The U.S. Occupational Safety and Health Administration (OSHA) has 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. Is your plant effectively managing the risks associated with combustible dust in its processes?

For decades Donaldson Torit has been providing quality dust collectors that have become an integral part of many plant’s combustible dust compliance strategies. Donaldson remains active in supplying dust collectors to support your combustible dust control strategy by interfacing with you and your experts on fire and explosion protection equipment and strategies.

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

WHERE TO START?
A Donaldson Torit representative can review your operational challenges to help you better understand how to integrate dust collection into your combustible dust management strategy. The following considerations are designed to help you decide how you want Donaldson Torit to support your combustible dust management strategy:

1. Do you have combustible materials?*
2. Are there sparks?
3. Has the process experienced fires?
4. Obtain test data on combustible properties $K_{st}$, $P_{max}$, MIE, MEC.
5. Do test results confirm combustible materials?
6. Materials may not be combustible. Get verification of material properties.
7. Documented Process Hazard Assessment may suggest options to consider during collector selection.
8. Do you want Donaldson Torit to include options to support your combustible materials management strategies?
9. Options for your combustible material risks management strategies are provided by others.
10. Options for combustible materials may not be necessary for your collector.
11. Collector selections could be made without options for combustible material risk management.

* See the partial list from OSHA on page 6.
FIRE TRIANGLE

Fire management 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.” Managing one or more of the elements in the triangle can decrease the fire risk.

EXPLOSION PENTAGON

Explosion risk management strategies consider a slightly expanded set of 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 necessary for an explosion: “Dispersion of Dust” and “Confinement of Dust.” As with fire management strategies, the management or removal of one or more of the elements in the explosion pentagon can reduce the explosion risk. While many explosion management strategies focus on controlling the same elements in the fire triangle, explosion risk management 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.

UNDERSTANDING THE BASICS

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 if the particles are combustible, they can represent a potentially explosive dust cloud if disturbed.

It is essential for plant leaders to understand the risks of combustible dust and ensure they manage combustible dusts in their facilities. Donaldson Torit can supply dust collectors to support your combustible dust control strategy by interfacing with you and your experts on fire and explosion protection equipment and solutions. Combustible dusts generally present both fire and explosion risks so it may help to consider the management of these risks separately (see side bar).

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 good 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 also help you reduce the risk of dust explosions in your facility, particularly the destructive secondary explosions, by helping reduce the presence of dispersed fuel in your facility.

* For more information, please see page 6.
### Inlet Options

<table>
<thead>
<tr>
<th>ITEM #</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Explosion Relief Panels</td>
</tr>
<tr>
<td>2</td>
<td>Detector / Sensor – Chemical or Actuated System Devices</td>
</tr>
<tr>
<td>3</td>
<td>Chemical Suppressant Delivery Device</td>
</tr>
<tr>
<td>4</td>
<td>Suppression System Control Panel</td>
</tr>
<tr>
<td>5</td>
<td>Fire Extinguisher/ Fire Suppression/ Sprinkler Coupling</td>
</tr>
<tr>
<td>6</td>
<td>Overflow Drain</td>
</tr>
<tr>
<td>7</td>
<td>Rotary Valve/ Airlock</td>
</tr>
<tr>
<td>8</td>
<td>Flow Actuated Isolation Valve - Inlet</td>
</tr>
<tr>
<td>9</td>
<td>In-line Spark Abatement</td>
</tr>
<tr>
<td>10</td>
<td>Spark Detection &amp; Extinguishing System</td>
</tr>
<tr>
<td>11</td>
<td>Actuated Knife Gate - Inlet</td>
</tr>
<tr>
<td>12</td>
<td>Chemical Isolation Device - Inlet</td>
</tr>
<tr>
<td>13</td>
<td>Automatic Fast Acting Abort Gate</td>
</tr>
<tr>
<td>14</td>
<td>Actuated Knife Gate - Outlet</td>
</tr>
<tr>
<td>15</td>
<td>Flow Actuated Isolation Valve - Outlet</td>
</tr>
<tr>
<td>16</td>
<td>Chemical Isolation Device - Outlet</td>
</tr>
</tbody>
</table>
## COMBUSTIBLE DUST STRATEGIES

### Some Components in Risk Management Strategies for:

<table>
<thead>
<tr>
<th>Item #</th>
<th>EXPLOSION</th>
<th>FIRE</th>
</tr>
</thead>
</table>

### FIRE PROTECTION
- Fire Extinguisher/ Fire Suppression / Sprinkler Coupling
- Overflow Drain
- Automatic Fast Acting Abort Gate
- In-line Spark Abatement
- Spark Detection & Extinguishing System

