Contact person
Christian Mossberg
Energy Technology
+46 10 516 59 13
Christian.Mossberg@sp.se

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1002
ISO/IEC 17025

Lindbergs Ventilation AB
Västkustvägen 400
254 77 FLENINGE

Testing of Air Filter according to EN779:2002

(2 appendices)

An annual test according to CR055 (Certification rules for air filters) has been performed according to EN 779:2002.

The report of the production inspection is P800136-11.

Tested item

Lindbergs Ventilation AB, F7 Microglas, art.nr 700150M10, 592 mm x 592 mm x 500 mm, 10 pocket air filter.
Lindbergs Ventilation AB, F7 Microglas, art.nr 700150M10, filter medium samples from a 592 mm x 592 mm x 500 mm,10 pocket air filter (for discharging test).

The items were sent to SP by Lindbergs Ventilation AB and were received by SP on June 29, 2011.

The items were without visible defects.

Date and Place

The test was carried out at SP's laboratory of Energy Technology in Borås, Sweden on February 15, 2012. Discharging test was carried out on February 16-20, 2012.

Test method

The test was carried out according to standard EN 779:2002.

Results

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

Measurement equipment

- Pressure gauge Furness FC016, SP's inventory no. 202 587 (static P Filter)
- Pressure gauge Furness FC016, SP's inventory no. 202 588 (static P Flow)
- Pressure gauge Furness FC012, SP's inventory no. 201 690 (ΔP Filter)
- Pressure gauge Furness FC012, SP's inventory no. 201 691 (ΔP Flow)
- 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. 202 742
- Flow meter, MFS-C50, SP's inventory no. 202 190
- Kr-85 Aerosol Neutralizer, TSI, SP's inventory no. 202 635

Uncertainty of measurement

The uncertainty of the Air flow is better than ± 5 %
The uncertainty of the Pressure Drop is better than ± 3 %
The uncertainty of the Temperature is better than ± 0.5 ºC
The uncertainty of the Relative Humidity is better than ± 4 % RH
The uncertainty of the Atmospheric Pressure is better than ± 2 mbar
The uncertainty of the Measured mass is better than ± 0.1 g

The method error in determination of the filtration efficiency is:

η = 0-90 %:	± 0.1 of penetration value [%]
η = 90-99 %:	± 0.2 of penetration value [%]
η = 99-99.99 %:	± 0.5 of penetration value [%]
η > 99.99 %:	± 1 of penetration value [%]

The uncertainty of the filtration efficiency according to EN 779:2002 is presented in the appendix.

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

Performed by

Signed by: Christian Mossberg
Reason: I am the author of this document
Date & Time: 2012-02-28 10:54:12 +01:00

Christian Mossberg

Examined by

Signed by: Marie Rönnbäck
Reason: I have reviewed this document
Date & Time: 2012-02-28 13:42:49 +01:00

Marie Rönnbäck

Appendices
1.Test results according to EN779:2002
2. Picture of tested item

Appendix 1

Testing organisation: SP Technical Research Institute of Sweden Report no.: PX14794A

EN 779:2002 AIR FILTER RESULTS

GENERAL

Test no.: SP201202151	Date of test: 15/02/2012	Supervisor: CM
Test requested by: SP Technical Research Institute of Sweden		Device receiving date
Device delivered by: Lindbergs Ventilation AB		29/06/2011

