PERFORMANCE TEST OF AN ELECTRICAL PRECIPITATOR

CAET_001.EVS
592 x 592 x 300 mm
With Aluminium plates

TEST REPORT: IN 230601-PL1

July 31st, 2023

According to EN 1822-1:2019
and ISO 29463-5:2022

Initiated by:

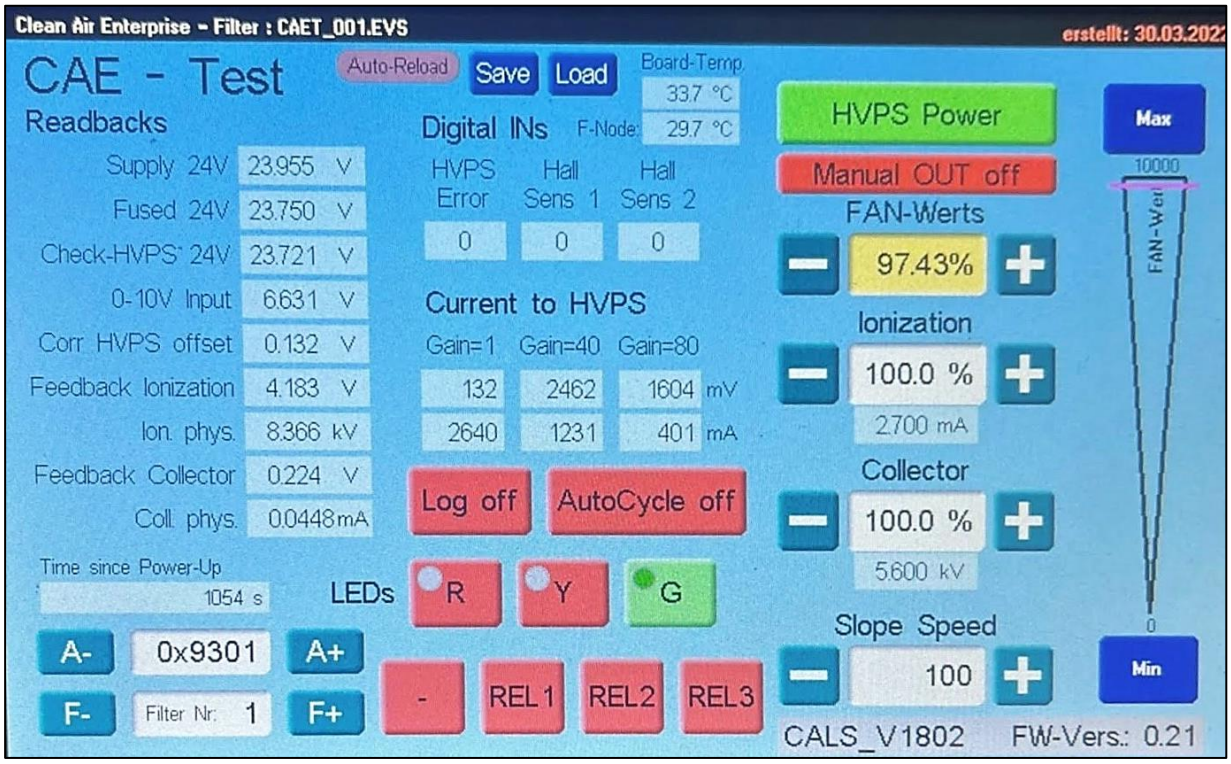
InnoRat GmbH

Requested by:	InnoRat GmbH Wannenhofstrasse 41 UNTERKULM AG, CH-5726 SWITZERLAND
Contact person:	Mr. Kaspar Schindler

1. Subject: Performance test of an electrical precipitator according to ISO 29463-5:2022.
   Comment: EN 1822 part 2 to part 5 has been replaced by the corresponding parts of ISO 29463. Certification is according to EN 1822-1:2019

