How To Get Cleaner Air:
Your Bottom Line For Dust Collection

Unclear about the choices in dust collection technology? Cleaner air comes easily if you understand how cartridge dust collectors have evolved and what still separates the very different technologies available today.

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Donaldson Torit

Government regulations. Employee health and safety. Productivity. These are vital considerations when deciding what type of dust collection technology will help you get cleaner in-plant air. While there are many choices, significant differences exist in the performance of technologies currently available for dust collection.

Dust collection has evolved significantly over the last 30 years, and it's essential to understand how certain technologies today are engineered to ensure that you maintain a cleaner, safer work environment. And while cleaner air is your chief concern, advances in cartridge dust collection technology have also helped extend filter life and lower costs for many manufacturers today. The bottom line — proven and trustworthy information is your key to getting cleaner air.

CONTENTS

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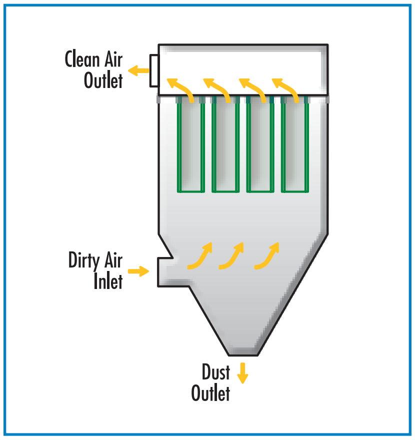
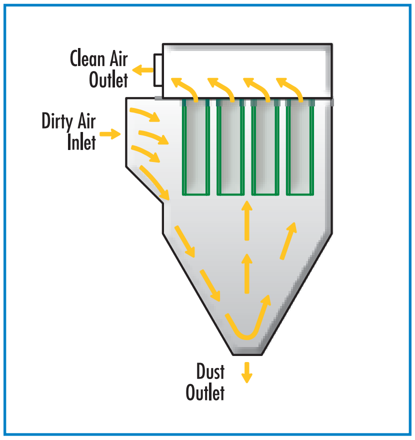
What The Experts Say

According to EPA sponsored research, downward flow of the dirty air stream in a dust collector results in superior filtration performance. The American Conference of Governmental Industrial Hygienists also recommends use of downward flow technology. These endorsements have not been given to baghouse dust collectors that have an upward airflow path or cartridge technologies with a hybrid cross flow/upflow air path. Why?

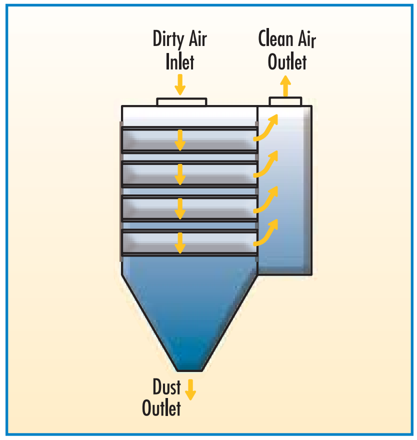
Like baghouse technology, cartridge collectors with a hybrid airflow path require air to work against gravity and travel upward through vertically hung filters to disperse "cleaned" air back into the plant. This causes uneven air velocity distribution and significant areas of high velocities in the collector, prompting greater potential for filter abrasion. Sophisticated Fluent™ (Fluid Dynamics Finite Element Program) flow modeling software clearly indicates that a cross flow pattern causes significant hopper sweeping and an upflow air pattern, which can result in major dust re-entrainment and difficulty pulse cleaning the filters. In turn, this often results in higher pressure drop and shorter filter life. In addition, managing the airflow in a hybrid cartridge collector is problematic because, with high velocities through the collector, dust is suspended in the air and doesn't drop into the hopper.



