

**RCM / RCH series**

**Chilled Ceilings**



# Chilled Ceiling

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# Chilled Ceilings

Type Designation  
Meander Type RCM  
High Capacity Type RCH

Composition type designation:

**RCM - 1800 - 600 - 4 - H - A - A**

**RCM**

Position 1,2,3 : **Product group**

RCM = Meander Type Chilled Ceiling

RCH = High Capacity Type Chilled Ceiling

**1800**

Position 4,5,6,7 : **Panel Length mm**

**600**

Position 8,9,10 : **Panel Width mm**

**4**

Position 11 : **Number of heat exchange elements**

**H**

Position 12 : **Tube connector position**

H = Horizontal

V = Vertical

**A**

Position 13 : **Color Code**

A = RAL 9010

B = RAL 9001

C = Special Color

**A**

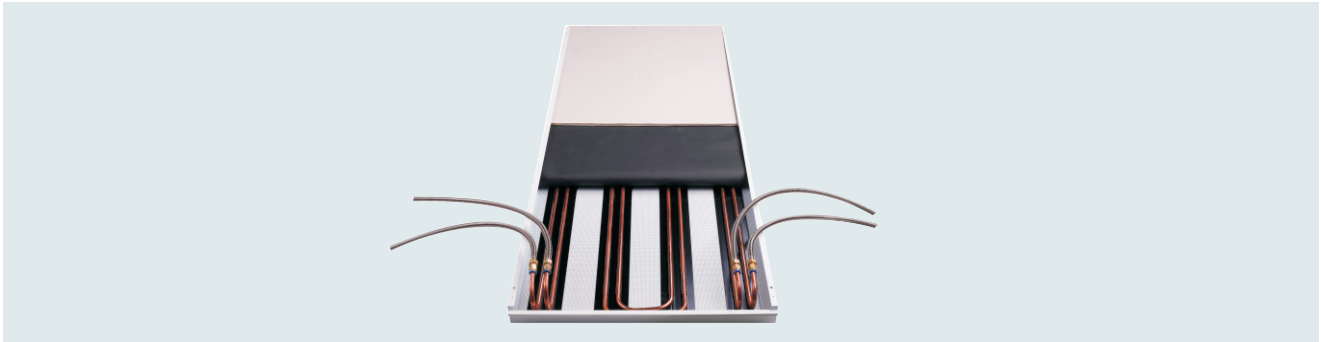
Position 14 : **Acoustic Options (RCM type only)**

A = Rockwool inlay 25mm thick with 35 kg/m<sup>3</sup> density in PE film envelope

B = Same as A plus 8mm gypsum backing board

# Chilled Ceilings

Type Designation  
Meander Type RCM



## Application

Type RCM meander heat exchange chilled ceiling panels are designed for use with metal ceiling systems to provide high comfort levels using radiant cooling technology.

With the chilled ceiling system 50% of the heat transfer is by radiation allowing the air supply to the occupied space to be reduced to only that required for ventilation control. The result is the avoidance of air drafts and high comfort levels.

The system is well suited to office environments, public buildings and is extensively used for hospitals and medical facilities which value the elimination of air drafts and recirculated air.

The RCM cooling panels comprise heat exchange elements bonded to the rear surface of the metal ceiling tile in order to achieve an effective heat transfer from the cooling water that passes through the cooling elements to the ceiling tile.

## Features

- High comfort levels and the elimination of drafts with radiant cooling.
- Nominal cooling of  $87\text{W/m}^2$  of active area when cooled with water with a 10K differential between the mean of the entering and leaving water temperature and the room temperature.
- Reduced energy consumption with the use of reduced air quantities, high chilled water temperatures and the benefit of the radiant cooling effect which allows the ability to operate with 2 degrees C higher room temperatures with the same level of perceived comfort.
- Flexible ceiling tile and heat exchanger sizes and configurations to meet the ceiling design requirements.
- 2 pipe cooling only or heating only heat transfer elements and also 4 pipe elements for separate heating and cooling circuits.
- Various ceiling tile perforation patterns.
- Alternative acoustic treatment configurations to meet different acoustic performances.
- Powder paint finish to meet architectural requirements.
- Ceiling tiles fully factory assembled.

## Technical Information

### *Metal tiles:*

Manufactured from electro plated galvanized sheet steel, finished with polyester powder paint. Finish color to suit project. Aluminium tiles are available as an option.