Test specimen:	Electrical precipitator
Model / Parts ID:	Clean Air Enterprise - Filter: CAET_001.EVS
Additional identification:	Power supply: 24V (not tested) – see picture below
Media type:	Aluminium plates under voltage
Upstream side:	Side with prefilter grid
Dimensions:	592 x 592 x 300 mm
Nominal air flow:	2523 / 1262 / 631 m³/h
Ambient pressure:	963 mbar
Samples received:	July 25th, 2023
Test performed:	July 25th, 2023

Settings Filter Unit:



2. Test method: Test has been performed according to the procedures as defined in ISO 29463-5:2022 "High-efficiency filters and filter media for removing particles in air – Part 5: Test method for filter elements".

3. Variations from the test standard: None.

4. Conditioning method (discharging): Not discharged (Electrical precipitator).

5. Refer to data summary for details of instrumentation (page 4).

6. General remark: This test report consists of 9 pages and must only be published in full wording. Publication of parts of this report is only permissible with written authorisation of fiatec GmbH experts.

7. Results: See test report for detailed information.
The findings are summarized on page 4.

7.1. According to the classification requirements described in EN 1822-1:2019 the filter element complies with the grade:
E11 at a nominal air flow of 2523 m³/h and a media velocity of **2,0 m/s**.
E12 at a nominal air flow of 1262 m³/h and a media velocity of **1,0 m/s**.
E12 at a nominal air flow of 631 m³/h and a media velocity of **0,5 m/s**.This is a theoretical classification since the MPPS cannot exactly be determined.

7.2. The results apply to the tested specimen only. Filtration performance under certain application conditions cannot necessarily be predicted from these data.

7.3. The marking of the tested filter does not comply with all requirements of the standard described in chapter 9. No label found.

7.4. The net effective face area of 0,35 m² was calculated using the overall dimensions:
Note: This calculated value can differ from the total used media area as calculated by the manufacturer of the filter. Also for example small variations in the pleat height can cause some % difference.

Monday, July 31st, 2023

Matthias Eber
(Managing Director)

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Test report according to EN 1822:2019 (ISO 29463-5:2018)
Report number: IN 230601-PL1

Data summary

GENERAL

Testing organsiation:	fiatec GmbH, Germany, Burgkunstadterstr. 3 , 95336 Mainleus, +49(0)9229 99390				
Test sample no.:	PL1	Date of test:	25.07.2023	Supervisor:	Matthias Eber
Test requested by:	InnoRat GmbH			Samples received:	25.07.2023
Samples submitted by:	InnoRat GmbH			Lab Technician:	Susanne Weiß

DETAILS OF TEST SAMPLES

Model: Clean Air Enterprise - Filter: CAET_001.EVS	Manufacturer: InnoRat GmbH	Filter state: New
Construction: Electrical precipitator with power supply: 24V	Calc. net effective face area [m²]: 0,35	Number of samples: 1
Overall sample dimensions [mm]: ca. 592 x 592 x 300	Type of media: Aluminium plates under voltage	Article number or LOT number Not indicated
Additional information:		

TEST PARAMETERS

Air flow:	[m³/h]	**2523 / 1262 / 631**
Media velocity:	[m/s]	**2,0 / 1,0 / 0,5**
Temperature:	[°C]	23
Rel. humidity:	[%]	52
Ambient pressure:	[mbar]	963
Pressure at sample loc.:	[Pa]	0
Mounting orientation filter:		vertical
Median diam. test aerosol:	[nm]	180
Geom. standard deviation (Aerosol):		1,63

TEST INSTRUMENTATION

Aerosol:	PAO (pure), polydisperse
Sampling probe:	fixed
Sampling diameter / sample flow:	2 mm / 0.4 l/min
Particle generator:	TDA4B Laskin
Particle detector:	SMPS (TSI Inc.)
	same for concentration up / down
Neutralizer:	N/A
Dilution system:	N/A
Pressure transducer (range):	0 - 100 Pa