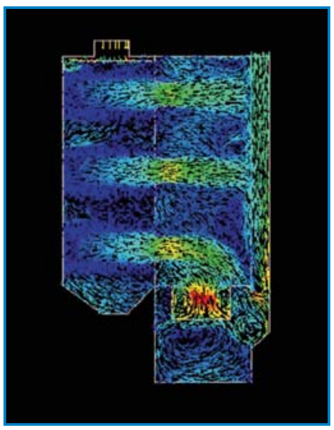
Upward Flow Technology
Circa 1974



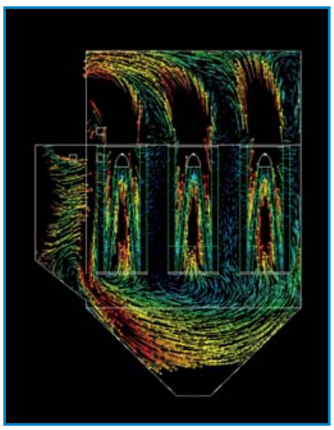
Cross Flow/Upflow Technology
Circa 1978



Downward Flow Technology
Circa 1982



Fluent Airflow Analysis
Downward Flow



Fluent Airflow Analysis
Cross Flow/Upflow

Like the baghouse, cartridge collectors with hybrid airflow technology enlist blow pipes across the filters for cartridge cleaning. This outdated method of cleaning doesn't deliver and disperse enough energy to properly clean the filters.

On the other hand, cartridge collectors with a downward airflow have lower velocities (fewer red areas as shown in comparison at left) as air travels with gravity down through the collector and filters, automatically depositing dust into the hopper. With this more balanced and uniform air velocity distribution through the collector, operating pressure drop is stable, filters are more easily cleaned and potential for filter abrasion is minimized.

Retracing the Steps of Cartridge Collection Evolution

The development of downward flow cartridge dust collection technology didn't happen overnight. The first generation of hybrid cartridge dust collectors was introduced in the 1970s, drawing from baghouse collection technology that was the predominant method of dust collection at the time. These cartridge collectors, even though they still enlisted upward airflow technology, were a welcome advance at the time. They were smaller than baghouses and required fewer filters, which in turn, offered improved maintenance and service time.

But still, there was significant room for improvement. With the introduction of downward flow dust collectors in the early 1980s, new developments in pulse cleaning technology eliminated poorer performing blow pipes. As a result, dust was more easily released from the cartridge filters. Advances in nanofiber filter media increased the operating efficiency of cartridge collectors while providing users with more durable, effective filters.

These early downward flow cartridge collectors offered improved performance and easier maintenance than hybrid collectors, but engineers still had their sights set on further improving the technology.

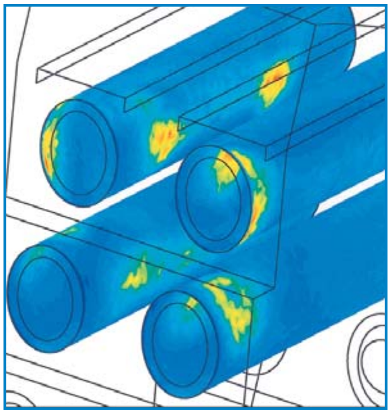
As manufacturers began to seek higher performing dust collectors in smaller footprints to conserve valuable plant floor space, R&D efforts turned to developing new dust collection technology that allowed increased airflow through the collector — without adding more filter media or increasing the size of the collector. This flew in the face of the accepted logic at the time — that increasing airflow through the same amount of media would increase face velocities, causing filter abrasion, reducing filter life and poorer performance. The next wave of development in downward flow cartridge collection did, in fact, increase airflow without increasing face velocities or cabinet velocities.

Breaking The Mold With DFO

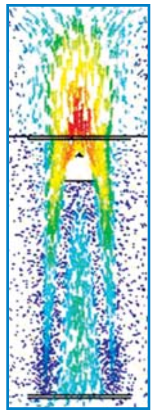
Major advances occurred in the late 1990's, when engineers focused more intensely on all system components in the cartridge collector. The result was the Donaldson Torit Downflo® Oval™ (DFO) cartridge collector. This completely new technology was born from the discovery that airflow could be increased in the collector without adding more media, by further improving the media and pulse cleaning technology along with redesigning the shape of the cartridge filter itself. Throughout 25 years of ongoing development in cartridge collector technology, no one had thought to abandon the conventional round-shaped filter.

