

# Presenter Introduction

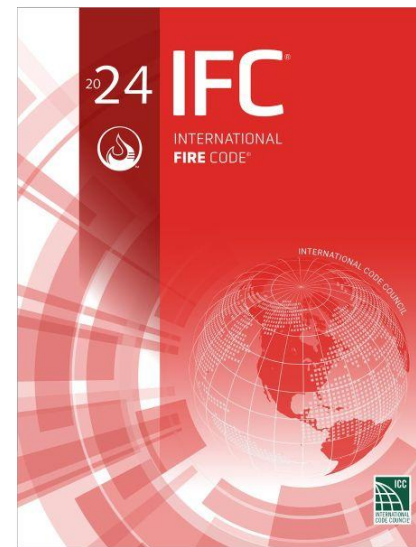
Russ Bainbridge, *P.E., CFPS, MS*

***Fire Protection Engineer***

- Fire Protection Engineer at SenecCo specializing in dust hazard analysis, laboratories, government facilities, risk assessments, and suppression system design.
- Former technical lead for fire protection at Leidos supporting FAA sites.
- Former fire protection engineer at Los Alamos National Laboratory and Pantex.
- Adjunct instructor at Oklahoma State University and lecturer at University of Idaho.
- Holds a B.S. from Oklahoma State University (OSU) and M.S. in Fire Protection Engineering from California Polytechnic State University (Cal Poly).
- Licensed PE in Alaska, California, Ohio, Oklahoma, Oregon, Texas, Virginia, Washington, and West Virginia.
- NFPA Certified Fire Protection Specialist.
- Active member of multiple SFPE, NFPA (NFPA 660), UL, and DOE committees.

# Codes and Standards

- NFPA 652: Standard on the Fundamentals of Combustible Dust
  - NFPA 660: Standard for Combustible Dust and Particulate Solids
- FM Global: Factory Mutual (FMDS 7-76)
- International Fire Code



# International Fire Code MAQ

**TABLE 5003.1.1(1) MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD<sup>a, c, i, l, m, o</sup>**



MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE <sup>b</sup>			USE-CLOSED SYSTEMS <sup>b</sup>			USE-OPEN SYSTEMS <sup>b</sup>	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Combustible dust	NA	H-2	See Note p	NA	NA	See Note p	NA	NA	See Note p	NA
Combustible fibers <sup>p</sup>	Loose	H-3	(100)	NA	NA	(100)	NA	NA	(20)	NA
	Baled		(1,000)			(1,000)			(200)	

p. Where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 104.2.2.

**[A] 104.2.2: Technical assistance.**



To determine compliance with this code, the fire code official is authorized to require the owner or owner's authorized agent to provide a technical opinion and report.

**[A] 104.2.2.1: Cost.**

A technical opinion and report shall be provided without charge to the jurisdiction.

**[A] 104.2.2.2: Preparer qualifications.**

The technical opinion and report shall be prepared by a qualified engineer, specialist, laboratory or fire safety specialty organization acceptable to the fire code official. The fire code official is authorized to require design submittals to be prepared by, and bear the stamp of, a registered design professional.

**[A] 104.2.2.3: Content.**

The technical opinion and report shall analyze the properties of the design, operation or use of the building or premises and the facilities and appurtenances situated thereon to identify and propose necessary recommendations.

**[A] 104.2.2.4 : Tests.**



Where there is insufficient evidence of compliance with the provisions of this code, the fire code official shall have the authority to require tests as evidence of compliance. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized test standards, the fire code official shall approve the testing procedures. Such tests shall be performed by a party acceptable to the fire code official.

# NFPA 652: Chapter 7 Dust Hazard Analysis

- 7.1.2 The owner/operator of a facility where materials determined to be combustible or explosible in accordance with Chapter 5 are present in an enclosure shall be responsible to ensure a DHA is completed in accordance with the requirements of this chapter.
- 7.1.3 The absence of previous incidents shall not be used as the basis for not performing a DHA.
- 7.1.4 The DHA shall be reviewed and updated at least every 5 years.

# NFPA 652: Chapter 7 Dust Hazard Analysis

- 7.2.1 The DHA shall evaluate the fire, deflagration, and explosion hazards and provide recommendations to manage the hazards in accordance with Section 4.2.
- 7.2.2 The DHA shall be performed or led by a qualified person.
- 3.3.41 A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems related to the subject matter, the work, or the project.
- 7.2.3 The results of the DHA review shall be documented, including any necessary action items requiring change to the process materials, physical process, process operations, or facilities associated with the process.

# NFPA 652: Chapter 7 Dust Hazard Analysis

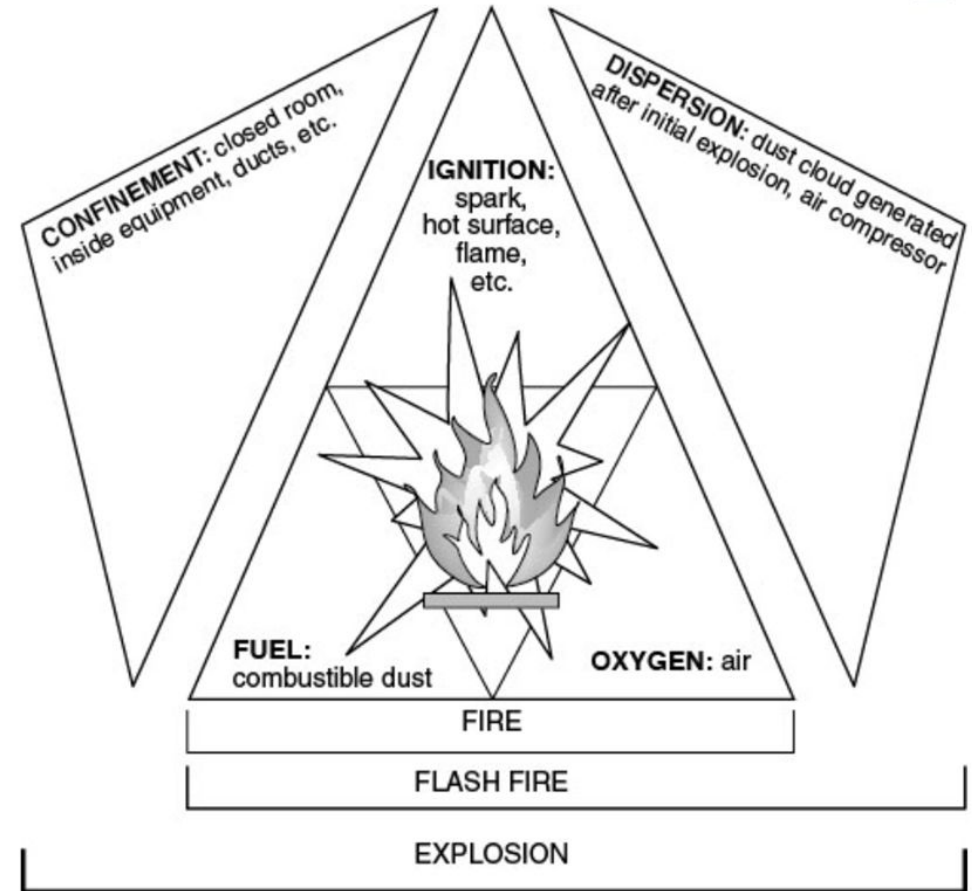
## 7.3.1

- (1) Identification and evaluation of the process or facility areas where fire, flash fire, and explosion hazards exist.
- (2) Where such a hazard exists, identification and evaluation of specific fire and deflagration scenarios shall include the following:
  - (a) Identification of safe operating ranges
  - (b) Identification of the safeguards that are in place to manage fire, deflagration, and explosion events
  - (c) Recommendation of additional safeguards where warranted, including a plan for implementation

# NFPA 652: Chapter 7 Dust Hazard

## Analysis

- The objective is to identify and remove more than one of the five elements required to cause a:
  - Combustible dust fire
  - Flash fire, and/or explosion



**Figure  
A.5.2**

# Elements of a DHA

- Quality DHAs provide:
  - Action items that need to be addressed in a manner that is easy to understand what needs to be done.
  - Action items that are realistic to the customer's needs when it comes to timeline, budget, and process requirements without reducing the level of safety required.
  - A breakdown of risk levels if action items are not addressed.
  - A thorough breakdown of what was reviewed and what was not reviewed.

# Elements of a DHA

- DHAs should not include:
  - Large amounts of “boiler plate” documentation. Every facility and process is different, and DHAs need to reflect this reality.
  - Information that requires a large amount of support to understand what is contained within the DHA.
  - Action items that do not take into consideration timeline, budget, and process requirements.

# Basic Information Example

Customer

Facility Information					
Customer	Contacts	DHA Team Members	Facility	Areas	Building Construction
XXXX	XXXXXXXXX (email)	XXXXXX	XXXXXXXX	XXXXXX	XXXXXX
	XXXXXXXXX (email)	XXXXXX		XXXXXX	XXXXXX
	XXXXXXXXX (email)	XXXXXX		XXXXXX	
	XXXXXXXXX (email)	XXXXXX			
	XXXXXXXXX (email)	XXXXXX			
		XXXXXX			

# Basic Information Example

List of Dust															
Dust Number	Dust Name	CAS #	Chemical Name	Test Sample	Particle Size	Moisture Content	Go/No Go	MEC (Minimum Explosible Concentration) g/m <sup>3</sup>	MIE (Minimum Ignition Energy) mJ	LIT (Layer Ignition Temperature) °C	MIT (Minimum Autoignition Temperature) °C	K <sub>st</sub> (Explosion Severity) bar.m/s	P <sub>max</sub> (Maximum Explosion Pressure) bar-g	dP/dt <sub>max</sub> (Maximum Rate of Explosion Pressure Rise)	LOC (Limiting Oxygen Concentration)
1	XXXXXXXX	XXXXXX	XXXXXXXX	XXXXXXXXXXXXXX	<75µm	0	Go	XXXXXX	XXXXXX	XXXXX	XXXX	XXXX	XXXXX	XXXX	XXXX

# Basic Information Example

List of Equipment								
Equipment Number	Equipment	Equipment Description	Location	Associated Dust	Suspension Mechanisms	Ignition Sources	Associated Consequences	Associated Recommendations
1	Bag Break Station 1	Bag of material are opened with a knife and then poured into the bag break station.	XXXXXX	1 & 2	Materials being poured	Electronics not rated Class II, Div. 1. Foreign material striking equipment surface.	1, 5, 7, 11, & 12	1, 2, 3, 6, 7, 8, 9, 10, 11, 13, & 17
2	Mixer	Bag break station 1 and XXXXXXXX feed material into the mixer	XXXXXX	1, 2, 3, & 4	Material entering the top of the mixer and falling. Mixer spinning at 15 rpm.	Electronics not rated Class II, Div. 1. Foreign material striking equipment surface.	1 & 7	1, 2, 3, 6, 7, 8, 9, 10, 11, 13, & 17

