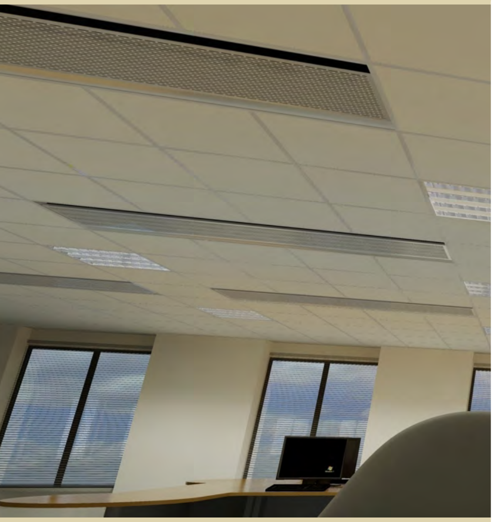
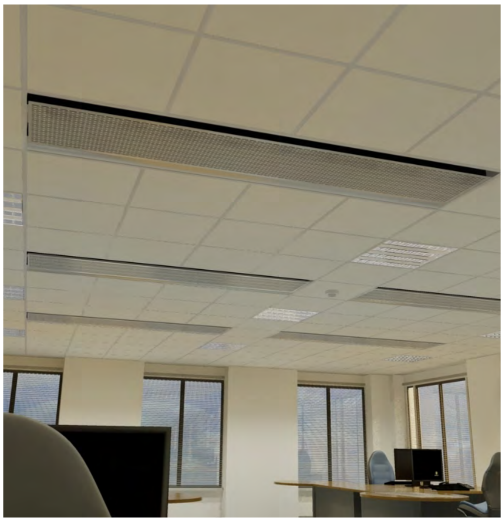
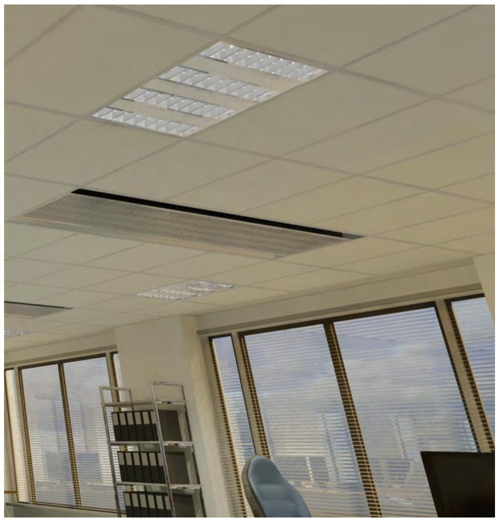
the future of space conditioning

Ultima®

active chilled beam







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FRENGER® systems

Contents

Product Description

Ultima 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.

Ultima is only **208mm deep** and can achieve **1050 watts per meter total cooling** (based on 10Δtk and 26 ltrs / sec / m for a 2.4m long beam supplied at 16°C with a 100Pa).

The Ultima beam contains a number of **Frenger's Patent pending performance enhancing features** and as can be expected from the Frenger brand, the Ultima beam is designed to be easily tailored to suit the unique parameters of individual project sited, for the optimum product / system efficiencies. This is partly achieved by Frenger's "burst nozzle" arrangement that not only encourages induction, but also reduces noise. Given the size and amount of burst nozzles being appropriately quantified for each project, this provides consistent jet velocities, equal distribution of the air discharge and continuous induction through the heat exchanger (battery). There are no dead spots due to plugging back nozzles from a standard pitch or having to adjust the pressure in the system to suit the amount of open standard nozzle sizes as associated with many competitors' active beams as dead spots and / or reduced velocities decrease their cooling capacities / efficiencies.

Frenger's heat exchanger batteries are also fitted with extruded aluminium profiles to not only enhance performance but also provide a continuous clip on facility for the underplates. This arrangement keeps the underplates true and flat for long lengths, even up to 3.6m

Ultima beams all have a "closed back", this means that all induced air (recirculated room air) is induced through the underplate within the room space to avoid any need for perimeter flash gaps and / or openings in the ceiling system. This also provides for a better quality of recirculated air as the recirculated air does not mix with any air from the ceiling void. The induction ratio of Ultima is typically 4-5 times that of the supply air (fresh air) rate.

The Ultima Chilled Beam outer casing is constructed from extruded aluminium and zintec pressed steel. The casing facilitates an aluminium burst nozzle strip (project specific) and a high performance heat exchange battery constructed from copper and aluminium. Beams are available in lengths from 0.6m up to 3,6m in 0.1m increments. Typically 0.6m wide (0.5m wide is also available).

In addition to Ultima's high cooling performace capability of in excess of 1000 watts per meter, **Ultima can operate well and induce at low air volumes, as little as 3.4 l / s / m and even with a low static pressure of just 40Pa. Likewise Ultima can handle high air volumes up to 30 l / s / m and up to 120Pa.** Please note however that these high air volumes should be avoided wherever possible and are the absolute maximum and should not ever be exceeded. As a "rule of thumb" 25 ltrs / sec / m from a 2 way discharge beam is the maximum for occupancy comfort compliance to BS EN 7730.

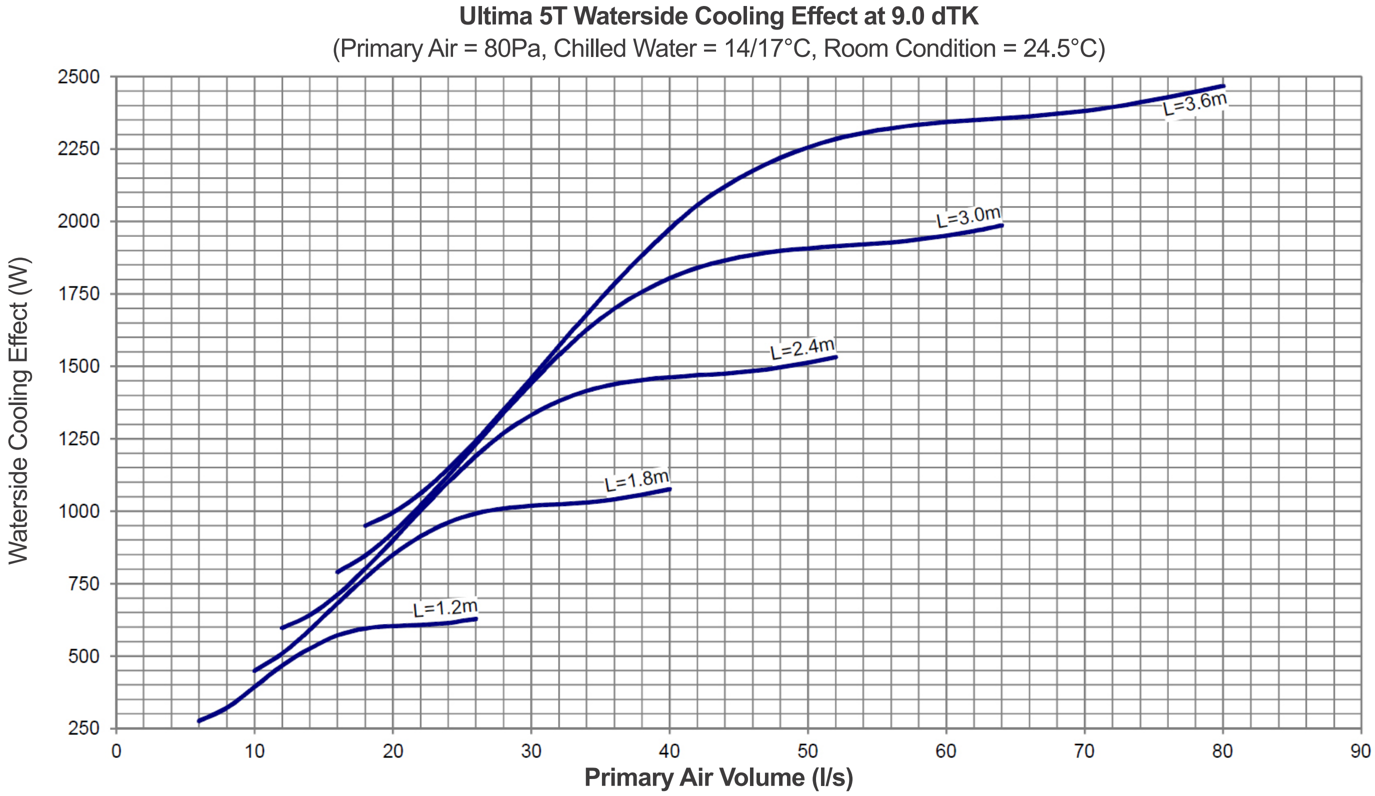
The maximum total supply air for the product is limited to 80 ltrs / sec. If the total air volume is less than 50 ltrs / sec, refer to the Compact active chilled beams by Frenger. Visually both units appear identical from the underside.

