



REPORT

issued by an Accredited Testing Laboratory

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Reference
PX27501F

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Vokes Air AB
512 85 SVENLJUNGA

Testing of Air Filter according to EN779:2012

(3 appendices)

A test according to EN 779:2012 was carried out by request from Vokes Air AB.

Tested item

Vokes Air AB, Revo II M6 592x592x635 5P 25H, PP Plastic + Gsk,
art no: 3550630464, 592 mm x 592 mm x 635 mm, 5 pocket air filter.

The item was handed to SP by Vokes Air AB on December 13, 2013.

The item was without visible defects.

Date and Place

The test was carried out at SP's laboratory of Energy Technology in Borås, Sweden on December 27, 2012 (initial measurements) and January 9, 2013.

Test method

The test was carried out according to standard EN 779:2012 "Particulate air filters for general ventilation – Determination of the filtration performance".

Results

The results are presented in appendix 1 and are valid only for the items tested.

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Measurement equipment

- Pressure gauge Furness model 318, SP's inventory no. 901 568 (static P Filter)
- Pressure gauge Furness model 318, SP's inventory no. 901 569 (static P Flow)
- Pressure gauge Furness FC012, SP's inventory no. 201 691 (ΔP Filter)
- Pressure gauge Furness FC012, SP's inventory no. 201 690 (ΔP Flow)
- Particle counter Las-X II, SP's inventory no. 701 378
- Barometer, Testo 511, SP's inventory no. 701 274
- Temperature and RH, Testo 635, SP's inventory no. 900 065
- Weighing scale, Mettler PC16, SP's inventory no. 202 741
- Flow meter, MFS-C-315, SP's inventory no. 202 193
- Kr-85 Aerosol Neutralizer, TSI, SP's inventory no. 202 635

Uncertainty of measurement

The uncertainty of the Air flow is better than $\pm 5\%$

The uncertainty of the Pressure Drop is better than $\pm 3\%$

The uncertainty of the Temperature is better than $\pm 0.5\text{ }^\circ\text{C}$

The uncertainty of the Relative Humidity is better than $\pm 3\%$ RH

The uncertainty of the Atmospheric Pressure is better than $\pm 1\text{ mbar}$

The uncertainty of the Measured mass is better than $\pm 0.5\text{ g}$

The method error in determination of the filtration efficiency is:

$\eta = 0\text{-}90\%$: ± 0.1 of penetration value [%]

$\eta = 90\text{-}99\%$: ± 0.2 of penetration value [%]

$\eta = 99\text{-}99.99\%$: ± 0.5 of penetration value [%]

$\eta > 99.99\%$: ± 1 of penetration value [%]

The uncertainty of the filtration efficiency according to EN 779:2012 is presented in the appendix.

SP Technical Research Institute of Sweden Energy Technology - Combustion and Aerosol Technology

Performed by

Examined by

Tobias Eriksson

Marie Rönnbäck

Appendices

1. Test report according to EN779:2012
2. Picture of test item
3. Interpretation of test reports according to section 13.2 in EN779:2012

Appendix 1

Testing organisation: SP Technical Research Institute of Sweden

Report no.: PX27501F

EN 779:2012 AIR FILTER RESULTS

GENERAL

Test no.: SP201212271	Date of test: 27/12/2012 - 09/01/2013	Supervisor: UH/TEr
Test requested by: Vokes Air AB	Device receiving date	
Device delivered by: Vokes Air AB	13/12/2012	

DEVICE TESTED

Model: Revo II M6 592x592x635 5P 25H, PP Plastic + Gsk, art no: 3550630464	Manufacturer: Vokes Air AB	Construction: Pocket filter, 5 pockets
Type of media: Synthetic	Net effective filtering area: 3.6 m ²	Filter dimensions (width x height x depth): 592 mm x 592 mm x 635 mm