# Basic Information Example

List of Processes										
Process Number	Process	Process Description	Location	Associated Equipment	Associated Dust	Suspension Mechanism	Ignition Source	Protection Measure/Equipment	Associated Consequences	Associated Recommendations
1	XXXXXX	The material enters the XXXXXX process from the bag break stations and then XXXXXXXXXX.	XXXXXXX	1, 2, 3, 4, 5, XXXXXXXX	1, 2, 3, XXXX	Materials being poured Material entering the top of the mixer and falling. Mixer spinning at 15 rpm. Compressed air blowing off dust on sensor head. Equipment moving in and out of area with dust collection.	Electronics not rated Class II, Div. 1. Knife could create spark if it were to strike foreign material. Bearing overheating.	Bearings are press fit into equipment to reduce dust build up. Equipment grounded and bonded where applicable. Area dust collection. Photo electric sensors to determine material alignment.	1, 2, 3, 5, 7, 8, 9, 11, 13, 14, 18, 19, & 20	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, & 18
2	Tab stiffening	A pneumatic cylinder (7) presses a patterning roller (8) into the foil of the electrode as it passes an idler roller (2). This is to strengthen the copper foil. The cylinder is on a rail that allows manual adjustment for set-up.  There are two places this is used to allow both sides of the electrode foil to contact the pattern rollers. Between the two stages there is an edge position sensor (5).  The electrode is not contacted or the material is unusable. Any dust generated would be copper powder or residual contaminations from the roll of electrode.	Winding	2 - Idler roller - qty 3 5 - Position sensor - qty 1 7 - Clamping cylinder - qty 2 8 - Patterning roller - qty 2	1 & 2	Dust being lifted off the material as the material is fed through the equipment.	Electronics not rated Class II, Div. 1. Bearing overheating.	Bearings are press fit into equipment to reduce dust build up. Equipment grounded and bonded where applicable. Area dust collection. Edge sensors to determine material alignment.	1, 3, 7, & 9	1, 2, 3, 6, 7, 8, 9, 10, 11, 13, 17, & 18
3	Laser cutting	<b>Summary:</b> This module is for cutting tabs that will form the battery terminals from the strip of electrode foil. A laser is used to cut the material into the correct shape.  This module is sealed from the other sections with two openings to allow entrance/exit of electrode. The top of the module is a fan-filter unit to assist in decontamination. There is a smoke alarm connected to the PLC to alarm in the case of fire. The system is designed to be in a slight negative pressure to minimize contamination.  The electrode first goes through an edge correction system (9) that rotates slightly to move the electrode in the cross position to guarantee alignment. The laser system (10) is on a servo motor that matches this position to guarantee consistent cutting position as the electrode moves.  The laser system is a partially enclosed space that has a connected dust collection port to remove the resulting fumes. The dust collection pipes (16) are a telescoping type to allow movement with the electrode. Each section is grounded.  Scrap sections that are cut away from the foil are evacuated from the system by a vacuum belt (11) feeding into a scrap collection line (15). These chunks of material are taken to a collection equipment for disposal.  While the scrap material is taken by the vacuum belt, a vacuum roller (12) pulls the newly cut tabs to prevent any bending that would render the cell unusable.	Winding	2 - Idler roller - qty 8 5 - Position sensor - qty 2 9 - Edge correction system - qty 2 10 - Laser system - qty 2 11 - Vacuum belt - qty 2 12 - Vacuum roller - qty 2 13 - Smoke alarm - qty 2 14 - Fan filter unit - qty 2 15 - Scrap collection line - qty 2 16 - Dust collection line - qty 2	1 & 2	Dust being lifted off the material as the material is fed through the equipment. Dust created and suspended when material is cut.	Class 4 laser capable of cutting the material. Electronics not rated Class II, Div. 1. Bearing overheating.	Dust collection. Bearings are press fit into equipment to reduce dust build up. Equipment grounded and bonded where applicable. Alignment sensors to determine material alignment. Smoke detection with program interlocks. Space under negative pressure.	1, 2, 3, 5, 7, 8, 9, 11, 16, 17, 18, 20, 21, 22, 23, & 24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 16, 17, & 18

# Basic Information Example

List of Consequences								
Consequence Number	Associated Equipment	Associated Process	Consequence	Protection Measures Currently in Place	Severity	Likelihood	Risk	Risk Level
1	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 17, 18, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 34, 35, 36, 37, 41, 45, 50, 51, 52, 53, & 54	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 15, & 16	Suspension caused by material moving through equipment, creating a dust cloud at the MEC and ignition source of electrical equipment not being rated at a minimum of Class II, Div 1 providing a current greater than the MIE of the combustible material.	Area dust collection.	2	3	6	Low
2	3, 10, 20, 33, & 40	1, 3, 4, 9, 11,	Suspension caused by material being cut, creating a dust cloud at the MEC and ignition source of electrical equipment not being rated at a minimum of Class II, Div 1 providing a current greater than the MIE of the combustible material.	Area dust collection.	2	3	6	Low
3	5, 10, 19, 30, & 40	1, 2, 3, 4, 5, 8, 11, & 15	Suspension caused by material being blown off, creating a dust cloud at the MEC and ignition source of electrical equipment not being rated at a minimum of Class II, Div 1 providing a current greater than the MIE of the combustible material.	Area dust collection.	2	4	8	Medium
4	19	4	Suspension caused by material being brushed off, creating a dust cloud at the MEC and ignition source of electrical equipment not being rated at a minimum of Class II, Div 1 providing a current greater than the MIE of the combustible material.	Area dust collection.	2	4	8	Medium

# Basic Information Example

List of Recommendations					
Recommendation Number	Associated Equipment	Associated Process	Recommendation	Effects if Recommendations are Implemented	Reference
1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, & 54	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, & 16	Provide dusttight containment for the process or provide a 2-hr fire barrier from the room containing the combustible dust.	The room will no longer be considered an H-2 occupancy and equipment required to be Class II, Div. 1 rated electronic equipment can be reduced to Class II, Div. 2 rated electronic equipment.	IBC § 307.4 IFC Chapter 22 IFC Table 5003.1.1(1) NFPA 652 § 8.2.2, 8.2.3, 8.2.6 & 8.3.2
2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, & 54	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, & 16	Relocate dust collectors to exterior of the facility.	Decrease possibility and severity of event.	NFPA 652 § 8.3.4.1.1 & 8.7.3.2 NFPA 91 § 7.1.6
3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, & 54	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, & 16	Provide Class II, Div. 1 rated electronic equipment within 20 ft. of a dust source with a moderate or dense dust cloud and/or dust layer greater than 1/8 in.	Decrease possibility of ignition.	NFPA 652 § 8.5.6 NFPA 499 § 6.3, Figure 6.10(a), & Figure 6.10(b)
4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, & 54	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, & 16	Provide Class II, Div. 2 rated electronic equipment greater than 20 ft. but within 30 ft. of a dust source with no visible dust cloud and/or a dust layer less than 1/8 in. and surface color is not discernible.	Decrease possibility of ignition.	NFPA 652 § 8.5.6 NFPA 499 § 6.3, Figure 6.10(a), & Figure 6.10(b)
5	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 17, 19, 22, 24, 26, 27, 28, 30, 32, 33, 34, 35, 40, 41, 42, 51, & 54	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, & 16	Monitor bearing temperature, wear, and/or alignment.	Decrease possibility of ignition.	NFPA 652 § 8.5.5.2 & 8.5.5.3
6	3, 20, 33, 34, 40, & 43	1, 4, 9, & 10	Provide nonsparking (nonferrous) knives.	Decrease possibility of ignition.	NFPA 652 § 8.5.12
7	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 18, 20, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, & 54	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, & 16	Regular cleaning of equipment to keep dust layer accumulation less than 1/8 in. and surface color discernible	Decrease possibility and severity of event.	NFPA 652 § 8.4.6 NFPA 499 § 6.3

# Basic Information Example

Risk Matrix					
Severity/ Likelihood	Minimal 1	Minor 2	Major 3	Hazardous 4	Catastrophic 5
Extremely Improbable 1	1	2	3	4	5
Extremely Remote 2	2	4	6	8	10
Remote 3	3	6	9	12	15
Probable 4	4	8	12	16	20
Frequent 5	5	10	15	20	25

Risk Level	
	Low
	Medium
	High

# NFPA 652: Chapter 7 Material Evaluation

- 7.3.2.1 The DHA shall be based on data obtained in accordance with Chapter [5](#) for material that is representative of the dust present.
- 5.1 The owner/operator of a facility with potentially combustible dusts shall be responsible for determining whether the materials are combustible or explosible, and, if so, for characterizing their properties as required to support the DHA.
  - 5.1.1 Where dusts are determined to be combustible or explosible, the hazards associated with the dusts shall be assessed in accordance with Chapter [7](#).
  - 5.1.2 Where dusts are determined to be combustible or explosible, controls to address the hazards associated with the dusts shall be identified and implemented in accordance with [4.2.4](#).

# NFPA 652: Chapter 5 Hazard Identification

- Samples of any dust in the process are to be tested by a certified testing lab. The individual materials need to be tested as well

Summary of Results and Important Remarks

Graphite Anode Sample		
Test Screening- Unit	Results	Comments
Explosibility Screening (Go/No-Go)	Go	Explosible dust
Minimum Explosible Concentration (MEC) g/m <sup>3</sup>	150	Dust Cloud Explosible at 150g/m <sup>3</sup> or at higher concentration
Minimum Ignition Energy (MIE) mJ	MIE > 1000mJ	No ignition observed at 1000mJ
Layer Ignition Temperature (°C)	LIT > 450	No ignition observed at 450°C
Minimum Autoignition Temperature (cloud) (°C)	700	Autoignition observed at 700°C.
Maximum explosion pressure (Pmax) bar-g	5.7	-
Explosion Severity (Kst) bar.m/s	63	St-1 Class

# NFPA 652: Chapter 4 Compliance Options

- 4.2.4 The objectives in Section [4.2](#) shall be deemed to have been met by implementing either of the following:
  - (1) A prescriptive approach in accordance with Chapters [5](#), [7](#), [9](#), and [8](#) in conjunction with any prescriptive provisions of applicable commodity-specific NFPA standards
  - (2) A performance-based approach in accordance with Chapter [6](#)

# NFPA 652: Chapter 7 Process System Requirements for DHA

- 7.3.3.1 Each part of the process system where combustible dust is present or where combustible particulate solids could cause combustible dust to be present shall be evaluated, and the evaluation shall address the following:
  - (1) Potential intended and unintended combustible dust transport between parts of the process system
  - (2) Potential fugitive combustible dust emissions into a building or building compartments
  - (3) Potential deflagration propagation between parts of the process system

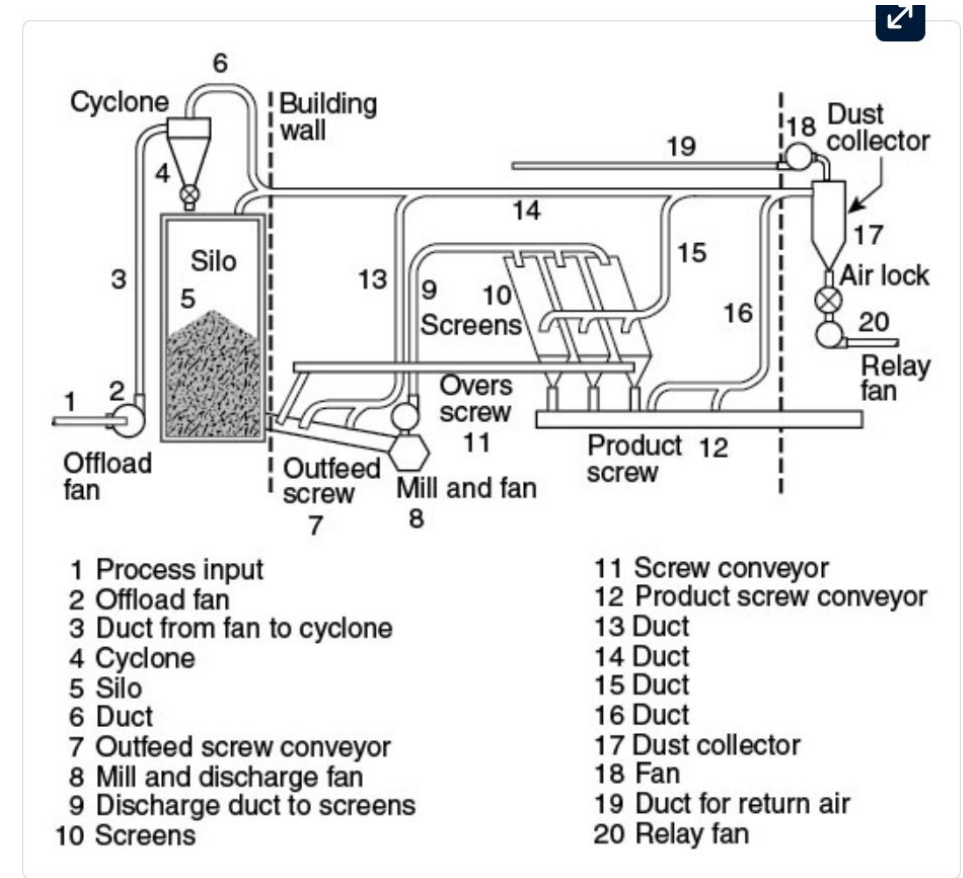
# NFPA 652: Chapter 7 Process System Requirements for DHA

- A P&ID is required to see how the material flows through the process.
- Data sheets are required for each piece of equipment to be able to determine risk levels.
- How the materials are transferred between pieces of equipment need to be understood to determine risk levels.
- Any protective measures and devices need to be included.

