PURMO

PURMO Air

VENTILATION RADIATORS

August 2001

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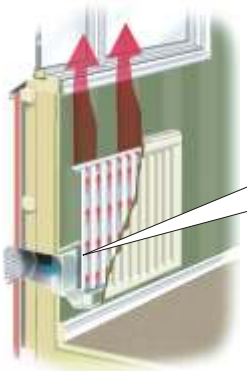
General

A new fresh air radiator

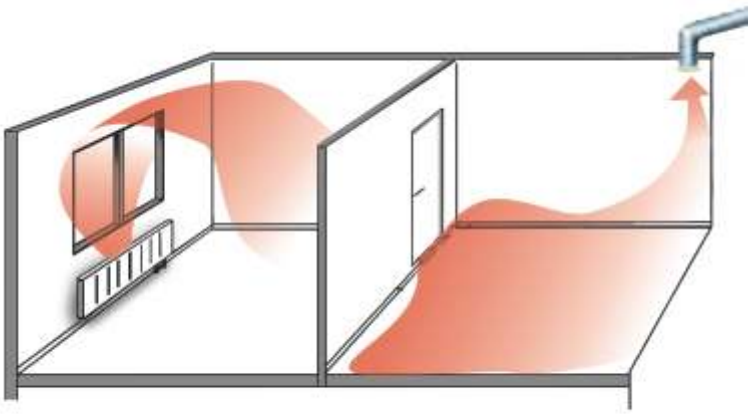
Rettig Värme Ab has more than ten years experience of manufacturing fresh air radiators and their behaviour under operating conditions. ComfortAir already a proven and successful fresh air radiator in Finland and in export markets has now been developed further to satisfy the expectations of a wider circle of customers.

The new PURMO Air is the result of this product development. A combination of PURMO Air supply air device and PURMO radiator, either Compact or Plan VKO, PURMO Air has more advanced technical features than its predecessor, is more profitable and has a wider model range.

Purmo Air is a patented product and its heat outputs conform to the European Standard for radiators EN 442.



In the exterior wall, behind the radiator, is an air duct through which outdoor air enters the PURMO Air supply air device and radiator being filtered and heated at the same time. The suction necessary is created by the central extract fan. Clean and fresh air flows into the room without any noise or draught.



The fresh air radiator system is also more energy efficient. Ventilation is demand controlled, where people are. Properly balanced and controlled ventilation with PURMO Air optimises total energy consumption. Airflow paths are needed for balanced ventilation, for example with make-up air grilles in doors or sufficient air gaps above doorsills.

Required ventilation rate

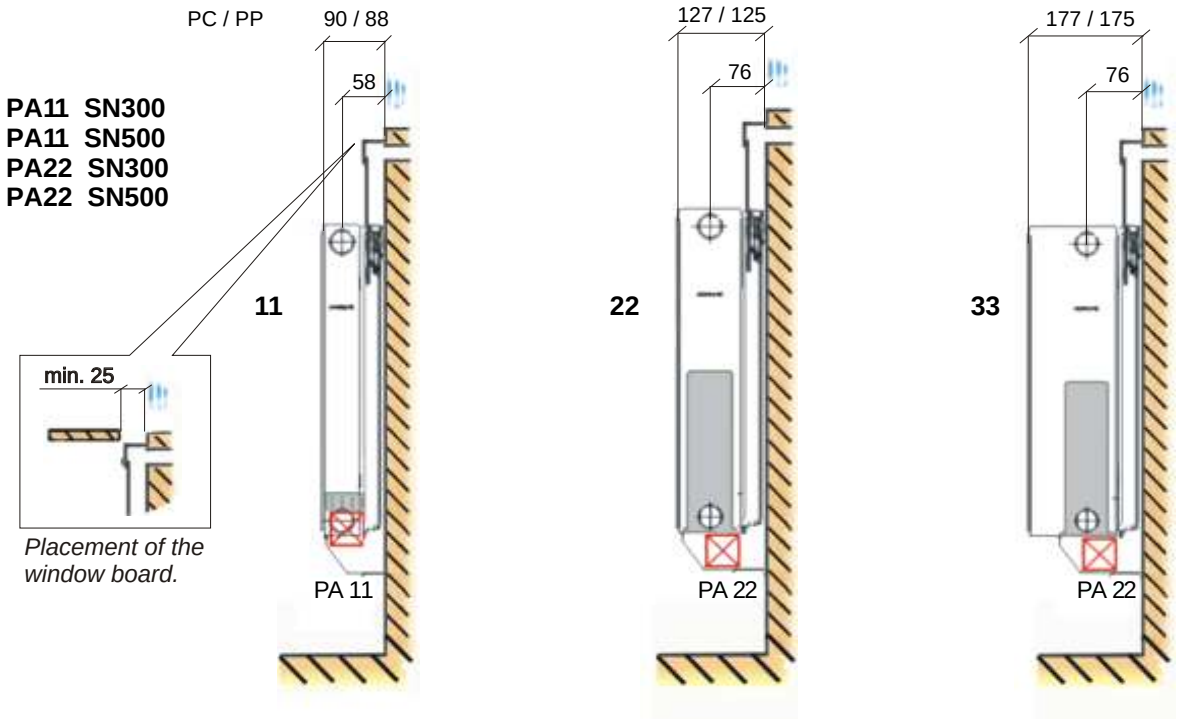
Lack of ventilation is a common problem in modern airtight buildings and an underlying reason for a number of illnesses and general lack of indoor comfort. Typical characteristics of poor indoor air quality are a high concentration of carbon dioxide, excessive humidity, emissions from building materials and furnishings and pollutants from the ground soil. In addition, gases and particulate matter from outside can build up indoors. If ventilation is insufficient, the prevalence of allergies, asthma and other respiratory diseases, as well as mould growth due to high humidity, will increase. A high concentration of carbon dioxide is sensed as stuffy air and will decrease the ability to concentrate and cause poor sleep and discomfort.