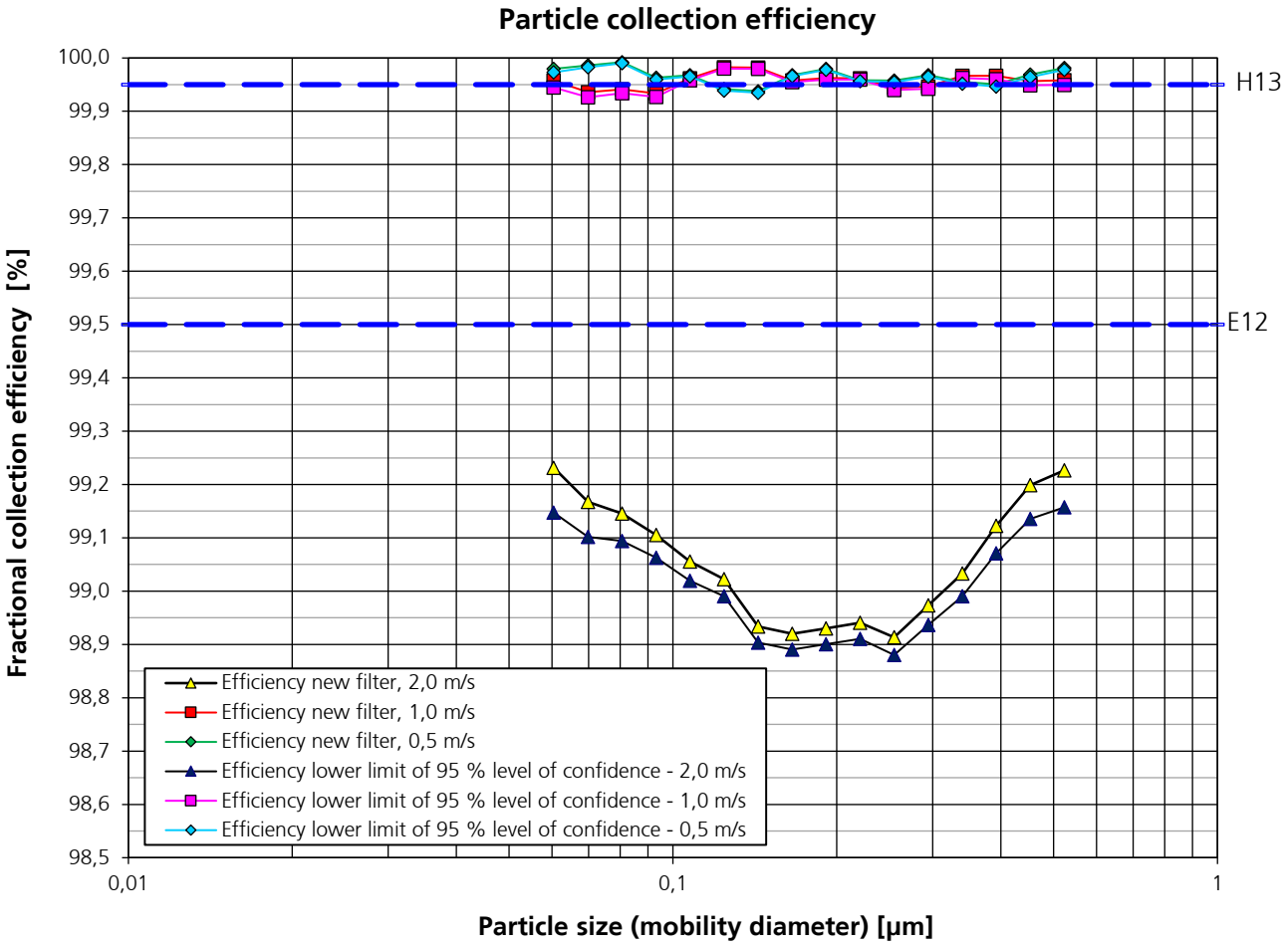
TEST RESULTS

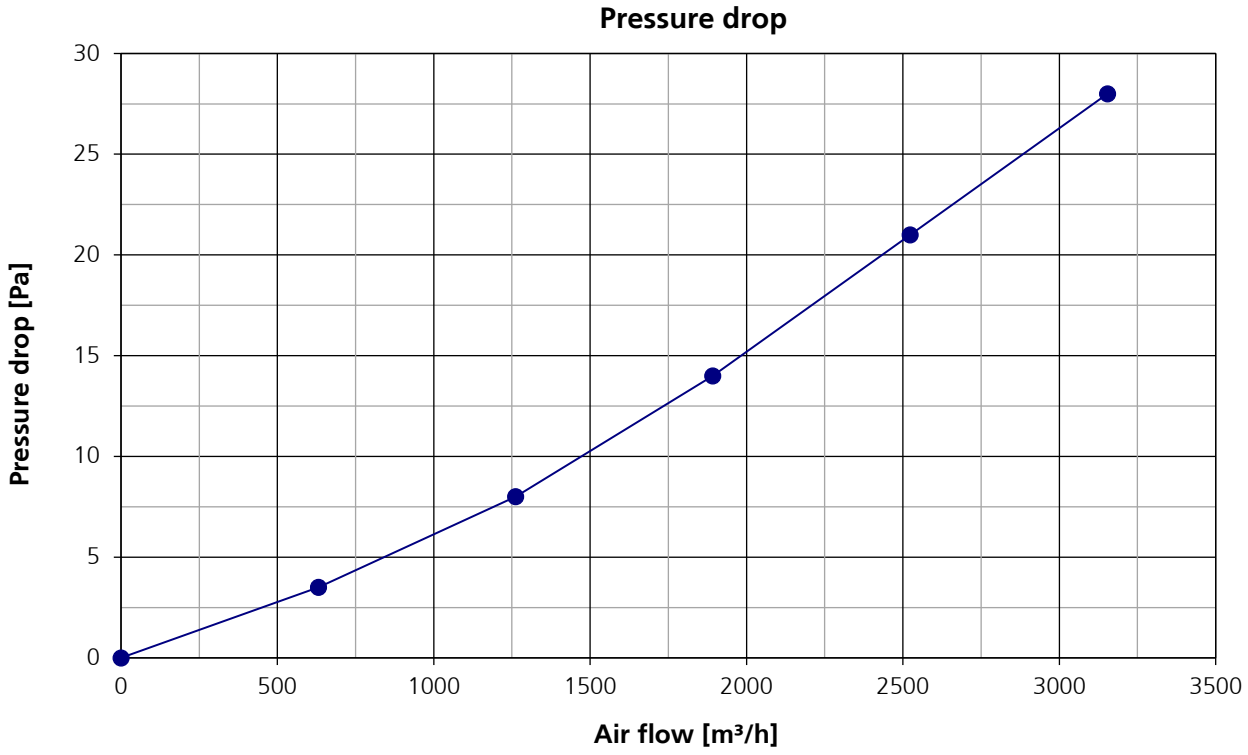
	At start of test	At end of test	
Mean initial differential pressure drop [Pa]	21	24	2,0 m/s
Mean initial differential pressure drop [Pa]	8	8	1,0 m/s
Mean initial differential pressure drop [Pa]	4	4	0,5 m/s

	2,0 m/s	**1,0 m/s**	**0,5 m/s**
MPPS new [µm]	Cannot exactly be determined	Cannot exactly be determined	Cannot exactly be determined
Mean Eff. at MPPS [%]	98,913	99,933	99,938
Mean $E_{95\%}$ at MPPS [%]	98,880	99,926	99,935
Theor. Filter grade:	**E11**	**E12**	**E12**

31.07.2023

Date Signature


Particle collection efficiency
Fractional collection efficiency [%]
100,0
99,9
99,8
99,7
99,6
99,5
99,4
99,3
99,2
99,1
99,0
98,9
98,8
98,7
98,6
98,5
H13
E12
Efficiency new filter, 2,0 m/s
Efficiency new filter, 1,0 m/s
Efficiency new filter, 0,5 m/s
Efficiency lower limit of 95 % level of confidence - 2,0 m/s
Efficiency lower limit of 95 % level of confidence - 1,0 m/s
Efficiency lower limit of 95 % level of confidence - 0,5 m/s
0,01
0,1
1
Particle size (mobility diameter) [µm]


