CHAPTER 8

Chilled beam OKNM

The Solid Air OKNM is an active chilled beam for application in suspended ceilings.

- Air-outflow direction: 4-sided,
- Air supply: vertical or horizontal,
- Available in various nozzle configurations and colours
- Available for nearly all modular ceilings, including permanent plaster ceilings.

Applications:

- offices, open-plan offices
- teaching rooms
- meeting rooms
- general rooms

Functions:

- ventilation
- cooling
- heating

Specifications:

- type: 600
- model: 600 (optional 1200)
- ventilation: to 100 m^3/h
- cooling: to 510 W
- heating: to 2320 W
- water flow: to 300 l/h.

8.1

Application

The OKNM 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 introduces supply air from four sides and it's highly efficient air distribution offers freedom in office applications. A staggered pattern provides the most optimum combination of ventilation air and cooling capacity in every situation.

Contents

Properties and benefits of the OKNM

- Application in offices, meeting rooms, teaching rooms, open-plan offices, general areas
- High comfort level with even, 4-sided outflow of cooled or heated air,
- Room temperature controlled with amount of water (cooling and heating)
- 2 standard heat exchanger lengths
- Housing 600x600mm or optional 1200x600mm,
- Perforated face has the same look as the Solid Air perforated diffusers, providing an aesthetic solution
- Option to adjust the outflow direction to being 1, 2, 3 or 4 sided.

The unit has been designed as an insert module for modular ceilings with various T-bars and a module size of 300 and 600mm. The unit can also be used as an intermediate element in coffered ceilings or permanent ceilings. The standard length is 595mm, but there is an optional 1195mm length.

The low weight of the unit makes it easy to handle and integrate into modular ceilings.

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

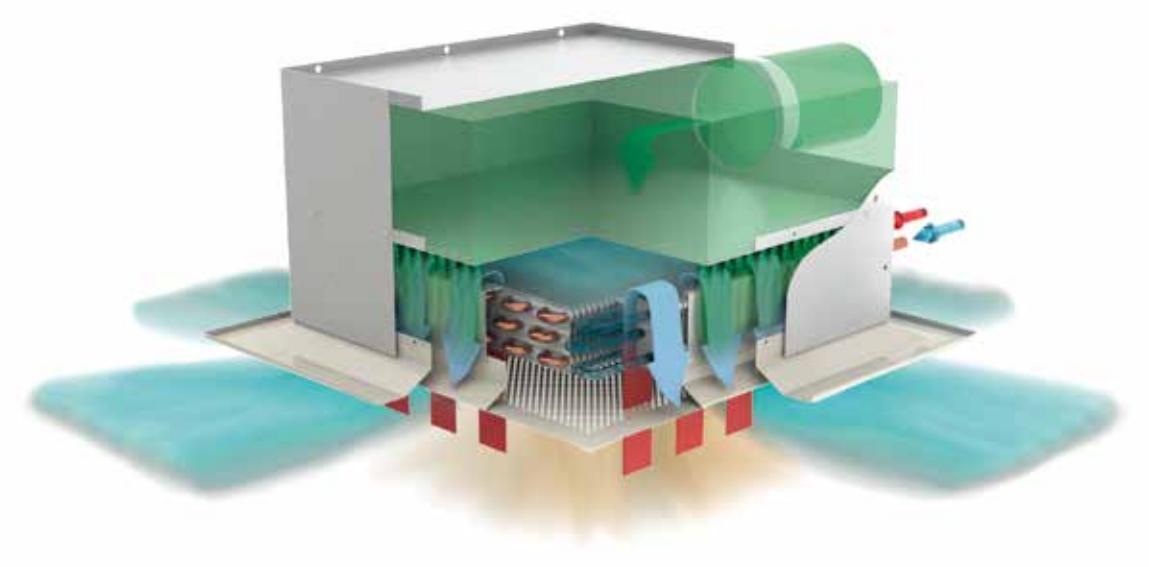
EUROVENT CERTIFIED PERFORMANCE
www.eurovent-certification.com

8.2

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 outflow openings.



Specifications:

Active chilled beam for water-air systems with high thermal capacities, limited noise levels and a high comfort level. The wide range of edge constructions and standard dimensions makes it suitable for T-bar, integrated, and permanent ceilings.

Suitable for cooling, ventilating and heating rooms with a height of 2.4 to 4.0 m. Extremely 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 versions 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.

