Lucerne University of
Applied Sciences and Arts
HOCHSCHULE
LUZERN
Technik & Architektur
Zentrum für Integrale Gebäudetechnik

Centre for Integrated Building Technology

Test Report Nr: HP- 151554

Test object: **Aeris Air Purifier**

Client:

Aeris Cleantec AG
Stegackerstrasse 48
CH- 8409 Winterthur

Date: **Horw, 2016-10-15**

Author:

Andrii Zakovorotnyi, M.Sc.
Academic Research Associate

Reviewer:

Benoit Sicre, PhD
Academic Research Associate Senior

Contents

1 Summary

The portable room air cleaner 'Aeris' was tested by the Centre for Integrated Building Technology at the Lucerne University of Applied Sciences and Arts – Engineering & Architecture. The aim of the tests was to measure:

- 100:1 recovery time with new filter
- 100:1 recovery time with electrostatic discharged filter

The recovery time indicates the time in which the device reduces the aerosol concentration to 1% from the initial level in a standardised test chamber (particle size fraction fraktion ≥ 0.5 µm). The air circulation and air cleaning in the test room are performed solely by the tested air cleaner.

The results show that the average recovery times with new and discharged filters are the same and equal 18 min 10 seconds. It can also be said that the air in the test chamber was well mixed by air cleaner.

2 Client

Ordering party	Aeris Cleantec AG Stegackerstrasse 48 CH- 8409 Winterthur
Contact person:	Mr. Constantin Overlack

3 Description of order

Aeris is the portable room air cleaner designed by the Aeris Cleantec AG Winterthur.

The Centre for Integrated Building Technology ZIG was contracted by Aeris Cleantec AG on Oct. 13th 2016 to carry out a particle measurement of its air cleaner device to determine the time needed to decrease the particle concentration in the air in ratio 100:1 with new and electrostatic discharged filters according to "Test Guideline for Portable Room Air Cleaners" of Hochschule Luzern[1].

4 Device identification, delivery date, testing date

Product description:

Supplier	Aeris Cleantec AG
Model (according supplier designation) Serial No.:	Aeris Air Purifier, aair Not available
Delivery date:	09.10.2016
Period of test:	from 12.10.2016 to 28.10.2016

Fig. 1: Aeris Air Purifier (1) with its block-filter (2) and the opened shell (3)

5 Test procedure

Presently there exist no international standards for testing the particle removal rate of portable air cleaners. Therefore, the test was carried out according "Test Guideline for Portable Room Air Cleaners" published by Hochschule Luzern on 14.05.2012 [1].

The portable room air cleaner was placed in the standardised, not ventilated test chamber of ZIG opposite to the patient bed with a distance of 10 cm from the wall (s. *Fig. 2*). The chamber air conditions were kept unchanged during all tests at approx. 21°C and relative humidity of approx. 45 %. The concentration of particles of size larger or equal than 0.5 µm was recorded in 3 places in series: on top of patient bed at height 1 m – measurement point M1, in the left corner near the patient bed at height 1.8 m – measurement point M2, in front of the entrance door at height 1 m –

measurement point M3 (s. *Fig. 2*). A test aerosol of type DEHS[1] was used. It has a maximum of particle size at 0.5 µm. Prior to measurement the air in the test chamber was enriched with DEHS-particles to reach similar particle concentration (initial concentration of particle ≥ 0.5 µm was approx. $6 \cdot 10^6$ P/ft^3).

A circulation fan provides homogeneous distribution of particle load in the room before starting the test. During the test, the circulation fan was shut off.

The measurement was carried out according the specification of Aeris with the fan switched to the highest ventilation level (Display on speed 6). At this level the volume flow rate equals to 600 m^3/h according to manufacturer's data. [(2)].

All doors were kept closed during the measurement.

After the measurements with the new filter were done, it was taken out of the Aeris and sent for discharging to Unifil AG Filtertechnik in Niederlenz, Switzerland. After obtaining the discharged filter back, it was plugged back in Aeris and the device was tested under the same conditions as the new filter.

[1] Di-2-Ethylhexyl-Sebacat: for more information s. http://www.topas-gmbh.de/dateien/prospekt/dehs_prspe.pdf
[2] This value was NOT measured or verified by ZIG.

