

TEST REPORT

NO. PFP-S-01398-08 8.2.2008



Determination of the filtration performance of air filter MV-F8-03 according to EN 779:2002

Laboratory to perform measurements according to EN 779:2002.



TEST REPORT

NO. PFP-S-01398-08 8.2.2008

Task Determination of the filtration performance of air filter MV-F8-03 according to EN 779:2002

Sample Two air filters were delivered by the customer. One air filter, which is detailed in Appendix 1 Device tested, was arbitrarily chosen for complete filtration performance tests. The second identical filter was chosen for the discharge tests.

The samples were received 13.12.2007.
The measurements were made 5. — 7.2.2008.

Test method The tests were made according to EN 779:2002/1/.

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 filter material discharging tests were made on a complete filter. Discharging was made by loading the air filter with diesel engine exhaust gas.

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 6.

FINAS Finnish Accreditation Service has accredited our laboratory (T001) to perform measurements according to EN 779:2002.

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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.

Results of the filter material discharging tests are presented in Appendix 4.

Measurement data relating to pressure drop and dust loading are presented in Appendix 5.

The results are only valid for the tested filter samples.

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, 8.2.2008

APPENDICES

6

DISTRIBUTION

Customer

Original (2 pcs)

Original

TEST REPORT

NO. PFP-S-01398-08 8.2.2008

EN 779:2002 AIR FILTER TEST RESULTS

GENERAL

Test no.:	082263	Date of test: 5. - 7.2.2008	Supervisor: RHo
Test requested by:			Device receiving date
Device delivered by:			13.12.2007

DEVICE TESTED

Model MV-F8-03	Manufacturer	Construction Compact filter
Type of media Micro glass fiber	Net effective filtering area 17.4 m ² (estimated)	Filter dimensions (width x heigth x depth) 592mm x 592mm x 294mm

TEST DATA

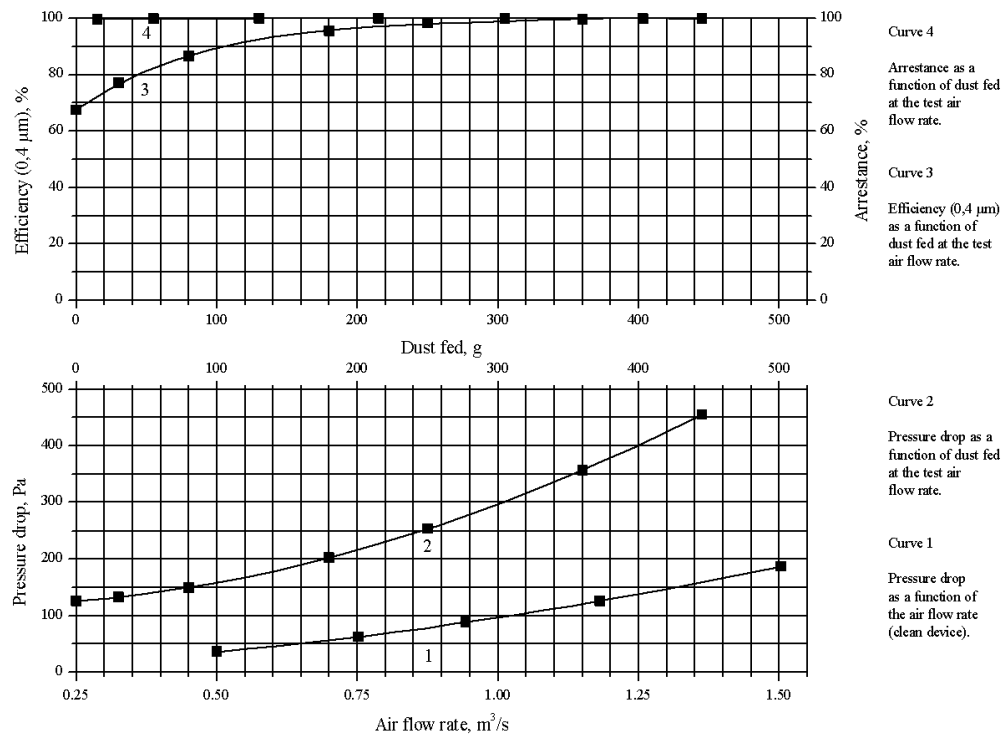
Test air flow rate	Test air temperature	Test air relative humidity	Test aerosol	Loading dust
1.181 m ³ /s	20-23°C	23-26%	DEHS	ASHRAE

RESULTS

Initial pressure drop 126 Pa	Initial arrestance >99%	Initial efficiency (0,4 µm) 68%	Dust holding capacity 246 / 354 / 441 g	Untreated / discharged efficiency of filter material (0.4µm) 75 / 75%
Final pressure drop 250/350/450Pa	Average arrestance >99/>99/>99%	Average efficiency (0,4µm) 89±1/ 92±1/ 93±1%	Filter class (450 Pa) F8(1.181m 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.

