



Lindbergs Ventilation AB
Västkustvägen 400
254 77 FLENINGE

Testing of Air Filter according to EN779:2012

(3 appendices)

An annual test according to CR055 (Certification rules for air filters) has been performed according to EN 779:2012.

Tested item

Lindbergs Ventilation AB, M6 Microglas, Art. No: 600150M08,
592 mm x 592 mm x 500 mm, 8 pocket air filter.

The item was collected by SP on October 24, 2012, from the production at Lindbergs Ventilation AB.

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 August 21-22, 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 tested item.

SP Technical Research Institute of Sweden

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Measurement equipment

- Pressure gauge Furness model 318, SP's inventory no. 901 568
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- Pressure gauge Furness FC012, SP's inventory no. 201 691
- Pressure gauge Furness FC012, SP's inventory no. 201 690
- 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-250, SP's inventory no. 202 742
- 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

Christian Mossberg

Marie Rönnbäck

Appendices

1. Test report according to EN779:2012

2. Picture of tested 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.: 3P03838B

EN 779:2012 AIR FILTER RESULTS

GENERAL

Test no.: SP201308211	Date of test: 21/08/2013 - 22/08/2013	Supervisor: CM
Test requested by: SP Technical Research Institute of Sweden	Device receiving date	
Device delivered by: Lindbergs Ventilation AB	24/10/2012	

DEVICE TESTED

Model: M6 Microglas, Art.no:600150M08	Manufacturer: Lindbergs Ventilation AB	Construction: Pocket filter, 8 pockets
Type of media: Glass	Net effective filtering area: 4.9 m ²	Filter dimensions (width x height x depth): 592 mm x 592 mm x 500 mm

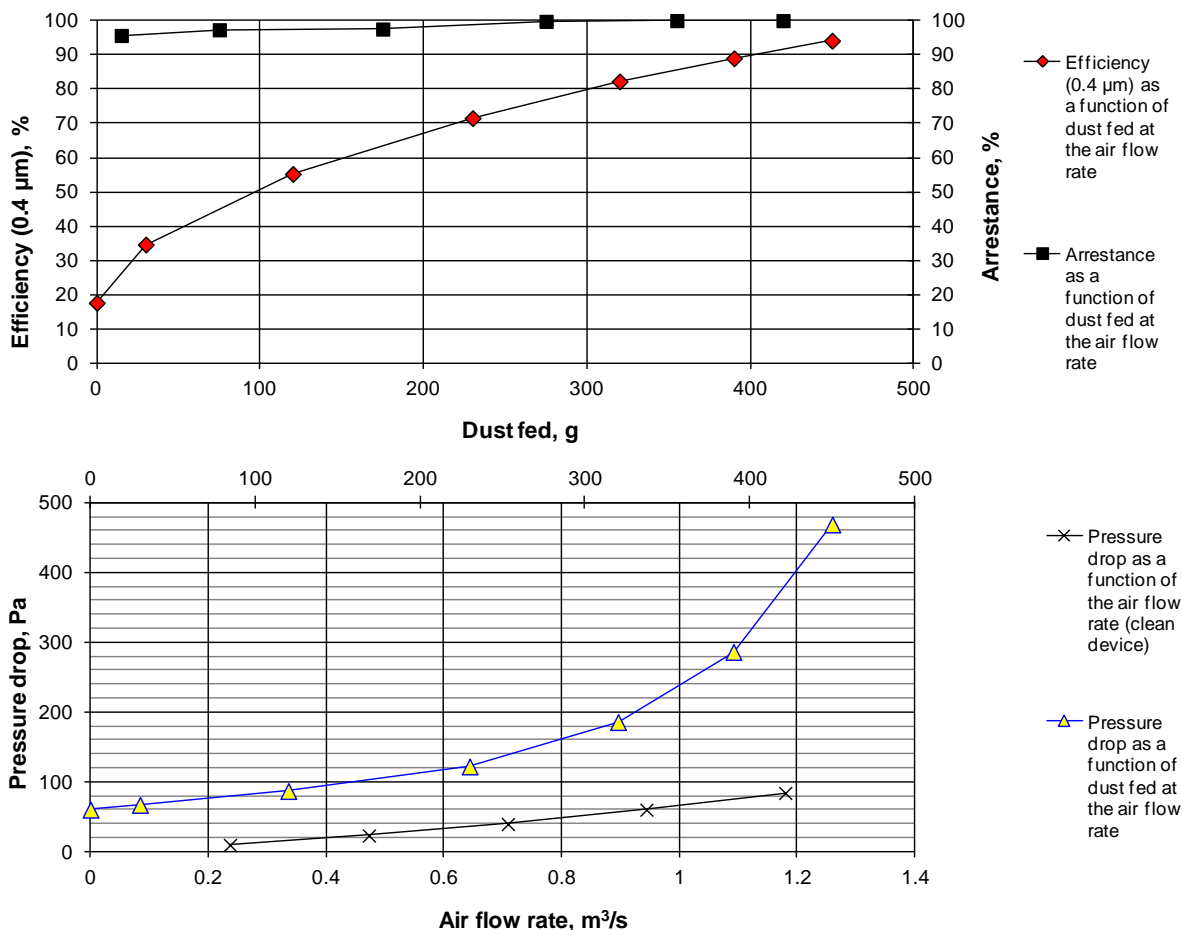
TEST DATA

Test air flow rate: 0.944 m ³ /s	Test air temperature: 25 to 34 °C	Test air relative humidity: 24 to 40 %	Test aerosol: DEHS	Loading dust: ASHRAE 52/76
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RESULTS

