

Combustible Dust

The Basics



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Why the Recent Focus?

2003 - 3 catastrophic dust explosions

- **January - 7 Fatalities, 38 injured**

2006 – US Chemical Safety and Hazard Investigation Board issues *Combustible Dust Hazard Study*

- **February - 7 Fatalities, 37 injured**

2008 – OSHA issues *Combustible Dust National Emphasis Program*

- **October - 1 Fatality, 7 injured**

Why the Recent Focus?

2003 - 3 dust explosions kill 14 employees

2006 – US Chemical Safety and Hazard Investigation Board issues *Combustible Dust Hazard Study*

2008 – OSHA issues *Combustible Dust National Emphasis Program*

- **No Comprehensive OSHA Standard**
- **NFPA Standards Voluntary**
- **Fire Codes, Inspections Inconsistent**
- **Hazard Awareness Weak**
- **MSDSs Inadequate**

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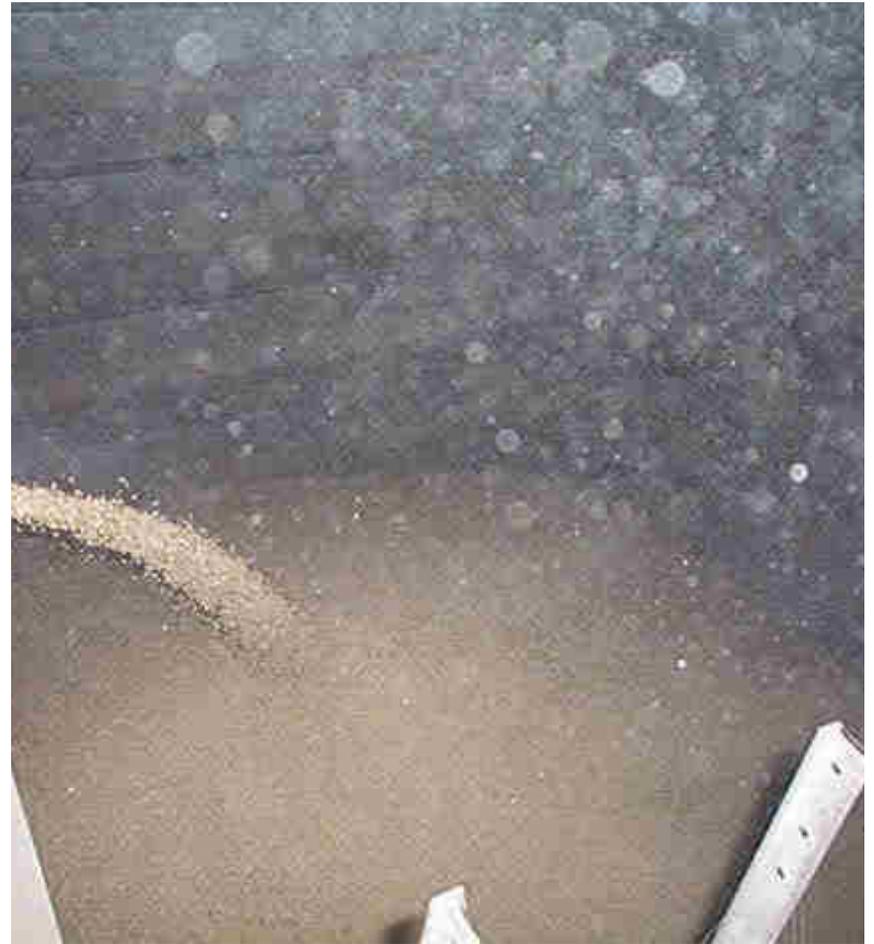
2008 – OSHA issues *Combustible Dust National Emphasis Program*

- **Inspection guidelines**
- **Discussion of hazards**
- **Sampling and analytical methods**

What is Combustible Dust?

A combustible particulate:

- Which presents a fire or deflagration hazard;
- When suspended in air/oxidizing medium;
- Over a range of concentrations;
- Regardless of size or shape.



