

Test of Wetality-2001 Air Purifier

Report no. 974403



**DANISH
TECHNOLOGICAL
INSTITUTE**



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Prepared for:
Quantum Vitality Group d.o.o.
1000 Ljubljana
Slovenia
Att: Karsten Poulsen

Prepared by
Teknologisk Institut
Kongsvang Allé 29
8000 Aarhus C

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Author:
Stig Koust Hansen, consultant, ph.d.,
stko@dti.dk, +45 7220 1151

Quality Assurance:
Søren Legarth Brødsgaard, senior consultant, M.Sc.,
slb@teknologisk.dk, +45 7220 1431

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1. Summary

The purpose of the test is to determine the efficiency of the air purifier to reduce the concentration of particles from cigarette smoke using a modified ANSI/AHAM AC-1-2015 method. The tested air purifier is "Wetality-2001 Air Purifier".

The test is performed in a 20 m³ non-ventilated test chamber. The efficiency is expressed as a value for "Clean Air Delivery Rate" (CADR).

In addition, the relative reduction in the concentration 30 minutes after the end of the smoking phase compared with the reference measurement is calculated.

This test both examines the efficiency to reduce particles based on the number and mass concentration.

In addition, it is assessed if the air purifiers give rise to ozone accumulation in the test chamber. This is evaluated by monitoring the ozone concentration in the test chamber continuously for a period of 20 hours.

The air purifier is tested in the period 13th to the 21st of April 2021 at the Danish Technological Institute.

2. Conclusion

Table 1: Summary of results for the test of Beyond Guardian Air

Reduction*		CADR (m ³ /h)	
Particle Mass	Particle Number	Particle Mass	Particle Number
99.7%	99.4%	225	228

* Calculated reduction in the test chamber 30 minutes after the end of the smoking phase compared with the reference measurement

The background ozone concentration in the test chamber was measured to 4±2 ppb prior to the tests. During the test period with air purifier turned on (20 hours) there was not measured any increase in ozone concentration (see Figure 8).

Danish Technological Institute assess that the tested air purifier does not give rise to ozone accumulation.

The protocol for testing is elaborated in Section 3 and the results are presented in detail and graphically in Section 5.



Figure 1: The tested product: Wetality-2001

3. Procedure

For the experiments, cigarette smoke is used as a source of particles. The experiments are carried out in a non-ventilated test chamber of 20 m³, where the walls are covered with Teflon foil to reduce the adsorption of particles. The test chamber is airtight and non-ventilated and is therefore suitable for testing air purifier efficiency (see Figure 3).

The air purifier is tested for particles on fan speed 4 (Maximum fan speed) with the functions "ANION" and "UV" switched on.

Each test begins with the measurement of the background level of particles, and it is ensured that the starting point for all experiments is comparable. When a suitably low background level is reached in the chamber, the smoking phase is initiated. The smoking phase consists of sequential smoking of three cigarettes using a smoking robot over a period of 20 - 25 minutes. An external recirculation fan on low setting is used to circulate the air in the test chamber during the measurements to ensure a homogeneous mixture.

The smoking phase is immediately followed by a 2-minute period where the cigarette smoke is mixed, before the air purifier is turned on. This marks the beginning of the 30-minutes product test period (Figure 2)

Particle concentration data are continuously logged throughout the period of the test. Temperature and relative humidity are also logged continuously. After each test run the test chamber is thoroughly ventilated before beginning the next test run.

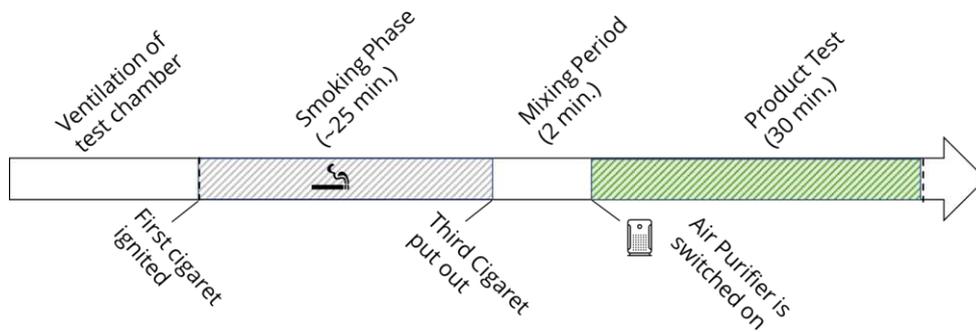


Figure 2: Schematic overview of protocol for testing air purifiers against cigarette smoke.

