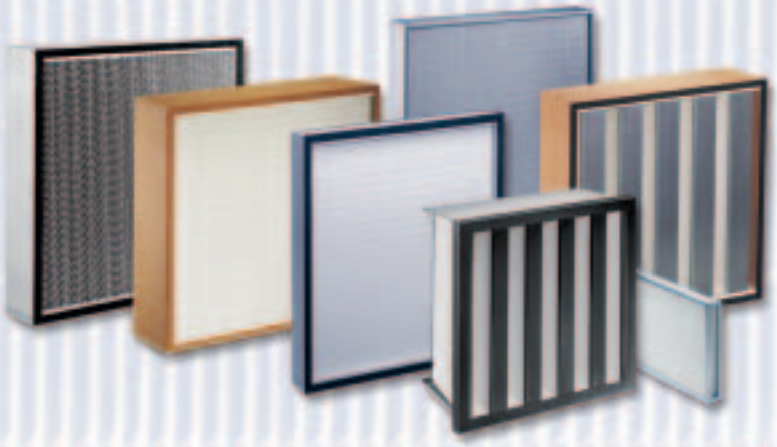
Air filter test method for testing high efficiency particulate filters

EN 1822:2009



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Leaflet P/2/1/EN

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for testing high efficiency particulate filters

Detail

European standard EN 1822:2009 (High efficiency air filters (EPA, HEPA and ULPA) defines a method for testing the efficiency based on a particle counting method using a liquid test aerosol and permits a systematic classification of the particulate filter according to the efficiency.

HEPA and ULPA filters are used as top-quality air filters for the separation of aerosols, toxic dusts, viruses and bacteria, and also for applications with most critical requirements for air purity in clean room technology. They are tested and classified according to EN1822:2009.

The complete European standard comprises the following parts:

» **EN 1822-1:2009**
Classification, performance test, marking.

» **EN 1822-2:2009**
Aerosol production, measuring equipment, particle counting statistics

» **EN 1822-3:2009**
Testing the flat sheet filter media.

» **EN 1822-4:2009**
Determining leakage of filter element (scan method).

» **EN 1822-5:2009**
Determining the efficiency of filter element.

EN 1822-1:2009

Part 1 of this standard contains the classification, performance test, and marking of EPA, HEPA and ULPA filters

On the basis of the determined values for the local efficiency and the overall efficiency, the filter is assigned to a filter class according to the table below.

Filter class	Overall value		Local value	
	Efficiency in %	Penetration in %	Efficiency in %	Penetration in %
E10	85	15	-	-
E11	95	5	-	-
E12	99.5	0.5	-	-
H13	99.95	0.05	99.75	0.25
H14	99.995	0.005	99.975	0.025
U15	99.9995	0.0005	99.9975	0.0025
U16	99.99995	0.00005	99.99975	0.00025
U17	99.999995	0.000005	99.9999	0.0001

Table 1: Classification of air filters according to EN 1822-1:2009

EN 1822-2:2009

Part 2 of this standard describes the measuring equipment and aerosol generators used within the scope of this test.

In addition, with regard to particle counting it specifies the statistical basis for the evaluation of counts with only small numbers of counted events.

EN 1822-3:2009

On flat sheet filter media, the particle size efficiency is measured and the MPPS is determined.

During the test, the particle size efficiency is determined on the flat sheet filter medium using the particle counting method.

Specimens of the sheet filter medium are fixed in a test filter assembly and subject to the test air flow corresponding to the prescribed filter medium velocity. The test aerosol from the aerosol generator is conditioned (e.g. vaporisation of a solvent) then neutralised, mixed homogeneously with filtered test air and led to the test filter assembly.

In order to determine the efficiency, partial flows of the test aerosol are sampled upstream and downstream of the filter medium.

Using a particle counting instrument, the number concentration of the particles contained is determined for the various particle sizes. The results of these measurements are used to draw a graph of penetration against particle size for which the penetration is a maximum. The particle size is known as the “most penetrating particle size” (MPPS).

