

Carboline Radiant Heating and Cooling Ceiling Panels

Catalog





Zehnder decorative radiators



Heating and cooling ceiling systems

zehnder
always the
best climate



Comfortable indoor ventilation



Clean air solutions

Always the best climate for

IMPROVED QUALITY OF LIFE

With Zehnder, you will find the perfect climate for any space.

www.zehnder-systems.com

Heating and cooling with Zehnder Carboline

Optimal indoor climate and efficient use of energy throughout the year. New regulations now dictate how energy efficient a building should be, as a saving in energy also reduces CO₂ emissions. While this helps create an ideal indoor climate in the winter months, it subsequently creates a new problem in the transitional seasons and in summer:

- The fabric of these buildings is well insulated, therefore, the rooms within easily over-heat.
- The high external temperatures are boosted by the interior heat load: computers, copiers, printers and other technical equipment cause increased indoor temperatures, as do the people occupying the space.

Because the excess heat can no longer be dissipated, the cooling load rises, especially in buildings with high-grade insulation.

As part of the requirement for an ideal indoor climate, cool rooms in the summer will become equally important in the future. Zehnder Carboline is an elegant and innovative response to the requirements placed on modern indoor climate control – in summer and in winter. This is because Zehnder Carboline allows rooms to be heated and cooled. The main areas of application are:

- Offices
- Schools
- Hospitals
- Meeting rooms
- Operating rooms

Zehnder Carboline guarantees even heat distribution within a room and extremely high energy efficiency.

General information	2	Cost benefits	12
Product benefits	4	Suspension & installation	14
Features	5	Technical data	17
Structure	8	Dimensions	18
Heat distribution	10	Panel specifications	20
Energy savings	11	Warranty	23

Principles and operation

How do modern ceiling-mounted heating and cooling systems work? To explain this, we first need to compare the various forms of heat transmission:

Thermal conduction

The heat is transmitted within a body through vibration. The particles are at rest with each other.

Example: touching a hot object.

Convection

The heat is transmitted from a liquid or gas to a solid body, or vice versa. The particles are in motion with each other.

Example: the hot air rising from a radiator.

Radiation

Each body radiates heat, depending on the nature of its surface and temperature. The heat is transmitted from one body to another by means of electromagnetic waves (light).

Example: Sensing the heat radiated by the sun on a snow-covered mountain.

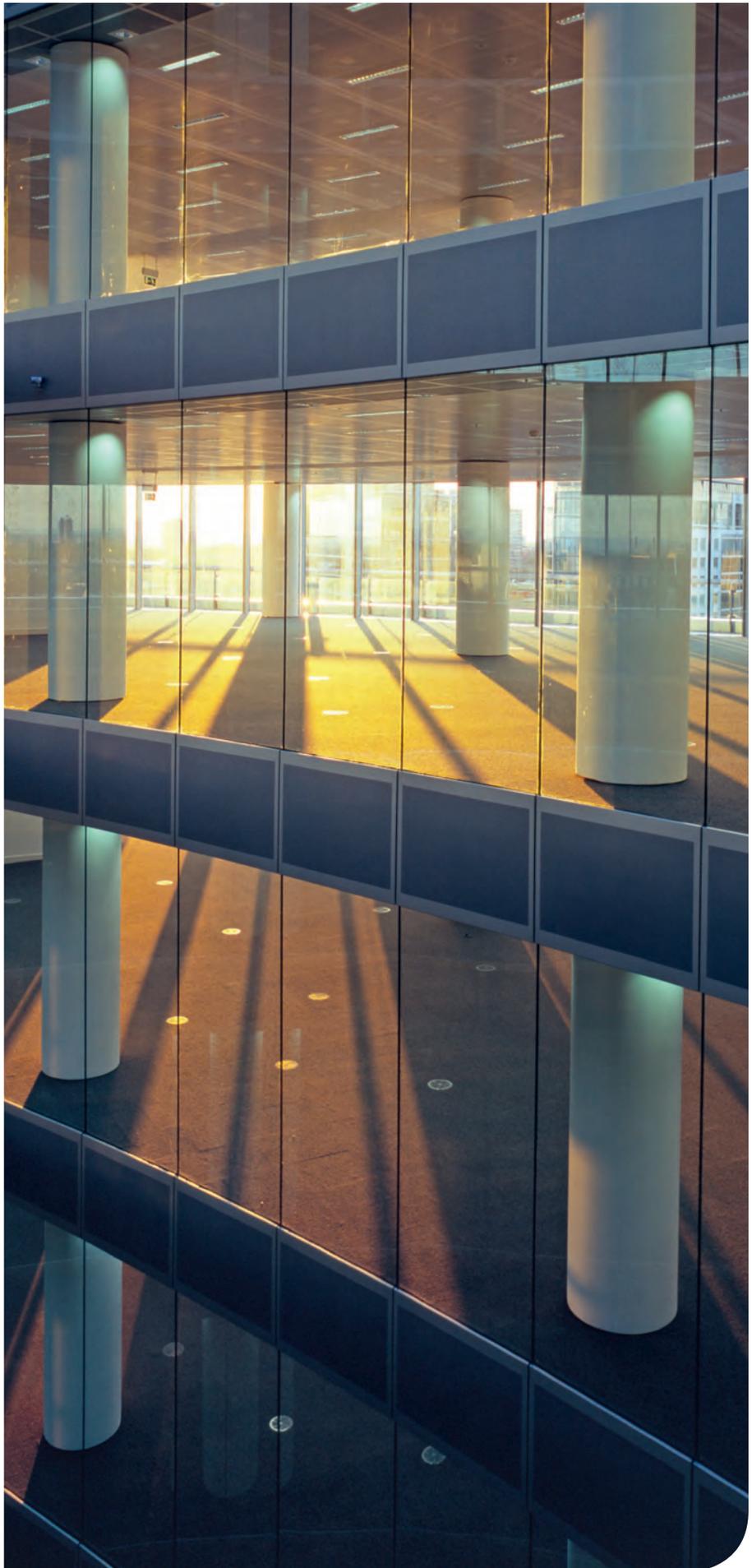
Logistics

Delivery and unloading

Zehnder Rittling arranges the desired delivery date with the customer with ample time, so the customer can ensure that personnel and suitable unloading equipment are available. A forklift truck is the best means of unloading.

Protection during transport

An adhesive film protects each individual element on the visible side. Protected by this film, all modules are placed vertically next to each other on a wooden pallet.



Heating effect of our system

Radiant ceiling panels give off most of their heat through radiation. The remaining heat is transmitted via convection.