Heat exchanger:

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

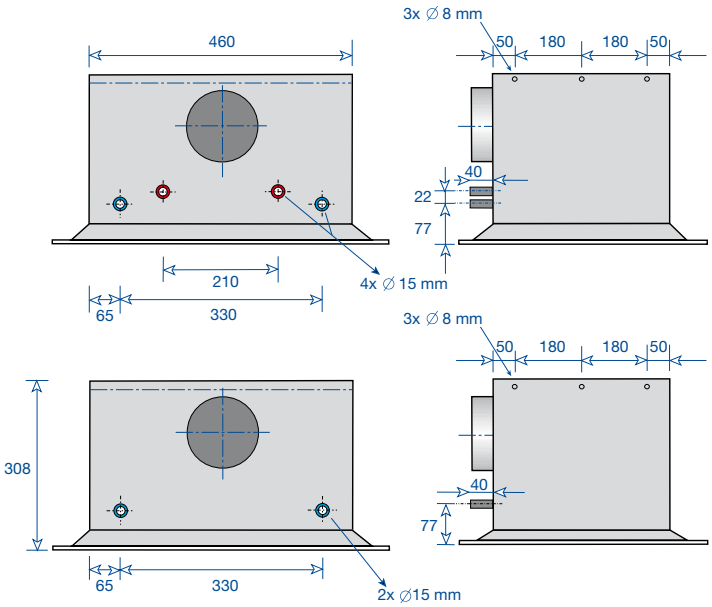
8.3

Main dimensions, connection sizes and ceiling integration

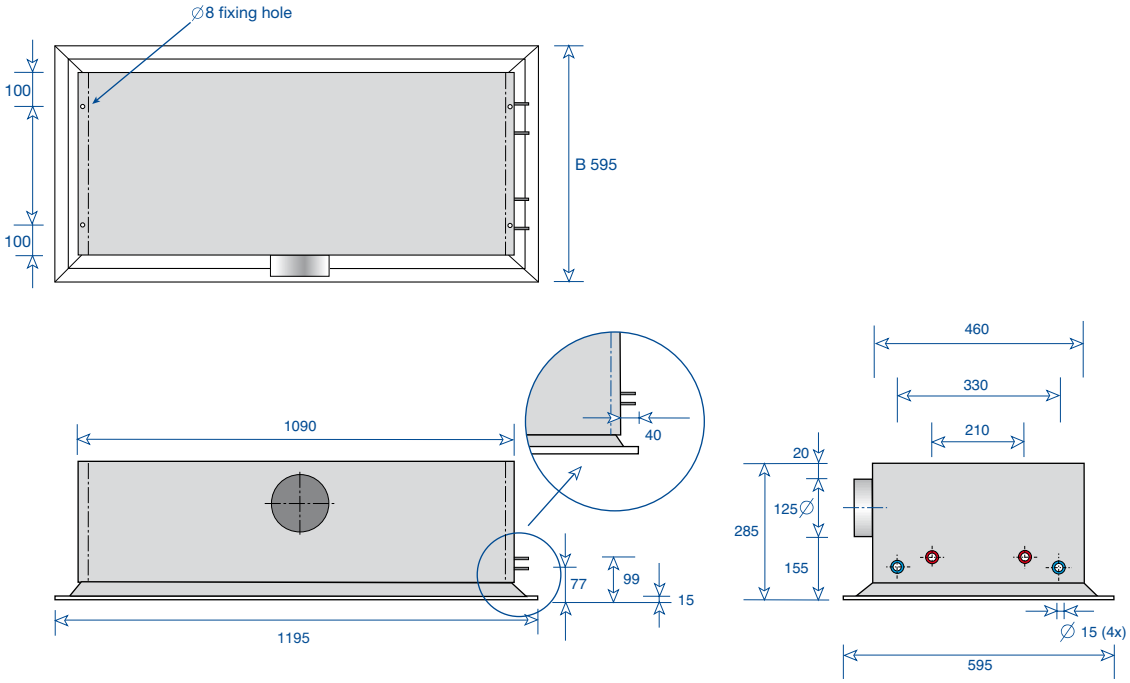
Available dimensions and weights: (different widths and lengths available upon request).

type	model	weight kg
OKNM 600	600	12,5
	1200	24

OKNM 600 / 600



OKNM 600 / 1200



The selection of the chilled beam OKNM must take account of the following tolerances of main dimensions in combination with the side-edge configuration to ensure an optimum integration into the ceiling.

