BARCOL-AIR Radiant Gypsum Ceiling System (BRG)

Radiant for Cooling or Heating

BARCOL-AIR

Barcol-Air Ltd
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General Description

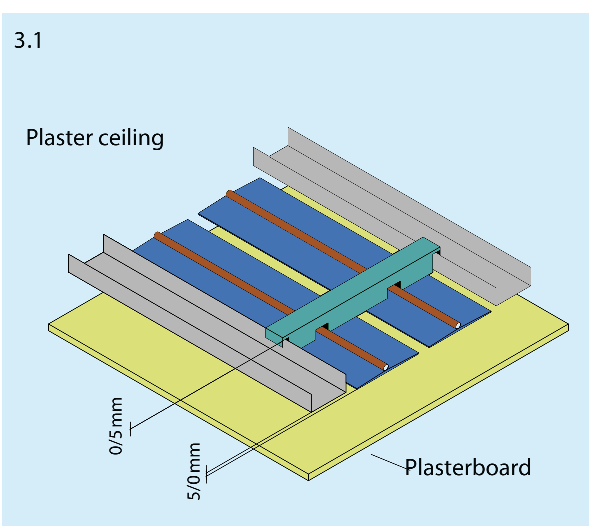
There is no visible difference between the BRG Chilled Ceiling and an ordinary plaster ceiling. It is distinguished not only by its ingenious technical functionality but also by its high aesthetic quality. The plaster underside produces a seamless ceiling

The BRG is used in office buildings, government buildings, deparment stores, shopping centers and in R&D laboratories. It is used wherever a high standard of finish is required, demanding a combination of aesthetics and high preformance. It is particularly outstanding when used in quiet rooms, as thermal expansion of the coils does not create any noise.

Piping in The Ceiling Cavity

Installation of the coil is particularly advantageous, as it is installed absolutely independently of the ceiling. Additionally, to maintain the independence of the panels, the Barcol-Air Ltd. coils are connected to the cold water piping via flexible hoses. The connection can also be made by soldered or threaded connection to the copper pipe. Barcol-Air Ltd. has carried out a long series of experiments to create a permanently-sealed, maintenance-free connection between the coil and the hose connectors, in order to provide the best possible solution for its customers. Barcol-Air also pays very close attention to the quality of material and workmanship when selecting its hose suppliers. The hose material used is precisely matched to the high demands, thus providing a reliable connection, even in inaccessible ceiling cavities.

- Flexible design for architectures; i.e. unique possibilities with a seamless ceiling finish
- Energy-efficient cooling
- Draft-free cooling, in accordance with DIN, ISO, SIA and EN standards
- May be used for heating
- Low cost of product
- Minimal maintenance outlay
- Highest Possible Human ComfortSM
- 100% reproducible output
- Low water resistance
- Installation without a permanent connection between the heat conductors and panels or substructure, preventing any cracks in the filled seams between the panels. In addition, no noise occurs in the ceiling, as there are no permanent (hydraulic) connections.
- Calibrated copper pipes (diameter = 12 mm)
- Efficient and quick installation
- Cooling or heating effect with a high heat transfer



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Ceiling Finish

Selection of the panels depends on the cooling capacity to be achieved and the architectural design. The panels may be in the form of fiber-reinforced plasterboard, plasterboard, thermo board or metal honeycomb panels. Perforated surfaces in other patterns are also possible. Panel lengths may be up to about eight feet, and the width up to four feet, depending on the type of surface and the manufacturer selected.

As there are no restrictions to any individual surface finish, different techniques may be used, e.g. plaster stopping, simple rolling or even thin plaster. However, a thick layer of plaster means a reduction in cooling capacity is expected. It is not necessary to activate the entire surface of the ceiling in most cases, resulting in a combination of thermally active and inert ceiling surfaces. It is, of course, also possible to combine seamless ceiling surfaces (e.g. plasterboard) with other ceiling systems (e.g. metal acoustic panels). The plaster ceiling can also be integrated into the space as a single sail.

Free Design of Ceiling Surface

The division of the ceiling into an active cooling surface and an inert surface, is a function of the cooling capacity requirements. The surfaces must be divided so that installation of lighting or loudspeakers may be implemented properly. There is also a variety of methods of joining seamless ceiling surfaces to the wall. Alternatives, such as projecting edges and indirect lighting cavities are available alongside common wall connections such as ames tape or open shadow gaps. Removable panels may be used for access to the ceiling cavity.

