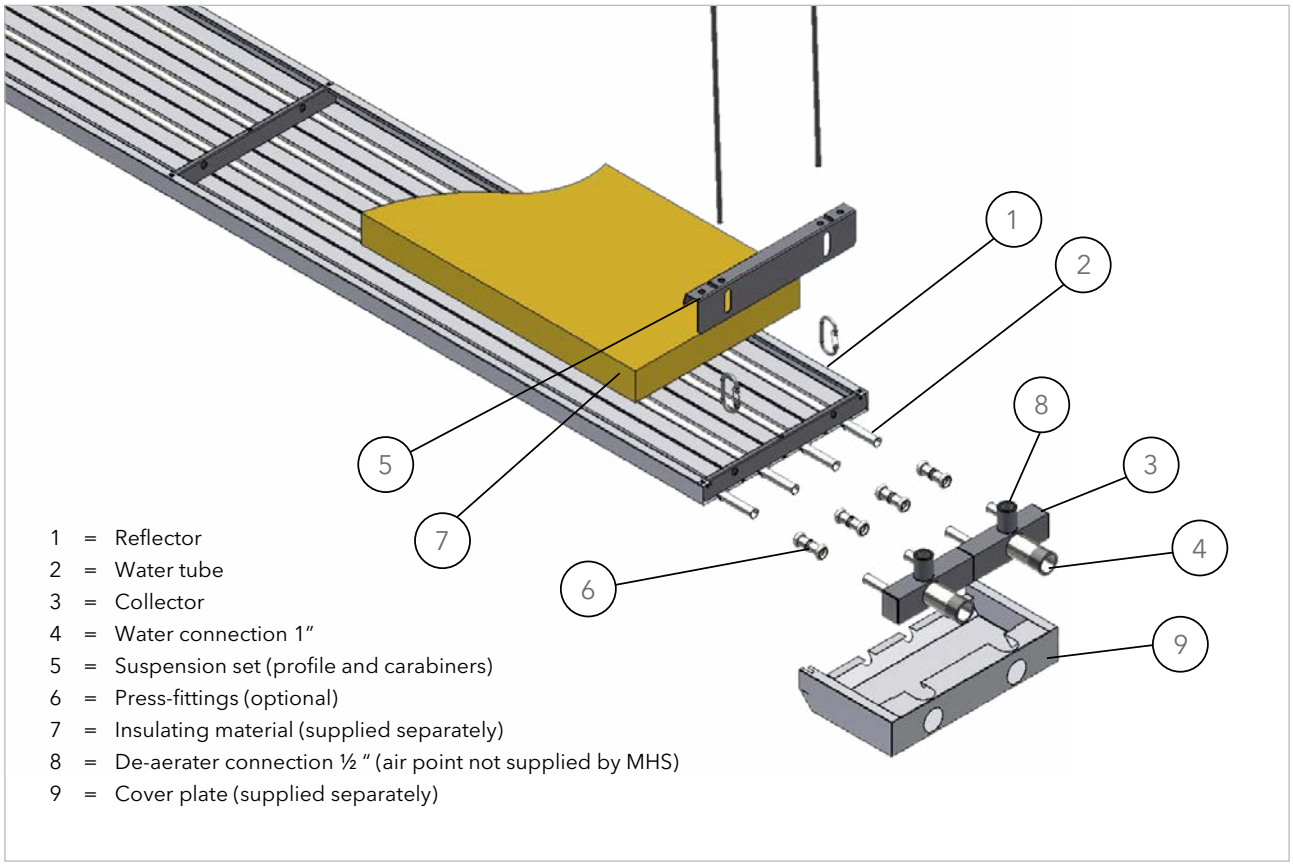
The Aqua Line radiant panel consists of a multiple of four pipes, which are mounted on a profiled steel plate. As the tubes are mounted in the profile of the steel sheet, there is a large contact surface, boosting the the heat output.

The radiant panel has to be insulated on the top side with the insulating material supplied seperately (by the installer). This minimises heat loss to the upper side of the room. Insulation strips must be set manually to length, with the material comprising mineral wool with an aluminium foil layer. The fire class of the insulation material is A2 (higher classes are available on request).

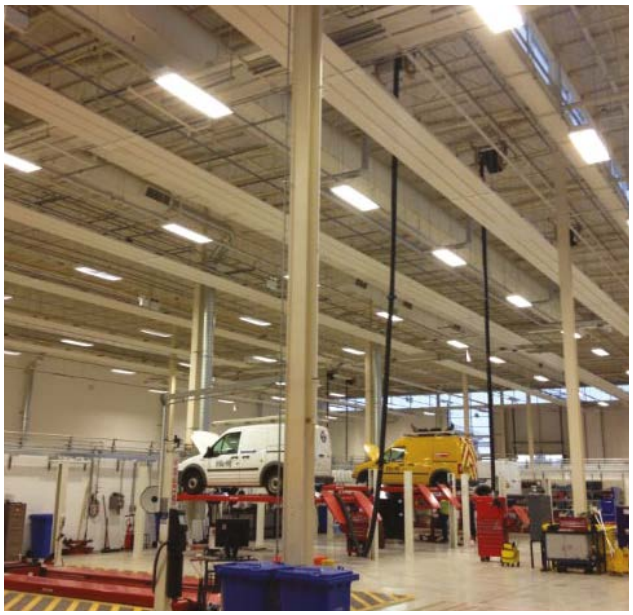
The Aqua Line radiant panel has a very high heat output in watts per meter. This heat has been measured and certified by the HLK Stuttgart institute in accordance with EN 14037 1-3. The panels are supplied in standard lengths of 4m or 6m and are attached to eachother with press fittings. Longer lengths can be created, although there must be consideration of the water flow. Variable widths are also available on request.

The collectors are also mounted with press fittings, which can be covered with a reflector cover plate for a neat finish.

Along with the standard black iron pipes, the panels can be supplied with galvanised pipes, which make the panel suitable for cooling according to EN 14240.



