TEST REPORT

DIN EN 13141-7

Test laboratory	AirExchange® Confidential Information
Test object	Heat pump energy recovery ventilator
Model No.	AirExchange® 350-HC (AE-350-HC)
Manufacturer	AirExchange® Confidential Information
Scope of Assignment	Tests according to DIN EN 13141-7:2022-12 Building ventilation Performance testing of components/equipment for residential ventilation Part 7:Performance testing of ducted mechanical supply and extract units (including heat recovery)
Date of receipt of test object	20.08.2024
Test periods	21.08.2024 – 04.09.2024
Test Location	Guangzhou China
Testing items	Air capacity, static pressure, input power, sensible&enthalpy heat efficiency in Winter, sensible&enthalpy heat efficiency in Summer. cooling capacity,heating capacity,

Date: 2024-9-6

This document consists of 22 Pages

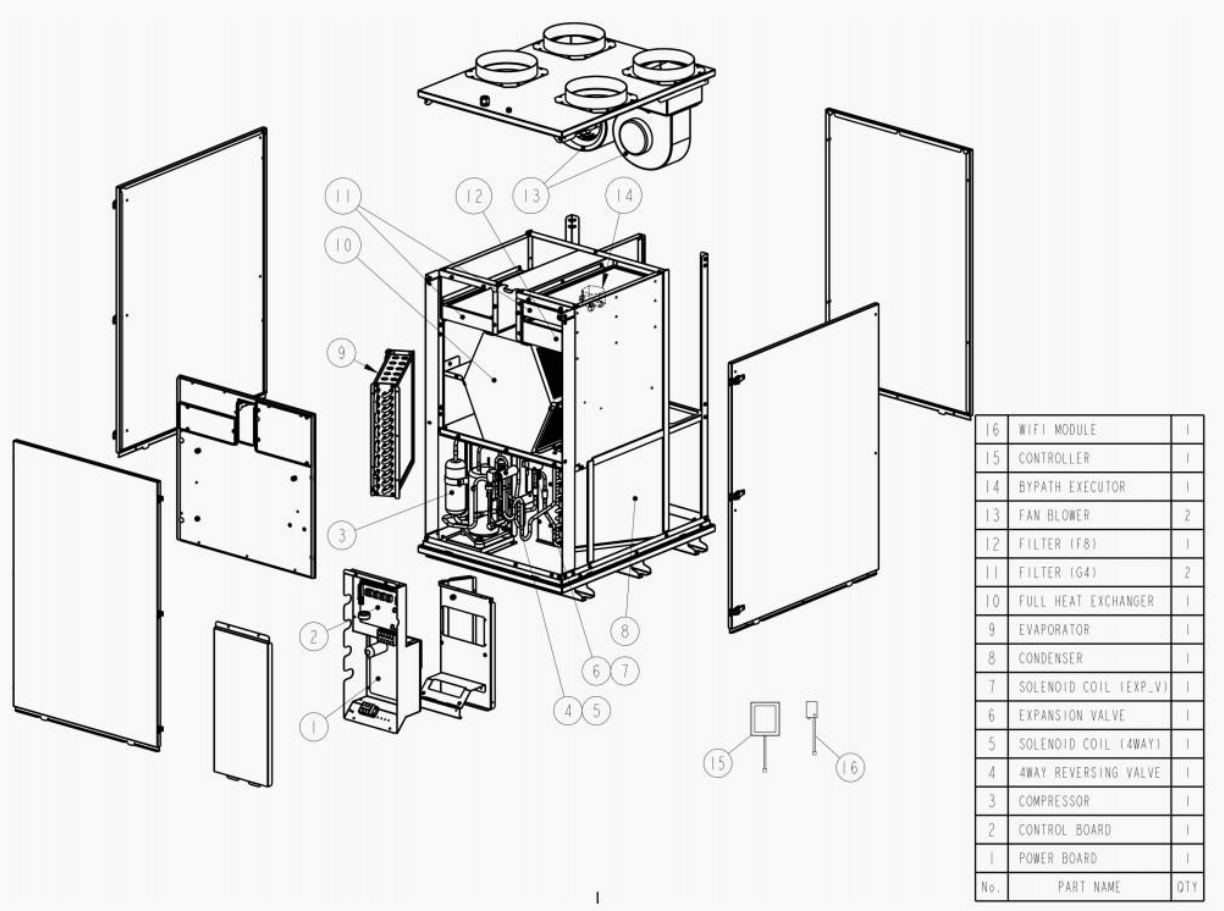
The test results refer exclusively to the units under test.

For and on behalf of AirExchange®

1. Introduction

Tests according to DIN EN 13141-7:2022-12
Building ventilation Performance testing of components/equipment for residential ventilation
Part 7:Performance testing of ducted mechanical supply and extract units (including heat recovery)
The testing of air capacity, static pressure, input power, sensible&enthalpy heat efficiency in Winter, sensible&enthalpy heat efficiency in Summer, cooling capacity,heating capacity are carried out in the Enthalpy Testing Lab.