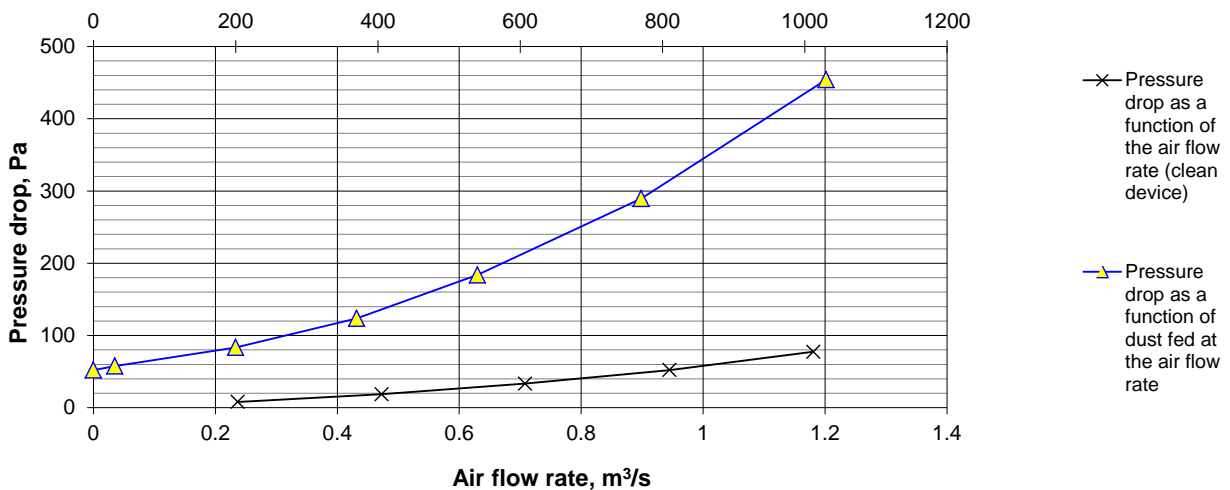
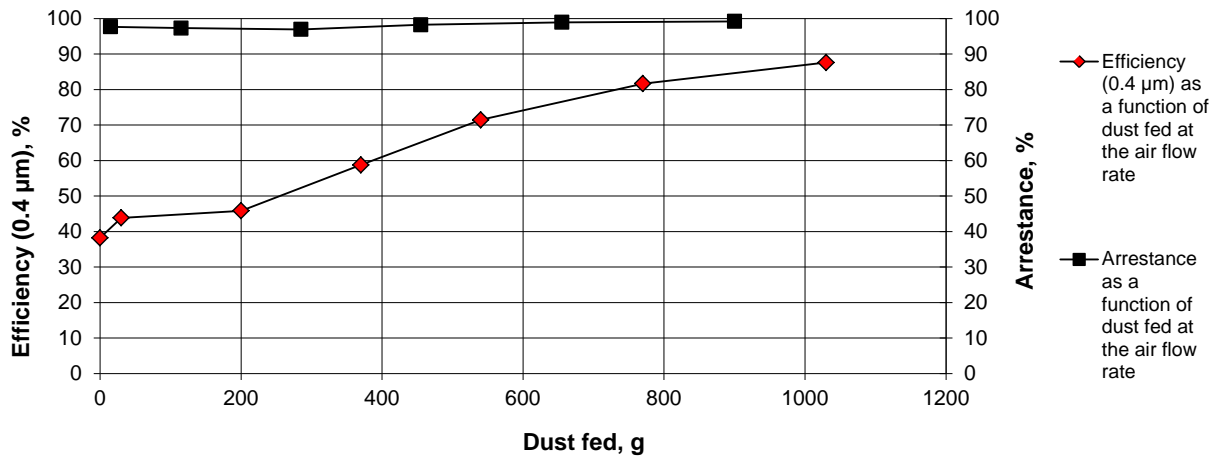
TEST DATA

Test air flow rate: 0.944 m ³ /s	Test air temperature: 27 to 33 °C	Test air relative humidity: 17 to 20 %	Test aerosol: DEHS	Loading dust: ASHRAE 52/76
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RESULTS

Initial pressure drop: 52 Pa	Initial arrestance: 98 %	Initial efficiency (0.4 µm): 38 %	Test dust capacity: 672 / 851 / 1009 g	Untreated/ discharged efficiency of media (0.4 µm): -
Final test pressure drop: 250 / 350 / 450 Pa	Average arrestance: 98% / 98% / 98%	Average efficiency (0.4 µm): 58% / 63% / 66%	Filter class (450 Pa): M6	Remarks:

Note: The performance results are only valid for the tested item and cannot by themselves be quantitatively applied to predict efficiency and lifetime in service



Appendix 1

EN779:2012 - Efficiency after different dust loading phases

Air filter: Revo II M6 592x592x635 5P 25H, PP Plastic + Gsk, art no: 3550630464
 Test no.: SP201212271
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s

