



HAFCOVAC

Solid Leadership
In Industrial Safety



COMBUSTIBLE DUST

Understanding How To Prevent
Industrial Fire Hazards

Supplying Superior Compressed Air Industrial Vacuums



Many manufacturing and mining industries create large amounts of Combustible Dust that have the potential of becoming highly explosive and causing fatalities and millions of dollars in damage.

WOOD



METAL



PAPER



DIRT



CONTENT



The site of a devastating blast Feb. 7, 2008, at the Imperial Sugar Refinery in Port Wentworth, GA. The massive explosion and fire killed 14 people, injured dozens and caused millions of dollars in property damage.

- 4 Executive Summary**
- 5** What is Combustible Dust
- 6** Example of Combustible Dust
- 6** Industries at Risk
- 7** Causes of a Combustible Dust Explosion
- 7** Secondary Explosions
- 7** Conditions Needed for A Dust Explosion
- 7** Dust Hazard Assessment
- 8** Preventative Measures
- 8** Administration
- 9** How to Select an Anti-Static Explosion Proof Vacuum
- 10** Intrinsic Safety
- 11** Explosion Proof Certification
- 12** Explosion Proof Applications
- 13** OSHA Information
- 13** National Fire Protection

EXECUTIVE SUMMARY



HAFCOVAC provides a comprehensive dust control solution for combustible materials.



4

More than 450 accidents involving combustible dust have killed nearly 130 workers and injured another 800-plus since 1980, according to a Center for Public Integrity analysis of data compiled by the federal Occupational Safety and Health Administration and the U.S. Chemical Safety Board. These fires and explosions have been caused by a variety of dust sources including sugar, nylon fiber, coal, iron, plastic and wood. Most in the manufacturing industry are aware of some of the dangers and have read or seen reports of these explosions in the news. An explosion ripped through the New Cumberland A.L. Solutions titanium plant in West Virginia on December 9, 2010, fatally injuring three workers. The plant workers were processing titanium powder at the time of the explosion. The

AL Solutions incident is one of nine serious combustible dust incidents investigated by the CSB since 2003, including the Imperial Sugar disaster near Savannah, Georgia, in 2008 as well as three combustible dust incidents over a six month period in 2011 at the Hoeganaes facility located in Gallatin, TN. These nine explosions and fires caused a total of 36 deaths and 128 injuries.

Dust and other debris will always be present in the manufacturing process. Since dust is inevitable in the process, manufacturing facilities must take the proper

measures to understand the risks, learn as much as possible about the threat and take solid measures to prevent potential hazards and be prepared should an incident take place.

We hope this Introduction to Combustible dust is a first step in learning more and taking adequate measures to reduce risks. We encourage you to learn more and seek additional information from the resources listed at the back of this guide.



What is Combustible Dust?

The technical definitions for combustible dust will differ depending on the source that you reference. The Occupational Safety and Health Administration (OSHA) in the United States defines combustible dust as “a solid material composed of distinct particles or

pieces, regardless of size, shape, or chemical composition, which presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations”.

In Canada, one example is Alberta’s Occupational Health and Safety Code which defines combustible dust as “a dust that can create an explosive atmosphere when it is suspended in air in ignitable concentrations”.



OSHA defines combustible dust as “fine particles that present an explosion hazard when suspended in air under certain conditions. A dust explosion can cause catastrophic loss of life, injuries, and destruction of buildings.”

What are examples of materials that can be a combustible dust hazard?

Believe it or not the Occupational Safety and Health Administration (OSHA) lists over 120 materials as combustible dust makers. See that chart to the right for a full list.

What Industries Are at Risk for Combustible Dust?

OSHA notes some of the industries at risk include:

- Agriculture
- Food
- Pharmaceutical
- Pesticide
- Rubber
- Plastic
- Woodworking
- Textiles
- Chemical
- Recycling
- Coal fired Power Plants



OSHA is an agency of the United States Department of Labor. Congress established the agency under the Occupational Safety and Health Act on December 29, 1970. OSHA's mission is to assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance.

