25 Year Guarantee

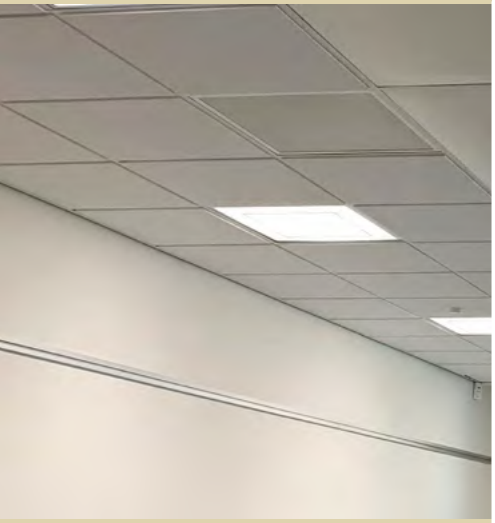
Subject to terms and conditions. Contact Frenger for more details.

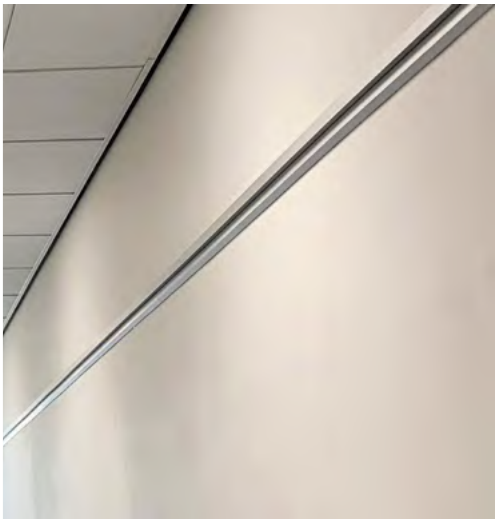
Independently tested to EN 14037-2016 at HLK Stuttgart

the future of space conditioning

Modula HP (High Performance)

radiant heating panel





Application
Commercial, hospitals, hotels, schools, shops, sports halls, offices, laboratories, food industry etc.

Installation
Ceiling integrated
Free hanging
Surface mounted
Flanged recessed

Capacity
588 W/m² @ 55 dtK.

Features
Smooth finish
Technology proven over 50 years
Low construction depth
High capacity
Cost effective
Simple to install

FRENGER® systems

www.frenger.co.uk
an FTF Group Company

Contents

Introduction

What is Radiant Heating

Radiant Heating is a form of heat transfer. Radiant Heating Panels emit most of their heat via longwave infrared radiation as opposed to convection or conduction. The longwave radiation that is emitted from the Radiant Heating Panels travels through the air (without directly heating the air) to its surroundings of a lower temperature (such as walls, floors, desks and occupants) thus raising the temperature of these surroundings. A secondary effect of the longwave radiation being emitted from the Radiant Heating Panels is that the air is heated by being in contact with the warmer surfaces.

Most radiant heating solutions achieve approximately 70% of the total heating via radiant exchange and 30% via convection. In general, you can have an air room temperature circa 2 deg C lower than the perceived room temperature as the occupants are also heated via the long wave infrared radiation.

How does a Radiant Heating system work

A Radiant Heating Systems emits heat similarly to that of the sunshine. If you were to stand outside on a hot summers day then you would feel warm and comfortable as the Radiant Heat from the sunshine is travelling through the air and warming your body temperature. However, if a cloud were to prevent the sunshine from reaching you then you would immediately feel colder, even though the air temperature hasn't changed, this is because the cloud is preventing the Radiant Heat from reaching your body.

This works the same way if you think about a Radiant Heating System in an office environment. The Radiant Heat that is being emitted from the Radiant Heating System travels through the air and heats up its surroundings of a lower temperature.

The surfaces of the radiant heating panel have the ability to omit radiation. The ability to omit radiation is measured as an epsilon value, whereby 1.0 is the highest possible and 0.001 the lowest. Typically, unpainted aluminium has an epsilon value of 0.2 and matt white powder coated metal 0.95 and matt black powder coated metal 0.97. The surface area and surface temperature are also critically important.

Radiant Equation:

Surface Area x Surface Temperature x 5.67 x epsilon value

Note: 5.67 is a constant value, known as the Stephan Boltzmann constant.

Radiant Heating is by omitting heat energy, whereby the highest temperature interacts with opposing surfaces of a lower temperature, giving its higher energy to the surface with the lower energy to try to become in equilibrium.

Is Radiant Heat expensive to run

As illustrated in 'How does a Radiant Heating system work?' demonstrates that Radiant Heat is fairly instantaneous and as such is an ideal solution for heating large open spaces such as Sports Halls and other environments where you want to heat the occupants quickly without having the heat all the air first. Because Radiant Heating systems don't have to heat up the air first, it means that it drastically reduces energy usage and therefore can save you money.

This principle also applies to Office Developments, Hospitals, Schools, Universities, and Airports, hence why Radiant Heating is a popular solution for heating large commercial buildings.