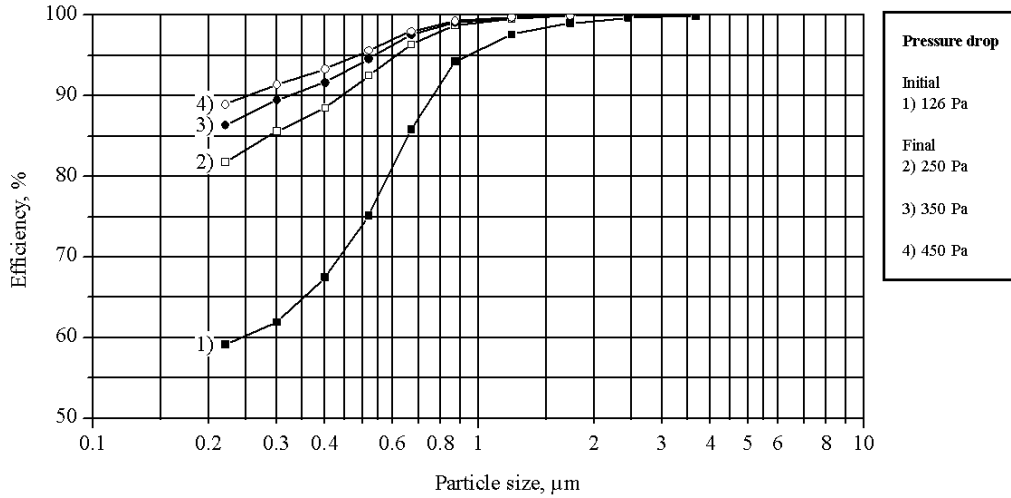


TEST REPORT

NO. PFP-S-01398-08 8.2.2008

Air Filter: MV-F8-03
Initial and Average Efficiency at Differential Final Pressure Drops
EN 779:2002

Test No. 082263
 Test Aerosol: DEHS
 Air Flow Rate: 1.181m³/s



Air Filter: MV-F8-03
Initial and Average Efficiency at Differential Final Pressure Drops
EN 779:2002

Test No.: 082263
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 Air Flow Rate: 1.181m³/s

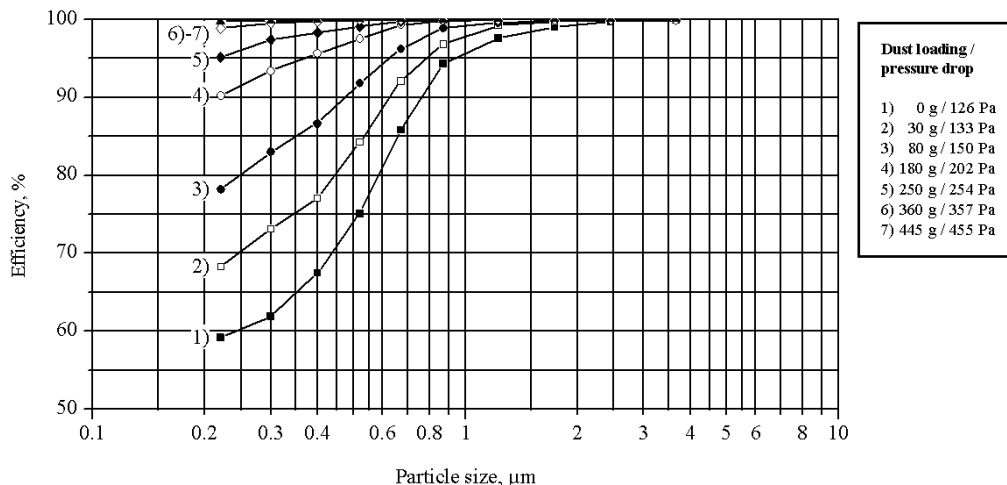
Particle size µm		Initial efficiency, %	Average efficiency %		
Interval	Mean	Pressure drop 126 Pa	Final pressure drop		
			250 Pa	350 Pa	450 Pa
0.20 ... 0.25	0.22	59.2 ± 3.6	81.8 ± 1.9	86.4 ± 1.6	88.9 ± 1.3
0.25 ... 0.35	0.3	61.9 ± 1.9	85.6 ± 0.9	89.5 ± 0.7	91.4 ± 0.6
0.35 ... 0.45	0.4	67.5 ± 2.7	88.5 ± 1.1	91.7 ± 0.9	93.3 ± 0.8
0.45 ... 0.60	0.52	75.1 ± 0.9	92.5 ± 0.9	94.6 ± 0.7	95.6 ± 0.5
0.60 ... 0.75	0.67	85.8 ± 0.8	96.4 ± 0.5	97.5 ± 0.4	98.0 ± 0.3
0.75 ... 1.00	0.87	94.3 ± 0.8	98.7 ± 0.5	99.1 ± 0.3	99.3 ± 0.3
1.00 ... 1.50	1.22	97.6 ± 0.5	99.6 ± 0.1	99.7 ± 0.1	99.8 ± 0.1
1.50 ... 2.00	1.73	99.0 ± 0.3	99.9 ± 0.1	99.9 ± 0.1	99.9 ± 0.1
2.00 ... 3.00	2.45	99.7 ± 0.3	99.9 ± 0.1	99.9 ± 0.1	100.0 ± 0.1
3.00 ... 4.50	3.67	99.9 ± 0.3	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0
Dust Holding Capacity		-	246 g	354 g	441 g
Filter Class		-	-	-	F8

