



# NFPA 664 Combustible Dusts – Overview

– does not cover hybrid mixtures or gas



The National Fire Protection Association - NFPA® has issued several standards and it can be quite difficult to get a good overview of these standards. WMMA Dust Task Force has developed this tool to help you to get a simplified way to get an overview of the requirements set out in the NFPA standards. It is important for the user to understand that in each case the user must consult with the applicable standard to assure the particular facility/process being assessed comply with the correct standard.

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Link to NFPA



### Instructions of how to navigate the guide

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### Other hyperlinks instructions

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The requirements of the NFPA standards are complex. The standards have a lot of interrelated references and often segments are confusing and subject to interpretation.

The ultimate responsibility for compliance is the responsibility of the Owner/Operator.


Some issues have to be managed by the Owner/Operator and others he can be supported by a qualified Supplier/Vendor. To help the Owner/Operator get an overview of the issues and costs related to compliance with NFPA 664 the WMMA Dust Task Force has developed this tool

Owner/Operator		Supplier/Vendor	
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Click on subject you want to get more information about

Each rectangle is a hyperlink

Click

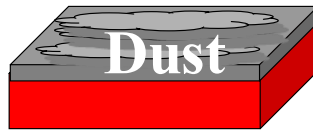


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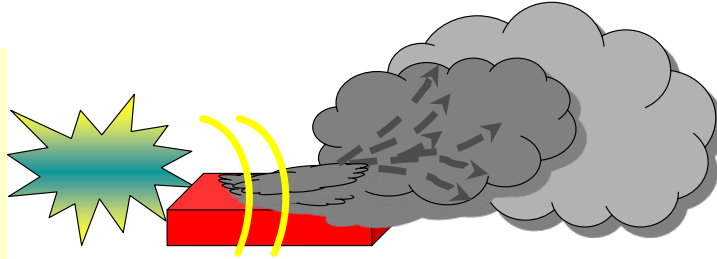
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# Awareness and Education

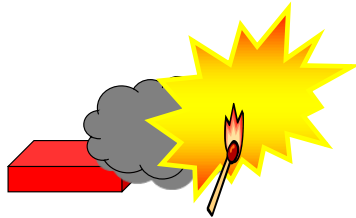


Dust settles on flat surfaces

Some event disturbs the settled dust into a cloud



Dust cloud is ignited and explodes



## Employees need to know

- The safe work practices applicable to their job tasks,
- The overall plant programs for dust control and ignition source control.

## Employee training must be

- Before he/she initially start work
- Periodically to refresh their knowledge
- When reassigned
- When hazards or processes change



Lack of awareness of the danger of fires and explosions in wood dust can cause this to happen



Only thing left intact of the plant was the dust collector



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# Housekeeping

## Housekeeping is your first line of defense.

- Work area must be kept clean for dust accumulation
- Machinery should be equipped with engineered dust collection hoods
- Dust accumulation must be kept below minimum layer thickness
- Remove dust from up-facing surfaces i.e. beams, piping and ductwork, machine enclosures etc
- Watch out for hot surfaces and or potential ignition sources

[See details in  
NFPA 664 –  
Chapter 11  
\(click here for NFPA 664\)](#)

## Use proper equipment for housekeeping

- Do not use compressed air for cleaning [Click here for rule on compressed air cleaning](#)
- All hot sources must be shut down and cooled off before commencement of cleaning
- Use only vacuum cleaners certified to work in dusty environment
- Alternative install central vacuum system with vacuum device placed outside

Electric  
Explosion proof



Cost:  
\$8,000 +up

Air  
Explosion proof



Cost:  
\$5,000 +up

Electric  
General duty



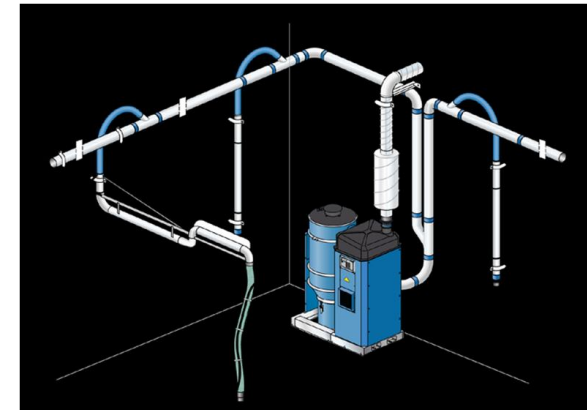
Cost:  
\$3,000 +up

Electric  
General duty



Cost:  
\$4,000 +up

Fixed system



Cost:  
\$20,000 +up



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## Compressed air cannot be used for cleaning.



### Exemption

- the area first has been cleaned by vacuum up all accessible areas
- All heat producing components has been turn off
- All lighting fixtures are rated Class II division 2G
- Air pressure is reduced to 15 PSIG (30 PSI)



# Maintenance and Repair

Record and maintain for each event

## Inspection and Maintenance.

An inspection, testing, and maintenance program shall be developed to ensure that fire and explosion protection systems are in accordance with NFPA 664 Chapter 9.

The inspection, testing, and maintenance program shall be a documented program detailing the equipment inspected, testing performed, test results formulated, and maintenance or repair requirements.

