

# Air filter

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A particulate **air filter** is a device composed of fibrous materials which removes solid particulates such as dust, pollen, mould, and bacteria from the air. Filters containing an absorbent or catalyst such as charcoal (carbon) may also remove odors and gaseous pollutants such as volatile organic compounds or ozone.

<sup>[1]</sup> Air filters are used in applications where air quality is important, notably in building ventilation systems and in engines.

Some buildings, as well as aircraft and other human-made environments (e.g., satellites and space shuttles) use foam, pleated paper, or spun fiberglass filter elements. Another method, air ionisers, use fibers or elements with a static electric charge, which attract dust particles. The air intakes of internal combustion engines and air compressors tend to use either paper, foam, or cotton filters. Oil bath filters have fallen out of favor. The technology of air intake filters of gas turbines has improved significantly in recent years, due to improvements in the aerodynamics and fluid dynamics of the air-compressor part of the gas turbines.

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Used auto engine air filter, clean side



Used auto engine air filter, dirty side



Auto engine air filter clogged with dust and grime

## Automotive cabin air filters

The cabin air filter is typically a pleated-paper filter that is placed in the outside-air intake for the vehicle's passenger compartment. Some of these filters are rectangular and similar in shape to the combustion air filter. Others are uniquely shaped to fit the available space of particular vehicles' outside-air intakes.

The first automaker to include a disposable filter to clean the ventilation system was the Nash Motors "Weather Eye", introduced in 1940.<sup>[2]</sup>

Being a relatively recent addition to automobile equipment, this filter is often overlooked, and can greatly reduce the effectiveness of the vehicle's air conditioning and heating performance. Clogged or dirty cabin air filters can significantly reduce airflow from the cabin vents, as well as introduce allergens into the cabin air stream. The poor performance of these filters is obscured by manufacturers by not using the MERV rating system. Some people mistakenly believe that some of these are HEPA filters.



Low-temperature oxidation catalyst used to convert carbon monoxide to less toxic carbon dioxide at room temperature. It can also remove formaldehyde from the air.

## Internal combustion engine air filters

The combustion air filter prevents abrasive particulate matter from entering the engine's cylinders, where it would cause mechanical wear and oil contamination.

Most fuel injected vehicles use a pleated paper filter element in the form of a flat panel. This filter is usually placed inside a plastic box connected to the throttle body with ductwork. Older vehicles that use carburetors or throttle body fuel injection typically use a cylindrical air filter, usually a few inches high and between 6 inches (150 mm) and 16 inches (410 mm) in diameter. This is positioned above the carburetor or throttle body, usually in a metal or plastic container which may incorporate ducting to provide cool and/or warm inlet air, and secured with a metal or plastic lid. The overall unit (filter and housing together) is called the **air cleaner**.

## Long Life Filtration System

In 2003 Ford Motor Company introduced the Visteon Long Life Filtration System to the Ford Focus.<sup>[3]</sup> This system has a foam filter placed in the bumper of the car and is stated to have a 150,000-mile (240,000 km) service interval.<sup>[3]</sup> According to a technical paper published by Society of Automotive Engineers, this design offers higher and more stable filtration efficiency than conventional air filters.<sup>[3]</sup>

## Paper

Pleated paper filter elements are the nearly exclusive choice for automobile engine air cleaners, because they are efficient, easy to service, and cost-effective. The "paper" term is somewhat misleading, as the filter media are considerably different from papers used for writing or packaging, etc. There is a persistent belief amongst tuners, fomented by advertising for aftermarket non-paper replacement filters, that paper filters flow poorly and thus restrict engine performance. In fact, as long as a pleated-paper filter is sized appropriately for the airflow volumes encountered in a particular application, such filters present only trivial restriction to flow until the filter has become significantly clogged with dirt. Construction equipment engines also use this.

## **Foam**

Oil-wetted polyurethane foam elements are used in some aftermarket replacement automobile air filters. Foam was in the past widely used in air cleaners on small engines on lawnmowers and other power equipment, but automotive-type paper filter elements have largely supplanted oil-wetted foam in these applications. Foam filters are still commonly used on air compressors for air tools up to 5Hp. Depending on the grade and thickness of foam employed, an oil-wetted foam filter element can offer minimal airflow restriction or very high dirt capacity, the latter property making foam filters a popular choice in off-road rallying and other motorsport applications where high levels of dust will be encountered. Due to the way dust is captured on foam filters, large amounts may be trapped without measurable change in airflow restriction.

## **Cotton**

Oiled cotton gauze is employed in a growing number of aftermarket automotive air filters marketed as high-performance items. In the past, cotton gauze saw limited use in original-equipment automotive air filters. However, since the introduction of the Abarth SS versions, the Fiat subsidiary supplies cotton gauze air filters as OE filters.

## **Stainless Steel**

Stainless steel mesh is another example of medium which allow more air to pass through. This also allow automotive ecu tuners to maximise the performance of engine to its peak. Stainless steel mesh also comes with different mesh count offering filtration standards. In extreme modified engine lacking in space for a cone based air filter, some will opt to install a simple stainless steel mesh over the turbo to ensure no particles enter the engine via the turbo.

