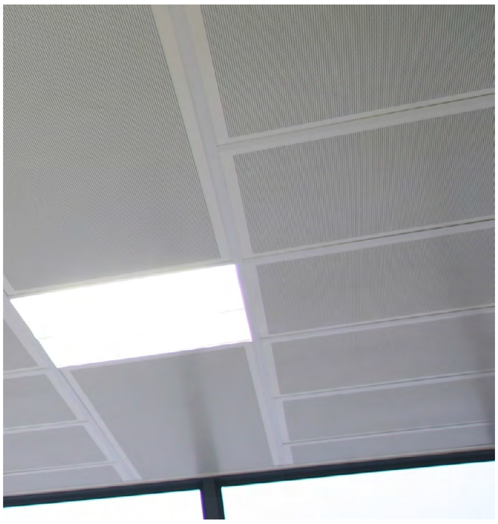
the future of space conditioning

X-Wing®

passive "Radiant" chilled beam



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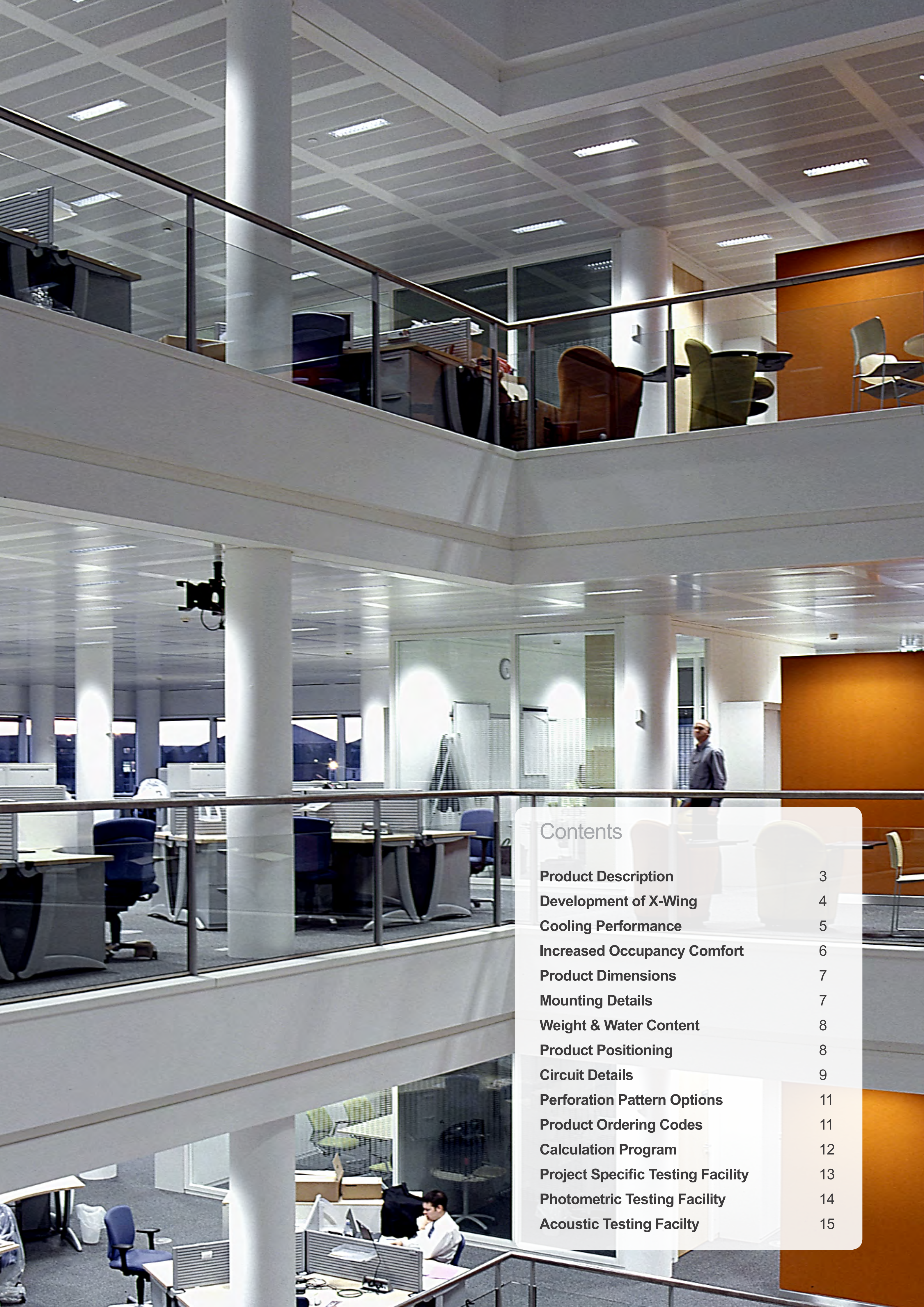
FRENGER® systems



Contents

Product Description

X-Wing is one of Frenger's latest range of next generation Chilled Beams. Energy efficiency has been a key driver for such advancements in Frenger's Chilled Beam Technology.

X-Wing is only **125mm deep** and can achieve up to **370 watts per meter as an exposed passive "Radiant" / convective cooling** unit and up to **170 watts / m² when concealed behind an S5046 perforated metal ceiling** (both sets of maximum performance are based on 10Δtk).

NB. The above performance figures are waterside cooling and no inclusion made for any additional cooling effect from any serperate supply sir system for respiratory requirements.

X-Wing contains a number of **Frenger's Patent pending performance enhancing features**, as can be expected from the Frenger brand.

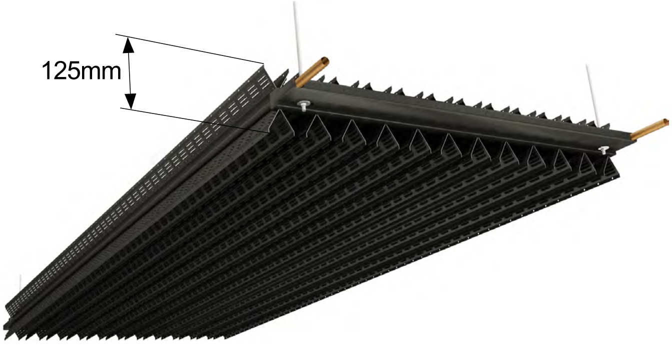
X-Wing is constructed from copper and aluminium and is 100 percent recyclable. The copper coil is produced by Frenger's in house fully automatic bespoke "state of the art" serpentine bending machine. This produces seamless sinusoidal copper coils (without any joins) up to 5.6m in length, with up to 12 water passes at 70mm tube centres. The aluminium radiant "wings" are produced in house by bespoke power press and roll forming machines, all of which are then assembled by Frengers fully automatic CNC controlled machine which mechanically bonds the "radiant wings" to be in metal to metal contact with the seamless copper waterways and this providing 100% encapsulation of the waterways for optimum transfer of energy from the radiant wings to the copper waterways.

The finished products are hydraulically tested to 17 bar positive pressure as standard before automatic machine wrapping and packing.

Fenger, have automated the vast majority of processes for **this particular next generation product to ensure that the highest levels of quality are both repeatable and consistent at all times.**

Function

X-Wing provides cooling by both convection and "Radiation". The radiant proportion creates no air movement, the only air movement comes from the convective proportion. As cold water passes through the chilled beam the warm air is cooled against the beams cooler surfaces. This cooled air, which is heavier due to its higher density, then streams through the punched louvres in the radiant wings and percolates through the small ceiling perforations into the room space below (when concealed). In this way air is circulated within the room, with warm air from the room being continually replaced by cooled air.



In addition to this convective cooling process, the cold surfaces of the beam (the radiant wings / 4 per waterway) also absorb heat radiation from the building occupants and the warmer surrounding surfaces. X-Wing's radiant quotient is approximately 40% of the total cooling effect (the other 60% of cooling being generated by the convective cooling effect described above). The ability of X-Wing to cool by radiation means that, when compared to a finned tube battery, X-Wing can deliver 40% more cooling without any additional risk of draft.

The efficiency of the convection process, coupled with the ability of the product to exchange energy by way of long-wave radiation, means that X-Wing retains a high cooling effect even when the air temperature in the room is relatively low (e.g. at night or when the building is unoccupied). In this way large amounts of cold energy can be stored in the building structure during low load periods, and used to offset heat gains when the need arises.