Modula HP

Heating Panel

Description

Modula is an unobtrusive modular radiant heating panel. The panels are manufactured from 1.0mm thick smooth-faced zinc coated mild steel which are then polyester powder-coat finished white (RAL 9010) as standard (other RAL colours available on request). These panels are designed to be integrated within a standard 24mm exposed grid ceiling system, freehanging (exposed) or surface mounted. Copper pipes are expanded under pressure into extruded aluminium pipe seats to give high metal-to-metal contact and the pipe seats are bonded to the rear of the steel panels. All serpentine copper coils are produced in-house by Frenger on it's full CNC state-of-the-art serpentine bend machine from thousand metre drums of copper to avoid any joints in the heating coil. This arrangement delivers excellent heat transfer characteristics. Panels are insulated with 25mm thick class 'O' foil encapsulated mineral wool insulation 45 kg/m³ density. The technology employed in the construction of the panel results in very high heating capacity at low water mass flow rates.

Modula has been specifically developed for use in schools and healthcare environments where a smooth faced simple-to-install panel with the highest comfortable heating capacity is the preferred solution.

Standard Features

- Modular system to fit into 600mm exposed grid ceiling.
- Joint free copper coils.
- Modular lengths; 0.6m, 1.2m, 1.8m, 2.4m, 3.0m.
- Panel depth 45mm.
- Smooth faced, unobtrusive design.
- 588 W/m² @ 55 dtK room (mwt - room temp).
- Standard polyester finish RAL 9010 (25% gloss).
- Outputs independently certified to EN14037

water connections: 15mm OD Copper, to EN12449 / EN127352

weight: less than 21 kg / m²

Connection Possibilities
water; vertical, same end for flow and return.
Alternative options available upon request.

Maintenance
The unit has no moving parts, and therefore maintenance requirement is limited to periodic cleaning of the surface of the panel with a soapy sponge and drying with a cotton towel.

Installation
Standard fixing arrangement from the structural soffit using rigid threaded rod (supplied by others), suspended via pre punched keyhole slots.

For simplicity and flexibility we recommend that flexible stainless steel braided EPDM hoses are used to connect the Modula panel.

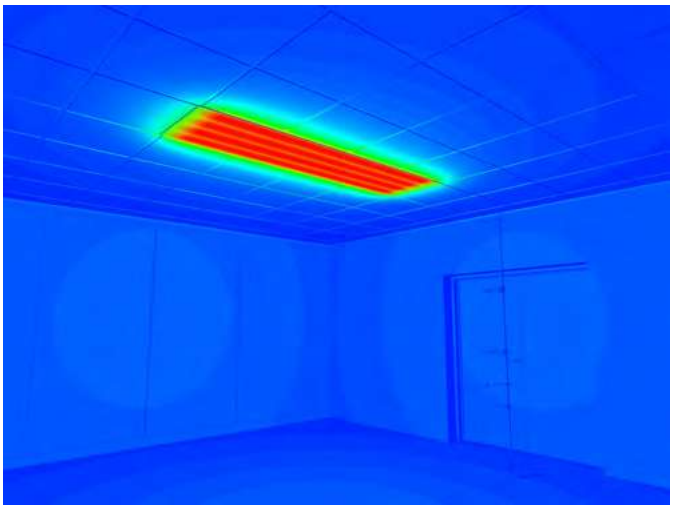
Function

With an output of 588 W/m² at 55 dtK. Modula is one of the most efficient smooth - faced radiant heating panels currently available.

The secret to Modula's outstanding performance rests in its unique method of expanding the water-carrying copper pipes within the heat radiating aluminium extrusions and bonding techniques. The aluminium extrusions are bonded to the zintec steel panel face using a heat transfer adhesive. Due to the high
metal-to-metal contact between the copper waterways and extrusions and the fact that the aluminium pipe seats are fully bonded to the panel face, the energy transport between the pipe and panel face is extremely efficient.

The manufacture of Modula is semi-automated in our purpose-built facility in Derby, UK. Panels can be produced to very high tolerances. Furthermore, the processes employed and the standardised design means that the cost of Modula remains highly competitive.

Modula is so simple to install that it is most often fitted by the ceiling installer.



Design

Dimensions: Modula HP is available in three widths, as standard - 0.3m, 0.6m and 0.9m. These nominal dimensions are reduced by 8mm on length and width so that panels can be integrated within a traditional suspended ceiling using exposed T-bars (24mm wide) on a 600 x 600mm grid module. The depth of the Modula panel is just 45mm.

Lengths: Modula is produced in nominal module lengths of 0.6m, 1.2m, 1.8m, 2.4m and 3.0m as standard; non-standard lengths are available upon request.

Water connection: Modula is available with two different connection configurations (C and D) please see page 7 for further details.

