REDEC CB Gypsum Radiant Ceiling System

BARCOL-AIR

Introduction

There is no visible difference between the REDEC CB Gypsum 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 REDEC CB gypsum is used in office blocks, government buildings, deparment stores, shops and in R & D laboratories. It is used wherever a high standard of finish is required, demanding a combination of aesthetics and technical skill. It is particularly outstanding when used in quiet rooms, as thermal expansion of the coils does not create any noise.

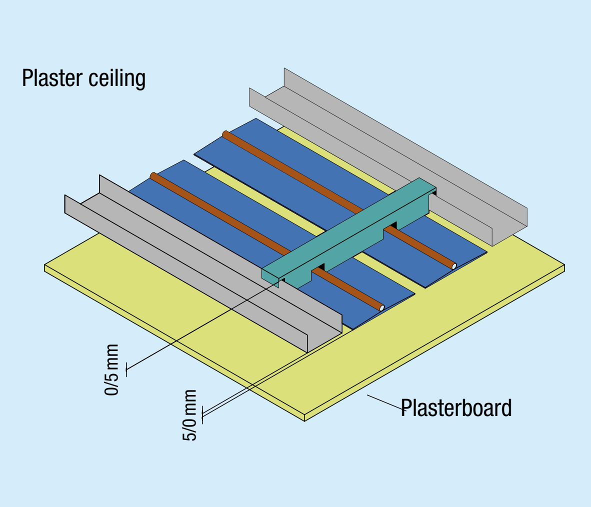
Piping in the ceiling cavity

Installation of the coil is particularly advantageous, as it is installed absolutely independently of the panelling. In order to maintain this advantage in relation to the hydraulic connection too, the Barcol-Air AG coils are connected to the cold water supply by flexible hoses. The connection can also be made by soldered copper pipes, if desired. Barcol-Air AG has carried out a long series of experiments to create a permanently-sealed, maintenance-free connection between the coil and the hose connector, ultimately 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 prov ding a reliable connection, even in inaccessible ceiling cavities.

Advantages

- Implementation of archictectonic aims; i.e. potential for individual variations and a seamless ceiling finish
- Energy-efficient cooling
- draught-free cooling
- also utilisable as a heated ceiling
- low investment outlay
- minimal maintenance outlay
- Highest Possible Human Comfort^{SM}
- 100% reproducible output
- low water resistance
- Installation without a permanen- connection between the heat conductors and panels or substructure, preventing and cracks in the filled seams between the panels. In addition, no noise occurs in the ceiling, as there are no permanent (hydraulic) connec tions.
- calibrated copper pipes (d = 10 mm and d = 12 mm) are possible
- efficient installation
- Cooling effect with a high proportion of radiation
- Draught-free in accordance with DIN, ISO, SIA and EN standards

2.1



2.2

REDEC CB Gypsum

Ceiling finish

Selection of the panels depends on the cooling capacity to be achieved and the archictectonic aspect. The panels may be in the form of fibre-reinforced plasterboard, plasterboard, thermoboard or metal honeycomb panels. Perforated surfaces in many patterns are also possible.
Panel length may be up to about 2500 mm and the width up to about 1250 mm, depending upon the type of surface and the manufacturer selected.
As there are no restrictions whatsoever on the 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 that a reduction in cooling capacity must be expected.
It is not necessary to activate the entire surface of the ceiling in most cases, making a simple combination of thermally active and inert ceiling surfaces possible. 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 the ceiling surface
The division of the ceiling into an active cooling surface and an inert surface takes place as a function of the cooling capacity to be provided. The surfaces must be divided so that the planning requirements for installations such as lighting or loud-speakers 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 inspection panels may be used for access to the ceiling cavity. They are available in various sizes. Their finish is identical to that of the ceiling.


4.1


4.2


4.3

Installation

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5.2

5.3

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 panelling.
The Barcol-Air AG 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 aluminium 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 aluminium.
A high-quality connection is made between the aluminium 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 optimised pre-stressing of the C-section flanks facilitate constant contact between the two materials and thus practically loss-free heating capacity.

At this point the surface is formed by seamless panels (plasterboard, plaster thermoboard 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 panelling 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 CB Gypsum chilled ceiling is between 80 and 100 mm, from the lower surface of the finished ceiling to the upper surface of the substructure or cooling coil.

Recommendations for installation
The REDEC plaster chilled ceiling is designed so that the alternative installations known from conventional dry mortrless construction and detail solutions, such as the installation of lighting, sensors, wall connections, aprons, the installation of loudspeaker and multimedia projectors, ventilation outlets, sprinkler systems, stepped ceilings, etc, can all be fully integrated into the surface.