Ultima can have integrated heating with separate connections (2 pipe connections for cooling and 2 pipes for heating).

At a glance

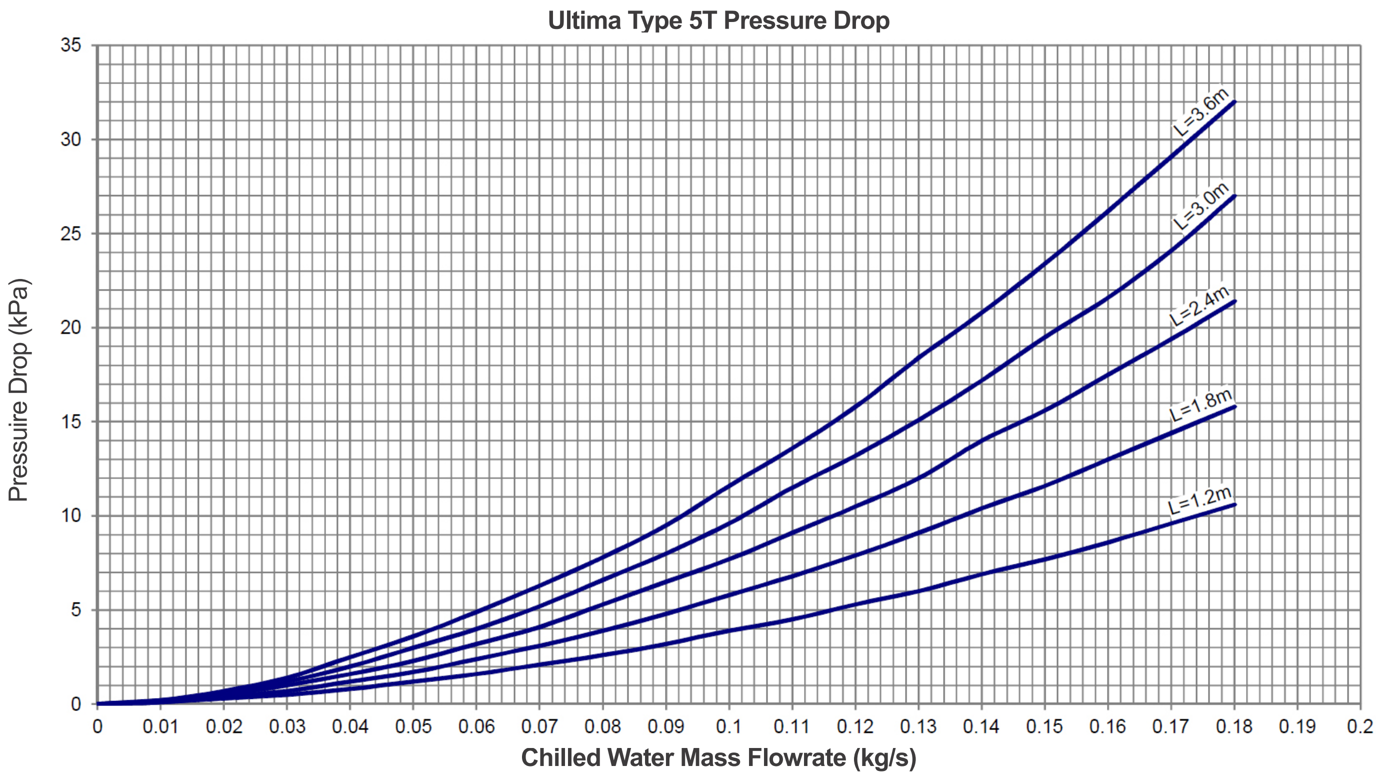
- Can handle high Air Volume (upto 80ltrs / sec total).
- High output **"1050 W / m"**.
- Optimise discharge nozzle sizes and pitch factory set to best suit project requirements.
- Coanda effect is initiated within the beam.
- Smooth curved discharged slot as opposed to traditional faceted discharge slots for improved aesthetics.
- Discharge veins are concealed within the beam for improved aesthetics.
- **Fan shape distribution for increased occupancy comfort.**
- Unique fast fixing of removable underplates that prevents any sagging eben on long beam lengths of 3.6m.
- Various different perforation patterns available for removable underplates.
- Multiple manifold variants to enable **reduced chilled** (and LTHW, if applicable) **water mass flow rates** to be facilitated for **increased energy efficiencies.**
- Operates well at **"Low Pressure"** and **"Low Air Volume"** for **increased energy efficiencies.**
- Provides indoor climate **in accordance with BS EN ISO 7730.**

Cooling Performance

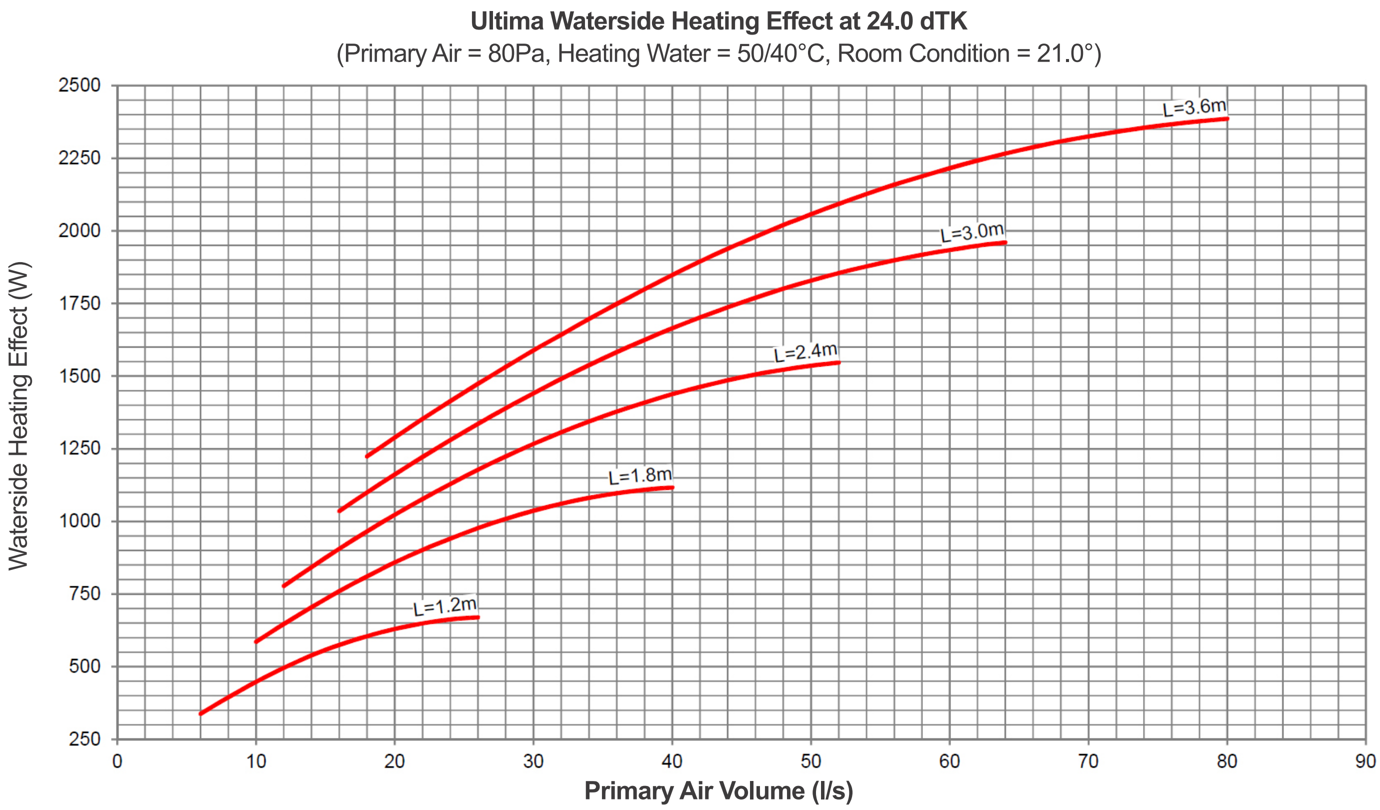


Cooling figures are based on a cooling & heating beam, additional cooling is possible with a cooling only product - contact Frenger for more information