## **Oil bath**

An oil bath air cleaner consists of a sump containing a pool of oil, and an insert which is filled with fibre, mesh, foam, or another coarse filter media. When the cleaner is assembled, the media-containing body of the insert sits a short distance above the surface of the oil pool. The rim of the insert overlaps the rim of the sump. This arrangement forms a labyrinthine path through which the air must travel in a series of U-turns: up through the gap between the rims of the insert and the sump, down through the gap between the outer wall of the insert and the inner wall of the sump, and up through the filter media in the body of the insert. This U-turn takes the air at high velocity across the surface of the oil pool. Larger and

heavier dust and dirt particles in the air cannot make the turn due to their inertia, so they fall into the oil and settle to the bottom of the base bowl. Lighter and smaller particles are trapped by the filtration media in the insert, which is wetted by oil droplets aspirated there into by normal airflow.

Oil bath air cleaners were very widely used in automotive and small engine applications until the widespread industry adoption of the paper filter in the early 1960s. Such cleaners are still used in off-road equipment where very high levels of dust are encountered, for oil bath air cleaners can sequester a great deal of dirt relative to their overall size without loss of filtration efficiency or airflow. However, the liquid oil makes cleaning and servicing such air cleaners messy and inconvenient, they must be relatively large to avoid excessive restriction at high airflow rates, and they tend to increase exhaust emissions of unburned hydrocarbons due to oil aspiration when used on spark-ignition engines.

## **Water bath**

In the early 20th century (about 1900 to 1930), water bath air cleaners were used in some applications (cars, trucks, tractors, and portable and stationary engines). They worked on roughly the same principles as oil bath air cleaners. For example, the original Fordson tractor had a water bath air cleaner. By the 1940s, oil bath designs had displaced water bath designs because of better filtering performance.

## **HVAC Air Filters**

### **Filter classes**

European Normalisation standards recognise the following filter classes:

Usage	Class	Performance	Performance test	Particulate size approaching 100% retention	Test Standard
Coarse filters (used as Primary)	G1	65%	Average value	>5 μm	BS EN779
	G2	65–80%	Average value	>5 μm	BS EN779
	G3	80–90%	Average value	>5 μm	BS EN779
	G4	90%–	Average value	>5 μm	BS EN779
Fine filters (used as Secondary)	M5	40–60%	Average value	>5 μm	BS EN779
	M6	60–80%	Average value	>2 μm	BS EN779
	F7	80–90%	Average value	>2 μm	BS EN779
	F8	90–95%	Average value	>1 μm	BS EN779
	F9	95%–	Average value	>1 μm	BS EN779
Semi HEPA	E10	85%	Minimum value	>1 μm	BS EN1822
	E11	95%	Minimum value	>0.5 μm	BS EN1822
	E12	99.5%	Minimum value	>0.5 μm	BS EN1822
HEPA	H13	99.95%	Minimum value	>0.3 μm	BS EN1822
	H14	99.995%	Minimum value	>0.3 μm	BS EN1822
ULPA	U15	99.9995%	Minimum value	>0.3 μm	BS EN1822
	U16	99.99995%	Minimum value	>0.3 μm	BS EN1822
	U17	99.999995%	Minimum value	>0.3 μm	BS EN1822

## See also

- Air purifier
- Clean Air Delivery Rate
- Cyclonic separation
- HEPA (High Efficiency Particulate Air)
- Impingement filter
- Nose filter
- Oil filter
- Respirator
- Swan neck duct
- Louis Pasteur

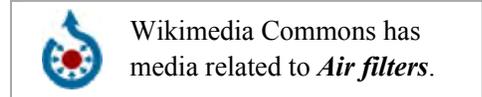
## References

1. "California Environmental Protection Agency - Air Cleaning Devices for the Home, Frequently Asked Questions" (PDF). California Environmental Protection Agency Air Resources Board. Retrieved 2016-12-14.
2. Nash engineering items (<http://vwlarry.blogspot.com/2009/05/ive-been-wanting-to-do-piece-about-this.html>)

3. "Performance and Benefits of Zero Maintenance Air Induction Systems". Society of Automotive Engineers. CiteSeerX 10.1.1.122.3342 

## External links

- Comparative filtration efficacy and airflow tests for different types of automotive air filter elements (<http://www.bobistheoilguy.com/airfilter/airtest1.htm>)
- Engineered Systems Magazine ([http://www.esmagazine.com/CDA/Archives/86b24e5bd9ba8010VgnVCM100000f932a8c0\\_\\_\\_\\_](http://www.esmagazine.com/CDA/Archives/86b24e5bd9ba8010VgnVCM100000f932a8c0____)) Filter Selection: A Standard Procedure (June 2000) MERV designations (Minimum Efficiency Reporting Value)
- Filter Manufacturers Council bulletin on cleaning heavy duty air filter elements ([http://www.fleetmag.com/online/fmxlibrary/Heavy\\_Duty\\_Air\\_Filter\\_Elements.pdf](http://www.fleetmag.com/online/fmxlibrary/Heavy_Duty_Air_Filter_Elements.pdf))



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