1 = Reflector
2 = Water tube
3 = Collector
4 = Water connection 1"
5 = Suspension set (profile and carabiners)
6 = Press-fittings (optional)
7 = Insulating material (supplied separately)
8 = De-aerater connection ½ " (air point not supplied by MHS)
9 = Cover plate (supplied separately)



Why radiant heating?

Why radiant heating?

Radiant heating has been used for decades in areas ranging from 2.5 to 25 metres suspension height. The technology is installed in applications where wall space is at a premium, with radiant heating offering a quick assembly, low maintenance, no noise and long term durability.

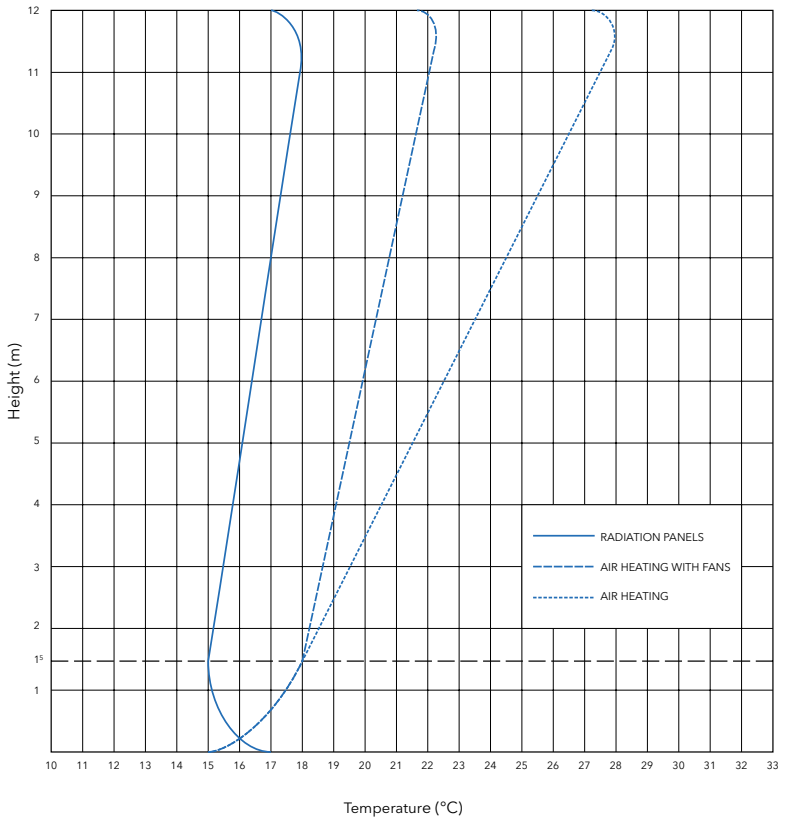
Zone heating

Radiant heating is also ideal for zone heating, as only the area to be heated is radiated. As a result, the energy costs are significantly reduced.

System benefits:

- Controllability through little water content
- Uniform temperature distribution
- Very low vertical temperature gradient
- Zonal heating is possible
- Stationary air layer, no dust or drafts
- Room temperature is 3°C lower than heating by radiators or air heating
- 25-30% energy savings compared to conventional air heating
- 15% less full load hours
- Very long life
- Completely maintenance free.
- Great comfort by direct radiation
- Heated floor
- Space saving
- Silent
- Can be applied everywhere due to unobtrusive design

CHART (the difference in the vertical temperature gradient for radiation heating and air-heating)



Typical application

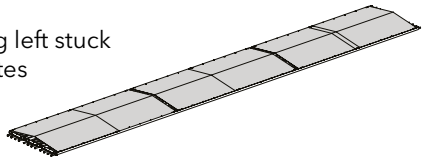
The most optimal way of heating a sports hall or gymnasium is by means of water based radiant panels. Spaces can be heated quickly and separately without the displacement of air and the associated noise. In addition to this, the panels on the ceiling do not form a danger to the users of the space.

Benefits in sports hall:

- No air movement
- Zone control
- Silent
- Does not take up space
- Stand can be controlled separately

Ball removal plates

In order to prevent balls getting left stuck on the panels, ball removal plates can be mounted.



Direct mounting

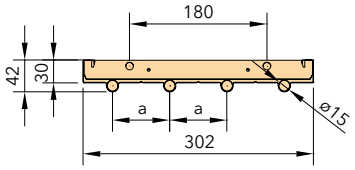
If the radiant panel is mounted tightly against the ceiling, no space is lost in a sports hall. Another advantage is that ball removal plates are unnecessary.

The brackets are equipped with a click system with an extra anchoring plug.

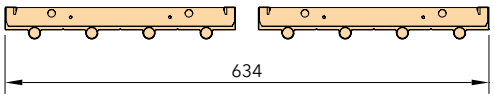
Technical features

Dimensions

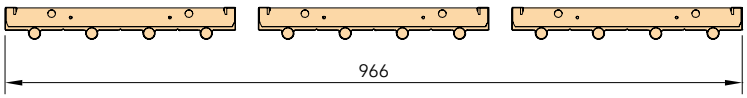
TYPE 1



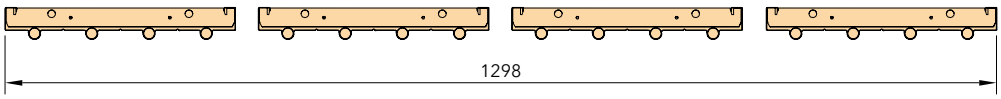
TYPE 2

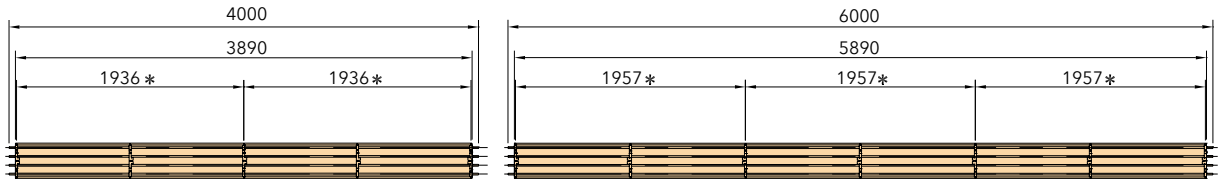


TYPE 3



TYPE 4





* Heart to heart distance suspension points.