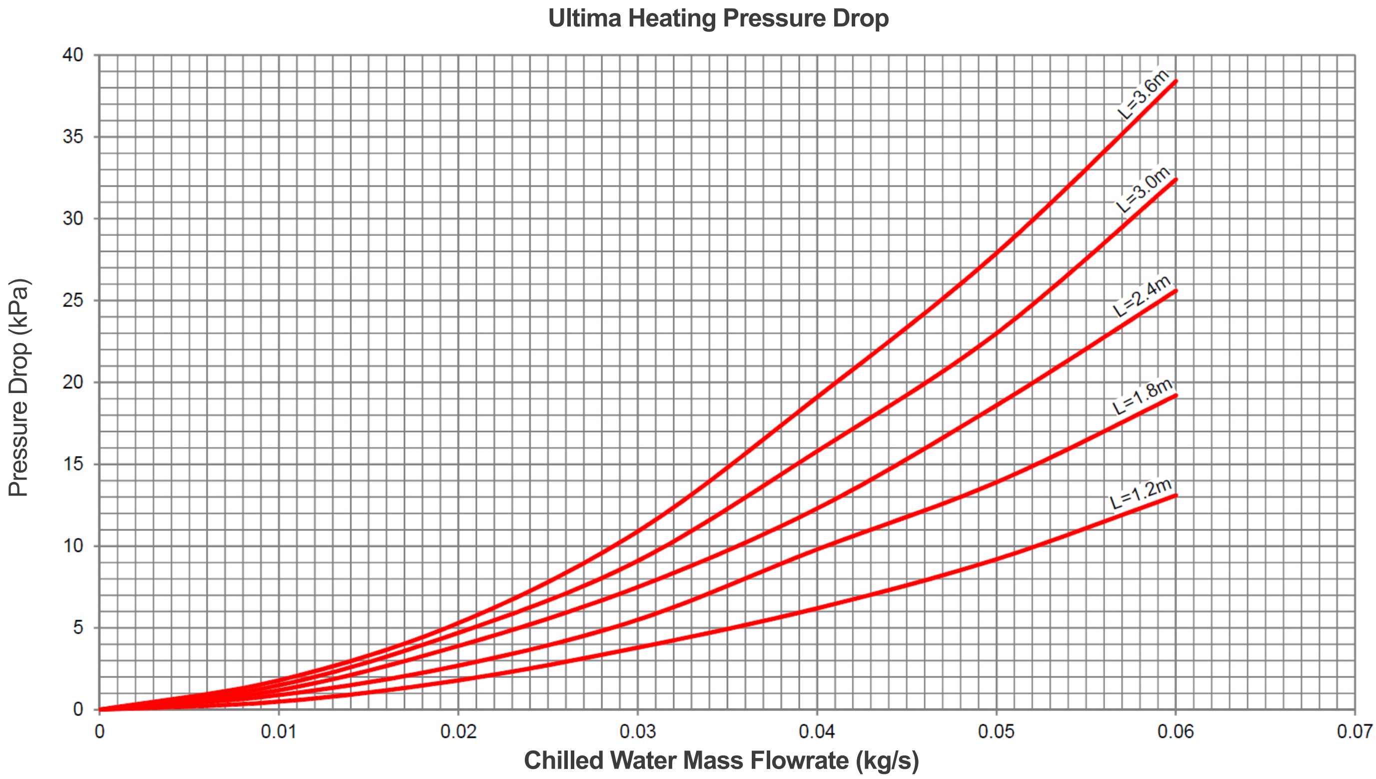
Pressure Drop



Heating Performance



Pressure Drop



Cooling Selection Tables

Cooling at 40Pa Nozzle Pressure

Nozzle Pressure 40 Pa		Water															
Q (l/s)	Ultima	ΔtK - 7°C				ΔtK - 8°C				ΔtK - 9°C				ΔtK - 10°C			
	L (m)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)
10	1.2	312	0.025	C2	3.3	346	0.021	C2	2.4	415	0.033	C2	5.4	467	0.037	C2	6.7
	1.8	355	0.025	C2	6.5	396	0.024	C2	4.8	470	0.037	C2	10.7	528	0.042	C2	13.2
	2.4	349	0.028	C2	8.7	390	0.023	C2	6.4	461	0.037	C2	14.2	517	0.042	C2	17.4
	3.0	368	0.029	C2	12.0	412	0.025	C2	8.9	485	0.039	C2	19.6	518	0.041	C3	7.5
	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	567	0.045	C2	14.6	630	0.038	C2	10.7	706	0.056	C3	7.4	795	0.063	C3	9.1
	2.4	689	0.055	C3	9.5	764	0.046	C3	7.0	913	0.073	C3	15.7	1025	0.082	C3	19.3
	3.0	739	0.059	C3	13.7	822	0.049	C3	10.1	937	0.075	C4	9.2	1054	0.084	C4	11.4
	3.6	738	0.059	C3	16.5	822	0.049	C3	12.2	937	0.075	C4	11.2	1052	0.084	C4	13.8
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	775	0.062	C3	11.7	860	0.051	C3	8.6	1024	0.082	C3	19.2	1105	0.088	C4	9.7
	3.0	937	0.075	C4	9.1	1089	0.065	C3	16.3	1241	0.099	C4	15.0	1394	0.111	C4	18.5
	3.6	1066	0.085	C4	13.8	1185	0.071	C4	10.2	1366	0.109	C5	12.8	1535	0.122	C5	15.7
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.0	984	0.078	C4	9.9	1143	0.068	C3	17.8	1303	0.104	C4	16.3	1418	0.113	C5	11.3
	3.6	1195	0.095	C4	16.8	1329	0.079	C4	12.4	1531	0.122	C5	15.5	1719	0.137	C5	19.1

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 40 Pa, 1 x Ø125 air connection.
For green values, a Ø22 mannifold connection size is required.
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)	Ultima	ΔtK - 7°C				ΔtK - 8°C				ΔtK - 9°C				ΔtK - 10°C			
	L (m)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)
10	1.2	342	0.027	C2	3.8	377	0.022	C2	2.8	457	0.036	C2	6.4	515	0.041	C2	7.9
	1.8	352	0.028	C2	6.4	391	0.023	C2	4.7	467	0.037	C2	10.6	524	0.042	C2	13.0
	2.4	387	0.031	C2	10.3	431	0.026	C2	7.6	510	0.041	C2	16.9	543	0.043	C3	6.5
	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	429	0.034	C2	5.7	471	0.028	C2	4.1	574	0.046	C2	9.5	647	0.052	C2	11.7
	1.8	648	0.052	C3	6.3	774	0.046	C2	15.2	867	0.069	C3	10.4	977	0.078	C3	12.9
	2.4	733	0.058	C3	10.6	810	0.048	C3	7.7	972	0.077	C3	17.5	1045	0.083	C4	8.8
	3.0	735	0.059	C3	13.6	816	0.049	C3	10.0	932	0.074	C4	9.2	1049	0.083	C4	11.3
	3.6	738	0.059	C3	16.6	822	0.049	C3	12.2	937	0.075	C4	11.2	1053	0.084	C4	13.8
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	683	0.054	C3	6.9	816	0.049	C2	16.6	913	0.073	C3	11.4	1029	0.082	C3	14.1
	2.4	973	0.077	C3	17.2	1078	0.064	C3	12.6	1233	0.098	C4	11.6	1388	0.110	C4	14.4
	3.0	1079	0.086	C4	11.6	1192	0.071	C4	8.5	1431	0.114	C4	19.1	1556	0.124	C5	13.2
	3.6	1124	0.086	C4	15.1	1246	0.074	C4	11.1	1439	0.115	C5	14.0	1618	0.129	C5	17.2
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	990	0.079	C3	17.8	1097	0.066	C3	13.0	1255	0.100	C4	12.0	1412	0.112	C4	14.8
	3.0	1239	0.099	C4	14.7	1370	0.082	C4	10.7	1586	0.126	C5	13.6	1784	0.142	C5	16.8
	3.6	1392	0.111	C5	13.0	1602	0.096	C4	17.0	1846	0.147	C5	20.0	2072	0.165	C5	20.0