An Inclusive Hazard

Agriculture

Chemical

Pharmaceutical

Plastics

Food

Woodworking

Wastewater Treatment

- Wood/Paper/Cork
- Coal
- Carbon Black
- Drugs
- Plastic
- Textiles
- Pesticides
- Biosolids
- Food Stuffs

Relative Explosivity

Coal	1.0
Vitamin C	2.2
Acrylamide	2.5
Polycarbonate	8.6
Cornstarch	9.5
Bis-phenol A	>10
Aspirin	>10
Aluminum	>10

Explosibility Index

- **Weak** <0.1
- **Moderate** 0.1-1.0
- **Strong** 1.0 -10.0
- **Severe** >10

Combustibility

Contributing Factors

% Moisture

Particle Size

MEC

K_{ST}

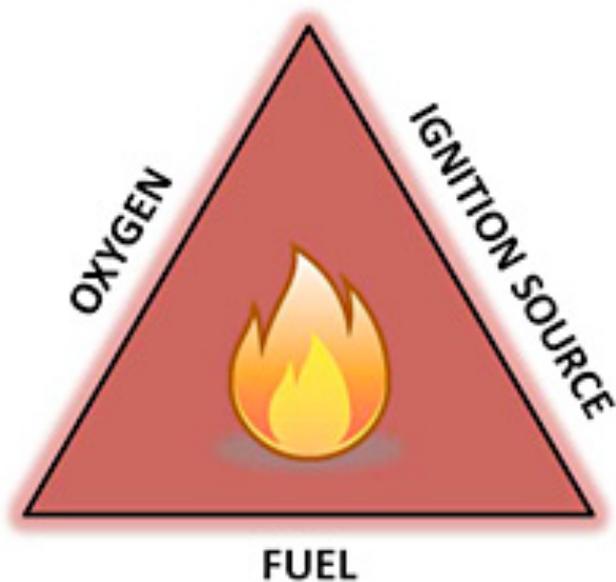
Class II

- % Combustible Material
- % Combustible Dust
- Resistivity
- Minimum Ignition Energy
- Minimum Ignition Temperature
- Max Explosion Pressure
- Layer Ignition temp
- Dust Cloud Ignition temp

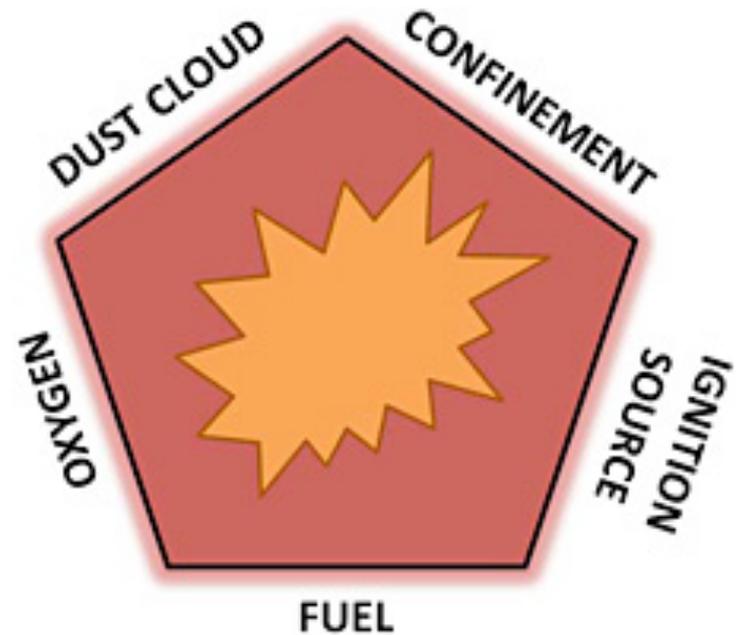
Combustibility Contributing Factors

% Moisture		Less moisture/greater hazard
Particle Size		< 420 um (40 mesh sieve)
MEC	Minimum Explosible Conc.	Minimum amount of dust dispersed in air for explosion
Kst	Deflagration Index	Estimates severity of explosion. (Class St 0 – St 3)
Class II	Explosion severity (ES)	Determines if Class II electrical equipment required