Aqua Line		Type 1	Type 2	Type 3	Type 4
Tube Distance (a)	mm	75	75	75	75
Outside diameter tube	mm	15	15	15	15
Building Width base	mm	305	636	968	1300
Number of suspension points per axis	Pieces	2	2	2	2
Operating weight with water content and insulation (4m)	Kg	12.4	24.8	37.2	50
Operating weight with water content and insulation (6m)	Kg	18.5	37	55.5	74

max. working temperature: 120°C max operating pressure:. 8 bar

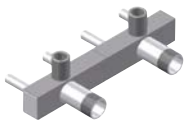
Heat output

Heat output table for panels in watts/m in accordance with EN 14037 1-3

Delta T (ΔT) [K]	Type 1	Type 2	Type 3	Type 4
115	476	952	1428	1904
110	451	903	1354	1806
105	427	855	1282	1709
100	403	807	1210	1613
95	380	759	139	1518
90	356	712	1068	1424
85	333	666	98	1331
80	310	619	929	1239
75	287	574	861	1148
70	264	209	793	1058
69	260	520	780	1040
68	256	511	767	1022
67	251	502	753	1004
66	247	493	740	987
65	242	485	727	969
64	238	476	714	951
63	233	467	700	934
62	229	458	687	916
61	225	449	674	899
60	220	441	661	881
59	216	432	648	864
58	212	423	635	847
57	207	415	622	830
56	203	406	609	812
55	199	398	896	795
54	195	389	584	778
53	190	381	571	761
52	186	372	558	744
51	182	364	545	727
50	178	355	533	710
49	173	347	520	694
48	169	338	508	677
47	165	330	495	660
46	161	322	483	644
45	157	314	470	627
44	153	305	458	611
43	149	297	446	594
42	144	289	433	578
41	140	281	421	562
40	136	273	409	546
39	132	265	397	529
38	128	257	385	513
37	124	249	373	497
36	120	241	361	482
35	116	233	349	466
30	97	194	291	388
25	78	156	235	313
20	60	120	180	240
15	43	85	128	171

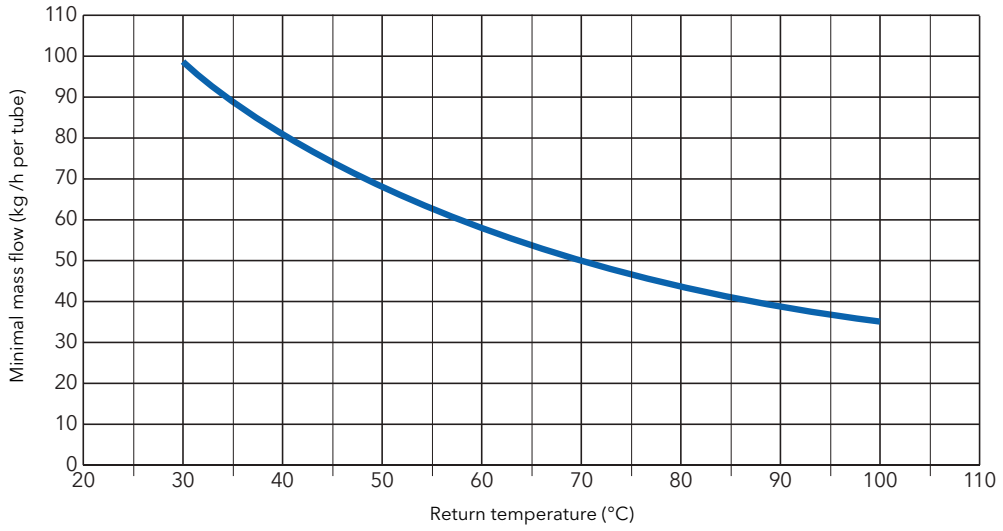
Values at a mass flow of 0.04 litres per second / pipe.

Heat output table per two collectors in watts/unit in accordance with EN 14037 1-3



Delta T (ΔT) [K]	Type 1	Type 2	Type 3	Type 4
115	165	330	494	659
110	156	312	468	624
105	147	295	442	590
100	139	278	417	556
95	131	261	392	522
90	122	244	367	489
85	14	228	342	456
80	106	212	318	423
75	98	196	293	391
70	90	180	270	360
69	88	177	265	353
68	87	174	260	347
67	85	170	256	341
66	84	167	251	335
65	82	164	246	329
64	81	161	242	322
63	79	158	237	316
62	78	155	233	310
61	76	152	228	304
60	74	149	223	298
59	73	146	219	292
58	71	143	214	286
57	70	140	210	280
56	68	137	205	274
55	67	134	201	268
54	66	131	197	262
53	64	128	192	256
52	63	125	188	250
51	61	122	183	244
50	60	119	179	239
49	58	116	175	233
48	57	113	170	227
47	55	111	166	221
46	54	108	162	215
45	52	105	157	210
44	51	102	153	204
43	50	99	149	198
42	48	96	145	193
41	47	94	140	187
40	45	91	136	182
39	44	88	132	176
38	43	85	128	171
37	41	83	124	165
36	40	80	120	160
35	39	77	116	154
30	32	64	96	128
25	26	51	77	102
20	19	39	58	78
15	14	27	41	55

