

WHITE PAPER

How to Make Sure Your Dust Collection System Complies with Combustible Dust Standards

Combustible dust explosions are a risk in many areas of a plant, but one of the most common locations is the dust collection system. How do you know if your dust collection system complies? What do you do if it doesn't? Are your employees at risk?



This white paper reviews the OSHA National Emphasis Program for combustible dust, the NFPA standards that address how to prevent or limit explosion hazards, how to identify these hazards, and the types of equipment used for explosion protection. It will also examine the most common shortfalls to compliance and how to avoid them.

*By Tony Supine, Plant Manager, Camfil APC
and Mike Walters, Senior Engineer, Camfil APC*

How to Make Sure Your Dust Collection System Complies with Combustible Dust Standards

By Tony Supine, Plant Manager, Camfil APC
and Mike Walters, Senior Engineer, Camfil APC

Combustible dust explosions are a risk in many areas of a plant, but one of the most common locations is the dust collection system. How do you know if your dust collection system complies? What do you do if it doesn't? Are your employees at risk? What are the hazards and how do you identify them?

The National Fire Protection Association (NFPA) sets standards and codes to protect buildings against fire and explosion risks, and the Occupational Safety & Health Administration (OSHA) is applying these standards with increasing vigilance. When it comes to combustible dust, several standards must be considered. This white paper reviews the current status of the OSHA National Emphasis Program for combustible dust, the NFPA standards that address how to prevent or limit explosion hazards, how to identify these hazards, and the types of equipment used to eliminate or control explosion hazards. We will also examine the most common shortfalls to compliance and how to avoid them.

The last decade: a look back

In January 2003, an explosion at the West Pharmaceutical facility in Kingston, North Carolina killed six workers and injured 38 others, including two firefighters. The culprit: inadequate control of dust hazards at the plant. Only a month later, in February 2003, another explosion and fire damaged the CTA Acoustics manufacturing plant in Corbin, Kentucky, fatally injuring seven workers. Investigators found that resin dust, accumulated in a production area, was likely ignited by flames from a malfunctioning oven, triggering the explosion.

The most famous combustible dust explosion in the past decade – and the one responsible for re-focusing the national spotlight on this issue – was the February 2008 accident at the Imperial Sugar Company's Wentworth,



These dust collectors are equipped with passive and active controls. Passive controls are an explosion vent and ducting that control the pressure and flame direction, and a rotary valve that contains the flame in the hopper. The active control is a chemical isolation system mounted on the inlet duct. Triggered by a pressure/flame detector, it will extinguish a flame front passing through the inlet pipe before it goes back into the plant.

Georgia refinery. A dust cloud explosion triggered a fatal blast and fire that killed 13 workers and injured 42 others, generating a storm of media attention and government scrutiny.

These are by no means the only fatal explosions to occur in U.S. manufacturing plants, though they are the three deadliest to be investigated. More recently, in December 2010, two brothers lost their lives in a chemical explosion at the New Cumberland, West Virginia plant of AL Solutions. And during 2011, three deadly fires and explosions occurred at a Hoeganaes Corp. plant in Gallatin, Tennessee. Investigators found that accumulations of fine iron powder in the facility led to the explosions.

In the U.S. alone in the 25 years between 1980 and 2005, the Chemical Safety Board reported 281 explosions caused by ignited combustible dust. These explosions resulted in 199 fatalities and 718 injuries. Combustible dust explosions over the past decade in U.S. plants are blamed for well over 100 fatalities and hundreds more injuries. Sadly, experts believe these accidents could have been prevented if the companies involved had followed best practices for fire and explosion protection such as the methodologies described in this white paper.

Agencies involved

There are three key entities involved in combustible dust issues, each with its own particular area of responsibility:

NFPA: The NFPA sets safety standards, amending and updating them on a regular basis. As noted, when



This dust collector is equipped with an explosion vent with vertical upblast deflector plate. Other safety features include a sprinkler system and filters with special carbon-impregnated media for static dissipation.

it comes to combustible dust, there are several different documents that come into play, as summarized in the section directly below. Together these standards add up to total protection to prevent an explosion, vent it safely, and/or ensure that it will not travel back inside a building. Most insurance agencies and local fire codes state that NFPA standards shall be followed as code. Exceptions would be where the authority having jurisdiction (AHJ), such as Factory Mutual, specifies an alternative safety approach which might be even more stringent.

