

Combustible Dust: An Explosive Topic

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This article reviews the applicable standards related to combustible dust, profiles the pertinent standard-setting organizations, and offers tips on avoiding combustible dust fires and explosions.

Combustible dust is an explosive issue—literally. Last year alone, there were hundreds of thousands of dollars worth of citations related to combustible dust hazards issued in the U.S. by the Occupational Safety and Health Administration (OSHA), as well as fires and explosions all related to combustible dust. You do not want the dreaded situation where you are dealing with a fire, an explosion, or even a combustible dust inspection and fine.



Courtesy Chemical Safety Board (CSB)

A series of explosions at the Hayes Lemmerz cast aluminum automotive wheel manufacturing plant in Huntington, IN, was traced to an accumulation of aluminum dust, a byproduct of the production process.

What Is Combustible Dust?

“Combustible dusts are fine particles that present an explosion hazard when suspended in certain conditions,” according to the combustible dust fact sheet from OSHA.

The National Fire Protection Association (NFPA) 654 Standard for the Prevention of Fire and Dust Explosion from the Manufacturing, Processing, and Handling of Combustible Particulate Solids defines combustible dust as: “a finely divided combustible particulate solid that presents a flash-fire hazard or explosion hazard when suspended in air or the process-specified oxidizing medium over a range of concentrations.”

The issue is not simply defining a dust; it is determining the explosibility of the dust. Important factors in doing so include size, shape, moisture, and environment. If there is any doubt about combustibility and explosibility, screening tests must be done by a certified facility.

In the draft of the newly proposed NFPA 652 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, Section 4.5.3.1, states: “the determination of explosibility of fine particulate and dust shall be determined according to a ‘go/no-go’ screening test” (yes, it blows up, or no, it doesn’t) known as ASTM E-1226 Standard Test Method for the Explosibility of Dust Clouds. Some additional tests include, but are not limited to, the Minimum Ignition Energy (MIE) test ASTM E-2019 and the Explosion Severity Test (Kst and P_{MAX}) ASTM E-1226. Testing

prices range from \$350 to \$1,300, up to \$3,850-plus for a full OSHA National Emphasis Program (NEP) package. This test would address items in the NEP, which — since there is no formal regulation — is the best source from OSHA with which we have to work.

Who's in Charge?

OSHA, which has focused on combustible dust via providing detailed information on its website and implementing an NEP, also continues to explore the creation of an actual enforceable combustible dust regulation. The process has been ongoing and takes several years to develop.

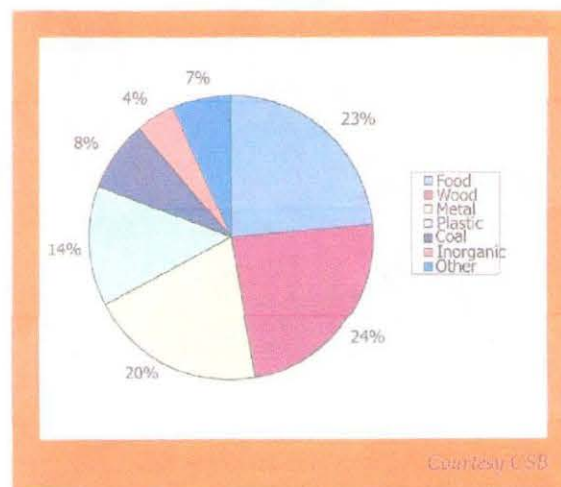
In the interim, NFPA, an international codes and standards organization that creates voluntary consensus standards, plays a critical role in understanding and providing guidelines on dealing with combustible dust. The organization has several standards relating to the topic, including the two already mentioned. Relevant NFPA standards are:

- *NFPA 61 Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities.* According to the NFPA, the standard “protects lives and property from fires and dust explosions in facilities handling, processing, or storing bulk agricultural materials, their byproducts, or other agricultural-related dusts and materials.”
- *NFPA 68 Standard on Explosion Protection by Deflagration Venting.* Scope of this standard “applies to the design, location, installation, maintenance, and use of devices and systems that vent the combustion gases and pressures resulting from a deflagration within an enclosure so that structural and mechanical damage is minimized.”
- *NFPA 69 Standard on Explosion Prevention Systems.* NFPA 69 covers “the following methods for explosion prevention: control of oxidant and combustible concentrations, pre-deflagration detection and control of ignition sources, explosion suppression, active isolation, passive isolation, deflagration pressure containment, and passive explosion suppression. Criteria also are provided for installation, inspection, and maintenance of explosion protection systems.”
- *NFPA 484 Standard for Combustible Metals.* Covers metals such as aluminum, magnesium, tantalum, titanium or zirconium and considers combustible metal dust “any finely divided metal 425 microns (40 mesh) or smaller.”
- *NFPA 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids* states, “This standard presents safety measures to prevent and mitigate fires and dust explosions in facilities that handle combustible particulate solids, which include combustible dusts, fibers, flocks, flakes, chips, and chunks.”
- *NFPA 664 Standard for the Prevention of Fires and Explosions on Wood Processing and Woodworking Facilities.* NFPA states: “this standard provides requirements for fire and explosion prevention and protection of industrial, commercial, or institutional facilities that process wood or manufacture wood products in order to protect life, property, and mission continuity.”