Relationship between the minimum mass flow and return temperature

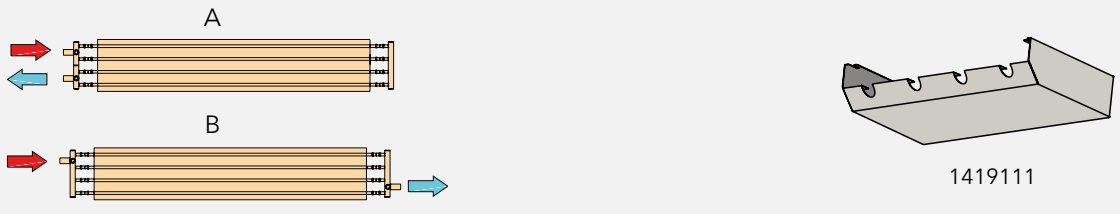


Cooling load

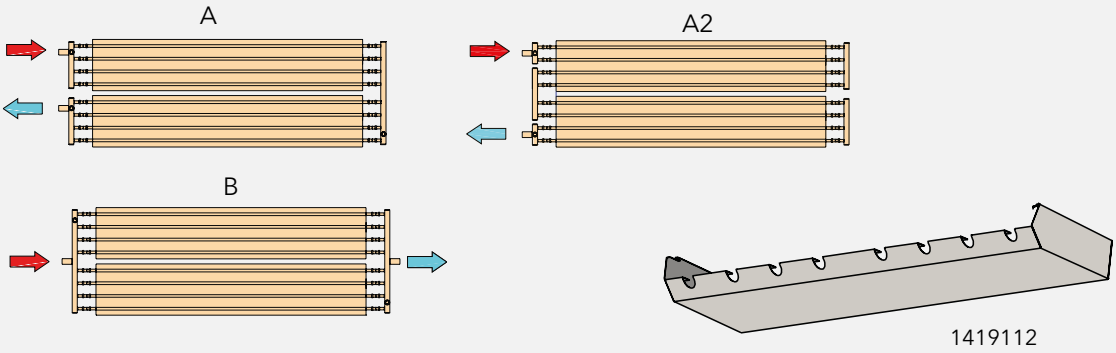
Cooling load in [W/m] measured according to EN 14 240.
Panel on top with glass wool insulation.

Delta T (ΔT) [K]	1 panel [W/m]	2 Panels	3 Panels	4 Panels
1	2	5	7	10
2	5	10	16	21
3	8	16	24	33
4	11	22	34	45
5	14	29	43	57
6	18	35	53	70
7	21	42	62	83
8	24	48	72	97
9	27	55	82	110
10	31	62	93	124
11	34	69	103	137
12	38	76	113	151
13	41	83	124	165
14	45	90	134	179
15	48	97	145	193