Components Required for an Explosion

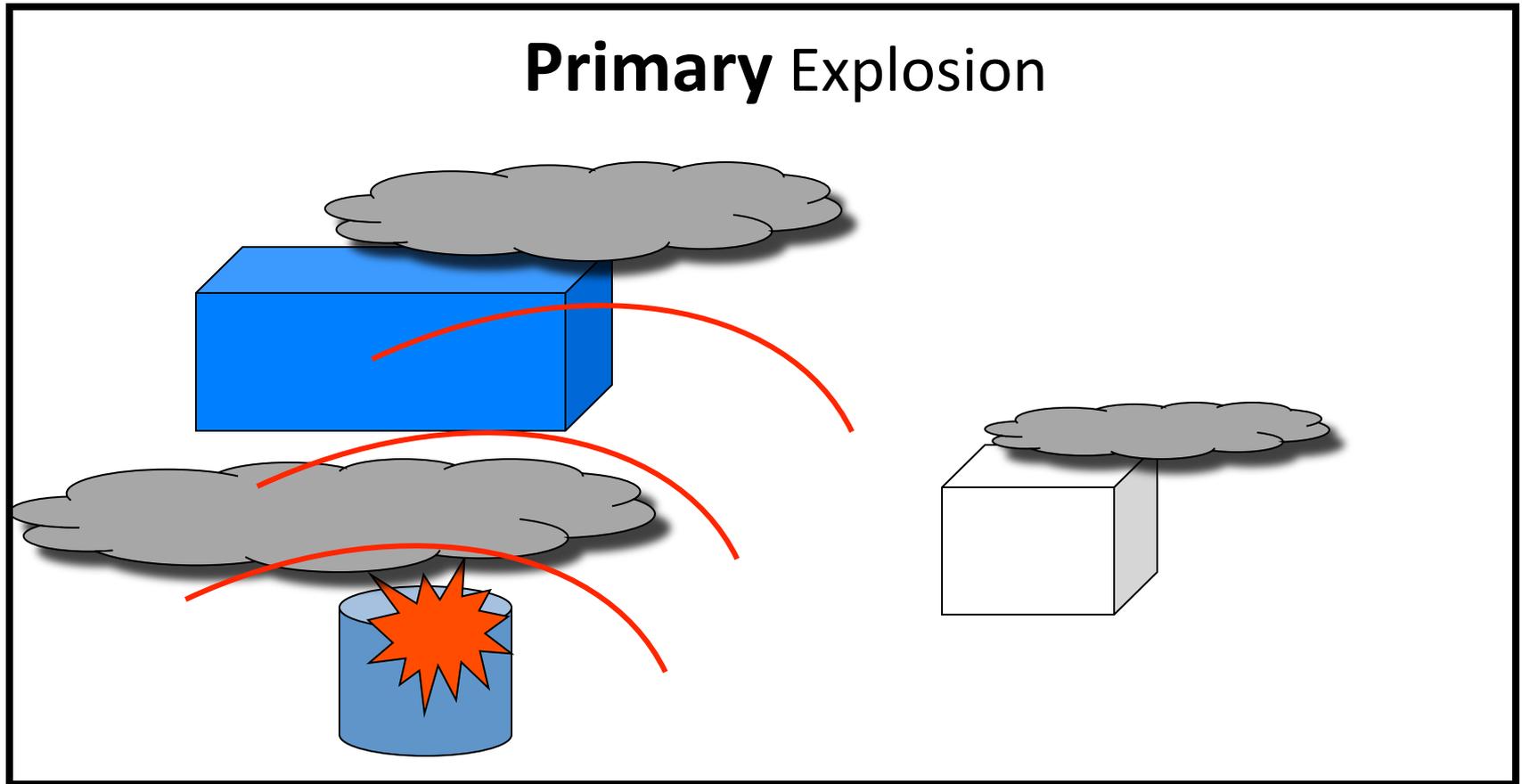


FIRE TRIANGLE



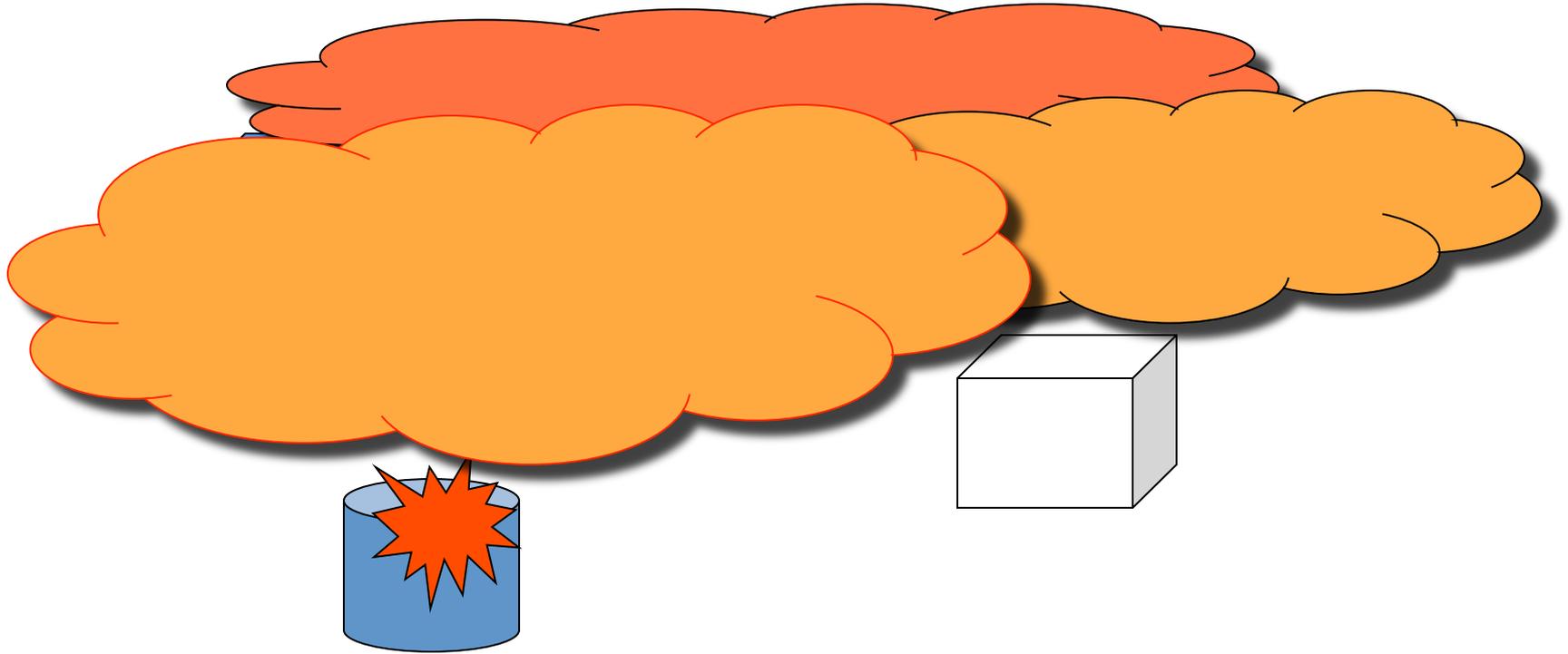
EXPLOSION PENTAGON

Anatomy of an Explosion

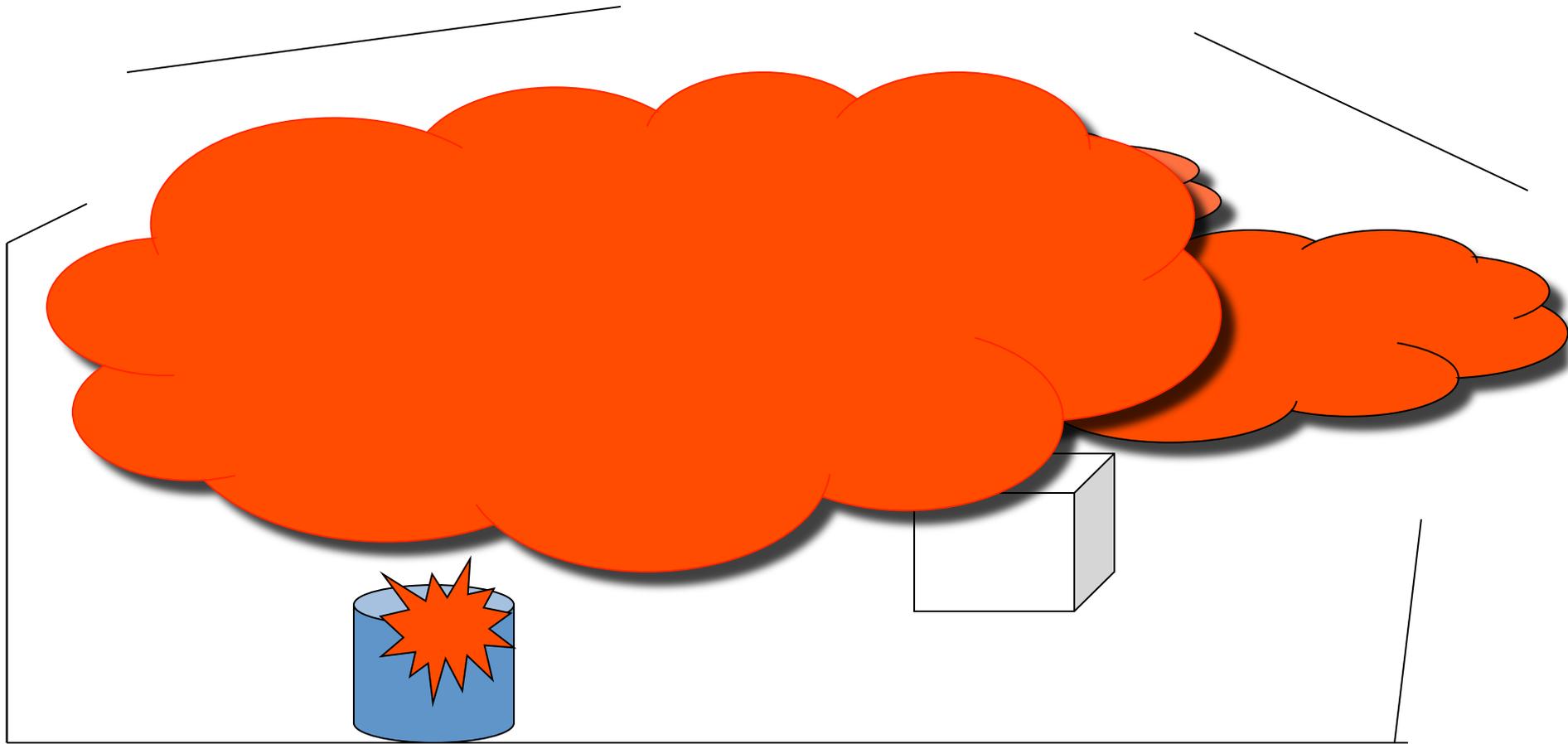


Anatomy of an Explosion

Secondary Explosion



Anatomy of an Explosion



Components Required for an Explosion

Ignitable Dust

Air

Ignition Source

Confinement

- $> 1/32''$ accumulation on surfaces
- Coverage 5% of floor area
- **All** horizontal surfaces
(Layer rarely uniform)

Components Required for an Explosion

Ignitable Dust

Oxidant (air)

Ignition Source

Confinement

- **Hybrid mixtures**
(presence of a flammable gas/vapor – even if $< \text{LEL}$)

Examples:

- Coal dust/methane
- Plastic/vapors

Components Required for an Explosion

Ignitable Dust

Air

Ignition Source

Confinement

- Sparks
- Foreign Materials
- Hot Surfaces
- Belts/Bearings
- Electrical
- Static Electricity
- Hot Work

Components Required for an Explosion

Ignitable Dust
Air
Ignition Source
Confinement

- Dust Collectors
- Dryers
- Grinders/Pulverizers
- Blenders/Mixers
- Silos
- Storage Bins
- Bagging/Packaging