See figs. 5.4 and 5.5 for examples.

5.4

5.5

Determining the surface-specific cooling capacity

Standard cooling

Fig. 6.1 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:

- 2.70m ceiling height
- 70% active cooling surface
- without ventilation in the ceiling area
- symmetrical arrangement of the sources of heat in the room
- No allowance for mass storage potential
- 10 mm thermoboard or 12.5 mm standard board
- Mineral wool acoustic lining
- Substructure spacing of 420 mm is used for unperforated panels and 320 mm for perforated panels.

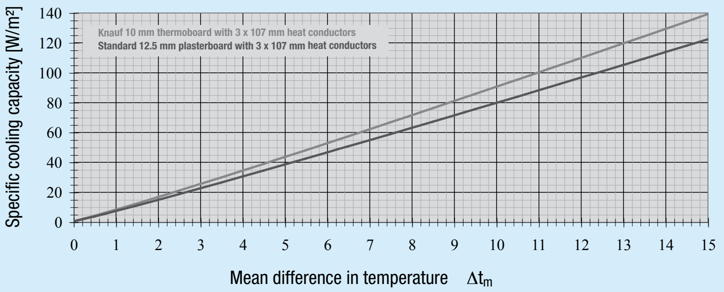
$\Delta t_m = t_R - (t_{VL} + t_{RL})/2$

Δt_m = mean temperature diff. in K
t_R = Room temperature in °C
t_{VL} = Flow temperature in °C
t_{RL} = Return temperature in °C

If there are differences of less than 6K between the room and cooling water return temperatures, the logarithmically-determined difference between the room and the return temperature should be used instead of the arithmetically determined temperature.