Particle size		Efficiency %									
Interval µm	Mean µm	Pressure drop, Pa and Dust fed, g									
		52 Pa 0 g	58 Pa 30 g	83 Pa 200 g	124 Pa 370 g	184 Pa 540 g	290 Pa 770 g				
0.12 - 0.15	0.13	42.6 ± 1.5	43.3 ± 1.5	41.0 ± 0.9	51.0 ± 1.0	62.7 ± 1.2	73.5 ± 1.0				
0.15 - 0.20	0.17	37.9 ± 1.7	40.0 ± 1.9	38.0 ± 0.7	50.7 ± 0.9	62.2 ± 0.9	72.4 ± 0.7				
0.20 - 0.25	0.22	35.9 ± 1.8	39.3 ± 1.9	38.9 ± 2.0	50.4 ± 0.5	63.7 ± 0.7	74.8 ± 1.3				
0.25 - 0.35	0.30	35.6 ± 1.6	40.0 ± 2.0	42.0 ± 1.4	53.3 ± 1.0	66.1 ± 1.0	77.6 ± 0.9				
0.35 - 0.45	0.40	38.2 ± 1.1	43.9 ± 1.3	45.8 ± 1.1	58.8 ± 1.4	71.4 ± 0.8	81.7 ± 0.6				
0.45 - 0.60	0.52	44.6 ± 1.1	48.8 ± 1.6	51.9 ± 1.3	64.3 ± 1.0	77.4 ± 0.8	85.7 ± 1.0				
0.60 - 0.75	0.67	49.9 ± 2.7	56.4 ± 2.2	58.0 ± 2.1	70.0 ± 1.8	81.2 ± 2.2	89.2 ± 0.8				
0.75 - 1.00	0.87	56.3 ± 2.0	60.8 ± 2.1	62.8 ± 2.5	76.0 ± 1.4	85.1 ± 1.1	92.6 ± 0.9				
1.00 - 1.50	1.22	63.5 ± 3.4	67.9 ± 2.3	69.3 ± 2.3	80.5 ± 1.4	89.8 ± 1.8	94.9 ± 1.1				
1.50 - 2.00	1.73	71.1 ± 2.2	75.4 ± 1.9	78.6 ± 1.9	87.5 ± 1.0	94.2 ± 1.0	98.0 ± 0.8				
2.00 - 3.00	2.45	85.9 ± 2.3	90.5 ± 2.6	88.6 ± 3.7	95.5 ± 2.0	98.5 ± 1.7	99.5 ± 1.0				
3.00 - 4.50	3.67	100.0 ± 0.0	94.4 ± 14.3	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0				

NOTE The uncertainty of the measured efficiencies is reported on a 95 % confidence level.

Particle size		Efficiency %			
Interval µm	Mean µm	Pressure drop, Pa and Dust fed, g			
		454 Pa 1030 g			
0.12 - 0.15	0.13	81.6 ± 1.2			
0.15 - 0.20	0.17	81.2 ± 1.0			
0.20 - 0.25	0.22	82.6 ± 0.8			
0.25 - 0.35	0.30	84.0 ± 0.6			
0.35 - 0.45	0.40	87.6 ± 0.3			
0.45 - 0.60	0.52	91.1 ± 0.6			
0.60 - 0.75	0.67	93.6 ± 1.4			
0.75 - 1.00	0.87	96.5 ± 0.7			
1.00 - 1.50	1.22	98.4 ± 0.3			
1.50 - 2.00	1.73	99.3 ± 0.4			
2.00 - 3.00	2.45	99.7 ± 0.4			
3.00 - 4.50	3.67	95.2 ± 12.2			

NOTE The uncertainty of the measured efficiencies is reported on a 95 % confidence level.