### *Heat transfer elements:*

Seamless 10mm diameter copper tubes with 0.7mm wall thickness expanded into precision extruded aluminum heat transfer elements. The heat transfer elements are bonded to the metal ceiling tile using VHB very high bonding adhesives and a proprietary bonding process.

### *Acoustic options:*

Acoustic blankets with rockwool internal insulation and nominal thickness of 25mm and  $35\text{kg/m}^3$  density sealed in a PE film envelope.

Added gypsum panel for higher performance acoustic attenuation.

### *Flexible hose connections:*

Flexible hoses manufactured from corrugated 316 stainless steel with quick lock connectors for snap on connection to the chilled ceiling tile heat exchange copper tubes ends and brass connectors for compression fitting to water supply headers. Quick lock connectors have brass bodies with stainless steel retainer clips and EPDM 'O' ring seals.

# Chilled Ceilings

*Type Designation  
MeanderType RCM*

## Delivery format

- The chilled ceiling tiles are supplied completely assembled with the heat exchange elements bonded to the ceiling tile and with acoustic options installed.
- Units can be supplied with vertical or horizontal pipe connections to suit project requirements.
- Ceiling tiles are suitable for installation with C or Omega channel ceiling systems which can be supplied with the ceiling tiles.
- Panel hanging supports available.
- Controls, valves and sensors are available to suit project configurations.

## Specify as:

*Example:*  
Supply and install, chilled ceiling tiles constructed of electro galvanized steel with heat exchange elements factory bonded to the inside of the ceiling tile to ensure permanent bonding and effective heat transfer.

Ceiling tiles to be manufactured from 0.6mm electro galvanized steel and perforated with 2.5mm diameter holes with 16% free area and to be finished with polyester powder painting to RAL 9010 with 30 % gloss finish.

Heat exchange elements to comprise 10mm ØD seamless copper tubes expanded into precision aluminum extruded heat transfer rails

Heat exchange elements to be permanently bonded to ceiling tiles using VHB very high bond adhesives under high pressure and to be suitable for operation at temperatures between 0 and 50 deg C

Heat exchange elements to be performance tested and rated in accordance with EN 14240.

Ceiling tiles to include acoustic inlay blankets made from 25mm thick 35kg/m<sup>3</sup> rockwool sealed in a PE film envelope.

The acoustic inlay blanket shall be backed with 8mm thick gypsum board.

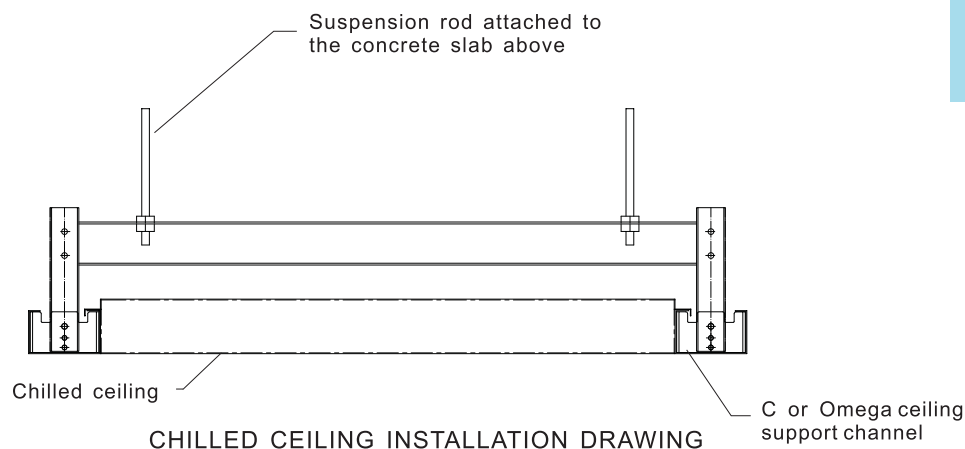
Flexible hoses shall be manufactured from corrugated 316 stainless steel with quick lock connectors for snap on connection to the chilled ceiling tile heat exchange copper tubes ends and brass connectors for compression fitting to water supply headers. Quick lock connectors shall have brass bodies with stainless steel retainer clips and EPDM 'O' ring seals.

## Installation Instructions:

The chilled ceiling panels shall be supported using C or Omega channels supported with hanging and spacer brackets fixed with adjuster strips to the ceiling slab.