1.1 The structure of "Heat pump energy recovery ventilator" is pictured in figure 1:



No.	PART NAME	QTY
16	WIFI MODULE	1
15	CONTROLLER	1
14	BYPATH EXECUTOR	1
13	FAN BLOWER	2
12	FILTER (F8)	1
11	FILTER (G4)	2
10	FULL HEAT EXCHANGER	1
9	EVAPORATOR	1
8	CONDENSER	1
7	SOLENOID COIL (EXP_V)	1
6	EXPANSION VALVE	1
5	SOLENOID COIL (4WAY)	1
4	4WAY REVERSING VALVE	1
3	COMPRESSOR	1
2	CONTROL BOARD	1
1	POWER BOARD	1

Figure 1

1.2 The general layout of the HPERV components are as shown below in figure 2:

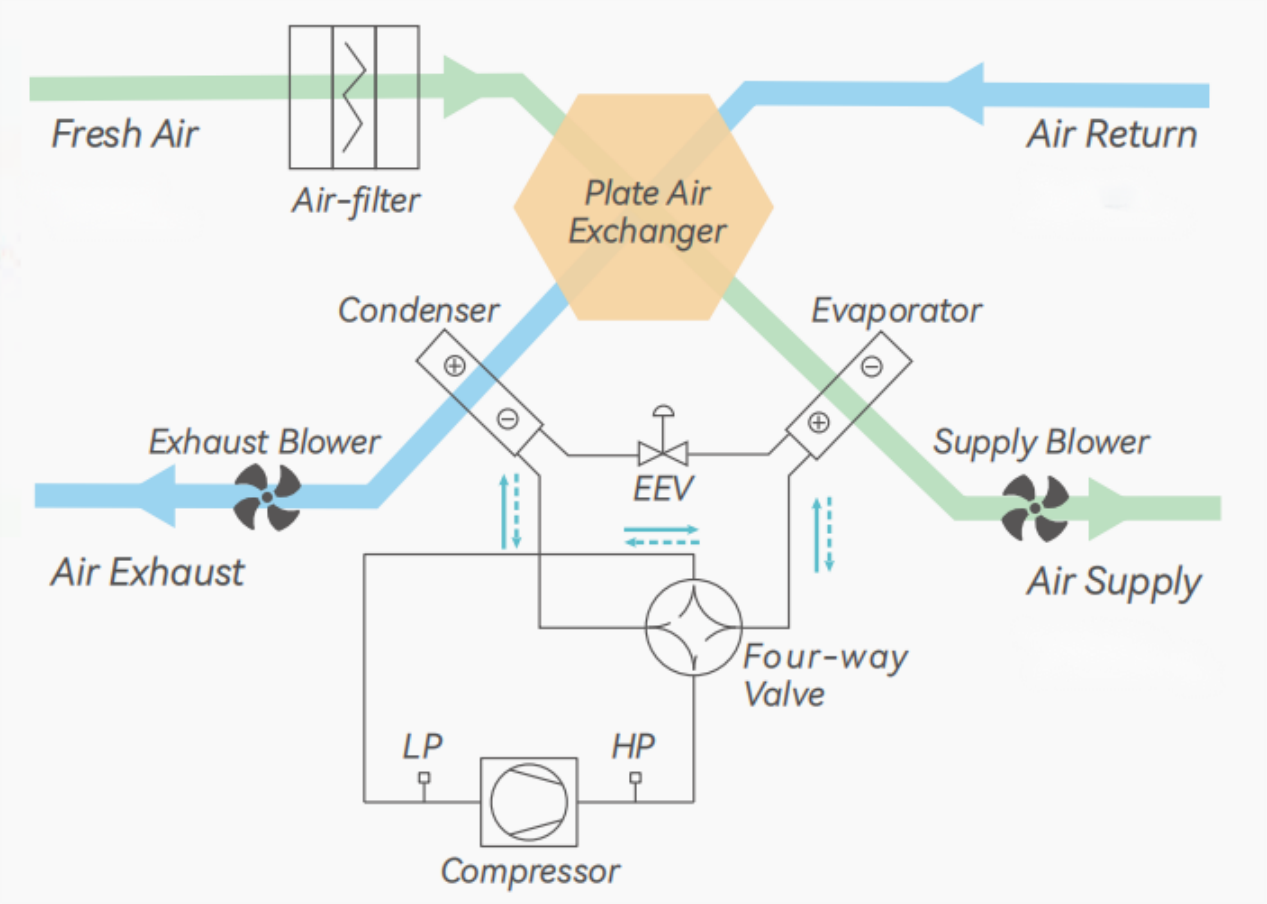


Figure 2

1.3 Specification

Model			AE-350-HC
Rated airflow		CMH	350
Exhaust Airflow (Ventilation mode)		CMH	350
Exhaust Airflow (Heating/Cooling mode)		CMH	350
External static pressure (350CMH)		Pa	100
Ventilation mode	Temperature Effi. (Heating)	%	76.5
	Temperature Effi. (Cooling)	%	72
	Enthalpy Effi. (Heating)	%	72.6
	Enthalpy Effi. (Cooling)	%	69.4
	Input power	W	185
	Input current	A	1.08
Cooling/Heating	Norminal Cooling Capacity	W	3798
	Max Cooling Capacity	W	4173
	Input power (Cooling)	W	847
	Operation Current (Cooling)	A	4.42
	Norminal Heating Capacity	W	4604
	Max Heating Capacity	W	4981
	Input power (Heating)	W	790
	Operation Current (Heating)	A	3.82
Noise		dB(A)	37 / 42
Power			220V 1P 50/60Hz
Dimension		mm（LWH）	760×600×1000
Air Inlet/Outlet Diameter		mm	188
Air Inlet/Outlet Height		mm	60
Machine Base Height		mm	61.5
Drainage pipe		Inch	1/2"
Refrigerant			R32
Refrigerant charge		g	300
Operation Temperature		℃	-15~50

