report
No.: WRG 756-REV.1
DIBt

Industrie Service

Mehr Wert.
Mehr Vertrauen.

Date: March 21, 2023

Our sign:
IS-TAK-MUC/ul

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A-No.: 3691294/ 3760301

The test results refer exclusively to the test items examined.

checkpoint TÜV SÜD Industrie Service GmbH
Center of Competence for
Refrigeration and air conditioning technology

Test item Alternating, decentralized ventilation system with heat recovery of the “Ambientika advanced+” type from Südwind GmbH

Serial no. not specified

Client Südwind GmbH
Handwerkerstr. 14
I-39057 (BZ) Eppan on the Wine Route

Scope of the order Testing according to the agreements of the Expert Committee-A (SVA-A) “Ventilation Technology” for testing ventilation devices (LÜ-A. No. 22-2.1)

Receipt date October 24, 2022

Test period October 24, 2022 – March 7, 2023

Test location(s) Olching/Munich

Expert Björn Ulrich

Test basis Agreements of the SVA-A “Ventilation Technology” for the testing of ventilation devices (LÜ-A. No. 22-2.1, as of March 16, 2020)

DAkkS Deutsche Akkreditierungsstelle D-PL-14153-04-00

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1 Scope of testing

On behalf of Südwind GmbH, tests were carried out in accordance with the agreements of the SVA-A "Ventilation Technology" for testing ventilation devices on a decentralized ventilation system carried out with heat recovery of the "Ambientika advanced+" type.

Note: The ventilation system is also available in the two versions "Ambientika Wireless+". and "Ambientika Smart" available. The devices communicate with each other wirelessly. To do this, one device is configured as a "master" and all other devices as "slaves". The master device is operated via the remote control and then sends the corresponding control parameters to the slave devices. The "Ambientika Smart" variant is also designed for integration into a WiFi network and can also be operated via the "Ambientika App" user software for mobile devices.

Report revision 1 contains data from additional ventilation measurements on the two variants "Ambientika Wireless+" and "Ambientika Smart".

The results of determining the free-blowing volume flows and electrical power consumption for these variants are presented in appendix C3 to C6 and appendix D6.

Due to comparable free-blowing air volume flows, the results of the air-technical and thermodynamic tests can be transferred from the "Ambientika advan-ced+" variant to the "Ambientika Wireless+" and "Ambientika Smart" variants.

The ventilation system is also available in the versions "Ambientika ECO, Ambientika SOLO+ and "Ambientika ADVANCED+100". These variants were not part of the test.

2 "Ambientika advanced+" ventilation system

2.1 Device description of the ventilation system

The decentralized ventilation system consists of at least two identical ventilation units, which are operated alternately in opposite air directions in the "heat recovery" operating mode.

The structure of a decentralized ventilation device with heat recovery is shown in Figure 1.

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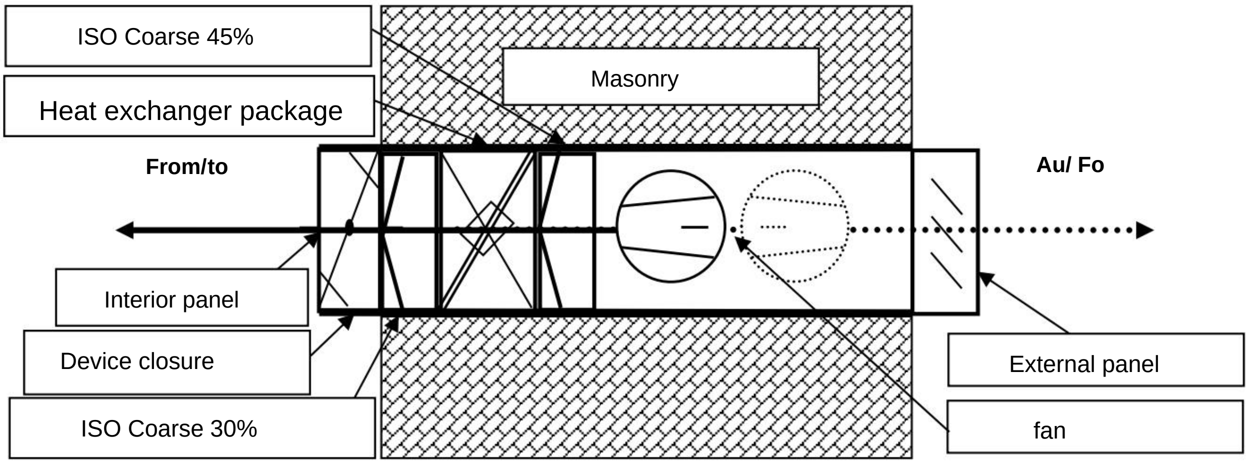

Figure 1: Schematic diagram of a ventilation device with heat recovery (top view)
Type “Ambientika advanced+” from Südwind GmbH1

Images of the ventilation system presented for testing are shown in Appendix A.

The data of the tested ventilation system and its built-in parts are listed in Appendix B.

According to the manufacturer, the ventilation system is designed for ventilation of residential and residential-like rooms. It is suitable for installation in new buildings as well as for subsequent installation in old buildings. Installation is generally carried out in the outer wall.

On the room side, the devices are equipped with an inner panel made of plastic. To achieve the tested indoor/ outdoor airtightness, the inner panel must be closed.

The device is equipped with an outer cover made of plastic.

Any condensate that accumulates is drained to the outside via the installation pipe installed at a gradient.

The tests were carried out on two devices.

2.2 How the ventilation device works

2.2.1 Ventilation and ventilation

To ventilate a room, one ventilation device removes air from the room, while the other ventilation device simultaneously supplies air to the room. Both devices can be operated either in ventilation mode with a constant air direction, or in alternating operation.

1 Note: The filter classes specified in the test report refer to the manufacturer's information.
Tests to determine the filter class were not carried out as part of the tests.

2.2.2 Heat and moisture recovery

Heat and moisture recovery can only be realized when the devices operate alternately. The devices are always operated in pairs in the opposite direction of fan rotation. The respective heat exchanger package absorbs room air heat in exhaust air mode.

After the time interval has elapsed, the central control reverses the direction of rotation of the fan, meaning that the ventilation device now ventilates the room.
The outside air absorbs the indoor air heat stored in the heat exchanger package and releases it into the supply air.

The time interval is independent of the selected fan level and is 70 s per air direction.

3 Carrying out the exams

The tests were carried out on the test benches of the Center of Competence for Refrigeration and Air Conditioning Technology at TÜV SÜD Industrie Service GmbH.

The tests included the following test steps:

- Incoming inspection
- Leak test
- ventilation testing
- Detection of short-circuit currents
- Thermodynamic testing
- Frost protection test

The list of the measuring equipment used is stored at the testing center.

The thermodynamic tests were carried out on a ventilation system consisting of two ventilation devices.

3.1 Incoming inspection

During the entrance inspection, the relevant technical data of the ventilation system was revealed recorded.

3.2 Leak test

3.2.1 Indoor/outdoor air leakage

To determine the indoor/outdoor air leakage, the inner panel was closed. Instead of the outer cover, a blind flange was attached to the outside or exhaust air side.

The indoor/outdoor air leakage of the ventilation device was determined by creating a pressure difference of +/- 20 Pa between the device closures and its surroundings. The measured air volume flow required to maintain the pressure difference represents the indoor/outdoor air leakage.

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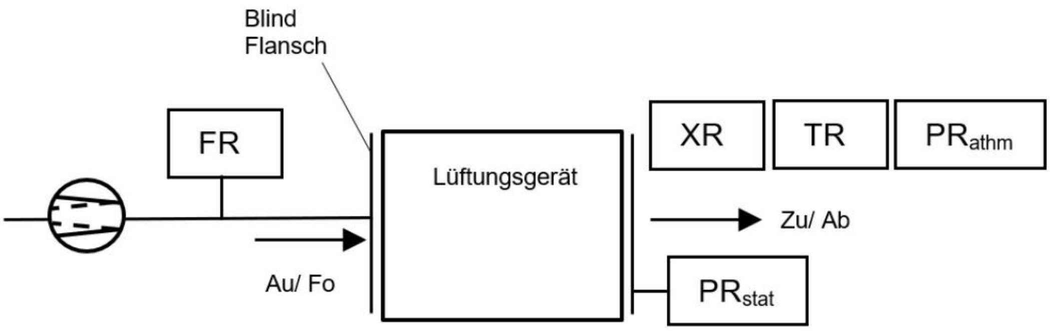
The measurement setup is shown schematically in Figure 2.



Legend:

Group 1 measured variable		Group 2 measure	
F	volume flow	R	Registration
T	temperature		
X	humidity		
P	stat. or atm. Pressure		

Figure 2: Measuring setup for determining indoor/outdoor air leakage

3.2.2 External leak test

The external leakage cannot be determined due to the design.

3.2.3 Internal leak test

Due to the design, the internal leakage cannot be determined.

3.3 Air technical test

The free-blowing air volume flows were measured one after the other on both devices in the ventilation system in both fan rotation directions on an air test bench in accordance with the DIN EN ISO 5801:2018-04 standard.

The air temperature during the measurement was 21°C +/- 2 K.

The characteristic curves determined ran through the points:

Level 1 (qvmin)	at	0 Pa
Level 2 (0.7 x qvd)	at	0 Pa
Level 3 (qvd)	at	0 Pa

The determined electrical active power consumption as well as the static differential pressures were converted to an air density of 1.2 kg/m³ and relate to the entire ventilation system.

To determine the volume flow-specific power consumption, the average value of the supply air and exhaust air volume flow was used.

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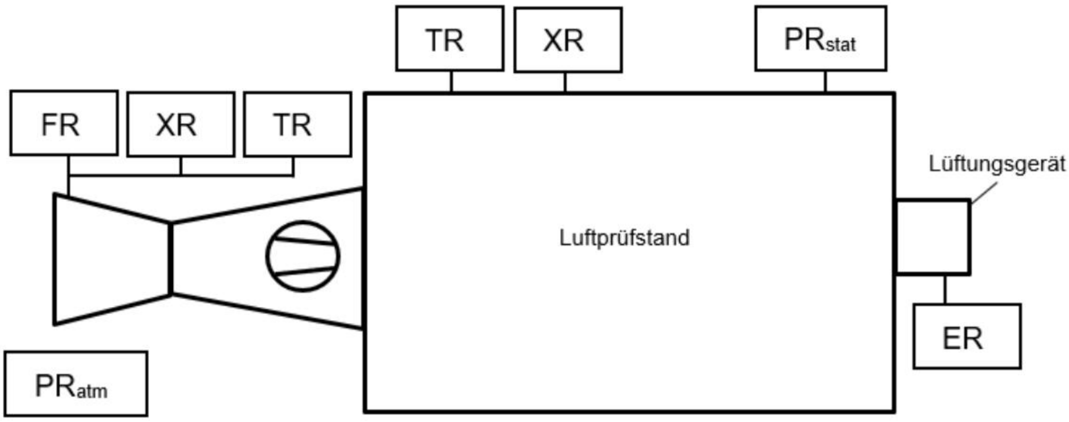
To describe the aerodynamic properties, the sensitivity of the air flow to fluctuations in the pressure difference was determined with the fans switched on at a pressure of +/-20 Pa.

The measurement structure of the ventilation tests is shown schematically in Figure 3.



Legend:

Group 1 measured variable F		Group 2 measure	
volume flow T temperature		R	Registration
X	humidity		
P	stat. or atm. Pressure		
E	electrical quantities		

Figure 3: Measurement setup for ventilation testing

To determine a ventilation short circuit between the supply and exhaust air as well as the outside and exhaust air, both fans with filters and mass heat storage were inserted into a mounting pipe and operated in a stationary state. Afterwards, tests were carried out with artificial fog.

After introducing the mist on the suction side into one of the two chambers of the ventilation device, it was visually determined whether short-circuit currents on the blowing side were sufficiently prevented.

The test was carried out both on the outside and on the room side.

3.4 Thermodynamic testing

The temperature ratio was determined using two airtight and heat-insulated balance chambers. One chamber is located on the outside air side (outside air chamber), the other on the exhaust air side (exhaust air chamber) of the devices. Both chambers were operated under atmospheric air pressure without differential pressure. The system's two ventilation devices were installed airtight between the chambers. The surface of the

The mounting pipe was thermally insulated.

The balancing chambers each have a partition to prevent a ventilation short circuit between the devices. Each ventilation device takes the air from the respective sub-chamber (depending on the current direction of action) and blows it into the other sub-chamber.

The balance chambers were flushed with a purge air flow that was greater than the device volume flow and corresponded to the conditions of the exhaust or outside air.

The measurement setup is shown schematically in Figure 4.