# NFPA 652: Section 9.3 Equipment Design

- 9.3.1 A documented risk assessment acceptable to the AHJ shall be permitted to be conducted to determine the level of protection to be provided, including, but not limited to, protection measures addressed in Section [9.3](#).

- NFPA 652, Figure B.4.5



# NFPA 652: Chapter 7 Process System Requirements for DHA

- Equipment examples from FM Datasheet 7-76:

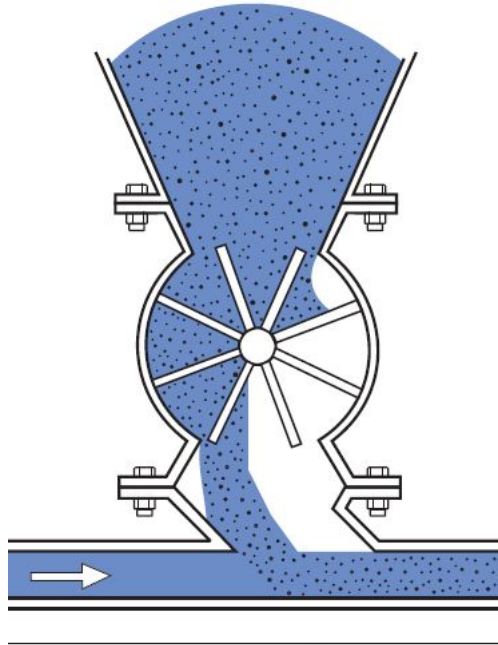
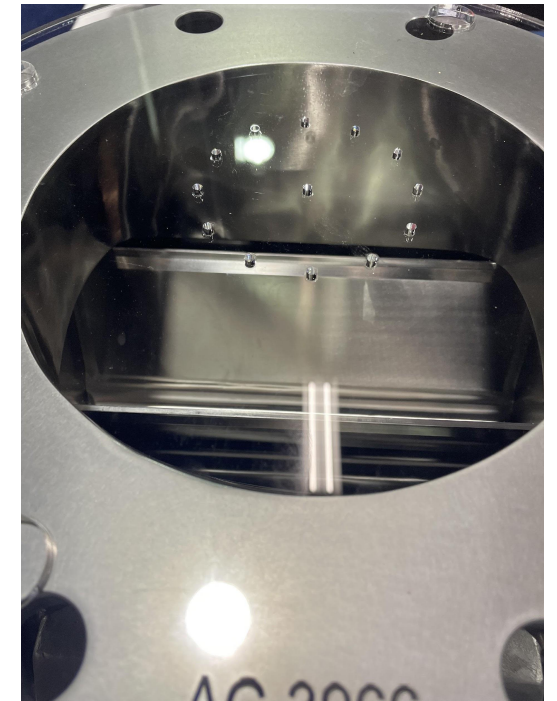


Fig. 4. Rotary Air Lock



# NFPA 652: Chapter 7 Process System Requirements for DHA

- Equipment examples from FM Datasheet 7-76:

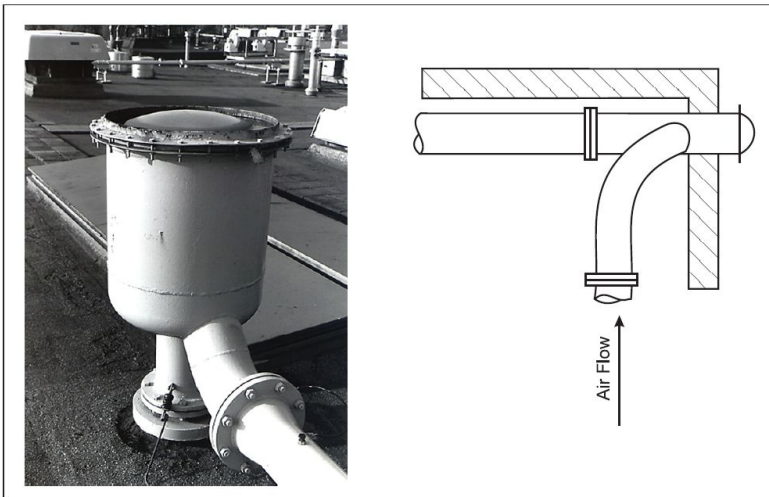


Fig. 6. Explosion diverter

Fig. 7. Indoor installation of explosion diverter



# NFPA 652: Chapter 7 Process System Requirements for DHA

- Equipment examples from FM Datasheet 7-76:

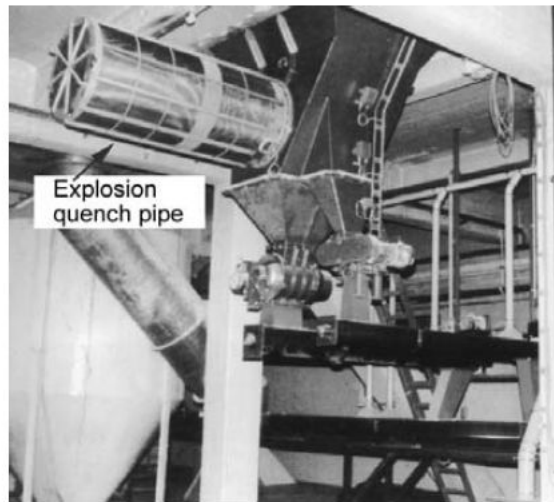
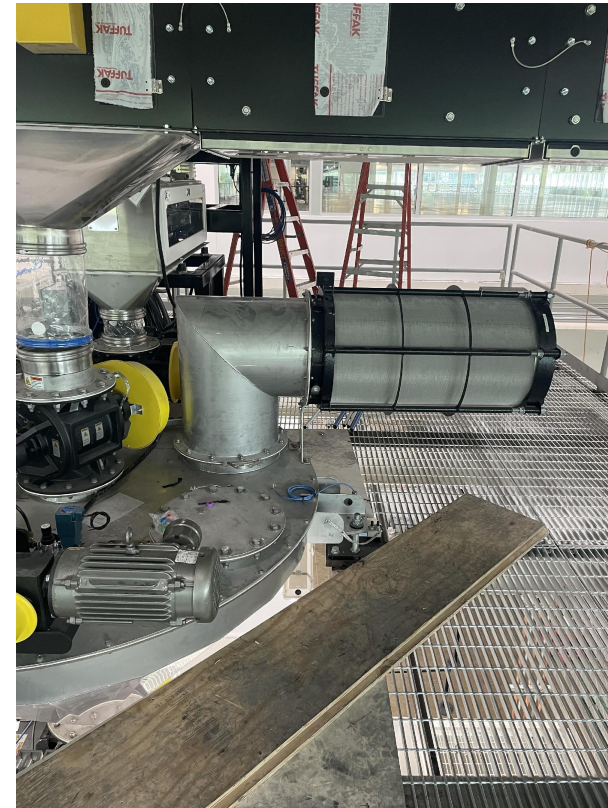


Fig. 10. FM Approved flameless venting device (Photo courtesy of Rembe GmbH)



# NFPA 652: Chapter 7 Process System Requirements for DHA

- Examples of equipment information needed for DHA:

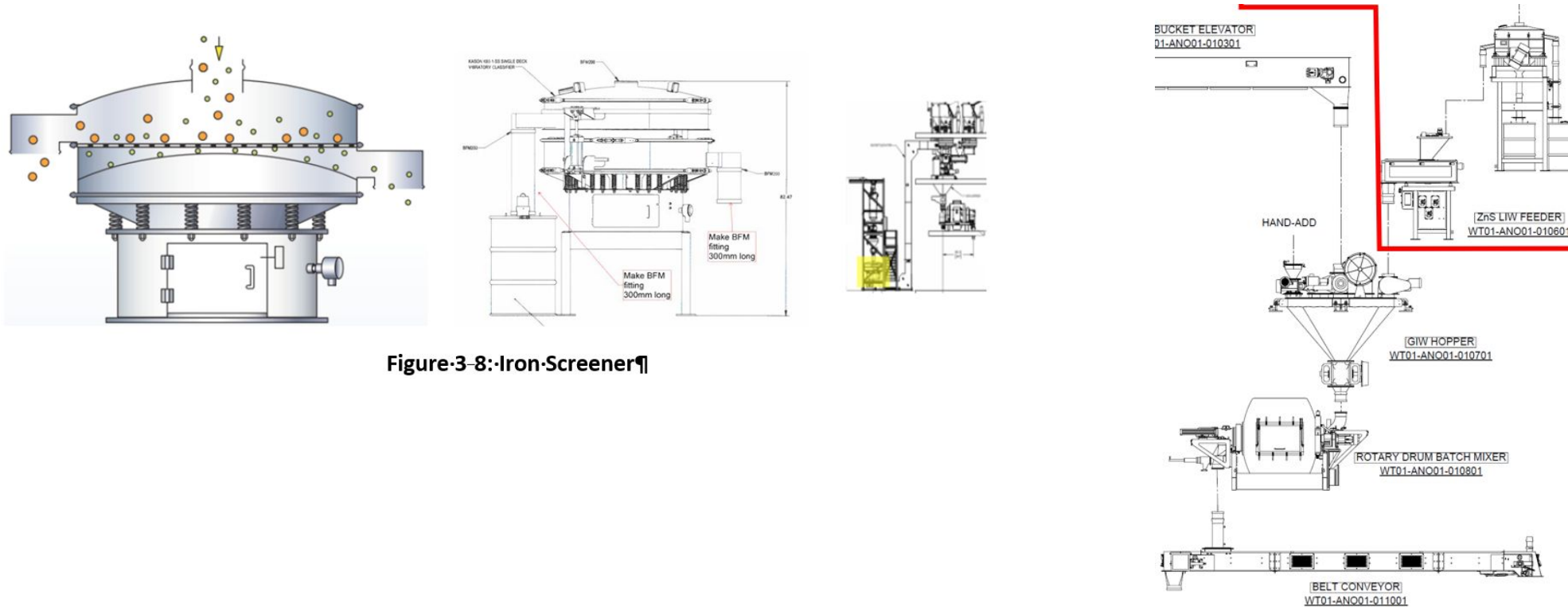
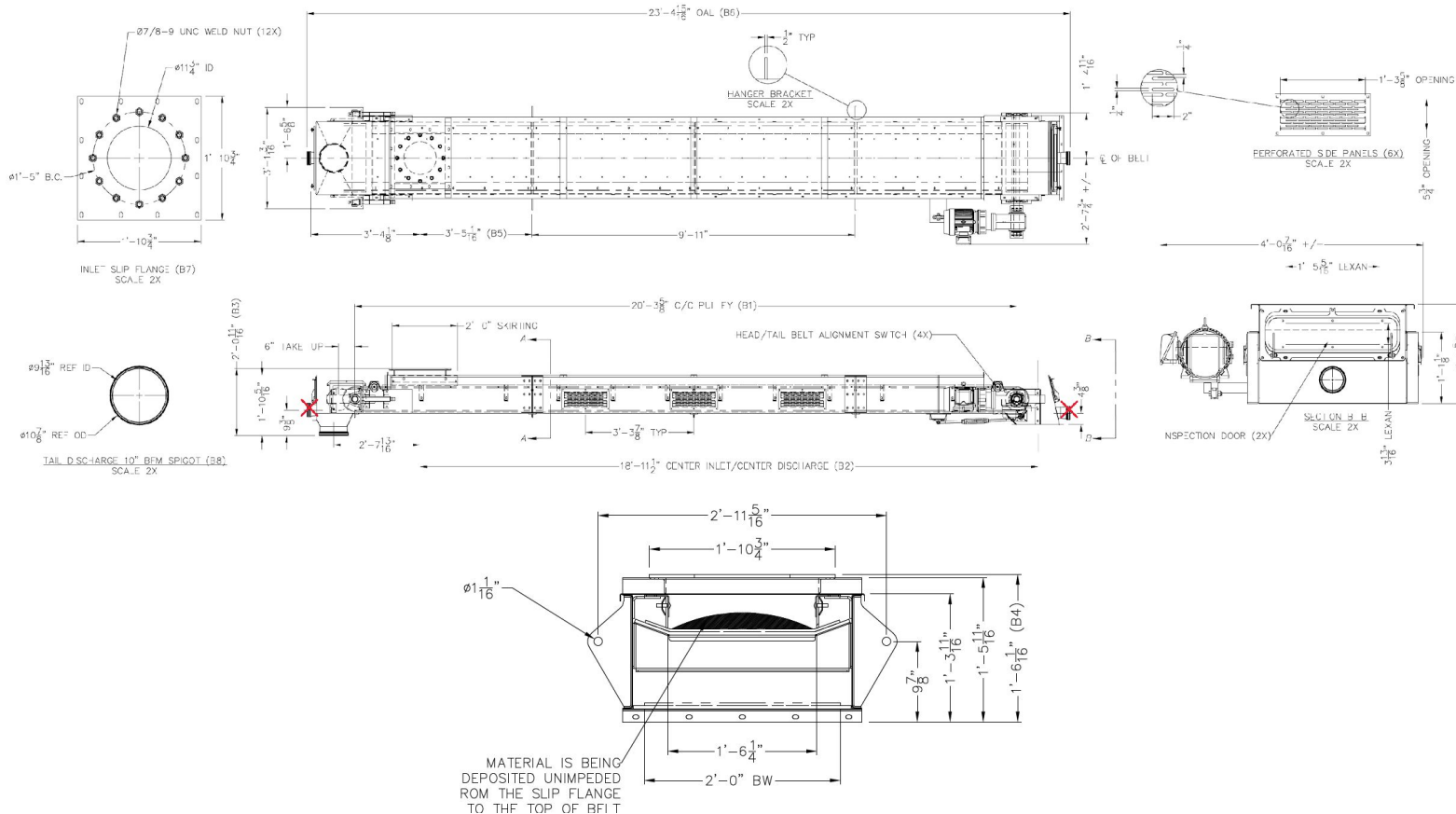


