CHAPTER 6

Chilled beam OKNB 400

The Solid Air OKNB chilled beam is an active chilled beam that can be built into a bulkhead or a facade in rooms.

- Air-outflow direction: horizontal.
- Air supply: horizontal
- Large cooling capacity at low ventilation-air velocities
- Air supply and outflow sections of variable lengths.
- Available in several colours.

Applications:

- hotel rooms
- bedrooms in hospitals and care homes
- offices

Functions:

- ventilation
- cooling
- heating

Specifications:

- type: 400
- model: 1000
- ventilation: to 190 m^3/h
- cooling: to 1300 W
- heating: to 2200 W
- water flow: to 300 l/h.

6.1

Application

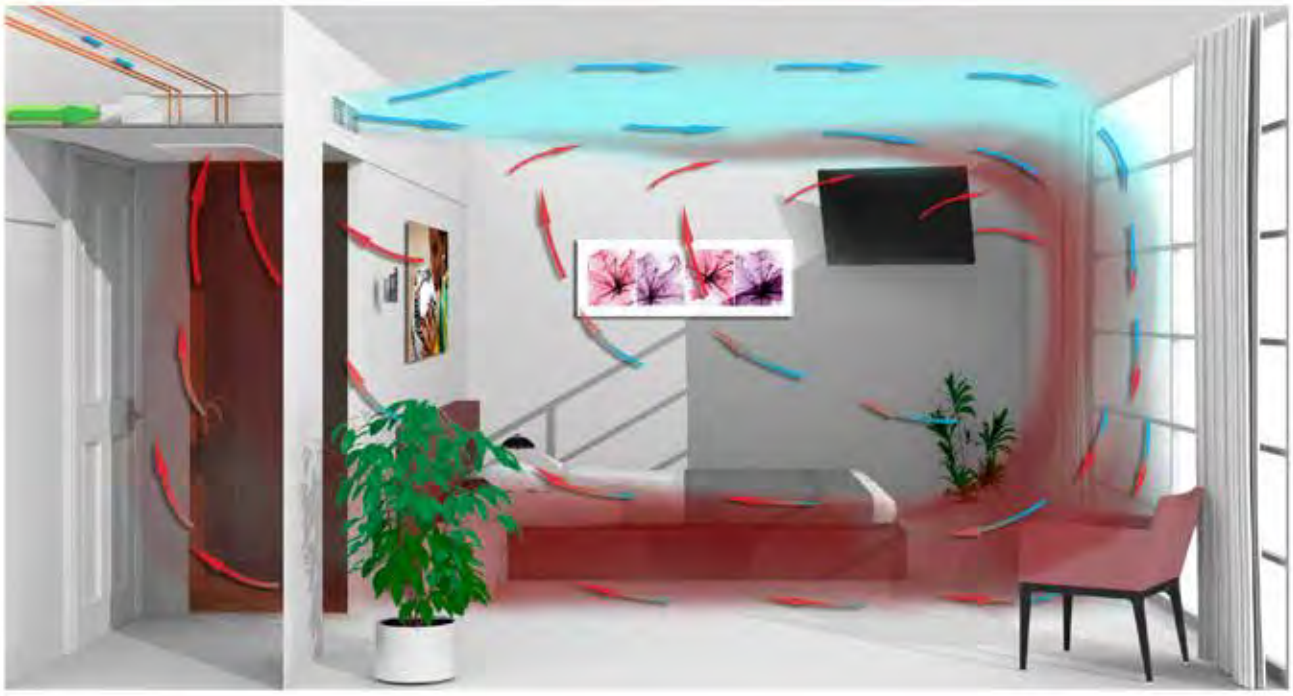
The OKNB has been designed as a compact chilled beam, with a low built-in height; it has a high capacity and is suitable for ventilation, cooling and heating rooms of 2.4 to 3.5 metres high.

The closed unit brings the supply air horizontally, one-sided into the room and because of its highly efficient blow-in effect it can be placed in a bulkhead on the side of the room in hotel rooms, patient rooms, bedrooms and offices. The choice of various nozzle configurations enables an optimum combination of ventilation air and cooling capacity in every situation.

Contents

Properties and benefits of the OKNB

- Application in hotel rooms, bedrooms in hospitals, care homes and offices
- Suitable for rooms without modular ceilings, but with a cove on the facade or corridor side
- Room temperature controlled with amount of water (cooling and heating)
- CO_2 control possible with VAV air control
- Large heat exchanger for higher emission on water side without requiring a high ventilation level
- Heat exchanger for cooling and heating
- Option to use various diffusers.



The OKNB (bulk head unit) is fitted fully out of sight, and is aesthetically pleasing. The option of various diffusers and colours will benefit the ambiance of the hotel room. The low noise level of the unit will not have an adverse effect on the comfort of the room.

The unit has been designed for bulkhead integration into suspended plaster ceilings. The low weight of the unit makes it easy to handle for integration. The air intake section and the air outlet section are variable in length, which makes the unit universally applicable in many installations.

Eurovent Certified

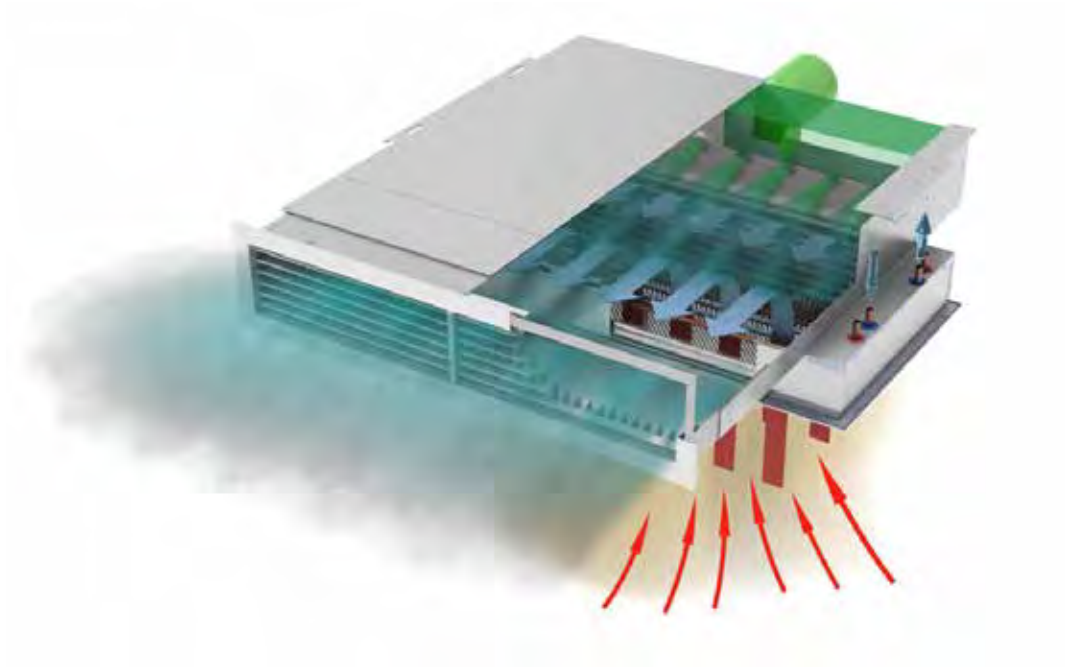
Solid Air is a member of the Eurovent certification programme for "chilled beams". The products are certified under number 09.11.431 and are listed on the Eurovent website at www.eurovent-certification.com

6.2

Operation

Introduction of air through nozzles from a pressure chamber brings primary (ventilation) air to a high velocity. This produces a powerful pump effect (induction) and secondary air (room air) is drawn in via the heat exchanger. When the air passes the heat exchanger, it is cooled or heated in function of the need in the room.

