Comparison of EU Standards to ASHRAE 52.1, 52.2 (MERV Ratings)

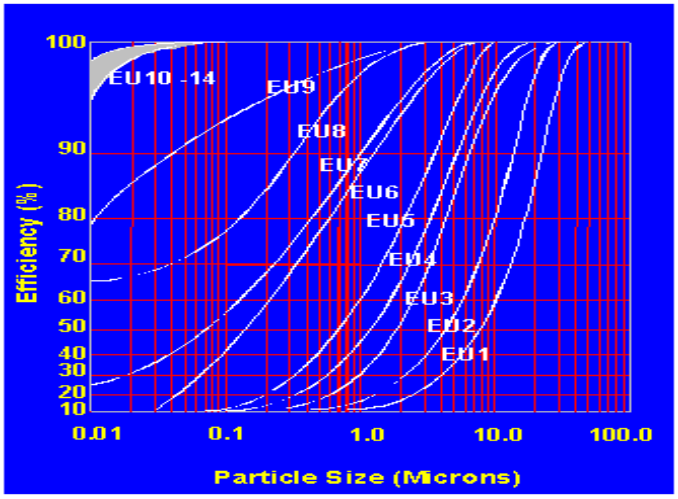
Standard European Filter Classification

Filter	General properties	Class	Effect	Applications
Basis filters	In general: - produced in synthetic fibers - efficient for particles > 4-5 mm - air speed < 2.5 m/s - start pressure drop approximately 50 Pa - final pressure drop approximately 150 Pa	EU1	Protects against insects and fibers. Limited effect against larger pollen (<70%) Ineffective against smoke and blacking particles	Window units Heat exchangers Air heaters Fiber filters in textile industry
		EU2	Effective against larger pollen (>85%) and larger atmospheric dust. Limited effect against dust and blacking particles	Heating and cooling units in electrical transformers garages industrial halls offices in industry
		EU3	Effective against larger pollen (>85%) and larger atmospheric dust. Limited effect against dust and blacking particles	Heating and cooling units in electrical transformers garages industrial halls offices in industry
		EU4	Limited effect against dust and blacking particles	In addition to EU3 kitchens and spray paint work shops
Fine filters	In general: - produced in glass fibers - efficient for particles > 0.1 mm - air speed < 2- 3 m/s - start pressure drop approximately 50-100 Pa - final pressure drop approximately 200 -250 Pa	EU5	Effective against pollen and finer atmospheric dust Considerable effect against smoke. No effect against tobacco smoke	Churches, sport halls, department stores, schools, hotels Food stores
		EU6	As EU5	As EU5
		EU7	Effective against pollen and blacking dust	As EU6 and food industry, laboratories, theatres, hospital rooms, data rooms
		EU8	Very effective against particles and blacking. Very effective against microbes. Effective against tobacco smoke.	Operating theatres, production rooms for fine optics and electronics. Hospital examination rooms.
		EU9	As EU8	As EU8

Micro filters	In general: - produced in glass fibers in combination with separators of paper, plastic or aluminum - efficient for particles > 0.01 mm - air speed < 0.5 - 1.0 m/s - start pressure drop approximately 250 Pa - final pressure drop according life span and economy	EU10
		EU11
		EU12
		EU13
		EU14

Typically, a EU3 filter would be used for pre-filtering, coupled to an EU6 or EU7 main filter. This gives approximately 97% efficiency down to 2.5 mm and between 44% (EU6) and 55% (EU7) at 0.1mm. Subject to good design and building air tightness, this filtration approach is therefore potentially effective at reducing the higher end of respirable particle concentration. To reduce fine particle concentration (e.g. below 2.5 mm) by a greater amount, however, high efficiency (HEPA) filters in the EU10-14 range must be considered.

Typical filtration performance, European 'EU' specification



In the European Union, filtration performance is governed by a Standard ‘EU’ rating which categorizes filtration performance by means of the efficiency with which it can trap particles of varying size. The classification system is presented in the Figure.

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Filter Specification: United States

In the United States, filtration is covered by ASHRAE Standard 52.2-1999. This classifies performance by particle removal efficiency using a standard Minimum Efficiency Reporting Value (MERV). There are a total of 16 performance ranges covering efficiency in three particle size ranges (i.e. range 1: 0.3-1.0mm, range 2: 1.0 -

3.0mm and range 3: 3.0 - 10.0mm). A MERV value of 1 covers the lowest performance filters with an efficiency of < 20% for range 3 particles. A MERV value of 10, equates to a filter with a 50 - 65% efficiency for rang 2 (>85% for range 3). A MERV value of 16 equates to a filter with > 95% performance in all three ranges.

Minimum Efficiency Reporting Value, commonly known as MERV Rating is a measurement scale designed in 1987 by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) to rate the effectiveness of air filters. The scale "represents a quantum leap in the precision and accuracy of air-cleaner ratings"[1] and allows for improved health, reduced cost and energy efficiency in Heating, Ventilation and Air Conditioning (HVAC) design. For example, a HEPA filter is often impractical in central HVAC systems due to the large pressure drop the dense filter material causes. Experiments indicate that less obstructive, medium-efficiency filters of MERV 7 to 13 are almost as effective as true HEPA filters at removing allergens, with much lower associated system and operating costs.[2]

The scale is designed to represent the worst case performance of a filter when dealing with particles in the range of 0.3 to 10 micrometres. The MERV rating is from 1 to 16. Higher MERV ratings correspond to a greater percentage of particles captured on each pass, with a MERV 16 filter capturing more than 95% of particles over the full range.

