

Dust Collectors & Combustible Dust Strategies

Donaldson
FILTRATION SOLUTIONS

INTRODUCTION TO COMBUSTIBLE DUST

For decades Donaldson has been providing quality dust collectors that have become an integral part of many plant's combustible dust management strategies. As standards are updated or new requirements enacted, Donaldson continues to supply dust collectors to support your combustible dust control strategy. By interfacing with you and your experts on fire and explosion protection equipment and strategies, we can offer a selection of products to fit your application.

Understanding the Basics

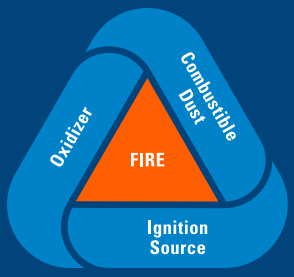
The U.S. Occupational Safety and Health Administration (OSHA) issued a National Emphasis Program and continues to communicate with most industries on the hazards of combustible dust. The agency's focused effort is targeted at reducing combustible dust risks in industrial plant settings.

Many manufacturing processes create very small particles of dust which may become airborne, where they settle on surfaces and in crevices throughout the plant. Eventually these particles not only create a housekeeping issue, but they can also create a potentially explosive dust cloud when disturbed.

It is essential for plant leaders to understand the risks of combustible dust and ensure they manage combustible dusts in their facilities. Combustible dusts generally present both fire and explosion risks. It may help to consider the management of these risks separately.

This document is intended to increase your understanding of typical combustible dust management strategies and some of the components involved.





FIRE TRIANGLE

Fire mitigation strategies traditionally focus on the control or elimination of one of the three key elements necessary for a fire — often represented by the "fire triangle." Controlling one or more of the elements in the triangle can decrease the fire risk.



EXPLOSION PENTAGON

Explosion risk mitigation strategies consider a slightly expanded set of control elements often represented as an "explosion pentagon."

In addition to the key elements from the fire triangle — fuel, heat, and oxygen, the explosion pentagon includes two additional elements: "Dispersion of Dust" and "Confinement of Dust." As with fire mitigation strategies, the control or removal of one or more of the elements in the explosion pentagon can reduce the explosion risk. Controlling the same elements in the fire triangle, will also mitigate the explosion risk. Any mitigation strategies that focus on the dispersion of dust, or the containment of dust alone, may require a separate strategy to address any remaining fire risks.

MITIGATION STRATEGIES

Combustible Dust Management Strategy

The first step is to complete a dust hazard analysis on your facility to determine if there are any combustible dust risks present. Next, review your options for both prevention and protection strategies. There are a variety of combustible dust mitigation strategies available allowing you to determine what will work for your facility.





Why Dust Collectors Should Be Part of Your Strategy Decision

Many process requirements may make elimination of combustible dust, mist, or fume impractical. However, it may still be very possible to manage the dispersion of dust within your plant by using an appropriate and effective industrial ventilation system including dust collection. A well designed, maintained, and operated industrial ventilation system including effective hoods, proper duct sizes, and properly selected collection equipment can provide effective dust control and can therefore help manage the presence of dispersed dust. This not only reduces housekeeping frequency and expense, but could help you reduce the risk of dust explosions or fires in your facility, by helping reduce the presence of dispersed fuel in your facility.

To be compliant with OSHA regulations, you must meet other requirements and all applicable standards or codes. **Visit www.osha.gov to learn more about OSHA regulations.**

WHERE TO START?

The first step is to review any dust(s) generated at the facility and determine if a risk is present. A qualified lab can work with you to determine dust characteristics. Next, perform a dust and process hazard analysis.

A Donaldson representative can then review your operational challenges to help you better understand how to integrate dust collection into your combustible dust management strategy. These considerations are designed to help you decide how you want Donaldson to support your combustible dust management strategy.