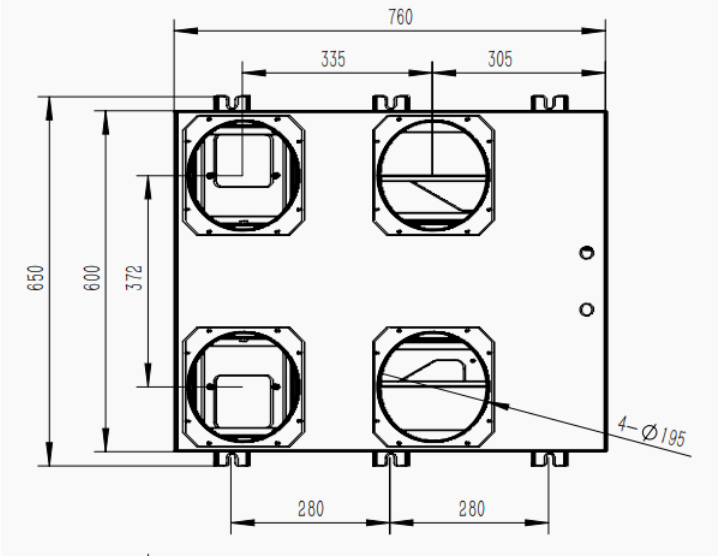
2. Configuration of the testing sample

2.1 The product tested is shown in Figure 3

Figure 3

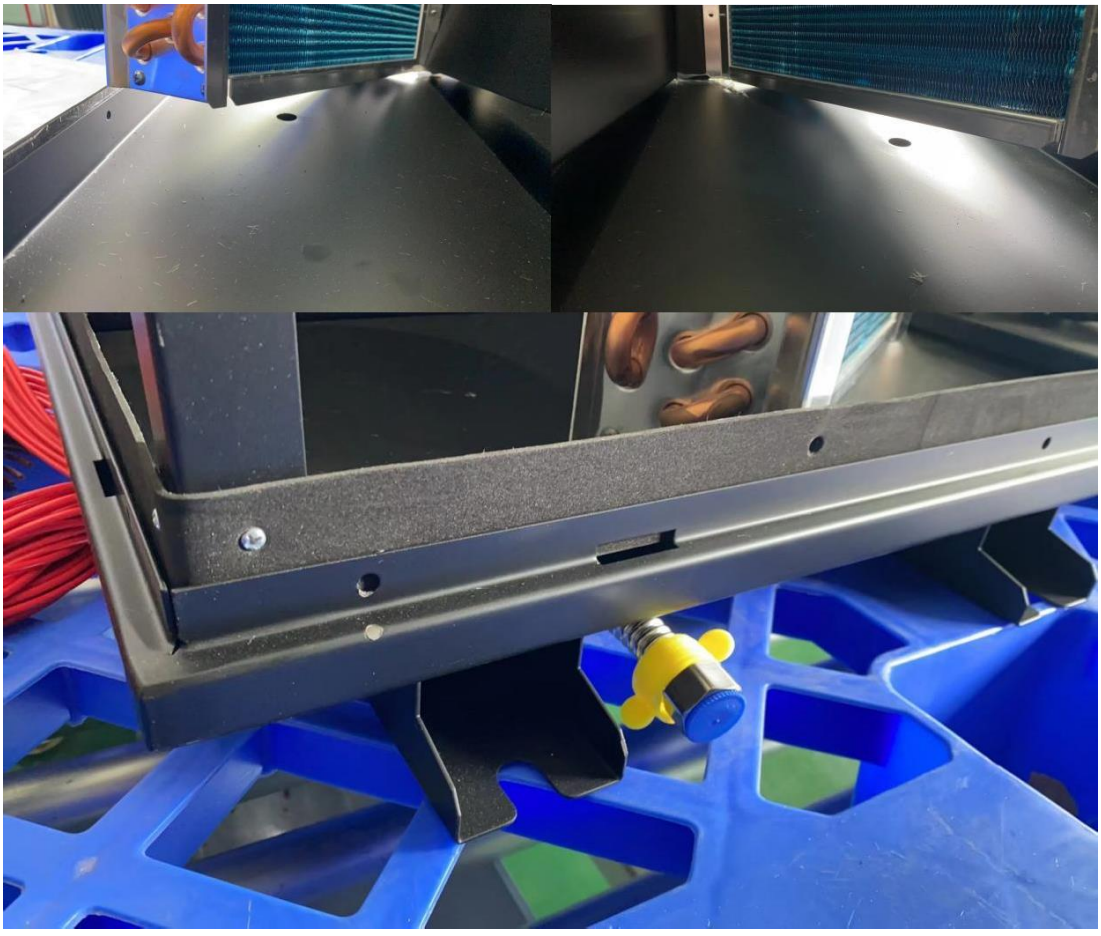
2.2 Spigots:

The spigots are all located on the top of the HPERV casing and are all 195 mm diameter, metal.



2.3 Condensate drain pipe

Condensate is drained from the bottom of the unit. Supply and exhaust air drain connections are provided.



2.4 Filters

The filters installed in this HPERV are G4, coarse 65% on both the extract and supply sides, and F8, coarse 95% on supply side. The filters are located immediately before the heat exchanger in both the supply and exhaust air flow paths. The filters can be seen in figure 4 & 5.