Below is a table of example MERV ratings:

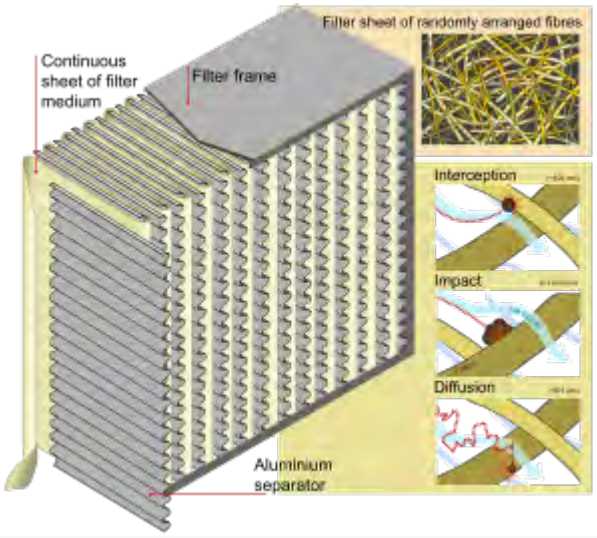
MERV	Min. Particle Size	Typical Controlled Contaminant [2]	Typical Application [2]
17-20[3]	< 0.3 µm	Virus, Carbon dust, Sea salt, Smoke	Electronics & Pharmaceutical manufacturing cleanroom
13-16	0.3-1.0 µm	Bacteria, Droplet nuclei (sneeze), Cooking oil, Most smoke and insecticide dust, Most face powder, Most paint pigments	Hospital & General surgery
9-12	1.0-3.0 µm	Legionella, Humidifier dust, Lead dust, Milled flour, Auto emission particulates, Nebulizer droplets	Superior Residential, Better Commercial, Hospital Laboratories
5-8[4]	3.0-10.0 µm	Mold, Spores, Dust mite debris, Cat and dog dander, Hair spray, Fabric protector, Dusting aids, Pudding mix	Better Residential, General Commercial, Industrial workspaces
1-4	> 10.0 µm	Pollen, Dust mites, Cockroach debris, Sanding dust, Spray paint dust, Textile fibers, Carpet fibers	Residential window AC units

References

1. ^ Wilkinson, Ron. "Air Filters: New Facilities, New Standard". Retrieved 2007-03-29.
2. ^ a b c "Residential Air Cleaners (2nd Edition): A Summary of Available Information". EPA. Retrieved 2011-05-24.
3. ^ MERV values of 17-20 are not part of the official standard test. These are sometimes compared to HEPA filters but the specifications are fundamentally different.
4. ^ ANSI/ASHRAE Standard 62.2-2007 requires a filter of at least MERV 6 efficiency for residential applications in the USA.

- M.N.Rama Rao & Company. "Industrial Filters (Eurovent and ASHRAE Classifications)". Retrieved 2007-09-19.
- Newell, Donald (February 2006). "Interpreting Filter Performance: The meaning behind the terminology of ASHRAE standards 52.1 and 52.2". *HPAC Engineering*. Retrieved 2009-05-11.

Understanding the differences between HEPA in the USA and the EU



HEPA-Filter with functional description

Function

HEPA filters are composed of a mat of randomly arranged fibers. The fibers are typically composed of fiberglass and possess diameters between 0.5 and 2.0 micrometers. Key factors affecting function are fibre diameter, filter thickness, and face velocity. The air space between HEPA filter fibres is much greater than 0.3 µm. The common assumption that a HEPA filter acts like a sieve where particles smaller than the largest opening can pass through is incorrect.
Unlike membrane filters, where particles as wide as the largest opening or distance between fibers cannot pass in between them at all, HEPA filters are designed to target much smaller pollutants and particles. These particles are trapped (they stick to a fibre) through a combination of the following three mechanisms:

1. *Interception*, where particles following a line of flow in the air stream come within one radius of a fibre and adhere to it.
2. *Impaction*, where larger particles are unable to avoid fibers by following the curving contours of the air stream and are forced to embed in one of them directly; this effect increases with diminishing fibre separation and higher air flow velocity.
3. *Diffusion*, an enhancing mechanism is a result of the collision with gas molecules by the smallest particles, especially those below 0.1 µm in diameter, which are thereby impeded and delayed in their path through the filter; this behavior is similar to Brownian motion and raises the probability that a particle will be stopped by either of the two mechanisms above; it becomes dominant at lower air flow velocities.

Diffusion predominates below the 0.1 µm diameter particle size. Impaction and interception predominate above 0.4 µm. In between, near the Most Penetrating Particle Size (MPPS) 0.3 µm, both diffusion and interception are comparatively inefficient. Therefore, the HEPA specifications use the retention of these particles to define the filter.

HEPA as Defined by the United States Department of Energy

HEPA stands for "High-Efficiency Particulate Air" [1]. A HEPA filter is a type of air filter that satisfies certain standards of efficiency such as those set by the United States Department of Energy (DOE). By government standards, a HEPA air filter must remove 99.97% of all particles greater than 0.3 microns from the air that passes through.

HEPA as defined by the European Union

The specification usually used in the European Union is the European Norm EN 1822:2009. It defines several classes of HEPA filters by their retention at MPPS:

HEPA class	retention (total)	retention (local)
E10	> 85 %	---
E11	> 95 %	---
E12	> 99.5 %	---
H13	> 99.95 %	> 99.75 %
H14	> 99.995 %	> 99.975 %
U15	> 99.9995 %	> 99.9975 %
U16	> 99.99995 %	> 99.99975 %

U17	> 99.999995 %	> 99.9999 %