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Installation

The C mounting sections, rigid under compression, are suspended from the bare ceiling lengthwise on nonius hangers, in accordance with DIN 18168, the standard for ceiling paneling.
The Barcol-Air Ltd. heat conductors are inserted between the C-sections of the substructure, using specially developed supports. It is essential that no rigid connection be made between the C-sections and the coils. The heat conductors are made of high-quality extruded aluminum section. The section itself consists principally of a circular duct open at the top and a precision flat heat diffusion board. The surfaces are in unfinished or black aluminum.

High surface contact is achieved between the aluminum heat conductors and the calibrated precision copper pipe in a special rolling process. The standard diameter is 12 mm. The high precision of the C-section of the heat conductor and the copper pipe and the optimized, pre-stressing of the C-section flanks facilitate optimal contact between the pipe and heat conductor, thus minimizing any heat transfer loss

At this stage, a surface is formed by seamless panels (plasterboard, plaster thermo board or metal honeycomb panels). The range of alternatives is almost infinite. The panels are joined to the C-mounting sections of the ceiling substructure. It is essential that they only be attached to the mounting sections, to prevent noise and cracking in the filled seams of the panels. When the ceiling is complete, the seams are filled and the visible side of the ceiling sanded ready for painting.

Perforated panels with acoustic fleece and rock wool matting on the reverse may also be used to improve acoustic absorption in the room. A variety of perforation patterns is available, of course, to suit the developer‘s wishes. The entire thickness of a seamless BRG chilled ceiling is between 3 1/8” and 4”, from the lower surface of the finished ceiling to the upper surface of the substructure or cooling coil.

Recommendations for Installation

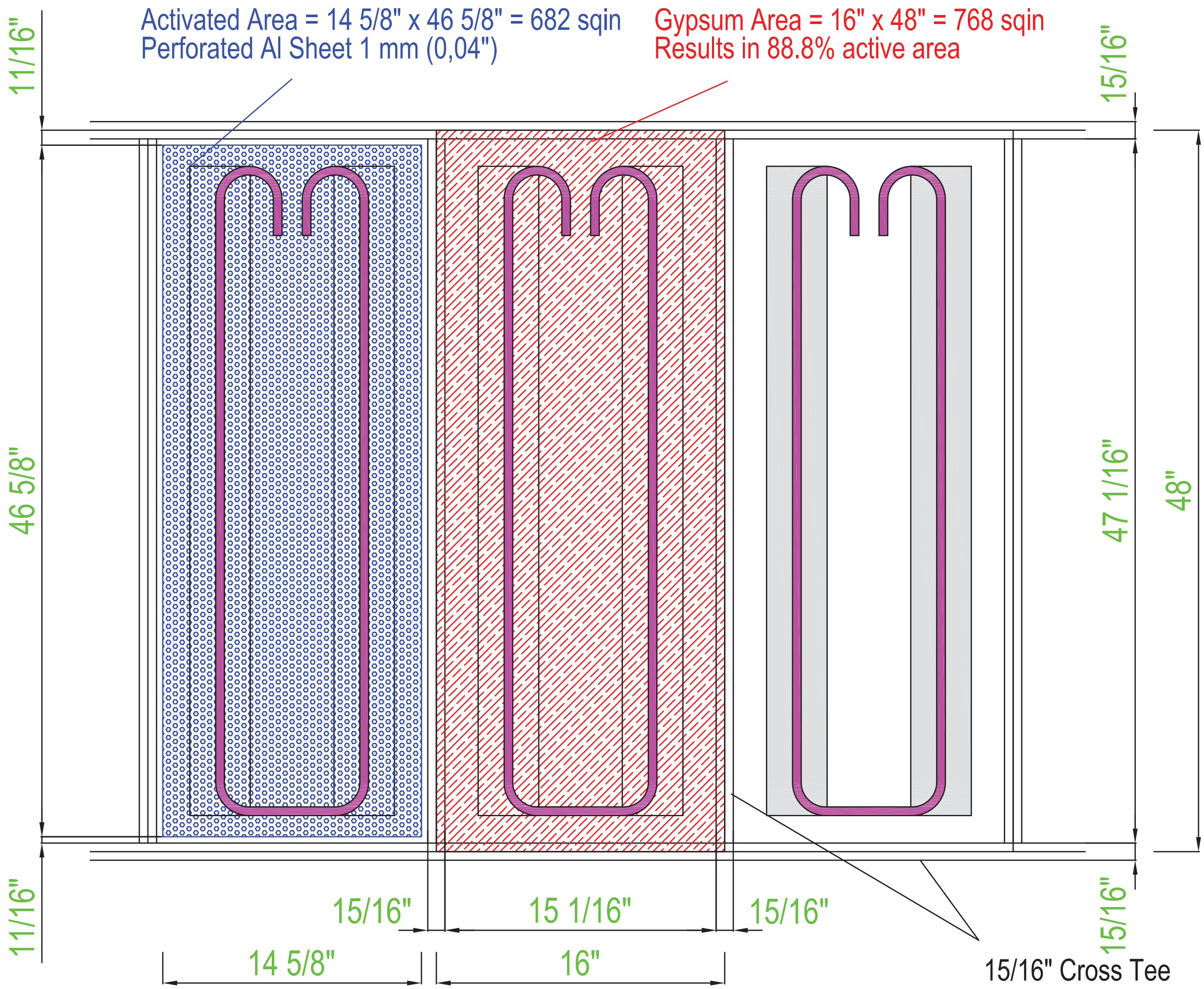
The BRG plaster chilled ceiling is designed to integrate installations such as, lighting, sensors, wall connections, aprons, loudspeaker and multimedia projectors, ventilation outlets, sprinkler systems, stepped ceilings etc. These installation and other details are typically known to use conventional dry, mortar-free construction, which can all be fully integrated into the BRG chilled ceiling. See figures 5.4 and 5.5 for examples.