At a glance

- **Shallow depth unit (only 125mm).**
- Only 65mm clearance required behind the unit and as little as 252mm total ceiling construction (see page 8).
- Widths available 0.4m, 0.54m, 0.68m and 0.82m.
- Lengths available 1.2m up to 5.6m in increments of 8cm.
- Can be installed exposed or ideal for "concealed" applications such as behind perforated metal ceilings or within architectural metal ceilings such for ceiling integration or freely suspended Multi Service Chilled Beams.
- **Eliminated risk of water leakage. No joints in the copper coil,** just one continuous serpentine for all product widths up to 4.0m long and up to 5.6m long for up to 0.54m wide models (only 2 joints for 0.68m and 0.82m wide models over 4 meters in length).
- **Specialist black coating for smooth, long lasting, easy to clean, uniform finish that increase the radiant absorption coefficient for the product.**
- 40 percent more allowable passive cooling for X-Wing without increased draft risk, this is due to X-Wings "Radiant" quotient as compared to passive fin coil convective cooling products by others.
- Can be installed above light fittings with no loss of performance.
- Provides indoor climate **in accordance with BS EN ISO 7730.**

Development of X-Wing

Shell Centre - London - 1962

BT Leavensden Park - Watford - 2001

The Bond - Sydney - Australia - 2004

X-Wing delivers the best of both worlds

Static cooling systems (chilled ceilings and chilled beams) have, over the past 40 years, proven themselves capable of delivering high levels of occupancy comfort at reduced running costs. Frenger was at the vanguard of this technology when, in 1962, we supplied 175,000m² of chilled ceilings to the Shell HQ building in London (Europes first fully-sealed air conditioned building).

Since this time the cooling requirements for a typical office environment have increased considerably; improved insulation, higher occupancy densities and a much higher usage of IT equipment have all fueled this increase. It became apparent in the mid 1990's that the cooling capacity of a traditional chilled ceiling was not sufficient to meet these increased heat gains, and consequently higher-capacity passive chilled beam batteries were introduced into perimeter zones to offse the solar load generated at the building façade.

However, this mixture of systems was not without its problems. The chilled ceiling part of the system requires careful co-ordintation with a bespoke ceiling system, offers no flexibility to increase cooling capacity when office use changes (e.g. when creating meeting areas), is difficult to access for maintenance and carries a premium supply / install cost. Where finned tube batteries are used they are generally placed above metal ceilings with large perforation holes (at least 5mm in diameter) and with an excessive open area (typically 50% clear); requiring the "blacking out" of the ceiling void and resulting in an inconsistent ceiling aesthetic. The challenge was to provide a one-system solution that delivered the higher cooling capacity and lower cost of a chilled beam system, whilst maintaining the comfort and aesthetic advantages of chilled ceilings.

The introduction of "Radiant Chilled Beams" is arguably the perfect marriage of these two technologies; the beam delivers high cooling capacities (up to 170 W / m²) and high comfort levels (lower air velocities and lower perceived temperature due to the radiant effect) in a package that can look no different to contemporary high-spec ceiling system. All this at the substantially lower cost associated with chilled beam installations.

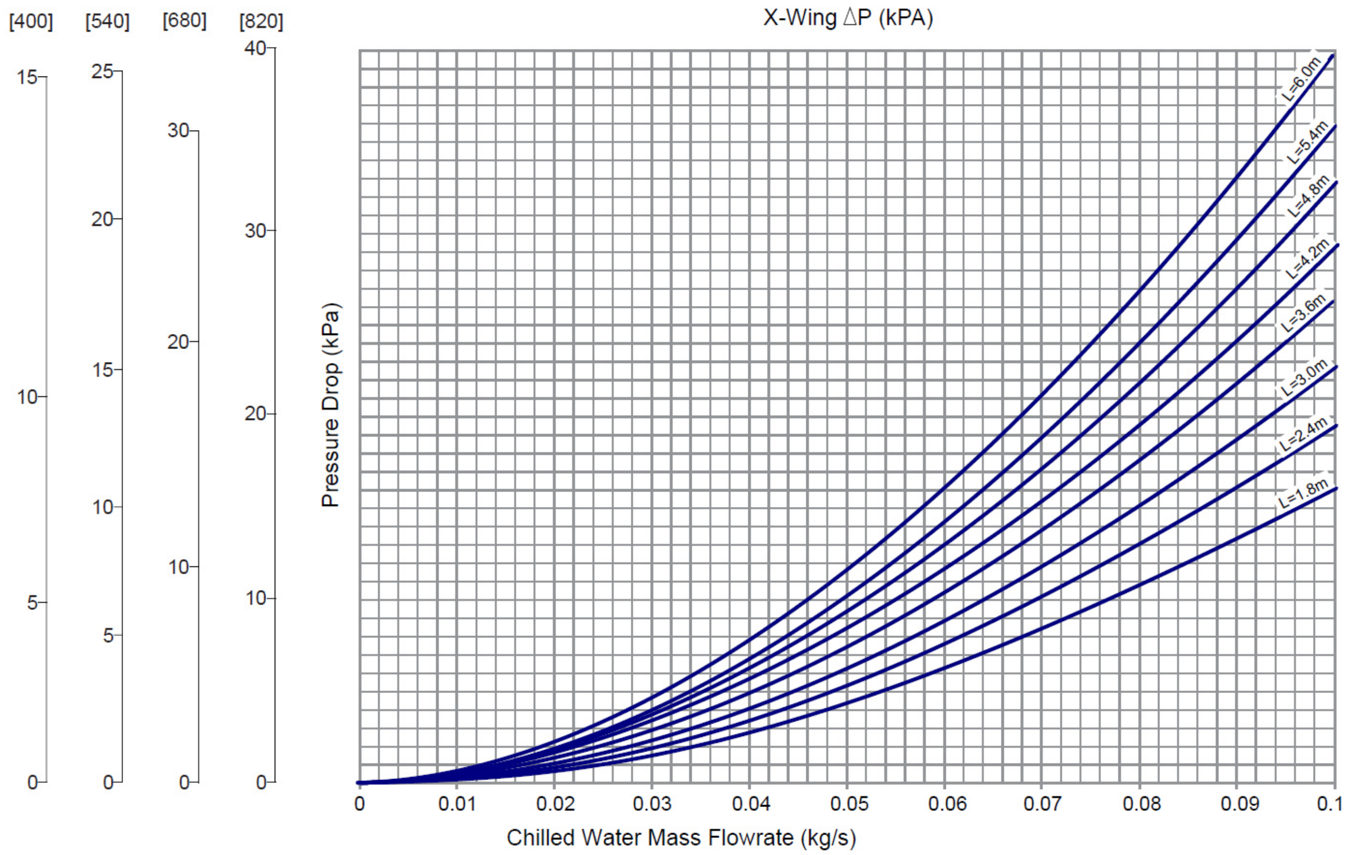
This natural progression for chilled ceilings has been employed successfully on many high-profile projects - from the 25,000m² call centre for BT in Watford to Bovis Lend Lease's HQ building in Sydney, Australia - and many other projects of note throughout Europe.

Frenger have further developed this chilled beam / chilled ceiling hybrid to incorporate an increased radiant surface are within a shallower depth and narrower width than ever before, for such levels of cooling (now even more cooling performance).

Cooling Performance

Perforation Pattern	X-Wing Output (W / m / K)				Max Ceiling Output (W / m² / °C)
	XW 400-15	XW 540-15	XW 680-15	XW 820-15	
Exposed	17.7	24.1	30.8	34.4	-
S5050	17.5	22.6	27.6	32.4	17.2
S5046	17.4	22.6	27.6	32.1	17.0
D4033	16.6	21.4	25.8	29.8	12.8
D3534	16.5	21.1	25.5	29.3	12.7
D3022	15.2	19.1	22.8	25.9	9.3
S2426	15.2	19.1	22.8	25.9	10.0

