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HOW FOLLOWING NEC REDUCES DUST EXPLOSION HAZARDS

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CEO/President, Knobelsdorff

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Feed&Grain^{LIVE}



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PURPOSE

Understanding the Unique Hazards in our Industry

NEC Hazardous Location Classifications

Types of Ignition Sources

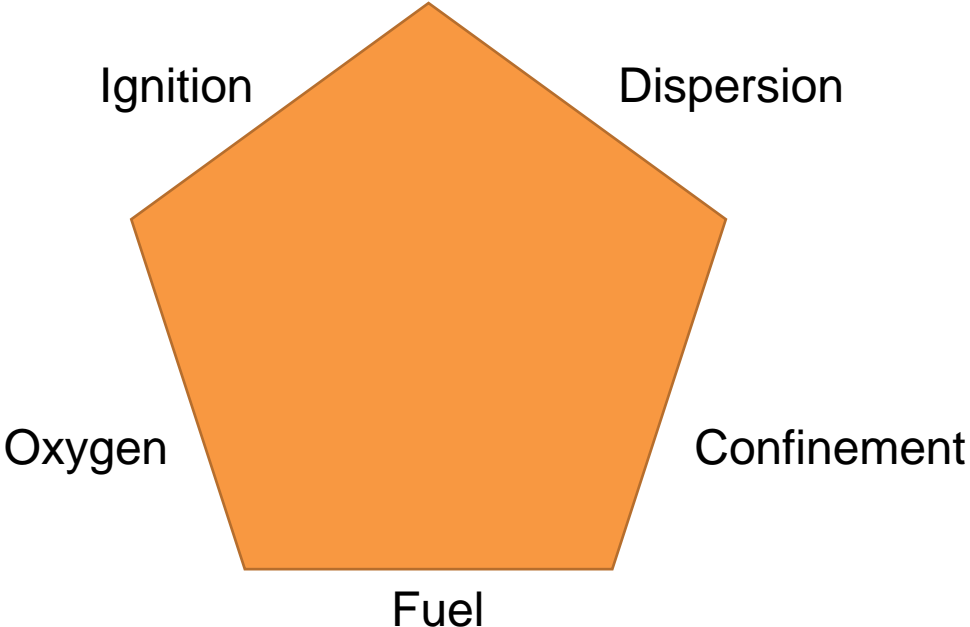
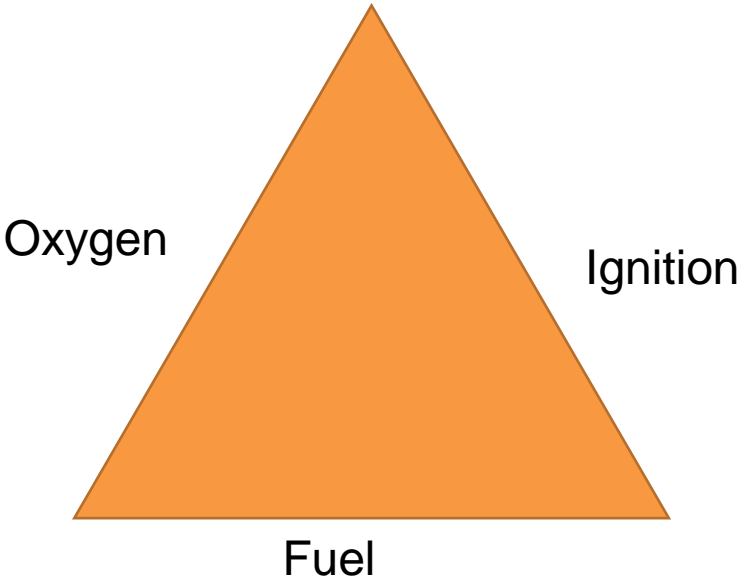
NEMA Enclosure Types and Examples

