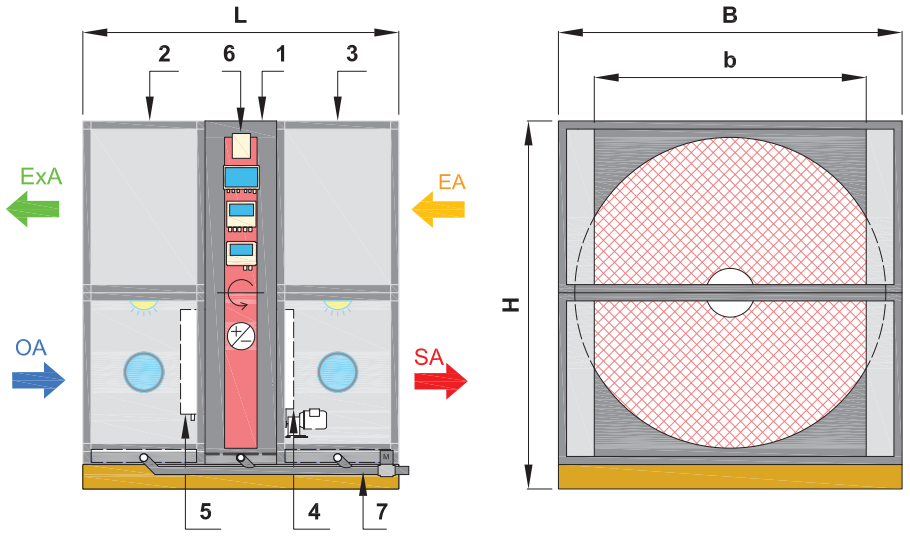
WSA-RV Rotor units with cleaning system

More than 80% of the workshop ventilation costs are saved with rotor units WSA-RV equipped with automatic cleaning

COMPLETE EQUIPPED WSA-RV UNITS 2,5..7 m³/s



Three unit sizes:

WSA-RV-2.5

WSA-RV-4.5

WSA-RV-7

EA = Exhaust air
ExA = Extract air
OA = Outside air
SA = Supply air

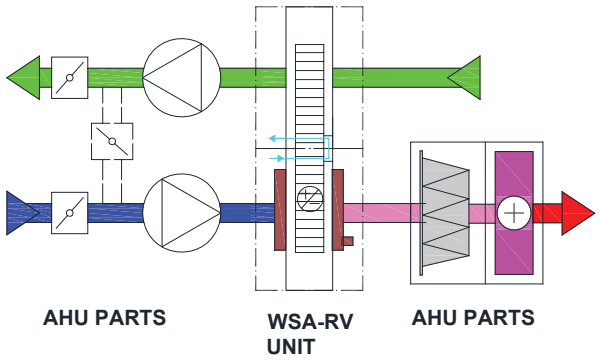
Figure 1: Complete equipped WSA-RV rotor units

DELIVERY AND INSTALLATION

WSA-RV heat recovery units are intended for on-site installation with ventilation units from different manufacturers. The unit is equipped with a pressurized water cleanable rotor, as well as a automatic cleaning device, jet receiving chute, RCC and RCD control units and drainage chambers. The control units are cabled to the cleaning device and pre-programmed. The WSA-RV unit is assembled and factory tested.

N.B! No filtration before the rotor.

INSTALLATION IN THE AHU



WSA-RV-sections are installed as part of the ventilation unit. Shut-off damper-mixing section, as well as supply and extract fans are installed. After the rotor, filter and heating coils are required. It should be noted that there is no filtering in exhaust air and outside air. The purge chamber effectively prevents exhaust air leakage into the supply air. In addition to unit sections, accessory is required (see parts list).

EQUIPPED WSA-RV UNITS

The WSA-RV size is selected from Table 1 according to the air flow. The width of the connection opening (b) depends on the ventilation device used. The rotor efficiency meets the requirement of the Eco Directive 2018. In Table 1, m_1=mass without and m_2=mass with Beam platform.