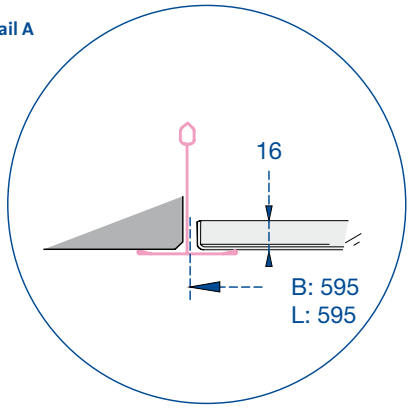
OKNM type 600 & 1200 side-edge configuration: dimensions and tolerances main dimensions

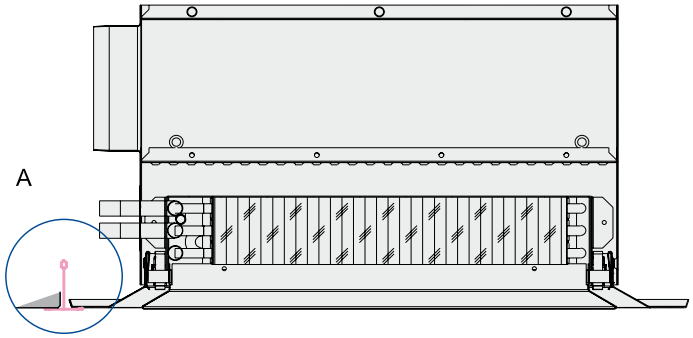
Actual dimensions chilled beam: dimensions in mm, tolerance +/- 2.0 mm

T-bar (insert) ceilings

OKNM 600 / 600

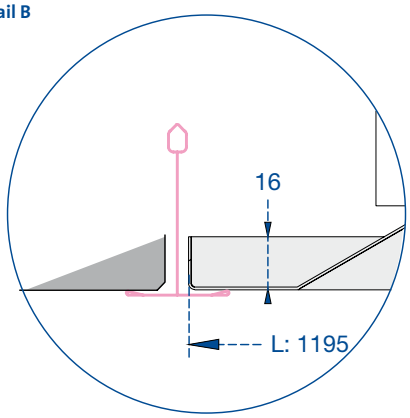
Detail A

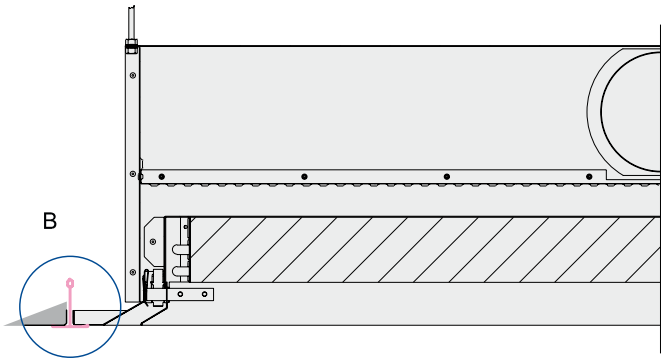




OKNM 600 / 1200

Detail B





8.4

Versions and options

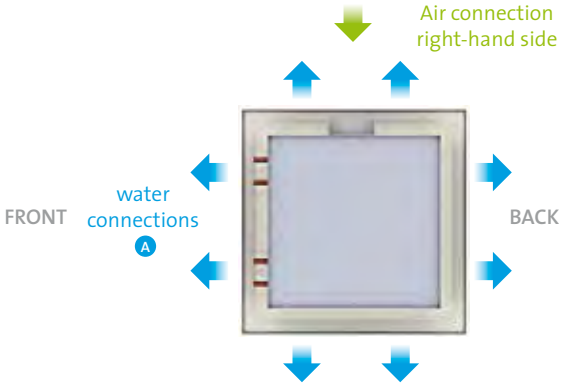
Nozzle configurations
3 standard nozzles are available.

Oval air connection
Oval air connection is available which is equivalent to Ø 125 mm. This reduces the integration height from 300mm to 260mm. A standard flexible duct can be connected.

Length dimensions
Besides the standard length of 595mm, there is an optional 1195mm available.

Asymmetrical outflow pattern
The nozzles can be covered with blanking plates on one, two or three sides, which reduces the beam capacity. The side with the water connections cannot be covered. Consult our specialists for more information.

Order codes OKNM



Left/right position:
standing in the direction
of the water connections
A
on the opposite side

Example order code:	OKNM	600/	600	C2	V5	RO3U	O1O	595x595	9010	-	55
	1	2	3	4	5	6	7 8 9 10	11 12 13	14	15	16		17

1	**Version**	OKNM	
2	**Type**	600	
3	**Model**	600	
		1200	
4	**Nozzle configuration**	B2	
		C2	
		D2	
5	**Heat exchanger**	K	Cooling
		V	Cooling & Heating
6	**Discharge configuration**	5	4-sided discharge
7	**Air connection**	T	Top
		L	Left
		A	Back
		R	Right
8	**Water connection**	O	Standard
9	**Diameter air connection**	3	125mm
		V	Oval equivalent to 125 Ø
10	**Plenum version**	U	Not insulated
		R	Insulated
11	**Diffuser**	O	Not applicable
12	**Edge configuration**	1	Suitable for T-bar (insert)
		2	Superstructure version permanent ceilings
13	**FPC**	O	Not applicable
14	**Actual width B**	595	
15	**Actual length L**	595	
		1195	
16	**Colour (RAL)**	9010	(standard)
17	**Gloss value**	55%	(standard)