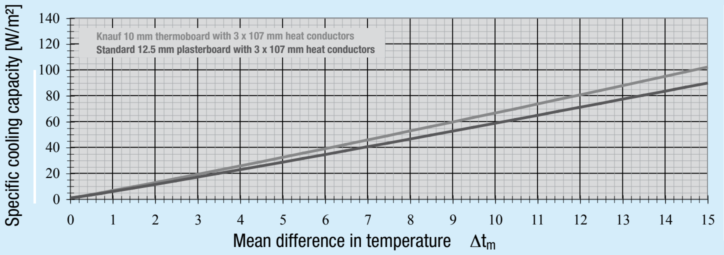
6.1

Specific cooling capacity per square metre of active heat conductor surface area

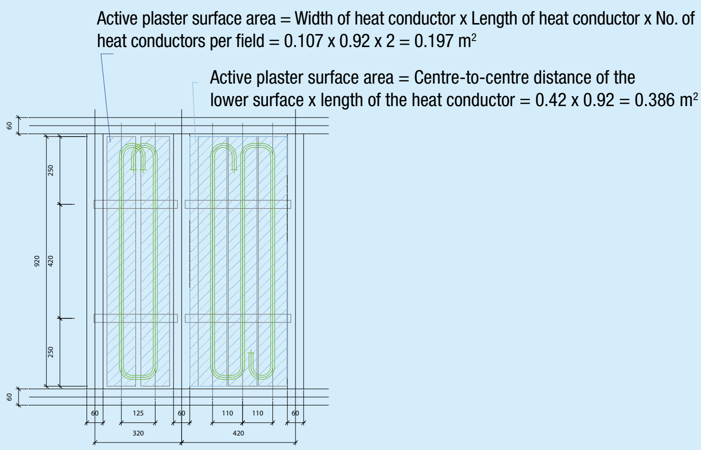


6.2

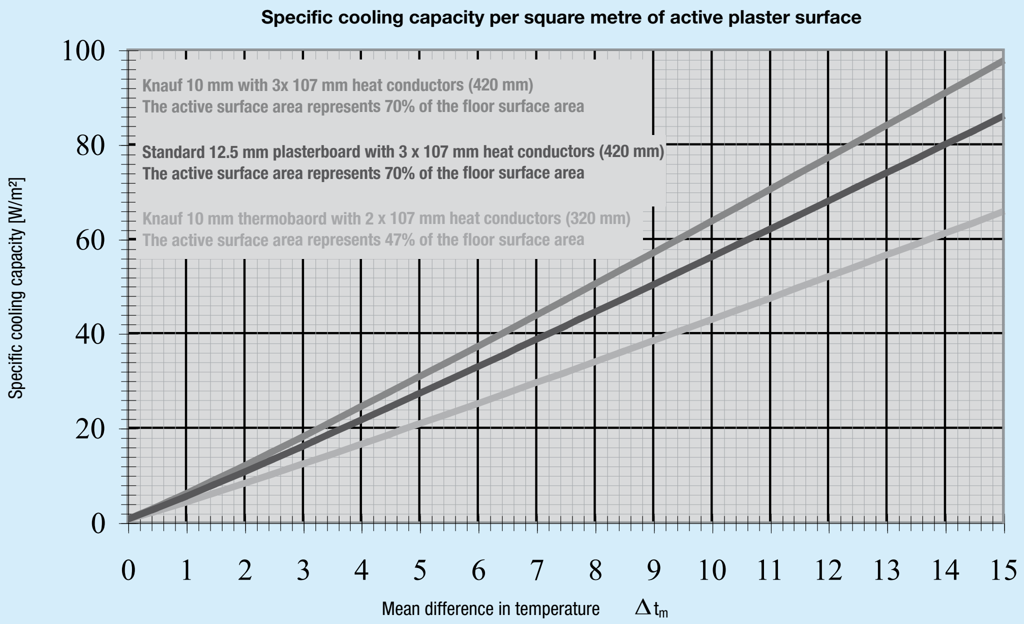
Specific cooling capacity per square metre of active heat conductor surface area



6.3



7.1



Correction variables for additional cases of use

The combination of a chilled ceiling with a ventilation inlet in the ceiling area will produce an increase in the surface-specific cooling capacity due to the superimposed forced flow. The precise percentage depends upon the ventilation component and the corresponding exhaust flow.

The following formula makes allowance for the ceiling height:

$q = q_n * f_H$

q = surface-specific cooling capacity at ceiling height H
q_N = surface-specific normal cooling capacity in accordance with graph 7.1
f_H = height correction factor

Ceiling height				
in metres	2,40	2,70	3,00	3,30
Factor f_H	1,046	1,000	0,954	0,913

Other capacity-enhancing factors are:
- open edge areas
- higher bare ceiling temperature, e.g. due to transmission
- powerful lighting
- high façade temperatures

Cooling capacity under conditions specific to the property will be determined on request.

Determining pressure loss from a Ø 12 mm Cu pipe

The excellent transfer of heat from the REDEC chilled ceiling from the ceiling cooling surface to the cooling water is based on a high internal coefficient of heat transmission (internal) for turbulent currents.

Graph 8.1 shows the individual pressure loss of a heat conductor with a Ø 12 mm copper pipe as a function of the volume of water in the circuit and the length of the circuit.
This figure must be multiplied by the number of heat conductors co nected in series and added to the pressure loss of the connecting hoses to determine the total pressure loss.