WSA-RV PARTS LIST

Device size	(m³/s) max.	L (mm)	B (mm)	H (mm)	m_1 (kg)	m_2 (kg)
WSA-RV-2.5	2,5	1940	1750	2260	519	635
WSA-RV-4.5	4,0	1940	2110	2260	779	910
WSA-RV-7	6,8	2010	2750	2850	1230	1370

Table 1: Device size and dimensions

1. Rotary heat exchanger

Figure 2: WSA-RV rotor section with cleaning device installed

The material of the rotor heat transfer matrix is corrosion-resistant special aluminium. The structure and material thickness are designed for 120 bar max. cleaning jet pressure. The casing is 40 mm insulated and made of galvanized sheet steel. The rotor housing has a built-in drainage basin. The rotor is equipped with a purge chamber, which, along with the placement of fans, completely prevents the transfer of exhaust air impurities to the supply air.

2. O.A /Extract Air chamber FeZn, insulated
At the bottom of the O.A.chamber there is a stainless steel basin for the cleaning water drainage.

3. S.A /Exhaust Air chamber FeZn, insulated
At the bottom of the S.A.chamber there is an stainless steel basin for the cleaning water drainage.

4. Automatic cleaning device WSA-C70
The cleaning device has nozzles for pressurized water and -air. The jet of pressurized water removes dirt trapped in the rotor. Compressed air blowing removes water from the matrix throughout the washing cycle. High-pressure (70 bar) cold domestic water is used. The device is delivered installed and tested. Cleaning is started from building automation or manually. The process is controlled by the RCC and RCD center. Washing is carried out with the AHU at a standstill.The scope of delivery is specified on page 4.

5. Washing Jet receiving gutter
A receiving gutter leads the water to the basin.

6. Cleaning control center RCC and RCD
The control centers are installed, cabled and factory tested, see page 4. The parameters are set in RCC during commissioning.

7. Drainage accessory
Equipment sewer which is connecting the three basins of the WSA-R unit. The drain has a ball spindle valve with an actuator. The valve is opened for washing.

ACCESSORIES
- High pressure washer 70 bar, cold water, 0.17 l/s
- Water solenoid valve (not included)
- Compressed air solenoid valve (included)

UNIT SIZE SELECTION
The size of the rotor unit is selected according to the air flow rate and temperature efficiency in the yellow column of Table 2. These three device sizes have an extra-low corrugation height and the highest temperature efficiency. The efficiency shall be 73% according to the Eco Directive, unless the contamination of the exhaust air requires a lower efficiency.

Rotor	Low well height (L)			
η (%) f=1:1	76	75	74	73
Δp (Pa)	129	143	157	173
Unit size	V (m³/s)			
WSA-RV-2.5	1,86	2,05	2,25	2,5
WSA-RV-4.5	3,01	3,32	3,65	4,0
WSA-RV-7	5,14	5,67	6,22	6,8

Table 2: WSA-RV units 2,5..6,8 m3/s, air pressure drop and efficiency

Figure 3: Cleaning device

Figure 4:Gutter

Figure 5: Center

Figure 6: Nozzles

Figure 7: Pressure Washer

Water	0,15 l/s	80 bar
Air	102 l/min	7 bar

COST OF CLEANING VS. FILTRATION

In the cleaning process, cold tap water and compressed air of 6-7 bar are used. The cost of cleaning depends on the diameter of the rotor, as well as the cost of water and electricity. The annual cost is a fraction compared to the cost of an AHU with exhaust filters. 25-100 washes are needed per year. Water consumption for washing and the cost of washing and exhaust filtration in 1-, 2- and 3-shift work are shown in Table 3 below.

Unit size	Building Vol. (m³)	Cleaning (EUR/a)			Filters (EUR/a)			Water cons. (dm³/wash)
		Shifts in day			Shifts in day			
		1	2	3	1	2	3	
WSA-RV-2.5	4580	76	152	304	2800	5600	11100	458
WSA-RV-4.5	7360	104	209	417	4200	8300	16600	620
WSA-RV-7	12600	138	276	553	5600	11200	22400	801

Table 3: Cost of cleaning EUR/a, vs. cost of exhaust air filters

SEWAGE TREATMENT

Due to precipitation, drained washing water sometimes has to be discharged into an intermediate tank. The capacity of the container must be sufficient to provide an appropriate interval for cleaning. Table 3 shows the water consumption per wash. In 1-shift work, this amount of water accumulates in 2 weeks, in 2-shift work per week and in 3-shift work twice a week
.