Process controls, equipment, and machinery shall be inspected, tested, and maintained in accordance with the manufacturer's recommended guidelines and safe practices.

In addition to inspecting the fire and explosion protection systems that could be in place, such a program should include, but not be limited to, inspections of dust collection system components, electrical transformers, switchgear and switches, large motors (e.g., greater than 200 hp), hydraulic and lubricating systems, rotating machinery (e.g., debarkers, chippers, mills, refiners, dryers, roll presses, planers, sanders etc.), and deficiencies with electrical devices (e.g., arcing, lighting, and damaged wiring) in and around dust-producing processes. Arcing switches, worn bearings, worn belts, damaged wiring, and misaligned parts, including gears, pulleys, guards, and fairings, have all been identified as being sources of ignition.

## Record Retention.

Records of inspections, tests, and maintenance of fire protection equipment and components shall be retained and made available to the authority having jurisdiction upon request.

All records required to be kept shall be retained until their usefulness has been served or until no longer required by the applicable standard or authority having jurisdiction.

Records shall be maintained on-site by the owner/Operator.

Retained records shall indicate the procedure performed (e.g., installation, inspection, testing, training, or maintenance), the organization that performed the work, the results, and the date the work was performed.



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## Documentation

- Owner must have complete set of **Drawings and Specifications** for his facility and process – on file for the life of the process
- A **Process Hazard Analysis (PHA)** must be done for the process and updated when changes to the process made – procedural changes or equipment changes – and at least every 5 years.
- Owner must have a **Management of Change Procedure** documented and executed for each facility and process change
- Owner must have **Training** procedures documented - regular re-training at least annually – each activity must be documented
- Owner must have **Inspection and Maintenance** procedures documented - each activity must be documented
- Owner must have **Housekeeping** procedures documented – each activity must be documented.



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## OSHA Combustible Dust National Emphasis Program



- OSHA implements National Emphasis Program (NEP) for combustible dust. CPL 03-00-008 – Provides policies and procedures for inspecting workplaces that create or handle combustible dusts that could cause deflagration, fire or explosion
- 800 inspections Oct. 2007 – October 2009
  - 164 in wood
  - 123 in food
  - 103 in chemical
- Issued 4,900 violations
  - 74% serious
  - Average violations per visit – 7
  - Average \$1,300 per serious violation
  - Only 20% were in compliance
  - 80% dust collectors inside building
- Selection by Industry Type .
  - Or Employee Complaint
  - Or Incident



# Hot Work Permit

## HOT WORK PERMIT

\_\_\_\_\_ (company name)

Date \_\_\_\_\_ Time \_\_\_\_\_

Name of Person(s) Performing Work \_\_\_\_\_

Specific Location of Work \_\_\_\_\_

Yes No

- Cutting or welding permitted in an area that has been made fire safe.
- All movable fire hazards in the vicinity have been taken to a safe place.
- Guards used to contain the heat, sparks and slag if fire hazards cannot be removed.
- Floor or wall openings or cracks, open doorways and windows protected or closed.
- Fire extinguisher available for instant use.
- Fire watch in areas where other than a minor fire might develop such as around combustible material.
- Floors swept clean of combustible material for a radius of 35'.
- Combustible floors have been kept wet, covered with damp sand or protected by fire resistant shields.
- Welding/cutting done only in areas authorized by management. No welding/cutting in sprinkled building when sprinkler system is impaired or in presence of explosive atmosphere, or in area of storage of readily ignitable material.
- Dusts and conveyor systems that might carry sparks to distant combustibles protected or shutdown.
- Cutter/welder is trained in safe operation of equipment and the safe use of the process.
- Any on-site contractors advised about flammable material or hazardous conditions of which they may not be aware.
- Welding or cutting containers:
  - Container thoroughly cleaned and ventilated;
  - Any pipe lines or connections to containers disconnected or blanked.
  - PPE used as needed— e.g., eye protection, helmet, protective clothing, respirator, gloves.
  - Warning sign posted to warn other workers of hot metal.
  - Appropriate ventilation provided.
  - When working in confined spaces a permit has been issued as per 1910.146.

For specific requirements refer to General Industry Standards 1910.146; 1910.252; .253;, .254 and .272 and Construction Standards 1926.803; .350; .352 and .353.

\_\_\_\_\_  
Authorized Signature – Supervisor

CSB 5/28/05 Rev 1



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# Forklifts

OSHA 29 CFR 1910.178 regulates powered industrial trucks in dust areas

When powered industrial trucks are used in CLASSIFIED AREAS they must be rated in accordance with the link below

[Link to  
OSHA  
Powered Industrial  
Trucks](#)



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# Dust Layer

## Deflagration Hazard

– potential for flash fire and explosions

A deflagration hazard shall be determined to exist when either of the two following conditions exists:

1. Layer of accumulated fugitive dust exceed  $1/8^{\text{th}}$  inch over 5% of the area or 2,000 ft<sup>2</sup>, whichever is smaller.

