



T018 (EN ISO/IEC 17025)



Determination of the filtration performance of air filter CD408/34.5/141 according to EN 779:2002

Requested by: Nordic Air Filtration A/S



Requested by Nordic Air Filtration A/S
Bergenvvej 1
DK-4900 NAKSKOV
Denmark

Order Jørgen Paulsen

Contact person at VTT **VTT TECHNICAL RESEARCH CENTRE OF FINLAND**
Research Scientist Rolf Holmberg
Kivimiehentie 4, Espoo
P.O. Box 1000, FIN-02044 VTT, Finland
Tel. + 358 20 722 4706
Fax + 358 20 722 4815
E-mail rolf.holmberg@vtt.fi

Task **Determination of the filtration performance of air filter
CD408/34.5/141 according to EN 779:2002**

Sample The customer delivered one air filter, which is detailed in Appendix 1, Device tested.

The sample was received 19.12.2005.
The measurements were made 27. - 30.1.2006.

Test method The tests were made according to EN 779:2002 /1/. Diverging from the standard, the filter material discharging test was not made.

The test aerosol was DEHS and the bipolar aerosol charger (neutralizer) was a radioactive Am-241 source. The particle counter was of type PMS LAS-X.

The air flow rate was measured with a calibrated orifice plate with corner pressure tappings. The orifice plate has been calibrated against an orifice plate built according to ISO 5167:1980 /2/.

The instruments used in the measurements are presented in Appendix 5.

The Centre for Metrology and Accreditation has accredited our laboratory (no. T018, FINAS Accreditation) to perform the following measurements mentioned in this test report: EN 779:2002.

Results

A summary of the test results is presented in Appendix 1.

A summary of the initial and average efficiencies is presented in Appendix 2. The average efficiencies have been interpolated/ extrapolated to the final pressure drops 250, 350 and 450 Pa.

Efficiencies after different dust loading phases are presented in Appendix 3.

Measurement data relating to pressure drop and dust loading are presented in Appendix 4.

The results are only valid for the tested filter sample.

References

/1/ EN 779:2002. Particulate air filters for general ventilation – Determination of the filtration performance.

/2/ ISO 5167:1980. Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes in circular ducts running full.

Espoo, 2.2.2006



Juhani Laine
Senior Research Scientist



Rolf Holmberg
Research Scientist

APPENDICES

5

DISTRIBUTION

Customer
VTT

Original (2pcs)
Original

EN 779:2002. AIR FILTER TEST RESULTS

GENERAL

Test no.:	062004	Date of test: 27. - 30.1.2006	Supervisor: RHO
Test requested by:	Nordic Air Filtration A/S		Device receiving date 19.12.2005
Device delivered by:	Nordic Air Filtration A/S		

DEVICE TESTED

Model	Manufacturer	Construction
CD408/34.5/141	Nordic Air Filtration A/S	Cylindrical cartridge filter
Type of media	Net effective filtering area	Filter dimensions (diameter x length)
NA 141 GT	33.5 m ²	408 mm x 876 mm