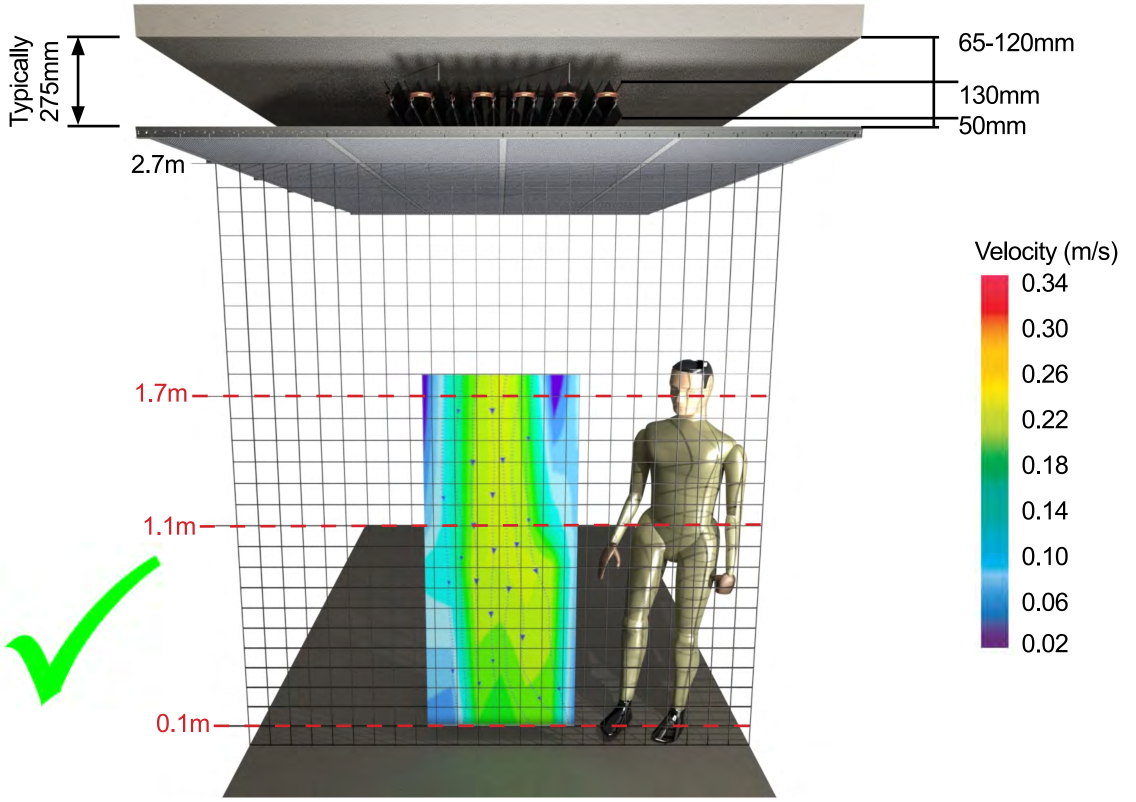
Pressure Drop



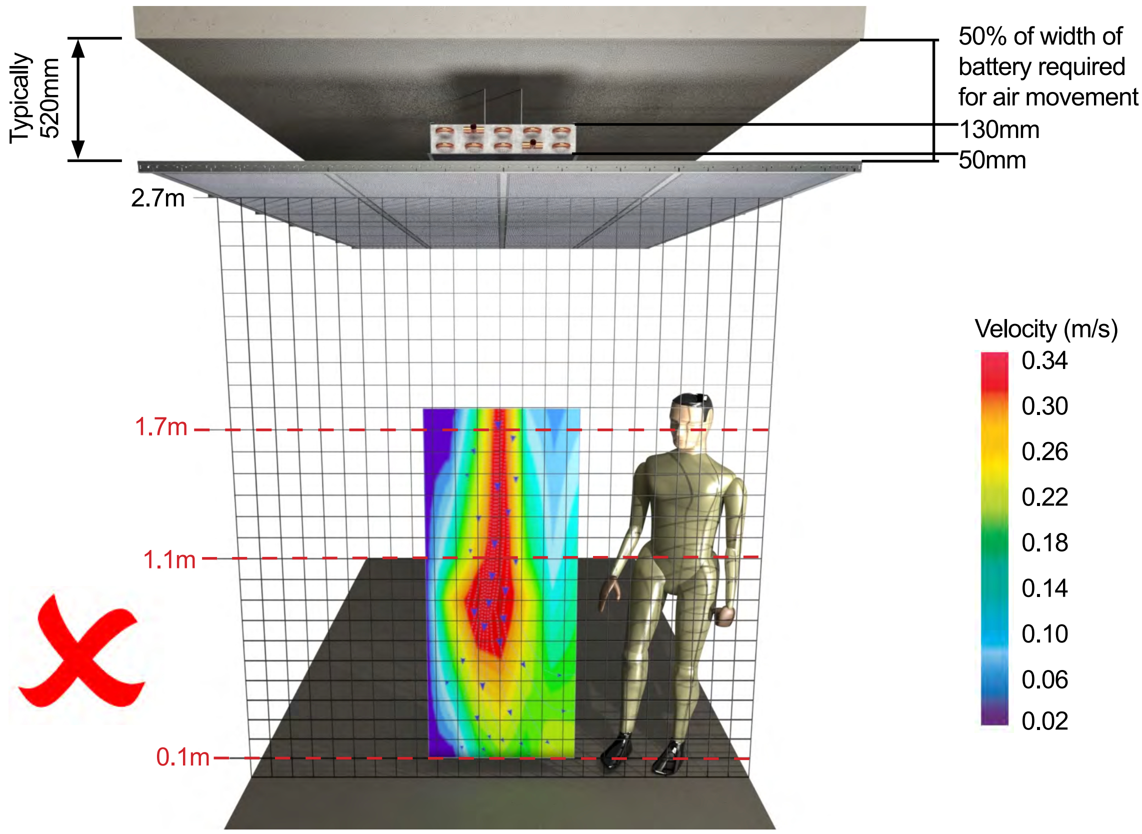
Increased Occupancy Comfort

The following Climatic Test Report colour Topography below shows comfortable air velocities directly below the X-Wing radiant convective beam achieving 300 W / lm as opposed to a convective only fin-coil battery also performing 300 W / lm

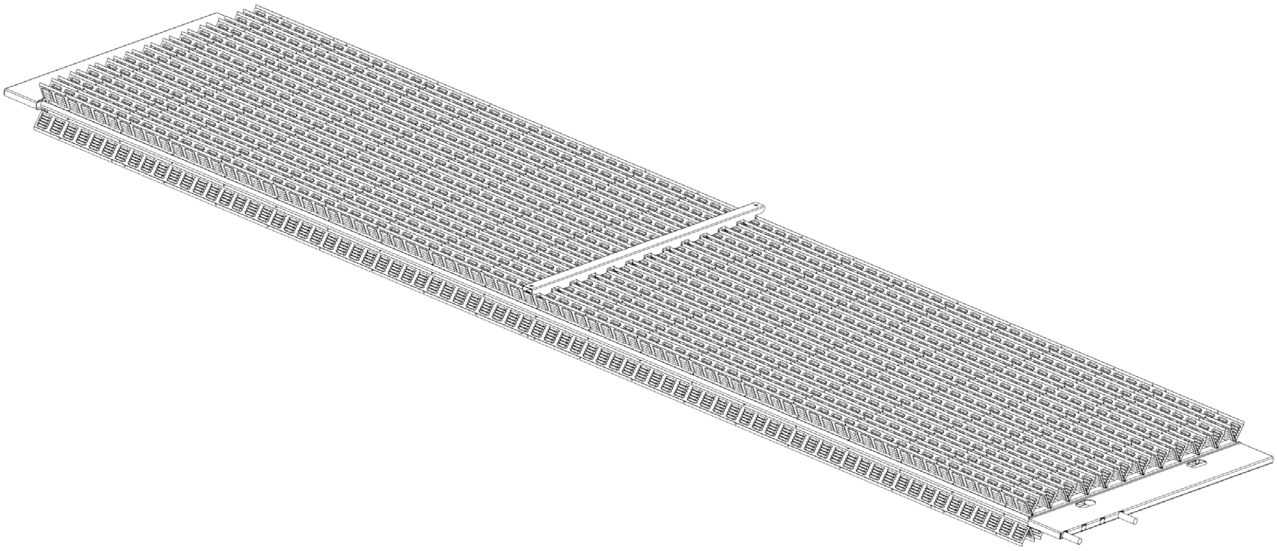
X-Wing (Radiant Chilled Beam)

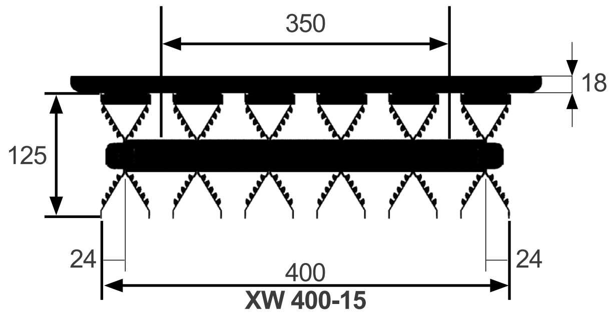


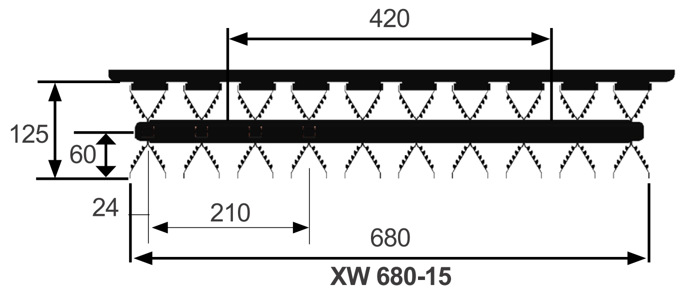
Fin-Coil Battery (Convective only Chilled Beam)