Reference Measurement:

To measure the natural decay of particles in the test chamber a test run like the one described above is performed, where the air purifier is not turned on.

Calculation of CADR-value¹:

The CADR-value is calculated as described in the method ANSI / AHAM AC-1-2015. A separate CADR value is calculated for each pollution parameter, thus a total of 2 CADR values is calculated (see Table 1). CADR is based on the exponential decay constants for the product test and the reference test (natural decay) found by regression on the concentration profiles.

In addition, the relative reduction during the 30-minute product test is calculated as follows:

$$Reduction = \frac{C_{(reference)} - C_{(product)}}{C_{(reference)}} \cdot 100\%$$

Where $C_{(xxx)}$ denotes the relative reduction in concentration in 30 minutes after the end of the smoking and mixing period for either particles or VOC.

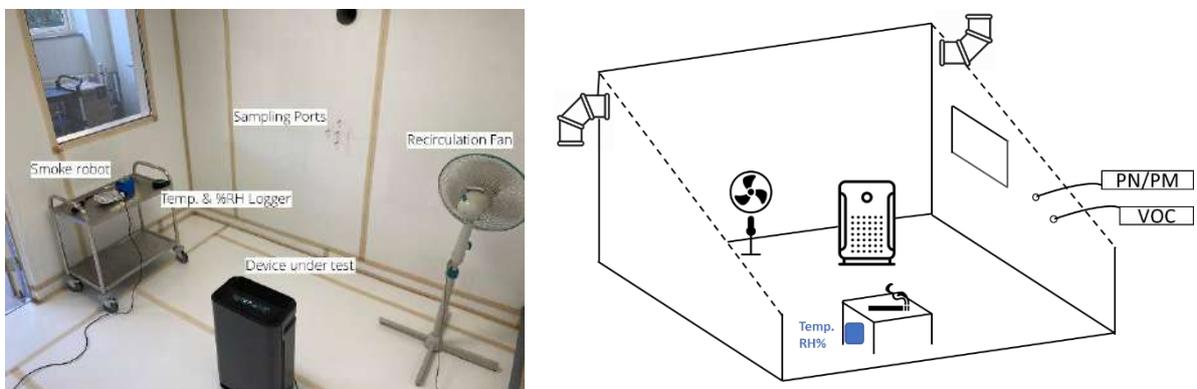


Figure 3: Left) Image of test chamber setup. Right) Schematic overview of test chamber setup. PN = Particle Number Instrument (NANOSCAN), PM = Particle Mass Instrument (DustTrak).

¹ According to "ANSI/AHAM AC-1-2015", Section 8.2 – 8.4.

4. Equipment

4.1. Particle Number Concentration

Particle number concentration was continuously measured with a SMPS Nanoparticle Sizer (TSI NANOSCAN 3910). The instrument counts particles in the size range 10-420 nm (0.01 - 0.42 μm) with a time resolution of 60 seconds. The majority of particles from cigarette smoke is known to be smaller than 0.1 μm (100 nm).

4.2. Particle Mass Concentration

Particle mass concentration was measured continuously with a DustTrak DRX (model 8533, TSI Inc.). The instrument measures particle mass in the size range ~ 0.1 -15 μm and in the concentration range 0.001 – 150 mg/m^3 . The unit measures in the size fractions PM1, PM2.5, PM4, PM10 and PMtotal with a time resolution of 10 seconds. The mass determination is based on an optical principle using laser diffraction.

4.3. Ozone

The ozone concentration was continuously measured with a Teledyne API Ozone Analyzer model 430. The instrument can measure ozone concentration in the range from 0 - 20 000 ppb (20 ppm) with a precision of 0.5 ppb and a lower detection limit of 2 ppb. The measurement was performed with time resolution of 10 seconds.

4.4. Temperature og Relative Humidity

Temperature and relative humidity are measured in the test chamber using a Chauvin Arnoux Air Quality Monitor (C.A 1510) with a time resolution of one minute.

