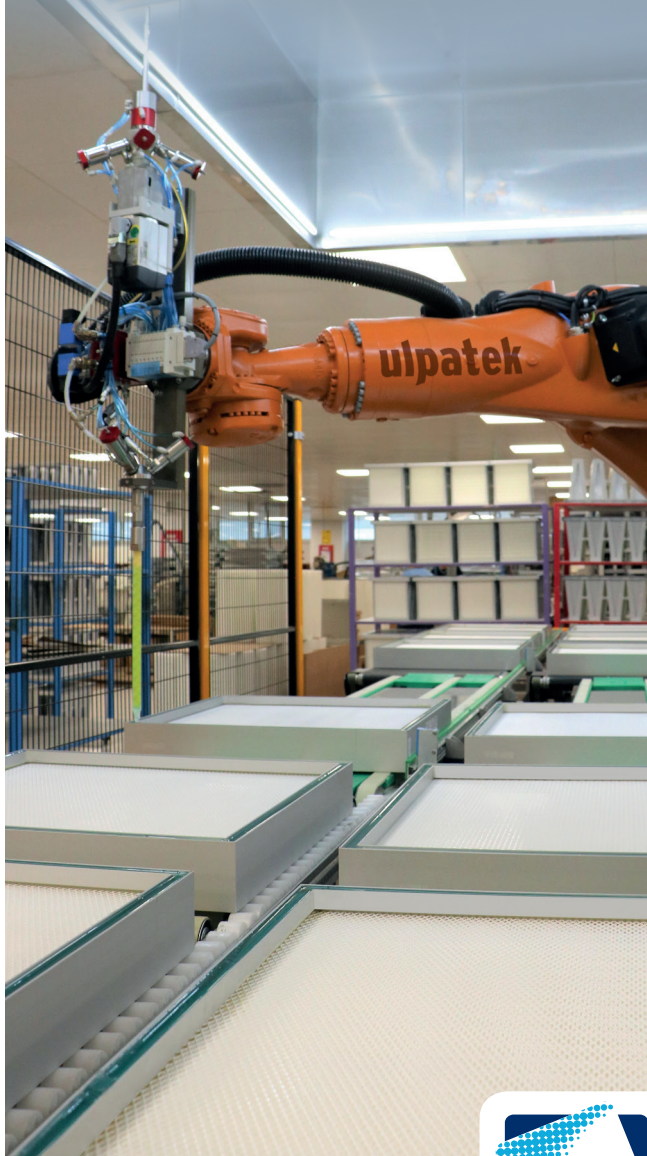


ULPALAB

ULPATEK Filter Testing Laboratory



"Advanced filtration for a better future"



CURRENT STANDARDS IN AIR FILTRATION

ISO 16890

ISO 16890 standard is the new standard that has replaced the EN779: 2012. This standard covers Coarse filters (Class G), Medium filters (Class M) and Fine filters (Class F) and eliminate the insufficient points of the old standard. With this change in standard, filter users will be able to choose the filter much more accurate according to their needs. ISO 16890 standard considers for the particle size (Particulate Matter = PM) between 0.3 µm and 10 µm for efficiency evaluation. Filters are divided into 4 groups.

ISO ePM ₁	ISO ePM _{2,5}	ISO ePM ₁₀	ISO Coarse
ePM ₁ 95%	ePM _{2,5} 95%	ePM ₁₀ 95%	Coarse 90%
ePM ₁ 90%	ePM _{2,5} 90%	ePM ₁₀ 90%	Coarse 80%
ePM ₁ 85%	ePM _{2,5} 85%	ePM ₁₀ 85%	Coarse 70%
ePM ₁ 80%	ePM _{2,5} 80%	ePM ₁₀ 80%	Coarse 60%
ePM ₁ 75%	ePM _{2,5} 75%	ePM ₁₀ 75%	Coarse 50%
ePM ₁ 70%	ePM _{2,5} 70%	ePM ₁₀ 70%	Coarse 40%
ePM ₁ 65%	ePM _{2,5} 65%	ePM ₁₀ 65%	Coarse 30%
ePM ₁ 60%	ePM _{2,5} 60%	ePM ₁₀ 60%	Coarse 20%
ePM ₁ 55%	ePM _{2,5} 55%	ePM ₁₀ 55%	Coarse 10%
ePM ₁ 50%	ePM _{2,5} 50%	ePM ₁₀ 50%	
Requirement ≥50% Initial Efficiency ≥50% Discharged Efficiency	Requirement ≥50% Initial Efficiency ≥50% Discharged Efficiency	Requirement ≥50% Initial Efficiency No discharge requirement	No discharge requirement

EN 1822

Efficiency Particulate Air Filters (EPA), High Efficiency Particulate Air Filters (HEPA) and Ultra Low Penetration Air Filters (ULPA) classified and tested according to EN 1822 standards. These filters are used in many industries including, pharmaceutical manufacturing, Bio-Tech, Electronics, Aerospace, Hospitals, and more.

There are independent tests for EPA / HEPA / ULPA class filter and filter media according to EN 1822.