Determining the Surface-Specific Heating and Cooling Capacity

Determining the Active Area

Fig. 6 shows the gypsum area in red and the active area in blue:
As the active are is smaller than the gypsum ceiling area, the active area must be used to determine the total cooling capacey of any given ceiling area.

Fig. 6



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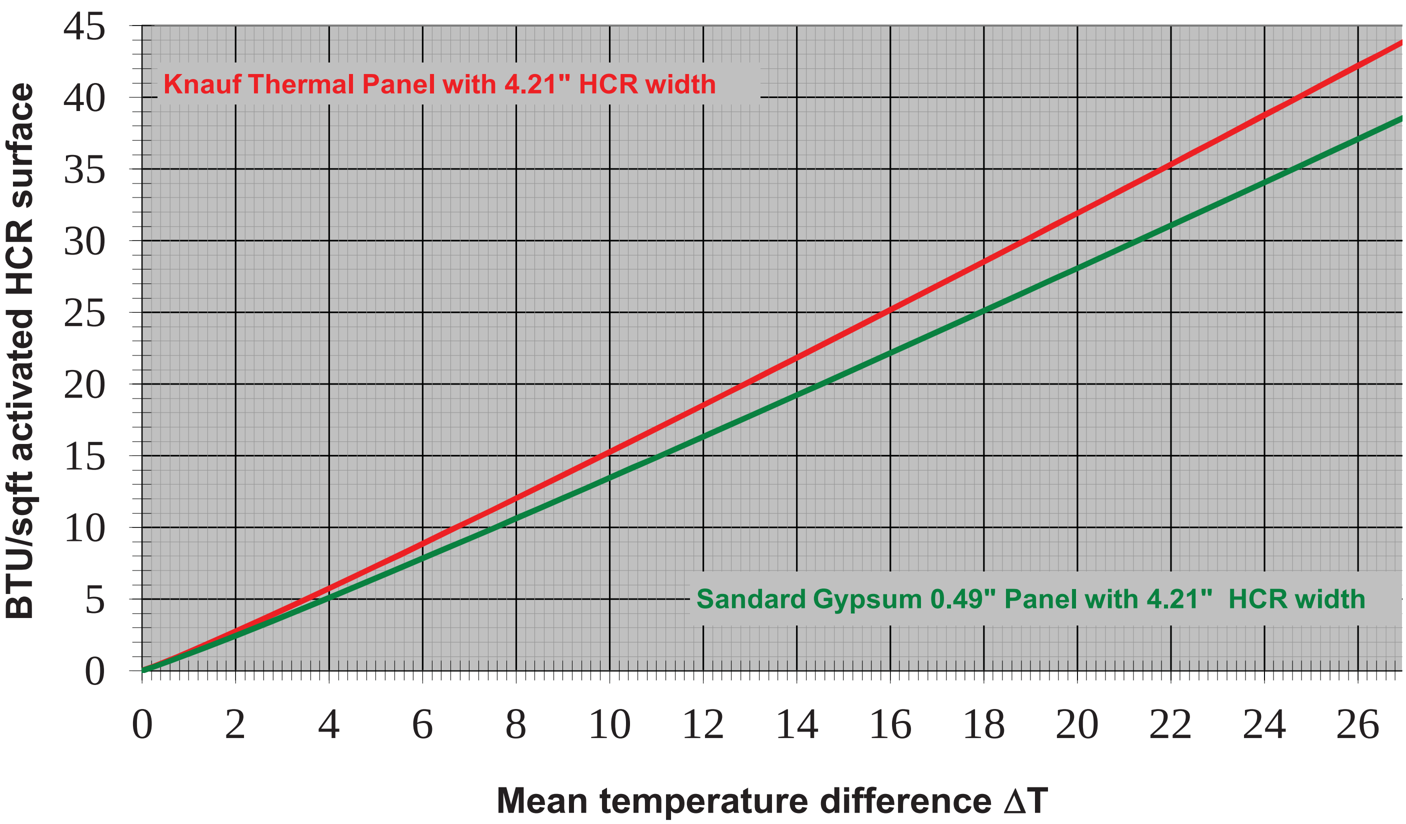
Standart Cooling