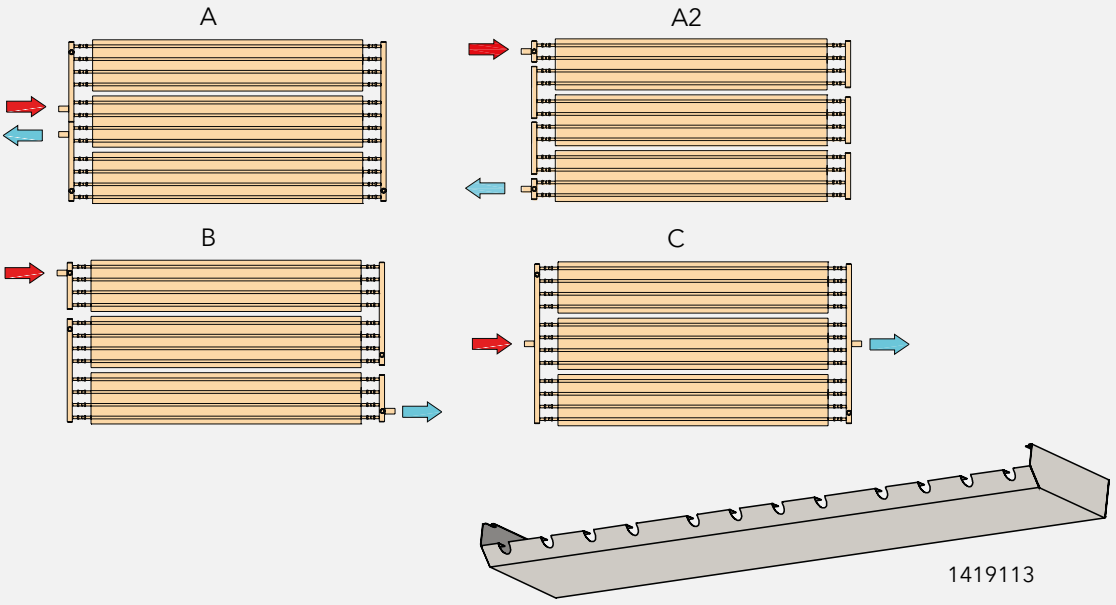
Overview hydronic connection and covers



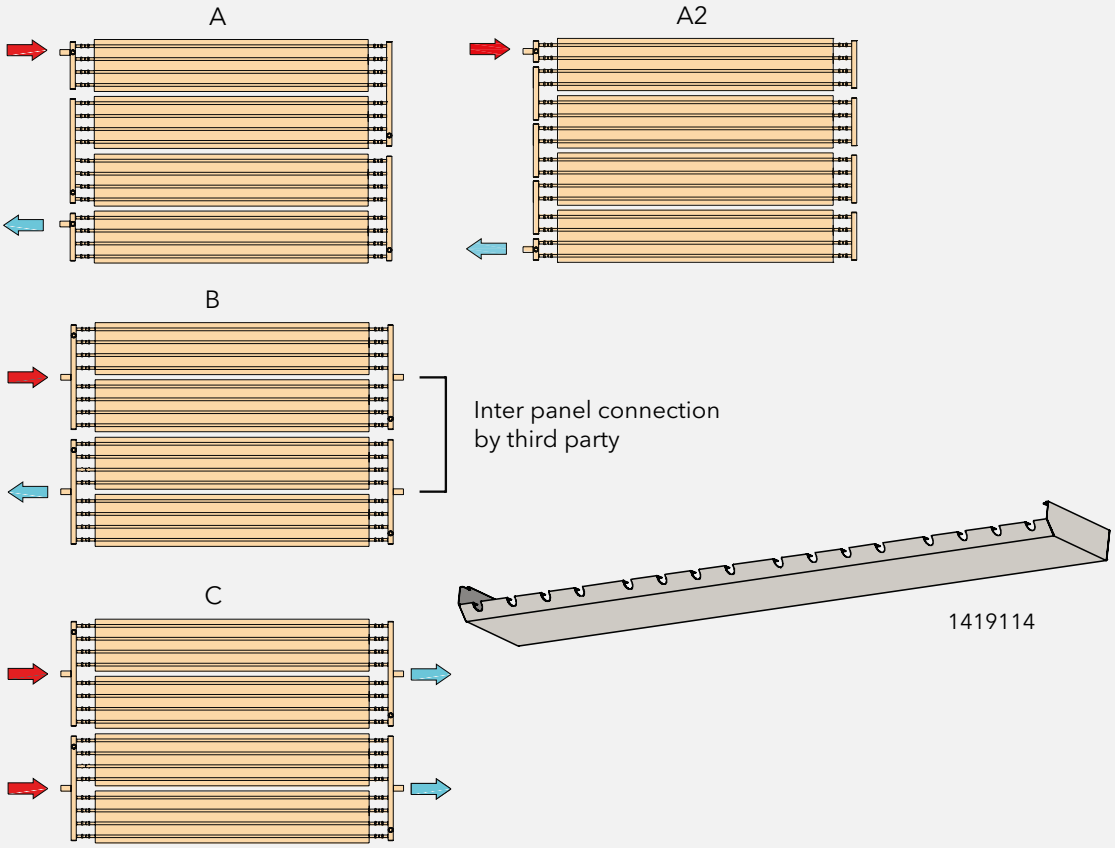
1419111



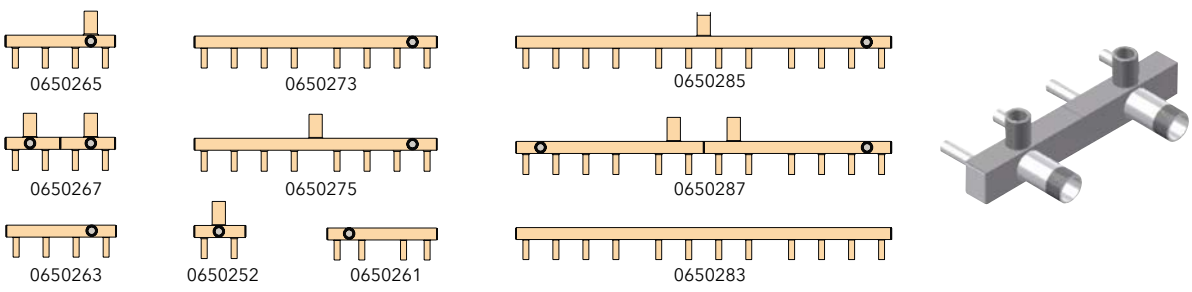
1419112



1419113

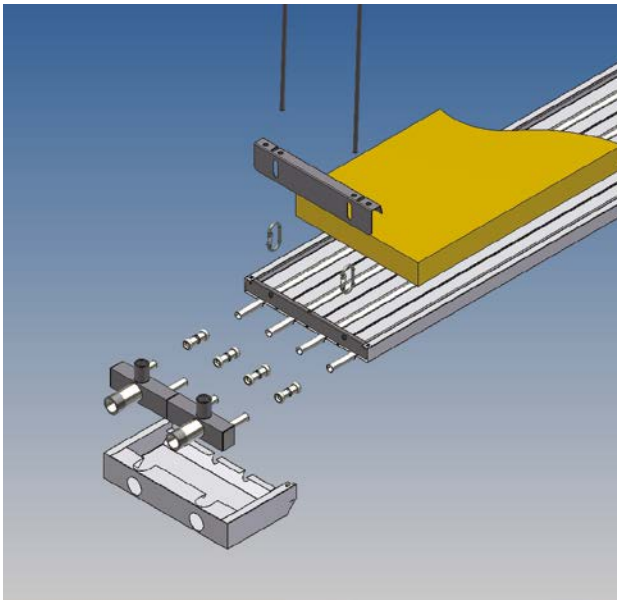


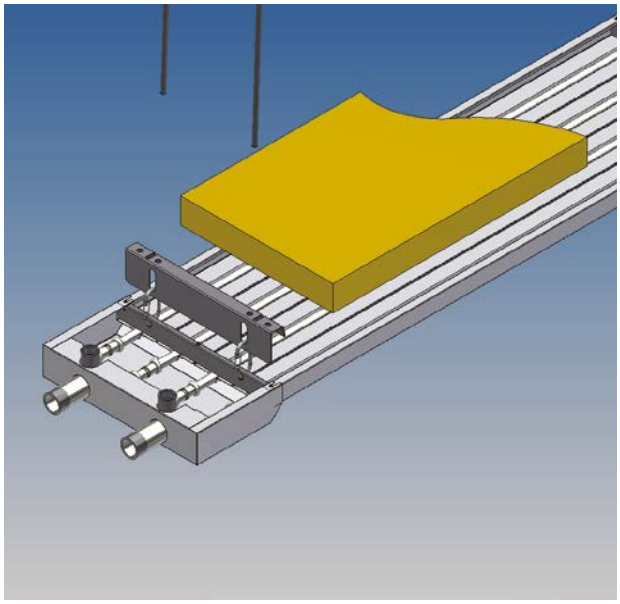
Types of collectors

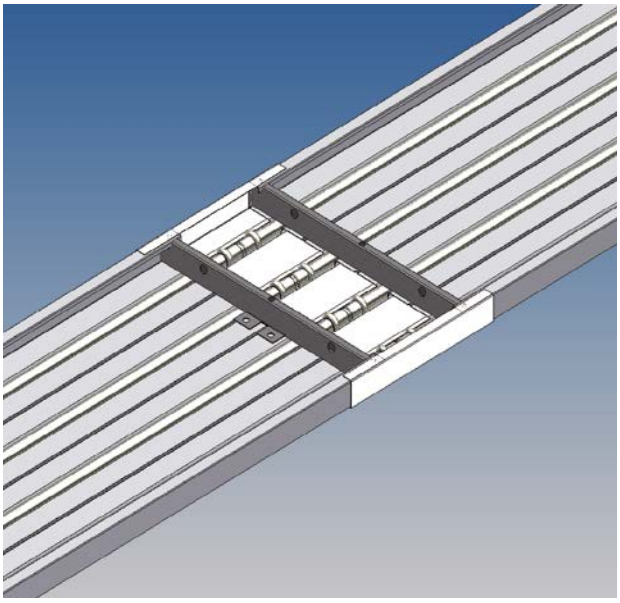


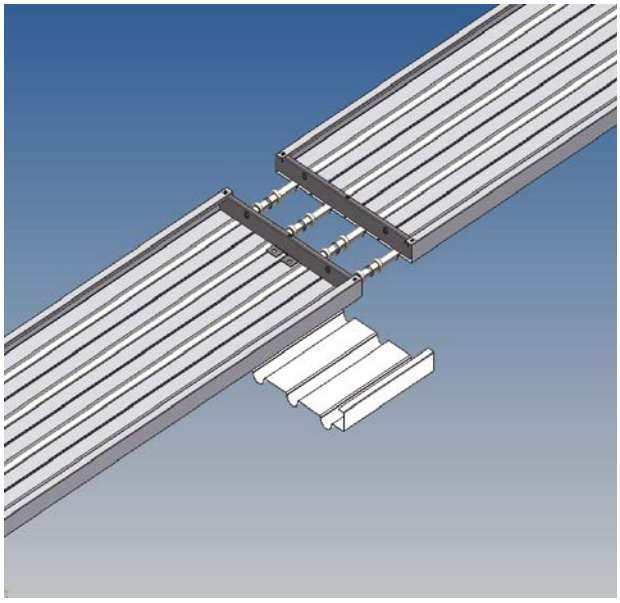
Plates & panels

The Aqua Line radiant panels are fitted with cover plates between the panels, as well additional covers on the collectors. Depending on the location of the water connection, the corresponding press-through holes can be opened. This should be completed on site.