Planning and Design to Reduce Risks of Explosions

Explosion Suppression Systems



HAZARDS IN THE GRAIN INDUSTRY

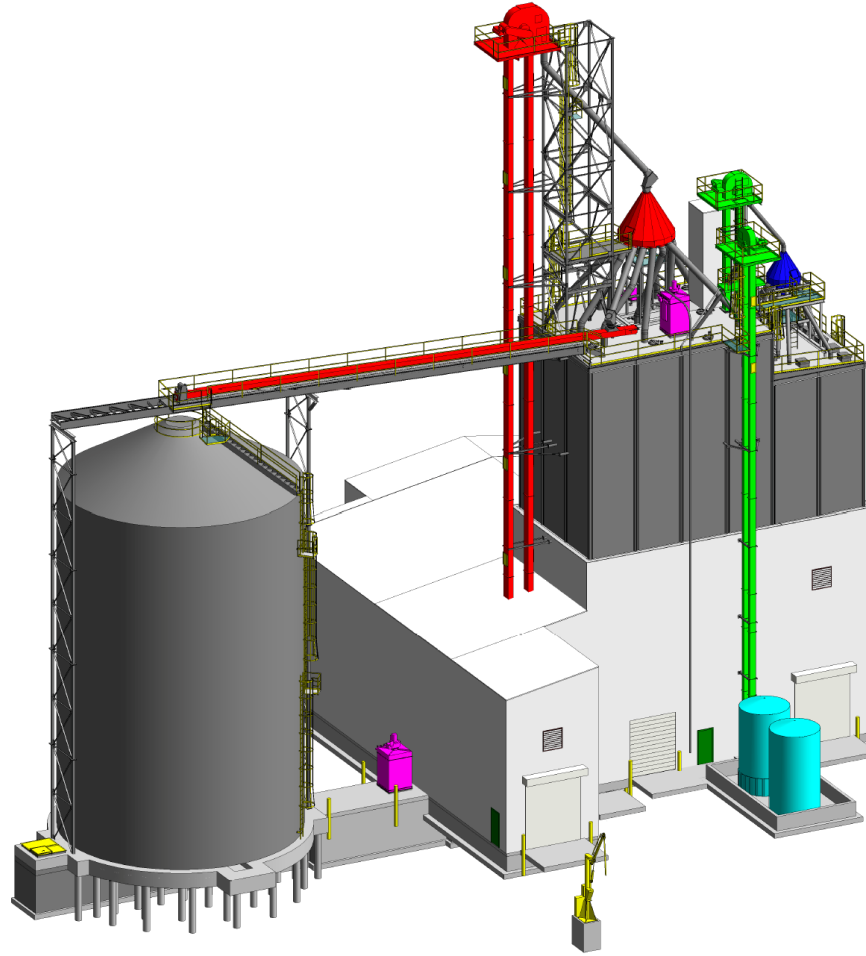


RECIPE FOR DISASTER

Enclosed Building

Grain Dust

Spark / Heat



HAZARDOUS CLASSIFICATIONS

NFPA 70:

National Electrical Code (NEC)

Chapter 5:

Special Occupancies specifically article 500 and 502

NFPA 499

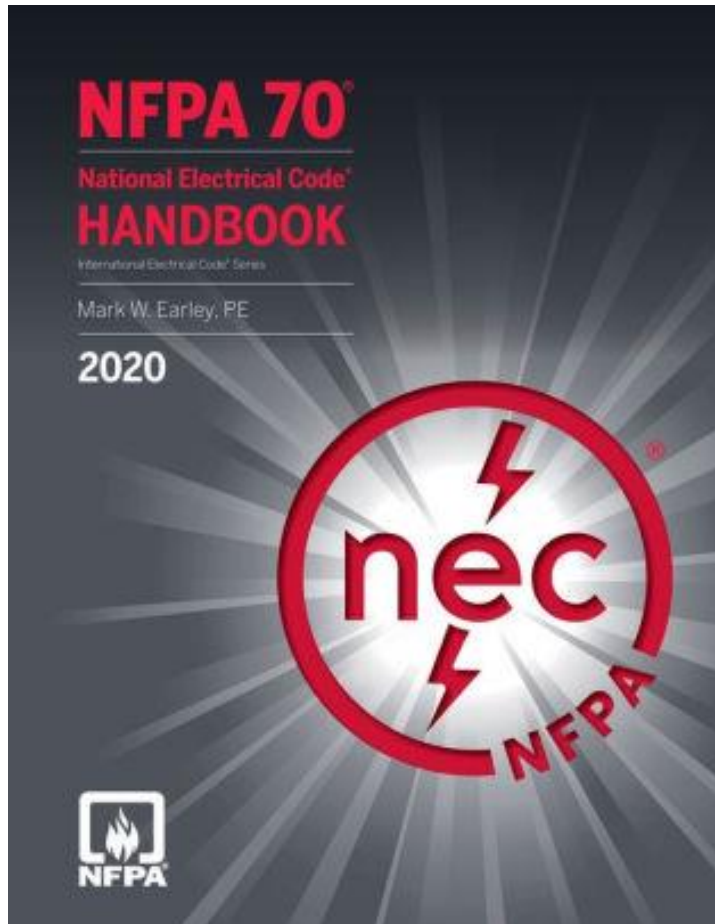
Recommended Practice for Classifications of locations with combustible dust