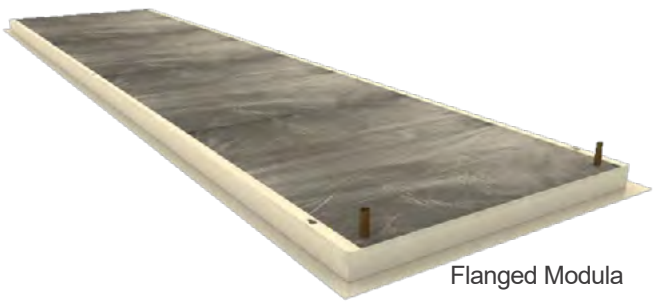
Surface finish: Modula is polyester coated as standard in RAL 9010, gloss value 25%, emissivity 0.94.

Insulation: Modula is supplied with integrated 25mm thick 45 kg/m³ class 'O' foil encapsulated mineral wool insulation within the panels returned flanges.

Ceiling Recessed Modula

Application

Modula is particularly suited for use in hospitals, schools, shops and offices; in fact wherever there is a need for a high-output radiant heating panel which is simple to install, easy to keep clean and comes at a very competitive price. Modula is the perfect solution for integration with an exposed grid ceiling system, but is equally suited to free hanging applications. The panel can also be adapted to suit surface mounted applications or recessed into a plasterboard ceiling (Flanged Modula available as optional extra).



Flanged Modula

We upgrade the Modula panels to have welded and linished corners and a neat seamless interconnection of panel sections for exposed (free hanging) panel run applications.

Installation

The Modula panels are designed to be fixed directly back to the structural soffit. Panels are supplied with pre-punched keyhole slots which are suitable for suspension using rigid threaded rod systems (by others). Four holes are required for each heating panel up to 1.8m long, each positioned no more than 200mm in from each end . Panels 2.4m long or over require 6 No. fixings.

It should be remembered that the ceiling system “main runners” must be designed to run either side of the Modula panel and parallel to its long sides. Ceiling system “cross noggin” bayonets must be capable of being bent back so as not to clash with the Modula panel.

For simplicity and flexibility we recommend that flexible stainless steel braided EPDM hoses are used to connect the Modula panel.

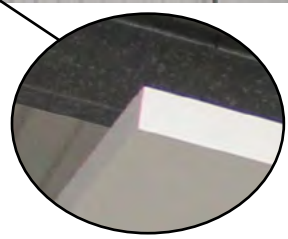
Installation Examples

Surface mounted

Recessed into plasterboard ceiling

Installation - Freehanging

Freehanging Modula - Using rigid rods



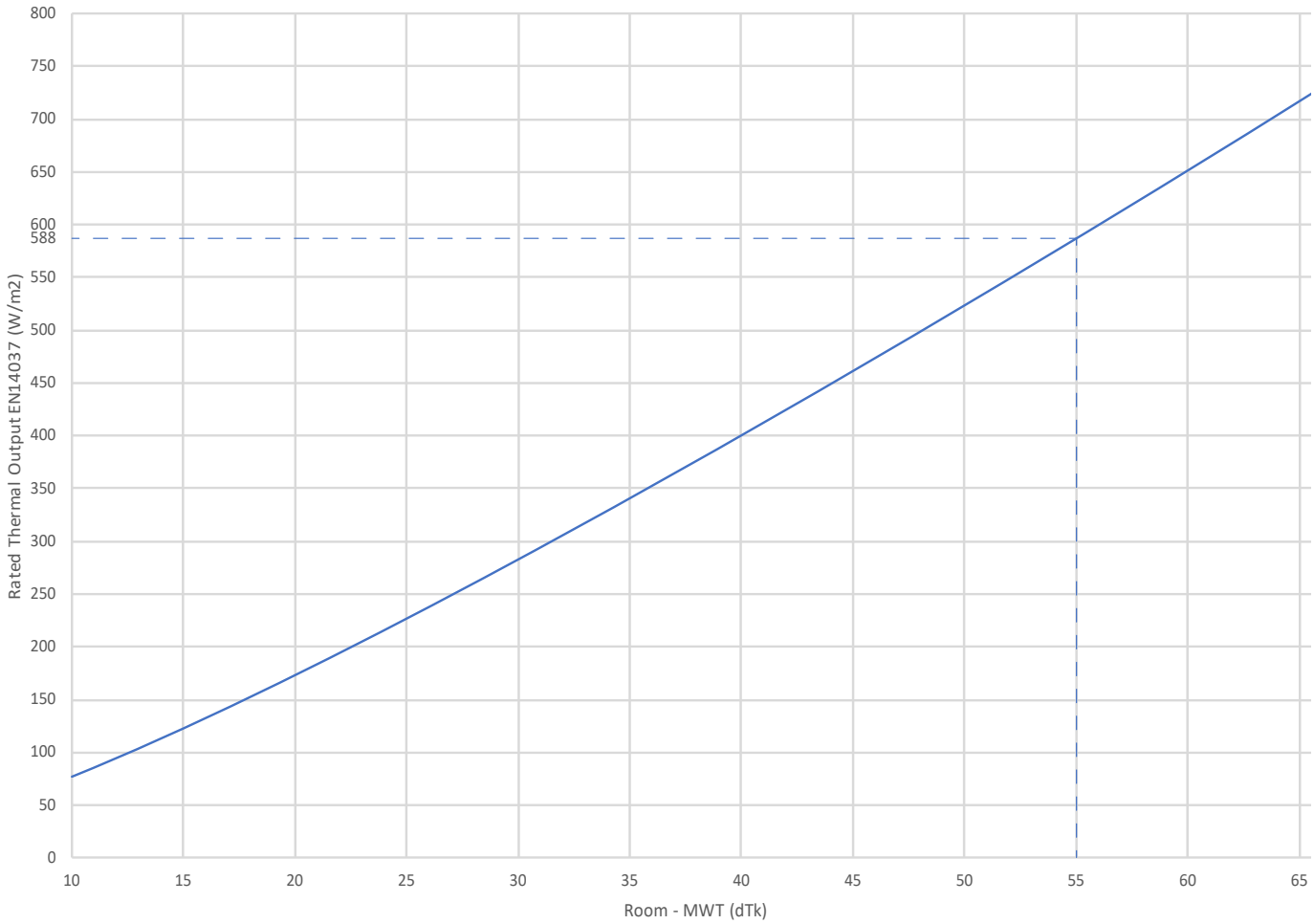
External corners are welded
linished and powdercoated

