Universität Stuttgart

IGE

Institut für
GebäudeEnergetik

Lehrstuhl für
Heiz- und
Raumlufttechnik

Test report Nr. PL.16.WLG.262.ENa

Testing of a residential ventilation system with heat recovery

Client	ALNOR Systemy Wentylacji Sp. z o.o. 00-719 Warszawa, ul. Zwierzyniecka 8b, Poland
Test item	Unducted residential ventilaton system with heat recovery, Manufacturers name **HRU-WALL-150-60**
Test center	Prüfstelle HLK Universität Stuttgart, Institut für GebäudeEnergetik Pfaffenwaldring 6A D-70569 Stuttgart, Germany
Tests	Testings based on **EN 13141-8:2011** Details see following pages
Results	Performance values at nominal step: **$\eta_{\Theta su}$= 74,3%, SPI=0,13** Details and additional results on following pages.

Stuttgart, 3.2.17

i. A. [signature]

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The test results are referring to the test item exclusively.
This report consists of 8 pages. Without the permission of the test center it is only allowed to publish the full report.
The test center HLK of the institute for energetics of buildings (IGE) at the University of Stuttgart is an accredited as testing laboratory according to ISO/IEC 17025 by DAKKS.

Content

Abbreviations

ODA – outdoor air

SUP – supply air

ETA – extracted air

EHA – exhaust air

** - manufactural declaration

1 Test item

Date of delivery of the test item 23.3.14

1.1 Description of function

The test item is an unducted residential ventilation system with heat recovery for the installation on an outside wall.

Figure 1: Test item

For heat recovery a regenerative heat exchanger is used. There are at least two single devices engaged. For heat recovery the devices get operated alternating.

1.2 Marking of the test item

A name plate was afterwards delivered. Main information on the data label:

Type	HRU-WALL-150-60
Serial number	001077

1.3 Measures

	Crossection	Depth
Mounting duct	D=155mm	410mm
Inside cover	218mmx218mm	45mm
Outside cover	150mmx150mm	10mm

1.4 Fans

Manufacturer**	Alnor systemi wentylacji
Type**	HRU-WALL-150-60
Construction	Axial
Maximum power consumption**	3,8W
Diameter **	D=148
Motor**	DC
Arrangement	Inside

1.5 Heatexchanger

Construction	Regenerativ
Manufacturer**	IBIDEN
Material**	Keramik
Measures	D=142mm, L=x150mm

1.6 Filter

Type/Arrangement	Class **	Measures
Inside	G3	D=142mm, H=8mm

1.7 Insulation

The mounting duct is not insulated.

2 Test method and test rig

2.1 Test rig

The aerodynamic tests were performed on the test rig PRWLG of the Prüfstelle HLK. The thermal tests were performed on the test rig PRRLS of the Prüfstelle HLK. The test rigs fulfil the requirements of the EN 13141-8. The required uncertainties and tolerances are kept.

2.2 Air flow curves

The air flow characteristics are measured according to EN 13141-4 category A based on EN ISO 5801:2008. The airflow curves of both sides are measured simultaneously with nozzles.

The static pressure difference is measured in chambers of the test rig.

2.3 Thermodynamic test with purge air method

2.3.1 Test set-up

Alternating working ventilation devices work with regenerative heat exchangers for heat recovery which gets charged and discharged through periodical changing of flow direction. For keeping the air balanced, there are at least two devices, working the opposite way, necessary. For measuring the heat recovery rate for those type of devices, the strategy for recuperators, as explained in EN 13141-8 gets modified. A strategy is used which measures the average temperature of the supply air and of which the rate of heat recovery according to EN 13141-8 gets calculated. For this the two devices are operated between two chambers which do not have any pressure difference (supply- and exhaust air chamber). The chambers are purged with air, which has the desired conditions of the supply- and exhaust air. The purge air flow is higher than the volume flow of the device, so a reverse current in the balance chamber can be excluded. The chamber is constructed in the way that the heat flow of the surrounding can be ignored in relation to the amount of energy the ventilator system converts.