These are health risk factors which can be reduced by proper ventilation.

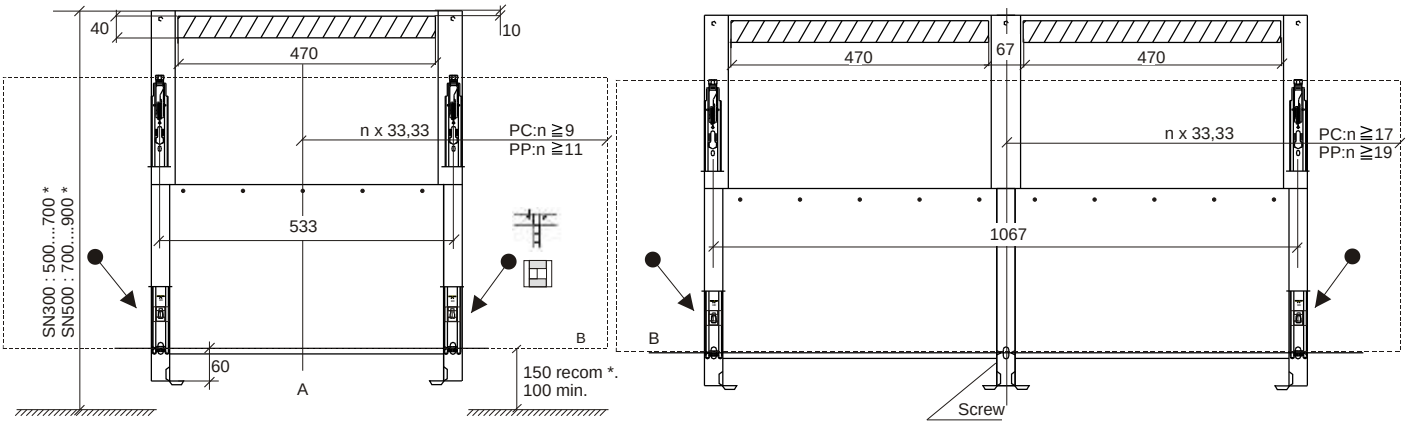
Indoor carbon dioxide concentration is a good measure of indoor air quality in dwellings. At least 5 litres per second fresh supply air per person is needed to keep carbon dioxide concentration at a reasonable level and the number of persons occupying a room is the typical design criterion for fresh air intake. The total air change rate of the apartment or house is regulated by the building codes.

PURMO Air fresh intake air system can be used in buildings equipped with hot water central heating radiators and mechanical extraction ventilation. PURMO Air is suitable for most of types of building, such as dwelling houses, offices, schools, hospitals, nursing homes, day care centres, hotels, etc.

Installation dimensions for PA SN - models



Radiator type 11 is equipped with a splined gasket directing airflow; radiator types 22 and 33 with direction walls. The distance between the floor and lower edge of the radiator is recommended to be 150 mm; the minimum is 100 mm. Monclac brackets are used in the installation.



PA SN is equipped with top and bottom covers which can be opened for cleaning and replacing the air filter.

The air duct on the wall behind the radiator must be located in the marked area in the figure. A flat rectangular duct corresponding to the cross section of a 100 mm diameter circular duct is recommended:

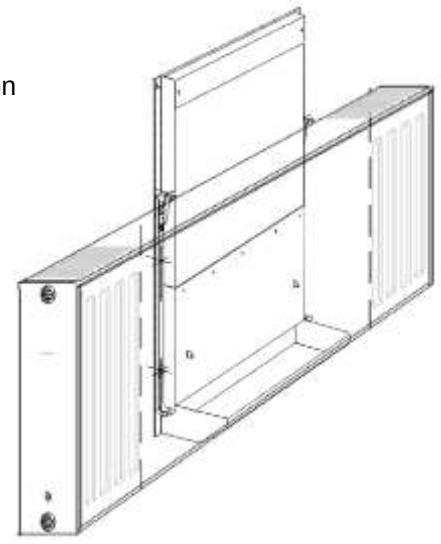
Width 300…400 mm
Height 20…30 mm
For example 20 by 400 or 25 by 300

The position of the air duct on the wall (e.g. the height of window sill):

PA SN300 500…700
PA SN500 700…900
These dimensions correspond to a distance 150mm between the floor and lower edge of the radiator.

The minimum lengths of radiators:

	PC	PP
1 PA	600	700
2 PA	1 200	1 200
3 PA	1 800	1 800



Design

Heat losses and ventilation

PURMO Air supply air system has similar dimensioning bases as other hot water heating systems equipped with mechanical extraction ventilation: radiator heat output is equal to room heat losses plus the ventilation heat loss. Additionally, to achieve perfect performance of the supply air system, two other factors have to be taken into account when selecting radiators: first, a comfort factor, i.e. temperature of the supply air, and secondly, the operating pressure difference of supply air system created by the extraction system. Fresh air radiators are dimensioned according to total heat loss. Operation of the system should be verified for all extreme conditions, where temperatures/air flows differ from each other. Radiators should be sized to satisfy the most extreme conditions.

Design values for airflows, for example in dwellings, are given in building codes and other authorized guidelines. The total airflow is divided over a sufficient number of PURMO Air supply devices, through which air enters the rooms. A proper value for design airflow is about 10 litres per second per PURMO Air unit. This corresponds to the ventilation requirement of a room occupied by two persons. (5 litres per second thus corresponds to the ventilation requirement of a single person room.) When the room is designed for several persons, several PURMO Air units should be installed in the same proportion. PURMO Air should be placed preferably in bedrooms and living rooms, and those rooms where fresh air supply is primarily needed. PURMO Air fresh air devices are not recommended for rooms with extraction vents, such as bathroom, WC, kitchen, clothes closet, sauna, etc.

