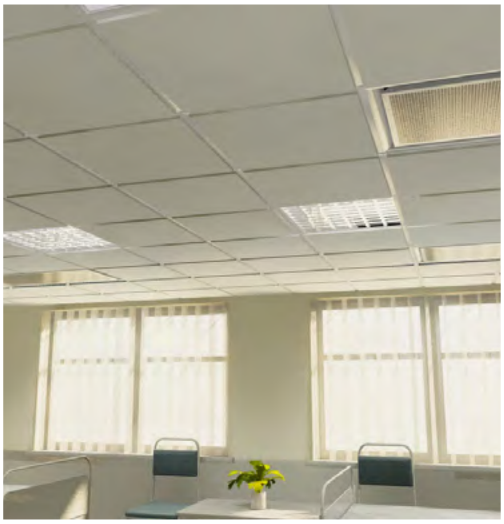
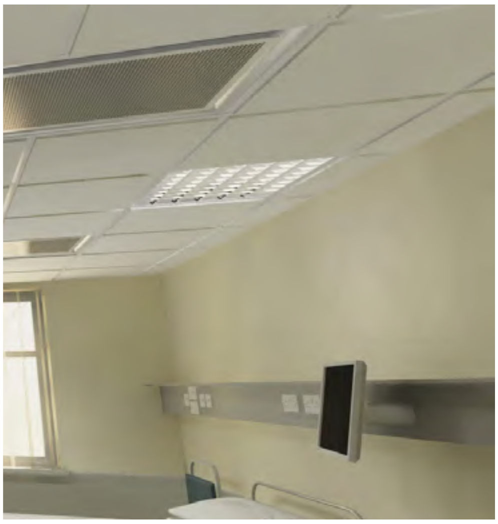
the future of space conditioning

Halo®

active chilled beam

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FRENGER® systems

Contents

Product Description

Halo is one of Frenger's latest range of high performance Chilled Beams. Energy efficiency has been a key driver for such advancements in Frenger's Chilled Beam Technology.

Halo is only 230mm deep and can achieve up to 1463 watts total cooling (based on a 1.2m long beam with a 10 Δtk between room and mean water temperature and 44 ltrs / sec of air 16°C with a 100Pa).

The Halo beam contains a number of Frenger's patented performance enhancing features and Registered Designs for aesthetic enhancements, all as can be expected from the Frenger brand.

These high - capacity Active Chilled Beams have a small footprint and as such have become increasingly popular as they can free up ceiling area whilst still handling significant heat gains and heat losses. However, the challenge has been to meet these demands whilst still delivering high levels of occupancy comfort. Frenger's Halo active chilled beam meets these challenges with its unique 360° air discharge characteristics with concealed air discharge veins.

The latest - generation of 360°Active Chilled Beam combines cooling and optional heating function with revolutionary air discharge system and pattern. By introducing the air with set back air deflector veins further up into the point of discharge rather than being mounted on the underplates like earlier models, this not only improves the 360° diffusion pattern it also vastly improves the products aesthetics. This latest development is a Registered Design in addition to the Patented performance enhancing items by Frenger. When compared to traditional 2 - way or 4 - way discharge pattern by others, Halo can deliver a reduction in air velocities of up to 35%.

This optimal method of spreading the air in all directions means the shortest possible air throws are created, resulting in optimal levels of comfort to building occupants.

At a glance

- Halo is only 230mm deep and can achieve up to 1463 watts total cooling.
- High - capacity active chilled beams with a small footprint.
- True 360° air discharge characteristics.
- Concealed air discharge veins.
- Spreading the air in all directions means the shortest possible air throws are created.
- Halo is offered in 3 standard models; "I", "C" and "F":
  - Halo "I" models are for integrated ceiling installations.
  - Halo "C" - 60 and Halo "C" - 120 are designed for integration into metal clip - in ceiling systems.
  - Halo "F"- 60 is designed for free - hanging exposed applications.
- Providing a comfortable environment, compliant to BS EN ISO 7730.

Construction

Halo is offered in 3 standard models; "I", "C" and "F".

Halo "I" models are for integrated ceiling installations in standard 15 or 24mm exposed tee bar grids (Lay - In grid systems) replacing 600 x 600mm or 1200 x 600mm tile modules and can be used for integration with either "mineral fibre" tiles or plaster board ceilings.

Halo "C" - 60 and Halo "C" - 120 are designed for integration into metal clip - in ceiling systems.

Halo "F" - 60 is designed for free-hanging exposed applications. This is a standard model with an additional factory fitted architectural frame enhancement kit that can be finished in white to match the Halo beam, or provided as a different colour to make a feature of the extruded aluminium outer frame.

Halo® Active Chilled Beam 600 x 600 Module.

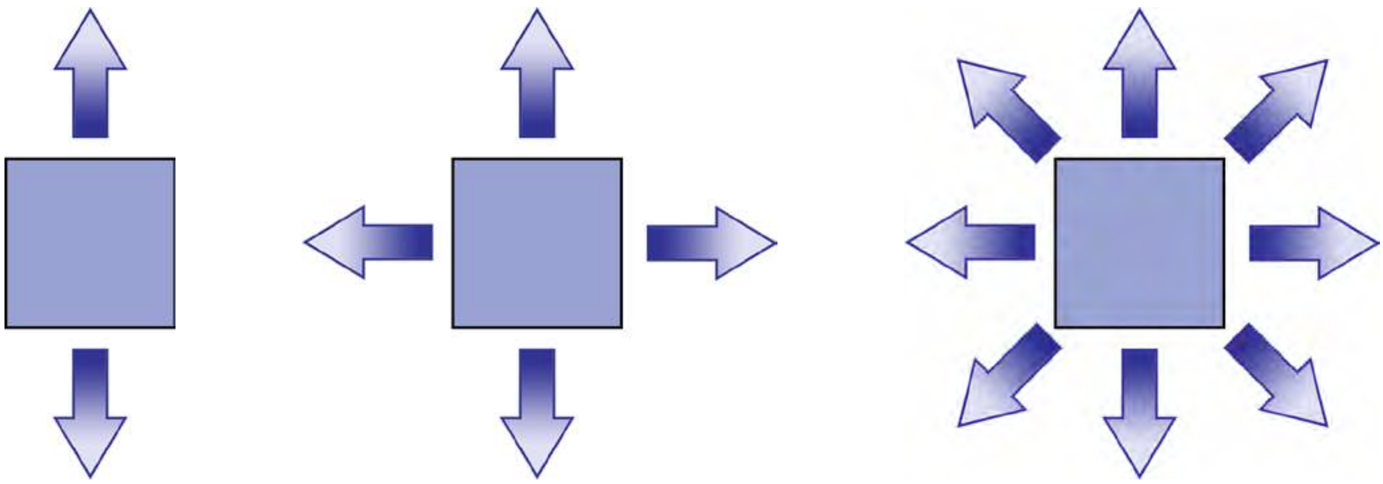
Optimum Diffusion Pattern

In addition to the flexibility offered by a modular designed small unit, Halo has been designed to deliver the most comfortable environment at any given air volume. Traditional Active Chilled Beams with a 1 - way or 2 - way throw have the potential to throw air at high velocities over long distances, however this may result in low comfort levels - particularly where the air streams from adjacent beams meet and fall downwards into the occupied zone or where beams are located close to walls or partitions.

Beams with a 4 - way throw help to alleviate this problem, however Frenger's Halo beam takes the concept to the next level with is "true" 360° diffusion pattern.

The substantially shorter air discharge throws (35%) offered by Halo can enable more chilled beams to be positioned into a given room space for higher total heat gains to be offset whilst still avoiding draughts and providing a comfortable environment, compliant to BS EN ISO 7730.

