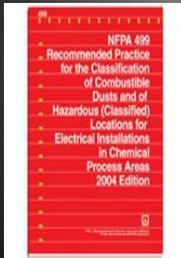


Electrical Classification for Combustible Dusts

Introduction

- ▶ Two Documents are used for the Classification of Combustible Dusts and Hazardous Locations:
 - NFPA 499–Recommended Practices for the Classification of Combustible Dusts and Hazardous Locations for Electrical Installations in Chemical Process Areas
 - NFPA 70, Article 500 of the National Electrical Code (NEC)
 - Design standard for the system
 - Prevent the use of electrical equipment that would ignite a combustible dust

NFPA 499



- ▶ Relationship to NEC
- ▶ Does not address pyrotechnics
- ▶ Does not apply to grain handling
- ▶ Situations involving catastrophic failure of or discharges from equipment are not addressed

National Electrical Code



- ▶ Article 500 address the requirements for hazardous locations:
 - Wiring
 - Equipment

National Electrical Code Article 502

- ▶ Pertains to the requirements for wiring and methods for classified areas for combustible dust
- ▶ Does not provide any guidance on classification of the areas
- ▶ The areas must first be classified using NFPA 499, then you can refer to the NEC to determine the type of equipment and wiring methods that are appropriate

National Electrical Code Article 502

- ▶ The NEC addresses the following:
 - Wiring methods(i.e.-threaded rigid conduit, MI cable with listed terminations, and fitting and boxes with threaded bosses for connection)
- ▶ Flexible connections (dust-tight flex connector or liquid tight metal or non metallic with listed fit.)
- ▶ Boxes and fittings (dust-tight)
- ▶ Sealing requirements
- ▶ Non-insulated exposed parts not permitted
- ▶ Specified grounding requirements



Causes of Electrical Ignition

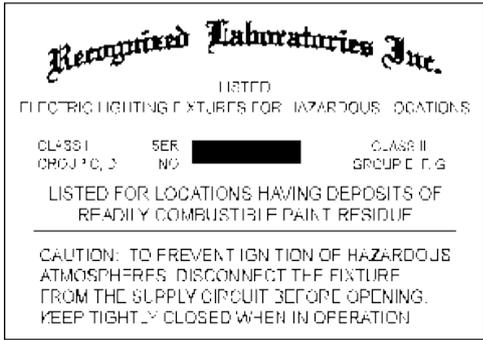
- ▶ The following lists examples that may ignite clouds or layers of combustible dust:
 - Arcing or sparking parts
 - Hot surface temperatures
 - Layers can carbonize or dehydrate
 - Hybrid mixtures (combustible vapor/dust mixture)
- ▶ System maintenance issues:
 - Some chemicals may melt (plastics)





Hazardous Locations

- ▶ NEC classifies areas in which there is a combustible material present or can be present in concentration to produce an ignitable mixture.
- ▶ There are three types of hazardous locations:
 - Class I
 - Class II
 - Class III
- ▶ We are concerned with Class II
 - Design and Wiring types for areas with combustible dusts



Class I Locations

- ▶ Class I locations are designed to handle vapor and/or gases.
- ▶ A class I system is not designed for class II areas as there is a fundamental design:
 - The system is design for vapors/gases
 - Class II equipment is designed to be dust proof
- ▶ Class II locations are hazardous due to presence of combustible dust.

Class II Locations

- ▶ Class II locations are further divided into:
 - Division 1
 - Division 2
- ▶ The divisions are based upon the fact of having combustible dust present in an ignitable condition under the following circumstances:
 - Normal Operation
 - Abnormal Operation

Divisions

- ▶ A class II Division 1 location:
 - Combustible dust is present in quantity to produce an explosion
 - Mechanical failure or abnormal operation may produce an ignitable mixture
 - Electrically conductive combustible dust may be present in a hazardous quantity
- ▶ An example would be a blasting room that uses organic materials

Class II, Division 1 Location



Divisions

- ▶ A class II Division 2 location:
 - Dust is not normally present in combustible quantities with normal operation, but may be present during malfunction of equipment
 - Combustible dust accumulates on, in, or in the vicinity of electrical equipment
 - Interferes with dissipation of heat
 - Abnormal operation of the electrical equipment

Groups

- Group E. Atmospheres containing combustible metal dusts, including:
 - aluminum, magnesium, and their commercial alloys, and other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment.
- Hazards
 - Short circuit electrical equipment
 - Arcing effect to ignite cloud or layer
 - Low ignition temperatures (uranium and thorium)



Groups

- Group F. Atmospheres containing combustible carbonaceous dusts that have more than 8 percent total entrapped volatiles as per ASTM D 3175 *, OR
 - Those that have been sensitized by other materials so that they present an explosion hazard
 - Coal, carbon black, charcoal, and coke dusts are examples of carbonaceous dusts.
- Group G. Atmospheres containing other combustible dusts, including
 - flour, grain, wood flour, plastic and chemicals.



Protective Techniques

- ▶ Avoid the potential of igniting the dust cloud with wiring designed for a hazardous atmosphere.
- ▶ Two areas of concern for electrical equipment in areas with combustible dust:
 - Surface temperatures high enough to carbonize or dehydrate dust
 - Arcing parts



Protective Techniques

- ▶ Some examples of protective techniques (not all inclusive) are:
 - Dust ignition proof electrical equipment
 - Pressurization
 - Intrinsically safe equipment
 - Dust-tight enclosures to exclude the materials
 - Non-incendive circuits, components, or equipment
- ▶ Remember, class 1 division 1 location equipment (designed for vapor) are not required and may not be suitable



Protective Techniques

- ▶ Dust-ignition proof equipment is designed in a manner to exclude dust and does not permit arcs, sparks, or heat inside the enclosure to ignite exterior dust cloud and/or accumulation.
- ▶ Dust tight enclosures are constructed to exclude dust from entering the equipment.
- ▶ Pressurization is a method that uses instrument grade or inert gases to prevent the entrance of the materials.