The radiation of heat is achieved by passing heated water through pipes. The entire system transfers this heat to the room.

The benefit of our system lies in the direct heating effect it has on the body, without the need to heat another medium (air).

How do people sense heat? The ability to sense heat is determined by exchanging the heat generated in the body with the environment. In cool rooms, too much heat is drawn from the body and the temperature of the room is perceived as being too low. This can be offset by raising the air temperature and through heat radiation.

In the case of radiant heating systems, the room is heated through a raised surface temperature with a simultaneously low air temperature. This allows valuable energy to be saved!



Cooling effect of our system

The cooling effect is based on the same physical principles as the heating effect. Only now, the heat is not radiated, but absorbed.

As the cold radiant ceiling panel exchanges radiation with the warmer surfaces, the warmer surfaces give off part of their heat to the panel. About 60% of this radiant heat is absorbed. The remaining 40% arises through convection as the warm indoor air rises due to the difference in density and flows along the ceiling, where it transmits its heat to the radiant ceiling panel. The cooled air flows – again based on the difference in density – back into the room.

In this case, the air temperature is perceived as being lower than it actually is. And yet again, it is also possible to save precious energy compared to pure air cooling systems.



Product benefits

Zehnder Carboline is based on the combination of design, optimal climate, perfect technology and economic efficiency. Here are the main benefits at a glance:

Excellent technology and performance

- Very high heating and cooling output, tested to DIN EN 14037 and DIN EN 14240
- Extremely quick reaction time of the system to temperature changes in the room, due to the low storage mass and good thermal conductivity of the modules
- Low heating flow temperatures enable the use of alternative energy sources (solar cells, calorific value technology, heat pump)
- The low subnormal temperature enables the use of alternative energy sources (ground water)
- Simple, quick and affordable installation

Economic efficiency

- Cooling and heating with a single system: Zehnder Carboline
- High energy savings, thanks to the radiation principle
- Low investment and operating costs
- Long service life

Feel-good climate

- Pleasant indoor climate, thanks to high radiation component and low convection: no drafts or dust dispersal
- Even, comfortable heat distribution
- Silent operation
- Perforated design for acoustic absorption

Design

- Elegant design
- Variable room use
- Floor and walls can be used flexibly

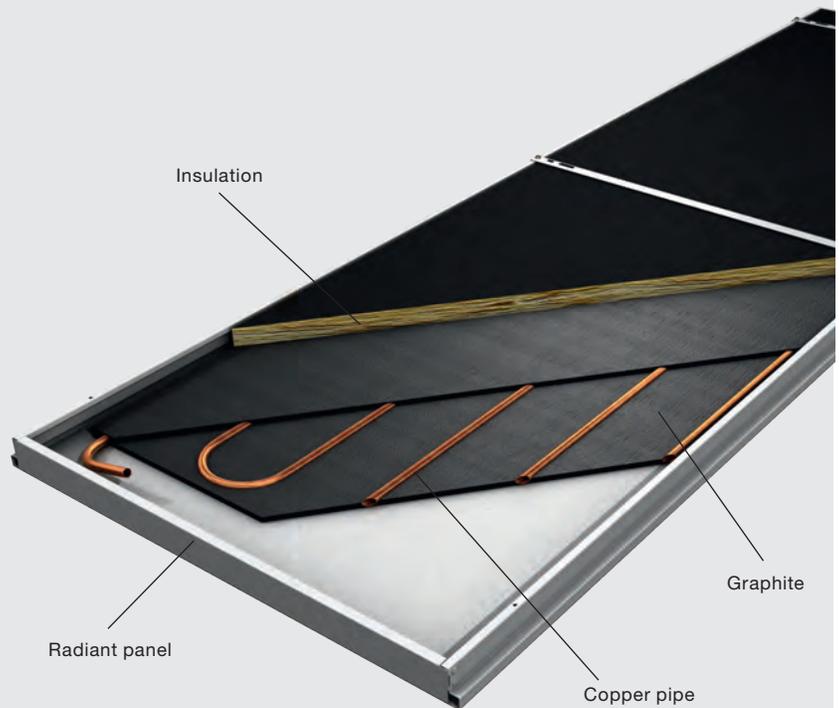
Standard unit features

Zehnder Carboline comprises of a copper pipe ($\varnothing 10$ mm) which is embedded in an expanded graphite sandwich. This high-performance thermal element is bonded to a sheet steel cassette. The radiant panel has an angled profile on the side and top to create a self-supporting panel.

- Brackets are added to the steel cassette to add hanging stability to the structure
- Steel panel has a powder coat finish
- Panel is connected to supply/return or other panels with flexible hoses. The hoses connect to the panel with a push-to-connect fitting.
- All panels are non-flammable and are safe for indoor use
- RAL 9010 matte

Operating Parameters

- Max. working temperature: 185 °F
- Max. working pressure: 10 bar

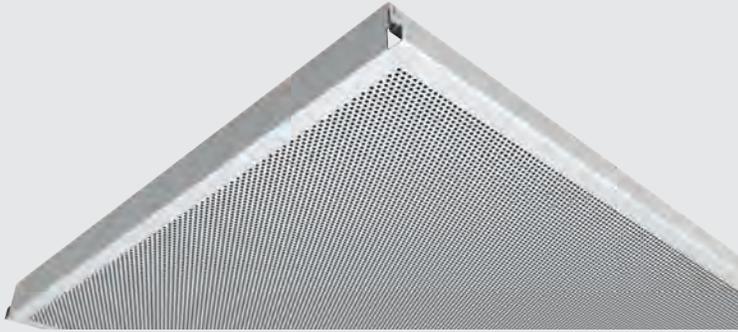


T-bar style shown

Optional features

Perforated surface

■ Zehnder Carboline is available with the option of either a smooth or perforated surface. Both types of surfaces are coated with a high-quality, powder-baked enamel finish. A perforated surface has the additional benefit of sound absorption. The reverberation within a room can be decreased on average of 44%. (Results based on perforated panel with insulation in a free hanging configuration, tested to DIN EN ISO 354. Results will vary based on room configuration.)



Ceiling cut-outs

■ Ceiling cut-outs are integrated into the panel elements of Zehnder Carboline as required. Cut-outs typically accommodate air outlets, projector brackets, loudspeakers, fire alarms, lighting and similar items. Cut-outs cannot interfere with the copper tubing. Precise locations are confirmed by the factory.