The chambers are partitioned in two partial chambers to prevent device sided bypass. Depending on the current direction of operation the device takes air of a partial chamber and blows it in the chamber next to it. The flows of the purged air in the chambers are balanced, so both chambers are without any difference of pressure. The way of the airflow in the chambers is optimized by air conduction plates.

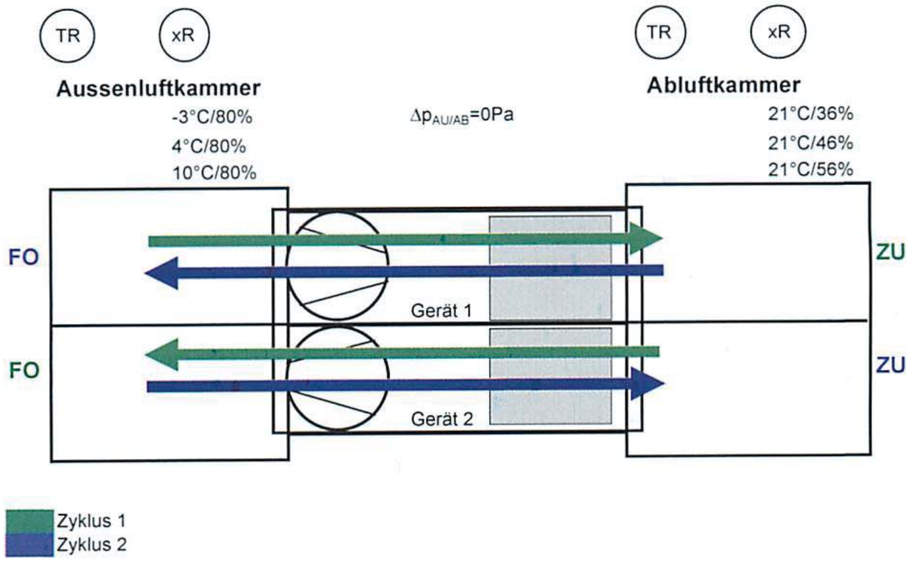

Figure 2: **Set-up of the chambers for measuring (view from above)**

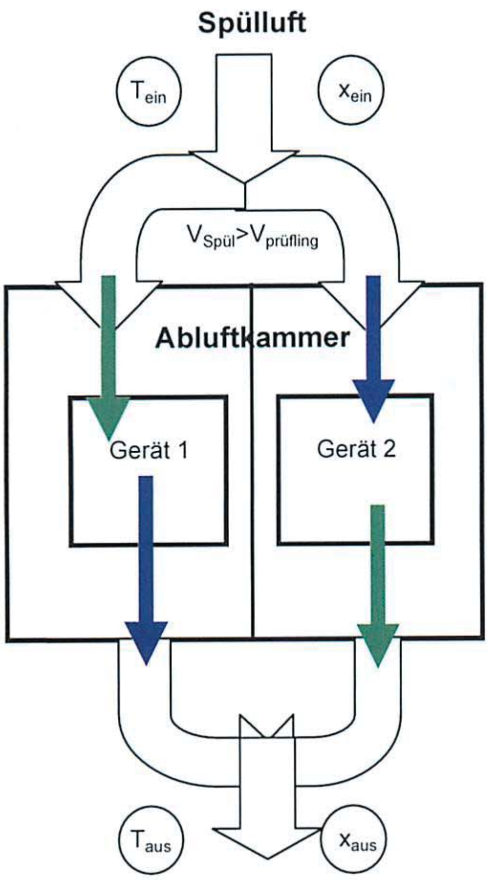

Figure 3: **Flow of purged air through the chamber for exhaust air (front view)**

2.3.2 *Analysis of the method of balanced chamber*

For defining the rate of heat recovery two measurements for each point of measuring are made. During the measurement the devices are operated in the ventilating mode (steady measurement), so the devices operate constantly in the opposite way. At a second measurement the devices are operated in the mode for heat recovery (unsteady measurement). In this measurement the devices run controlled by its controller in alternation mode. The relation of temperature on the outlet of the exhaust air chamber is equitable with the supply temperature ratio according to EN 13141-8:

$$\eta_{ZU} = \frac{T_{AB,aus,instat} - T_{AB,aus,stat}}{T_{AB,ein} - T_{AB,aus,stat}}$$

The determined rate of heat recovery is independent of the air flow of purge air.