TEST DATA

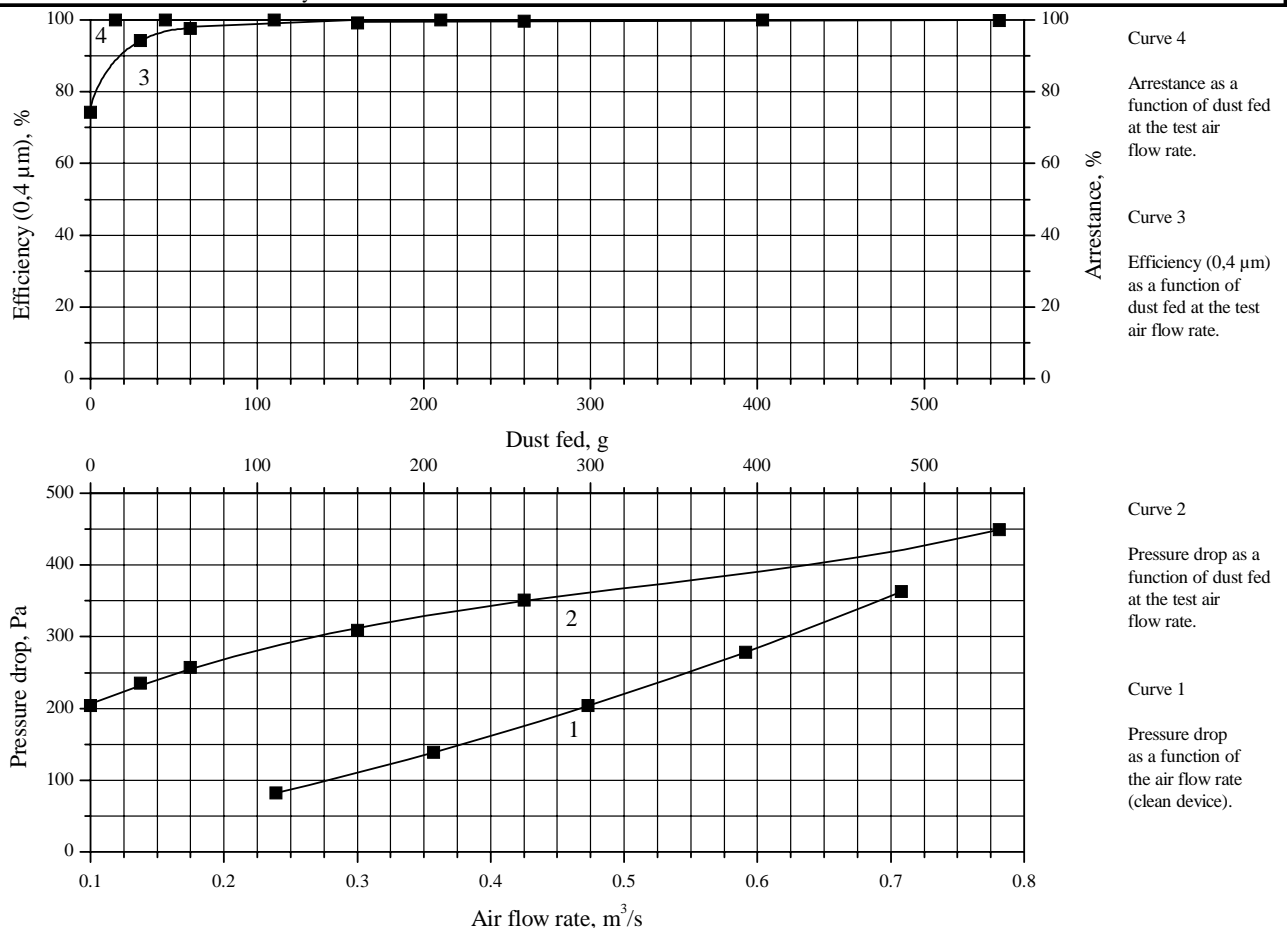
Test air flow rate	Test air temperature	Test air relative humidity	Test aerosol	Loading dust
0.472 m ³ /s	20 - 21 °C	20 - 27 %	DEHS	ASHRAE

RESULTS

Initial pressure drop	Initial arrestance	Initial efficiency (0,4 µm)	Dust holding capacity	Untreated / discharged efficiency of filter material (0.4 µm) Not measured
204 Pa	>99 %	74 %	47 / 258 / 548 g	
Final pressure drop	Average arrestance	Average efficiency (0,4 µm)	Filter class (450 Pa)	
250 / 350 / 450 Pa	>99 / >99 / >99 %	90±0 / 97±0 / 98±0 %	F9 (0.472 m ³ /s)	