Appendix 1

EN779:2012 - Average efficiency at different final test pressure drops

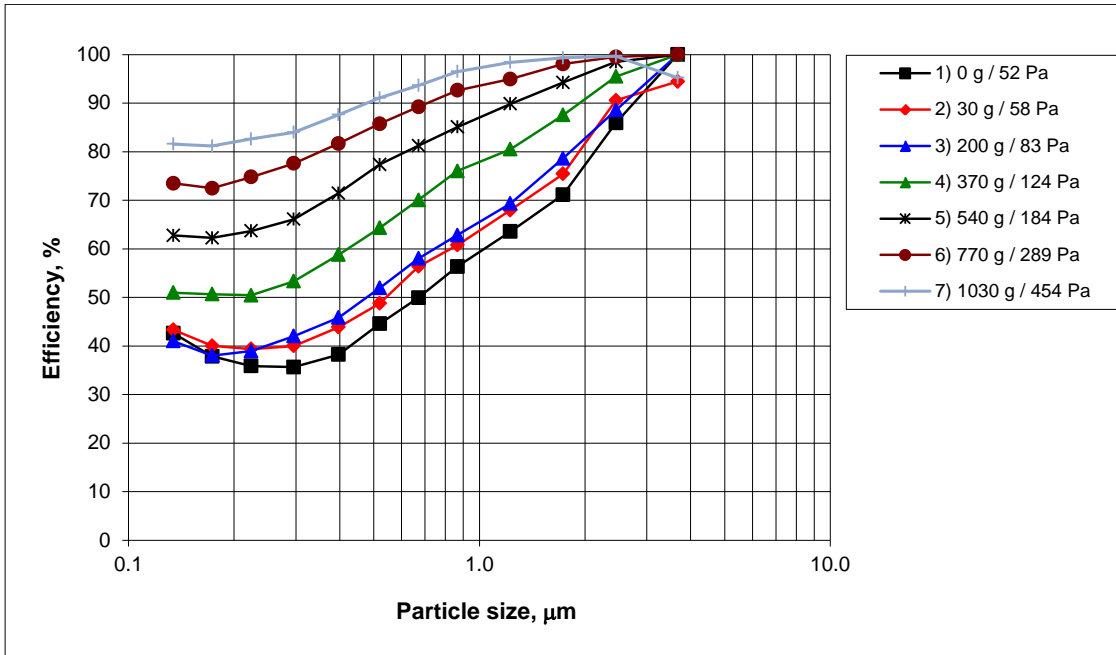
Air filter: Revo II M6 592x592x635 5P 25H
 PP Plastic + Gsk, art no: 3550630464
 Test no.: SP201212271
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s

Particle size		Average efficiency %					
Interval µm	Mean µm	Final test pressure drop					
		250 Pa	350 Pa	450 Pa	250 Pa	350 Pa	450 Pa
0.12 - 0.15	0.13	51.8 ± 1.5	56.2 ± 1.4	59.8 ± 1.1	51.8 ± 1.5	56.2 ± 1.4	59.8 ± 1.1
0.15 - 0.20	0.17	50.1 ± 1.3	54.8 ± 1.1	58.5 ± 1.0	50.1 ± 1.3	54.8 ± 1.1	58.5 ± 1.0
0.20 - 0.25	0.22	50.7 ± 1.6	55.6 ± 1.4	59.5 ± 1.2	50.7 ± 1.6	55.6 ± 1.4	59.5 ± 1.2
0.25 - 0.35	0.30	53.1 ± 1.5	58.0 ± 1.3	61.9 ± 1.1	53.1 ± 1.5	58.0 ± 1.3	61.9 ± 1.1
0.35 - 0.45	0.40	57.7 ± 1.3	62.5 ± 1.1	66.3 ± 0.9	57.7 ± 1.3	62.5 ± 1.1	66.3 ± 0.9
0.45 - 0.60	0.52	63.2 ± 1.4	67.9 ± 1.2	71.3 ± 1.0	63.2 ± 1.4	67.9 ± 1.2	71.3 ± 1.0
0.60 - 0.75	0.67	68.7 ± 2.4	72.9 ± 2.0	76.0 ± 1.7	68.7 ± 2.4	72.9 ± 2.0	76.0 ± 1.7
0.75 - 1.00	0.87	73.5 ± 2.0	77.3 ± 1.7	80.2 ± 1.4	73.5 ± 2.0	77.3 ± 1.7	80.2 ± 1.4
1.00 - 1.50	1.22	78.8 ± 2.3	82.1 ± 1.9	84.6 ± 1.5	78.8 ± 2.3	82.1 ± 1.9	84.6 ± 1.5
1.50 - 2.00	1.73	85.5 ± 1.6	88.1 ± 1.4	89.9 ± 1.1	85.5 ± 1.6	88.1 ± 1.4	89.9 ± 1.1
2.00 - 3.00	2.45	93.8 ± 2.7	95.0 ± 2.2	95.8 ± 1.9	93.8 ± 2.7	95.0 ± 2.2	95.8 ± 1.9
3.00 - 4.50	3.67	99.2 ± 3.4	99.1 ± 3.6	98.9 ± 3.0	99.2 ± 3.4	99.1 ± 3.6	98.9 ± 3.0
Test dust capacity		672 g	851 g	1009 g			
Filter class					M6		
NOTE The uncertainty of the measured efficiencies is reported on a 95 % confidence level.							