DEVICE TESTED

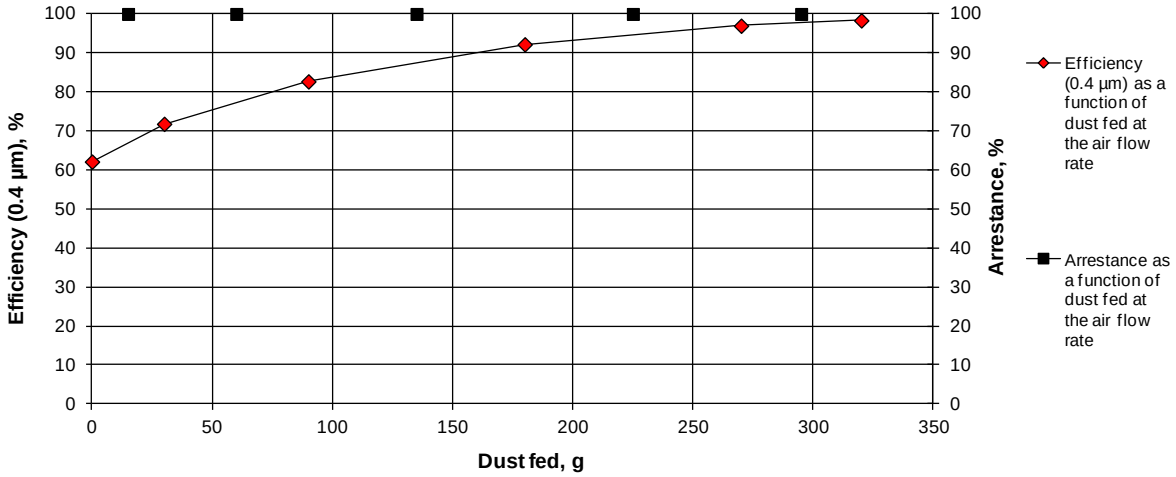
Model: F7 Microglas, art.nr 700150M10	Manufacturer: Lindbergs Ventilation AB	Construction: Pocket filter, 10 pockets
Type of media: Glass	Net effective filtering area: 5.9 m²	Filter dimensions (width x height x depth): 592 mm x 592 mm x 500 mm

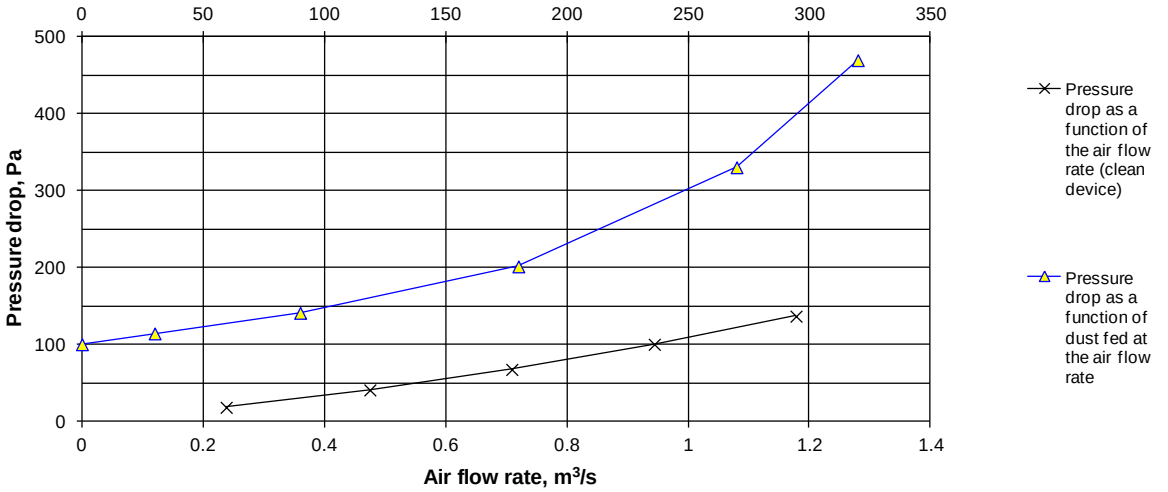
TEST DATA

Test air flow rate: 0.944 m^3/s	Test air temperature: 23 to 33 °C	Test air relative humidity: 10 to 19 %	Test aerosol: DEHS	Loading dust: ASHRAE 52/76

RESULTS

Initial pressure drop: 100 Pa	Initial arrestance: >99 %	Initial efficiency (0.4 µm): 62 %	Dust holding capacity: 213 / 276 / 311 g	Untreated/ discharged efficiency of media (0.4 µm, Annex A): 65 % / 57 %
Final pressure drop: 250 / 350 / 450 Pa	Average arrestance: >99% / >99% / >99%	Average efficiency (0.4 µm): 82% / 86% / 87%	Filter class (450 Pa): F7	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

EN779:2002 - Efficiency after different dust loading phases

Air filter: F7 Microglas, art.nr 700150M10
Test no.: SP201202151
Test aerosol: DEHS
Air flow rate: 0.944 m^3/s

