INTRODUCTION TO COMBUSTIBLE DUST

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:

- **DO YOU HAVE COMBUSTIBLE MATERIALS?**
  - **YES**
    - Obtain test data on combustible properties $K_v$, $P_{max}$, MIE, MEC.
    - Do test results confirm combustible materials?
      - **YES**
        - Do you want Donaldson Torit to include options to support your combustible materials management strategies?
          - **YES**
            - Donaldson Torit will include options to support your combustible material risk management strategies. Additional options may be provided by others.
          - **NO**
            - Collector selections could be made without options for combustible material risk management.
      - **NO**
        - Do you have test results confirming no combustible materials?
          - **YES**
            - Options for your combustible material risks management strategies are provided by others.
          - **NO**
            - Options for combustible materials may not be necessary for your collector.
  - **NO**
    - Has the process experienced fires?
      - **YES**
        - Materials may not be combustible. Get verification of material properties.
      - **NO**
        - Material properties may not be combustible. Get verification of material properties.
    - Are there sparks?
      - **YES**
        - May suggest options to consider during collector selection.
      - **NO**
        - Do you need to include options to support your combustible materials management strategies?
          - **YES**
            - Donaldson Torit will include options to support your combustible material risk management strategies. Additional options may be provided by others.
          - **NO**
            - Collector selections could be made without options for combustible material risk management.
    - Are there sparks?
      - **YES**
        - Obtain test data on combustible properties $K_v$, $P_{max}$, MIE, MEC.
      - **NO**
        - Are there combustible materials?
          - **YES**
            - Collect test data on combustible properties $K_v$, $P_{max}$, MIE, MEC.
          - **NO**
            - Do you have test results confirming no combustible materials?
              - **YES**
                - Collector selections could be made without options for combustible material risk management.
              - **NO**
                - Options for your combustible material risks management strategies are provided by others.

* 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.

COMPLIANCE STRATEGY COMPONENTS

DUST CONTROL

PROTECTION

PREVENTION

IGNITION CONTROL

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

* For more information, please see page 6.
# GUIDE TO EXPLOSION/FIRE PROTECTION COMPONENTS FOR DUST COLLECTIONS

<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>
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<td>5</td>
<td>Fire Extinguisher/Fire Suppression/Sprinkler Coupling</td>
</tr>
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<td>6</td>
<td>Overflow Drain</td>
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<tr>
<td>7</td>
<td>Rotary Valve/ Airlock</td>
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<tr>
<td>8</td>
<td>Flow Actuated Isolation Valve - Inlet</td>
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<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>
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<tr>
<td>12</td>
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<tr>
<td>13</td>
<td>Automatic Fast Acting Abort Gate</td>
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</tr>
<tr>
<td>16</td>
<td>Chemical Isolation Device - Outlet</td>
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</table>

## INLET OPTIONS

8. Flow Actuated Isolation Valve - Inlet
9. In-line Spark Abatement
11. Actuated Knife Gate - Inlet
12. Chemical Isolation Device - Inlet
## Some Components in Risk Management Strategies for:

<table>
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<tr>
<td><strong>EXPLOSION PROTECTION</strong></td>
<td></td>
<td></td>
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<tr>
<td>MECHANICAL</td>
<td>Explosion Relief Panels</td>
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<td><strong>DUST COLLECTOR ISOLATION</strong></td>
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<td>HOPPER</td>
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</tr>
<tr>
<td></td>
<td>Rotary Valve/ Airlock</td>
<td>7</td>
</tr>
<tr>
<td><strong>OUTLET (IF AIR IS RETURNED TO THE BUILDING)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MECHANICAL</td>
<td>Actuated Knife Gate – Outlet</td>
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### OUTLET OPTIONS

![Outlet Options Diagram]
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

**A_v (Vent Area):**
Calculated from \( P_{max} \), container volume, \( K_d \), \( P_{red} \), 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

**\( K_d \) (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

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

<table>
<thead>
<tr>
<th>NFPA Standard</th>
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</thead>
<tbody>
<tr>
<td>NFPA 652</td>
<td>Standard on the Fundamentals of Combustible Dust</td>
</tr>
<tr>
<td>NFPA 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>NFPA 68</td>
<td>Standard for Explosion Protection by Deflagration Venting</td>
</tr>
<tr>
<td>NFPA 69</td>
<td>Standard on Explosion Prevention Systems</td>
</tr>
<tr>
<td>NFPA 91</td>
<td>Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids</td>
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<tr>
<td>NFPA 61</td>
<td>Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities</td>
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<tr>
<td>NFPA 484</td>
<td>Standard for Combustible Metals</td>
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<tr>
<td>NFPA 664</td>
<td>Standard for Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities</td>
</tr>
<tr>
<td>NFPA 33</td>
<td>Standard for Spray Applications Using Flammable or Combustible Materials</td>
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</table>

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

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.
Dust Control Measures
• The dust-containing systems (ducts and dust collectors) are designed in a manner (i.e., no leaking) that fugitive dusts are not allowed to accumulate in the work area.
• The facility has a housekeeping program with regular cleaning frequencies established for floors and horizontal surfaces, such as ducts, pipes, hoods, ledges, and beams, to minimize dust accumulations within operating areas of the facility.
• The working surfaces are designed in a manner to minimize dust accumulation and facilitate cleaning.

Protection Measures
• The facility has an emergency action plan.
• Dust collectors are not located inside of buildings. (Some exceptions)
• Rooms, buildings, or other enclosures (dust collectors) have explosion relief venting distributed over the exterior wall of buildings and enclosures.
• Explosion venting is directed to a safe location away from employees.
• The facility has isolation devices to prevent deflagration propagation between pieces of equipment connected by ductwork.
• The dust collector systems have spark detection and explosion/deflagration suppression systems.
• Emergency exit routes are maintained properly.

Ignition Control Measures
• Electrically-powered cleaning devices such as vacuum cleaners, and electrical equipment are approved for the hazard classification for Class II locations.
• The facility has an ignition control program, such as grounding and bonding and other methods, for dissipating any electrostatic charge that could be generated while transporting the dust through the ductwork.
• The facility has a HotWork permit program.
• Areas where smoking is prohibited are posted with “No Smoking” signs.
• Duct systems, dust collectors, and dust-producing machinery are bonded and grounded to minimize accumulation of static electrical charge.
• The facility selects and uses industrial trucks that are approved for the combustible dust locations.

Prevention Measures
• The facility has separate devices to remove foreign materials capable of igniting combustible dusts.
• MSDSs for the chemicals which could become combustible dust under normal operations are available to employees.
• Employees are trained on the explosion hazards of combustible dusts.

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/operators hazard mitigation strategies.

Upon request, Donaldson can assist owners/operators to incorporate Donaldson Filtration Product into a 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 process owner/operator intends to pursue.

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Important Notice
Many factors beyond the control of Donaldson can affect the use and performance of Donaldson products in a particular application, including the conditions under which the product is used. Since these factors are uniquely within the user’s knowledge and control, it is essential the user evaluate the products to determine whether the product is fit for the particular purpose and suitable for the user’s application. All products, product specifications, availability and data are subject to change without notice, and may vary by region or country.

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