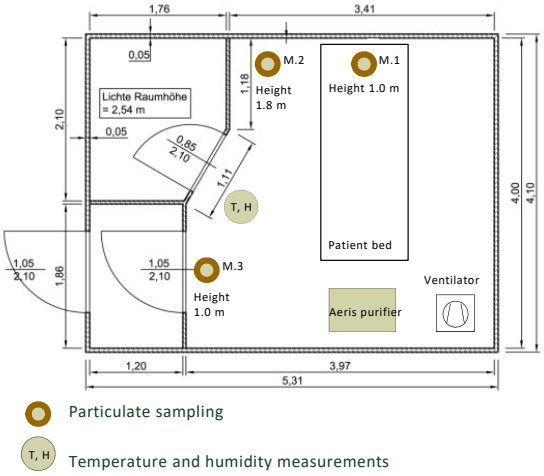


Fig. 2: Testing setup in the "isolation room" test chamber. The volume of the test chamber is approx. 35 m^3.

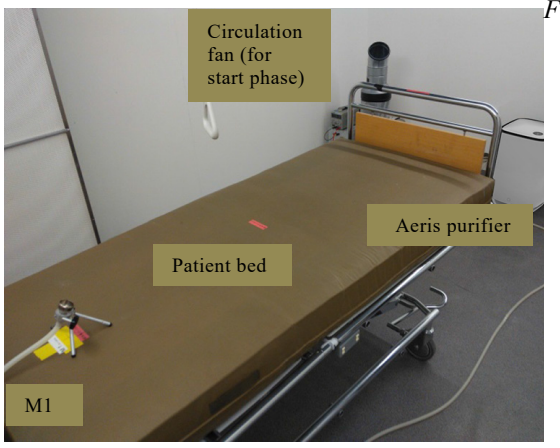
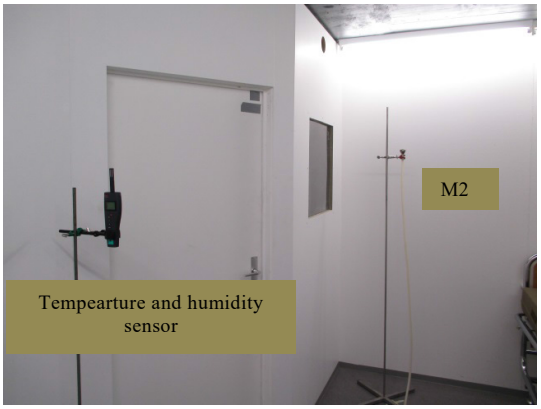
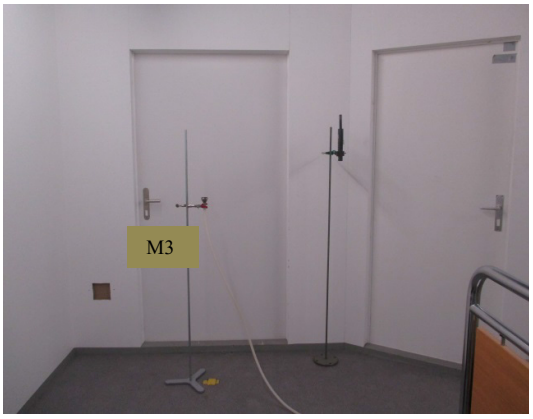


Fig. 3: Testing setup in the "isolation room"





6 Test results

Note: the test aerosol used is DEHS, an organic component that can evaporate by itself and so does not damage or obstruct or foul the tested products. DEHS as an aerosol can vanish slowly with time from the air of the testing chamber, resulting from evaporation, recombination in bigger droplets, from sedimentation on the floor, etc. One should keep this in mind while evaluating the particle counting results. For the evaluation of the particle removal rate, some preliminary measurements at rest[3] have shown that an observation interval of **14 hours** is a reasonable compromise to this respect, which is much higher than the obtained recovery time of the device.

The results are shown on table below and supplied with graphs on *Fig. 4* and *Fig.5*.

The theoretical recovery time was calculated according to the formula in Chapter 8, Annex. 2 of ISO 14644-3:2006 [2]. It equals to 17 minutes and results from the ventilation flow: 600 m^3/h in the test chamber of 35 m^3 of net volume (ventilation rate LW = 600/35 = 17.14 h^{-1}). Compared to the theoretical minimum possible time the tested device displays an increase in cleaning time of about 10%.

The results also showed that the current volume flow rate of the device provides good mixing of the air volume inside the chamber (due to the fact that all measured points lie on one straight line).