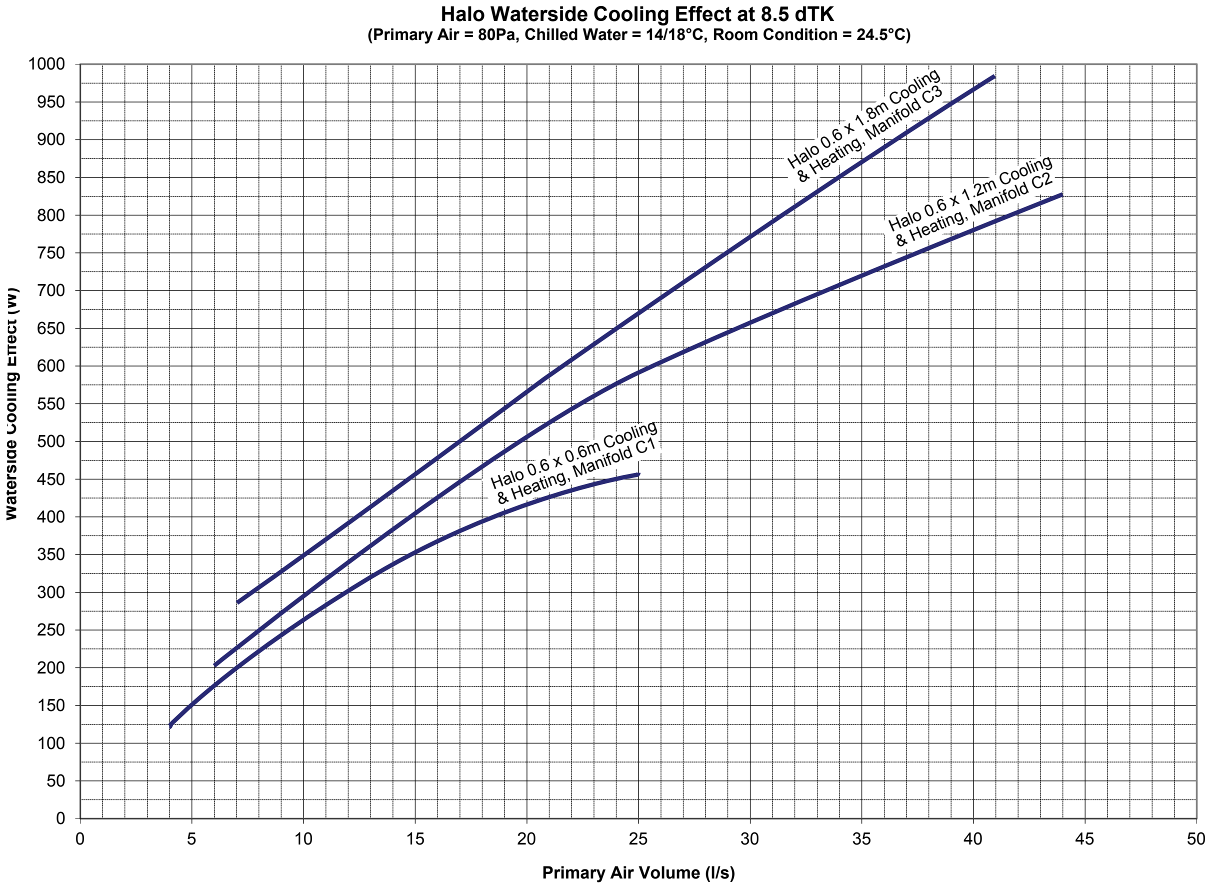
Halo® Free-Hanging Exposed Active Chilled Beam 600 x 600 optional extra



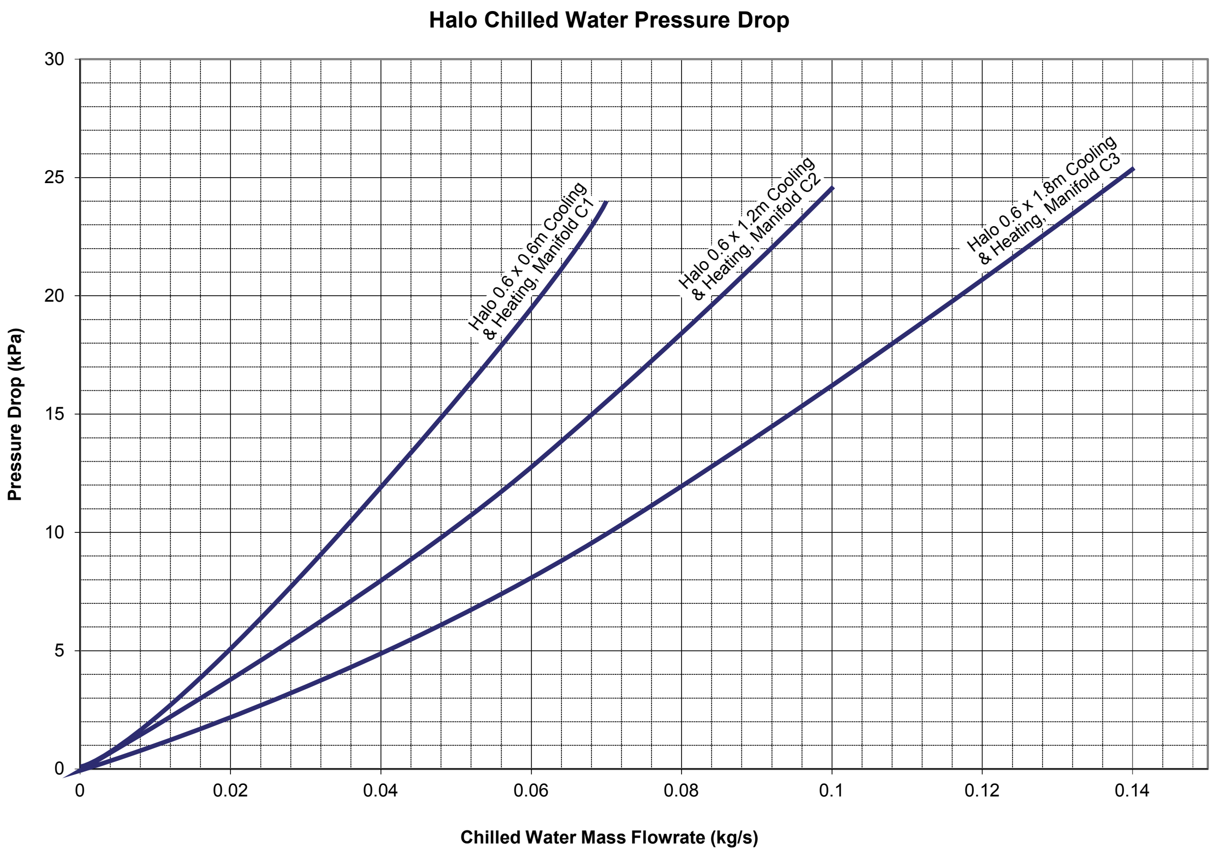
Traditional 2 - way discharge beam | *More recent 4 - way discharge beam* | *Halo™ "True" 360° discharge beam*