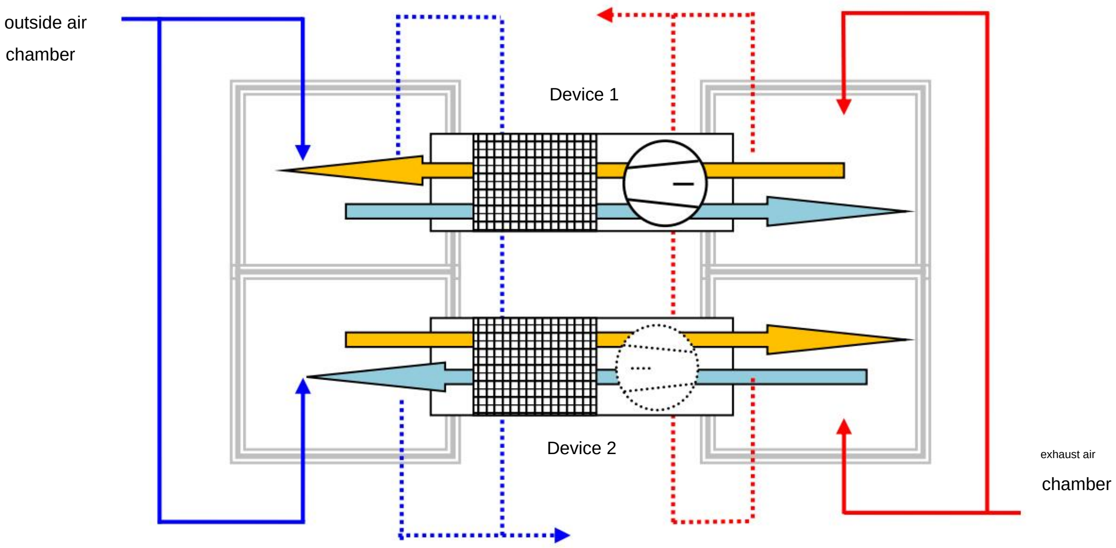


Figure 4: Schematic diagram of the test setup for the thermodynamic test

To determine the temperature ratio, the temperature difference between the stationary mode of operation (both devices work in the same direction) and the transient mode of operation (both devices work in the opposite direction) is determined using measurements.

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The resulting temperature ratio at the outlet of the exhaust air chamber is determined using the following formula.

$$\text{ÿ},TO\ \text{ÿ} = \frac{\text{ÿ}_{AB,from,instat}\ \text{ÿ}\ \text{ÿ}_{AB,out,stat}}{\text{ÿ}_{AB,\ on}\ \ AB,out,stat} \cdot \frac{q_{m,TO}}{q_{m,AB}} \quad \text{for } sqm,AB > sqm,TO$$

$$\text{ÿ},TO\ \text{ÿ} = \frac{\text{ÿ}_{AB,from,instat}\ \text{ÿ}\ \text{ÿ}_{AB,out,stat}}{\text{ÿ}_{AB,\ on}\ \ AB,out,stat} \quad \text{for } sqm,AB\ \text{ÿ}\ sqm,TO$$

Since the mass flow balance cannot be measured during the thermodynamic test, the temperature ratio in the event of excess exhaust air is corrected with the volume flow ratio from the ventilation test.

A difference in density is taken into account using the following formula.

$$\frac{q_{m,TO}}{q_{m,AB}} = \min \left(\frac{q_{v,TO}}{q_{v,AB}}\ \text{ÿ}(1)03\ ;1 \right)$$

The parameters of the incoming and outgoing purge air flow (temperature, humidity, air volume flow) as well as the total active electrical power consumption of the ventilation system were recorded at the balance limits of the chambers. The average caloric temperatures2 were determined based on the standard DIN EN 308:1997-07.

The balance limit was defined as the entry of the exhaust air into and the exit of the exhaust air from the chamber, as well as the entry of the outside air into and the exit of the supply air from the chamber.

The thermodynamic tests were carried out under the following air conditions:

	Air condition 1 symbol Air condition 2		
Outside air temperature	t21	7°C	2°C
Outdoor air wet bulb temperature	twb21	-	1°C
Exhaust air temperature	t11	20°C	20°C
Exhaust air wet bulb temperature	twb11	12°C	15°C

The following air volume flows were set:

Designation	Declared Air volume flow	More measured Air volume flow	Purge air volume flow
	[m³/h]	[m³/h]	[m³/h]
Level 1 (qvmin)	20.0	20.6	30
Level 2 (0.7 x qvd)	40.6	40.9	49
Level 3 (qvd)	58.0	61.3	73

The determined active power consumption was not density corrected.

2 The caloric mean temperature describes the mean temperature of the measuring sensors used at the balance limit of the device, from which the Energy content of the air flow can be derived.

3.5 Frost protection test

During the frost protection test, starting from an outside air temperature of 2°C, this was gradually reduced and the behavior of the devices was observed during the test.

The test was carried out at 0.7 x qvd with the following air condition:

	Air condition icon	
Exhaust air temperature	ÿ11	20°C
Exhaust air wet bulb temperature	ÿwb11	12 °C
Outside air temperature	ÿ21	-15 °C
Outdoor air wet bulb temperature	ÿwb21	-

4 Results of the exams

The assessment of the test results with regard to conformity with the test basis was carried out exclusively in accordance with the requirements formulated in the test basis.
The measurement results were based on the actual measured values or the values converted to standard conditions according to the test basis.
Tolerances or measurement uncertainties were not taken into account when evaluating the test results.

4.1 Incoming inspection

The relevant technical data determined for the ventilation system and its built-in parts are listed in Appendix B.

The visual inspection of the ventilation system gave the following results:

- Labeling of the ventilation system

  - The ventilation system presented for testing came with a nameplate and a CE marked.

  - A contact address for the company was not given on the nameplate.

- electric security

  - Opening the cover for the device electronics is not possible without using it of a tool possible.

  - Live parts were not accessible when the device lock was open. lich.

  - The ventilation system is not activated when the device closure is opened Contact switch switched off.

- mechanical security

  - The device lock cannot be opened without the use of a tool. totally possible.

  - After removing the device lock, there were no moving components accessible.

  - The ventilation system is not activated when the device closure is opened Contact switch switched off.

- Operation and assembly

  - The manufacturer has assembly and operating instructions for the tested device attached.

  - As standard, the ventilation system is operated via a remote control. tion

  - The “Ambientika Smart” variant can also be integrated into a WiFi network and operated via the “Ambientika App” user software for mobile devices.

  - A total of 16 devices can be operated together. A device is called a “Master” configured.

  - The volume flow balance cannot be set separately for the supply and exhaust air become.

- Maintenance

  - The filters are located on the room side and outside of the heat exchanger and can be be removed after it has been removed.

  - The ventilation system is equipped with runtime-controlled filter monitoring. After the adjustable time interval has expired, the user is informed by a message in the control panel.

4.2 Leak test

The indoor/outdoor airtightness of the ventilation system, consisting of the leakage via the Inner panels of both devices, according to the standard DIN EN 13141-8:2014-09, were:

Measurement Pstat		Direction of flow	Indoor/outdoor airtightness
No.	[Pa]	-	[m³/h]
	+20	Outside => Inside	3.3
1 2	-20	Inside => Outside	3.2
In total			6.5

The indoor/outdoor airtightness of the ventilation system did not exceed the permissible limit of 7 m³/h at a pressure of +/- 20 Pa.

The external and internal leakage cannot be determined due to the design.

4.3 Ventilation testing

The pressure-volume flow characteristics in extract air and supply air mode are shown in Appendix C.

The measured values from the ventilation test are presented in tabular form in Appendix D.

The results of checking the sensitivity of the air flow to fluctuations in the pressure difference are presented both graphically and in tables in Appendix E.

Images for assessing a ventilation short circuit are shown in Appendix F.

4.4 Thermodynamic testing

The measured and calculated values for the thermodynamic test are shown in Appendix G.

4.5 Frost protection test

The course of the experiment is shown in Appendix H1.

No influence of the frost protection test on the heat exchanger could be determined.

Deposits caused by frost formed in the area of the outer panel.
Pictures of the device after the antifreeze test are shown in Appendix H2.

4.6 Heat losses across the surface of the ventilation device

The data for the insulation materials were provided by the manufacturer and the resulting thermal conductivity resistances were calculated with Rÿ = d / ÿ as follows:

Description	material	Insulation thickness d [mm]	ÿ [W/mK]	Rÿ = d / ÿ [m^2K/W]
Wall sleeve DN160	PVC	2	0.16	0.025

According to DIN V 4701-10 , the degree of heat provision ÿ`w must be corrected if the determination of the degree of heat provision (or temperature ratio) does not take into account the heat losses or gains over the surface of the device.
There is no need to reduce the degree of heat provision (or temperature ratio) if the housing of the ventilation device, including all insulation materials used, has a thermal conductivity resistance Rÿ ÿ 1 m^2K/W.

Since the ventilation devices for testing were provided with insulation (Rÿ = 1.2 m^2K/W) in the laboratory to avoid environmental influences, no influence on the temperature ratio can be derived from heat losses via the device surface.

5 Summary

5.1 Incoming inspection

The ventilation system presented for testing came with a nameplate and a CE marked.

The fans of the devices are located on the outside of the heat exchanger.

The ventilation device is equipped with runtime-controlled filter monitoring.

5.2 Leak test

The indoor/outdoor airtightness across both devices was 6.5 m³/h.

The indoor/outdoor airtightness of the ventilation system therefore did not exceed the permissible limit of 7 m³/h at a pressure of +/- 20 Pa.

The leakage class of the indoor/outdoor airtightness of the ventilation system according to the standard DIN EN 13141-8:2014-09 was D1.

The external and internal leakage cannot be determined due to the design.

5.3 Air technical test

The air volume flows determined for the ventilation system are in Appendix C and D presented graphically and in tables.

The results of checking the sensitivity of the air flow to fluctuations in the pressure difference are presented both graphically and in tables in Appendix E.

The ventilation system is not classified according to the standard DIN EN 13141-8:2014-09 for the sensitivity of the air flow to fluctuations in the pressure difference.

Images for assessing a ventilation short circuit are shown in Appendix F.

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5.4 Thermodynamic testing

The following device-specific key figures were determined for the ventilation system (see also Appendix G):

Air volume flow		Supply air side temperature ratio ÿÿ,su in % (uncorrected)	
	[m³/h]	ÿOutside air =	ÿOutside air = 2°C
qvmin	17.0	7°C	89.7
0.7 x qvd qvd	**39.4**	91.8	**78.7**
	55.7	**80.8** 72.9	71.7

Air volume flow		Supply air side temperature ratio ÿÿ,su in % (mass flow corrected)		
	[m³/h]	ÿOutside air =	ÿOutside air =	Reference value
qvmin	17.0	7°C	2°C	-
0.7 x qvd qvd	**39.4**	91.8	89.7	**79.8**
	55.7	**80.8** 72.9	**78.7** 71.7	-

5.5 Frost protection test

The course of the test and images of the device after the frost protection test are shown in Appendix H

No influence of the frost protection test on the heat exchanger could be determined.

Center of Competence for refrigeration
and air conditioning technology

Test area for ventilation and air conditioning technology: WRG

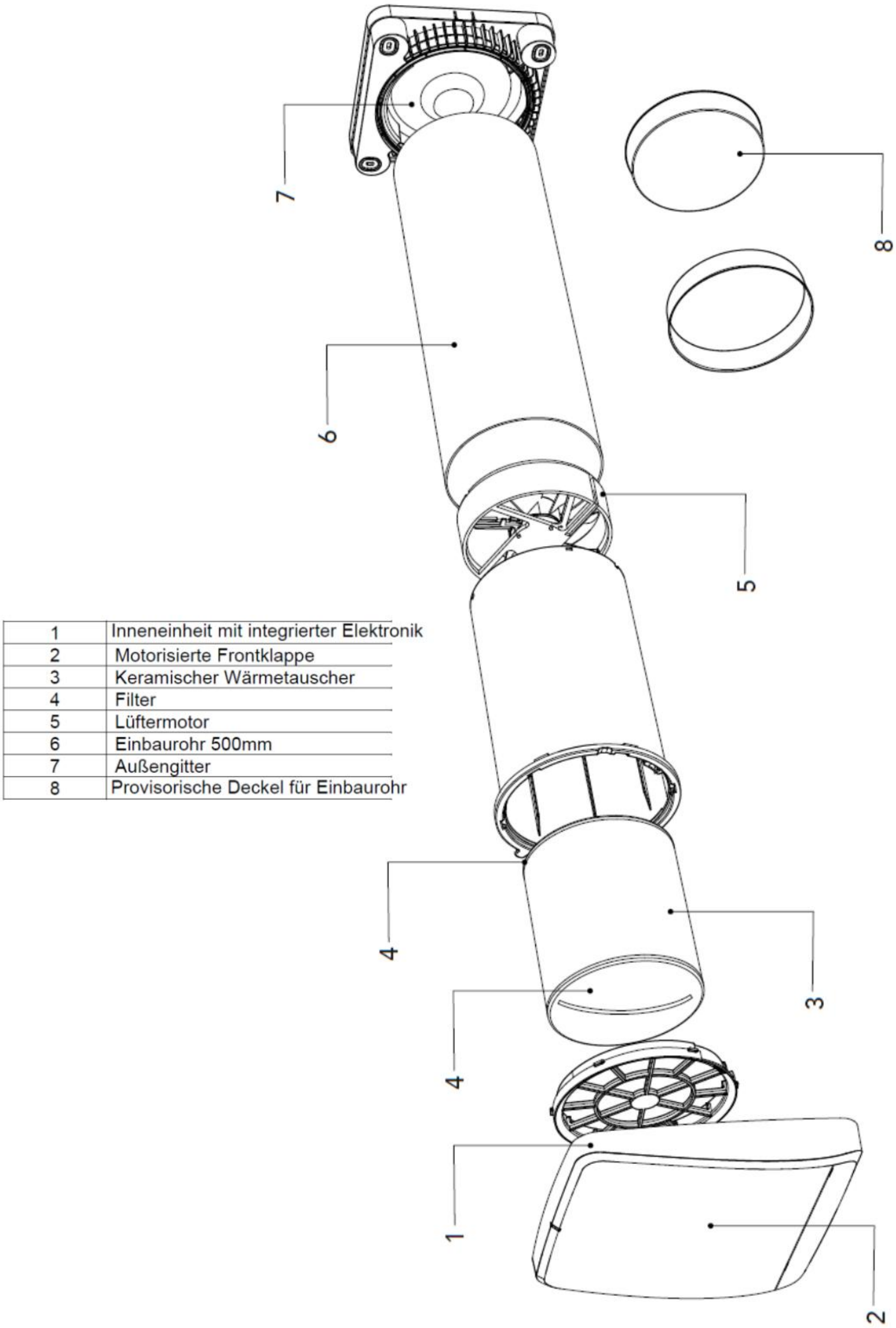
Person responsible for the testing area | expert

