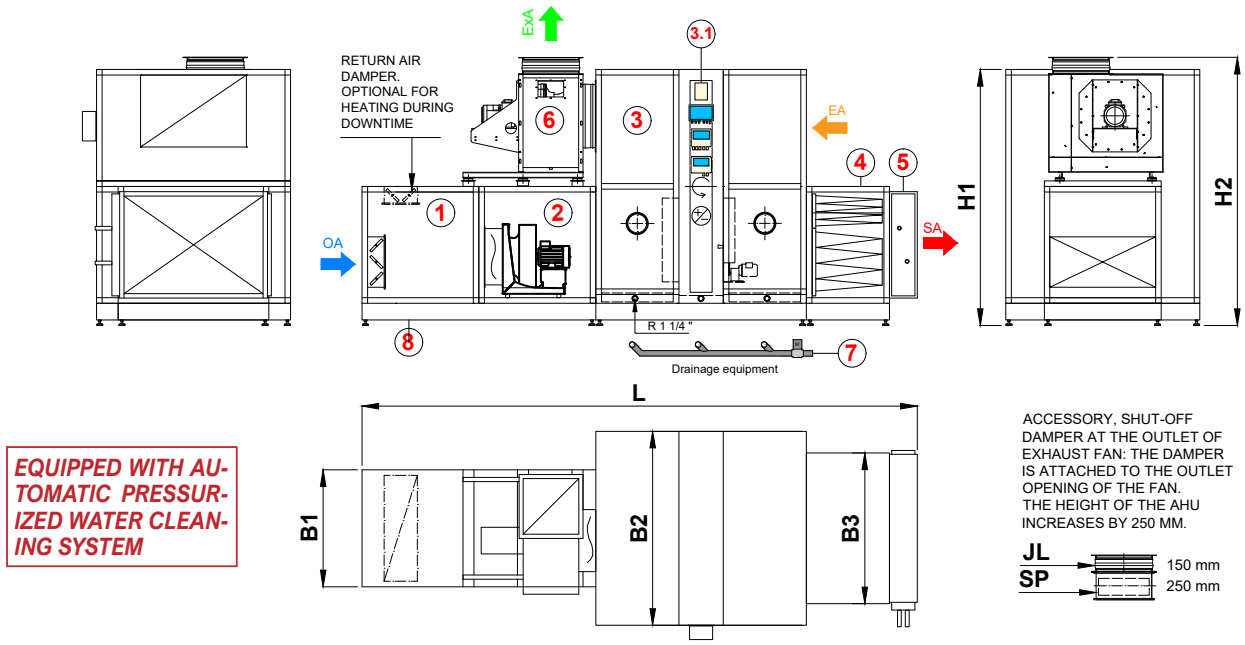
TANIPLAN OY

PSA-K for Paint Shop ventilation

PSA-K AIR HANDLING UNIT ACHIEVES VERY LARGE SAVINGS IN THE OPERATING COSTS OF PAINT SHOP VENTILATION



EQUIPPED WITH AUTOMATIC PRESSURIZED WATER CLEANING SYSTEM

UNIT DELIVERY IN THREE OPTIONS

(1) Assembled, not equipped

(2) Assembled and equipped

(3) Delivery in sections

PSA-K air handling unit includes a powerful rotary heat exchanger, which is kept clean by an automatic high-pressure water cleaning system. The rotor efficiency is 66-73%.

SCOPE OF APPLICATION OF PSA-K UNITS

Applications include paint shops and other surface treatment plants. High pressure cleanable rotors have excellent operating experience from more than thirty years in paint shops in the German automotive industry (hundreds of rotors supplied). ATEX equipment is made as required by the facility category.

VENTILATION REQUIREMENTS

The air distribution method is displacement ventilation, in which supply air is brought to the working area with low-speed terminals. See page 2 Design Guide.

MAIN DIMENSIONS OF PSA-K UNITS

The dimensions L, B1 and B3 in the table are indicative. Depends on the ventilation device used.