The tertiary airflow (the total of room air and primary air) is brought into the room through integrated outlet openings.



Specifications:

Active chilled beam for water-air systems with high thermal capacities, low noise levels and a high comfort level. The variable lengths of the intake and outflow sections make it applicable to many bulkhead constructions. Suitable for cooling, ventilating and heating rooms with a height of 2.4 to 3.5m. Suitable for heating rooms with low warm-water temperatures of heat-pump systems. Heat exchangers available as a 2 or 4-pipe version. Various standard nozzle configurations for optimum determination of the ventilation air/ recirculation air ratio.

The materials that are used are 100% recyclable. Housing is made from galvanised sheet steel, of which the visible parts are painted with an epoxy paint RAL colour (standard white RAL 9010). The heat exchanger is made from copper pipes with aluminium cooling fins. Leak-tightness 100% tested at 15 bar.

Housing:

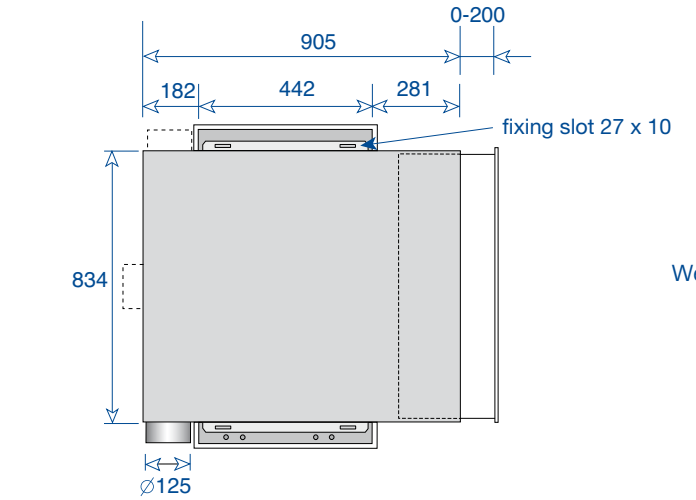
Material:	galvanised sheet steel.
Finish of visible parts:	epoxy paint standard colour white RAL 9010.
Outlet diffuser:	anodised aluminium profile or steel diffuser with aluminium frame.

Heat exchanger:

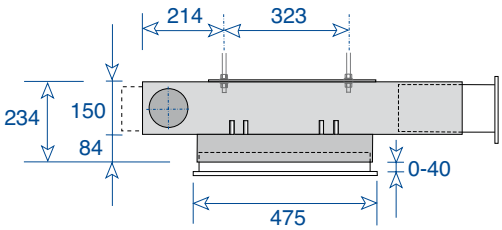
Pipe material:	copper
Fin material:	aluminium
Post-treatment:	none
Test pressure:	15 bar

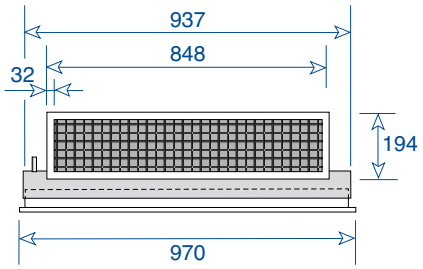
6.3

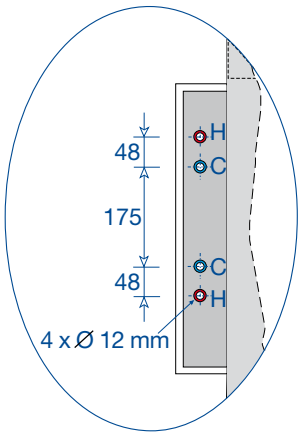
Main dimensions, connection sizes and ceiling integration

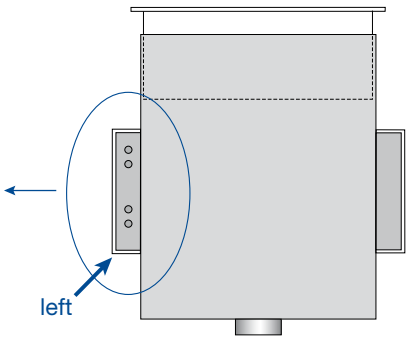


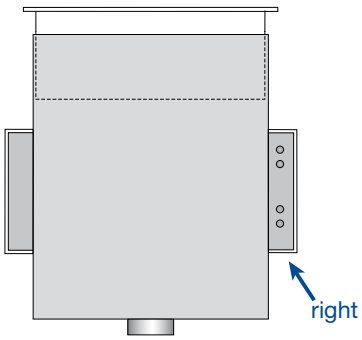
Weight: 21 kg.







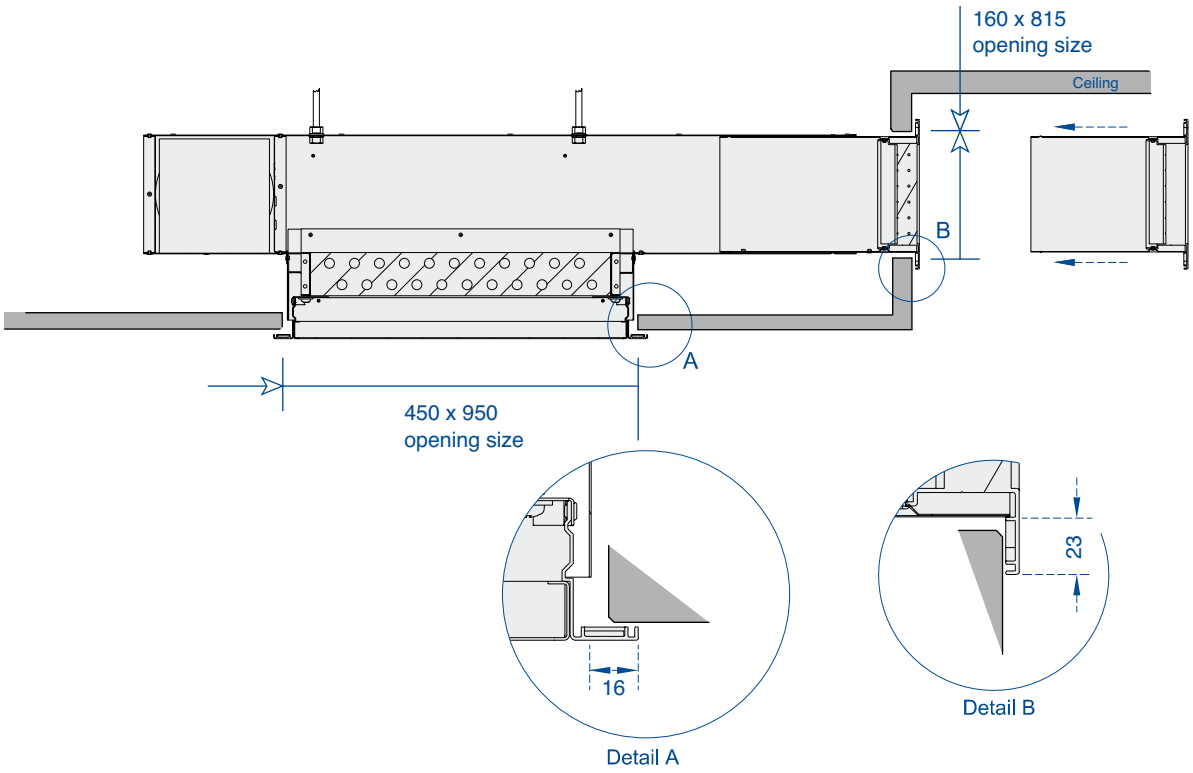




The following tolerances should be taken into account when selecting an OKNB chilled beam, to ensure optimum integration into the bulkhead or the wall.