Particle size		Efficiency %					
Interval	Mean	Pressure drop, Pa and Dust fed, g					
		100 Pa	115 Pa	141 Pa	202 Pa	330 Pa	470 Pa
µm	µm	0 g	30 g	90 g	180 g	270 g	320 g
0.10 - 0.12	0.11	49.5 ± 1.8	57.1 ± 1.2	68.3 ± 4.0	82.3 ± 1.3	90.6 ± 0.8	94.1 ± 0.5
0.12 - 0.15	0.13	43.8 ± 0.7	55.2 ± 1.3	67.6 ± 1.3	81.3 ± 0.7	90.3 ± 0.6	93.6 ± 0.3
0.15 - 0.20	0.17	44.8 ± 0.9	54.5 ± 1.0	67.1 ± 0.7	81.3 ± 0.6	90.9 ± 0.4	94.4 ± 0.3
0.20 - 0.25	0.22	45.5 ± 1.9	57.3 ± 1.1	70.5 ± 0.5	83.7 ± 0.9	92.6 ± 0.4	95.4 ± 0.4
0.25 - 0.35	0.30	52.6 ± 1.2	62.8 ± 1.0	75.0 ± 0.5	87.3 ± 0.5	94.6 ± 0.3	96.8 ± 0.1
0.35 - 0.45	0.40	62.1 ± 0.6	71.8 ± 0.6	82.7 ± 1.0	92.2 ± 0.2	97.0 ± 0.3	98.3 ± 0.2
0.45 - 0.60	0.52	72.6 ± 1.4	81.3 ± 0.6	89.7 ± 0.5	95.7 ± 0.4	98.6 ± 0.1	99.3 ± 0.1
0.60 - 0.75	0.67	80.6 ± 1.6	87.4 ± 0.8	93.2 ± 0.9	97.8 ± 0.5	99.5 ± 0.2	99.7 ± 0.1
0.75 - 1.00	0.87	86.7 ± 1.1	92.1 ± 0.9	96.5 ± 0.6	98.8 ± 0.4	99.8 ± 0.2	99.9 ± 0.1
1.00 - 1.50	1.22	93.1 ± 0.8	95.9 ± 0.8	98.1 ± 0.3	99.5 ± 0.2	99.9 ± 0.1	99.9 ± 0.1
1.50 - 2.00	1.73	96.9 ± 0.7	98.3 ± 0.4	99.2 ± 0.3	99.7 ± 0.1	99.9 ± 0.1	100.0 ± 0.1
2.00 - 3.00	2.45	99.2 ± 0.6	99.7 ± 0.3	100.0 ± 0.0	100.0 ± 0.0	99.8 ± 0.4	100.0 ± 0.0
NOTE	The uncertainty of the measured efficiencies is reported on a 95 % confidence level.						

EN779:2002 - Average efficiency at different final pressure drops

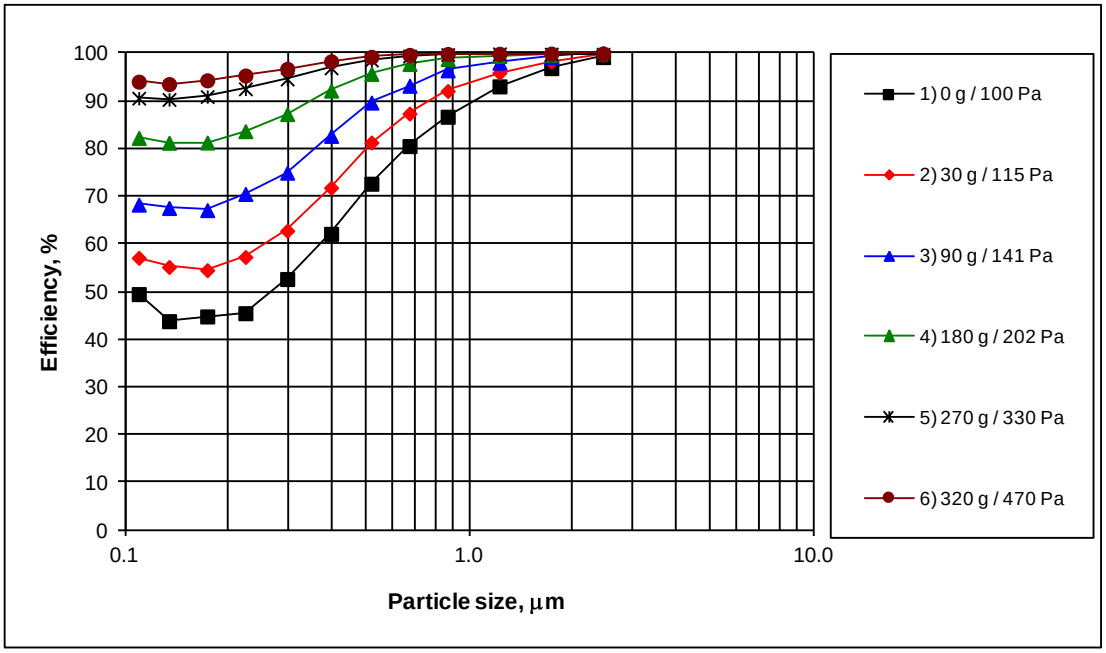
Air filter: F7 Microglas, art.nr 700150M10
Test no.: SP201202151
Test aerosol: DEHS
Air flow rate: 0.944 m^3/s