OSHA: It is OSHA's role, together with local authorities, to uphold the standards published by NFPA. In

the aftermath of the Imperial Sugar Company explosion in 2008, OSHA re-issued its 2007 Combustible Dust National Emphasis Program (NEP) outlining policies and procedures for inspecting workplaces that create or handle combustible dusts. As defined by OSHA, “These dusts include, but are not limited to: metal dust such as aluminum and magnesium; wood dust; coal and other carbon dusts; plastic dust and additives; bio-solids; other organic dust such as sugar, flour, paper, soap, and dried blood; and certain textile materials.” The revised NEP, which OSHA reissued on March 11, 2008, was designed to ramp up inspections, focusing in particular on 64 industries with more frequent and serious dust incidents.

According to an October 2011 OSHA update on its Combustible Dust NEP, since the commencement of inspections under the 2008 program, more than 2,600 inspections have occurred. More than 12,000 violations were found during this timeframe, including more than 8,500 which are classified as serious. Federal penalties and fines for these violations have totaled \$22,738,909, with nearly another \$1,600,000 in state fines. OSHA uncovered a variety of dust collection violations in these inspections, including dust collectors that were not equipped with proper explosion protection devices and systems that were not vented to safe locations. (Figure 1)

U.S. Chemical Safety Board (CSB): The CSB is an independent federal agency responsible for investigating industrial chemical accidents. Staff members include chemical and mechanical engineers, safety experts, and other specialists with chemical industry and/or investigative experience. The CSB conducts thorough investigations of explosions like the ones mentioned above – sifting through evidence to determine root causes and then publishing findings and recommendations. The CSB has a wealth of information on their web site (www.csb.gov), including educational videos depicting how combustible dust explosions occur.

The CSB has become an outspoken advocate of the need for more stringent combustible dust regulations and enforcement. On February 7, 2012, the fourth anniversary of the Imperial Sugar explosion, the chairman of the CSB issued a statement in which he applauded the progress made to date in dealing with combustible dust issues. He noted, however: “Completing a comprehensive OSHA dust standard is the major piece of unfinished business from the Imperial Sugar tragedy.... We believe such a standard is necessary to reduce or eliminate hazards from fires and explosions from a wide variety of combustible powders and dust.” The CSB has also recommended that the International Code Council, which sets safety standards that are often adopted by state and local government, revise its standards to require mandatory compliance with the detailed requirements of the various NFPA standards relating to combustible dust.

Combustible Dust NEP

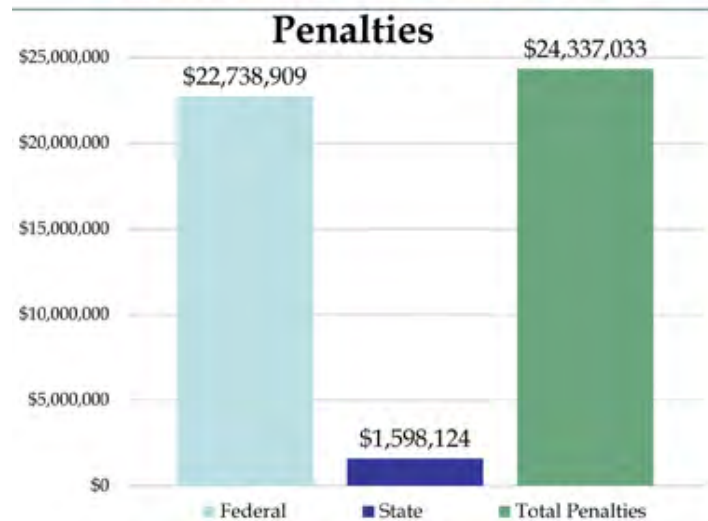


Figure 1: Penalty graph shows fines imposed from commencement of the OSHA Combustible Dust National Emphasis Program (NEP) in 2008 until October 2011. (Image courtesy of www.oshalawupdate.com)