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CLASS

The type of material of substance presenting a hazard



CLASS 1 // Gas & Vapors

CLASS 2 // Dust

CLASS 3 // Fibers

GROUPS

Define the type of hazardous material in the area



Groups A – D: Various Gasses and Vapors Gasoline, Propane, Acetylene, Methane, Toluene, Methanol, Hexane

Group E: Metals Dust

Group F: Carbon Black/Coal Dust

Group G: Grains/Starch/Flour/Wood



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DIVISIONS

Probability of hazardous material being present

DIVISION 1 // During Normal
Operating Conditions

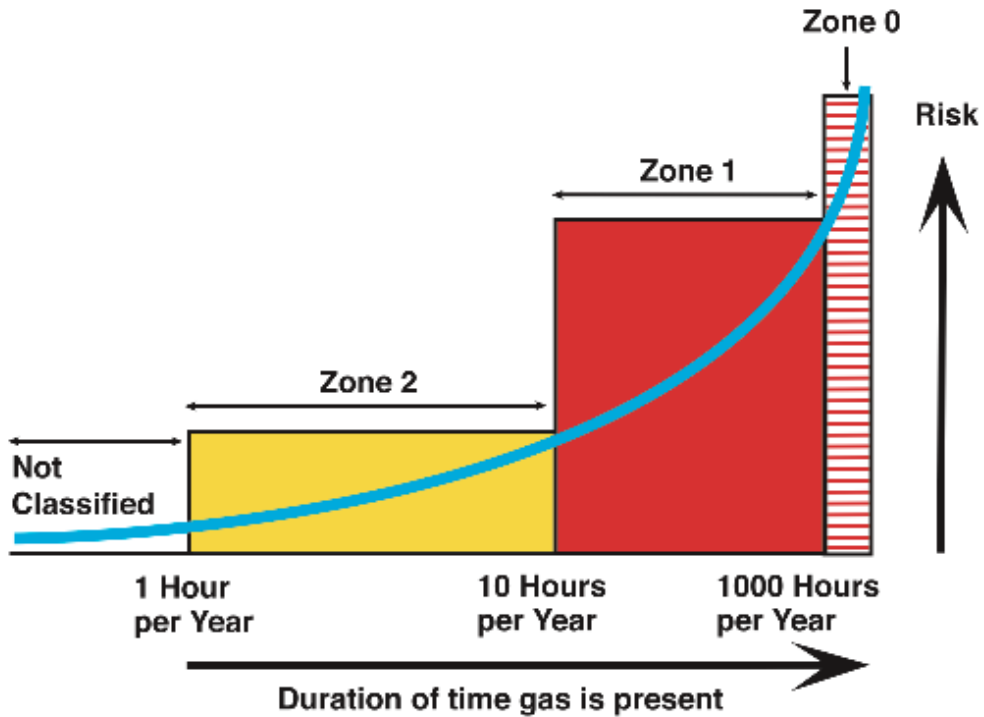
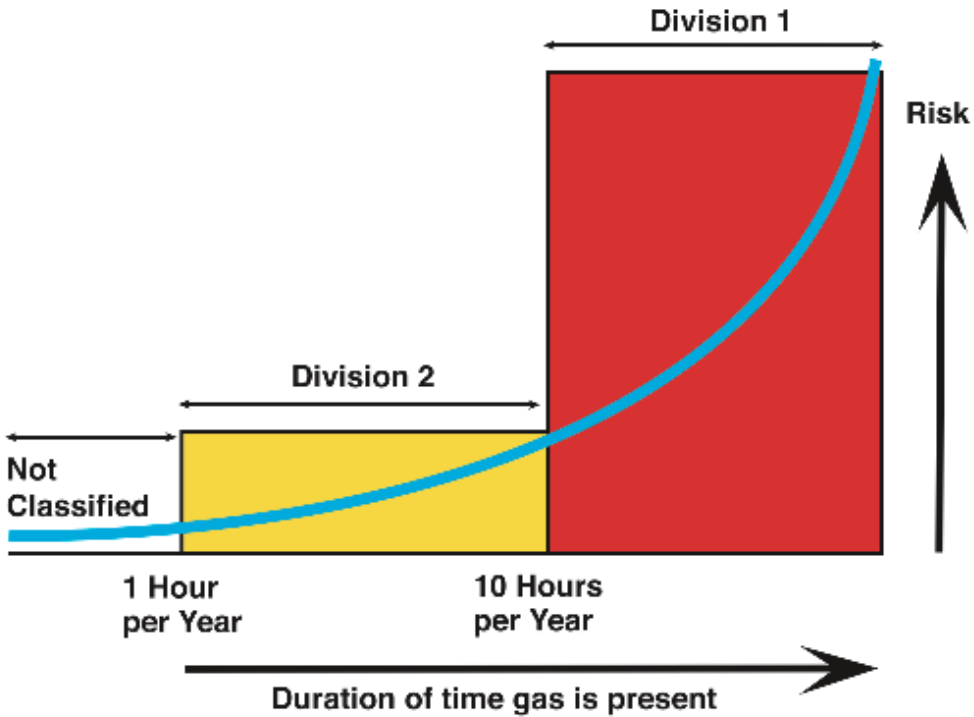
DIVISION 2 // Not Likely in
Normal Operating Conditions



