Understanding NEC and NEMA for Locations with Combustible Dust

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Scope and Purpose

Understand the Unique Hazards in our Industry

NEC Hazardous Location Classifications

Ignition Sources

NEMA Enclosure Types and Examples
Scope and Purpose

National Fire Protection Association
Planning and Design to Reduce Risks
Explosion Suppression
Electrical Hazards Facing all Facilities
Industrial Solvent

Made from combining Propane and Nitric Acid

Used in Dry Cleaning
Safety in Motorsports

Hazards are known

Safety is Priority

Rules keep People Safe
Hazards in the Grain Industry

- Oxygen
- Ignition
- Fuel

- Oxygen
- Ignition
- Dispersion
- Confinement
- Fuel
Enclosed Building
Grain Dust
Spark or Heat
Hazardous Classifications

NFPA 70: National Electrical Code (NEC)

Chapter 5 Special Occupancies
Hazardous Classifications

Class:
The type of material or substance presenting a hazard

Class I – Gas or Vapors
Class II – Dust or Particles
Class III – Lint or Fibers
Hazardous Classifications

Divisions:
Probability of a hazardous material being present

Division 1 - During Normal Operating Conditions
Division 2 - Not Likely in Normal Operating Conditions
Hazardous Classifications

Class I Division 1:
Gases exist under normal conditions
Gases exist due to faulty operations

Class I Division 2:
Gases or Liquids can only be released by rupture or breakdown
Failure of ventilation equipment
Hazardous Classifications

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

Class II Division 2:
Normal conditions do not present high levels of combustible dust
Hazardous Classifications

Class III Division 1:
Locations where easily ignited fibers are used or manufactured

Class III Division 2:
Locations where easily ignited fibers are stored or handled
Hazardous Classifications

Groups:
Define the type of hazardous material in the area

Groups A – D: Various Gasses & Vapors
Group E: Metals (exotic / fine particles)
Group F: Carbon Black / Coal Dust
Group G: Grains / Starch / Flour / Wood
Hazardous Classifications

Classification Zones: Based on Hours Per Year

![Diagram showing Hazardous Classifications based on hours per year.](image)
Hazardous Classifications

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
Explosive Grain Dust

Common Locations

Receiving

Batching Scales/Mixers

Bindecks

Loadout
Explosive Grain Dust

Housekeeping

Have Plan in Place

Secondary Explosions

Thickness of Dust Layer

1/8” or more of dust and you have a serious hazard for secondary explosion
Ignition Sources

Motors
Totally Enclosed, Fan-Cooled (TEFC)
Explosion Proof (EXP)
Ignition Sources

Control Devices
- Position Switches
- Solenoids
- Temperature Transmitters
Ignition Sources

Light fixtures & Power
Area Lighting
Emergency Lighting
Receptacles
Ignition Sources

Powered Industrial Equipment

Hazard Monitoring (HazMon)
- Bearings
- Rub Blocks
- Speed Sensors
Ignition Sources

Explosion Proof Devices

Contains the Explosion

Listed for the Hazardous Area

Engaged Threads
NEMA Ratings

National Electrical Manufacturers Association (NEMA)

Type 1: Indoor use
Type 3: Outdoor use (Water Tight, 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
NEMA Ratings

Type 1: Indoor use

Non Hazardous Locations
NEMA Ratings

Type 3: Outdoor Use

“Dust Tight”

3R - “Weather Tight”
NEMA Ratings

Type 4/4X: Indoor or outdoor use

“Dust Tight”
Class 2 Division 2
NEMA Ratings

Type 7: Explosion-proof

Contains the Explosion

Class 1, Division 1 & 2
NEMA Ratings

Type 9: Dust-ignition proof

Not as Common

Class 2, Division 1 & 2
NEMA Ratings

NEMA 3

GFCI where required
NEMA Ratings

NEMA 3

Gasketed

Designed to keep out water and dust
NEMA Ratings

NEMA 3

Faulty Cover: Spring Malfunction
NEMA Ratings

NEMA 3 Outdoor

NEMA 4 Dust Tight

Look for sticker inside
NEMA Ratings

NEMA 4 “Dust Tight”
Junction Box

NEMA 7 “Explosion Proof"
Light Fixture”
Provisions in NEC that allow the mixing of NEMA 3, 4, 7, & 9 equipment