8.6

Installation requirements and maintenance

Fitting

The unit has been designed as an insert module (dimensions 600 mm) for T-bar ceilings, plaster ceilings, and permanent ceilings. The low weight of the unit makes it easy to handle in modular ceilings. The unit should be fitted with safety retainers. 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. It is recommended that 2 fitters lift any unit. The unit must be suspended on 4 points. 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, noted with the marking C (Cold), there is no specific preference for inlet or outlet; 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:

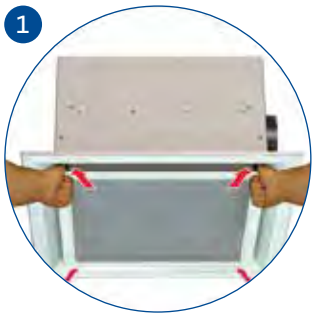
- Treated water — low mineral component
- Acidity — between 8.0 – 8.5 pH
- Carbon dioxide — less than 25 ppm
- Sulphates — less than 17 ppm
- Chloride — less than 20 ppm

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.

In view of cleaning the heat exchanger, it is possible to remove the middle segment of the unit in a simple fashion.

This works as follows:



Use your thumbs to push the corner clips of two adjacent corners slightly open and pull the front slightly down from the corner clips.

Then push in the two clips.

Lower the front. The front stays connected to the unit with 2 steel safety cables.

Clean the surface 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. Finally, check that the suspension rods of the front are stable in the corner clips and the corner clips closed.

8.7

Selection 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 OKNM

Concentration room for 1 person (LxWxH)		3.0 x 3.0 x 2.7m
Requirement:	Ventilation rate	at least double
	Cooling capacity (55 Watt/m²)	495 Watt
	Heating capacity (45 Watt/m²)	405 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 required minimum ventilation rate lead to a minimum fresh air requirement of 48.6 m³/h. The selection of the OKNM is based on a minimum fresh air requirement of 50 m³/h.

The next page contains the selection table for the OKNM type 600 model 600 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 is 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 OKNM - type 600 - model 600

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 B 2

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	$W_{9,9}$	$W_{9,10}$
8.3	30	40	15	81	91	101	50	0.5	97	1.7	113	2.0	129	2.2	145	2.5	161	2.8	177	3.1	236	252
							100	1.5	112	1.0	130	1.1	149	1.3	167	1.4	186	1.6	205	1.8	258	277
							200	5.0	121	0.5	141	0.6	162	0.7	182	0.8	202	0.9	222	1.0	273	293
							300	10.0	125	0.4	146	0.4	166	0.5	187	0.5	208	0.6	229	0.7	278	299
11.1	40	73	23	107	121	134	50	0.5	119	2.0	139	2.4	158	2.7	178	3.1	198	3.4	218	3.7	299	319
							100	1.5	143	1.2	167	1.4	190	1.6	214	1.8	238	2.0	262	2.2	335	359
							200	5.0	159	0.7	186	0.8	212	0.9	238	1.0	265	1.1	292	1.2	359	386
							300	10.0	165	0.5	192	0.6	220	0.6	248	0.7	275	0.8	302	0.9	369	396
13.9	50 ①	117 ②	30 ③	134	151 ④	168	50	0.5	139	2.4	162	2.8	185	3.2	208	3.6	231	4.0	254	4.4	359	382
							100	1.5	172	1.5	200	1.8	229	2.0	257	2.2	286	2.5	315	2.8	408	437
							200	5.0	195	0.8	228	1.0	260	1.1	292	1.3	325	1.4	358	1.5	443	476
							300 ⑥	10.0	205	0.6	239	0.7	273	0.8	307	0.9	341 ⑤	1.0	375	1.1	458	492 ⑦
16.7	60	171	35	161	181	201	50	0.5	155	2.6	181	3.1	206	3.5	232	4.0	258	4.4	284	4.8	413	439
							100	1.5	198	1.7	231	2.0	264	2.2	297	2.5	330	2.8	363	3.1	478	511
							200	5.0	230	1.0	269	1.2	307	1.4	346	1.5	384	1.7	422	1.9	527	565
							300	10.0	244	0.7	284	0.8	325	1.0	365	1.1	406	1.2	447	1.3	546	587
19.4	70	237	40	188	212	235	50	0.5	169	2.9	197	3.4	226	3.9	254	4.4	282	4.9	310	5.4	466	494
							100	1.5	223	1.9	260	2.2	297	2.6	334	2.9	371	3.2	408	3.5	546	583
							200	5.0	264	1.1	308	1.3	352	1.5	396	1.7	440	1.9	484	2.1	608	652
							300	10.0	282	0.8	329	0.9	376	1.0	423	1.2	470	1.3	517	1.4	635	682