Pressure drop
Pressure drop [Pa]
30
25
20
15
10
5
0
0
500
1000
1500
2000
2500
3000
3500
Air flow [m³/h]

Data tables, new filter element

Table 1: Pressure drop

Air flow	Media velocity	$_{\Delta}$p at start of test
[m³/h]	[cm/s]	[Pa]
0	0,0	0
631	50,0	4
1262	100,0	8
1892	150,0	14
2523	**200,0**	**21**
3154	250,0	28

Table 2: Efficiencies and lower limit of 95%-level of confidence - at 2,0 m/s

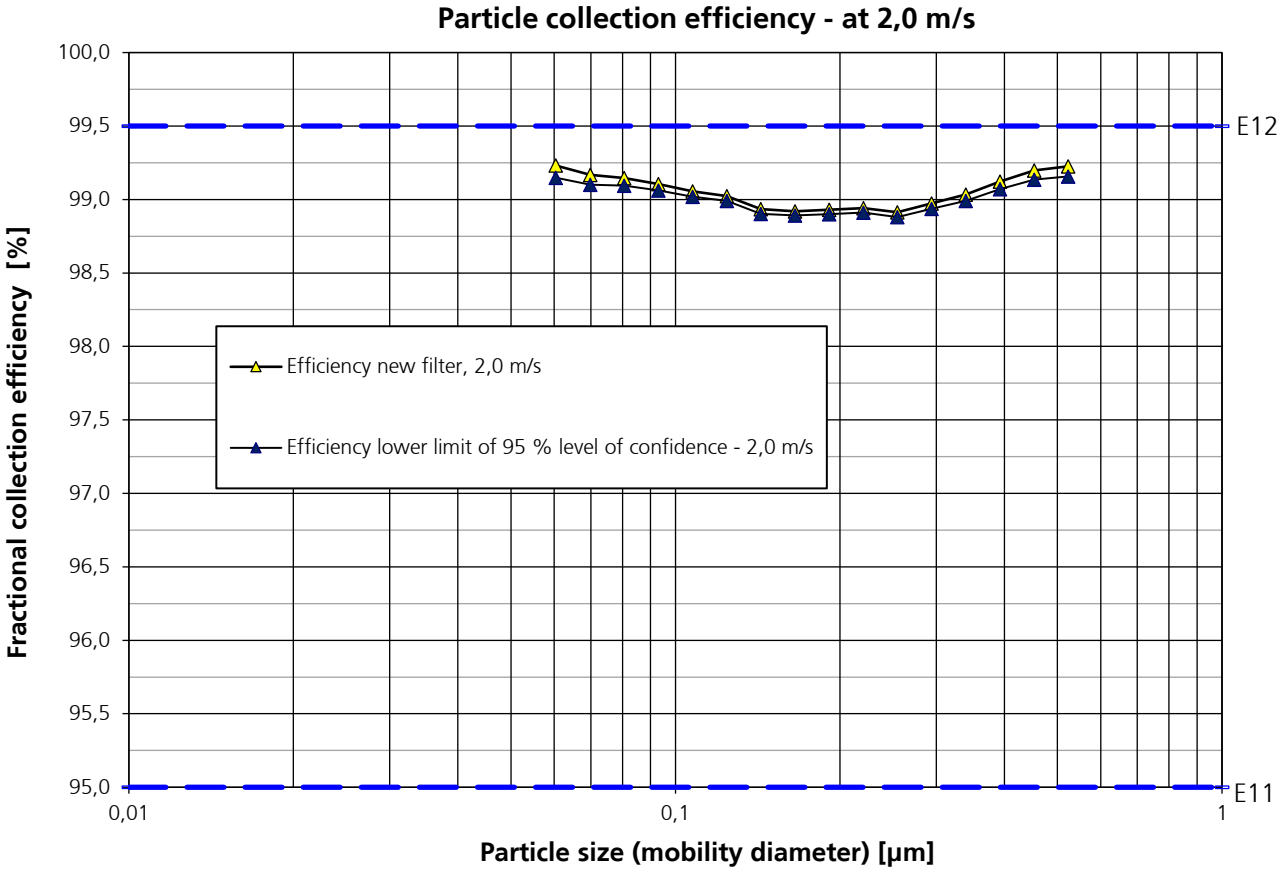
Particle size [µm]	Efficiency [%]	Efficiency, 95% min [%]	Penetration [%]	Penetration, 95% [%]
0,060	99,232	99,147	0,768	0,853
0,070	99,167	99,101	0,833	0,899
0,081	99,146	99,094	0,854	0,906
0,093	99,105	99,063	0,895	0,937
0,108	99,055	99,020	0,945	0,980
0,124	99,022	98,990	0,978	1,010
0,143	98,934	98,903	1,066	1,097
0,166	98,920	98,891	1,080	1,109
0,191	98,930	98,901	1,070	1,099
0,221	98,940	98,910	1,060	1,090
0,255	98,913	98,880	1,087	1,120
0,294	98,973	98,936	1,027	1,064
0,340	99,033	98,990	0,967	1,010
0,392	99,122	99,071	0,878	0,929
0,453	99,199	99,135	0,801	0,865
0,523	99,226	99,157	0,774	0,843