Fig. 7 shows the spatial curve, determined by analogy with DIN 4715-1, as a function of the mean difference in temperature. Standard cooling capacity relates to applications under the following conditions:

- 9 feet ceiling height
- Active area
- No ventilation in the ceiling area
- Symmetrical arrangement of the sources of heat in the room
- No allowance for mass storage potential
- 3/8" thermo board or 1/2" standard board
- Mineral wool acoustic lining
- Substructure spacing of 16 1/2" is used for panels with no perforation and 12 1/2" for perforated panels.

Fig. 7



<u>The mean temperature difference (Δtm ºF) for cooling is calculated as follows:</u>

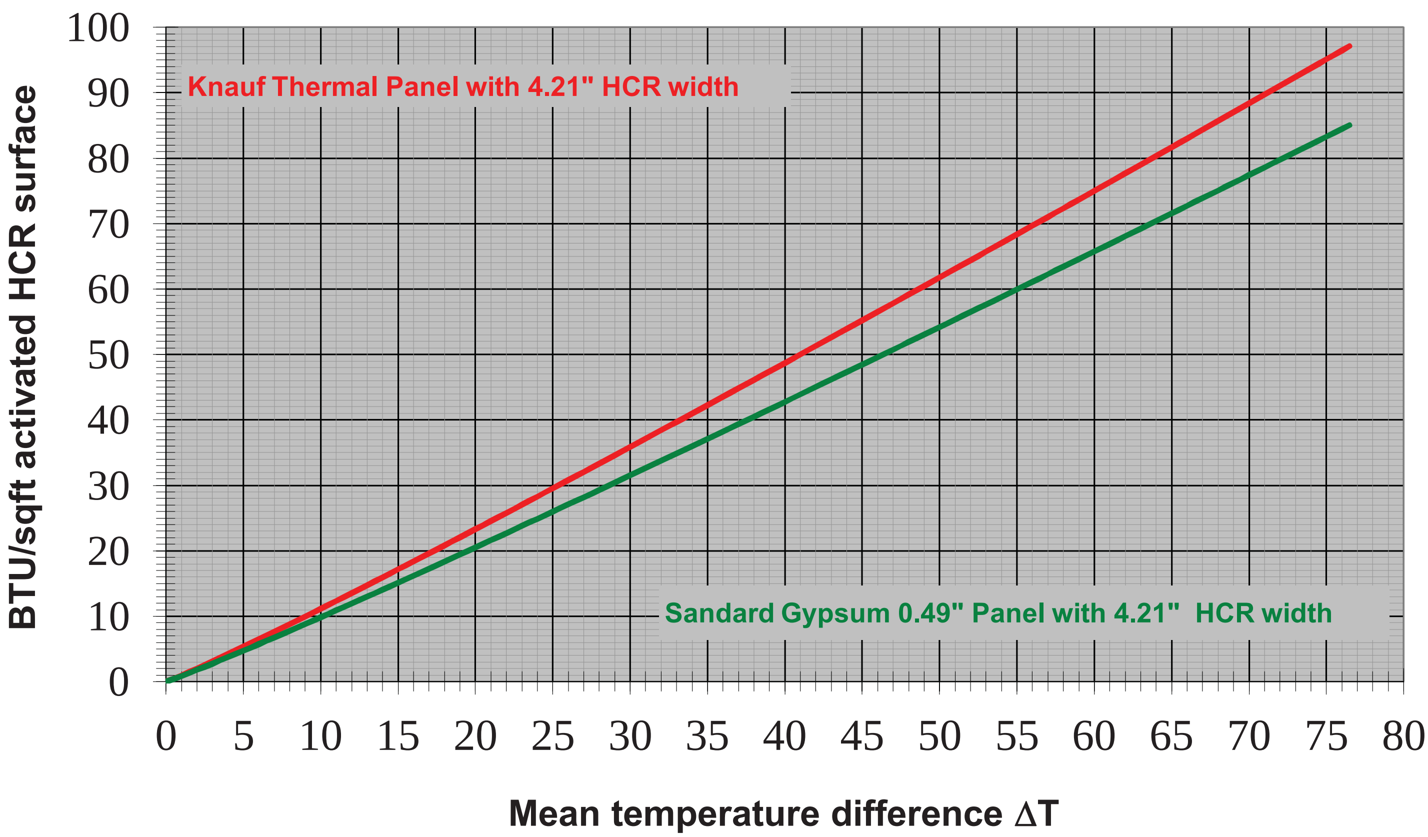
Δtm (ºF) = Room Temp. (ºF) - [(Supply Water Temp. (ºF) + Return Water Temp. (ºF))/2]