Unit size	V max (m^3/s)	L (mm)	B1 (mm)	B2 (mm)	B3 (mm)	H1 (mm)	H2 (mm)
PSA-K-2.5	2,55	5010	1055	1750	1360	2310	2420
PSA-K-4.5	4,14	5050	1970	2110	1970	2410	2560
PSA-K-7	7,08	5210	1970	2750	2275	2900	3010

Table1: Main dimensions and maximum airflow

PARTS LIST

1. Outdoor air chamber. Return air is used only for heating downtime by the supply air unit.
2. Supply air fan ATEX, direct drive
3. Rotor section PSA-RV

- Splashproof chambers and RFe drainage basins
- Rotary exhanger: special material for washing up to 120 bar high pressure water. A third water collection basin is installed in the rotor housing.
- Cleaning device PSA-C120, hot water 120 bar, compressed air 7 bar, factory tested with water.
- Washing jet receiving gutter behind the rotor
- Cleaning control system RCC+RDC, rotor control center and the terminal block housing (3.1) are mounted and cabled on the outside of the rotor casing.

4. Supply air filter according to space requirements
5. Heating coil, hot water
6. Exhaust fan ATEX, direct drive, insulated fan casing
7. Drainage equipment, including ball spindle valve
8. Beam platform with adjustable legs
9. Equipment

9.1 Standard equipment

- Inspection windows and lighting 2 pcs
- Air flow meters
- EMC safety switches for motors cabled

9.2 . Accessories

- On-site user guidance and commissioning
- Inverters
- Electrical and control equipment and internal cabling
- High pressure washer 120 bar with hose, hot water 80°C

DESIGN BASES OF VENTILATION IN THE PAINT SHOP

1. DISPLACEMENT AIR DISTRIBUTION

In displacement air distribution, supply air that is colder than room air is brought to the working area using low-speed terminals. The impurities generated in the process rise with the warm air to the upper part of the room, from where they are led out with the exhaust air. The supply air units are mainly located at the edges of the workspace, but some of them can also be placed in the middle of the room 3-4 m above floor level. The principle is that the filtered supply air flows to the workstations with as little turbulence as possible. Correct implementation of air distribution always requires expert planning. The air distribution system shall conform to the conceptual drawing (Figure 1) in order to maintain contaminants above the seating area. The supply air temperature is 1-3 °C lower than the room temperature. N.B! When using solvent-borne paints, part of the exhaust air must be taken close to floor level.

2. REPLACEMENT AIR VOLUME

In painting workshops, the dimensioning air exchange is approx. 2.2 x the volume of the room space per hour. It is important to distribute the supply air evenly over the entire working area. Exhaust air is collected at several points along the roof line. Car paint shops, painting chambers, etc. are different from the workshop paint shops referred to here, and their ventilation is dimensioned on other grounds. **N.B!: Air circulating filter devices or heating devices must not be used during working hours, as solvent gases will then mix with the room air.**

3. CLEANING SYSTEM REQUIREMENTS

The cleaning device is connected to a water hose from the high-pressure washer and to a 6-7 bar compressed air network..

3.1 Starting the cleaning cycle

Washing is started according to the time schedule from the building control or manually from the RCC centre. The interval between washing cycles depends on how much paint accumulates on the rotor, i.e. The rate of fouling is case-specific. Since the cost of one wash is small, in practice it is enough to wash the disc often enough. To monitor the washing interval to detect the pressure drop on the outlet side of the rotor, a differential pressure gauge can be installed.

3.2 Cleaning water and compressed air

The water and air nozzles of the rotor washer are connected to the high-pressure washer and pressurized air with hoses included in the delivery. Outside the PSA-unit solenoid valves are required for water (0.21l/s) and compressed air (7 bar/102 l/min). The valves are controlled from the controller RCC.

Technical data:

Pressure washer	Motor (kW)	Press. (bar)	Cold water (l/s)	Air 7 bar (l/min)	Controller
PSA-C-120	8	120	0,21	102	RCC

3.2. Sewage treatment

The washing water is led out of the unit's water collection basins through the drainage equipment. The motor valve for drainage fitting is open during the cleaning cycle and is closed when cleaning is completed. This prevents supply air from being blown into the engine room. Drained washing water often has to be discharged into an intermediate tank. The tank is not included in the equipment delivery. The volume of the tank must be large enough to provide an appropriate interval between cleaning and emptying..