The water connections can be of the compression or quick lock type but quick lock type are preferable to facilitate easy removal and relocation of the ceiling tiles if required.

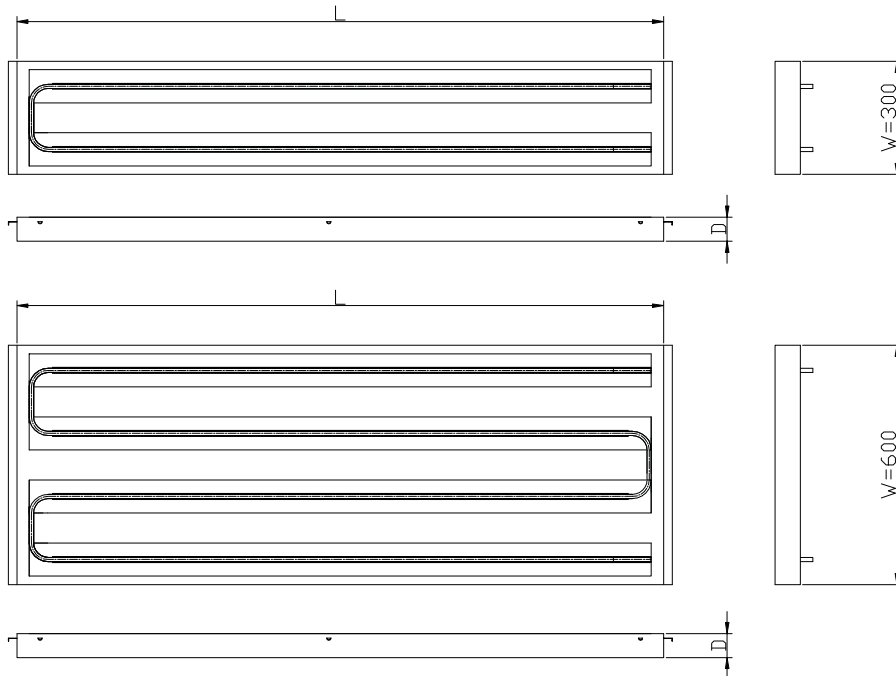
Hanging wires shall be provided to allow each panel to be disconnected from the support channels and hung down without strain on the connecting water hoses.



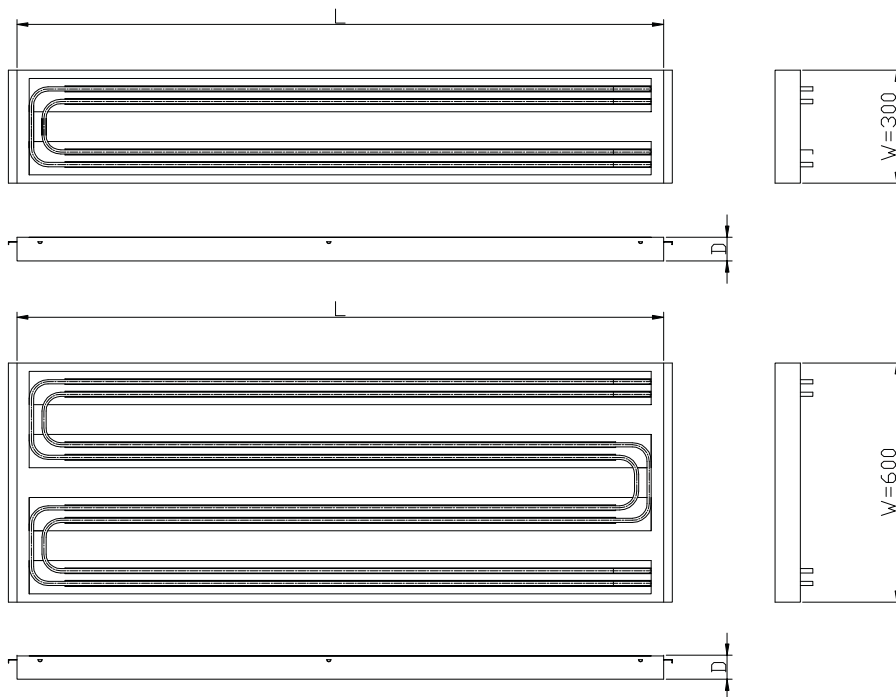
# Chilled Ceilings

Type Designation  
Meander Type RCM

2 Pipe Models – Cool only or Heat only



4 Pipe Models – Independent Cooling and Heating Circuits



Dimensions	
L	600 to 3000mm
W	300 to 600mm
D	25 to 60mm depends on acoustic options

Connection Types	
Horizontal	
Vertical	

# Chilled Ceilings

Type Designation  
High Capacity Type RCH



## Application

Type RCH high capacity chilled ceiling panels are designed for those applications where higher cooling capacities are required together with the high level of comfort provided by radiant cooling.