The role of Congress: Some members of Congress are also advocating faster action by OSHA to implement a combustible dust standard. In February 2013, Representative George Miller of California, together with Representatives John Barrow of Georgia and Joe Courtney of Connecticut, reintroduced a bill titled The Worker Protection against Combustible Dust Explosions and Fires Act (H.R. 691). If enacted, it would require OSHA to issue an interim standard within one year of passage and the Secretary of Labor to issue a proposed rule 18 months later, with a final rule due within another three years. This is similar to another bill, H.R. 522, which was introduced in 2011 but never enacted. An earlier bill passed the House in April 2008 but never went to the Senate.

Relevant NFPA Standards

In trying to sort through the list of combustible dust standards, a good starting point for every plant engineer or manager is **NFPA 654**, the Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing and Handling of Combustible Particulate Solids. Simply stated, NFPA 654 is an all-encompassing standard on how to design a safe dust collection system. It is regarded as the guiding dust document and the most general on the topic, and it will lead you to other relevant documents.

Depending on the nature and severity of the hazard, NFPA 654 will guide you to the appropriate standard(s) for explosion venting and/or explosion prevention, as follows:

NFPA 68 – Standard on Explosion Protection by Deflagration Venting: This document focuses on explosion venting – i.e., on devices and systems that vent combustion gases and pressures resulting from a deflagration within an enclosure, for the purpose of minimizing structural and mechanical damage. The current edition, published in 2007, contains much more stringent requirements than past editions, essentially elevating it from a guideline to a standard.

NFPA 69 – Standard on Explosion Prevention Systems: This standard covers explosion protection of dust collectors when venting is not possible. It covers the following methods for prevention of deflagration explosions: control of oxidant concentration, control of combustible concentration, explosion suppression, deflagration pressure containment, and spark extinguishing systems.



At the startup of a staged explosion, explosive dust is injected into the dust collector to create a flammable cloud.



About 50 milliseconds later, the dust ignites and the vent opens.



The flame is diverted away from the dust collector to a safe area.



The smoke quickly clears. The whole event took about 150 milliseconds.

The general document (NFPA 654) also directs the reader to appropriate standards for specific manufacturing industries. The NFPA recognizes that different industries and processes have varying requirements, and it relaxes or tightens some aspects of its dust standards accordingly. Wood dusts, for example, tend to contain high moisture content that make for a potentially less explosive environment, resulting in a less stringent overall dust standard for that industry. Conversely, metal dusts can be highly explosive and subject to more vigilant regulation.

The industry-specific standards most commonly employed are:

NFPA 61 – Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities. This standard covers facilities engaged in dry agricultural bulk materials including grains, oilseeds, agricultural seeds, legumes, sugar, flour, spices, feeds, and other related materials; facilities that manufacture and handle starch; seed preparation and meal-handling systems of oilseed processing plants not covered by NFPA 36, Standard for Solvent Extraction Plants. Examples of facilities covered by NFPA 61 include but are not limited to bakeries, grain elevators, feed mills, flour mills, corn and rice milling, dry milk products, mix plants, soybean and other oilseed preparation operations, cereal processing, snack food processing, tortilla plants, chocolate processing, pet food processing, cake mix processing, sugar refining and processing, and seed plants.

NFPA 484 – Standard for Combustible Metals. This standard covers all metals and alloys in a form that is capable of combustion or explosion, and it outlines procedures that shall be used to determine whether a metal is combustible or noncombustible form. It also applies to processing or finishing operations that produce combustible metal powder or dust such as machining, sawing, grinding, buffing and polishing. Parts that contain multiple metals or alloys are subject to the requirements of the metal whose combustion characteristics they most closely match. The standard also defines exclusions such as the transportation of metals or the primary production of aluminum, magnesium, and lithium.

