

WHITE PAPER

Keeping Dust Out of Non-Manufacturing Spaces in Industrial Facilities



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AIR POLLUTION CONTROL

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High efficiency dust collectors are best known for maintaining cleanliness in industrial manufacturing spaces. But offices, conference areas, control rooms, server rooms and similar spaces in these facilities must also be protected against dust infiltration from nearby manufacturing processes or from particulate contaminants in the outdoor air.

Pressurization in combination with proper air filtration is the most effective approach to this challenge. High-efficiency HVAC filters are the most common solution, but cartridge-type industrial dust collectors can offer an effective and often overlooked alternative.

How pressurization works

Pressurization is a well-known ventilation technique in which a positive or negative atmospheric pressure is maintained in an isolated or semi-isolated environment. It has been used by the health care industry for many years for infectious disease control.

A patient with an immunodeficiency disorder will typically be housed in a positive pressure isolation room, which maintains a flow of air out of the room, protecting the individual from contaminants and pathogens which might otherwise enter. Conversely, a patient with a contagious disease will be housed in a negative pressure isolation room, which maintains a flow of air into the room to keep the infection from spreading to other patients and health care workers.

In industrial settings, positive pressure (known as “inflating the building”) is similarly used to keep particulate or gaseous contaminants out of a room, creating an air barrier between the outside and the inside. This makes it possible to protect the space from dirty outdoor air conditions, from dust or fumes generated by an adjacent production process, or even from excess humidity that might seep in through walls or other openings. Offices, labs, electrical rooms and server rooms in industrial facilities are especially prone to dust infiltration that can create unpleasant or even hazardous working conditions while causing problems with critical equipment, especially electronics.



Multiple dust collectors, each containing six high efficiency filter cartridges, are used to pressurize electrical rooms at a copper mine. The units have been operating for more than two years without a filter change. Blowers are controlled by VFDs and pressure sensors inside the room.

Conversely, in a pharmaceutical facility where potent compounds are used, or a mining facility where toxic minerals are being processed, negative pressure may be applied – sometimes in conjunction with containment systems – to prevent the dust generated in a manufacturing space from cross-contaminating other areas of the plant.

Determining whether to pressurize

How do you decide whether pressurization is a good choice for your facility? The decision can't be based solely on the volume of dust to be controlled, because other factors must be considered, as follows:

- ***What, or whom, are you trying to protect?*** If the space is unoccupied and/or there is nothing much of value inside, pressurization may not be worth the expense. But if you are protecting expensive electrical equipment from damage or from creating a safety hazard due to contact with dust, it will be worth investing a fraction the cost of that equipment in a pressurizing system that will ensure protection.

Similarly, if workers in an office area are exposed to unhealthy levels of dust or fumes, you will want to keep the area clean to protect occupants and comply with OSHA regulations for exposure. The importance of this cannot be understated. Though it has long been known that dirty air is hazardous to the health, the International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization, announced in 2013 that both air pollution and particulate matter (a major component of it) would now be classified among its Group 1 human carcinogens.

- ***What are the local climate conditions?*** Climate might also impact your cost analysis. In the tropics, if you inject large amounts of warm, moisture-laden air from outside to pressurize a building, the additional air conditioning load could be cost-prohibitive. However, in colder climates or during winter season, you can take advantage of the “free cooling” and use your pressurizing system for conditioning, saving substantially on



A cartridge dust collection pressurizing system is installed on the roof of a maintenance building in the harbor of a European coal power plant to prevent ambient coal dust from entering the building. The unit is installed in front of a ventilation system and uses a water and moisture eliminator filter at the intake to keep rain from entering the unit.



A 16-cartridge dust collector pressurizes and ventilates a compressor room in a power generation plant. Wall louvers allow for air exchange and are calibrated to maintain a specific pressure inside the facility.

air conditioning costs required to keep servers and electrical equipment from overheating.

• **What is the anticipated return on investment (ROI)?** ROI should typically be less than two years for pressurization to be cost-effective, and field experience shows that the payback is often much faster. Though as stated before, in many cases the main justification is to guarantee a certain air quality in a space to protect something or someone valuable. In addition to the health benefits, a clean work environment will also enhance morale and boost productivity.

Pressurization is used in many industries, including cement and lime production, metal and coal mining, pharmaceutical processing, grain processing, or potentially anywhere that high volumes of dust are generated. Areas that are most commonly protected using this technique include control rooms, clean rooms, compressor rooms, offices, quality control labs, substations, electrical equipment and motor control center (MCC) rooms, and server rooms.

Pressurizing with dust collection can be applied whether it is a new plant, an addition or expansion, or often even a plant renovation. Retrofitting of air handling units, although possible, can be more costly and complex depending on the set-up and location. To cite a hypothetical example: If an air handling unit is pressurizing a mechanical room and you want to replace it with a dust collector, there might be a problem if the collector won't fit in the room and/or the roof cannot take the weight of the equipment. Then you will have to engineer a solution that might not be cost-effective.

Deciding between HVAC filtration and dust collection

As noted, the non-manufacturing sections of industrial plants will often be pressurized using HVAC air handlers, which may contain ASHRAE-grade or HEPA filters capable of capturing very small particulate matter. However, HVAC filters are not designed for the heavy dust loads generated by some manufacturing processes; and in these situations filter life can be limited to a few months or even a few weeks, resulting in high maintenance and replacement costs.

Pressurizing with industrial cartridge-style dust collectors offers an excellent alternative to air handlers, especially in very dusty conditions. Cartridge dust collector filters are designed specifically



A small cartridge collector is used to pressurize an electrical room. Located in a warm climate, the room has its own backpack-type A/C unit for cooling, and the dust collector is sized for 10 percent of the capacity of this unit.