1. Efficiency test of the filter fiber: An efficiency test performed by the filter material manufacturers at the nominal speed and MPPS.
2. Filter leak test: It is the test done at MPPS by using particle counters. An alternative to this test is the oil smoke leakage test for H13 and H14 class filters.
3. Filter efficiency test at MPPS: A method of measurement by scanning the filter surface under test conditions. Efficiency is measured with the particle counters used in this test.

MPPS: Most Penetrating Particle Size

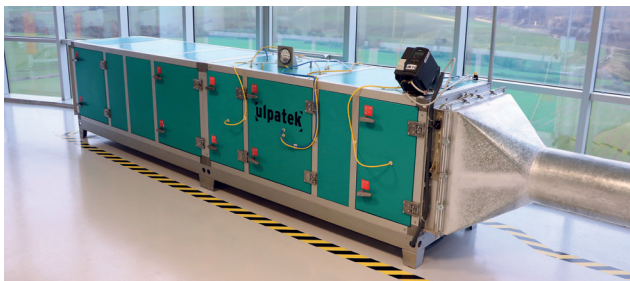
EN1822 Classification

Filter Group	Class	MPPS Integral Values		MPPS Local Values	
		Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)
EPA	E10	85	15	-	-
	E11	95	5	-	-
	E12	99,5	0,5	-	-
HEPA	H13	99,95	0,05	99,75	0,25
	H14	99,995	0,005	99,975	0,025
ULPA	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

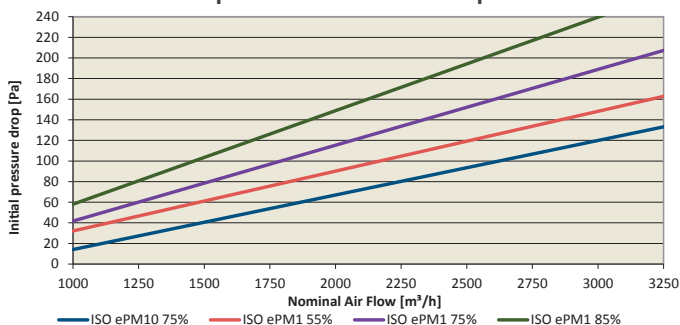
PERFORMANCE TEST SYSTEM - PTS 5002

Used performance measurements for different model and different efficiency of filters.

- The pre-tests of the new designs are carried out after than the design giving the best results replaces the standard product.
- Comparison tests of filters which has the same efficiency but made from different raw materials.
- Air flow and pressure drop graphs are prepared by measuring the initial pressure drop values of the filter at different rated air flow.



Sample Performance Test Graphics



FILTER MEDIA TEST SYSTEM - FMT 102

Used measuring the raw material's filtration efficiency and initial pressure drop values at different air velocities.

▪ Different oils (Emery 3004, Paraffin etc.) and salt (NaCl) can be used as the source of liquid and solid aerosols in the tests.



▪ Pre-tests are made for raw materials manufactured by different suppliers to make detailed comparisons. The selection of the best quality raw materials is supported by the test results obtained here.

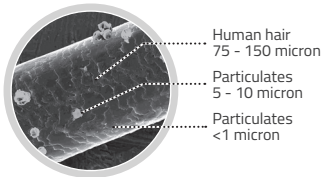
▪ Raw material quality control tests are carried out with this system before production.



ISO 16890 TEST SYSTEM - FTS 3401



Discharging Cabinet



Particulate Matter	Size Range
PM ₁₀	≤ 10 μm
PM _{2,5}	≤ 2,5 μm
PM ₁	≤ 1 μm

ISO 16890 standard considers for the particle size (Particulate Matter = PM) between 0.3 μm and 10 μm for efficiency evaluation.

ISO 16890 TEST PROCEDURE STEP BY STEP



Step 1

Test procedure of the ISO 16890 standard begins with measuring the efficiency of an air filter at a particle size range of 0.3 μm to 10 μm.



Step 2

The Filter is subjected to an isopropanol vapor atmosphere to eliminate efficiency of electrostatic mechanism.



Step 3

Isopropanol vapor atmosphere conditioned Filter tested again to measure the minimum efficiency ePM_{1,min} and ePM_{2,5,min}



Step 4

Efficiency for each PM size is calculated by the mean of both conditioned and the conditioned filter.



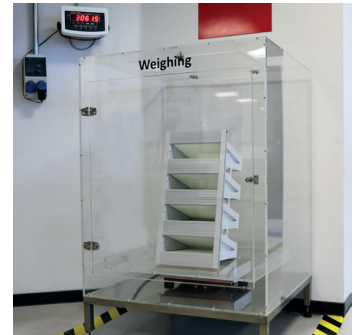
Step 5

The efficiencies for ePM, are calculated for the particle size 0,3 - 1 μm, ePM_{2,5} for the particle size range of up to 2,5 and ePM₁₀ for the particle size range of up to 10 microns.