Standard Heating

Fig. 8 shows the spatial curve, determined by analogy with DIN 4715-1, as a function of the mean difference in temperature. Standard heating capacity relates to applications under the following conditions:

- 9 feet ceiling height
- Active area
- No ventilation in the ceiling area
- No allowance for mass storage potential
- 3/8” thermo board or 1/2” standard board
- Mineral wool acoustic lining
- Substructure spacing of 16 1/2” is used for unperforated panels and 12 1/2” for perforated panels.

Fig. 8



<u>The mean temperature difference (Δtm ºF) for heating is calculated as follows:</u>

Δtm (ºF) = [(Supply Water Temp. (ºF) + Return Water Temp. (ºF))/2] - Room Tempe. (ºF)

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Determining Pressure Loss Through 12mm Copper Tube

The excellent heat conduction from the surface of the active panels to the chilled water of the BRG system is based on a high internal heat conduction coecient applicable to turbulent flow.
The diagram in Fig 9 shows the resistance of one heat conducting rail with a copper tube of 12 mm diameter as a function of the circuit water volume and the length of the heat conducting rail. In order to determine the total circuit resistance, the value derived from the diagram must be multiplied by the number of panels and heat conducting rails (HCR) connected in series and added to the resistance of all flexible hoses in the circuit.