Thomas Busler | Björn Ulrich

Attachment:

Appendix A1 – A6: Image documentation
Appendix B1 – B3: Data of the tested ventilation system
Appendix C1 – C6: Pressure-volume flow characteristics
Appendix D1 – D7: Measured values of the ventilation test
Appendix E1 – E4: Sensitivity of airflow to fluctuations in the pressure difference
Appendix F: Images for assessing a ventilation short circuit
Appendix G1 – G2: Measured and calculated values for the thermodynamic test
Appendix H1 – H2: Frost protection test
Appendix I: Change history of the test report

Appendix A1: Image documentation



1	Inneneinheit mit integrierter Elektronik
2	Motorisierte Frontklappe
3	Keramischer Wärmetauscher
4	Filter
5	Lüftermotor
6	Einbaurohr 500mm
7	Außengitter
8	Provisorische Deckel für Einbaurohr

Figure A-1: Drawing of the “Ambientika advanced+” device

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Appendix A2: Image documentation

Figure A-2: Front and back of the inner panel

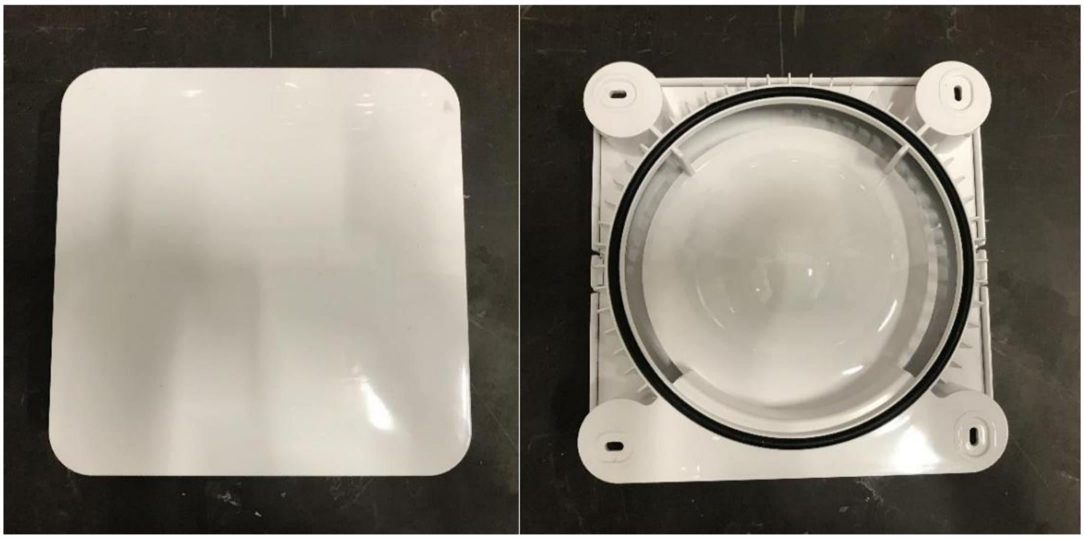

Figure A-3: Front and back of the outer panel

Appendix A3: Image documentation

Figure A-4: Side view of the housing

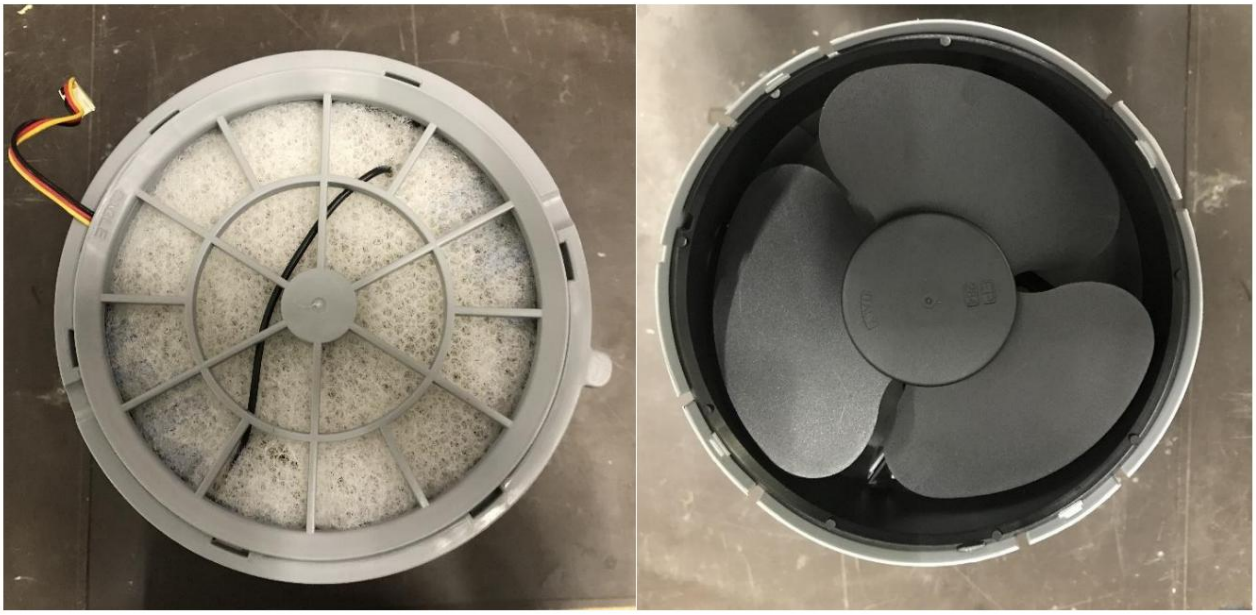

Figure A-5: Front and back of the housing

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Appendix A4: Image documentation

Figure A-6: Filter ISO Coarse 30% (room side)

Figure A-7: Filter ISO Coarse 45% (outside)

Appendix A5: Image documentation

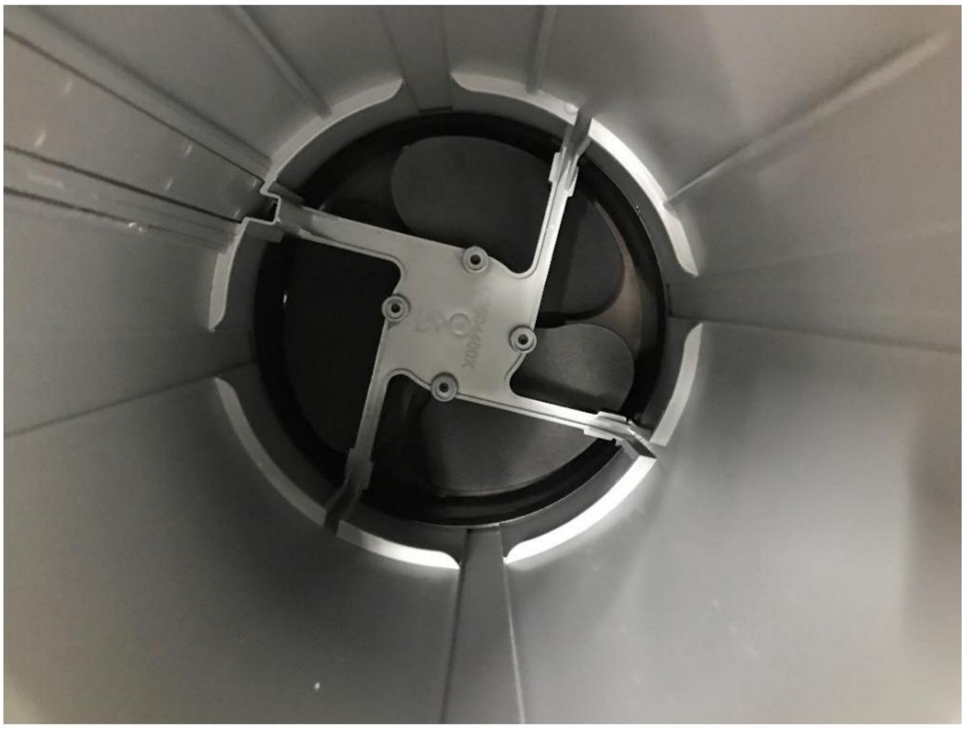

Figure A-8: Room-side view of the fan in the housing

Figure A-9: Fan nameplate

Appendix A6: Image documentation

Figure A-10: Front and side view of the heat accumulator

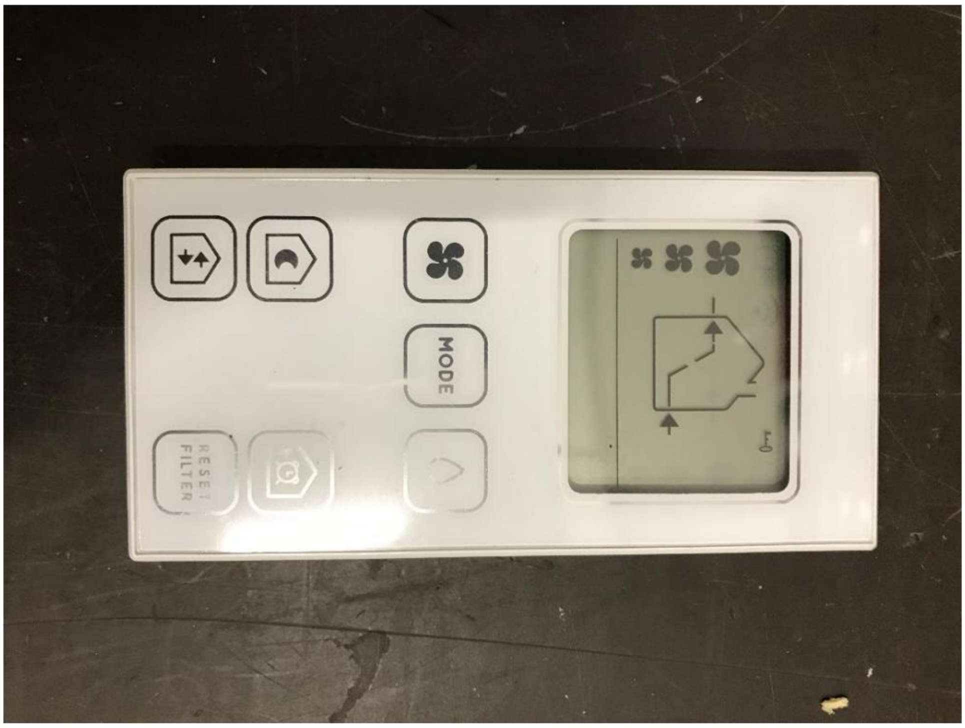

Figure A-11: Remote control

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Appendix B1: Data of the tested ventilation system

Figure B-1: Nameplate of the “Ambientika advanced+” ventilation system

Information according to the nameplate

Manufacturer:	South wind
Company headquarters	not specified
Type:	Ambientika advanced+
Protection class:	IPX4
Protection class:	2
Nominal voltage:	220 – 240 V / 50 Hz
Rated capacity:	6.7W

Data of the mounting pipe

Length:	500mm
Outside diameter:	DN 160
Material:	plastic

Appendix B2: Data of the tested ventilation system

Interior panel data

Height:	247mm
Width:	230mm
Depth:	40mm
Material:	plastic

External panel data

Height:	210mm
Width:	210mm
Depth (maximum):	50mm
Material:	plastic

Housing data

Diameter:	156mm
Depth:	250mm
Material:	plastic

filter

	Number (per device)	Filter class	dimensions
Room side	1	ISO Coarse 30%	Ø 145mm x 10mm
Outside	1	ISO Coarse 45%	Ø 150mm x 15mm

fan

Number (per device):	1
Design type:	Axial
Manufacturer:	E.P
Type:	COD.D11021000
Tension:	24VDC
Current consumption:	0.22A
Number of revolutions:	4000 rpm
Construction year:	03.2022

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Appendix B3: Data of the tested ventilation system

Heat exchanger

Number (per device):	1
Design type:	ceramic heat storage
Moisture recovery:	Yes
Dimensions:	Ø 145mm x 150mm