With the chilled ceiling system 50% of the heat transfer is by radiation allowing the air supply to the occupied space to be reduced to only that required for ventilation and humidity control. The result is the avoidance of air drafts and high comfort levels.

The system is well suited to office environments, public buildings and is extensively used for hospitals and medical facilities which value the elimination of air drafts and recirculated air.

The RCH cooling panels comprise heat exchange elements mounted in a metal frame to allow the free flow of air through the panel. This increases the air contact with the cooling elements which results in a high rate of convective as well as radiant cooling.

Different configurations and densities of heat exchange elements provide different levels of cooling capacity and aesthetic appearance.

### Features

- High comfort levels and the elimination of drafts with radiant cooling.

- High cooling capacity with nominal cooling of up to 230W/m<sup>2</sup> of active area when cooled with water with a 10K differential between the mean of the entering and leaving water temperature and the room temperature.
- Reduced energy consumption with the use of reduced air quantities, high chilled water temperatures and the benefit of the radiant cooling effect which allows the ability to operate with 2 degrees C higher room temperatures with the same level of perceived comfort.
- Different ceiling panel sizes to meet the ceiling design requirements.
- 2 pipe cooling only or heating only configuration.
- Powder paint finish to meet architectural requirements.
- Ceiling tiles fully factory assembled.

## Technical Information

### Metal frames:

Manufactured from electro plated galvanized sheet steel, finished with polyester powder paint. Finish color to suit project.

### Heat transfer elements:

Seamless 10mm diameter copper tubes with 0.7mm wall thickness expanded into precision extruded aluminum heat transfer elements.

### Flexible hose connections:

Flexible hoses manufactured from corrugated 316 stainless steel with quick lock connectors for snap on connection to the chilled ceiling tile heat exchange copper tubes ends and brass connectors for compression fitting to water supply headers. Quick lock connectors have brass bodies with stainless steel retainer clips and EPDM 'O' ring seals.

## Delivery format

- The chilled ceiling tiles are supplied completely assembled with the heat exchange elements bonded to the ceiling tile and with any acoustic options installed.
- Units can be supplied with vertical or horizontal pipe connections to suit project requirements.
- Ceiling panels are suitable for installation with C or Omega channel ceiling systems which can be supplied optionally if required.
- Panel hanging supports available.
- Controls, valves and sensors are available to suit project configurations.

# Chilled Ceilings

## Specify as:

### *Example:*

Supply and install, high capacity chilled ceiling panels constructed with electro galvanized steel support frames with heat exchange elements finished with polyester powder paint in RAL 9010 with 30% gloss.

Heat exchange elements to comprise 10mm OD seamless copper tubes expanded into precision aluminum extruded heat transfer rails

Chilled Ceiling panels shall be fully factory assembled and the water circuits are to be pressure tested at 20 bar pressure.

Heat exchange elements to be performance tested and rated in accordance with EN 14240.

Connection to the chilled water system is to be by flexible hoses manufactured from corrugated 316 stainless steel with quick lock connectors for snap on connection to the chilled ceiling panel heat exchange copper tubes ends and brass connectors for compression fitting to water supply headers. Quick lock connectors shall have brass bodies with stainless steel retainer clips and EPDM 'O' ring seals.

*Type Designation  
High Capacity Type RCH*

## Installation Instructions:

The chilled ceiling panels shall be supported using C or Omega channels supported with hanging and spacer brackets fixed with adjuster strips to the ceiling slab.

The water connections can be of the compression or quick release type but quick release type are preferable to facilitate easy removal and relocation of the panels if required.

Hanging wires shall be provided to allow each panel to be disconnected from the support channels and hung down without strain on the connecting water hoses.