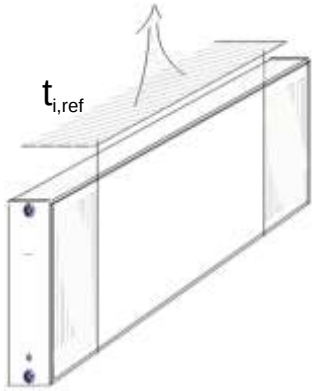
Comfort

The fresh air system should be designed in such a way that it does not create annoying draughts; water flow temperature should be controlled according to heat losses and outdoor temperature. There are many factors affecting the sensation of draught: air temperature and velocity, radiation conditions, metabolic rate, clothing, age, vitality, and other sensory factors. To achieve a proper comfort level the reference temperature of air $t_{i,ref}$ may be used as criterion.

Class 1: $t_{i,ref} > t_{room} - 2\ ^{\circ}C$
A normal target value, such as living-rooms, where the occupied zone is close to radiators. The criterion of Class 1 should be fulfilled with both full speed and low speed ventilation.

Class 2: $t_{i,ref} > t_{room} - 8^{\circ}C$
A lower target value. The criterion of Class 2 should be fulfilled with full speed and the criterion of Class 1 with low speed ventilation.

NB! A typical feature of fresh air systems is a short duration of decreased supply air temperature caused by closing of the thermostatic radiator valve.

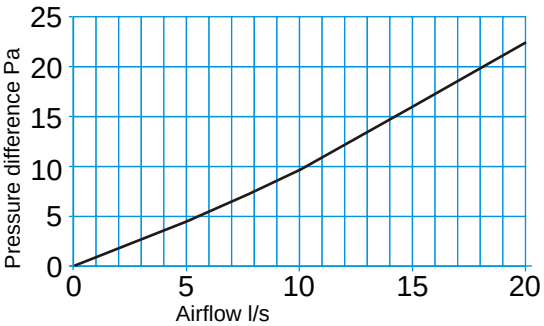


The reference air temperature $t_{i,ref}$ denotes the average temperature above the radiator in the interaction-region of the supply air device.

Pressure difference and leakage airflows

To achieve the proper performance of ventilation and airflow through the fresh air radiator, the design value of pressure difference cannot be too high. The appropriate pressure difference depends on the air-tightness of the building: the more leaky the building the higher the rate of leakage air flow (infiltration) in the total air change rate. The design value of Δp = 15 Pa should not be exceeded even for an airtight building. The shape and size of the air duct behind the radiator as well as the outlet grille will create pressure loss which has to be taken into account in design.

In case of excessive leakage airflow rate, the heat output of radiators might turn out to be insufficient. This uncertainty deserves consideration in radiator dimensioning.



Pressure drop of PURMO Air fresh air system measured from Φ100 mm air duct to the room.

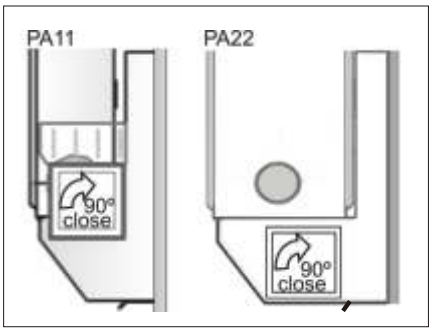
Adjustment of supply airflow

Completely open circular duct of diameter 100 mm corresponds to the air change requirement of two person room. When supply airflow has to be halved a reducing element, included in the packaging of PURMO Air, is installed into the air duct. (See installation instructions.)

Reducing socket for PA models and rectangular reducing element for PA SN models.

The adjustment of total air change rate may be done by setting extraction air vents to the required pressure ratios, for example in bathrooms, toilets, clothing closets and kitchens. The ventilation system is balanced by adjusting the extraction air fan and air dampers.

PURMO Air's supply may be shut down simply by turning the air filter through 90°. This might be needed for example in case of fire or gas emergency.



PURMO Air design software

PURMO Air design software is downloadable from the web page: www.purmo.com/fi and may be used for dimensioning and selecting the radiators. Check also the current model range from the web page.

The programme will guide the user to the correct choices: heat outputs; air temperatures; reference temperature $t_{i,ref}$; pressure drops, Δp; the effect of air leakage (infiltration), % etc. An example of the PURMOAir programme is shown below.

PURMO Air + PURMO Compact

Dimensioning Data

t_{flow}= 55.0 °C t_{rtn}= 45.0 °C t_{room}= 20.0 °C t_{out}= -20.0 °C V_{100}= 10.0 l/s-$_{unit}$ n= 1 pcs

V_{leak} **Compensation=** 20 **%**

Δ T_{in}= 29.7 K Δ T_{out}= 69.9 K Δp= 9.9 Pa

Output Data - Total Outputs

Purmo Air - PA11

PC11	300	400	450	500	600
600	301	367	399	429	489
700	329	403	438	473	540
800	356	438	478	516	591
900	384	474	517	560	642
1000	411	509	557	603	694
1100	438	545	596	647	745
1200	466	581	636	690	796
1400	521	652	715	777	898
1600	575	723	794	864	1001
1800	630	794	873	951	1103
2000	685	865	952	1038	1205
2300	767	971	1071	1168	1359
2600	849	1078	1189	1299	1512
3000	959	1220	1347	1472	1717

Purmo Air - PA22

PC22	300	400	450	500	600
600	464	564	612	659	748
700	512	625	678	730	832
800	560	685	744	802	915
900	608	745	810	874	998
1000	656	805	876	946	1081
1100	705	865	942	1018	1164
1200	753	925	1008	1089	1248
1400	849	1046	1140	1233	1414
1600	945	1166	1272	1377	1581
1800	1042	1286	1404	1520	1747
2000	1138	1407	1537	1664	1914
2300	1282	1587	1735	1879	2163
2600	1427	1768	1933	2095	2413
3000	1620	2009	2197	2382	2746