To see a detailed Combustible Dust Roadmap and to learn more, visit: Donaldson.com/combustible-dust

Important Information: It is the process owner's responsibility to understand the risks in their process and to mitigate those risks in accordance with all applicable laws, regulations and standards, including consideration of those published by the NFPA. Note this Roadmap may not identify all potential mitigation steps and does not cover the commissioning and on-going testing and maintenance required for various mitigation strategies. This Roadmap is a high-level summary of steps for a process owner to consider and is not intended as a replacement for careful review of all applicable laws, regulations, and standards. Equipment suppliers can assist a process owner in understanding what products are available to help mitigate their risks but they are not regulatory experts. If you need assistance finding an expert in the field, please contact us and we will assist you in finding resource options. Please note that various strategies can help mitigate, but not eliminate risks of fire and explosion.

[1] Water or CO_2 extinguishing strategies may not be suitable for all combustible materials. A recognized expert on fire mitigation can assist in selecting suitable extinguishing strategies (e.g. combustible metals may require Argon systems).

An actual Dust and Process Hazard Analysis should address all the risks identified in a process and will likely define mitigation considerations that are not shown in this simplified example.

Combustible Dust Roadmap

Dust Hazard Analysis (DHA)

Completed and Maintained by the Process Owner

A Dust Hazard Analysis allows a process owner to determine potential combustion risks for dusts produced or handled in their facility.

Dust combustible? Data and/or tests

- **YES or Unknown** → **Combustible Screening** Determines if dust can burn in a pile
  - **Dust is not combustible** → If dust is confirmed as not combustible, additional testing and mitigation may not be required.
  - **Dust is combustible** → **Go/No-Go Screening** Determines if dust is explosible in a cloud
    - **Dust is explosible** → **Explosibility Testing:** Since the dust is explosible, consider the following tests:
      - **Explosibility Severity (K_{st} and P_{max})** Used for Explosion Protection
      - **Minimum Explosible Concentration (MEC)** Used for Explosion Avoidance
      - **Minimum Ignition Energy (MIE)** Used for Ignition Avoidance
      - **Minimum Autoignition Temperature (MIT)** Avoidance of hot surfaces or hot environments
    - **Dust is not explosible**

Ensure samples used for testing are representative. Samples may require special handling to ensure they stay representative (e.g. avoid oxidation during transmission and storage).

- **Dust is not combustible** → If dust is confirmed as not combustible, additional testing and mitigation may not be required.

Additional Testing

Dust & Process Hazard Analysis (DHA & PHA)

Completed and Maintained by the Process Owner

A Dust & Process Hazard Analysis allows a process owner to review combustion risks in their processes, and assists the process owner in determining if additional testing and/or mitigation activities are needed to reduce their combustion risks.

DHA/PHA indicates Fire Mitigation may be needed?

- **YES – Fire Mitigation may be needed**

  Consider Fire Prevention
  - **Spark Mitigation** – Passive (Spark Cooler®) or Active (Detect & Extinguish)
  - **Collector Choice** – Dry Media, Cyclone, or Wet Collectors – primarily with Metal Dusts
  - **Dust Additives to "Inert" Combustible Dust** – such as Limestone

  Consider Fire Protection
  - **Sprinklers** (and Water Drain Valve) or **CO_2 Extinguishing System**[1]
  - **Collection Location** – place collector outdoors
  - **Abort Gate** – if air returns to the building

- **NO – Fire Mitigation may not be needed** → **No Fire Mitigation**

DHA/PHA indicates Explosion Mitigation may be needed?

- **YES – Explosion Mitigation may be needed**

  Consider Explosion Prevention
  - **Spark Mitigation** – Passive (Spark Cooler®) or Active (Detect & Extinguish)
  - **Collector Choice** – Dry Media, Cyclone, or Wet Collectors – primarily with Metal Dusts
  - **Dust Additives to "Inert" Combustible Dust** – such as Limestone
  - **Explosion Isolation from other Deflagrations**

  Consider Explosion Protection
  - **Active Explosion Suppression Systems**
  - **Explosion Venting with Ducts or Flameless Vents**
  - **Explosion Isolation** – Air Inlet/Outlet, Hopper Discharge

- **NO – Explosion Mitigation may not be needed** → **No Explosion Mitigation**

PREVENTION & PROTECTION COMPONENTS

PREVENTION



In-Line Spark Abatement. Located within the intake ducting, this device creates turbulence in the airstream that cools and extinguishes sparks without water or chemicals.

