Understanding NEC and NEMA for Locations with Combustible Dust

Knobelsdorff Electric



Dust Explosion





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



IGNITION

DISPERSION

OXYGEN

CONFINEMENT

FUEL





Enclosed Building

Grain Dust

Spark or Heat

NFPA 70: National Electrical Code (NEC)

Chapter 5 Special Occupancies



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





Divisions: **Probability of a hazardous material being present**

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



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





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



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



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**



Classification Zones: Based on Hours Per Year



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 expolosion







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







Control Devices Position Switches Solenoids Temperature Transmitters





Light fixtures & Power Area Lighting Emergency Lighting Receptacles





Powered Industrial Equipment

Hazard Monitoring (HazMon) Bearings Rub Blocks Speed Sensors



Explosion Proof Devices

Contains the Explosion

Listed for the Hazardous Area

Engaged Threads



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





Type 1: Indoor use

Non Hazardous Locations





NEMA Ratings

Type 3: Outdoor Use

"Dust Tight"

3R - "Weather Tight"







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 3

GFCI where required



NEMA Ratings

NEMA 3

Gasketed

Designed to keep out water and dust





NEMA 3

Faulty Cover: Spring Malfunction





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









TB Type

- Suitable for wet locations when used with gasketed covers.
- Federal Specification W-C-586D/A-A 50563.
- 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.

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



| OSION | PREMIUM E 3-PHASE INDU | FFICIENCY EQPIL |
|-----------|--|---|
| | MODEL NO. | UETAXIEI |
| | TYPE | VOLTS SEAT (HE 20) HE 20 |
| | FORM | |
| | DUTY COL | SER NO. LECECCHE |
| G 1.15 | MAX AMB. 40 °C NOM. EFF. 93.0 MIN. EFF. 92.4 | BRG. L.S. CO 2000 NO. 0.S.CO 2000 P.F. 50.0 |
| | TEMPERATURE CONVERTION OP1 | |
| | TYPE WTOOK | FOR CL 1 GR & GR E FAG |
| | HOUSTON, T | EXAS-MADE IN U.S.A. |

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



NFPA

Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food **Processing Facilities**

2017





Hazard Management: Mitigation & Analysis

 Facilities/Structures Conveying Equipment Process Equipment Dust System Equipment Ventilation & Isolation



NFPA

Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food **Processing Facilities**

2017





Management Systems

 Procedures and Practices Inspection, Testing & Maintenance Training & Hazard awareness



Standard on the Fundamentals of **Combustible Dust**

2019





PPE

- Hazard Identification & Design Options Hazard Management: Mitigation & Prevention Housekeeping Methodology & Procedures **Ignition Source Control**
- **Explosion Segregation and Suppression Example Dust Hazard Analysis**



NFPA

Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible **Particulate Solids**

2017



• Storage

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



Dust Revie expl Priori

Dust Hazard Analysis (DHA)

Review of a facility for potential fire or explosion hazards

Prioritize and generate plans to manage risk



Building Design

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 Year7,000 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







Smart MCCS

HMI/SCADA for troubleshooting



Conclusion - Review

Hazardous Locations

Class 2, Division 1 and 2

Ignition Sources

NEMA Types and Ratings



Questions

Karl von Knobelsdorff CEO - Knobelsdorff Electric karl@knobelsdorffelectric.com