Purmo Air - PA22/33

PC33	300	400	450	500	600
600	578	710	775	837	961
700	643	794	867	939	1079
800	708	878	960	1040	1197
900	774	962	1053	1142	1314
1000	839	1046	1146	1243	1432
1100	904	1130	1238	1344	1550
1200	970	1214	1331	1446	1668
1400	1100	1382	1517	1649	1904
1600	1231	1549	1702	1851	2140
1800	1362	1717	1888	2054	2376
2000	1492	1885	2073	2257	2612
2300	1688	2136	2351	2561	2966
2600	1884	2388	2630	2865	3320
3000	2146	2724	3001	3271	3792

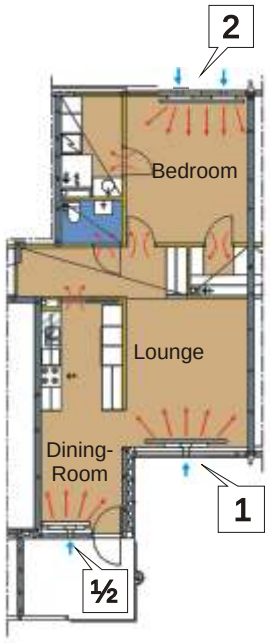
Air Ref. Temps by V_{100} Note! Very Low Temperature Note! Low Temperature

	300	400	450	500	600		300	400	450	500	600		300	400	450	500	600
ti,ref.	5	9	11	13	16	ti,ref.	15	21	24	26	30	ti,ref.	15	21	24	26	30
	X	X	X														
	X	X	X	X	X		X						X				

NB! Heat outputs of PURMO Air fresh air systems correspond to EN 442-2.

Dimensioning example

A typical small apartment.



In this case two design conditions have to be checked.

Example:	1	2
Design outdoor temperature, DOT:	-20 °C	-5 °C
Air change rate, V_{air}:	18 l/s (0,5 1/h)	36 l/s (1,0 1/h)
Temperatures (flow, return, air):	55/45/20 °C	to be found
	(E.g.i $\Delta t_{aritm.}$ = 30 °C)	

Supply air system has to be sized for the highest airflow which is 36 l/s. This airflow will be divided over three fully open and one partly open supply air devices. NB! About 10 l/s is a good starting value for PAunit.

I Air change

2 DOT = -5°C ja V_{air} =36 l/s

Bedroom	2 x 36/3,5 = 20,6 l/s
Lounge	1 x 36/3,5 = 10,3 l/s
Dining-room	0,5 x 36/3,5 = 5,1 l/s

1 DOT = -20°C ja V_{air} = 18 l/s

Bedroom	= 10,3 l/s
Lounge	= 5,1 l/s
Dining-room	= 2,6 l/s

II Heat losses

1 DOT = -20°C ja V_{air} = 18 l/s

Bedroom	Ventilation heat loss	494 W
	Conduction heat loss	512 W
	Σ	1 006 W
Lounge	Ventilation heat loss	245 W
	Conduction heat loss	464 W
	Σ	709 W
Dining-room	Ventilation heat loss	125 W
	Conduction heat loss	432 W
	Σ	557 W
Appartment	Σ	2 272 W

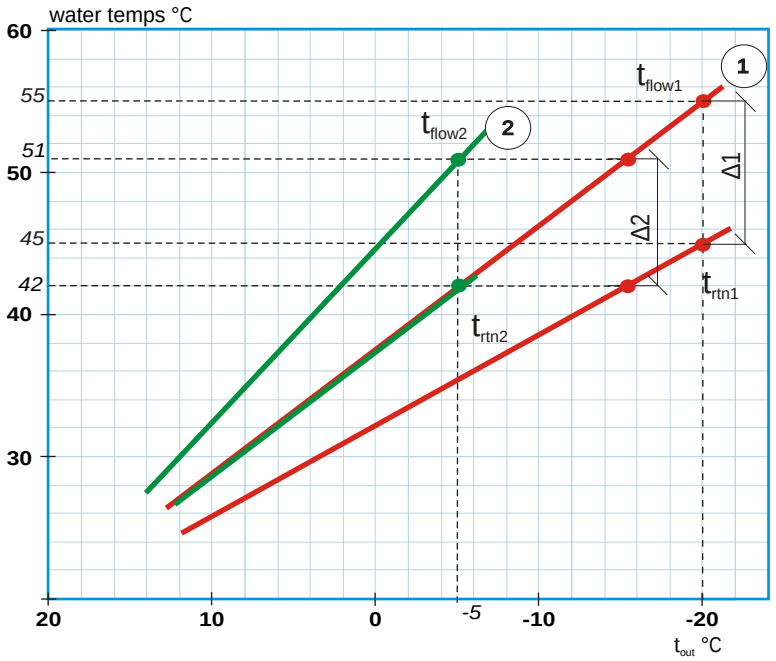
2 DOT = -5°C ja V_{air} = 36 l/s

Bedroom	Ventilation heat loss	618 W
	Conduction heat loss	320 W
	Σ	938 W
Lounge	Ventilation heat loss	309 W
	Conduction heat loss	290 W
	Σ	599 W
Dining-room	Ventilation heat loss	155 W
	Conduction heat loss	270 W
	Σ	425 W
Appartment	Σ	1 962 W

The water temperatures must correspond to total heat loss also in design condition 2. Corresponding temperature level can be found with sufficient accuracy as follows:

$$\left(\frac{\Delta t_2}{30} \right)^{1,3} = \frac{1962}{2272}$$

⇨ Δt_2 = 26,8 °C, which corresponds to the temperatures 51/42/21 ºC at a constant water flow rate.



The water flow temperature should be controlled according to curve 1 at half speed ventilation (18 l/s) and according to curve 2 at full speed ventilation (36 l/s).