This layer thickness can be adjusted for “settled” bulk density (on dry weight bases) using following formula:

$$\text{Allowable thickness, } T_p = \frac{0.125 \times 20 \text{ (lb/ft}^3\text{)}}{\text{Measure Bulk Density (lb/ft}^3\text{)}} \text{ inch}$$

2. Deflagrable wood dust in the air at a concentration in excess of 25% of MEC (Minimum Explosive Concentration) under normal operating conditions

**NFPA 664**

**- 3.2 mm (1/8") thickness**

**(Bulk density 20 lb/ft<sup>3</sup>)**



**< OK**  
**> NO**



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## Authority Having Jurisdiction - AHJ

Who makes the final decision about compliance?  
It is the Authority Having Jurisdiction or AHJ.

The problem for the Owner/Operator is that the authority is held by several entities and they may work from different guidelines and codes.

Here are some of the authorities that may apply:

- **OSHA**
- **Local Fire Marshall**
- **Local Building Inspector**
- **Insurance Company**
- **Corporate Mandate or Guidelines**

Ultimately it is the Owner/Operator that must assure and document that he has a safe workplace.

[See details in  
NFPA 664 –  
Chapter 3.2.2](#)  
[\(click here for NFPA 664\)](#)



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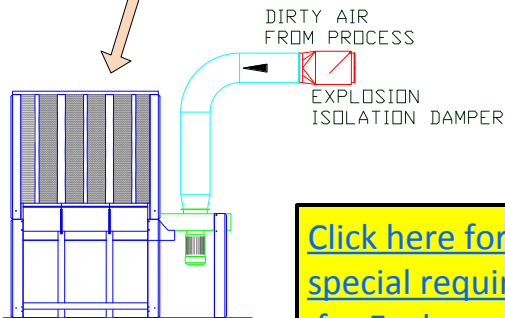
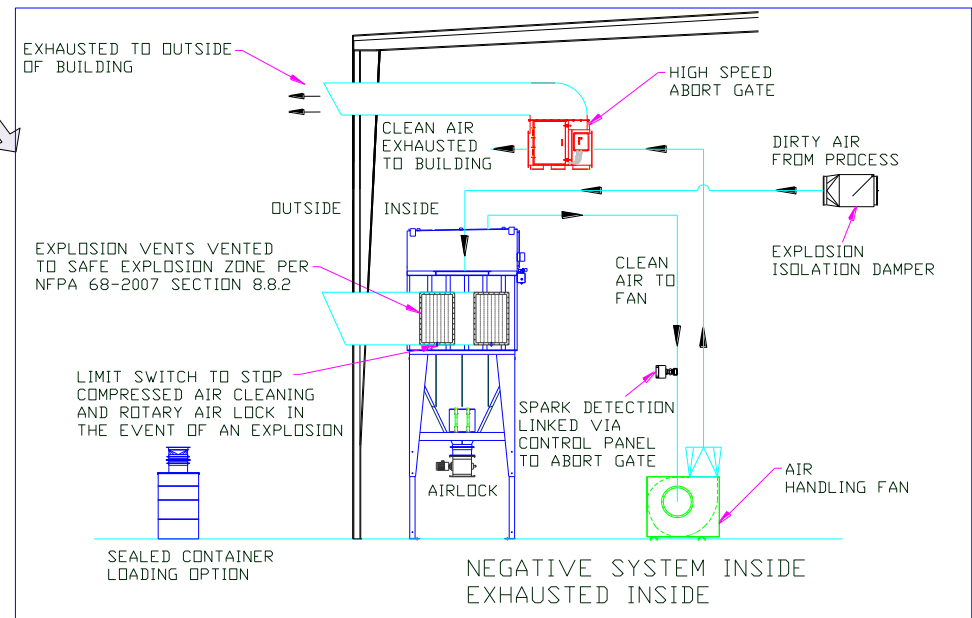
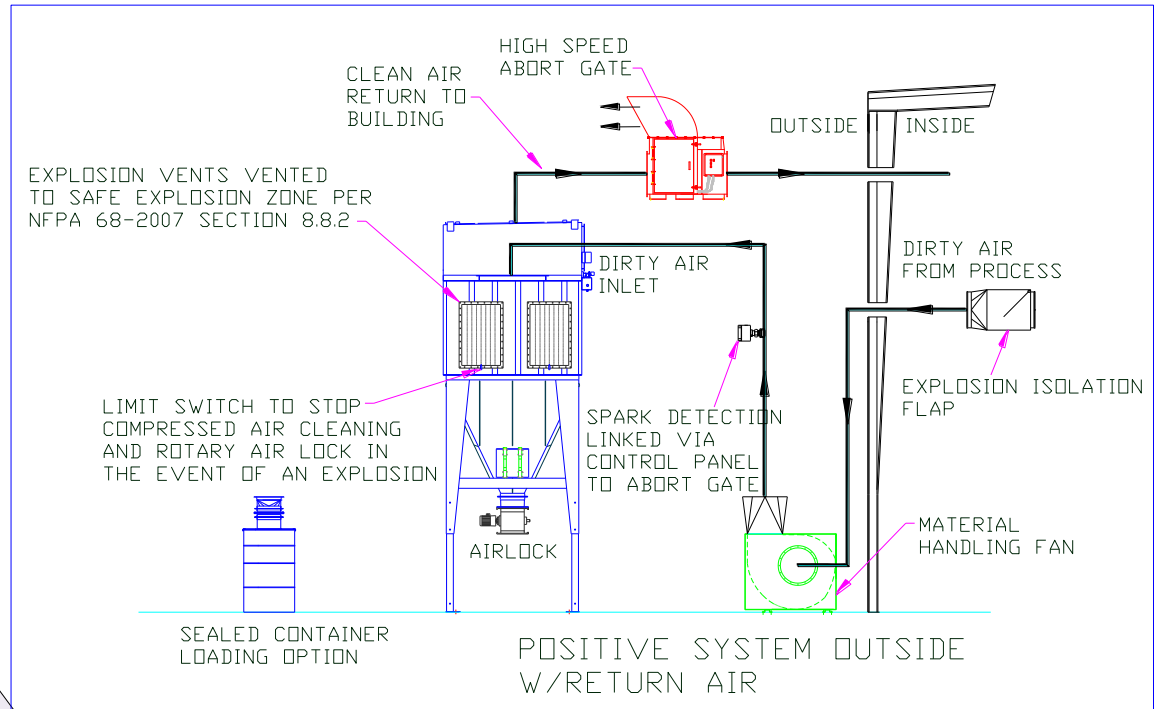
# Collector Location