No.	Criterion	PAC classes / guide value			Values determined				Remarks
		A	B	C					
P.1	**New filter 100:1 recovery time**	$t_{0.01} \leq 20$ minutes	$t_{0.01} \leq 30$ minutes	$t_{0.01} \leq 40$ minutes	**100:1 recovery time at highest fan stage (600 m³/h)**	**Measuring point**			The most unfavourable value is for point M3 equals to **1,008 %** of initial concentration
						M1	**M2**	**M3**	
					100:1 recovery time [min] $t_{0.01}$	**18:10**	**18:10**	**18:10**	
P.2	**Discharged filter 100:1 recovery time if the filter unit used has been discharged**	$t_{0.01} \leq 20$ minutes	$t_{0.01} \leq 30$ minutes	$t_{0.01} \leq 40$ minutes	**100:1 recovery time at highest fan stage (600 m³/h)**	**Measuring point**			The most unfavourable value is for point M1 equals to **1,06 %** of initial concentration
						M1	**M2**	**M3**	
					100:1 recovery time [min] $t_{0.01}$	**18:10**	**18:10**	**18:10**	
Hence, the PAC complies with PAC class:			**B**		**(The most unfavourable values for P.1, P.2 and P.3 are representative values for the rating.)**				

PAC: Portable Air Cleaner

[3] Reference measurement with air cleaner shut off

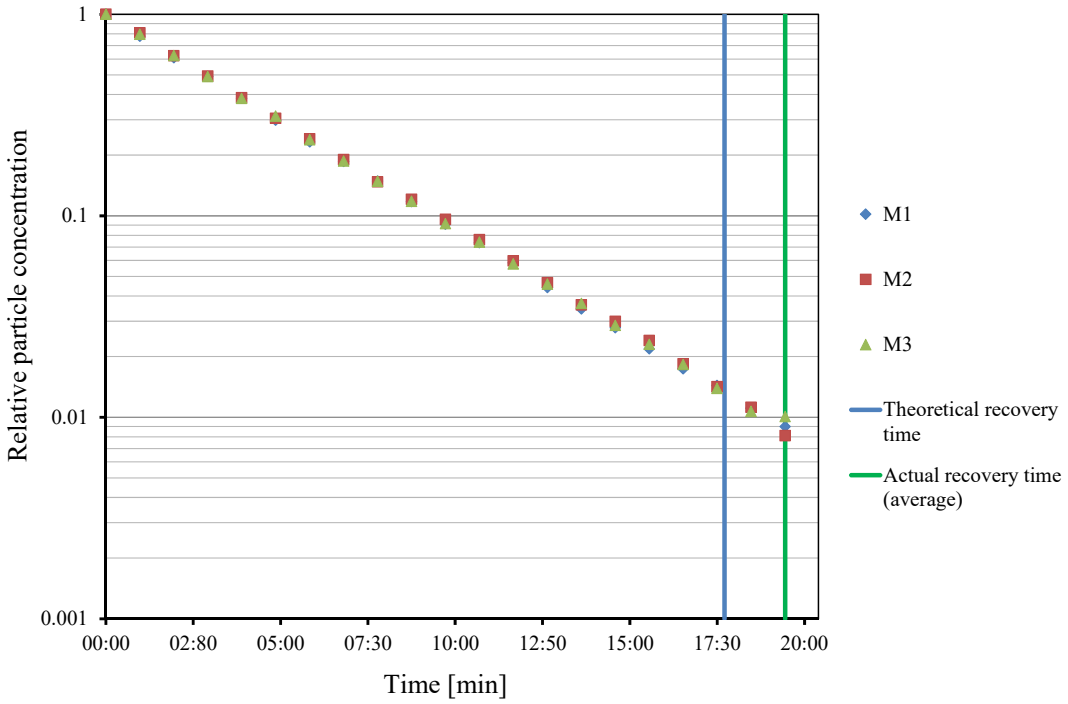


Fig. 4: 100:1 recovery time for New Filter

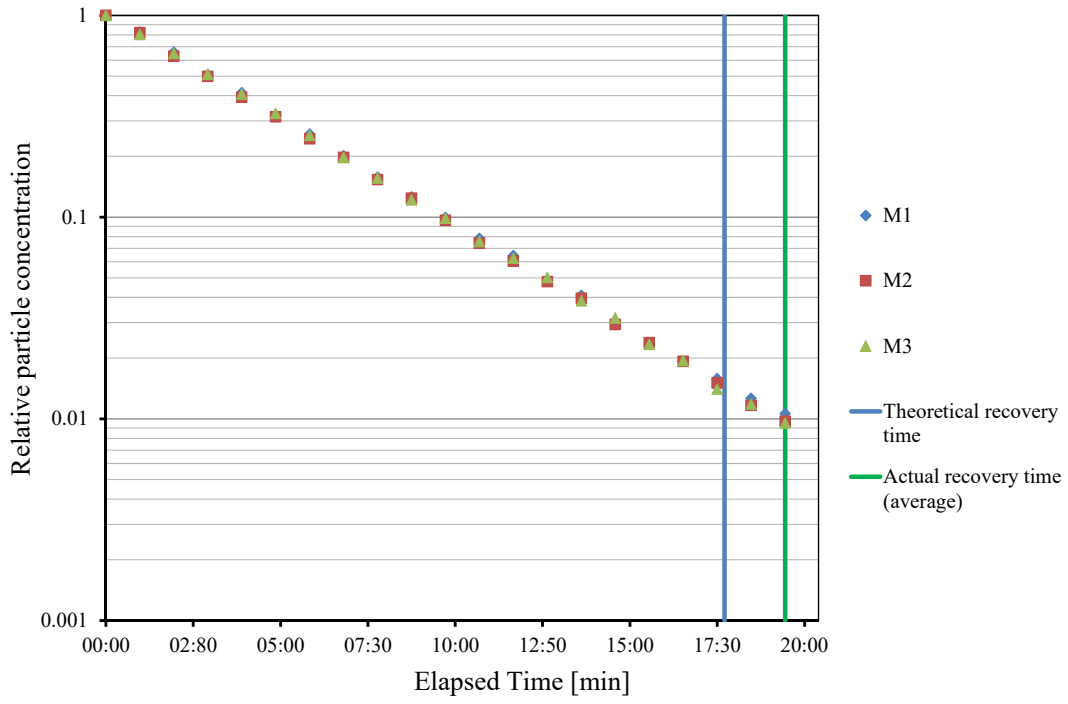


Fig. 5: 100:1 recovery time for Discharged Filter

7 Conclusions

A portable air cleaner was tested upon particle removal in a test chamber according “Test Guideline for Portable Room Air Cleaners” published by Centre for Integrated Building Technology on 14.05.2012.