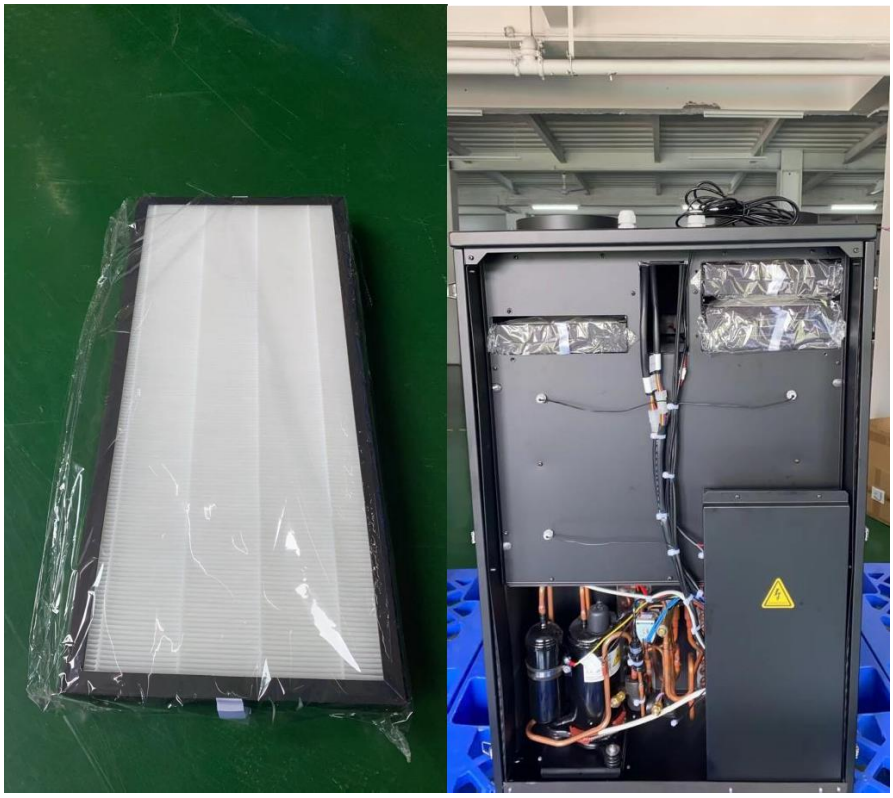
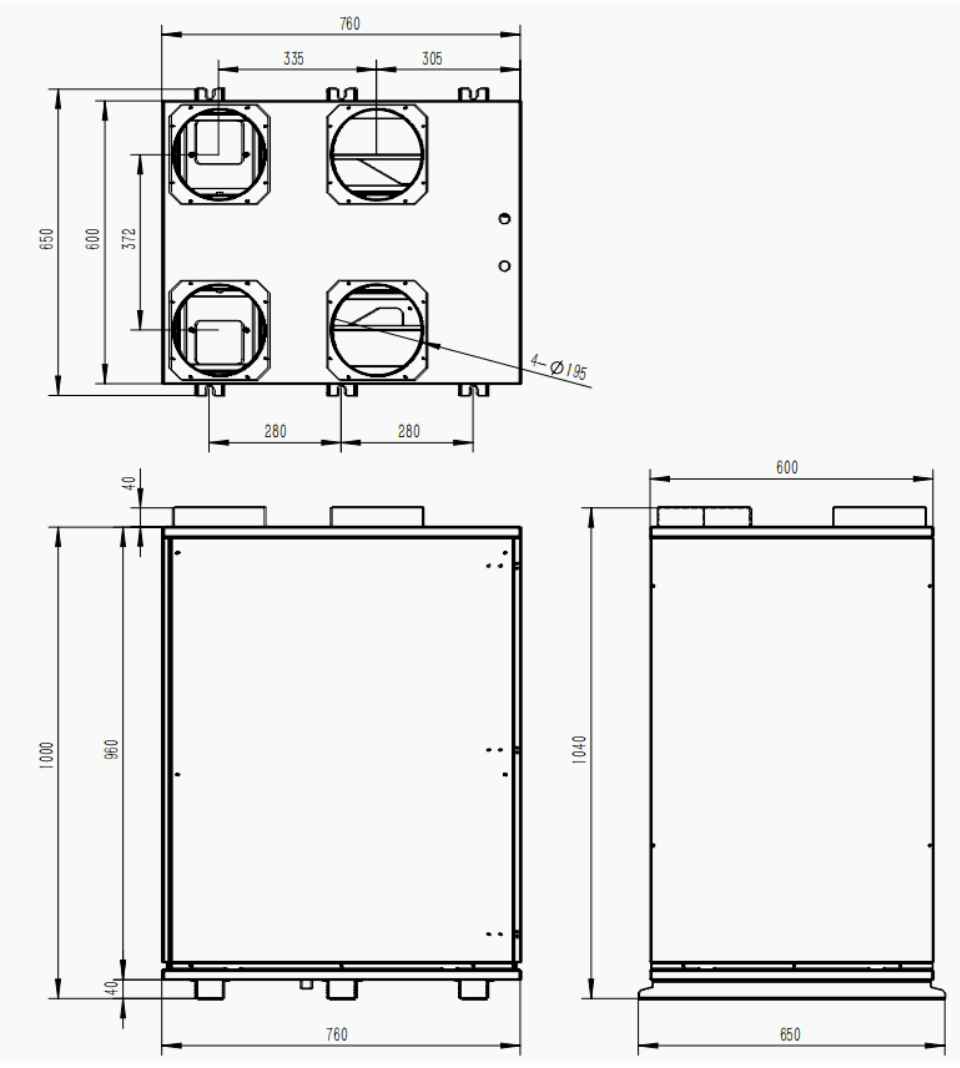


Figure 4 & 5

2.5 The overall dimensions of the HPERV unit are :



2.6 Type of fan control

Both the supply and exhaust fan are located back of the heat exchanger. The fans were controlled independently. The Modbus fans control is in, m^3/h, and are controlled from the main pcb.

	Supply air fan	Extract air fan
Impeller type	Forerake curved	Forerake curved
Manufacturer	Airflow	
Electrical rating	0.6A	
Power rating	80W	
Rotational speed	1800	

2.7 Summer by-pass -type

There is a complete summer by-pass installed in this MVRH. Details of summer by-pass installed can be seen in figure 6:

Figure 6

2.8 Heat exchanger

The heat exchanger installed in this product is plastic polymer membrane, counterflow, enthalpy. The total depth is 400 mm. The heat exchanger installed in the HPERV can be seen in Figure 7.