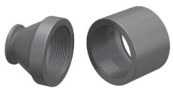


Spark Detection & Extinguishing System. Highly sensitive spark sensors located on the ductwork automatically trigger an extinguishing device and a spark alarm. The extinguishing assembly reacts within 300 milliseconds of an alarm releasing a water spray curtain to extinguish sparks.

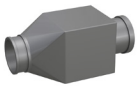
FIRE PROTECTION



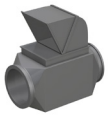
Fire Suppression System. Delivers clean, dependable CO_2-based fire suppression to deep-seated fires in seconds.



Sprinkler Couplings. Allow ease of installation of sprinkler systems to extinguish fires quickly.



Inlet/Outlet Damper. Inlet and outlet dampers work with a CO_2-based fire suppression system to isolate the CO_2 in the dust collector.



Automatic Fast-Acting Abort Gate. Fast-acting abort gates used in conjunction with spark detection systems can divert sparks, flames, smoke and other dangerous material to a safe location.

EXPLOSION PROTECTION



Explosion Relief Panels. Designed to rupture at specific pressure, these vents help minimize damage and direct the fireball and pressure into a safe area in the case of an explosion.



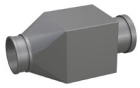
Chemical Suppressant. These suppression systems can detect and react to explosion pressures in less than one millisecond to chemically suppress explosions before they become catastrophic.



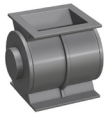
Chemical Isolation – Inlet/Outlet. These systems detect explosive pressure and quickly inject a chemical suppressive to prevent the flames from an explosion from propagating through the inlet or outlet duct.



Actuated Knife Gate – Inlet/Outlet. Knife gates actuate within milliseconds of an explosion event to prevent the explosion from propagating back into the building from either the inlet or outlet duct.



Flow-Actuated Isolation Valve – Inlet. Flow-actuated isolation valves on the inlet duct prevent the flames from explosions from propagating back into the building from the dust collector.



Rotary Valve/Airlock. Rotary valves can help prevent explosions from propagating through the dust collector hopper outlet.

STANDARDS, CODES & GUIDELINES THAT IMPACT DUST COLLECTOR DECISIONS

As a process owner, you are responsible for the selection of your combustible material management strategy and to ensure compliance with all applicable federal, state, and local codes and standards.

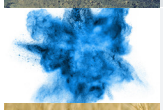
Many standards and codes may influence your decisions on dust control, including federal, state, and local regulations. Knowing the codes that apply to your facility is critical, and you should always research the code requirements in your area. A few commonly referenced standards for combustible dust risk management strategies include those issued by the National Fire Protection Association (NFPA), the International Mechanical Code, the International Fire Code, Factory Mutual Property Loss Data Sheets, and OSHA (federal).

Since each Authority Having Jurisdiction may have a specific set of codes or standards it references, you may need to have knowledge of more than one standard or code. Some of the most commonly referenced standards are published by NFPA, including both design and operational standards focused on combustible dust.

Since these standards are often referenced by OSHA, and have been adopted as code in many areas of the country, they may be a good starting point for consideration in developing your combustible dust management strategy.

Visit www.nfpa.org for more information.

Short list of NFPA Design Standards with associated visual images to reinforce the topic covered by the standard.