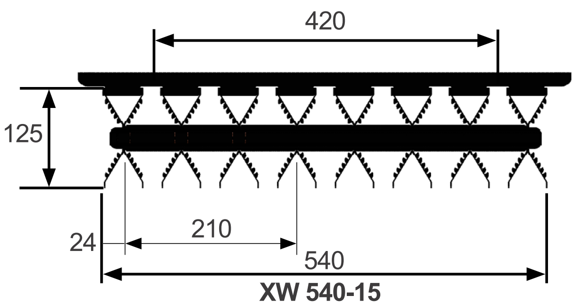


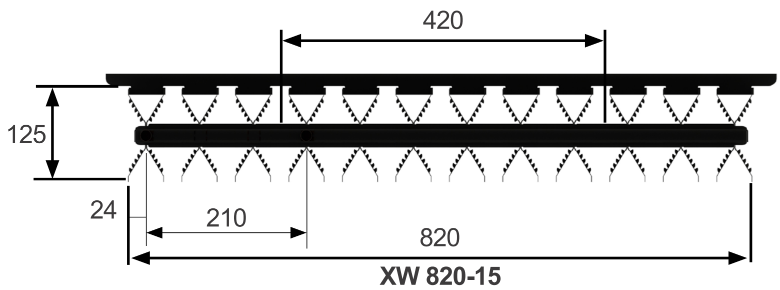
Product Dimensions





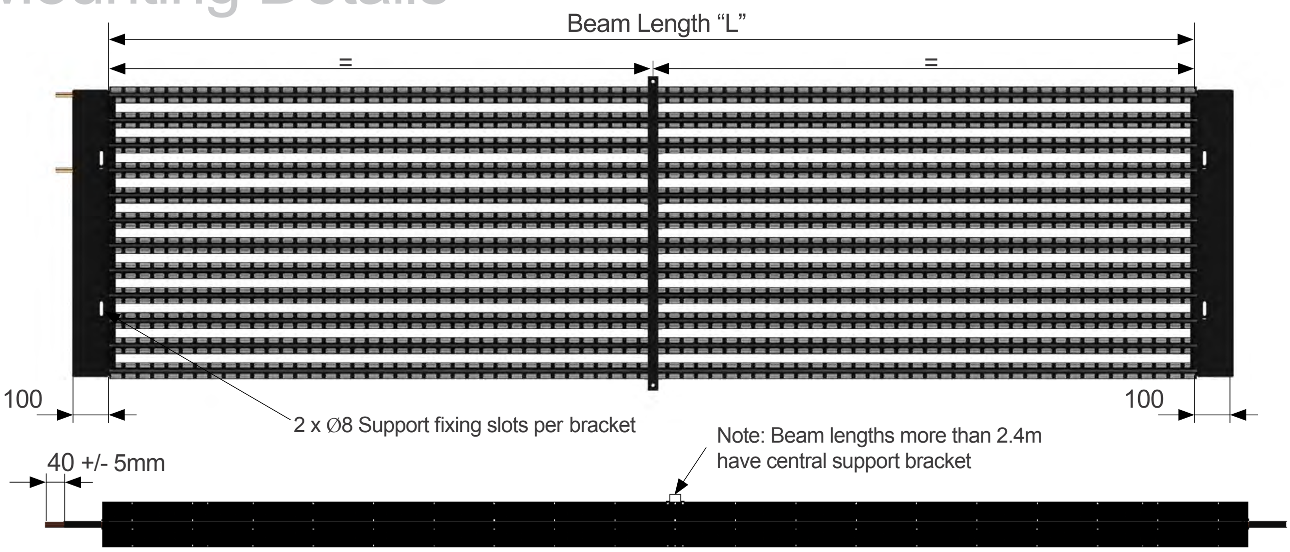






*Note all dimensions are ± 5mm

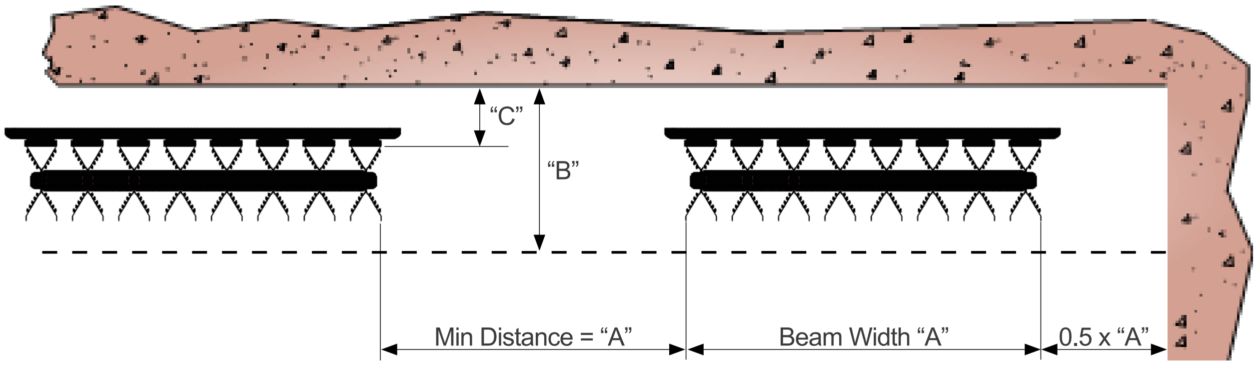
Mounting Details



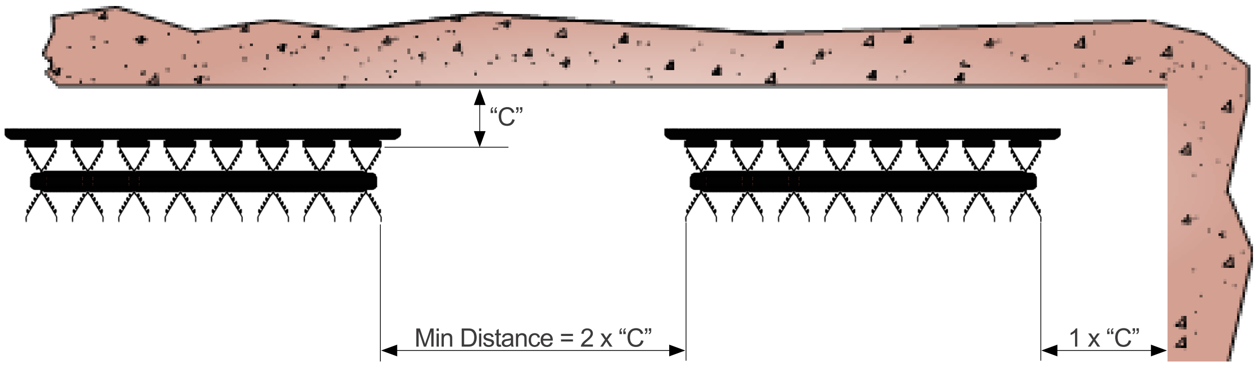
Weight & Water Content

Model Ref.	XW 400-15	XW 540-15	XW 680-15	XW 820-15
Dry Weight (kg / m)	5.4	7.2	9.0	10.7
Water Content (l / m)	1.0	1.3	1.6	1.9

