

# HEPA filter performance testing, classification EN1822

Filtec Ltd.

Filter test laboratory FFL

Test report This is the abridged version of the test report no K119/030526/9.

CH-5702 Niederlenz/Switzerland

Test requested by (orderer): INCEN AG CH-9403 Goldach / Switzerland (Order date: November 16<sup>th</sup>, 2001)

Test filter element: **HyperHEPA Filter** (Label print on filter element)

Application: HEPA filter for air cleaners (Indication from the orderer.)

Classification: H13 EN1822-1 (Label print on filter element)

Nominal air flow rate: 190 m<sup>3</sup>/h (112CFM) (Label print on filter element)

Nominal outside dimensions: 330 mm x 330 mm front side dimension, depth in the air direction: 120 mm (Indications from the orderer)

Gasket system description (by FFL): Tongue and groove; the groove is located all along in the front side of the EPS filter frame, the tongue is located in the air cleaner frame module. (The sealing system is named: 3 D UltraSeal, indic. from the orderer.)

Air flow direction: Sealed at upstream side (↓ Label print on filter element.)

Filter element description (by FFL): Pleated glass fiber paper, positioned between 2 layers (filter foam, colour: blue) with 2 touch protection meshes, inserted and sealed into a 2-part EPS frame (EPS: Expanded polystyrene, colour: white).

Type of filter medium: Wet laid glass fiber paper, pleated, pleat spacing with hot melt line separators. (Description by FFL)

Effective filter medium area: 3.5 m<sup>2</sup> (Measured value FFL, test sample FFL no K119-13)

Filter medium face velocity at nominal air flow rate: 1.5 cm/s (The nominal air volume flow rate divided by the effective filter medium area of the filter element.)

Test sample procurement: Furnished by orderer

Number of samples, FFL receiving date: 13 filter elements (FFL no K119-1,-2, ...-13, receiving date: Nov. 16<sup>th</sup>, 2001, production date: 15<sup>th</sup> Nov. 2001), 10 flat sheets of glass fibre paper (FFL no M157-1,-2, ...-10, rec. date: Nov. 16<sup>th</sup>, 2001, prod. date: Nov. 2001).

Test order: Reference filter testing regarding class H13 EN 1822-1.

Test method: EN1822-1:1998 High efficiency particulate air filters (HEPA, ULPA) classification, performance testing, marking.  
EN1822-2:1998 Measuring equipment, Aerosol production, particle counting statistics.  
EN1822-3:1998 Testing the planar filter medium.  
EN1822-4:2000 Efficiency test of the filter element using the scan method and monodisperse DEHS aerosol.

Test equipment: Test rig and equipment EN1822 of Filtec Ltd. Filter test laboratory FFL, Niederlenz/Switzerland  
Test rig and equipment EN1822-3, for testing of the planar filter medium,  
Test rig and equipment EN1822-4, for testing of the filter elements

Measured value: **MPPS EN1822-3 of planar filter medium**

Location, test date, atmospheric conditions: Niederlenz, November 16<sup>th</sup>, 2001, temperature: 16°C, barometric pressure: 1004 hPa

Tested samples: M157-6/-7/-8/-9/-10 (FFL selected these 5 samples in advance.)

Face velocity: 1.5 cm/s (The nominal air flow rate divided by the net effective filtering area from the filter element: 1.5 cm/s)

Particle size at MPPS: 220 nm (MPPS: Most penetrating particle size)

Measured value: **Efficiency EN1822-4 of filter elements**

Location, test date, start time, air flow conditions: Niederlenz, November 17<sup>th</sup>, 2001, start time: 15:01, temperature: 17°C, barometric pressure: 993 hPa

Measuring object proc. by orderer (up- to downstr.): -1 frame 762mmx762mmx21mm, -4 air cleaner frames with tongue for gasket groove, -4 tested filter elements.

Tested filter elements: K119-9/-10/-11/-12 (The test was carried out with 4 filter elements, operating in parallel.)

Test aerosol: DEHS oil mist (di-ethyl-hexyl-sebacate, Merck 1.09672)

Particle size: 219 nm (Median value of the particle size distribution.)

Geometrical standard deviation: 1.37 (≤1.5: The particle size distribution was quasi-monodisperse.)

Test air flow rate: 758 m<sup>3</sup>/h (The test was carried out with 4 filter elements, operating in parallel.)

Pressure difference: 99 Pa

Efficiency, local value, stat. min.<sup>5</sup>: 99.89 % (Minimum local efficiency at a section of 9 cm<sup>2</sup> in the whole passage area of the filter elements.)

Efficiency, integral value, stat. min.<sup>5</sup>: 99.971 % (Integral efficiency, averaged over the whole passage area of the filter elements.)