2.4 Electronic measurement

The power input is measured as the total power input by a wattmeter on the plug of the test rig.

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3 Test results

Test period: 23.3.16 – 19.4.16

3.1 Air flow courves

Voltage: 230V

Maximum volume flow q_{VD}: 52m³/h

Reference volume flow q_{Vref}: 36,4m³/h

Tabelle 1: Measurements for the air flow curves device 1=ETA:

S 1	AU/ZU	q_{V2}	m³/h	**17,7**	61	53	43	32	22	19	14	4					
		p_{tU2}	Pa	**0**	-20	-16	-11	-6	-1	0	2	5					
	AB/FO	q_{V1}	m³/h	**17,9**	63	56	45	34	27	20	13	5					
		p_{tU1}	Pa	**0**	-20	-16	-10	-6	-3	0	2	4					
		P_{el}	W	**3**	3	3	3	3	3	3	3	3					
		SPI	$\frac{W}{m^3/h}$	**0,15**	0,04	0,05	0,06	0,08	0,10	0,14	0,20	0,59					
S 2	AU/ZU	q_{V2}	m³/h	**36,4**	70	64	55	46	40	37	33	27	17	8			
		p_{tU2}	Pa	**0**	-20	-16	-11	-5	-2	0	2	5	10	14			
	AB/FO	q_{V1}	m³/h	**34,4**	72	65	56	47	41	35	29	22	7	7			
		p_{tU1}	Pa	**0**	-20	-16	-11	-5	-2	0	3	5	10	10			
		P_{el}	W	**4**	4	4	4	4	4	4	4	4	5	5			
		SPI	$\frac{W}{m^3/h}$	**0,13**	0,05	0,06	0,08	0,09	0,11	0,13	0,15	0,20	0,63	0,63			
S 3	AU/ZU	q_{V2}	m³/h	**51,5**	82	74	67	59	55	52	48	43	36	25	17		
		p_{tU2}	Pa	**0**	-21	-16	-11	-5	-2	0	2	6	10	16	21		
	AB/FO	q_{V11}	m³/h	**52,7**	85	77	70	62	57	53	50	44	33	20	10		
		p_{tU}	Pa	**0**	-21	-16	-11	-5	-2	0	2	5	10	15	19		
		P_{el}	W	**8**	7	7	7	8	8	8	8	8	8	8	8		
		SPI	$\frac{W}{m^3/h}$	**0,15**	0,08	0,09	0,11	0,12	0,13	0,15	0,16	0,18	0,24	0,40	0,80		

Tabelle 2: Measurements for the air flow curves device 2=ETA:

S 1	AU/ZU	q_{V2}	m³/h	**18,1**	60	53	43	32	25	20	14	5					
		p_{tU2}	Pa	**0**	-20	-16	-11	-6	-2	0	2	5					
	AB/FO	q_{V1}	m³/h	**20,0**	65	57	46	35	28	22	16	5					
		p_{tU1}	Pa	**0**	-20	-16	-11	-5	-3	0	2	5					
		P_{el}	W	**3**	3	3	3	3	3	3	3	3					
		SPI	$\frac{W}{m^3/h}$	**0,14**	0,04	0,05	0,06	0,08	0,10	0,12	0,18	0,51					
S 2	AU/ZU	q_{V2}	m³/h	**37,4**	70	64	56	48	42	37	34	28	18	8			
		p_{tU2}	Pa	**0**	-20	-16	-11	-6	-3	0	2	5	10	14			
	AB/FO	q_{V1}	m³/h	**36,0**	74	66	57	49	41	38	32	23	8	8			
		p_{tU1}	Pa	**0**	-20	-16	-11	-6	-2	-1	2	6	11	11			
		P_{el}	W	**5**	4	4	4	5	5	5	5	5	5	5			
		SPI	$\frac{W}{m^3/h}$	**0,13**	0,06	0,06	0,08	0,09	0,11	0,12	0,15	0,21	0,60	0,61			
S 3	AU/ZU	q_{V2}	m³/h	**53,4**	82	76	69	61	57	54	50	45	37	29	20		
		p_{tU2}	Pa	**0**	-20	-16	-11	-6	-2	0	2	5	11	15	21		
	AB/FO	q_{V11}	m³/h	**51,2**	83	77	70	61	56	52	47	42	30	18	10		
		p_{tU}	Pa	**0**	-21	-16	-11	-5	-2	0	2	5	10	15	18		
		P_{el}	W	**8**	7	7	7	8	8	8	8	8	8	8	8		
		SPI	$\frac{W}{m^3/h}$	**0,15**	0,08	0,09	0,11	0,13	0,14	0,15	0,17	0,19	0,27	0,46	0,81		

The values at free flow (0Pa) were interpolated from the curves. S2 refers to the reference flow.

3.2 Air flow sensitivity

The airflow sensitivity is evaluated at maximum flow.

Tabelle 3: Evaluation of the air flow sensitivity:

AU v [m³/h]	AU p [Pa]	AB v [m³/h]	AB p [Pa]	S P el [W]
Interpolation/Extrapolation +/-20Pa				
24,7	20,0	24,4	20,0	8,6
81,8	-20,0	82,8	-20,0	7,1
Frei ausblasend:				
53,4	0,0	51,2	0,0	7,7
Bezogen auf frei ausblasend:				
54%	**20,0**	**52%**	**20,0**	
-53%	**-20,0**	**-62%**	**-20,0**	

The airflow sensitivity is not classified according to EN 13141-8.

3.3 Thermodynamic test

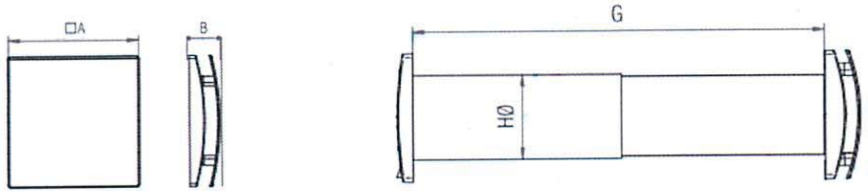
The following values were measured with the purge air method:

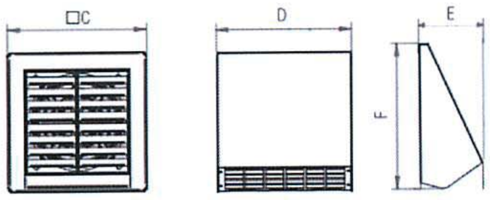
Table 1: Measured values of the thermodynamic test at A7