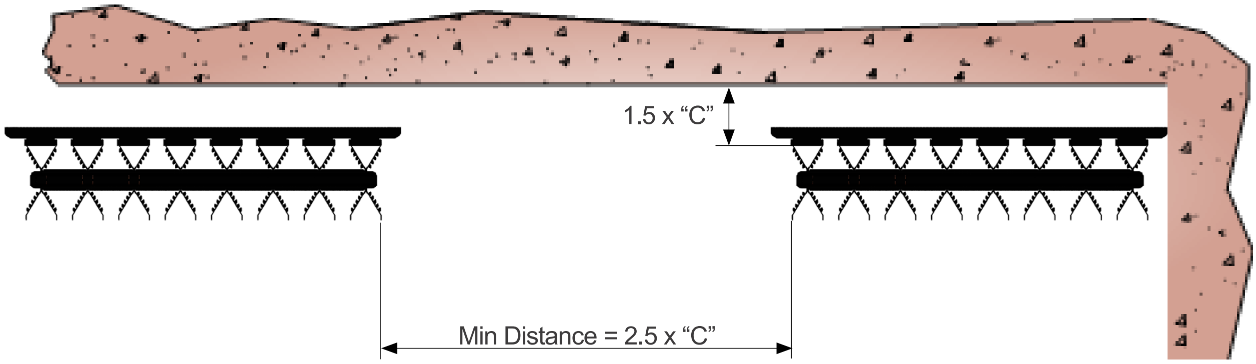
Product Positioning



XW Above Perforated Ceiling



XW Exposed

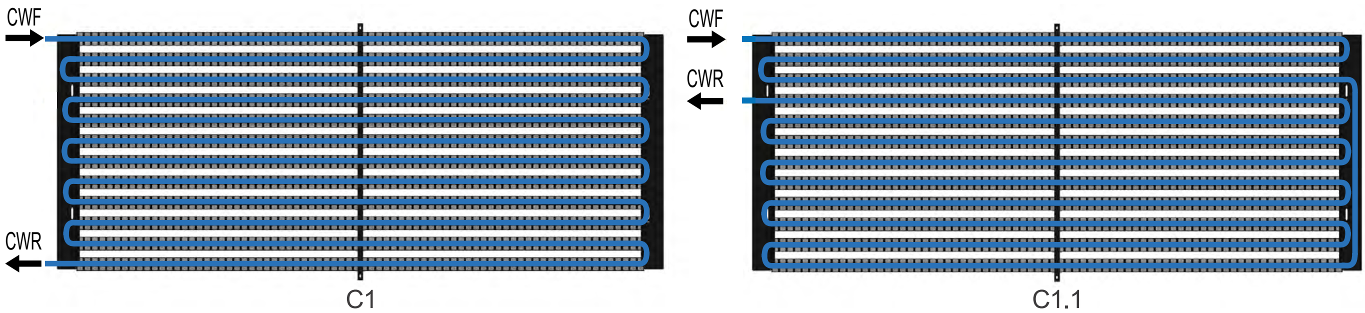


XW Exposed

Model Ref.	Dim “B”	Dim “C”
XW 400-15	252mm	65mm
XW 540-15	267mm	80mm
XW 680-15	302mm	100mm
XW 820-15	322mm	120mm

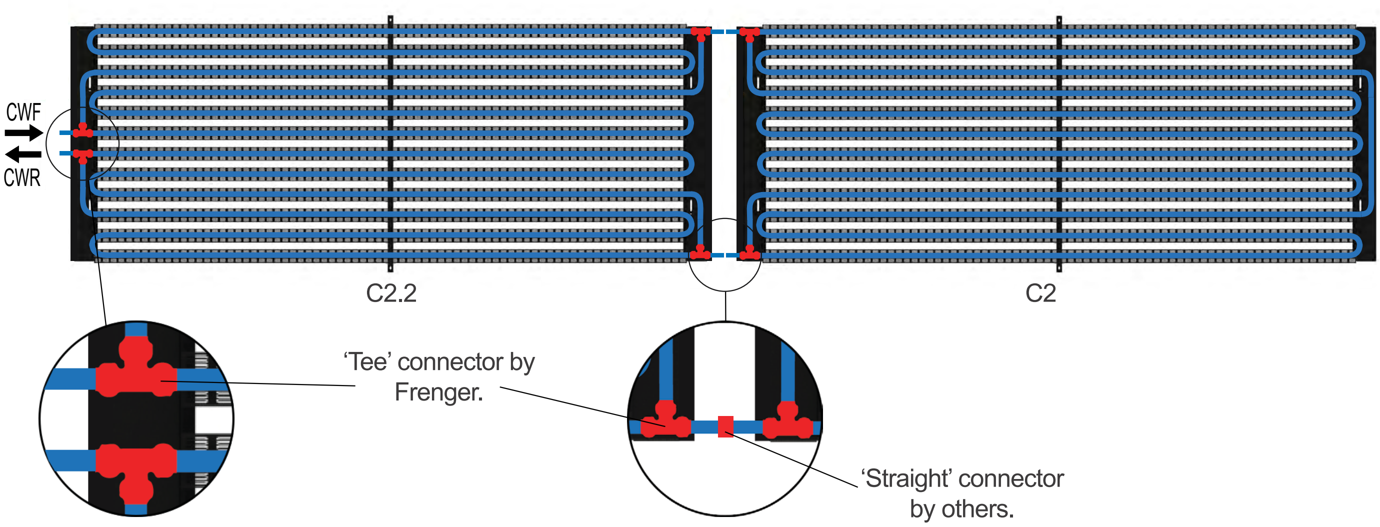
Circuit Details

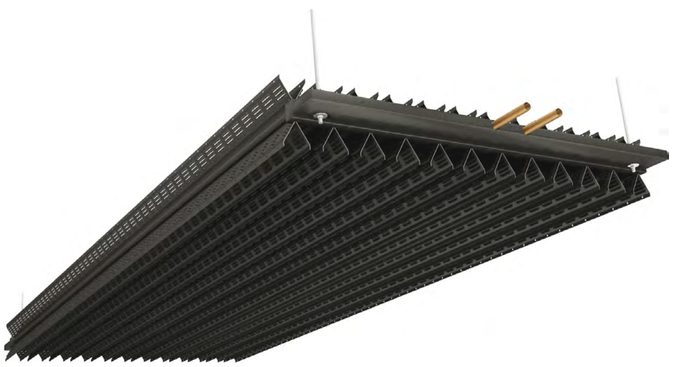
X-Wing 820 Maniffold Type C1 and C1.1

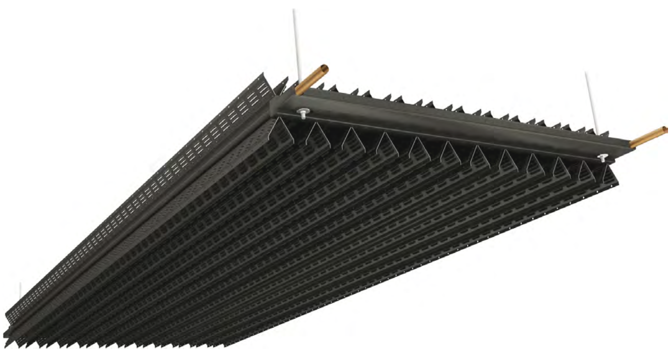


Type C1 is the standard X-Wing and is good for all single beam lengths upto 4.6m, anything over 4.6m C2 can be used.

X-Wing 820 Maniffold Type C2 and C2.2





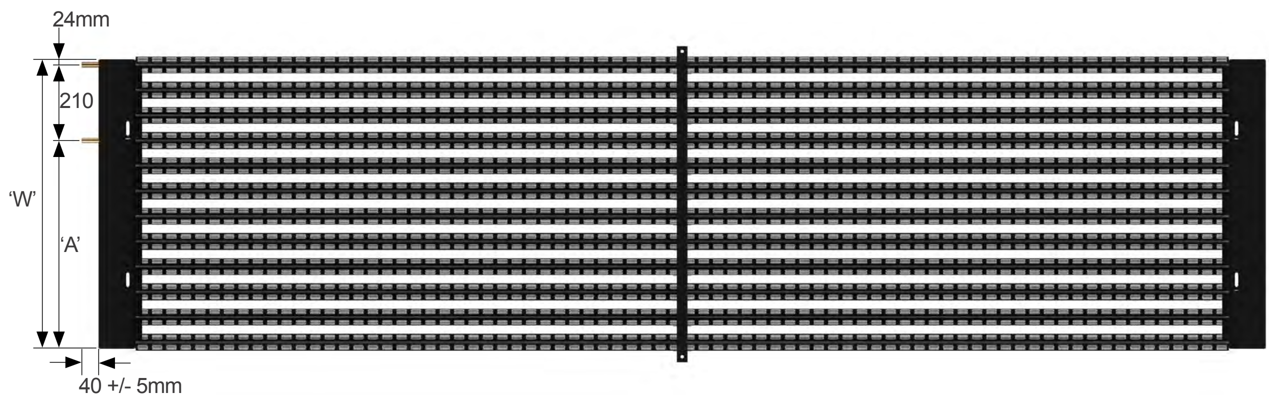


Type C2 manifold is 'Special' and can be used for parrallel circuits for high mass flowrates only.