EXAMPLE

Welding Shop L/B/H = 48/20/10 m, volume V = 48 x 20 x 10 = 9600 m³, located in climate zone II (2). The utilization rate is 2-shift work. The ventilation coefficient of 2.2 gives the air flow qv = 2.2 x 9600/3600 = 5,86 m³/s (< 6,8 m3s). A suitable device size is WSA-RV-7 (Table 2). Table 3 yields: The cost of the automatic cleaning is 276 EUR/a and the water consumption of the wash is 801 dm³. The cost of replacement filters would be EUR 11,200/a.

COST AND SAVINGS OF AUTOMATIC HIGH-PRESSURE CLEANING

We make an operating cost calculation of the rotors, which takes into account the estimated running time, the stability of the outdoor air temperature in the location, and energy and water prices. This provides a good default value for future costs of using the system. Below is a calculation for the example case on the previous page.

WSA/PSA ROTOR UNITS: HEAT ENERGY SAVING, CONSUMPTION AND CLEANING COST 2023

TANIPLAN OY

Date 15.9.2023
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Object **WSA-R-7 CALCULATION, EXAMPLE: WELDING SHOP**

Unit type: WSA-RV os WSA-R (f = 1:1)	**7**	(koot 2.5;4.5;5-6;7;9;11;13;15;19;24;28;33 tai 38)	
Air flow (m3/s)	**5,86**	= Provided airflow	**5,86** <--- Provide other airflow if desired
Running time	**80**	h/week	
Exhayst air temperature	**20**	°C	73 % <-- Temperature efficiency of the rotor
Supply air temperature	**15**	°C	Help: yellow cells, enter a number or character
Climate zone (According to D5, Finland)	**2**	1, 2, 3 or 4	
Ventilation coefficient	**2,2**	x Room volume /h	

Red sizes: Type WSA-RV are used in equipped in WSA-K equipped ventilating units, too.

Max. workspace volume with this airflow 9600 m^3

1. OPERATING COSTS AND SAVINGS OF THE WASHING SYSTEM

Water pressure in nozzle: welding shop 70 bar, paint shop, etc. 120 bar
Water temperature: welding shop 55°C, paint shop, etc. 80°C

Water pressure in nozzle 70 or 120	(bar)	70	Water initial temperature	°C	10		
Water price	€/m3	3,6	Water final temperature	°C	10		
Electricity price	€/MWh	110	Water Jet width	mm	10		
Heating energy price	€/MWh	80	Rotor diameter	mm	2500		
High pressure washer motor power	kW	4,5	Rot.speed (washing)	r/min	1,5		
Power need of fan motors	kW *)	12,3	Add.drying with air	(h)	2		

*) a. 2,1 kW/m3/s, with full airflow, inlet and outlet total
Drying with return air2 h at 30% airflow

DURING ONE CLEANING CYCLE:

Compressed air (7ba	l/min	102
Water flow	l/s	0,159
Duration of the cycle	min	84
Water consumprion	l	801
Compr.air consumption	Nm^3	8,6
Price of water cleaning		4,78 €
Price of return air drying		0,41 €
Price of cleaning cycle		**5,18 €**

The need for washing according to experience. Select an option by marking x :

1shit work	Once every two weeks	
2-shift work	Once a week	x
3-shift work	Twice a week	

Annual cost of washing **270 €**

Comparison between exhaust filter cost (Class M5) and automatic cleanihg:

Filter change	Once every two weeks	
(Price of one set of filters a. 215 EUR)	Once a week	x
N.B! Exchange work is not included.	Twice a week	
	Other: filter changes per year	

Replacement filters EUR/a **11 180 €**

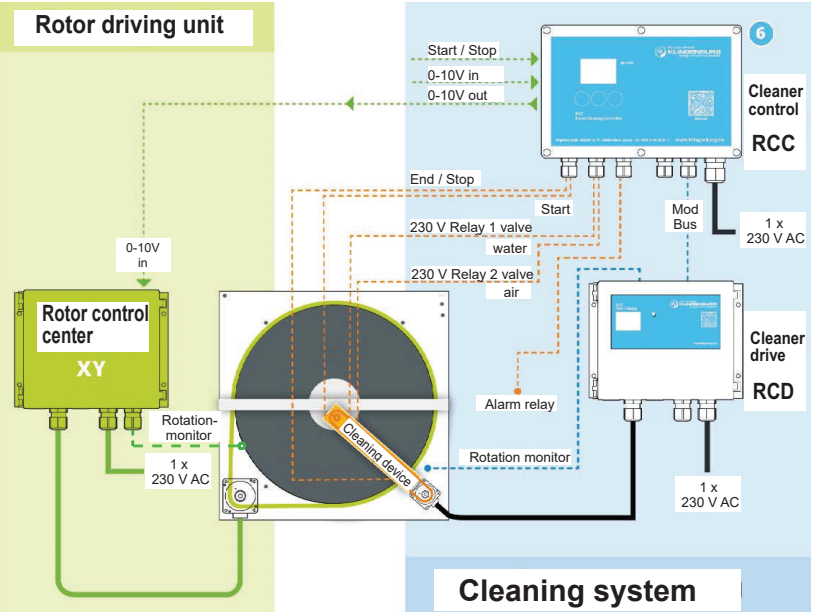
Savings achieved with an automatic cleaning system compared to the use of exhaust filters EUR/a: **10 910 €**