**Dust collectors shall always be installed outside with explosion vents exhausting to a safe area**

Exemptions:

1. Inside with explosion vent exhausting to and outside safe area (See NFPA 68)

2. Enclosureless dust collector meeting specific requirements

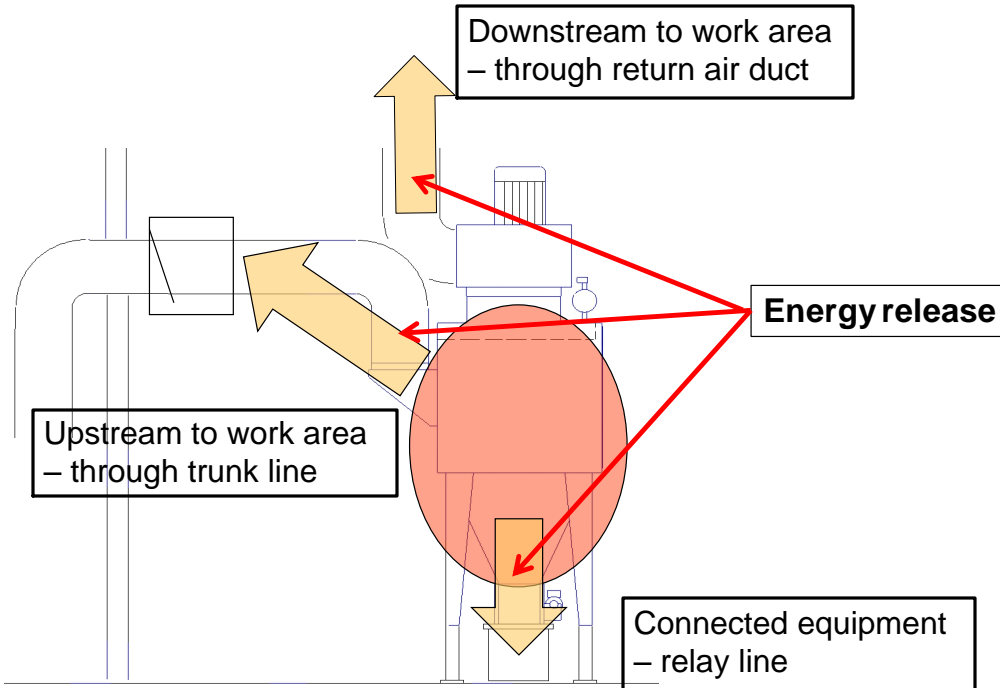


[Click here for special requirements for Enclosureless Dust collectors](#)



# Isolation

If an explosion happen in a dust collector the system must be designed to prevent the transfer of energy to upstream and downstream areas and equipment



Trunk line isolation methods:

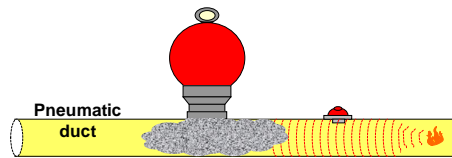
- Explosion Isolation Flap
- Chemical Isolation
- Fast acting Valve

Return air duct isolation methods:

- High speed abort gate
- Chemical Isolation
- Fast acting Valve

Downstream equipment isolation methods:

- Install compliant rotary valve on collector
- RV must stop immediately on event
- Chemical Isolation
- Fast acting Valve
- Note: If enclosed vessel is downstream special engineering required.