A critical breakthrough came when engineers shifted focus to increasing the *effective* media area of the filter, which allowed more airflow through the collector without adding more physical media. When particulate loads into a round cartridge filter, the effective area is reduced because particulates tend to blind off the top half of the media section more quickly, prohibiting additional airflow. Further research and development revealed that effective media area could be increased by re-shaping the cartridge filter from circular to oval — without adding more media or increasing the cartridge size. Combined with new pleat configurations, increased space between pleats, shorter 1.5-inch pleat height, and improved nanofiber filter media technology, oval-shaped filters provided more effective media area and virtually eliminated clogging problems.

The narrower oval filters also opened up cabinet space in the DFO collectors and allowed increased cross-section flow area, which in turn lowered cabinet velocities. Convex side panels were incorporated into the collector design to accommodate the new filter shape, eliminating turbulence inside the collector and erosion problems from structural reinforcements.



Airflow Analysis
Oval-Shaped Filters



Airflow Analysis
Cone Filters

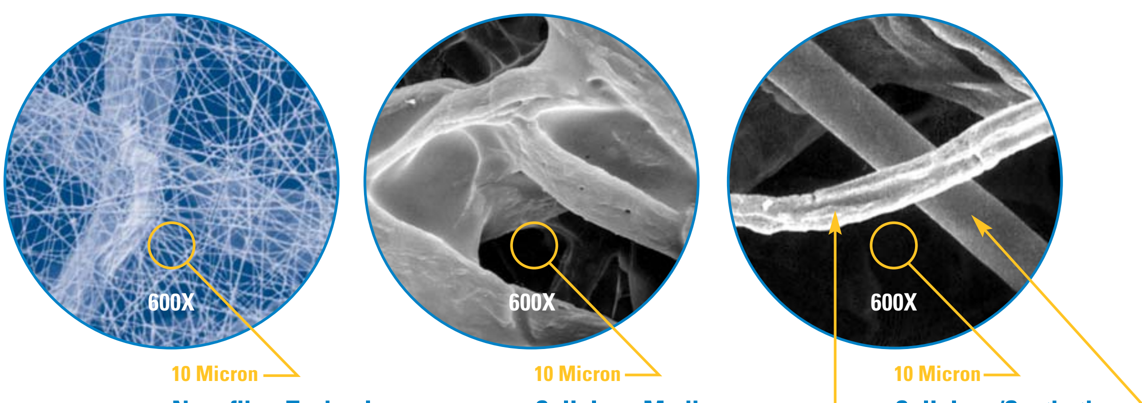
Cone Filters Don't Compare

Other filter developments have attempted to rival the advances of oval-shaped filters through the years, but they have consistently fallen short. For instance, filters with a cone in the middle actually cause unbalanced airflow in the collector and reduce overall filter life. The cone adds 30% more media to the collector, restricts the airflow path at the bottom of the cartridge and over-compresses the pleats at the top. Also, the cone design cleans less effectively and retains more dust, allowing the media on the cone section to plug. Cone cartridges use commodity filter media, which depend on more filtration area to work. With more media, the cone is over-packed, and in turn, restricts airflow.

Nanofiber vs. Commodity Filter Media

Oval-shaped cartridge filters, in tandem with patented Ultra-Web® nanofiber filter media technology, resulted in huge leaps in cartridge dust collector performance. Available for DFO and other brands of cartridge collectors, Ultra-Web nanofiber filter media is a high performance alternative to commodity-type pleated cellulose or cellulose/synthetic blended media that captures submicron dust particles on the surface of the media. Cellulose and blended media are depth-loading media that allow particulates to penetrate deep into the filter and choke off airflow. By keeping dust on the surface of the filter, nanofiber allows dust to be more easily released through pulse cleaning and promotes self-cleaning in the collector, helping maintain a greater effective media area over a longer period of time.

Nanofiber is a cellulose/synthetic composite media that forms a web-like net of very fine fibers 0.2 to 0.3 microns in diameter. Cellulose and blend media have fibers at least 10 micron in diameter and large pores between fibers (up to 60 micron) that allow dust to penetrate deep into the media, quickly plugging and reducing filter life.