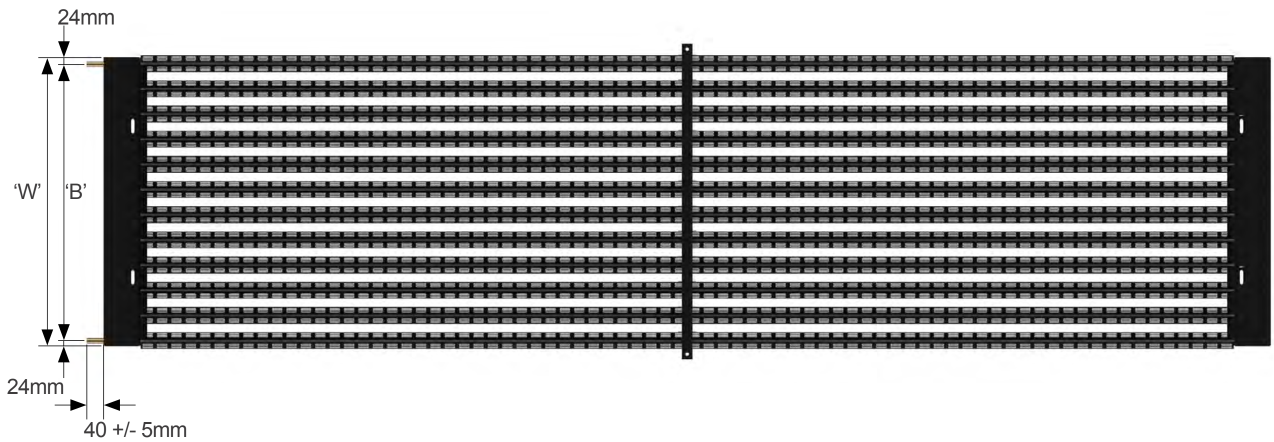
X-Wing 820 Type C1 Maximum Mass Flowrate based on a 30kPa maximum pressure drop **				
Nominal Active Length (m)	<3.6	4.2	4.8	5.4
Maximum Mass Flowrate (kg / s)	0.103*	0.101	0.095	0.090

Note:
* Maximum mass flowrate limited to ensure tubside velocity is less than 1.0 m /s.
** Although not normally required the X-Wing unit can be specially supplied with either C2 or C2.2 manifold enabling higher mass flowrates and connection in series; however these options should be selected on an as needed basis given the C2 and C2.2 X-Wing units would have a longer lead time than C1, increased cost and introduction of internal tee connections within the manifold.

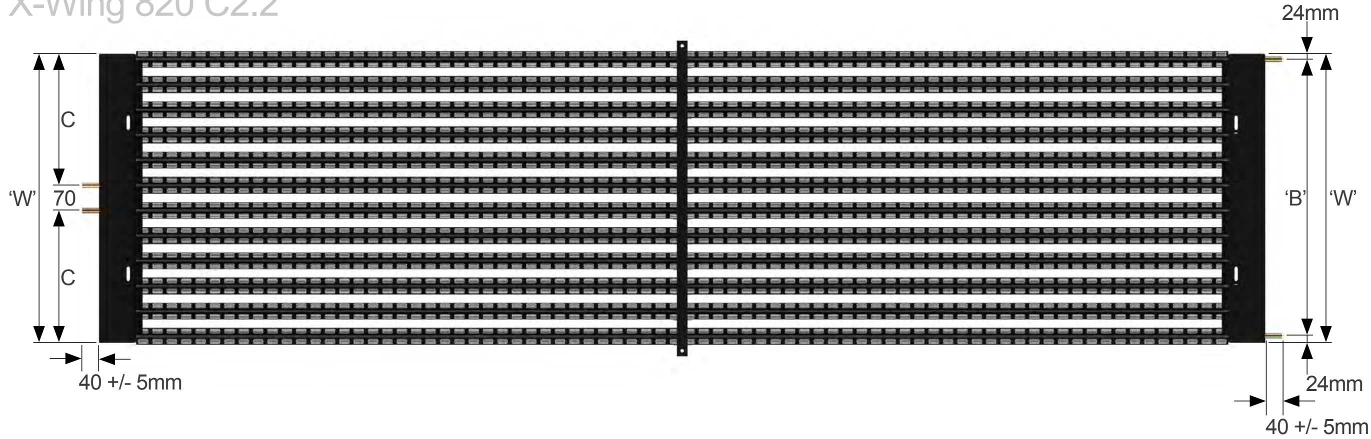
X-Wing 820 C1.1



X-Wing 820 C1 and C2



X-Wing 820 C2.2

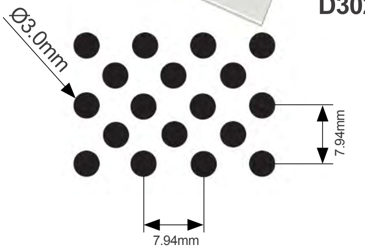


Model Ref.	Width 'W'	Dim 'A'	Dim 'B'	Dim 'C'
XW 400-15	400mm	190mm	280mm	165mm
XW 540-15	540mm	330mm	490mm	235mm
XW 680-15	680mm	470mm	630mm	305mm
XW 820-15	820mm	610mm	770mm	375mm

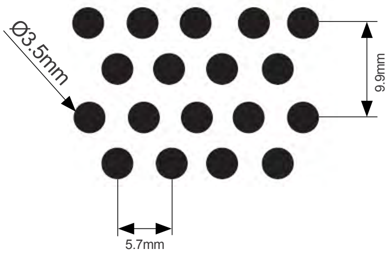
Perforation Pattern Options

Diagonal Pitch

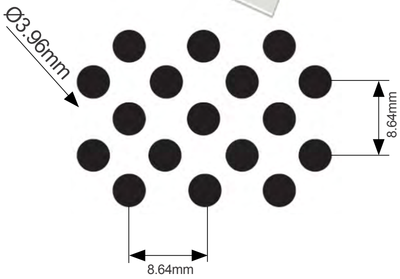
3mm hole
7.94mm pitch
22% open area
D3022



3.5mm hole
5.7mm x 9.9mm pitch
34% open area
D3534

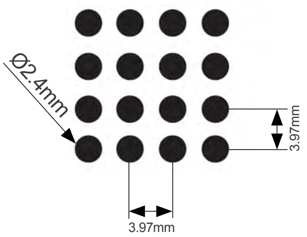


3.96mm hole
8.64mm pitch
33% open area
D4033

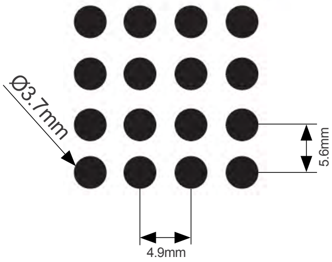


Square Pitch

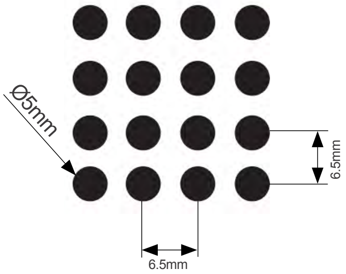
2.4mm hole
3.97mm pitch
28% open area
S2428



3.7mm hole
4.9mm x 5.6mm pitch
39% open area
S3739

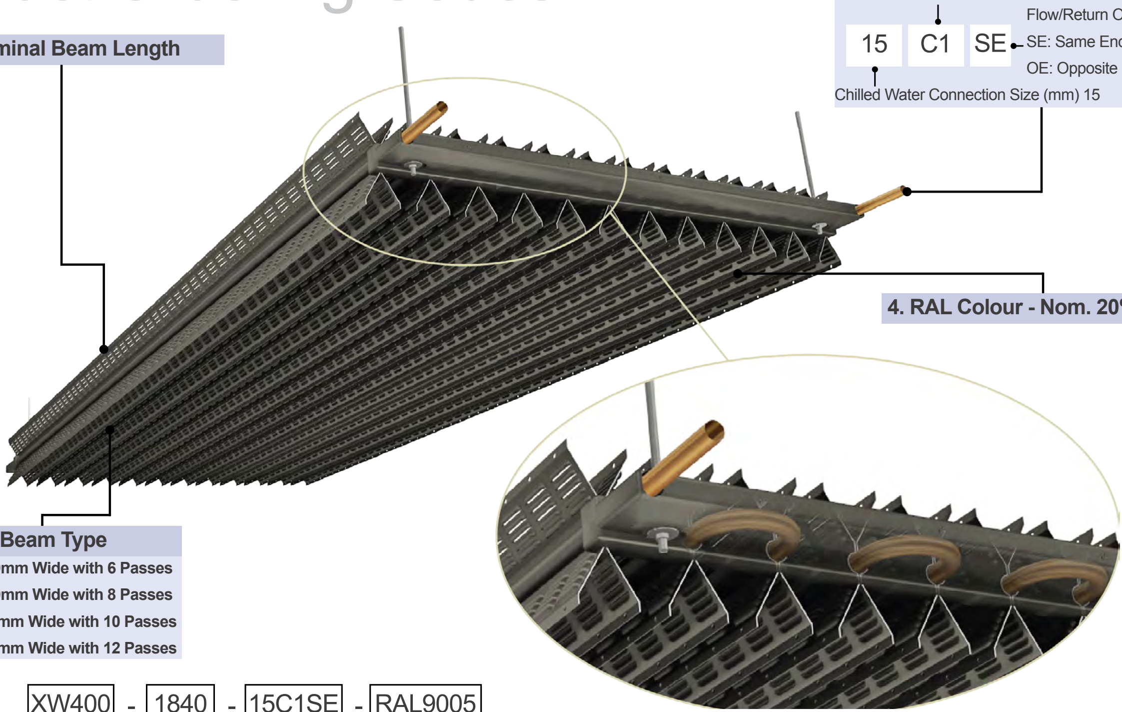


5mm hole
6.5mm pitch
46.5% open area
S5046



Alternative perforation patterns can be utilised, please consult our technical services department for further advice.

