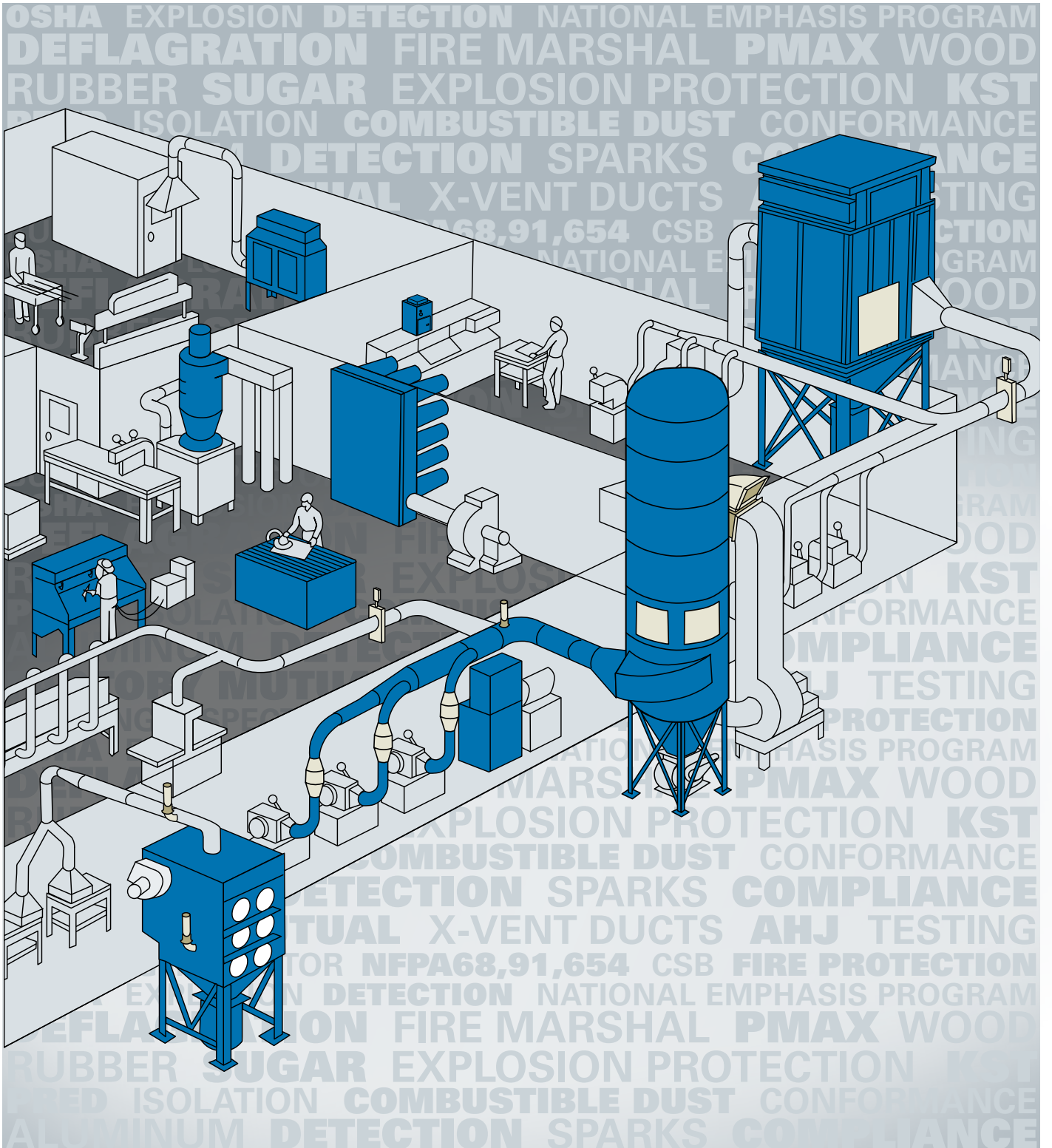


Donaldson®  
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## DUST COLLECTORS AND COMBUSTIBLE DUST STRATEGIES