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 60 Pa, 1 x Ø125 air connection.
For green values, a Ø22 mannifold connection size is required.
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)	Ultima	ΔtK - 7°C				ΔtK - 8°C				ΔtK - 9°C				ΔtK - 10°C			
	L (m)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)
10	1.2	345	0.028	C2	3.9	345	0.028	C2	3.9	465	0.037	C2	6.6	525	0.042	C2	8.2
	1.8	370	0.030	C2	7.0	370	0.030	C2	7.0	491	0.039	C2	11.6	552	0.044	C2	14.2
	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	479	0.038	C2	6.8	479	0.038	C2	6.8	645	0.051	C2	11.5	728	0.058	C2	14.3
	1.8	682	0.054	C3	6.8	682	0.054	C3	6.8	918	0.073	C3	11.5	1036	0.082	C3	14.2
	2.4	742	0.059	C3	10.8	742	0.059	C3	10.8	987	0.079	C3	17.9	1059	0.084	C4	9.0
	3.0	752	0.060	C3	14.1	752	0.060	C3	14.1	953	0.076	C4	9.5	1073	0.085	C4	11.7
	3.6	790	0.063	C3	18.6	790	0.063	C3	18.6	1003	0.080	C4	12.6	1127	0.090	C4	15.5
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	764	0.061	C3	8.2	764	0.061	C3	8.2	1025	0.082	C3	13.9	1155	0.092	C3	17.2
	2.4	1048	0.083	C3	19.5	1048	0.083	C3	19.5	1326	0.106	C4	13.1	1495	0.119	C4	16.2
	3.0	1115	0.089	C4	12.2	1115	0.089	C4	12.2	1426	0.114	C5	11.3	1609	0.128	C5	14.0
	3.6	1139	0.091	C4	15.4	1139	0.091	C4	15.4	1458	0.116	C5	14.3	1641	0.131	C5	17.6
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	1049	0.084	C4	8.6	1049	0.084	C4	8.6	1406	0.112	C4	14.5	1583	0.126	C4	17.9
	3.0	1345	0.107	C4	16.8	1345	0.107	C4	16.8	1721	0.137	C5	15.5	1938	0.154	C5	19.2
	3.6	1462	0.116	C5	14.0	1462	0.116	C5	14.0	1945	0.155	C5	20.0	2185	0.174	C5	20.0

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 80 Pa, 1 x Ø125 air connection.
For green values, a Ø22 mannifold connection size is required.
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)	Ultima	ΔtK - 7°C				ΔtK - 8°C				ΔtK - 9°C				ΔtK - 10°C			
	L (m)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)	P (w)	p(kg/s)	Mannifold	p(kPa)
10	1.2	372	0.030	C2	4.4	410	0.024	C2	3.2	496	0.039	C2	7.4	558	0.044	C2	9.1
	1.8	401	0.032	C2	8.0	446	0.027	C2	5.9	530	0.042	C2	13.2	595	0.047	C2	16.2
	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	529	0.042	C2	8.1	579	0.035	C2	5.8	706	0.052	C2	13.5	794	0.063	C2	16.7
	1.8	739	0.059	C3	7.8	878	0.052	C2	18.9	983	0.078	C3	13.0	1105	0.088	C3	16.0
	2.4	787	0.063	C3	12.0	873	0.052	C3	8.8	1040	0.083	C3	19.7	1123	0.089	C4	10.0
	3.0	801	0.064	C3	15.8	892	0.053	C3	11.6	1018	0.081	C4	10.7	1143	0.091	C4	13.1
	3.6	824	0.066	C4	8.9	955	0.057	C3	15.9	1088	0.087	C4	14.5	1220	0.097	C4	17.8
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	844	0.067	C3	9.8	928	0.055	C3	7.1	1124	0.089	C3	16.3	1204	0.096	C4	8.2
	2.4	1076	0.086	C4	9.1	1253	0.075	C3	16.3	1429	0.114	C4	15.0	1605	0.128	C4	18.5
	3.0	1184	0.094	C4	13.6	1312	0.078	C4	10.0	1516	0.121	C5	12.6	1705	0.136	C5	15.5
	3.6	1202	0.096	C4	17.0	1338	0.080	C4	12.5	1540	0.123	C5	15.7	1729	0.138	C5	19.4
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	896	0.074	C3	10.8	980	0.059	C3	7.8	1195	0.095	C3	18.1	1278	0.102	C4	9.0
	2.4	1160	0.092	C4	10.3	1351	0.081	C3	18.6	1541	0.123	C4	17.1	1674	0.133	C5	11.8
	3.0	1452	0.116	C4	19.4	1615	0.096	C4	14.2	1861	0.148	C5	17.9	2089	0.166	C5	20.0
	3.6	1558	0.124	C5	15.8	1726	0.103	C5	11.5	2056	0.164	C5	20.0	2303	0.183	C5	20.0

Flow-adjusted waterside cooling effect table. Cooling circuit Δt = 3°C (Water in-out), nozzle pressure of 100 Pa, 1 x Ø125 air connection.
For green values, a Ø22 mannifold connection size is required.
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)	Ultima	ΔtK - 15°C			ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°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)
10	1.2	-	-	-	338	0.012	0.6	419	0.012	0.7	471	0.012	0.6
	1.8	337	0.012	1.0	429	0.012	1.2	513	0.012	1.1	635	0.015	1.6
	2.4	385	0.012	1.4	479	0.012	1.4	619	0.012	2.1	761	0.018	2.9
	3.0	435	0.012	2.1	554	0.013	2.2	713	0.017	3.4	873	0.021	4.7
	3.6	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	438	0.012	1.2	564	0.014	1.3	741	0.018	2.1	920	0.022	3.0
	2.4	499	0.012	1.5	705	0.017	2.7	916	0.022	4.2	1127	0.027	5.8
	3.0	583	0.014	2.5	816	0.020	4.4	1051	0.025	6.7	1285	0.031	9.3
	3.6	655	0.016	3.7	910	0.022	6.5	1165	0.028	9.8	1419	0.034	13.4
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	604	0.014	2.1	857	0.021	3.8	1110	0.027	5.8	1359	0.033	8.1
	3.0	727	0.017	3.7	1018	0.024	6.5	1307	0.031	9.8	1589	0.038	13.5
	3.6	824	0.020	5.6	1144	0.027	9.7	1460	0.035	14.5	1770	0.042	19.8
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	-	-	-	-	-	-	-	-	-	-	-	-
	3.0	823	0.020	4.6	1149	0.028	8.1	1467	0.035	12.1	1780	0.043	16.5
	3.6	955	0.023	7.3	1320	0.032	12.5	1676	0.040	18.4	2028	0.049	25.1

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)	Ultima	ΔtK - 15°C			ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°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)
10	1.2	-	-	-	351	0.012	0.6	434	0.012	0.7	501	0.012	0.6
	1.8	356	0.012	1.2	445	0.012	1.1	544	0.013	1.2	674	0.016	1.7
	2.4	416	0.012	1.7	510	0.012	1.5	662	0.016	2.4	817	0.020	3.3
	3.0	-	-	-	-	-	-	-	-	-	-	-	-
	3.6	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	333	0.012	0.7	430	0.012	0.7	511	0.012	0.7	646	0.015	1.0
	1.8	454	0.012	1.1	603	0.014	1.5	792	0.019	2.4	981	0.023	3.3
	2.4	529	0.013	1.7	748	0.018	3.0	970	0.023	4.6	1191	0.029	6.4
	3.0	618	0.015	2.8	866	0.021	4.9	1113	0.027	7.4	1358	0.033	10.3
	3.6	696	0.017	4.2	968	0.023	7.2	1238	0.030	10.9	1503	0.036	14.9
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	477	0.012	1.0	690	0.017	1.9	908	0.022	3.0	1125	0.027	4.2
	2.4	649	0.016	2.4	919	0.022	4.3	1187	0.028	6.6	1450	0.035	9.1
	3.0	773	0.019	4.1	1080	0.026	7.2	1382	0.033	10.9	1679	0.040	14.9
	3.6	873	0.021	6.2	1209	0.029	10.7	1538	0.037	15.9	1862	0.045	21.6
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	710	0.017	2.8	1007	0.024	5.0	1300	0.031	7.7	1586	0.038	10.6
	3.0	884	0.021	5.2	1232	0.030	9.1	1571	0.038	13.6	1905	0.046	18.6
	3.6	1016	0.024	8.1	1400	0.034	13.8	1776	0.043	20.4	-	-	-

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)	Ultima	ΔtK - 15°C			ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°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)
10	1.2	-	-	-	365	0.012	0.6	449	0.012	0.7	530	0.013	0.7
	1.8	363	0.012	1.0	446	0.012	0.9	575	0.014	1.3	715	0.017	1.9
	2.4	-	-	-	-	-	-	-	-	-	-	-	-
	3.0	-	-	-	-	-	-	-	-	-	-	-	-
	3.6	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	369	0.012	0.8	453	0.012	0.7	566	0.014	0.8	717	0.017	1.2
	1.8	457	0.012	1.0	643	0.015	1.7	842	0.020	2.6	1042	0.025	3.7
	2.4	560	0.012	1.9	792	0.019	3.3	1025	0.025	5.1	1255	0.030	7.0
	3.0	654	0.016	3.1	915	0.022	5.4	1175	0.028	8.2	1429	0.034	11.2
	3.6	739	0.018	4.6	1027	0.025	8.0	1309	0.031	12.0	1586	0.038	16.3
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	524	0.012	1.2	759	0.018	2.2	998	0.024	3.5	1235	0.030	5.0
	2.4	694	0.017	2.7	980	0.023	4.8	1264	0.030	7.3	1543	0.037	10.1
	3.0	819	0.020	4.6	1141	0.027	8.0	1457	0.035	11.9	1769	0.042	16.3
	3.6	923	0.022	6.8	1273	0.030	11.7	1616	0.039	17.3	1955	0.047	23.5
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	-	-	-	-	-	-	-	-	-	-	-	-
	2.4	778	0.019	3.3	1102	0.026	5.9	1421	0.034	9.0	1732	0.041	12.4
	3.0	946	0.023	5.9	1315	0.032	10.2	1676	0.040	15.2	2033	0.049	20.8
	3.6	1077	0.026	8.9	1480	0.035	15.2	1878	0.045	22.5	-	-	-