OKNB edge configuration: Dimensions and tolerances main dimensions

Actual dimensions chilled beam: Wall or bulkhead dimensions in mm, tolerance +/- 2.0mm



6.4

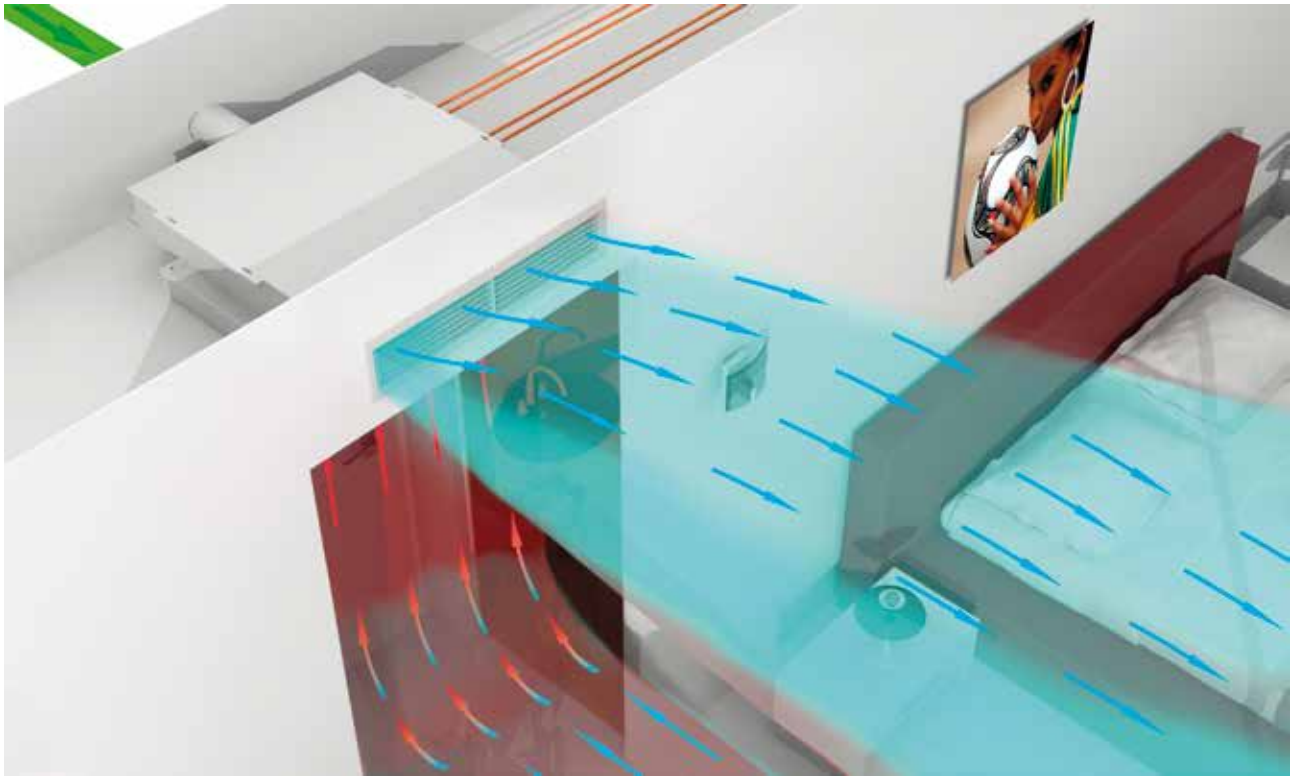
Versions and options

Nozzle configurations

This catalogue lists 4 standard nozzle configurations. Other nozzle configurations are also possible in consultation with Solid Air.

Different diffusers

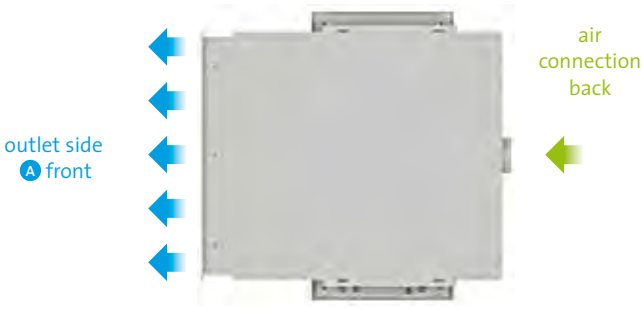
The outflow diffuser can be supplied with vertical or horizontal aluminium blades, a combination of vertical and horizontal aluminium blades or with a high-induction steel diffuser.



6.5

Order codes OKNB

Left/right position:
standing in the direction
of the outlet side (A)
on the opposite side



Example order code: OKNB 400 / 1000 L1V1 AL3O DOO OxO 9010 - 55

1	**Version**	OKNB	
2	**Type**	400	
3	**Model**	1000	
4	**Nozzle configuration**	L1	
		L3	
		L6	
		L8	
5	**Heat exchanger**	K	Cooling
		V	Cooling & Heating
6	**Discharge configuration**	1	One-sided outlet
7	**Air connection**	A	Back
		L	Left
		R	Right
8	**Water connection**	L	Left
		R	Right
9	**Diameter air connection**	3	125mm
10	**Plenum version**	O	Standard
11	**Diffuser**	A	Single deflection (horizontal) WUAA
		U	Single deflection (vertical) WUBA
		D	Double deflection WUCA
		W	High induction WTHA
		O	No diffuser
12	**Edge configuration**	O	Not applicable
13	**FPC**	O	Not applicable
14	**Actual width**	O	See dimensional sketch
15	**Actual length**	O	See dimensional sketch
16	**Colour (RAL)**	9010	(standard)
17	**Gloss value**	55%	(standard)

6.6

Installation requirements and maintenance

Fitting

The unit has been designed to be integrated into a bulkhead or a wall. The low weight of the unit makes it easy to handle in modular ceilings. The unit should be fitted with fall protection.
The suspension points are noted on the dimensional sketches earlier in this Chapter. Only trained, specialised fitters should install, connect and set the units. Fitting and installation work must be carried out in accordance with national legislation and regulations.
It is also essential to comply with the requirements, as included in this document.
If certain fitting details are not entirely clear, please do not hesitate to contact us.
Besides these requirements, there may be specifications or sector-specific requirements that apply to fitting air and water-side accessories.

Unpacking and handling the unit must be done carefully. We recommend that every unit is lifted by 2 fitters by picking it up by the central housing and not by the diffusers. They can be suspended with rods, cable braid, chains or metal hooks.

The air intake is connected to the central ventilation system with a flexible acoustic-insulating duct that is also thermally insulated. The flexible duct is clamped to the air intake of the unit with a duct clip, following which the connection can be taped down without tension.