# INTRODUCTION TO COMBUSTIBLE DUST

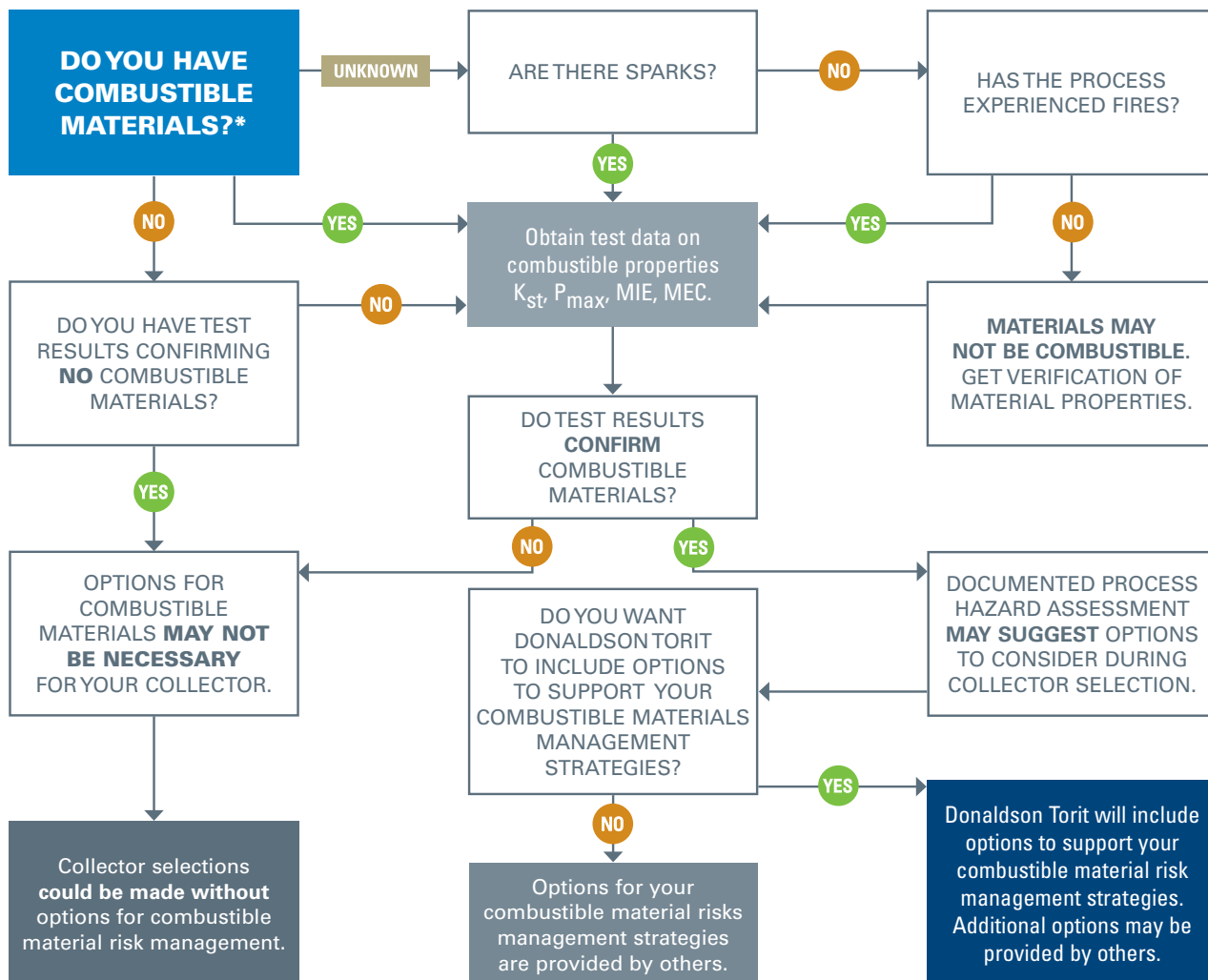
The U.S. Occupational Safety and Health Administration (OSHA) has issued a National Emphasis Program and continues to communicate with most industries on the hazards of combustible dust. The agency's focused effort is targeted at reducing combustible dust risks in industrial plant settings. **Is your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

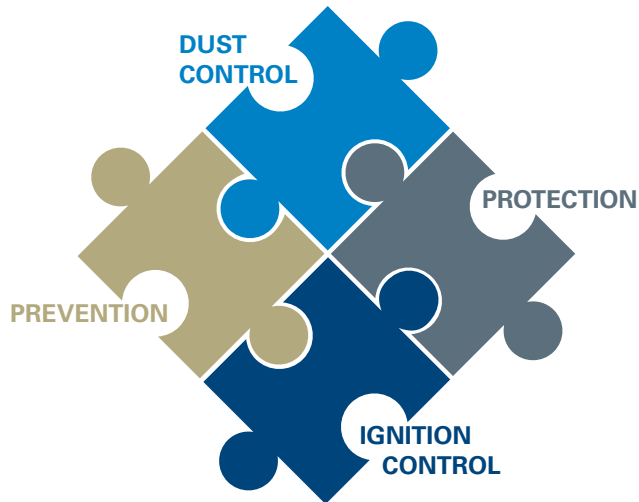
## WHERE TO START?