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)	Ultima	ΔtK - 15°C			ΔtK - 20°C			ΔtK - 25°C			ΔtK - 30°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)
10	1.2	-	-	-	372	0.012	0.6	455	0.012	0.7	541	0.013	0.7
	1.8	368	0.012	1.0	456	0.012	1.0	588	0.014	1.4	731	0.018	2.0
	2.4	-	-	-	-	-	-	-	-	-	-	-	-
	3.0	-	-	-	-	-	-	-	-	-	-	-	-
	3.6	-	-	-	-	-	-	-	-	-	-	-	-
20	1.2	369	0.012	0.6	459	0.012	0.6	601	0.014	0.9	757	0.018	1.3
	1.8	462	0.012	1.0	659	0.016	1.8	860	0.021	2.7	1062	0.025	3.8
	2.4	571	0.014	1.9	806	0.019	3.4	1043	0.025	5.2	1277	0.031	7.3
	3.0	667	0.016	3.2	934	0.022	5.6	1200	0.029	8.5	1461	0.035	11.7
	3.6	757	0.018	4.8	1053	0.025	8.4	1345	0.032	12.5	1631	0.039	17.1
30	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	553	0.013	1.3	795	0.019	2.4	1040	0.025	3.8	1281	0.031	5.3
	2.4	713	0.017	2.8	1002	0.024	5.0	1288	0.031	7.6	1569	0.038	10.4
	3.0	834	0.020	4.7	1160	0.028	8.2	1480	0.035	12.2	1795	0.043	16.7
	3.6	939	0.022	7.0	1296	0.031	12.1	1644	0.039	17.8	1989	0.048	24.3
40	1.2	-	-	-	-	-	-	-	-	-	-	-	-
	1.8	590	0.014	1.5	858	0.021	2.8	1128	0.027	4.4	1393	0.033	6.2
	2.4	813	0.019	3.6	1143	0.027	6.3	1467	0.035	9.5	1784	0.043	13.0
	3.0	970	0.023	6.1	1342	0.032	10.6	1705	0.041	15.7	-	-	-
	3.6	1096	0.026	9.2	1503	0.036	15.7	1904	0.046	23.1	-	-	-

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.

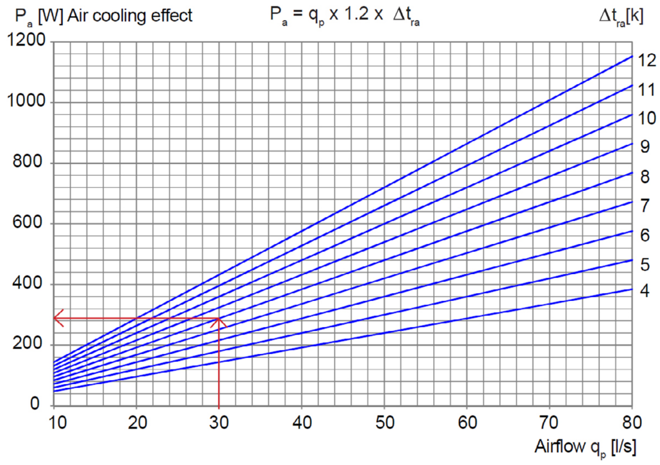
Air Cooling Effect

Cooling effect supplied in the ventilation air [W]

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

Formula for air cooling effect: P = m x Cp x Δt
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]

