



T018 (EN ISO/IEC 17025)



Determination of the filtration performance of air filter CD408/34.5/171 according to EN 779:2002

Requested by: Nordic Air Filtration A/S



Requested by Nordic Air Filtration A/S
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Task **Determination of the filtration performance of air filter
CD408/34.5/171 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 30.1. - 1.2.2006.

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



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APPENDICES

5

DISTRIBUTION

Customer
VTT

Original (2pcs)
Original

EN 779:2002. AIR FILTER TEST RESULTS

GENERAL

| | | | | | |
|----------------------|---------------------------|---------------|------------------|-----------------------|------------|
| Test no.: | 062005 | Date of test: | 30.1. - 1.2.2006 | 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 |
| CD408/34.5/171 | Nordic Air Filtration A/S | Cylindrical cartridge filter |
| Type of media | Net effective filtering area | Filter dimensions (diamater x length) |
| NA 171 GT | 33.5 m ² | 408 mm x 876 mm |

TEST DATA

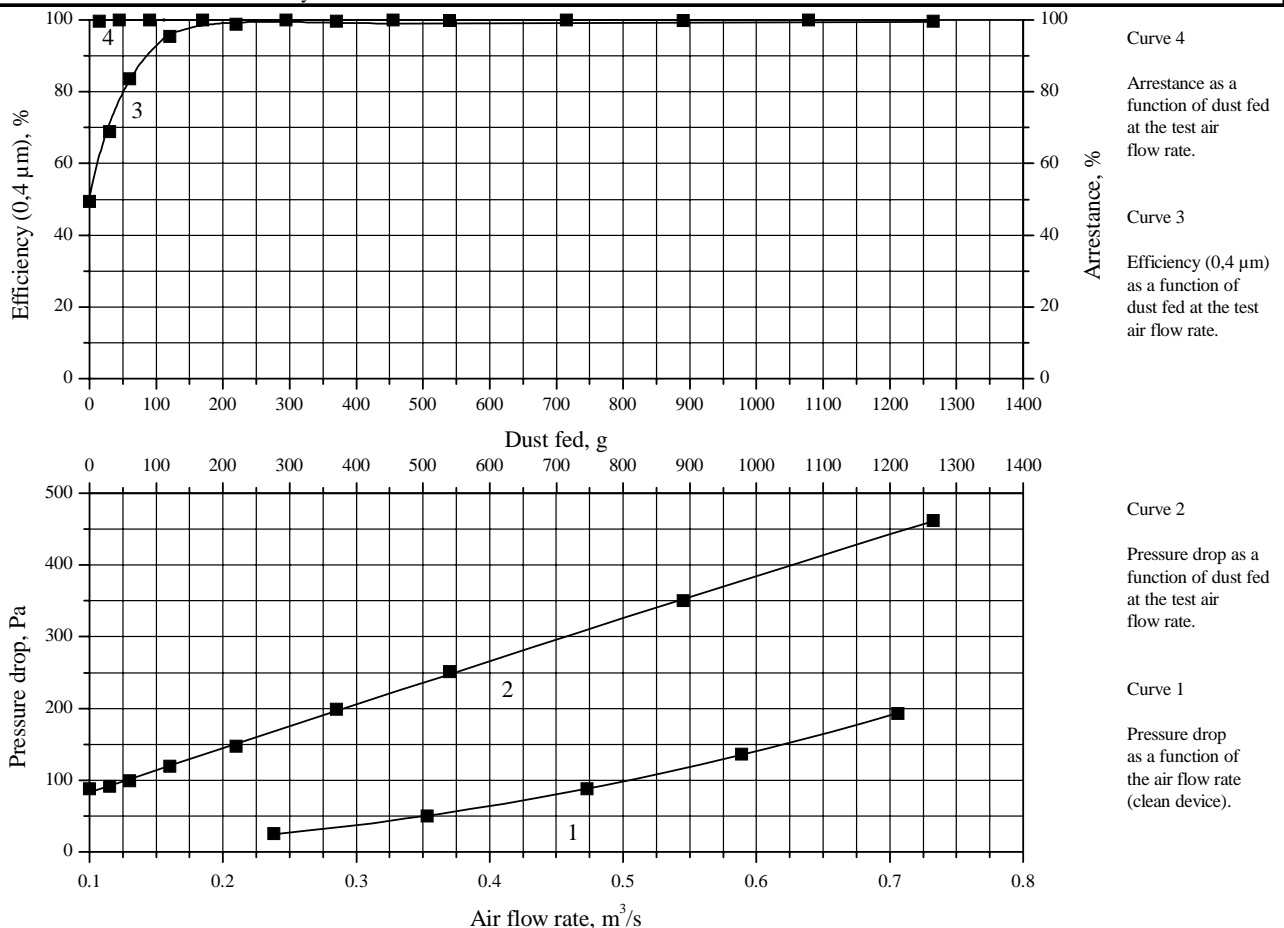
| | | | | |
|-------------------------|----------------------|----------------------------|--------------|--------------|
| Test air flow rate | Test air temperature | Test air relative humidity | Test aerosol | Loading dust |
| 0.472 m ³ /s | 21 - 22 °C | 18 - 23 % | DEHS | ASHRAE |