Initial pressure drop: 60 Pa	Initial arrestance: 96 %	Initial efficiency (0.4 µm): 18 %	Test dust capacity: 358 / 404 / 437 g	Untreated/ discharged efficiency of media (0.4 µm): -
Final test pressure drop: 250 / 350 / 450 Pa	Average arrestance: 98% / 98% / 99%	Average efficiency (0.4 µm): 62% / 65% / 67%	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: M6 Microglas, Art.no:600150M08
 Test no.: SP201308211
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s

Particle size		Efficiency %									
Interval µm	Mean µm	Pressure drop, Pa and Dust fed, g									
		60 Pa 0 g	67 Pa 30 g	87 Pa 120 g	122 Pa 230 g	186 Pa 320 g	286 Pa 390 g				
0.10 - 0.12	0.11	22.1 ± 11.2	29.3 ± 4.0	53.0 ± 6.9	61.2 ± 7.1	75.1 ± 1.7	80.3 ± 3.0				
0.12 - 0.15	0.13	14.2 ± 2.3	22.6 ± 2.9	41.7 ± 1.3	60.5 ± 2.1	70.0 ± 0.8	78.6 ± 0.9				
0.15 - 0.20	0.17	11.5 ± 1.7	21.8 ± 0.9	40.7 ± 2.4	58.9 ± 1.6	71.0 ± 0.6	79.2 ± 0.6				
0.20 - 0.25	0.22	13.9 ± 1.7	23.0 ± 2.5	43.1 ± 1.3	60.3 ± 0.8	72.4 ± 1.6	81.0 ± 0.7				
0.25 - 0.35	0.30	13.1 ± 2.0	26.8 ± 2.2	47.5 ± 1.7	65.4 ± 0.6	77.2 ± 0.6	84.9 ± 0.4				
0.35 - 0.45	0.40	17.7 ± 3.0	34.7 ± 2.6	55.3 ± 1.8	71.6 ± 1.1	82.3 ± 0.8	89.0 ± 0.3				
0.45 - 0.60	0.52	24.6 ± 2.2	41.0 ± 1.1	63.4 ± 1.9	79.2 ± 1.2	87.6 ± 0.8	93.0 ± 0.5				
0.60 - 0.75	0.67	33.9 ± 4.8	49.9 ± 2.4	70.7 ± 2.0	84.7 ± 1.5	92.0 ± 1.2	95.8 ± 0.5				
0.75 - 1.00	0.87	42.1 ± 1.9	56.5 ± 1.3	76.7 ± 1.1	88.6 ± 1.1	94.3 ± 0.3	97.5 ± 0.4				
1.00 - 1.50	1.22	51.6 ± 4.7	69.5 ± 2.6	84.3 ± 1.4	92.6 ± 1.7	97.0 ± 0.5	99.2 ± 0.3				
1.50 - 2.00	1.73	63.9 ± 4.2	77.7 ± 2.1	91.5 ± 0.6	96.6 ± 1.1	98.9 ± 0.3	99.7 ± 0.2				
2.00 - 3.00	2.45	89.6 ± 2.4	93.4 ± 3.8	96.6 ± 1.6	98.9 ± 0.7	99.8 ± 0.5	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			
		469 Pa 450 g			
0.10 - 0.12	0.11	85.8 ± 4.0			
0.12 - 0.15	0.13	86.3 ± 1.1			
0.15 - 0.20	0.17	87.1 ± 0.4			
0.20 - 0.25	0.22	88.8 ± 0.9			
0.25 - 0.35	0.30	91.3 ± 0.6			
0.35 - 0.45	0.40	94.1 ± 0.3			
0.45 - 0.60	0.52	96.9 ± 0.4			
0.60 - 0.75	0.67	98.5 ± 0.3			
0.75 - 1.00	0.87	99.4 ± 0.3			
1.00 - 1.50	1.22	99.9 ± 0.1			
1.50 - 2.00	1.73	99.9 ± 0.1			
2.00 - 3.00	2.45	100.0 ± 0.0			