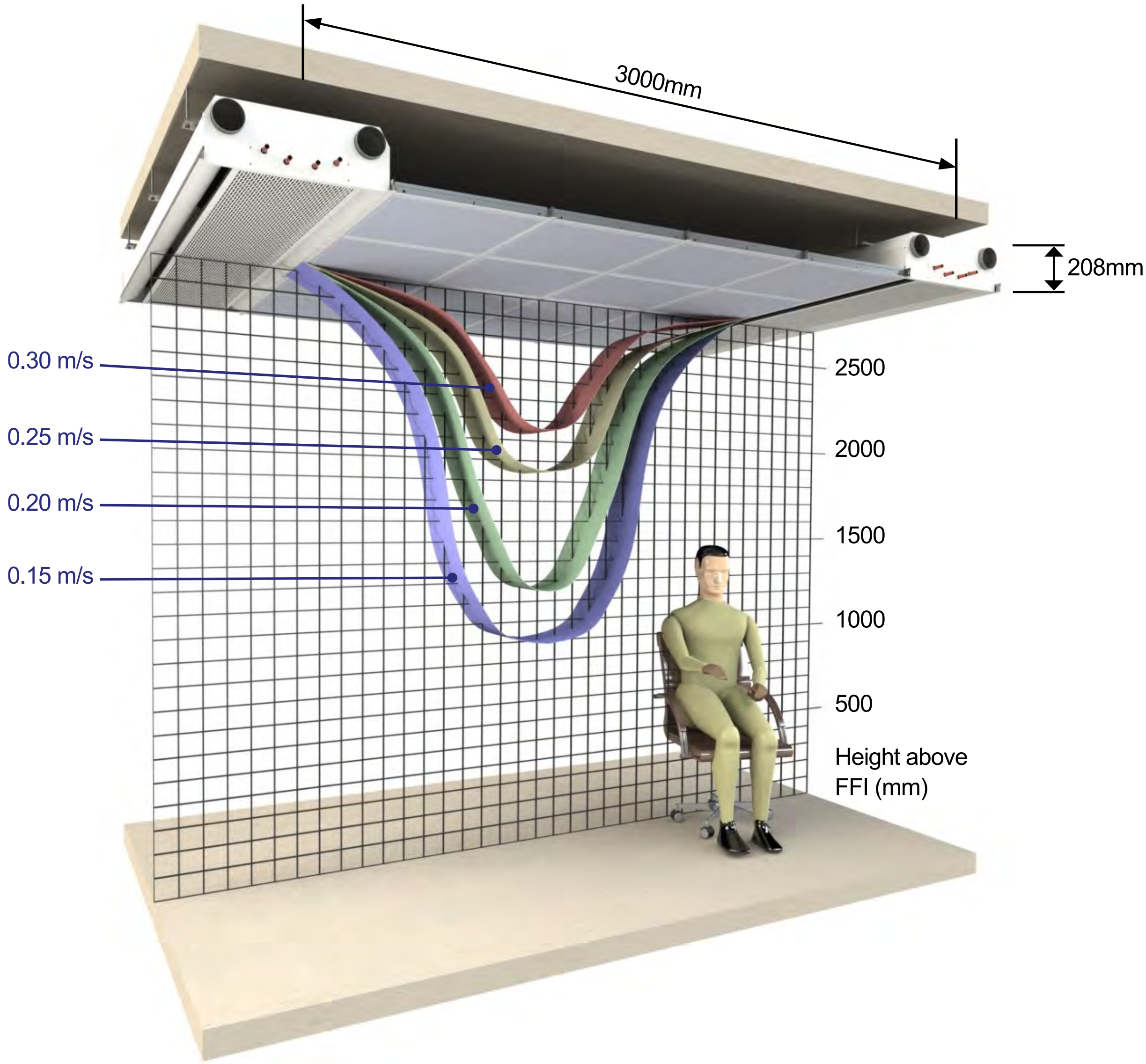
It is usually m x Cp ≈ qp x 1.2



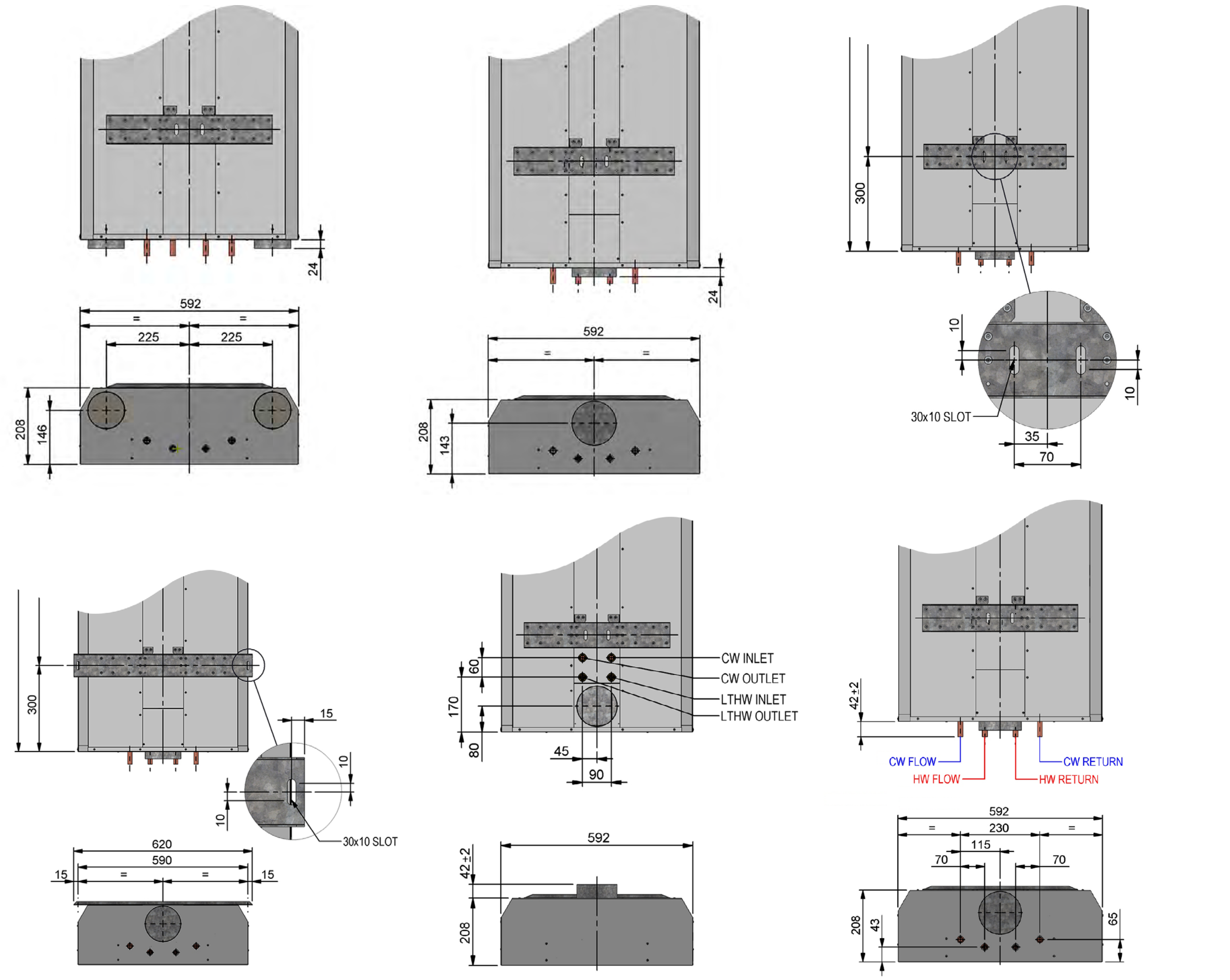
Air cooling effect as a function of airflow. For example, if the air flow is 30 l / s and the under-temperature of the supply air is Δt_{ra} = 8K, the cooling effect from the graph is 290W.

Scatter Diagram

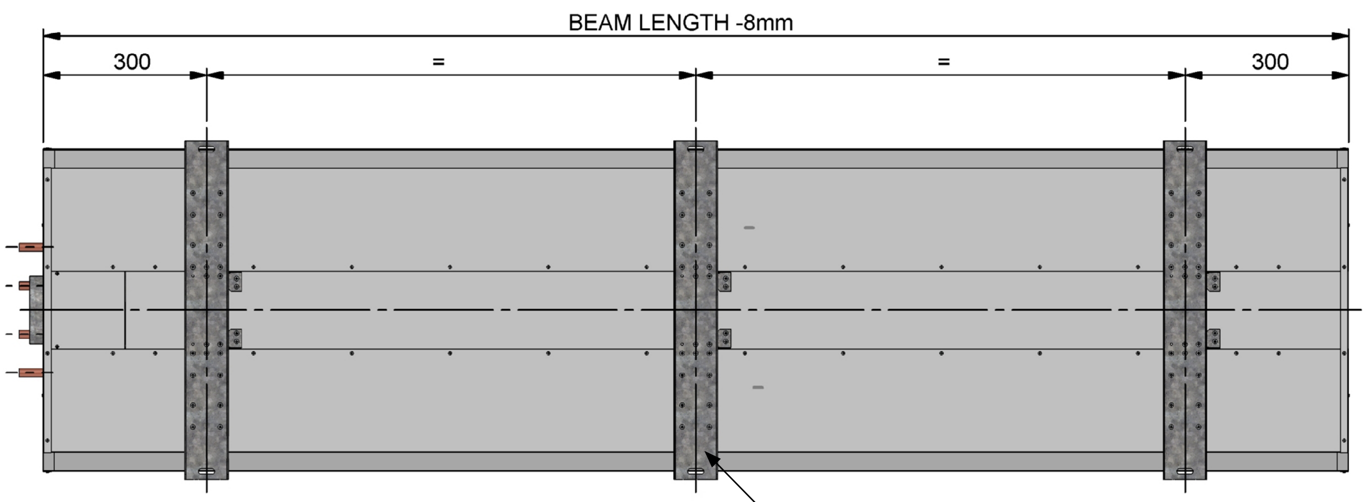
Fresh Air Volume 22 l / s / Active m @ 80Pa



Product Dimensions



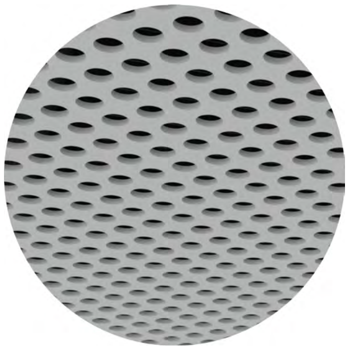
Mounting Details



Note: Beam lengths less than or equal to 1.8m have no central support bracket.

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
MO - Multiservice Cooling Only
MH - Multiservice Cooling & Heating

4. Underplate

7D - 7Ø & 4Ø Double Dot / 51% Free Area
4D - 4Ø Dot / 33% Free Area
5S - 5 X 35 Slot / 45% Free Area

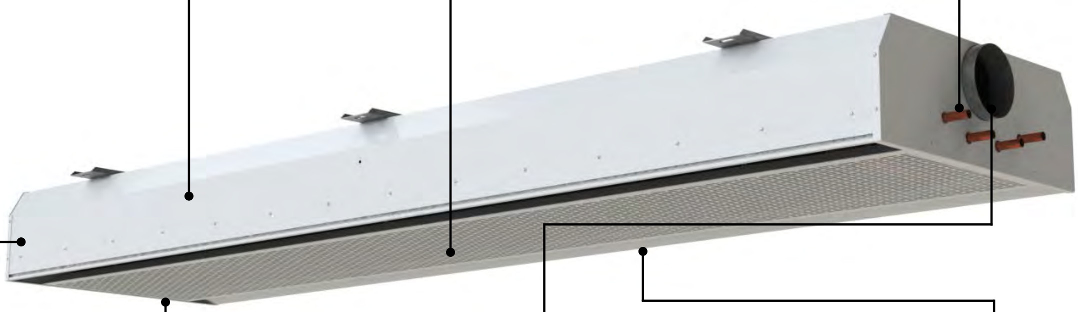
6. Waterside Connection

Battery Manifold Types - C1/C2/C3/C4/C5

22 | C5 | H

Orientation - H: Horizontal / V: Vertical

Chilled Water Connection Size (mm) 15 / 22



1. Beam Type

UL - Ultima

3. Nominal Beam Length (mm)

5. Airside Connection

Air Connection Qty

1 x 125 H

Orientation - H: Horizontal / V: Vertical

Air Connection Spigot Size (mm) 80/100/125

7. Air Supply / Discharge

Air Supply Volume (l/s)

