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Applying Modern Fire & Explosion Protection Standards to Legacy Equipment

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Bruce McLelland

Fike Corporation

Business Development Director,
Explosion Protection

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Risk Management – Safety Combustible Dust

Applying Modern Fire & Explosion Protection Standards to Legacy Equipment

Presentation by: Bruce McLelland

BECAUSE SO MUCH IS AT STAKE™

March 2022

Manufacturing
Research and Testing
Consulting
System Design
System Installation
System Services
Explosion Protecti
Pressure Relief
Fire Protection

Since 1945 Family-owned, privately-held independent company

Manufacturer of life and critical-asset protection systems

Consultants to the Combustible Dust needs of our clients including Strength Analysis and Computational Fluid Dynamics

Global experts in local regulations, with Localized consultative capabilities

Sales and service offices across North and South America, Europe, Asia and the Middle East

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Bartlett Grain Co. L.P. Atchinson, KS

- 6 Fatalities – country grain elevator
- Company faced five willful and eight serious safety violations cited by the U.S. Department of Labor's Occupational Safety and Health Administration

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CASE STUDY

Imperial Sugar Refinery Explosion

Feb 7, 2008 // Port Wentworth, GA

- 14 Fatalities
- 38 Injured
- $8.7M Fine

Rebuild Cost in Excess of:

$300 Million

Completion: **Jan 2010**

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IMPERIAL SUGAR REFINERY

CSB Video

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IMPERIAL SUGAR REFINERY

What Caused the Explosion?

Deep piles of combustible dust accumulated on building surfaces and equipment.

Courtesy of CSB

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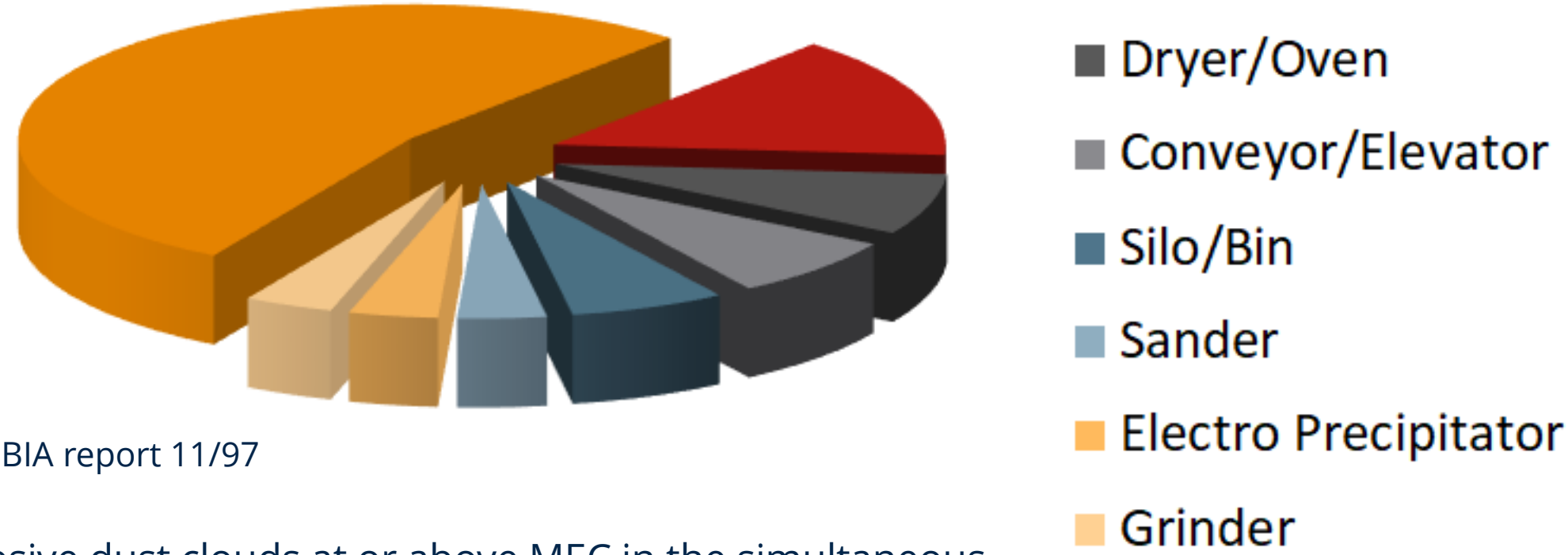
Industrial Equipment Where Dust Explosions Originate



Source: BIA report 11/97

Explosive dust clouds at or above MEC in the simultaneous presence of ignition sources can occur inside equipment enclosures.

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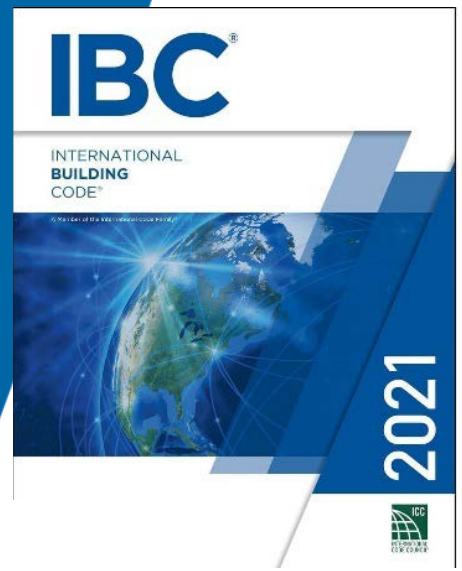
Types of Regulations

Two categories of regulations exist regarding dust explosion hazards:

- **Safe Plant Regulations** – Directed toward facility owners, ensure workers exposure to dust hazards are minimized and generally address operations, facility and building construction.

- **Safe Equipment Regulations** – Directed toward facility owners, ensure equipment, machinery and protective systems are designed to operate reasonably safe in workplaces where combustible dust explosion hazards can or do exist.



Each independent city, county, state, country, nation or federation typically has its own legal regulations; some by self creation and many by adoption of other authoritative bodies.

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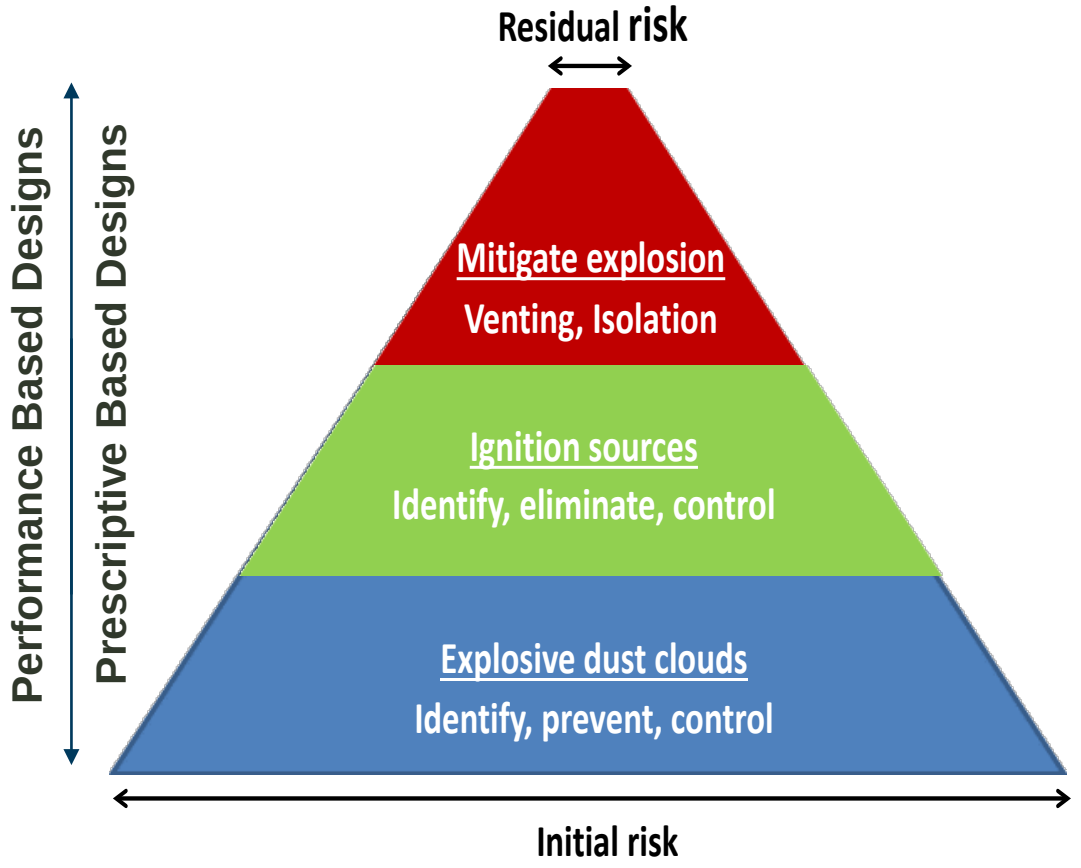
Protecting Against Dust Explosions

Prevention		Mitigation
Ignition Sources (Hot surfaces, flames, electrostatic discharge, sparks)	**Explosable Dust Clouds**	
Temperature control	Inerting by N_2, CO_2 and rare gases	Partial inerting by inert gas
Hot work permits	Intrinsic Inerting	Isolation
Grounding, bonding	Inerting by adding inert dust	Venting
Magnetic screen	Dust concentration monitoring Oxygen monitoring	Automatic Suppression
Hazardous area classification	Good Housekeeping (cleaning & dust removal)	Pressure Resistant construction



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Know Your Material Behavior

- Reduce Qty of transfer points
- Minimize Dust Suspension
- Low conveyor speed
- Dust aspiration
- Inspect-Repair-Replace Flex Joints
- Clean-Up!

