

Lindbergs Ventilation AB
Västkustvägen 400
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Long term test of Air Filter according to SP Method 1937

(3 appendices)

At the request of Lindbergs Ventilation AB, SP has carried out a test of an air filter to evaluate the long term performance of the filtration efficiency. The long term test have been carried out as a part of P-marking of air filters according to SP's certification rules CR 055 "Certification rules for air filter".

Tested item

Lindbergs Ventilation AB, F7 Microglas, art.nr 700150M10, 592 mm x 592 mm x 500 mm, 10 pocket air filter with glass media (UPF).

The item was sent to SP by Lindbergs Ventilation AB and was received by SP on June 25, 2012.

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 July 4, 2012 – January 16, 2013.

Test method

The test was carried out according to SP Method 1937. The filter was weighed before and after the test. Initially, filtration efficiency and pressure drop were measured in an indoor test rig as specified in EN 779. After that, the filter was installed in a continuously running test rig with outdoor air for six months. Adjustment of the nominal air flow through the filter was done regularly. Filtration efficiency and pressure drop were measured in the EN779 test rig every second month during this 6 months period.

The filtration efficiency was determined by measuring the particle concentration. The particle concentration was measured upstream and downstream the filter with an optical particle counter. A polydisperse aerosol of DEHS was generated by a laskin nozzle. The static pressure was measured upstream and downstream the filter to get the pressure drop.

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Results

The tested filter has fulfilled the requirements regarding long-term performance for a filter of class F7 (see appendix 2) during the entire test period.

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

Measurement equipment

• Pressure gauge Furness FC016	SP's inventory no. 202 587
• Pressure gauge Furness FC016	SP's inventory no. 202 588
• Pressure gauge Furness FC012	SP's inventory no. 201 691
• Pressure gauge Furness FC012	SP's inventory no. 201 690
• Pressure gauge Furness FC012	SP's inventory no. 202 747
• Particle counter Las-X II	SP's inventory no. 701 378
• Auto sampler	SP's inventory no. 201 455
• Barometer, Druck DPI 260	SP's inventory no. 201 637
• 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. 202 192
• Flow meter, MFS-C-315	SP's inventory no. 202 193
• Flow meter, MFS-C-400	SP's inventory no. 202 718
• Kr-85 Aerosol Neutralizer, TSI	SP's inventory no. 202 635

Uncertainty of measurement

The uncertainty of the Airflow 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 $\pm 4\%$ RH

The uncertainty of the Atmospheric Pressure is better than $\pm 2\text{ mbar}$

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

The statistical uncertainty of the filtration efficiency is presented in appendix 1.

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

Performed by

Examined by

Christian Mossberg

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Appendices

1. Test results
2. Limit values
3. Picture of tested item

Appendix 1

Testing organisation: SP Technical Research Institute of Sweden

Report no.: PX23030B

SP Method 1937 AIR FILTER RESULTS

GENERAL

Test no.: 201207041	Date of test: 2012-07-04 - 2013-01-16	Supervisor: CM
Test requested by: Lindbergs Ventilation AB	Device receiving date	
Device delivered by: Lindbergs Ventilation AB	2012-06-25	

DEVICE TESTED

Model: F7 Microglas, art.nr 700150M10	Manufacturer: Lindbergs Ventilation AB	Construction: Pocket filter, 10 pockets
Type of media: Glass UPF	Net effective filtering area: 6.1 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: 23 to 26 °C	Test air relative humidity: 13 to 48 %	Test aerosol: DEHS	
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RESULTS

Initial, efficiency 0.4 µm: 67.6 %	2 months, efficiency 0.4 µm: 55.2 %	4 months, efficiency 0.4 µm: 53.7 %	6 months, efficiency 0.4 µm: 52.5 %	Initial pressure drop: 108 Pa
Initial, efficiency 0.87 µm: 90.6 %	2 months, efficiency 0.87 µm: 82.6 %	4 months, efficiency 0.87 µm: 80.7 %	6 months, efficiency 0.87 µm: 79.1 %	Increase in weight: 106.0 g
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

