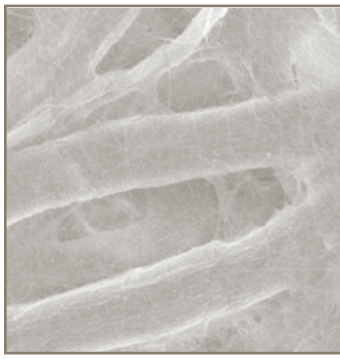
by Travis Haynam, Senior Product Manager,
Ed Ravert, Senior Application Engineer,
Parker Hannifin

Nanofiber Filtration In Combination With Dusthog® SFC Dust Collectors

How To Achieve Maximum System Performance and Efficiency—Plus Significant Savings In Energy, Operational Costs



Parker

ENGINEERING YOUR SUCCESS.

Call it "The Best of Both Worlds"! Today, for a dust collector to perform to its full potential and your expectations, it is important to use the advanced surface-loading capabilities of nanofiber filters instead of traditional commodity filters. The combination of nanofiber filtration in conjunction with an optimized downward flow dust collector will result in less pulse cleaning cycles (less compressed air use) and significantly longer filter life. Most importantly, this combination, in addition to maximizing overall system performance and efficiency, will bring significant savings in energy and operational costs.

Downward flow (Figure 1) dust collectors are among the most common pieces of equipment used to remove harmful pollutants from such processes as grinding, sanding, thermal spraying and the manufacture of graphite, ink dyes, silica, talc and toner that produce submicron dust particles. These air pollution removal systems are critical to helping you control the air quality in your plant, increasing employee productivity and maintaining the performance of your manufacturing equipment.

Choosing an optimally designed downward flow dust collector is critical to providing clean workplace air. Although there are many factors to consider when evaluating the performance and quality of a cartridge collector, two elements are critical to your purchase/use decision:

- Quality of the filter media
- Performance of the cleaning mechanism

Both factors have the most overall profound impact on the air quality you will achieve and filter life. If your collector is lacking in either of these two factors, your dust collection system will never perform to its full potential.

Filter Technology

There are two basic types of cartridge dust collection filters on the market today:

- Traditional commodity filters
- Latest technology advanced nanofiber filters

Figure 1: DustHog SFC downward flow dust collectors

They differ in the type of substrate material and surface coating used. Traditional commodity filters are straight cellulose (Figure 2) with one homogenous layer of cellulose fiber. Blended cellulose filters typically consist of 80 percent cellulose and 20 percent synthetic fiber. Sometimes these commodity filters come with a melt-blown surface layer added to improve efficiency at capturing submicron particles.

As shown in Figure 2, if you look at any cartridge filter media through large magnification, you will see open spaces or "holes." The smaller the holes, the better the media will be at capturing fine particulate. The best way to do this is to use the smallest fibers possible.

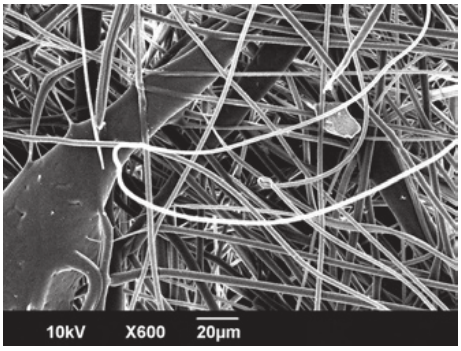


Figure 2: Commodity Filter 600x

The most technologically advanced and highest performing filters are nanofiber filters. These filters, such as genuine Advanced Nanofiber cartridges, use fibers 1/1,000 of a micron (Figure 3).

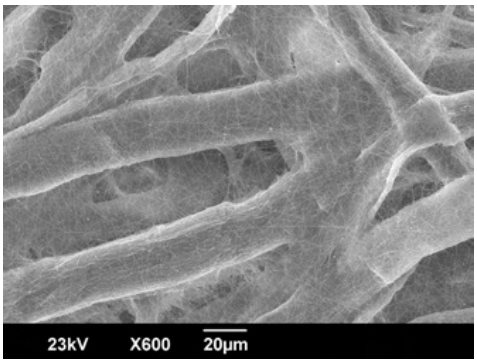


Figure 3: Nanofiber Filter 600x

Just how small are these fibers? Consider that there are 25,400 microns in an inch. The lower limit of visibility with the naked eye is 40 microns. And, the average pore openings in your skin are 10 microns. As such, an extremely thin nanofiber layer on a cartridge filter is capable of capturing submicron particles and trapping them on the surface of the media. Nanofiber filters are scientifically proven to outperform commodity filters in three main measures of quality: efficiency, pressure drop and emissions.