Materials Testing may be Recommended

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Dust Combustion & Explosion Tests

ID	Test	Determines	ASTM Standard	CEN/VDI standard
Go / No-Go	Dust Explosibility Screening Test	If dust supports self-sustaining combustion in air and is explosible	ASTM E1226	EN 80079-20-2
P_{max} / K_{st}	Dust Explosibility Test for Maximum explosion pressure and Maximum rate of explosion pressure rise	The maximum pressure developed during a contained deflagration, and the rate of pressure rise, i.e. the strength of an explosion	ASTM E1226	EN14034-1 Annex C
MEC	Minimum Explosible Concentration	Which concentration of dust in air is required for an explosion	ASTM E1515	EN14034 3 Annex C
MIE	Minimum Ignition Energy	Lowest spark energy required to initiate a dust explosion	ASTM E2019	EN80079-20-2 EN13822 (with inductance) EN13821 (w/o inductance)
MAIT (MIT_{Cloud})	Minimum (Auto)Ignition Temperature of dust clouds	Minimum temperature at which a dust cloud will ignite when exposed to heated air	ASTM E1491	EN80079-20-2 VDI 2263, Blatt 1, 2.6
MIT_{layer}	Minimum Ignition Temperature of dust layers	Lowest surface temperature required to ignite a dust layer	ASTM E2021	EN50281-2-1
VRT	Volume Resistivity Test	Measures the tendency of a powder to generate and retain electrical charge and the likelihood of electrostatic discharges from the powder	ASTM D257	EC 61241-2.2
LOC	Limiting Oxygen Concentration for dusts (LOC)	Lowest oxygen concentration in air at which a dust explosion can occur	ASTM E2931	EN14034 1-2 Annex C

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Dust and Explosion Protection Standards

NFPA Document	Title
NFPA 67	Guide on Explosion Protection for Gaseous Mixtures in Pipe Systems
NFPA 68	Standard on Explosion Protection by Deflagration Venting
NFPA 69	Standard on Explosion Prevention Systems
NFPA 61	Standard on the Prevention of Fires and Combustible Dust Explosion in Agricultural and Food Processing Facilities
NFPA 499	Recommended Practice for Classification of Combustible Dust and of Hazardous Locations for Electrical Installations in Chemical Process Locations
NFPA 101	Life Safety Code
NFPA 652	Standard on the Fundamentals of Combustible Dust
NFPA 654	Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing and Handling of Combustible Particulate Solids
NFPA 655	Standard for Prevention of Sulfur Fires and Explosion
NFPA 664	Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities
NFPA 484	Standard for Combustible Metals

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NFPA Standards Form Basis for Safety

- **Hazard control objectives**
  - Prevent or limit formation of hazardous atmosphere
  - Prevent ignition of the hazardous atmosphere
  - Limit the consequences of a deflagration to acceptable levels
    - Includes secondary explosion protection
  - Living documents

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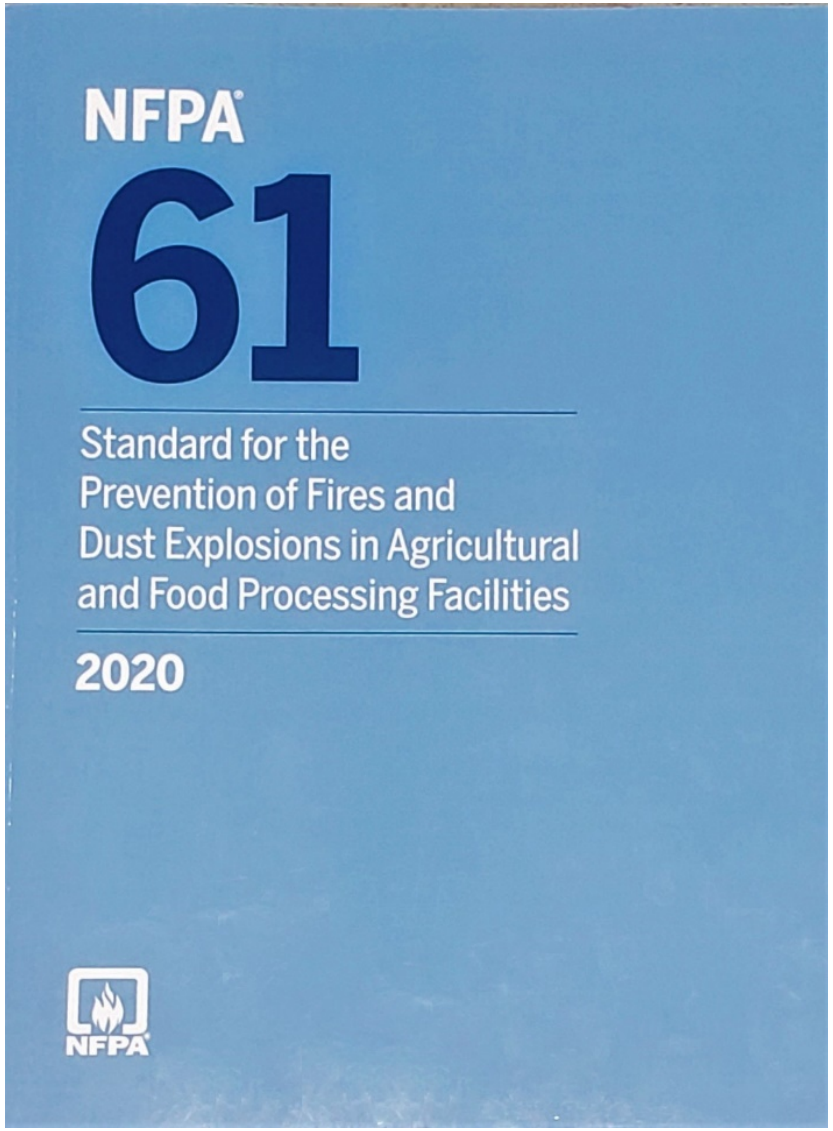
NFPA 61 UPDATES

- General
  - Format – Language continues to be updated to NFPA standard practices much like other dust standards
  - Many definitions added to Standard
  - Clearly stipulates the requirement to perform a Dust Hazard Analysis is to be applied Retroactively
  - Clearly identifies required DHA's to be completed by January 1, 2022



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NFPA 61 UPDATES

DHA – DUST HAZARD ANALYSIS

- See Annex Chapter 7 – Annex is not part of the regulatory body of the standard, it is however very useful information
- See Annex F – Contains a very helpful model of Dust Hazard Analysis Checklist
- See Annex A5.2 Testing Actual material from the process……
- See Annex A5.2.2 New Table for Test Data Agricultural Dusts

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NFPA 61 UPDATES

CHAPTER 8 MANAGEMENT SYSTEMS

- Chapter 8.4 Housekeeping (New material)
  - Methodology
    - Written Program
    - Vacuum Cleaning Method
    - Sweeping, Shoveling, Scoop and Brush Cleaning Method
    - Compressed Air Blowdown Method
    - Additional elements to be added at a later time
- Chapter 8.5 Hot Work
  - 8.5.6 Use of Portable Equipment (New material)
- Chapter 8.6 Personal Protective Equipment
  - 8.6.1 Clothing Compliance Requirements

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NFPA 61 UPDATES

CHAPTER 9 HAZARD MANAGEMENT: MITIGATION and PREVENTION

- Chapter 9.2.6 Separation of Hazard Areas from Other Hazard Areas and from other Occupancies (New material)
- Chapter 9.3.16 Mixers and Blenders (New material)
- Chapter 9.3.17.5 Spray Dryer Systems (New material)
- Chapter 9.4 Ignition Source Control (New material)

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NFPA 61 UPDATES

OTHER REMINDERS

- See Chapter 2 Referenced Publications
  - The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document
- Annex Chapter 7 – Annex is not part of the regulatory body of the standard, it is however very useful information
- See Annex F – Contains a very helpful model of Dust Hazard Analysis Checklist
- See Annex A5.2 Testing Actual material from the process……
- See Annex A5.2.2 New Table for Test Data Agricultural Dusts

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Dust Hazard Analysis (DHA)

What is a DHA?

- Review of the **entire process, equipment, and building** to identify fire, flash-fire and explosion hazards.
- *It is a risk analysis.*

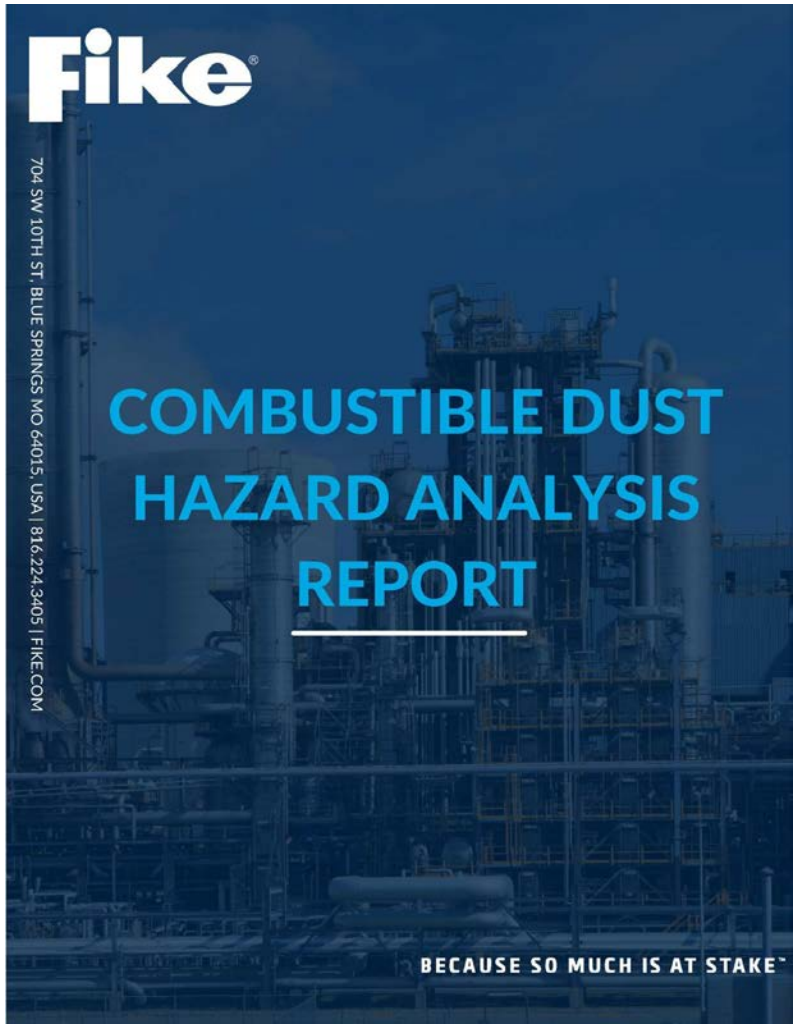
Who are they for?

- Facilities that **process or generate combustible dust**.

Why do we conduct them?

- Provides a holistic u**nderstanding of the combustible dust hazards** at the facility guiding our **prioritize and action plan**
- NFPA requires it. And many insurance companies, OSHA, and local building permit authorities ask for them.