Nozzle C 2

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	$W_{9,9}$	$W_{9,10}$
16.7	60	46	24	161	181	201	50	0.5	121	2.1	141	2.4	162	2.8	182	3.2	202	3.5	222	3.8	363	383
							100	1.5	149	1.3	174	1.5	199	1.7	224	1.9	249	2.1	274	2.3	405	430
							200	5.0	169	0.7	197	0.8	226	1.0	254	1.1	282	1.2	310	1.3	435	463
							300	10.0	178	0.5	207	0.6	237	0.6	266	0.7	296	0.8	326	0.9	447	477

On the basis of the amount of air, the choice is for:

Nozzle B2:	① Primary air	50 m³/h
	② Required static pressure Ps	117 Pa.
	③ Sound power level Lw	30 dB(A).
	④ Air-side capacity (based on L_9)	151 Watt
	⑤ Water-side capacity at ⑥ 300 l/h (based on W_{10})	341 Watt
	⑦ Total cooling capacity per unit	492 Watt

As the stated temperature conditions match exactly with the temperature conditions L_9W_{10}, the far right column lists the total capacity of 492 Watt. This is 3 Watt less than the required capacity of 495 Watt. However, the difference is nil, which means these details can be used.

Selection example OKNM - type 600 - model 600

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 B 2																			
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
8.3	**30**	40	15	101	152	202	50	0.3	305	5.3	382	6.6	458	7.9	611	10.5	763	13.2	916	15.8
							100	1.0	348	3.0	435	3.8	522	4.5	696	6.0	870	7.5	1044	9.0
							200	3.4	375	1.6	468	2.0	562	2.4	749	3.2	937	4.0	1124	4.8
							300	6.9	384	1.1	480	1.4	576	1.7	768	2.3	960	2.8	1152	3.4
11.1	**40**	73	23	134	201	268	50	0.3	371	6.4	463	8.0	556	9.6	741	12.8	927	16.0	1112	19.2
							100	1.0	436	3.7	545	4.7	654	5.6	872	7.5	1090	9.3	1308	11.2
							200	3.4	478	2.1	598	2.6	717	3.1	956	4.1	1195	5.2	1434	6.2
							300	6.9	494	1.4	618	1.8	741	2.1	988	2.8	1235	3.5	1482	4.2
13.9	**50** ①	117	30	168	252	336	50 ②	0.3	425	7.3	531 ③	9.2	637	11.0	849	14.7	1062	18.3	1274	22.0
							100	1.0	513	4.4	641	5.5	769	6.6	1025	8.8	1282	11.0	1538	13.2
							200	3.4	572	2.5	715	3.1	858	3.7	1144	4.9	1430	6.2	1716	7.4
							300	6.9	595	1.7	744	2.2	893	2.6	1191	3.5	1488	4.3	1786	5.2
16.7	**60**	171	35	201	302	402	50	0.3	471	8.1	588	10.1	706	12.1	941	16.1	1177	20.2	1412	24.2
							100	1.0	581	5.0	727	6.2	872	7.5	1163	10.0	1453	12.5	1744	15.0
							200	3.4	659	2.8	823	3.5	988	4.2	1317	5.6	1647	7.0	1976	8.4
							300	6.9	689	2.0	862	2.5	1034	3.0	1379	4.0	1723	5.0	2068	6.0
19.4	**70**	237	40	235	352	470	50	0.3	509	8.7	637	10.9	764	13.1	1019	17.5	1273	21.8	1528	26.2
							100	1.0	642	5.5	802	6.9	963	8.3	1284	11.1	1605	13.8	1926	16.6
							200	3.4	737	3.2	922	4.0	1106	4.8	1475	6.4	1843	8.0	2212	9.6
							300	6.9	776	2.2	970	2.8	1164	3.3	1552	4.4	1940	5.5	2328	6.6
Nozzle C 2																			
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
16.7	**60**	46	24	201	302	402	50	0.3	373	6.4	467	8.0	560	9.6	747	12.8	933	16.0	1120	19.2
							100	1.0	429	3.7	537	4.6	644	5.5	859	7.3	1073	9.2	1288	11.0
							200	3.4	465	2.0	581	2.5	697	3.0	929	4.0	1162	5.0	1394	6.0
							300	6.9	478	1.4	598	1.8	717	2.1	956	2.8	1195	3.5	1434	4.2

For the heating data, the following applies:

Nozzle B2:	①	Primary air	50 m³/h
		Air-side capacity based on L_o (not in table)	0 Watt
	②	Water-side capacity at ③ 50 l/h (based on W_{25})	531 Watt
		Total heating capacity	531 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 selection, the supplied capacity is higher than the required capacity. In this situation, the water valve will be controlled open at full load to just under 50 l/h to supply the required 405 Watt.