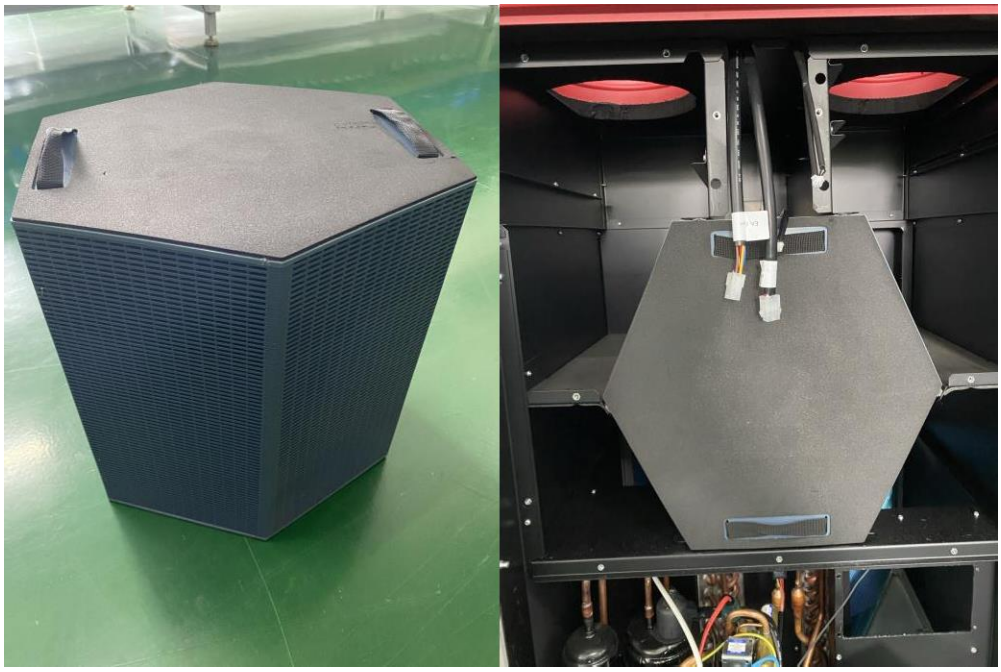


Figure 7

3. Execution of tests

All testing was undertaken at the testing laboratory in Guangzhou, China.
The following tests were undertaken in accordance with the specific requirements for testing ventilation products with heat recovery in the EN13141-7:2022.

3.1 Details of test program

Heat pump performance

When the system includes a heat pump, the performance test consists of the determination of the heating capacity and the coefficient of performance (COP) of the heat pump as defined in EN 14511 (all parts).

The tests shall be performed in accordance with the temperature conditions specified in Table 1. The temperature conditions given in Table 1 should not be applied during the air flow performance test.

Temperature conditions for the heating performance test

Extract air inlet dry bulb (wet bulb) temperature °C	Outdoor air inlet dry bulb (wet bulb) temperature °C
20 (12)	7 (6)
20 (12)	2 (1)
20 (12)	- 7 (- 8)

Table 1

In the case of reverse cycle heat pump, the performance in cooling mode, i.e. cooling capacity and energy efficiency ratio (EER) shall also be measured in the temperature conditions given in Table 2.

Temperature conditions for the cooling performance test

Point for cooling performance	Extract air inlet dry bulb (wet bulb) temperature °C	Outdoor air inlet dry bulb (wet bulb) temperature °C
1 (mandatory)	27 (19)	35 (24)
2 (optional)	27 (19)	27 (19)

Table 2

For operating conditions, the tests shall be performed as described in 7.3.2.1 for reference point and optional at minimum or maximum air flow and shall be reported.

The heating and/or cooling performance shall be determined in accordance with the test methods and procedures as described in EN 14511-3.

Cold climate test

Beginning from + 2 ° C the outdoor temperature is gradually decreasing down to – 15 ° C within at least 3 h.

The test shall run for a minimum of 6 h up to maximum of 24 h to a point where the air flow is stabilized.

The test is successful, if the temperatures and mass flows during the operating cycles are stabilized without harmful icing over the complete unit.

Following a test for cold climates, the unit shall be visually inspected. This inspection shall be carried out immediately after defrosting or other similar action. Observations shall be noted in the test report as to the influence of freezing and condensation on the operation of the heat recovery device, and the condensation water outlet.

Table 3 gives the temperature conditions for cold climate test when this one is required.

Table 12 — Temperature conditions for cold climate test

Application mode	**Cold climate test**
Point number	4
Heat exchanger category	HRC1 and HRC3
Extract air	
Temperature θ_{11}	20 °C
Wet bulb temperature θ_{w11}	12 °C
Outdoor air	
Temperature θ_{21}	- 15 °C
Wet bulb temperature θ_{w21}	—

Table 3

7.3.5 Evaluation on supply air side (mandatory measurement)

If in any case $q_{m11} \leq q_{m22}$ the temperature ratio on supply air side is given by Formula (7).

$$\eta_{\theta,su} = \frac{\theta_{22} - \theta_{21}}{\theta_{11} - \theta_{21}} \tag{7}$$

If in any case $q_{m11} > q_{m22}$ the temperature ratio on supply air side shall be corrected according to the following Formula (8).

$$\eta_{\theta,su} = \frac{\theta_{22} - \theta_{21}}{\theta_{11} - \theta_{21}} \cdot \frac{q_{m22}}{q_{m11}} \tag{8}$$

If in any case $q_{m11} \leq q_{m22}$ the humidity ratio on supply air side is given by Formula (9).

$$\eta_{x,su} = \frac{x_{22} - x_{21}}{x_{11} - x_{21}} \tag{9}$$

If in any case $q_{m11} > q_{m22}$ the humidity ratio on supply air side shall be corrected according to the following Formula (10).

$$\eta_{x,su} = \frac{x_{22} - x_{21}}{x_{11} - x_{21}} \cdot \frac{q_{m22}}{q_{m11}} \tag{10}$$

For balanced units, the mass flows q_{m11} (extract air) and q_{m22} (supply air) shall deviate not more than MAX(3 % with regard to extract air flow (q_{m11}); 3,6 kg/h). Over this limit, the unit is declared unbalanced and the imbalance shall be reported.