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CLASSIFICATION ZONES

Based on hour per day



HAZARDOUS CLASSIFICATIONS



Class 1
Division 1 Gases exist under normal conditions

Gases exist due to faulty operations

Class 1
Division 2 Gases or Liquids can only be
released by rupture or breakdown

Failure of ventilation equipment

HAZARDOUS CLASSIFICATIONS



Class 2
Division 1 High concentrations of dust are present during normal conditions (explosive levels)

Class 2
Division 2 Normal conditions do not present high levels of combustible dust to be explosive



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MATERIAL CONCENTRATION REQUIRED FOR EXPLOSION



Saw Dust – 40 g/m³

Corn Dust – 60 g/m³

Wheat/Starch – 30 g/m³

Sugar Dust – 200 g/m³



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EXPLOSIVE GRAIN DUST

Common Locations

- ✓ Receiving
- ✓ Bin decks
- ✓ Loadout



EXPLOSIVE GRAIN DUST

Housekeeping



- ✓ Thickness of Dust Layer
- ✓ 1/8" or more of dust, serious hazard for secondary explosion
- ✓ Secondary Explosions



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IGNITION SOURCES

Motors 502.125



- ✓ Totally enclosed Fan-Cooled (TEFC) C2D2 MUST BE T3B
- ✓ Explosion Proof (EXP) C2D1



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IGNITION SOURCES

Control Devices 502.115, 502.150



- ✓ Position Switches
- ✓ Solenoids
- ✓ Temperature Transmitters
- ✓ Type 7 and 9 and Intrinsically Safe C2D1
- ✓ Type 4/12 C2D2

IGNITION SOURCES

Light Fixtures & Power



- ✓ Area Lighting 502.130
- ✓ Emergency Lighting 502.130
- ✓ Receptacles 502.145
- ✓ General Use Equipment 520.135



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IGNITION SOURCES

Powered Industrial Equipment



- ✓ Hazard Monitoring (HazMon)
- ✓ Bearings
- ✓ Rub Blocks
- ✓ Speed Sensors
- ✓ Static Electricity, often missed source



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NEMA RATINGS



TYPE 1: Indoor use

TYPE 3: Outdoor use (watertight, dust tight)

TYPE 4/4X: Indoor or Outdoor Use (dust tight)

TYPE 7: Indoor use (explosion-proof) CLASS 1 and 2

TYPE 9: Indoor use (dust ignition proof) CLASS 2



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TYPE 1: INDOOR USE

Nonhazardous Locations



TYPE 3: OUTDOOR USE

Nonhazardous Locations



3R Weather Tight

TYPE 4/4X: INDOOR/OUTDOOR USE



Class 2, Division 1 & 2

Depending on what is in the enclosure
dictates it's location it can be used

TYPE 7: EXPLOSION PROOF



Class 1, Divisions 1 & 2

Contains the explosion

TYPE 9: DUST IGNITION PROOF



Class 2, Divisions 1 & 2

Not as common

Type 3: NON-HAZARD ONLY



Type 3, 4,12: CONDUITS

Design to keep water & dust out can be used in hazardous locations with no splices