Step 6

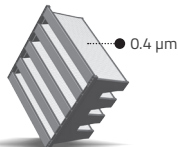
Calculated efficiency values are rounded to the nearest lower value according to the efficiency values in the ISO 16890 classification groups.



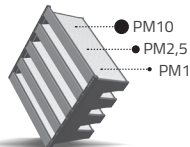
Weighing Cabinet

The dust loaded into the filter is weighed as gradually in dust loading test.

EN 779:2012



ISO 16890



Reference particle sizes according to EN 779: 2012 and ISO 16890 standards

For example; According to the test result, the F8 class V-Compact Filter is classified as "ISO ePM₁, 70%". This means that the filter separates 70% of PM₁ particles.

The "e" stands for efficiency in combination with the particulate matter (PM).

Product Code	Classification according to EN779	Particulate Matter Efficiency (%)			Classification according to ISO 16890
		ISO ePM ₁	ISO ePM _{2,5}	ISO ePM ₁₀	
FV-F8 592x592x292	F8	73	80	93	ISO ePM ₁ , 70%

Some details about ISO16890

Efficiency is given according to PM₁₀, PM_{2,5} and PM₁.

The dust holding capacity is calculated for ISO A2/AC Fine synthetic test powder.

Initial gravimetric arrestance efficiency is calculated.

The filter differential pressure drop (Δp) is measured at the nominal air flow rate.

For efficiency evaluation, the particle size is between 0.3-10 μm.

The efficiency is measured separately according to the particle range.

The efficiency measurement is repeated 24 hours after the IPA process.

The «ePMx efficiency» is calculated with the measured efficiencies.

The filter performance is determined according to PM₁₀, PM_{2,5} and PM₁.

Separately efficiency results in each particle channel.

The process is considered when selecting the filter.

Global (ISO, International Organization for Standardization).

HEPA / ULPA FILTER TEST SYSTEMS

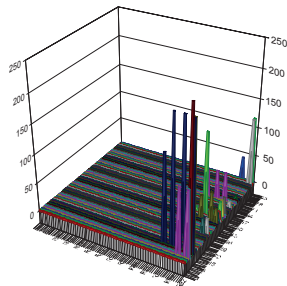
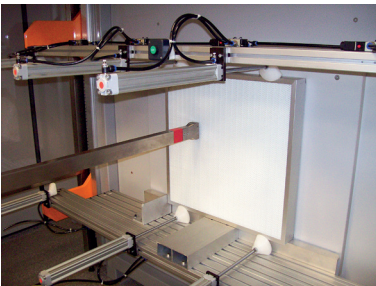
CEN standards in Europe, IEST and MIL standards in the US are used for HEPA and ULPA filters. HEPA / ULPA filters are individually tested and certified in accordance with both standards in Ulpatek.

HUF-SCAN 4002



In the system, the filter surface is scanned at nominal air velocity by automatic probe which counts particles at MPPS by connecting particle counters. Counters are connected at MPPS and nominal air flow rates.

- Aerosol concentration is counted by the particle counters before and after the filter during test.
- It is a test method in which the lowest penetration value which is accepted according to the filter class is checked in Class 100. If there is a leak, it detects the leakage points and print as a figure.
- Scanning test is the most advanced filter efficiency test used to test HEPA and ULPA filters.



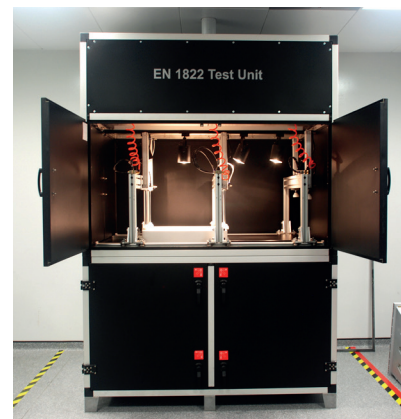
HF-SCAN 3004



Test operator scans the filter surface with the probe which is connected to photometer to check the leakage at 0,3 μm particle size. Test is applied for each filter individually.

- In the leak tests of HEPA filters performed at the nominal air flow rate, aerosols such as Emery 3004, PAO etc. are used according to standard.
- The high concentration of aerosol fed during the test is checked in the Class 100 test area by scanning the filter surface and sealing surface with the probe to check leakage.
- If there is leakage, repairing can be carried out by applying special adhesive according to the standard and customer requirements to the leakage point.
- After installation of the filters in the field, performing this test is recommended before commissioning system.

HF-OIL MIST 1200



Oil Thread Leak Test is done by naked eye for checking leakage on the HEPA filter surface at a nominal air flow rate using DEHS as aerosol.

- The particles formed as oil smoke lines from their leak points can be easily seen with the black colored cabin interior design and the appropriate light angle.
- If there is leakage, repairing can be carried out by applying special adhesive according to the standard

and customer requirements to the leakage point.

- Used as an alternative leak test method for class H13 and H14 class filters.
- It provides easy testing for filters which are not suitable for the scanning test (V-Compact, cylinder filter, filters without faceguard protection).



AIR FILTER TECHNOLOGY



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