# Chilled Ceilings

*Type Designation  
High Capacity Type RCH*

**Series A**



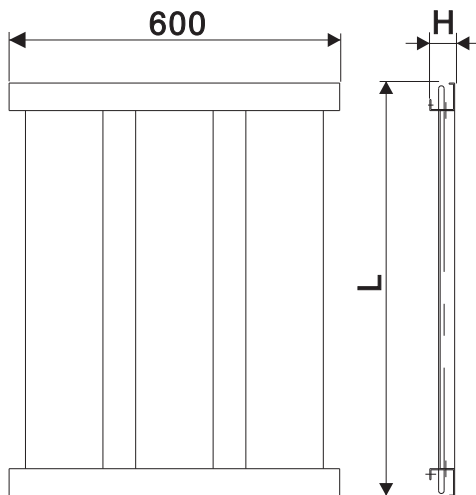
**Series B**



**Series C**



## Dimensions



Type	H (mm)
A	45
B	110
C	130

L = 600 - 4000mm

# Chilled Ceilings

Performance Data  
Type RCM & RCH

## Theory

Chilled ceilings remove sensible heat from the space by radiation and convection. In most applications the heat is removed 50% by radiation and 50% by convection and is proportional to the difference between the panel mean temperature and the room mean temperature.

The radiant heat transfer can be determined from the Stefan-Boltzmann equation. Using an enclosure emittance of 0.9 and a view factor for the ceiling to the remainder of the room of 0.87 which are typical for this application the following equation emerges:

$$Q \text{ radiant W/m}^2 = 0.15 \times 10^{-8} [(t_p)^4 - (AUST)^4]$$

Where: Q radiant = Radiant Cooling (W/m<sup>2</sup>)

$t_p$  = Mean panel surface temperature (K)

AUST = Area weighted average temperature of the non radiant room surfaces (K)

The Heat transfer by convection consists of both natural and forced convection. Natural convection is due to the cooled air adjacent to the panels falling to be replaced by the warmer air. Forced convection is due to air movement from the introduction of ventilation air.

For panel applications without forced convection the convective heat transfer can be determined using the following equation:

$$Q \text{ convection W/m}^2 = 0.31(t_p - t_a)(0.31)(t_p - t_a)$$

Where: Q convection = Convection Cooling (W/m<sup>2</sup>)

$t_p$  = Mean panel surface temperature (K)

$t_a$  = Mean room air temperature (K)

Research has shown that in practice the combined radiation and convective heat transfer are proportional to the temperature difference between the mean temperature of the ceiling panels and the mean room air temperature and rating standards commonly rate the ceiling panel performance as a function of this differential temperature.

# Chilled Ceilings

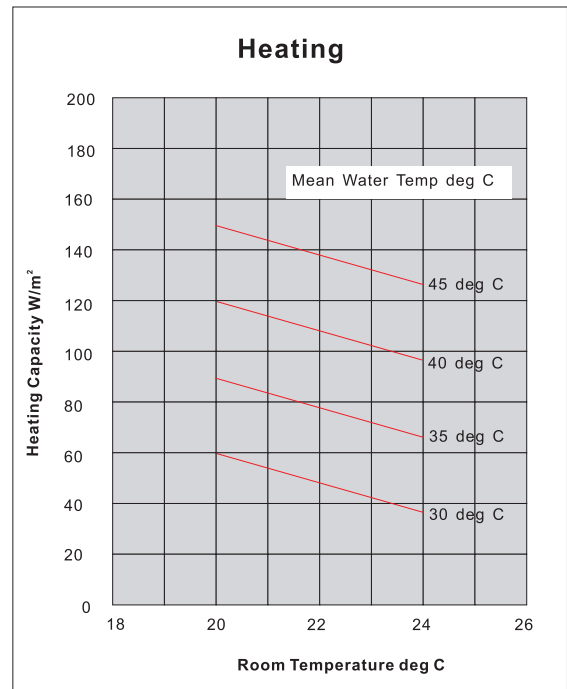
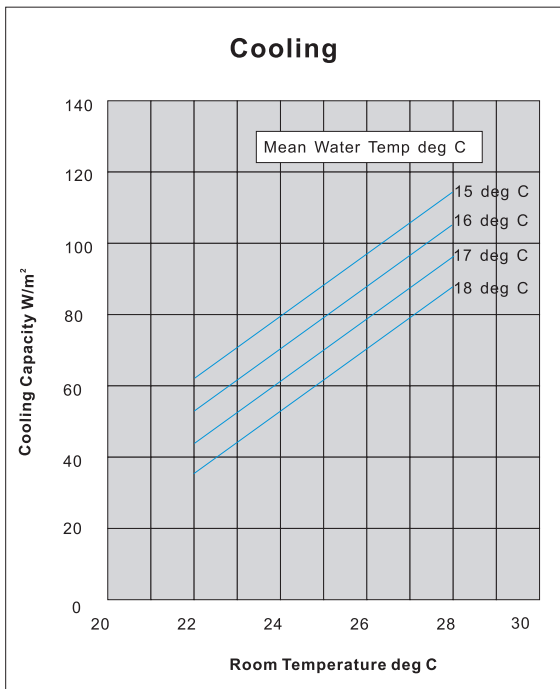
Performance Data  
Meander Type RCM