NEMA 3

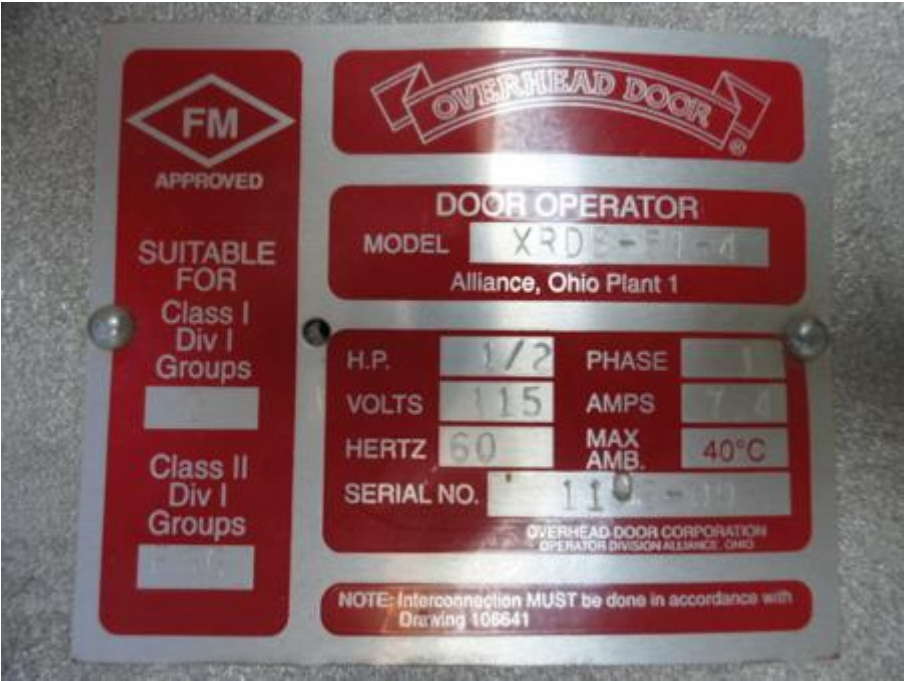
Does not work in hazardous locations



MIXING OF TYPE 4, 7 & 9 Enclosures



NEMA 7 Explosion Proof



NEMA 7/9 2-Stage Receptacle



NEMA 7/9



NEMA 7/9 Start/Stop Switch



DUAL LISTED MOTOR



Temperature Code

T3B: Max temp = 165 C

KNOW THE MOTOR PLATES