Protective Techniques

- ▶ Intrinsically Safe system is designed so that electrical energy of the circuit is not high enough to cause ignition of the cloud or layers even under double fault conditions.
- ▶ Non-incendive protection prevents thermal effects or arcing effects from igniting the materials under normal operating conditions.
 - Electrical equipment has electrical/electronic circuitry that is incapable of causing ignition of materials of a specified mixture due to arcing or sparking parts.



Class II Requirements

- ▶ It must seal out the dust.
- ▶ It must operate below the ignition temperature of the hazardous substance.
- ▶ It must allow for a dust blanket. That is, the build-up of dust collecting on top of the device that can cause it to run "hot" and ignite the surrounding atmosphere.

Junction box for Class II Group E, F, and G



Equipment Requirements

- ▶ Division 1 location:
 - Enclosed in a manner that will exclude dust or arcs and sparks
 - Will not permit the heat generated or liberated to ignite the mixture
- ▶ Division 2 location:
 - Normal operation of the equipment does not present an ignition source
 - Protection during breakdown is not provided
 - Arcing and sparking devices are enclosed or insufficient to ignite mixture

Equipment Requirements

- ▶ Presence of combustible gases/vapors and dust:
 - Requires equipment suitable for simultaneous exposure to class 1 and 2
- ▶ Division 2 is not recognized for Group E (metals)
- ▶ The following factors may dictate equipment:
 - Corrosion, weather, and maintenance
 - Equipment standardization and interchangeability

Requirements for Electrical Ignition

- ▶ Dust present in air sufficient for an ignitable mixture and in the vicinity of electrical equipment with a thermal or electrical energy sufficient to ignite the material
- ▶ Combustible dust present and layered to prevent heat dissipation and ignite dust at its ignition temperature or dry out and self heat
- ▶ Group E dust with layering or suspension and current through dust causes an ignition



Steps to Classification

- ▶ Step 1: Determine the presence on the probability that a combustible dust cloud is present.
- ▶ Step 2: Determine the degree of the hazard:
 - Division 1
 - Division 2
- ▶ Division 1
 - Dust Cloud is present under normal conditions
 - Dust cloud is present under conditions of maintenance
 - Build up of dust layers without presence of dust clouds



Steps to Classification

- ▶ Step 2: Determine the classification of Division 2:
 - Abnormal conditions
 - Breakdown of the equipment
 - Process equipment does not fail often (e.g.: spark contained in an enclosure)
 - Separation
 - A division 2 location can be a transition zone
 - Walls can also be a buffer between Division 1 and unclassified areas



Example of a Control



Unclassified Areas

- ▶ Some examples of areas that are not usually classified are:
 - Warehouses provided that materials are stored in sealed containers
 - Transport in closed pipes
 - Closed tanks used for storage and handling
 - Adequate dust removal systems(warning system in the failure) result in:
 - No visible dust cloud
 - Control of layers
 - Adequate housekeeping (no dust cloud or layers)

[BACK TO CATEGORIES](#)

Photo ID: 1199
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Category:
Housekeeping

Hazard:
Fire Hazard

Standard Violated:
1910.22(a)(1)

Corrective Action:
Employer investigated canopy exhaust system and implemented service contract for cleaning.

Description:
Hazard: Housekeeping not maintained. Very large/deep accumulation of combustible product on electrical components



Extent of Hazardous Location

- ▶ Adequate walls or partitions can be used as the terminating point.
- ▶ In the absence of walls, the extent can be determined using:
 - Visual observation (dust layer is not greater 1/8")
 - Experience with similar dusts and operations
 - Diagram in NFPA 499



Extent of Hazardous Location

- ▶ The use of diagrams to determine extent of hazardous location:
 - Particle size > 40lb/cubic ft (finer dust drifts)
 - Good engineering practices, housekeeping, and dust removal systems are necessary to limit the extent of classified areas



Classification with Diagram

- ▶ Step 1: Need for Classification
- ▶ Step 2: Information Gathering
 - Proposed facility
 - History
 - Cloud formation
 - Layers or accumulation (24 hours)
 - Equipment condition
 - Maintenance practices
 - Dust collection equipment
 - Plot plan to show how items affect dispersion
 - Fire Hazard Properties (ignition temperature/group)

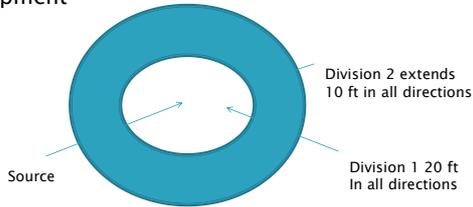


Classification with Diagram

- ▶ Step 3: Select Diagram on the following criteria:
 - Type of system (open or enclosed)
 - Group
 - Storage consideration
- ▶ Observations
 - Group E dust walled area–Division 1 extends to wall and 10 ft beyond opening
 - Group F, G dust walled area–Division 1 to wall and Division 2 within 10 ft of any opening
 - Storage Areas–Enclosed system is usually not classified

Classification

- ▶ Group F or Group G dust–Indoor, Unrestricted, open or semi-enclosed equipment



Classification

- ▶ Remember Group E does not recognize division 2 equipment, so it resembles:
 - A circle of division 1 that extends 20 ft around the area and extends an 10 additional 10 ft
- ▶ Example, indoor, unrestricted, open Group E