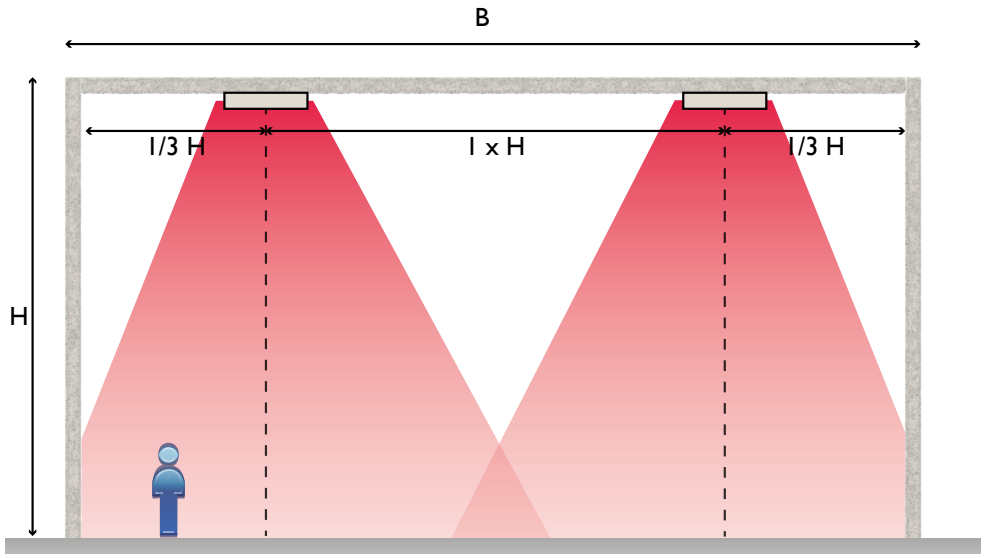








Project planning



H = Height, w =width

Tight assembly against the ceiling

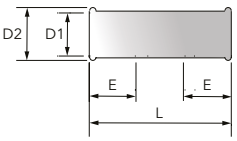
By mounting the panel tightly against a ceiling, a far neater and attractive effect is created. Plus, this brings an added benefit in sports hall as no ball removal plates are required.

Through a special mounting bracket, the panels can be mounted tightly against the ceiling. The bracket is adapted to mount one single panel (type I).

Press fittings

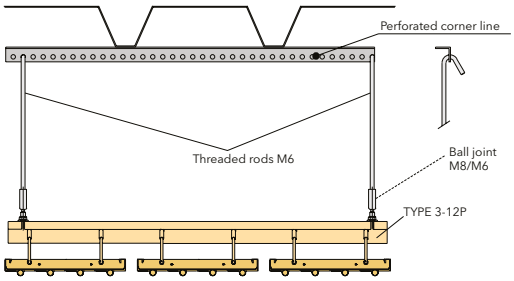
MHS Radiators can provide approved press fittings as an option. Applying other fittings can lead to leaks for which MHS cannot be held liable.