Combustible Dust Makers

Agricultural Products

Egg White
Milk, Powdered
Milk, Nonfat, Dry
Soy Flour
Starch, Corn
Starch, Rice
Sugar
Sugar, Milk
Sugar, Beet
Tapioca
Whey
Wood Flour

Agricultural Dusts

Alfalfa
Apple
Beet Root
Carrageen
Carrot
Cocoa Bean Dust
Cocoa Powder
Coconut Shell Dust
Coffee Dust
Corn Meal
Cornstarch
Cotton
Cottonseed
Garlic Powder
Gluten
Grass Dust
Green Coffee
Hops (malted)
Lemon Peel Dust
Lemon Pulp
Linseed
Locust Bean Gum
Malt
Oat Flour
Oat Grain Dust
Olive Pellets
Onion Powder
Parsley (dehydrated)
Peach
Peanut Meal & Skins
Peat
Potato

Potato Flour
Potato Starch
Raw Yucca Seed Dust
Rice Dust
Rice Flour
Rice Starch
Rye Flour
Semolina
Soybean Dust
Spice Dust
Spice Powder
Sugar (10X)
Sunflower
Sunflower Seed Dust
Tea
Tobacco
Tomato
Walnut Dust
Wheat Flour
Wheat Grain Dust
Wheat Starch
Xanthan Gum

Carbonaceous Dust

Charcoal (activated)
Charcoal (wood)
Coal (bituminous)
Coke (petroleum)
Lampblack
Lignite
Peat (22%H₂O)
Soot (pine)
Cellulose
Cellulose Pulp
Cork
Corn

Chemical Dusts

Adipic Acid
Anthraquinone
Ascorbic Acid
Calcium Acetate
Calcium Stearate
Carboxy-Mehtylcellulose
Dextrin
Lactose

Lead Stearate
Methyl-Cellulose
Paraformaldehyde
Sodium Ascorbate
Sodium Stearate
Sulfur

Metal Dust

Aluminum
Branze
Iron Carbonyl
Magnesium
Zinc

Plastic Dusts

(Poly) Acrylamide
(Poly) Acrylonitrile
(Poly) Ethylene (low pressure process)
Epoxy Resin
Melamine Resin
Melamine Molded (phenol-cellulose)
Melamine Molded (wood flour and mineral filled phenolformaldehyde)
(Poly) Methyl Acrylate
(Poly) Methyl Acrylate (emulsion)
Polymer
Phenolic Resin
(Poly) Propylene
Terpene-Phenol Resin
Urea-Formaldehyde/Cellulose (molded)
(Poly) Vinyl Acetate/Ethylene Copolymer
(Poly) Vinyl Alcohol
(Poly) Vinyl Butyral
(Poly) Vinyl Chloride/Ethylene/Vinyl Acetylene Emulsion Copolymer



Causes of a Combustible Dust Explosion

There are three elements need for a dust fire to occur and is referred to as the “**Fire Triangle**”. They are:

- Combustible dust (*i.e. the fuel*)
- Oxygen
- Heat source



Fire Triangle

There are also two additional elements needed to cause a combustible dust explosion, often called the “**Dust Explosion Pentagon**”

- Dispersion of dust particle in sufficient quantity
- Confinement of the dust cloud



Dust Explosion Pentagon

Secondary Explosions

After the initial combustible dust explosion, there is often a secondary explosion caused. The second explosion is caused by dust that is shaken loose from the primary explosion which also ignites. The secondary explosion may be actually larger and more severe than the initial explosion.

Conditions Needed for a Dust Explosion to Occur

The simple recipe for a dust explosion to happen is for combustible dust particles to be suspended in air and include an ignition source. In reality, several other conditions generally need to be present

- The combustible dust must release enough heat to sustain the fire.

- The dust must be suspended in air.
- The dust must have a particle size large enough to spreading the flame.
- The concentration of the dust suspension must be within the explosive range.
- An ignition source must be in contact with the suspended dust.
- Adequate oxygen must be present to support and sustain combustion

Dust Hazard Assessment for Your Facility

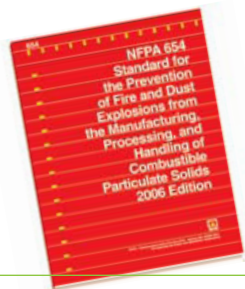
Plants should carefully look at the following areas to determine the potential for dust explosions:

- Materials
- Processes
- Open Areas of dust
- Hidden Areas of dust
- Dust dispersion sources
- Ignition sources



Preventative Measures

- Develop a housekeeping plan
- Use only approved vacuum cleaners for dust collection
- Find and eliminate hidden areas where dust accumulates
- If possible, avoid or minimize horizontal surface where dust may accumulate
- Use cleaning methods that do not generate dust clouds
- Use proper electrical and ventilation systems



You may also want to consult NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, which contains comprehensive guidance on the control of dusts to prevent explosions.