All Facilities and All Processes With Combustible Dust are Required to Have a DHA



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NFPA 61 UPDATES

DHA – DUST HAZARD ANALYSIS

- A systematic review to identify and evaluate the potential fire, flash fire, or explosion hazards associated with the presence of one or more combustible particulate solids in a process or facility.
  - Hot work (ignition source)
  - Housekeeping – accumulation exceeds action threshold and methods used stir up dust into cloud (fuel source)
  - Mechanical equipment malfunction (ignition source)
  - Engineering control – dust collector not protected (limit spread)
  - Electrical equipment – not approved for use in an area where dust cloud or dust layers present (ignition source)
  - Facility design – drop ceiling creates inaccessible area where fine dust accumulation can occur (fuel source)

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NFPA 61 UPDATES

DHA – DUST HAZARD ANALYSIS

- Hazard analysis – not only tells you where you have a problem but also where you don't have one
  - Identify your most common ignition sources and determine whether they pose viable sources for combustible dust clouds and layers
  - Electrical area classification – focus here should probably be on layer accumulation on hot surfaces (motors, pumps)
  - Review construction regarding penetrations between rooms or areas, inaccessible areas (drop ceilings), elevated flat surfaces, non-smooth wall surfaces, fire barriers/walls
  - Consider measures that limit spread of combustion event – construction of fire barriers, venting, housekeeping, suppression and isolation

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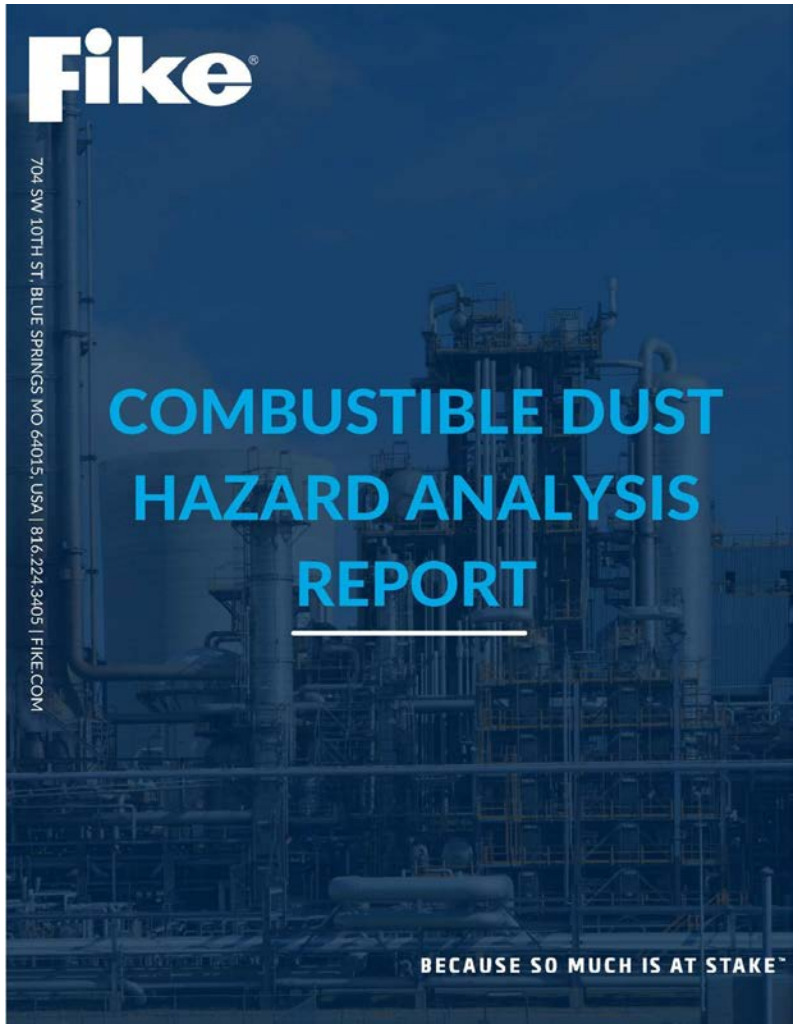
Risk Ranking Prioritization

What is Risk Ranking?

- Review of the entire process, equipment, and building to semi quantify the facility and equipment combustible dust hazards
- It permits a first order of magnitude identification of risk by addressing frequency, likelihood and possible consequences
- Assists in prioritizing corrective actions, scheduling and budgeting recommended fire, flash-fire and explosion hazard improvements



All Facilities and All Processes With Combustible Dust are Required to Have a DHA

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NFPA RECOGNIZED METHODS PROTECT THE EQUIPMENT ENCLOSURE

PRESSURE CONTAINMENT

DILUTION

OXIDANT REDUCTION

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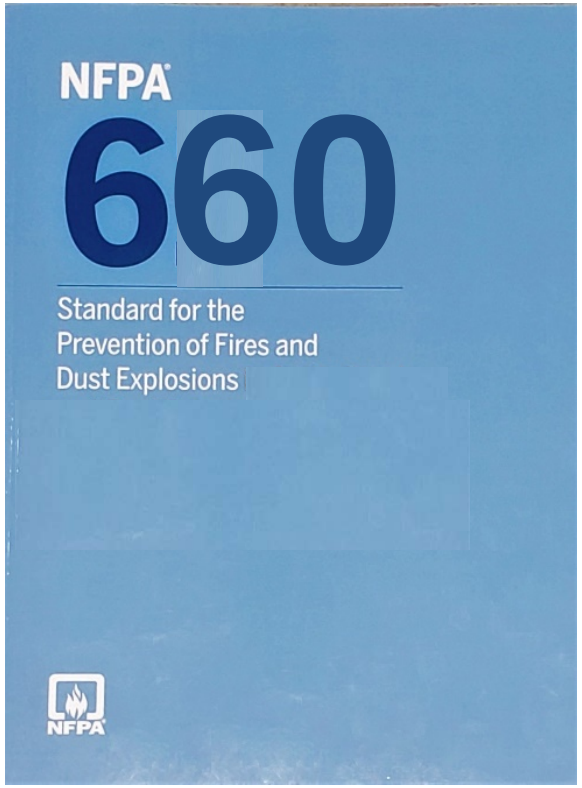
WHAT'S NEXT



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- Equivalency (Paraphrased)
- ….equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed (component vs. system)
- ….technical documentation required
- ….approved for intended purpose by AHJ

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Retroactivity (Paraphrased)

- ….standard reflects a consensus of what is necessary to provide an acceptable degree of protection from hazards addressed in this standard at time of issue
- ….provisions shall not apply to facilities, equipment, structures, or installations existing or approved prior to the effective date of this standard.
- Where specified the provisions of this standard shall be retroactive.
- ….the AHJ shall be permitted to apply any provisions retroactively….to achieve an acceptable degree of risk.

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- Retroactivity – Continued (Paraphrased)
- NFPA 61 – Latest Issue 2020
- Where specified the provisions of this standard shall be retroactive.
- Chapter 7 Dust Hazard Analysis – Applies Retroactive
- Chapter 8 Management Systems – Applies retroactive
- ….the AHJ shall be permitted to apply any provisions retroactively….to achieve an acceptable degree of risk.
- AHJ’s are training to current Standards of Practice (most often NFPA 652)

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Challenges of Retroactive Application to Legacy Equipment and Process

- Absence of known values
  - No or Little Documentation
  - Behavior of Combustibles
  - Mitigation Equipment or System Design
  - Process Equipment Strength
  - Vendor Design of Supplied Equipment
  - Logistics of the equipment and / or facility

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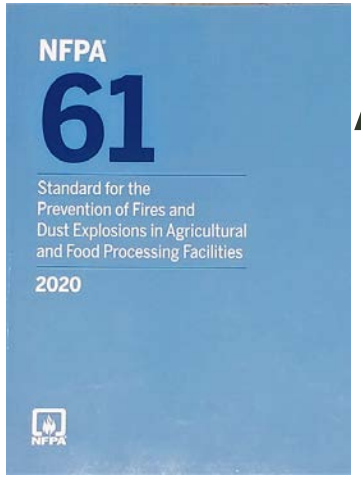
Bucket Elevators

- Pressure - Unknown Strength
- Extended L/D on legs
- Site Specific Conditions
- Construction Variations
- Indoor –Outdoor – Both Installations
- Independent vs. Integrated Structures
- No Existing Mitigation – Unknown
- Preventative Measures ?
- Venting Device-Known Tested Performance



Apply by Size, Volume and Spacing

NFPA 68
Application Design

Apply by Pressure, Size, Volume and Spacing

ATEX Methods

Apply by Pressure, Size, Volume and Spacing

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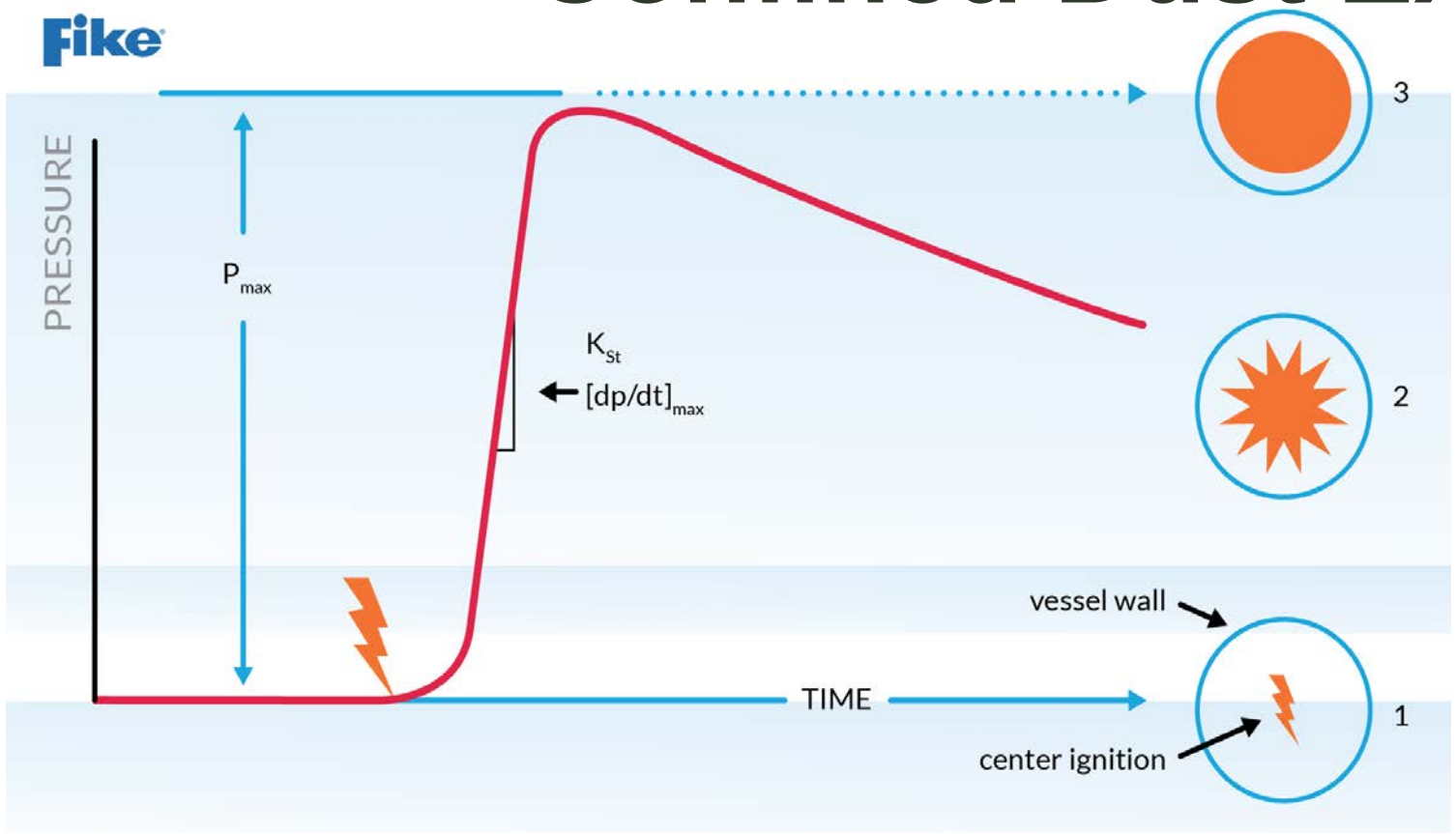
Confined Dust Explosion