<sup>1</sup> Penetration D, <sup>4</sup> Efficiency A: <sup>1</sup> Penetration D % =  $K_{downstream} / K_{upstream} \times 100\%$  (K = Particle concentration). <sup>4</sup> Efficiency A: A % = 100 % - D %

<sup>2</sup> Penetration, stat. max., <sup>5</sup> Efficiency, stat. min.: <sup>2</sup> Penetration D stat. max. % =  $K_{downstream\ u} / K_{upstream\ u} \times 100\%$ . <sup>5</sup> Efficiency A stat. min. % = 100 % - D stat. max. %

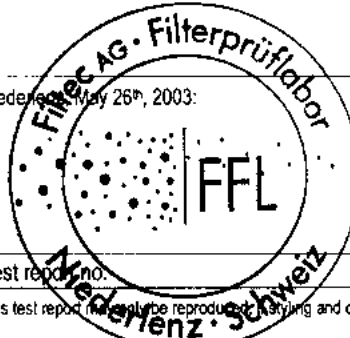
<sup>3</sup> Particle number concentration limits K<sub>u</sub>, K<sub>l</sub>: Upper and lower particle concentration limits were calculated on the basis of the particle count, for the confidence level 95% of a Poisson distribution.

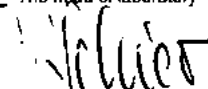
Test result: **Classification of the HyperHEPA Filter**

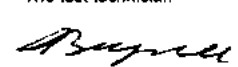
At the air flow rate of 190 m<sup>3</sup>/h (112CFM) the tested filter elements meet the requirements of HEPA filters of class H13 EN1822-1 (efficiency limits: - integral <sup>5</sup> ≥ 99.95 %, - local <sup>5</sup> ≥ 99.75 %). The marking of the filter element meet the requirements of the standard as well.

Validity of this test report: This test report documents the test of reference filter elements. It is valid for filter elements, that are used maximally at the tested rated air flow and that are identical with the tested samples. The identity is not supervised by FFL. This test report will lose its validity immediately, before the expiry of the below-mentioned date: - If it is noticed, that the penetration limits will be exceed in use; - If material, production or any technical specification of the filter type will be amended; - If the test standards will be amended.

This test report expires June 1<sup>st</sup>, 2006.

Niederlenz, July 26<sup>th</sup>, 2003:  Filtec Ltd. Filter test laboratory FFL, Niederlenz/Switzerland

The head of laboratory:  Josef Schier

The test technician:  Otto Bryner

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# HEPA filter performance testing, classification EN1822

Filtec Ltd.

Filter test laboratory FFL

## Test report

This is the abridged version of the test report no K119/030526/10.

CH-5702 Niedertenz/Switzerland

Test requested by (orderer): INCEN AG CH-9403 Goldach / Switzerland (Order date: November 7<sup>th</sup>, 2001)

Test filter element: **HyperHEPA Filter** (Label print on filter element)

Application: HEPA filter for air cleaners (Indication from the orderer.)

Classification: H12 EN1822-1 (Label print on filter element)

Nominal air flow rate: 475 m<sup>3</sup>/h (280CFM) (Label print on filter element)

Nominal outside dimensions: 330 mm x 330 mm front side dimension, depth in the air direction: 120 mm (Indications from the orderer)

Gasket system description (by FFL): Tongue and groove; the groove is located all along in the front side of the EPS filter frame, the tongue is located in the air cleaner frame module. (The sealing system is named: 3 D UltraSeal, indic. from the orderer.)

Air flow direction: Sealed at upstream side (↓ Label print on filter element)

Filter element description (by FFL): Pleated glass fiber paper, positioned between 2 layers (filter foam, colour: blue) with 2 touch protection meshes, inserted and sealed into a 2-part EPS frame (EPS: Expanded polystyrene, colour: white).

Type of filter medium: Wet laid glass fiber paper, pleated, pleat spacing with hot melt line separators. (Description by FFL)

Effective filter medium area: 3.5 m<sup>2</sup> (Measured value FFL, test sample FFL no K119-13)

Filter medium face velocity at nominal air flow rate: 3.8 cm/s (The nominal air volume flow rate divided by the effective filter medium area of the filter element.)

Test sample procurement: Furnished by orderer

Number of samples, FFL receiving date: 13 filter elements (FFL no K119-1,-2, ...-13, receiving date: Nov. 16<sup>th</sup>, 2001, production date: 15<sup>th</sup> Nov. 2001), 10 flat sheets of glass fibre paper (FFL no M157-1,-2, ...-10, rec. date: Nov. 16<sup>th</sup>, 2001, prod. date: Nov. 2001).

Test order: Reference filter testing regarding class H12 EN 1822-1.