Freehanging Modula - With and without integrated lighting

Heating Effect

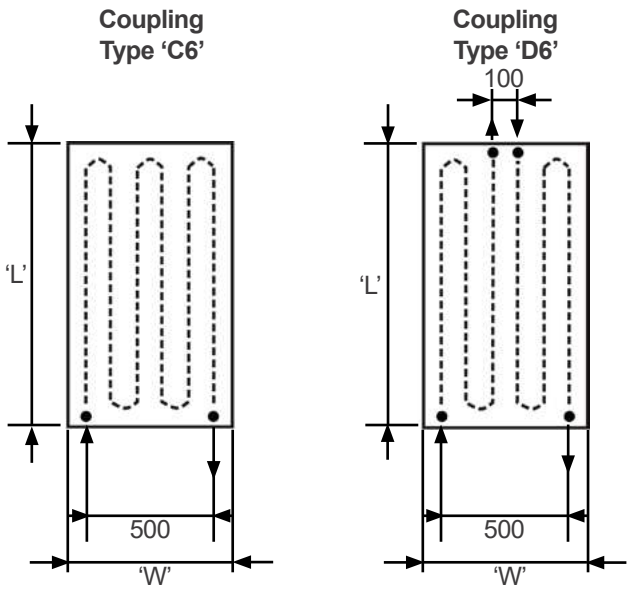
Panel Dimensions		ΔtK (Mean water Temperature less room temperature (°C))																	
		48		50		52		54		55		56		58		60		62	
Width (m)	Length (m)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)	Q̇(w)	ṁ (l/s)
0.6	0.6	180	0.012	189	0.012	198	0.012	207	0.012	212	0.012	216	0.012	226	0.012	235	0.012	244	0.012
	1.2	360	0.012	378	0.012	396	0.012	414	0.012	423	0.012	433	0.012	451	0.012	470	0.012	489	0.012
	1.8	540	0.012	567	0.012	594	0.013	621	0.014	635	0.014	649	0.014	677	0.015	705	0.015	733	0.016
	2.4	720	0.016	756	0.016	792	0.017	829	0.018	847	0.018	865	0.019	902	0.020	940	0.020	977	0.021
	3.0	900	0.020	945	0.021	990	0.022	1036	0.023	1059	0.023	1082	0.024	1128	0.025	1175	0.026	1222	0.027
0.9	0.6	270	0.012	283	0.012	297	0.012	311	0.012	318	0.012	325	0.012	338	0.012	352	0.012	366	0.012
	1.2	540	0.012	567	0.012	594	0.013	621	0.014	635	0.014	649	0.014	677	0.015	705	0.015	733	0.016
	1.8	810	0.018	850	0.019	891	0.019	932	0.020	953	0.021	974	0.021	1015	0.022	1057	0.023	1099	0.024
	2.4	1080	0.024	1134	0.025	1188	0.026	1243	0.027	1270	0.028	1298	0.028	1354	0.029	1410	0.031	1466	0.032
	3.0	1350	0.029	1417	0.031	1485	0.032	1554	0.034	1588	0.035	1623	0.035	1692	0.037	1762	0.038	1832	0.040

Above stated radiant flow rates based on 82°C Flow and 72°C return with a room temperature of 21.5°C.
For red values the flow rate has been adjusted to the recommended minimum flow of 0.012 kg/s.



