CZECH TECHNICAL UNIVERSITY IN PRAGUE
FACULTY OF CIVIL ENGINEERING –
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Order No.: A24041

TEST REPORT number: 181154/2024

on testing: Air handling unit (trade name CPV8) from manufacturer MANDÍK, a.s. according to standard EN 308.

Client's name and address:

MANDÍK, a.s., Dobříšská 550, 267 24 Hostomice

Czech Republic

Date of test report issue: 27.3. 2024

place for stamp

Approved by:

name, OL 181 Technical Manager

doc. Ing. Jiří Litoš, Ph.D.

.....

signature

Subject of the test: Heat exchangers for heat recovery in ventilation systems

Testing procedure: Serial No. 181/14 - Measurement of performance parameters

Test regulation: EN 308

Test specimen were manufactured by: Client – results refer to the specimen as it was taken over

Date of taking over test specimen: 21.2.2024

Specimen taken over by: Martin Kny

Manufacturing site of test specimen: Dobříšská 550, Hostomice, Czech Republic

Date of manufacturing test specimen: 2023

Test specimen manufactured by: MANDÍK, a.s

Marking of test specimen: CPV8

Test execution date: 26 - 27.3. 2024

Test execution place: Czech Technical University In Prague, University Center For Energy Efficient Buildings, Třinecká 1024, 273 43, Bustěhrad, Czech Republic

Potential data on deviations from the test regulation: According to the client's request, only the temperature ratio test for winter conditions (Winter W1) was carried out at a nominal air flow rate of 800 m^3/hr.

Data on uncertainties of quantitative results: The expanded uncertainties of measurement U are the product of standard measurement uncertainties and the expansion coefficient k=2, which provides a confidence interval of ca 95 %

Name of the person who performed the test (measurement): Martin Kny

Name of the person who compiled the test report: Daniel Adamovský

Test results: are shown on page 5.

1) Test Specimen Parameters - Air handling unit

Tab. 1 Parameters of the air handling unit

Dimensions	2110 x 450 x 1580 mm (L x V x H)
Weight	#290 kg#
AHU class according to standard	HRC1a
Supply fan	In position behind the heat exchanger
Exhaust fan	In position behind the heat exchanger

Detailed photodocumentation of the air handling unit is given in chapter 5

2) Test boundary conditions according to ČSN EN 308

Tab. 2 Boundary condition

Test TYPE B
Precision Class P2
Test condition Winter W1 (without condensation)

According to the client's requirements, only the thermal efficiency $\eta_{t.gro}$ was measured at a nominal flow rate of 800 m^3/hr.

Tab. 3 Boundary condition for test condition Winter W1

Inlet dry bulb temperature exhaust air	25	°C
Inlet wet bulb exhaust air	<14	°C
Inlet dry bulb temperature fresh air	5	°C
Inlet wet bulb temperature fresh air	no requirement	°C

3) Measuring equipment

Tab. 4 Measuring equipment

Sensor/Manufacturer	Serial number	Calibration validity	Calibration range	Number of cal. points
Temp. and humidity Rotronic HC2-S+E2-XX	20043035	15.12.2025	-20 to 60 °C	3
		15.12.2025	10 to 85 % rh	3
Temp. and humidity Rotronic HC2-S+E2-XX	20043036	15.12.2025	-20 to 60 °C	3
		15.12.2025	10 to 85 % rh	3
Temp. and humidity Rotronic HC2-S+E2-XX	20043070	15.12.2025	-20 to 60 °C	3
		15.12.2025	10 to 85 % rh	3
Temp. and humidity Rotronic HC2-S+E2-XX	20043071	15.12.2025	-20 to 60 °C	3
		15.12.2025	10 to 85 % rh	3
Temp. and humidity Rotronic HC2-S+E2-XX	20043072	15.12.2025	-20 to 60 °C	3
		15.12.2025	10 to 85 % rh	3
Anemometer SVH-14SVH	4F151108492	27.01.2026	0.5 to 9.5 m/s	4

