

**INDOOR AIR HYGIENE GROUP**

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**Report No.: TR-KKL-2021-070-R1**

**Test on an Air Cleaner System**

**Client** **VFA Solutions B.V.**  
Admiraal de Ruyterstraat 2  
3115 HB Schiedam, The Netherlands

**Testing object** Air Cleaner System  
"ASPRA elektrostatische precipitation section"  
with filter "EF-80 + HAF-2 = EF-110"

**Order** D404/600313-20210315 7  
dated 17.03.2021

**Arrival of the testing object** 13.04.2021

**Content of order** Determination of retention efficiency for different  
particle sizes and air flow rates and – if definable –  
documentation of the "Most Penetration Particle Size"  
using monodisperse particulate matter of DEHS

**Standard of test** Based on DIN EN ISO 29463-5:2019

**Test period** April to June 2021

*This revised report replaces the previous test report TR-KKL-2021-070 dated 08 July 2021.*

**The test report consists of 7 pages.**

The test results refer exclusively to the test objects.  
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## 1 Introduction

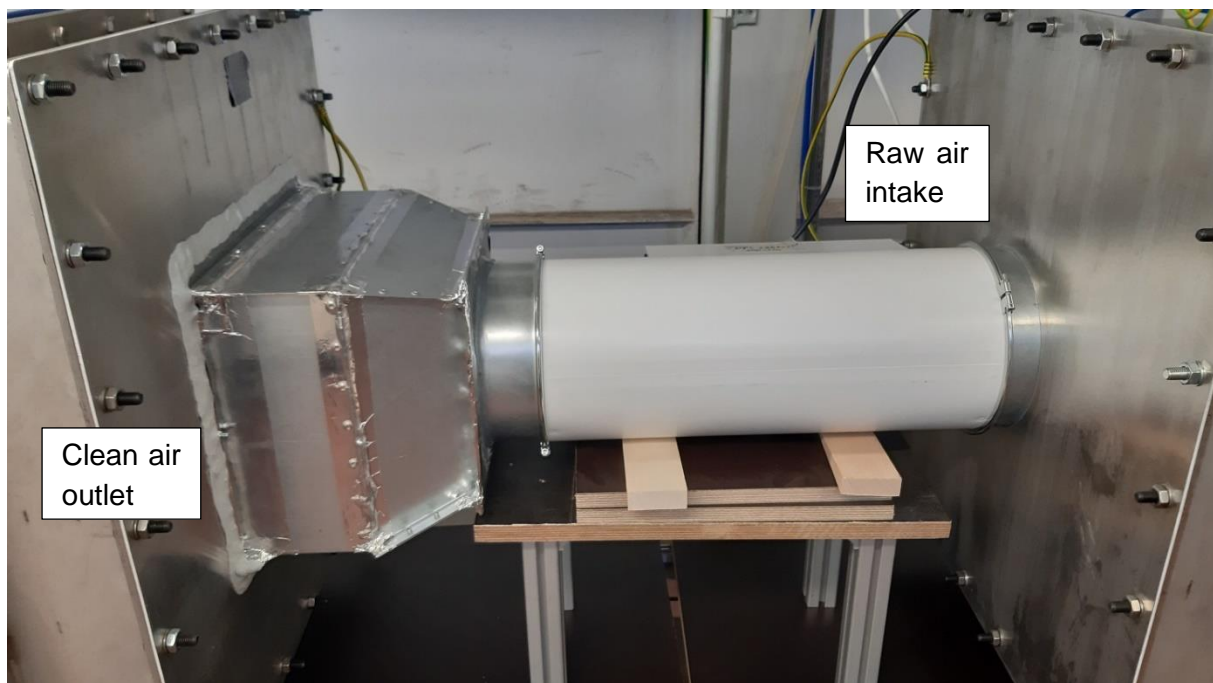
The Air Cleaner System "ASPRA elektrostatische precipitation section" of VFA Solutions is tested based on "DIN EN ISO 29463-5:2019" and the standards cited therein.

Chapter 2 provides a general overview of the test object and test conditions. The results of the test are listed in Chapter 3. The tests are carried out in the Air Hygiene Testing Laboratory, DMT GmbH & Co. KG, Essen (Germany).