Ceiling Recessed Coupling & Connection Arrangements

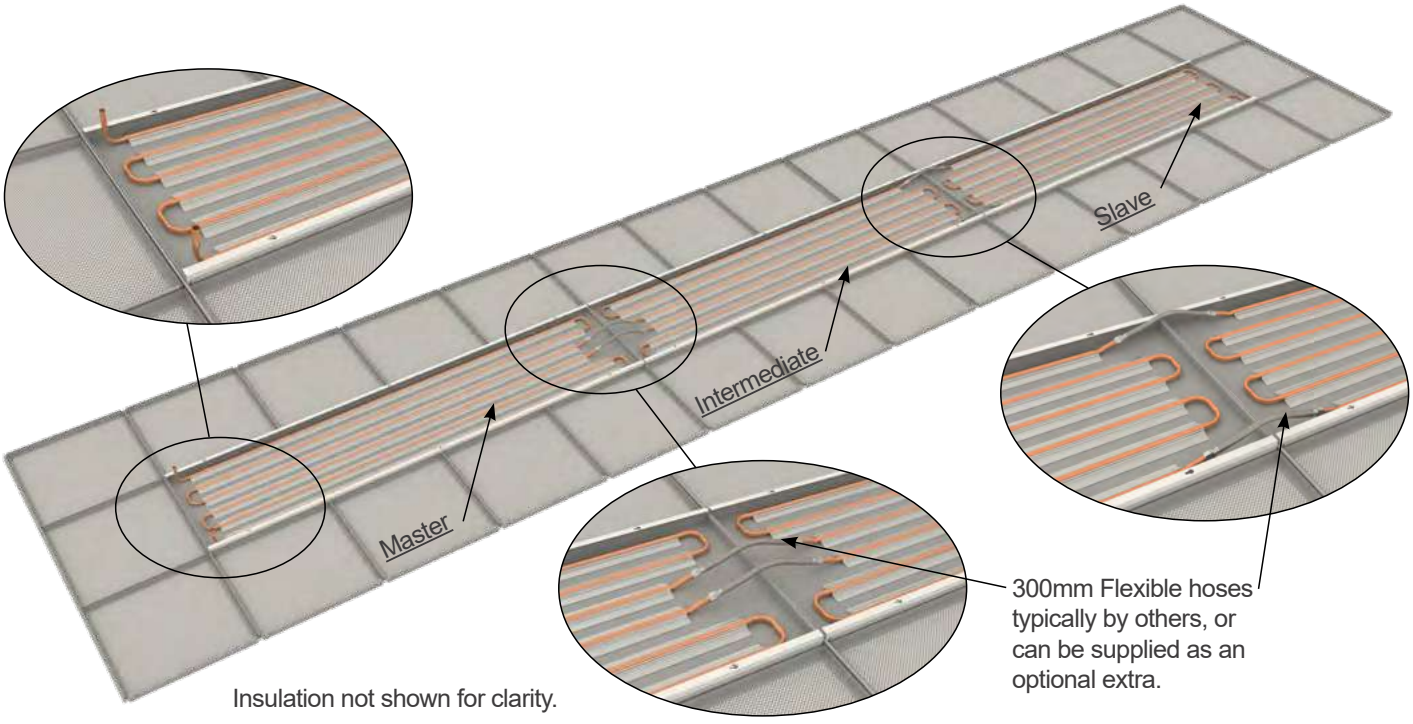
Modula HP 600mm Coupling Details Example



View from above (Dimensions in mm)

Modula HP Panel Specifications	
Water Content (per tube)	0.15 l/m
Panel Weight (Dry)	11.5 kg/m
Minimum Flow Rate*	0.012kg/s
Maximum Flow Rate**	0.105 kg/s
Thermal Expansion***	1.6 mm/m

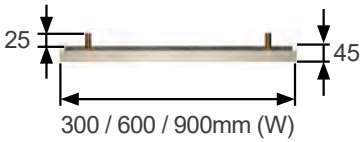
Note: All flow and return connections manifolds are 15mm OD vertical.
* @ 76°C MWT
** (1.0 m/s) with ΔP = 13.7 kPa (3.0m long panel)
*** @ 55°C Above Ambient

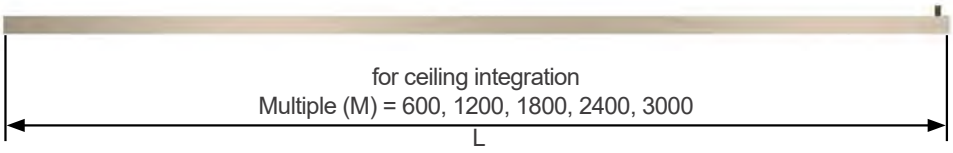


300mm Flexible hoses typically by others, or can be supplied as an optional extra.

Insulation not shown for clarity.

Product Dimensions (mm)





Modula is manufactured in standard module lengths (L) from 0.6m, up to 3.0m. Actual dimensions are less 8mm to fit into standard T-bars. All panels are manufactured to a dimensional tolerance of ±1mm.

Testing Protocols

Maximum working pressure	8.7 Bar (g)
Maximum test pressure	13.0 Bar (g)
Classification category	SEP
Pressure equipment directive 97 / 23 / EC	

Extrusion Specification

Section tolerances	BS 1474
Chemical properties	BS 1472
Heat treatment	BS 1490

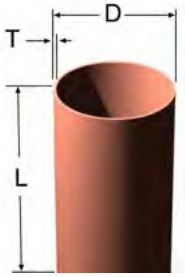
Thermal Insulation

Modula panels are supplied with integrated 25mm thick 45 kg/m³ class 'O' foil encapsulated mineral wool insulation within the panels returned flanges.