43 | 100 | L

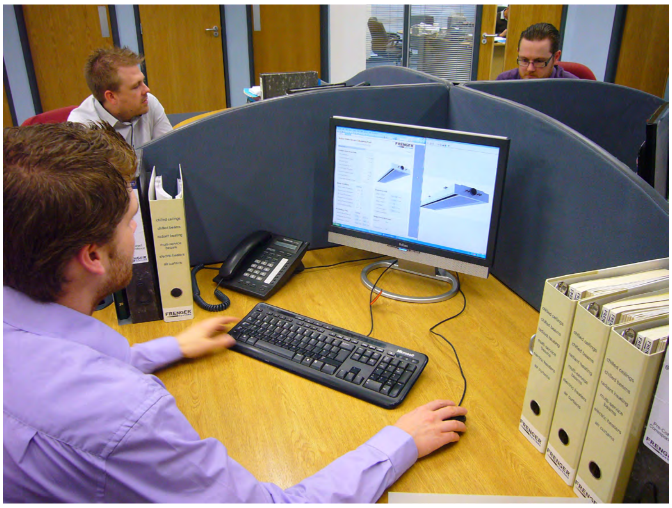
Air Discharge Characteristic -
L: Long Throw - No Discharge Vanes
M: Medium Thrown - 18° Discharge Vanes
S: Short Throw - 35° Discharge Vanes

Air Supply Nozzle Pressure (Pa)

Example:

UL	CH	3600	7D	-	1 x 125H	22C5H	-	43100L
1	2	3	4		5	6		7

Calculation Program



Ultima Active Beam Data

Air Connection	2x100	mm
Product Overall Length	3.6	m
Manifold Type	C5	
Air Discharge Throw	L	
Nozzle Static Pressure	100	Pa
Fresh Air Supply Volume	25	l/s
Heating Function	Yes	
Underplate Perforation Type	51% DOT	

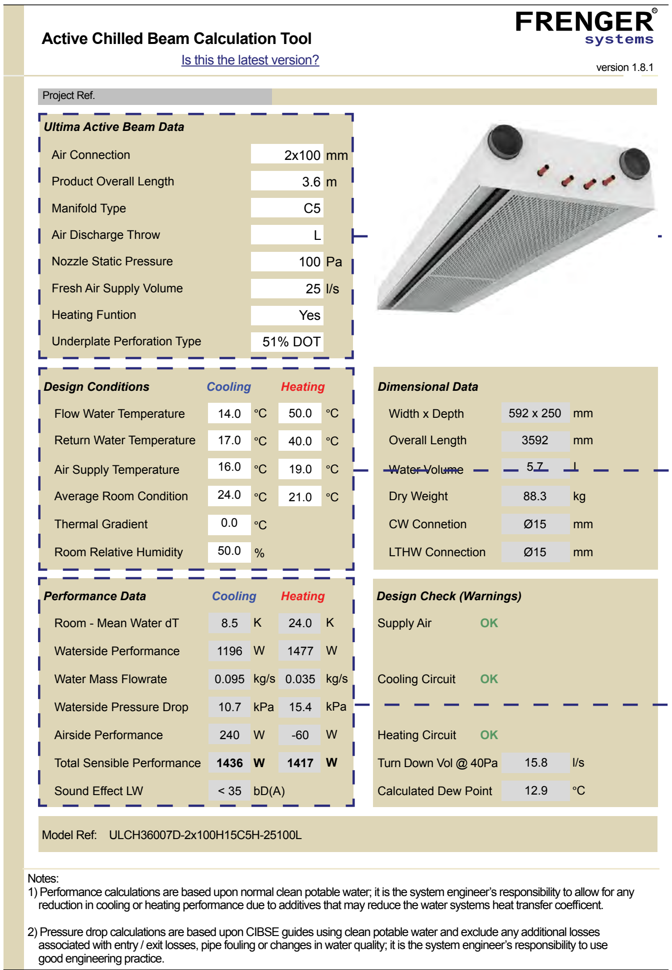
Frenger's calculation programme for Ultima is extremely user friendly.

Simply select from the drop down menu the "Air Connection" configuration. Air volumes in excess of 40 ltrs / sec should be 2 x 100 diameter.

"Manifold types" can be changed in the 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 (C5 being the highest and C2 being the lowest).

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

"Underplate Perforated" options can be found on page 12.



Active Chilled Beam Calculation Tool

FRENGER systems

Is this the latest version?

version 1.8.1

Project Ref.

Ultima Active Beam Data

Air Connection	2x100	mm
Product Overall Length	3.6	m
Manifold Type	C5	
Air Discharge Throw	L	
Nozzle Static Pressure	100	Pa
Fresh Air Supply Volume	25	l/s
Heating Funtion	Yes	
Underplate Perforation Type	51% DOT	

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
Thermal Gradient	0.0	°C		
Room Relative Humidity	50.0	%		

Dimensional Data		
Width x Depth	592 x 250	mm
Overall Length	3592	mm
Water Volume	5.7	l
Dry Weight	88.3	kg
CW Connetion	Ø15	mm
LTHW Connection	Ø15	mm

Performance Data	Cooling		Heating	
Room - Mean Water dT	8.5	K	24.0	K
Waterside Performance	1196	W	1477	W
Water Mass Flowrate	0.095	kg/s	0.035	kg/s
Waterside Pressure Drop	10.7	kPa	15.4	kPa
Airside Performance	240	W	-60	W
Total Sensible Performance	**1436**	**W**	**1417**	**W**
Sound Effect LW	< 35	bD(A)		

Design Check (Warnings)		
Supply Air	OK	
Cooling Circuit	OK	
Heating Circuit	OK	
Turn Down Vol @ 40Pa	15.8	l/s
Calculated Dew Point	12.9	°C

Model Ref: ULCH36007D-2x100H15C5H-25100L

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 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

	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
Thermal Gradient	0.0	°C		
Room Relative Humidity	50.0	%		

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	8.50	K	24.0	K
Waterside Performance	1196	W	1477	W
Waterside Mass Flowrate	0.095	kg/s	0.035	kg/s
Waterside Pressure Drop	10.7	kPa	15.4	kPa
Airside Performance	240	W	-60	W
Total Sensible Performance	**1436**	**W**	**1417**	**W**
Sound Effect Lw	<35	dB(A)		

"Performance Data" will then automatically be calculated. Likewise "Dimensional Date" will be also automatically calculated.

Finally, the "Design Check" should read "OK" in green, or detail some warning in red.
Calculation programmes for Ultima are available upon request.

Contact our technical department or complete an application request form from 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 6.3m (L) x 5.7m (W) x 3.3m (H) 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

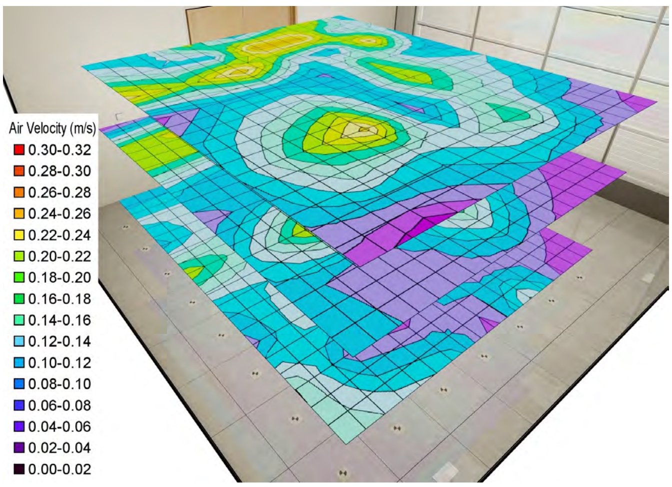
Project specific mock-up testing is a valuable tool which allows the Client to fully asses the proposed system and determine the resulting indoor quality and comfort conditions; the physical modeling is achieved by installing a full scale representation of a building zone complete with internal & external heat gains (Lighting, Small Power, Occupancy & Solar Gains).

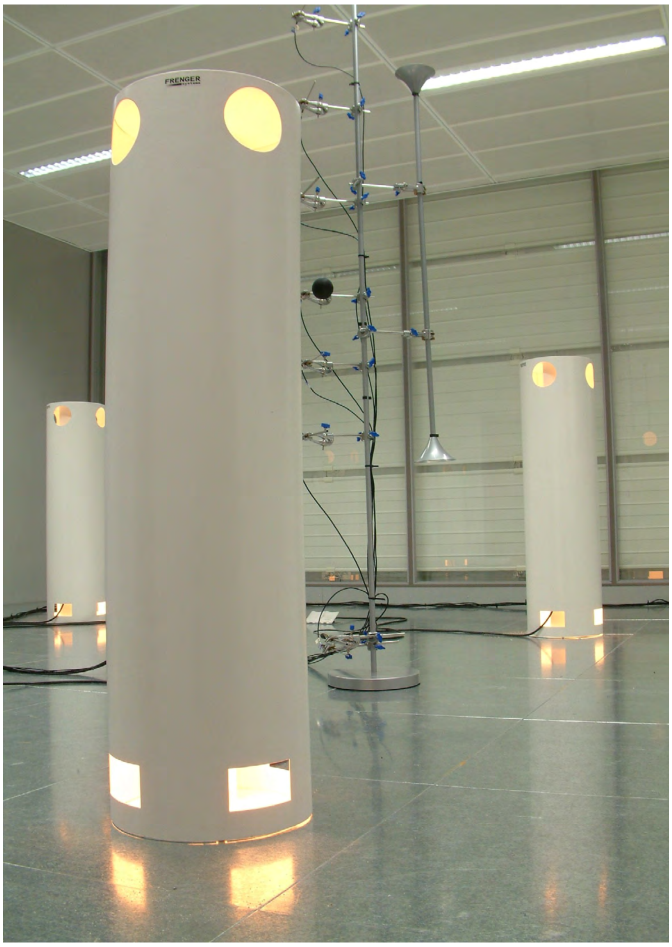
The installed mock-up enables the client to verify the following:

- 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.
  - 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 the 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.