NEC – Chapter 5

Boxes containing taps, joints, or terminal connections, in addition to being dust tight, must be provided with threaded hubs and must be identified for use in Class II locations
- Suitable for wet locations when used with gasketed covers.
- Suitable for use in hazardous location applications when installed according to NEC Articles 501.10(b), Class I, Div. 2, (Suitable for use in Class I Zone 2 applications) 502.10 and 503.10.

UL Listed File No. E3397

Certified File No. LR11852
Mixing of NEMA 3, 4, 7, & 9 enclosures
Know the location

Look for Motor Plate Info
Dual Listed Motor

Temperature Code

T3B:
Max Temp = 329 degrees F
Know the Motor Plates

Different designs for each manufacturer
Not Dual Listed on motor tag

Class 1, Division 2
Class 1, Zone 2

TEFC
Need to Look Deeper
More Motor Plate Info

Document while clean
NEMA 7 “Explosion Proof”
Class 2 Division 1

Covers installed

Ventilation
NEMA 9
“Dust Ignition Proof”
2-stage Receptacle
NEMA 9

“Dust Ignition Proof”

Spring Cover
NEMA 9

“Dust Ignition Proof”

Start/Stop Switch
Design with Safety in Mind

- Reduce Risk During Design Phase
- Classify Hazardous Locations
- Lowering Risk and Cost
Hazard Management: Mitigation & Analysis

- Facilities/Structures
- Conveying Equipment
- Process Equipment
- Dust System Equipment
- Ventilation & Isolation
Management Systems

• Procedures and Practices
• Inspection, Testing & Maintenance
• Training & Hazard awareness
Hazard Identification & Design Options
Hazard Management: Mitigation & Prevention
Housekeeping Methodology & Procedures
Ignition Source Control
PPE
Explosion Segregation and Suppression
Example Dust Hazard Analysis
National Fire Protection Association

Facility/System Design
Dust Handling Area Segregation
Equipment Explosion Assessment
• Storage
• Material transfer Systems
• Dust Collection/Vacuumed Systems
Cleaning Methods
Ignition Sources and Fire Protection

National Fire Protection Association

NFPA 654
Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids
2017
Dust Hazard Analysis (DHA)

Review of a facility for potential fire or explosion hazards

Prioritize and generate plans to manage risk
Concrete Mills

Minimize dust ledges
Electrical conduit can be cast into the wall

Steel tubes minimize ledges on floor steel
Conduit can be imbedded into the floor
Building Design

Steel Mills

Interior liner panels conceal girts

Tube steel and solid floors
Checkered plate helps segregate dirty areas
Building Design

Venting

Pressure Relief Venting
• Legs
• Filters

Hazardous Areas
• “H” occupancy
• Pressure relief panels
• Louvers
Building Design

THE BACKUP PLAN:

Flame-arresting and particulate retention vent system

Explosion Suppression System
Electrical Hazards

Design Out the Hazards

Goal is to Not wear PPE

Keep employees out of harms way
Electrical Hazards

30,000 Arc Flash Incidents Per Year
• 7,000 Burn Injuries
• 2,000 Hospitalizations
• 400 Fatalities

80% of fatalities due to burns, not electrical shock

81 Electrocutions in 2015
• 40% at 250 volts or less
Electrical Hazards

- Design Out the Hazards
- Remote Mains
- Smart MCCS
- HMI/SCADA for troubleshooting
Conclusion - Review

Hazardous Locations

Class 2, Division 1 and 2

Ignition Sources

NEMA Types and Ratings
Questions

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