Explosion Isolation Flap  
Cost:  
\$2,500 - \$8,000

High Speed Abort Gate  
Cost:  
\$8,000 - \$20,000+

Chemical Isolation  
Cost:  
\$12,000 - \$25,000+

High Speed Gate Valve  
Cost:  
\$20,000 +up

Compliant Rotary Valve  
Cost:  
\$3,000 +up



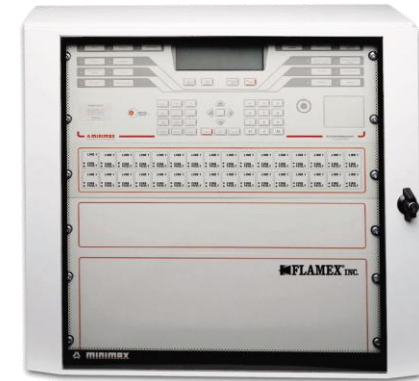
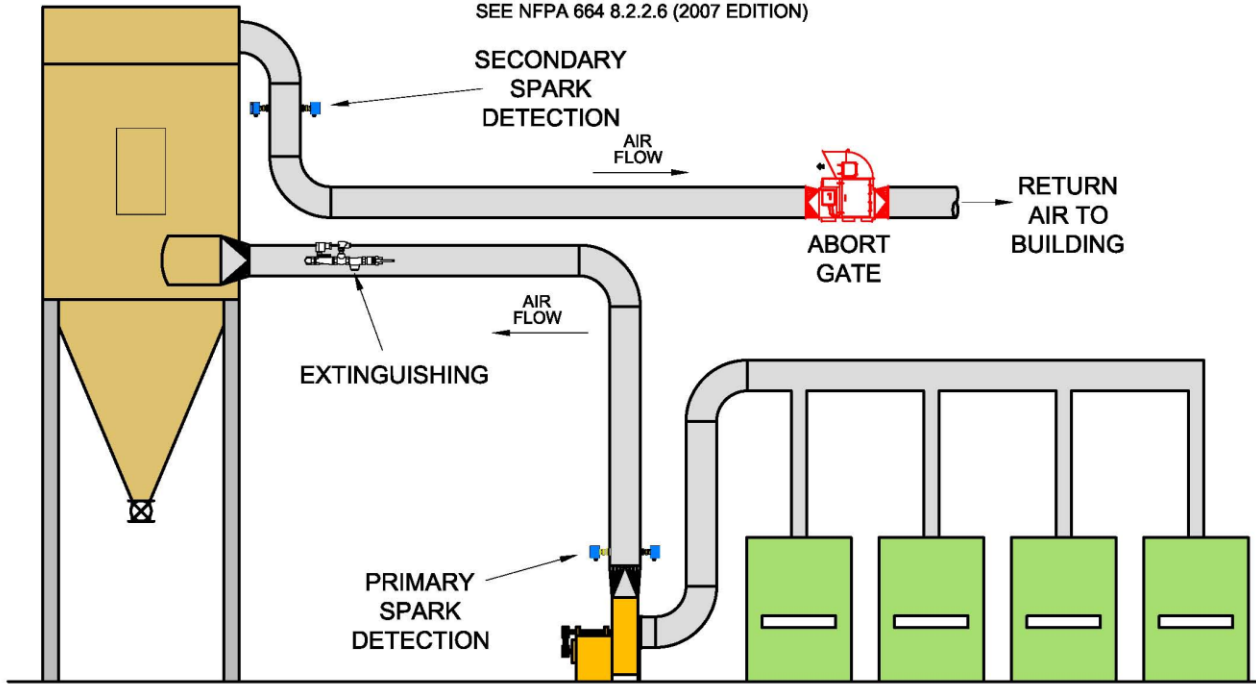
[Click here for more info on abort gate](#)

[Click here for more info on chemical isolation](#)

# Spark Detection

## TYPICAL SPARK DETECTION SYSTEM DESIGN ON SYSTEMS RECYCLING EXHAUST AIR

SEE NFPA 664 8.2.2.6 (2007 EDITION)



Cost:  
\$5,000 to \$8,000  
per zone/duct  
( $<30''$ ) + pump if  
required



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## Enclosureless Dust Collector

If your dust collection requirement is **below 5,000 cfm** then an enclosureless dust collector that complies with the NFPA664 design practices can be used inside your facility as long as;

- You are collecting just wood dust – no metal – no lacquers.
- You empty the waste containers at least once daily.
- It is 20' away from where people egress.
- It is 20' away from any other enclosureless dust collectors
- The fan is a TEFC design.
- The collector will not be extracting from wide-belt sanders or other machinery with a mechanical feed.



# Equipment Documentation -Operating and Maintenance Manual

## Design and submittal documentation:

- Mfg. data sheet & instruction manuals
- Design calc. inc. final reduced ( $P_{red}$ ) pressures
- General specifications
- Explosion prevention system equipment list
- Sequence of operation for each system
- End user inspection and maintenance forms
- User conformity with applicable standards and the appropriate chapter of this standard
- Combustible material properties and source of data
- Process hazard review
- Process plan view including protected process, placement location of all explosion prevention devices, and personnel work locations
- Process elevation view
- Electrical wiring diagram, including process interlock connection details
- Mechanical installation drawings and details
- Electrical installation drawings and details
- Process interlocks identifying each equipment interlock and function (P&ID)
- Employee training

## Mechanical Installation:

- Must follow drawings as system requirements are location sensitive
- Manufacturer's requirements must be followed related to environmental conditions and process material handled
- Safe access for inspection, service and maintenance

## Electrical Installation:

- Must comply with NFPA 70, National Electrical Code
- Hazardous areas identified in accordance with NFPA 70, 497 and 499 must be documented and information kept on file for life.
- Wiring and control circuits must be properly isolated and shielded from other circuits
- Control systems shall be installed, maintained, and isolated from the basic process control system
- Minimum functional testing must be performed
- Special requirements for type A and B circuits as described in NFPA 72
- An reliable source of electrical energy shall be used that meets the requirements of the manufacturer