Figure-3-8: Iron-Screener

# NFPA 652: Chapter 7 Process System Requirements for DHA:

- Examples of equipment information needed for DHA:



## Touchswitch™ Belt & Pulley Misalignment Sensor

**APPLICATION**  
Detects belt tracking and misalignment problems on bucket elevators and conveyors.

**METHOD OF OPERATION**  
The Touchswitch is an electro-mechanical limit-switch with no moving parts, which detects tracking and misalignment problems on bucket elevators and conveyors.

When a belt misaligns or a pulley moves over and contacts the sensor, the built in solid-state electronic circuitry detects the lateral force of the belt or pulley and activates a voltage free relay contact. This relay contact is used to immediately alarm and shutdown the machine.

The face of the sensor is made from hardened and annealed stainless steel, not soft brass or aluminum, so wear life is longer when a belt contacts it. The sensor is not affected by dust or material build up and will still work when completely covered by material. An external test knob allows for quick and simple sensor/system testing.

The sensors are usually installed in pairs on opposite sides of the machine. The sensors can be connected directly to a PLC input, or for greater safety, to a central independent monitoring system, such as the T500 Hotbus or the Watchdog Elite.

- FEATURES**
- ▶ No Moving Parts
  - ▶ Immediate Misalignment Signal
  - ▶ Changeover Relay Contact Output
  - ▶ Adjustable Sensitivity
  - ▶ External Test Function
  - ▶ Not a "Rub" Block
  - ▶ CSA Class II Div. 1 Approved

- PART NUMBERS/ACCESSORIES**
- ▶ TS2V30C Touchswitch 12 VDC
  - ▶ TS2V4C Touchswitch 24 VDC
  - ▶ PS3500V3 12 VDC Power Supply
  - ▶ PS2000V4 24 VDC Power Supply
  - ▶ T5001V46C T500 Hotbus Monitoring System
  - ▶ WDC3V46C Watchdog Elite Monitoring System
  - ▶ B4004V46C B400 Elite Misalignment Monitor



U.S. Patent # 6,731,219  
Other Patents Pending



Default specification, wiring diagrams and installation/operating instructions available upon request.

4B COMPONENTS LIMITED  
625 Erie Avenue, Morton, IL 61550 USA Tel: 309-698-5611 Fax: 309-698-5615

www.go4b.com

# NFPA 652: Chapter 7 Process System Requirements for DHA:

- Examples of equipment information needed for DHA:

## No transfer points

These design features deliver important advantages. By running horizontally and vertically without transfer points, your product can move from one process to another without spillage, degradation, dusting or segregation of blended products.

## No spillage

The interlocking buckets ensure that there is no spillage at the infed and because the buckets never separate, even on vertical lift, the only place your product leaves the buckets is at the discharge. Even here the TipTrak design allows for a gentle cascading of product, further reducing degradation.

## No moving parts

The TipTrak chain, through its unique combination of design and materials, delivers trouble free operation, year after year, even in the most demanding industrial environment. There are no roller chains to stretch or bushings to wear out. In fact, there are no moving parts in the TipTrak chain. The chain runs slack and, after the initial setup, never needs adjusting.

Non-metallic construction makes the TipTrak ideal for situations requiring sanitary or corrosion resistant materials. This feature also means that our conveyors are quiet. In short, the unique TipTrak construction means the gentlest handling, the least spillage, the lowest possible maintenance, and the quietest operation of any mechanical elevating device.

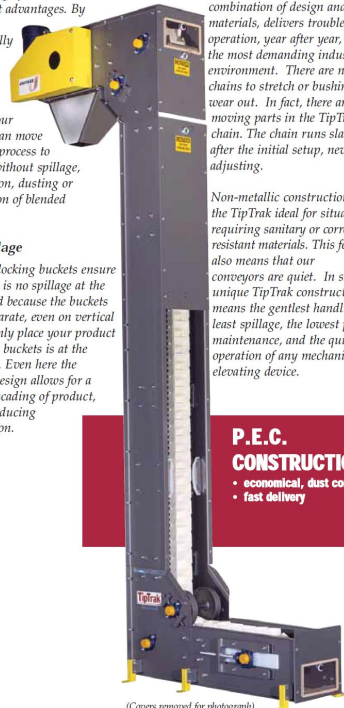
## Open Construction

Open TipTraks use a square tubing frame that supports but doesn't enclose the buckets. They offer economy, ease of cleaning, and at-a-glance monitoring of your operation. They are available in carbon steel and stainless steel. Optional round tubing can be substituted for the square tubing.

Where required, personnel guards can be fitted to meet government safety standards while still providing easy access and maximum visibility.

## P.E.C. Construction

Suitable for most applications, the P.E.C. model uses "stock" components, allowing for dust containment, fast delivery, and operator protection. It can be customized with available options to fit your application requirements. Options include inlet hoppers with vibratory feeders, speed switches and discharge assists for sticky products. Covers can be provided in expanded mesh, clear polycarbonate and steel sheet.



(Covers removed for photograph)

**P.E.C. CONSTRUCTION**  
 • economical, dust containment  
 • fast delivery

## TipTrak Included Options

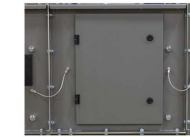
- A. Clean-out Drawers (under lower (end-removal style)/upper horizontal) - Keyed, 304SS
- B. Bucket Knocker - Discharge Assist Device, 304 Stainless Steel
- C. Rectangle to Round Discharge Chute w/Ø10" (250mm) BFM fitting, 304 Stainless Steel
- D. Dust Collection Ports - Ø4" BFM (100mm) fittings, (6) Locations, 304 Stainless Steel
- E. Fully Conductive TipTrak
  - Conductive Bucket Assembly
  - Static W/pper
  - Grounding Studs/Straps
  - Conductive Support Idlers/Vertical Guides
- F. Electrosensors Speed Switch, 24V DC, 1-1000 RPM, c/w Guard Cover
- G. Perforated Venting Panels (locations as shown), 304 Stainless Steel
- H. Custom Paint (RAL 9017) - Traffic Black
- I. Explosion Proof Motor, Class 2 Div.1 Grp. E
- J. No VFD - to be supplied by customer
- K. No Vendor specific logos/stickers etc.



## TipTrak Bucket Conveyors For Explosive Applications



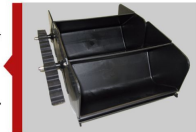
TipTrak™ bucket conveyors can be supplied to service explosive applications, including those with ATEX requirements. Here are some of the features of the TipTrak™ bucket conveyors for explosive environments.



**Ground studs and grounding wire.** The entire TipTrak™ is grounded via welded grounding studs and ground straps on each of parts of the entire frame to ensure a fully conductive path to ground, or "earthing".

**Ability to operate under a nitrogen purge.** The frame of a TipTrak™ conveyor is reinforced with custom-designed ribs and factory-installed nozzles to enable operation with a nitrogen purge to virtually eliminate the accumulation of any explosive atmosphere within the machine.

**Conductive bucket assemblies.** All TipTrak™ bucket conveyors designed for explosive applications are supplied with fully conductive bucket assemblies, which includes the buckets, joint strips and the TipTrak™ rubber BeltChain. Our rubber chains can never create any sparking, and our specially formulated plastic buckets and joint strips never accumulate any static charge.



**Explosion proof electrical components.** TipTrak™ bucket conveyors designed for explosive environments are equipped with explosion proof motors, and all other aspects of the electrical system, including speed sensors and ionizer assemblies.



**No interior ledges.** The interior of a TipTrak™ conveyor is free of ledges and crossbar supports where explosive dust could accumulate.

**Options available.** All TipTraks™ can be "customized" to suit your requirements, options such as rupture panels, explosion venting, dust collection connections and easily removable clean out drawers can be added.

TipTrak™ bucket conveyors are designed to service a wide variety of bulk material conveying applications. With over 45 years of proven performance in facilities the world over, TipTrak™ bucket conveyors provide unmatched reliability in even the most demanding applications. TipTrak™ bucket conveyors are available in a wide range of constructions, sizes, and configurations, and every unit can be precisely customized for your application.

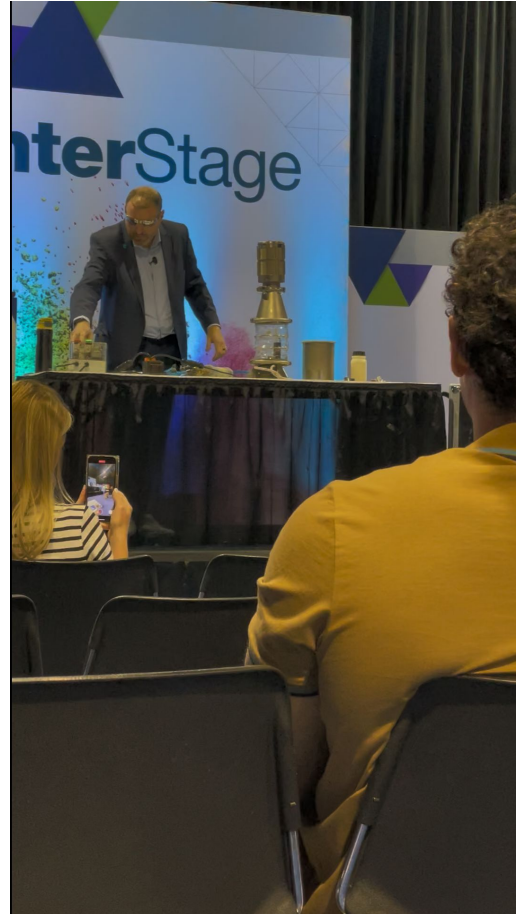
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 SALES@UNITRAK.COM OR +1-905-885-8168

# Rembe Demo



# Rembe Demo



# NFPA 652: Chapter 7 Process System Requirements for DHA

- 7.3.3.2 Each part of the process that contains a combustible particulate solid and that can potentially include both of the following conditions shall be considered a fire hazard and shall be documented as such:
  - (1) Oxidizing atmosphere
  - (2) Credible ignition source

# NFPA 652: Chapter 7 Process System Requirements for DHA

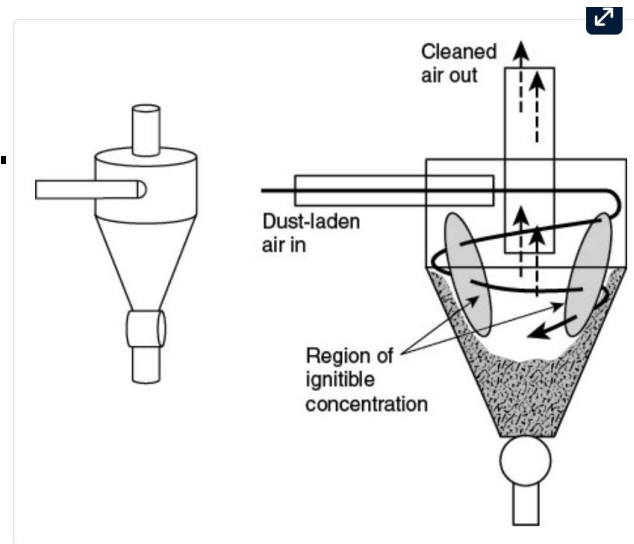
- Anywhere with oxygen or oxidizing agent, and possible ignition sources like electrical equipment, bearings, dryers, static discharge, etc. is considered a risk.
- Inert atmospheres and relocating devices should be considered and may be required.