Appendix 1

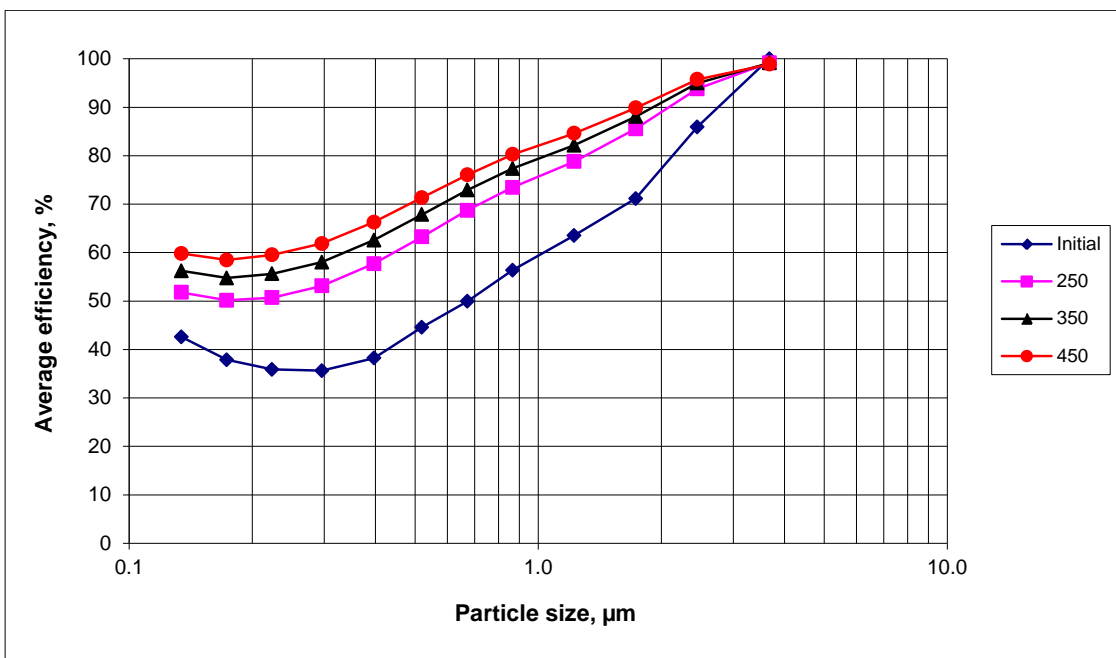
EN779:2012 - Efficiency after different dust loading phases

Air Filter: Revo II M6 592x592x635 5P 25H, PP Plastic + Gsk, art no: 3550630464
 Test no.: SP201212271
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s



EN779:2012 - Initial and average efficiency at different final test pressure drops

Air Filter: Revo II M6 592x592x635 5P 25H, PP Plastic + Gsk, art no: 3550630464
 Test no.: SP201212271
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s



Appendix 1

EN779:2012 - Air flow rate and pressure drop after different dust loading phases

Air filter: Revo II M6 592x592x635 5P 25H, PP Plastic + Gsk, art no: 3550630464
 Test no.: SP201212271
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s