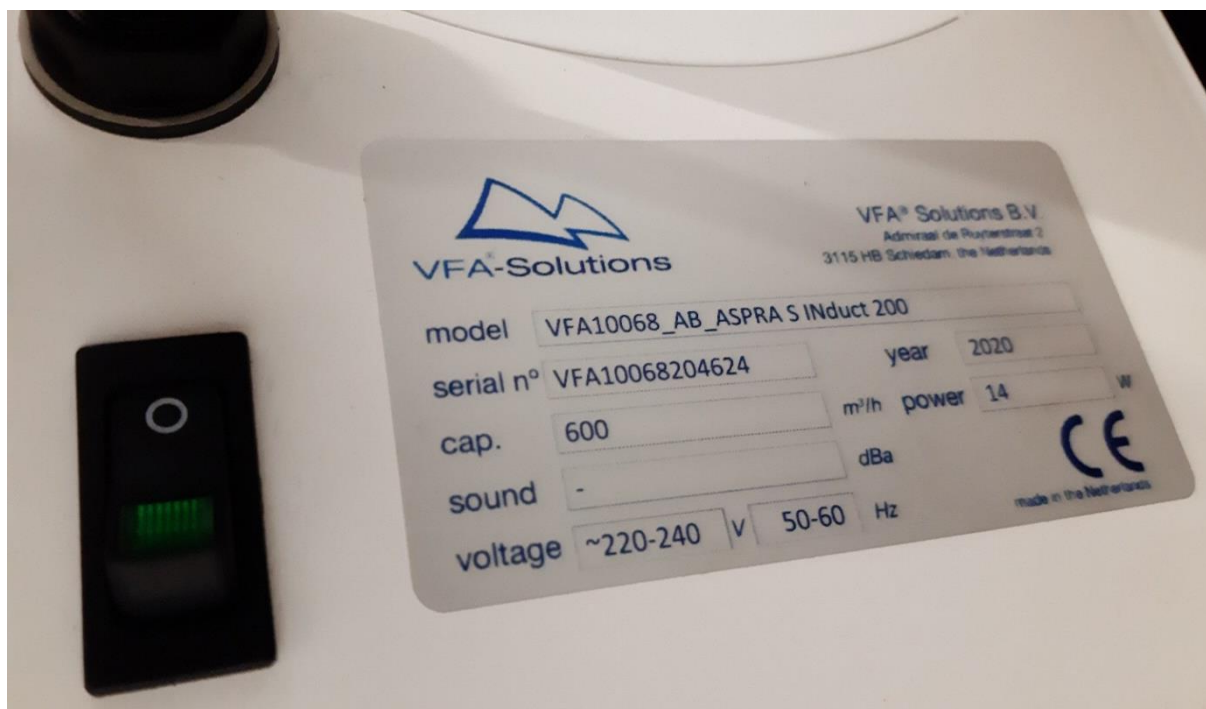
## 2 Testing object and test conditions

### 2.1 Description of the test object

Figures 1 and 2 show a photograph and the identification plate of the tested Air Cleaner System.



**Figure 1: Photograph of the Air Cleaner System – "ASPRA elektrostatische precipitation section" (integrated in the test rig)**



**Figure 2: Identification plate of the Air Cleaner System – "ASPRA electrostatic precipitation section"**

## 2.2 Test conditions and procedure

The test object is set up in a test rig according to DIN EN ISO 29463-5:2019. In contrast to the standard, the test object is an air cleaner system and not only a filter element. Adapters are used to connect the test object to the test rig (cf. Figure 1).

The determination of the retention efficiency follows chapter 8.4.1 and 8.4.2 according to DIN EN ISO 29463-5:2019. The test aerosol is DEHS (di-ethyl-hexyl-sebacate). The tests are carried out on two operating points. Point 1: air flow rate 300 m<sup>3</sup>/h and particle size range 0,07 – 0,25 µm. Point 2: air flow rate 175 m<sup>3</sup>/h and particle size range 0,03 – 0,30 µm.

DIN EN ISO 29463-5:2019 ("High-efficiency filters and filter media for removing particles in air – Part 5: Test method for filter elements") describes the test methods for high-efficiency filters. DIN EN 1822-1:2019 ("High efficiency air filters (EPA, HEPA and ULPA) – Part 1: Classification, performance testing, marking") describes the requirements of high efficiency air filters for EPA, HEPA and ULPA classes.