$\Delta p_{TOT} = (\Delta p_1 * n_P * n_{HCR}) + \Sigma\Delta p_c$

Δp_{tot} = total resistance of the circuit

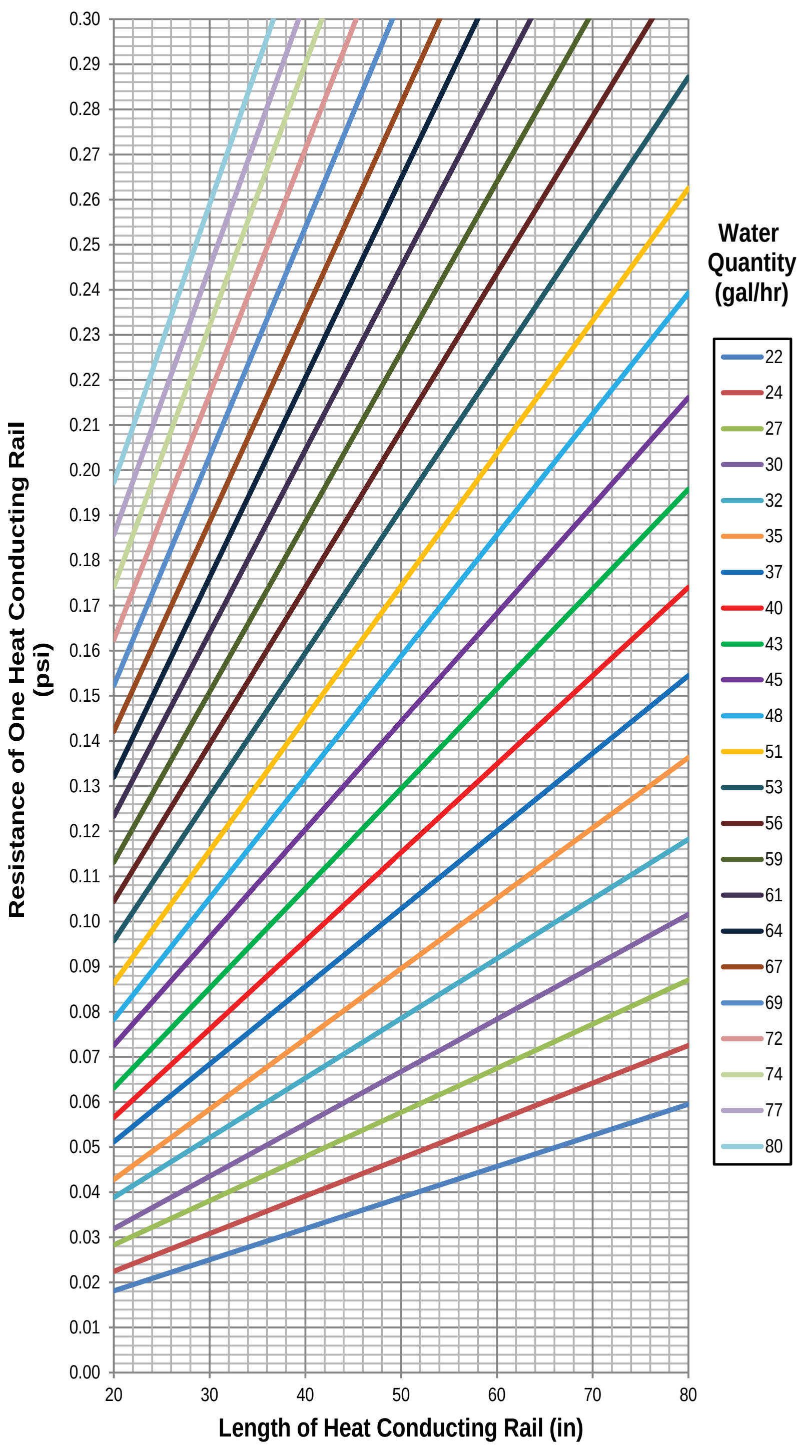
Δp_1 = resistance of one heat conducting rail according to diagram 9

n_p = number of panels in series

n_{HCR} = number of heat conducting rails on each panel

$\Sigma\Delta p_c$ = residance of flexible connectors, as indicated in the section ‘Hydraulic”

Fig. 9



Miminum Flow Rate

In order to obtain turbulent flow conditions the water quantity of the circuit should not be below 18.49 gal/h for the12 mm tube. This can be achieved by connecting the necessary number of panels in series. In situations where turbulent flow can not be achieved, the specic cooling capacity must be corrected accordingly.

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Hydraulics

When planning the cold water distribution, water should circulate through the cooling panels from the window wall inward. It is usually possible to connect the active ceiling panels in a line in series, due to the large area the water pipes cover in the chilled ceiling.

Connections to the cold water piping are made in accordance with the division of the room or zone. In large rooms or zones, the same number of active panels should be used for even water distribution. If this is not possible, the individual circuits must be matched by using suitable chokes (see Fig. 10.3).

It is fundamentally recommended that shut off valves be used to isolate individual cooling zones at the water inlet and outlet. The benefits of this tried and tested type of installation lie in commissioning and in possible subsequent work on the chilled ceiling system. Firstly, the main water network can be flushed and checked for leaks when the stop cocks are closed. Secondly, subsequent modifications or additions can be made to the cooling zone without switching off and draining the entire system.