- **Pmax** - The maximum pressure developed in a contained deflagration
- **Kst** - The rate of pressure rise (how quickly pressure builds over time) in a standard, unvented vessel; measures the explosion severity compared to other dusts

$K_{st} = (dP/dt)_{max} V^{1/3}$

The rate of pressure rise (how quickly pressure builds over time) in a standard, unvented vessel; measures the explosion severity compared to other dusts

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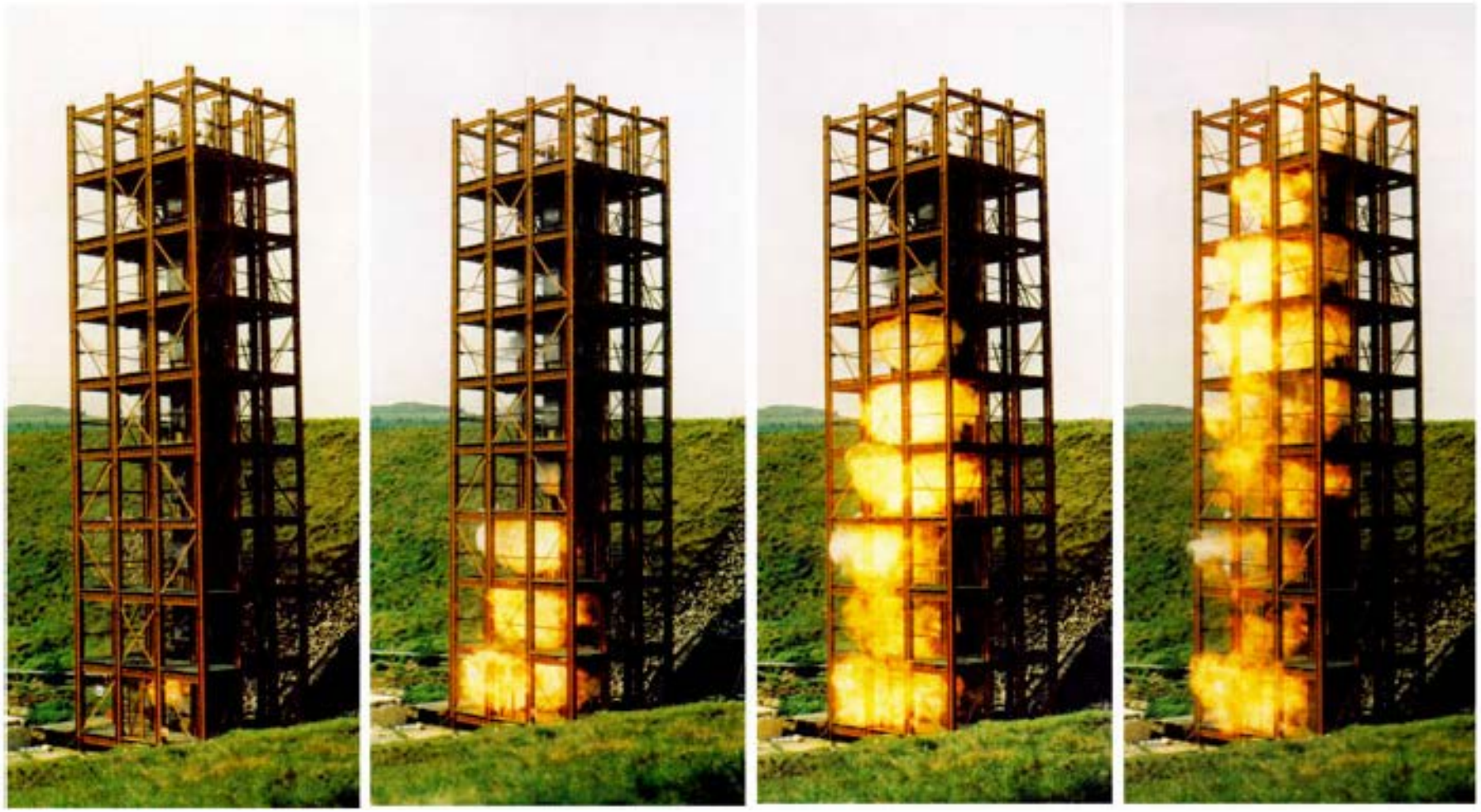
Vented Bucket Elevator Explosion

Vented Bucket Elevator Explosion



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BUCKET ELEVATOR CONSIDERATIONS

Elevator Head

Top section of elevator housing the drive pulley and material discharge.

Elevator Head (volume):

Defined as the internal volume above the leg connection including the discharge chute.

Elevator Casing:

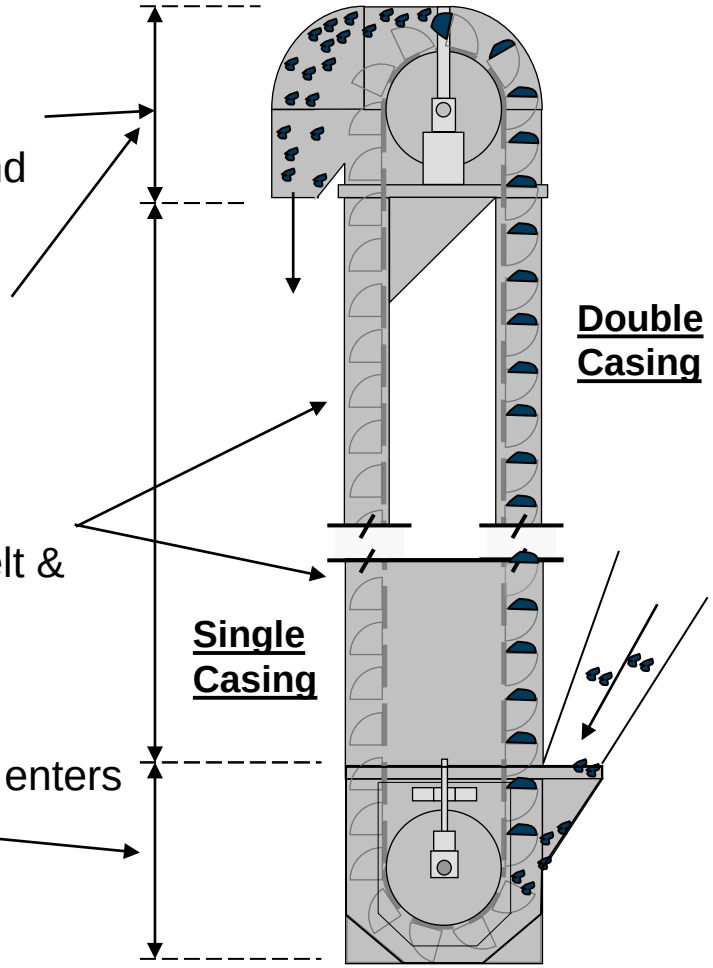
Section connecting the head and boot encasing belt & buckets. *(sometimes called a leg)*

Elevator Boot:

Bottom section of elevator where product typically enters the elevator houses the return pulley.

Elevator Leg:

Entire Bucket Elevator including Head, Casing(s) & Boot.