For practical reasons the water pipes are usually connected with flexible hoses to the cold and warm-water circuits of the units. For the cold-water circuit, market with blue stickers, there is no specific preference for intake or outflow. The same applies to the warm-water circuit, which is marked with red stickers .

Solid Air does not have a preference concerning connection accessories. Applications vary from country to country and from fitter to fitter - from fixed fittings with soldering, clamping with brass cutting rings (using insert bushes), clips with plastic seals, or double socket couplings with double O-ring seals.
Quick-release couplings are not considered ideal, because if they are tight, they cause significant torque on the solder connections of the heat exchanger, and that may cause water leaks.
Before commissioning, test the leak-tightness of the connections between the copper connection pipes and the water hoses. We also recommend insulating the cold-water pipe because of the risk of condensation.

Standard water parameters:

- Water-side pressure loss: 0 - 10 kPa.
- Water speed: 0.2 - 0.8 m/s
  The local flow speed in the pipes may never exceed 1.5 m/s.
- The water must circulate at least once every 3 days.
- Water inlet temperature (in cooling mode): approx. 15 - 18°C.
  The temperature of the water must always be above freezing.
  If this cannot be guaranteed, anti-freeze fluid must be added.
- Water inlet temperature (in heating mode): approx. 35 - 60°C.
  Maximum water temperature may not exceed 90°C.
- Test pressure: 15 bar
  All Solid Air water circuits are 100% tested at this testing pressure.
- Operating pressure: 10 bar

Water quality:

- Treated water — low mineral component
- Acidity — between 8.0 – 8.5 pH
- Carbon dioxide — less than 25 ppm
- Sulphates — less than 17 ppm
- Chloride — less than 20 ppm

Maintenance:

Depending on the quality of the room air, this may contain various levels of dust particles and other contamination. As the room air is recirculated through the units, the corresponding electrostatic effect may cause this dirt to build up in the chilled beam. In normal room-air situations, we recommend to inspect, and if necessary clean, the units annually. The perforated return diffuser can be easily removed to clean the heat exchanger.

This works as follows:

1

Insert a small Allen key into a hole in the corner of the perforation.

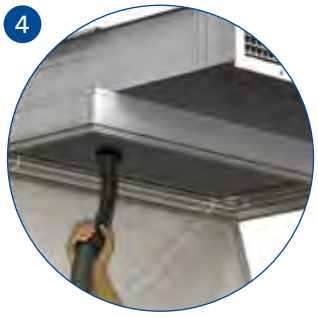
2

Pull the diffuser carefully from the snap connections.

3

The diffuser remains connected to the unit with 2 safety cables.

4



Clean the surfaces with an industrial vacuum cleaner, fitted with a soft brush. Make sure you do not bend the aluminium fins of the heat exchanger.

Points of attention:

- Fit in reverse order.
- Check that the perforated diffuser is properly centred in the snap connections in the edge of the diffuser.

6.7

Selection example and selection details

Explanation of abbreviations:

parameter	unit	explanation
V_{prim}	l/s or m^3/h	primary airflow (= fresh air)
t_{pri}	°C	temperature of the primary airflow
t_{room}	°C	temperature of the room
$t_{water\ in}$	°C	temperature of the water on entry into the heat exchanger
Sat	%	percentage saturation
Q_l	W	supplied cooling capacity of the primary air
P_s	Pa	static pre-pressure
L_w	dB[A]	sound power level of the unit
V_w	l/h	amount of water in litres per hour
ΔP_w	kPa	water-side pressure drop over the heat exchanger
Q_{wk}	W	supplied cooling capacity water side
Q_{ww}	W	supplied heating capacity water side
Δ_{tw}	°C	difference between incoming and outgoing temperature over the heat exchanger
Q_t	W	supplied capacity by heat exchanger and primary air
quick selection:		
L_9	°C	difference between room temperature and primary air temperature is 9°C
W_9	°C	difference between room temperature and water-entry temperature is 9°C
W_{10}	°C	difference between room temperature and water-entry temperature is 10°C

Selection example OKNB - type 400

Hotel room for 2 people (LxWxH)		7.8 x 3.6 x 2.6m
Requirement:	Ventilation rate	1.3 times ventilation
	Cooling capacity	900 Watt
	Heating capacity	750 Watt
Temperatures:	Summer:	
	Room (t_{room}, 50% Sat)	25°C
	Primary air (t_{pri})	16°C
	Cooling water ($t_{water\ in}$)	15°C
	Winter:	
	Room (t_{room})	20°C
	Primary air (t_{pri})	20°C
	Heating water ($t_{water\ in}$)	45°C
This means:	Summer:	
	Temperature difference air side (t_{room}-t_{pri})	9°C (L_9)
	Temperature difference water side (t_{room}-$t_{water\ in}$)	10°C (W_{10})
	Winter:	
	Temperature difference air side (t_{pri}-t_{room})	0°C
	Temperature difference water side ($t_{water\ in}$-t_{room})	25°C

The room dimensions and the 1.3 ventilation rate requires an air supply of 95 m^3/h. The hotel unit is usually fitted in the suspended ceiling near the entrance to a room and blows directly under the ceiling towards the facade side.

Below there is a selection table for OKNB type 400 model 1000 for cooling:
The table is split into two parts - one part with air-side details (left side of the table) and one part with water-side details (right side).
The total capacity of a chilled beam is the sum of the air-side capacity and the water-side capacity.
For the two common temperature conditions L_9W_9 and L_9W_{10}, the total capacity has been included in the dark-blue columns. These quick-selection columns show you instantly whether the maximum available capacities are enough for your selection example.

Selection example OKNB - type 400 - model 1000 (nozzle L1 and L3)

AIR						WATER														Fast selection*	
Primary			Cooling capacity air t_{room} -t_{pri} °C					Cooling capacity water t_{room} -$t_{water\ in}$ °C												L_9W_9	L_9W_{10}
			8	9	10			6		7		8		9		10		11			
Vprim	Ps	Lw	Q_l	Q_l	Q_l	V_w	ΔP_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_t	Q_t

Nozzle L1

l/s	m³/h	Pa	dB(A)	W_8	W_9	W_{10}	l/h	kPa	W_6	°C	W_7	°C	W_8	°C	W_9	°C	W_{10}	°C	W_{11}	°C	$W_{9.9}$	$W_{9.10}$
9.7	**35**	39	14	94	105	117	50	0.5	146	2.5	170	2.9	194	3.4	219	3.8	243	4.2	267	4.6	324	348
							100	1.8	175	1.5	204	1.8	234	2.0	263	2.2	292	2.5	321	2.8	368	397
							200	6.4	194	0.8	227	1.0	259	1.1	292	1.3	324	1.4	356	1.5	397	429
							260	10.3	200	0.7	233	0.8	266	0.9	300	1.0	333	1.1	366	1.2	405	438
12.5	**45**	65	21	121	136	151	50	0.5	170	2.9	198	3.4	226	3.9	255	4.4	283	4.9	311	5.4	391	419
							100	1.8	211	1.8	246	2.1	282	2.4	317	2.7	352	3.0	387	3.3	453	488
							200	6.4	241	1.0	281	1.2	321	1.4	361	1.5	401	1.7	441	1.9	497	537
							260	10.3	248	0.8	290	1.0	331	1.1	373	1.3	414	1.4	455	1.5	509	550
15.3	**55**	98	26	148	166	185	50	0.5	188	3.2	220	3.8	251	4.3	283	4.9	314	5.4	345	5.9	449	480
							100	1.8	242	2.1	283	2.4	323	2.8	364	3.2	404	3.5	444	3.8	530	570
							200	6.4	283	1.2	330	1.4	378	1.6	425	1.8	472	2.0	519	2.2	591	638
							260	10.3	294	1.0	343	1.1	392	1.3	441	1.4	490	1.6	539	1.8	607	656
18.1	**65**	137	31	174	196	218	50	0.5	204	3.5	238	4.1	272	4.6	306	5.2	340	5.8	374	6.4	502	536
							100	1.8	270	2.3	315	2.7	360	3.1	405	3.5	450	3.9	495	4.3	601	646
							200	6.4	322	1.4	375	1.6	429	1.8	482	2.1	536	2.3	590	2.5	678	732
							260	10.3	337	1.1	393	1.3	449	1.5	505	1.7	561	1.9	617	2.1	701	757