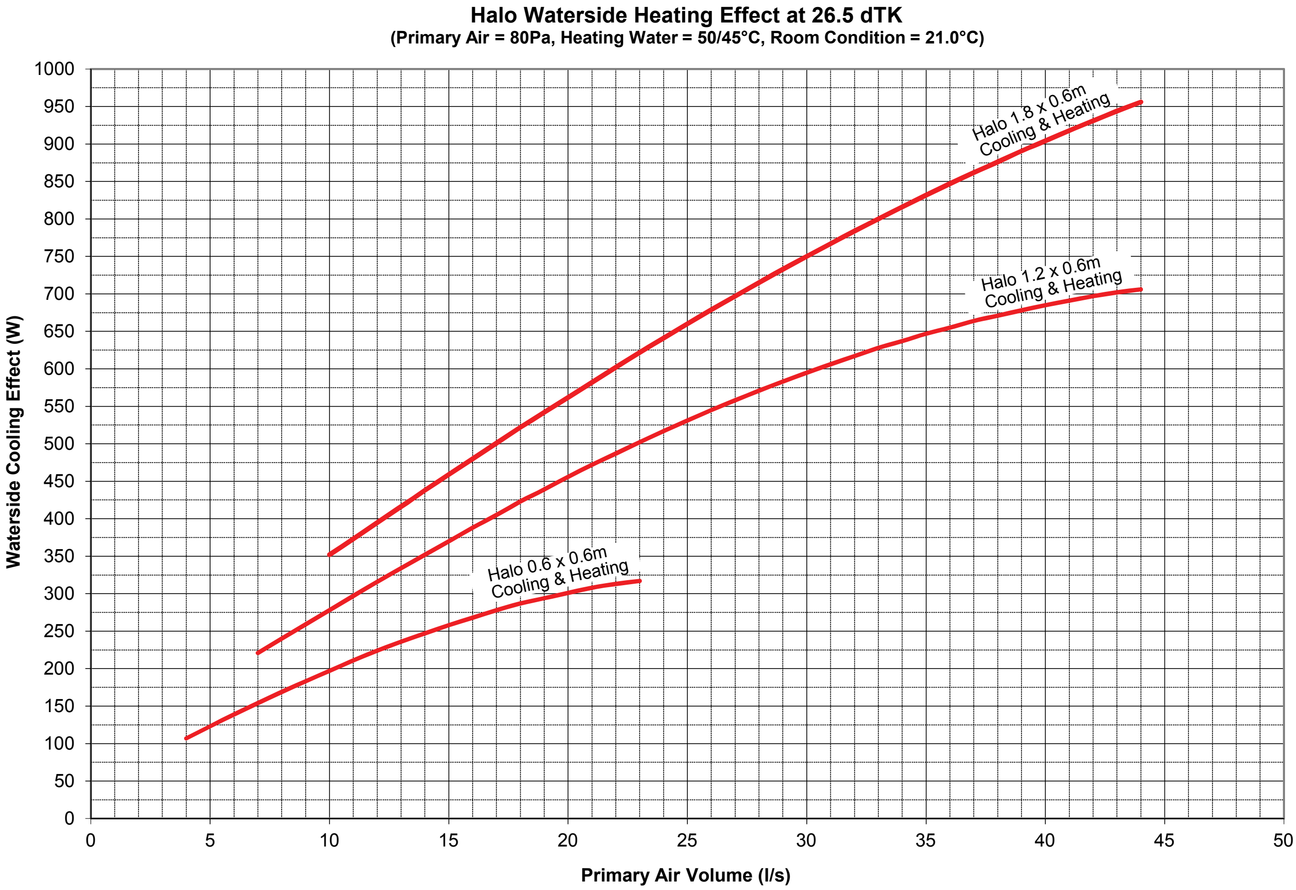
Halo distributes air in a 360° pattern for shorter air throws and optimum comfort.