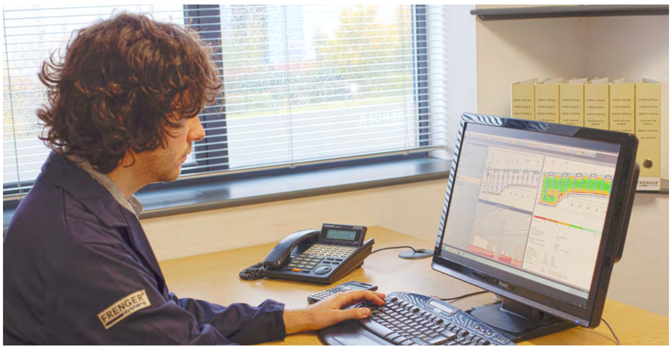
The intensity distribution is obtained by the use of a Goniophotometer to measure the intensity of light emitted from the surface of the fitting at pre-determined angles. The light intensity is measured using either a photometer with a corrective spectral response filter to match the CIE standard observer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

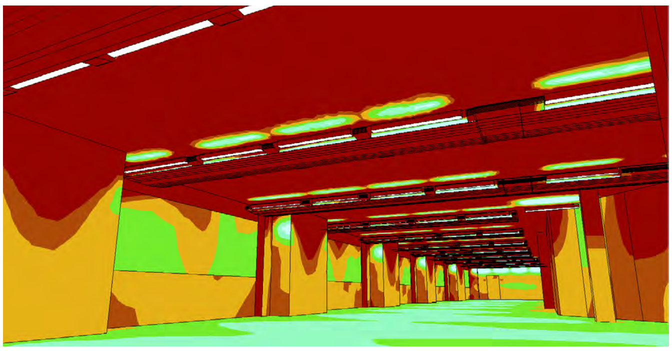
Luminaire outputs are measured using our integrated sphere for smaller luminaires or our large integrator room for large fittings and Multi Service Chilled Beams. For both methods we can use traceable calibrated radiant flux standards for absolute comparisons.

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 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

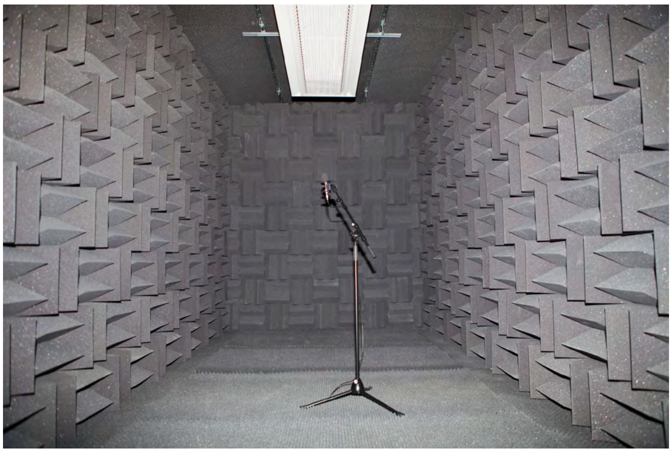
The Acoustic Test Room at Frenger is a hemi-anechoic chamber which utilises sound abosrbing acoustic foam material in the shape of wedges to provide an echo free zone for acoustic measurements; the height of the acoustic foam wedges has direct relationship with the maximum absorption frequency, hence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

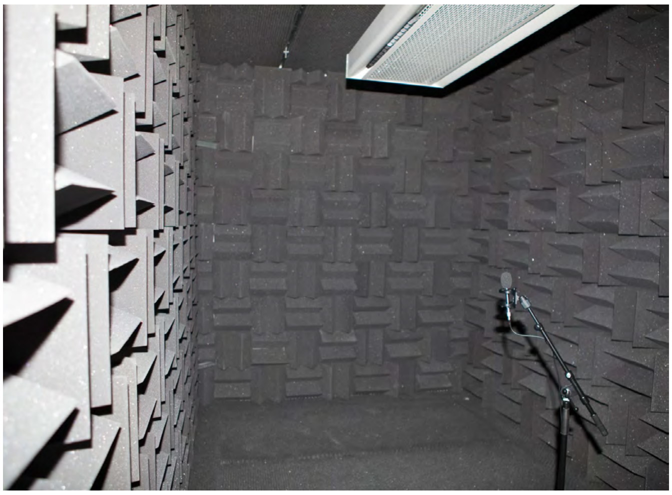
The use of acoustic absorbing material within the test room provides the simulation of a quiet open space without "reflections" which helps to ensure sound measurements from the sound source are accurate, in addition the acoustic material also helps reduce external noise entering the test room meaning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

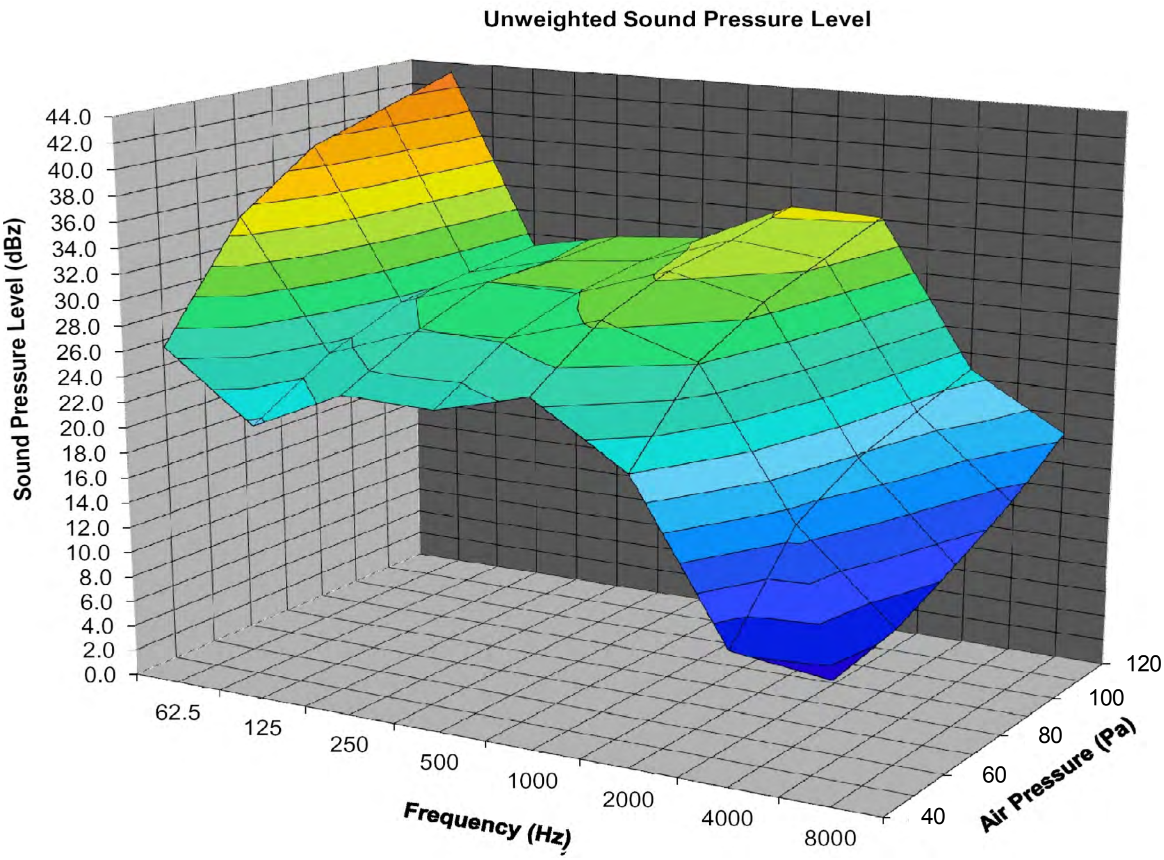
The acoustic facilities allow Frenger to provide express in-house sound evaluation so that all products, even project specific designs can be assessed and optimised.

To ensure accuracy Frenger only uses 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) sumultaneous weightings.

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







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