Higher Efficiency

The fibers that make up nanofiber filters are produced using an innovative electrostatic process that yields the finest synthetic fiber used in any current filtration product. The thin fibers form a permanent mesh-like surface with exceptionally small openings, or pores. These tiny openings are extremely efficient in filtering even submicron particles (less than 1 micron) from the contaminated air stream.

In rating filter efficiency, the MERV[1] (Minimum Efficiency Reporting Value) system is the industry-respected benchmark. The higher the MERV, (Figure 4), the better the filter's efficiency and ability to remove submicron dust particles from the air and minimize emissions. MERV ratings are based on a scale of 1 to 20, and broken into three particle size ranges:

- Range 1 – 0.30 to 1.0 micron
- Range 2 – 1.0 to 3.0 microns
- Range 3 – 3.0 to 10.0 microns

Standard commodity filters typically achieve MERV 10 and are only rated to capture 1.0 micron and larger particulate. Independent lab testing has certified our nanofiber filters at MERV 15—the highest of any standard cartridge filter used in industrial dust collection. This means the filter is between 85 – 95 percent efficient at capturing particle sizes 0.30 to 1.0 micron in Range 1, and more than 90 percent efficient capturing 1.0 micron particles or greater in Ranges 2 and 3.

As noted, commodity filters do not perform as well. The key point here is that they are not even efficient enough to be rated in Range 1 because they cannot capture dust that is in the 0.30 to 1.0 micron range. In Range 2, commodity filters are only rated to be 50 to 65 percent efficient. Importantly, this means that submicron dust passes right through commodity filters and back into the workspace and your employees' breathing zones. For reference, the manufacture of the following products that produce submicron dust would be a major problem with a commodity filter system:

- Graphite 0.3 micron
- Ink dyes 0.1 micron
- Silica 0.5 micron
- Talc 0.5 micron
- Toner 0.5 micron

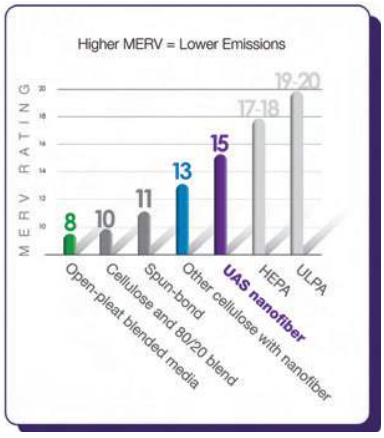


Figure 4: MERV ratings compared with filter type

While MERV is the most accurate efficiency measurement available, filters should not be selected on just MERV alone. Other criteria, such as pressure drop, cleanability, compressed air usage and filter life are important in determining a filter's total performance and life cycle cost. Commodity filters with a melt blown layer may achieve a higher MERV rating but operate at a higher pressure drop, have shorter life and require additional compressed air and electrical power to operate.

Lower Pressure Drop

The surface layer of a nanofiber filter provides the highest possible filtering efficiency. In effect, this nanofiber layer does all of the work, preventing particulate from building up within the filter's substrate and restricting airflow. As a result, pressure does not build up as rapidly as it will with a commodity filter. Because the pressure drop is low, your dust collection system requires less energy to run, and you may be able to use a smaller, less expensive blower.

Reduced Emissions

In addition to removing smaller particles from the air, nanofiber filters also reduce the amount of dust that escapes back into the workplace air.

An unavoidable by-product of the filter cleaning process is that a small percentage of the collected dust is released back into the atmosphere. Because nanofiber filters require less frequent pulse cleaning, total outlet emissions are reduced.

Commodity filters typically emit up to 35 times more dust back into the atmosphere than our nanofiber filters.