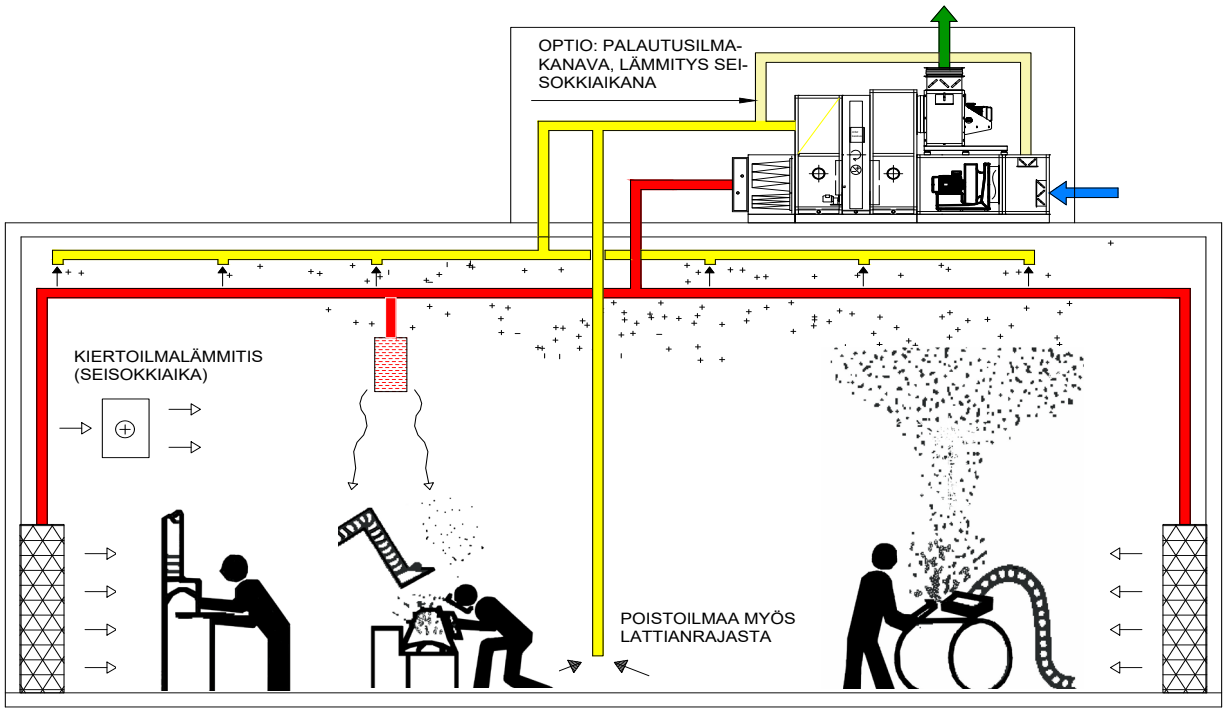


Figure 1: The principle of displacement ventilation in Paint Shop

PSA-K UNIT SIZE SELECTION

The unit size is selected on the basis of the air flow required for the workspace. The efficiency requirement of 73% in the Eco-Directive is often impossible to achieve, because the well height of the heat exchanger matrix cannot be lowered due to its cleanability.

Example: The required airflow is 5 m^3/s ->unit size is 7. The temperature efficiency is > 71%.

Table 2 on the right: Unit size selection

Rotor	Standard well height							
η (%) f=1:1	73	72	71	70	69	68	67	66
Δp rotor (Pa)	67	73	80	86	93	100	107	114
Unit size	Airflow (m^3/s)							
PSA-K-2.5	1,55	1,69	1,83	1,97	2,11	2,26	2,40	2,55
PSA-K-4.5	2,52	2,75	2,97	3,20	3,43	3,68	3,90	4,14
PSA-K-7	4,30	4,69	5,08	5,47	5,86	6,28	6,67	7,08