NFPA 664 – Standard for the Prevention of Fire and Explosions in Wood Processing and Woodworking Facilities. This standard establishes the minimum fire and explosion prevention requirements for facilities that process wood or manufacture wood products using wood or cellulosic fibers, creating wood chips, particles, or dust. Examples include wood flour plants, industrial woodworking plants, furniture plants, plywood plants, composite board plants, lumber mills, and production-type woodworking shops and carpentry shops that meet minimum requirements for plant size or dust collection flow rates.

Using Performance-Based Codes: In 1995, the NFPA created a Performance-Based (PB) Support Team to assist NFPA Technical Committees with the transition to performance-based documents. Since that time, the NFPA has been incorporating performance-based options into its updated standards: The NFPA 654 general dust document first adopted this concept in 2006, with the other more specific combustible dust standards following suit since that time. Using the newer performance-based codes, solutions no longer have to follow NFPA standards to the letter *if the variance is backed by full-scale, real-world destructive test data.*

Performance-based provisions state specific life safety objectives and define approved methods to demonstrate that your design meets these objectives. They give equipment manufacturers and plant engineers greater flexibility by allowing methods to quantify equivalencies to existing prescriptive-based codes or standards, as long as the proposed solution demonstrates compliance.

A performance-based design procedure includes the following steps: (1) establish safety goals; (2) evaluate all aspects of the facility with regard to safety; (3) identify potential hazards; (4) define appropriate hazard scenarios; (5) establish performance objectives and criteria; (6) select calculation methods (e.g. computer models); (7) develop a proposed solution; (8) assess the solution; and (9) obtain approval.

Technologies for explosion protection

There are many types of devices and systems used to comply with NFPA standards for the explosion protection of dust collection systems, but they fall into two general categories: passive and active. Passive systems react to the event, while active systems detect and react prior to or during the event.

The goal of a passive system is to control an explosion so as to keep employees safe and minimize equipment damage in the plant. An active system, by contrast, can prevent an explosion from occurring. An active system involves much more costly technology and typically requires re-certification every three months.

Passive devices include:

- **Explosion venting:** Designed to be the “weak” link of the dust collector vessel, an explosion vent opens when predetermined pressures are reached inside the collector, allowing the excess pressure and flame front to exit to a safe area. It is designed to minimize damage to the collector and prevent it from blowing up in the event of a deflagration, thereby reducing the hazard. (Figure 2)
- **Flameless venting:** Designed to install over a standard explosion vent, a flameless vent extinguishes the flame front exiting the vented area, not allowing it to exit the device. This allows conventional venting to be accomplished indoors where it could otherwise endanger personnel and/or ignite secondary explosions. (Figure 3)
- **Passive float valve:** Designed to be installed in the outlet ducting of a dust collection system, this valve utilizes a



Figure 2: A dust collector explosion vent designed in accordance with NFPA standards.

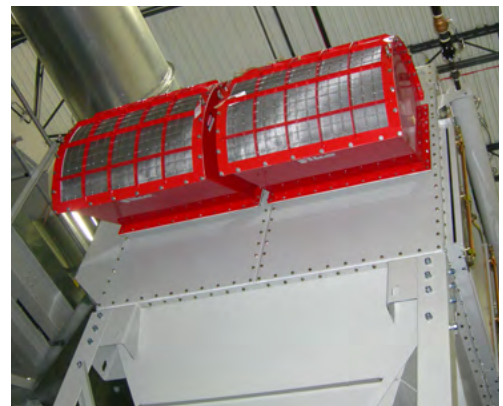


Figure 3: Flameless venting device

mechanical barrier to isolate pressure and flame fronts caused by the explosion from propagating further through the ducting. The mechanical barrier reacts within milliseconds and is closed by the pressure of the explosion.

- **Flow operated flap valve:** This is a mechanical back draft damper positioned in the inlet ducting. It utilizes a mechanical barrier that is held open by the process air and is slammed shut by the pressure forces of the explosion. When closed, this barrier isolates pressure and flame fronts from being able to propagate further up the process stream.
- **Flame front diverters:** These devices divert the flame front to atmosphere and away from the downstream piping. Typically, these devices are used between two different vessels equipped with their own explosion protection systems. The flame front diverter is used to eliminate “flame jet ignition” between the two vessels that could overpower the protection systems installed.