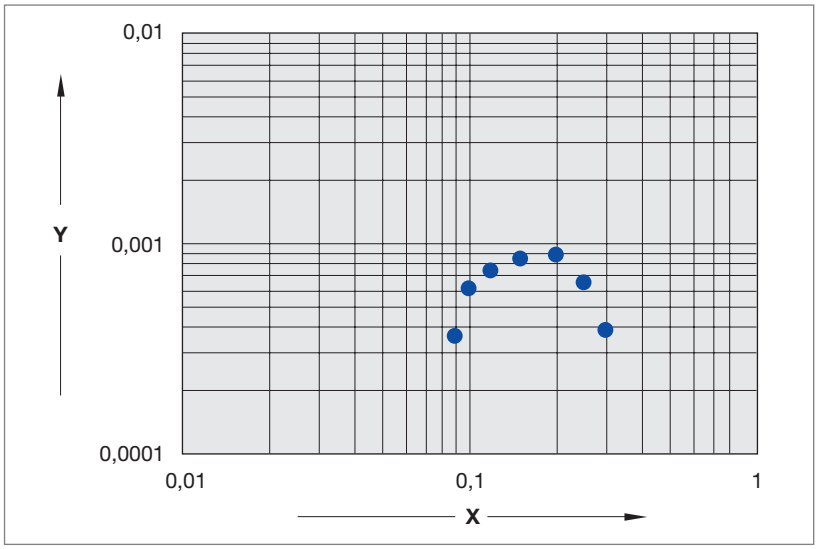

Diagram 1: Particle penetration

X = Particle diameter in µm
Y = Penetration in %

Test rig EN 1822-3:2009

Photo 1: Test rig EN 1822-3:2009

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EN 1822-4:2009

With a test aerosol whose average particle size corresponds to the MPPS, the filter element is checked for leakage. The overall efficiency is calculated from the measured local filtration efficiencies.

The leakage test serves to test the filter element for the local penetration values which exceed the permissible levels (see EN 1822-1:2009)

For leakage testing the test filter is installed in the mounting assembly and subjected to a test air flow corresponding to the nominal air flow rate, the filter is purged and the test aerosol produced by the aerosol generator is mixed with the prepared test air along a mixing duct so that it is spread homogeneously over the cross-section of the duct.

The particle flow rate on the downstream side of the test filter is smaller than the particle flow rate reaching the filter on the upstream side by the factor mean penetration.

The manufacturing irregularities of the filter material or leaks lead to a variation of the particle flow rate over the filter face area. In addition, leaks at the boundary areas and within the components of the test filter (sealant, filter frame, seal of the filter mounting assembly) can lead locally to an increase in the particle flow rate on the downstream side of the test filter.

For the leakage test, the particle flow distribution is determined on the downstream side of the filter in order to check where the limit values are exceeded. The coordinates of these positions are recorded.

When the filter is leak-free and fulfils the criteria of the overall efficiency, a test report is created. The test report contains the test number, target data for the filter, and the actual data of the sample. The leak-free state of the filter is confirmed and a filter number is assigned.

Repair of leakage points

If the signal value is not exceeded during the probe run then the filter is free of leaks.

If the signal value is exceeded then this is an indication that the limit value for the local penetration may be exceeded at this position. If it is necessary to check the local penetration, then the probe is returned to the coordinates for which the signal value was reached on the scan test. The aim is to find the point with the maximum count rate.

The count rate is measured there with a stationary probe. The concentration of the aerosol on the upstream side is also measured continually or intermittently

A filter may be repaired if necessary and shall be retested.

NOTE:

» All repairs together (including those made by the filter manufacturer shall not block or restrict more than 0.5% of the filter face area (not including the frame).

» The maximum length of each single repair shall not exceed 3.0cm. Alternative repair criteria may be otherwise agreed between buyer and seller.

Test rig EN 1822-4:2009

Photo 2: Test rig EN 1822-4

Annex A (normative) Oil thread test

Within the framework of works testing, the oil thread test may be used to test for leaks for the filter classes E 12 to H14 instead of scan testing. The oil thread test is also acceptable as a reference test procedure for filters which cannot be scan tested because of their constructional form.

In the oil thread test, the freedom from leaks is demonstrated visually. The filter is placed horizontally on a diffuser or box, and then subjected to an oil drop aerosol.

EN 1822-5:2009

Part 5 of this standard deals with the efficiency test of filter elements that could not be tested according to Part 4 due to their design.

The downstream sampling to determine the overall efficiency takes place using stationary sampling probes.

Installation example for EN 1822:2009 tested high efficiency particulate filters

Photo 3: Städtische Kliniken (City Clinics) (Düsseldorf)

Photo 4: Städtische Kliniken (City Clinics) (Düsseldorf)

Foto 5: Polfa Tarchomin pharmaceutical factory (Poland)

Installation example for EN 1822:2009 tested high efficiency particulate filters

Photo 6: Pharma-Forschungszentrum Bayer (Pharmaceutical Research Centre) (Wuppertal)

Photo 7: Max Planck Institute (Mainz)

Photo 8: Centre Hospitalier Universitaire (Vaudois)

TROX® TECHNIK
The art of handling air

TROX GmbH

Siemensstraße 24
47574 Goch, Germany
Phone +49 (0) 28 23/10 09-0
Fax +49 (0) 28 23/10 09-14
E-mail troxfilter@trox.de
www.troxtechnik.com

Filters