Cooling Performance

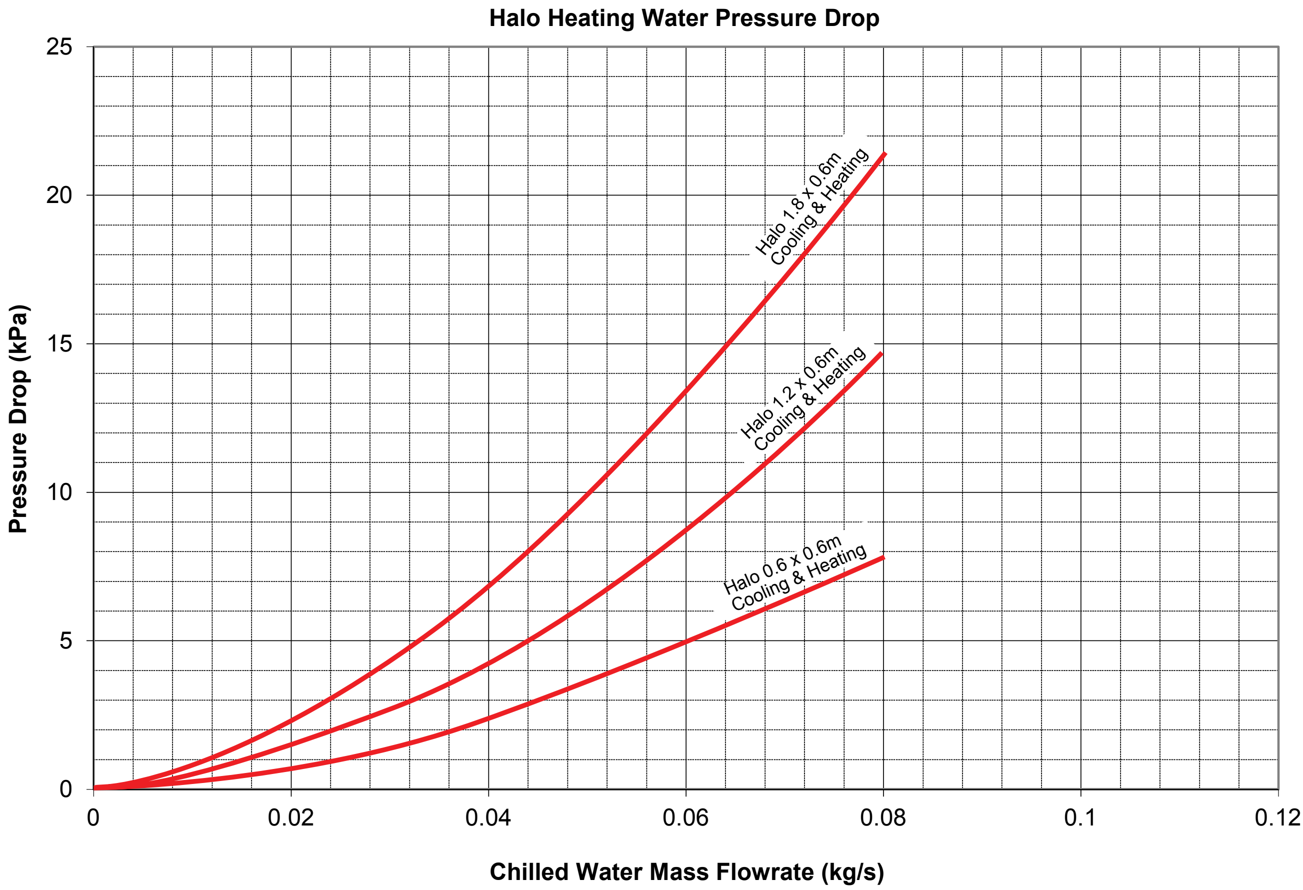


Pressure Drop





Pressure Drop



Cooling Selection Tables

Cooling at 40Pa Nozzle Pressure

Nozzle Pressure 40 Pa		Water															
Q (l/s)	Halo	ΔtK - 7°C				ΔtK - 8°C				ΔtK - 9°C				ΔtK - 10°C			
	L (m)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)
5	0.6	82	0.007	C1	1.3	104	0.008	C1	1.7	128	0.010	C1	2.1	152	0.012	C1	2.6
	1.2	135	0.011	C1	6.1	168	0.013	C1	7.9	201	0.016	C1	9.8	234	0.019	C1	11.8
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	0.6	162	0.013	C1	2.8	201	0.016	C1	3.6	241	0.019	C1	4.5	279	0.022	C1	5.5
	1.2	244	0.019	C1	12.5	292	0.023	C1	16.0	339	0.027	C1	19.9	383	0.030	C1	24.1
	1.8	211	0.017	C2	3.8	264	0.021	C2	4.9	320	0.025	C2	6.1	378	0.030	C2	7.4
15	0.6	209	0.017	C1	3.8	260	0.021	C1	5.0	310	0.025	C1	6.4	357	0.028	C1	7.9
	1.2	335	0.027	C1	19.6	392	0.031	C1	25.0	359	0.029	C2	4.3	423	0.034	C2	5.2
	1.8	309	0.025	C2	5.9	383	0.030	C2	7.5	457	0.036	C2	9.4	530	0.042	C2	11.4
20	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	304	0.024	C2	3.5	380	0.030	C2	4.6	457	0.036	C2	5.8	533	0.042	C2	7.1
	1.8	404	0.032	C2	8.1	493	0.039	C2	10.4	579	0.046	C2	12.9	662	0.053	C2	15.7
25	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	350	0.028	C2	4.2	439	0.035	C2	5.5	528	0.042	C2	7.0	614	0.049	C2	8.6
	1.8	490	0.039	C2	10.3	589	0.047	C2	13.2	683	0.054	C2	16.5	773	0.062	C2	20.0
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	382	0.030	C2	4.7	482	0.038	C2	6.2	580	0.046	C2	8.0	675	0.054	C2	9.9
	1.8	562	0.045	C2	12.4	669	0.053	C2	16.0	770	0.061	C2	19.9	868	0.069	C2	24.1

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 40 Pa, 1 x Ø125 air connection.
Please refer to Frenger Technical Department for selections not covered within these tables.

Cooling at 60Pa Nozzle Pressure

Nozzle Pressure 60 Pa		Water															
Q (l/s)	Halo	ΔtK - 7°C				ΔtK - 8°C				ΔtK - 9°C				ΔtK - 10°C			
	L (m)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)
5	0.6	100	0.008	C1	1.6	127	0.010	C1	2.1	155	0.012	C1	2.6	183	0.015	C1	3.2
	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	0.6	187	0.015	C1	3.3	231	0.018	C1	4.3	274	0.022	C1	5.3	316	0.025	C1	6.5
	1.2	285	0.023	C1	15.4	337	0.027	C1	19.7	387	0.031	C1	24.4	348	0.028	C2	4.1
	1.8	262	0.021	C2	4.8	326	0.026	C2	6.2	392	0.031	C2	7.7	458	0.036	C2	9.4
15	0.6	245	0.019	C1	4.6	300	0.024	C1	6.1	351	0.028	C1	7.6	399	0.032	C1	9.4
	1.2	378	0.030	C1	23.5	346	0.028	C2	4.1	418	0.033	C2	5.1	489	0.039	C2	6.3
	1.8	370	0.029	C2	7.2	453	0.036	C2	9.3	535	0.043	C2	11.6	615	0.049	C2	14.1
20	0.6	278	0.022	C1	5.5	337	0.027	C1	7.2	392	0.031	C1	9.1	443	0.035	C1	11.1
	1.2	353	0.028	C2	4.2	438	0.035	C2	5.5	523	0.042	C2	6.9	605	0.048	C2	8.4
	1.8	471	0.037	C2	9.8	568	0.045	C2	12.6	660	0.053	C2	15.6	748	0.060	C2	19.0
25	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	411	0.033	C2	5.1	509	0.040	C2	6.7	603	0.048	C2	8.4	693	0.055	C2	10.3
	1.8	560	0.045	C2	12.3	666	0.053	C2	15.9	766	0.061	C2	19.7	863	0.069	C2	23.8
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	455	0.036	C2	5.8	562	0.045	C2	7.6	664	0.053	C2	9.7	760	0.060	C2	11.9
	1.8	635	0.051	C2	14.8	749	0.060	C2	19.0	856	0.068	C2	23.5	894	0.071	C3	9.2

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 60 Pa, 1 x Ø125 air connection.
Please refer to Frenger Technical Department for selections not covered within these tables.

Cooling at 80Pa Nozzle Pressure

Nozzle Pressure 80 Pa		Water															
Q (l/s)	Halo	ΔtK - 7 °C				ΔtK - 8 °C				ΔtK - 9 °C				ΔtK - 10 °C			
	L (m)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)
5	0.6	122	0.010	C1	2.0	154	0.012	C1	2.6	186	0.015	C1	3.2	186	0.015	C1	3.2
	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	0.6	222	0.018	C1	4.0	271	0.022	C1	5.2	317	0.025	C1	6.6	317	0.025	C1	6.6
	1.2	330	0.026	C1	19.1	385	0.031	C1	24.3	353	0.028	C2	4.2	353	0.028	C2	4.2
	1.8	323	0.026	C2	6.1	398	0.032	C2	7.9	473	0.038	C2	9.8	473	0.038	C2	9.8
15	0.6	299	0.024	C1	6.0	357	0.028	C1	7.8	410	0.033	C1	9.8	410	0.033	C1	9.8
	1.2	330	0.026	C2	3.9	410	0.033	C2	5.0	490	0.039	C2	6.3	490	0.039	C2	6.3
	1.8	440	0.035	C2	9.0	533	0.042	C2	11.5	622	0.049	C2	14.3	622	0.049	C2	14.3
20	0.6	353	0.028	C1	7.7	414	0.033	C1	9.9	472	0.038	C1	12.2	472	0.038	C1	12.2
	1.2	421	0.033	C2	5.2	517	0.041	C2	6.8	609	0.048	C2	8.5	609	0.048	C2	8.5
	1.8	549	0.044	C2	12.0	653	0.052	C2	15.4	752	0.060	C2	19.1	752	0.060	C2	19.1
25	0.6	379	0.030	C1	8.6	441	0.035	C1	11.0	504	0.040	C1	13.5	504	0.040	C1	13.5
	1.2	501	0.040	C2	6.5	607	0.048	C2	8.5	708	0.056	C2	10.6	708	0.056	C2	10.6
	1.8	645	0.051	C2	15.1	758	0.060	C2	19.4	866	0.069	C2	24.0	866	0.069	C2	24.0
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	569	0.045	C2	7.7	683	0.054	C2	10.1	788	0.063	C2	12.6	788	0.063	C2	12.6
	1.8	730	0.058	C2	18.3	851	0.068	C2	23.3	901	0.072	C3	9.3	1027	0.072	C3	9.3

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 80 Pa, 1 x Ø125 air connection.
Please refer to Frenger Technical Department for selections not covered within these tables.

Cooling at 100Pa Nozzle Pressure

Nozzle Pressure 100 Pa		Water															
Q (l/s)	Halo	ΔtK - 7 °C				ΔtK - 8 °C				ΔtK - 9 °C				ΔtK - 10 °C			
	L (m)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)	P (w)	p(kg/s)	Manifold	p(kPa)
5	0.6	146	0.012	C1	2.4	183	0.015	C1	3.2	220	0.017	C1	4.0	256	0.020	C1	4.9
	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	0.6	249	0.020	C1	4.7	301	0.024	C1	6.1	349	0.028	C1	7.6	395	0.031	C1	9.2
	1.2	375	0.030	C2	23.3	344	0.027	C2	4.1	416	0.033	C2	5.1	487	0.039	C2	6.2
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	0.6	326	0.026	C1	6.8	385	0.031	C1	8.8	440	0.035	C1	10.9	497	0.040	C1	13.2
	1.2	378	0.030	C2	4.5	467	0.037	C2	5.9	554	0.044	C2	7.4	637	0.051	C2	9.1
	1.8	513	0.041	C2	10.9	614	0.049	C2	14.0	709	0.056	C2	17.4	800	0.064	C2	21.1
20	0.6	377	0.030	C1	8.5	440	0.035	C1	10.9	504	0.040	C1	13.5	578	0.046	C1	16.3
	1.2	472	0.038	C2	6.0	574	0.046	C2	7.8	670	0.053	C2	9.8	761	0.061	C2	11.9
	1.8	619	0.049	C2	14.2	729	0.058	C2	18.2	834	0.066	C2	22.5	871	0.069	C3	8.9
25	0.6	403	0.032	C1	9.5	470	0.037	C1	12.1	541	0.043	C1	14.9	766	0.050	C1	18.0
	1.2	552	0.044	C2	7.4	663	0.053	C2	9.6	766	0.061	C2	12.0	864	0.069	C2	14.6
	1.8	713	0.057	C2	17.6	831	0.066	C2	22.4	879	0.070	C3	9.0	1007	0.080	C3	10.9
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	620	0.049	C2	8.7	736	0.059	C2	11.3	844	0.067	C2	14.1	952	0.076	C2	17.0
	1.8	795	0.063	C2	20.9	847	0.067	C3	8.5	991	0.079	C3	10.7	1127	0.090	C3	13.0

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 100 Pa, 1 x Ø125 air connection.
Please refer to Frenger Technical Department for selections not covered within these tables.