7.3.6 Evaluation on exhaust air side (optional measurement)

If in any case $q_{m21} \leq q_{m12}$ the temperature ratio on exhaust air side is given by Formula (11).

$$\eta_{\theta,ex} = \frac{\theta_{11} - \theta_{12}}{\theta_{11} - \theta_{21}} \quad (11)$$

If in any case $q_{m21} > q_{m12}$ the temperature ratio on exhaust air side shall be corrected according to Formula (12).

$$\eta_{\theta,ex} = \frac{\theta_{11} - \theta_{12}}{\theta_{11} - \theta_{21}} \cdot \frac{q_{m12}}{q_{m21}} \quad (12)$$

If in any case $q_{m21} \leq q_{m12}$ the humidity ratio on exhaust air side is given by Formula (13).

$$\eta_{x,ex} = \frac{x_{11} - x_{12}}{x_{11} - x_{21}} \quad (13)$$

If in any case $q_{m21} > q_{m12}$ the humidity ratio on exhaust air side shall be corrected according to Formula (14).

$$\eta_{x,ex} = \frac{x_{11} - x_{12}}{x_{11} - x_{21}} \cdot \frac{q_{m12}}{q_{m21}} \quad (14)$$

For balanced units, the mass flows q_{m11} (extract air) and q_{m22} (supply air) shall deviate not more than MAX(3 % with regard to extract air flow (q_{m11}); 3,6 kg/h). Over this limit, the unit is declared unbalanced and the imbalance shall be reported.

3.2 Determination of leakage test

3.2.1 External leakage test

The external leakage was determined by means of establishing a pressure difference between the interior of the unit and its environment. The measured air volume flow required to maintain the pressure difference indicates the external leakage.

3.2.2 Internal leakage test

In order to determine the leakage volume flow between the exhaust air / extract air side and the outdoor air / supply air side, the exhaust air / extract air side of the unit were pressurized and a volume flow was supplied to or extracted from the outdoor air / supply air side, so as to keep the differential pressure between the environment and the outdoor air / supply air side at zero.

As there is no differential pressure between the environment and the outdoor air / supply air side the leakage volume flow corresponds to the ingoing or outgoing volume flow which exists when the specified differential pressures are established.

3.3 Determination of ventilation test

Thermal tests should be performed at standard test temperature conditions, depending on the type and use of the heat recovery device:

Tests on a ducted residential ventilation unit type: ”HPERV“ following the standard DIN EN 13141-7:2022-12 (HP in OFF mode)

DIN EN 13141-7:2022-12	**Condition 1**
Extract air	20 °C / 12 °C (wb)
Outdoor air	1°C / - °C (wb)

3.4 Determination of thermodynamic test

The thermodynamic test was conducted on a heat pump energy recovery ventilator AV-HTPF35/EI32 in a double climate chamber.

3.4.1 Additional thermodynamic test on a ducted residential ventilation unit type: "HPERV" following DIN EN 13141-7:2022-12 (HP in OFF mode)

DIN EN 13141-7:2022-12	Condition 1	Condition 2
Extract air	20 °C / 12 °C (wb)	20 °C / 15 °C (wb)
Outdoor air	1 °C / - °C (wb)	2 °C / 1 °C (wb

3.4.2 Additional tests on a ducted residential ventilation unit type: " HPERV " following the standard DIN EN 13141-7:2022-12 (HP in ON mode)

DIN EN 13141-7:2022-12	Condition 1	Condition 2	Condition 3
Extract air	20 °C / 12 °C (wb)	20 °C / 12 °C (wb)	20 °C / 12 °C (wb)
Outdoor air	7 °C / - °C (wb)	2 °C / 1 °C (wb)	-7 °C / -8 °C (wb)

3.4.3 Additional tests on a ducted residential ventilation unit type: " HPERV " following the standard DIN EN 13141-7:2022-12 (HP in ON mode)

DIN EN 13141-7:2022-12	Condition 1	Condition 2
Extract air	27 °C / 19 °C (wb)	27 °C / 19 °C (wb)
Outdoor air	35 °C / 24 °C (wb)	27 °C / 19 °C (wb)

3.5 Determination of cold Climate test

Starting at + 2 ° C the outside temperature is gradually lowered to - 15 'C for at least 3 h. 'The test should last a minimum of 6 h to a maximum of 24 h until the point at which the volumetric airflow rate is stabilized.

The test is satisfactory if the temperature and mass flow rates during the operating cycles stabilize without frost damage to the unit as a whole.

Following a cold weather test, the unit should be visually inspected. The inspection should be performed immediately alter defrosting or other similar action, Observations should be noted in the test report as to the influence of frost and condensation on the operation of the heat recovery device, and of the condensation water outlet.

Below table gives the temperature conditions for cold weather testing when required.

DIN EN 13141-7:2022-12	Condition 4
Extract air	20 °C / 12 °C (wb)
Outdoor air	-15 °C / - °C (wb)
Test duration	6 - 24 h

4. Test results

4.1 Reception inspection

The recorded relevant technical data pertaining to the ventilation unit and its built-in components is listed in appendixes B.

