

# dust collection

## ANSI/ASHRAE STANDARD 199: A NEW TOOL FOR SPECIFYING PHARMACEUTICAL DUST COLLECTION EQUIPMENT

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*This article reviews how Standard 199 differs from previous test standards, how it measures dust collector performance, and how end-users can best apply its methodology in tandem with other guidelines and standards. The information will help you make more informed decisions about purchasing traditional and contained dust collection equipment.*

The pharmaceutical industry has for many years lacked an adequate test standard to compare the performance of different dust collector filters and equipment. Now, all that has changed with the June 2016 publication of ANSI/ASHRAE Standard 199-2016, "Method of Testing the Performance of Industrial Pulse Cleaned Dust Collectors." The new standard fills an important information gap and will help pharmaceutical manufacturers and other operators of dust collection systems to compare and evaluate the equipment with much greater accuracy. While manufacturers are certain to find the overall stan-

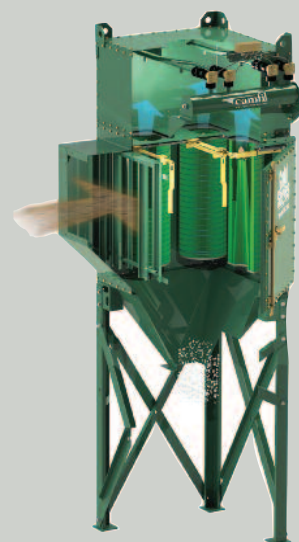
dard beneficial, they will be particularly interested in the comparative data it provides on emissions and operational and energy costs. As the standard is more widely adopted and more data are accrued, pharmaceutical manufacturers will have more guidance on issues such as whether secondary HEPA filtration is required, how to extend filter life, and whether a dust collector that uses a certified high-efficiency primary filter can reduce costs.

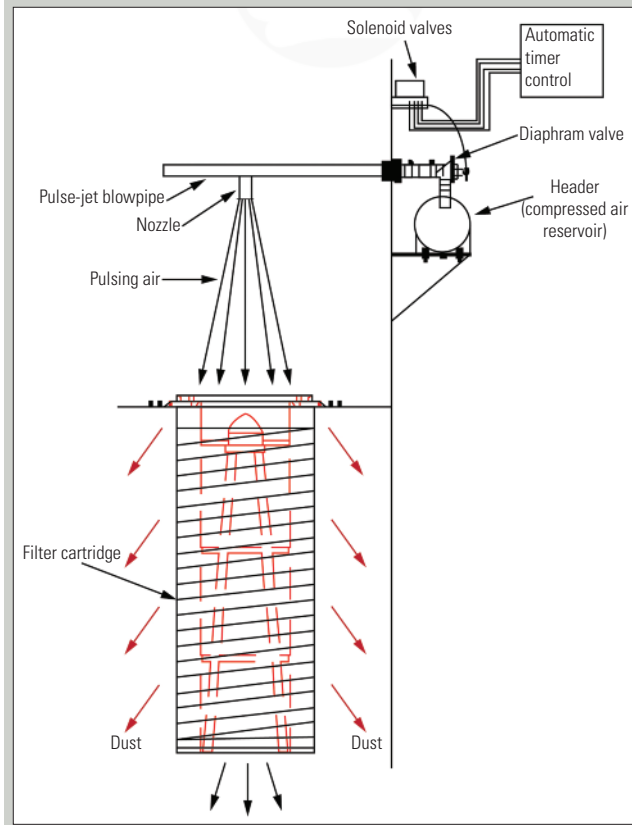
### Mimicking real-world performance

Until now, manufacturers had to rely on air filter test standards that weren't a good fit, such as those developed by ASHRAE to measure filter efficiency in HVAC systems. Perhaps the most widely used standard for comparing filters, ANSI/ASHRAE 52.2, calls for measuring air filter efficiency using the minimum efficiency reporting value (MERV) method. However, because ASHRAE 52.2 was developed for the HVAC filter market, it doesn't address how a dust collector operates, i.e., by pulse-cleaning filters periodically when a dust cake builds up. Figure 1 shows a typical cartridge dust collector, and Figure 2 shows a typical pulse cleaning system.

Standard 199 is the first document to provide a methodology for comparing performance results based on true dust collector operating conditions. It not only

**FIGURE 1**  
**Cutaway view of a cartridge-style dust collector**



**FIGURE 2****Schematic of a typical pulse cleaning system**

Courtesy of ASHRAE

analyzes how well the filters clean, but also how the collector performs as a whole. That enables manufacturers to make a much more accurate comparison when deciding which filters truly meet process needs.