5. Results

The temperature and relative humidity were 21.4 (± 1) °C and 41.0 (± 10) RH%, respectively, during the tests.

The graphical representations of the development in particle concentrations are shown in figure 5 and 6. The results are presented so that the concentration is displayed from the beginning of the smoking phase (approximately 20-25 minutes), followed by a 2-minute mixing period and 30 minutes of product test.

The measurement of particle mass indicates that the PM_{2.5} fraction accounts for more than 98% of the total measured particle mass, hence the calculated efficiency of the air purifier against PM_{2.5} and PM_{total} is considered to be the equal.

Parameter:	Air Purifier Wetality-2001
Particle Mass	Figure 4
Particle Number	Figure 5
Values for CADR	Table 2
Ozone	Figure 6

Reduction - Particle Mass [PM2.5]

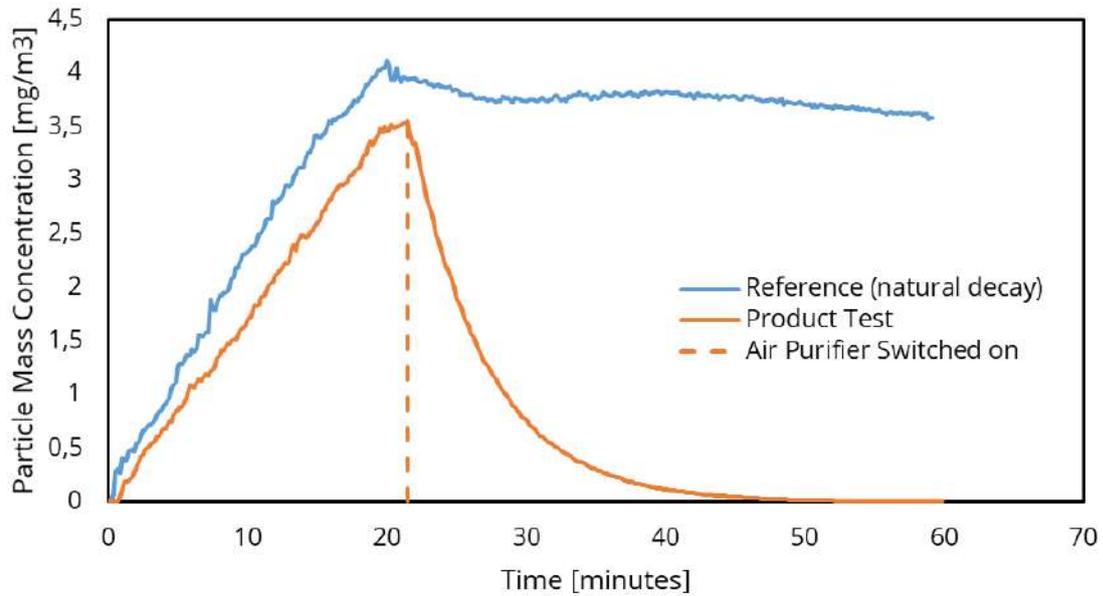


Figure 4: Particle Mass concentration measured over time. The smoke phase occurs during the initial 25 minutes, which is followed by a 2-minute mixing period. Hereafter the air purifier is turned on (only for product test) for 30 minutes.

Reduction in Particle Number (Particles smaller than 0,4 µm)