III PURMO Air programme obtains the following results

In these examples typical figures for leakage airflows (infiltration) are used. In practice, the amount of leakage airflow to total air change rate has to be estimated in every case individually.

1DOT =	-20°C; V_{air} = 18 l/s and temperature 55/45/20 °C	
Bedroom 1006 W	Leakage	20 %
	Radiator	PC22-400-1400
	PA22	2 pieces
	Total heat output	1 025 W
	Air temperature	32°C - (V_{100})
Lounge: 709 W	Leakage	30 %
	Radiator	PC22-300-1400
	PA22	1piece
	Total heat output	738 W
	Air temperature	25°C - (V_{100})
Dining-room 557 W	Leakage	40 %
	Radiator	PC11-500-1200
	PA11	1 piece
	Total heat output	553 W
	Air temperature	25°C - (V_{100})

2 DOT =	-5°C; V_{air} = 36 l/s and temperature 51/42/20 °C	
Bedroom 938 W	Leakage	20%
	Radiator	PC22-400-1400
	PA22	2 pieces
	Total heat output	987 W
	Air temperature	25°C - (V_{100})
Lounge 599 W	Leakage	30 %
	Radiator	PC22-300-1200
	PA22	1 piece
	Total heat output	591 W
	Air temperature	21°C - (V_{100})
Dining-room 425 W	Leakage	40 %
	Radiator	PC11-500-1000
	PA11	1 piece
	Total heat output	426 W
	Air temperature	24°C - (V_{100})

Radiators are selected according to most critical design conditions. In this case selected radiators and supply air devices are:

Bedroom:	PC22-400-1400 + 2 x Pa22
Lounge:	PC22-300-1400 + 1 x PA22
Dining-room:	PC11-500-1200 + 1 x PA11 + reducing socket

Note that pressure-losses are at maximum about 10 Pa and reference temperature of the air is within the range of Comfort Class 1.

PURMO Compact Standard heat output data for ΔT_{in} = 50K; ΔT_{out} = 85K

Equipped with one PURMO Air supply device.

V_{air} = 0 l/s

PC11	300	400	450	500	600	PC22	300	400	450	500	600	PC33	300	400	450	500	600
600	253	331	369	407	482	600	286	379	426	472	564	600	518	679	760	841	1004
700	307	400	446	491	582	700	381	498	557	614	730	700	650	848	946	1044	1240
800	360	469	522	576	681	800	476	617	687	757	895	800	782	1017	1133	1248	1476
900	413	538	599	660	780	900	571	736	818	899	1061	900	914	1185	1319	1451	1712
1000	466	607	676	744	879	1000	666	855	949	1042	1226	1000	1045	1354	1505	1655	1948
1100	519	676	752	828	978	1100	761	974	1079	1184	1391	1100	1177	1523	1692	1858	2184
1200	573	745	829	913	1078	1200	855	1093	1210	1326	1557	1200	1309	1692	1878	2062	2420
1400	679	883	983	1081	1276	1400	1045	1331	1472	1611	1888	1400	1573	2030	2251	2468	2892
1600	785	1021	1136	1250	1474	1600	1235	1569	1733	1896	2219	1600	1837	2367	2624	2875	3364
1800	892	1159	1289	1418	1673	1800	1425	1807	1995	2180	2550	1800	2101	2705	2997	3282	3836
2000	998	1296	1443	1587	1871	2000	1615	2045	2256	2465	2880	2000	2364	3043	3370	3689	4309
2300	1158	1503	1673	1840	2169	2300	1900	2402	2648	2892	3377	2300	2760	3549	3929	4300	5017
2600	1317	1710	1903	2093	2467	2600	2185	2759	3040	3319	3873	2600	3156	4055	4488	4910	5725
3000	1530	1986	2209	2430	2863	3000	2565	3235	3563	3889	4535	3000	3683	4731	5234	5724	6669

V_{air} = 5 l/s

PC11	300	400	450	500	600	PC22	300	400	450	500	600	PC33	300	400	450	500	600
600	404	505	554	602	695	600	589	734	803	872	1005	600	821	1033	1137	1240	1445
700	457	574	630	686	795	700	684	853	934	1014	1171	700	953	1202	1324	1444	1681
800	510	643	707	770	894	800	779	972	1065	1157	1336	800	1085	1371	1510	1647	1917
900	564	712	784	854	993	900	874	1091	1196	1299	1502	900	1217	1540	1697	1851	2153
1000	617	781	860	939	1092	1000	969	1210	1326	1441	1667	1000	1349	1709	1883	2054	2389
1100	670	850	937	1023	1191	1100	1064	1329	1457	1584	1832	1100	1481	1878	2069	2258	2625
1200	723	919	1014	1107	1291	1200	1159	1448	1588	1726	1998	1200	1613	2046	2256	2461	2861
1400	830	1057	1167	1276	1489	1400	1349	1686	1849	2011	2329	1400	1877	2384	2629	2868	3333
1600	936	1195	1320	1444	1688	1600	1539	1924	2111	2295	2660	1600	2140	2722	3002	3275	3805
1800	1042	1332	1474	1613	1886	1800	1729	2162	2372	2580	2990	1800	2404	3059	3374	3682	4277
2000	1149	1470	1627	1782	2084	2000	1919	2400	2634	2865	3321	2000	2668	3397	3747	4089	4750
2300	1308	1677	1857	2034	2382	2300	2204	2756	3026	3292	3818	2300	3064	3904	4307	4699	5458
2600	1468	1884	2087	2287	2680	2600	2489	3113	3418	3719	4314	2600	3459	4410	4866	5310	6166
3000	1681	2160	2394	2624	3076	3000	2868	3589	3941	4289	4976	3000	3987	5085	5611	6124	7110