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 B 2

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	$W_{9,9}$	$W_{9,10}$
8.3	30	40	15	81	91	101	50	0.5	97	1.7	113	2.0	129	2.2	145	2.5	161	2.8	177	3.1	236	252
							100	1.5	112	1.0	130	1.1	149	1.3	167	1.4	186	1.6	205	1.8	258	277
							200	5.0	121	0.5	141	0.6	162	0.7	182	0.8	202	0.9	222	1.0	273	293
							300	10.0	125	0.4	146	0.4	166	0.5	187	0.5	208	0.6	229	0.7	278	299
11.1	40	73	23	107	121	134	50	0.5	119	2.0	139	2.4	158	2.7	178	3.1	198	3.4	218	3.7	299	319
							100	1.5	143	1.2	167	1.4	190	1.6	214	1.8	238	2.0	262	2.2	335	359
							200	5.0	159	0.7	186	0.8	212	0.9	238	1.0	265	1.1	292	1.2	359	386
							300	10.0	165	0.5	192	0.6	220	0.6	248	0.7	275	0.8	302	0.9	369	396
13.9	50	117	30	134	151	168	50	0.5	139	2.4	162	2.8	185	3.2	208	3.6	231	4.0	254	4.4	359	382
							100	1.5	172	1.5	200	1.8	229	2.0	257	2.2	286	2.5	315	2.8	408	437
							200	5.0	195	0.8	228	1.0	260	1.1	292	1.3	325	1.4	358	1.5	443	476
							300	10.0	205	0.6	239	0.7	273	0.8	307	0.9	341	1.0	375	1.1	458	492
16.7	60	171	35	161	181	201	50	0.5	155	2.6	181	3.1	206	3.5	232	4.0	258	4.4	284	4.8	413	439
							100	1.5	198	1.7	231	2.0	264	2.2	297	2.5	330	2.8	363	3.1	478	511
							200	5.0	230	1.0	269	1.2	307	1.4	346	1.5	384	1.7	422	1.9	527	565
							300	10.0	244	0.7	284	0.8	325	1.0	365	1.1	406	1.2	447	1.3	546	587
19.4	70	237	40	188	212	235	50	0.5	169	2.9	197	3.4	226	3.9	254	4.4	282	4.9	310	5.4	466	494
							100	1.5	223	1.9	260	2.2	297	2.6	334	2.9	371	3.2	408	3.5	546	583
							200	5.0	264	1.1	308	1.3	352	1.5	396	1.7	440	1.9	484	2.1	608	652
							300	10.0	282	0.8	329	0.9	376	1.0	423	1.2	470	1.3	517	1.4	635	682

Nozzle C 2

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	$W_{9,9}$	$W_{9,10}$
16.7	60	46	24	161	181	201	50	0.5	121	2.1	141	2.4	162	2.8	182	3.2	202	3.5	222	3.8	363	383
							100	1.5	149	1.3	174	1.5	199	1.7	224	1.9	249	2.1	274	2.3	405	430
							200	5.0	169	0.7	197	0.8	226	1.0	254	1.1	282	1.2	310	1.3	435	463
							300	10.0	178	0.5	207	0.6	237	0.6	266	0.7	296	0.8	326	0.9	447	477
19.4	70	62	28	188	212	235	50	0.5	133	2.3	155	2.7	177	3.0	199	3.4	221	3.8	243	4.2	411	433
							100	1.5	167	1.4	195	1.7	222	1.9	250	2.2	278	2.4	306	2.6	462	490
							200	5.0	191	0.8	223	1.0	255	1.1	287	1.3	319	1.4	351	1.5	499	531
							300	10.0	201	0.6	234	0.7	268	0.8	302	0.9	335	1.0	368	1.1	514	547
22.2	80	81	32	215	242	269	50	0.5	142	2.5	166	2.9	190	3.3	213	3.7	237	4.1	261	4.5	455	479
							100	1.5	182	1.6	212	1.8	242	2.1	273	2.3	303	2.6	333	2.9	515	545
							200	5.0	211	0.9	246	1.0	282	1.2	317	1.3	352	1.5	387	1.6	559	594
							300	10.0	223	0.7	260	0.8	298	0.9	335	1.0	372	1.1	409	1.2	577	614
25.0	90	102	35	242	272	302	50	0.5	151	2.6	176	3.0	202	3.4	227	3.9	252	4.3	277	4.7	499	524
							100	1.5	196	1.7	229	2.0	262	2.2	294	2.5	327	2.8	360	3.1	566	599
							200	5.0	230	1.0	269	1.2	307	1.4	346	1.5	384	1.7	422	1.9	618	656
							300	10.0	245	0.7	286	0.8	326	1.0	367	1.1	408	1.2	449	1.3	639	680
27.8	100	126	38	269	302	336	50	0.5	160	2.8	186	3.2	213	3.7	239	4.1	266	4.6	293	5.1	541	568
							100	1.5	209	1.8	244	2.1	279	2.4	314	2.7	349	3.0	384	3.3	616	651
							200	5.0	248	1.1	290	1.3	331	1.4	373	1.6	414	1.8	455	2.0	675	716
							300	10.0	265	0.8	309	0.9	353	1.0	397	1.2	441	1.3	485	1.4	699	743