A good housekeeping plan goes a long way to reducing work hazards, providing employee safety, and increasing facility productivity within the entire work environment.



Administration

- Develop and implement a combustible dust inspection and control program including when inspections will take place and specific actions to control dust.
- Develop a hot work permit system for activities such as welding and cutting.
- Develop an ignition control program to eliminate or reduce sources of ignition. Keep ignition sources away from dusty areas or use suitable controls.
- Educate and train employees regarding the hazards of combustible dusts and their role in eliminating the threat of explosions
- Inspect for dust at regular intervals.
- Regularly inspect machines, ducts, and ventilation systems for dust. Repair



How to Select an Anti Static Explosion Proof Vacuum Cleaner

HafcoVac explosion proof vacuum cleaners are safe for use as part of a combustible dust control program and are suitable for many flammable and combustible materials. With no motors to arc and no moving parts to create friction or spark, our non-electric explosion proof vacuums are a safe, reliable and cost effective solution for your business.

HafcoVac explosion proof vacuum cleaners bond all components of the vacuum together, ensuring no part is left isolated from its path to ground. When used in conjunction

with our MSHA approved static conductive hose, a HafcoVac explosion proof vacuum is an economical alternative to other products which often sell for many times the cost.

With performance uncompromised by explosion proof vacuum safeguards, an upgrade to an explosion proof vacuum cleaner will perform with the same power HafcoVac is known for. Best of all, you don't have to sacrifice your budget to protect your business and employees.

If you are unsure if dust ignition proof vacuum equipment is necessary for your application or facility, a HafcoVac representative will gladly provide a thorough application analysis to ensure appropriate product selection.



Intrinsic Safety

HafcoVac explosion proof industrial vacuums are suitable for use in Class I, Class II, and Class III environments, Division 1 and 2. Our explosion proof pneumatic vacuums:

- **contains no moving parts**, eliminating possibility of ignition from mechanical friction or contact.
- **uses no electricity**, eliminating sparks from motor arcing, shorts, switches, etc.
- **are fully grounded** when an explosion proof vacuum unit configuration is ordered, ensuring dangerous static electricity will not accumulate.

Intrinsic Safety is a protection technique for equipment operating in explosive environments. The principal states that electrical and thermal energy must not build up sufficiently to discharge. With heat or friction risks such as those present when using an electrically operated industrial vacuum safely eliminated, static electricity remains.

The complete grounding of all components, including air supply line, vacuum generating head, collection drum, dolly and vacuum hose ensure that static electricity is continuously dissipated, protecting against dangerous static buildup, which could lead to electrostatic discharge (ESD), posing potentially serious consequences when in the presence of combustible substances. HafcoVac explosion proof vacuum models factory equipped as an explosion proof configuration ensures static electricity will not accumulate.

It is critically important that the operator understand the functions of the grounding system. Inspections are suggested prior to each use to ensure the integrity of all grounding wires and points. Care must be taken to not circumvent any grounding safeguards, and should also be exercised to ensure parts such as hoses aren't used interchangeably with those from non explosion proof systems.



Are HafcoVac's Vacuums Certified Explosion Proof?

To this date, there are no published certification procedures for air powered (pneumatic) equipment.

HafcoVac anti-static grounded units ("x" model designation) machines meet the criteria for intrinsically safe operation – no moving parts, non-electric & fully grounded means the unit will not spark and will not generate dangerous amounts of heat.

Additionally, we have designed these machines specifically for use in hazardous locations – building in a double safeguard of conductive static dissipative

materials & connections, coupled with complete grounding of all components of the unit.

An independent testing lab has stated that our "X" line can be used in hazardous locations, specifically in Class I, Class II, & Class III environments, divisions 1&2.



Explosion Proof Applications

HafcoVac explosion proof vacuum cleaners are suitable for a wide range of applications. Safeguard your business from worker injury, OSHA fines or catastrophic incident by protecting your facility with HafcoVac's safe non electric anti static vacuum cleaners.

Some typical applications which for which often require the use of appropriately equipped explosion proof vacuums include:

Hazardous Locations - If you need to operate a vacuum in an OSHA defined hazardous location, you must use equipment safe for use in that environment. HafcoVac explosion proof models are approved for use in Class I,II and III, divisions 1 and 2.