NFPA is working on a new standard, NFPA 652 Standard on Combustible Dusts, Proposed 2015 Edition. The best description of this new standard comes from the *NFPA Guide to Combustible Dusts*. “The overall goal for the new standard will be to determine those fundamental elements that apply across all five current standards — agricultural, combustible metals, general, sulfur, and wood processing/woodworking — and then direct the user to the dust-type-specific standard for those requirements unique to that industry sector or dust type.” NFPA 652 is currently listed as a “proposed” standard with a tentative edition date of 2015.

Others Involved in Combustible Dust Safety

The role of the Authority Having Jurisdiction (AHJ) — typically a government (local, state, federal, regional) representative, fire marshal, building inspector, labor department, health department, or other local or



Distribution of combustible dust incidents by material, according to the CSB.

state authority—is an essential part of understanding combustible dust and interpreting and enforcing standards in manufacturing facilities. Additionally, insurance organizations also play an important role. The industry has its own property loss prevention data sheets via FM Global. The primary document 7-76 “Prevention and Mitigation of Combustible Dust Explosion and Fire” states: “This data sheet describes recommended preventive measures to reduce the frequency of combustible dust explosions and protection features to minimize damage from a combustible dust explosion.”

It is important to note is that while there have been combustible dust explosions, there have been many more OSHA-related inspections citing combustible-dust-related issues. There is no clearly defined regulation, however, leaving much to interpretation. Canada has experienced combustible dust explosions, and, in this author’s opinion, has not been bogged down with the creation and implementation of regulations. The Canadian Centre for Occupational Health and Safety (CCOHS) has clear prevention measures focusing on “eliminate, substitute, engineering and administration.” According to one report, when a company was in violation of one or more of these measures, the operation simply was shut down for a day or two, giving the facility enough time to adequately address the issues. The company immediately reopened production, operating in a safer working environment. Contrast that to many of the OSHA inspections and corresponding responses from companies in the U.S. that seem to drag on for months, delaying the creation of a safer working environment.

Prevention

If a facility’s environment is conducive to combustible dust explosions, then one can happen. If the working environment does not meet the standards used by OSHA under the NEP, then inspections and resulting combustible dust citations can occur. An insightful quote from the *NFPA Guide to Combustible Dusts* states: “Without flour, there is no bread... Without cutting and sanding of wood, we could not build or furnish our homes. The beneficial aspects of many industries can often be achieved only by starting with or generating dust; therefore, the danger must be mitigated with a risk reduction strategy.”

Understanding the issues of combustible dust helps to mitigate the risks and establish a strategy. A manufacturing facility’s workforce is one of the most important and valuable assets in that endeavor, and training is important. As NFPA 652 (A.8.4.2.1) states:

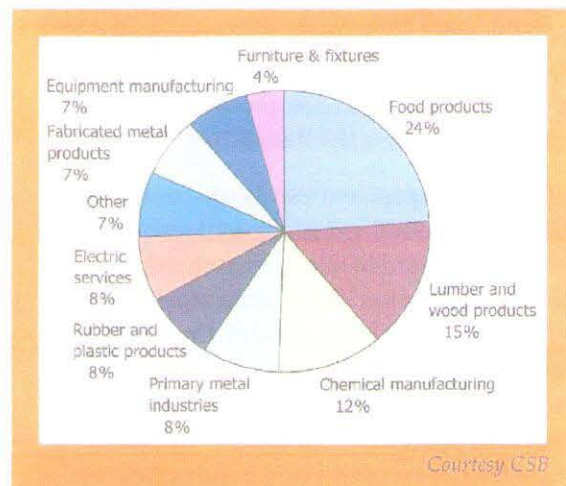
“Safe work habits are developed and do not occur naturally.” Issues to think about and risk-related questions to ask include: Do workers know what to do to avoid combustible dust? Have they read company operating procedures? Do employees understand those operating procedures? Have workers been tested to verify they understand? Has the training been documented? Do *you* understand the risks and ways to mitigate them?

Fugitive Emissions

While combustible dust is definitely a problem, fugitive combustible dust is what has the potential to cause catastrophic issues. Look at your facility and check areas prone to accumulating fugitive dust, such as flat surfaces, rectangular HVAC ducting, overhead beams, electrical cable trays, and horizontal lighting fixtures. Also check “invisible” areas, such as those above suspended ceilings. All are places where dust can potentially accumulate.