# NFPA 652: Chapter 7 Process System Requirements for DHA

- 7.3.3.3 Each part of the process that contains a sufficient quantity of combustible dust to propagate a deflagration and that can potentially include all the following conditions shall be considered a dust deflagration hazard and shall be documented as such:
  - (1) Oxidizing atmosphere
  - (2) Credible ignition source
  - (3) Credible suspension mechanism

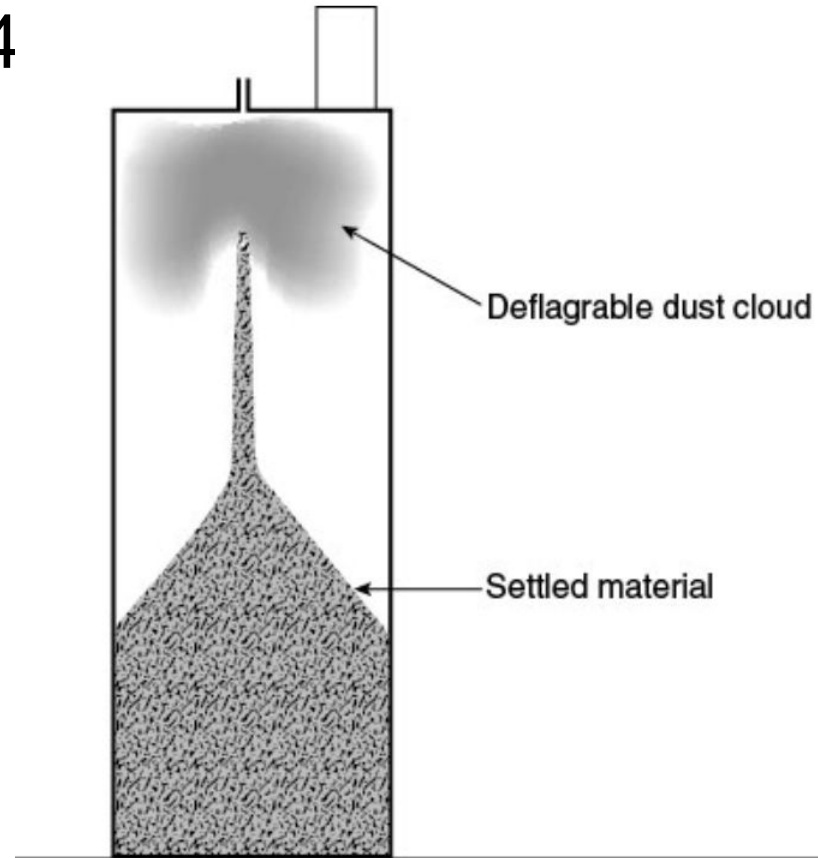
# NFPA 652: Chapter 7 Process System Requirements for DHA

- Areas where the dust is suspended for any period of time, like in mixers when material is being transferred from one piece of equipment to the next needs to be reviewed for possible ignition.
- NFPA 652, Figure B.4.5.



# NFPA 652: Chapter 7 Process System Requirements for DHA

- NFPA 652, Figure B.4



# NFPA 652: Section 9.3 Equipment Design

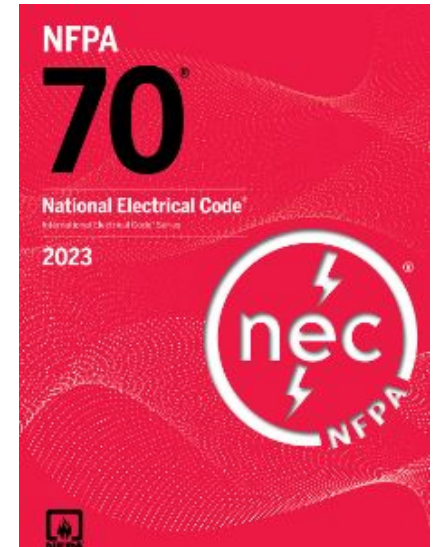
- All equipment is to be bonded and grounded.
- Equipment containing combustible dust is to be designed to contain the dust as much as possible.
  - If the equipment cannot be designed to contain the dust, alternate equipment or methods should be considered for the piece of equipment.
  - If there is no equipment or methods to contain the dust, then dust collection shall be provided.
- Ignition sources should be on the exterior of any equipment and separated from the dust.
- Flame arresters, explosion venting, explosion suppression, and/or pressure containment systems need to be part of the equipment.

# NFPA 499

- Recommended Practice for the Classification of Combustible Dust and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- NFPA 499 provides recommended best practices for protection of electrical equipment with locations that contain combustible dust.

# NFPA 652: Chapter 7 Hazardous Locations

- NFPA 70 requires areas where combustible dust is present to be classified as Class II, Division 1 and 2.
- 502.1 This article covers the requirements for electrical and electronic equipment and wiring for all voltages in Class II, Division 1 and 2 locations where fire or explosion hazards may exist due to combustible dust.



# NFPA 70: Article 500.6(B) Materials

- Combustible dust shall be grouped in accordance with [500.6\(B\)\(1\)](#) through (B)(3).
  - (1) Group E Atmospheres containing combustible **metal** dusts, including aluminum, magnesium, and their commercial alloys, or other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment.
  - (2) Group F Atmospheres containing combustible **carbonaceous** (carbon, graphene, carbon steel, etc.) dusts that have more than 8 percent total entrapped volatiles (see ASTM D3175, Standard Test Method for Volatile Matter in the Analysis Sample of Coal and Coke, for coal and coke dusts) or that have been sensitized by other materials so that they present an explosion hazard.
  - (3) Group G Atmospheres containing combustible dusts **not included in Group E or Group F**, including flour, grain, wood, plastic, and chemicals.

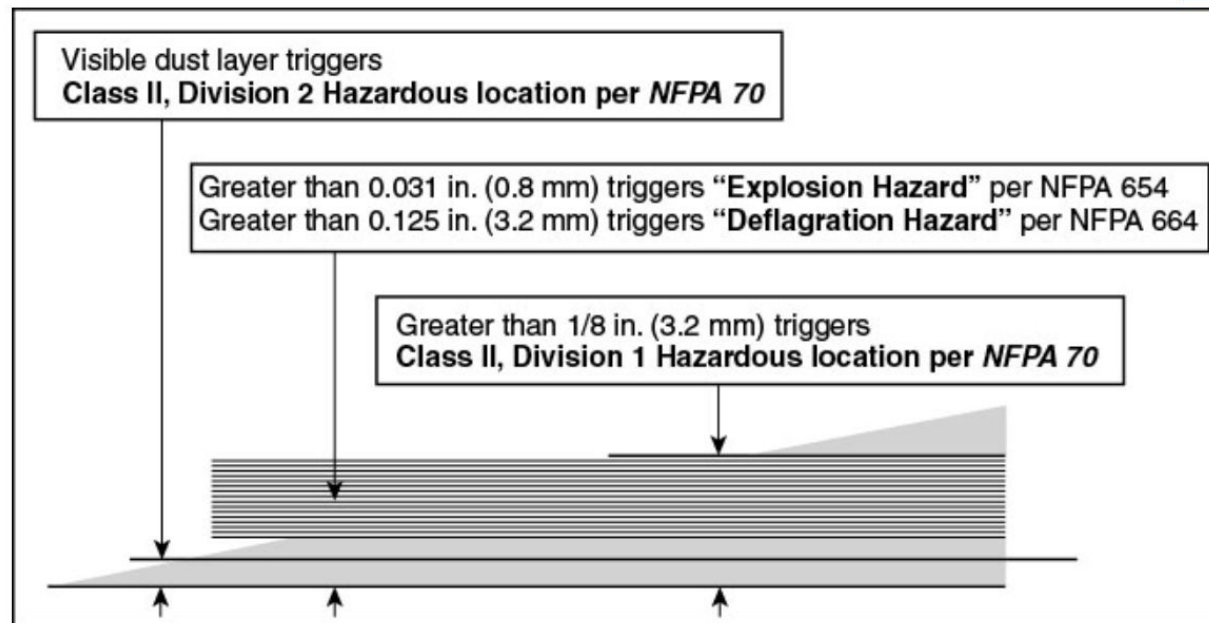
# NFPA 70: Article 500.5 Classifications of Locations

- 500.5(C) Class II Locations

- Class II locations are those that are hazardous because of the presence of **combustible dust**. Class II locations shall include those specified in [500.5\(C\)\(1\)](#) and (C)(2).
- Supplemental information from NFPA:
- Housekeeping, settlement rates, and air velocity are all factors in determining the need for, or the extent of, a Class II classified location. A settled layer of dust could ignite at a temperature different from that of the same dust dispersed into the air as a cloud. Classification of dust layers is based on the thickness of the dust or on the amount of dust expected to settle out, usually over a set period of time.

# NFPA 652, Chapter 7 Hazardous Locations

- The accumulation of fugitive dust will affect the NFPA 70 hazardous location determinations.
- NFPA 652, F



# NFPA 70: Article 500.5 Classifications of Locations

- 500.5(C)(1) Class II, Division 1
- A Class II, Division 1 location is a location:
  - (1) In which combustible dust is in the air under **normal operating conditions** in quantities sufficient to produce explosive or ignitable mixtures, **or**
  - (2) Where 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, **or**
  - (3) In which **Group E** combustible dusts may be present in quantities sufficient to be hazardous in **normal or abnormal operating conditions**.

# NFPA 70: Article 500.5 Classifications of Locations

- 500.5(C)(1) Class II, Division 1
- A Class II, Division 1 location is a location:
- Informational Note: Dusts containing magnesium or aluminum are particularly hazardous, and the use of extreme precaution is necessary to avoid ignition and explosion.
  - Supplemental information from NFPA:
  - Group E dusts (metal dusts, e.g., aluminum or magnesium) are particularly hazardous. For example, current through the dust can cause a sufficient temperature rise or electrical arc to trigger ignition. **The classification of an area where a Group E dust is or may be present will be Division 1.**

# NFPA 70: Article 500.5 Classifications of Locations

- 500.5(C)(2) Class II, Division 2
- A Class II, Division 2 location is a location:
  - (1) In which combustible dust due to **abnormal operations** may be present in the air in quantities sufficient to produce explosive or ignitable mixtures; **or**
  - (2) Where combustible **dust accumulations are present** but are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but could as a result of infrequent malfunctioning of handling or processing equipment become suspended in the air; **or**
  - (3) In which combustible **dust accumulations on, in, or in the vicinity** of the electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitable by abnormal operation or failure of electrical equipment.

# NFPA 70: Article 500.5 Classifications of Locations

- 500.5(C)(2) Class II, Division 2
- A Class II, Division 2 location is a location:
  - Informational Note No. 1: The quantity of combustible dust that may be present and the adequacy of dust removal systems are factors that merit consideration in determining the classification and may result in an unclassified area.
  - Informational Note No. 2: Where products such as seed are handled in a manner that produces low quantities of dust, the amount of dust deposited may not warrant classification.