Insulation

- 1" Fiberglass
- 1/2" Rockfon
- 1" Rockfon

Color

- 6 additional colors to choose from



Note: The number of panels, size of panels, optional cut-outs and perforated surface can be indicated on panel selection.

Special features

What distinguishes Zehnder Carboline from other ceiling-mounted heating and cooling systems? Expanded natural graphite: its properties are ideal for the ceiling-mounted cooling and heating elements.

Combined with Zehnder Rittling's expertise in the development and manufacture of panel-based heating and cooling systems, the result is a high performance system that can be easily and practically integrated into existing and new grid and suspended ceilings.

This makes Zehnder Carboline perfectly suited to providing climate control in offices, schools, hospitals, meeting rooms and operating rooms – in short, everywhere a comfortable and healthy indoor climate plays a decisive role.

Expanded natural graphite

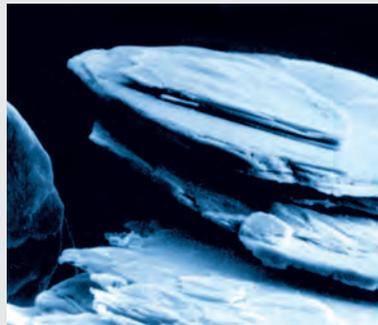
An innovative material with ideal properties

The material used for Zehnder Carboline is produced from scale shaped natural graphite with a defined crystalline structure. This is a naturally occurring material and an inorganic modification of carbon; the carbon atoms of the graphite are arranged in a hexagonal crystal lattice in flat, superimposed layers. The production process enlarges the volume of these parallel scales by

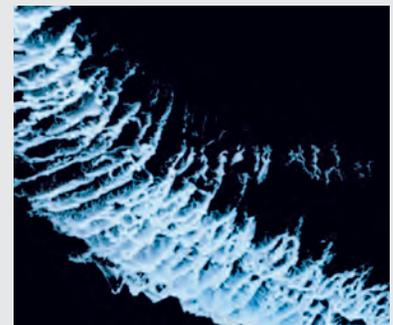
200 to 400 times. This expanded natural graphite is then processed further into lightweight panels.

Properties of expanded natural graphite

- Good thermal conductivity
- Low density
- Non-combustible
- Non-ageing
- Physically inert



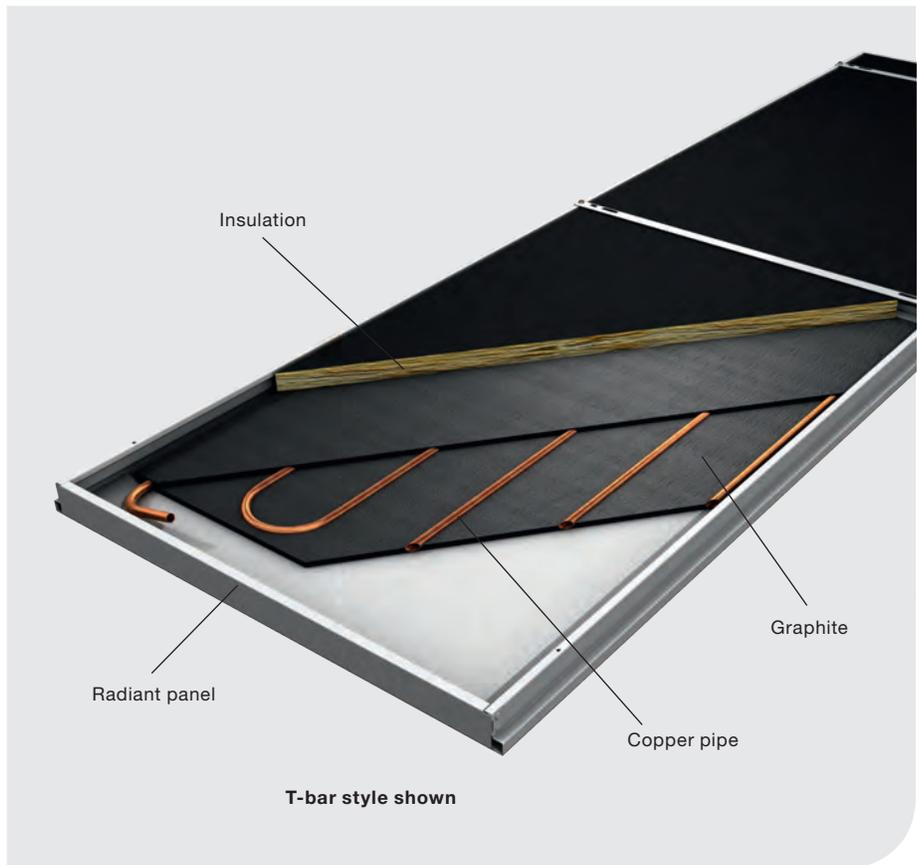
Natural graphite



Expanded natural graphite

Structure of the element

Zehnder Carboline comprises of a copper pipe which is embedded in a graphite layer. This thermal high performance element is placed inside a sheet steel cassette. The materials and their arrangement guarantee ideal heat transmission and high performance values. The radiant panel has an angled profile on the side and top. This increases the strength to create a self-bearing panel. The angled profiles are also intended for the mounting of fitting clips on the top of the panel. In addition, it is possible to use insulation, which keeps the heat in and absorbs noise (particularly effective in combination with a perforated radiant panel).



Versions

Zehnder Carboline ceiling-mounted heating and cooling systems have been specially developed for cooling and heating buildings.

Zehnder Carboline covers the entire range of grid ceilings for offices and meeting rooms, as well as schools, hospitals and operating rooms.

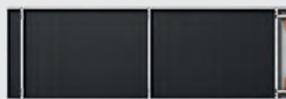
The elements come in five nominal standard sizes.



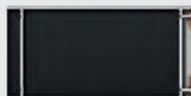
24" x 120"



24" x 96"



24" x 72"



24" x 48"



24" x 24"

Comfort criteria

More well-being, lower costs:

- Natural principle of radiant heat
- Even heat distribution throughout the room
- Heating and cooling effect is immediately noticeable
- Silent operation
- No circulation of dust – benefit for allergy sufferers

We spend almost three-quarters of our life indoors: at home, at work, during leisure time. The indoor climate (temperature and air quality) has a great influence on our general well-being and on our physical and mental performance.

Comfort is, above all, created by the type of heat transmission. For example, the radiant heat of a tiled stove is perceived as being pleasant and natural, because it warms the body directly. Modern ceiling mounted heating and cooling systems combine this principle with high energy efficiency.