	D1	L	D2	E
B	15	80	23	25

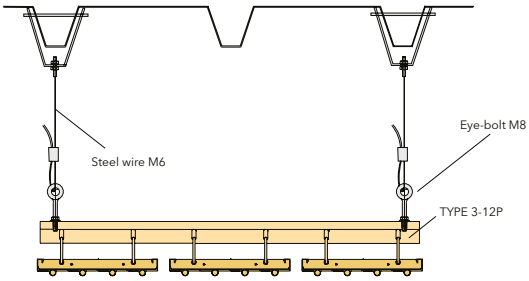


Mounting methods

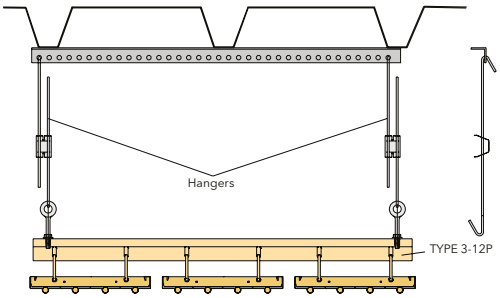
Method A
Suspension by means of threaded rods



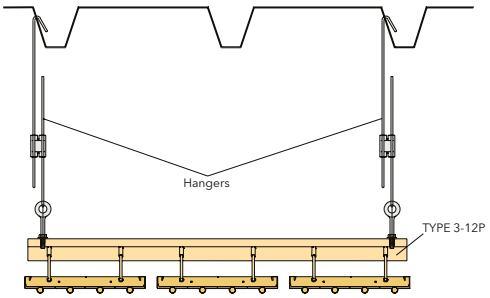
Method B
Suspension by means of steel wire



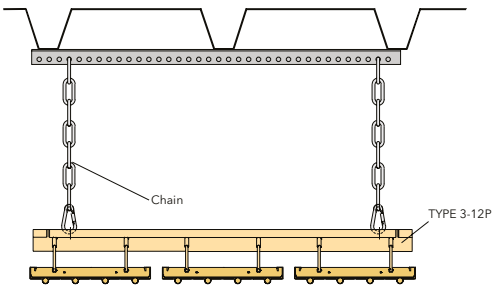
Method C
Suspension by means of hangers



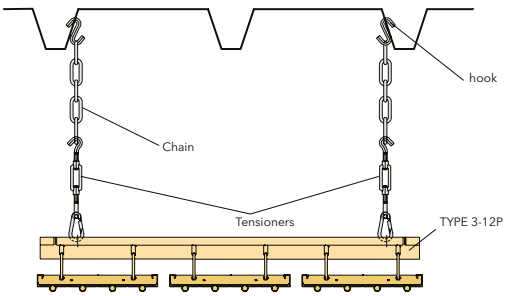
Method D
Suspension by means of hangers



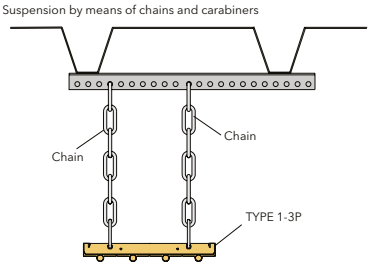
Method E
Suspension by means of chains and carabiners



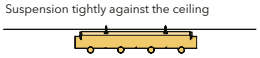
Method F
Suspension by means of chains and tensioners



Method G
Suspension by means of chains and carabiners



Method H
Suspension tightly against the ceiling



Control

Hydronic

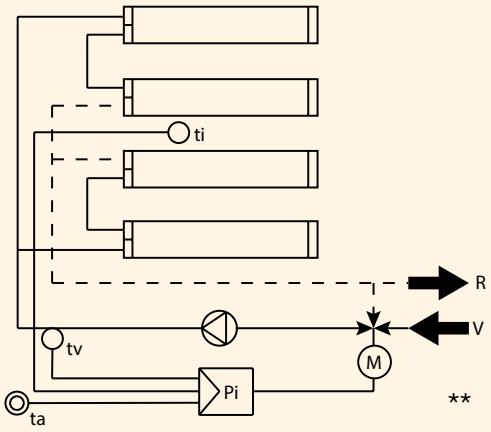
With reduced water content in the system and a relatively high flow rate, there is a very good controllability of the radiant panel installation. To maintain a constant design temperature, the control should be arranged through the flow temperature of the heating medium based on a mixed control, so that a turbulent flow in the tubes is maintained.

Room temperature

The room temperature is preferably controlled by a black bulb sensor.

Weather dependent flow temperature control
With room temperature compensation

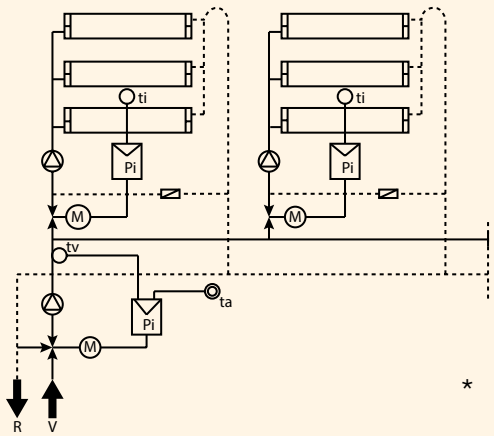
The set value Xs of the outdoor controller is altered until the desired temperature is reached.



Zone control

In order to obtain different indoor temperatures - see 'ti'

For example, a production area may need to be 18°C, while a warehouse needs to be 16°C. The outdoor temperature control works as a pre-control, enabling the system to work at a higher supply temperature than is strictly necessary for the individual zones.



* Pipe network according to Tichelman.

** Pipe network with series arrangement to provide the outer panels with a higher heat output.

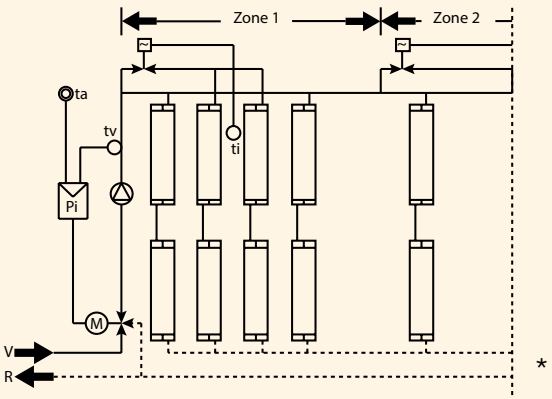
ta = outside temperature | ti = inside temperature | tv = supply temperature | Pi = regulator | R = return line | V = supply line