ATEX CLASS OF THE UNIT

The rotor matrix is not an explosion-proof structure. Electrical equipment complies with ATEX regulations: Motors Ex II 2D Ex tb IIIC T125°C (=IP65), rotation monitor Ex zone 1 and 21. The motors are equipped with winding thermistors (PTC). The rotor control center (MicroMax) is installed on the outside of the rotor housing. All motors are equipped with PTC thermistors and are cabled accordingly.
The fans are ATEX 3 G class as standard and the sensors connected to the unit casing interior are ATEX classified.
The rotor circumference seal is a spring-loaded plastic gasket (Murtfeld) to minimize seal leakage.
The placement of the fans in the unit ensures that the exhaust air cannot be transferred to the supply air side of the instrument at all.

CLEANING DEVICE PSA-C-120

PSA-C-120 is an automatic cleaning device that uses high-pressure hot water to clean the rotor. The adhering dirt is detached and crushed at the inlet edge of the disc due to pressure shock and temperature changes, and is transferred with the water jet through the rotor sols to the receiving chute. Cleaning device parts:

- Device housing, nozzle sledge, conveyor belt and conveyor motor
- High pressure nozzle for water (120 bar) and compressed air (7 bar)
- A guide chute that receives the jet behind the rotor
- Cleaning cotrol system RCC and RCD cabled
- Solenoid valves for water and drying compressed air (Not included)
- Pressure washer for 80°C water and water and compressed air hoses
- System testing with water at the factory

The cleaning system is delivered installed in place and tested. The high-pressure washer and water and compressed air hoses are delivered separately. Washing is started either according to the time schedule from the building control or manually as needed, for example:

- 1-shift work every one to two weeks
- 2-shift work once - two times a week
- 3-shift work two to three times a week

PHOTOS OF CLEANING SYSTEM COMPONENTS S BELOW:

Figure 3: Cleaning device

Figure 4: Receiving chute

Figure 5: Nozzles

Figure 6: Control center

Figure 7: Pressure washer

ESTIMATED COST OF CLEANING WITH MAXIMUM AIR FLOW

Unit size	Airflow (m^3/s)	Building vol. max. (m^3)	2 clean./ week (EUR/a)	Water/ clean. (dm^3)	Duration (min.)
WSA-K-2.5	**2,55**	**4170**	**785**	**602**	**48**
WSA-K-4.5	**4,14**	**6680**	**1063**	**815**	**65**
WSA-K-7	**7,08**	**11600**	**1374**	**1053**	**84**

Table 3: Cost of cleaning, water consumption and cleaning cycle time

The cleaning process uses hot (80°C) domestic water and 7 bar compressed air. The cost of washing depends on the diameter of the rotor, as well as on the prices of hot water, electricity and heatng energy.

Max. building volume, for which the air flow in the table is sufficient, corresponds to ventilation 2.2 x room volume per hour.

ENERGY SAVING, CONSUMPTION AND OTHER COSTS

Criteria: Electricity 110 €/MWh, heat 80 €/MWh. Water 3,6 €/m³, running time 80 h/week. Efficiency 66% = minimum in Table 2).

Unit size	Airflow max. (m^3/s)	Building-vol. max. (m^3)	Cleaning cost (EUR/a) 2 times /week	Water cons. (dm^3/ wash)	Energy saving / consumption MWh/a *) Climate zone I..IV (design outside temperature)			
					I (-26°C)	II (-29°C)	III (-32°C)	IV (-38°C)
PSA-RV-2.5	2,55	4200	785	458	126 /35	131 /37	139 /41	170 /54
PSA-RV-4.5	4,14	6700	1063	620	201 /55	210 /58	223 /65	272 /86
PSA-RV-7	7,08	11600	1374	801	349 /96	364 /101	387 /113	471 /150

In calculations, the exhaust air temperature is 20°C and the supply air temperature is 17°C.

The figures in the table are to be regarded as good indicative estimates.

UNIT DELIVERY OPTIONS

1. PRE-ASSEMBLED AND EQUIPPED

1.1 Factory assembled non-equipped: PSA-K

The cased unit sections and the ready-to-install rotor section PSA-RV are pre-installed on a beam base. The rotor section is always factory tested and electrified. Standard equipment (9) according to the parts list on page 1 is fitted to the unit.