Copper Pipe Specification

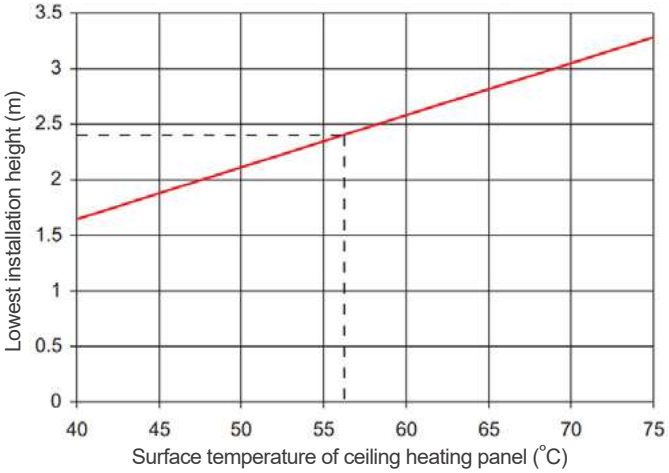
The copper pipe used in the manufacture of the Modula heating panel is compatible with the European Standard for Copper Tubes EN12449 / EN12735-2. The dimensional specification are as follows;

Outside Diameter (D): 15mm
Wall Thickness (T): 0.38mm
Minimum Straight Length (L): 35mm



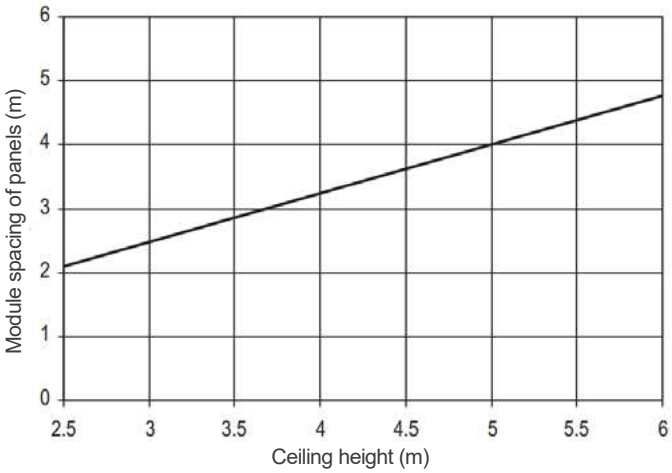
Modula Dimension Guidelines

Installation heights and temperature



Guide to lowest installation height for the ceiling heater with radiant temperature asymmetry of 5°C. Assumes panel installation adjacent to cold wall / window.

Panel Spacing



Recommended spacings between heating panels (centre-to-centre).

Bespoke Manufacturing

Frenger has the manufacturing capability required to deliver the most complex of bespoke solutions. Facilities include the latest full CNC machine centers, together with a dedicated powder-coat paint plant to paint all of the components of the products and project specific in-house testing laboratories.

Project Specific Testing Facility

The 3 number state-of-the-art Climatic Testing Laboratories at Frenger's technical facility in Derby (UK) have internal dimensions of 6.3m (L) x 5.7m (W) x 3.3m (H) high and includes a thermal wall so that both internal and perimeter zones can be simulated. Project specific testing validates product / solution performance (outputs) and resultant Room Comfort Conditions for compliance category grading in accordance with BS EN ISO 7730. All of Frenger's chilled beams have also been independently tested and certified by Eurovent in terms of product performance (output), as Eurovent can not test for thermal comfort; hence the need for Frenger's own laboratories.

Project Specific Testing

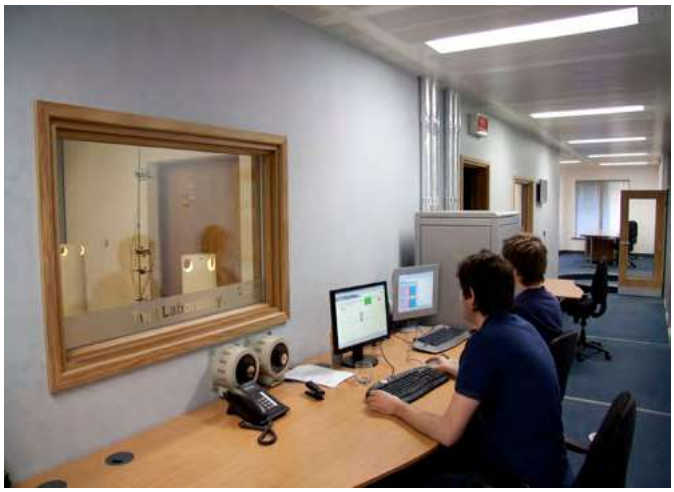
Project specific mock-up testing is a valuable tool which allows the Client to fully assess the proposed system and determine the resulting room occupancy Thermal Comfort conditions. The physical modelling is achieved by installing a full scale representation of a building zone complete with internal & external heat gains (Lighting, Small Power, Occupancy & Solar Gains).