Particle size		Average efficiency %		
Interval	Mean	Final pressure drop		
µm	µm	250 Pa	350 Pa	450 Pa
0.10 - 0.12	0.11	69.8 ± 2.7	74.2 ± 2.1	76.3 ± 1.8
0.12 - 0.15	0.13	68.4 ± 1.3	73.0 ± 1.0	75.1 ± 0.9
0.15 - 0.20	0.17	68.2 ± 0.9	72.9 ± 0.7	75.2 ± 0.6
0.20 - 0.25	0.22	70.9 ± 1.0	75.4 ± 0.8	77.5 ± 0.7
0.25 - 0.35	0.30	75.4 ± 0.8	79.4 ± 0.6	81.3 ± 0.6
0.35 - 0.45	0.40	82.4 ± 0.7	85.6 ± 0.5	86.9 ± 0.5
0.45 - 0.60	0.52	88.9 ± 0.6	91.0 ± 0.5	91.9 ± 0.4
0.60 - 0.75	0.67	92.7 ± 0.9	94.2 ± 0.7	94.8 ± 0.6
0.75 - 1.00	0.87	95.7 ± 0.7	96.6 ± 0.5	97.0 ± 0.5
1.00 - 1.50	1.22	97.8 ± 0.5	98.3 ± 0.4	98.4 ± 0.3
1.50 - 2.00	1.73	99.0 ± 0.3	99.2 ± 0.3	99.3 ± 0.2
2.00 - 3.00	2.45	99.9 ± 0.2	99.9 ± 0.2	99.9 ± 0.2
Dust holding capacity		213 g	276 g	311 g
Filter class		-	-	F7
NOTE	The uncertainty of the measured efficiencies is reported on a 95 % confidence level.			

Appendix 1

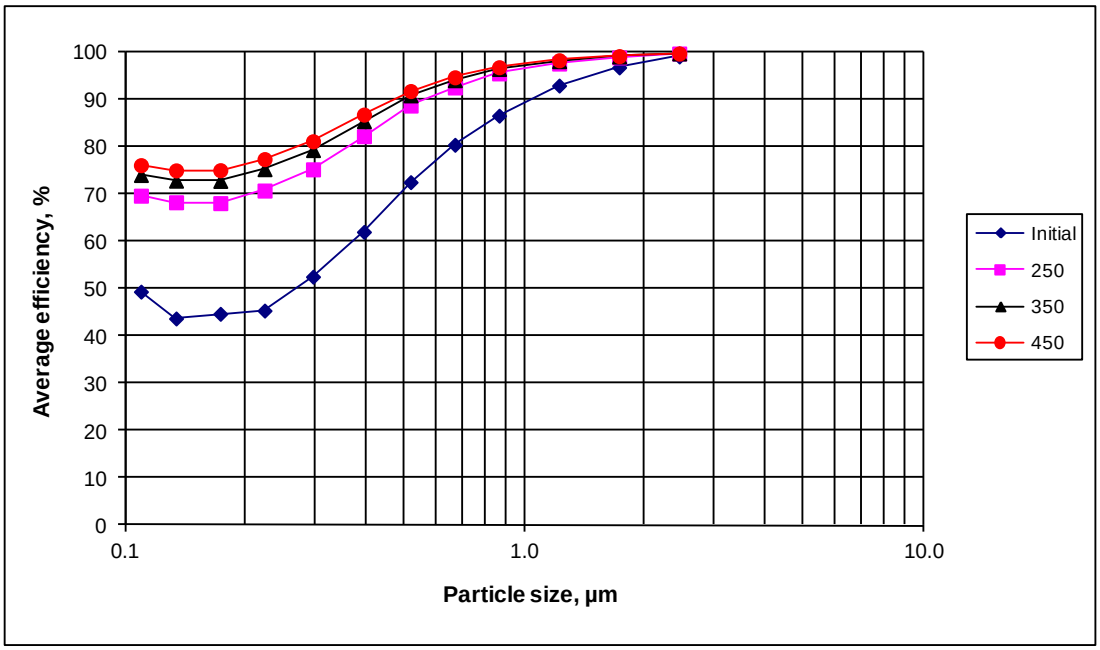
EN779:2002 - Efficiency after different dust loading phases