$\Delta p_{ges} = (\Delta p_1 * n_p * n_{WLS}) + \sum \Delta p_{Sch}$

Δp_{ges} = Total pressure loss of the water circuit

Δp_1 = Individual resistance of a heat conductor in accordance with graph 8.1

n_p = Number of panels connected in series

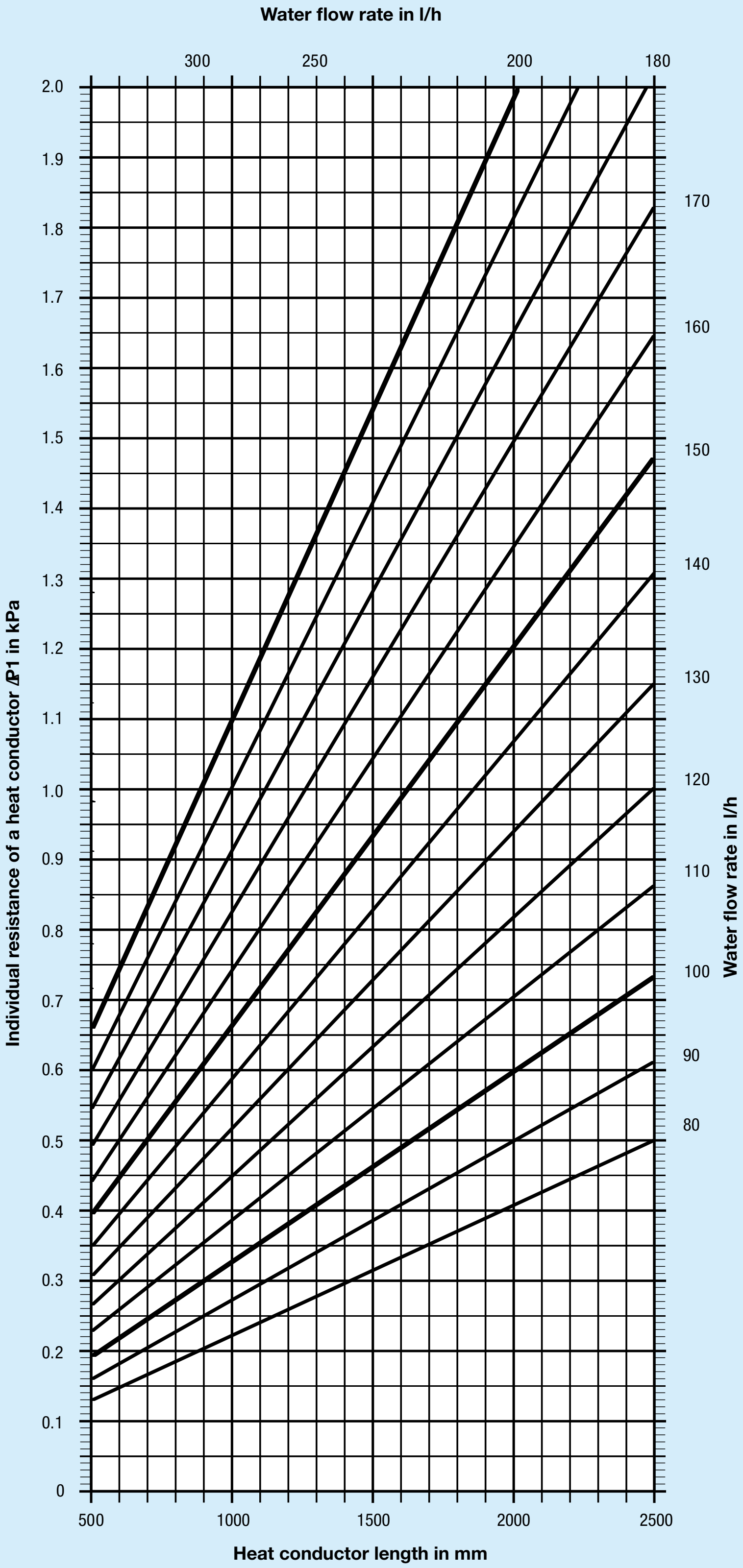
n_{WLS} = Number of heat conductors per panel

$\sum \Delta p_{Sch}$ = Pressure loss from hoses in accordance with the section on hydraulics

Minimum water flow

In order to produce a turbulent current, the number of active cooling elements connected in series should be set so that the flow rate of the water in a circuit is not less than 80 litres per hour at maximum cooling capacity. If this is not possible under exceptional circumstances, the chilled ceiling capacity must be corrected by applying a reduction factor.

8.1



REDEC

Hydraulics

When planning the cold water distribution network, care must be taken that water circulates through the cooling panels from the window wall into the room. It is usually possible to connect the active ceiling panels for a line of windows in series, due to the large cross-sectional surface area of the water-carrying pipes in the chilled ceiling.

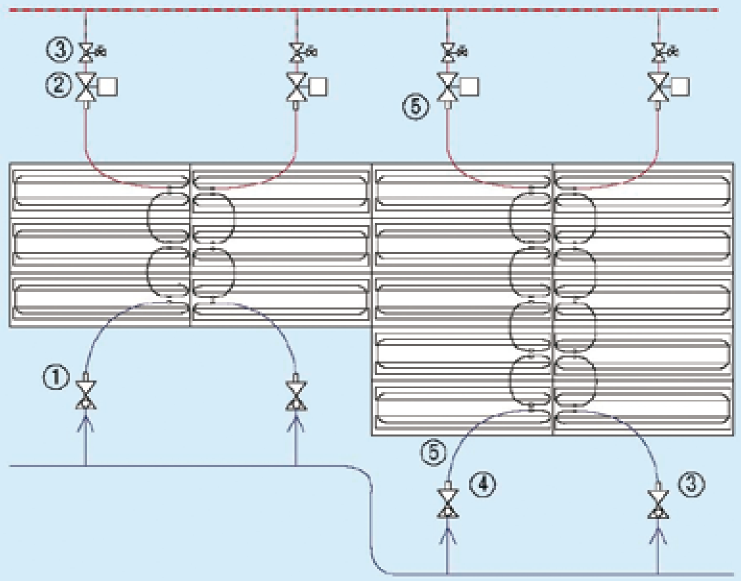
Connections to the cold water supply are made in accordance with the division of the room or zone. In large rooms or zones, care must be taken to connect the cooling panels to the same number of active ceiling panels (even water distribution). If this is not possible, the individual circuits must be matched by using suitable chokes (see Fig. 9.3).

It is fundamentally recommended that stop cocks 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 because the main water network can be flushed and checked for leaks when the stop cocks are closed and secondly because subsequent modifications or additions can be made to the cooling zone without switching off and draining the entire system.