Different designs for each manufacturer



NOT DUAL LISTED ON MOTOR TAG

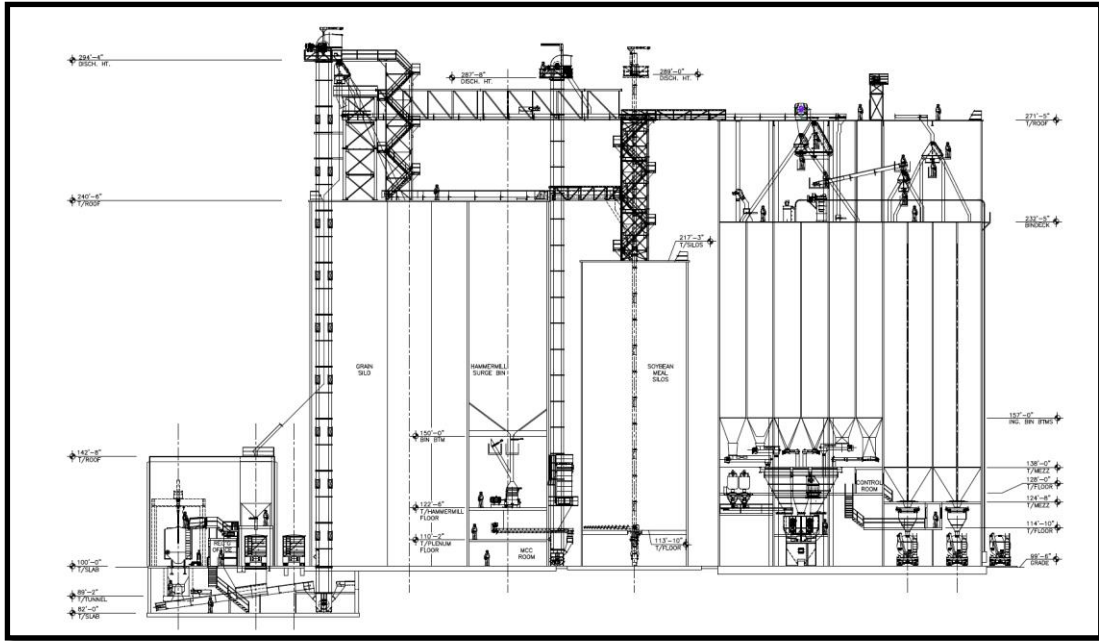


Class 1, Divisions 2

Class 1, Zone 2

TEFC, Need to look deeper

DESIGN WITH SAFETY IN MIND



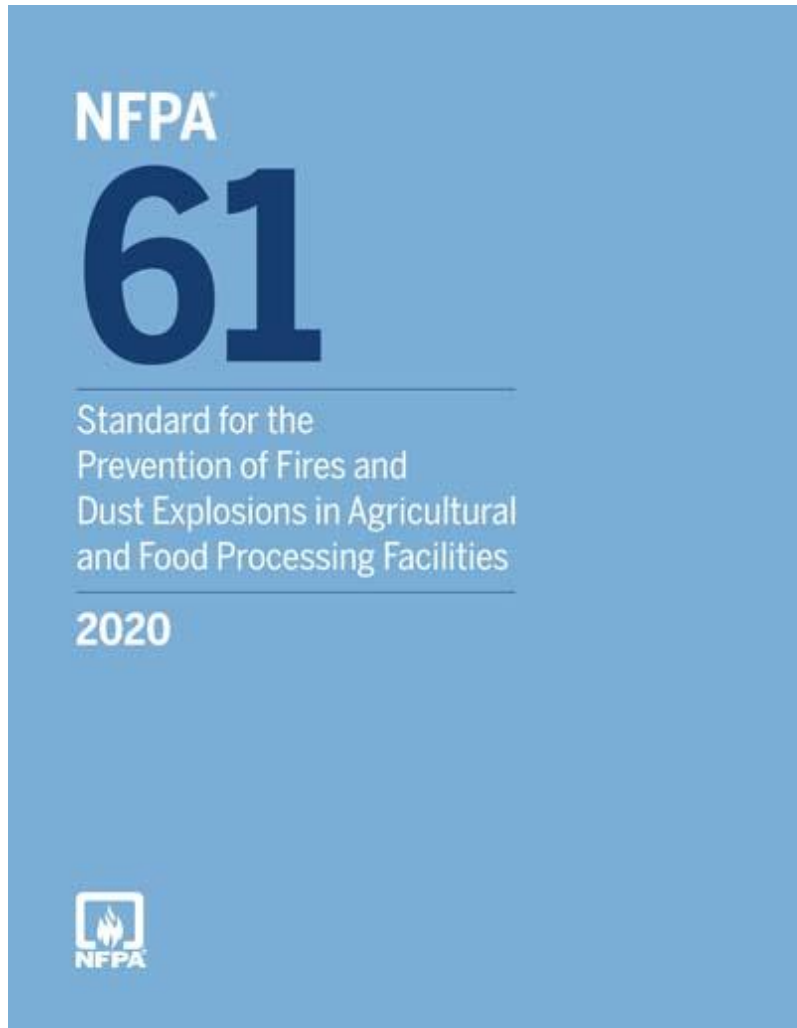
Reduce risk during design phase.

Classify hazardous locations.

Lowering risk and cost.