Using a DEHS aerosol, particle removal rate of above 99.0% have been observed for particle size fraction of 5 μm and above after 18 minutes and 10 seconds of operation.

These results are valid for both new and discharged filters.

The results also showed that the current volume flow rate of the device provides good mixing of the air volume inside the chamber.

Note: it was not part of the order to determine the sound emission level or the room air velocity of the tested unit while running in the test chamber. So it has not been possible to carry out a classification of the device according chap. 10 of [1] yet.

The test results described above are only valid for the tested unit.

The electronically recorded data will be stored for a period of 3 years. The test report and all the related documents will be kept 10 years. During this time the customer is entitled to look into these documents. Copies will be charged separately.

8 Appendix 1: Photos

9 Appendix 2: Testing equipment

9.1 Particle counter

The particle counter was used to monitor the particle object and measuring the number of particles at the measurement points.

Manufacturer	Met One
Type	Model 3413
Range	0.3 – 10.0 µm
Air suction flow	28.3 L/min
Log. Nr.	1.11 HP 040

9.2 Particle dilutor

The dilutor was used to reduce the particle concentration in the air inlet of particle counter to insure that it works in permeable range.

Manufacturer	Topas GmbH
Type	Dil 550
Dilution factor	100
Air suction flow	28.3 L/min
Log. Nr.	1.11 HP 050

9.3 Temperature and humidity measurement

The combi temperature and humidity measuring device was used to monitor temperature and humidity of air in the test chamber.