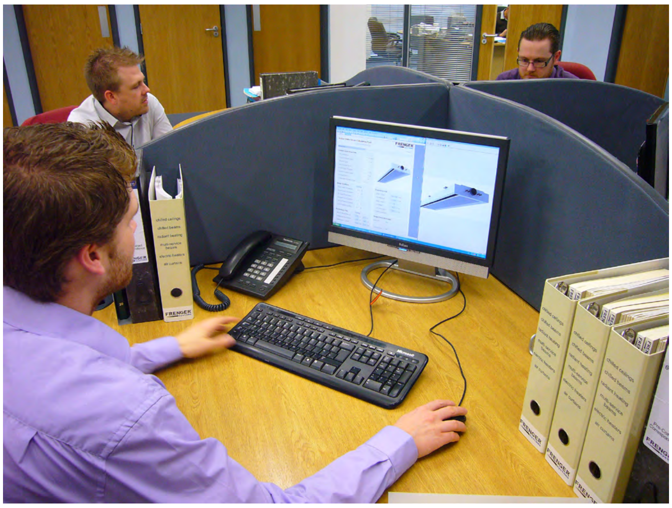
Product Ordering Codes



Example: XW400 - 1840 - 15C1SE - RAL9005

XW400	1840	15C1SE	RAL9005
1	2	3	4

Calculation Program

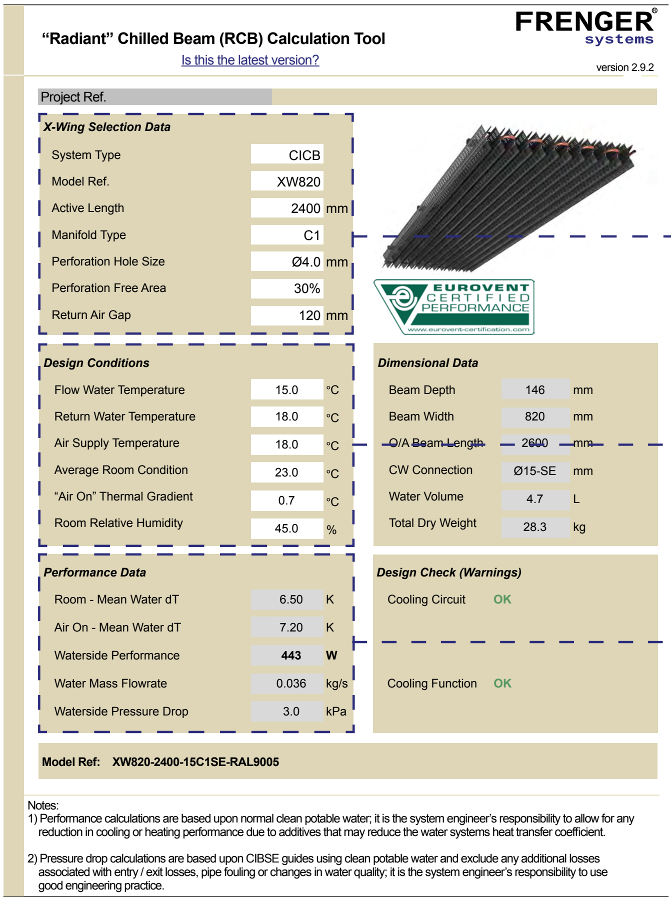


X-Wing Selection Data

System Type	CICB	
Model Ref.	XW820	
Active Length	2400	mm
Manifold Type	C1	
Perforation Hole Size	Ø4.0	mm
Perforation Free Area	30%	
Return Air Gap	120	mm

Frenger's calculation programme for X-Wing is extremely user friendly.

Simply select from the drop down menu the "system type". Select the model, manifold and perforation as per the particular project requirements.
The "return air gaps" is the clearance behind the X-Wing unit (see product positioning page 8) to the underside of the slab.


"Radiant" Chilled Beam (RCB) Calculation Tool
Is this the latest version?
FRENGER® systems
version 2.9.2

Project Ref.

X-Wing Selection Data

System Type	CICB	
Model Ref.	XW820	
Active Length	2400	mm
Manifold Type	C1	
Perforation Hole Size	Ø4.0	mm
Perforation Free Area	30%	
Return Air Gap	120	mm

Design Conditions

Flow Water Temperature	15.0	°C
Return Water Temperature	18.0	°C
Air Supply Temperature	18.0	°C
Average Room Condition	23.0	°C
"Air On" Thermal Gradient	0.7	°C
Room Relative Humidity	45.0	%

Dimensional Data

Beam Depth	146	mm
Beam Width	820	mm
O/A Beam Length	2600	mm
CW Connection	Ø15-SE	mm
Water Volume	4.7	L
Total Dry Weight	28.3	kg

Performance Data

Room - Mean Water dT	6.50	K
Air On - Mean Water dT	7.20	K
Waterside Performance	**443**	**W**
Water Mass Flowrate	0.036	kg/s
Waterside Pressure Drop	3.0	kPa

Design Check (Warnings)

Cooling Circuit OK

Cooling Function OK

Model Ref: XW820-2400-15C1SE-RAL9005

Notes:
1) Performance calculations are based upon normal clean potable water; it is the system engineer's responsibility to allow for any reduction in cooling or heating performance due to additives that may reduce the water systems heat transfer coefficient.

2) Pressure drop calculations are based upon CIBSE guides using clean potable water and exclude any additional losses associated with entry / exit losses, pipe fouling or changes in water quality; it is the system engineer's responsibility to use good engineering practice.

Design Conditions

Flow Water Temperature	15.0	°C
Return Water Temperature	18.0	°C
Air Supply Temperature	18.0	°C
Average Room Condition	23.0	°C
"Air On" Thermal Gradient	0.7	°C
Room Relative Humidity	45.0	%

Complete your project data in the "Design Conditions" section. Please not that the "Air On" Thermal Gradient can be used up to 1.0°C for MCSB system types without the calculation program flagging up "talk to Frenger's technical personnel" although we recommend that this is much safer to design to a worst case scenario and not to rely on a room temperature gradient.

Performance Data

Room - Mean Water dT	6.50	K
Air On - Mean Water dT	7.20	K
Waterside Performance	**443**	**W**
Water Mass Flowrate	0.036	kg/s
Waterside Pressure Drop	3.0	kPa

"Performance Data" will then be automatically be calculated. Likewise "Dimensional Data" will be also automatically calculated.
Finally, the "Design Check" should read "OK" in green, or detail some warnings in red.

Calculatoin programmes for X-Wing are available upon request.

Contact our technical department or complete an application request form on www.frenger.co.uk from the relevant link on our home page.

Project Specific Testing Facility

The 3 number state-of-the-art Climatic Testing Laboratories at Frenger's Derby based technical centre, have internal dimensions of 6.3 x 5.7 x 3.3m high and includes a thermal wall so that both core and perimeter zones can be modelled. The test facilities are fixed in overall size and construction therefore simulation of a buildings specific thermal mass cannot be completed, it should, however be noted that a specific project can be simulated more accurately by recessing the floor and reducing the height as necessary.