NFPA 61, 652, 654

NFPA 61- 2020



Hazard
Management:
Mitigation &
Analysis

Facilities/Structures

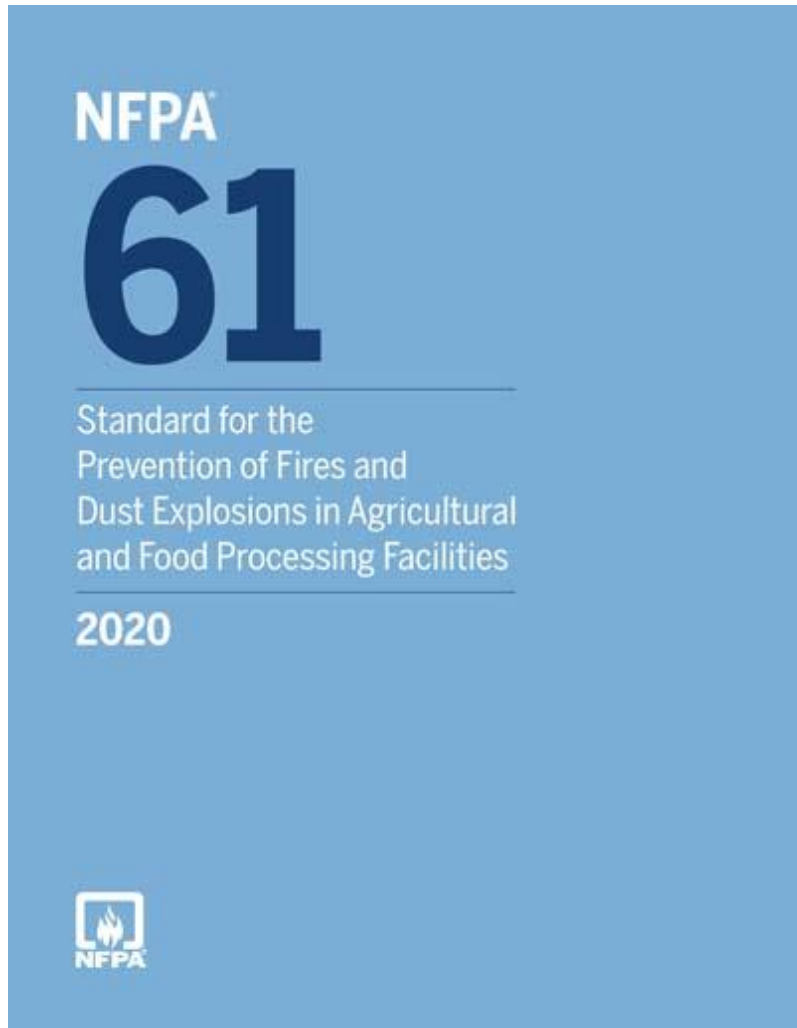
Conveying equipment

Process equipment

Dust system equipment

Ventilation & isolation

NFPA 61- 2020



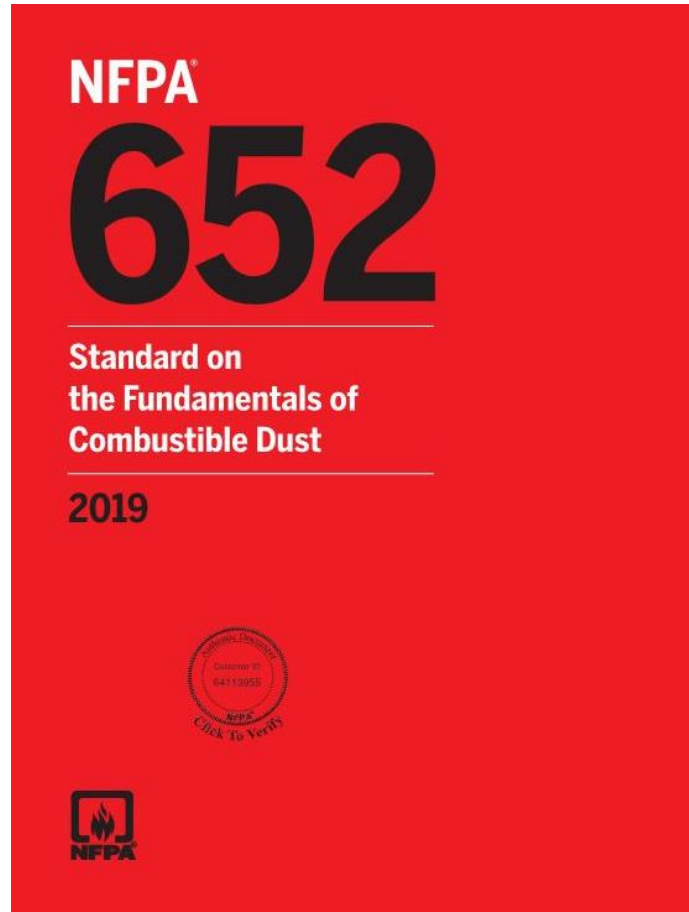
Management
Systems

Procedures and practices

Inspection, testing and maintenance

Training and hazard awareness

NFPA 652- 2019



Hazard identification and Design options

Hazard management: Mitigation and prevention

Housekeeping methodology and procedures

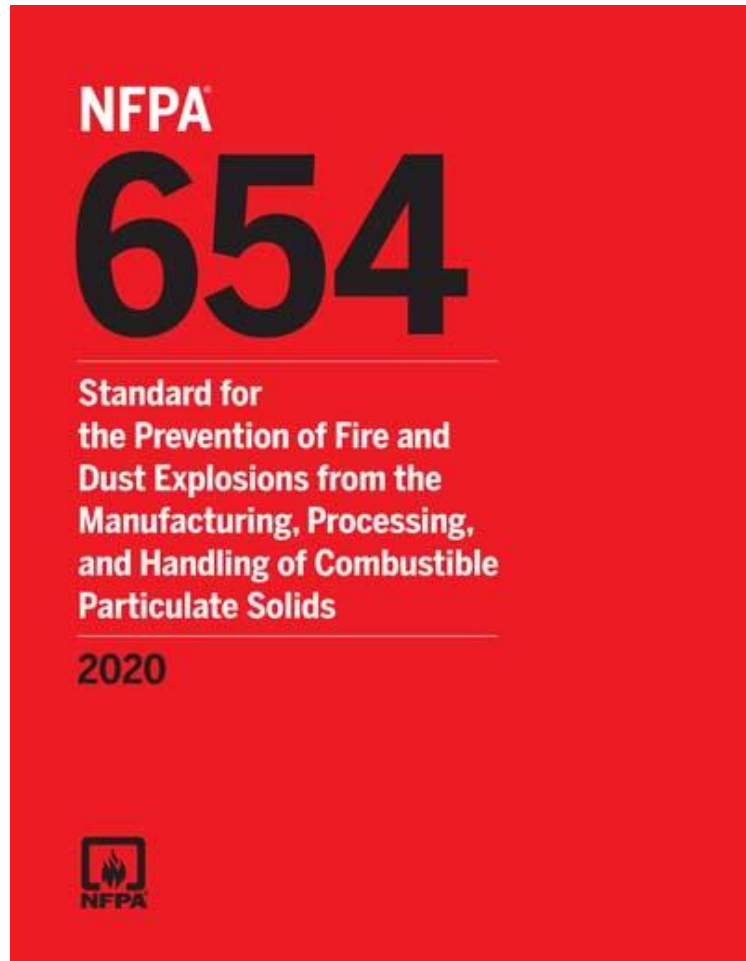
Ignition source control

PPE

Explosion segregation and suppression

Example dust hazard analysis

DESIGN WITH SAFETY IN MIND



Facility/System
Design Dust
Handling Area
Segregation
Equipment
Explosion
Agreement

Storage

Material transfer systems

Dust collection/vacuumed systems
cleaning methods

Ignition sources and fire protection

DUST HAZARD ANALYSIS (DHA)



Review of a facility for potential fire or explosion hazards.

Prioritize and generate plans to manage risk.

DESIGN BUILD: CONCRETE FACILITIES



Electrical conduit can be cast into the wall

Steel tubes minimize dust on ledges

Conduit can be imbedded into the floor



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DESIGN BUILD: STEEL FACILITIES



Interior liner panels conceal girts

Tube steel and solid floors

Checkered plate helps segregate dirty areas



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DESIGN BUILD: VENTING



Pressure
relief
venting

Legs

Filters

Hazardous
Area

“H” occupancy

Pressure relief panels

Louvers

DESIGN BUILD: BACKUP PLAN



Flame-arresting and particulate retention vent system

Explosion suppression system

ELECTRICAL HAZARDS



30,000
Arc flash
incidents
per year

7,000 burn injures

2,000 hospitalizations

400 fatalities

80% of fatalities due to burns, not electrical shock

81 electrocutions in 2015

40% at 250 volts or less

DESIGNING OUT THE HAZARDS



Goal is to NOT wear PPE

Keep employees out of harms way

DESIGN OUT THE HAZARDS



Remote Mains

Smart MCCS

HMI/SCADA for troubleshooting

Q&A

Thank you

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