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Knowing areas having chief risk of explosion is next step

Once the contributing factors of a grain dust explosion are known, the next step is to understand what areas in a facility pose the greatest danger and what can be done to minimize that risk.

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Dust explosions are one of the most challenging, dangerous and least understood hazards facing a grain-handling facility today. Previously examined were the contributing factors of a dust explosion as well as how an explosion occurs (*Feedstuffs*, Aug. 2). This knowledge is a good start to formulating a prevention strategy, and the next step is to understand what areas in a facility pose the greatest danger and what can be done about them.

This article explains the industry standards of electrical area classification in grain-handling facilities, provides a brief overview of the codes associated with area classification and looks at why specific areas are classified as they are.

Area classification describes the hazardous materials that are, or may be, present in a given area and the probability that they are present. This information is then used to select the right equipment for a given area and to ensure safe installation.

The National Fire Protection Assn. (NFPA) publishes the primary standards for classification of areas that are dust hazardous. Similar standards are available in Europe under the International Electrotechnical Commission (IEC). Some additional references are also available from the Instrumentation, Systems & Automation Society.

NFPA 499 explains the U.S. system for classifying hazardous areas, which is based on three classifications: class, division and group.

Hazardous areas are initially broken down by the general type — or class — of material involved. Class I materials include gases and vapors, Class II includes dusts and Class III includes fibers and flyings.

The standards further classify the degree of the hazard by Division 1 or Division 2 definitions. A Division 1 area is where hazardous dust clouds or layers will be present on a regular basis. In a Division 2 area, hazardous dust clouds or layers will only be present due to a malfunction or failure of handling equipment.

Additional factors often considered when determining area classification are the potential quantity of combustible dust present and the adequacy of dust removal systems. These factors could result in an unclassified area. The specific division definitions are stated in NFPA 499 and should be reviewed carefully when determining the classification of specific facility areas.

Hazardous dust areas must also be considered with respect to two other principles. First, the potential for existing dust to be airborne in an enclosed area must be considered along with the potential presence of an ignition source. The primary means of managing this risk is to use dust ignition-proof or dust-tight equipment.

Second, one must consider dust layers that can accumulate in excess of 1/32 in. on electrical or mechanical equipment that could potentially interfere with the dissipation of heat and allow the layer of material to reach ignition temperature.

To avoid the risk of overheating, electrical equipment in dusty areas must be rated in terms of the equipment's surface temperature under normal operation.

The National Electric Code (NEC)

TABLE

Classification of maximum surface temperature

Maximum temperature		Temperature Class
C°	F°	(T code)
450	842	T1
300	572	T2
280	536	T2A
260	500	T2B
230	446	T2C
215	419	T2D
200	392	T3
180	356	T3A
165	329	T3B
160	320	T3C
135	275	T4
120	248	T4A
100	212	T5

FIGURE

Class	Division	Group*
I. Gas	1. Hazard exists — Area where gases or vapors are normally present	A. Acetylene B. Hydrogen C. Ethyl, ether, etc. D. Gasoline hexane, natural gas
	2. Potential hazard — Area where gases or vapors are handled or stored but are normally confined or in closed container systems	
II. Dust	1. Hazard exists — Area where combustible dust is always present	E. Metal dust, aluminum, magnesium, etc. F. Carbon black coal dust, coke dust G. Flour, grain
	2. Potential hazard — Area where combustible dust may be present in atmosphere	
III. Fibers	1. Production areas	No groups Atmospheres with textile, wood or synthetic fibers
	2. Handling or storage areas	

Classifications based on material's chemical and physical properties.

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provides "T" ratings to categorize and designate maximum allowable surface temperatures for hazardous-location electrical equipment. The T rating of an electrical device in a specific hazardous location may not exceed the ignition temperature of the material present in that location. The Table (500.8[B] from the 2002 NEC) shows the T ratings and maximum temperatures associated with each rating.

As previously discussed, grain dust is particularly dangerous in this regard due to a phenomenon known as carbonization. A layer of grain dust exposed to air and alternating periods of high and low temperatures will chemically decompose over time and form a cake-like layer on the equipment.

The ignition temperature of carbonized grain is significantly lower than the ignition temperature of a cloud of grain dust — approximately 250°C compared to 390°C, respectively. Because of this lowered ignition temperature, NEC requires that the T rating for equipment in Class II (dusty) hazardous areas be a maximum of 165°C, or "T3B."

The final NFPA 499 classification — group — is based on the material's chemical and physical properties. For some examples, as well as an outline of the entire classification system, see the related Figure.

The process to determine the hazardous area classifications should involve multiple disciplines and jurisdictions. The electrical engineer is often viewed as the authority on determining the hazardous areas in new construction projects.

However, in order to properly classify an area, the process equipment designer; heating, ventilation and air conditioner (HVAC) designer; owner; the owner's insurance company, and the local authority having jurisdiction must all contribute.

It is a good approach to use the electrical designer to drive the project team toward an agreed-upon area classification; however, asking the electrical designer to determine the classification alone is not.

It is the owner's responsibility to ensure that all areas within existing facilities are properly designated and documented. This can be done by hiring an electrical engineer or designating a city or county electrical inspector who has jurisdiction over the locality. Another option is to ask the insurance carrier for the facility to provide a professional to determine the classification.

Many grain storage terminals are similarly constructed, so the hazardous area classifications for the various parts of these facilities have become somewhat standardized. Different facilities with different operating procedures will vary, but in general, a grain elevator will have the following area classifications:

- Class II, Division 1, Group G: receiving pit, receiving drive(s), bin interiors, tunnels and boot pits below grade, work floor of grain elevators.
- Class II, Division 2, Group G: work floor, pellet mill floor, cooler floor, head house, grinder room, load-out drives, scale pits.
- Non-hazardous: outside areas, warehouse (use dust-tight equipment), boiler room, control and electrical rooms (if positively pressurized by HVAC).

In a future article in this section, the typical equipment installation standards in the hazardous areas now identified will be reviewed. ■