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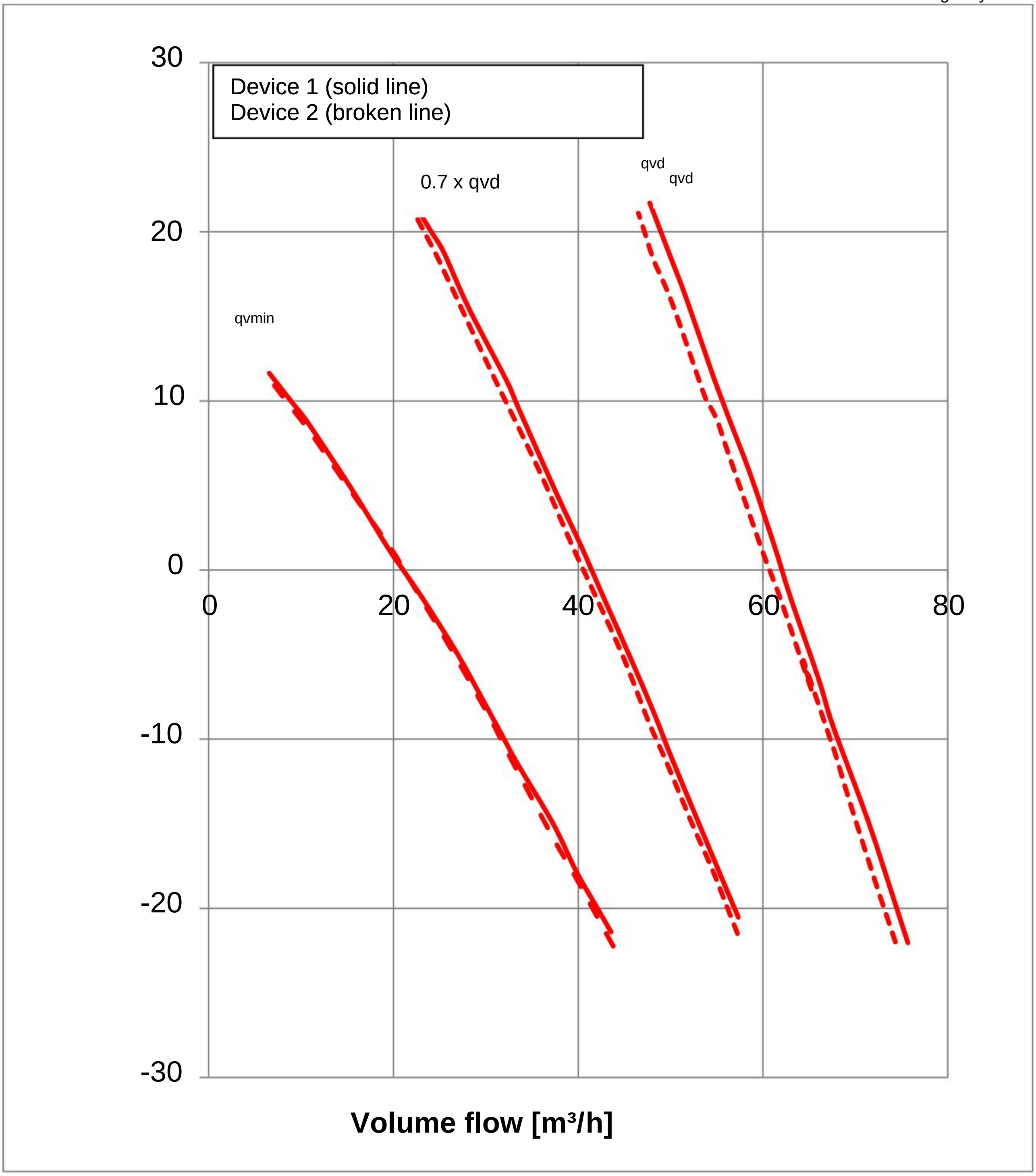
Appendix C1: Pressure-volume flow characteristics

Exhaust air

= 1.2 kg/m³ ÿ



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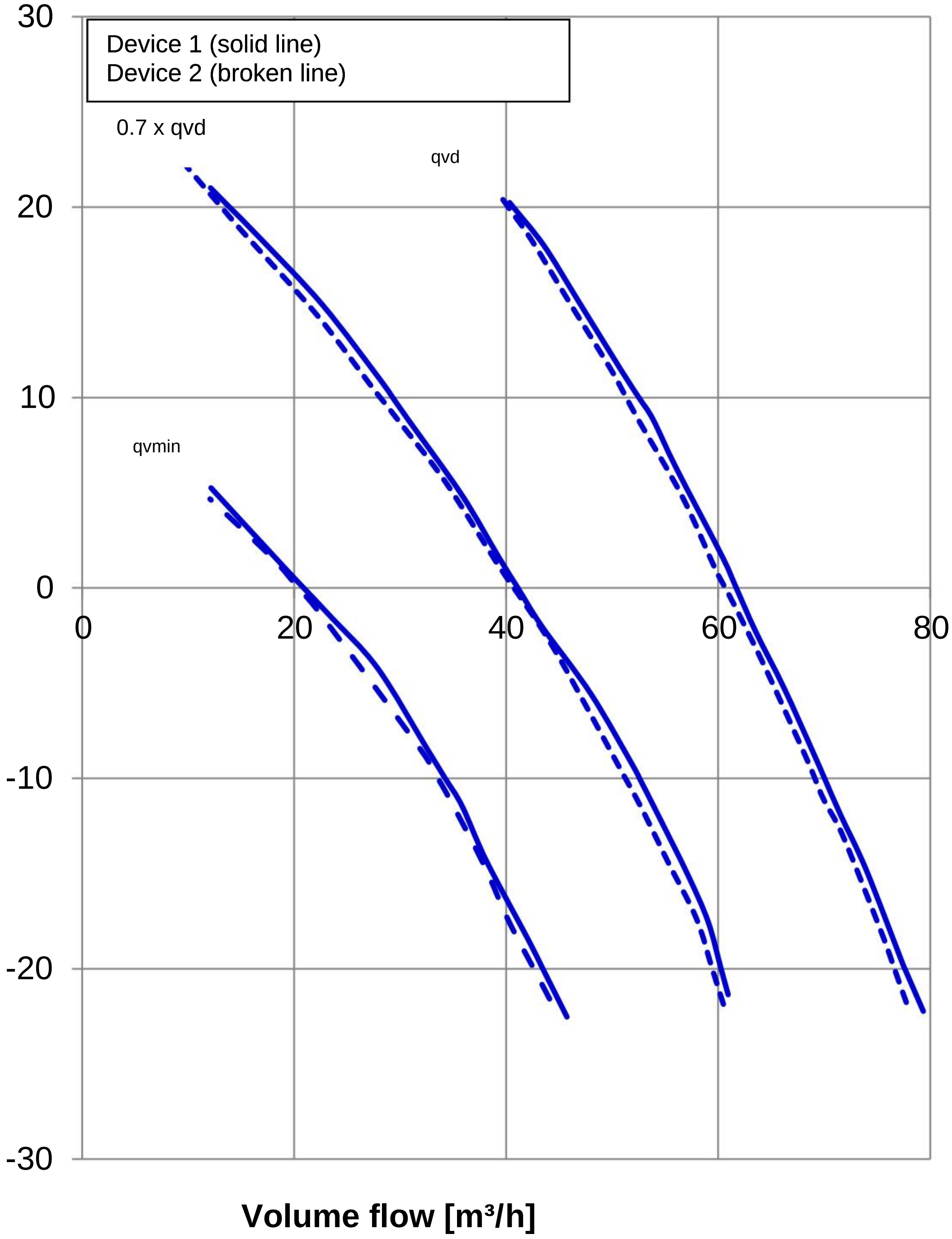
Appendix C2: Pressure-volume flow characteristics

supply air

= 1.2 kg/m³ ÿ



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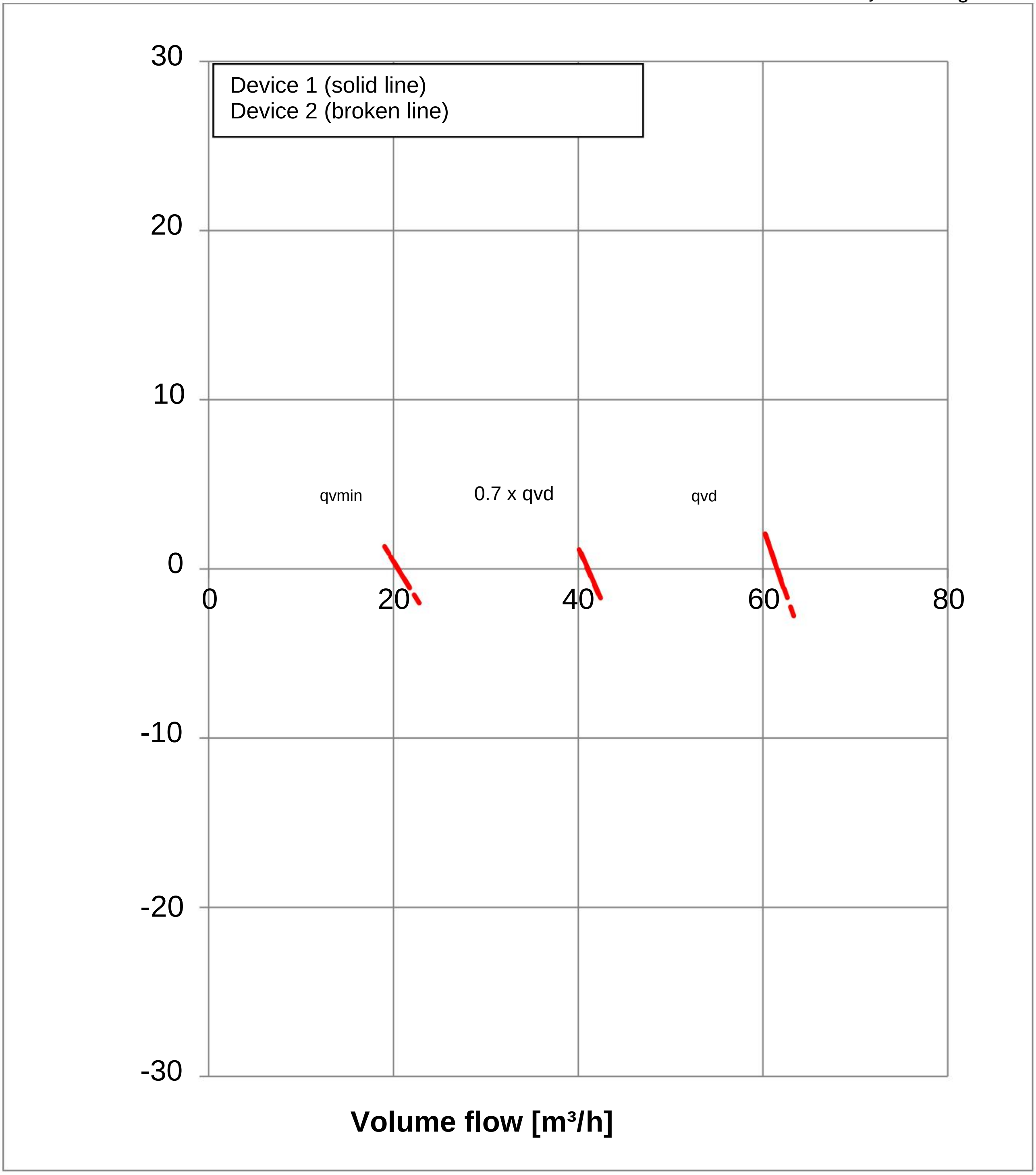
Appendix C3: Pressure-volume flow characteristics