## Performance Ratings

The cooling capacity of Chilled Ceilings determined in accordance with EN 14240 standard is expressed as a function of Mean Temperature Difference.  
Mean Temperature Difference is the difference between the dry bulb room temperature and the mean of the entering and leaving water temperature.

$\Delta T$  mean = Mean Temperature Difference K =  $T_{\text{room}} - (T_{\text{water in}} + T_{\text{water out}}) / 2$   
 $T_{\text{room}}$  = Room Temperature (dry bulb) C  
 $T_{\text{water in}}$  = Entering water temperature C  
 $T_{\text{water out}}$  = Leaving water temperature C

Nominal Cooling Capacities rated according to EN 14240 and Heating Capacities are as follows based on the mean water temperature and the room temperature.



Nominal Cooling Capacity by Panel Size

Panel Size		Cooling Capacity W	Mean Temperature Difference K					
Width	Length		7	8	9	10	11	12
300	1200	Cooling Capacity W	22	25	28	31	34	38
	1800		33	38	42	47	52	56
	2400		44	50	56	63	69	75
600	1200		44	50	56	63	69	75
	1800		66	75	85	94	103	113
	2400		88	100	113	125	138	150

Nominal Heating Capacity by Panel Size

Panel Size		Heating Capacity W	Mean Temperature Difference K					
Width	Length		10	13	16	19	22	25
300	1200	Heating Capacity W	21	27	34	40	46	53
	1800		32	41	51	60	69	79
	2400		42	55	67	80	93	105
600	1200		42	55	67	80	93	105
	1800		63	82	101	120	139	158
	2400		84	109	135	160	185	211

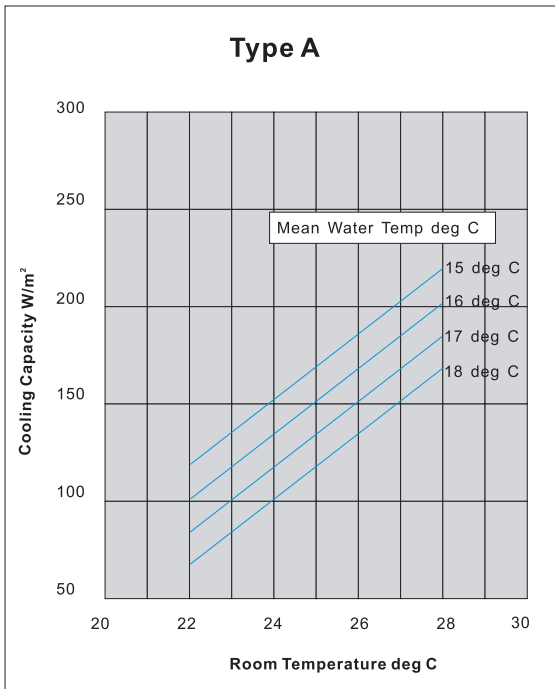
Ratings are based on:

1. Ceiling free area > 70%
2. Distance between top of cooling element and floor slab after > 130mm

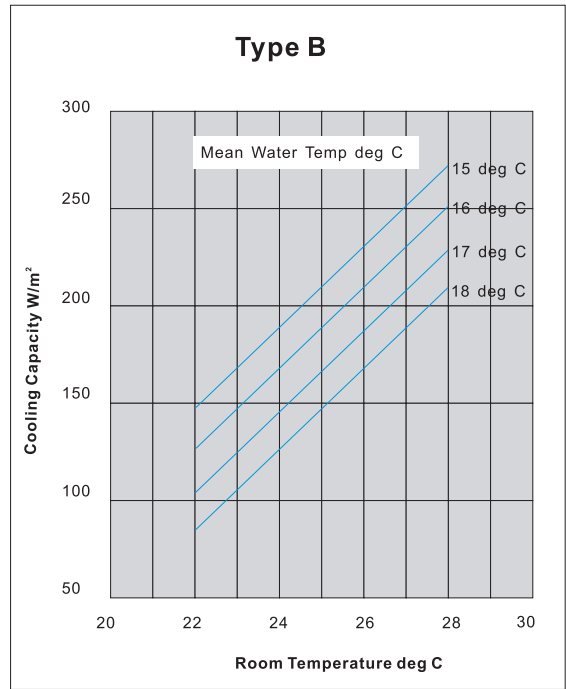
For other configurations please contact us for the performance

