Designing your dust collection system to meet NFPA standards — Part II

Gary Q. Johnson  Workplace Exposure Solutions

About 40 percent of combustible dust explosions reported in the US and Europe over the last 25 years have involved dust collectors. Dust collection systems are now a primary focus of inspections required by OSHA’s National Emphasis Program on safely handling combustible dusts. OSHA also has the authority to enforce National Fire Protection Association (NFPA) standards for preventing or protecting against dust explosions. This two-part article focuses on how you can design your dust collection system’s dust collector, ductwork, and exhaust fan to meet the intent of these NFPA requirements. Part I (December) covered dust explosion basics and how to prevent dust accumulation in system ductwork; Part II covers how to eliminate ignition sources in the system, how to use explosion prevention and protection methods at the collector, and how to meet additional NFPA requirements.

Eliminating ignition sources

Grounding the system equipment, selecting electrical components for your hazardous area classification, and protecting the exhaust fan are all ways to eliminate ignition sources in your dust collection system.

Grounding equipment. To prevent a static electrical discharge from providing an ignition source for a dust explosion, you must ground the dust collector and its components, the ductwork, the exhaust fan, and other system components to dissipate static electricity. This includes selecting filters with integral grounding straps that provide a grounding path between the filter and the tubesheet, which also must be grounded. Component materials must be conductive, as well. Don’t select duct made of plastic, which is nonconductive. If your ductwork includes flexible hose, the hose should be molded with grounding wires, and you must clamp these wires to the upstream and downstream metal ducts to ground the hose. Examples of how to ground typical system components are shown in Figure 1.

The grounding wires on various components should be visible to operators so they can quickly check that the grounding is in place. Operators should also routinely check the resistance to ground in the wires to ensure that it’s less than 10⁶ ohms. You can find more information on how to use grounding to minimize these electrostatic hazards in NFPA 77: Recommended Practice on Static Electricity (2007).

Selecting electrical components for your hazardous area classification. You’ll also need to choose electrical components for your dust collection system that are certified for use in your hazardous location, as detailed in NFPA 499: Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas (2008). In the US, this certification is provided by Underwriter Laboratories and Factory Mutual. The type of hazardous protection your electrical components must have — such as being dust-ignition-proof or mounted in dust-tight enclosures — depends on the explosion risk in your system’s location, and these hazardous locations are rated by classes, divisions, and groups. Hazardous locations with combustible dust are Class II. In Class II, Division I, locations, the dust is present...
during normal conditions, and in Class II, Division 2, locations, the dust is present only in abnormal conditions, such as a system breakdown. The additional group subclassification depends on the type of dust in the surrounding environment: for example, Group E is for metal dusts, Group F is for carbonaceous dusts, and Group G is for all other dusts. To determine the right hazardous area classification for your system’s electrical components, consider your dust type, dust quantity, whether the system’s dust collector is inside or outside, and related factors.

**Figure 1**

Grounding system components to eliminate ignition sources

**Protecting the exhaust fan.** If your exhaust fan fails mechanically, the fan impeller can shift and rub or hit the housing. A spark from such metal-to-metal contact has enough energy to ignite a combustible dust. To avoid this hazard, you should do two things: First, place the exhaust fan on the dust collector’s clean side, where it can’t contact dust under normal conditions, as detailed in NFPA 654: Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids (2006). Second, train and equip your operators to practice good dust collector maintenance so they can spot filter leaks early and replace the affected filters before dust can escape the system. One tool available from multiple suppliers for helping the operators spot filter leaks before they cause a problem is a filter-leak detection system; the system uses an inductive or triboelectric probe inserted into the system ductwork to sense particles escaped from a leaking filter.

**Using explosion prevention and protection methods at the collector**

To meet NFPA requirements for protecting your dust collector from a dust explosion, you must use one (or more) explosion prevention or protection method, including venting, suppression, isolation, and others. Explosion venting is covered in NFPA 68: Standard on Explosion Protection by Deflagration Venting (2007), and suppression, isolation, and other methods are covered in NFPA 69: Standard on Explosion Protection Systems (2008). You can see a dust collector equipped with various explosion prevention and protection devices in Figure 2.

Of the several ways to meet NFPA 68 requirements for protecting your dust collector from an explosion, explosion venting is the most common. NFPA 68 venting requirements are described in detail in the PBE article “Five ways the new explosion venting requirements for dust collectors affect you.” As the article states: “The purpose of explosion venting is to save lives, not property. A well-designed explosion vent functions as a weak element in the equipment’s pressure envelope, relieving internal combustion pressure to keep the collector from blowing up into pieces. ...Typically, the collector is located outside and designed to vent away from buildings and populated locations.” Additional venting information in the article highlights NFPA 68 areas that have changed or are of most importance to bulk solids processors, including the performance-based design option and sizing vents and discharge ducts.