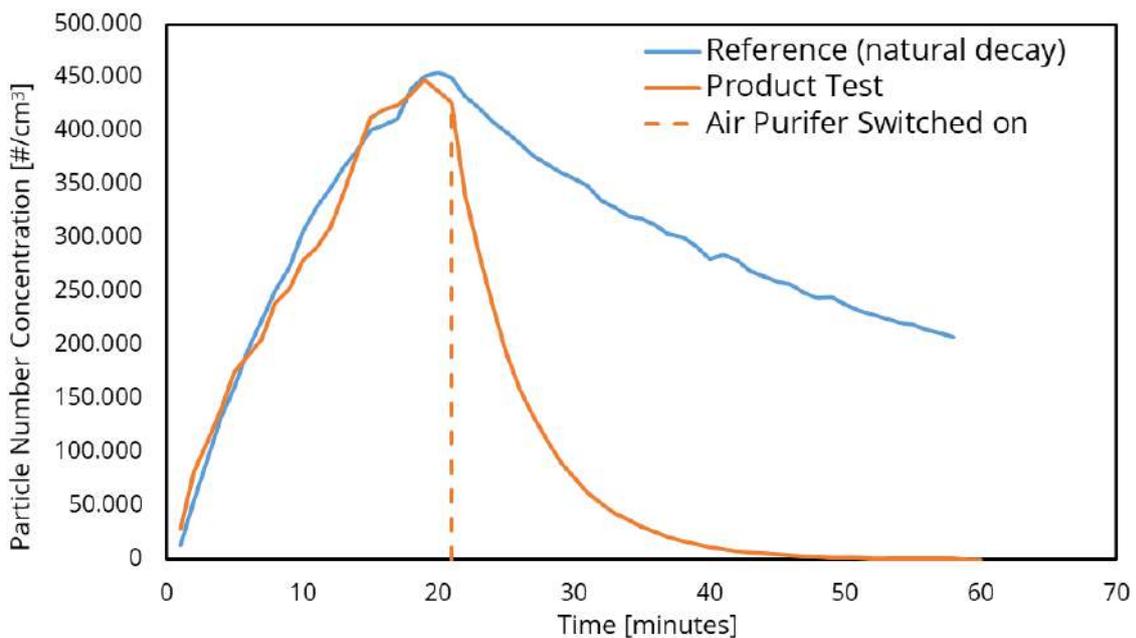


Figure 5: Particle Number concentration measured over time. The smoke phase occurs during the initial 25 minutes, which is followed by a 2-minute mixing period. Hereafter the air purifier is turned on (only for product test) for 30 minutes.

Table 2: Decay constants from exponential fit used for the calculation of CADR-values

	Particle Mass	Particle Number
Reference	0.002	0.002
Max Airflow	0.189	0.192

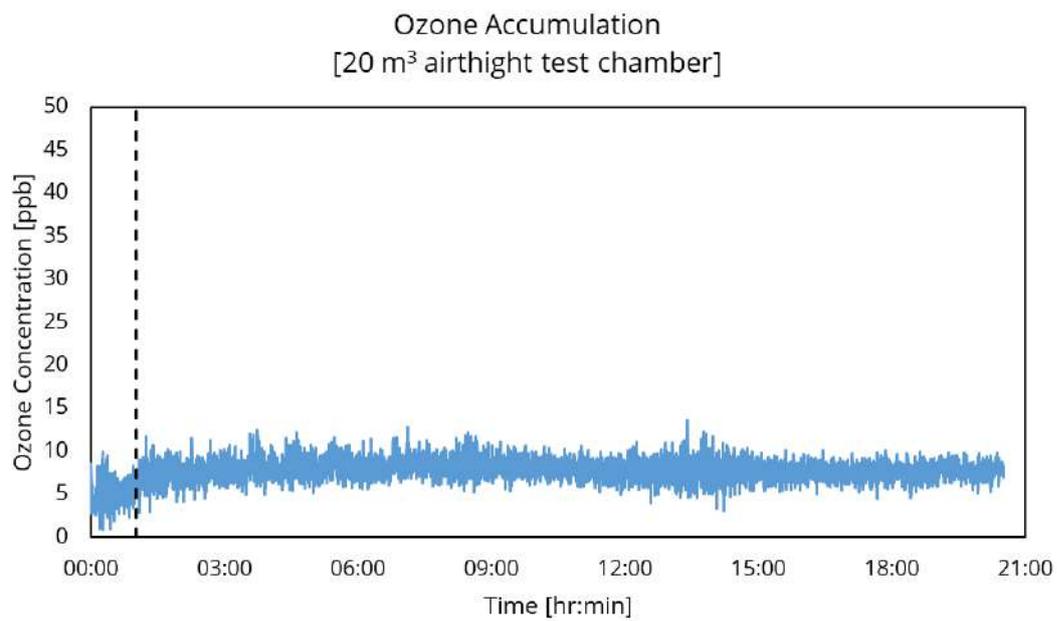


Figure 6: Ozone concentration measured in test chamber during test of Wetality-2001. The dashed line indicates time for switching on the air purifier.