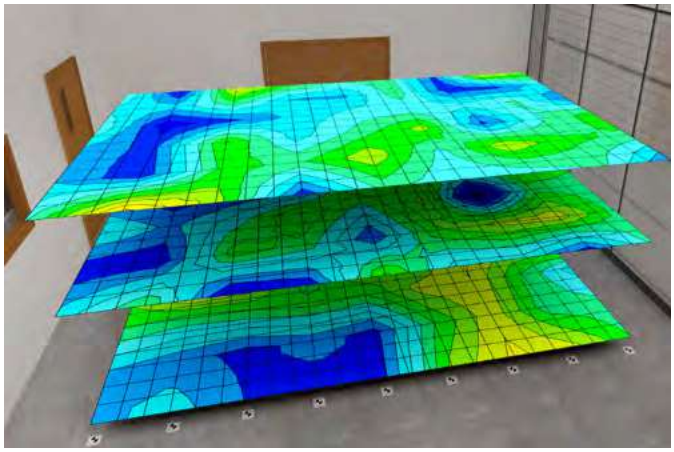
The installed mock-up enables the client to verify the following:

- Product performance under project specific conditions.
- Spatial air temperature distribution.
- Spatial air velocities.
- Experience thermal comfort.
- Project specific aesthetics.
- Experience lighting levels (where relevant).
- Investigate the specific design and allow the system to be optimised.

The project-specific installation and test is normally conducted to verify:

- Product capacity under design conditions.
- Comfort levels
  - air temperature distribution.
  - thermal stratification.
  - draft risk.
  - radiant temperature analysis.
- Smoke test video illustrating air movement.
- Live Thermal Imaging





Photometric Testing Facility

The in-house Photometric test laboratories at Frenger are used to evaluate the performance of luminaires. To measure the performance, it is necessary to obtain values of light intensity distribution from the luminaire. These light intensity distributions are used to mathematically model the lighting distribution envelope of a particular luminaire. This distribution along with the luminaires efficacy allows for the generation of a digital distribution that is the basis of the usual industry standard electronic file format. In order to assess the efficacy of the luminaire it is a requirement to compare the performance of the luminaire against either a calibrated light source for absolute output or against the “bare” light source for a relative performance ratio.

The industry uses both methods. Generally absolute lumen outputs are used for solid state lighting sources and relative lighting output ratios (LOR) are used for the more traditional sources. Where the LOR method is chosen then published Lamp manufacturer’s data is used to calculate actual lighting levels in a scheme and for LED light source the integration chamber is used to measure LED luminance efficacy.

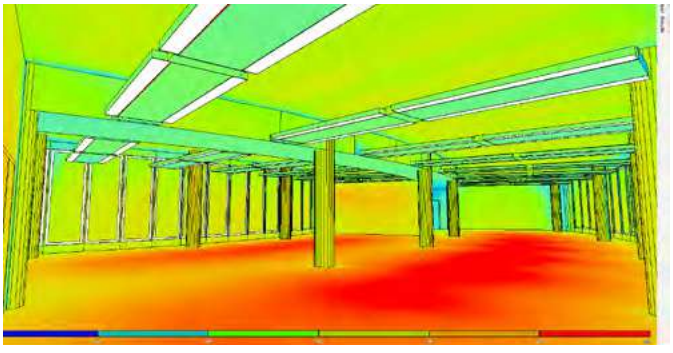
The intensity distribution is obtained by the use of a Goniophotometer to measure the intensity of light emitted from the surface of the fitting at pre-determined angles. The light intensity is measured using either a photometer with a corrective spectral response filter to match the CIE standard observer curves or our spectrometer for LED sources.

Luminaire outputs are measured using our integrating sphere for smaller luminaires or our large integrator room for large fittings and Multi Service Chilled Beams. For both methods we can use traceable calibrated radiant flux standards for absolute comparisons.

All tests use appropriate equipment to measure and control the characteristics of the luminaire and include air temperature measurements, luminaire supply voltage, luminaire current and power. Thermal characteristics of luminaire components can be recorded during the testing process as required.

A full test report is compiled and supplied in “locked” PDF format. Data is collected and correlated using applicable software and is presented electronically to suit, usually in Eulumdat, CIBSE TM14 or IESN standard file format.

Frenger conduct photometric tests in accordance with CIE 127:2007 and BS EN 13032-1 and sound engineering practice as applicable. During the course of these tests suitable temperature measurements of parts of LED’s can be recorded. These recorded and plotted temperature distributions can be used to provide feedback and help optimise the light output of solid state light source based luminaires which are often found to be sensitive to junction temperatures.