Date	Dust fed m _{tot} g	Air flow meter				Filter						
		t _f °C	p _{sf} Pa	dp _f Pa	q _m kg/s	t °C	φ %	p _a kPa	ρ kg/m ³	q _v m ³ /s	Δp Pa	Δp _{1.20} Pa
Clean filter												
27/12/2012	0	25.8	30	31	0.27	25.8	19.5	97.2	1.130	0.237	8	8
27/12/2012	0	26.5	83	126	0.53	26.5	18.9	97.2	1.127	0.473	19	19
27/12/2012	0	26.8	148	275	0.80	26.8	18.7	97.3	1.127	0.708	33	33
27/12/2012	0	26.5	229	490	1.07	26.5	19.4	97.4	1.129	0.945	52	52
27/12/2012	0	27.2	324	763	1.33	27.2	18.2	97.5	1.127	1.181	77	77
Clean filter pressure drop is proportional to (q _v) ⁿ , where n = 1.3935												
Dust loading phase												
09/01/2013	30	29.2	237	495	1.078	29.2	19.8	99.4	1.142	0.944	58	58
09/01/2013	30	30.6	235	493	1.073	30.6	18.1	99.4	1.137	0.944	58	58
09/01/2013	200	31.1	273	492	1.070	31.1	17.6	99.2	1.133	0.945	83	83
09/01/2013	200	31.7	275	490	1.067	31.7	17.2	99.2	1.130	0.944	83	83
09/01/2013	370	31.7	297	490	1.067	31.7	17.7	99.2	1.130	0.944	123	124
09/01/2013	370	32.3	288	490	1.066	32.3	17.4	99.2	1.128	0.945	123	123
09/01/2013	540	32.0	334	490	1.067	32.0	17.8	99.3	1.130	0.944	183	184
09/01/2013	540	32.5	329	488	1.065	32.5	17.6	99.3	1.128	0.944	181	182
09/01/2013	770	32.1	403	489	1.065	32.1	17.6	99.1	1.127	0.944	288	290
09/01/2013	770	32.9	385	488	1.062	32.9	17.4	99.1	1.124	0.945	286	287
09/01/2013	1030	33.4	475	487	1.060	33.4	16.6	99.2	1.123	0.944	452	454
09/01/2013	1030	34.2	470	487	1.059	34.2	16.2	99.2	1.120	0.945	450	452

2 = after dust increment

1 = before next dust increment

Symbols and units

- | | | | |
|--------------------|---|----------------|---|
| dp _f | air flow meter differential pressure, Pa | q _m | mass flow rate, kg/s |
| m _{tot} | cumulative mass of dust fed to filter, g | q _v | air flow rate filter, m ³ /s |
| Δp | measured filter pressure drop, Pa | t _f | temperature at air flow meter, °C |
| Δp _{1.20} | filter pressure drop at air density 1.20 kg/m ³ , Pa | t | temperature upstream of filter, °C |
| p _a | absolute air pressure upstream of filter, kPa | φ | relative humidity upstream of the filter, % |
| p _{sf} | air flow meter static pressure, kPa | ρ | air density upstream of filter, kg/m ³ |

Appendix 1

EN779:2012 - Pressure drop and arrestance after different dust loading phases

Air filter: Revo II M6 592x592x635 5P 25H, PP Plastic + Gsk, art no: 3550630464
 Test no.: SP201212271
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s

Date	Δp_1	dm	m_{tot}	Δp_2	m_1	m_2	Δm	m_d	A	A_m
	Pa	g	g	Pa	g	g	g	g	%	%
09/01/2013	52	30	30	58	2215.0	2215.7	0.7	0.0	97.7	97.7
09/01/2013	58	170	200	83	2215.7	2220.3	4.6	0.0	97.3	97.3
09/01/2013	83	170	370	124	2220.3	2225.5	5.2	0.0	96.9	97.2
09/01/2013	123	170	540	184	2225.5	2228.5	3.0	0.0	98.2	97.5
09/01/2013	182	230	770	290	2228.5	2231.0	2.5	0.0	98.9	97.9
09/01/2013	287	260	1030	454	2231.0	2233.1	2.1	0.0	99.2	98.2

Symbols and units

- A arrestance, %
- A_m average arrestance, %
- dm dust increment, g
- Δp_1 pressure drop before dust increment (air density 1.20 kg/m³), Pa
- Δp_2 pressure drop after dust increment (air density 1.20 kg/m³), Pa
- m_d dust in duct after device, g
- m_1 mass of final filter before dust increment
- m_2 mass of final filter after dust increment
- m_{tot} cumulative mass of dust fed to filter, g
- Δm mass gain of final filter, g