Manufacturer	Rotronic
Type	HygroPalm 3.1a
Range	0…100% rh, -50…+200 °C
Accuracy	±1.5% rh, ±0.3K (0.5°F)
Log. Nr.	1.09 HP 088

10 Appendix 3: Literature

[1] Hochschule Luzern: Test Guideline for Portable Room Air Cleaners; Lucerne University of Applied Sciences and Arts; Lucerne; 2012

[2] ISO 14644-3:2006: Reinräume und zugehörige Reinraumbereiche – Prüfverfahren. (in English: Cleanrooms and associated controlled environments - Part 3: Test methods); Beuth Verlag; Berlin; 2006

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LUZERN
Technik & Architektur
Zentrum für Integrale Gebäudetechnik

Centre for Integrated Building Technology

Test Report Nr: HP-213442

Test object: **Aeris Aairlite**

Client:

Aeris Cleantec AG
Stegackerstrasse 48
CH- 8409 Winterthur

Date: **Horw , 2018-01-15**

Author:

Andrii Zakovorotnyi, M.Sc.
Academic Research Associate

Reviewer:

Benoit Sicre, PhD
Academic Research Associate Senior

Contents

1 Summary

The portable room air cleaner 'Aairlite' was tested by the Centre for Integrated Building Technology at the Lucerne University of Applied Sciences and Arts – Engineering & Architecture. The aim of the tests was to measure:

- 100:1 recovery time with new filter
- 100:1 recovery time with electrostatic discharged filter

The recovery time indicates the time in which the device reduces the aerosol concentration to 1% from the initial level in a standardised test chamber (particle size fraction fraktion ≥ 0.5 µm). The air circulation and air cleaning in the test room are performed solely by the tested air cleaner.

The results show that the average recovery times with new and discharged filters are the same and equal 30 min 00 seconds. It can also be said that the air in the test chamber was well mixed by air cleaner.

2 Client

Ordering party	Aeris Cleantec AG Stegackerstrasse 48 CH- 8409 Winterthur
Contact person:	Mr. Constantin Overlack

3 Description of order

Aeris is the portable room air cleaner designed by the Aeris Cleantec AG Winterthur.

The Centre for Integrated Building Technology ZIG was contracted by Aeris Cleantec AG on Oct. 23th 2017 to carry out a particle measurement of its air cleaner device to determine the time needed to decrease the particle concentration in the air in ratio 100:1 with new and electrostatic discharged filters according to "Test Guideline for Portable Room Air Cleaners" of Hochschule Luzern[1].

4 Device identification, delivery date, testing date

Product description:

Supplier	Aeris Cleantec AG
Model (according supplier designation) Serial No.:	Aeris Aairlite Air Purifier, Grey Not available
Delivery date:	02.12.2017
Period of test:	from 12.12.2017 to 28.12.2017

Fig. 1: Aeris Aairlite Air Purifier (1) with its filters (2) and the opened shell (3)

5 Test procedure

Presently there exist no international standards for testing the particle removal rate of portable air cleaners. Therefore, the test was carried out according "Test Guideline for Portable Room Air Cleaners" published by Hochschule Luzern on 14.05.2012 [1].

The portable room air cleaner was placed in the standardised, not ventilated test chamber of ZIG opposite to the patient bed with a distance of 10 cm from the wall (s. *Fig. 2*). The chamber air conditions were kept unchanged during all tests at approx. 21 °C and relative humidity of approx. 45 %. The concentration of particles of size larger or equal than 0.5 µm was recorded in 3 places in series: on top of patient bed at height 1 m – measurement point M1, in the left corner near the patient bed at height 1.8 m – measurement point M2, in front of the entrance door at height 1 m –

measurement point M3 (s. *Fig. 2*). A test aerosol of type DEHS[1] was used. It has a maximum of particle size at 0.5 µm. Prior to measurement the air in the test chamber was enriched with DEHS-particles to reach similar particle concentration (initial concentration of particle ≥ 0.5 µm was approx. $6 \cdot 10^6$ P/ft^3).

A circulation fan provides homogeneous distribution of particle load in the room before starting the test. During the test, the circulation fan was shut off.

The measurement was carried out according the specification of Aeris with the fan switched to the highest ventilation level (LED on the device's top lights green). At this level the volume flow rate equals to 315 m^3/h according to manufacturer's data. [(2)].

All doors were kept closed during the measurement.

After the measurements with the new filter were done, it was taken out of the Aeris and sent for discharging to Unifil AG Filtertechnik in Niederlenz, Switzerland. After obtaining the discharged filter back, it was plugged back in Aeris and the device was tested under the same conditions as the new filter.

[1] Di-2-Ethylhexyl-Sebacat: for more information s. http://www.topas-gmbh.de/dateien/prospekt/dehs_prspe.pdf
[2] This value was NOT measured or verified by ZIG.