## Installation Checkout and Commissioning:

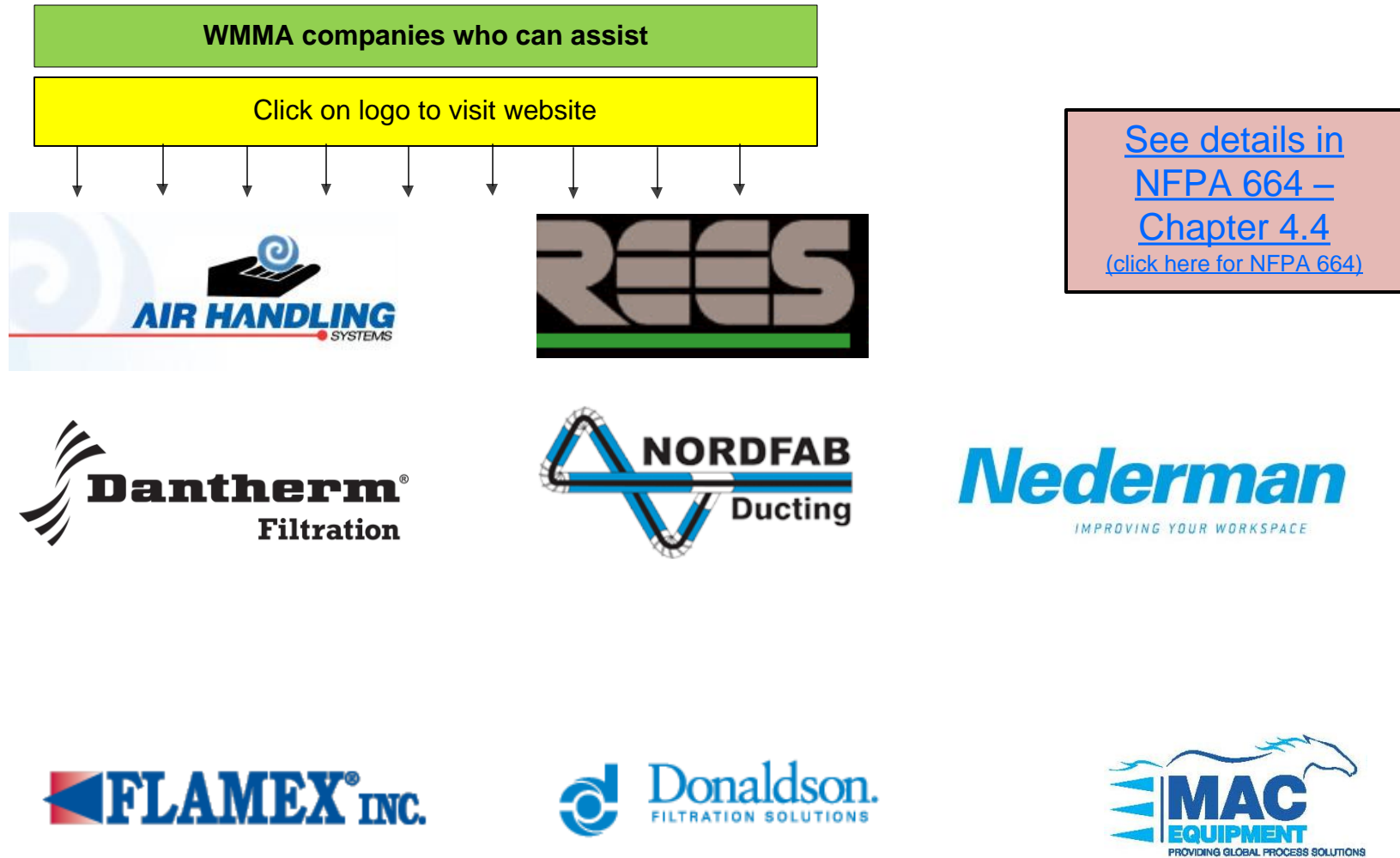
- Prior to start up and use of a protection system following steps are applicable:
- Walkthrough and inspect that the right equipment is installed in the location
- Inspect each components for mechanical and electrical integrity
- Conduct control unit function test
- Make point-to-point wiring checks of all circuits
- Ensure continuity and conditions of all field wiring
- Inspect sensing pathway and calibrate initiating devices
- 

- Verify installation of all system components
- Verify system sequence of operation by simulating activation to verify system inputs and outputs
- Conduct pre-validation testing. verify systems interlock, and shutdown circuits
- Complete record of system commissioning inspection, including hardware serial numbers, operational data, air flow readings, power readings, as appropriate
- Conduct user training
- Turn system over to Owner/Operator



# Designer Qualifications

**Designer and Installer Qualifications** – systems to be designed and installed under supervision of qualified engineers who are knowledgeable of these systems and their associated standards



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# Return Air – High Speed Abort Gate

Recycling of exhaust from dust collectors to buildings shall only be permitted if following are met:

1. it is from wood dust only and the collector efficiency is greater that 99.9% at 10  $\mu\text{m}$

2. the system is equipped with a listed spark detection system installed in accordance with NFPA 72