Do you have a method to prevent the escape of dust? Do you have a policy to remove fugitive dust from surfaces? OSHA wants written rules and established guidelines, such as “Management of Change” procedures, to manage changes related to process materials, technologies, equipment, operations, and facilities.

Do you have an active housekeeping policy for fugitive dust control? If you can see dust, don’t ignore it. If underlying surface colors in an area are not readily discernible, it warrants immediate cleaning. Clean



Combustible dust explosions can occur in any industry handling combustible dusts, but four industry sectors — food products, lumber and wood products, chemicals, and primary metals — account for more than half of those explosions, according to a CSB study.



Courtesy CSB

Fine plastic powder collected above a suspended ceiling over a manufacturing area at the West Pharmaceutical Services plant in Kinston, NC. The combustible dust caused an explosion and fire that destroyed the facility.

what's visible and examine any potential dust sources. Seal all openings to prevent the release of additional dust.

Also be careful of cleaning methods as they can worsen a situation. Per NFPA 664-2012 11.2.1.1, "surfaces shall be cleaned in a manner that minimizes the generation of dust clouds. Blowing down with compressed air or even vigorous sweeping shall be permitted only if the following requirements are met: The floor area and equipment shall be vacuumed prior to blowdown. Electrical power and other sources of ignition shall be shut down, removed from the area, or classified for use in dusty areas per NFPA 70, National Electrical Code. Only a low gauge pressure 15 psi steam or compressed air shall be used. No open flames, sparks from spark-producing equipment, or hot surfaces. All fire protection equipment shall be in service." In addition, explosion-proof vacuums or fixed-pipe suction systems shall be used per NFPA.

Appropriate safety equipment also should be in place: Do you have abort gates to exhaust hazardous airflow from the ducting? Used in return air systems, abort gates safely exhaust hazardous air to the atmosphere, thereby protecting plant and personnel. Do you have explosion protection venting or suppression and do you regularly monitor its functionality? Do you have spark detection? Spark detection systems are primarily used as a fire prevention method in dust collectors by detecting and extinguishing sparks and embers. A dull tool, a damaged fan bearing, an overheated motor, or a foreign object within the material can be the cause.



Courtesy CSB

An accumulation of iron dust caused three fatal flash-fires in a six-month period at Hoeganaes Corp., a Gallatin, TN-based producer of powdered iron.

Combustible dust is a serious issue, but understanding the seriousness and using common sense is always the first measure to mitigating risk and ensuring a safe and productive working environment. **APC**

Resources

ASTM International ASTM E1226 - 12a, Standard Test Method for Explosibility of Dust Clouds: www.astm.org/Standards/E1226.htm

FM Global Insurance Company — Loss Prevention Data Sheet 7-76, Prevention and Mitigation of Combustible Dust Explosions and Fires: www.fmglobal.com/fmglobalregistration/Vshared/FMD50776.pdf

OSHA – Occupational Safety & Health Administration: www.osha.gov/dsg/combustibledust/index.html

NFPA – National Fire Protection Association

NFPA 61 Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities: www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=61

NFPA 68 Standard on Explosion Protection by Deflagration Venting: www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=68

NFPA 69 Standard on Explosion Prevention Systems: www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=69

NFPA 484 Standard for Combustible Metals: www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=484

NFPA 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids: www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=654&DocNum=654

NFPA 664 Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities: www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=664&DocNum=664

NFPA 652 (Proposed) Standard on Combustible Dusts: www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=652&docnum=652

NFPA Guide to Combustible Dusts, Authors Walter L. Frank, P.E. & Samuel A. Rodgers, P.E. Editor Guy R. Colonna, P.E. Published by NFPA, copyright 2012.

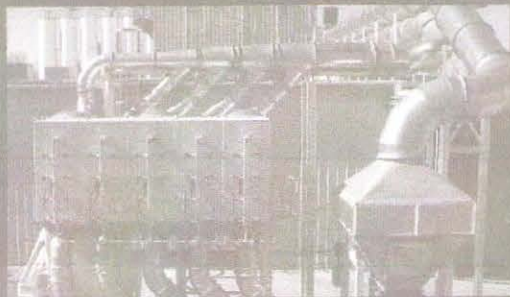
Jamison J. Scott serves as executive vice president of Air Handling Systems, a third-generation, family-owned business in Woodbridge, CT. His primary responsibilities include determining business strategies, formulating policies, and providing overall direction of the company. Scott has presented seminars and authored papers on combustible dust for national and international trade publications. He serves on APC's Technical Advisory Board and chairs the Industrial Dust Task Force for the Wood Machinery Manufacturers of America. He recently was elected president of the organization. A fierce advocate for Connecticut industry, Scott is in constant communication with federal, state, and local representatives on behalf of Air Handling Systems and manufacturers across the nation. For additional information call 800-367-3828 or go to www.airhand.com.

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