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

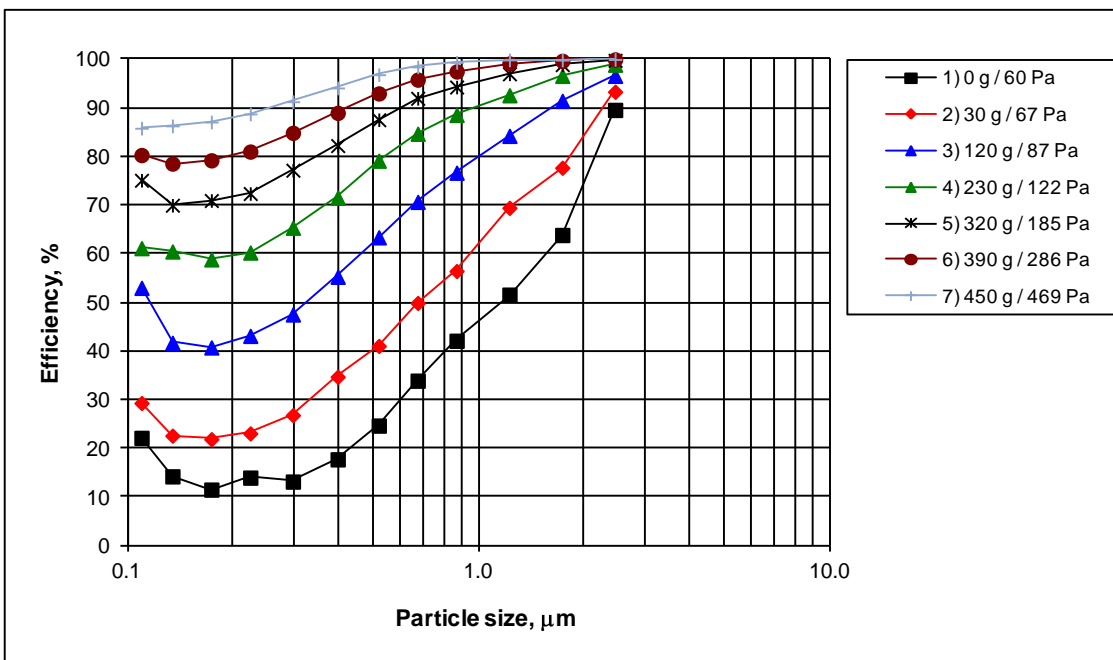
Air filter: M6 Microglas, Art.no:600150M08
 Test no.: SP201308211
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s

Particle size		Average efficiency %		
Interval µm	Mean µm	Final test pressure drop		
		250 Pa	350 Pa	450 Pa
0.10 - 0.12	0.11	55.6 ± 6.0	58.5 ± 5.5	60.3 ± 5.1
0.12 - 0.15	0.13	49.8 ± 1.9	53.1 ± 1.7	55.3 ± 1.6
0.15 - 0.20	0.17	49.1 ± 1.5	52.5 ± 1.4	54.9 ± 1.3
0.20 - 0.25	0.22	50.8 ± 1.5	54.2 ± 1.4	56.6 ± 1.3
0.25 - 0.35	0.30	55.1 ± 1.3	58.5 ± 1.2	60.7 ± 1.1
0.35 - 0.45	0.40	61.7 ± 1.6	64.7 ± 1.4	66.8 ± 1.3
0.45 - 0.60	0.52	68.5 ± 1.4	71.3 ± 1.2	73.1 ± 1.1
0.60 - 0.75	0.67	74.9 ± 1.9	77.3 ± 1.7	78.8 ± 1.6
0.75 - 1.00	0.87	79.6 ± 1.1	81.6 ± 1.0	82.9 ± 0.9
1.00 - 1.50	1.22	86.0 ± 1.6	87.4 ± 1.5	88.4 ± 1.4
1.50 - 2.00	1.73	91.3 ± 1.1	92.3 ± 1.0	92.8 ± 0.9
2.00 - 3.00	2.45	97.2 ± 1.5	97.5 ± 1.3	97.7 ± 1.2
Test dust capacity		358 g	404 g	437 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: M6 Microglas, Art.no:600150M08
 Test no.: SP201308211
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s



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

Air Filter: M6 Microglas, Art.no:600150M08
 Test no.: SP201308211
 Test aerosol: DEHS
 Air flow rate: 0.944 m³/s



Appendix 1

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

Air filter: M6 Microglas, Art.no:600150M08
 Test no.: SP201308211
 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	%	%
21/08/2013	60	30	30	67	2625.9	2627.2	1.3	0.0	95.7	95.7
21/08/2013	66	90	120	87	2627.2	2629.6	2.4	0.0	97.3	96.9
22/08/2013	87	110	230	122	2629.6	2632.3	2.7	0.0	97.5	97.2
22/08/2013	122	90	320	186	2632.3	2632.5	0.2	0.0	99.8	97.9
22/08/2013	184	70	390	286	2632.5	2632.4	-0.1	0.0	100.0	98.3
22/08/2013	278	60	450	469	2632.4	2632.4	0.0	0.0	100.0	98.5

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:	2 252.9 g
After complete test:	2 692.4 g

Test dust

ASHRAE 52/76, Particle Technology Ltd.
 Batch no: 8097

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.