RESULTS

| | | | | |
|-----------------------|--------------------|-----------------------------|------------------------------|---|
| Initial pressure drop | Initial arrestance | Initial efficiency (0,4 µm) | Dust holding capacity | Untreated / discharged efficiency of filter material (0.4 µm) |
| 88 Pa | >99 % | 49 % | 537 / 890 / 1225 g | |
| Final pressure drop | Average arrestance | Average efficiency (0,4 µm) | Filter class (450 Pa) | Not measured |
| 250 / 350 / 450 Pa | >99 / >99 / >99 % | 94±0 / 97±0 / 97±0 % | F9 (0.472 m ³ /s) | |

Remarks: -

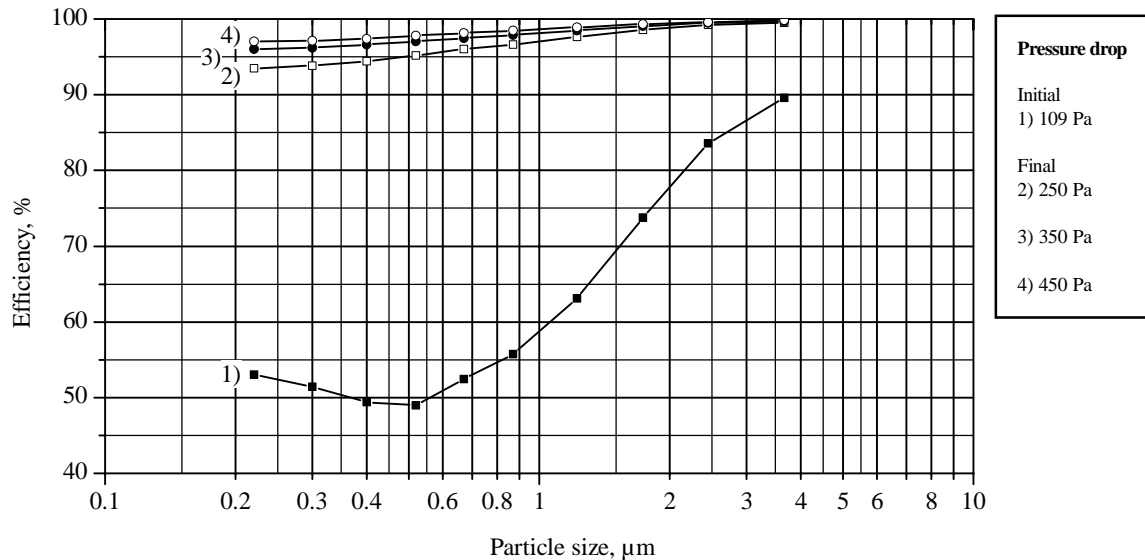
NOTE: The performance results cannot by themselves be quantitatively applied to predict filter performance in service.
The results relate only to the tested item.



Air filter: CD408/34.5/140
Initial and average efficiency at different final pressure drops
EN 779:2002

Test no.: 062003

Test aerosol: DEHS

 Air flow rate: 0.472 m³/s

Air filter: CD408/34.5/171
Initial and average efficiency at different final pressure drops
EN 779:2002