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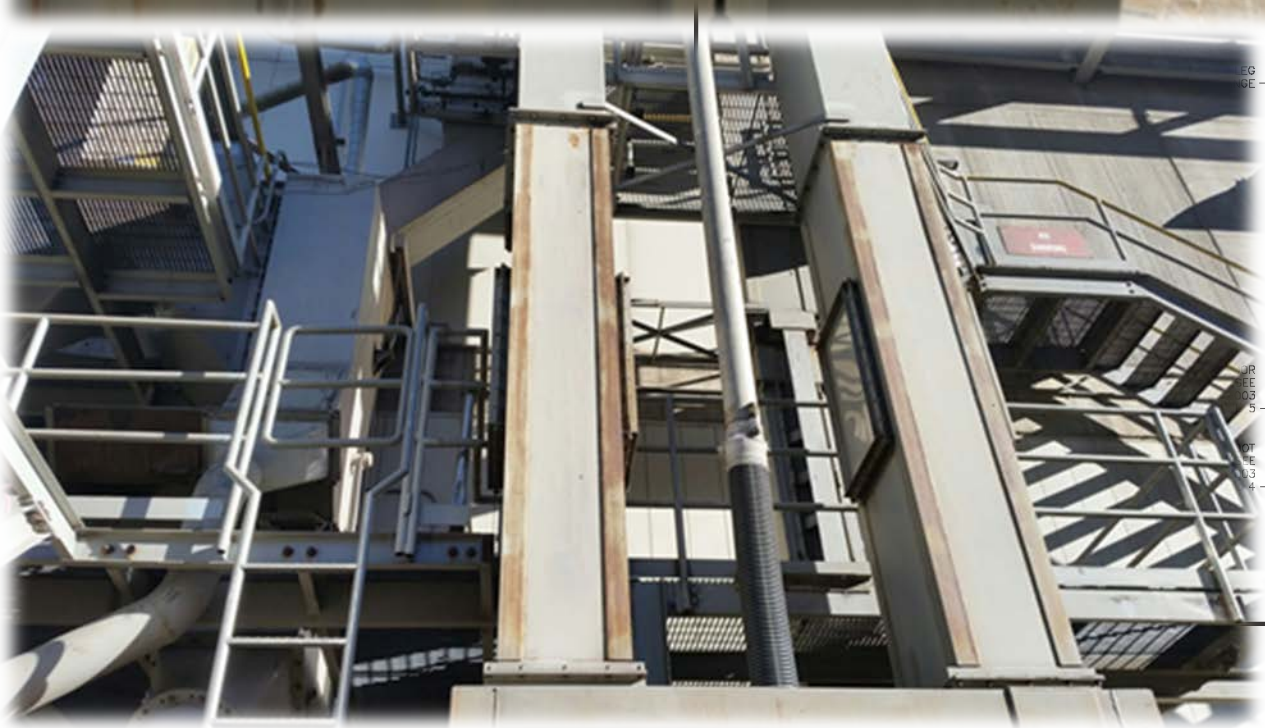
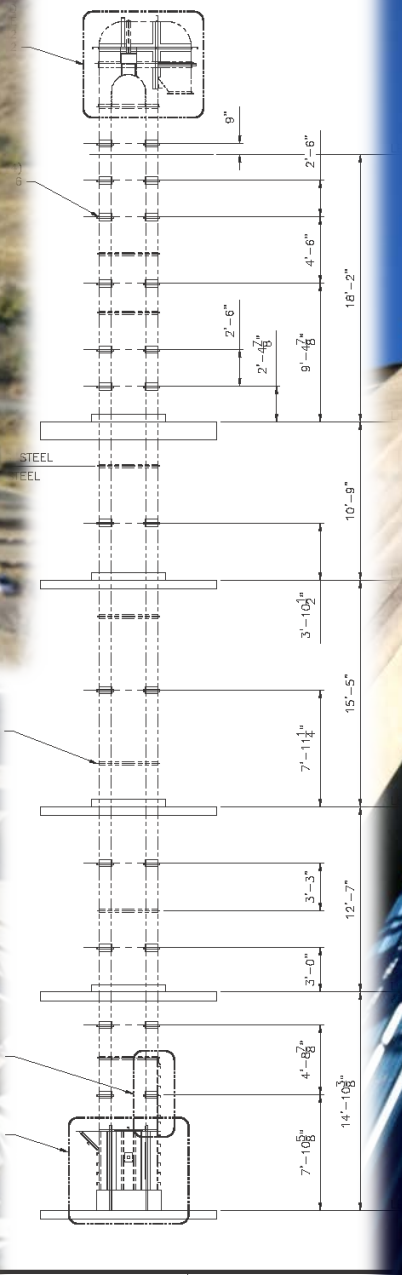
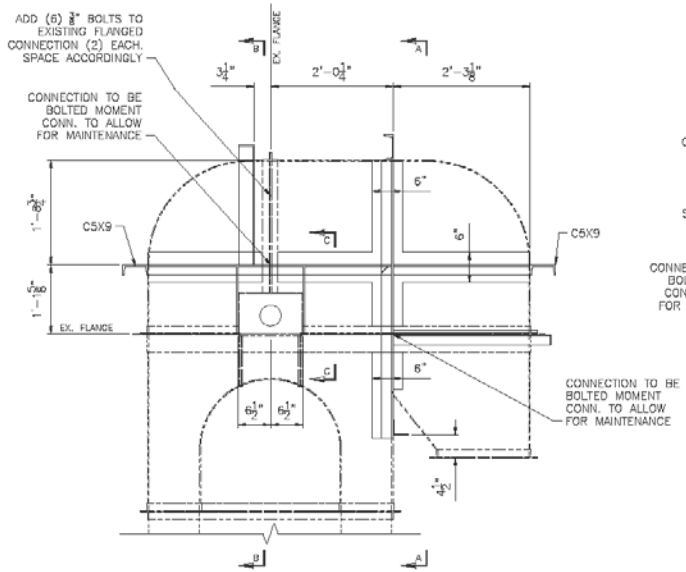
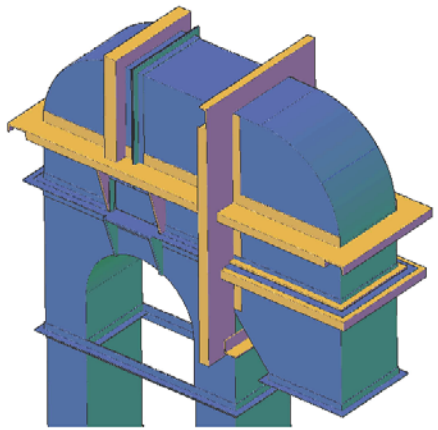
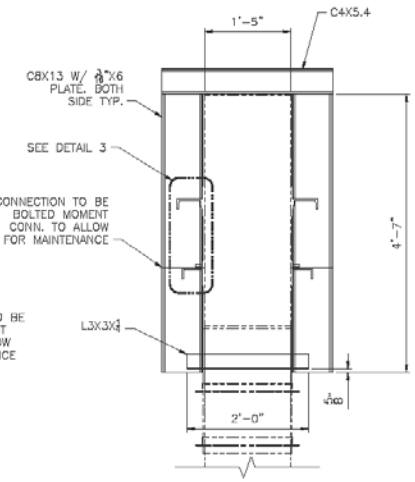



9"
2'-6"
4'-6"
2'-6"
2'-4 7/8"
9'-4 7/8"
16'-2"
10'-9"
3'-10 1/2"
7'-11 1/4"
15'-5"
3'-3"
3'-0"
12'-7"
4'-8 7/8"
7'-10 5/8"
14'-10 3/8"

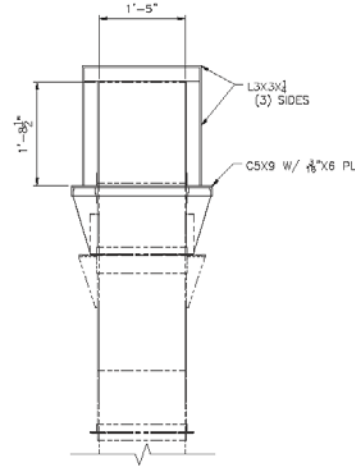


DETAIL 2: HEAD REINFORCEMENT
SCALE 1" = 1'-0"

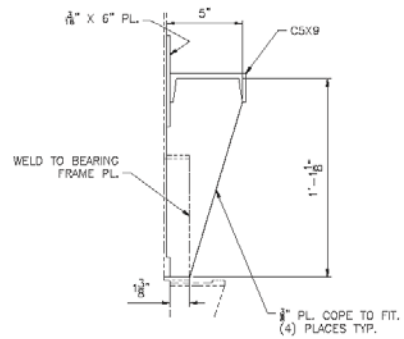




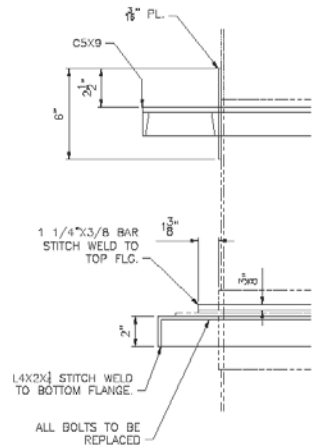
SECTION A
SCALE 1" = 1'-0"



SECTION B
SCALE 1" = 1'-0"



SECTION C
SCALE 3" = 1'-0"



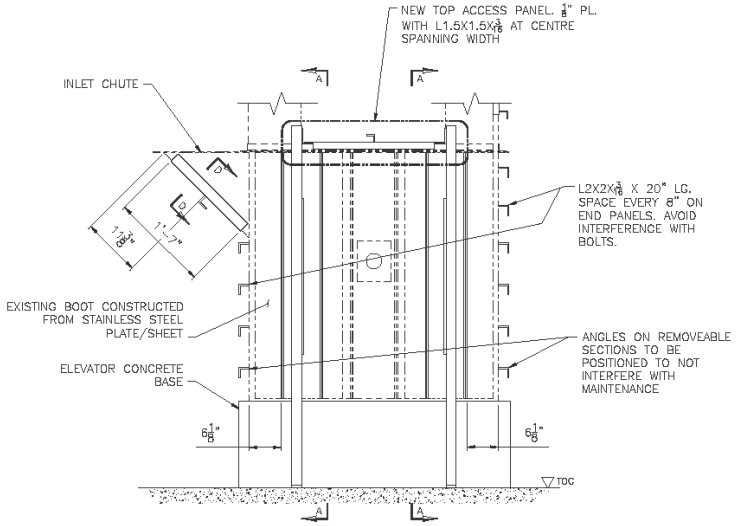
DETAIL 3
SCALE 3" = 1'-0"

REFERENCE DRAWINGS

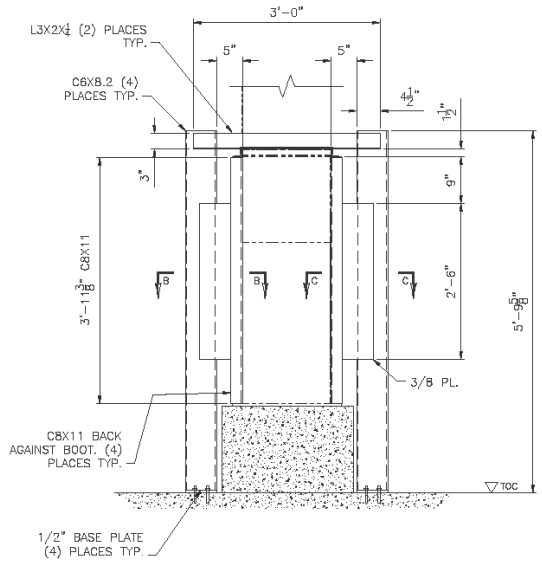
DWG. NO.	DESCRIPTION

STRUCTURAL NOTES

1. SEE DRAWING 2021024-0012 FOR GENERAL NOTES.
2. DO NOT SCALE THIS DRAWING. USE FIGURE DIMENSIONS ONLY.
3. ABBREVIATIONS USED ON THIS DRAWING ARE ACCORDING TO ASME Y14.38 "ABBREVIATIONS AND ACRONYMS".
4. ALL DIMENSIONS ARE IN FEET & FRACTIONAL INCHES UNLESS OTHERWISE SPECIFIED.
5. STRUCTURAL MATERIAL SHALL BE AS FOLLOWS UNLESS OTHERWISE SPECIFIED:
   - 5.1. C AND I SHAPES_____ CSA G40.21-44W OR 50W
   - 5.2. PLATE_____ CSA G40.21-44W OR 50W
   - 5.3. BOLTS_____ ASTM A325
   - 5.4. NUTS_____ ASTM B563 GR. DH
   - 5.5. WASHERS_____ ASTM F436
6. FINAL DIMENSION TO SUIT ACTUAL INSTALLED LOCATION.
7. FULLY WELDED CONSTRUCTION; 1/4" FILLETS OR GROOVE WELDS BETWEEN STRUCTURAL MEMBERS. STITCH WELD BETWEEN STRUCTURAL MEMBERS/PLATES AND EXISTING ELEVATOR SHEET METAL TO BE 2'-6" WITH CONTINUOUS WELDS AT EACH END. ALL WELDING TO BE DONE IN ACCORDANCE WITH CSA W59-18.
8. PAINTING: NEW MEMBERS TO BE PRIMED AND THEN PAINTED TO MATCH EXISTING USING ZINC RICH PAINT. ALL WELDS AND MODIFICATIONS TO BE PRIMED AND PAINTED TO MATCH.