Active devices include:

- **Chemical isolation:** Designed to react within milliseconds of detecting an explosion, a chemical suppression system can be installed in either inlet and/or outlet ducting. Typical components include explosion pressure detector(s), flame detector, and a control panel. This system creates a chemical barrier that suppresses the explosion within the ducting and reduces the propagation of flame through the ducting and minimizes pressure increase within connected process equipment.
- **Chemical suppression:** Whereas chemical isolation is used to detect and suppress explosions within the ducting, chemical suppression protects the dust collector itself. It is often used, together with isolation, when it is not possible to safely vent an explosion or where the dust is harmful or toxic. The system detects an explosion hazard within milliseconds and releases a chemical agent to extinguish the flame before an explosion can occur.
- **Fast acting valve:** Designed to close within milliseconds of detecting an explosion, the valve installs in either inlet and/or outlet ducting. It creates a mechanical barrier within the ducting that effectively isolates pressure and flame fronts from either direction, preventing them from propagating further through the process.
- **High-speed abort gate:** The gate is installed in the inlet and /or outlet ducting of a dust collection system and is used to divert possible ignition hazards from entering the collector, preventing a possible explosion from occurring and preventing flame and burning debris from entering the facility through the return air system. A mechanical barrier diverts process air to a safe location. Abort gates are activated by a spark detection system located far enough upstream to allow time for the gate to activate.

When planning explosion protection, don't overlook additional devices and materials that can help reduce fire risk within the dust collection system. For spark-generating applications, a range



Figure 4: Example of horizontally-mounted dust collector filters

amounts of extra fuel for the event. Horizontal cartridges are also exposed to all of the dust entering the collector, coarse and fine. This leads to premature failure from abrasion and leaks. These leaks can go unnoticed for quite some time while fine combustible dust is blown into your facility. Vertically-mounted filters use baffle systems to segregate much of the dust into the hopper, which reduces the load on the filters and helps eliminate these problems.

Mistakes, misconceptions and pitfalls

A wide range of problems can contribute to explosion risk in a facility, but some common denominators exist. Based on years of field experience, the ones we have most commonly encountered are:

Insistence on maintaining the status quo: “I’ve worked here for 30 years and we’ve never had a problem” is a frequently heard response. This mindset stems in part from a common misconception that the dust is not explosive because the facility has not had an event— when in fact, the opposite may be true. In some cases, it may take many years for dust to accumulate to explosive levels as seen in the CTA Acoustics event.

To understand the risks, it is necessary to review the five elements comprising what is known as the “dust explosion pentagon” (Figure 5). They are (1) combustible dust; (2) an ignition source; (3) oxygen in the air; (4) dispersion of the dust in sufficient concentration to be explosive; and (5) containment of the dust cloud within a confined or semi-confined vessel or area. All five of these elements may exist in an industrial facility, but *all must be present at the same time* for an explosion to occur. If there is no containment, it is still possible for a flash fire to erupt if elements #1-4 are present simultaneously.

of features and technologies are available, from flame-retardant and carbon anti-conductive filter media to spark arrestors in the form of drop-out boxes, perforated screens or cyclone device installed at the collector inlet. Fire sprinkler systems may also be required with some installations.

A dust collector that uses vertically-mounted filter cartridges can also reduce fire and explosion risks. With horizontally-mounted cartridges, dust becomes trapped in the pleats in the upper third of the filters (Figure 4). This dust will become dispersed during a deflagration providing unnecessary excessive

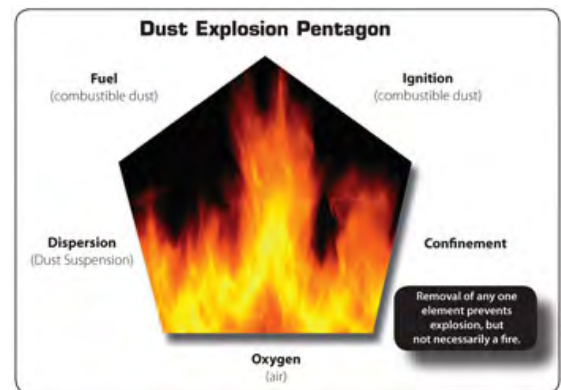


Figure 5: Dust explosion pentagon shows the elements that must be present for a combustible dust explosion to occur.