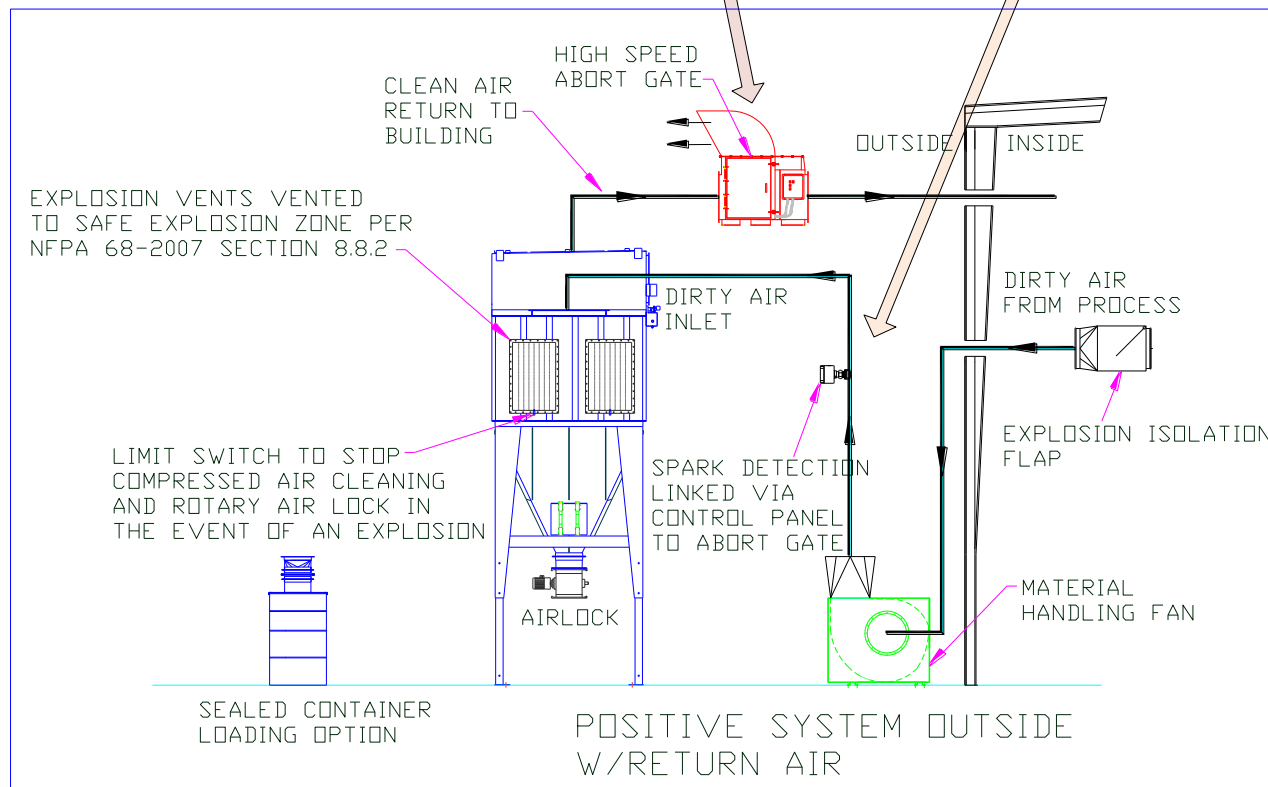
3. the exhaust air duct conveying the recycled air back to the building is equipped with a high speed abort gate w/ manual reset

[Click here for more Information on Spark Detection](#)

High Speed Abort Gate  
Cost:  
**\$8,000 - \$20,000+**

Alternatively chemical isolation can be used in return air ducting

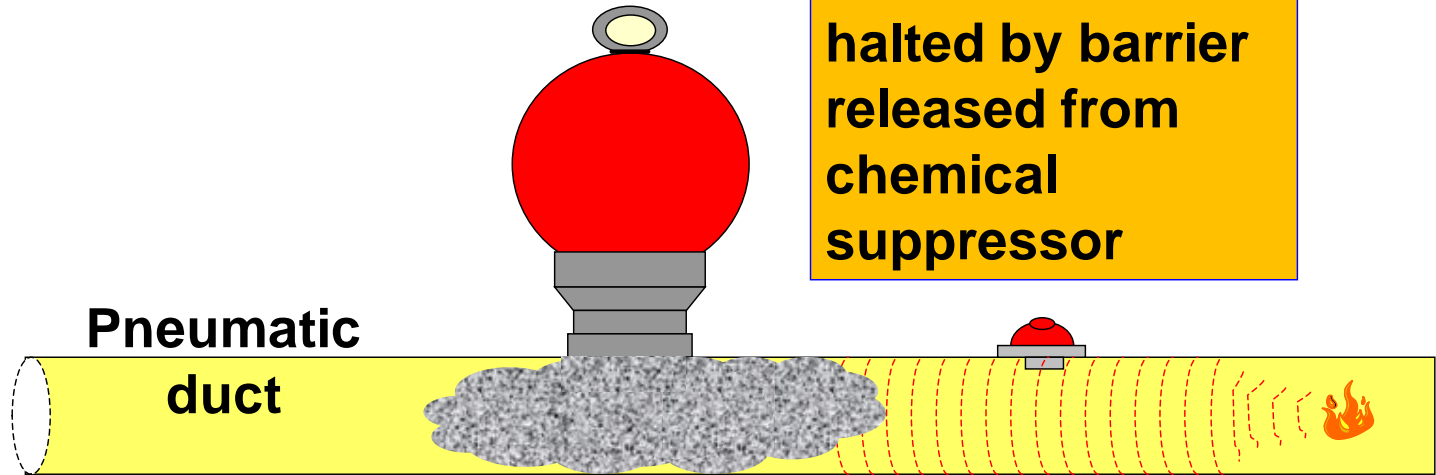
[Click here for more Information on Chemical isolation](#)