# NFPA 70: Article 502 Class II Locations

- 502.1

- Supplemental information from NFPA:

- Class II, Division 1 and 2 locations are defined in [500.5\(C\)](#) as “hazardous because of the presence of combustible dust.” Two different types of dust environments typically warrant a Class II, Division 1 area classification. The first is where a cloud of combustible dust is likely to be present continuously or intermittently under normal operating conditions or because of repair or maintenance operations or leakage. The other environment is one in which a dust layer is likely to accumulate to a depth greater than 1/8 inch on major horizontal surfaces over a defined period of time, usually 24 hours. A Class II, Division 2 location is typically one where these conditions exist infrequently or under abnormal conditions.

# NFPA 70: Article 506.6 Material Groups

- For the purposes of testing, approval, and area classification, various air mixtures (not oxygen enriched) shall be grouped as follows:
  - (1) Group IIIC Combustible **metal** dust, including combustible metal fibers/flyings.
  - (2) Group IIIB Combustible dust **other** than combustible metal dust.
  - (3) Group III A Combustible fibers/flyings **or ignitable** fibers/flyings **other** than metal.

# NFPA 70: Article 506 Zone 20, 21, & 22 Locations for Combustible Dusts or Ignitable Fibers/Flyings

- Zone 20 A Zone 20 location is a location where one of the following apply:
  - (1) Ignitable concentrations of combustible dust, combustible fibers/flyings, or ignitable fibers/flyings are present continuously or for long periods of time.
  - (2) Group IIIC combustible dusts are present in hazardous quantities continuously or for long periods of time.

# NFPA 70: Article 506 Zone 20, 21, & 22 Locations for Combustible Dusts or Ignitable Fibers/Flyings

- Zone 21 A Zone 21 location is a location where one of the following apply:
  - (1) Ignitable concentrations of combustible dust, combustible fibers/flyings, or ignitable fibers/flyings are likely to exist occasionally under normal operating conditions.
  - (2) Ignitable concentrations of combustible dust, combustible fibers/flyings, or ignitable fibers/flyings might exist frequently because of repair or maintenance operations or because of leakage.

# NFPA 70: Article 506 Zone 20, 21, & 22 Locations for Combustible Dusts or Ignitable Fibers/Flyings

- Zone 21 A Zone 21 location is a location where one of the following apply:
  - (3) Equipment is operated or processes are carried on of such a nature that equipment breakdown or faulty operations could result in the release of ignitable concentrations of combustible dust, combustible fibers/flyings, or ignitable fibers/flyings and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition.

# NFPA 70: Article 506 Zone 20, 21, & 22 Locations for Combustible Dusts or Ignitable Fibers/Flyings

- Zone 21 A Zone 21 location is a location where one of the following apply:
  - (4) The location is adjacent to a Zone 20 location from which ignitable concentrations of combustible dust, combustible fibers/flyings, or ignitable fibers/flyings could be communicated
    - Exception: When communication from an adjacent Zone 20 location is minimized by adequate positive pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

# NFPA 70: Article 506 Zone 20, 21, & 22 Locations for Combustible Dusts or Ignitable Fibers/Flyings

- Zone 21 A Zone 21 location is a location where one of the following apply:
  - (5) Group IIIC combustible dusts are present in hazardous quantities occasionally, under normal or abnormal operating conditions, or frequently because of repair or maintenance operations or because of leakage.

# NFPA 70: Article 506 Zone 20, 21, & 22 Locations for Combustible Dusts or Ignitable Fibers/Flyings

- Zone 22 A Zone 22 location is a location where one of the following apply:
  - (1) Ignitable concentrations of combustible dust, combustible fibers/flyings, or ignitable fibers/flyings are not likely to occur in normal operation and, if they do occur, will only persist for a short period.
  - (2) Combustible dust, combustible fibers/flyings, or ignitable fibers/flyings are handled, processed, or used, but the dust or fibers/flyings are normally confined within closed containers or closed systems from which they can escape only as a result of the abnormal operation of the equipment with which the dust or fibers/flyings are handled, processed, or used.

# NFPA 70: Article 506 Zone 20, 21, & 22 Locations for Combustible Dusts or Ignitable Fibers/Flyings

- Zone 22 A Zone 22 location is a location where one of the following apply:
  - (3) The location is adjacent to a Zone 21 location, from which ignitable concentrations of combustible dust, combustible fibers/flyings, or ignitable fibers/flyings could be communicated.
    - Exception No. 1: When communication from an adjacent Zone 21 location is minimized by adequate positive pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.
    - Exception No. 2: For Group IIIC combustible dusts or metal combustible fibers/flyings, there shall only be Zone 20 or 21 locations.

# NFPA 499: Section 3.3.9 Material Groups

- Supplemental information from NFPA:
- The zone classification system includes both dusts and combustible fibers and flyings. The grouping of material by hazard also differs from the system used in Articles 500, 502, and 503. The table below contrasts the classification in the

Comparison of Zone and Division Classification Systems

Hazard	Zone Classification	Division Classification
Combustible metal dusts, fibers, and flyings	Group IIIC	Class II, Group E
Coal, coke, and other carbonaceous dusts	Group IIIB	Class II, Group F
Combustible dusts other than combustible metal dust	Group IIIB	Class II, Group G
Combustible fibers and flyings other than metals	Group IIIA	Class III

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499 Recommendations
  - Areas classified as Group E and equipment is open or semi-enclosed are required to have equipment classified as Class II Div. 1 within 9.15 m of the source.
  - Must meet dust cloud and dust layer requirements.

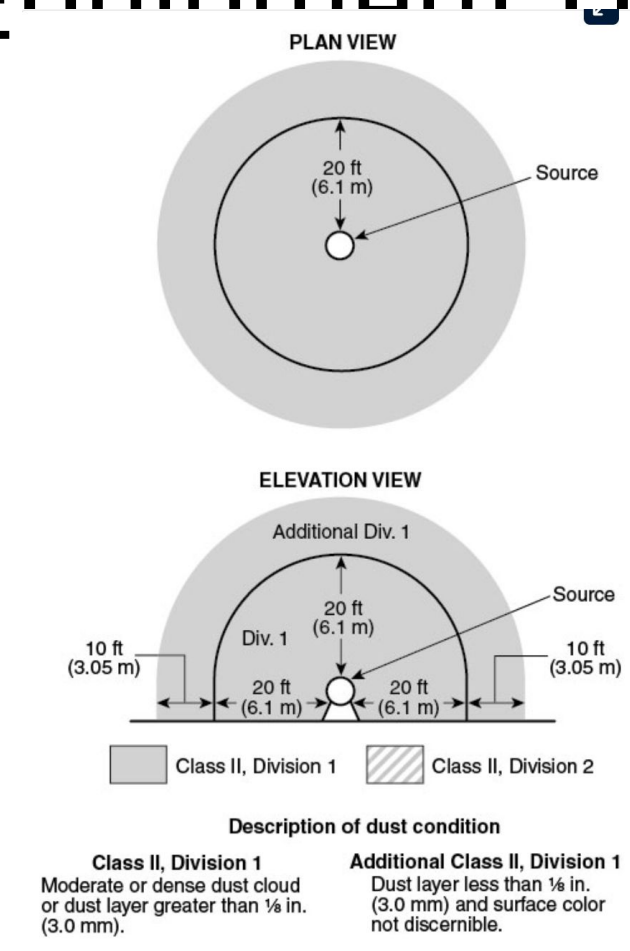


Figure 6.10(b) Group E Dust – Indoor, Unrestricted Area; Open or Semi-Enclosed Operating Equipment.

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499 Recommendations
  - Areas classified as Group F or G and equipment is open or semi-enclosed are required to have equipment classified as Class II Div. 1 within 6.1 m of the source and Class II Div. 2 between 6.1 m and 9.15 m from the source.
  - Must meet dust cloud and dust layer requirements.

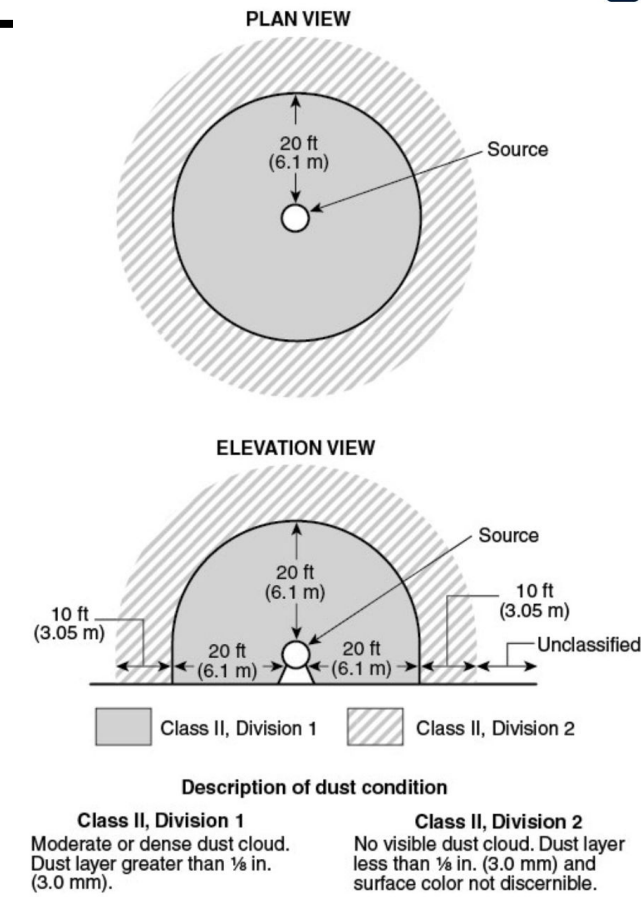


Figure 6.10(a) Group F or Group G Dust – Indoor, Unrestricted Area; Open or Semi-Enclosed Operating Equipment.

# NFPA 652: Section 9.3 Environment Design

- NFPA 499 Recommendations
  - Areas classified as Group F or G and equipment enclosed are required to have equipment classified as Class II Div. 2 within 9.15 m of the source.
  - Must meet dust cloud and dust layer requirements.

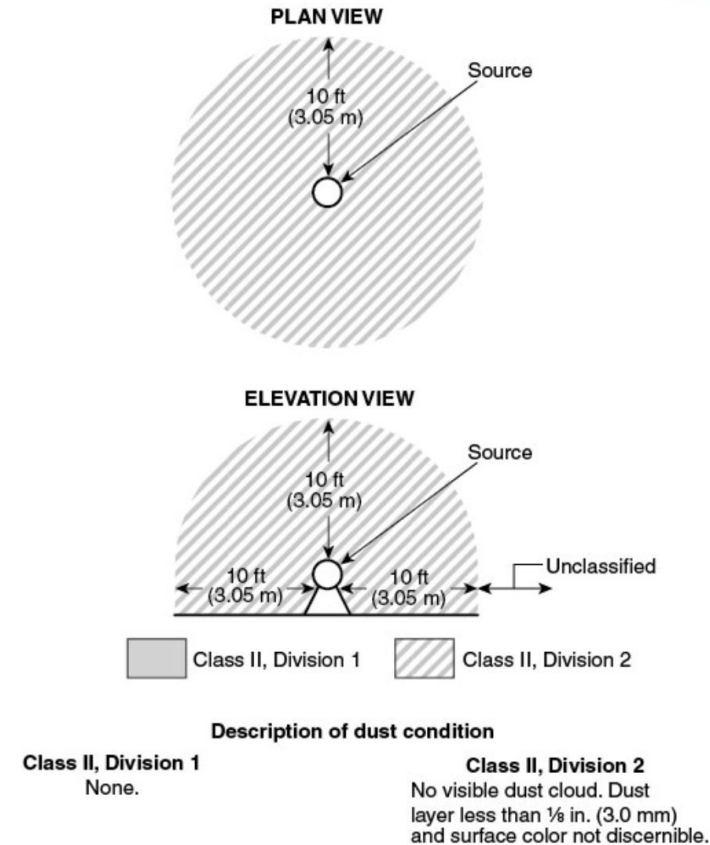


Figure 6.10(c) Group F or Group G Dust – Indoor, Unrestricted Area; Operating Equipment Enclosed; Area Classified as a Class II, Division 2 Location.