"Ambientika Wireless+" variant

Exhaust air

ÿ = 1.2 kg/m³

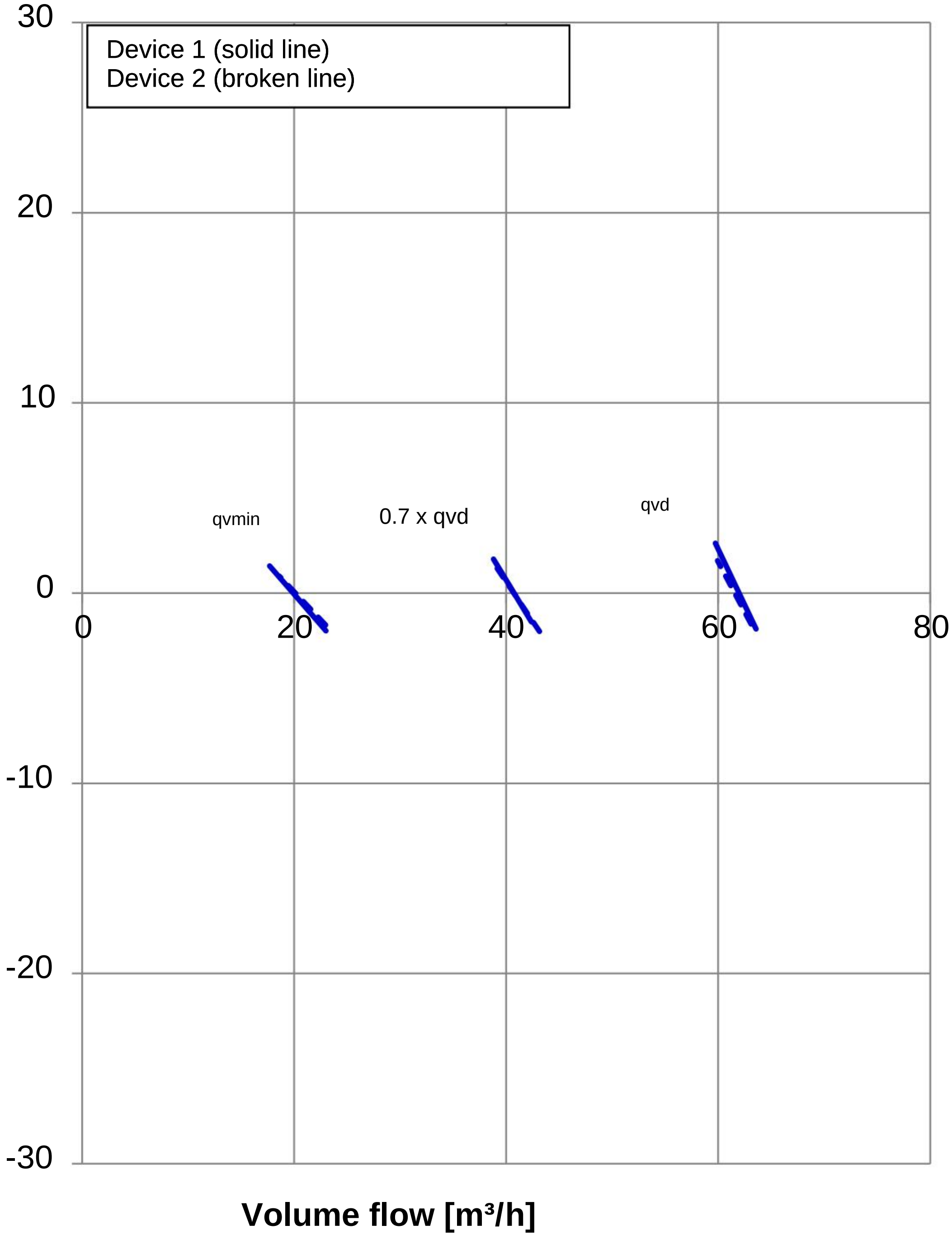


Appendix C4: Pressure-volume flow characteristics

"Ambientika Wireless+" variant

supply air

= 1.2 kg/m³ ÿ



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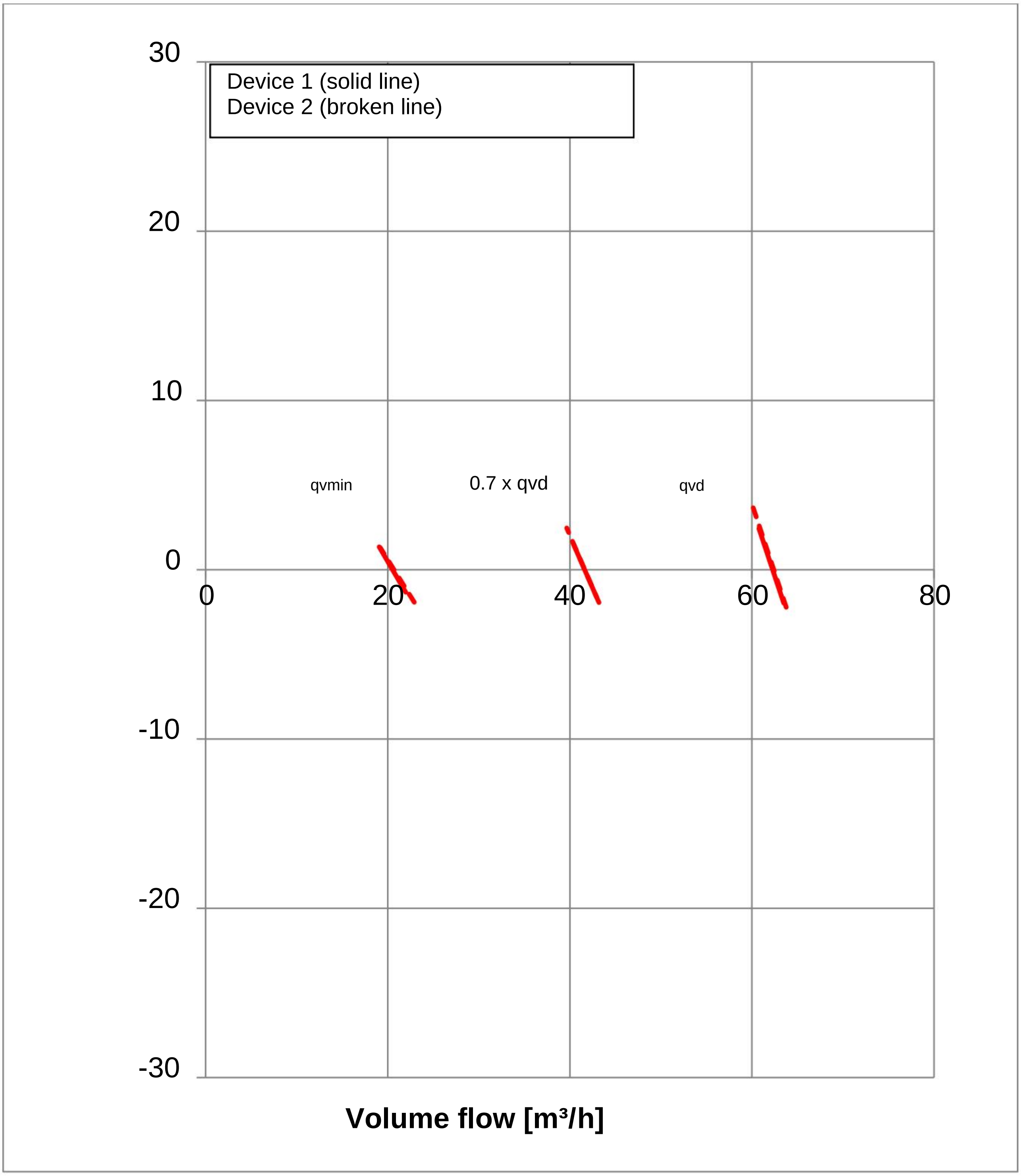
Appendix C5: Pressure-volume flow characteristics

“Ambientika Smart” variant

Exhaust air

ÿ = 1.2 kg/m³

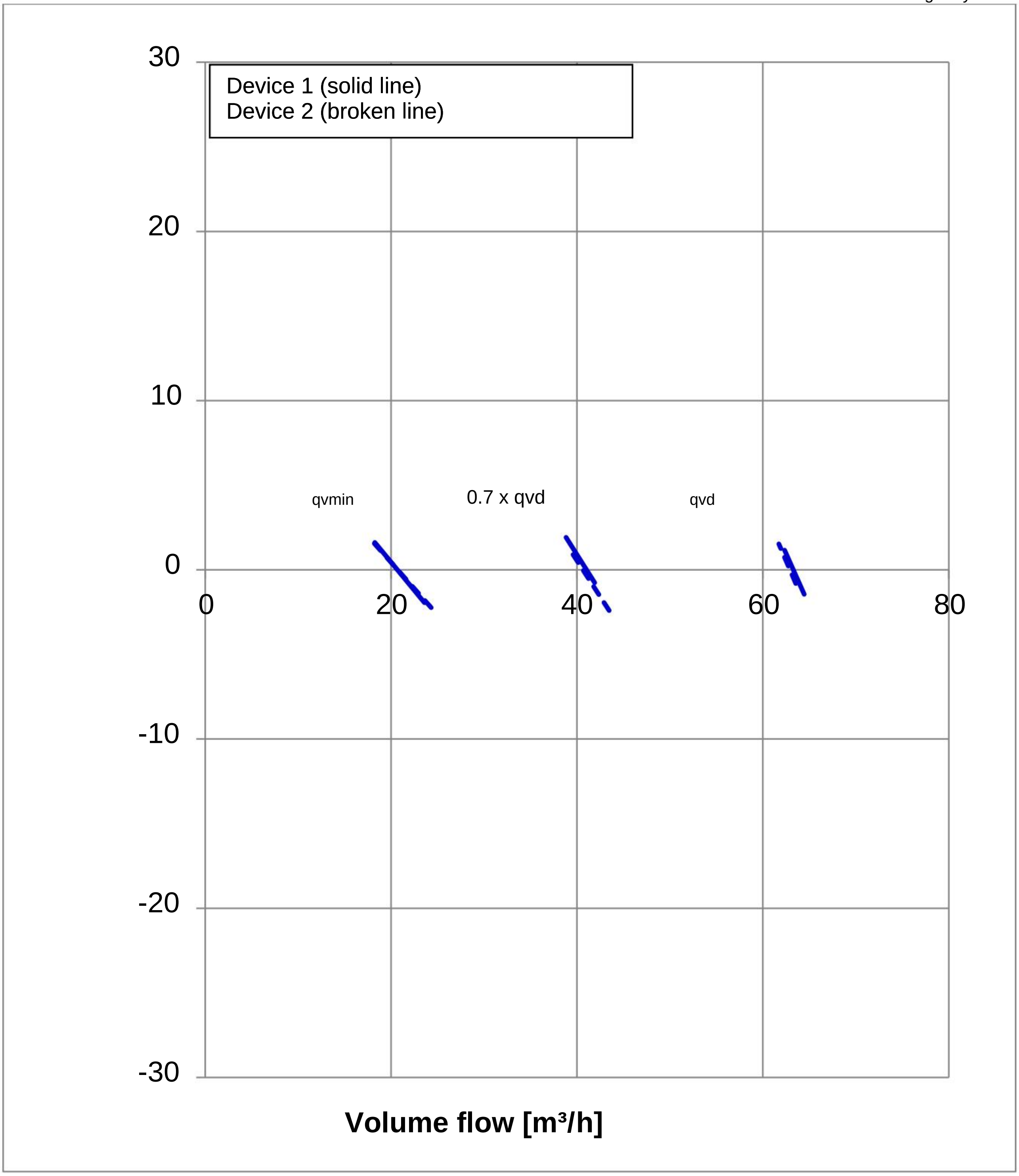


Appendix C6: Pressure-volume flow characteristics

“Ambientika Smart” variant

supply air

= 1.2 kg/m³ ÿ



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Appendix D1: Measured values of the ventilation test

- Free-blowing air volume flows of the “Ambientika Advanced+” variant

		Device 1		Device 2		Average of device 1 and device 2					
Device setting	p stat. ÿ = 1.2 kg/m³	TO	AWAY	TO	AWAY	TO	AWAY	Pel (TO,DOWN)	Pel 1,2 (TO,DOWN)	spec. El. Power pel	spec. El. Power pel 1.2
Level	[pa]	[m^3/h] [3]						[W] [4]		[W/(m^3/h)] [5]	
1 / (qvmin)	0	20.9	21.1	20.4	21.1	20.6	21.1	8.7	9.3	0.42	0.45
2 / (0.7 x qvd) 3/	0	41.1	41.5	40.7	40.6	40.9	41.0	11.6	12.3	0.28	0.30
(qvd)	0	61.7	62.1	60.7	60.7	61.2	61.4	15.5	16.5	0.25	0.27

- Free-blowing air volume flows of the “Ambientika Wireless+” variant

		Device 1		Device 2		Average of device 1 and device 2					
Device setting	p stat. ÿ = 1.2 kg/m³	TO	AWAY	TO	AWAY	TO	AWAY	Pel (TO,DOWN)	Pel 1,2 (TO,DOWN)	spec. El. Power pel	spec. El. Power pel 1.2
Level	[pa]	[m^3/h]						[W]		[W/(m^3/h)]	
1 / (qvmin)	0	19.9	20.5	20.1	20.5	20.0	20.5	10.9	11.8	0.54	0.59
2 / (0.7 x qvd) 3/	0	40.7	41.1	40.7	41.0	40.7	41.0	13.4	14.5	0.33	0.36
(qvd)	0	62.0	61.5	61.6	61.6	61.8	61.5	16.2	17.5	0.26	0.28

- Free-blowing air volume flows of the “Ambientika Smart” variant

		Device 1		Device 2		Average of device 1 and device 2					
Device setting	p stat. ÿ = 1.2 kg/m³	TO	AWAY	TO	AWAY	TO	AWAY	Pel (TO,DOWN)	Pel 1,2 (TO,DOWN)	spec. El. Power pel	spec. El. Power pel 1.2
Level	[pa]	[m^3/h]						[W]		[W/(m^3/h)]	
1 / (qvmin)	0	20.7	20.5	20.7	20.7	20.7	20.6	9.2	9.9	0.45	0.48
2 / (0.7 x qvd) 3/	0	41.0	41.6	40.6	41.6	40.8	41.6	11.7	12.6	0.29	0.31
(qvd)	0	63.3	62.3	62.9	62.4	63.1	62.3	15.6	16.8	0.25	0.27

[3] The specified air volume flows are values interpolated from individual measurements.

[4] The stated power consumption refers to the entire system

5 The volume flow-specific power consumption was calculated as follows:

spec. pel = power consumption of the ventilation system / (average value of supply air and exhaust air volume flow)

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Appendix D2: Measured values of the ventilation test

- Device 1 on the exhaust side/variant “Ambientika Advanced+”

	step 1		**Level 2**		**level 3**	
No.	**p stat.** = 1.2 ÿ ÿ	kg/m³ AWAY	**p stat.** ÿ = 1.2 kg/m³	AWAY	**p stat.** = 1.2 kg/m³	AWAY
	[Pa] [m³/h]	**[Pa] [m³/h]**	**[Pa] [m³/h]**			
	-21.4 43.6	-20.5 57.3	-22.0 75.7			
1 **2 6**	**-20.0 42.1**	**-20.0 56.9**	**-20.0 74.5**			
3	-17.8 39.8	-19.1 56.2	-19.7 74.3			
4	-15.0 37.3	-15.4 53.4	-15.0 71.5			
5	-11.5 33.4	-11.1 50.1	-10.0 68.1			
6	**-10.0 32.0**	**-10.0 49.3**	**-10.0 68.1**			
7	-8.2 30.2	48.1 -8.7	67.2 -8.3			
8th	-5.0 26.9	45.8 -6.3	65.9 -5.3			
	-1.8 23.3	43.0 -1.7	63.0 -1.9			
9 **10**	**0.0 21.1**	**41.5 0.0**	**62.1 0.0**			
11	1.3 19.4	40.2 1.5	61.2 1.6			
12	4.9 15.4	37.6 5.7	58.6 4.6			
13	8.7 10.7	34.0 8.9	56.3 8.9			
14	**10.0 8.9**	**33.2 10.0**	**55.6 10.0**			
15	11.6 6.6	32.3 11.5	54.6 11.2			
16			15.5	28.2 16.0	51.7	
17			18.8	25.4 18.6	49.9	
18			**20.0**	**24.1 20.0**	**48.9**	
19			21.0	23.0 21.7	47.7	

[6] The air volume flow values marked in bold are interpolated from the lines above and below.