Combustible Dust Mitigation - OSHA has been increasingly strict about enforcing it's General Duty Clause, Section 5(a)(1) through it's Combustible Dust National Emphasis Program. Many businesses have faced steep fines for failing to adhere to these require-

ments. Additional regulation is pending, if your company doesn't already have a combustible dust program, you'll likely catch the attention of an OSHA inspector if you don't have suitable equipment such as a HafcoVac explosion proof vacuum.

Flammable Liquids - Many industries need to recover flammable liquids or fuels produced as a byproduct of a manufacturing process, or inadvertently spilled. Even if your facility does not regularly produce hazardous byproducts, ensuring your vacuum is safe for any unpredicted application is prudent protection.

Manufacturing Byproducts - Many processes such as milling, grinding, cutting produce dangerous scrap which must be safely collected and properly disposed of without endangering employees or the facility.

Static prone materials - Many materials, even those which pose no explosion hazard, create dangerous static electricity buildup as they are conveyed through an ungrounded system. An explosion proof unit will provide static dissipation. A HafcoVac is an excellent choice as a powder paint vacuum

Protection from the unknown - You may not anticipate a vacuum being used for picking up flammable or combustible materials, but you never quite know what a tool in your facility may be used for outside it's normal application. Add explosion protection for peace of mind.





OSHA Information

OSHA Standards, Interpretations, and Publications

U.S. Department of Labor/OSHA
OSHA Publications Office
200 Constitution Ave., NW,
N-3101
Washington, DC 20210
Telephone: (202) 693-1888
Fax: (202) 693-2498

Related OSHA standards found in 29 CFR:

- **1910.22** - General Requirements: Housekeeping
- **1910.38** - Emergency Action Plans
- **1910.94** - Ventilation
- **1910.107** - Spray Finishing Using Flammable and Combustible Materials
- **1910.146** - Permit-Required Confined Spaces (references combustible dust)
- **1910.178** - Powered Industrial Trucks
- **1910.269** - Electric Power Generation, Transmission and Distribution (coal handling)
- **1910.272** - Grain Handling Facilities
- **1910.307** - Hazardous (classified) Locations (for electric equipment)
- **1910.1200** - Hazard Communication



National Fire Protection

National Fire Protection Association (NFPA)

1 Batterymarch Park
Quincy, MA 02169-7471
Telephone: (800) 344-3555

Related NFPA Standards:

- **NFPA 61**, Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities
- **NFPA 68**, Guide for Venting of Deflagrations
- **NFPA 69**, Standard on Explosion Prevention Systems
- **NFPA 70**, National Electrical Code®
- **NFPA 91**, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids
- **NFPA 120**, Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities
- **NFPA 432**, Code for the Storage of Organic Peroxide Formulations
- **NFPA 480**, Standard for the Storage, Handling, and Processing of Magnesium Solids and Powders
- **NFPA 481**, Standard for the Production, Processing, Handling, and Storage of Titanium
- **NFPA 482**, Standard for the Production, Processing, Handling, and Storage of Zirconium

HafcoVac is providing information on pertinent OSHA and NFPA standards as a convenience to our customers. Our reference to OSHA, NFPA, MSHA or other governing bodies is not intended to be construed as an endorsement of this, or any specific product, by the respective agency.

- **NFPA 484**, Standard for Combustible Metals, Metal Powders, and Metal Dusts
- **NFPA 485**, Standard for the Storage, Handling, Processing, and Use of Lithium Metal
- **NFPA 495**, Explosive Materials Code
- **NFPA 499**, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- **NFPA 505**, Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operation
- **NFPA 560**, Standard for the Storage, Handling, and Use of Ethylene Oxide for Sterilization and Fumigat
- **NFPA 654**, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids
- **NFPA 655**, Standard for Prevention of Sulfur Fires and Explosions
- **NFPA 664**, Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities
- **NFPA 1124**, Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles
- **NFPA 1125**, Code for the Manufacture of Model Rocket and High Power Rocket Motors



Supplying Superior Compressed Air Industrial Vacuums



HAFCOVAC

*301 Greenwood Avenue
Midland Park, NJ 07432*

(201)447-0433 (p)

(201)447-1065 (f)

Info@HafcoVac.com

Copyright© 2013. All rights reserved. Hafcovac logo and icon are owned by Hafcovac, Inc. No part of this material may be reprinted or duplicated without the written consent of Hafcovac.

HAFCOVAC Combustible Dust 1114.Whitepaper