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# Chemical isolation

Flame front is halted by barrier released from chemical suppressor



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Chemical Isolation  
Cost:  
\$12,000 - \$25,000+

## Ductwork and Duct Design

- Processes that generates sparks, flames or hot material i.e. grinding wheels, welding, sanding shall not be manifolded into ducts conveying flammable or combustible material.
- An exhaust system shall be “inherently” balanced – or a means shall be provided to balance the system
  - Inherently balanced means it is designed using the “velocity pressure method”
- The velocity must be high enough to keep the duct interior clean and free of residual material
- Branch ducts shall not be added or removed without redesign of the system.
- Removal of branch duct also require redesign of system to assure required velocity is maintained.
- If the dust is combustible determine the concentration of combustible dust and compare it to the MEC for the product conveyed. (if >25% of MEC explosion relief may be required).
- Changes in duct sizes shall be designed to prevent accumulation of material by utilizing tapered transition with the included angle of taper not more than 30 degrees (preferred) or 45 degrees if necessary.
- When duct passes through physical barriers that is erected to segregate dust deflagration hazards, physical protection shall be provided to prevent propagation of deflagration between segregated spaces.
- Ductwork shall be metallic. Exception: Flexible duct is only permitted at an inlet when movability or portability is required.
- Ductwork shall be bonded and grounded
- Ducts shall be isolated to prevent propagation of deflagration to other vessels.



## Hazard Locations

- **The NEC (National Electrical Code) establishes the criteria for electrical safety for “Hazardous Locations” in Article 500 through 504.**
- **The sole concern of NEC is preventing the electrical service from serving as an ignition source or electrical shock hazard.**
- **“Class I Hazard Locations” are areas containing gasses and vapors**
- **“Class II Hazard Locations” are areas containing combustible dusts**

### Class II Division 1 areas

A location where:

Combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures

Mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced and might also provide a source of ignition through simultaneous failure of electrical equipment, through operation of protection devices, or from other causes

Group E (combustible metals) combustible dusts may be present in quantities sufficient to be hazardous

### Class II Division 2 areas

A location where:

Combustible dust may be present in the air in quantities sufficient to produce explosive or ignitable mixtures, due to abnormal operations

Combustible dust accumulations are present but are normally insufficient to interfere with normal operation of electrical equipment or other apparatus, but could become suspended in the air as a result of infrequent malfunctioning of handling or process equipment

Combustible dust accumulations on, or in vicinity of electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignited by abnormal operation or failure of electrical equipment

None Hazardous areas are “Unclassified” or “general purpose” areas



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## Resources

Click on subject you want to view

[OSHA – Occupational Safety and Health Administration](#)

[Combustible Dust](#)

[OSHA Advanced Notice of Proposed Rulemaking](#)

[NFPA – National Fire Protection Association](#)

[NFPA 664 – Standard for the Prevention of Fire and Explosions in Wood Processing and Woodworking Facilities](#)

[NFPA 654 – Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing and handling of Combustible Particulate Solids](#)

[NFPA 68 – Standard on Explosion Protection by Deflagration Venting](#)

[NFPA 69 – Standard on Explosion Prevention Systems](#)

[FM Global – Insurance Company](#)

[Loss Prevention Data Sheet 7-73, Dust Collection Systems](#)

[Loss Prevention Data Sheet 7-76, Prevention and Migration of Combustible Dust Explosions and Fires](#)

[Congress](#)

[US Chemical Safety Board](#)

[Linkedin – The Combustible Dust Forum](#)

[Building Code Reference Library](#)

[Combustible Dust Policy Institute](#)

[Imperial Sugar Company Dust Explosion and Fire](#)



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# Dust Testing

As part of the Process (Hazard) Analysis as outlined in NFPA 664 Chapter 4.2 the Owner/Operator must establish the severity of a potential explosion in the materials handled in the process.

Chapter 4.2.2 says:

“The design of systems and facilities that handles combustible particulate solids shall address the physical and chemical properties and hazardous characteristics of the materials in the hazard area”

This means that sampling of potentially Combustible Dusts must be taken and analyzed and tested to establish its characteristics.

This information is required and used by the designer of the dust handling systems.

The data is established through testing at specialized laboratories using test methods established by ANSI.

OSHA may require its own standardized tests if you are inspected under the NEP program.

Typical tests required on wood dust	
<b>Explosion Severity Test</b> ( $P_{max}$ , $dP/dt_{max}$ , $K_{St}$ )	Cost: \$1500 - \$2,500
<b>Minimum Explosible Concentration (MEC)</b>	Cost: \$900 - \$1,500
<b>OSHA Combustible Dust NEP Testing</b>	Cost: \$4,000 - \$5,000

Multiple test may be required for each facility/process.

Owner/operator should engage professional assistance for Process (Hazard) Analysis and dust testing