Remarks: -

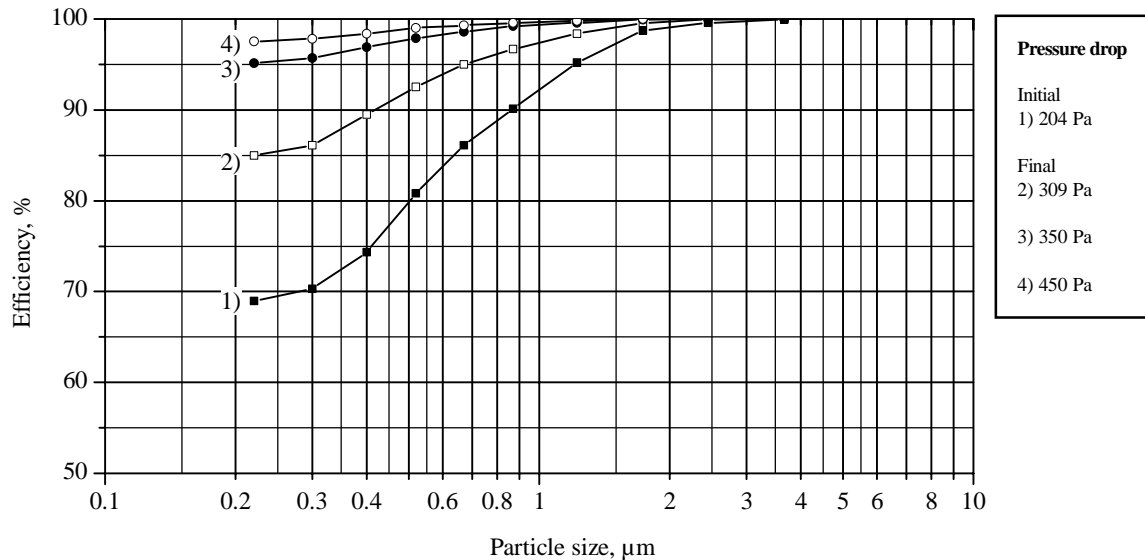
NOTE: The performance results cannot by themselves be quantitatively applied to predict filter performance in service.
The results relate only to the tested item.



Air filter: CD408/34.5/141
Initial and average efficiency at different final pressure drops
EN 779:2002

Test no.: 062004

Test aerosol: DEHS

 Air flow rate: 0.472 m³/s

Air filter: CD408/34.5/141
Initial and average efficiency at different final pressure drops
EN 779:2002