SP Method 1937 - Efficiency

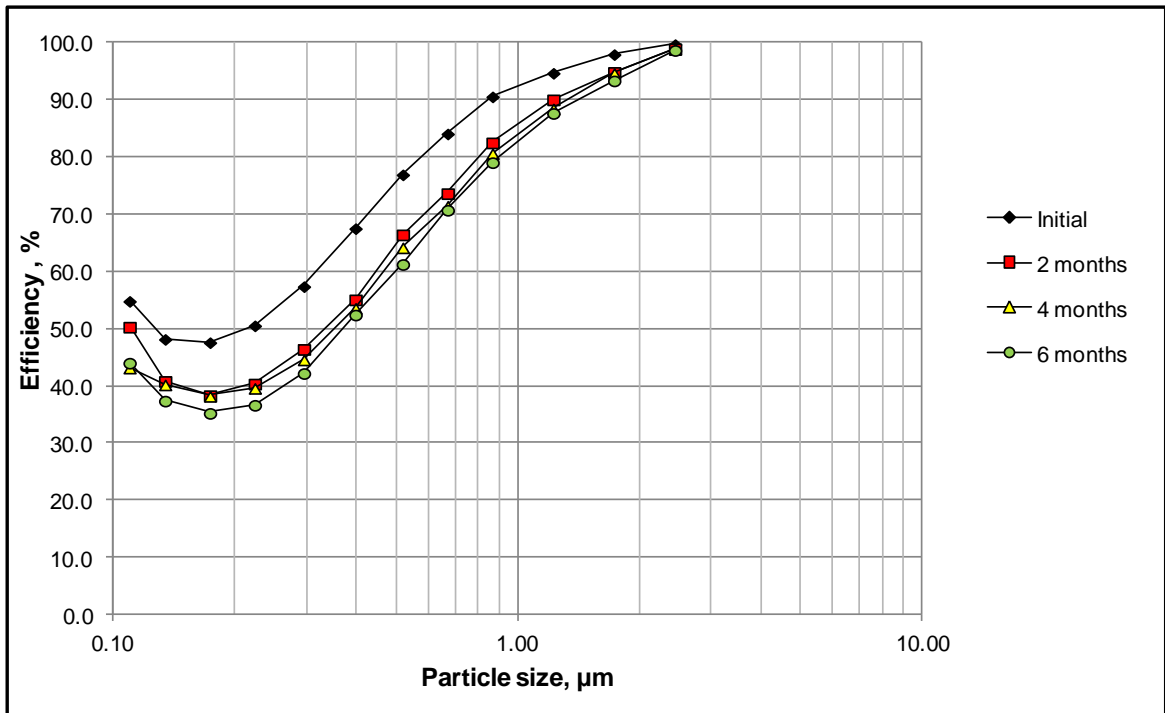
Air filter: F7 Microglas, art.nr 700150M10

Test aerosol: DEHS

Air flow rate: 0.944 m³/s

Particle size		Efficiency %			
Interval µm	Mean µm	Initial 2012-07-04 0 days	2 months 2012-09-03 61 days	4 months 2012-11-05 124 days	6 months 2013-01-16 196 days
0.10 - 0.12	0.11	54.9 ± 2.5	50.4 ± 5.2	43.2 ± 3.9	44.1 ± 5.5
0.12 - 0.15	0.13	48.2 ± 1.3	40.9 ± 1.1	40.3 ± 1.4	37.5 ± 1.1
0.15 - 0.20	0.17	47.7 ± 1.1	38.4 ± 0.8	38.3 ± 1.0	35.3 ± 1.4
0.20 - 0.25	0.22	50.6 ± 0.5	40.4 ± 0.9	39.7 ± 1.1	36.7 ± 0.7
0.25 - 0.35	0.30	57.5 ± 0.8	46.5 ± 1.1	44.7 ± 1.0	42.3 ± 1.2
0.35 - 0.45	0.40	67.6 ± 0.9	55.2 ± 0.9	53.7 ± 1.1	52.5 ± 1.8
0.45 - 0.60	0.52	77.0 ± 0.9	66.5 ± 0.6	64.3 ± 1.3	61.3 ± 0.9
0.60 - 0.75	0.67	84.2 ± 1.2	73.7 ± 1.5	71.5 ± 1.5	70.8 ± 1.7
0.75 - 1.00	0.87	90.6 ± 0.6	82.6 ± 1.1	80.7 ± 1.2	79.1 ± 0.9
1.00 - 1.50	1.22	94.8 ± 0.6	90.1 ± 1.7	88.5 ± 0.6	87.8 ± 1.7
1.50 - 2.00	1.73	98.0 ± 0.3	94.9 ± 0.9	94.7 ± 0.5	93.4 ± 1.4
2.00 - 3.00	2.45	99.8 ± 0.3	99.1 ± 0.6	98.9 ± 0.8	98.8 ± 1.1