V_{air} = 10 l/s

PC11	300	400	450	500	600	PC22	300	400	450	500	600	PC33	300	400	450	500	600
600	479	591	646	698	802	600	723	890	970	1048	1200	600	956	1190	1304	1417	1639
700	532	660	722	783	901	700	818	1009	1101	1191	1365	700	1087	1359	1491	1620	1875
800	585	729	799	867	1000	800	913	1128	1232	1333	1531	800	1219	1528	1677	1824	2112
900	639	798	876	951	1099	900	1008	1247	1362	1475	1696	900	1351	1696	1863	2027	2348
1000	692	867	952	1036	1198	1000	1103	1366	1493	1618	1862	1000	1483	1865	2050	2231	2584
1100	745	936	1029	1120	1298	1100	1198	1485	1624	1760	2027	1100	1615	2034	2236	2434	2820
1200	798	1005	1106	1204	1397	1200	1293	1604	1755	1903	2193	1200	1747	2203	2423	2638	3056
1400	905	1143	1259	1373	1595	1400	1483	1842	2016	2187	2523	1400	2011	2541	2796	3045	3528
1600	1011	1281	1412	1541	1794	1600	1673	2080	2278	2472	2854	1600	2274	2878	3168	3452	4000
1800	1117	1419	1566	1710	1992	1800	1863	2318	2539	2757	3185	1800	2538	3216	3541	3859	4472
2000	1224	1557	1719	1878	2191	2000	2053	2556	2800	3041	3516	2000	2802	3554	3914	4266	4944
2300	1383	1764	1949	2131	2488	2300	2338	2913	3193	3469	4012	2300	3198	4060	4473	4876	5652
2600	1543	1971	2179	2384	2786	2600	2623	3270	3585	3896	4509	2600	3593	4567	5033	5486	6361
3000	1756	2247	2486	2721	3183	3000	3002	3746	4108	4465	5170	3000	4121	5242	5778	6300	7305

V_{air} = 15 l/s

PC11	300	400	450	500	600	PC22	300	400	450	500	600	PC33	300	400	450	500	600
600	539	661	719	776	887	600	828	1012	1100	1186	1352	600	1060	1312	1434	1554	1791
700	593	730	796	861	986	700	923	1131	1231	1328	1517	700	1192	1481	1620	1758	2027
800	646	799	873	945	1085	800	1018	1250	1362	1471	1682	800	1324	1650	1807	1961	2263
900	699	868	949	1029	1184	900	1113	1369	1492	1613	1848	900	1456	1818	1993	2165	2499
1000	752	937	1026	1113	1284	1000	1208	1488	1623	1755	2013	1000	1588	1987	2180	2368	2735
1100	805	1006	1103	1198	1383	1100	1303	1607	1754	1898	2179	1100	1719	2156	2366	2572	2971
1200	859	1075	1179	1282	1482	1200	1398	1726	1884	2040	2344	1200	1851	2325	2553	2775	3207
1400	965	1213	1333	1451	1680	1400	1588	1964	2146	2325	2675	1400	2115	2662	2925	3182	3680
1600	1071	1351	1486	1619	1879	1600	1777	2202	2407	2609	3006	1600	2379	3000	3298	3589	4152
1800	1178	1489	1640	1788	2077	1800	1967	2440	2669	2894	3337	1800	2643	3338	3671	3996	4624
2000	1284	1627	1793	1956	2276	2000	2157	2678	2930	3179	3668	2000	2906	3675	4044	4403	5096
2300	1444	1834	2023	2209	2573	2300	2442	3035	3322	3606	4164	2300	3302	4182	4603	5013	5804
2600	1603	2041	2253	2462	2871	2600	2727	3392	3715	4033	4660	2600	3698	4688	5162	5624	6512
3000	1816	2316	2560	2799	3268	3000	3107	3868	4238	4602	5322	3000	4225	5364	5908	6438	7456

Heat outputs conform to the European Standard for radiators EN 442 - WTP GmbH Berlin.

PURMO Plan VKO Standard heat output data for ΔT_{in} = 50K; ΔT_{out} = 85K

Equipped with one PURMO Air supply device.

V_{air} = 0 l/s

PP11	300	400	500	600	PP22	300	400	500	600	PP33	300	400	500	600
700	288	380	471	561	**700**	364	479	595	710	**700**	629	827	1024	1220
800	340	447	553	658	**800**	456	595	734	873	**800**	762	995	1225	1453
900	392	514	635	754	**900**	548	711	874	1036	**900**	894	1163	1426	1686
1000	443	582	717	851	**1000**	639	828	1014	1199	**1000**	1027	1331	1628	1919
1100	495	649	799	947	**1100**	731	944	1153	1362	**1100**	1160	1499	1829	2152
1200	547	716	882	1044	**1200**	823	1060	1293	1525	**1200**	1293	1667	2031	2385
1400	650	851	1046	1237	**1400**	1006	1292	1572	1850	**1400**	1558	2003	2433	2851
1600	754	985	1210	1430	**1600**	1190	1524	1852	2176	**1600**	1824	2340	2836	3317
1800	857	1120	1375	1623	**1800**	1373	1756	2131	2502	**1800**	2090	2676	3239	3784
2000	961	1254	1539	1816	**2000**	1557	1988	2411	2828	**2000**	2355	3012	3642	4250
2300	1116	1456	1785	2106	**2300**	1832	2336	2830	3317	**2300**	2754	3516	4246	4949
2600	1271	1657	2032	2395	**2600**	2107	2684	3249	3806	**2600**	3152	4021	4850	5648
3000	1478	1926	2360	2781	**3000**	2474	3149	3808	4458	**3000**	3683	4693	5656	6581