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:



\* See the partial list from OSHA on page 6

## COMPLIANCE STRATEGY COMPONENTS\*



## 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.

## 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.

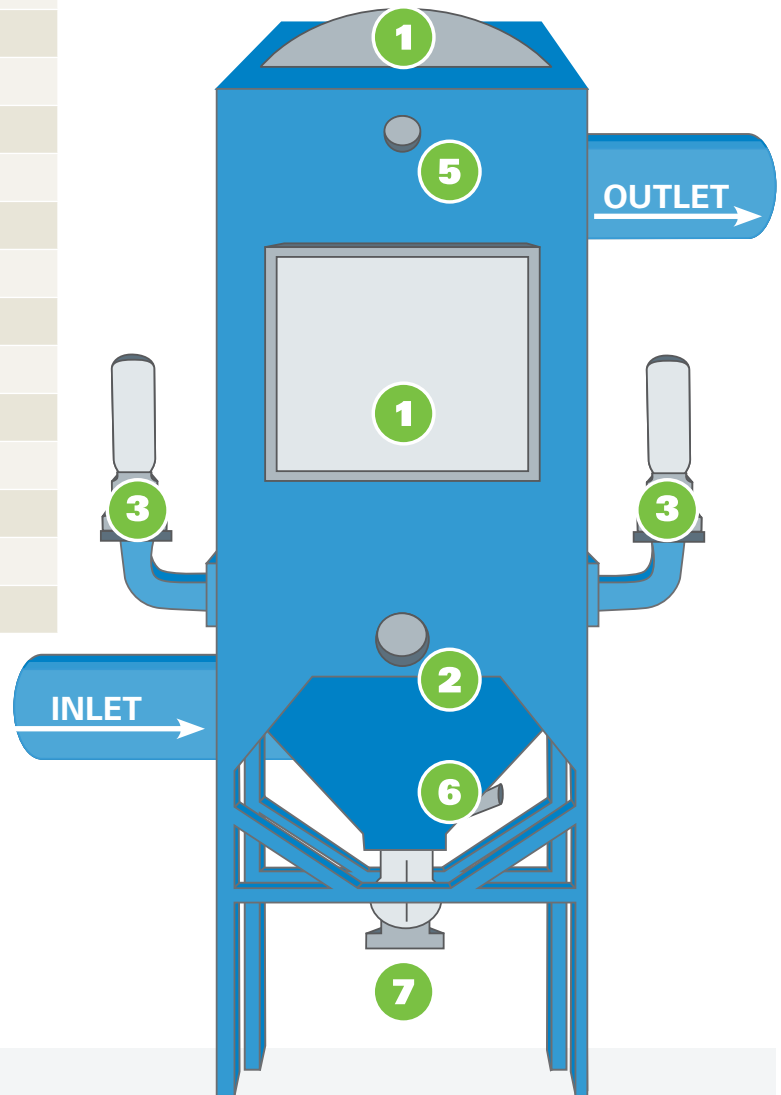


To be compliant with OSHA regulations, you must meet other requirements and all applicable standards or codes.

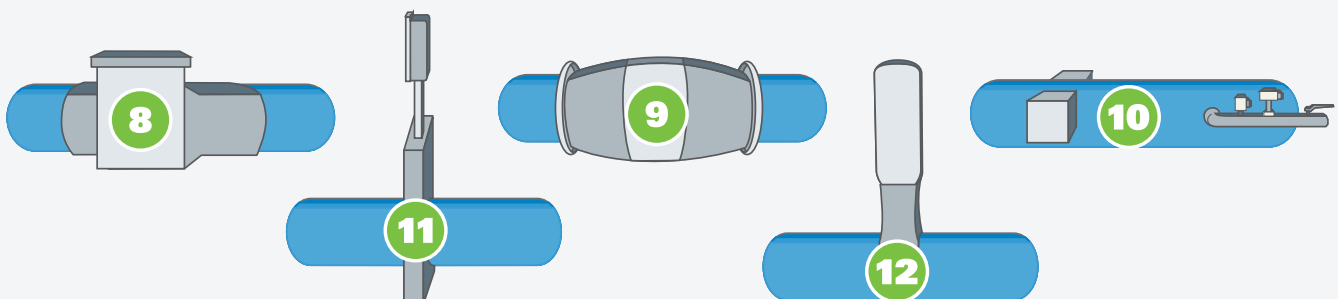
Visit [www.osha.gov](http://www.osha.gov) to find OSHA regulations.