The visual inspection of the central ventilation unit yielded the following results:

- Unit labelling
  - The unit was equipped with a type plate.
  - The unit is marked with a CE sign.
- Electrical safety
  - The electrical parts are not accessible if the cover of the unit was open.
  - Tools are required for opening the unit cover.
- Mechanical safety
  - The unit will not be cut out by opening the unit cover.
  - Tools are required for opening the unit cover.
- Operation and installation
  - The unit is operated by a control panel
  - By the control panel 10 speeds can be chosen.
  - The control voltage of speed low and speed high can be adjusted at the electric of the "heat pump energy recovery ventilator AV-HTPF35/EI32" . Medium speed is a result of the adjustment of speed low and high.
  - There was no possibility to adjust a disbalance of the fans.
- Maintenance
  - The filters are situated at the outdoor and extract side. They can be removed over the Filter access panels.

4.2 Working range of the ventilation unit

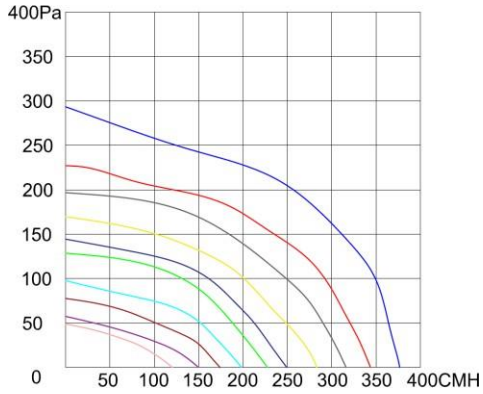
4.2.1 Tests on a ducted residential ventilation unit type: ”HPERV“ following the standard DIN EN 13141-7:2022-12 (HP in OFF mode)

Condition 1: Extract air:20 °C / 12 °C (wb); Outdoor air:1°C / - °C (wb)			
Speed	1	3	10
Supply air DB(℃)	18.03	17.19	15.97
Supply air WB(℃)	10.61	10.15	9.48
Supply air enthalpy	30.84	29.76	28.22
Return air DB(℃)	20	20.02	20
Return air WB(℃)	12	12	12.01
Return air enthalpy	34.22	34.22	34.24
Outdoor air DB(℃)	1.01	1.01	1.01
Outdoor air WB(℃)	0	-0.01	-0.03
Outdoor air enthalpy	9.54	9.42	9.39
Air volume(m³/h)	97.56	173.16	347.47
Input power(kw)	0.0275	0.08589	0.23573
Sensible heat efficiency(%)	89.63	85.11	78.78
Enthalpy heat efficiency(%)	86.30	82.02	75.77

4.2.2

Condition 2: Extract air:20 °C / 15 °C (wb); Outdoor air:2 °C / 1 °C (wb)				
Speed	1	3	6	10
Supply air DB(℃)	18.94	18.02	17.14	16.95
Supply air WB(℃)	12.74	12.29	11.71	11.74
Supply air enthalpy	36.12	34.98	33.53	33.61
Return air DB(℃)	20.99	21.02	21	21.01
Return air WB(℃)	14.99	14.99	15.01	14.99
Return air enthalpy	42.16	42.16	42.21	42.16
Outdoor air DB(℃)	1.97	1.99	2.02	1.92
Outdoor air WB(℃)	1.05	0.95	1.1	1.01
Outdoor air enthalpy	11.36	11.19	11.45	11.29
Air volume(m³/h)	97.56	173.16	239.36	347.47
Input power(kw)	0.06259	0.08283	0.14272	0.19374
Sensible heat efficiency(%)	89.22	84.24	79.66	78.73
Enthalpy heat efficiency(%)	80.39	76.82	71.78	72.30

4.2.3 The pressure-airflow curves air / supply air side are shown the P-Q chart:



4.3 Leakage test

The leakage volume flow and the leakage of the central ventilation unit type “heat pump energy recovery ventilator AE-350-HC”, related to the nominal air volume flow of 350m³/h are as follows:

		external leakage		internal leakage	
Measurement	**P_{stat}**	**leakage volume flow**	**leakage**	**leakage volume flow**	**leakage**
Nr.	[Pa]	[m³/h]	%	[m³/h]	%
1	-300	5.95	1.7	5.5	1.5
2	-250	5.5	1.5	4.9	1.4
3	-200	4.9	1.4	4.9	1.4
4	-100	4.55	1.3	4.2	1.2
5	-50	4.2	1.2	3.85	1.1
6	0	3.85	1.1	3.5	1
7	50	4.2	1.2	3.85	1.1
8	100	4.55	1.3	4.2	1.2
9	200	4.9	1.4	4.9	1.4
10	250	5.5	1.5	4.9	1.4
11	300	5.95	1.7	5.5	1.5

4.4 Thermodynamic test

4.4.1 Additional thermodynamic test on a ducted residential ventilation unit type: “HPERV”

Condition 1: Extract air:20 °C / 12 °C (wb) Outdoor air:7 °C / - °C (wb)						
Speed	5	6	7	8	9	10
Supply air enthalpy	54.02	53.74	52	51.25	51.04	51.07
Supply air DB(℃)	38.18	37.77	36.43	35.68	35.32	35.31
Supply air WB(℃)	19.02	18.93	18.38	18.14	18.07	18.08
Outdoor air enthalpy	21.93	21.85	21.13	21.13	21.02	21.07
Outdoor air DB(℃)	7.73	7.69	7.54	7.55	7.57	7.49
Outdoor air WB(℃)	6.58	6.54	6.19	6.19	6.14	6.16
Air volume(m³/h)	218.24	239.36	284.56	311.27	332.03	347.47
Input power(kw)	0.90976	0.90694	0.90872	0.92074	0.94138	0.94478
Heating capacity(kw)	2.33	2.54	2.93	3.13	3.32	3.47
COP	2.57	2.81	3.22	3.39	3.53	3.68

following DIN EN 13141-7:2022-12 (HP in ON mode)