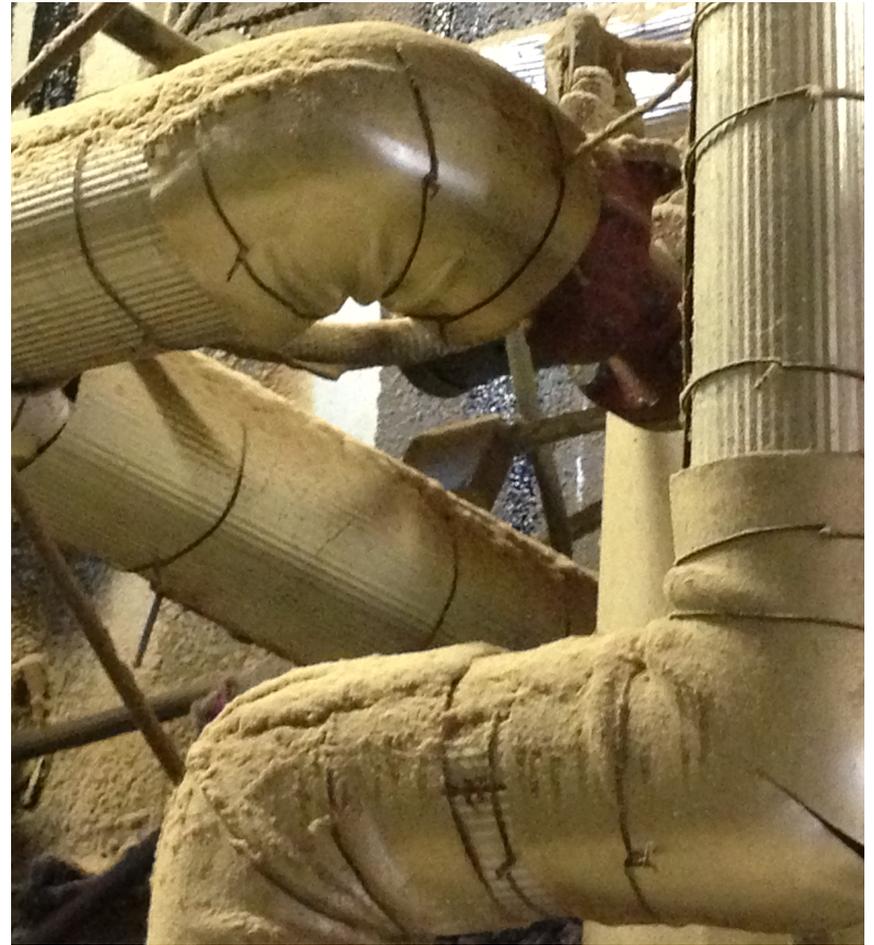
Engineering Controls

- **Facility Design**
- **Specific Process**
- **Equipment Controls**
- **Containment**
- **Inerting**
- **Mechanical Isolation**

Segregation/Separation
Spark Detection
Deflagration Systems
Extinguishment Systems
Explosion Venting
Inerting
Bonding/Grounding