If your dust collector is indoors and can’t be vented outside through an exterior wall or ceiling, you must equip it with an explosion prevention method, such as a suppression system, that can prevent a dust explosion from propagating to connected equipment. You can use any of several systems described in NFPA 69. One common example is a chemical suppression system, which senses a developing explosion in the dust collector and rapidly injects a chemi-
that’s part of a closed-circuit process, you may consider an explosion prevention method that uses nitrogen to inert the dust collection system; using nitrogen inerting in a closed-circuit application minimizes nitrogen consumption, which otherwise would be prohibitively expensive.

NFPA 69 also describes methods for isolating upstream and downstream equipment from an explosion in the dust collector. One common example is a flame-front diverter, which is an explosion vent in the duct (Figure 2). The diverter is typically placed at the dust collector’s dirty-air inlet when the collector is located near the dust collection system’s exhaust fan and ductwork. When an explosion occurs in the collector, the flame-front diverter’s vent opens and releases the explosion to the atmosphere, thus isolating other equipment from the flame front. Another isolation device is a high-speed isolation valve, which is located in the dirty-air duct and wired to an explosion detector in the collector. The valve’s location on the duct is far enough from the explosion detector to allow the detector to respond to an explosion and close the valve before the flame front can reach upstream equipment. A float valve (Figure 2) is another isolation device that protects the exhaust fan or the ventilation equipment that recirculates cleaned air to the workplace. Placed on the dust collector’s clean-air side between the fan and collector or after the fan, the float valve works like a ball check valve — that is, it’s pushed shut by the pressure and airflow changes caused by an explosion in the collector.

Meeting additional NFPA requirements

According to our industry’s current interpretation of the NFPA standards covering dust collection system design, you don’t have to update equipment in your system each time a particular standard is updated unless your location’s authority having jurisdiction (“an organization, office, or individual responsible for enforcing the requirements of a code or standard” [NFPA 68]) decides otherwise. However, the standards require you to follow certain procedures related to maintenance, housekeeping, explosion protection, and managing system changes, and you must implement the procedures retroactively.

Here are some of the key retroactive requirements in NFPA 68, 69, and 654:

- You must provide both initial training and refresher training to employees on the established operating and maintenance procedures for your dust collection system and explosion prevention and protection equipment.
- You must provide housekeeping and cleaning for the dust collection system and surrounding area using procedures (such as vacuum cleaning) that minimize dust-cloud generation and at a frequency that minimizes dust accumulation in your workplace. The portable vacuum cleaners you use must meet Class II hazardous location requirements when operated in a combustible dust hazard area.
- You must ensure that all dust collection system components are conductive, bonded (to protect workers from

![Figure 2](image-url)
electric shock), and grounded to a resistance of less than $10^6$ ohms.

- You must inspect, test, and maintain the dust collection system and its explosion prevention and protection equipment according to the manufacturer’s recommendations. You also must keep records of these inspections and tests and sign off on them.

- You need to establish change management procedures for the dust collection system and its explosion prevention and protection equipment and address related technical issues before making any system changes; after a system change, you must update the system’s design documentation to reflect the change.

Also be aware that if equipment in your dust collection system has changed or the dust collected by your system has changed since you initially tested the dust for combustible properties and conducted a hazard analysis of your system, you must revisit the hazard analysis to see if you need to change any of the system’s explosion risk mitigation strategies, such as explosion vent size and location. Don’t forget that NFPA requires that you keep the hazard analysis up to date for the life of the process it protects and that you review and update the analysis at least once every 5 years. PBE

References


3. Lee Morgan and Terry Supine, “Five ways the new explosion venting requirements for dust collectors affect you,” Powder and Bulk Engineering, July 2008, pages 42-49; see “For further reading” for information on purchasing a copy of this article.

For further reading

Find more information on designing dust collection systems and preventing dust explosions in articles listed under “Dust collection and dust control” and “Safety” in Powder and Bulk Engineering’s comprehensive article index (later in this issue and at PBE’s Web site, www.powderbulk.com) and in books available on the Web site at the PBE Bookstore. You can also purchase copies of past PBE articles at www.powderbulk.com.

Gary Q. Johnson is principal consultant with Workplace Exposure Solutions, 7172 Willowood Drive, Cincinnati, OH 45241; phone/fax 513-777-4626 (gary@workexposoln.com, www.workexposoln.com). He holds a master’s degree in business administration from the University of Scranton, Scranton, Pa., and a bachelor’s degree in chemical engineering from Ohio State University in Columbus.