

Filters 101

It is important to note that just because a filter uses HEPA media, it may not provide HEPA filtration. This is because High Efficiency filters are rated at specific maximum flow rates. A given HEPA filter may be rated HEPA at a maximum of 150 CFM but would not be rated HEPA at 200 CFM. It is important to make sure the filter being used is designed and rated for the flow rate it needs to handle.

All Clayton HEPA, ULPA, and MERV rated filters are designed to work in specific vacuums and are not interchangeable.

HEPA

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 fiber diameter, filter thickness, and face velocity. The air space between HEPA filter fibers 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 at this pore size, 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 fiber) 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 fiber 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 fiber separation and higher air flow velocity.
3. Diffusion, an enhancing mechanism that 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.

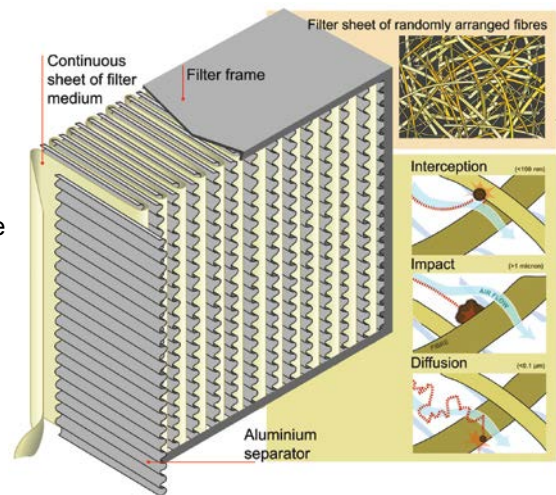
Diffusion predominates below the 0.1 μm diameter particle size. Impaction and interception predominate above 0.4 μm . In between, near the most penetrating particle size (MPPS) 0.3 μm , both diffusion and interception are comparatively inefficient. Because this is the weakest point in the filter's performance, the HEPA specifications use the retention of these particles to classify the filter.

Lastly, it is important to note that HEPA filters are designed to arrest very fine particles effectively, but they do not filter out gases and odor molecules. Circumstances requiring filtration of volatile organic compounds, chemical vapors, cigarette, pet, and/or flatulence odors call for the use of an activated carbon (charcoal) filter instead of or in addition to a HEPA filter.

	Class	retention (total)	retention (local)
HEPA	E10	> 85%	---
	E11	> 95%	---
	E12	> 99.5%	---
	H13	> 99.95%	> 99.75%
ULPA	H14	> 99.995%	> 99.975%
	U15	> 99.9995%	> 99.9975%
	U16	> 99.99995%	> 99.99975%
	U17	> 99.999995%	> 99.9999%

HEPA filters, as defined by the DOE standard adopted by most American industries, remove at least 99.97% of airborne particles 0.3 micrometers (μm) in diameter. The filter's minimal resistance to airflow, or pressure drop, is usually specified around 300 Pa at its nominal flow rate.

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 the given most penetrating particle size (MPPS):



ULPA

ULPA is an acronym for Ultra Low Penetration Air or Ultra Low Particulate Air. An ULPA filter can remove at least 99.99% of airborne particles 0.12 μm or larger.

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MERV

The Minimum Efficiency Reporting Value or 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 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.

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 μm . The MERV rating is from 1 to 20. 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.

MERV	Min particle size	Typical controlled contaminant	Typical Application
17–20	< 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	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

While the smallest MERV value in each row has no minimum requirement for filtering that row's particle size, it does have stricter requirements for all larger particle sizes than any smaller MERV value. For example, MERV 13 the "0.3–1.0 μm " row has no minimum requirement for removing 0.3–1.0 μm particles (the standard specifies "<75%") but has higher minimum removal percentages of 1.0–3.0 μm , 3.0–10.0 μm , and > 10 μm particles than MERV 12 and all smaller MERV values. All other MERV values on each row do have minimum removal percentages for that row's particle size.

HEPA Filters

Clayton High Efficiency Particulate Air (HEPA) are engineered to provide maximum protection from hazardous dust. HEPA filters capture 99.97% of particles 0.3 µm or larger. These filters are the ideal solution when working with chromated primers, lead paints, or composites.

HEPA Filters

Model	NSN	Description
627-12H	4310-01-520-6794	HEPA Filter Warthog
627-12HX		HEPA Filter Conductive Stingray
627-12C		HEPA Filter Coalescing Hydrophobic Barracuda
600-116	4310-01-519-5796	Hepa Filter, Dustmaster, 1 Pk
627-516H	4460-01-519-5158	HEPA Filter for Hornet / Scorpion



627-516H



627-12H



600-116

Pre-Filters

Clayton Pre-filters have been designed to prolong the life of the HEPA filters. Pre-filters provide protection from larger particles which might escape when a bag filter is installed incorrectly or has sustained damage.

Pre-filters

Model	NSN	Description	Price
627-12P		PreFilter Warthog 3pk	
627-516P		Prefilter Scorpion HEPA	
600-115	4310-01-519-5205	Pre-Filter, DM Vacs, 3 Pk	



627-516P



627-12P



600-115

Bag Filters

Disposable bag filters are the first stage of filtration on most Clayton vacuums. These vacuum bags are designed to capture larger particles and debris. Most are manufactured with a lining to resist 'caking' of dust on the inside of the bag. Bag filters are intended for single use.

Bag Filters

Model	NSN	Description	Price
600-313A	7910-01-520-6435	Filter Bag, Dustmaster Main Compartment 5 Pk	
610-313A	4310-01-520-8595	Filter Bag Cyclone 10 Pk	
627-16B	7910-01-459-0352	Filter Bag, 15gal Warthog 5pk	
627-0913B	4130-01-459-1257	Filter Bag 5 Gal Poly 5 Pak	
627-1414B		Filter Bag 5 Gal Steel 5 Pak	
627-1218M10		Filter Sock Barracuda 12 x 18 x 1mu, 5 pk	



600-313A



610-313A



627-0913B



627-1414B



627-16B

Bag Filters Conductive

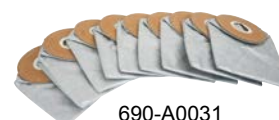
Model	NSN	Description	Price
627-16BC		Filter Bag, 15 Gal Conductive, 5 Pk	
627-1414BC		Filter Bag, 5 Gal Conductive, 5 Pk	
690-A0031	4460-01-519-5125	Filter Bag, Super Hornet, 10 Pk	



627-1414BC



627-16BC



690-A0031

★ Available on GSA Advantage website @ www.GSAadvantage.gov