Nozzle L3

l/s	m³/h	Pa	dB(A)	W_8	W_9	W_{10}	l/h	kPa	W_6	°C	W_7	°C	W_8	°C	W_9	°C	W_{10}	°C	W_{11}	°C	$W_{9.9}$	$W_{9.10}$
18.1	**65**	52	18	174	196	218	50	0.5	191	3.3	223	3.9	255	4.4	287	5.0	319	5.5	351	6.1	483	515
							100	1.8	245	2.1	286	2.4	326	2.8	367	3.2	408	3.5	449	3.8	563	604
							200	6.4	285	1.2	332	1.4	380	1.6	428	1.8	475	2.0	522	2.2	624	671
							260	10.3	296	1.0	346	1.1	395	1.3	445	1.4	494	1.6	543	1.8	641	690
22.2	**80**	78	24	215	242	269	50	0.5	211	3.6	246	4.2	281	4.8	316	5.4	351	6.0	386	6.6	558	593
							100	1.8	277	2.4	323	2.8	370	3.2	416	3.6	462	4.0	508	4.4	658	704
							200	6.4	330	1.4	385	1.7	440	1.9	495	2.2	550	2.4	605	2.6	737	792
							260	10.3	346	1.1	403	1.3	461	1.5	518	1.7	576	1.9	634	2.1	760	818
26.4	**95** ❶	109 ❷	30 ❸	255	287 ❹	319	50	0.5	226	3.9	263	4.6	301	5.2	338	5.9	376	6.5	414	7.2	625	663
							100	1.8	305	2.6	356	3.1	406	3.5	457	4.0	508	4.4	559	4.8	744	795
							200	6.4	370	1.6	431	1.8	493	2.1	554	2.3	616	2.6	678	2.9	841	903
							260 ❻	10.3	389	1.3	454	1.5	518	1.7	583	1.9	648 ❺	2.1	713	2.3	870	935 ❼
30.6	**110**	146	34	295	332	369	50	0.5	237	4.1	276	4.8	316	5.4	356	6.1	395	6.8	434	7.5	688	727
							100	1.8	328	2.8	382	3.3	437	3.8	491	4.2	546	4.7	601	5.2	823	878
							200	6.4	404	1.7	472	2.0	539	2.3	607	2.6	674	2.9	741	3.2	939	1006
							260	10.3	427	1.4	498	1.7	570	1.9	641	2.2	712	2.4	783	2.6	973	1044

On the basis of the required amount of air of 80 m³/h, nozzle type L3 is chosen.

The details would be:

Nozzle L3:	❶	Primary air	95 m³/h
	❷	Required static pressure Ps	109 Pa.
	❸	Sound power level Lw	30 dB(A).
	❹	Air-side capacity (based on L_9)	287 Watt
	❺	Water-side capacity at ❻ 260 l/h (based on W_{10})	648 Watt
	❼	Total cooling capacity per unit	935 Watt

As the stated temperature conditions match exactly with the temperature conditions L_9W_{10}, the far right column lists the total capacity of 935 Watt. This is a little more than the required capacity of 900 Watt.

Selection example OKNB - type 400 - model 1000 (nozzle L1 and L3)

AIR						WATER													
Primary			Heating capacity air t_{pri} -t_{room} °C					Heating capacity water $t_{water\ in}$ -t_{room} °C											
			10	15	20			20		25		30		40		50		60	
Vprim	Ps	Lw	Q_l	Q_l	Q_l	V_w	ΔP_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w

Nozzle L1

l/s	m³/h	Pa	dB(A)	W_{10}	W_{15}	W_{20}	l/h	kPa	W_{20}	°C	W_{25}	°C	W_{30}	°C	W_{40}	°C	W_{50}	°C	W_{60}	°C
9.7	**35**	39	14	117	176	234	50	0.1	304	5.2	380	6.5	456	7.8	608	10.4	760	13.0	912	15.6
							100	0.5	356	3.1	445	3.8	534	4.6	712	6.1	890	7.7	1068	9.2
							200	2.0	390	1.7	488	2.1	585	2.5	780	3.3	975	4.2	1170	5.0
							300	4.4	403	1.1	503	1.4	604	1.7	805	2.3	1007	2.8	1208	3.4
12.5	**45**	65	21	151	226	302	50	0.1	347	5.9	433	7.4	520	8.9	693	11.9	867	14.8	1040	17.8
							100	0.5	417	3.6	521	4.5	625	5.4	833	7.2	1042	9.0	1250	10.8
							200	2.0	463	2.0	579	2.5	695	3.0	927	4.0	1158	5.0	1390	6.0
							300	4.4	481	1.4	602	1.8	722	2.1	963	2.8	1203	3.5	1444	4.2
15.3	**55**	98	26	185	278	370	50	0.1	379	6.5	473	8.2	568	9.8	757	13.1	947	16.3	1136	19.6
							100	0.5	464	4.0	580	5.0	696	6.0	928	8.0	1160	10.0	1392	12.0
							200	2.0	523	2.3	654	2.8	785	3.4	1047	4.5	1308	5.7	1570	6.8
							300	4.4	547	1.6	683	2.0	820	2.4	1093	3.2	1367	4.0	1640	4.8
18.1	**65**	137	31	218	327	436	50	0.1	402	6.9	503	8.7	603	10.4	804	13.9	1005	17.3	1206	20.8
							100	0.5	501	4.3	626	5.4	751	6.5	1001	8.7	1252	10.8	1502	13.0
							200	2.0	571	2.5	713	3.1	856	3.7	1141	4.9	1427	6.2	1712	7.4
							300	4.4	599	1.7	748	2.2	898	2.6	1197	3.5	1497	4.3	1796	5.2