Heating Selection Tables

Heating at 40Pa Nozzle Pressure

Nozzle Pressure 40 Pa		Water											
Q (l/s)	Halo	ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°C			ΔtK - 35°C		
	L (m)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)
5	0.6	101	0.012	0.3	121	0.012	0.3	140	0.012	0.3	161	0.012	0.3
	1.2	134	0.012	0.6	161	0.012	0.6	186	0.012	0.6	212	0.012	0.6
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
10	0.6	148	0.012	0.3	182	0.012	0.3	211	0.012	0.3	243	0.012	0.3
	1.2	194	0.012	0.6	230	0.012	0.6	269	0.012	0.6	309	0.012	0.6
	1.8	215	0.012	0.7	265	0.012	0.8	308	0.012	0.8	354	0.012	0.9
15	0.6	181	0.012	0.3	219	0.012	0.3	254	0.012	0.3	292	0.012	0.3
	1.2	232	0.012	0.5	290	0.012	0.6	337	0.012	0.6	380	0.012	0.6
	1.8	272	0.012	0.8	327	0.012	0.8	383	0.012	0.8	432	0.012	0.8
20	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	273	0.012	0.5	333	0.012	0.6	389	0.012	0.6	439	0.012	0.6
	1.8	321	0.012	0.9	382	0.012	0.8	442	0.012	0.8	503	0.012	0.8
25	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	296	0.012	0.5	361	0.012	0.5	418	0.012	0.5	475	0.012	0.5
	1.8	359	0.012	0.9	423	0.012	0.8	495	0.012	0.8	593	0.014	1.1
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	317	0.012	0.5	393	0.012	0.6	445	0.012	0.5	523	0.013	0.6
	1.8	388	0.012	0.8	471	0.012	0.9	556	0.012	1.0	676	0.016	1.4

Flow-adjusted waterside heating effect table. Heating circuit Δt = 10°C (Water in-out), nozzle pressure of 40 Pa, 1 x Ø125 air connection.

For red values, the flow rate has been adjusted to the recommended minimum flow of 0.012 kg/s.

Heating at 60Pa Nozzle Pressure

Nozzle Pressure 60 Pa		Water											
Q (l/s)	Halo	ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°C			ΔtK - 35°C		
	L (m)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)
5	0.6	112	0.012	0.3	134	0.012	0.3	157	0.012	0.3	183	0.012	0.3
	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
10	0.6	167	0.012	0.3	200	0.012	0.3	233	0.012	0.3	264	0.012	0.3
	1.2	213	0.012	0.6	257	0.012	0.6	301	0.012	0.6	341	0.012	0.6
	1.8	248	0.012	0.8	298	0.012	0.9	347	0.012	0.9	397	0.012	0.9
15	0.6	200	0.012	0.3	239	0.012	0.3	279	0.012	0.3	318	0.012	0.3
	1.2	260	0.012	0.6	311	0.012	0.6	364	0.012	0.6	413	0.012	0.6
	1.8	301	0.012	0.8	361	0.012	0.8	418	0.012	0.8	479	0.012	0.8
20	0.6	209	0.012	0.3	251	0.012	0.3	293	0.012	0.3	333	0.012	0.3
	1.2	305	0.012	0.6	365	0.012	0.6	416	0.012	0.6	484	0.012	0.6
	1.8	349	0.012	0.9	415	0.012	0.9	484	0.012	0.8	571	0.014	1.0
25	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	326	0.012	0.5	387	0.012	0.5	450	0.012	0.5	531	0.013	0.6
	1.8	386	0.012	0.8	461	0.012	0.8	552	0.012	1.0	670	0.016	1.3
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	347	0.012	0.5	412	0.012	0.5	482	0.012	0.5	585	0.014	0.7
	1.8	417	0.012	0.8	502	0.012	0.8	625	0.015	1.2	760	0.018	1.7

Flow-adjusted waterside heating effect table. Heating circuit Δt = 10°C (Water in-out), nozzle pressure of 60 Pa, 1 x Ø125 air connection.

For red values, the flow rate has been adjusted to the recommended minimum flow of 0.012 kg/s.

Heating at 80Pa Nozzle Pressure

Nozzle Pressure 80 Pa		Water											
Q (l/s)	Halo	ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°C			ΔtK - 35°C		
	L (m)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)
5	0.6	125	0.012	0.3	150	0.012	0.3	176	0.012	0.3	197	0.012	0.3
	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	
10	0.6	185	0.012	0.3	221	0.012	0.3	255	0.012	0.3	295	0.012	0.3
	1.2	237	0.012	0.6	285	0.012	0.6	330	0.012	0.6	373	0.012	0.6
	1.8	278	0.012	0.8	333	0.012	0.9	388	0.012	0.9	439	0.012	0.8
15	0.6	223	0.012	0.3	268	0.012	0.3	314	0.012	0.3	359	0.012	0.3
	1.2	291	0.012	0.6	348	0.012	0.6	401	0.012	0.6	455	0.012	0.6
	1.8	333	0.012	0.8	400	0.012	0.9	464	0.012	0.9	535	0.012	0.9
20	0.6	245	0.012	0.3	292	0.012	0.3	341	0.012	0.3	387	0.012	0.3
	1.2	334	0.012	0.6	402	0.012	0.6	465	0.012	0.6	534	0.012	0.6
	1.8	382	0.012	0.8	455	0.012	0.9	539	0.012	0.9	655	0.016	1.3
25	0.6	254	0.012	0.3	308	0.012	0.3	353	0.012	0.3	422	0.012	0.3
	1.2	373	0.012	0.6	438	0.012	0.6	509	0.012	0.6	618	0.015	0.8
	1.8	426	0.012	0.9	503	0.012	0.8	632	0.015	1.2	769	0.018	1.7
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	385	0.012	0.5	463	0.012	0.5	570	0.014	0.7	693	0.017	1.0
	1.8	442	0.012	0.7	572	0.012	1.0	720	0.017	1.5	876	0.021	2.2

Flow-adjusted waterside heating effect table. Heating circuit Δt = 10°C (Water in-out), nozzle pressure of 80 Pa, 1 x Ø125 air connection.

For red values, the flow rate has been adjusted to the recommended minimum flow of 0.012 kg/s.