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



Appendix 1

SP Method 1937 - Air flow rate and pressure drop

Air filter: F7 Microglas, art.nr 700150M10

Air flow rate: 0.944 m³/s

Date	Air flow meter				Filter						
	t _f °C	p _{st} 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
Initial											
2012-07-04	25.3	52	32	0.27	25.3	46.4	100.1	1.162	0.236	20	20
2012-07-04	25.5	126	127	0.55	25.5	46.2	100.2	1.162	0.473	45	44
2012-07-04	25.5	221	283	0.82	25.5	46.0	100.2	1.163	0.708	74	73
2012-07-04	25.4	332	502	1.10	25.4	46.8	100.4	1.164	0.944	108	108
2012-07-04	25.4	410	782	1.38	25.4	46.8	100.4	1.165	1.180	151	150
Clean filter pressure drop is proportional to (q _v) ⁿ , where n = 1.2453											
2 months											
03/09/2012	24.5	49	31	0.27	24.5	44.6	99.9	1.164	0.232	18	17
03/09/2012	24.6	123	127	0.55	24.6	44.6	100.0	1.164	0.472	41	40
03/09/2012	24.3	217	285	0.83	24.3	45.5	100.1	1.166	0.709	68	68
03/09/2012	23.1	331	507	1.11	23.1	48.0	100.2	1.172	0.946	102	102
03/09/2012	24.6	422	783	1.38	24.6	45.0	100.3	1.167	1.181	142	142
Filter pressure drop is proportional to (q _v) ⁿ , where n = 1.2790											
4 months											
2012-11-05	23.7	48	11	0.26	23.7	29.9	97.8	1.144	0.229	17	17
2012-11-05	23.9	133	48	0.54	23.9	29.8	97.9	1.144	0.474	41	41
2012-11-05	23.8	241	108	0.81	23.8	30.2	97.9	1.145	0.708	69	69
2012-11-05	23.2	371	194	1.08	23.2	31.0	98.1	1.149	0.945	103	104
2012-11-05	24.0	525	304	1.35	24.0	30.0	98.2	1.147	1.181	144	144
Filter pressure drop is proportional to (q _v) ⁿ , where n = 1.29302											
6 months											
2013-01-16	25.9	44	32	0.27	25.9	13.1	99.4	1.156	0.238	22	21
2013-01-16	26.1	116	126	0.55	26.1	13.0	99.4	1.156	0.472	48	47
2013-01-16	26.1	206	282	0.82	26.1	13.2	99.5	1.157	0.707	78	78
2013-01-16	25.6	316	503	1.09	25.6	13.5	99.6	1.160	0.944	115	115
2013-01-16	26.0	423	785	1.37	26.0	13.3	99.7	1.159	1.181	154	153
Filter pressure drop is proportional to (q _v) ⁿ , where n = 1.2272											