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499

## Recommendations

- Areas classified as Group F or G and equipment enclose, without a dust cloud and discernible surface color is considered an Unclassified location.

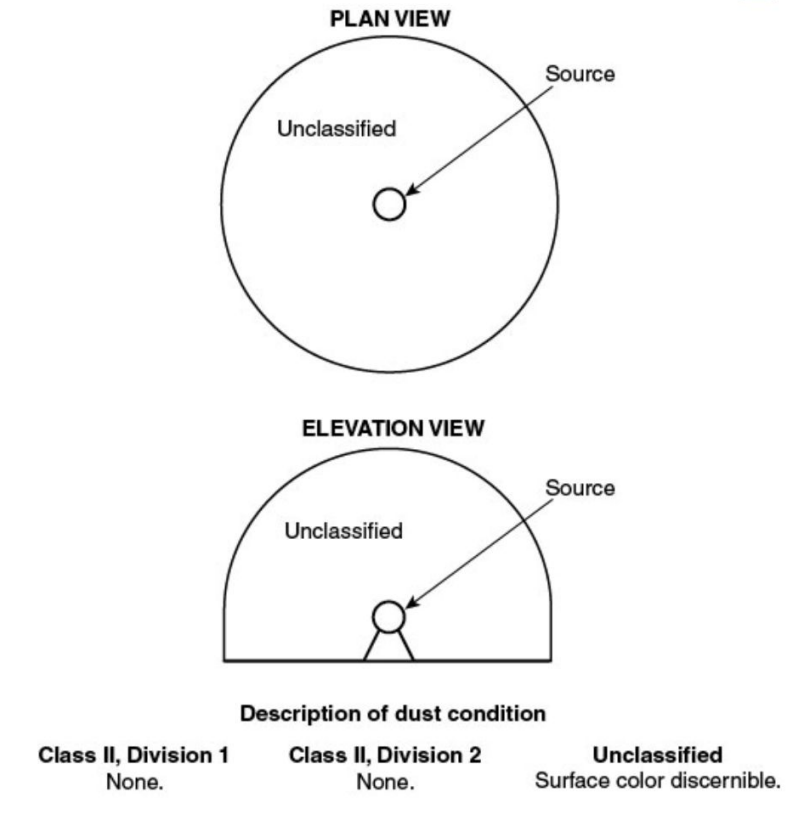


Figure 6.10(d) Group F or Group G Dust – Indoor, Unrestricted Area; Operating Equipment Enclosed; Area is an Unclassified Location.

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499 Recommendations
  - Areas classified as Zone Group IIIB and equipment is open or semi-enclosed are required to have equipment classified as Zone 21 within 6.1 m of the source and Zone 22 between 6.1 m and 9.15 m from the source.
  - Must meet dust cloud and dust layer requirements.

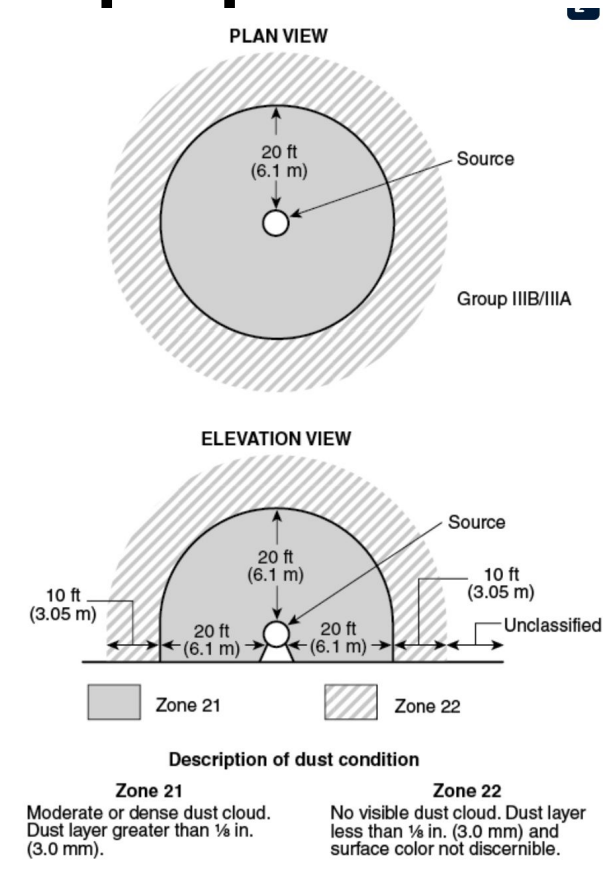


Figure 6.10(j) Zone Group IIIB Dust – Indoor, Unrestricted Area; Open or Semi-Enclosed Operating Equipment.

# NFPA 652: Section 9.3 Environment Design

- NFPA 499 Recommendations
  - Areas classified as Zone Group IIIB and equipment is enclosed are required to have equipment classified as Zone 22 within 9.15 m of the source.
  - Must meet dust cloud and dust layer requirements.

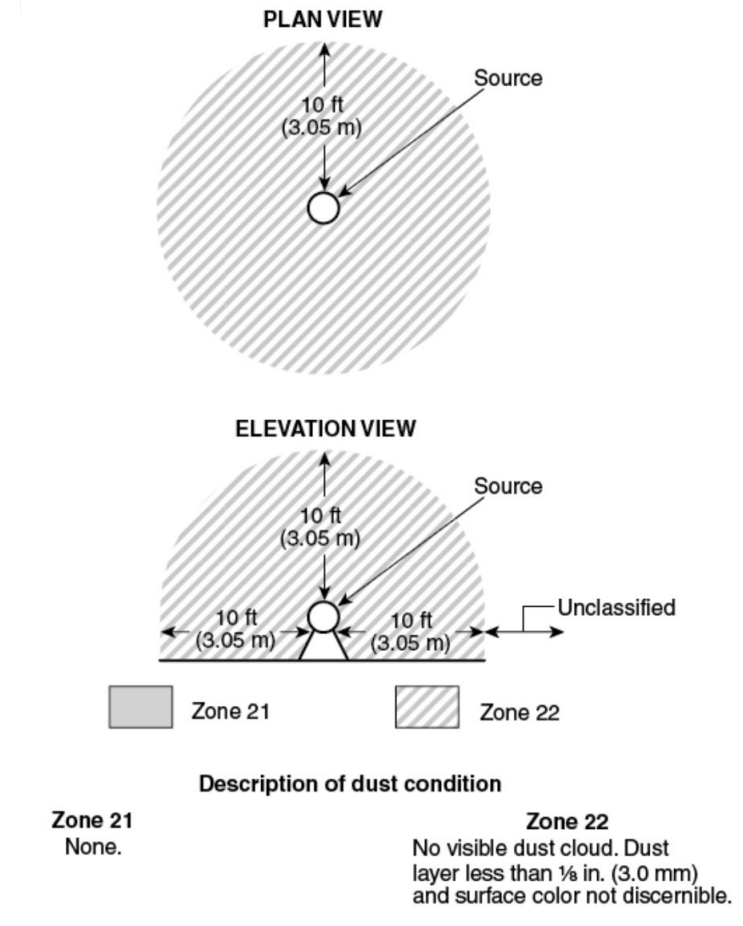


Figure 6.10(l) Zone Group IIIB Dust – Indoor, Unrestricted Area; Operating Equipment Enclosed; Area Classified as a Class II, Zone 22 Location.

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499 Recommendations
  - Areas classified as Zone Group IIIB and equipment enclosed, without a dust cloud and discernible surface color is considered an Unclassified location.

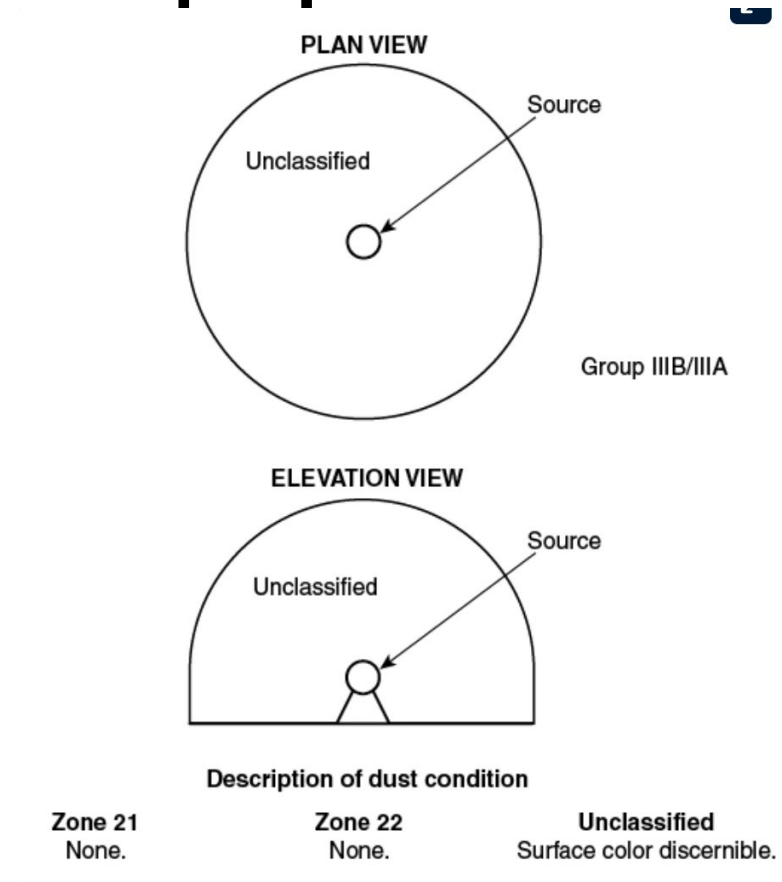


Figure 6.10(m) Zone Group IIIB Dust – Indoor, Unrestricted Area; Operating Equipment Enclosed; Area Is an Unclassified Location.

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499

## Recommendations

- Areas classified as Zone Group IIIC and equipment is open or semi-enclosed are required to have equipment classified as Zone 20/21 within 6.1 m of the source and Zone 21 between 6.1 m and 9.15 m from the source.
- Must meet dust cloud and dust layer requirements.

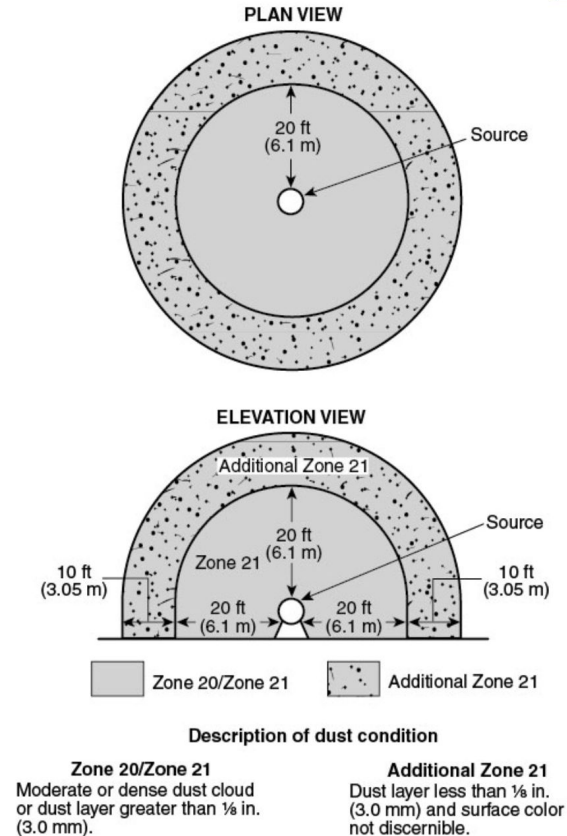


Figure 6.10(k) Zone Group IIIC Dust – Indoor, Unrestricted Area; Open or Semi-Enclosed Operating Equipment.