Anemometer SVH-14SVH	4F151108493	27.01.2026	0.5 to 9.5 m/s	4
Anemometer SVH-14SVH	4F151108494	27.01.2026	0.5 to 9.5 m/s	4
Anemometer SVH-14SVH	4F151108496	27.01.2026	0.5 to 9.5 m/s	4
Air temperature Sensit TG8-40 10 m	30646/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30647/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30117/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30128/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30650/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30130/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30652/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30653/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30654/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30655/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30656/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30657/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30708/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30714/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30679/1015	09.12.2025	-20 to 60 °C	3
Air temperature Sensit TG8-40 10 m	30680/1015	09.12.2025	-20 to 60 °C	3
Differential pressure SVD 311	2524/15	05.01.2026	0 to 500 Pa	6
Differential pressure SVD 311	2525/15	06.01.2026	0 to 500 Pa	6
Differential pressureBeck 984Q	Z2-11106588/ 000	08.01.2026	0 to 500 Pa	12
Differential pressure Beck 984A	122816	08.01.2026	0 to 2500 Pa	10
Atmospheric pressure HUBA Control	155782	15.12.2025	0.8 to 1 bar	4
Wattmeter HIOKI PW 3335	160128191	11.12.2025	0 to 700 W	4
Tape measure	160128197	11.12.2025	0 to 5m	5

All electronic equipment was calibrated as a complete chain together with the Datataker DT85 data loggers (sn. 106149 or sn. 106146).

4) Measurement results

Tab. 5 Measurement results

Electrical power		P_E	466 ± 1.5	W
Fan speed adjustment (fresh air/exhaust air)		-	F79/E78	%
Atmospheric air pressure		P_{atm}	97.9 ± 0.3	kPa
Fresh air	Inlet dry bulb temperature	θ_{21}	5.17 ± 0.3	°C
	Inlet relative air humidity	rh_{21}	80.2 ± 2.4	%
	Outlet dry bulb temperature	θ_{22}	20.79 ± 0.3	°C
	Outlet relative air humidity	rh_{22}	26.8 ± 2.4	%
	Inlet total pressure	p_{21}	71 ± 0.8	Pa
	Outlet total pressure	p_{22}	273 ± 1.3	Pa
	Available total pressure	$\Delta p_{s1,ext}$	202 ± 1.1	Pa
	Volumetric air flow	q_{v22}	800 ± 4.3	m^3/hr
	Mass flow rate	q_{m22}	0.257 ± 0.013	kg/s
Exhaust air	Inlet dry bulb temperature	θ_{11}	25.00 ± 0.3	°C
	Inlet relative air humidity	rh_{11}	21.1 ± 2.4	%
	Outlet dry bulb temperature	θ_{12}	9.35 ± 0.3	°C
	Outlet relative air humidity	rh_{12}	53.9 ± 2.4	%
	Inlet total pressure	p_{11}	52 ± 0.8	Pa
	Outlet total pressure	p_{12}	253 ± 1.3	Pa
	Available total pressure	$\Delta p_{s2,ext}$	201 ± 1.8	Pa
	Volumetric air flow	q_{v12}	809.2 ± 4.4	m^3/hr
	Mass flow rate	q_{m12}	0.257 ± 0.014	kg/s
Temperature gross efficiency		$\eta_{t,gro}$	**0.788 ± 0.025**	-

The expanded uncertainties of measurement U are the product of standard measurement uncertainties and the expansion coefficient k=2, which provides a confidence interval of ca 95 %