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NO. PFP-S-01398-08 8.2.2008

Air Filter: MV-F8-03
Efficiency After Differential Dust Loading Phases
EN 779:2002

Test No.: 082263
 Test Aerosol: DEHS
 Air Flow Rate: 1.181m³/s



Air Filter: MV-F8-03
Efficiency and Uncertainty After Different Dust Loading Phases
EN 779:2002

Test No.: 082263
 Test Aerosol: DEHS
 Air Flow Rate: 1.181m³/s

Particle size µm		Efficiency %						
Interval	Mean	Pressure drop, Pa / Dust fed, g						
		126 Pa 0g	133 Pa 30g	150 Pa 80g	202 Pa 180g	254 Pa 250g	357 Pa 360g	455 Pa 445g
0.20 ... 0.25	0.22	59.2 ± 3.6	68.3 ± 3.2	78.2 ± 1.9	90.3 ± 1.1	95.1 ± 1.4	98.9 ± 0.3	99.7 ± 0.2
0.25 ... 0.35	0.3	61.9 ± 1.9	73.1 ± 1.3	83.0 ± 1.0	93.4 ± 0.6	97.4 ± 0.3	99.5 ± 0.3	99.8 ± 0.1
0.35 ... 0.45	0.4	67.5 ± 2.7	77.1 ± 1.5	86.7 ± 1.2	95.6 ± 1.0	98.3 ± 0.3	99.7 ± 0.3	99.9 ± 0.1
0.45 ... 0.60	0.52	75.1 ± 0.9	84.3 ± 1.0	91.8 ± 1.2	97.5 ± 0.7	99.1 ± 0.3	99.9 ± 0.1	100.0 ± 0.1
0.60 ... 0.75	0.67	85.8 ± 0.8	92.1 ± 1.0	96.2 ± 0.7	99.3 ± 0.2	99.7 ± 0.1	100.0 ± 0.0	100.0 ± 0.1
0.75 ... 1.00	0.87	94.3 ± 0.8	96.8 ± 0.9	98.9 ± 0.6	99.8 ± 0.2	99.9 ± 0.1	100.0 ± 0.0	99.9 ± 0.1
1.00 ... 1.50	1.22	97.6 ± 0.5	99.2 ± 0.3	99.6 ± 0.2	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.1	100.0 ± 0.1
1.50 ... 2.00	1.73	99.0 ± 0.3	99.7 ± 0.3	99.9 ± 0.1	100.0 ± 0.1	100.0 ± 0.1	100.0 ± 0.0	100.0 ± 0.0
2.00 ... 3.00	2.45	99.7 ± 0.3	99.8 ± 0.2	99.9 ± 0.1	100.0 ± 0.1	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0
3.00 ... 4.50	3.67	99.9 ± 0.3	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0