# NFPA 652: Chapter 7 Building Requirements for DHA

- If dust cannot be contained to the equipment, the system is open or semi-open, or fugitive dust cannot be contained the process needs to be separated by fire barriers with explosion venting built into the structure. This requires the equipment to be located on exterior walls or in a separate

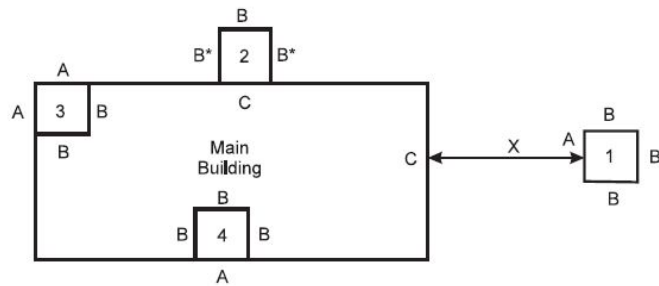


Fig. 1. Preferred locations for processes or equipment handling combustible dusts



# NFPA 652: Chapter 7 Building Requirements for DHA

- 7.3.4.1 Each building or building compartment where combustible dust is present shall be evaluated.
  - 7.3.4.1.1 Where multiple buildings or building compartments present essentially the same hazard, a single evaluation shall be permitted to be conducted as representative of all similar buildings or building compartments.
  - 7.3.4.1.2 The evaluation shall address potential combustible dust migration between buildings or building compartments.
  - 7.3.4.1.3 The evaluation shall address potential deflagration propagation between buildings or building compartments.

# NFPA 652: Chapter 7 Building Requirements for DHA

- 7.3.4.2 Each building or building compartment that contains a combustible particulate solid and that can potentially include both of the following conditions shall be considered a fire hazard and shall be documented as such:
  - (1) Oxidizing atmosphere
  - (2) Credible ignition source

# NFPA 652: Chapter 7 Building Requirements for DHA

- 7.3.4.2.1 The evaluation of dust deflagration hazard in a building or building compartment shall include a comparison of actual or intended dust accumulation to the threshold housekeeping dust accumulation that would present a potential for flash-fire exposure to personnel or compartment failure due to explosive overpressure.
- 7.3.4.2.2 Threshold housekeeping dust accumulation levels and nonroutine dust accumulation levels (e.g., from a process upset) shall be in accordance with relevant industry- or commodity-specific NFPA standards.

# NFPA 652, Chapter 7 Building Requirements for DHA

- Any areas with the potential for dust to be spilled or for fugitive dust to escape should have the following protection features:
  - All surfaces should be sloped to decrease the amount of dust accumulation on building and equipment surfaces.
  - 9.2.5.1 Interior surfaces where dust accumulations can occur shall be designed and constructed so as to facilitate cleaning and to minimize combustible dust accumulations.

# NFPA 652, Chapter 7 Building Requirements for DHA

- A.9.2.5.1 To the extent feasible and practical from a cost and sanitation standpoint, horizontal surfaces should be minimized to prevent accumulation of dust. Horizontal surfaces that can benefit from a sloped cover include girders, beams, ledges, and equipment tops. Overhead steel I-beams and similar structural shapes can be boxed with concrete or other noncombustible material to eliminate surfaces for dust accumulation. The additional weight of the box enclosures should be considered in the structural design. Surfaces should be as smooth as possible to minimize dust accumulations and to facilitate cleaning. One option based on clean design concepts is to construct the building walls so that the structural supports, electrical conduit, and so forth are on the exterior side of the building walls; therefore, the interior building compartment walls are smooth and less likely to collect fugitive dust.

# NFPA 652: Chapter 7 Building Requirements for DHA

- Any areas with the potential for dust to be spilled or for fugitive dust to escape should have the following protection features:
  - All surfaces SHALL have a color where dust accumulation can be readily discernible.
  - 9.2.6.3.3 Either the separation area shall be free of dust or where dust accumulations exist on any surface, the color of the surface on which the dust has accumulated shall be readily discernible.

# NFPA 652: Chapter 7 Building Requirements for DHA

- 7.3.4.3 Each building or building compartment that contains a sufficient quantity of combustible dust to propagate a deflagration and that can potentially include all of the following conditions shall be considered a dust deflagration hazard and shall be documented as such:
  - (1) Oxidizing atmosphere
  - (2) Credible ignition source
  - (3) Credible suspension mechanism

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499

## Recommendations

- Walled-off areas classified as Group E with enclosed equipment and still have dust are recommended to have equipment classified as Class II Div. 1 in the room and 915 mm from any opening from the room.

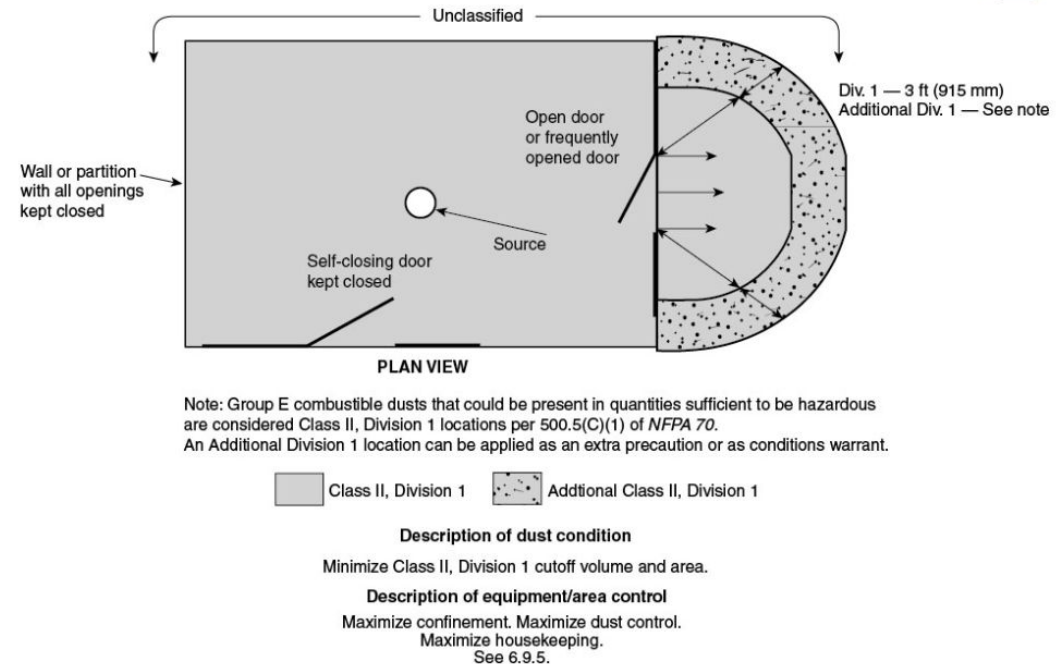


Figure 6.10(f) Group E Dust – Indoor, Walled-Off Area; Operating Equipment Enclosed.

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499

## Recommendations

- Walled-off areas classified as Group F or G with open or semi-open equipment and still have dust are recommended to have equipment classified as Class II Div. 1 in the room and 915 mm from any opening from the room.

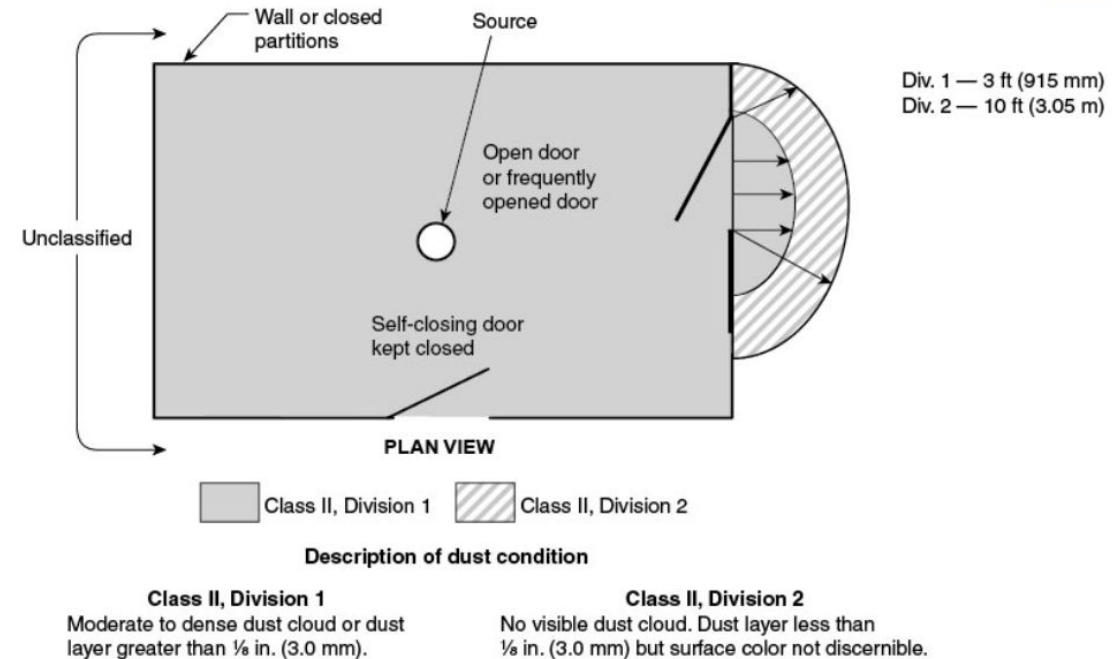


Figure 6.10(g) Group F or Group G Dust – Indoor, Walled-Off Area; Operating Equipment Open or Semi-Enclosed.

# NFPA 652: Section 9.3 Equipment Design

- NFPA 499

## Recommendations

- Walled-off areas classified as Group F or G with open or semi-open equipment and still have dust are recommended to have equipment classified as Class II Div. 1 in the room and 915 mm from any opening from the room.

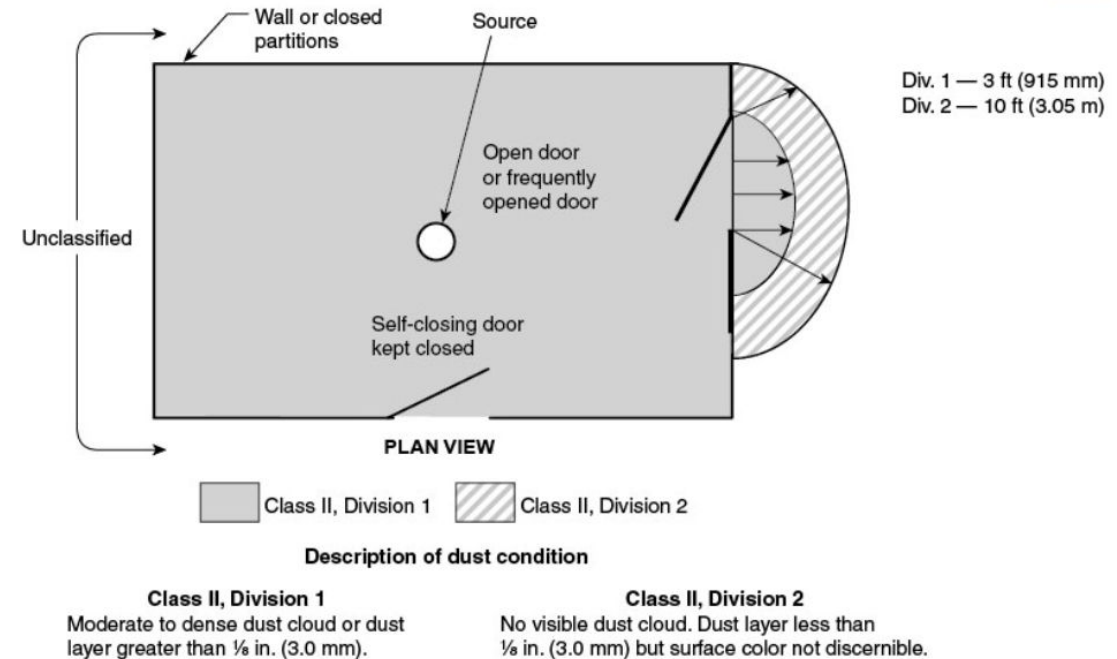


Figure 6.10(g) Group F or Group G Dust – Indoor, Walled-Off Area; Operating Equipment Open or Semi-Enclosed.

Questions?

# Thank you!



**Russ Bainbridge**  
Senior Fire Protection Engineer