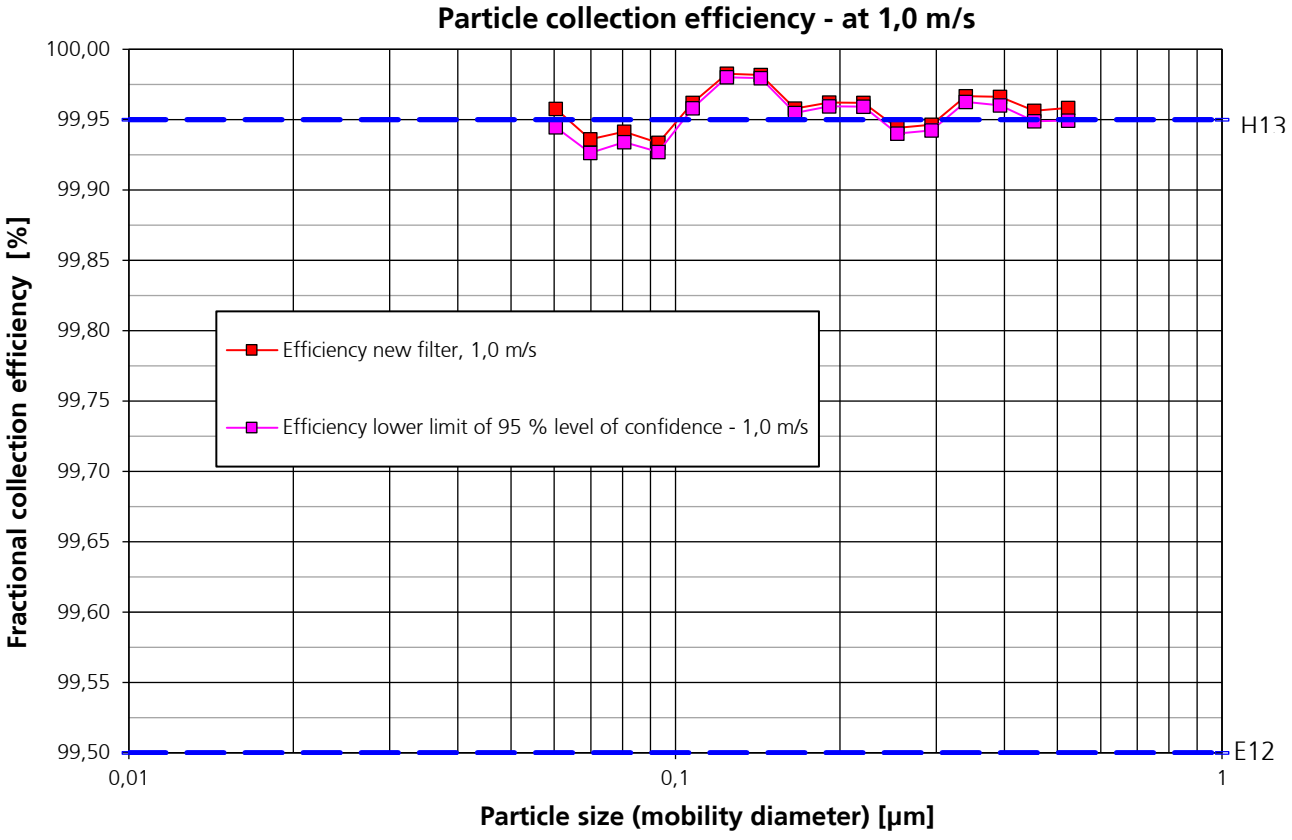
Table 3: Efficiencies and lower limit of 95%-level of confidence - at 1,0 m/s