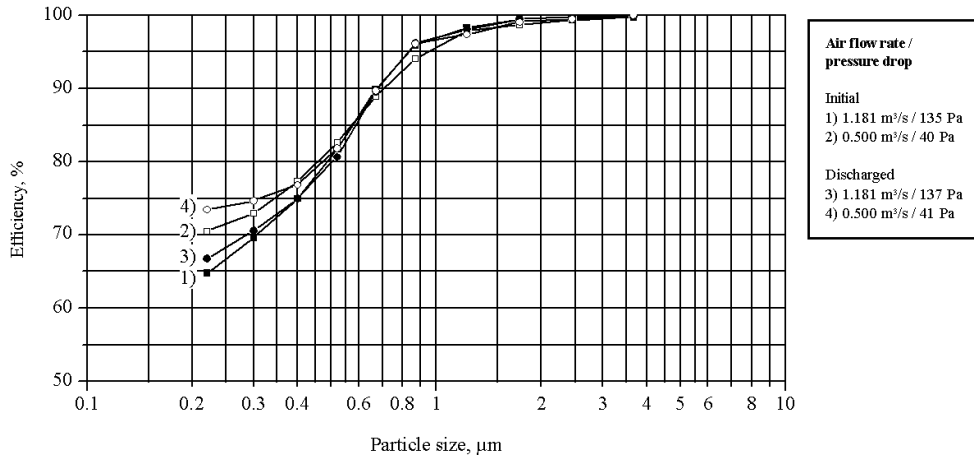
The uncertainty of the measured efficiencies is reported on a 95% confidence level.

TEST REPORT

NO. PFP-S-01398-08 8.2.2008

Air Filter: MV-F8-03
Efficiency of Untreated and Discharged Filter Material
EN 779:2002

Test No.: 082263
 Discharge Treatment Method: Diesel Engine Exhaust Gas
 Test Aerosol: DEHS
 Size of Material Sample: 17.4 m² (estimated)



Air Filter: MV-F8-03
Efficiency and Pressure Drop of Untreated and Discharged Filter Material
EN 779:2002

Test No.: 082263
 Discharge Treatment Method: Diesel Engine Exhaust Gas
 Test Aerosol: DEHS
 Size of Material Sample: 17.4 m² (estimated)

Particle size µm		Efficiency, %			
Interval	Mean	Untreated filter		Discharged filter	
		Air flow rate / Pressure drop		Air flow rate / Pressure drop	
		1.181 m ³ /s 135 Pa	0.500 m ³ /s 40 Pa	1.181 m ³ /s 137 Pa	0.500 m ³ /s 41 Pa
0.20 ... 0.25	0.22	64.8 ± 2.3	70.5 ± 2.8	66.8 ± 1.5	73.5 ± 2.2
0.25 ... 0.35	0.3	69.6 ± 1.3	73.0 ± 1.7	70.6 ± 0.9	74.7 ± 2.1
0.35 ... 0.45	0.4	75.0 ± 1.2	77.3 ± 1.2	75.0 ± 0.6	76.9 ± 1.5
0.45 ... 0.60	0.52	81.8 ± 1.6	82.6 ± 1.6	80.7 ± 1.6	81.8 ± 1.1
0.60 ... 0.75	0.67	89.9 ± 0.5	89.0 ± 0.8	89.6 ± 0.6	89.7 ± 1.0
0.75 ... 1.00	0.87	95.9 ± 0.7	94.1 ± 1.0	96.2 ± 1.1	96.1 ± 1.9
1.00 ... 1.50	1.22	98.3 ± 0.6	97.9 ± 0.6	98.1 ± 0.4	97.4 ± 0.8
1.50 ... 2.00	1.73	99.5 ± 0.2	98.7 ± 0.5	99.5 ± 0.2	99.1 ± 0.3
2.00 ... 3.00	2.45	99.8 ± 0.2	99.4 ± 0.2	99.7 ± 0.3	99.5 ± 0.3
3.00 ... 4.50	3.67	99.9 ± 0.3	99.7 ± 0.5	99.8 ± 0.3	100.0 ± 0.0
Mass of filter:		6521.6 g		6530.0 g	