4.4.2

Condition 2:
Extract air:20 °C / 12 °C (wb);
Outdoor air:2 °C / 1 °C (wb)

Speed	5	6	7	8	9	10
Supply air enthalpy	50.07	49.2	47.59	46.61	46.58	46.38
Supply air DB(℃)	34.96	34.74	33.6	32.81	32.67	32.61
Supply air WB(℃)	17.76	17.48	16.94	16.61	16.6	16.53
Outdoor air enthalpy	12.03	12	11.84	11.77	11.79	12
Outdoor air DB(℃)	2.65	2.61	2.52	2.46	2.46	2.62
Outdoor air WB(℃)	1.43	1.41	1.32	1.28	1.29	1.41
Air volume(m³/h)	218.24	239.36	284.56	311.27	332.03	347.47
Input power(kw)	0.85223	0.85237	0.85788	0.87456	0.89707	0.9008
Heating capacity(kw)	2.77	2.97	3.39	3.61	3.85	3.98
COP	3.25	3.48	3.95	4.13	4.29	4.42

4.4.3

Condition 3: Extract air:20 °C / 12 °C (wb); Outdoor air:-7 °C / -8 °C (wb)						
Speed	5	6	7	8	9	10
Supply air enthalpy	41.84	42.38	42.38	38.86	40.17	40.08
Supply air DB(℃)	30.23	29.54	29.54	27.03	27.9	28.07
Supply air WB(℃)	14.94	15.13	15.13	13.83	14.32	14.29
Outdoor air enthalpy	-1.98	-1.69	-1.69	-2.21	-1.68	-2.74
Outdoor air DB(℃)	-6.06	-6.11	-6.11	-6.28	-5.93	-6.22
Outdoor air WB(℃)	-7.1	-6.9	-6.9	-7.26	-6.89	-7.63
Air volume(m³/h)	218.24	239.36	284.56	311.27	332.03	347.47
Input power(kw)	0.77546	0.78288	0.78288	0.77291	0.82549	0.83049
Heating capacity(kw)	3.19	3.52	4.18	4.26	4.63	4.96
COP	4.11	4.49	5.34	5.51	5.61	5.97

4.4.4 Additional tests on a ducted residential ventilation unit type: " HPERV " following the standard DIN EN 13141-7:2022-12 (HP in ON mode)

Condition 1: Extract air:27 °C / 19 °C (wb); Outdoor air:35 °C / 24 °C (wb)						
Speed	5	6	7	8	9	10
Supply air enthalpy	46.39	47.59	48.38	48.75	49.37	49.43
Supply air DB(℃)	21.03	21.23	21.25	21.39	21.53	21.56
Supply air WB(℃)	16.45	16.85	17.11	17.23	17.43	17.45
Outdoor air enthalpy	67.07	71.75	71.67	72.16	72.24	72.28
Outdoor air DB(℃)	35.44	35.75	35.67	35.64	35.61	35.59
Outdoor air WB(℃)	22.67	23.86	23.84	23.96	23.98	23.99
Air volume(m³/h)	218.24	239.36	284.56	311.27	332.03	347.47
Input power(kw)	0.96394	1.03893	1.01575	1.11315	1.13208	1.13058
Cooling capacity(kw)	1.52	1.94	2.23	2.45	2.55	2.67
EER	1.57	1.87	2.19	2.20	2.25	2.36

4.4.5

Condition 2: Extract air:27 °C / 19 °C (wb); Outdoor air: 27 °C / 19 °C (wb)						
Speed	5	6	7	8	9	10
Supply air enthalpy	40.45	40.43	41.01	41.34	41.95	41.98
Supply air DB(℃)	18.45	18.37	18.36	18.41	18.63	18.65
Supply air WB(℃)	14.36	14.35	14.56	14.68	14.9	14.91
Outdoor air enthalpy	55.1	55.27	55.97	56.25	56.79	60.37
Outdoor air DB(℃)	27.72	27.72	27.63	27.59	27.57	27.56
Outdoor air WB(℃)	19.26	19.31	19.52	19.6	19.76	20.79
Air volume(m³/h)	218.24	239.36	284.56	311.27	332.03	347.47
Input power(kw)	0.99368	0.98831	1.02066	1.0304	1.05061	1.05214
Cooling capacity(kw)	1.07	1.19	1.43	1.56	1.66	2.15
EER	1.08	1.21	1.40	1.51	1.58	2.04

4.7 Cold Climate test

A continuous cold climate test was carried out under the conditions of an indoor air temperature 20 ° C / 12 ° C (wb), outdoor air temperature -15 ° C / - ° C (wb), uninterruptedly running for 6hrs and observe the status and conditions of the HPERV, 5 speeds are tested.

The testing results shows that the HPERV runs normally but will enter into defrost mode for protection.

Speed	Operation and status	Remark
5	After running for 75 minutes, the compressor copper was frosted, the unit ran normally, and entered into defrost mode at the 75th minute.	the HPERV runs continuously for 6 hours in low-temperature conditions, and changes from speed 5-10 uninterruptedly. For detailed pictures and videos, please see the attached figure.
6	The compressor copper was frosted after running for 60 minutes, but the unit was running normally.	
7	The compressor runs for 60 minutes, during which the copper is frosted. The unit runs normally and enters into defrost mode at the 30th minute of operation.	
8	After 45 minutes of operation, the compressor copper was frosted, but the unit was operating normally.	
9	The compressor runs for 60 minutes, during which the copper is frosted. The unit runs normally and enter into defrost mode at 30 minutes.	
10	The compressor copper was frosted after running for 60 minutes, but the unit was running normally.	

5. Testing pictures

Indoor conditions Figure 1

Indoor conditions Figure 2

Outdoor conditions Figure 3

Testing status