Nanofiber Technology **Cellulose Media** **Cellulose/Synthetic Media Blend**

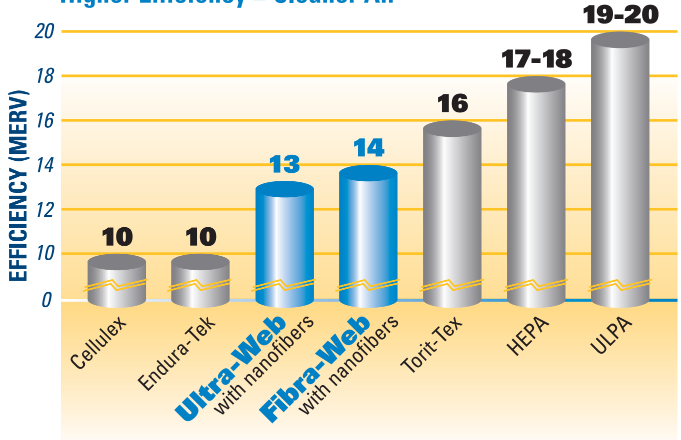
1 micron = 1/25,400 of an inch

What's Your Filters MERV Rating?

Since the late '90s, the MERV (Minimum Efficiency Reporting Value) rating system based on ASHRAE Standard 52.2-1999 has been deemed the most accurate scale for determining a cartridge filters efficiency and ability to filter submicron dust particles. Recent independent lab tests of nanofiber, cellulose and blend media revealed there is a dramatic difference in the MERV efficiency ratings for the various types of filter media.

For instance, Ultra-Web® nanofiber filter media rates at a MERV 13 on the 20-point efficiency scale, and is considered pre-HEPA efficiency suitable for filtering submicron and larger dust. Typical cellulose and blend media filters had a significantly lower MERV 10 rating and some new blend media filters rated at MERV 8 efficiency. This is significant because MERV 10 filters are rated to capture 1-3 micron dust particles and MERV 8 filters are only rated to capture larger 3-10 micron particles. Since most every application generates some submicron dust, a higher MERV rated filter provides better assurance that smaller particles are being captured, along with the larger ones of course, and your air is cleaner.

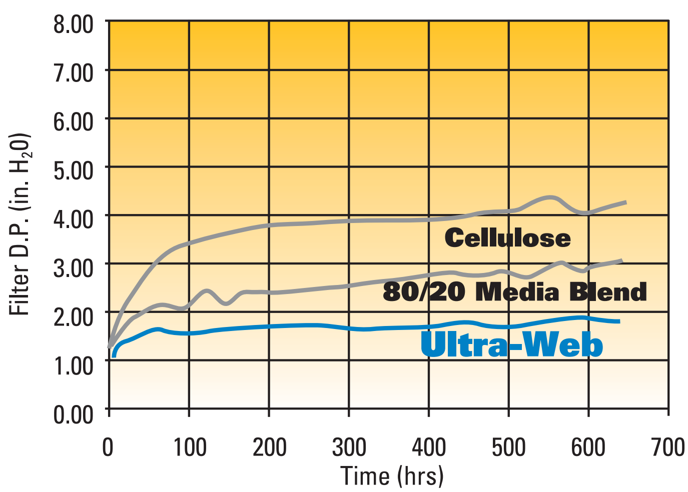
Higher Efficiency = Cleaner Air



Ultra-Web MERV 13 efficiency has been certified by independent lab tests and tested per the ASHRAE Standard 52.2-1999, the most current industry accepted test method used to evaluate filter performance.

While MERV 13 meets the efficiency demands of most applications, it's important to note that some applications do require even higher efficiency. There are higher performance nanofiber filters available with MERV 14 efficiency and other specialty filters such as Torit-Tex (MERV 16) and HEPA (MERV 17-18) and ULPA (MERV 19-20) to meet those demands. However, higher MERV rated filters with melt blown media didn't fare well during lab testing. Melt blown media by nature tends to retain any static electricity buildup, binding the dust to the media. Dust that is electrostatically bound to the media is more difficult to pulse clean, which can result in higher pressure drop and much shorter filter life. During testing in a cartridge collector, melt blown media only lasted 150 hours due to higher pressure drop.