9.1

9.2

9.3 Outline diagram



1 Branch regulator valve
2 Control valve
3 Stop cock with/without bleeding/draining
4 Screw-in nipple
5 Flexible connecting hose with bayonet fitting
6 Flexible connecting hose with bayonet fitting

Acoustics

In working premises, 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 plaster-board lined with fleece ex works.

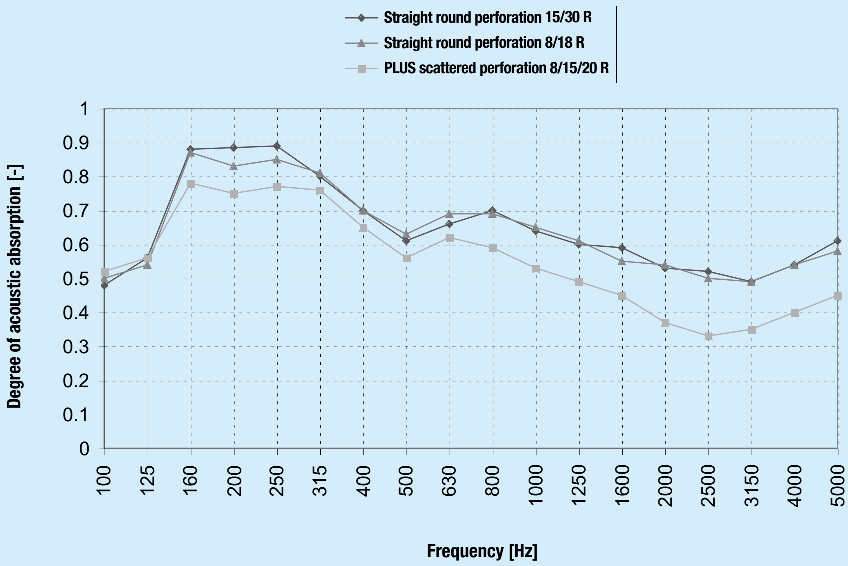
The graph below shows the degree of acoustic absorption in a standard ceiling board as a function of frequency.

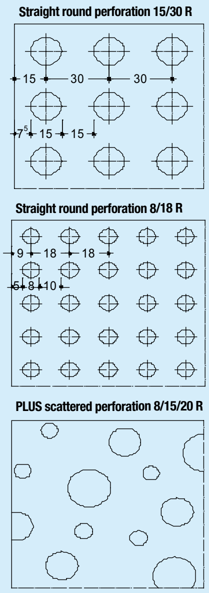
- standard plasterboard, 12 mm thick
- perforation patterns 15/30 R, 8/18 R, 8/15/20 R
- with acoustic fleece, without rock wool

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)

10.1





Commissioning

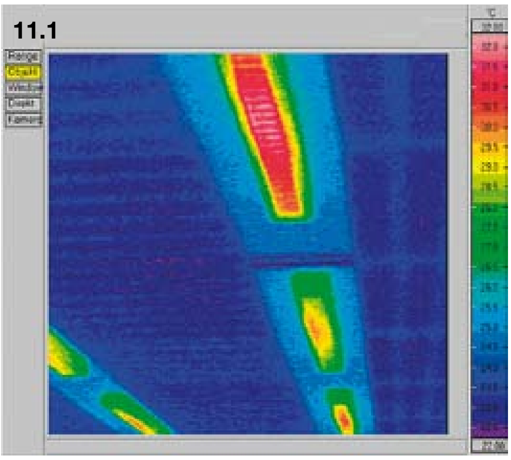
Pressure test

The chilled ceiling system must be checked for leaks before commissioning, like any domestic hydraulic network. 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 panelling. Local regulations and requirements must be observed.

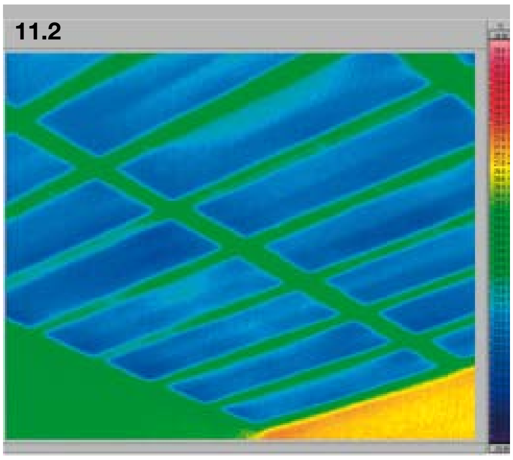
Commissioning

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. 11.1 and 11.2 show infrared photographs after successful commissioning of a zone. e.

11.1



11.2



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