Acoustic Testing Facility

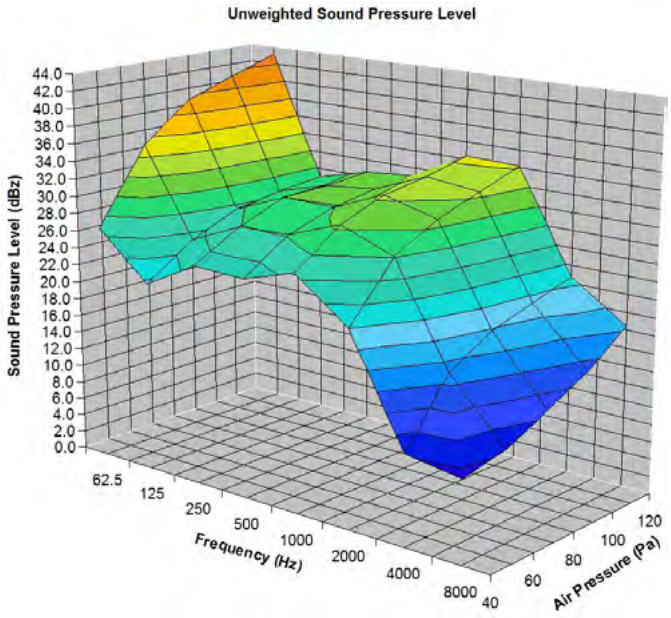
The Acoustic Test Room at Frenger is a hemi-anechoic chamber which utilises sound absorbing acoustic foam material in the shape of wedges to provide an echo free zone for acoustic measurements; the height of the acoustic foam wedge has a direct relationship with the maximum absorption frequency, hence Frenger had the acoustic wedges specifically designed to optimise the sound absorption at the peak frequency normally found with our active chilled beam products.

The use of acoustic absorbing material within the test room provides the simulation of a quiet open space without “reflections” which helps to ensure sound measurements from the sound source are accurate, in addition the acoustic material also helps reduce external noise entering the test room meaning that relatively low levels of sound can be accurately measured.

The acoustic facilities allow Frenger to provide express in-house sound evaluation so that all products, even project specific designs can be quickly and easily assessed and optimised.

To ensure accuracy, Frenger only use Class 1 measurement equipment which allows sound level measurements to be taken at 11 different ⅓ octave bands between 16 Hz to 16 kHz, with A, C and Z (un-weighted) simultaneous weightings.

In addition to the above, Frenger also send their new products to specialist third party Acoustic Testing. The results of which are very close and within measurement tolerances to that of Frenger’s in-house measurement of sound.



Industry Associations

Always mindful of its place within the HEVAC industry, Frenger Systems pride themselves on broad range of trade associations and accreditations. With a clear service, product and environmental ethos across everything they do, Frenger is focused on meeting and consistently surpassing the expectations of its customers. Frenger invest heavily in achieving industry recognised accreditations and as part of ongoing commitment to their customers and continually assess the level of services they provide. Opening up their company to these independent organisations allows Frenger to continually improve their customer service and satisfaction.

As an engaged member of the HEVAC industry, Frenger are actively asked to participate in industry specific discussions and studies. With this in mind Frenger are proud to have achieved and be linked with the following associations:

BSI EN ISO 9001:2015

Frenger Systems are registered by BSI for operating a Quality Management System which complies with the requirements of BS EN 9001:2015.

Eurovent

Frenger Systems participate in the EC programme for Chilled Beams. Check ongoing validity of certificate: www.eurovent-certification.com or www.certiflash.com Certiflash. The heat exchanger for the Recepto HRU is a Klingenburg Eurovent Certified aluminium static heat exchanger.

Chilled Beam and Ceiling Association

The Chilled Beam and Ceiling Association has been formed by leading companies within the construction industry. The objective of the Association is to promote the use of Chilled Beams and Chilled Ceilings, and encourage best practice in their development and application.

HEVAC Member

HEVAC is the heating and ventilating contractors association. As a HEVAC member Frenger Systems are subject to regular, third party inspection and assessment to ensure their technical and commercial competence.

Federation of Environment Trade Association

The Federation of Environment Trade Association (FETA), of which Frenger Systems is a member of, is the recognised UK body which represents the interests of manufacturers, suppliers, installers and contractors within the heat pump, controls, ventilating, refrigeration & air conditioning industry.

UK Trade & Investment

Frenger Systems are members of both the UK TI (the former Department of Trade and Industry) as well as the Chamber of Commerce for Export Documentation.

Certified CIBSE CPD

Frenger Systems is a CIBSE approved “Continued Professional Development” (CPD) provider. Frenger offers 1 hour lunch time CPD presentations regarding “Chilled Beam Technology”, CPD presentations are usually held at Consulting Engineers local practices with lunch provided courtesy of Frenger. Alternatively half or full day Chilled Beam Technology training is available at Frenger’s UK Technical Academy in a dedicated training theatre with fully operational BMS system with various different Chilled Beam and Ceiling solutions integrated.

Booking of a CPD Presentation can be requested on Frenger’s home page, under the drop down menu headed “Company”, then “CPD Booking”. Alternatively email sales@frenger.co.uk.

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Independently Tested Output to BS EN 14037

bsi ISO 9001 Quality Management Systems CERTIFIED

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