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Appendix D3: Measured values of the ventilation test

- Device 1 supply air side/variant “Ambientika Advanced+”

	step 1		Level 2		level 3	
No.	**p stat.** = 1.2 ÿ ÿ kg/m³	**TO**	**p stat.** ÿ = 1.2 kg/m³	**TO**	**p stat.** = 1.2 kg/m³	**TO**
	[Pa]	**[m³/h]**	**[Pa]**	**[m³/h]**	**[Pa]**	**[m³/h]**
	-22.5	45.7	-21.4	60.9	-22.2	79.3
1 2 7	**-20.0**	**43.5**	**-20.0**	**60.3**	**-20.0**	**77.6**
3	-18.5	42.1	-17.5	59.0	-19.8	77.4
4	-14.3	38.1	57.1	-14.8	-75.0	
5	-11.5	35.8	-11.9	54.3	-11.9	71.5
6	**-10.0**	**34.2**	**-10.0**	**52.6**	**-10.0**	**70.0**
7	-8.4	32.5	52.1	-8.6	68.9	-9.5
8	-4.2	27.9	48.0	-5.3	66.5	-2.6
9	-1.6	23.5	43.4	-2.3	63.2	-6.0
10	**0.0**	**20.9**	**41.1**	**0.0**	**61.7**	**0.0**
11	1.2	18.9	39.3	1.6	60.4	1.6
12	5.3	12.2	35.8	6.3	56.0	4.9
13	-22.5	45.7	30.8	8.8	53.8	9.8
14	**-20.0**	**43.5**	**29.3**	**10.0**	**52.5**	**10.0**
15	-18.5	42.1	28.2	11.4	50.8	10.9
16	-14.3	38.1	22.6	15.2	46.7	16.9
17	**-11.5**	**35.8**	**16.8**	**18.0**	**43.6**	**18.4**
18			20.0	13.9	20.0	40.7
19			21.0	12.1	20.2	40.3

[7] The air volume flow values marked in bold are interpolated from the lines above and below.

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Appendix D4: Measured values of the ventilation test

- Device 2 on the exhaust side/variant “Ambientika Advanced+”

	step 1		Level 2		level 3	
No.	p stat. = 1.2 ÿ ÿ kg/m³	AWAY	p stat. ÿ = 1.2 kg/m³	AWAY	p stat. = 1.2 kg/m³	AWAY
	[Pa]	[m³/h]	[Pa]	[m³/h]	[Pa]	[m³/h]
	-22.2	43.8	-21.5	57.2	-22.0	74.3
1 **2 8**	**-20.0**	**41.6**	**-20.0**	**56.2**	**-20.0**	**73.1**
3	-18.0	39.6	-17.8	54.6	-18.9	72.4
4	-15.7	37.2	-14.8	52.2	-13.7	69.4
5	-10.9	32.5	-11.8	49.9	-11.0	67.9
6	**-10.0**	**31.6**	**-10.0**	**48.5**	**-10.0**	**67.3**
7	-8.6	30.3	47.6	-5.4	64.4	-8.9
8th	-4.6	26.1	44.8	-7.0	65.2	-5.0
	-1.9	23.2	41.7	-1.9	62.0	-1.3
9 **10**	**0.0**	**21.1**	**40.6**	**0.0**	**60.7**	**0.0**
11	1.1	19.9	39.4	1.2	59.9	1.3
12	4.8	15.2	36.0	7.0	56.2	5.6
13	8.1	11.0	32.9	8.8	55.1	9.2
14	**10.0**	**8.4**	**32.1**	**10.0**	**53.9**	**10.0**
15	10.9	7.1	30.9	10.2	53.7	11.3
16			14.4	28.2	15.8	50.1
17			18.4	24.8	18.3	48.2
18			**20.0**	**23.3**	**20.0**	**47.2**
19			20.8	22.6	21.1	46.5

''' The air volume flow values marked in bold are interpolated from the lines above and below.

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Appendix D5: Measured values of the ventilation test

- Device 2 supply air side/variant "Ambientika Advanced+"

	step 1		Level 2		level 3	
No.	**p stat.** = 1.2 ÿ ÿ kg/m³	**TO**	**p stat.** ÿ = 1.2 kg/m³	**TO**	**p stat.** = 1.2 kg/m³	**TO**
	[Pa]	**[m³/h]**	**[Pa]**	**[m³/h]**	**[Pa]**	**[m³/h]**
	-21.6	44.1	-21.9	60.5	-21.8	77.7
1 2 [9]	**-20.0**	**42.6**	**-20.0**	**59.4**	**-20.0**	**76.6**
3	-17.4	40.2	-17.3	57.9	-18.3	75.5
4	-14.5	37.8	-14.4	55.2	-13.1	71.8
5	-10.9	34.5	-11.6	52.8	-11.1	70.0
6	**-10.0**	**33.5**	**-10.0**	**51.2**	**-10.0**	**69.1**
7	-8.7	32.2	50.5	-8.9	68.3	-9.2
8	-5.1	27.5	45.8	-4.3	64.6	-4.4
9	-1.0	22.0	43.3	-1.1	61.7	-2.1
10	**0.0**	**20.4**	**40.7**	**0.0**	**60.7**	**0.0**
11	1.6	17.8	39.0	1.0	59.7	1.4
12	4.7	12.1	34.3	4.8	56.6	5.6
13			8.5	30.2	8.7	52.6
14			**10.0**	**28.1**	**10.0**	**51.3**
15			10.5	27.4	11.5	49.8
16			14.4	22.1	14.8	46.2
17			18.8	15.0	18.2	42.4
18			**20.0**	**13.1**	**20.0**	**40.2**
19			22.1	9.8	20.4	39.7

[9] The air volume flow values marked in bold are interpolated from the lines above and below.

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Appendix D6: Measured values of the ventilation test

• Device 1 on the exhaust side/variant "Ambientika Wireless+"

	step 1		Level 2		level 3	
No.	**p stat.** = 1.2 ÿ ÿ	kg/m³ **AWAY**	**p stat.** ÿ = 1.2 kg/m³	**AWAY**	**p stat.** = 1.2 kg/m³	**AWAY**
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
	-1.1 21.8	**0.0 20.5**	-1.7	42.4 -1.1	**41.1**	62.2
1 **2** **10**	0.7 19.7		**0.0**	**0.0** 40.3	2.0	**61.5**
3			0.9			60.3

• Device 1 on the supply air side/variant "Ambientika Wireless+"

	step 1		Level 2		level 3	
No.	**p stat.** = 1.2 ÿ ÿ	kg/m³ **TO**	**p stat.** ÿ = 1.2 kg/m³	**TO**	**p stat.** = 1.2 kg/m³	**TO**
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
1	-2.0 23.0	42.4 -1.9 63.6	-1.5			
2	**0.0 19.9**	**40.7 0.0 62.0**	**0.0**			
3	1.4 17.7	38.8 2.6 59.7	1.8			

• Device 2 on the exhaust side/variant "Ambientika Wireless+"

	step 1		Level 2		level 3	
No.	**p stat.** ÿ = 1.2 kg/m³	**AWAY**	**p stat.** ÿ = 1.2 kg/m³	**AWAY**	**p stat.** ÿ = 1.2 kg/m³	**AWAY**
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
1	-2.0 22.8	42.2 -2.8 63.3	-1.5			
2	**0.0 20.5**	**41.0 0.0 61.6**	**0.0**			
3	1.3 19.0	39.7 2.6 59.9	1.6			

• Device 2 supply air side/variant "Ambientika Wireless+"

	step 1		Level 2		level 3	
No.	**p stat.** = 1.2 ÿ ÿ	kg/m³ **TO**	**p stat.** ÿ = 1.2 kg/m³	**TO**	**p stat.** = 1.2 kg/m³	**TO**
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
1	-1.7 23.0	-1.6 63.1	-2.0	43.1		
2	**0.0 20.1**	**0.0 61.6**	**0.0**	**40.7**		
3	0.9 18.6	1.7 59.9	1.7	38.6		

[10] The air volume flow values marked in bold are interpolated from the lines above and below.

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Appendix D7: Measured values of the ventilation test

- Device 1 on the exhaust side/variant “Ambientika Smart

	step 1		Level 2		level 3	
No.	p stat. = 1.2 ÿ ÿ	kg/m³ AWAY	p stat. ÿ = 1.2 kg/m³	AWAY	p stat. = 1.2 kg/m³	AWAY
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
	-1.3 22.0	**0.0 20.5**	-1.6	42.9 -2.0	**41.6**	63.5
1 **2** [11]	1.4 19.1		**0.0**	**0.0** 40.4	2.4	**62.3**
3			1.5			60.8

- Device 1 on the supply air side/variant “Ambientika Smart”

	step 1		Level 2		level 3	
No.	p stat. = 1.2 ÿ ÿ	kg/m³ TO	p stat. ÿ = 1.2 kg/m³	TO	p stat. = 1.2 kg/m³	TO
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
1	-1.9 23.6	41.9 -1.4 64.4	-0.8			
2	**0.0 20.7**	**41.0 0.0 63.3**	**0.0**			
3	1.6 18.2	38.8 1.2 62.3	1.9			

- Device 2 on the exhaust side/version “Ambientika Smart”

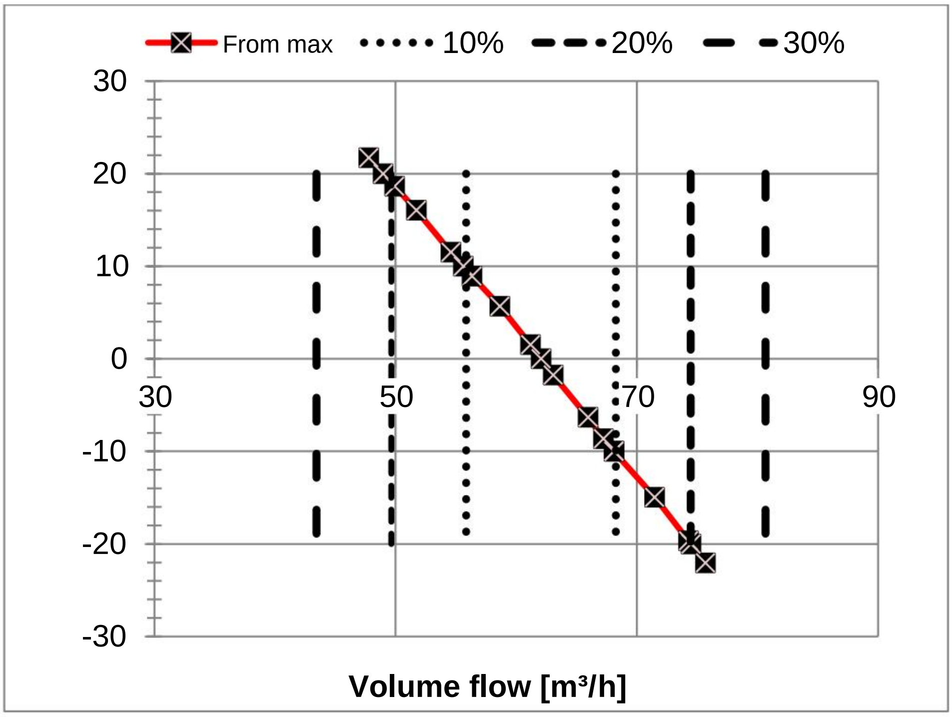
	step 1		Level 2		level 3	
No.	p stat. ÿ = 1.2 kg/m³	AWAY	p stat. ÿ = 1.2 kg/m³	AWAY	p stat. ÿ = 1.2 kg/m³	AWAY
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
1	-1.9 22.9	**0.0 20.7**	-1.9	43.2 -2.2	**41.6**	63.8
2	1.3 19.2		**0.0**	**0.0** 39.7	3.7	**62.4**
3			2.5			60.1

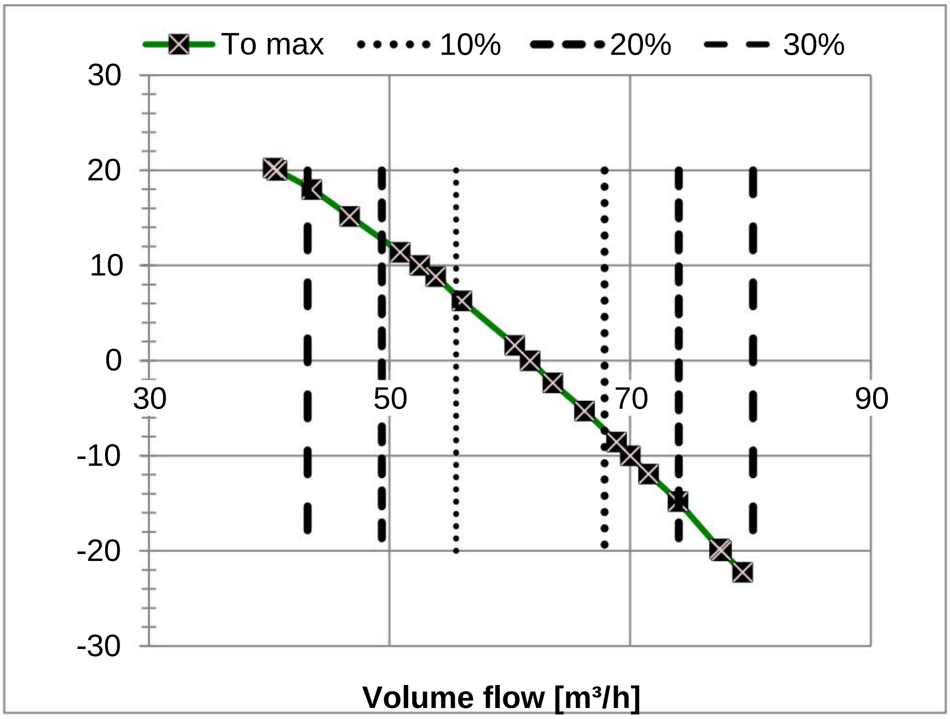
- Device 2 on the supply air side/variant “Ambientika Smart”

	step 1		Level 2		level 3	
No.	p stat. = 1.2 ÿ ÿ	kg/m³ TO	p stat. ÿ = 1.2 kg/m³	TO	p stat. = 1.2 kg/m³	TO
	[Pa] [m³/h] [Pa] [m³/h] [Pa] [m³/h]					
1	-2.2 24.3	43.5 -0.8 63.5	-2.4			
2	**0.0 20.7**	**40.6 0.0 62.9**	**0.0**			
3	1.7 18.0	39.2 1.5 61.7	1.3			

[11] The air volume flow values marked in bold are interpolated from the lines above and below.