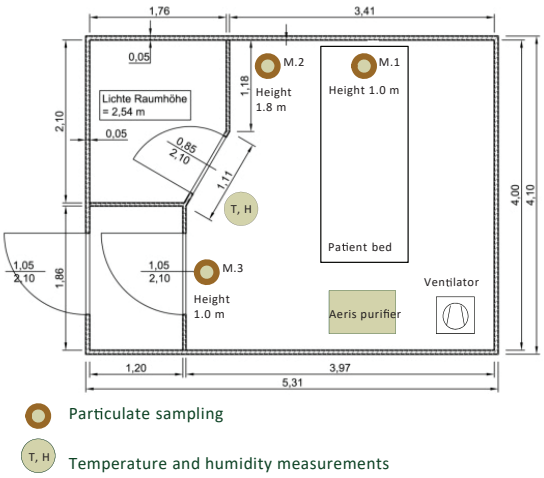


Fig. 2: Testing setup in the "isolation room" test chamber. The volume of the test chamber is approx. 35 m^3.

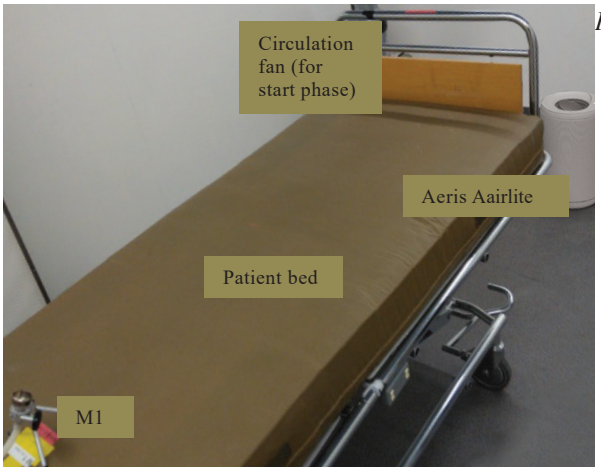
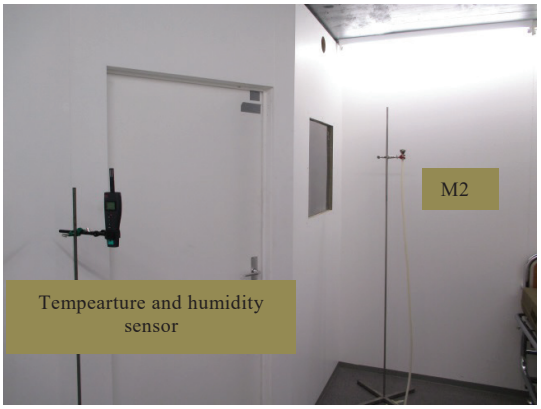


Fig. 3: Testing setup in the "isolation room"



6 Test results

Note: the test aerosol used is DEHS, an organic component that can evaporate by itself and so does not damage or obstruct or foul the tested products. DEHS as an aerosol can vanish slowly with time from the air of the testing chamber, resulting from evaporation, recombination in bigger droplets, from sedimentation on the floor, etc. One should keep this in mind while evaluating the particle counting results. For the evaluation of the particle removal rate, some preliminary measurements at rest[3] have shown that an observation interval of **14 hours** is a reasonable compromise to this respect, which is much higher than the obtained recovery time of the device.

The results are shown on table below and supplied with graphs on *Fig. 4* and *Fig.5*.

The theoretical recovery time was calculated according to the formula in Chapter 8, Annex. 2 of ISO 14644-3:2006 [2]. It equals to 31.5 minutes and results from the ventilation flow: 315 m^3/h in the test chamber of 35 m^3 of net volume (ventilation rate LW = 315/3 = 5.72 h^{-1}). Compared to the theoretical minimum possible time the tested device displays an increase in cleaning time of about 10%.

The results also showed that the current volume flow rate of the device provides good mixing of the air volume inside the chamber (due to the fact that all measured points lie on one straight line).

No.	Criterion	PAC classes / guide value			Values determined				Remarks
		A	B	C					
P.1	**New filter 100:1 recovery time**	$t_{0.01} \leq 20$ minutes	$t_{0.01} \leq 30$ minutes	$t_{0.01} \leq 40$ minutes	**100:1 recovery time at highest fan stage (455 m^3/h)**	**Measuring point**			The most unfavourable value is for point M3 equals to **1,008 %** of initial concentration
						M1	**M2**	**M3**	
					100:1 recovery time [min] $t_{0.01}$	**33:00**	**33:00**	**33:00**	
P.2	**Discharged filter 100:1 recovery time if the filter unit used has been discharged**	$t_{0.01} \leq 20$ minutes	$t_{0.01} \leq 30$ minutes	$t_{0.01} \leq 40$ minutes	**100:1 recovery time at highest fan stage (455 m^3/h)**	**Measuring point**			The most unfavourable value is for point M1 equals to **1,06 %** of initial concentration
						M1	**M2**	**M3**	
					100:1 recovery time [min] $t_{0.01}$	**33:00**	**33:00**	**33:00**	
Hence, the PAC complies with PAC class:			**B**		**(The most unfavourable values for P.1, P.2 and P.3 are representative values for the rating.)**				