Lower Pressure Drop = Longer Filter Life



Results were derived testing Atomite test dust in an 8-cartridge collector @1.0 gr./cu.ft, Goyen Millennium valves, 90 psi cleaning pressure, 100ms on time 10 second off time. Airflow goal = 4064 scfm.

Longer Filter Life and Lower Emissions

When testing nanofiber filters against cellulose and blend media filters, nanofiber had the lowest operating pressure drop at 500 hours of operation and was still going strong. At 400 hours of operation, some new filters touted as providing lower pressure drop and longer filter life actually had the highest pressure drop during testing, exceeding the 6-inch mark when filters are typically changed.

Nanofiber filters also provide significantly lower emissions than other types of commodity media— 40% lower emissions on 1 micron dust particles and 58% lower emissions on 0.5 micron dust. The bottom line is that nanofiber filters provide cleaner air, lower pressure drop and longer filter life.

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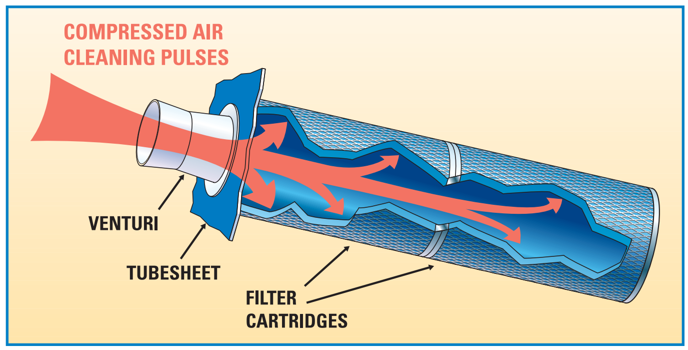
How Important Is Pleat Configuration?

Pleat configuration also plays a significant role in filter performance. Rigid 1.5-inch pleats minimize dust entrapment, improve filter cleaning and won't collapse. Taller 2-inch pleats allow more dust to embed in the pleats and won't clean as easily. Filters with proven Pleatloc™ technology allow uniform pleat spacing and promote airflow while filters that use bead spacing method to keep pleats open restrict airflow. With Pleatloc, the filter maintains a 99% effective filtration area as opposed to other filters that have only 93% effective filtration area due to bead spacing.

Another important factor to consider is whether the pleats are attached to the inner liner of the filter. The best scenario is a filter that uses adhesive to keep pleats from moving against the liner without restricting airflow. Pleats that aren't attached to the inner line can cause movement during pulse cleaning and filter media fatigue.

Light Years Beyond Blow Pipes

Blow pipe cleaning technology is a thing of the past. Along with oval-shaped filter design, nanofiber media and more rigid pleats, DFO cartridge collectors have enhanced pulse cleaning technology that works in tandem with the filter media to manage airflow through the collector. This sophisticated, uniquely shaped, computer-modeled Venturi manages the pulse air volume and air delivery to the cartridge to ensure the right pressure is applied when the system pulses air through the filter.



The Choice Is Clear For Cleaner Air

All of these developments — downward airflow path, oval-shaped cartridge filters, nanofiber media advancements, more rigid pleats and improved pulse cleaning — bring us to one clear conclusion. More media isn't needed to increase airflow. More effective media area is the key and, in fact, less media could be used to increase airflow for higher performance filtration. With less media required, and therefore fewer cartridges, the goal to provide higher performance cartridge collectors in smaller footprints was achieved with DFO collectors.

Today, DFO collectors provide up to a 25 percent increase in airflow capacity, an improved airflow path and up to 30 percent more pulse cleaning energy — all in a smaller collector. For example, a 3-36 DFO cartridge collector with oval-shaped nanofiber filters is nearly half the size of a 3-36 cartridge collector with hybrid airflow path and commodity filters. Furthermore, a 4-96 DFO cartridge collector is less than half the size of a hybrid 4-96 cartridge collector.

Advancing cartridge collection to where it is today hasn't been the result of a few small steps. Rather, giant leaps have produced the most significant strides in cartridge dust collection history. When it comes to getting cleaner air for your plant, the choice is now clearer than it's ever been.

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