	Einheit	S1	S2	S3
Device				
Mean volume flow (from aerodynamic	m^3/h	20	36	51
Temperature at the fan	°C	13,5	13,5	13,5
Density at the fan	kg/m^3	1,17	1,16	1,16
Mean massflow	kg/s	0,0065	0,0116	0,0164
Unsteady operation				
Measurement				
Temperature ODA	°C	***7,0***	***7,0***	***7,0***
Humidity ODA	%	***90,4***	***88,3***	***88,0***
Purge air flow ODA	m^3/h	33,5	50,4	67,5
Temperature ETA	°C	***20,0***	***20,0***	***20,0***
Humidity ETA	%	***39,3***	***38,5***	***39,1***
Purge air flow ETA	m^3/h	35,0	52,7	70,6
Temperature ETA out	°C	19,0	18,1	17,6
Ambient pressure	Pa	96.200	96.090	95.750
Electric power	W	2,4	4,1	6,9
Calculation				
Water content ODA	g/kg	5,91	5,78	5,79
Water content ETA	g/kg	6,00	5,88	6,01
Density ODA	kg/m^3	1,19	1,19	1,19
Density ETA	kg/m^3	1,14	1,14	1,13
Purge air flow ODA	kg/s	0,011	0,017	0,022
Purge air flow ETA	kg/s	0,011	0,017	0,022
Steady operation				
Measurement				
Measurement	°C	***7,0***	***7,0***	***7,0***
Humidity ODA	%	***90,3***	***87,3***	***88,9***
Purge air flow ODA	m^3/h	33,5	50,4	67,4
Temperature ETA	°C	***20,0***	***20,0***	***20,0***
Humidity ETA	%	***38,2***	***38,3***	***38,5***
Purge air flow ETA	m^3/h	35,0	52,8	70,6
Temperature ETA out	°C	14,6	12,6	12,0
Ambient pressure	Pa	96.130	96.160	95.780
Electric power	W	2,8	4,6	7,7
Calculation				
Water content ODA	g/kg	5,91	5,71	5,84
Water content ETA	g/kg	5,84	5,85	5,90
Density ODA	kg/m^3	1,19	1,19	1,19
Density ETA	kg/m^3	1,14	1,14	1,13
Purge air flow ODA	kg/s	0,011	0,017	0,022
Purge air flow ETA	kg/s	0,011	0,017	0,022
Results				
Heat recovery rate SUP	%	82,0	74,3	70,0

4 Attachment

4.1 Sketch of the manufacturer





Terminale esterno

Terminale esterno (accessorio)

Modello	HRU-WALL-100-25	HRU-WALL-150-60
Peso Kg	2,3	3,9
A □	164	218
B	46	51
C □	164	218
D	205	252
E	103	114
F	209	262
G	270÷510	300÷560
H Ø	108	158

4.2 Fotos

Bild 1: Indoor hood

Bild 2: Indoor cover removed, filter

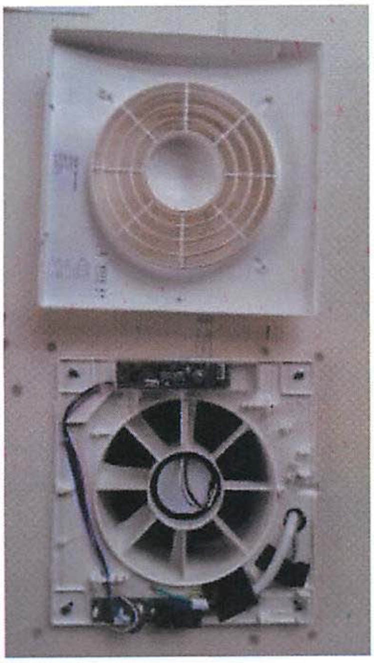


Bild 3: Indoor casing opened

Bild 4: Ventilator removed, heatexchanger pulled out

Bild 5: Heatexchanger

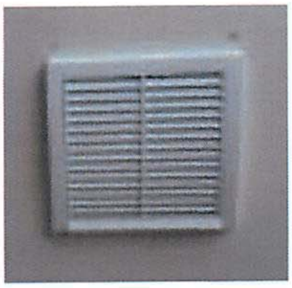


Bild 6: Outdoor hood

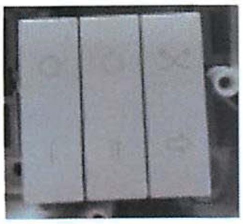


Bild 7: Control panel

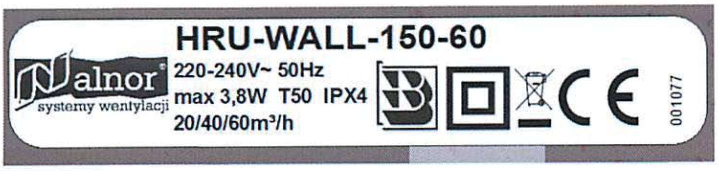


Bild 8: Name plate (afterwards delivered)