Radiant panels arranged evenly across the ceiling create a comfortable indoor climate and help to save energy. The heat is distributed over the entire area of the room. Unlike conventional air heating systems, radiant panels are also totally clean. This is because they emit or absorb heat without producing drafts and, therefore, do not circulate any dust. An enormous benefit for allergy sufferers and everyone who works or lives in dusty rooms.

Optimal heat distribution and controllability

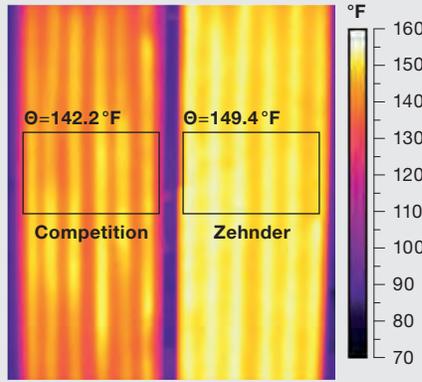
Zehnder Carboline sets new standards in terms of performance, temperature distribution and controllability.

The expanded natural graphite guarantees an extremely even distribution of temperature. Due to the high and even surface temperature, the radiant component of Zehnder Carboline is much higher than in comparable ceiling-mounted heating and cooling systems. This additional radiant heat provides extra comfort in the various rooms, while simultaneously reducing energy costs.

As well as the better heat distribution, the reaction time of Zehnder Carboline under alternating cooling or heating loads is unrivaled. The system reacts much quicker than conventional ceiling-mounted heating and cooling systems. Critical to this is the combination of good conductivity and low mass found in expanded natural graphite. Due to the rapid response, energy efficiency is much higher than in conventional systems.

The reaction test also shows that Zehnder Carboline reacts faster than the competing product during a change of temperature from heating to cooling. Both systems were subjected to the same temperature and same mass flow for the test series. It can be seen that the Zehnder Carboline cools much quicker and also shows better performance after 25 minutes.

Thermographic comparison

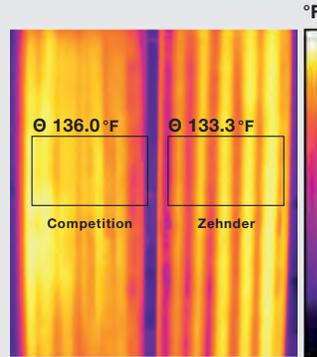
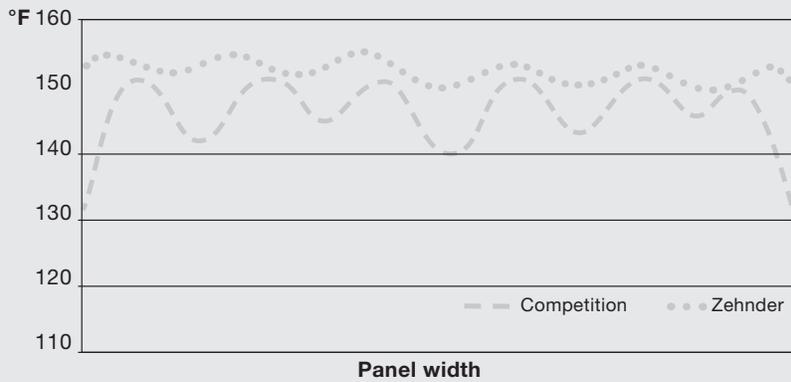


The thermographic imaging shows the comparison between Zehnder Carboline and a competing product, both exposed to the same temperature and mass flow.

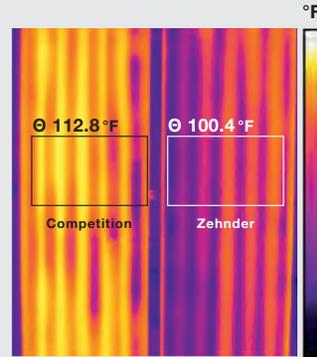
Θ = average surface temperature

See below for surface temperature across panel width.

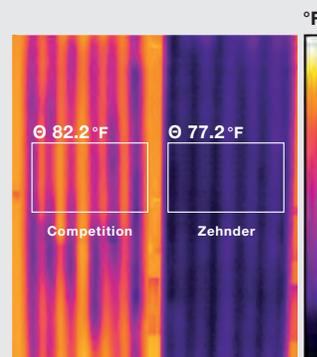
Temperature gradient over panel



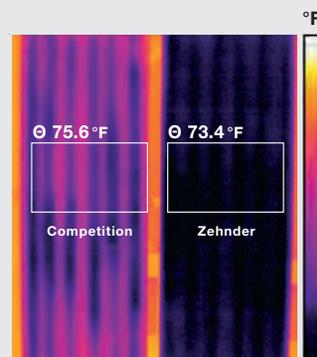
After 30 Seconds



After 1 Minute



After 5 Minutes



After 25 Minutes

Θ = average surface temperature

Energy-saving considerations

The temperature a person senses in a room is the arithmetic mean average of the indoor air temperature and the surface temperatures (e.g. walls, ceilings, floors).

Due to the radiation and the higher surface temperature of ceiling-mounted cooling and heating systems, the indoor air temperature during heating can be kept lower. The indoor air temperature can also be higher during cooling, and still be perceived as comfortable.

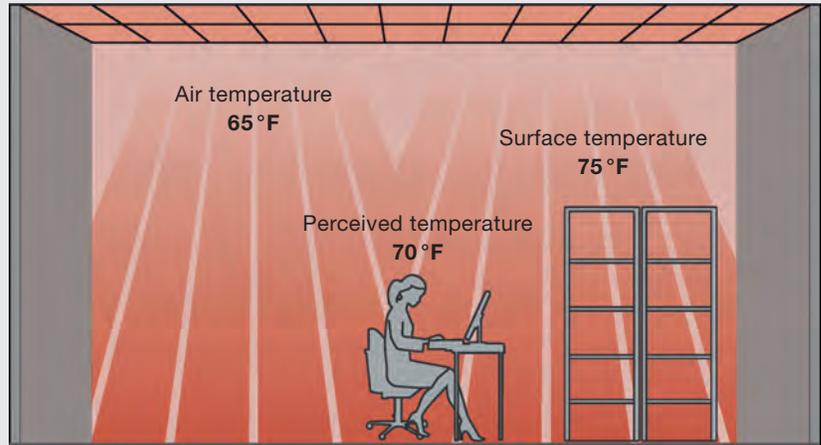
Energy costs are reduced, both when heating and when cooling, due to the lower or higher air temperature.