### EXPLOSION PROTECTION
- **MECHANICAL**
  - Explosion Relief Panels
- **CHEMICAL**
  - Chemical Suppressant Delivery Device
  - Suppression System Control Panel
  - Detector / Sensor – Chemical or Actuated System Devices

### DUST COLLECTOR ISOLATION

#### INLET
- **MECHANICAL**
  - Actuated Knife Gate – Inlet
  - Flow Actuated Isolation Valve – Inlet
- **CHEMICAL**
  - Chemical Isolation Device – Inlet
  - Suppression System Control Panel
  - Detector / Sensor – Chemical or Actuated System Devices

#### HOPPER
- Rotary Valve/ Airlock

#### OUTLET (IF AIR IS RETURNED TO THE BUILDING)
- **MECHANICAL**
  - Actuated Knife Gate – Outlet
  - Flow Actuated Isolation Valve – Outlet
- **CHEMICAL**
  - Chemical Isolation Device – Outlet
  - Suppression System Control Panel
  - Detector / Sensor – Chemical or Actuated System Devices

### OUTLET OPTIONS
![Outlet Options](image-url)
As a process owner, you are responsible for the selection of your combustible material management strategy and to assure compliance with all applicable federal, state, and local codes and standards.

**DEFINITIONS**

**Authority Having Jurisdiction (AHJ):** an organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

**Av (Vent Area):** Calculated from $P_{red}$, container volume, $K_{st}$, $P_{max}$ and $P_{stat}$

**Combustible dust:** a combustible particulate solid that presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations, regardless of particle size or shape.

**Deflagration:** propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium.

**Detonation:** propagation of a combustion zone at a velocity that is greater than the speed of sound in the unreacted medium.

**Explosion:** the bursting or rupturing of an enclosure or container due to the development of internal pressure from a deflagration.

**$K_{st}$ (Deflagration Index for Dust):** the maximum rate of pressure rise during a contained deflagration of an optimum mixture.

**Millisecond (msec):** 1,000th of a second
- Time for light to travel: 300km in a vacuum=1 msec
- Honeybee wing flap= 5 msec
- Reaction speed of a human= 100 msec
- Blink of a human eye= 300-400 msec

**$P_{max}$ (Maximum Pressure):** the maximum pressure developed in a contained deflagration of an optimum mixture.

**$P_{red}$ (Reduced Pressure):** the calculated maximum pressure developed in a vented enclosure during a vented deflagration.

**$P_{stat}$ (Static Activation Pressure):** the pressure that activates a vent closure when the pressure is increase slowly (with a rate of pressure rise less than 0.1 bar/min).

**TSP (Total Suppressed Pressure):** pressure in an enclosure after a suppressed event.

**STANDARDS, CODES, & GUIDELINES THAT IMPACT DUST COLLECTOR DECISIONS**

<table>
<thead>
<tr>
<th>NFPA STANDARD</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INDUSTRY AND APPLICATION SPECIFIC STANDARDS</strong></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities</td>
</tr>
<tr>
<td>484</td>
<td>Standard for Combustible Metals</td>
</tr>
<tr>
<td>664</td>
<td>Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities</td>
</tr>
<tr>
<td>33</td>
<td>Standard for Spray Application Using Flammable or Combustible Materials</td>
</tr>
<tr>
<td><strong>DESIGN STANDARDS</strong></td>
<td></td>
</tr>
<tr>
<td>654</td>
<td>Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids</td>
</tr>
<tr>
<td>68</td>
<td>Standard for Explosion Protection by Deflagration Venting</td>
</tr>
<tr>
<td>69</td>
<td>Standard on Explosion Prevention Systems</td>
</tr>
<tr>
<td>91</td>
<td>Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids</td>
</tr>
</tbody>
</table>

Many standards and codes may influence your decisions on dust control, including local, state, and federal 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: National Fire Protection Association (NFPA), the International Mechanical Code, the International Fire Code, Factory Mutual Property Loss, and OSHA (federal).

Since each Authority Having Jurisdiction may have a specific set of codes it references, you may need to have general 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 (see above).

Since these standards are often cited 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](http://www.nfpa.org) for more information.
Does your company or firm process any of these products or materials in powdered form? See side bar.**

If so, there is potential for a “Combustible Dust” explosion.

** Information on this page from “Combustible Dust—Does your company or firm process any of these products or materials in powdered form?” OSHA Poster, (2008).

** The above list from OSHA should not be considered complete, nor should it replace the need to obtain validated test data on your dust.
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Dust Collectors and Combustible Dust Strategies Brochure (1/11)
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