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

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NO. PFP-S-01398-08 8.2.2008

Air Filter: MV-F8-03

**Air Flow Rate and Pressure Drop After Differential Dust Loading Phases
EN 779:2002**

Test No. 082263

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	Ψ %	P _a kPa	P kg/m ³	q _v m ³ /s	Δp Pa	Δp _{1.20} Pa	
Clean filter													
6.2.2008	0	20.5	-0.22	2688	1.794	21.6	23.5	101.2	1.194	1.503	187	187	
	0	20.7	-0.148	1659	1.411	21.5	23	101.3	1.195	1.181	126	126	
	0	20.9	-0.105	1056	1.126	21.5	23.8	101.2	1.194	0.943	88	88	
	0	21	-0.071	668	0.897	21.6	24.1	101.2	1.194	0.751	63	63	
	0	21	-0.042	295	0.597	21.6	24.1	101.2	1.194	0.5	36	36	
Clean filter pressure drop is proportional to (q _v) ⁿ , where n = 1.495													
Dust loading phase													
6.2.2008	30	21.8	-0.385	1659	1.406	22.4	25.4	101.2	1.19	1.181	133	133	2*
	30	22	-0.385	1653	1.403	23.3	24.2	101.2	1.186	1.182	132	132	1*
	80	22	-0.404	1649	1.401	22.8	25	101.1	1.188	1.18	150	150	2*
	80	22.3	-0.408	1648	1.4	23.2	24	101.1	1.186	1.18	149	149	1*
	180	22.2	-0.462	1650	1.4	23	24.3	101.1	1.187	1.18	202	202	2*
7.2.2008	180	20	-0.456	1672	1.417	20.3	25.6	101.4	1.201	1.18	201	201	1*
	250	214	-0.509	1667	1.412	22	25.7	101.5	1.195	1.181	254	254	2*
	250	21.7	-0.527	1668	1.411	22.7	24.8	101.5	1.193	1.183	254	254	1*
	360	21.8	-0.625	1662	1.408	22.5	25.3	101.6	1.193	1.18	357	357	2*
	360	22.3	-0.608	1657	1.405	23.4	24.3	101.6	1.191	1.18	356	356	1*
	445	22.3	-0.71	1662	1.407	23.1	24.6	101.7	1.193	1.18	456	455	2*
Clean filter before and after discharge treatment													
5.2.2008	0	22.7	-0.153	1649	1.402	23.1	23.8	101.4	1.189	1.179	135	135	
	0	22.2	-0.044	296	0.596	22.3	21.1	101.3	1.192	0.501	40	40	
6.2.2008	0	19.7	-0.161	1668	1.418	20.2	27.8	101.3	1.201	1.181	137	137	
	0	20.9	-0.051	295	0.598	21.6	26.8	101.3	1.194	0.5	41	41	

1* measured before next dust increment

2* measure 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	P	Air Density Upstream of Filter, kg/m ³
P _s	Air Flow Meter Static Pressure, kPa	Ψ	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	Δp _{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

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NO. PFP-S-01398-08 8.2.2008

Air Filter: MV-F8-03

Pressure Drop and Arrestance After Different Dust Loading Phases

EN 779:2002

Test No. 082263

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 %
6.2.2008	126	30	30	133	2626.9	2627	0.1	0	99.7
"	132	50	80	150	2627	2627	0	0	100
"	149	100	180	202	2627	2627	0	0	100
7.2.2008	201	70	250	254	2627.2	2627.2	0	0	100
"	254	110	360	357	2627.2	2627.2	0	0	100
"	356	85	445	455	2627.2	2627.2	0	0	100

Mass of Tested Device

Initial Mass of Tested Device: 6512.4g
 Final Mass of Tested Device: 6958.7g

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 Final Before After Dust Increment, g
 m_2 Mass 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: AFTL Inc.
 Batch No. -

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Instrument	Type code	Serial number	Calibration date	Used
Micromanometer	Alnor MP6KS	1020843	19.4.2007	X
	AlnorMP6KS	1020847	18.4.2007	X
Barometer	Lr.nro. 9002588	-	18.1.2007	X
Hygrometer	Rotronic MS 100TST	1188900/6	8.2.2007	X
Temperature	Nokeval 538-8	18455014	12.2.2007	X
Balance	Mettler PC8000-52	A90263	6.2.2006	X
Particle counter	PMS LAS-X	26004-1091-380	25.6.2007	X
	Calibration check with 0.299 µm and 0.994 µm latex particles		11.1.2008	-
Dust feeder	ASHRAE 52-76	-	13.4.2007	X
Orifice plate	0 216 / 610 x 610	-	8.9.1999	X
	Ø272/610x610	-	25.5.1999	-
	Ø90/610x610	-	17.3.2005	-