V_{air} = 5 l/s

PP11	300	400	500	600	PP22	300	400	500	600	PP33	300	400	500	600
700	439	554	665	774	**700**	668	834	994	1151	**700**	932	1181	1423	1661
800	491	621	747	871	**800**	760	950	1134	1314	**800**	1065	1349	1625	1894
900	542	688	830	967	**900**	851	1066	1274	1477	**900**	1198	1517	1826	2127
1000	594	756	912	1064	**1000**	943	1182	1413	1640	**1000**	1331	1686	2028	2360
1100	646	823	994	1161	**1100**	1035	1298	1553	1803	**1100**	1464	1854	2229	2593
1200	698	890	1076	1257	**1200**	1127	1414	1693	1965	**1200**	1596	2022	2430	2826
1400	801	1024	1240	1450	**1400**	1310	1646	1972	2291	**1400**	1862	2358	2833	3292
1600	904	1159	1405	1643	**1600**	1493	1878	2252	2617	**1600**	2128	2694	3236	3758
1800	1008	1293	1569	1836	**1800**	1677	2110	2531	2943	**1800**	2393	3030	3639	4225
2000	1111	1428	1733	2029	**2000**	1860	2343	2810	3269	**2000**	2659	3367	4042	4691
2300	1267	1630	1980	2319	**2300**	2135	2691	3229	3758	**2300**	3057	3871	4646	5390
2600	1422	1831	2226	2608	**2600**	2411	3039	3648	4247	**2600**	3456	4375	5250	6089
3000	1629	2100	2555	2994	**3000**	2778	3503	4207	4899	**3000**	3987	5048	6056	7022

V_{air} = 10 l/s

PP11	300	400	500	600	PP22	300	400	500	600	PP33	300	400	500	600
700	514	640	762	881	**700**	802	990	1171	1345	**700**	1067	1338	1600	1855
800	566	708	844	977	**800**	894	1106	1310	1508	**800**	1199	1506	1801	2088
900	617	775	927	1074	**900**	985	1223	1450	1671	**900**	1332	1674	2003	2322
1000	669	842	1009	1170	**1000**	1077	1339	1590	1834	**1000**	1465	1842	2204	2555
1100	721	909	1091	1267	**1100**	1169	1455	1730	1997	**1100**	1598	2010	2405	2788
1200	773	977	1173	1363	**1200**	1261	1571	1869	2160	**1200**	1731	2178	2607	3021
1400	876	1111	1337	1556	**1400**	1444	1803	2149	2486	**1400**	1996	2514	3010	3487
1600	980	1246	1502	1749	**1600**	1627	2035	2428	2812	**1600**	2262	2851	3413	3953
1800	1083	1380	1666	1942	**1800**	1811	2267	2707	3138	**1800**	2527	3187	3815	4419
2000	1186	1515	1830	2135	**2000**	1994	2499	2987	3464	**2000**	2793	3523	4218	4885
2300	1342	1716	2077	2425	**2300**	2270	2847	3406	3953	**2300**	3191	4027	4822	5585
2600	1497	1918	2323	2714	**2600**	2545	3195	3825	4442	**2600**	3590	4532	5427	6284
3000	1704	2187	2652	3100	**3000**	2912	3660	4384	5093	**3000**	4121	5204	6232	7216

V_{air} = 15 l/s

PP11	300	400	500	600	PP22	300	400	500	600	PP33	300	400	500	600
700	574	710	840	966	**700**	906	1112	1308	1497	**700**	1171	1460	1737	2007
800	626	777	922	1062	**800**	998	1228	1448	1660	**800**	1304	1628	1939	2240
900	678	845	1004	1159	**900**	1090	1344	1588	1823	**900**	1437	1796	2140	2473
1000	729	912	1086	1255	**1000**	1182	1460	1727	1986	**1000**	1569	1964	2341	2706
1100	781	979	1169	1352	**1100**	1273	1577	1867	2149	**1100**	1702	2132	2543	2939
1200	833	1046	1251	1448	**1200**	1365	1693	2007	2312	**1200**	1835	2300	2744	3172
1400	936	1181	1415	1641	**1400**	1548	1925	2286	2638	**1400**	2101	2636	3147	3639
1600	1040	1315	1579	1834	**1600**	1732	2157	2565	2964	**1600**	2366	2973	3550	4105
1800	1143	1450	1744	2027	**1800**	1915	2389	2845	3290	**1800**	2632	3309	3953	4571
2000	1247	1584	1908	2220	**2000**	2099	2621	3124	3615	**2000**	2897	3645	4356	5037
2300	1402	1786	2155	2510	**2300**	2374	2969	3543	4104	**2300**	3296	4149	4960	5736
2600	1557	1988	2401	2800	**2600**	2649	3317	3962	4593	**2600**	3694	4654	5564	6436
3000	1764	2257	2730	3186	**3000**	3016	3781	4521	5245	**3000**	4225	5326	6370	7368

Heat outputs conform to the European Standard for radiators EN 442-WTP GmbH Berlin.

Sound insulation

Standard: ISO 140-10:1991
Classification: ISO 717-1:1996
Absorption area: 10 m^2

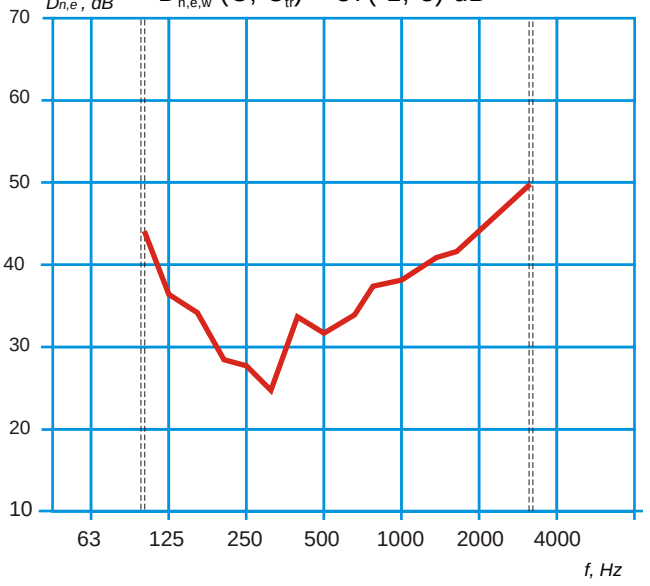
Reducing socket in PA models and reducing element in PA SN models improves sound insulation by about 3dB.