PAC: Portable Air Cleaner

[3] Reference measurement with air cleaner shut off

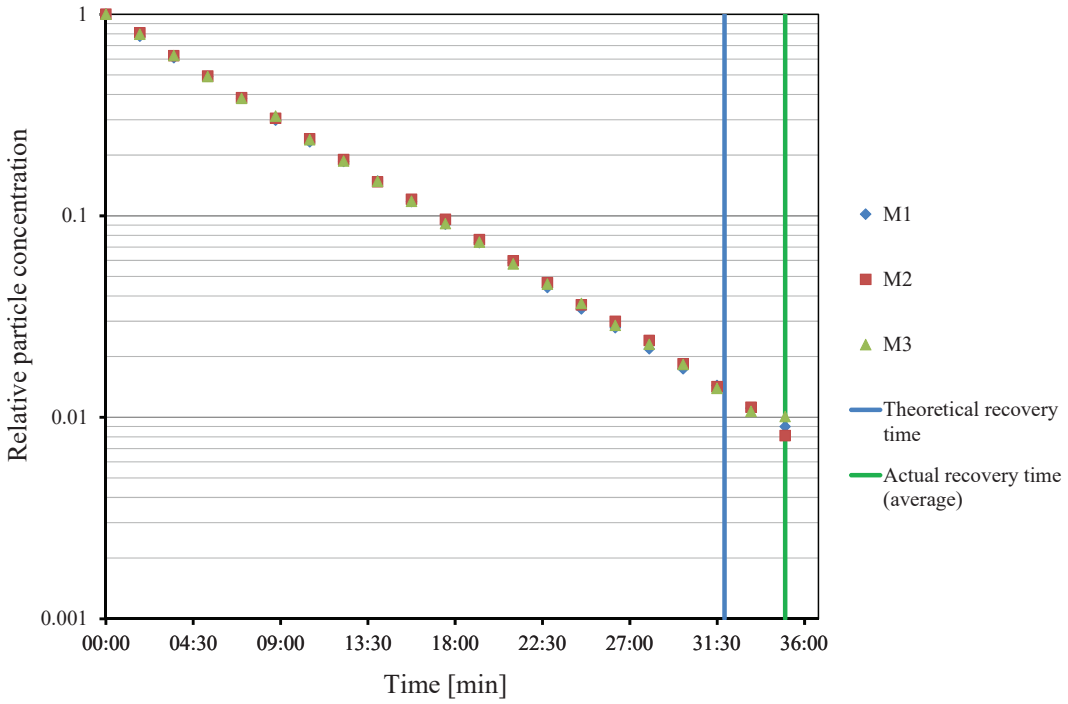


Fig. 4: 100:1 recovery time for New Filter

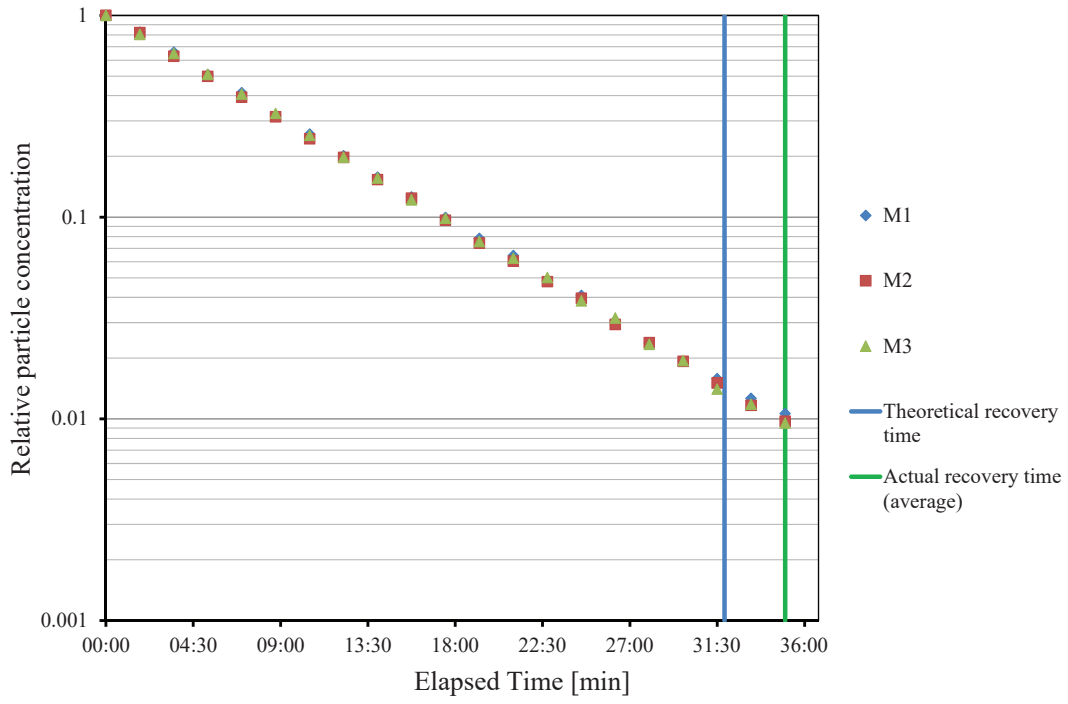


Fig. 5: 100:1 recovery time for Discharged Filter

7 Conclusions

A portable air cleaner was tested upon particle removal in a test chamber according “Test Guideline for Portable Room Air Cleaners” published by Centre for Integrated Building Technology on 14.05.2012.

Using a DEHS aerosol, particle removal rate of above 99.0% have been observed for particle size fraction of 5 µm and above after 33 minutes and 00 seconds of operation.

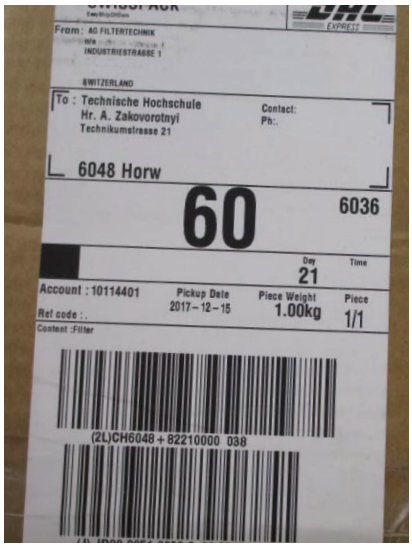
These results are valid for both new and discharged filters.

The results also showed that the current volume flow rate of the device provides good mixing of the air volume inside the chamber.

Note: it was not part of the order to determine the sound emission level or the room air velocity of the tested unit while running in the test chamber. So it has not been possible to carry out a classification of the device according chap. 10 of [1] yet.

The test results described above are only valid for the tested unit.