DETAIL 4: BOOT REINFORCEMENT
SCALE 1" = 1'-0"



SECTION A
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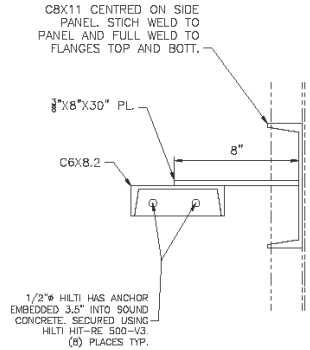
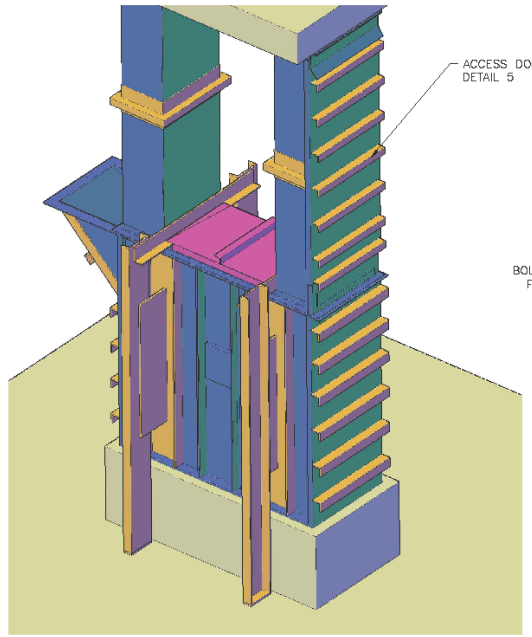
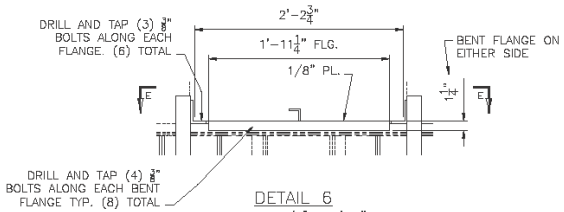
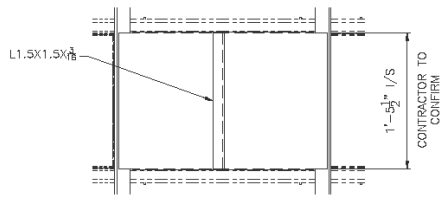


SECTION B (2 PLACES)
SECTION C OPP. (2 PLACES)
SCALE 3" = 1'-0"

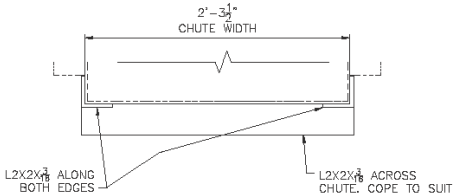




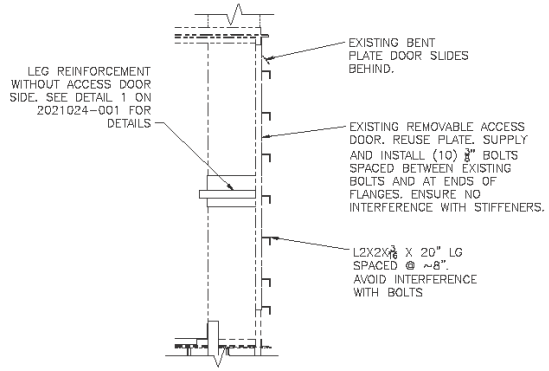
DETAIL 6
SCALE 1 1/2" = 1'-0"



SECTION E
SCALE 1 1/2" = 1'-0"



SECTION D
SCALE 3" = 1'-0"



DETAIL 5: ACCESS DOOR
SCALE 1" = 1'-0"

REFERENCE DRAWINGS

DWG. NO.	DESCRIPTION

STRUCTURAL NOTES

1. SEE DRAWING 2021024-0012 FOR GENERAL NOTES.
2. SEE DRAWING 2021024-002 FOR STRUCTURAL AND WELDING NOTES.

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Explosion Venting Demonstration

Source: Fike

FREE VENTING

FLAMELESS VENTING

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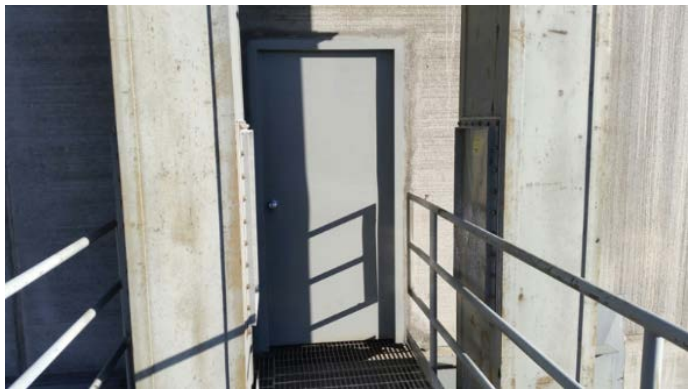
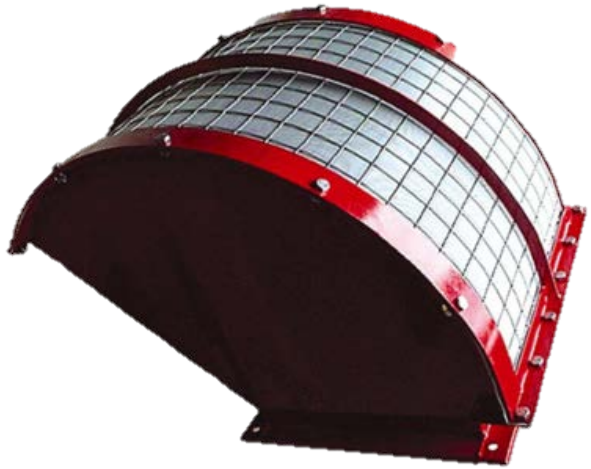
Flameless Venting for Bucket Elevators

- Indoor Installations
- Personnel Exposures
- Facility and Equipment Exposures
- Extinguishes external flame and retains majority of dust
- Provides savings:
  - Construction Cost
  - Down Time
  - Realestate – footprint
  - Equipment Modifications

Flame and Particulate Retention Venting

- Releases the pressure and extinguishes flame
- For indoor installations – eliminates need for equipment relocation or duct work
- For outdoor installations-eliminates flame path





Milling – Conveying – AMS / Dust Separators - Drying

Milling – Classifying

AMS - Cyclone

Filtration – Bags / Cartridges

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Dust Collectors

- Found in almost all industrial powder and bulk processes
- Remove dust from process air to
  - Improve air quality to which operators are exposed
  - Improve processing operation
  - Reduce combustible dust clouds and layers and explosion hazards
- Typically collect the finest and most explosive dusts
- Incident reports from the CSB indicate that up to 40% of industrial dust explosion involve dust collectors
- Incident reports from the Factory Mutual indicate that nearly 50% of industrial dust explosion involve dust collectors

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Explosion Venting

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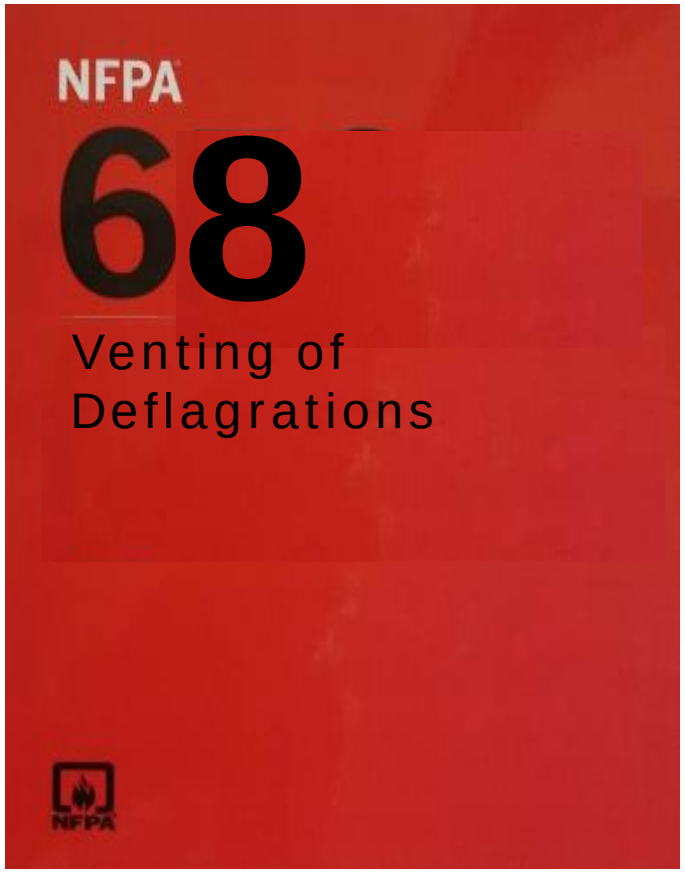

Apply by Pressure, Size, Volume Placement and Spacing

- **2007 Edition became a Standard**
- **2018 Edition latest**
- **Legacy Changes**
  - Enclosure Design Pressure Guidance
  - Vent device construction
  - Vent device location on equipment
  - Enclosure volume calculations
  - Vent closure fastner type / location
  - Performance validation
  - Process Interface / Controls
  - Reaction Force effect
  - Blast Deflector Plate Design
  - Effects of Vent Discharge Ducts
  - Flame Arresting and Particulate Retention
  - Provision of flame radius calculations
  - Recommended Venting of Pipe or Duct
  - Maintenance / Inspection Frequency and Requirements

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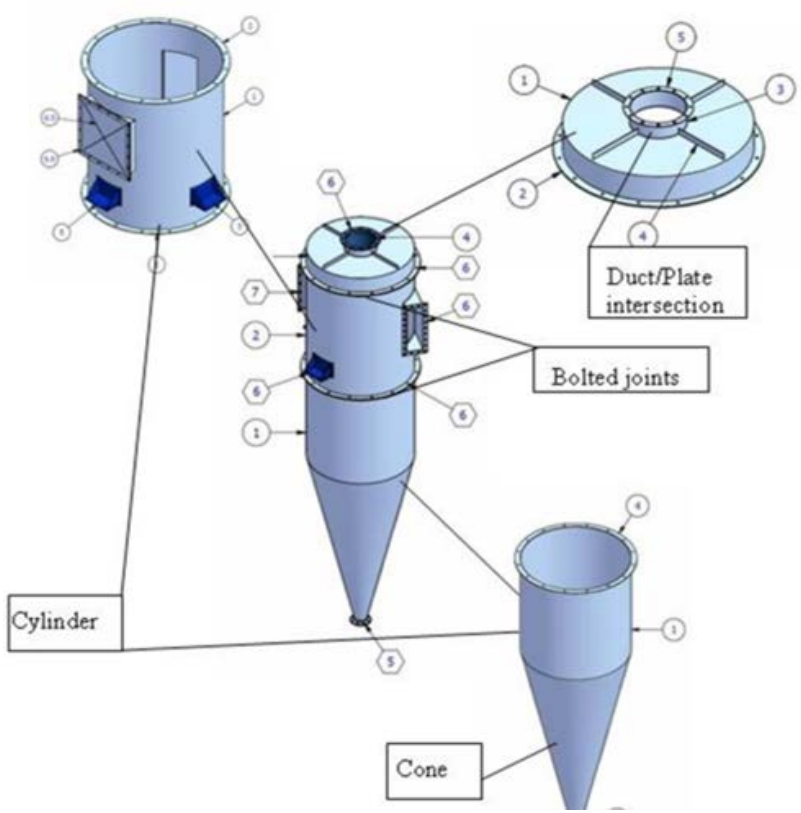
Tune up your process Explosion Venting