The special properties of Zehnder Carboline reinforce this saving effect even more. Both through the even and high surface temperature of the cooling and heating elements and through the extremely quick reaction time. This allows indoor temperatures to be controlled as required within a very short time, without unnecessary losses of energy.

In terms of energy consumption, the Zehnder Carboline has many advantages:

- Air temperature can be up to 5°F lower (when heating) or higher (when cooling)
- Very good controllability of the system

- High radiant component due to high surface temperature
- Short heating and cooling time of the system through low storage masses



Due to the higher surface temperature, a much lower air temperature is sufficient for a ceiling-mounted radiant heating system in order to give people a sense of comfortable warmth.



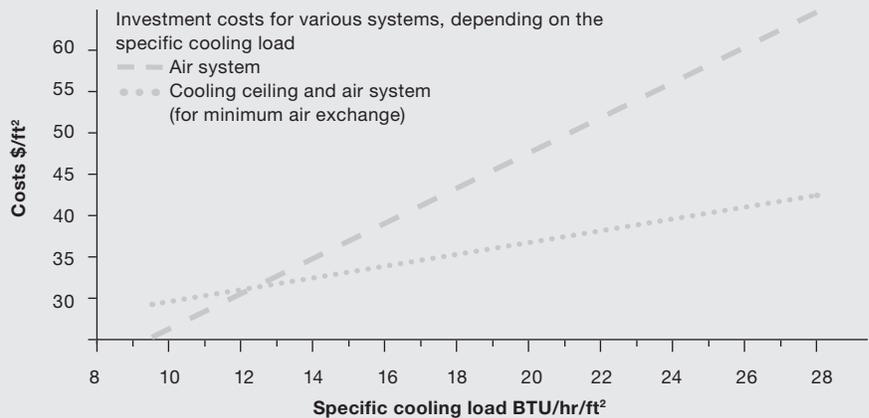
Cost-benefit consideration

A pleasant indoor climate, excellent comfort control and high energy efficiency are all good reasons for choosing Zehnder Carboline. However, when selecting a system for heating and cooling rooms, there is another important factor: the total cost. The first cost of a radiant ceiling system can be up to 30% less expensive when compared to a standard central air handling with VAV box system. In addition to these savings, 10-20% energy cost reduction can be possible, depending upon the region of the U.S. and the cost per kilowatt hour. These costs are the driving factors for the developer in the planning or building phase. Of course, with constantly rising energy prices, it will become increasingly important to be aware of ongoing energy costs.

It is worthwhile investing in an appropriate ceiling-mounted cooling and heating system, especially if the property is to be rented out at a later time. After all, low ancillary costs inherently make every building more attractive.

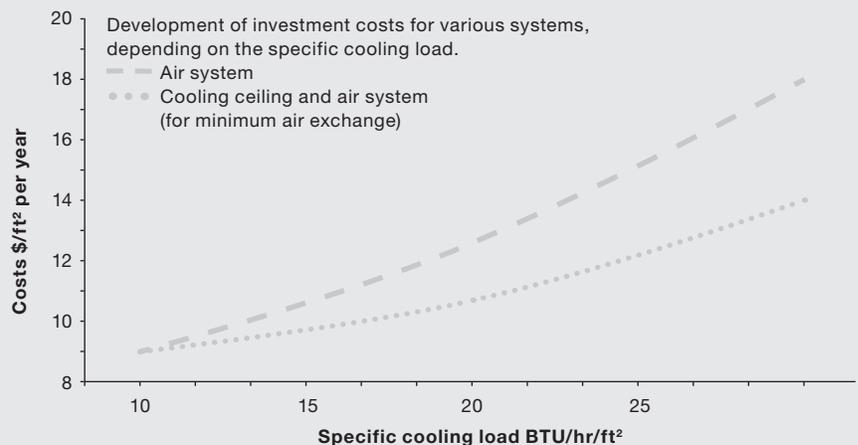
Investment costs

The level of investment for providing climate control within a building depends on several factors: For cooling, the type of distribution system, the cooling source, the comfort required and, finally, the architectural requirements. Zehnder Carboline is especially suited for large cooling loads and where a high value is placed on comfort and aesthetics. Since the panels can operate at relatively low heights, lower story heights can also be achieved without problem. As complex ventilation systems and ducts can also be dispensed with, there is no need for additional plant rooms and service shafts. This results in additional savings, which should be included in the calculation.



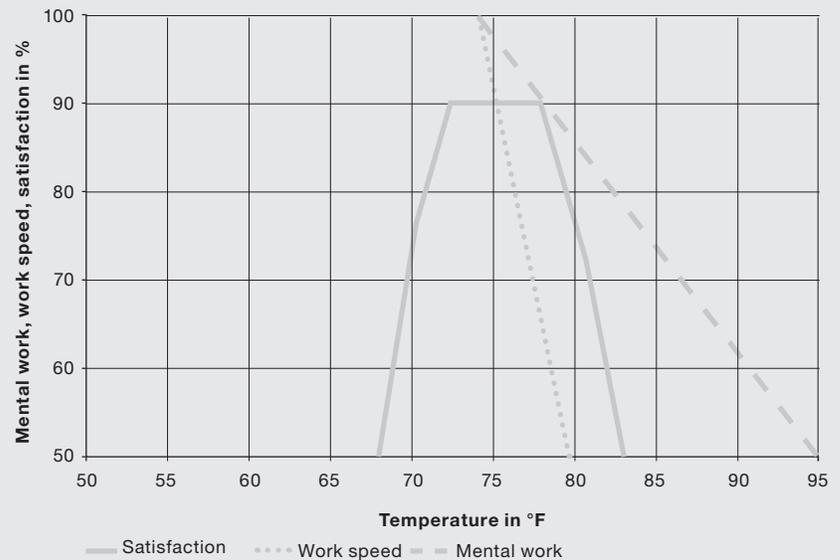
Energy costs

The energy costs of a building primarily depend on the type of energy system used, how the energy is produced and the heat that is given off or absorbed. All this, in turn, influences any additional costs, e.g. for maintenance and servicing or for the operation of fans. With Zehnder Carboline, these costs disappear completely. Further cost benefits are generated through lower temperatures being sufficient during heating and higher temperatures during cooling, in order to perceive the room temperature as comfortable. In the case of air systems, the initial costs for a low temperature level are very high, while a higher level can also be achieved through cheaper means, e.g. through free ventilation or using alternative sources of energy.



Performance depends on the indoor temperature

A room that gets too warm not only impacts on personal comfort, but also significantly reduces the speed at which people work and their mental capacity.