8 Appendix 1: Photos



9 Appendix 2: Testing equipment

9.1 Particle counter

The particle counter was used to monitor the particle object and measuring the number of particles at the measurement points.

Manufacturer	Met One
Type	Model 3413
Range	0.3 – 10.0 µm
Air suction flow	28.3 L/min
Log. Nr.	1.11 HP 040

9.2 Particle dilutor

The dilutor was used to reduce the particle concentration in the air inlet of particle counter to insure that it works in permeable range.

Manufacturer	Topas GmbH
Type	Dil 550
Dilution factor	100
Air suction flow	28.3 L/min
Log. Nr.	1.11 HP 050

9.3 Temperature and humidity measurement

The combi temperature and humidity measuring device was used to monitor temperature and humidity of air in the test chamber.

Manufacturer	Rotronic
Type	HygroPalm 3.1a
Range	0…100% rh, -50…+200 °C
Accuracy	±1.5% rh, ±0.3K (0.5°F)
Log. Nr.	1.09 HP 088

10 Appendix 3: Literature

[1] Hochschule Luzern: Test Guideline for Portable Room Air Cleaners; Lucerne University of Applied Sciences and Arts; Lucerne; 2012

[2] ISO 14644-3:2006: Reinräume und zugehörige Reinraumbereiche – Prüfverfahren. (in English: Cleanrooms and associated controlled environments - Part 3: Test methods); Beuth Verlag; Berlin; 2006