In a closed vessel such as a cartridge dust collection system, an explosion typically begins when an ignition source enters the dust collector. This ignition source can come from many things and in most cases is never identified. When a pulse cleaning event occurs, a suspended cloud of combustible dust is present in high concentration within the collector. This completes the five elements of a dust explosion and initiates the explosion.

Though some incidents involve a single explosion, it is more common for a series of deflagrations to occur. The initial explosion can dislodge ignitable dust hidden on overhead surfaces or other areas over a large area and trigger secondary explosions that can be ignited from the initial explosion or from other ignition sources. It is these secondary explosions that have historically caused the majority of injuries and damage to property.

How do you know if your facility is at risk? *Even if there has never been a problem before, this is no guarantee of future safety.* The level of hazard can change from day to day and even from moment to moment – whether due to the introduction of a new process, a temporary lapse in housekeeping, or a static electricity discharge caused by improper grounding. It takes ongoing vigilance and management of change to identify conditions in your plant that might cause a potential safety problem.

Lack of a risk evaluation or hazard analysis:

Failure to conduct a hazard analysis is an all too common oversight. The NFPA states that a hazard analysis is needed to assess risk and determine the required level of fire and explosion protection. The analysis can be conducted internally or by an independent consultant, but either way the authority having jurisdiction will ultimately review and approve the findings.

Regarding explosion protection, the first step in a hazard analysis is determining whether your dust is explosive. Many commercial test laboratories offer a low-cost test to establish whether a dust sample is combustible. If the test is positive, then the explosive index (Kst) and the maximum pressure rise (Pmax) of the dust should be determined by ASTM E 1226-10, Standard Test Method for Explosibility of Dust Clouds.

Your dust collection equipment supplier will need the Kst and Pmax values in order to cor-

Kst Values of Common Dusts		
Common Dusts	Micron	Kst Value
Activated Carbon	18	44
Aluminum Grit	41	100
Aluminum Powder	22	400
Asphalt	29	117
Barley Grain Dust	51	240
Brown Coal	41	123
Charcoal	29	117
Cotton	44	24
Magnesium	28	508
Methyl Cellulose	37	209
Milk Powder	165	90
Paper Tissue Dust	54	52
Pectin	59	162
Polyurethane	3	156
Rice Starch	18	190
Silicon	10	126
Soap	65	111
Soy Bean Flour	20	110
Sulphur	20	151
Tobacco	49	12
Toner	23	145
Wood Dust	43	102

Figure 6: Kst values of common dusts

rectly size explosion venting or suppression systems. Failure to provide this information will increase your costs, since the supplier will have to use worst-case estimates of the Kst and Pmax values or may even refuse to provide the equipment. The liability to the manufacturer and to the equipment purchaser is too high to ignore the life safety objectives.

The fact is, *any dust above 0 Kst is now considered to be explosive, and the majority of dusts fall into this category.* If OSHA determines that even a very low Kst dust is present in a facility with no explosion protection in place, a citation will result. This is one of the biggest changes to occur with the re-introduction of the OSHA NEP in 2008. Figure 6 shows the Kst values of a number of common dusts.

Bargain-hunting: Every plant engineer and manager is acquainted with the benefits of basing purchasing decisions on life-cycle cost – sometimes called “total cost of ownership” – over choosing equipment with the lowest price tag. A dust collector is no exception. A well-designed dust collection system can pay for itself rapidly in energy and maintenance savings, costing far less to operate than a unit with a low initial price.

A high-quality, heavy duty collector can also offer a less obvious advantage in the event of a combustible dust problem. As documented both in full-scale testing and field experience, in the event that a dust explosion occurs in the collector, a “bargain” model will more than likely require total replacement. A collector made of thicker-gauge metal with higher vessel strength, however, will survive an explosion and can often continue in service with only the explosion vent and filter cartridges needing to be replaced.