Combination with other systems

Mechanical ventilation may be needed in larger buildings to ensure the required minimum air exchange. Polluted air can be removed from the building via the outgoing air, while the incoming air can be prepared by an AC system, e.g. in terms of air humidity, in order to support an optimal indoor climate.

With Zehnder Carboline, this is easy and straightforward to do. The incoming air outlets can be integrated into the radiant panel– as tailor-made ventilation holes.

Important: When combining mechanical ventilation with Zehnder Carboline, it should be ensured that the actual number of air exchanges is not exceeded. Removal of the cooling load or coverage of the heating requirement should continue to be done by the radiant panel.

This is the only way to ensure the benefits of the system are optimally used and the disadvantages of air systems are eliminated.



Zehnder Carboline with integrated air outlet

Grid ceiling

Zehnder Carboline is specially tailored for use in new or existing grid ceilings. The length of the various panel elements is based on the grid size and can be up to five times the basic dimension. The use of longer panels reduces the cost of installation by up to 80% compared to standard systems available on the market, whose width is the same as their length. The special side construction makes it possible to insert the panels easily into the ceiling grid.



Suspension and attachment

Zehnder Carboline is installed as standard into a ceiling grid. It is also possible to attach the panels directly to the ceiling.



T-bar style with fixing clips

Installation styles

Zehnder Rittling offers two styles to choose from based upon the needs of the space.

■ T-bar

Nominal 24" width and a variety of lengths fit standard T-bar tracks used in commercial applications today.

■ Free hanging

Architecturally pleasing looks can be accomplished by installing ceiling panels in a free hanging arrangement. Additional convective capacity is also a result.



Free hanging style with Gripple



T-bar style with Gripple at panel ends

Panel connections

Fixing clips

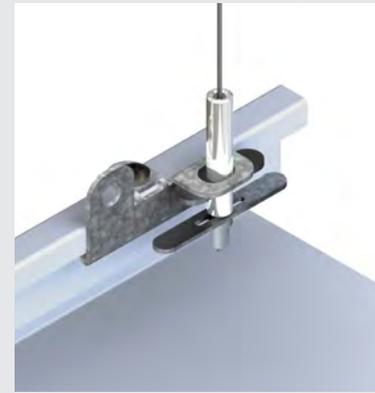
Designed to fix the panel to the ceiling. These simply clip into the lip on the side of the panel. The individual clips can be moved along the panel, providing flexibility to the conditions the building.

Gripple

Provides a faster, more flexible installation. Leveling the panel with the cable assembly is easy, which gives infinite range of adjustability.



Fixing clips panel connection



Gripple panel connection

Installation sets

A variety of standard installation sets are available for installing the cooling and heating elements to the ceiling. These installation sets allows the panels to be fixed directly to the concrete ceiling.



Ceiling installation with fixing clips



Ceiling installation with Gripple

Connection technology

Special connection hoses are used to connect several individual elements to each other; they can be pushed directly onto the pipes with no need for an additional tool or soldering. This reduces installation time dramatically.



Connection options

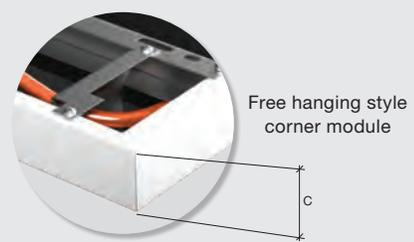
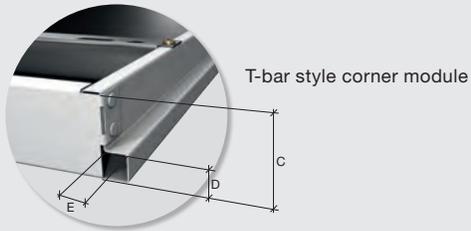
For Zehnder Carboline, both connection pipes are located on the same side. This enables easy installation and quick connection of the panels. Connections to panels require a 10mm push-to-connect fitting. Do not braze/solder tubes or use ProPress fittings.



Technical data

Description		Unit	24" x 24"	24" x 48"	24" x 72"	24" x 96"	24" x 120"
Dimensions							
Real lengths	T-bar style	Inch	23-5/8	47-5/8	71-5/8	95-5/8	119-5/8
	Free hanging style	Inch	23-5/8	47-1/4	70-7/8	94-1/2	118-1/8
Real width	T-bar style	Inch	23-5/8				
	Free hanging style	Inch	23-5/8				
Number of suspension points per module		Pcs.	4	4	4	4	6
Number of pipe rows		Pcs.	6				
Pipe separation		Inch	3-15/16				
Pipe material/dimension (external diameter)		-	Copper pipe, 3/8" nominal O.D.				
Panel Mmaterial		-	Steel				
Parameters							
Maximum operating temperature		°F	185				
Maximum operating pressure		PSI	145				
Weights							
Empty weight without water, with insulation		lbs.	10.5	18.9	28.0	36.3	45.4
Operating weight with water, with insulation		lbs.	11.0	19.9	29.4	38.3	47.9
Weight of insulation		lbs.	0.5	0.9	1.4	1.9	2.4
Weight of water content		lbs.	0.5	1.0	1.5	2.0	2.5

Dimensions



	Description	Style									
		T-bar					Free hanging				
A	Total width	23-5/8"					23-5/8"				
B	Total length	23-5/8"	47-5/8"	71-5/8"	95-5/8"	119-5/8"	23-5/8"	47-1/4"	70-7/8"	94-1/2"	118-1/8"
C	Total height	1-5/8"					1-5/8"				
D	Height of lip	9/16"					N/A				
E	Width of lip	3/8"					N/A				

Note: 4 pipe units are 2-1/8" high

Attachment sizes



	Description of distance	Size
		T-bar and free hanging style
a	Suspension point to suspension point	21-3/4"
Real module lengths: 23½" – 96½"		
b	End of panel to 1st suspension point	1/4 of panel length
c	Suspension point to suspension point	1/2 of panel length
d	Bottom panel to top suspension point	2-1/4"
Real module length: 118 • 119½" • 120"		
b	Suspension point to suspension point	1/6 of panel length
c	End of panel to 1st suspension point	1/3 of panel length
d	Suspension point to suspension point	2-1/4"