5) Photo documentation

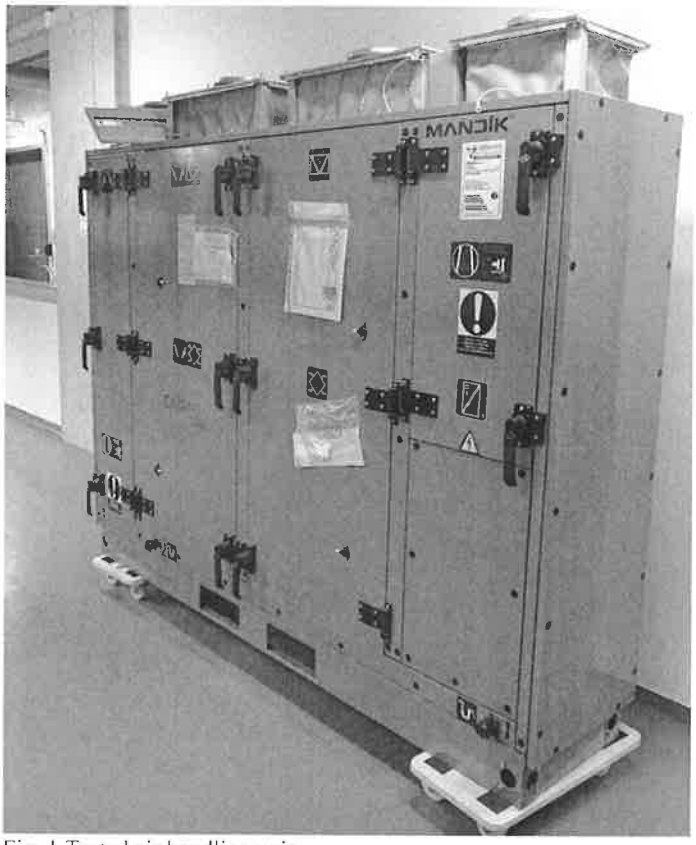

Fig. 1 Tested air handling unit

Fig. 2 Air handling unit during measurement

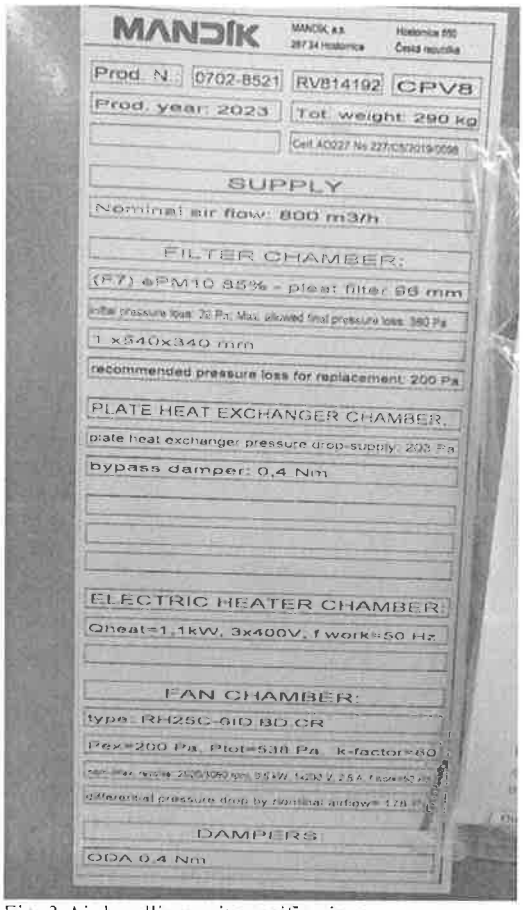

Fig. 3 Air handling unit specifications

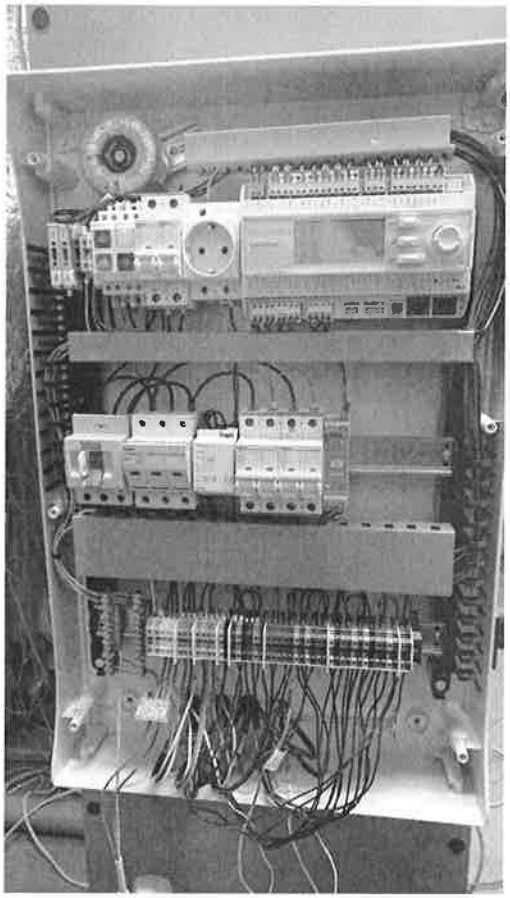
Fig. 4 Switchboard after removing the cover