Appendix E1: Sensitivity of airflow to variations in the Pressure difference / fan 1





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Appendix E2: Sensitivity of airflow to variations in the Pressure difference / fan 1

Free-blowing volume flows (calculated)

Exhaust air volume flow: 62.1 m³/h at 0 Pa
Supply air volume flow: 61.7 m³/h at 0 Pa

Limits for classifying the sensitivity of the air flow to fluctuations in the Pressure difference:

Exhaust air	Measured value m³/h @ 20 Pa	Minimum permissible value m³/h	Class
-10%	48.9	>55.8	S1
-20%		>49.6	S2
-30%		>43.4	S3

Exhaust air
%
-21.1

	Measured value m³/h @-20 Pa	maximum permissible value m³/h	Class
10%	74.5	<68.3	S1
20%		<74.5	S2
30%		<80.7	S3

Exhaust air
%
20.0

supply air	Measured value m³/h @ 20 Pa	Condition m³/h	Class
-10%	40.7	>55.5	S1
-20%		>49.4	S2
-30%		>43.2	S3

supply air
%
-34.1

	Measured value m³/h @-20 Pa	Condition m³/h	Class
10%	77.6	<67.9	S1
20%		<74.0	S2
30%		<80.2	S3

supply air
%
25.8

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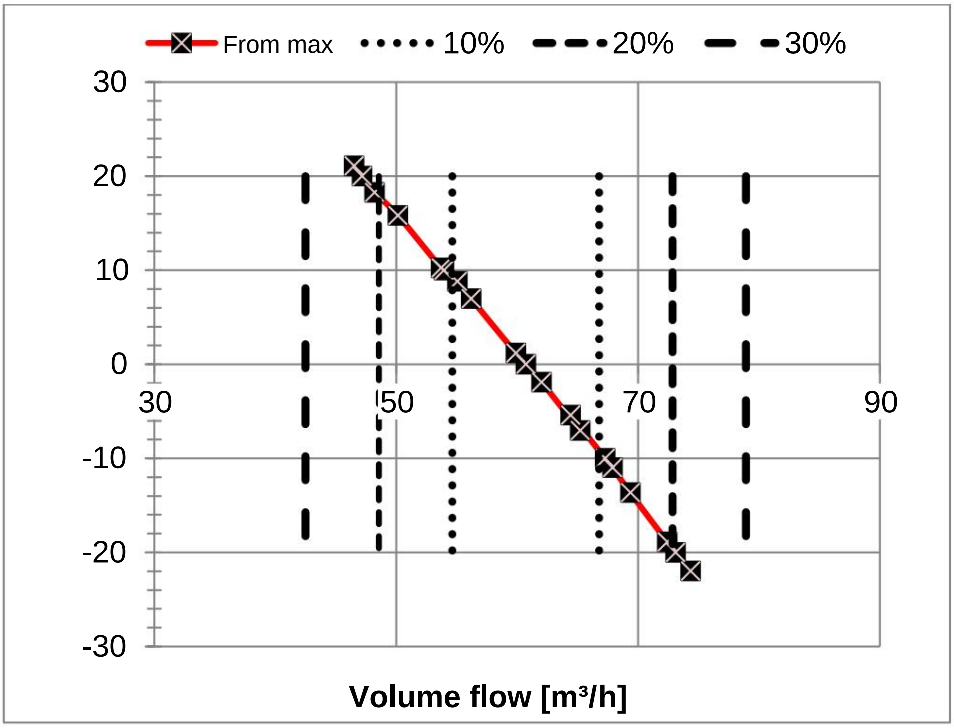
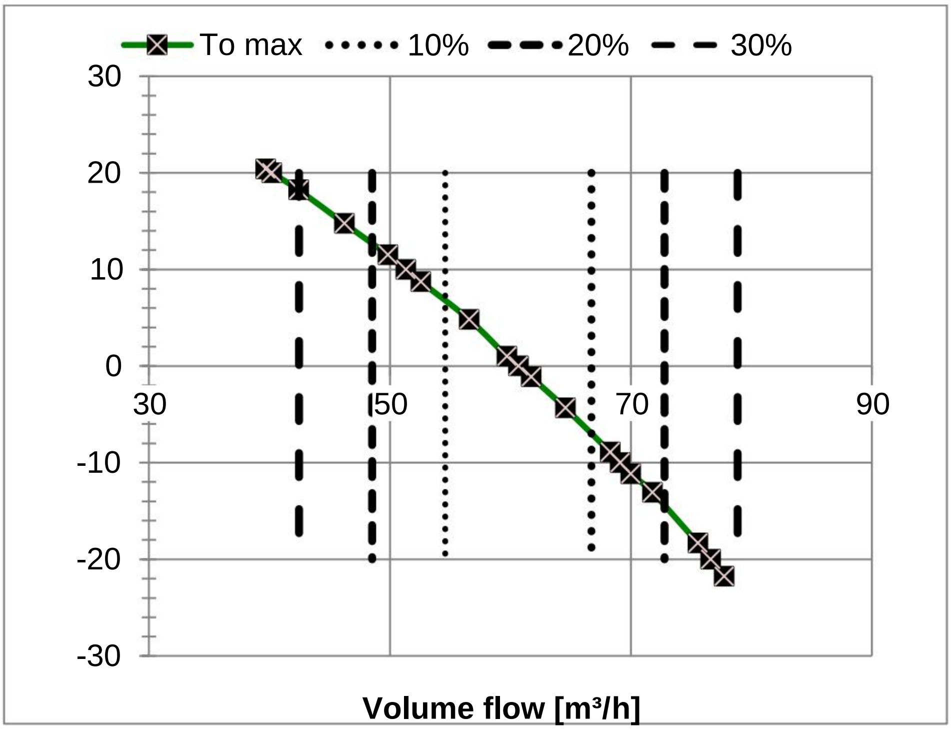
Appendix E3: Sensitivity of airflow to variations in the Pressure difference / fan 2





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Appendix E4: Sensitivity of airflow to variations in the Pressure difference / fan 2

Free-blowing volume flows (measured)

Exhaust air volume flow: 60.7 m³/h at 0 Pa
Supply air volume flow: 56.5 m³/h at 0 Pa

Limits for classifying the sensitivity of the air flow to fluctuations in the Pressure difference:

Exhaust air	Measured value m³/h @ 20 Pa	Minimum permissible value m³/h	Class
-10%	**47.2**	>54.6	S1
-20%		>48.6	S2
-30%		>42.5	S3

Exhaust air
%
-22.3

	Measured value m³/h @-20 Pa	maximum permissible value m³/h	Class
10%	**73.1**	<66.8	S1
20%		<72.9	S2
30%		<78.9	S3

Exhaust air
%
20.4

supply air	Measured value m³/h @ 20 Pa	Condition m³/h	Class
-10%	**40.2**	>54.6	S1
-20%		>48.5	S2
-30%		>42.5	S3

supply air
%
-33.7

	Measured value m³/h @-20 Pa	Condition m³/h	Class
10%	**76.6**	<66.7	S1
20%		<72.8	S2
30%		<78.9	S3

supply air
%
26.3

Appendix F: Images for assessing a ventilation short circuit

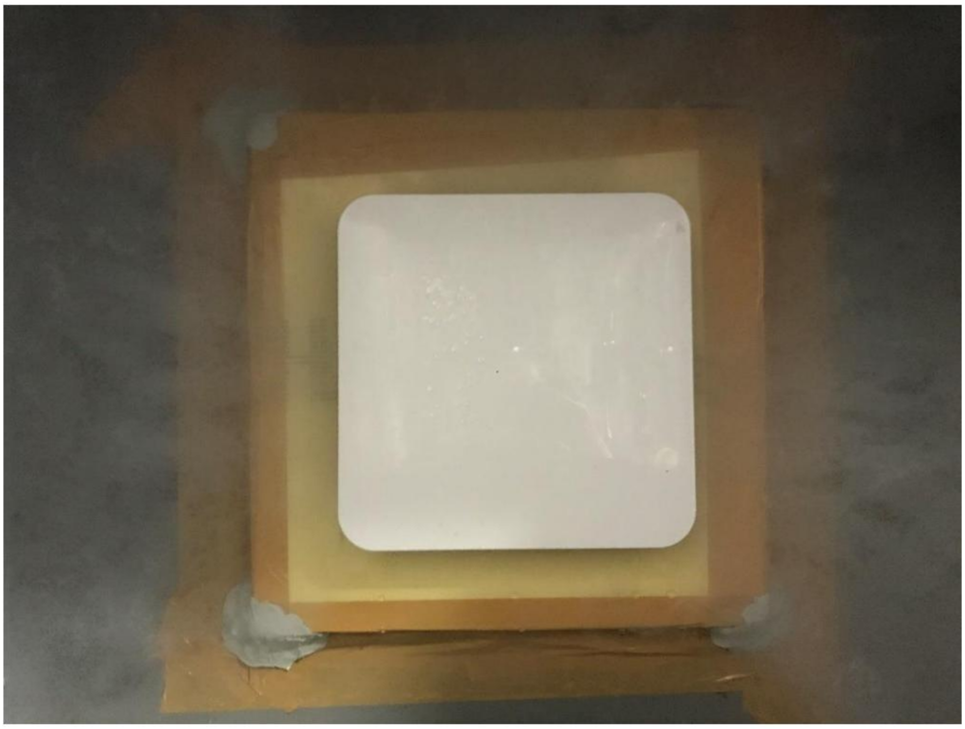

Figure F-2: Mist exiting the outer panel

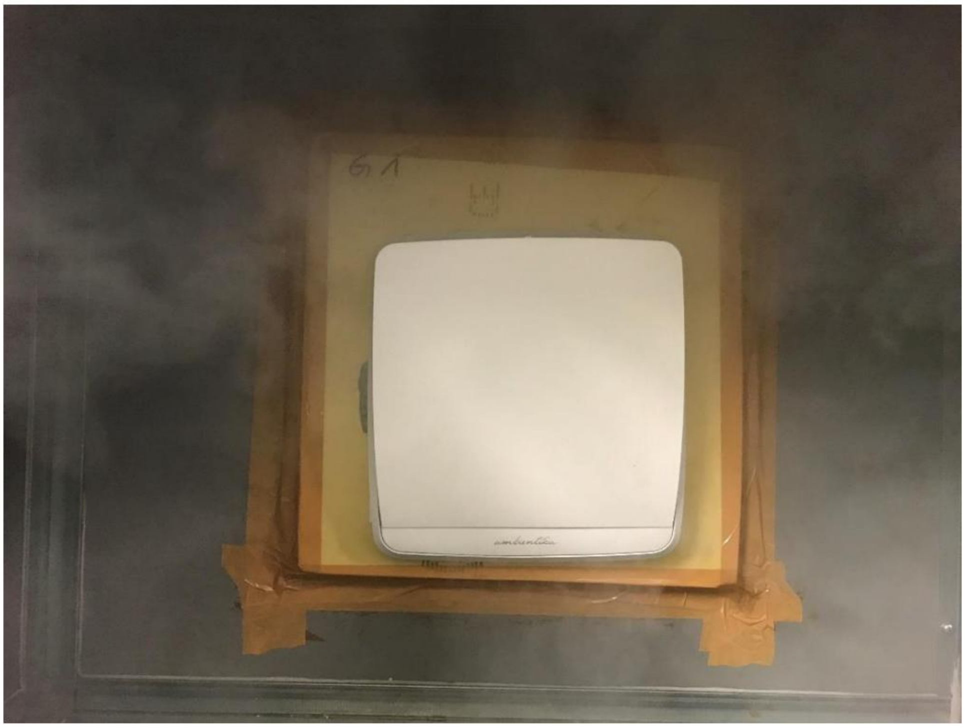

Figure F-1: Mist exiting the inner panel

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Appendix G1: Measured and calculated values for the thermodynamic test