1.2 Pre-equipped AHU: PSA-K-V

Configuration 1.1 is fitted with the accessories listed on page 1. The frequency converters, group centre and control equipment have been installed and internal cabling has been completed at the factory. The device is tested before delivery at the factory. Testing on site and user guidance are included.

1.3 Unit supplied in pieces: PSA-K-P

In the piece delivery, the unit parts are connected and installed on site. Accessories are supplied according to the customer's choice.

1.4 About ready-to-install instruments

The physical sizes of PSA-K enable normal road transport anywhere. When the airflow of one unit is insufficient, two units are used in parallel, In this case, the functions of two instruments can be programmed behind one controller.

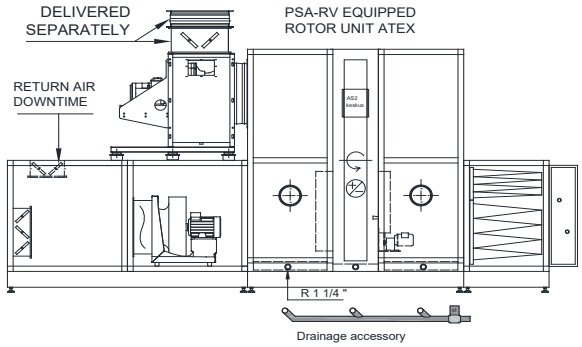


Figure 8: Delivery assembled and, if desired, equipped. PSA-K or PSA-K-V, see sections 1.1 and 1.2.

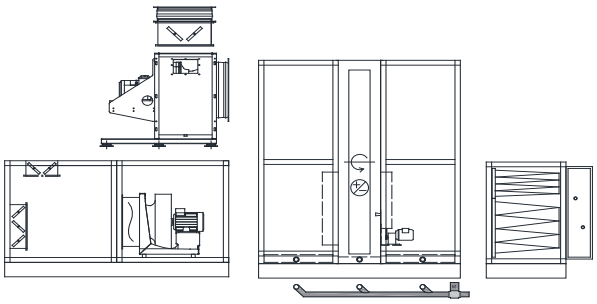


Figure 9: AHU delivery in pieces, unit type PSA-K-P

In the type designation:
K = AHU comprising all cased unit parts and rotor
V = Unit with controls and electrical devices
P = AHU to be supplied in pieces. Accessory if included are installed on site.