Air Filter: F7 Microglas, art.nr 700150M10
Test no.: SP201202151
Test aerosol: DEHS
Air flow rate: 0.944 m^3/s



EN779:2002 - Initial and average efficiency at different final pressure drops

Air Filter: F7 Microglas, art.nr 700150M10
Test no.: SP201202151
Test aerosol: DEHS
Air flow rate: 0.944 m^3/s



Appendix 1

EN779:2002 - Air flow rate and pressure drop after different dust loading phases

Air filter: F7 Microglas, art.nr 700150M10

Test no.: SP201202151

Test aerosol: DEHS

Air flow rate: 0.944 m^3/s

Date	Dust fed	Air flow meter				Filter							
	m_{tot}	t_f	p_{sf}	dp_f	q_m	t	φ	p_a	ρ	q_v	Δp	$\Delta p_{1.20}$	
	g	°C	Pa	Pa	kg/s	°C	%	kPa	kg/m³	m³/s	Pa	Pa	
Clean filter													
15/02/2012	0	23.9	47	32	0.27	23.9	18.0	97.4	1.140	0.238	19	19	
15/02/2012	0	24.0	114	126	0.54	24.0	17.7	97.5	1.140	0.475	41	41	
15/02/2012	0	24.0	200	279	0.81	24.0	18.0	97.5	1.141	0.709	68	68	
15/02/2012	0	23.2	309	494	1.08	23.2	18.8	97.6	1.145	0.944	100	100	
15/02/2012	0	23.9	423	765	1.35	23.9	17.9	97.8	1.144	1.178	137	137	
Clean filter pressure drop is proportional to $(q_v)^n$, where n = 1.2452													
Dust loading phase													
15/02/2012	30	29.6	318	484	1.059	29.6	12.1	97.7	1.122	0.945	115	115	2
15/02/2012	30	30.8	320	482	1.055	30.8	11.1	97.7	1.117	0.945	114	114	1
15/02/2012	90	31.9	344	481	1.052	31.9	10.4	97.7	1.113	0.945	142	141	2
15/02/2012	90	31.6	341	481	1.053	31.6	10.6	97.7	1.115	0.945	141	140	1
15/02/2012	180	32.2	392	483	1.057	32.2	10.0	98.2	1.119	0.945	203	202	2
15/02/2012	180	32.1	391	483	1.057	32.1	9.9	98.2	1.119	0.945	202	201	1
15/02/2012	270	32.6	498	482	1.056	32.6	9.9	98.3	1.118	0.944	333	331	2
15/02/2012	270	32.9	497	482	1.055	32.9	9.7	98.3	1.117	0.944	331	328	1
15/02/2012	320	33.1	615	482	1.055	33.1	9.5	98.5	1.118	0.944	474	470	2
15/02/2012	320	34.0	610	481	1.053	34.0	8.9	98.5	1.115	0.945	471	467	1

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}	total 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
$\Delta p_{1.20}$	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

EN779:2002 - Pressure drop and arrestance after different dust loading phases

Air filter: F7 Microglas, art.nr 700150M10
Test no.: SP201202151
Test aerosol: DEHS
Air flow rate: 0.944 m^3/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	%	%
15/02/2012	100	30	30	115	2610.5	2610.5	0.0	0.0	100.0	100.0
15/02/2012	114	60	90	141	2610.5	2610.5	0.0	0.0	100.0	100.0
15/02/2012	140	90	180	202	2610.5	2610.5	0.0	0.0	100.0	100.0
15/02/2012	201	90	270	331	2610.5	2610.5	0.0	0.0	100.0	100.0
15/02/2012	328	50	320	470	2610.5	2610.5	0.0	0.0	100.0	100.0

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}	total mass of dust fed to filter, g
Δm	mass gain of final filter, g

Mass of tested item:

Clean filter:	2 524.8	g
After complete test:	2 837.4	g

Test dust

ASHRAE 52/76, Particle Technology Ltd.
Batch no: 7681

Appendix 1

EN 779:2002 - Efficiency and pressure drop of untreated filter material

Air filter: F7 Microglas, art.nr 700150M10
Test no.: SP201202161
Test aerosol: DEHS
Discharging method: Isopropanol
Air flow rate: 14.8 l/s
Media velocity: 0.16 m/s
Size of material sample: 924 cm²

Particle size µm		Sample 1	Sample 2	Sample 3	Average
		Efficiency %			
Interval	Mean	Pressure drop			
		79 Pa	82 Pa	81 Pa	81 Pa
0.10 - 0.12	0.11	45.2 ± 4.8	48.4 ± 1.7	50.0 ± 8.7	47.8
0.12 - 0.15	0.13	41.0 ± 2.3	47.9 ± 1.5	48.6 ± 2.1	45.8
0.15 - 0.20	0.17	41.6 ± 2.0	46.1 ± 1.6	47.2 ± 1.5	45.0
0.20 - 0.25	0.22	44.2 ± 2.6	48.7 ± 2.4	50.4 ± 1.4	47.8
0.25 - 0.35	0.30	52.3 ± 2.7	56.0 ± 1.7	56.2 ± 0.8	54.8
0.35 - 0.45	0.40	62.6 ± 1.4	65.7 ± 1.2	67.2 ± 1.0	65.2
0.45 - 0.60	0.52	72.6 ± 1.3	76.7 ± 1.7	76.7 ± 0.9	75.3
0.60 - 0.75	0.67	81.0 ± 1.6	83.6 ± 0.9	84.0 ± 1.7	82.9
0.75 - 1.00	0.87	88.2 ± 1.0	89.0 ± 0.7	90.6 ± 0.8	89.3
1.00 - 1.50	1.22	92.6 ± 0.9	94.6 ± 0.8	94.6 ± 0.5	93.9
1.50 - 2.00	1.73	97.2 ± 0.6	97.6 ± 0.6	97.4 ± 0.3	97.4
2.00 - 3.00	2.45	99.5 ± 0.6	99.6 ± 0.3	99.4 ± 0.4	99.5
NOTE	The uncertainty of the measured efficiencies is reported on a 95 % confidence level.				

EN 779:2002 - Efficiency and pressure drop of discharged filter material

Air filter: F7 Microglas, art.nr 700150M10
Test no. SP201202161
Test aerosol: DEHS
Discharging method: Isopropanol
Air flow rate: 14.8 l/s
Media velocity: 0.16 m/s
Size of material sample: 924 cm²

Particle size µm		Sample 1	Sample 2	Sample 3	Average
		Efficiency %			
Interval	Mean	Pressure drop			
		69 Pa	73 Pa	72 Pa	71 Pa
0.10 - 0.12	0.11	43.2 ± 4.3	46.8 ± 4.9	44.9 ± 4.8	45.0
0.12 - 0.15	0.13	41.0 ± 1.7	41.3 ± 2.4	40.3 ± 2.3	40.9
0.15 - 0.20	0.17	39.8 ± 2.1	39.8 ± 2.6	39.6 ± 2.2	39.7
0.20 - 0.25	0.22	42.2 ± 2.2	43.7 ± 2.1	41.5 ± 1.1	42.5
0.25 - 0.35	0.30	46.9 ± 1.6	48.7 ± 1.8	47.1 ± 1.4	47.6
0.35 - 0.45	0.40	55.8 ± 1.7	58.0 ± 1.7	56.5 ± 1.6	56.8
0.45 - 0.60	0.52	66.1 ± 1.1	68.5 ± 1.6	68.0 ± 1.0	67.5
0.60 - 0.75	0.67	74.5 ± 1.7	77.4 ± 1.7	75.3 ± 1.9	75.8
0.75 - 1.00	0.87	82.3 ± 1.5	84.9 ± 1.1	84.1 ± 1.0	83.8
1.00 - 1.50	1.22	89.7 ± 1.6	91.0 ± 1.6	91.4 ± 1.0	90.7
1.50 - 2.00	1.73	94.4 ± 0.6	95.5 ± 0.6	95.4 ± 0.7	95.1
2.00 - 3.00	2.45	99.2 ± 0.4	99.2 ± 0.3	99.2 ± 0.6	99.2
NOTE	The uncertainty of the measured efficiencies is reported on a 95 % confidence level.				

Appendix 2