Fig. 10.1

Fig. 10.2

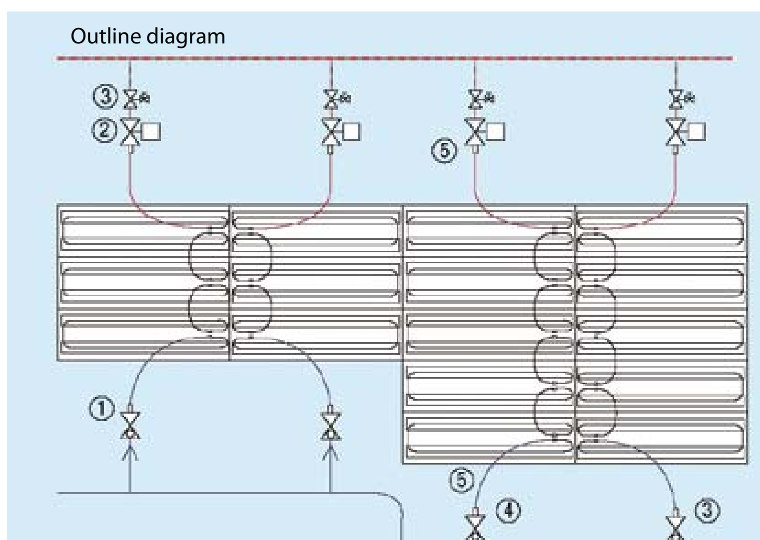

Fig. 10.3

1 Branch balancing valve
2 Control valve
3 Shut off valve with/without bleeding/draining
4 Screw-in nipple
5 Flexible connecting hose with quick connect/disconnect fitting
6 Flexible connecting hose with quick connect/disconnect fitting

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Acoustics

In working systems, the reverberation time is adapted to the respective requirements by specific absorbent lining of the surfaces surrounding the room. The suspended ceiling is a very important surface for this purpose. The deductible absorbent ceiling surface area is the surface area of perforated plasterboard lined with fleece ex works.

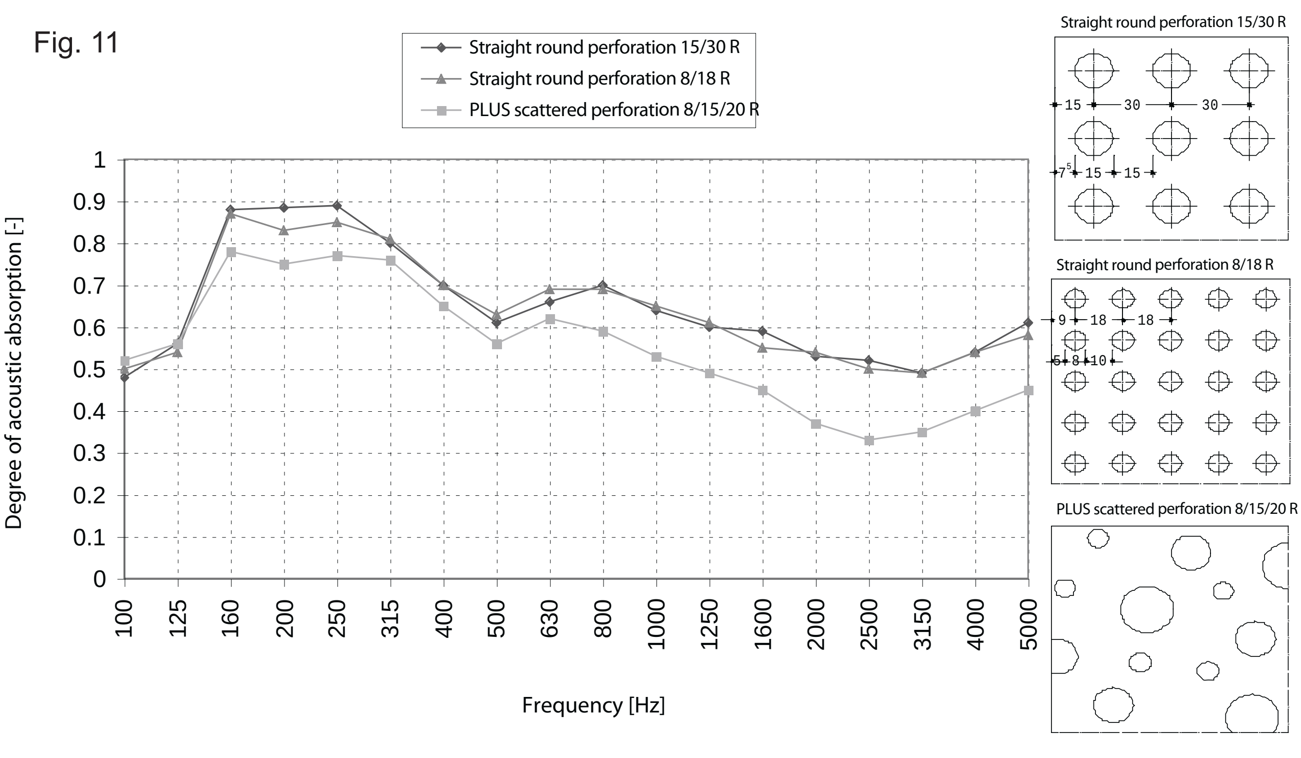
The graph in Fig 11 below shows the degree of acoustic absorption in a standard ceiling board as a function of frequency, under the following conditions:

- Standard plasterboard, 1/2” (12 mm) thick
- Perforation patterns 15/30 R, 8/18 R, 8/15/20 R
- With acoustic fleece, without rock wool

The principal factors influencing acoustic absorption are:

- The ceiling board material and the choice of acoustically-effective perforation
- The physical properties of the insulating material
- The design of the ceiling (geometry)

Fig. 11



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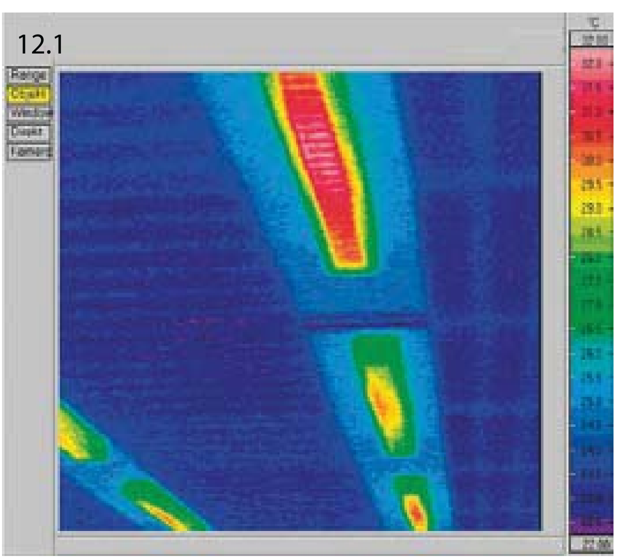
Commisioning

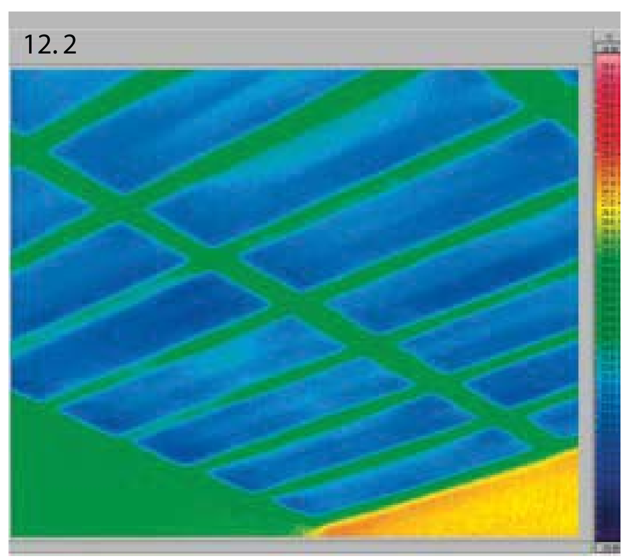
Pressure Test

The chilled ceiling system must be checked for leaks before commissioning, like any hydraulic system. The completely filled and bled chilled ceiling system, including capillary tubing, the plaster coils and the flexible hose connections must be subjected to a pressure test for at least 24 hours. The result must be recorded in a pressure certificate. The ceiling is then released for paneling. Local regulations and requirements must be followed.

Commissioning

Careful bleeding of the chilled ceiling system must be ensured, to guarantee faultless operation of the chilled ceiling. Proof of an unobstructed flow through all the pipes and chilled ceiling coils must also be provided. This is achieved by using modern thermal imaging systems, recording the image in all the zones tested. The commissioning certificate must include the recordings of the images. Figs. 12.1 and 12.2 show infrared photographs after successful commissioning of a zone.


12.1


12.2

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