The Standard applies to “bag, cartridge, or envelope industrial dust collectors that recondition the filter media by using a pulse of compressed air to discharge the dust

cake from the filter media while the air cleaning device remains on line.” It prescribes a method for testing the performance of these dust collectors from inlet to outlet and in so doing accurately portrays the dynamics of the equipment in multiple-filter arrangements, unlike the MERV method, which bases its comparison on the initial efficiency of a single filter.

### Multi-stage test sequence

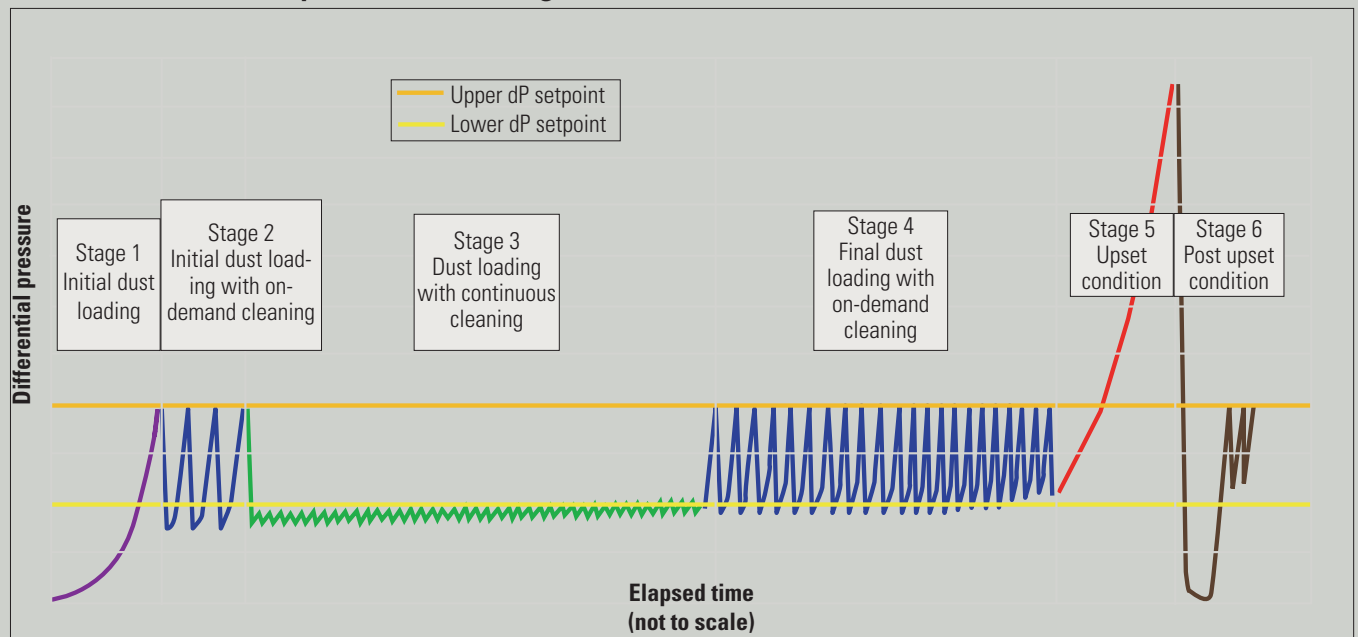
Under Standard 199, testing is a six-stage affair that challenges the dust collector just as a real-life application would (Figure 3).

In Stage 1, dust is fed to the collector at a specified rate—without pulse cleaning—until a specified differential pressure is reached. In Stage 2, on-demand pulse cleaning commences while the air flow and dust feed continue for 4 hours. On-demand cleaning conserves compressed air and maintains the filter pressure drop in a range that allows adequate air flow from the dust-generating process. It’s the most common cleaning method used in the pharmaceutical industry.

Stage 3 uses continuous pulse cleaning while maintaining the air flow and dust feed. This stage lasts 24 hours or until the specified maximum differential pressure is reached, whichever occurs first. The filters are cleaned at specified intervals, generally every 10 to 15 seconds.

Stage 4 involves final dust loading with on-demand cleaning, while the air flow and dust feed are maintained for another 24 hours. Cleaning is triggered by high and low differential pressure setpoints that the dust collector manufacturer provides. Data collected over the final 4 hours of this stage are used to assess performance.

Stage 5 simulates how the dust collector would perform in an upset condition. It calls for maintaining the dust feed while suspending pulse cleaning. This continues until the

**FIGURE 3****Sequence of six test stages as set forth in ANSI/ASHRAE Standard 199\***

\*Adapted from ANSI/ASHRAE Standard 199-2016

differential pressure reaches the specified maximum, usually 10 inches water gauge. At that point, the dust feed stops.