### 3 Test results

#### 3.1 Retention efficiency at operating point 1

Boundary conditions:

- air flow rate 300 m<sup>3</sup>/h
- particle size range 0,07 – 0,25 µm
- ionizer: in operation

**Table 1: Retention efficiency E<sub>95</sub> %**

Particle size	Efficiency E <sub>95</sub> %
µm	%
0,070	99,9359
0,087	99,9291
0,107	99,9169
0,132	99,8990
0,164	99,8744
0,202	99,8482
0,250	99,8310

#### 3.2 Retention efficiency at operating point 2

Boundary conditions:

- air flow rate 175 m<sup>3</sup>/h
- particle size range 0,03 – 0,30 µm
- ionizer: in operation

**Table 2: Retention efficiency E<sub>95</sub> %**

Particle size	Efficiency E <sub>95</sub> %
µm	%
0,030	99,9412
0,044	99,9733
0,065	99,9832
0,095	99,9868
0,139	99,9878
0,204	99,9858
0,300	99,9828

### 3.3 Complete results of measurements at operating point 1

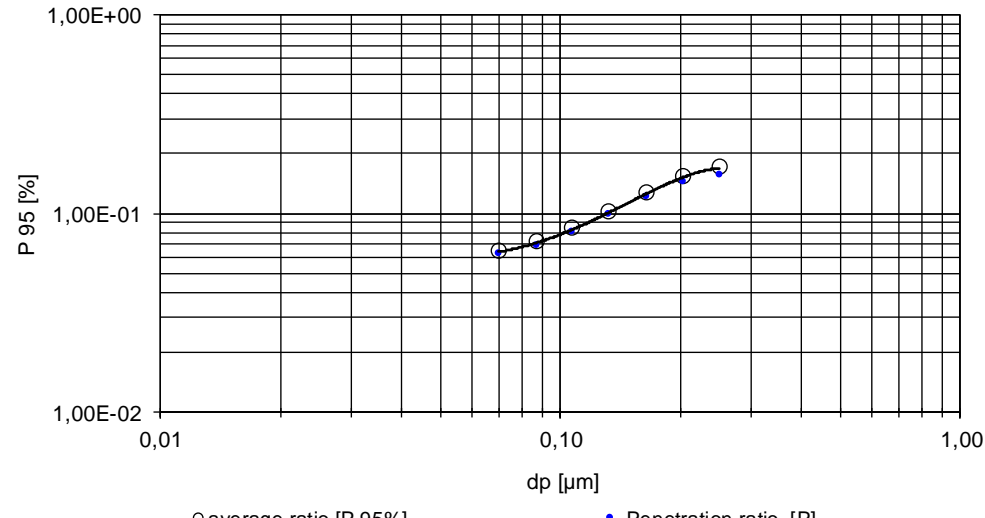
Table 3 contains all results of the measurements at operating point 1.

**Table 3: Measurements at operating point 1**

Client/Customer		VFA Solutions B.V.					
Name of the air cleaner system		ASPRa elektrostatische precipitation section					
DMT code		PPS 2 00 056 21.1					
Particle measuring device		Up CPC TSI Mod. 3750; Dn CPC Mod. TSI 3750					
Test aerosol; aerosol-generator		DEHS monodispers; DMA TSI Mod. 3080					
				Test date			
Nominal flow rate		300	m <sup>3</sup> /h	16.06.2021			
Nominal Air speed in filter medium		0,9	m/s				
Flow area		0,0921	m <sup>2</sup>	Comment			
Average volumetric test flow		301,17	m <sup>3</sup> /h	Ionizer in operation			
Flow Velocity Collector		0,91	m/s	Filter: EF-80 + HAF-2 = EF-110			
		p1 [Pa]	p2 [Pa]	p3 [Pa]	p4 [Pa]	p5 [Pa]	
Pressure drop		51	0	0	0	0	
Average pressure drop		51	Pa	temperature	24,4	°C	
Most penetration particle size		MPPS is not definable		humidity	41,0	%	
Penetration <sub>95%</sub> for MPPS		--		abs. pressure	1002	mbar	
dp [µm]	0,070	0,087	0,107	0,132	0,164	0,202	0,250
P 1 <sub>95%</sub>	0,0641	0,0709	0,0831	0,1010	0,1256	0,1518	0,1690
P 2 <sub>95%</sub>							
P 3 <sub>95%</sub>							
P 4 <sub>95%</sub>							
P 5 <sub>95%</sub>							
P <sub>95%</sub>	0,0641	0,0709	0,0831	0,1010	0,1256	0,1518	0,1690
E <sub>95%</sub>	99,9359	99,9291	99,9169	99,8990	99,8744	99,8482	99,8310
P	0,0620	0,0686	0,0803	0,0974	0,1197	0,1421	0,1531

**Penetration ratio**



○ average ratio [P 95%]      • Penetration ratio [P]