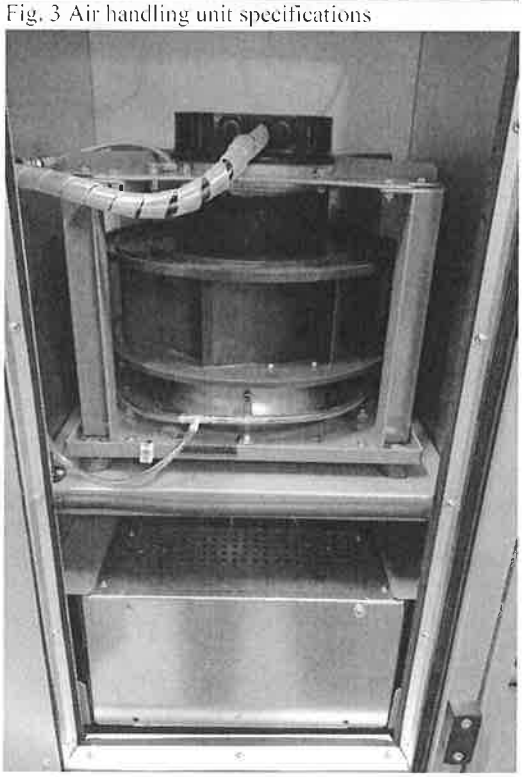
Fig. 5 Supply fan with electric heater


Fig. 6 Exhaust air filter and exchanger

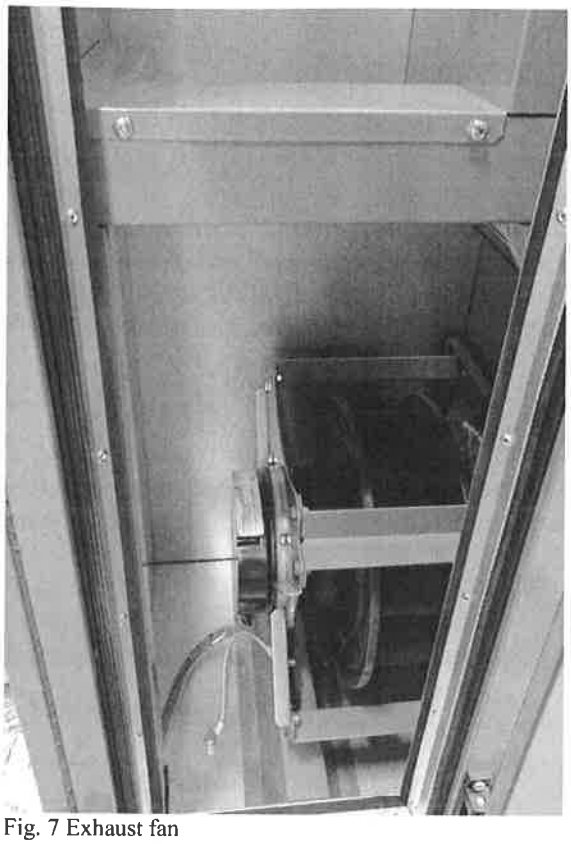

Fig. 7 Exhaust fan

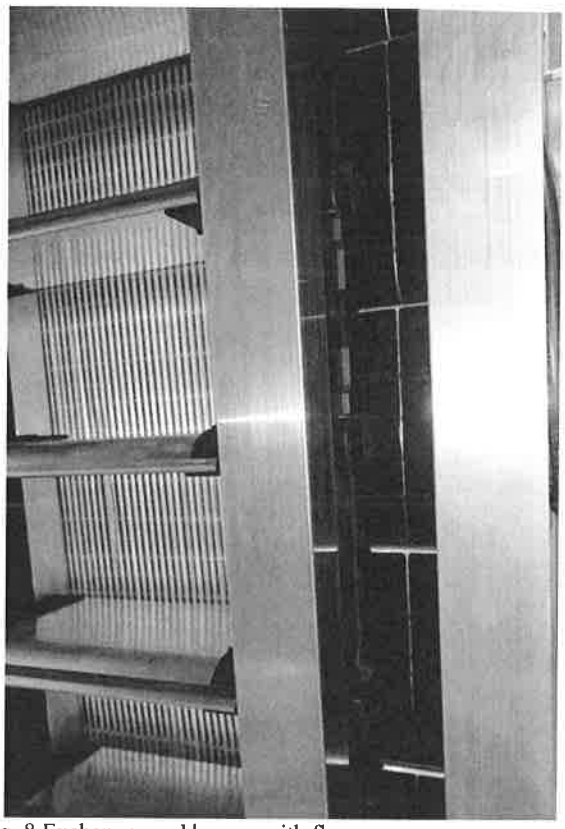

Fig. 8 Exchanger and bypass with flap

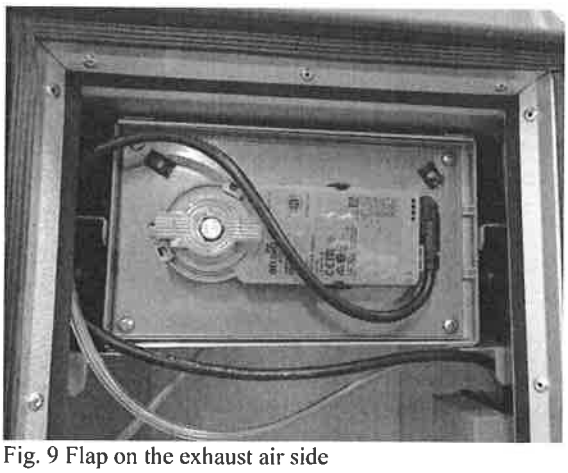

Fig. 9 Flap on the exhaust air side

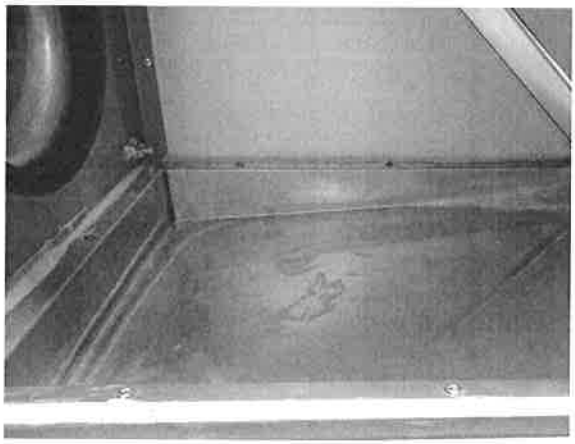

Fig. 10 The space between the heat exchanger and the fan on the exhaust air side

 # the data marked as such was supplied by the customer, OL181 is not responsible for it.

---------- end of test report ----------

Annex 1

According to the client's requirements, the results of the measurements according to EN 308 were also expressed according to the test code in paragraph 5.2.1 of the document:

"Doc_4.4_S.a_FR_Ventilateurs_et_Groupes_de_ventilation_v2.0_20211025"

Calculation of the temperature ratio

The test volume flow rate $q_{v,test}$ is defined as the lower of the following two volume flow rates the exhaust air volume flow rate (q_{v11}) and the supply air volume flow rate (q_{v22}) during the test. The thermal efficiency of the heat recovery unit is given by:

$$\eta_{test} = \frac{(\eta_{t,sup} + \eta_{t,eha})}{2}$$

The temperature ratios of the supply air side ($\eta_{t,sup}$) and the extract air side ($\eta_{t,eha}$) are calculated using the temperatures measured during the test and are conventionally corrected to take account of the heat from electrical energy consumed:

$$\eta_{t,sup} = \frac{t_{22} - \Delta t_{22} - t_{21} - \Delta t_{21}}{t_{11} + \Delta t_{11} - t_{21} - \Delta t_{21}} \quad \text{et} \quad \eta_{t,eha} = \frac{t_{11} + \Delta t_{11} - t_{12} + \Delta t_{12}}{t_{11} + \Delta t_{11} - t_{21} - \Delta t_{21}}$$

The temperature differences (Δt_{xx}) corresponding to the position of the fans.

Tab. 6 Measurement results

Fresh air fan position		behind the heat exchanger		
Exhaust air fan position		behind the heat exchanger		
Fan speed adjustment (fresh air/exhaust air)		-	F 79/E 78	%
Electrical power		$P_{elec,ahu,test}$	466	W
Specific Fan Power (SFP)		P_{SFP}	1.049	kW/m³/s
Atmospheric air pressure		P_{atm}	97.9	kPa
Fresh air	Inlet dry bulb temperature	t_{21}	5.17	°C
	Outlet dry bulb temperature	t_{22}	21.69	°C
	Available total pressure	-	202	Pa
	Volumetric air flow	q_{v22}	800.0	m³/hr
Exhaust air	Inlet dry bulb temperature	t_{11}	25.00	°C
	Inlet dew point temperature	-	1.2	°C
	Inlet wet air temperature	-	12.6	°C
	Outlet dry bulb temperature	t_{12}	10.25	°C
	Available total pressure	-	201	Pa
	Volumetric air flow	q_{v11}	809.2	m³/hr
Δt11		Δt_{11}	0.00	K
Δt12		Δt_{12}	0.90	K
Δt21		Δt_{21}	0.00	K
Δt22		Δt_{22}	0.90	K
ηt,sup		$\eta_{t,sup}$	78.8	%
ηt,eha		$\eta_{t,eha}$	78.9	%
Test air flow		**q_{vtest}**	**800**	m³/hr
Final thermal efficiency		**$\eta_{t,epb}$**	**79**	%