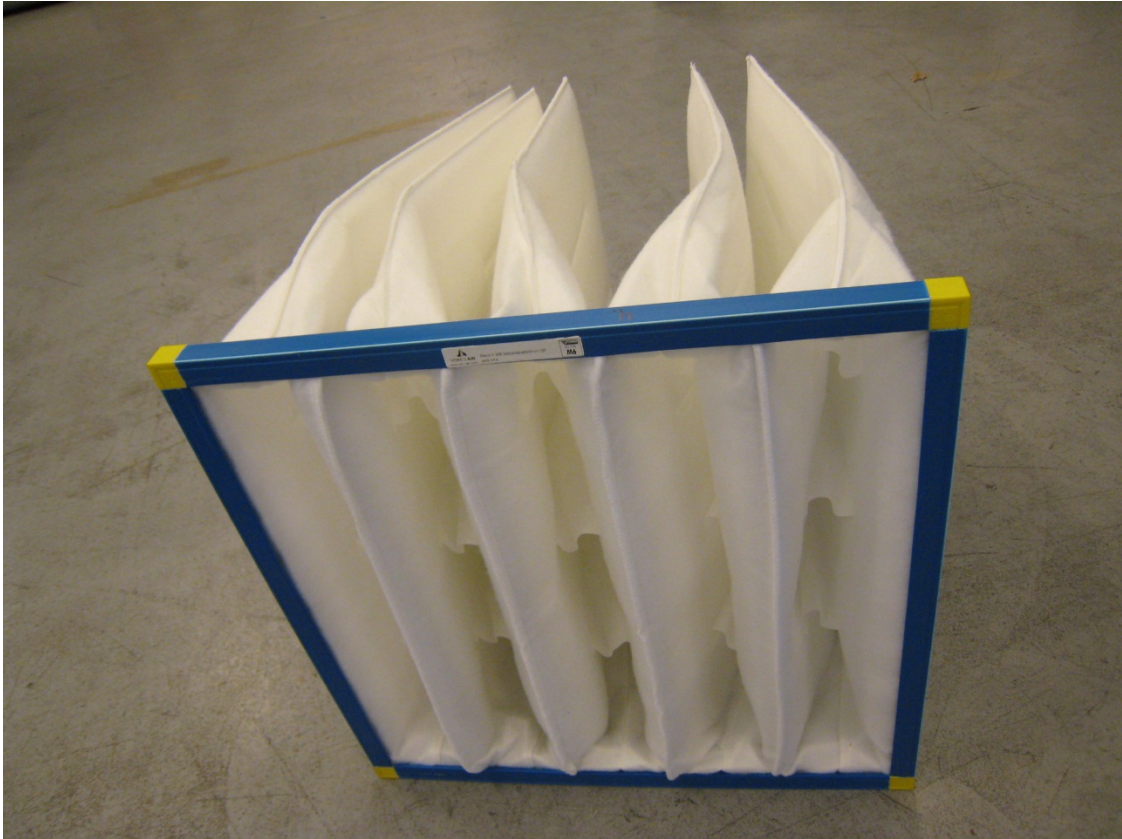
Mass of tested item:

Clean filter:	2 002.0 g
After complete test:	2 996.9 g

Test dust

ASHRAE 52/76, Particle Technology Ltd.
 Batch no: 7944

Appendix 2



Appendix 3

The interpretation of test reports – according to EN779:2012 13.2 Interpretation of test reports

This brief review of the test procedures, including those for addressing the testing of electrostatically charged filters, is provided for those unfamiliar with EN 779 procedures. It is intended to assist in understanding and interpreting the results in the test report/summary. (For further details of procedures the full EN 779 document should be consulted).

Many types of air filter rely on the effects of passive static electric charges on the fibers to achieve high efficiencies, particularly in the initial stages of their working life. Environmental factors encountered in service may affect the action of these electric charges so that the initial efficiency may drop substantially after an initial period of service. In many cases this is offset or countered by an increase in efficiency (“mechanical efficiency”) as dust deposits in filter media. In the later stages of operating life the efficiency may increase to equal or exceed the initial efficiency. The reported untreated and conditioned (discharged) efficiencies show the extent of the electrical charge effect on initial performance. It should not be assumed that the measured conditioned (discharged) efficiency represents real life behaviour. It merely indicates the level of efficiency obtainable with the charge effect completely removed and with no compensating increase in mechanical efficiency.

For reasons of consistency filter efficiencies are measured using artificially generated clouds of synthetic DEHS material (droplets) with closely controlled particle size. These efficiency measurements are repeated after the filter has been loaded with ASHRAE loading dust until the resistance has risen to a value of 250 Pa in the case of the coarse (G) procedure and with up to a value of 450 Pa for the fine and medium (F and M) procedure. Test dust capacities measured in this way may be used for to compare performances and for rankings but should not be assumed to simulate real life operating conditions as the properties of dusts encountered in service conditions vary very widely.