# GUIDE TO EXPLOSION/FIRE PROTECTION COMPONENTS FOR DUST COLLECTIONS

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

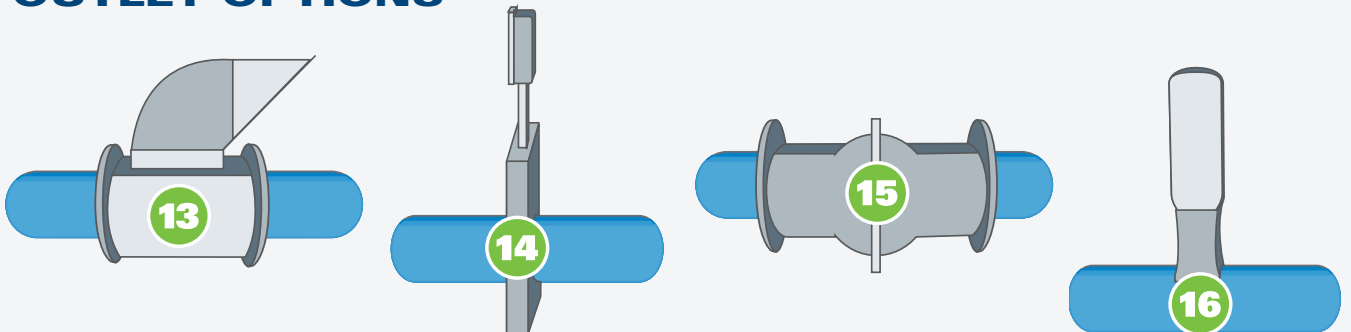


## INLET OPTIONS



		Item #	Some Components in Risk Management Strategies for:	
			EXPLOSION	FIRE
<b>FIRE PROTECTION</b>				
	Fire Extinguisher/ Fire Suppression / Sprinkler Coupling	5		✓
	Overflow Drain	6		✓
	Automatic Fast Acting Abort Gate	13		✓
	In-line Spark Abatement	9		✓
	Spark Detection & Extinguishing System	10		✓
<b>EXPLOSION PROTECTION</b>				
MECHANICAL	Explosion Relief Panels	1	✓	
CHEMICAL	Chemical Suppressant Delivery Device	3	✓	
	Suppression System Control Panel	4	✓	
	Detector / Sensor – Chemical or Actuated System Devices	2	✓	
<b>DUST COLLECTOR ISOLATION</b>				
<b>INLET</b>				
MECHANICAL	Actuated Knife Gate – Inlet	11	✓	
	Flow Actuated Isolation Valve – Inlet	8	✓	
CHEMICAL	Chemical Isolation Device – Inlet	12	✓	
	Suppression System Control Panel	4	✓	
	Detector / Sensor – Chemical or Actuated System Devices	2	✓	
<b>HOPPER</b>				
	Rotary Valve/ Airlock	7	✓	✓
<b>OUTLET (IF AIR IS RETURNED TO THE BUILDING)</b>				
MECHANICAL	Actuated Knife Gate – Outlet	14	✓	
	Flow Actuated Isolation Valve – Outlet	15	✓	
CHEMICAL	Chemical Isolation Device – Outlet	16	✓	
	Suppression System Control Panel	4	✓	
	Detector / Sensor – Chemical or Actuated System Devices	2	✓	

### OUTLET OPTIONS



**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  $P_{red}$ , 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

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

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

## 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.

**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.**

## 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 separator 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.

\* 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.

### Agricultural Products

Egg white  
Milk, powdered  
Milk, nonfat, dry  
Soy flour  
Starch, corn  
Starch, rice  
Starch, wheat  
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 blend  
Tomato  
Walnut dust

Wheat flour  
Wheat grain dust  
Wheat starch  
Xanthan gum

### Carbonaceous Dusts

Charcoal, activated  
Charcoal, wood  
Coal, bituminous  
Coke, petroleum  
Lampblack  
Lignite  
Peat, 22% H<sub>2</sub>O  
Soot, pine  
Cellulose  
Cellulose pulp  
Cork  
Corn  
Chemical Dusts  
Adipic acid  
Anthraquinone  
Ascorbic acid  
Calcium acetate  
Calcium stearate  
Carboxy-methylcellulose  
Dextrin  
Lactose  
Lead stearate  
Methyl-cellulose  
Paraformaldehyde  
Sodium ascorbate  
Sodium stearate  
Sulfur

### Metal Dusts

Aluminum  
Bronze  
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 & 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  
suspension copolymer  
(poly) Vinyl chloride/  
vinyl acetylene/  
emulsion/copolymer

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