Project Specific Testing

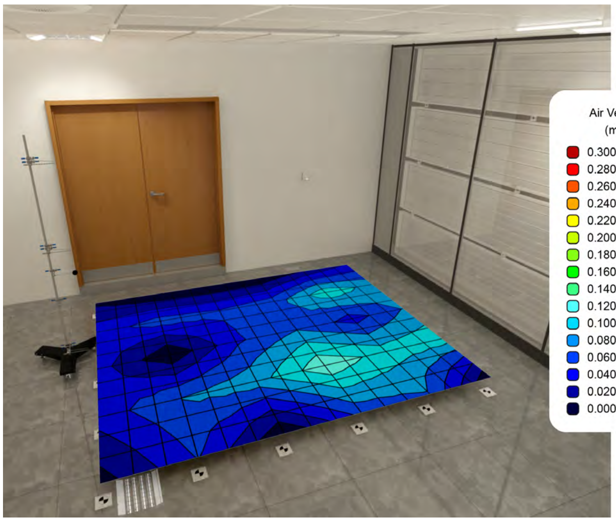
Project specific mock-up testing is a valuable tool which allows the Client to fully asses the proposed system and determine the resulting indoor quality and comfort conditions; the physical modeling is achieved by installing a full scale representation of a building zone complete with internal & external 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 enhanced.

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.



Photometric Testing Facility

The Photometric test laboratories at Frenger Systems 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 performance 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 absoulte 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 chosed then published lamp manufacturer’s data is used to calculate actual lighting levels in a design.

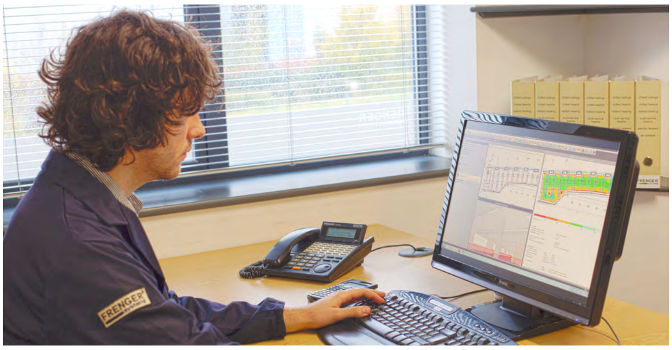
The intensity distribution is obtained by the use of a Goniophotometer to measure the intensity of light emitted from the surface of the fitting at pre-determined angles. The light intensity is measured using either a photometer with a corrective spectral response filter to match the CIE standard observer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

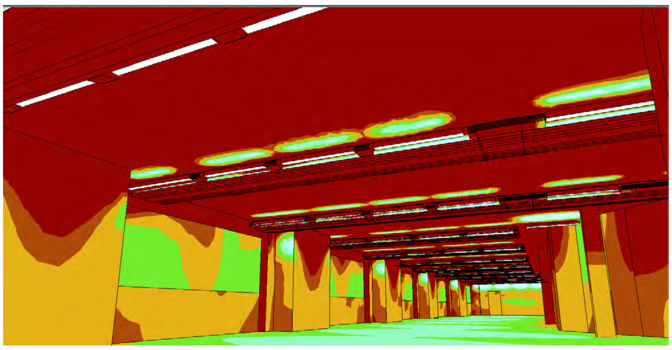
Luminaire outputs are measured using our integrating sphere for smaller luminaires or our large integrator room for large fittinfs and Multi Service Chilled Beams. For both methods we can use traceable calibrated radiant flux standards for absolute comparisons.

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.

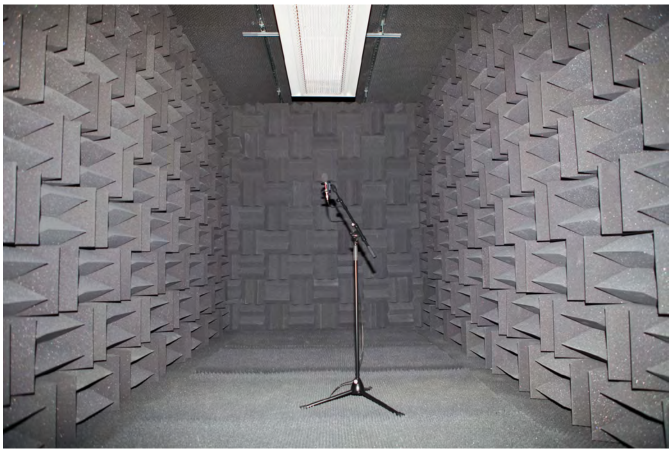
Frenger conduct photometric tests in accordance with CIE 127:2007 and BE EN 13032-1 and sound engineering practice as applicable. During the course of these tests suitable temperature measurements of parts of LED’s can be recorded. These recorded and plotted temperature distributions can be used to provide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





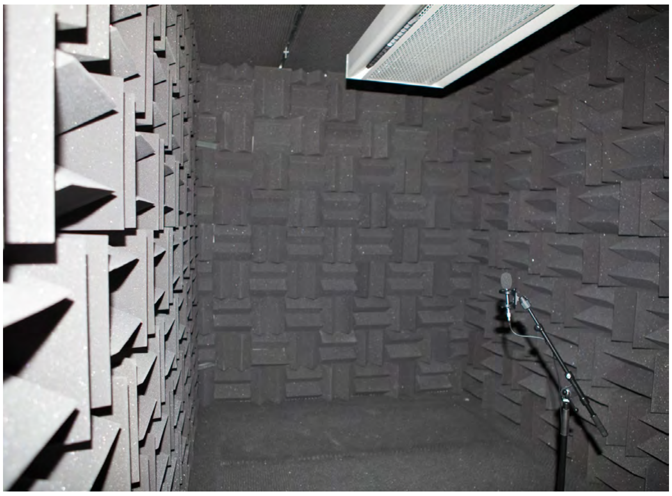
Acoustic Testing Facility

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 measurement; the height of the acoustic foam wedges has a direct relationship with the maximum absorption frequency, hence Frenger had the 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.

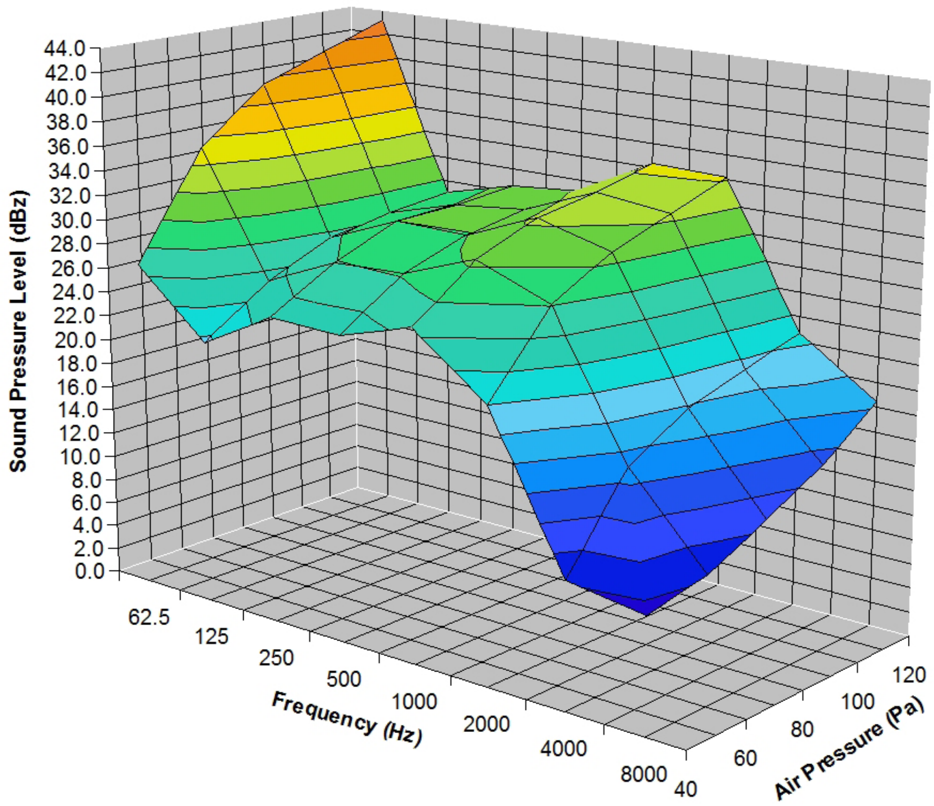
The acoustic facilities allow Frenger to provide express in-house sound evaluation so that all products, even project specific designs can be assessed and optimised.



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 for specialist third party Acoustic Testing. The results of which are very close and within measurement tolerances to that of Frengers in-house measurement of sound.

Unweighted Sound Pressure Level



Frenger Systems participates in the ECC program for Chilled Beams.
Check ongoing validity of certificate:
www.eurovent-certification.com or
www.certiflash.com

In accordance with our policy of continuous improvement, we reserve the right to amend any specification without prior notice.
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