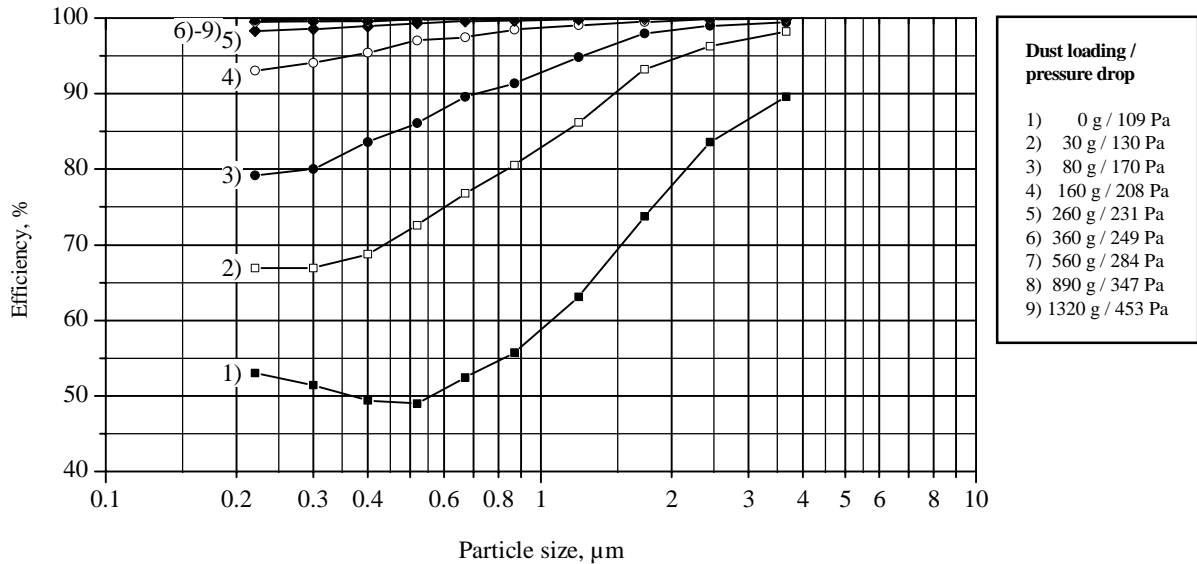
Test no: 062005

Test aerosol: DEHS

 Air flow rate: 0.472 m³/s

| Particle size µm | | Initial efficiency, % | Average efficiency % | | |
|-----------------------|------|--------------------------|-------------------------|------------|------------|
| Interval | Mean | | Final pressure drop | | |
| | | Pressure drop 88 Pa | 250 Pa | 350 Pa | 450 Pa |
| 0.20 ... 0.25 | 0.22 | 53.0 ± 1.2 | 93.5 ± 0.6 | 96.0 ± 0.4 | 97.0 ± 0.3 |
| 0.25 ... 0.35 | 0.30 | 51.4 ± 2.6 | 93.8 ± 0.4 | 96.2 ± 0.3 | 97.1 ± 0.3 |
| 0.35 ... 0.45 | 0.40 | 49.4 ± 2.5 | 94.4 ± 0.4 | 96.6 ± 0.3 | 97.4 ± 0.2 |
| 0.45 ... 0.60 | 0.52 | 49.0 ± 3.6 | 95.2 ± 0.6 | 97.0 ± 0.4 | 97.8 ± 0.4 |
| 0.60 ... 0.75 | 0.67 | 52.4 ± 3.9 | 96.0 ± 0.5 | 97.5 ± 0.4 | 98.1 ± 0.3 |
| 0.75 ... 1.00 | 0.87 | 55.7 ± 2.5 | 96.6 ± 0.5 | 97.9 ± 0.4 | 98.5 ± 0.3 |
| 1.00 ... 1.50 | 1.22 | 63.1 ± 2.2 | 97.6 ± 0.4 | 98.5 ± 0.3 | 98.9 ± 0.2 |
| 1.50 ... 2.00 | 1.73 | 73.8 ± 2.6 | 98.6 ± 0.2 | 99.1 ± 0.2 | 99.3 ± 0.1 |
| 2.00 ... 3.00 | 2.45 | 83.6 ± 2.0 | 99.2 ± 0.2 | 99.5 ± 0.1 | 99.6 ± 0.1 |
| 3.00 ... 4.50 | 3.67 | 89.6 ± 3.6 | 99.5 ± 0.3 | 99.7 ± 0.2 | 99.8 ± 0.1 |
| Dust holding capacity | | - | 537 g | 890 g | 1225 g |
| Filter class | | - | - | - | F9 |

Air filter: CD408/34.5/140
Efficiency after different dust loading phases
EN 779:2002
 Test no.: 062003
 Test aerosol: DEHS
 Air flow rate: 0.472 m³/s