### 3.4 Complete results of measurements at operating point 2

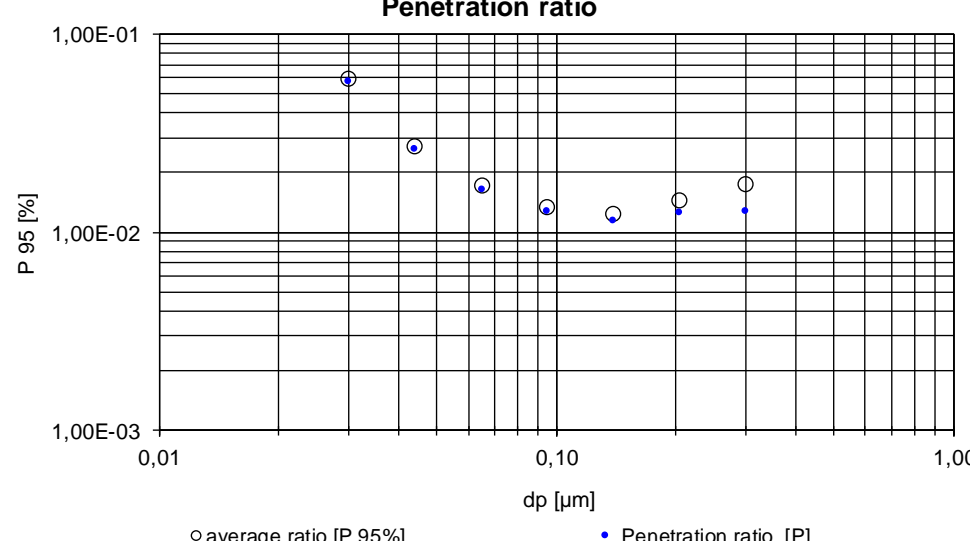
Table 4 contains all results of the measurements at operating point 2.

**Table 4: Measurements at operating point 2**

Client/Customer Name of the air cleaner system DMT code Particle measuring device Test aerosol; aerosol-generator		VFA Solutions B.V. ASPRa elektrostatic precipitation section PPS 2 00 056 21.1 Up CPC TSI Mod. 3750; Dn CPC Mod. TSI 3750 DEHS monodispers; DMA TSI Mod. 3080					
						Test date	
Nominal flow rate		175	m <sup>3</sup> /h	24.06.2021			
Nominal Air speed in filter medium		0,5	m/s				
Flow area		0,0921	m <sup>2</sup>	Comment			
Average volumetric test flow		175,03	m <sup>3</sup> /h	Ionizer in operation			
Flow Velocity Collector		0,53	m/s	Filter: EF-80 + HAF-2 = EF-110			
Pressure drop		p1 [Pa]	p2 [Pa]	p3 [Pa]	p4 [Pa]	p5 [Pa]	
		23	0	0	0	0	
Average pressure drop		23	Pa	temperature	23,2	°C	
Most penetration particle size		MPPS is not definable		humidity	50,2	%	
Penetration <sub>95%</sub> for MPPS		--		abs. pressure	1006	mbar	
dp [µm]	0,030	0,044	0,065	0,095	0,139	0,204	0,300
P 1 <sub>95%</sub>	0,0588	0,0267	0,0168	0,0132	0,0122	0,0142	0,0172
P 2 <sub>95%</sub>							
P 3 <sub>95%</sub>							
P 4 <sub>95%</sub>							
P 5 <sub>95%</sub>							
P <sub>95%</sub>	0,0588	0,0267	0,0168	0,0132	0,0122	0,0142	0,0172
E <sub>95%</sub>	99,9412	99,9733	99,9832	99,9868	99,9878	99,9858	99,9828
P	0,0568	0,0259	0,0163	0,0126	0,0113	0,0123	0,0126

**Penetration ratio**



○ average ratio [P 95%]      ● Penetration ratio [P]

#### **4 Conclusion**

The Air Cleaner System "ASPRA electrostatic precipitation section" of VFA Solutions is tested with the method described above. It is not possible to determine the Most Penetrating Particle Size ("MPPS") and a filter class according to DIN EN 1822-1 cannot be assigned. The results show a retention efficiency between 99,8310 % and 99,9359 % at operating point 1 and between 99,9412 % and 99,9878 % at operating point 2 for the Air Cleaner System "ASPRA electrostatic precipitation section".

Essen, 14 July 2021

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Project manager Indoor Air Hygiene Group