Ventilation units with regenerative heat exchangers

Heat exchanger with moisture transfer	Yes

Measured or calculated values	Size	Unit	A7 qVmin	A7 qVn	A7 qVd
Device					
Average volume flow AB (from test)	qv, AB, averaged	m³/h	**21.1**	**41.0**	**61.4**
Average volume flow CLOSED (from test)	qv, TO, averaged	m³/h	**20.6**	**40.9**	**61.2**
Average volume flow (from test)	qv, averaged	m³/h	**20.9**	**41.0**	**61.3**
Disbalance (according to test)	TO / DOWN	-	**1.0**	**1.0**	**1.0**
Unsteady measurements					
Temperature AU	**ÿAU**	**°C**	**7.0**	**7.0**	**7.0**
Humidity AU	Yep	%	94	94	93
Purge air flow AU	qV, flush, AU, inst	m³/h	31	48	72
Temperature AB	**ÿAB on, inst**	**°C**	**20.0**	**20.0**	**20.1**
Humidity AB	jAB, a, instat	%	40	40	39
Moist purge exhaust air from	jAB, off, instat qV,	%	41	43	44
purge air flow AB	flush, AB, inst ÿAB	m³/h	32	49	75
Temperature purge exhaust air	off, inst	°C	19.6	18.9	18.3
from ambient air pressure	p	Pa	93,593	93,727	93,860
electr. Total active power, **transient**	Pel	W	8.1	10.5	14.2
calculation values					
Wet bulb temperature AB	ÿwb AB, inst	°C	**12.1**	**12.1**	**12.0**
Wet bulb temperature AU	ÿwb AU; inst	°C	**-**	**-**	**-**
Water content AU	xAU	g/kg	6.35	6.31	6.23
Water content AB	xAB, on, instat	g/kg	6.26	6.24	6.14
Water content of the rinsing exhaust air	xAB, off, instat	g/kg	6.29	6.25	6.15
Density AU	ÿAU	kg/m³	1,159	1,161	1,162
Density AB	ÿAB	kg/m³	1.107	1.109	1,110
Purge air mass flow AU	sqm, rinsing, AU, inst	kg/s	0.0098	0.0154	0.0232
Purge air mass flow AB	sqm, rinsing, AB, inst	kg/s	0.0098	0.0152	0.0230
Stationary measurements					
Temperature AU	**ÿAU**	**°C**	**7.0**	**7.0**	**7.0**
Humidity AU	Yep	%	94	94	93
Purge air flow AU	qV, flush, AU, stat	m³/h	31	48	72
Temperature AB	**ÿAB on, stat**	**°C**	**20.0**	**20.0**	**20.0**
Humidity AB	jAB, a, stat	%	39	40	40
Moist rinsing exhaust air	jAB, off, stat qV,	%	52	58	60
Purge air flow AB	flush, AB, stat ÿAB	m³/h	32	50	75
Temperature of purge exhaust air	off, stat	°C	15.8	14.0	13.4
Ambient air pressure	pamb	Pa	93,584	93,700	93,768
electr. Total active power	Pel	W	8.8	11.6	16.0
stationary calculation values					
Wet bulb temperature AB	ÿwb AB, stat	°C	**11.9**	**12.1**	**12.1**
Wet bulb temperature AU	ÿwb AU; stat	°C	**-**	**-**	**-**
Water content AU	xAU	g/kg	6.33	6.29	6.26
Water content AB	xAB	g/kg	6.11	6.30	6.26
Water content of the rinsing exhaust air	xAB, off, stat	g/kg	6.22	6.26	6.22
Density AU	ÿAU	kg/m³	1.158	1.160	1,161
Density AB	ÿAB	kg/m³	1.108	1.109	1.109
Purge air mass flow AU	sqm, sink, AU, stat	kg/s	0.0098	0.0155	0.0231
Purge air mass flow AB	sqm, sink, AB, stat	kg/s	0.0099	0.0153	0.0231

Result			qVmin	qVn	qVd
Supply air temperature ratio	ÿÿTO	%	91.8	80.8	72.9
Supply air temperature ratio (corrected)	ÿÿTO , corr	%	91.8	80.8	72.9
Humidity ratio supply air (optional)	ÿxTO	%	-	-	-
Humidity ratio supply air (optional) corrected	ÿxZU, corr	%	-	-	-

Auxiliary variables are determined using the following constants:

cp,L [kJ/(kgK)]	r0 [kJ/kg]	cp,w [kJ/(kgK)]
1.004	2500	4.18

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Appendix G2: Measured and calculated values of the thermodynamic test

Ventilation units with regenerative heat exchangers

Heat exchanger with moisture transfer	Yes

Measured or calculated values	Size	Unit	A2		
			qVmin	qVn	qVd
Device					
Average volume flow AB (from test)	qv, AB, averaged	m³/h	**21.1**	**41.0**	**61.4**
Average volume flow CLOSED (from test)	qv, TO, averaged	m³/h	**20.6**	**40.9**	**61.2**
Average volume flow (from test)	qv, averaged	m³/h	**20.9**	**41.0**	**61.3**
Disbalance (according to test)	TO / DOWN	-	**1.0**	**1.0**	**1.0**
Unsteady measurements					
Temperature AU	**ÿAU**	**°C**	**2.0**	**2.0**	**2.0**
Humidity AU	Yep	%	86	86	85
Purge air flow AU	qV, flush, AU, inst	m³/h	30	49	73
Temperature AB	**ÿAB on, inst**	**°C**	**20.0**	**20.0**	**20.0**
Humidity AB	jAB, a, instat	%	61	61	60
Moist purge exhaust air from	jAB, off, instat qV,	%	54	54	54
purge air flow AB	flush, AB, inst ÿAB	m³/h	32	51	78
Temperature purge exhaust air	off, inst	°C	19.4	18.2	17.4
from ambient air pressure	p	Pa	94,632	94,611	94,660
electr. Total active power, **transient**	Pel	W	8.4	10.0	14.7
calculation values					
Wet bulb temperature AB	ÿwb AB, inst	°C	**15.1**	**15.1**	**15.0**
Wet bulb temperature AU	ÿwb AU; inst	°C	**1.1**	**1.1**	**1.1**
Water content AU	xAU	g/kg	4.00	4.00	3.97
Water content AB	xAB, on, instat	g/kg	9.51	9.48	9.36
Water content of the rinsing exhaust air	xAB, off, instat	g/kg	8.14	7.57	7.16
Density AU	ÿAU	kg/m³	1,195	1,194	1,195
Density AB	ÿAB	kg/m³	1,118	1,117	1,118
Purge air mass flow AU	sqm, rinsing, AU, inst	kg/s	0.0099	0.0162	0.0241
Purge air mass flow AB	sqm, rinsing, AB, inst	kg/s	0.0099	0.0158	0.0242
Stationary measurements					
Temperature AU	**ÿAU**	**°C**	**2.0**	**2.0**	**2.0**
Humidity AU	Yep	%	85	85	85
Purge air flow AU	qV, flush, AU, stat	m³/h	30	49	73
Temperature AB	**ÿAB on, stat**	**°C**	**20.0**	**20.0**	**20.0**
Humidity AB	jAB, a, stat	%	61	61	60
Moist purge exhaust air from	jAB, off, stat qV,	%	60	64	67
purge air flow AB	flush, AB, stat ÿAB	m³/h	32	51	78
Temperature purge exhaust air	off, stat	°C	13.8	11.6	10.8
from ambient air pressure	pamb	Pa	94,648	94,320	94,286
electr. Total active power	Pel	W	8.9	11.7	16.2
stationary calculation values					
Wet bulb temperature AB	ÿwb AB, stat	°C	**15.1**	**15.1**	**14.9**
Wet bulb temperature AU	ÿwb AU; stat	°C	**1.0**	**1.1**	**1.1**
Water content AU	xAU	g/kg	3.98	3.99	4.00
Water content AB	xAB	g/kg	9.51	9.47	9.33
Water content of the rinsing exhaust air	xAB, off, stat	g/kg	6.24	5.85	5.80
Density AU	ÿAU	kg/m³	1.195	1.191	1,190
Density AB	ÿAB	kg/m³	1.118	1.114	1,114
Purge air mass flow AU	sqm, flushing, AU, stat	kg/s	0.0099	0.0161	0.0240
Purge air mass flow AB	sqm, sink, AB, stat	kg/s	0.0100	0.0157	0.0240

Result			qVmin	qVn	qVd
Supply air temperature ratio	ÿÿTO	%	89.7	78.7	71.7
Supply air temperature ratio (corrected)	ÿÿTO , corr	%	89.7	78.7	71.7
Humidity ratio supply air (optional)	ÿxTO	%	58.0	47.5	38.3
Humidity ratio supply air (optional) corrected	ÿxZU, corr	%	58.0	47.5	38.3

Auxiliary variables are determined using the following constants:

cp,L [kJ/(kgK)]	r0 [kJ/kg]	cp,w [kJ/(kgK)]
1.004	2500	4.18

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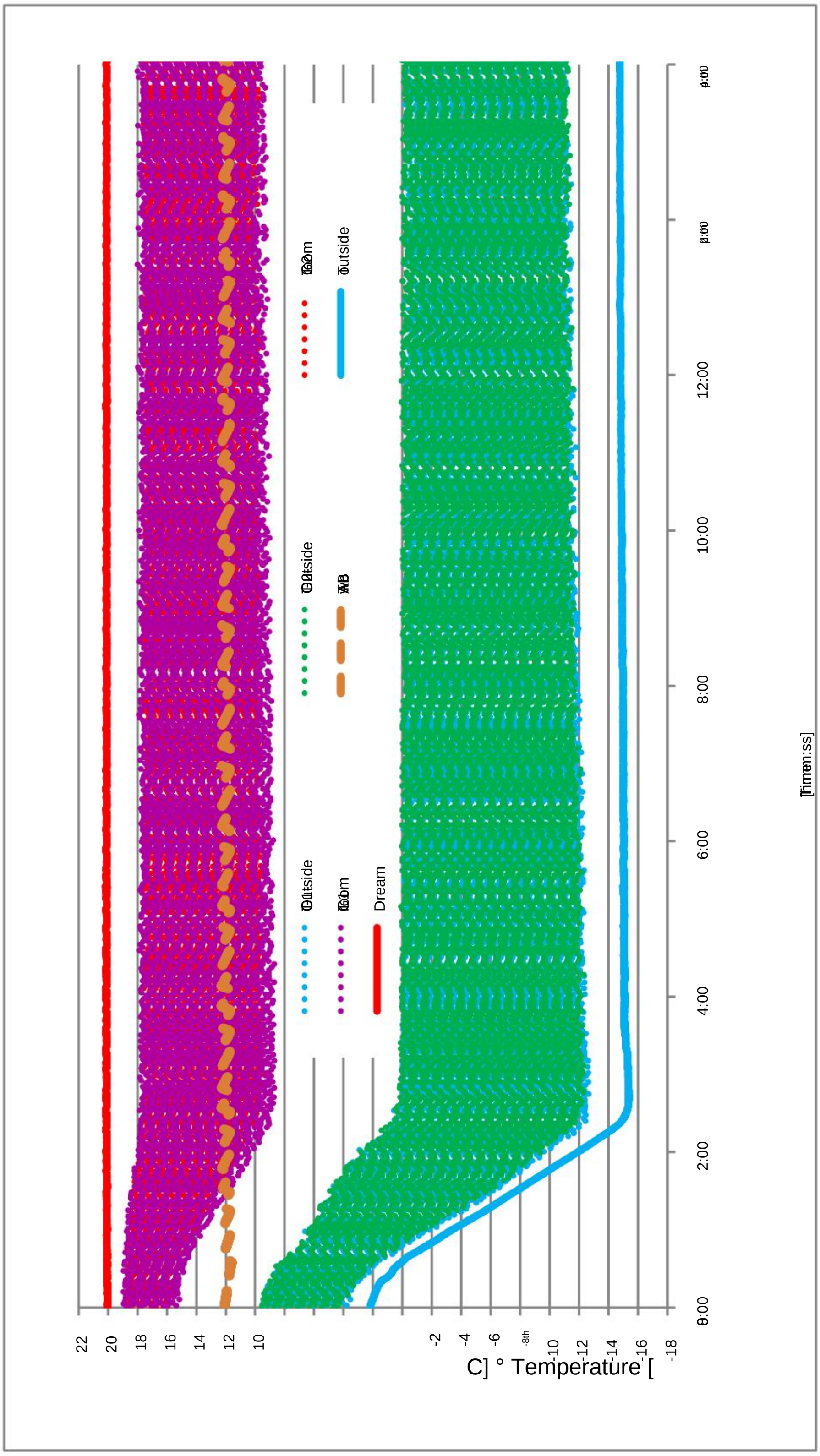
Appendix H1: Frost protection test

Frost protection test diagram



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Appendix H2: Frost protection test

Pictures of antifreeze testing

Figure H-1: Device without external cover after the end of the test

Figure H-2: Inside of the outer panel after the end of the test

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Appendix I: History of changes to the test report

Original version: Test report WRG756 DIBt **Revision:** Test report WRG756-REV.1 DIBt

Changes (page numbers refer to the audit report):

Page 2, point 1

Addition: Note on the variants “Ambientika Wireless+” and “Ambientika “Smart”

Page 11, point 4.1

Addition: Operation of the “Ambientika Smart” variant

Appendix C3 to C6:

Addition: Pressure-volume flow characteristics of the “Ambientika Wireless+” and variants “Ambientika Smart”

Appendix D1:

Addition: Measurement data of the free-blowing air volume flows and electrical power consumption of the “Ambientika Wireless+” and “Ambientika Smart” variants

Appendix D6 and D7:

Addition: Measured values from the ventilation testing of the “Ambientika Wireless+” and “Ambientika Smart” variants

Appendix I:

Addition: Appendix I: History of changes to the test report