Heating at 100Pa Nozzle Pressure

Nozzle Pressure 100 Pa		Water											
Q (l/s)	Halo	ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°C			ΔtK - 35°C		
	L (m)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)	P (w)	p(kg/s)	p(kPa)
5	0.6	139	0.012	0.3	171	0.012	0.3	196	0.012	0.3	221	0.012	0.3
	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
10	0.6	197	0.012	0.3	234	0.012	0.3	273	0.012	0.3	316	0.012	0.3
	1.2	258	0.012	0.6	315	0.012	0.6	367	0.012	0.6	410	0.012	0.6
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
15	0.6	234	0.012	0.3	275	0.012	0.3	320	0.012	0.3	369	0.012	0.3
	1.2	315	0.012	0.6	375	0.012	0.6	433	0.012	0.6	491	0.012	0.6
	1.8	368	0.012	0.9	437	0.012	0.9	511	0.012	0.9	613	0.015	1.2
20	0.6	255	0.012	0.3	306	0.012	0.3	355	0.012	0.3	422	0.012	0.3
	1.2	356	0.012	0.6	429	0.012	0.6	495	0.012	0.6	582	0.014	0.7
	1.8	414	0.012	0.9	498	0.012	0.9	605	0.014	1.1	735	0.018	1.6
25	0.6	269	0.012	0.3	323	0.012	0.3	375	0.012	0.3	436	0.012	0.3
	1.2	388	0.012	0.6	463	0.012	0.6	552	0.013	0.7	670	0.016	0.9
	1.8	451	0.012	0.8	556	0.012	1.0	700	0.017	1.5	851	0.020	2.0
30	0.6	-	-	-	-	-	-	-	-	-	-	-	-
	1.2	406	0.012	0.5	488	0.012	0.5	614	0.015	0.8	746	0.018	1.1
	1.8	473	0.012	0.7	626	0.015	1.2	789	0.019	1.8	960	0.023	2.5

Flow-adjusted waterside heating effect table. Heating circuit Δt = 10°C (Water in-out), nozzle pressure of 100 Pa, 1 x Ø125 air connection.

For red values, the flow rate has been adjusted to the recommended minimum flow of 0.012 kg/s.

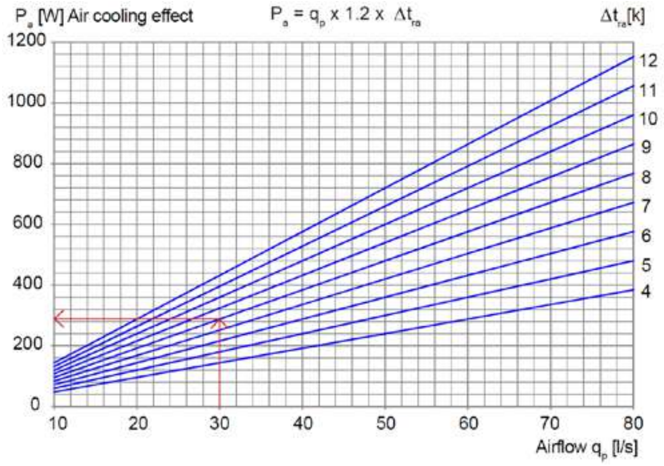
Air Cooling Effect

Cooling effect supplied in the ventilation air [W]

1. Start by calculating the required cooling effect that has to be supplied to the room in order to provide a certain temperature.
2. Calculate any cooling effect that is provided by the ventilation air.
3. The remaining cooling effect has to be supplied by the beam.

Formula for air cooling effect: $P = m \times Cp \times \Delta t$
Where:
m = mass flow [kg/s]
Cp = specific heat capacity [J/(kg-K)]
qp = air flow [l/s]
Δt = the difference between the temperature of the room and the temperature of the supply air [K].

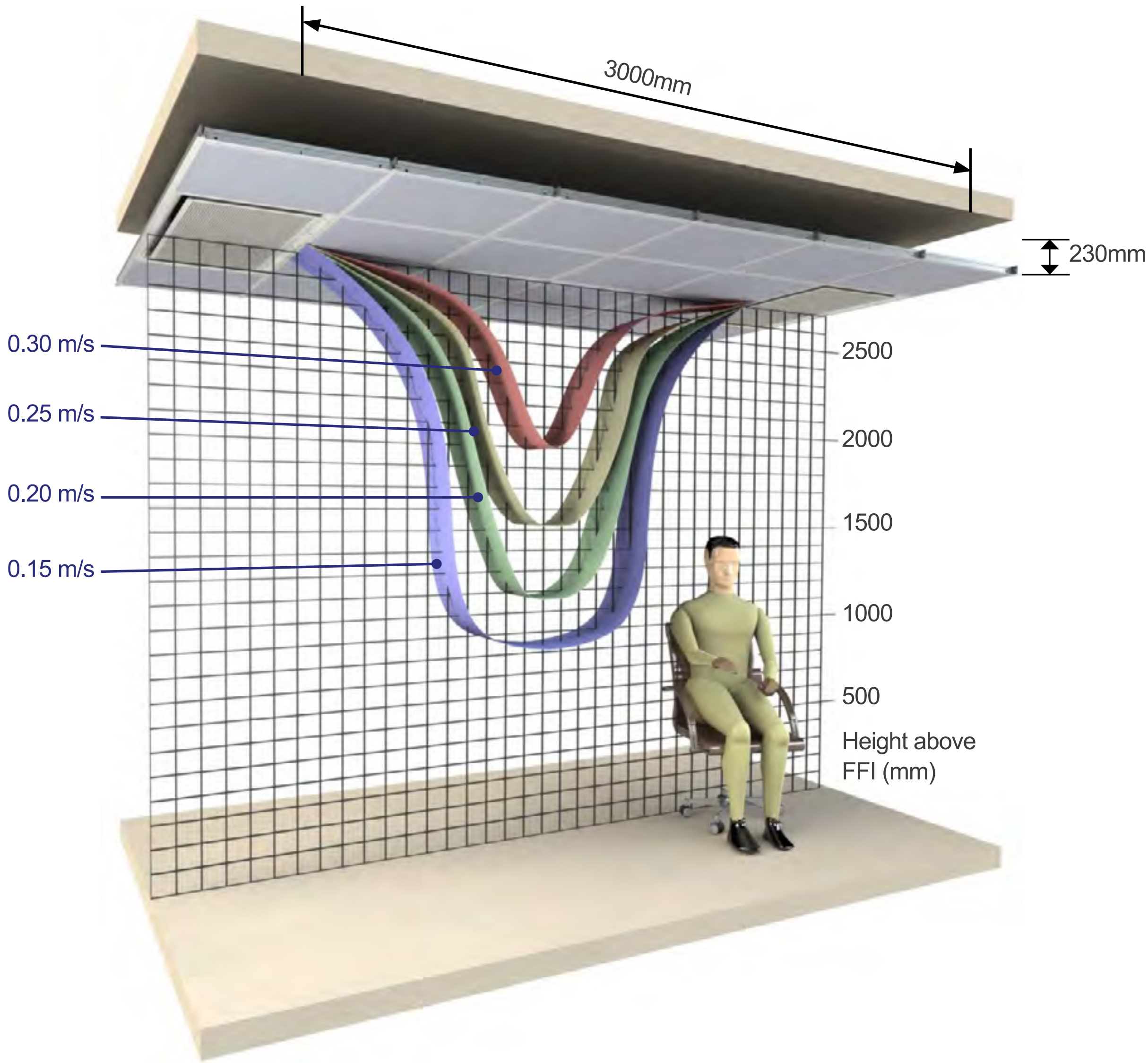
It is usually $m \times Cp \approx qp \times 1.2$



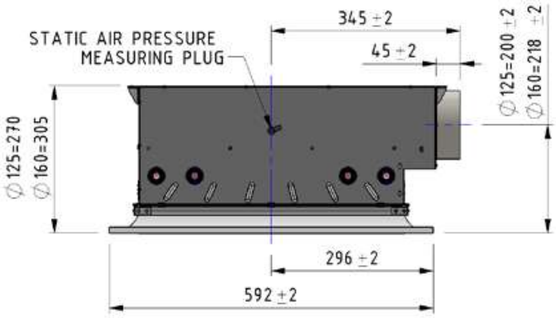
Air cooling effect as a function of airflow. For example, if the air flow is 30 l/s and the under - temperature of the supply air is Δt_{ra} = 8K, the cooling effect from the graph is 290W.