Cleaning System Technology

Most cartridge dust collectors use pulse-jet cleaning technology (Figure 5) to dislodge dust from the filters into a collection bin. While factory air is being cleaned, the system's cartridges are also being cleaned by a pulse blast of compressed air that is periodically sent through the center of the filter, causing dust to "pulse" off into a drawer or hopper for easy disposal.

While all pulse-jet cleaning systems are similar in concept, they differ in important ways that directly affect cleaning efficiency, ease of use and filter life.

Design of Nozzle and Venturi

The nozzle and venturi are the key components of a pulse-jet cleaning system. Their design determines the cleaning efficiency that can be achieved with each blast of air. By optimizing the spacing of the compressed air nozzle and perfecting the geometry of the venturi, air can be pulsed at a precise calculated distance with enough power to completely clean the entire filter length.

Filter Support

In the DustHog SFC downward cartridge flow collectors, the filters rest on rails. Competitive systems use an internal yoke support that acts as an obstruction to block the pulse cleaning jet. This interference also creates turbulence and thus, less pulse power and reduced cleaning efficiency. In that DustHog collectors have no internal obstruction at any point along the cartridge filter, the DustHog unit provides 25 percent more pulse cleaning power than competitive systems.

Ability to Clean the Full Length of the Filter

Maximum pulse power allows a pulse-jet cleaning system to remove particulate from the entire length of the cartridge filter. Systems with a poorly designed nozzle and venturi, and/or that have internal filter supports, can have difficulty overcoming high air velocities. These systems typically do not thoroughly clean the portion of the filter closest to the cleaning system.

Best of Both Worlds

As pointed out at the beginning of this paper, today for a dust collector to perform to its full potential it must utilize the advanced surface-loading capabilities of a nanofiber filter, and its downward flow cartridge dust cleaning system must be optimized to reap the full benefits of a surface-loading filter. The combination of these two elements directly results in less pulse cleaning cycles (less compressed air usage) and significantly longer filter life.

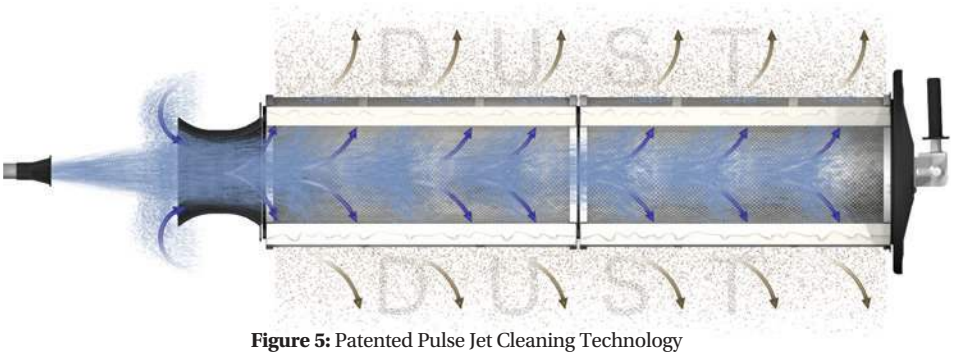


Figure 5: Patented Pulse Jet Cleaning Technology

Less Compressed Air Use

A cartridge collector's pulse-jet cleaning system can more easily remove dust from a nanofiber filter because dust remains on the surface, not deep within the substrate as happens with commodity filters. Hence, each pulse is more effective, the system pulses less and less compressed air is used. A commodity filter may pulse as much as 17 times more than a filter with our Advanced Nanofiber Filtration Technology.

Compressed air is one of the most expensive utilities in a manufacturing plant. About eight horsepower of electricity is used to generate one horsepower of compressed air. Over time, the additional usage from a depth-loading commodity filter media can add up to substantial cost. For example, if airflow is 20.4 SCFM at six pulses per minute, compressed air cost with a 32-cartridge system using commodity filters would be approximately $1,279. Compressed air cost for the same system using genuine our Advanced Nanofiber filters would be about $191, or a savings of $1,088 per year. (Based on the dust collection system running 4,160 hr/year and energy cost of 10 cents/kWh.)

Longer Filter Life

Because a nanofiber filter creates lower pressure drop and requires fewer pulse blasts, stress on the filter is reduced. This results in longer filter life. Advanced Nanofiber Filtration Technology as much as doubles the filter life than is possible with commodity filters and reduces replacement costs by half.