Nozzle D 2

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	$W_{9,9}$	$W_{9,10}$
22.2	80	43	34	215	242	269	50	0.5	132	2.3	154	2.7	176	3.0	198	3.4	220	3.8	242	4.2	440	462
							100	1.5	166	1.4	194	1.7	222	1.9	249	2.2	277	2.4	305	2.6	491	519
							200	5.0	191	0.8	223	1.0	254	1.1	286	1.3	318	1.4	350	1.5	528	560
							300	10.0	201	0.6	234	0.7	268	0.8	302	0.9	335	1.0	368	1.1	544	577
25.0	90	54	37	242	272	302	50	0.5	140	2.4	163	2.8	186	3.2	210	3.6	233	4.0	256	4.4	482	505
							100	1.5	179	1.6	209	1.8	239	2.1	269	2.3	299	2.6	329	2.9	541	571
							200	5.0	209	0.9	244	1.0	278	1.2	313	1.3	348	1.5	383	1.6	585	620
							300	10.0	221	0.7	258	0.8	294	0.9	331	1.0	368	1.1	405	1.2	603	640
27.8	100	66	40	269	302	336	50	0.5	148	2.5	172	2.9	197	3.4	221	3.8	246	4.2	271	4.6	523	548
							100	1.5	192	1.7	224	2.0	256	2.2	288	2.5	320	2.8	352	3.1	590	622
							200	5.0	226	1.0	263	1.1	301	1.3	338	1.4	376	1.6	414	1.8	640	678
							300	10.0	239	0.7	279	0.8	319	0.9	359	1.0	399	1.1	439	1.2	661	701

Performance data OKNM - type 600 - model 600

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 B 2

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
8.3	**30**	40	15	101	152	202	50	0.3	305	5.3	382	6.6	458	7.9	611	10.5	763	13.2	916	15.8
							100	1.0	348	3.0	435	3.8	522	4.5	696	6.0	870	7.5	1044	9.0
							200	3.4	375	1.6	468	2.0	562	2.4	749	3.2	937	4.0	1124	4.8
							300	6.9	384	1.1	480	1.4	576	1.7	768	2.3	960	2.8	1152	3.4
11.1	**40**	73	23	134	201	268	50	0.3	371	6.4	463	8.0	556	9.6	741	12.8	927	16.0	1112	19.2
							100	1.0	436	3.7	545	4.7	654	5.6	872	7.5	1090	9.3	1308	11.2
							200	3.4	478	2.1	598	2.6	717	3.1	956	4.1	1195	5.2	1434	6.2
							300	6.9	494	1.4	618	1.8	741	2.1	988	2.8	1235	3.5	1482	4.2
13.9	**50**	117	30	168	252	336	50	0.3	425	7.3	531	9.2	637	11.0	849	14.7	1062	18.3	1274	22.0
							100	1.0	513	4.4	641	5.5	769	6.6	1025	8.8	1282	11.0	1538	13.2
							200	3.4	572	2.5	715	3.1	858	3.7	1144	4.9	1430	6.2	1716	7.4
							300	6.9	595	1.7	744	2.2	893	2.6	1191	3.5	1488	4.3	1786	5.2
16.7	**60**	171	35	201	302	402	50	0.3	471	8.1	588	10.1	706	12.1	941	16.1	1177	20.2	1412	24.2
							100	1.0	581	5.0	727	6.2	872	7.5	1163	10.0	1453	12.5	1744	15.0
							200	3.4	659	2.8	823	3.5	988	4.2	1317	5.6	1647	7.0	1976	8.4
							300	6.9	689	2.0	862	2.5	1034	3.0	1379	4.0	1723	5.0	2068	6.0
19.4	**70**	237	40	235	352	470	50	0.3	509	8.7	637	10.9	764	13.1	1019	17.5	1273	21.8	1528	26.2
							100	1.0	642	5.5	802	6.9	963	8.3	1284	11.1	1605	13.8	1926	16.6
							200	3.4	737	3.2	922	4.0	1106	4.8	1475	6.4	1843	8.0	2212	9.6
							300	6.9	776	2.2	970	2.8	1164	3.3	1552	4.4	1940	5.5	2328	6.6