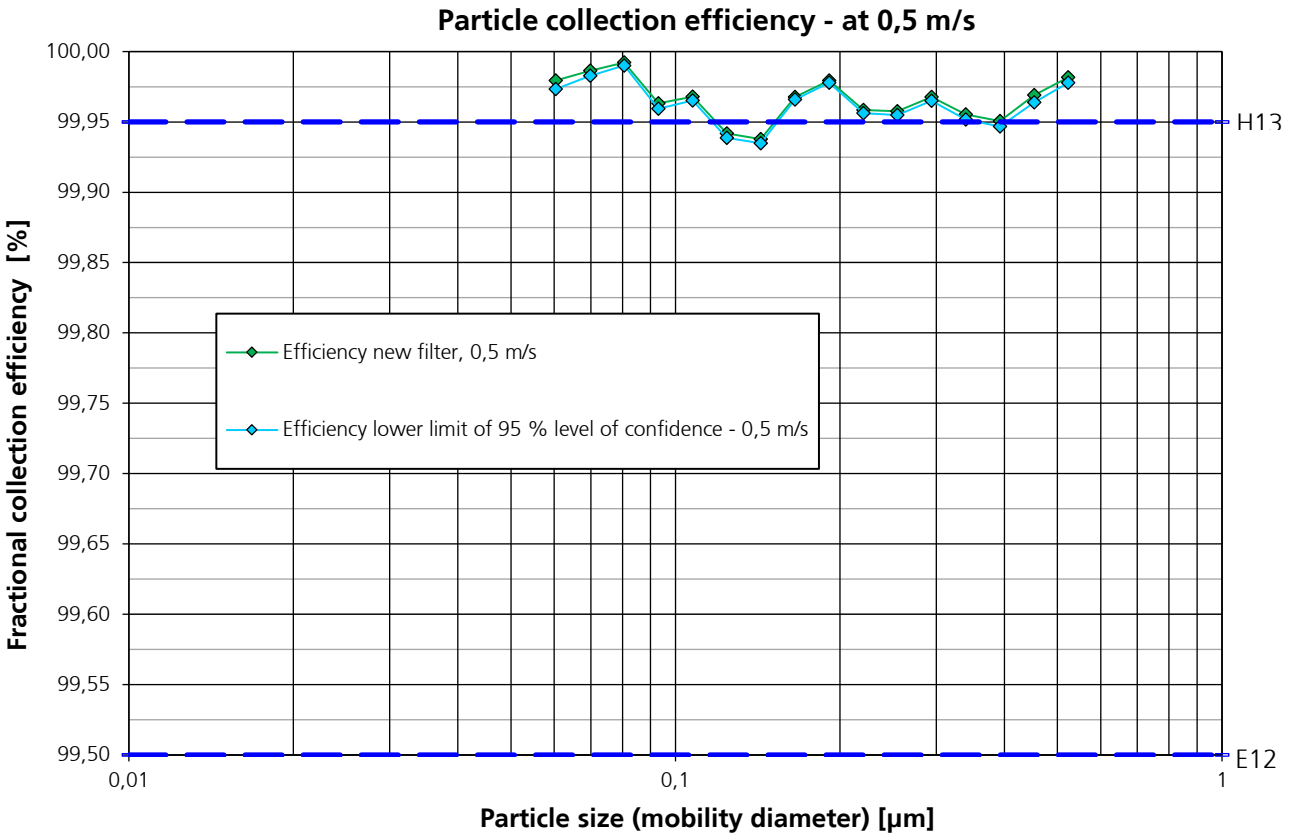
Particle size [µm]	Efficiency [%]	Efficiency, 95% min [%]	Penetration [%]	Penetration, 95% [%]
0,060	99,958	99,945	0,042	0,055
0,070	99,936	99,926	0,064	0,074
0,081	99,941	99,934	0,059	0,066
0,093	99,933	99,927	0,067	0,073
0,108	99,962	99,958	0,038	0,042
0,124	99,983	99,980	0,017	0,020
0,143	99,982	99,980	0,018	0,020
0,166	99,958	99,955	0,042	0,045
0,191	99,962	99,959	0,038	0,041
0,221	99,962	99,959	0,038	0,041
0,255	99,944	99,940	0,056	0,060
0,294	99,946	99,942	0,054	0,058
0,340	99,967	99,963	0,033	0,037
0,392	99,966	99,960	0,034	0,040
0,453	99,956	99,949	0,044	0,051
0,523	99,958	99,949	0,042	0,051