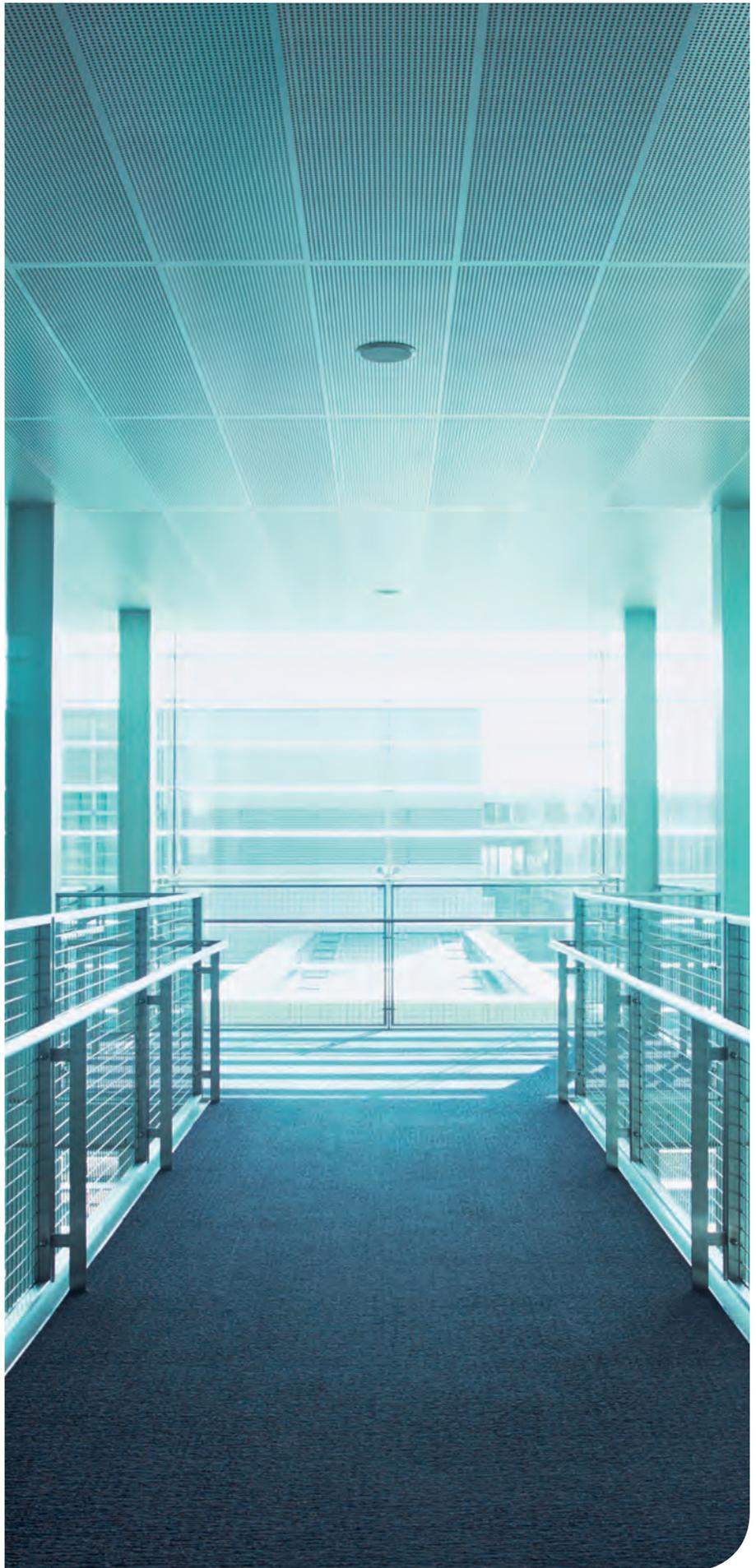
Zehnder Carboline

Ceiling-mounted cooling and heating panels for grid and suspended ceilings, for the cooling and heating of buildings. The cooling and heating element comprises a sheet steel cassette and a graphite element containing a copper pipe.

The copper pipes ($\varnothing 3/8"$, pipe centers 3-15/16") are fitted flush in a compressed graphite panel. This allows very quick and even thermal conductivity to be achieved across the entire area of the element. This high-performance element is firmly bonded to a galvanized sheet steel cassette. The deburred pipe ends are screwed to the cassette using location brackets in order to provide reinforcement and pressure relief. The visible side is coated with high-grade polyester fine-structure paint. The sheet steel cassette is available smooth or perforated (acoustically insulating). Fixing clips are applied at various points across the sheet steel cassette.

The maximum operating temperature is 185°F, the maximum operating pressure is 145 PSIG. The output of the cooling and heating element is tested to DIN EN 14037 and DIN EN 14240 respectively.

- With powder coating in RAL 9016 white
- With powder coating in RAL color as required
- Top-side insulation for thermal and acoustic insulation (optional)



Panel specifications

1. General

1.1 Related documents

- A. Drawings and general provisions of the contract, including general and supplementary conditions and division 1 specification sections, apply to this section.

1.2 Summary

- A. This section includes the following:
 - 1. Hydronic radiant heating and cooling ceiling panels.

1.3 Definitions

- A. Low voltage: as defined in NFPA 70 for circuits and equipment operating at less than 50V or for remote control, signaling and power limited circuits.

1.4 Submittals

- A. Product data: includes rated capacities, specialties and accessories for each product indicated.
- B. Shop drawings: Include plans, elevations, sections, details and attachments to other work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.
 - 1. Include schedule showing model designation, size, room location and accessories furnished.
 - 2. IOM
- C. Coordination drawings: reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Suspended ceiling components
 - 2. Method of attaching hanging systems to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures
 - b. Air outlets and inlets
 - c. Speakers
 - d. Sprinklers
 - e. Access panels
 - 5. Perimeter moldings
- D. Samples for initial selection: for units with factory applied color finishes.

1.5 Quality

- A. Product Options: Drawings indicating size, profiles, and dimensional requirements of radiant ceiling panels.
- B. Radiant ceiling panels shall be shipped with an adhesive film protective coating on each individual element on the visual side.
- C. Radiant ceiling manufacturer to supply 5 year warranty from date of shipment.
- D. Panels to be manufactured in a certified ISO9001:2015 facility.
- E. Radiant ceiling panels and accessories shall be rated and tested for pressures as shown on drawings and manufacturers technical documentation.

1.6 Coordination

- A. Coordinate layout and installation of radiant panels and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire suppression system and partition assemblies.

2. Products

2.1 Manufacturers

- A. Manufacturers: subject to compliance with requirements, provide products by one of the following:
 - 1. Zehnder Rittling
 - 2. Alternates: approved equals or alternates are acceptable if and only if a mock-up and witness test is performed to demonstrate that the substitution meets the design criteria.