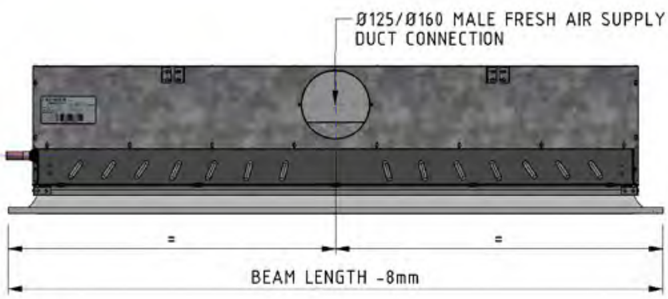
Scatter Diagram

Fresh Air Volume 35 l / s per beam @ 80 Pa

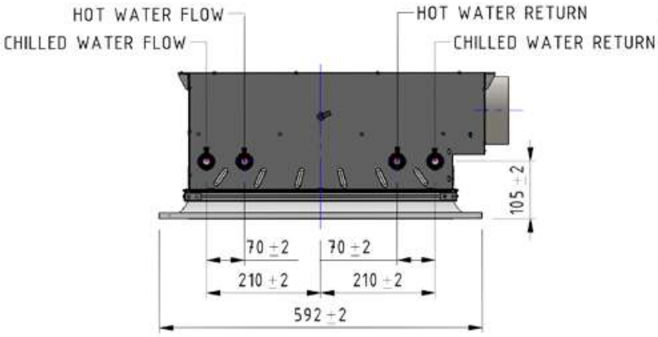


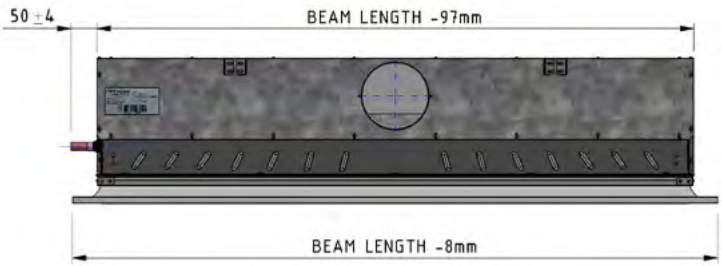
Air Connection



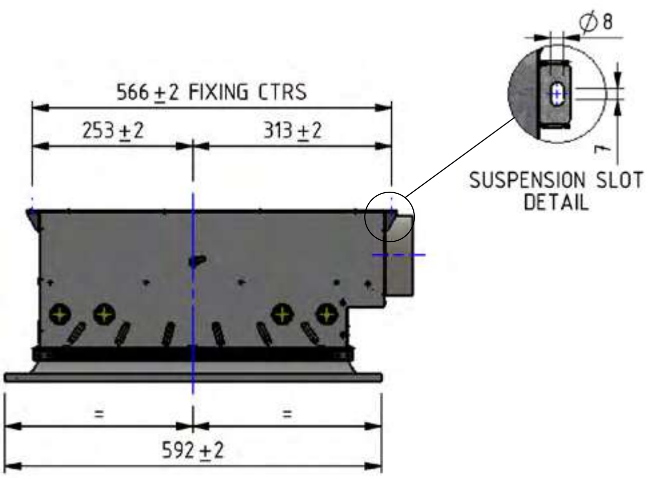


Water Connections





Mounting Details



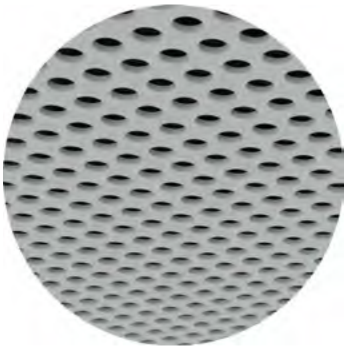
0.6m

1.2m

1.8m

Perforation Pattern Options

Slot Perforation
45% Free Area



Dot Perforation
33% Free Area

Double Dot Perforation
51% Free Area

Product Ordering Codes

2. Function

CO - Ceiling Int. Cooling Only

CH - Ceiling Int. Cooling & Heating

4. Underplate

7D - 7Ø & 4Ø Double Dot / 51% Free Area

4D - 4Ø DOT / 33% Free Area

5S - 5x35 Slot / 43% Free Area

6. Waterside Connection

Battery Manifold Types - C1/C2

15 C3 H — Orientation - H: Horizontal

Chilled Water Connection Size (mm) 15 / 22

1. Beam Type

HAI - Halo "Integrated"

HAC - Halo "Clip in"

HAF - Halo "Free Hanging"

3. Nominal Beam Length (m)

5. Airside Connection

Air Connection Qty

1 x 125 H — Orientation - H: Horizontal

Air Connection Spigot Size (mm) 125

7. Air Supply / Discharge

Air Supply Volume (l/s)

21 80 L

Air Discharge Characteristics

L: Long Throw - No Discharge Vanes

M: Medium Throw - 18° Discharge Vanes

S: Short Throw - 35° Discharge Vanes

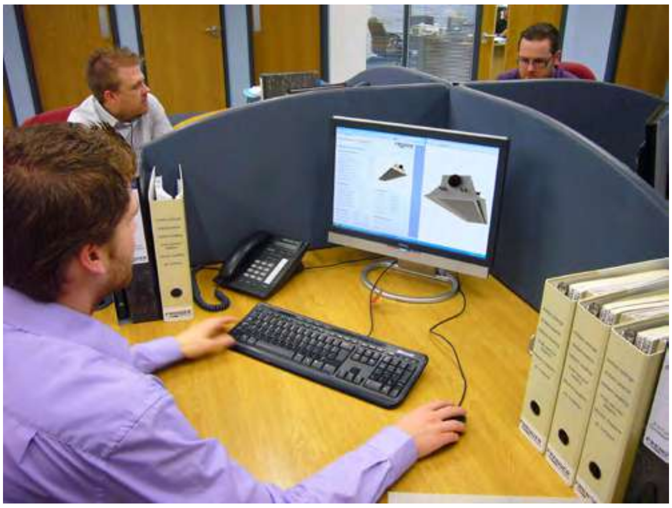
Air Supply Nozzle Pressure (Pa)

Example:

HAI	CH	0.6	7D	-	1 x 125H	H15C2H	-	2180L
1	2	3	4		5	6		7

Project Example - Tropical Medicine

Calculation Program



Active Chilled Beam Calculation Tool

FRENGER systems

Is this the latest version?

version 1.1.5c

Project Ref.

Halo Active Beam Data

Halo Type	Standard	
Air Connection Orientation	Vertical	
Air Connection	1x125	mm
Product Length	1.2	m
Manifold Type	C2	
Air Discharge Throw	S	
Nozzle Static Pressure	80	Pa
Fresh Air Supply Volume	20	l/s
Underplate Perforation Type	51% DOT	
Heating Function	Yes	
Ceiling System	Lay In Grid	

Design Conditions	*Cooling*		*Heating*	
Flow Water Temperature	14.0	°C	50.0	°C
Return Water Temperature	17.0	°C	40.0	°C
Air Supply Temperature	16.0	°C	19.0	°C
Average Room Condition	24.0	°C	21.0	°C
"Air On" Thermal Gradient	0.7	°C		
Room Relative Humidity	45.0	%		

Dimensional Data

Width x Depth	592 x 255	mm
Overall Length	1192	mm
Water Volume	2.5	
Dry Weight	32.5	kg
CW Connection	Ø15	mm
LTHW Connection	Ø15	mm

Performance Data	*Cooling*		*Heating*	
Room - Mean Water dT	9.20	K	24	K
Waterside Performance	522	W	309	W
Water Mass Flowrate	0.042	kg/s	0.007	kg/s
Waterside Pressure Drop	6.8	kPa	0.2	kPa
Airside Performance	192	W	-48	W
Total Sensible Performance	**714**	**W**	**281**	**W**
Sound Effect LW	<35	dB(A)		

Design Check (Warnings)

Supply Air	OK	
Cooling Circuit	OK	
Heating Circuit	OK	
Turn Down Vol @ 40Pa	14.2	°C
Calculated Dew Point	11.3	°C

Model Ref: HA-CH-12007D-1x125H15C2H-2080S

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 coefficent.