Other Controls

- SOP Housekeeping
- SOP Repair/
Maintenance
- Education/Training
- PHAs

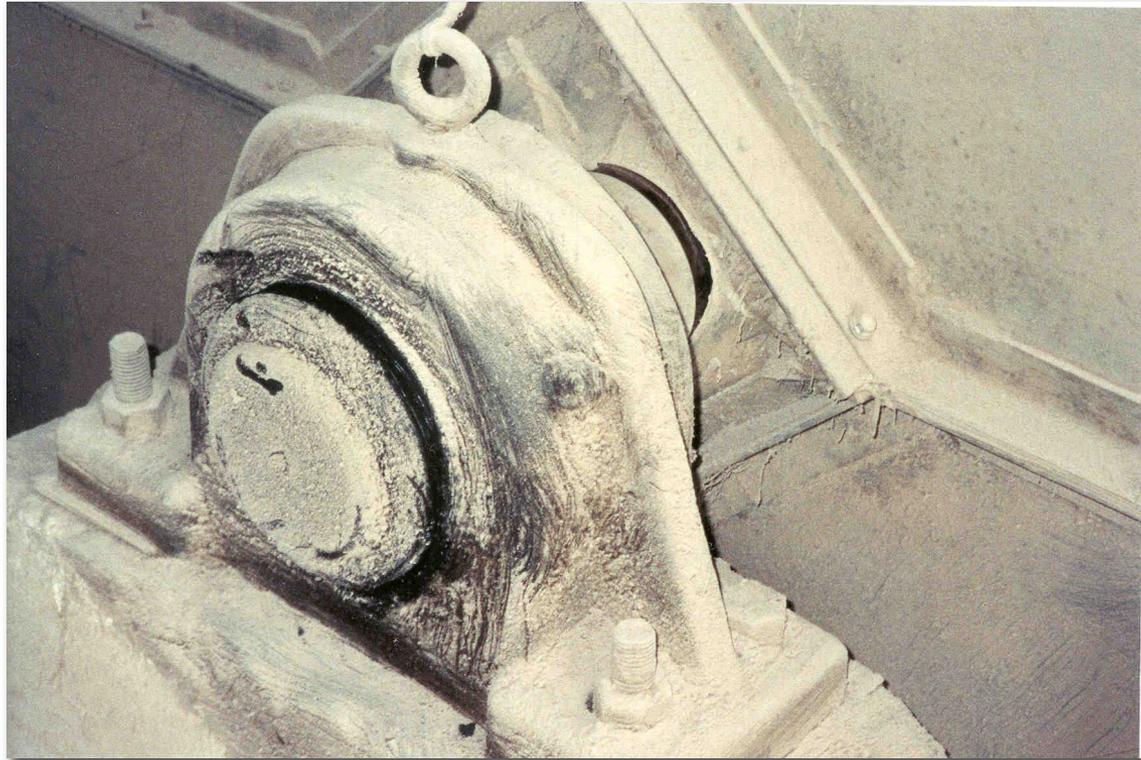


Common Issues



Mary Ann Heaney, CIH, CSP
January 14th, 2013

Common Issues



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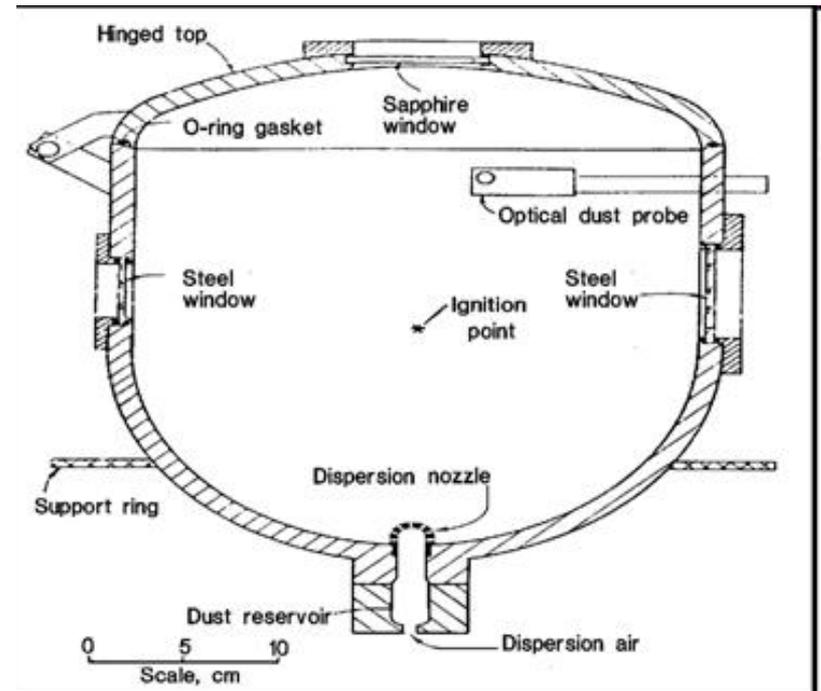
Fundamental Health and Safety

- **Ventilation Systems**
- **Industrial Trucks**
- **Life Safety**
- **Toxicity**
- **Fire Protection**



First Steps?

- Characterize dust
- Determine Dust Presence
(NFPA 654 Rule of thumb)
 - 1/32" over 5% of floor area
(paperclip thickness)
 - Bar joist surface area
equals about 5% of floor
area
 - >20,000 ft², 1000 ft² is dust
upper limit



First Steps?

- Evaluate equipment
- Add controls
- Educate
- Develop SOPs
- MOC System
- Review OSHA NEP
- Review OSHA ANPR

References

- NFPA 61** *Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities*
- NFPA 654** *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*
- NFPA 664** *Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities*
- US Chemical Safety Board** *Combustible Dust Hazard Study*
- ASTM Standard Test Methods** *E1226, E1515*
- FM Data Sheet No. 7-76** *Prevention and Mitigation of Combustible Dust Explosions and Fire*
- OSHA CPL 03-00-008** *Combustible Dust National Emphasis Program*
- OSHA CPL 02-01-004** *Inspection of Grain Handling Facilities*