Using non-compliant devices: A close cousin to the bargain-hunting issue involves the use of non-compliant or uncertified explosion protection devices. As an example, sometimes products such as back flap dampers may be reverse-engineered by suppliers that do not have any expertise in explosion protection or have chosen not to perform the required testing to satisfy the standards and/or the performance-based provisions. No testing exists to prove that the device will comply with current standards.

If an OSHA inspector finds this situation in the field, the plant will have to replace the device



Photos of a factory taken before and after installation of a dust collection system show how effectively the collector cleans up hazardous dust and fumes.

and may be subject to a fine. Worse yet, if a combustible dust problem should occur, there is no guarantee that the device will perform as expected.

It is also worth noting, there is no such thing as an “NFPA-approved” device. A supplier may correctly state that a device “carries CE and ATEX certifications” and/or is “manufactured in accordance with NFPA standards” – but test data must be available to support these claims. Such a device might cost more than its non-compliant counterpart, but in the long run it can save money, headaches, and even lives.

Housekeeping problems: In an October 2011 update on the Combustible Dust NEP, OSHA reported that one common violation encountered during inspections involved “hazardous levels of dust accumulation in the workplaces due to poor housekeeping practices”. In the authors’ experience, as a rule of thumb, if an OSHA inspector can run his finger across a dusty surface or see a footprint, that is considered a citable condition.

Diligent cleanup of floors and work surfaces is still not enough if more elevated areas are neglected: Dust that accumulates on rafters and other horizontal overhead surfaces, or on top of machinery, is a frequent culprit. In NFPA 654, hazardous surface dust is defined as any dust layer of 1/32 inch (0.8 mm) or greater.

When it comes to the dust collector, a simple but important housekeeping requirement is to change filters when airflow through the system reaches a differential pressure limit as prescribed by the manufacturer or when the pressure drop across the collector is negatively affecting the ability of the dust collection system to capture the dust, thus allowing it to escape into the facility. Some long-life cartridge filters available today can operate for two years or even longer between change-outs; but for heavy dust-loading applications, filter replacement might be considerably more frequent.

Also, use of a listed portable vacuum helps keep the surrounding area free of spilled dust and surface dust. Use of compressed air to control dust is permitted only under certain conditions because it can increase the hazard by creating a combustible dust cloud.

Another housekeeping misstep is storing dust in the dust collector’s hopper. The hopper should be equipped with a device that discharges the dust into a separate drum or storage container after it is pulsed off the filters during the cleaning process. Equally important, this storage container must be emptied regularly, or dust can back up into the hopper. Dust sitting in a hopper creates a potential fire or explosion risk, and may also affect performance of the dust collection system. This will lead to loss of airflow which will reduce conveying velocities, allowing build-up of dust in the ducting and emissions of dust at the process hoods.

Misunderstanding risks involved with “open” style dust collectors: Some plant managers mistakenly believe that open type dust collection systems, such as those incorporated into bag-dump stations, downdraft tables and booths, are not a hazard. While these collectors admittedly differ from traditional dust collectors in that they do not take the form of a tightly contained vessel, at least four of the five ingredients of the explosion pentagon may still be present: combustible dust, an ignition source, oxygen,

and dispersion of the dust in sufficient concentration to pose a hazard.

Thus, there is still a risk of flash fire directed by a pressure front – a potentially fatal risk, given that workers are in close proximity in these environments. If you are using an open type dust collector, you must still test and evaluate the combustibility of the dust and equip the area with fire and/or explosion protection equipment as required.

The error of over-specification: The problems described above involve not doing *enough* in one way or another. But sometimes plant engineers err on the side of doing *too much* – the error of over-engineering or over-specification, which results in explosion protection solutions that may be needlessly expensive and time-consuming to maintain and monitor.

The NFPA uses relatively conservative textbook calculations in its standards for explosion protection equipment, and justifiably so. However, as noted above (*see performance-based codes*), the NFPA also allows real-world destructive test data to be used in place of its own standard calculations, provided the dust collection supplier can provide adequate data to prove that the collection system is designed to meet a specific set of criteria for a given situation. The use of real-world destructive test data is thus a permissible and sometimes overlooked strategy.