# Chilled Ceilings

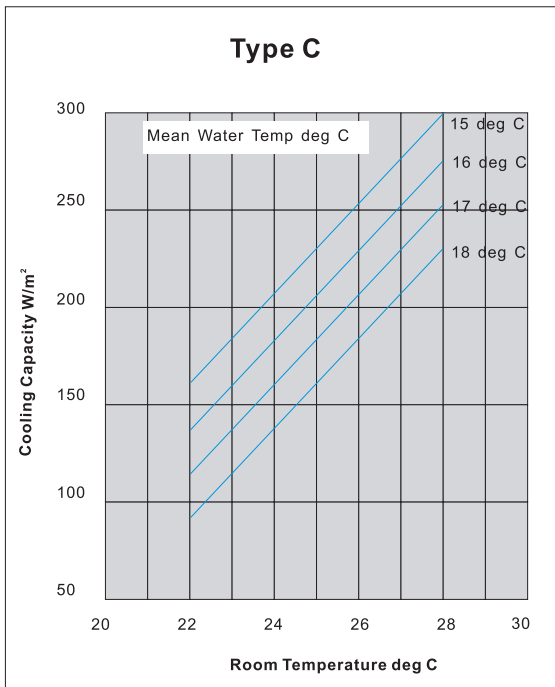
## Performance Data High Capacity Type RCH



Series A



Series B



Series C

### Nominal Cooling Capacity by RCH Panel Size (600mm wide)

Panel		Cooling Capacity W	Mean Temperature Difference K					
Type	Length		7	8	9	10	11	12
A	1200	Cooling Capacity W	86	98	110	122	135	147
	1800		129	147	165	184	202	220
	2400		171	196	220	245	269	294
B	1200		106	121	136	151	166	181
	1800		159	181	204	227	249	272
	2400		212	242	272	302	333	363
C	1200		116	132	149	166	182	199
	1800		174	199	224	248	273	298
	2400		232	265	298	331	364	397

Ratings are based on:

1. Ceiling free area > 70%
2. Distance between top of cooling element and floor slab > 130mm

For other configurations please contact us for the performance

# Chilled Ceilings

## Chilled Ceiling Selection Example Type RCM & RCH

### 1) Design Requirements

Zone length and width	7.2 m x 5.04 m
Outside wall dimensions	7.2 m x 3.0 m
Floor area	36.3 m <sup>2</sup>
Design room temperature T room	24°C (Summer)
Design room relative humidity	50%
Wall/Window heat load	15 W/m <sup>2</sup>
Lighting load	20 W/m <sup>2</sup>
Number of occupants	5 people
People Load    Sensible Heat	75 W per person
Latent Heat	60 W per person
Personal Computer Loads CPU + LCD	105 W x 5 sets
Infiltration	Negligible (building operates under positive pressure)
Required Ventilation rate (fresh air)	1.5 l/s per m <sup>2</sup> or 10 l/s per person
Ceiling Configuration	600 x 1800mm panels with C channel support system.

### 2) Calculation

#### 2.1 Determine the zone cooling loads

	<u>Sensible Load</u>	<u>Latent Load</u>
Wall/Window heat gain	7.2 x 3.0 x 15 = 324 W	
People	5 x 75 = 375 W	5 x 60 = 300 W
Lighting	36.3 x 20 = 726 W	
Computers	5 x 105 = 525 W	
Total	<u>1950 W</u>	<u>300 W</u>

#### 2.2 Determine the required fresh air flow to the zone.

Fresh air ventilation requirement = 36.3 x 1.5 = 54.5 l/s  
or 4 x 10 = 40.0 l/s  
Take 54.5 l/s

#### 2.3 Determine the required moisture content of the fresh air flow to satisfy the latent cooling requirement.

Based on T room = 24°C with 50% RH determine from the psychometric chart that the room moisture content = 9.30 g/kg.