2.2 Hydronic Radiant heating and cooling ceiling panels

- A. Material:
 - a. Radiant ceiling panels to include graphite activation, copper meander, steel cassette and supported steel cross channels.
 - b. Panel Surface: All panels to have <solid> perforation pattern consisting of 2mm (0.08") diameter holes providing 25% open area as standard. Perforated panels to be supplied with an acoustical absorbing fleece for sound attenuation. The microfiber fleece shall be non-flammable and meet the requirements of building material standards DIN 4102/B1 and BS 476/ASTM E84.

- c. Sound absorption data shall be available for all panel configurations and tested in accordance with DIN EN ISO 354.
- d. Factory cut outs shall be supplied for radiant panels for integration with lights, projector brackets, speakers, fire sprinklers, and other air outlet devices.
- e. Panel steel cassettes to be constructed of 24-gauge galvaneal sheet metal <stainless steel>. Cross channels to be constructed of 20-gauge galvanealed sheet metal to provide support for mounting system.
- f. Non active radiant panels shall be supplied where indicated on the drawings. Non active panel steel cassettes to be constructed of 24-gauge galvaneal sheet metal <stainless steel>.
- g. Radiant ceiling panel surface to be coated with highly emissive powder coat paint for optimal radiative properties. Color to be selected by architect.
- h. Carbon graphite activation to be comprised of copper pipe embedded in a expanded graphite layer. The graphite layer shall be bonded to the steel cassette using low VOC adhesive.
- i. Copper meander to be supplied with same end, opposite end or 2X meader connections based on drawings.
- j. Max working temperature/pressure to be 185F / 145psi.
- k. Radiant panels shall be 2-pipe <4-pipe>.
- l. Radiant ceiling panels to be supplied with the following edges:
 - a. T-Bar
 - b. Free Hanging, Sail or Cloud
 - c. Tegular
- m. Free hanging, cloud or sail panels shall be factory supplied with backclips to eliminate gaps.
- n. Factory installed fire resistant 1" Rockfon insulation <1" fiberglass> shall be provided with glass lined fiber fleece to provide acoustical absorption and shall have ASTM E85 / ASTM E1264 classification.
- o. Stainless steel flexible hoses to be supplied with panels for connections to surrounding panels and distribution system. Panel connection by means of brazing or press is not acceptable.
 - a. Corrugated flexible hoses shall have the following characteristics: standard length 30", maximum pressure 145 psi, maximum temperature 185° F, bend radius of 0.7 inches, water flow section comprised of stainless steel, and fire rating of UL-94 VO under card listing QMFZ2.E80017.
 - b. Braided flexible hoses shall have the following characteristics: standard length 30", maximum pressure 145 psi, maximum temperature 185 F, bend radius of 2.5 inches, water flow section comprised of ethylene thermoplastic rubber (EPTR), and fire rating of UL-94 VO under card listing QMFZ2.E80017.
- p. Factory supplied mounting and hanging hardware for radiant panels.
 - a. Standard G Kit
 - i. Kit shall consist of toggle end 5 foot No. 2 wire cable and express gripple connector.
 - b. Y-Configured Wire Rope
 - i. Kit shall consist of (2) toggle ends (Y) on 5 foot No. 2 wire cable and express gripple connector.
 - c. Standard G Kit with Fine Adjustment
 - i. Kit shall consist of toggle end on 5 foot No. 2 wire cable, express gripple connector, duct pin, toggle plate, panel mounting clip, and self-tapping screw.
 - d. Chain Kit
 - i. Kit shall consist of fixing clips for panel connection and chain.
 - e. Torsion Spring Hanging System
 - i. Specialized grid system with torsion spring hangers factory installed on radiant panels. Steel clips that locate and align the panels to the grid with torsion springs are to be factory machine riveted to the return edge of the panels using countersunk rivets and flush with the face of the panel. No fasteners of any kind shall be visible on exposed face surfaces of ceiling panels or support tees. No chains/ cables are required for panel installation.

- q. Radiant panel performance and output as measured in BTU/hr;
 - 1. Nominal panel size as scheduled
 - 2. Heating Performance:
 - 1. Radiant panel capacity shall be tested and certified by manufacturer in accordance with DIN 14037 or ASHRAE 138-2013.
 - 3. Cooling Performance:
 - 1. Radiant panel capacity shall be tested and certified by manufacturer in accordance with DIN 14240 or ASHRAE 138-2013.

- C. In addition to Division 23 Section “Hydronic Piping”, connect copper tubing to supply with shut-off valve, strainer, control valve, and union or flange, and to return with balancing valve and union or flange.

3. Execution

3.1 Pre-design services

- A. Bid shall include the costs to complete final selections and coordination with the Engineer at the Engineers office. Allow for a minimum of three (3) days.

3.2 Installation - General

- A. Install radiant panel level and plumb. Maintain sufficient clearance for normal services, maintenance, or in accordance with construction drawings.
- B. To ensure proper installation and handling of the radiant panels, a complete IOM shall be supplied and reviewed before installation has begun.
- C. Complete installation and startup checks according to manufacturer’s written instructions and perform the following:
 - 1. Verify that controls and control enclosure are accessible.
 - 2. Verify that control connections are complete to control valves as needed.
 - 3. Verify that any identification tags are visible.
 - 4. Verify that controls respond to inputs as specified.
 - 5. Removal of protective film coating before system startup.
 - 6. Release of stabilization profiles on panel edges.

3.3 Connections

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicated general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to radiant panels to allow for service and maintenance.

3.4 Field quality control

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak test: After installation, fill water tubes and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational test: After electrical circuitry has been energized, start units to conform to proper unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 Cleaning and protection

- A. Remove protective film coating before startup of the system.
- B. Clean all visible surfaces of equipment; touch up as required.
- C. Protect all units before, during and after installation. Damaged materials due to improper protection shall be cause for rejection.

Warranty

Zehnder Rittling guarantees its products to be free from defects in material and workmanship for a period of five years from date of shipment from our factory.

Should there be any defects in the good(s), the purchaser should promptly notify Zehnder Rittling. Upon receipt of written consent from Zehnder Rittling, the purchaser shall return the defective good(s) to the factory for inspection with freight prepaid. If inspection shows the goods to be defective, Zehnder Rittling will at its discretion repair or replace the said item(s). Defects arising from damage due to shipment, improper installation, negligence or misuse by others are not covered by this warranty.

This warranty is extended only to the original purchaser from Zehnder Rittling.