Table 4: Efficiencies and lower limit of 95%-level of confidence - at 0,5 m/s

Particle size [µm]	Efficiency [%]	Efficiency, 95% min [%]	Penetration [%]	Penetration, 95% [%]
0,060	99,979	99,973	0,021	0,027
0,070	99,986	99,983	0,014	0,017
0,081	99,992	99,990	0,008	0,010
0,093	99,963	99,959	0,037	0,041
0,108	99,968	99,965	0,032	0,035
0,124	99,942	99,939	0,058	0,061
0,143	99,938	99,935	0,062	0,065
0,166	99,968	99,966	0,032	0,034
0,191	99,979	99,978	0,021	0,022
0,221	99,959	99,956	0,041	0,044
0,255	99,958	99,955	0,042	0,045
0,294	99,968	99,965	0,032	0,035
0,340	99,955	99,952	0,045	0,048
0,392	99,951	99,947	0,049	0,053
0,453	99,969	99,964	0,031	0,036
0,523	99,982	99,978	0,018	0,022


Particle collection efficiency - at 2,0 m/s
100,0
99,5
99,0
98,5
98,0
97,5
97,0
96,5
96,0
95,5
95,0
E12
E11
Fractional collection efficiency [%]
Efficiency new filter, 2,0 m/s
Efficiency lower limit of 95 % level of confidence - 2,0 m/s
0,01
0,1
1
Particle size (mobility diameter) [µm]


Particle collection efficiency - at 1,0 m/s
100,00
99,95
99,90
99,85
99,80
99,75
99,70
99,65
99,60
99,55
99,50
H13
E12
Fractional collection efficiency [%]
Efficiency new filter, 1,0 m/s
Efficiency lower limit of 95 % level of confidence - 1,0 m/s
0,01
0,1
1
Particle size (mobility diameter) [µm]


Particle collection efficiency - at 0,5 m/s
100,00
99,95
99,90
99,85
99,80
99,75
99,70
99,65
99,60
99,55
99,50
H13
E12
Fractional collection efficiency [%]
Efficiency new filter, 0,5 m/s
Efficiency lower limit of 95 % level of confidence - 0,5 m/s
0,01
0,1
1
Particle size (mobility diameter) [µm]