A large 24-cartridge collector plays a critical role in pressurizing an MCC room at a U.S. iron mine, protecting the electronic equipment from possible short circuits created by dust infiltration.

to handle high dust loads in industrial environments; so when used in a pressurization system, high efficiency cartridge filters can last for years before needing replacement. The main difference between the technologies is that a dust collector automatically pulse-cleans its filters using very brief bursts of compressed air that blow the dirt off the filter surfaces and down into a collection device.

Which is best for your application, HVAC filtration or dust collection? To find out, you will need to compare: (a) the initial cost of the equipment/hardware and the filters; (b) the cost of electrical energy required to operate the system; and (c) life expectancy of the filters under the anticipated dust loading conditions. Based on expected changeout frequency, you can arrive at an annual cost estimate that takes into account not only the price of the replacement filters but also related labor costs, equipment downtime, inventory, disposal, etc.

If you are dealing with pharmaceutical-grade or some food-grade applications, these highly regulated industries may place some restrictions on the types of filters or level of filtration needed to comply with industry standards.

Dust collection equipment guidelines

Cartridge style dust collectors are the system of choice because they deliver much higher filtration efficiencies than baghouses, a necessity when protecting workers or sensitive equipment from high levels of fine dust. Cartridge collectors also operate at lower pressure drop, for more efficient performance. Dust collectors in these applications will be located outdoors, so they must be equipped with weather-resistant components and controls.

A very *high efficiency nano fiber filter media (MERV 15 or 16)* is the best choice for pressurizing applications. Typically, an outer layer of extra filtration fibers will ensure the maximum efficiency of the media from day one. This technology increases the efficiency and allows maximum filtration with low pressure drop, thus improving the energy performance of the system.

Don't rely solely on MERV values in choosing a filter media, however. The MERV scale was developed for the HVAC filter market and is not accurate for dust collectors because, among other things, it is calculated at different flow rates; it does not take into account the whole dust collector but only the filter media; and it considers only the initial efficiency of the filter. While MERV and other efficiency measures are useful for comparing different filters, it is more important to verify that emissions will be at or below required threshold limit values. Ask the filter manufacturer to provide a written guarantee of emissions performance stated as grains per cubic foot of air or milligrams per cubic meter of air.

As noted, cartridge filters only need infrequent change-out in pressurizing applications, but it is recommended that you replace filters every two to three years at longest. An older filter may develop a hole or leak after time and will no longer deliver the guaranteed efficiency.

For critical applications, *HEPA or after-filters*, also known as *safety monitoring filters*, may be installed in the ductwork downstream of the collector to provide backup protection in the unlikely event of an air leak through the dust collector filters. In certain cases, HEPA filters will be required to comply with regulations of a specific industry. *Carbon after-filters* are another option for use when odor control is desired – for example, to prevent outside odors from entering an occupied pressurized space.



Working at a 15,000+ ft. elevation, this 48-cartridge dust collector pressurizes and conditions the control room of a gold and silver mine.

A *variable frequency drive (VFD)* ensures precise control of dust collector fan speed, efficiently maintaining the desired airflow through the collector. It is a must for pressurized applications, and should always be used in tandem with a *pressure sensor* in the room. The two devices will work together to monitor and control pressure.

If you are pressurizing to protect a space from gaseous contaminants, a *wet scrubber system* will be needed to remove these contaminants. If dust is present, however, you will still need a cartridge dust collector, installed upstream of the wet scrubber, for particulate filtration.

Strategies for air conditioned vs. non-air conditioned spaces

A final consideration in pressurizing is whether or not the space to be pressurized is air conditioned.

If the space does *not* have to be heated or cooled, dust collector airflow calculations should be based on the ventilation requirement for indoor air quality + air leakage through cracks and openings (i.e., using standard formulas for infiltration). False ceilings, raised floors and other construction details may also impact the calculations. For suggested velocities across openings and their corresponding pressures, see table 7-1 of the ACGIH "Industrial Ventilation: A Manual of Recommended Practice".

If the space to be pressurized requires heating or cooling, dust collector airflow should average between 10 – 20 percent of the HVAC unit airflow at a given capacity. This approach assumes the HVAC system has been properly sized to account for infiltration and will ensure you do not overwork the HVAC system by injecting too much humidity. Heavy duty air handling components designed to withstand the dirty conditions are recommended.

General ventilation guidelines for industrial applications recommend a difference of 5 percent between supply and exhaust airflow. In most cases, a good standard is to set a pressure differential of 0.04 +/- 2"wg. (For more details see section 7.5 of the ACGIH industrial ventilation manual, above.) Uncontrolled pressure could create high velocity conditions that result in back drafts and slamming doors. That is why it is important to use a pressure sensor inside the room to adjust the supply air using a VFD on the fan of the pressurizing unit.

Example: To treat an area with office workers using an extraction system mounted on top of a building, you will need a certain number of air changes per hour, which will determine the airflow. You should then add 5-10 percent more on top of that airflow to create pressurization. So if the goal is to extract 1,000 cfm from the room, the dust collector should be sized with 1,100 cfm capacity to make sure you are injecting more air than you are extracting. If there are any openings or other leak paths, it's a good idea to oversize the dust collector slightly or to calculate infiltration and add it to the formula. And as noted, a VFD and pressure sensor should again be used as controls.

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Camfil APC (www.camfilapc.com) is a global manufacturer of dust, fume and mist collection equipment and is part of Camfil, the largest air filter manufacturer in the world. For further information, contact (800) 479-6801 or (870) 933-8048, e-mail filterman@camfil.com, or visit www.camfilapc.com.

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