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

3) Air discharge throw guidance based on beams on 3m centres for alternative layouts contact Frenger Technical Dept for throw settings.

Halo Active Beam Data

Halo Type	Standard	
Air Connection Orientation	Vertical	
Air Connection	1x125	mm
Product Length	1.2	m
Manifold Type	C2	
Air Discharge Throw	S	
Nozzle Static Pressure	80	Pa
Fresh Air Supply Volume	20	l/s
Underplate Perforation Type	51% DOT	
Heating Function	Yes	
Ceiling System	Lay In Grid	

Frenger's calculation programme for Halo is extremely user friendly.

"Manifold Types" can be changed in to drop down menu for increased waterside cooling effect, however attention needs to be taken regarding resultant pressure drops (hydraulic resistance). If pressure drops need reducing, choose a higher numbered manifold (C2 being the highest and C1 being the lowest.)

"Discharge Throw" can be S (short), M (medium) or L (long).

"Underplate Perforated" options can be found on page 13.
Note: Smaller perforations (Ref 4D) has slight reduced heating and cooling performance.

Design Conditions	*Cooling*		*Heating*	
Flow Water Temperature	14.0	°C	50.0	°C
Return Water Temperature	17.0	°C	40.0	°C
Air Supply Temperature	16.0	°C	19.0	°C
Average Room Condition	24.0	°C	21.0	°C
"Air On" Thermal Gradient	0.7	°C		
Room Relative Humidity	45.0	%		

Complete your project data in the "Design Conditions" section. Please note that the "Air On" Thermal Gradient should not be used in normal instances.

Performance Data	*Cooling*		*Heating*	
Room - Mean Water dT	9.20	K	24	K
Waterside Performance	522	W	309	W
Waterside Mass Flowrate	0.042	kg/s	0.007	kg/s
Waterside Pressure Drop	6.8	kPa	0.2	kPa
Airside Performance	192	W	-48	W
Total Sensible Performance	**714**	**W**	**281**	**W**
Sound Effect Lw	<35	dB(A)		

"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 warning in red.
Calculation programs for Halo are available upon request.

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

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

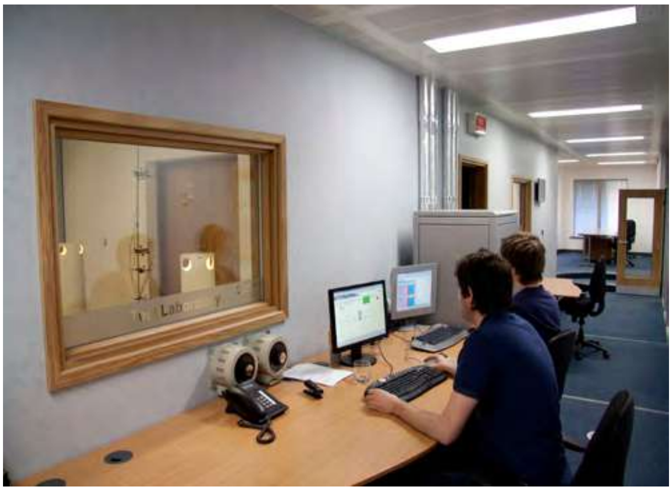
Project specific mock-up testing is a valuable tool which allows the Client to fully assess the proposed system and determine the resulting room occupancy Thermal Comfort conditions. The physical modelling is achieved by installing a full scale representation of a building zone complete with internal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

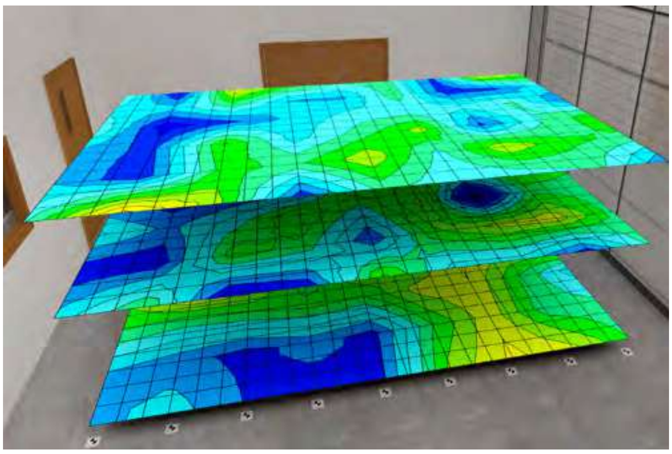
The installed mock-up enables the client to verify the following:

- 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.

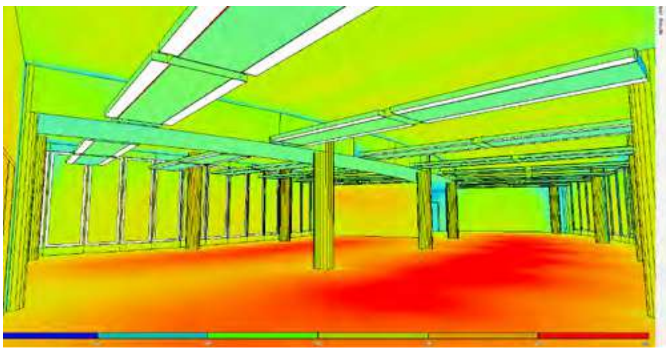
The intensity distribution is obtained by the use of a Goniophotometer to measure the intensity of light emitted from the surface of the fitting at pre-determined angles. The light intensity is measured using either a photometer with a corrective spectral response filter to match the CIE standard observer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

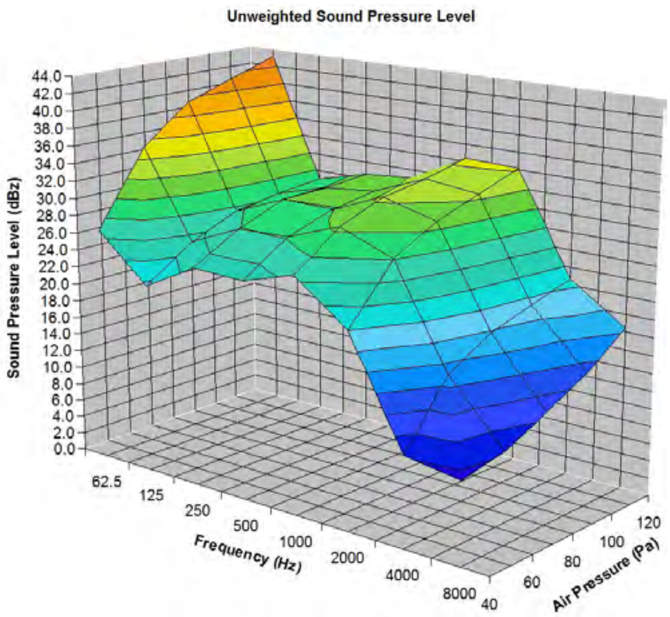
The Acoustic Test Room at Frenger is a hemi-anechoic chamber which utilises sound absorbing acoustic foam material in the shape of wedges to provide an echo free zone for acoustic measurements; the height of the acoustic foam wedge has a direct relationship with the maximum absorption frequency, hence 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.



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

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