An example is actual explosion testing of a dust collector to show that it will stand up to anticipated pressure conditions, instead of using the reduced pressure calculations in NFPA 68. By combining field testing and full-scale dust collection laboratory test apparatus to prove certain assumptions, this approach might allow you to install longer duct lengths in a given application; to use a single explosion vent where multiple vents might otherwise have been needed; or even to use explosion venting in place of a more costly chemical suppression system. Find out if your dust collection supplier can provide real-world test data to assist in a strategy that may help you to avoid over-engineering and save on equipment costs without compromising safety.

Conclusion

Not everyone agrees on the best way to tackle combustible dust issues. Some concur with the CSB position that OSHA needs to accelerate efforts to produce and enforce its own standard, citing a long-standing precedent with the grain industry.



Storage drum prevents dust from backing up in the hopper and creating an explosion hazard.

Explosions in grain bins used to be one of the biggest safety problems in the U.S. In 1987, following a series of deadly explosions, OSHA promulgated a Grain Handling Facilities Standard that remains in effect today. This standard has yielded major improvements in combustible dust safety in these facilities. According to OSHA, “The lessons learned in the grain industry can be applied to other industries producing, generating, or using combustible dust.”

Others argue that more stringent and perhaps consolidated dust standards from the NFPA, diligently enforced by OSHA and local authorities, would be preferable to a separate OSHA standard. What everyone *does* seem to acknowledge is that more drastic action is necessary to prevent combustible dust tragedies from continuing to occur.

Until such action is mandated, a certain degree of self-regulation is called for. Managers of industrial facilities can choose to be part of the problem or part of the solution. By following the guidelines in this article, and securing the help of engineering consultants and equipment suppliers with a proven track record in combustible dust applications and performance-based solutions, you can minimize risk factors and maximize combustible dust safety in your facility.



This heavy duty dust collector with explosion vent is designed to survive a combustible dust explosion with minimal damage.

#

Tony Supine has held numerous positions with Camfil APC including research and development manager, technical director and currently plant manager. Mike Walters, a registered Professional Engineer with 30 years' experience in air pollution control and dust collection systems, is a senior engineer with the company. Camfil APC is a leading manufacturer of dust collection equipment. The authors can be reached at (800) 479-6801 or (870)933-8048; email filterman@farrapc.com; website www.camfilapc.com.

References

National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169; www.nfpa.org.

- NFPA 61: Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities (2013)
- NFPA 68: Standard on Explosion Protection by Deflagration Venting (2013)
- NFPA 69: Standard on Explosion Prevention Systems (2008)

- NFPA 484: Standard for Combustible Metals (2012)
- NFPA 654: Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing and handling of Combustible Particulate Solids (2013)
- NFPA 664 – Standard for the Prevention of Fire and Explosions in Wood Processing and Woodworking Facilities (2012)

Occupational Safety & Health Administration (OSHA), 200 Constitution Avenue, Washington, DC 20210; www.osha.gov.

- OSHA Combustible Dust National Emphasis Program (Reissued) – Directive Number: CPL 03-00-008; effective date March 11, 2008.
- OSHA Combustible Dust Standards, July 2008.

U.S. Chemical Safety and Hazard Investigation Board (CSB), 2175 K. Street, NW, Suite 400, Washington, DC 20037; www.csb.gov.

The Library of Congress, 101 Independence Ave, SE, Washington, DC 20540; <http://beta.congress.gov/>: H.R. 691: Worker Protection Against Combustible Dust Explosions and Fires Act of 2013.

OSHA Law Update, a Hazard Communication, Epstein Becker Green, 1227 25th Street, NW, Suite 700, Washington, DC 20037; <http://www.oshalawupdate.com> : “2011 Rundown of OSHA’s Combustible Dust National Emphasis Program and Rulemaking”, Amanda R. Strainis-Walker and Eric J. Conn; December 29, 2011.

ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428; www.astm.org; “ASTM E 1226-10, Standard Test Method for Explosibility of Dust Clouds”, 2010.

© Copyright 2013 Camfil APC

)