A cartridge dust collector is an important investment that impacts the performance of the equipment in your operation and the health of your employees. To yield the greatest return on your investment and provide the safest work environment possible, your best option is to choose a surface-loading nanofiber filter and dust collection system that is specifically optimized to gain the maximum benefits of the filter's capabilities.

Cabinet design
Most cartridge dust collectors use pulse-jet The design of a dust collector's cabinet directly affects airflow and cleaning efficiency. The cabinet of DustHog SFC downward flow dust collectors, for example, is designed to evenly distribute air throughout the cabinet. This is accomplished using one of the largest volume pre-filter plenum available in combination with larger spacing between filters. The spacing is also designed to reduce the speed at which air hits the cartridge filters to eliminate the potential of particulate being driven deep into the filter substrate.

Maintenance and serviceability
A "push to seal" closure on the SFC's "QuickSeal" cartridge access doors eliminates the need to turn knobs and hook latches, significantly easing the cartridge replacement process. Some systems use angled filters, which cause dust to accumulate against the inside of the door and the top of the filter. When the door is opened and the filter removed, dust falls onto the maintenance worker. With the improved DustHog design, those dust particles that accumulate on the top of the filter are easily removed by rotating the filter. Dust drops directly into the hopper, not onto the maintenance worker. And, since maintenance workers don't have to change nanofiber filters as often as commodity filters, cartridge change outs occur less often and machine downtime is minimized.

Cabinet quality
A dust collector's cabinet should be entirely coated with an electro-statically applied, powder-coated finish to prevent fading and chalking. Also, it needs to be well constructed to withstand exterior conditions. Designed and manufactured with 10 gauge steel construction, DustHog cabinets meet the Seismic Zone 4 and 100 mph wind load structural ratings.

Add-on flexibility
Dust collector design should be modular to provide the flexibility to increase capacity as needed by just adding modules. DustHog units feature a screw panel fastening system that permits easy addition of new modular units by simply removing side panels.

Smaller footprint
The combination of the Parker Hannifin SFC patented cleaning system in combination with the use of nanofiber cartridge filters also allows for higher air-to-media ratios. This can potentially reduce the size of the dust collector and the number of filter cartridges needed – a significant cost savings.

Factory support
Some equipment customization is required for the installation of many dust collection systems. Hence, it is important to utilize a knowledgeable manufacturer's representative who has access to factory application engineers to ensure that your equipment will meet all environmental needs and operate effectively well into the future.

DUSTHOG®

Providing Clean Air Solutions

Parker Hannifin is committed to providing clean air solutions that protect your employees, improve plant performance and enable you to realize your operating goals.

State-of-the-Art Labs and Advanced Filtration Research for Optimized Performance. Purpose-built labs and test facilities with the latest equipment allow our engineers and technicians to quickly and accurately assess filter capabilities and develop innovative new medias.

High Performance Filters & Specialized Equipment Solutions. With decades of experience manufacturing high performance original equipment and aftermarket filters to meet a variety of system types and configurations, we can satisfy whatever requirement is needed including customized solutions.

World-class Manufacturing Processes with a Global Footprint. We produce top quality filtration solutions through stringent manufacturing processes.

Application Expertise for Any Filtration Challenge. Our ability to design a solution to fit your application begins with engineering expertise proven by hundreds of global installations.

Germany
Otto-Hahn-Strasse 6
D-65520 Bad Camberg
Germany
T: +49-6434-94220
Email: info@uas-inc.de
www.uas-inc.de

United Kingdom
Aston Lane North
Preston Brook
Runcorn, Cheshire
United Kingdom WA7 3GA
T: +44-1925-654321
Email: uas@clarcoruk.com
www.uasuk.com

China
1002 Unit 02-04, Floor 10
Tower I, Shanghai Arch
No.523 Loushanguan Rd, Shanghai
China
T: +86-21-52768288
Email: uasinfo@uasinc-cn.com
www.uasinc-cn.com

© 2018 Parker Hannifin Corporation

PH1810-033

Parker Hannifin Corporation
Industrial Gas Filtration and Generation Division
4087 Walden Avenue
Lancaster NY 14086 USA
Ph: 800-252-4647
Ph: 513-891-0400
dusthog@parker.com

Parker

ENGINEERING YOUR SUCCESS.