M = motor operated valve | ▭ = cartridge

Control

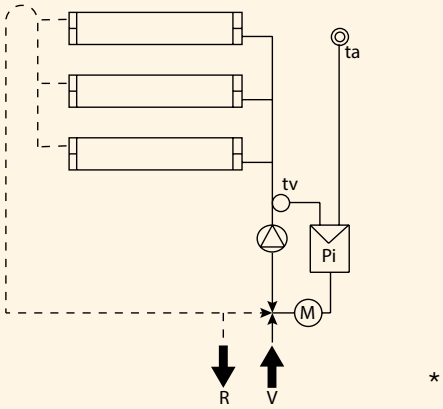
Zone Indoor Temperature Control By disconnecting and ringing of the radiant panels

Weather dependent flow temperature control with PI controller, that is supplemented by a room thermostat controlled solenoid valve. This switches a portion of the hydronic heated surface in case the set value Xs of the room thermostat are exceeded. With a pump, multiple zones can be fed hydronically, with each zone hydronically divided in to at least two groups. This is a very convenient control system for a installation with extreme heat loads and for time-controlled temperature reductions (e.g. night and weekend reductions).



Weather dependent flow temperature control 2

Handling (no control) of the inside temperature 'ti' by the flow temperature 'tv'.
Simplest solution, without feedback from the indoor temperature 'ti'.



* Pipe network according to Tichelman.
** Pipe network with series arrangement to provide the outer panels with a higher heat output.
ta = outside temperature | ti = inside temperature | tv = supply temperature | Pi = regulator | R = return line | V = supply line
M = motor operated valve | ▱ = cartridge

Accessories & parts

Possible accessories to be supplied are:

- Volume flow controllers
- High-pressure cartridge
- Press fittings
- Ball removal plate
- Black bulb sensor

Calculations

The calculation of pressure losses of the radiant panels

The optimal setup is for the panel types have the lowest possible resistance and yet sufficient mass flow.
The type of panel is defined by:

- The mass flow of the medium per panel.
- The method of connection of the hydraulic system.
- The connection diameter.

The mass flow per panel is calculated using the output and the difference between the flow and return temperature:

$$M = \frac{P}{Cp \times \Delta t} \text{ kg/s or } \frac{P \times 0{,}86 \text{ kg/h}}{\Delta t}$$

P = total release of the panel W
Δt = temperature difference between supply and return temperatures
Cp = specific heat of water ± 4200 J / (kg.K)

$$K = \frac{Ta + Tr}{2} - Tu$$

Ta = flow temperature of the water
Tr = return temperature of the water
Tu = room temperature

Calculation of pressure losses in registers, collectors and connections

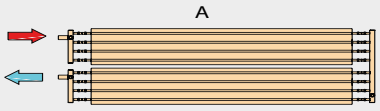
$$R = \left(\frac{\frac{m}{tubes}}{173} \right)^2 \times 196 \qquad Z = \left(\frac{m}{1000} \right)^2 \times 2000$$

R = resistance of water per panel length in Pa/m
Z = water resistance in Pa for both collectors
m = mass flow per panel (kg / h)

Example:

Aqua Line type 2 collector A (30 meters)

Water temperature 80/60 (15°C)



$$m = \frac{P}{Cp \times \Delta t} = \frac{((30 \times 398 \text{ W} + 67\text{w})}{4200 \times \left(\frac{80}{60} \right)} = \frac{12007}{84000} = 0{,}143 \text{ kg/s} \times 3600 = 515 \text{ kg/h}$$

Calculation of resistance

LB = track length (30m x 2)
R = tube resistance per meter (Pa/m)
Z = collective resistance (Pa)

ΔP = LB x R + Z

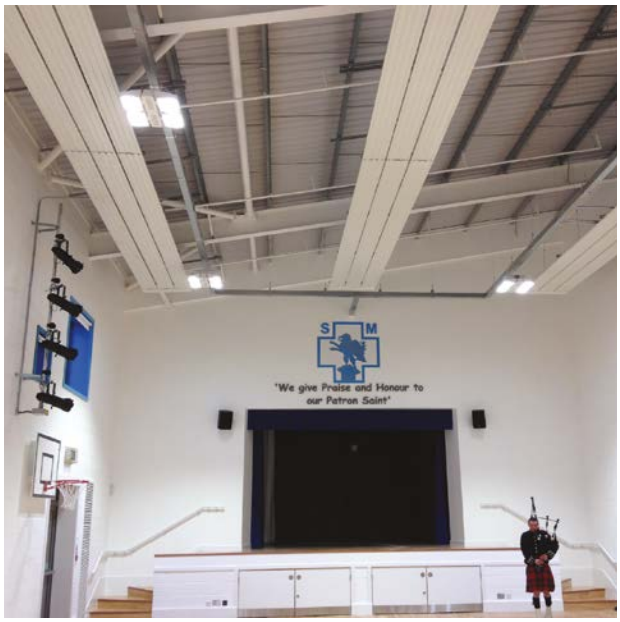
Example:

$$R = \left(\frac{\frac{515}{4}}{173} \right)^2 \times 196 = 109 \text{ Pa/m} \qquad Z = \left(\frac{515}{1000} \right)^2 \times 2000 = 530 \text{ Pa (per panel)}$$

ΔP = (2 x 30m x 109) + 530 = 7.070 Pa = 7,07 k Pa

UK applications

Ducati and Harley Davidson showroom



St Mark's Primary School

Total E&P Aberdeen

Total E&P Aberdeen

Fife Council Head Office Depot

RC/1218/7371RC

ISO 9001 REGISTERED FIRM
URS CERTIFICATE NO.75710

ISO 14001 REGISTERED FIRM
URS CERTIFICATE NO.07571

OHSAS 18001 REGISTERED FIRM
URS CERTIFICATE NO 07571

mhs RADIATORS

MHS Radiators Limited, 3 Juniper West, Fenton Way, Southfields Business Park, Basildon, Essex SS15 6SJ
Tel: 0345 521 5666 Fax: 01268 888260
orders@mhsradiators.co.uk enquiries@mhsradiators.co.uk www.mhsradiators.co.uk

SALES OFFICE - 0345 521 5666