Nozzle L3

l/s	m³/h	Pa	dB(A)	W_{10}	W_{15}	W_{20}	l/h	kPa	W_{20}	°C	W_{25}	°C	W_{30}	°C	W_{40}	°C	W_{50}	°C	W_{60}	°C
18.1	**65**	52	18	218	327	436	50	0.1	349	6.0	437	7.5	524	9.0	699	12.0	873	15.0	1048	18.0
							100	0.5	432	3.7	540	4.7	648	5.6	864	7.5	1080	9.3	1296	11.2
							200	2.0	489	2.1	612	2.7	734	3.2	979	4.3	1223	5.3	1468	6.4
							300	4.4	512	1.5	640	1.8	768	2.2	1024	2.9	1280	3.7	1536	4.4
22.2	**80**	78	24	269	404	538	50	0.1	383	6.6	479	8.2	575	9.9	767	13.2	958	16.5	1150	19.8
							100	0.5	483	4.1	604	5.2	725	6.2	967	8.3	1208	10.3	1450	12.4
							200	2.0	557	2.4	696	3.0	835	3.6	1113	4.8	1392	6.0	1670	7.2
							300	4.4	586	1.7	732	2.1	879	2.5	1172	3.3	1465	4.2	1758	5.0
26.4	**95** ❶	109	30	319	478	638	50	0.1	409	7.1	512	8.8	614	10.6	819	14.1	1023	17.7	1228	21.2
							100 ❷	0.5	525	4.5	656 ❸	5.7	787	6.8	1049	9.1	1312	11.3	1574	13.6
							200	2.0	611	2.6	763	3.2	916	3.9	1221	5.2	1527	6.5	1832	7.8
							300	4.4	646	1.9	807	2.3	969	2.8	1292	3.7	1615	4.7	1938	5.6
30.6	**110**	146	34	369	554	738	50	0.1	429	7.4	537	9.2	644	11.1	859	14.8	1073	18.5	1288	22.2
							100	0.5	557	4.8	696	6.0	835	7.2	1113	9.6	1392	12.0	1670	14.4
							200	2.0	653	2.8	817	3.5	980	4.2	1307	5.6	1633	7.0	1960	8.4
							300	4.4	693	2.0	867	2.5	1040	3.0	1387	4.0	1733	5.0	2080	6.0

For the heating data, the following applies:

Nozzle L3:

❶	Primary air	95 m³/h
	Air-side capacity based on L_o (not in table)	0 Watt
	Water-side capacity at ❷ 200 l/h (based on W_{25})	763 Watt
❸	Total heating capacity per unit	763 Watt.

With increasingly modern facade technology, which keeps the heat in better, capacity often does not need to be brought in air side. The primary air temperature is then equal to the required room air temperature. In this situation, the water valve will be controlled up to just under 200 l/h to supply the required 750 Watt.

Performance data OKNB - type 400 - model 1000 (nozzle L1 and L3)

COOLING

AIR						WATER														Fast selection*	
Primary			Cooling capacity air t_{room} -t_{pri} °C					Cooling capacity water t_{room} -$t_{water\ in}$ °C												L_9 W_9	L_9 W_{10}
			8	9	10			6		7		8		9		10		11			
Vprim	Ps	Lw	Q_l	Q_l	Q_l	V_w	ΔP_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_t	Q_t

Nozzle L1

l/s	m³/h	Pa	dB(A)	W_8	W_9	W_{10}	l/h	kPa	W_6	°C	W_7	°C	W_8	°C	W_9	°C	W_{10}	°C	W_{11}	°C	$W_{9.9}$	$W_{9.10}$
9.7	**35**	39	14	94	105	117	50	0.5	146	2.5	170	2.9	194	3.4	219	3.8	243	4.2	267	4.6	324	348
							100	1.8	175	1.5	204	1.8	234	2.0	263	2.2	292	2.5	321	2.8	368	397
							200	6.4	194	0.8	227	1.0	259	1.1	292	1.3	324	1.4	356	1.5	397	429
							260	10.3	200	0.7	233	0.8	266	0.9	300	1.0	333	1.1	366	1.2	405	438
12.5	**45**	65	21	121	136	151	50	0.5	170	2.9	198	3.4	226	3.9	255	4.4	283	4.9	311	5.4	391	419
							100	1.8	211	1.8	246	2.1	282	2.4	317	2.7	352	3.0	387	3.3	453	488
							200	6.4	241	1.0	281	1.2	321	1.4	361	1.5	401	1.7	441	1.9	497	537
							260	10.3	248	0.8	290	1.0	331	1.1	373	1.3	414	1.4	455	1.5	509	550
15.3	**55**	98	26	148	166	185	50	0.5	188	3.2	220	3.8	251	4.3	283	4.9	314	5.4	345	5.9	449	480
							100	1.8	242	2.1	283	2.4	323	2.8	364	3.2	404	3.5	444	3.8	530	570
							200	6.4	283	1.2	330	1.4	378	1.6	425	1.8	472	2.0	519	2.2	591	638
							260	10.3	294	1.0	343	1.1	392	1.3	441	1.4	490	1.6	539	1.8	607	656
18.1	**65**	137	31	174	196	218	50	0.5	204	3.5	238	4.1	272	4.6	306	5.2	340	5.8	374	6.4	502	536
							100	1.8	270	2.3	315	2.7	360	3.1	405	3.5	450	3.9	495	4.3	601	646
							200	6.4	322	1.4	375	1.6	429	1.8	482	2.1	536	2.3	590	2.5	678	732
							260	10.3	337	1.1	393	1.3	449	1.5	505	1.7	561	1.9	617	2.1	701	757

Nozzle L3

l/s	m³/h	Pa	dB(A)	W_8	W_9	W_{10}	l/h	kPa	W_6	°C	W_7	°C	W_8	°C	W_9	°C	W_{10}	°C	W_{11}	°C	$W_{9.9}$	$W_{9.10}$
18.1	**65**	52	18	174	196	218	50	0.5	191	3.3	223	3.9	255	4.4	287	5.0	319	5.5	351	6.1	483	515
							100	1.8	245	2.1	286	2.4	326	2.8	367	3.2	408	3.5	449	3.8	563	604
							200	6.4	285	1.2	332	1.4	380	1.6	428	1.8	475	2.0	522	2.2	624	671
							260	10.3	296	1.0	346	1.1	395	1.3	445	1.4	494	1.6	543	1.8	641	690
22.2	**80**	78	24	215	242	269	50	0.5	211	3.6	246	4.2	281	4.8	316	5.4	351	6.0	386	6.6	558	593
							100	1.8	277	2.4	323	2.8	370	3.2	416	3.6	462	4.0	508	4.4	658	704
							200	6.4	330	1.4	385	1.7	440	1.9	495	2.2	550	2.4	605	2.6	737	792
							260	10.3	346	1.1	403	1.3	461	1.5	518	1.7	576	1.9	634	2.1	760	818
26.4	**95**	109	30	255	287	319	50	0.5	226	3.9	263	4.6	301	5.2	338	5.9	376	6.5	414	7.2	625	663
							100	1.8	305	2.6	356	3.1	406	3.5	457	4.0	508	4.4	559	4.8	744	795
							200	6.4	370	1.6	431	1.8	493	2.1	554	2.3	616	2.6	678	2.9	841	903
							260	10.3	389	1.3	454	1.5	518	1.7	583	1.9	648	2.1	713	2.3	870	935
30.6	**110**	146	34	295	332	369	50	0.5	237	4.1	276	4.8	316	5.4	356	6.1	395	6.8	434	7.5	688	727
							100	1.8	328	2.8	382	3.3	437	3.8	491	4.2	546	4.7	601	5.2	823	878
							200	6.4	404	1.7	472	2.0	539	2.3	607	2.6	674	2.9	741	3.2	939	1006
							260	10.3	427	1.4	498	1.7	570	1.9	641	2.2	712	2.4	783	2.6	973	1044

Performance data OKNB - type 400 - model 1000 (nozzle L1 and L3)

AIR						WATER													
Primary			Heating capacity air t_{pri} -t_{room} °C					Heating capacity water $t_{water\ in}$ -t_{room} °C											
			10	15	20			20		25		30		40		50		60	
Vprim	Ps	Lw	Q_l	Q_l	Q_l	V_w	ΔP_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w