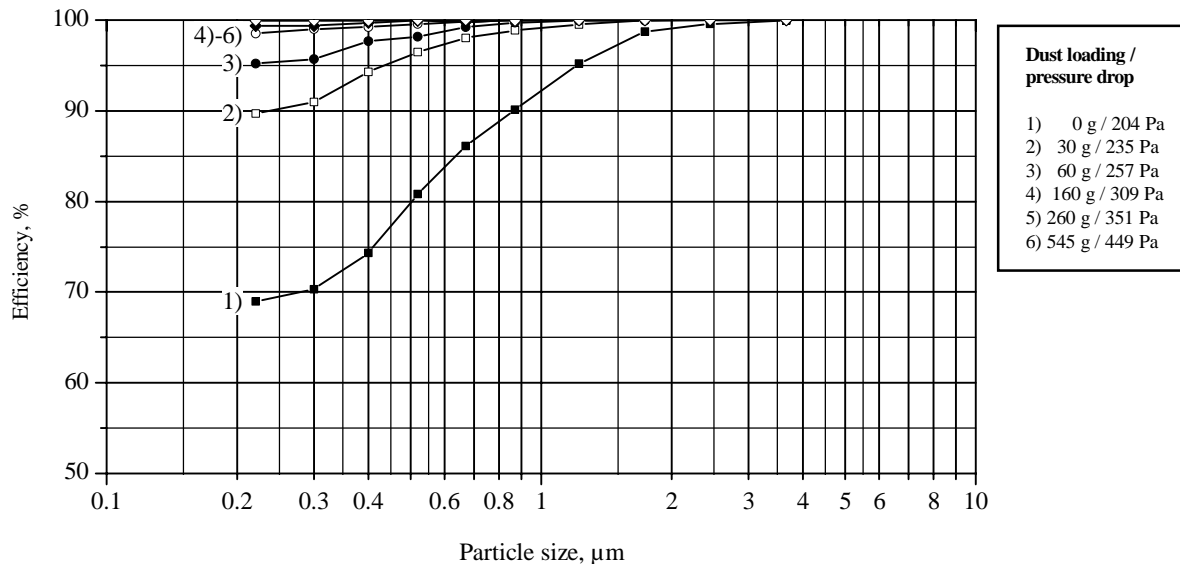
Test no: 062004

Test aerosol: DEHS

 Air flow rate: 0.472 m³/s

Particle size µm		Initial efficiency, %	Average efficiency %			
Interval	Mean		Final pressure drop			
		Pressure drop 204 Pa	250 Pa	350 Pa	450 Pa	
0.20 ... 0.25	0.22	69.0 ± 1.7	85.0 ± 1.1	95.1 ± 0.5	97.5 ± 0.4	
0.25 ... 0.35	0.30	70.3 ± 1.4	86.1 ± 0.9	95.7 ± 0.4	97.8 ± 0.2	
0.35 ... 0.45	0.40	74.3 ± 1.3	89.5 ± 0.6	96.9 ± 0.3	98.4 ± 0.2	
0.45 ... 0.60	0.52	80.8 ± 0.7	92.5 ± 0.5	97.9 ± 0.3	99.0 ± 0.2	
0.60 ... 0.75	0.67	86.1 ± 0.7	95.0 ± 0.4	98.6 ± 0.2	99.3 ± 0.1	
0.75 ... 1.00	0.87	90.1 ± 0.9	96.7 ± 0.5	99.2 ± 0.2	99.6 ± 0.2	
1.00 ... 1.50	1.22	95.2 ± 0.6	98.4 ± 0.3	99.6 ± 0.1	99.8 ± 0.0	
1.50 ... 2.00	1.73	98.7 ± 0.2	99.6 ± 0.1	99.9 ± 0.0	100.0 ± 0.0	
2.00 ... 3.00	2.45	99.6 ± 0.1	99.9 ± 0.1	100.0 ± 0.1	100.0 ± 0.1	
3.00 ... 4.50	3.67	99.9 ± 0.2	100.0 ± 0.1	100.0 ± 0.0	100.0 ± 0.0	
Dust holding capacity		-	47 g	258 g	548 g	
Filter class		-	-	-	F9	

Air filter: CD408/34.5/141
Efficiency after different dust loading phases
EN 779:2002
 Test no.: 062004
 Test aerosol: DEHS
 Air flow rate: 0.472 m³/s



Air filter: CD408/34.5/141
Efficiency and uncertainty after different dust loading phases
EN 779:2002
 Test no: 062004
 Test aerosol: DEHS
 Air flow rate: 0.472 m³/s

Particle size µm		Efficiency %					
Interval	Mean	Pressure drop, Pa / Dust fed, g					
		204 Pa 0 g	235 Pa 30 g	257 Pa 60 g	309 Pa 160 g	351 Pa 260 g	449 Pa 545 g
0.20 ... 0.25	0.22	69.0 ± 1.7	89.7 ± 1.2	95.2 ± 0.3	98.5 ± 0.4	99.4 ± 0.3	99.9 ± 0.1
0.25 ... 0.35	0.30	70.3 ± 1.4	91.0 ± 0.7	95.7 ± 0.6	99.0 ± 0.2	99.4 ± 0.1	99.9 ± 0.1
0.35 ... 0.45	0.40	74.3 ± 1.3	94.3 ± 0.4	97.7 ± 0.3	99.2 ± 0.1	99.7 ± 0.1	99.9 ± 0.1
0.45 ... 0.60	0.52	80.8 ± 0.7	96.5 ± 0.4	98.2 ± 0.3	99.6 ± 0.2	99.9 ± 0.1	100.0 ± 0.1
0.60 ... 0.75	0.67	86.1 ± 0.7	98.0 ± 0.3	99.2 ± 0.2	99.8 ± 0.1	99.8 ± 0.1	100.0 ± 0.1
0.75 ... 1.00	0.87	90.1 ± 0.9	98.9 ± 0.4	99.7 ± 0.2	100.0 ± 0.1	100.0 ± 0.1	99.9 ± 0.1
1.00 ... 1.50	1.22	95.2 ± 0.6	99.5 ± 0.2	99.9 ± 0.1	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0
1.50 ... 2.00	1.73	98.7 ± 0.2	100.0 ± 0.1	99.9 ± 0.1	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0
2.00 ... 3.00	2.45	99.6 ± 0.1	100.0 ± 0.0	100.0 ± 0.1	100.0 ± 0.1	100.0 ± 0.0	100.0 ± 0.1
3.00 ... 4.50	3.67	99.9 ± 0.2	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0

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

Air filter: CD408/34.5/141
Air flow rate and pressure drop after different dust loading phases
EN 779:2002
Test no: 062004