Nozzle C 2

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
16.7	**60**	46	24	201	302	402	50	0.3	373	6.4	467	8.0	560	9.6	747	12.8	933	16.0	1120	19.2
							100	1.0	429	3.7	537	4.6	644	5.5	859	7.3	1073	9.2	1288	11.0
							200	3.4	465	2.0	581	2.5	697	3.0	929	4.0	1162	5.0	1394	6.0
							300	6.9	478	1.4	598	1.8	717	2.1	956	2.8	1195	3.5	1434	4.2
19.4	**70**	62	28	235	352	470	50	0.3	410	7.1	512	8.8	615	10.6	820	14.1	1025	17.7	1230	21.2
							100	1.0	480	4.1	600	5.2	720	6.2	960	8.3	1200	10.3	1440	12.4
							200	3.4	525	2.3	657	2.8	788	3.4	1051	4.5	1313	5.7	1576	6.8
							300	6.9	543	1.5	678	1.9	814	2.3	1085	3.1	1357	3.8	1628	4.6
22.2	**80**	81	32	269	404	538	50	0.3	442	7.6	552	9.5	663	11.4	884	15.2	1105	19.0	1326	22.8
							100	1.0	526	4.5	658	5.7	789	6.8	1052	9.1	1315	11.3	1578	13.6
							200	3.4	581	2.5	727	3.2	872	3.8	1163	5.1	1453	6.3	1744	7.6
							300	6.9	603	1.7	753	2.2	904	2.6	1205	3.5	1507	4.3	1808	5.2
25.0	**90**	102	35	302	453	604	50	0.3	470	8.1	588	10.1	705	12.1	940	16.1	1175	20.2	1410	24.2
							100	1.0	568	4.9	710	6.1	852	7.3	1136	9.7	1420	12.2	1704	14.6
							200	3.4	634	2.7	792	3.4	951	4.1	1268	5.5	1585	6.8	1902	8.2
							300	6.9	659	1.9	824	2.3	989	2.8	1319	3.7	1648	4.7	1978	5.6
27.8	**100**	126	38	336	504	672	50	0.3	494	8.5	618	10.6	741	12.7	988	16.9	1235	21.2	1482	25.4
							100	1.0	605	5.2	757	6.5	908	7.8	1211	10.4	1513	13.0	1816	15.6
							200	3.4	682	2.9	852	3.7	1023	4.4	1364	5.9	1705	7.3	2046	8.8
							300	6.9	712	2.1	890	2.6	1068	3.1	1424	4.1	1780	5.2	2136	6.2

Nozzle D 2

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
22.2	**80**	43	34	269	404	538	50	0.3	397	6.9	497	8.6	596	10.3	795	13.7	993	17.2	1192	20.6
							100	1.0	470	4.1	588	5.1	705	6.1	940	8.1	1175	10.2	1410	12.2
							200	3.4	517	2.2	647	2.8	776	3.3	1035	4.4	1293	5.5	1552	6.6
							300	6.9	535	1.5	669	1.9	803	2.3	1071	3.1	1338	3.8	1606	4.6
25.0	**90**	54	37	302	453	604	50	0.3	425	7.3	531	9.2	637	11.0	849	14.7	1062	18.3	1274	22.0
							100	1.0	509	4.4	637	5.5	764	6.6	1019	8.8	1273	11.0	1528	13.2
							200	3.4	565	2.4	707	3.0	848	3.6	1131	4.8	1413	6.0	1696	7.2
							300	6.9	587	1.7	733	2.1	880	2.5	1173	3.3	1467	4.2	1760	5.0
27.8	**100**	66	40	336	504	672	50	0.3	449	7.7	562	9.7	674	11.6	899	15.5	1123	19.3	1348	23.2
							100	1.0	545	4.7	682	5.8	818	7.0	1091	9.3	1363	11.7	1636	14.0
							200	3.4	610	2.6	762	3.2	915	3.9	1220	5.2	1525	6.5	1830	7.8
							300	6.9	635	1.8	794	2.3	953	2.7	1271	3.6	1588	4.5	1906	5.4