Stage 6 mimics a post-upset scenario. Air flow is reduced to 25 percent of the specified value, and continuous pulse cleaning runs for 10 cycles. The system is then returned to the specified air flow, and the differential pressure is measured. Next, the dust feed is restarted and final measurements are taken. This stage replicates a process commonly known as "downtime cleaning."

As the filters are cleaned, emission levels will fluctuate because the shock of compressed air that cleans them also allows some dust to pass through the filter media. The pressure drop will increase when cleaning is paused and decrease when it restarts. The frequency of cleaning affects the pressure drop in the system, and the compressed air used for cleaning is the main driver of energy consumption. Filters with inherently greater pressure drop consume more energy because they require more pulsing/compressed air and thus more electricity is needed for the fan's motor to overcome the higher static pressure in the system.

The tests use calcium carbonate dust, and section 6.1 of the Standard specifies its properties, including particle size, bulk density, and moisture content. By using a standardized material, the test results are applicable across all industries.

### Measuring performance parameters

**Emissions.** The tests used in Standard 199 measure not only the initial emissions, but emissions over the duration of testing, an approach that is more meaningful to manufacturers than others. Emissions are measured in milligrams per cubic meter of air.

**Pressure drop.** The more dust a filter can hold and the better it can release the dust, the less frequently it will need cleaning. That, in turn, helps the system maintain a low pressure drop throughout the filter's service life.

**Compressed air usage.** How much air the system consumes varies according to how self-cleaning the filter is. The better the cleaning characteristics, the less compressed air the system needs.

**Energy consumption.** Pressure drop and compressed air usage largely determine how much you spend running the system. A filter with a low pressure drop—in conjunction with a variable-frequency drive, as is specified for the test rig in Standard 199—will reduce electricity usage and extend the filter's service life. Pulsing less frequently also cuts energy consumption because it conserves compressed air.

**Emission reading.** It's important to know how much dust penetrates the filters and reaches the outlet. The emissions undergo photometric measurement in accordance with 40 CFR Part 50 and are categorized by particulate mass (PM):

- PM1: Particles less than 1 micron,
- PM2.5: Particles less than 2.5 microns, and
- PM10: particles less than 10 microns.

All testing is performed on standard dust collection units. Even so, the results can also apply to containment

systems because a contained dust collector uses the same cleaning system as a conventional collector.

### Compliance is voluntary

Complying with Standard 199 is voluntary, and it's up to each dust collector and filter manufacturer to develop a compliance plan. It may take some suppliers several years to get on board due to limited test facilities and the cost involved in commissioning independent testing. Smaller suppliers may find these costs prohibitive. The photo below shows the test rig installed at our company's in-house lab.



This full-scale test rig, built in accordance with Standard 199 specifications, includes a cartridge dust collector with four high-efficiency filters.

Another factor that could influence how and when the Standard is followed within industry is the potential involvement of the International Organization for Standardization (ISO), which is considering whether to adopt it. If ISO does, more equipment suppliers and customers worldwide are likely to implement it.

### Questions to ask potential dust collector and filter suppliers

Since participation in Standard 199 testing is voluntary, ask the dust collection suppliers you're considering where they stand in the process and request their Standard 199 test reports. If a supplier doesn't yet offer the test data, it will limit your ability to make educated decisions. The more suppliers who are asked for test data, the greater the likelihood that the market will move toward widespread adoption of the Standard.

Here are other questions to consider asking. The responses should help you evaluate potential suppliers:

**Does your company operate an in-house lab to conduct Standard 199 testing?**

A supplier who has installed an in-house Standard 199 test rig demonstrates a strong commitment to the program. In addition, the lab helps the supplier improve its collector designs and, more importantly, it enables the supplier to test filter elements in equipment built by the manufacturers under evaluation. The test is the most accurate gauge of real-world performance. Note: This specialized data is not available from independent lab tests, where the same dust collector rig is used for all Standard 199 data.



### Has your company commissioned independent testing?

Even if in-house test facilities are available, a conscientious supplier will also commission independent testing and offer third-party verification of filter performance. Independently certified results are important and should be used in conjunction with the equipment manufacturer's in-house testing.

### Are the filter elements that your staff specified for my application the same as those that were tested under Standard 199?

It's very important to verify that the filter elements and filtration media used in the testing are the same ones that you'll receive when ordering the dust collector. Some manufacturers might test their best elements, then switch to less costly and poorer performing elements when packaging the collector.