Air filter: CD408/34.5/171
Efficiency and uncertainty after different dust loading phases
EN 779:2002
 Test no: 062005
 Test aerosol: DEHS
 Air flow rate: 0.472 m³/s

| Particle size µm | | Efficiency % | | | | | | | | |
|---------------------|------|---------------------------------|---------------|---------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| Interval | Mean | Pressure drop, Pa / Dust fed, g | | | | | | | | |
| | | 88 Pa 0 g | 91 Pa 30 g | 99 Pa 60 g | 119 Pa 120 g | 147 Pa 220 g | 199 Pa 370 g | 251 Pa 540 g | 350 Pa 890 g | 462 Pa 1265 g |
| 0.20 ... 0.25 | 0.22 | 53.0 ± 1.2 | 66.9 ± 1.4 | 79.2 ± 2.4 | 93.1 ± 0.6 | 98.3 ± 0.3 | 99.5 ± 0.3 | 99.8 ± 0.1 | 99.9 ± 0.1 | 99.7 ± 0.1 |
| 0.25 ... 0.35 | 0.30 | 51.4 ± 2.6 | 66.9 ± 1.7 | 80.0 ± 0.7 | 94.1 ± 0.6 | 98.6 ± 0.2 | 99.6 ± 0.1 | 99.9 ± 0.1 | 99.8 ± 0.2 | 99.6 ± 0.2 |
| 0.35 ... 0.45 | 0.40 | 49.4 ± 2.5 | 68.8 ± 0.9 | 83.6 ± 0.8 | 95.4 ± 0.6 | 98.9 ± 0.2 | 99.6 ± 0.1 | 99.9 ± 0.1 | 99.9 ± 0.2 | 99.7 ± 0.1 |
| 0.45 ... 0.60 | 0.52 | 49.0 ± 3.6 | 72.6 ± 1.1 | 86.1 ± 1.9 | 97.0 ± 0.6 | 99.3 ± 0.3 | 99.8 ± 0.2 | 99.8 ± 0.2 | 99.9 ± 0.3 | 99.8 ± 0.1 |
| 0.60 ... 0.75 | 0.67 | 52.4 ± 3.9 | 76.8 ± 1.4 | 89.6 ± 0.7 | 97.5 ± 0.7 | 99.6 ± 0.3 | 99.9 ± 0.1 | 99.9 ± 0.1 | 99.8 ± 0.3 | 99.8 ± 0.2 |
| 0.75 ... 1.00 | 0.87 | 55.7 ± 2.5 | 80.5 ± 2.5 | 91.4 ± 1.1 | 98.5 ± 0.4 | 99.7 ± 0.2 | 99.9 ± 0.2 | 100.0 ± 0.1 | 99.9 ± 0.2 | 99.9 ± 0.1 |
| 1.00 ... 1.50 | 1.22 | 63.1 ± 2.2 | 86.2 ± 1.7 | 94.8 ± 0.9 | 99.1 ± 0.4 | 99.8 ± 0.1 | 100.0 ± 0.1 | 100.0 ± 0.1 | 99.9 ± 0.1 | 99.9 ± 0.1 |
| 1.50 ... 2.00 | 1.73 | 73.8 ± 2.6 | 93.2 ± 0.9 | 98.0 ± 0.4 | 99.5 ± 0.2 | 99.9 ± 0.1 | 99.9 ± 0.1 | 100.0 ± 0.0 | 99.9 ± 0.1 | 100.0 ± 0.0 |
| 2.00 ... 3.00 | 2.45 | 83.6 ± 2.0 | 96.3 ± 0.8 | 99.0 ± 0.5 | 99.8 ± 0.1 | 99.9 ± 0.1 | 99.9 ± 0.1 | 100.0 ± 0.0 | 100.0 ± 0.0 | 100.0 ± 0.0 |
| 3.00 ... 4.50 | 3.67 | 89.6 ± 3.6 | 98.2 ± 0.8 | 99.4 ± 0.7 | 99.9 ± 0.2 | 100.0 ± 0.0 | 99.9 ± 0.2 | 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: CD408/34.5/171
Air flow rate and pressure drop after different dust loading phases
EN 779:2002
Test no: 062005