Validate and Document - Explosion Strength Calculation

- A critical input parameter for explosion protection design is the equipment strength or P_{red}
- Over estimating strength can result in equipment damage
- Under estimating strength can be costly to mitigation and construction cost
- A most accurate safety risk and mitigation solution will be obtained



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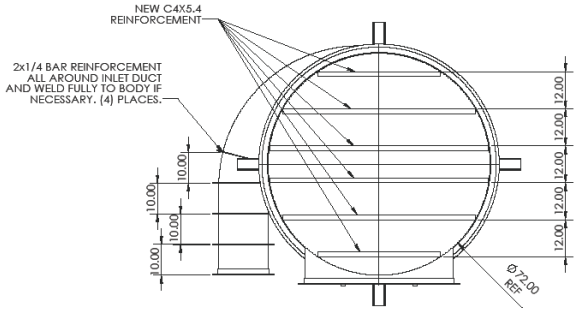

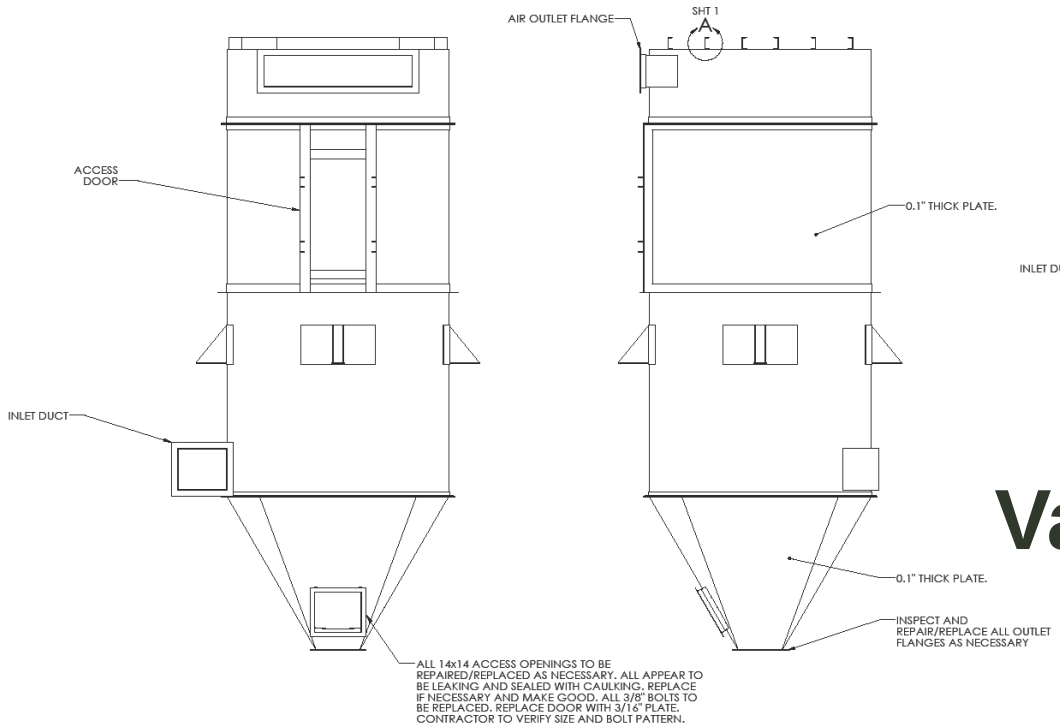

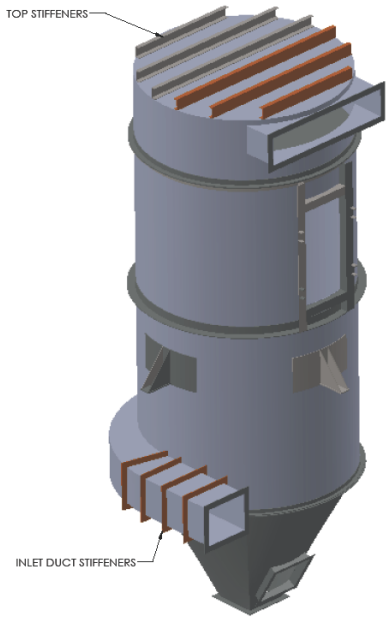

GENERAL NOTES

1. DO NOT SCALE THIS DRAWING. USE FIGURE DIMENSIONS ONLY. DIMENSIONS ARE IN INCHES.
2. EXPLOSION SUPPRESSION SYSTEM TO BE SIZED, SUPPLIED, AND INSTALLED PER NFPA 69.
3. CONTRACTOR TO INSTALL ALL FIKE EQUIPMENT PER VENDOR INSTRUCTIONS AND RECOMMENDATIONS.
4. EQUIPMENT WAS ANALYZED PER NFPA 69 LATEST EDITION. REQUIRED EQUIPMENT REINFORCEMENT IS DESCRIBED ON THIS DRAWING SET.
5. DESIGN DATA (PROVIDED BY FIKE CANADA):
   1. DEFLAGRATION INDEX Kst = 200 BAR*M/SEC YEAST DUST
   2. EXPLOSION PRESSURE Pmax = 10 BARG
   3. REDUCED PRESSURE Pred = 4 PSIG
   4. PROCESS TEMPERATURE = 40 DEG C
   5. AMBIENT TEMPERATURE = 0-40 DEG C
6. THE INLET AND OUTLET OF THE EQUIPMENT WAS NOT A PART OF THIS ANALYSIS.
7. ALL NEW MATERIAL TO BE CARBON STEEL.

STRUCTURAL NOTES

1. STRUCTURAL MATERIAL SHALL BE AS FOLLOWS UNLESS OTHERWISE SPECIFIED:
   1. C AND L SHAPES___CSA G40.21-44W OR 50W
   2. PLATE_____CSA G40.21-44W OR 50W
   3. RODS_____CSA G40.21-44W OR 50W
   4. W SHAPES_____ASTM A992 GR. 50
   5. S SHAPES_____ASTM A36
   6. HSS_____ASTM A500 GR. C
   7. BOLTS_____ASTM A325
   8. NUTS_____ASTM B563 GR. DH
   9. WASHERS_____ASTM F436
2. FINAL DIMENSION TO SUIT ACTUAL INSTALLED LOCATION.
3. ALL WELDING TO CONFORM TO CSA W59-18. ALL WELDING RODS TO BE 60KSI LOW HYDROGEN ELECTRODES OR BETTER
4. PAINTING
   1. ALL DUCTING, SUPPORT, & STIFFENERS TO BE PAINTED. DO NOT PAINT SLIDING SURFACES.
   2. PAINT TO MEET PLANT STANDARDS. COLOUR TO MATCH EXISTING.
5. THE FILLET SIZE SHALL MATCH THE BEAM ATTACHMENT THICKNESS UNLESS NOTED OTHERWISE.
6. CONTRACTOR TO VERIFY CONDITION OF EXISTING STEEL PRIOR TO WELDING. IF STEEL IS NOT STRUCTURALLY SOUND, INFORM PARHEIM TO DISCUSS ALTERNATE SUPPORT OPTIONS.

Validate and Document Explosion Strength

APPARATUS SHOWN IN THE DRAWING IS COVERED BY PATENTS.

Silo – Bin – Tank
Inside - Outside

NFPA 68

Standard on Explosion Protection by Venting of Deflagrations

- Calculated Vent Area using a Pstat designed to limit Pred
- Venting can be the roof, or installed on the roof and / or High on side wall above product fill
- Size and amount of vent panels are depending on calculations and application limits

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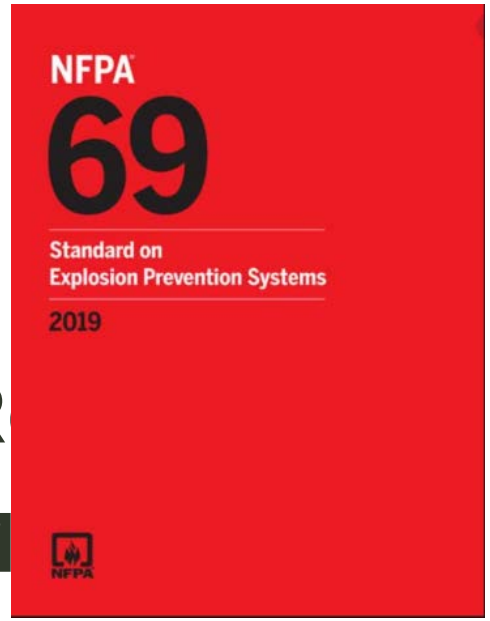


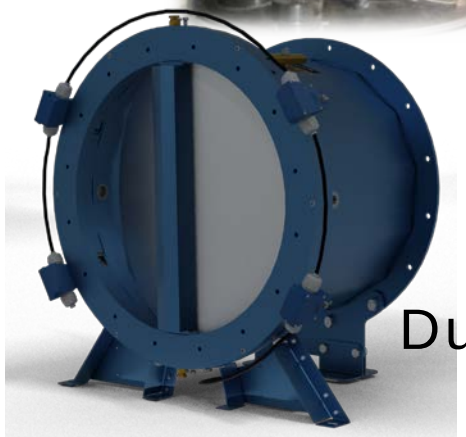
Explosion Isolation

R

M

- Rotary Valve
- Chemical Barrier
- Mechanical Barriers

Rotary Valve



Dual Flap

EIV

Chemical Isolation

ValvEx

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Explosion Isolation

Other Common Methods

Slide Gates

- Equivalency?

Dump Valves

- Single - NO
- Double – Maybe – Equivalency?

Open Drop

- NO
- Equivalency?
  - Flame and Pressure Containment

REGULATIONS TO PREVENT EXPLOSION AND FLAME PROPAGATION

9.3 Equipment Design

9.3.4.3 AMS Clean Air Exhaust

Recycling of air-material separator exhaust to buildings or rooms shall be permitted when all of the following requirements are met:

(2) Combustible particulate solids are not present in the recycled air in concentrations above the applicable industrial hygiene exposure limits or 1% of the MEC, which ever is lower.

(4) Provisions are incorporated to prevent transmission of flame and pressure effects from a deflagration in an air-material separator back to the facility unless a DHA indicates that those effects do not pose a threat to the facility or the occupants.

(5) Provisions are incorporated to prevent transmission of smoke and flame from a fire in an air-material separator back to the facility unless a process hazards analysis indicated that those effects do not pose a threat to the facility or the occupants.

(6) The system includes a method for detecting air-material separator malfunctions that would reduce collection efficiency and allow increases in the amount of combustible particulate solids returned to the building.