Test method: EN1822-1:1998 High efficiency particulate air filters (HEPA, ULPA) classification, performance testing, marking  
EN1822-2:1998 Measuring equipment, Aerosol production, particle counting statistics.  
EN1822-3:1998 Testing the planar filter medium  
EN1822-4:2000 Efficiency test of the filter element using the scan method and monodisperse DEHS aerosol.

Test equipment: Test rig and equipment EN1822 of Filtec Ltd. Filter test laboratory FFL, Niedertenz/Switzerland  
Test rig and equipment EN1822-3, for testing of the planar filter medium,  
Test rig and equipment EN1822-4, for testing of the filter elements

Measured value: **MPPS EN1822-3 of planar filter medium**

Location, test date, atmospheric conditions: Niedertenz, November 16<sup>th</sup>, 2001, temperature: 16°C, barometric pressure: 1004 hPa

Tested samples: M157-1/-2/-3/-4/-5 (FFL selected these 5 samples in advance.)

Face velocity: 3.8 cm/s (The nominal air flow rate divided by the net effective filtering area from the filter element: 3.8 cm/s)

Particle size at MPPS: 160 nm (MPPS: Most penetrating particle size)

Measured value: **Efficiency EN1822-4 of filter elements**

Location, test date, start time, air flow conditions: Niedertenz, November 17<sup>th</sup>, 2001, start time: 10:55, temperature: 17°C, barometric pressure: 994 hPa

Measuring object proc. by orderer (up- to downstr.): -1 frame 762mmx762mmx21mm, -4 air cleaner frames with tongue for gasket groove, -4 tested filter elements.

Tested filter elements: K119-9/-10/-11/-12 (The test was carried out with 4 filter elements, operating in parallel.)

Test aerosol: DEHS oil mist (di-ethyl-hexyl-sebacate, Merck 1.09672)

Particle size: 166 nm (Median value of the particle size distribution.)

Geometrical standard deviation: 1.5 (≤1.5: The particle size distribution was quasi-monodisperse.)

Test air flow rate: 1898 m<sup>3</sup>/h (The test was carried out with 4 filter elements, operating in parallel.)

Pressure difference: 277 Pa

Efficiency, local value, stat. min.<sup>5</sup>: 99.61 % (Minimum local efficiency at a section of 9 cm<sup>2</sup> in the whole passage area of the filter elements.)

Efficiency, integral value, stat. min.<sup>5</sup>: **99.83 %** (Integral efficiency, averaged over the whole passage area of the filter elements.)

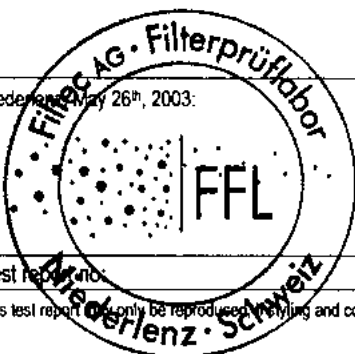
<sup>1</sup>Penetration D, <sup>4</sup>Efficiency A: <sup>1</sup>Penetration D % = K<sub>downstream</sub> / K<sub>upstream</sub> x 100 % (K = Particle concentration). <sup>4</sup>Efficiency A: A % = 100 % - D %  
<sup>2</sup>Penetration, stat. max., <sup>5</sup>Efficiency, stat. min.: <sup>2</sup>Penetration D stat. max. % = K<sub>downstream</sub> / i / K<sub>upstream</sub> / i<sub>0</sub> x 100 %, <sup>5</sup>Efficiency A stat. min. % = 100 % - D stat. max. %  
<sup>3</sup>Particle number concentration limits K<sub>u</sub>, K<sub>l</sub>: Upper and lower particle concentration limits were calculated on the basis of the particle count, for the confidence level 95% of a Poisson distribution.

Test result: **Classification of the HyperHEPA Filter**  
At the air flow rate of 475 m<sup>3</sup>/h (280CFM) the tested filter elements meet the requirements of HEPA filters of class H12 EN1822-1 (efficiency limits: - integral<sup>5</sup> ≥99.5 %, - local not specified for class H12 EN1822-1). The marking of the filter element meet the requirements of the standard as well.

Validity of this test report: This test report documents the test of reference filter elements. It is valid for filter elements, that are used maximally at the tested rated air flow and that are identical with the tested samples. The identity is not supervised by FFL. This test report will lose its validity immediately, before the expiry of the below-mentioned date: - if it is noticed, that the penetration limits will be exceed in use; - If material, production or any technical specification of the filter type will be amended; - If the test standards will be amended.

This test report expires June 1<sup>st</sup>, 2006.

Niedertenz, May 26<sup>th</sup>, 2003:



Filtec Ltd. Filter test laboratory FFL, Niedertenz/Switzerland

The head of laboratory

*Josef Schier*  
Josef Schier

The test technician

*Otto Bryner*  
Otto Bryner

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