The web page www.purmo.com/fi provides examples on air ducts behind the radiator and additional sound insulations.

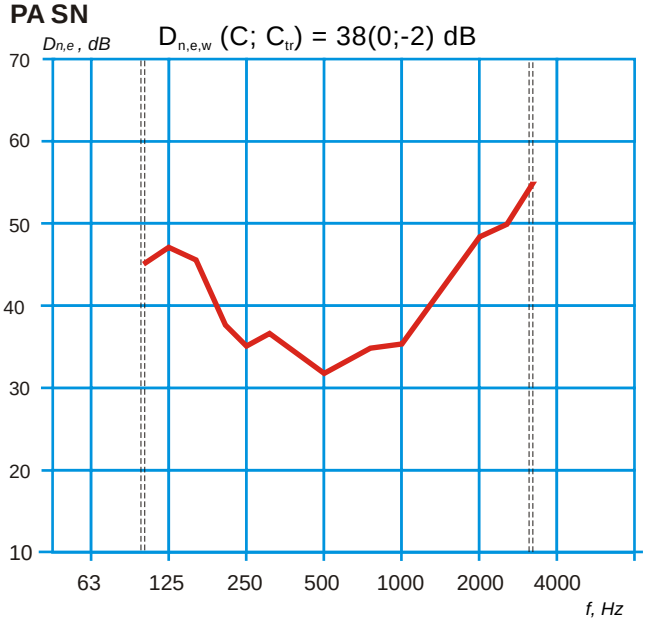
PA sound diagram: Ø100 mm iron-sheet, duct without additional insulation

PA SN sound diagram: 400 x 25 x 250 mm rectangular duct without additional insulation.

PA



PA SN



Abbreviations:

f	*Frequency, Hz*
$D_{n,e}$	*Sound transmission loss for 1/3 octave band dB*
$D_{n,e,w}$	*Sound insulation index, dB*
C	*Frequency weighting parameter, general, dB*
C_{tr}	*Frequency weighting parameter for traffic noise, dB*

Other important issues in installations

Protection against cooling and freezing

Water temperatures in the heating system should correspond to design temperatures and water flow temperature should be controlled according to changes in outdoor temperature. In this way, the conditions are maintained in which a properly designed fresh air system operates correctly.

In a fresh air system it is recommended to use a thermostatic valve with separate temperature sensor with freezing protection. A properly installed thermostatic valve with separate temperature sensor provides protection against both cooling down and freezing and thus is an important comfort and safety factor.

Correct location for the temperature sensor of the thermostatic valve is below the radiator at a distance of 20…50 mm from the supply air device

When the thermostat turns off the radiator, the supply air begins to cool down resulting in cold air dropping down to meet the temperature sensor and re-open the thermostat. Such pulsed operation prevents excessive cooling of the supply air so that there is no risk of freezing.

In buildings with high internal heat gains over a long duration, such as classrooms, it is recommended to use control valves with bypass flow: PURMO Plan VKO can be equipped with PURMO CF valve insert with bypass. As a consequence of maintaining continuous water flow, the radiator does not cool down and supply air temperature is higher.

It is recommended to fit an emergency switch between the pump of the heating system and the extract fan of the ventilation system which switches off the extract fan if the pump is damaged.

Compensating for wind pressure

In apartments where a strong wind creates a shortcut airflow through the apartment it is recommended to use non-return valves in the air ducts of the radiators.

Ventilation and energy savings

Mechanical extraction ventilation in tall apartment buildings is thermally unstable, causing problems especially in cold weather. It is recommended to have separate extract air ducts for each apartment providing stable performance of the ventilation system in all conditions. In this case, control of the ventilation system is also easier, for example by means of a timer, carbon dioxide, humidity or infrared control. Demand controlled ventilation allows significant savings to be achieved in heating energy consumption.

Heat recovery is possible by use of an air-water-heat pump which transfers heat from extract air to the domestic hot water or heating system. Nevertheless at current energy prices, heat recovery is usually not a profitable measure in small and middle-sized buildings. Larger buildings will provide better starting-points for heat recovery.

Maintenance

Replacing the filter and cleaning the device

PURMO Air's filter replacement interval depends on the quality of the outdoor air. For example, in big cities at ground floor level, the outdoor air quality is significantly poorer than on upper floors.

Use a vacuum cleaner to remove dust from the air filter a couples of times in a year. Clean the filter outdoors, as fine dust will blow through the vacuum cleaner indoors. For the same reason, the vacuum cleaner bag should be replaced after cleaning the filter.

The filter it should be inspected regularly to establish the appropriate replacement interval. The filter should be replaced when it is full of dust. Atypical filter replacement interval is one year.

Washing and re-painting

The exterior surfaces of PURMO Air supply air device and PURMO radiators may be cleaned with common domestic detergents. However, do not use detergents containing ammonia or scouring powder.

If the original paint is scratched for some reason it can be repaired with touch-up paint (shade RAL9010) which is available as a spare part.

Repainting may be done with alkyd-paints or, for a long-lasting finish, two-component urethane-paints may be used. For a good finish, the original paint should flattened carefully and washed.

PURMO Air service cover is opened for cleaning and replacing the air filter. Duct surfaces should be dry cleaned using a vacuum cleaner or brush.

PURMO Air is equipped with an air filter class F7 (EN-779).

Notes

Due to the continuous development of its product range Rettig Värme Ab reserves the right to change its products without prior notice.

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