		Standard for Combustible Dust and Particulate Solids	**NFPA 660**
	**Included in the new consolidated Standard NFPA 660**	Standard on the Fundamentals of Combustible Dust	**NFPA 652**
		Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities	**NFPA 61**
		Standard for Combustible Metals	**NFPA 484**
		Standard for the Prevention of Fire and Dust Explosions from Manufacturing, Processing, and Handling of Combustible Particulate Solids	**NFPA 654**
		Standard for Prevention of Sulfur Fires and Explosions	**NFPA 655**
		Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities	**NFPA 664**
		Standard for Explosion Protection by Deflagration Venting	**NFPA 68**
		Standard for Explosion Prevention Systems	**NFPA 69**
		Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids	**NFPA 91**
		Standard for Spray Applications Using Flammable or Combustible Materials	**NFPA 33**

COMBUSTIBLE DUST EQUIPMENT INSTALLATIONS



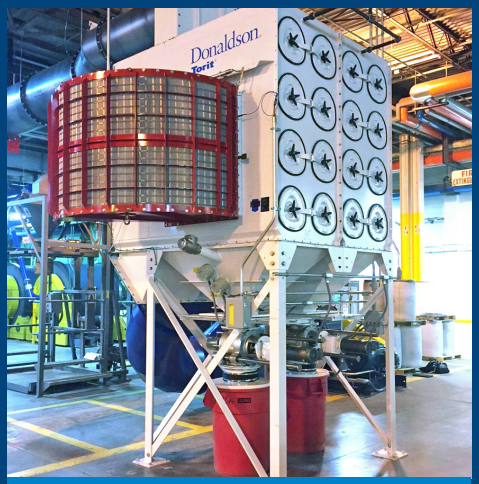
Explosion Vent



Flow-Actuated Isolation Valve



Rotary Valve



Flameless Explosion Vent



Chemical Suppressant



Fire Suppression

Combustible Dust Statement

As a manufacturer and supplier of Industrial Filtration Products, Donaldson can assist process owners/operators in the selection of filtration technologies. Donaldson cannot, however, select fire and/or explosion mitigation strategies for process owners.

Compliance with applicable codes and standards remains the responsibility of the process owner/operator. Among other considerations, the current NFPA standards require owners/operators whose processes involve potentially combustible materials to have a current Hazard Analysis, which can serve as the foundation for the process owner/operator's hazard mitigation strategies.

Upon request, Donaldson can assist owners/operators to incorporate Donaldson filtration products into their comprehensive fire and/or explosion mitigation strategy. To provide this support, Donaldson needs complete and accurate information on all potentially combustible contaminants and the fire and/or explosion mitigation strategies that a process owner/operator intends to pursue.



Collecting Confidence

Donaldson's comprehensive dust collection solutions help process owners effectively address their dust, fume, and mist collection challenges by providing knowledgeable guidance, industry-leading equipment as well as unrivaled aftermarket service and support.

With our Consultative, Comprehensive, Connected approach to dust, fume, and mist control, Donaldson is with you every step of the way.

Consultative: Donaldson completes a thorough review with you, listening to your operational needs and challenges.

Comprehensive: With that understanding, we will develop a solution using industry-leading products and technology.

Connected: You will have unrivaled access to global aftermarket specialists, collector performance monitoring, along with service and support professionals providing the answers you need.



Donaldson

Donaldson Company, Inc.
Minneapolis, MN

donaldson.com • shop.donaldson.com

North America
Email: donaldsontorit@donaldson.com
Phone: (USA) +1-800-365-1331

Latinoamerica
Email: industrialair@donaldson.com
Phone: +52-449-300-2442
Toll Free: (CO) (57) 601-580-1611
(CL) +800-914-544 • (PE) +800-712-10
(BR) +55 (11) 99707-6689

China
Email: info.cn@donaldson.com
Phone: +86-400-921-7956

Donaldson Europe B.V.
Email: IAF-europe@donaldson.com
Phone: +32-16-38-3811

India
Email: info.difs@donaldson.com
Phone: +91-124-4807-400 • +18001035018

Australasia
Email: marketing.australia@donaldson.com
Phone: +61-02-4350-2066
Toll Free: (AU) +1800-345-837 • (NZ) +0800-743-387

Korea
Email: contactus.kr@donaldson.com
Phone: +82-2-517-3333

South Africa
Email: SAMarketing@donaldson.com
Phone: +27-11-997-6000

Southeast Asia
Email: IAF.SEA@donaldson.com
Phone: +65-6311-7373

Japan
Email: jp-ndl.ifsweb@donaldson.com
Phone: +81-42-540-4114

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