HIGH AIRFLOWS: PSA-R UNITS 9..38 m³/s ARE USED

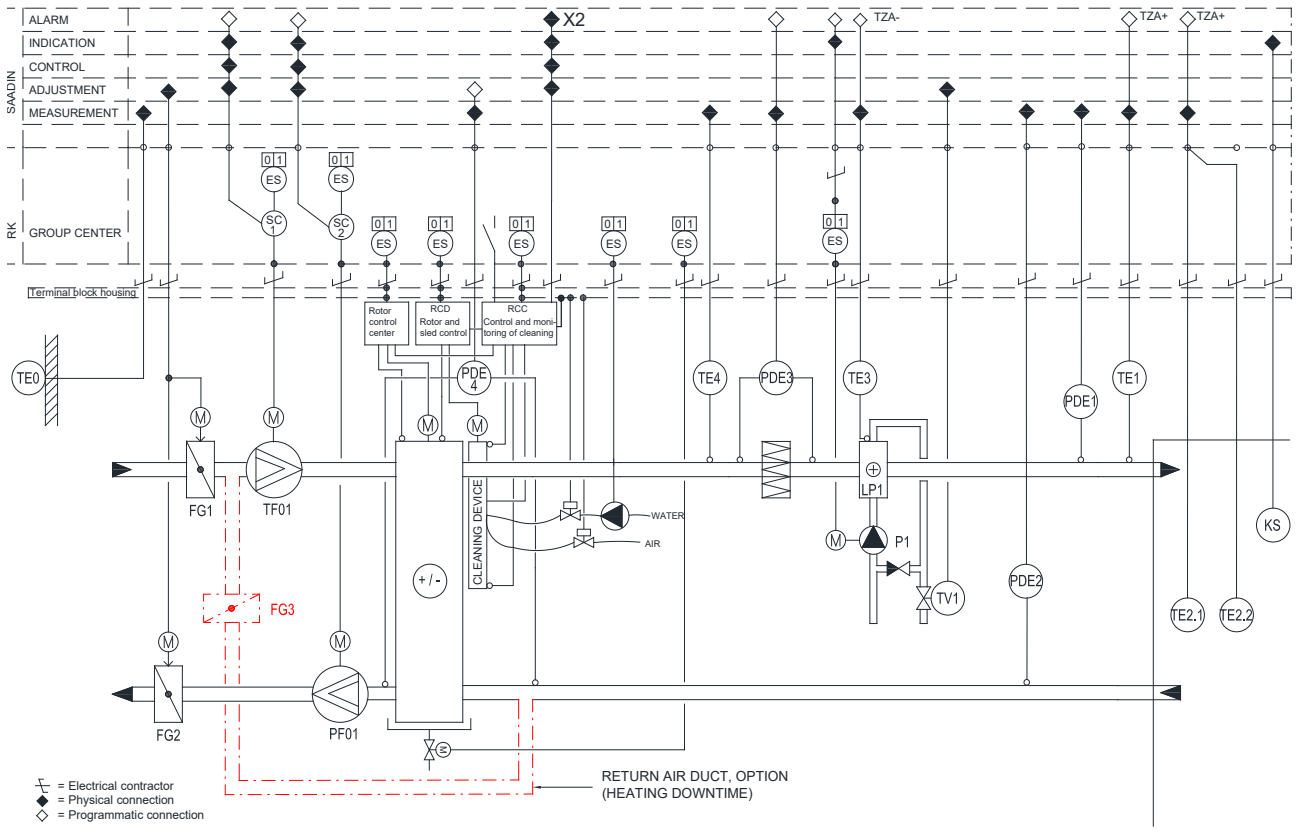
In large workshops, when even two PSA-K-7 instruments do not have sufficient airflow, PSA-R rotor units are used. These devices can achieve air flows of 9...38 m³/s. PSA-R device sizes are similar to WSA-R in the product catalog, only the technical characteristics of the rotor change.

"WSA-R Rotor units with cleaning" catalogue can be found on Taniplan Oy's website **www.taniplan.fi**.

"We have implemented dozens of workshop air conditioning projects with pressure-washable rotors, starting with Finland's first ventilation unit with a washable rotor in 1991.
Taniplan Oy has developed this system further. We are happy to help our customers and end users of products in all related design matters.
We do free of charge calculations related to operating costs and profitability of investments to support your investment decisions.
Taniplan Oy has been a pioneer in energy saving since 1983."

Jussi Tani, CEO

EQUIPPED PSA-K UNIT: OPERATION DIAGRAM



DESCRIPTION OF THE OPERATION

Running times are controlled according to the time programme of the building control system. With the switch KS, the running is controlled outside the program.
Heating during instrument downtime (Optional): Dampers FG1.. 3 drive into the return air position. The TE1 setpoint is adjusted based on your TE2.1/TE2.2 measurement. Requires construction of a return air duct (see diagram above).

Rotor cleaning operation

The water and air nozzles are mounted on a conveyor sled that runs on a rail parallel to the rotor radius. Washing is started according to the time schedule when the instrument is at a standstill. The cleaning control RCC is given a starting pulse (min. 3 s). The rotor rotation speed and conveyor sled are controlled by a regulator RCD. The sled is driven near the rotor hub. The solenoid valves for water and compressed air, as well as the shut-off valve for the sewer fitting, are opened and the pressure washer is started.
After each rotation of the rotor, the tray advances along the width of the nozzle jet. In this way, the rotor is completely cleaned of its entire surface..
When the cleaning cycle is completed, the high-pressure washer is stopped and the nozzle sled is driven to the circumference of the rotor and the compressed air solenoid valve closes. The motor valve of the sewer fitting closes after the water drainage time (1-2 h).
If additional drying of the rotor is selected, it will turn on automatically. In additional drying, a cycle without water is run, during which the compressed air dries the disc further.

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