Using the equation:  $Q \text{ latent W} = 3.0 \times \text{Air flow l/s} \times \Delta \text{Moisture content g/kg}$

$$\text{Determine } \Delta \text{Moisture content g/kg} = \frac{Q \text{ latent W}}{3.0 \times \text{Air flow l/s}} = \frac{300}{3.0 \times 54.5} = 1.84 \text{ g/kg}$$

Therefore the required moisture content of the fresh air to satisfy the latent cooling Requirement = Room moisture content 9.30 g/kg minus the required  $\Delta$  Moisture content 1.84 g/kg equals 7.46 g/kg.

Assuming that the fresh air will leave the fresh air air-handling unit cooling coil at 90% relative humidity then from the psychometric chart the required dry bulb temperature is 11.2°C

#### 2.4 Determine the sensible cooling capability of the ventilation air

$$Q \text{ sensible} = 1.213 \times 54.5 \times (24.0 - 11.2) = 846 \text{ W}$$

#### 2.5 Determine the sensible cooling required by radiant cooling

$$\text{Required } Q \text{ sensible radiant} = 1845 - 846 = 999 \text{ W}$$

# Chilled Ceilings

## Chilled Ceiling Selection Example Type RCM & RCH

### 3) Selection

#### 3.1 Select the Radiant Cooling Panels required

Determine the Mean Temperature Difference for the Ceiling Panels:-  
Entering water temperature = Room Dew Point Temperature + 2 C = 13.0 + 2.0 = 15.0 C  
Leaving water temperature = 15.0 + 3.0 = 18.0 C  
Mean temperature Difference  $\Delta T_m = T_{\text{room}} - (T_{\text{water out}} + T_{\text{water in}}) / 2$   
= 24 - (18.0 + 15.0) / 2 = 7.5 C

#### 3.2 Select Meander RCM type Chilled Ceiling Panels

Determine the capacity of each Ceiling Panel:-  
From Performance Data (Page 9 ) with ceiling panels 600mm x 1800mm  
Capacity with  $\Delta T_m = 7.5$  C is 71 W per panel.  
Therefore we require 999 / 71 = 14.07 active cooling panels to satisfy the cooling requirement.  
Select 14 panels.

Total number of active and inactive panels =

$$\frac{\text{Ceiling area } 36.3 \text{ m}^2 \times 0.8 \text{ (less 20\% for ceiling structure, sprinklers, lighting etc)}}{0.600\text{m} \times 1.800\text{m}}$$

= 26 panels. Therefore percentage of Active Panels = (14 / 26) x 100 = 54%

Assume an average of four panels connected in series with a temperature rise of 3.0 C, then:-

$$\text{Water Flow Rate} = \frac{\text{Cooling Capacity W} \times 4}{4190 \times \Delta T_{\text{water C}}} = \frac{71 \times 4}{4190 \times 3.0} = 0.023 \text{ l/s} = 83 \text{ l/hr}$$

#### 3.3 Select High Capacity RCH type - Series C - Chilled Ceiling Panels

Determine the capacity of each Ceiling Panel:-  
From Performance Data (Page 10 ) with ceiling panels 600mm x 1800mm  
Capacity with  $\Delta T_m = 7.5$  C is 186 W per panel.  
Therefore we require 999 / 186 = 5.4 cooling panels to satisfy the cooling requirement.  
Select 6 panels.

Total number of active and inactive panels =

$$\frac{\text{Ceiling Area } 36.3 \text{ m}^2 \times 0.8 \text{ (less 20\% for ceiling structure, sprinklers, lighting etc)}}{0.600\text{m} \times 1.800\text{m}}$$

= 26 panels. Therefore percentage of Active Panels = (6 / 26) x 100 = 23%

Assume an average of four panels connected in series with a temperature rise of 3.0 C, then:-

$$\text{Water Flow Rate} = \frac{\text{Cooling Capacity} \times 4}{4190 \times \Delta T_{\text{water C}}} = \frac{186 \times 4}{4190 \times 3.0} = 0.059 \text{ l/s} = 213 \text{ l/hr}$$

#### 4) Product Specifications

Quantity 14 Model RCM-1800-600-4-H-A-A Meander type chilled ceiling panels.

Alternatively

Quantity 6 Model RCH-1800-600-6-H-A-0 Series C High capacity type chilled ceiling panels.