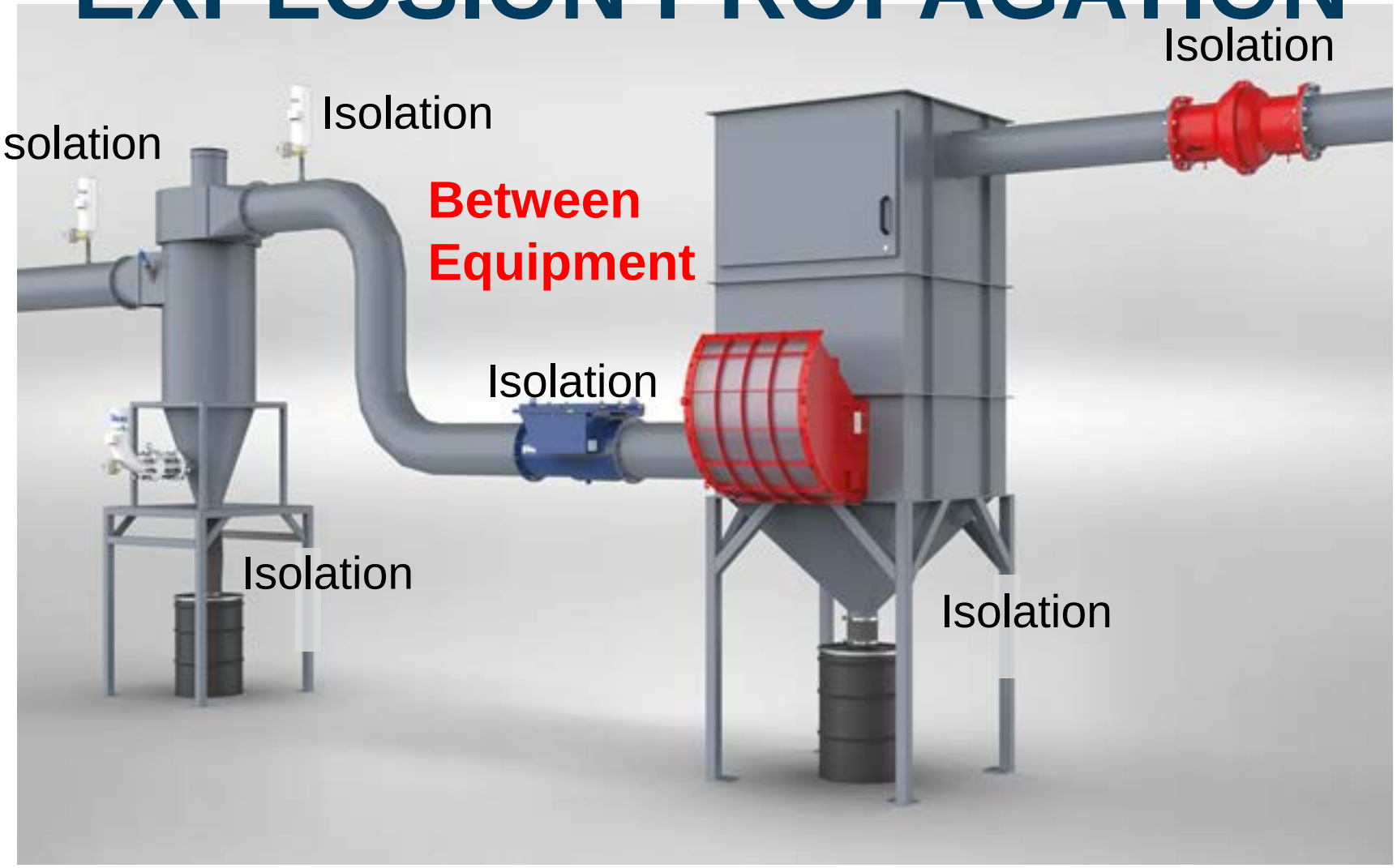
REGULATIONS TO PREVENT EXPLOSION AND FLAME PROPAGATION

9.7.4 Explosion Isolation

9.7.4.1 Where a dust explosion hazard exists, isolation devices shall be provided in accordance with NFPA 69 to prevent deflagration propagation between connected equipment.

9.7.4.3 Where a dust explosion hazard exists, isolation devices shall be provided in accordance with NFPA 69 to prevent deflagration propagation from equipment through ductwork to the work areas.

ISOLATE FLAME, PRESSURE AND EXPLOSION PROPAGATION



Work Space

Return Air to Inside

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Isolate Flame Propagation

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Isolate Flame Propagation

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Explosion Isolation - ValvEx

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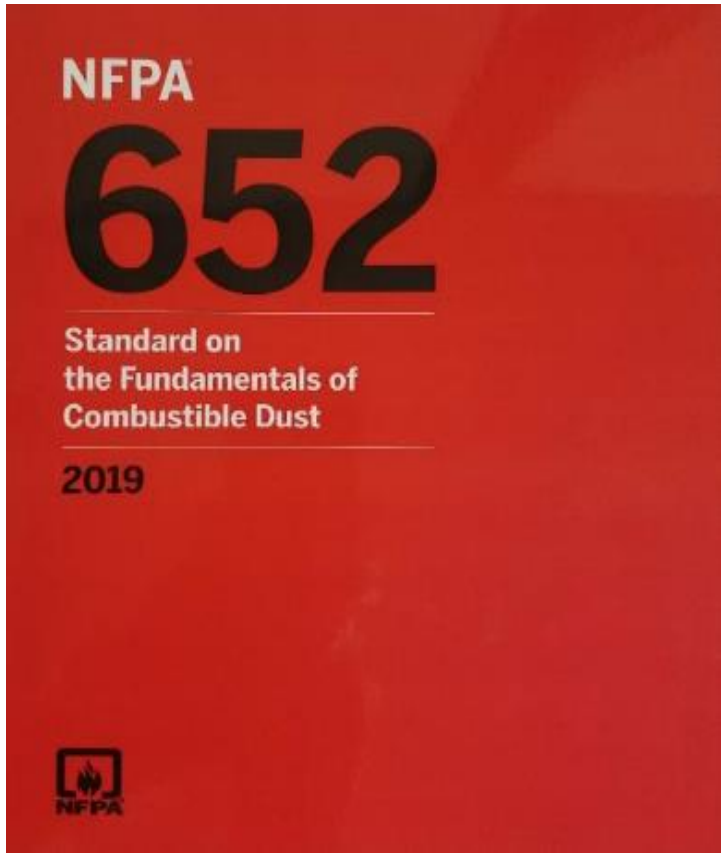
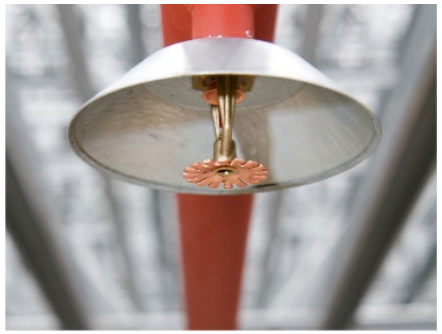
Automatic Fire Protection



9.8.1.1 Fire Protection

Where a fire hazard exists ***in an enclosure*** as determined in Chapter 7, manual or automatic fire protection means ***shall be provided*** in accordance with Section.....

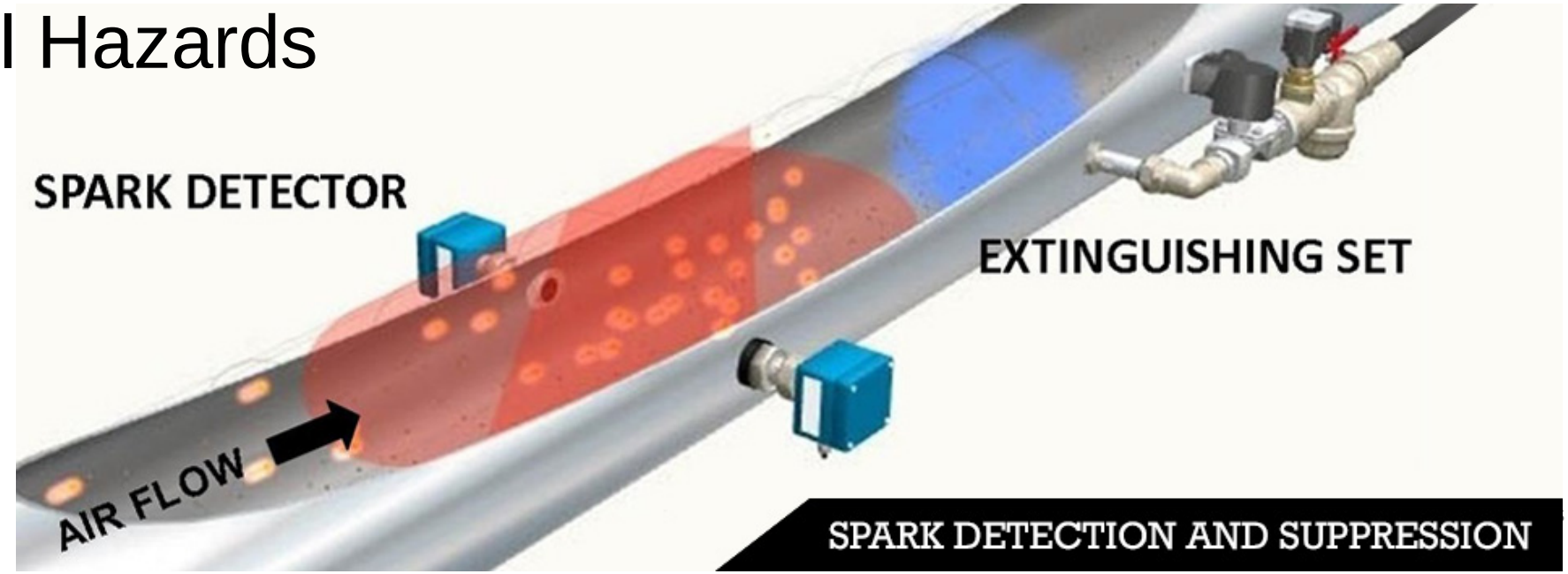


All Facilities and All Processes With Combustible Dust are Required to Have a DHA

Automatic Fire Protection

Deluge System
Duct Suppression
Enclosure Suppression
Sprinkler
Water Mist
Special Hazards
CO2

Flame Detection
Smoke and Smolder Detection
Air / Smoke Diversion
Back Draft Dampers
Smoke Diverters



Fire and Explosion Safeguards

PROOF IS REQUIRED – DOCUMENT THE DESIGN AND MAINTAIN THE INTEGRITY

ike Can Help You Meet Regulations

With decades of experience in serving all industries with inherent combustible dust hazards and participation in best practice documentation in standardization work, Fike can help you comply with nearly all regulations by:

- **Verify legacy designs / installations**
- **Testing dust samples** to determine how dangerous your dust is
- **Identifying all combustible material regulations** applicable to your business
- **Performing DHA (Dust Hazard Assessment)**, risk analysis and defining required protection measures.
- Explaining the details of **applicable standards**
- Understanding the nuance of **complying with regulations for any unique challenge**

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