Date	Dust fed m_{tot} g	Calibrated orifice plate ¹⁾				Filter						
		t_f °C	p_{sf} kPa	Δp_f Pa	q_m kg/s	t °C	φ %	p_a kPa	ρ kg/m ³	q_v m ³ /s	Δp Pa	$\Delta p_{1.20}$ Pa
Clean filter												
27.1.2006	0	20.5	-0.353	594	0.844	21.0	24.9	101.0	1.193	0.708	363	363
"	0	20.7	-0.274	414	0.706	20.9	24.9	101.0	1.194	0.591	278	278
"	0	20.5	-0.200	265	0.565	20.9	24.9	101.0	1.194	0.473	204	204
"	0	20.4	-0.136	150	0.426	20.8	24.9	101.0	1.195	0.357	139	139
"	0	20.4	-0.085	67	0.286	20.4	24.7	101.0	1.195	0.239	82	82
Clean filter pressure drop is proportional to $(q_v)^n$, where $n = 1.366$												
Dust loading phase												
27.1.2006	30	20.6	-0.288	265	0.566	21.2	22.9	101.1	1.194	0.473	235	235
"	30	21.0	-0.289	264	0.564	20.8	23.0	101.1	1.196	0.471	234	234
"	60	20.6	-0.314	264	0.565	21.3	22.2	101.2	1.195	0.473	257	257
30.1.2006	60	20.5	-0.314	265	0.564	20.6	26.9	100.7	1.191	0.473	258	258
"	160	20.6	-0.363	263	0.562	21.1	25.2	100.7	1.189	0.473	309	309
"	160	20.7	-0.363	264	0.562	20.9	25.3	100.7	1.190	0.473	310	310
"	260	20.6	-0.410	264	0.563	21.2	24.1	100.8	1.190	0.473	351	351
"	260	20.9	-0.406	265	0.564	20.9	24.3	100.8	1.191	0.473	352	352
"	545	20.6	-0.506	263	0.562	21.3	20.2	100.8	1.191	0.472	449	449

1* measured before next dust increment

2* measured after dust increment

Symbols and units

m_{tot}	Cumulative mass of dust fed to filter, g	t_f	Temperature at air flow meter, °C
p_a	Absolute air pressure upstream of filter, kPa	ρ	Air density upstream of filter, kg/m ³
p_s	Air flow meter static pressure, kPa	φ	Relative humidity upstream of filter, %
q_m	Mass flow rate, kg/s	Δp	Measured filter pressure drop, Pa
q_v	Air flow rate at filter, m ³ /s	Δp_f	Air flow meter differential pressure, Pa
t	Temperature upstream of filter, °C	$\Delta p_{1.20}$	Filter pressure drop at air density 1.20 kg/m ³ , Pa

¹⁾ Orifice plate dimensions

Duct dimensions: 610 mm x 610 mm

Orifice diameter: 216 mm

Air filter: CD408/34.5/141
Pressure drop and arrestance after different dust loading phases
EN 779:2002
Test no: 062004

Date	Δp_1 Pa	Δm g	m_{tot} g	Δp_2 Pa	m_1 g	m_2 g	Δm_{ff} g	m_d g	A %
27.1.2006	204	30	30	235	2749.4	2749.4	0.0	0.0	100.0
"	234	30	60	257	2749.4	2749.4	0.0	0.0	100.0
30.1.2006	258	100	160	309	2749.6	2749.6	0.0	0.0	100.0
"	310	100	260	351	2749.6	2749.6	0.0	0.0	100.0
"	352	285	545	449	2749.6	2749.6	0.0	0.0	100.0

Mass of tested device

Initial mass of tested device: 10860 g

Final mass of tested device: 11332 g

Symbols and units

A Arrestance, %

 m_d Dust in duct after device, g

 m_{tot} Cumulative mass of dust fed to filter, g

 m_1 Mass of final filter before dust increment, g

 m_2 Mass of final filter after dust increment, g

 Δm Dust increment, g

 Δm_{ff} Mass gain of final filter, 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

Loading dust

Type: ASHRAE test dust

Manufactured by: Particle Technology Ltd

Instruments used

Instrument	Type code	Serial number	Calibration date	Used
Micromanometer	Alnor MP6KS	1020843	4.5.2005	X
	Alnor MP6KS	1020847	4.5.2005	X
Barometer	No. 9002588	-	10.1.2006	X
Hygrometer	Rotronic MS100TST	1188900/6	1.2.2005	X
Temperature meter	Nokeval 538-8	18455014	1.2.2005	X
Balance	Mettler PC8000-S2	A90263	1.2.2005	X
Particle counter	PMS LAS-X	26004-1091-380	27.9.2005	X
	Calibration check with 0.304 µm and 0.993 µm latex particles		2.1.2006	-
Dust feeder	ASHRAE 52-76	-	16.8.2005	X
Orifice plate	φ 216 / 610 x 610	-	8.9.1999	X
	φ 272 / 610 x 610	-	25.5.1999	-
	φ 90 / 610 x 610	-	17.3.2005	-