### Using the test data to compare costs

Standard 199 will enable you to review and compare the results of different dust collectors and filters, including emissions, pressure drop, compressed air consumption, and energy usage. With these data, you can evaluate the total cost of ownership (TCO) of a dust collector. That's important because two collectors with similar price tags may incur very different costs over time. TCO helps you determine what it really costs to operate the dust collector by calculating expenses in three areas: energy, consumables, and maintenance and disposal.

**Energy.** This tallies how much energy the dust collector uses in day-to-day operation. It includes electrical costs and compressed air usage.

**Consumables.** A number of items require periodic replacement throughout the equipment's service life. Although Standard 199 cannot directly predict how long a filter will last, it provides comparative data on pressure drop that can shed light on which filter elements may last longest. Comparative emissions data are also useful, because lower emissions through the primary filters translate into a longer service life of costly secondary HEPA filters, which are required in potent and hazardous dust applications. In other applications, low emissions might even eliminate the need for HEPA filters.

**Maintenance and disposal.** How long it takes to service the equipment and the costs of disposing of the consumables can be major cost factors in any system, but especially in contained dust collectors and systems with HEPA filters. Be sure to consider both the primary and secondary filters.

A reputable equipment supplier should be able to calculate the TCO using data from a Standard 199 test report and other data unique to your application. Because it helps you choose the most cost-effective equipment, a TCO evaluation saves you money, but it also saves time and energy.

### Applying other rules and standards to dust collector design

Standard 199 does not measure all aspects of dust collector design and performance. It must be applied in conjunc-

tion with the normal risk assessment and hazard analysis that precede equipment selection. Combustible dust control is one area of concern. As part of the upfront analysis, your dust should undergo explosibility testing to determine its combustible and explosive properties. Explosibility testing is essential to analyzing which type of dust collection system is best for a specific application. It will also inform your selection of the explosion protection/prevention devices needed in order to comply with applicable NFPA standards. Figure 4 shows a rendering of a dust collector equipped with explosion suppression equipment.

**FIGURE 4**

### Dust collection system equipped with explosion suppression equipment



Where containment risks are a concern, you should also consider surrogate testing. Surrogate testing of contained dust collection equipment—when performed under controlled parameters using a surrogate that mimics the particle characteristics and flowability of the active pharmaceutical ingredient—is a safe and effective method to help predict how well the system will contain the process and remain in compliance with emission requirements. For best results, follow the testing protocol of ISPE's "Good Practice Guide."

Many manufacturers will also need to consider threshold limit values, or TLVs, which are established by the American Conference of Governmental Industrial Hygienists. The other option is to use internally prescribed occupational exposure limits, or OELs. Both measure the airborne concentration of a substance below which workers are believed to be protected while

exposed to the substance daily for 8 hours. Emissions readings from Standard 199 test reports can help you perform a risk assessment to determine which equipment best suits your application.

Until Standard 199 test reports become more widely available, it's likely that equipment specifiers will sometimes continue comparing filters using MERV rankings or other efficiency ratings. Although a MERV ranking is a good indicator of a filter's initial efficiency, keep in mind that it doesn't measure pressure drop, emissions while pulsing, energy performance, or the other parameters included in Standard 199 testing.

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## References

TLV/BEI Guidelines. American Conference of Governmental Industrial Hygienists, Cincinnati, OH. [www.acgih.org](http://www.acgih.org).

ANSI/ASHRAE Standard 199-2016, Method of Testing the Performance of Industrial Pulse Cleaned Dust Collectors. American Society of Heating, Air-Conditioning and Refrigeration Engineers, Atlanta, GA. [www.ashrae.org](http://www.ashrae.org).

ANSI/ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

Assessing the Particulate Containment Performance of Pharmaceutical Equipment, 2012. International Society for Pharmaceutical Engineering (ISPE), Bethesda, MD. [www.ispe.org](http://www.ispe.org).

NFPA 652: Standard on the Fundamentals of Combustible Dust. National Fire Protection Association (NFPA), Quincy, MA. [www.nfpa.org](http://www.nfpa.org).

NFPA 654: Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids.

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## Further reading

For more information about specifying dust collection equipment and filters, see:

- Selecting a cartridge dust collection system for tablet coating operations. David Steil. April 2015.
- How to ensure your dust collection system complies with combustible dust standards. David Steil, Tony Supine, and Mike Walters. May 2013.
- Ten tips for selecting cartridge dust collection equipment for tableting operations. David Steil. March 2012.
- Dust collector filters: Calculating the total cost of ownership. Tom Frungillo and Tony Supine. October 2012