| 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 | | | | | | | | | | | | |
| 30.1.2006 | 0 | 20.8 | -0.179 | 589 | 0.841 | 21.4 | 19.9 | 100.8 | 1.191 | 0.706 | 192 | 193 |
| " | 0 | 20.6 | -0.128 | 410 | 0.702 | 21.1 | 20.6 | 100.8 | 1.191 | 0.589 | 135 | 136 |
| " | 0 | 20.5 | -0.084 | 264 | 0.564 | 21.0 | 20.6 | 100.8 | 1.192 | 0.473 | 88 | 88 |
| " | 0 | 20.5 | -0.055 | 147 | 0.421 | 21.0 | 20.4 | 100.8 | 1.192 | 0.353 | 50 | 50 |
| " | 0 | 20.5 | -0.027 | 66 | 0.283 | 21.1 | 20.3 | 100.8 | 1.192 | 0.238 | 25 | 25 |
| Clean filter pressure drop is proportional to $(q_v)^n$, where $n = 1.881$ | | | | | | | | | | | | |
| Dust loading phase | | | | | | | | | | | | |
| 31.1.2006 | 30 | 20.4 | -0.147 | 264 | 0.564 | 20.9 | 19.0 | 101.0 | 1.194 | 0.473 | 91 | 91 |
| " | 30 | 20.6 | -0.148 | 264 | 0.564 | 20.6 | 19.2 | 100.9 | 1.195 | 0.473 | 91 | 91 |
| " | 60 | 20.5 | -0.155 | 261 | 0.561 | 21.2 | 18.7 | 100.9 | 1.193 | 0.471 | 99 | 99 |
| " | 60 | 20.8 | -0.152 | 263 | 0.563 | 20.8 | 18.8 | 100.9 | 1.194 | 0.472 | 99 | 99 |
| " | 120 | 20.5 | -0.171 | 263 | 0.563 | 21.3 | 18.4 | 100.9 | 1.192 | 0.472 | 118 | 119 |
| " | 120 | 20.8 | -0.172 | 264 | 0.564 | 20.9 | 18.5 | 100.9 | 1.194 | 0.472 | 118 | 118 |
| " | 220 | 20.5 | -0.202 | 265 | 0.565 | 21.2 | 17.9 | 100.9 | 1.193 | 0.473 | 146 | 147 |
| " | 220 | 20.9 | -0.202 | 264 | 0.564 | 20.9 | 18.2 | 100.9 | 1.194 | 0.473 | 148 | 149 |
| " | 370 | 20.7 | -0.256 | 263 | 0.562 | 21.4 | 18.1 | 100.9 | 1.192 | 0.472 | 198 | 199 |
| 1.2.2006 | 370 | 20.5 | -0.247 | 264 | 0.563 | 20.8 | 21.5 | 100.6 | 1.190 | 0.473 | 194 | 195 |
| " | 540 | 20.6 | -0.305 | 262 | 0.561 | 21.3 | 21.4 | 100.6 | 1.187 | 0.472 | 249 | 251 |
| " | 540 | 20.9 | -0.305 | 262 | 0.560 | 20.8 | 21.7 | 100.6 | 1.189 | 0.471 | 249 | 251 |
| " | 890 | 20.7 | -0.402 | 261 | 0.558 | 21.5 | 22.5 | 100.3 | 1.183 | 0.472 | 346 | 350 |
| " | 890 | 21.1 | -0.396 | 263 | 0.560 | 21.0 | 23.1 | 100.2 | 1.185 | 0.473 | 342 | 346 |
| " | 1265 | 20.8 | -0.512 | 261 | 0.557 | 21.6 | 22.9 | 100.1 | 1.180 | 0.472 | 455 | 462 |

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: CD408/34.5/171
Pressure drop and arrestance after different dust loading phases
EN 779:2002
Test no: 062005

| 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 % |
|-----------|--------------------|-----------------|----------------|--------------------|------------|------------|----------------------|------------|--------|
| 31.1.2006 | 88 | 30 | 30 | 91 | 2749.3 | 2749.4 | 0.1 | 0.0 | 99.7 |
| " | 91 | 30 | 60 | 99 | 2749.4 | 2749.4 | 0.0 | 0.0 | 100.0 |
| " | 99 | 60 | 120 | 119 | 2749.4 | 2749.4 | 0.0 | 0.0 | 100.0 |
| " | 118 | 100 | 220 | 147 | 2749.4 | 2749.4 | 0.0 | 0.0 | 100.0 |
| " | 149 | 150 | 370 | 199 | 2749.4 | 2749.4 | 0.0 | 0.0 | 100.0 |
| 1.2.2006 | 195 | 170 | 540 | 251 | 2749.5 | 2749.5 | 0.0 | 0.0 | 100.0 |
| " | 251 | 350 | 890 | 350 | 2749.5 | 2749.5 | 0.0 | 0.0 | 100.0 |
| " | 346 | 375 | 1265 | 462 | 2749.5 | 2749.5 | 0.0 | 0.0 | 100.0 |

Mass of tested device

Initial mass of tested device: 11784 g

Final mass of tested device: 12946 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

Batch no.: 4485 30 APR 05

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 | - |