2. EXPECTED HEAT ENERGY CONSUMPTION AND SAVINGS

Heat energy saving	**311,0**	MWh/a
Heat energy consumption	**22,6**	MWh/a
The value of heat energy saving	**24 882**	EUR/a
The value of heat energy consumption	**1 809**	EUR/a
The cost of rotor cleaning	**270**	EUR/a
Total annual cost (excl. electricity consumption of fans)	**2 079**	EUR/a

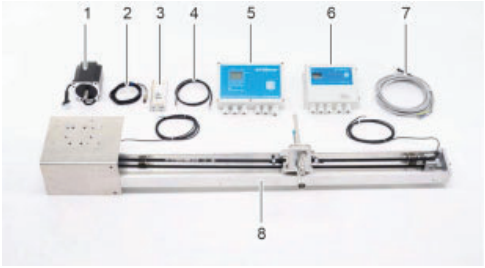
The heat recovery efficiency in energy calculations is 73%. The rotor matrix has a low well height.
Depending on the air flow, the efficiency may be different. However, the calculation is always made with an efficiency of 73%.
If the AHU had exhaust filters and no cleaning system, the annual cost would be 12989 EUR/a i.e. 525 % higher

FUNCTION LAYOUT OF CLEANING



WSA-RV UNITS ARE CABLED AND FACTORY TESTED

PARTS OF SYSTEM



1. Stepper motor
2. Clock sensori (RCD)
3. Clock sensor holder with fasteners
4. RS485 modbus cable
5. Cleaner control RCC
6. Cleaner drive RCD
7. Stepper motor cable with connector
8. Pre-assembled cleaning rail with stepper monitor, two deflection rollers, toothed belt, sled with high-pressure water and compressed air nozzle

FUNCTIONAL DESCRIPTION

The rotor cleaning device is used to clean the rotor disc in contaminating conditions, such as welding plants, foundries, etc. Cleaning prevents clogging of the disc channels, thereby preventing deterioration and failure of the rotary heat exchanger.

The rotor cleaning device has two control units: RCC for controlling and monitoring the cleaning process and RCD for adjusting the rotor speed and nozzle tray according to the rotor speed and parameters set in the regulator.

The pressurized water and air nozzles are mounted on a nozzle tray that is moved over the surface of the disc parallel to the beam.

Compressed air and water are switched on and off via two solenoid valves, which are switched on by the purifier control according to the position of the cleaning trolley. The position of the nozzle tray is detected by two inductive proximity sensors mounted on the conveyor rail. The nozzle tray is driven by a timing belt driven by a stepper motor.

The stepper motor is controlled by a central RCD. A clock sensor mounted on the rotor housing records the revolutions of the rotor. The cleaning process can be started either manually using the start button on the RCC controller, or by an external message from the building control system.

The tray moves to the rotor hub. When the tray arrives, the inductive sensor sends a signal to the RCC switchboard, which switches on the compressed air and water supply via solenoid valves. The high-pressure washer starts under the control of building supervision.

The clock sensor records the revolutions of the rotor and sends a signal to the RCD center. After each revolution of the rotor, the RCD moves the nozzle tray 10 mm forward. This process is repeated until the tray has reached the sensor located on the circumference of the rotor. This transmits a signal to the RCD center.

The RCC then shuts off the water supply, the construction automation stops the high-pressure washer and the tray moves back to the centre of the rotor while the compressed air is still on. When the tray has reached the center of the rotor, the sensor in the center of the rotor sends a signal to the RCC center, which cuts off the compressed air supply. The cleaning trolley then moves back to its parking position around the circumference of the rotor. The cleaning process is complete

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