Nozzle L1

l/s	m³/h	Pa	dB(A)	W_{10}	W_{15}	W_{20}	l/h	kPa	W_{20}	°C	W_{25}	°C	W_{30}	°C	W_{40}	°C	W_{50}	°C	W_{60}	°C
9.7	**35**	39	14	117	176	234	50	0.1	304	5.2	380	6.5	456	7.8	608	10.4	760	13.0	912	15.6
							100	0.5	356	3.1	445	3.8	534	4.6	712	6.1	890	7.7	1068	9.2
							200	2.0	390	1.7	488	2.1	585	2.5	780	3.3	975	4.2	1170	5.0
							300	4.4	403	1.1	503	1.4	604	1.7	805	2.3	1007	2.8	1208	3.4
12.5	**45**	65	21	151	226	302	50	0.1	347	5.9	433	7.4	520	8.9	693	11.9	867	14.8	1040	17.8
							100	0.5	417	3.6	521	4.5	625	5.4	833	7.2	1042	9.0	1250	10.8
							200	2.0	463	2.0	579	2.5	695	3.0	927	4.0	1158	5.0	1390	6.0
							300	4.4	481	1.4	602	1.8	722	2.1	963	2.8	1203	3.5	1444	4.2
15.3	**55**	98	26	185	278	370	50	0.1	379	6.5	473	8.2	568	9.8	757	13.1	947	16.3	1136	19.6
							100	0.5	464	4.0	580	5.0	696	6.0	928	8.0	1160	10.0	1392	12.0
							200	2.0	523	2.3	654	2.8	785	3.4	1047	4.5	1308	5.7	1570	6.8
							300	4.4	547	1.6	683	2.0	820	2.4	1093	3.2	1367	4.0	1640	4.8
18.1	**65**	137	31	218	327	436	50	0.1	402	6.9	503	8.7	603	10.4	804	13.9	1005	17.3	1206	20.8
							100	0.5	501	4.3	626	5.4	751	6.5	1001	8.7	1252	10.8	1502	13.0
							200	2.0	571	2.5	713	3.1	856	3.7	1141	4.9	1427	6.2	1712	7.4
							300	4.4	599	1.7	748	2.2	898	2.6	1197	3.5	1497	4.3	1796	5.2

Nozzle L3

l/s	m³/h	Pa	dB(A)	W_{10}	W_{15}	W_{20}	l/h	kPa	W_{20}	°C	W_{25}	°C	W_{30}	°C	W_{40}	°C	W_{50}	°C	W_{60}	°C
18.1	**65**	52	18	218	327	436	50	0.1	349	6.0	437	7.5	524	9.0	699	12.0	873	15.0	1048	18.0
							100	0.5	432	3.7	540	4.7	648	5.6	864	7.5	1080	9.3	1296	11.2
							200	2.0	489	2.1	612	2.7	734	3.2	979	4.3	1223	5.3	1468	6.4
							300	4.4	512	1.5	640	1.8	768	2.2	1024	2.9	1280	3.7	1536	4.4
22.2	**80**	78	24	269	404	538	50	0.1	383	6.6	479	8.2	575	9.9	767	13.2	958	16.5	1150	19.8
							100	0.5	483	4.1	604	5.2	725	6.2	967	8.3	1208	10.3	1450	12.4
							200	2.0	557	2.4	696	3.0	835	3.6	1113	4.8	1392	6.0	1670	7.2
							300	4.4	586	1.7	732	2.1	879	2.5	1172	3.3	1465	4.2	1758	5.0
26.4	**95**	109	30	319	478	638	50	0.1	409	7.1	512	8.8	614	10.6	819	14.1	1023	17.7	1228	21.2
							100	0.5	525	4.5	656	5.7	787	6.8	1049	9.1	1312	11.3	1574	13.6
							200	2.0	611	2.6	763	3.2	916	3.9	1221	5.2	1527	6.5	1832	7.8
							300	4.4	646	1.9	807	2.3	969	2.8	1292	3.7	1615	4.7	1938	5.6
30.6	**110**	146	34	369	554	738	50	0.1	429	7.4	537	9.2	644	11.1	859	14.8	1073	18.5	1288	22.2
							100	0.5	557	4.8	696	6.0	835	7.2	1113	9.6	1392	12.0	1670	14.4
							200	2.0	653	2.8	817	3.5	980	4.2	1307	5.6	1633	7.0	1960	8.4
							300	4.4	693	2.0	867	2.5	1040	3.0	1387	4.0	1733	5.0	2080	6.0

Performance data OKNB - type 400 - model 1000 (nozzle L6 and L8)

COOLING

AIR						WATER														Fast selection*	
Primary			Cooling capacity air t_{room} -t_{pri} °C					Cooling capacity water t_{room} -$t_{water\ in}$ °C												L_9 W_9	L_9 W_{10}
			8	9	10			6		7		8		9		10		11			
Vprim	Ps	Lw	Q_l	Q_l	Q_l	V_w	ΔP_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_{wk}	Δt_w	Q_t	Q_t

Nozzle L6

l/s	m³/h	Pa	dB(A)	W_8	W_9	W_{10}	l/h	kPa	W_6	°C	W_7	°C	W_8	°C	W_9	°C	W_{10}	°C	W_{11}	°C	$W_{9.9}$	$W_{9.10}$
30.6	**110**	57	26	295	332	369	50	0.5	205	3.5	239	4.1	274	4.7	308	5.3	342	5.9	376	6.5	640	674
							100	1.8	276	2.4	322	2.8	368	3.2	414	3.6	460	4.0	506	4.4	746	792
							200	6.4	334	1.4	390	1.7	446	1.9	501	2.2	557	2.4	613	2.6	833	889
							260	10.3	352	1.1	410	1.3	469	1.5	527	1.7	586	1.9	645	2.1	859	918
36.1	**130**	80	31	349	392	436	50	0.5	220	3.8	257	4.4	294	5.0	330	5.7	367	6.3	404	6.9	722	759
							100	1.8	302	2.6	353	3.0	403	3.4	454	3.9	504	4.3	554	4.7	846	896
							200	6.4	372	1.6	434	1.9	496	2.2	558	2.4	620	2.7	682	3.0	950	1012
							260	10.3	393	1.3	458	1.5	524	1.8	590	2.0	655	2.2	720	2.4	982	1047
41.7	**150**	106	35	402	453	503	50	0.5	233	4.0	272	4.7	311	5.4	350	6.0	389	6.7	428	7.4	803	842
							100	1.8	326	2.8	380	3.3	434	3.8	489	4.2	543	4.7	597	5.2	942	996
							200	6.4	406	1.7	473	2.0	541	2.3	608	2.6	676	2.9	744	3.2	1061	1129
							260	10.3	430	1.4	502	1.7	574	1.9	645	2.2	717	2.4	789	2.6	1098	1170
47.2	**170**	136	39	457	514	571	50	0.5	245	4.2	286	4.9	327	5.6	368	6.3	409	7.0	450	7.7	882	923
							100	1.8	346	3.0	404	3.5	462	4.0	519	4.5	577	5.0	635	5.5	1033	1091
							200	6.4	436	1.9	509	2.2	582	2.5	654	2.8	727	3.1	800	3.4	1168	1241
							260	10.3	464	1.6	541	1.8	618	2.1	696	2.3	773	2.6	850	2.9	1210	1287