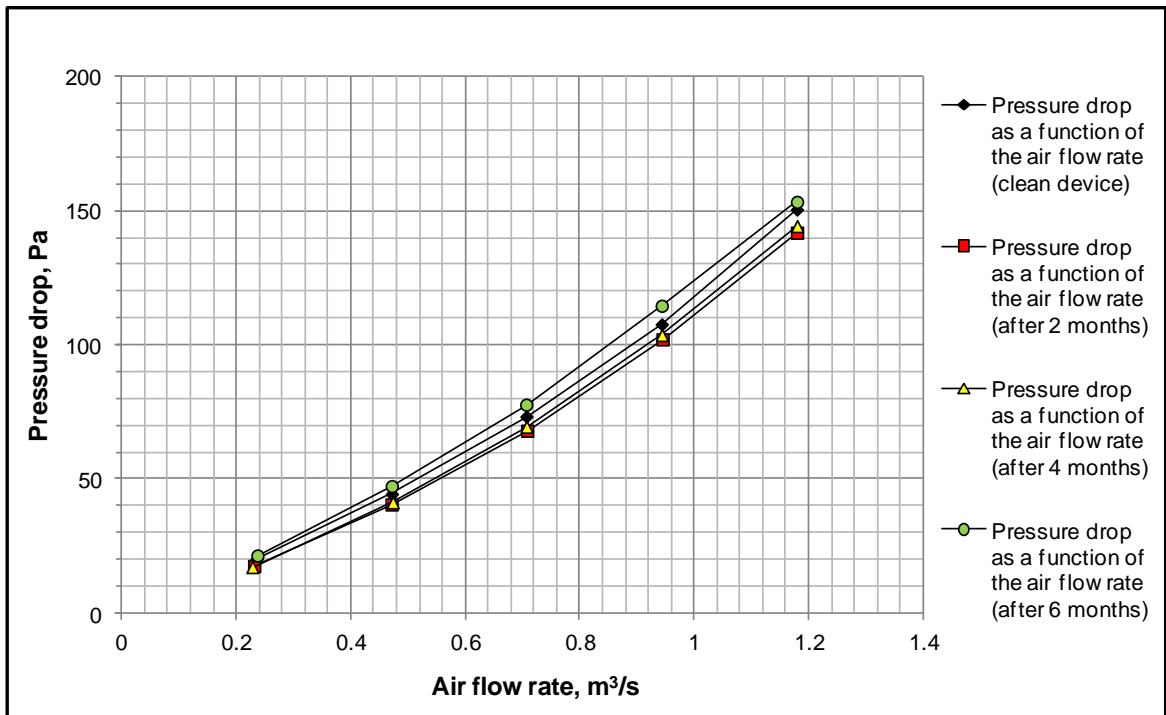
Symbols and units

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

Mass of tested item:

Clean filter:	2 541.3 g
After complete test:	2 647.3 g
Increase in weight:	106.0 g

Appendix 1



SP Method 1937 - Air flow rate, outdoor rig

Air filter: F7 Microglas, art.nr 700150M10
 Rig No.: 3
 Air flow rate: 0.944 m³/s

Date	t	φ	p _{atm}	q
	°C	%	kPa	m³/s
2012-07-06	20.0	78.3	99.5	0.944
2012-08-02	25.8	49.6	99.5	0.943
2012-09-06	14.8	50.4	99.8	0.945
2012-11-13	5.9	73.9	100.7	0.945

Symbols and units

- t temperature, °C
- φ relative humidity, %
- p_{atm} atmospheric pressure, kPa
- q air flow rate, m³/s

Appendix 2

Limit values

For the filter to be considered as fulfilling the requirements for P-marked air filters as specified in SPs certification rules CR055 “Certification rules for air filter”, the filtration efficiency must exceed the following limit values (see Table 1) at every measurement. On comparison of the measured value against the limit value, the statistical uncertainty and a method error are considered. This is described in SP-method 1937.

Table 1. Limit values

Filter class according to EN779	Minimum filtration efficiency at long-term test according to SP Method 1937	
	0,4 µm	0,87 µm
M5	2 %	8 %
M6	12 %	25 %
F7	50 %	70 %
F8	70 %	85 %
F9	80 %	90 %

Appendix 3