Nozzle L8

l/s	m³/h	Pa	dB(A)	W_8	W_9	W_{10}	l/h	kPa	W_6	°C	W_7	°C	W_8	°C	W_9	°C	W_{10}	°C	W_{11}	°C	$W_{9.9}$	$W_{9.10}$
36.1	**130**	52	29	349	392	436	50	0.5	208	3.6	243	4.2	278	4.8	312	5.4	347	6.0	382	6.6	704	739
							100	1.8	275	2.3	321	2.7	366	3.1	412	3.5	458	3.9	504	4.3	804	850
							200	6.4	327	1.4	382	1.6	436	1.8	490	2.1	545	2.3	600	2.5	882	937
							260	10.3	342	1.1	399	1.3	456	1.5	513	1.7	570	1.9	627	2.1	905	962
41.7	**150**	69	34	402	453	503	50	0.5	221	3.8	258	4.4	295	5.0	332	5.7	369	6.3	406	6.9	785	822
							100	1.8	298	2.6	348	3.0	398	3.4	447	3.9	497	4.3	547	4.7	900	950
							200	6.4	361	1.6	421	1.8	482	2.1	542	2.3	602	2.6	662	2.9	995	1055
							260	10.3	379	1.3	442	1.5	506	1.7	569	1.9	632	2.1	695	2.3	1022	1085
47.2	**170**	88	37	457	514	571	50	0.5	232	4.0	270	4.6	309	5.3	347	5.9	386	6.6	425	7.3	861	900
							100	1.8	318	2.8	371	3.2	424	3.7	477	4.1	530	4.6	583	5.1	991	1044
							200	6.4	391	1.7	456	2.0	522	2.2	587	2.5	652	2.8	717	3.1	1101	1166
							260	10.3	413	1.4	482	1.6	551	1.8	620	2.1	689	2.3	758	2.5	1134	1203
52.8	**190**	110	40	510	574	638	50	0.5	241	4.1	281	4.8	321	5.5	361	6.2	401	6.9	441	7.6	935	975
							100	1.8	336	2.9	392	3.4	448	3.8	504	4.3	560	4.8	616	5.3	1078	1134
							200	6.4	419	1.8	489	2.1	558	2.4	628	2.7	698	3.0	768	3.3	1202	1272
							260	10.3	444	1.4	518	1.7	592	1.9	666	2.2	740	2.4	814	2.6	1240	1314

Performance data OKNB - type 400 - model 1000 (nozzle L6 and L8)

AIR						WATER													
Primary			Heating capacity air t_{pri} -t_{room} °C					Heating capacity water $t_{water\ in}$ -t_{room} °C											
			10	15	20			20		25		30		40		50		60	
Vprim	Ps	Lw	Q_l	Q_l	Q_l	V_w	ΔP_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w	Q_{ww}	Δt_w

Nozzle L6

l/s	m³/h	Pa	dB(A)	W_{10}	W_{15}	W_{20}	l/h	kPa	W_{20}	°C	W_{25}	°C	W_{30}	°C	W_{40}	°C	W_{50}	°C	W_{60}	°C
30.6	**110**	57	26	369	554	738	50	0.1	379	6.5	474	8.2	569	9.8	759	13.1	948	16.3	1138	19.6
							100	0.5	487	4.2	608	5.2	730	6.3	973	8.4	1217	10.5	1460	12.6
							200	2.0	567	2.5	709	3.1	851	3.7	1135	4.9	1418	6.2	1702	7.4
							300	4.4	600	1.7	750	2.2	900	2.6	1200	3.5	1500	4.3	1800	5.2
36.1	**130**	80	31	436	654	872	50	0.1	405	7.0	507	8.8	608	10.5	811	14.0	1013	17.5	1216	21.0
							100	0.5	526	4.5	658	5.7	789	6.8	1052	9.1	1315	11.3	1578	13.6
							200	2.0	618	2.7	772	3.3	927	4.0	1236	5.3	1545	6.7	1854	8.0
							300	4.4	657	1.9	821	2.3	985	2.8	1313	3.7	1642	4.7	1970	5.6
41.7	**150**	106	35	503	754	1006	50	0.1	426	7.3	532	9.2	639	11.0	852	14.7	1065	18.3	1278	22.0
							100	0.5	557	4.8	696	6.0	835	7.2	1113	9.6	1392	12.0	1670	14.4
							200	2.0	658	2.8	822	3.5	987	4.2	1316	5.6	1645	7.0	1974	8.4
							300	4.4	701	2.0	876	2.5	1051	3.0	1401	4.0	1752	5.0	2102	6.0
47.2	**170**	136	39	571	856	1142	50	0.1	443	7.6	554	9.5	665	11.4	887	15.2	1108	19.0	1330	22.8
							100	0.5	581	5.0	726	6.2	871	7.5	1161	10.0	1452	12.5	1742	15.0
							200	2.0	687	2.9	859	3.7	1031	4.4	1375	5.9	1718	7.3	2062	8.8
							300	4.4	733	2.1	916	2.7	1099	3.2	1465	4.3	1832	5.3	2198	6.4

Nozzle L8

l/s	m³/h	Pa	dB(A)	W_{10}	W_{15}	W_{20}	l/h	kPa	W_{20}	°C	W_{25}	°C	W_{30}	°C	W_{40}	°C	W_{50}	°C	W_{60}	°C
36.1	**130**	52	29	436	654	872	50	0.1	374	6.5	468	8.1	561	9.7	748	12.9	935	16.2	1122	19.4
							100	0.5	469	4.0	586	5.0	703	6.0	937	8.0	1172	10.0	1406	12.0
							200	2.0	537	2.3	671	2.9	805	3.5	1073	4.7	1342	5.8	1610	7.0
							300	4.4	564	1.6	705	2.0	846	2.4	1128	3.2	1410	4.0	1692	4.8
41.7	**150**	69	34	503	754	1006	50	0.1	395	6.8	494	8.5	593	10.2	791	13.6	988	17.0	1186	20.4
							100	0.5	503	4.3	629	5.4	755	6.5	1007	8.7	1258	10.8	1510	13.0
							200	2.0	583	2.5	729	3.2	875	3.8	1167	5.1	1458	6.3	1750	7.6
							300	4.4	616	1.7	770	2.2	924	2.6	1232	3.5	1540	4.3	1848	5.2
47.2	**170**	88	37	571	856	1142	50	0.1	412	7.1	515	8.8	618	10.6	824	14.1	1030	17.7	1236	21.2
							100	0.5	532	4.6	665	5.8	798	6.9	1064	9.2	1330	11.5	1596	13.8
							200	2.0	623	2.7	778	3.3	934	4.0	1245	5.3	1557	6.7	1868	8.0
							300	4.4	660	1.9	825	2.3	990	2.8	1320	3.7	1650	4.7	1980	5.6
52.8	**190**	110	40	638	957	1276	50	0.1	425	7.3	532	9.2	638	11.0	851	14.7	1063	18.3	1276	22.0
							100	0.5	555	4.8	694	6.0	833	7.2	1111	9.6	1388	12.0	1666	14.4
							200	2.0	655	2.8	818	3.5	982	4.2	1309	5.6	1637	7.0	1964	8.4
							300	4.4	697	2.0	871	2.5	1045	3.0	1393	4.0	1742	5.0	2090	6.0