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# Preventing dust explosions means having proper equipment

Dust explosions are one of the most dangerous and least understood hazards for a grain-handling facility. Typical equipment installation standards in hazardous areas will be examined and a guide given for selecting the right equipment for an area to ensure safe installation.

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Dust explosions are one of the most challenging, dangerous and least understood hazards a grain-handling facility faces today.

In previous articles, we looked at the contributing factors of a dust explosion and how an explosion occurs (*Feedstuffs*, Aug. 2, 2004). Then, we discussed the different areas in a facility that pose the greatest danger and what can be done about them (*Feedstuffs*, Nov. 1, 2004). Finally, we will examine the typical equipment installation standards in the hazardous areas we have identified.

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.

There are three primary electrical categories affected by area classification: equipment, wiring and grounding. Section 502 of the National Electric Code (NEC) defines the requirements for electrical installation in Class II areas.

As we go on to discuss these categories, there is one important distinction to keep in mind: the difference between dust-tight and dust-ignition-proof enclosures.

Dust-tight enclosures will keep dust out of an enclosure. Dust-ignition-proof fittings not only keep out the dust but are also built to contain an explosion that occurs inside. This is also referred to as an explosion-proof enclosure, a term that can be confused with Class I (hazardous gas) rated enclosures, which do not meet the requirements of Class II areas unless specifically listed for both environments.

The general requirement in Class II areas is that equipment and wiring should be dust tight. If there is any type of splice, terminal or joint, it must be dust-ignition proof when in a Division 1 area.

## Electrical equipment

Electrical equipment used in grain-handling facilities includes motors, lights, circuit breakers and fuses, instrumentation and transformers.

Motors applied in hazardous dust locations are designed to keep out dust and minimize surface temperatures. Motors in a Group G (grain dust) area have a maximum surface temperature requirement of less than 120°C.

Dust in contact with hot motor enclosures can become excessively dry or carbonized, which is highly susceptible to spontaneous combustion. Dust buildup on a motor restricts heat dissipation and causes the surface to overheat. Good housekeeping that minimizes dust on motors is very important for safe motor operation in Class II areas.

Motors in Class II-Division 1 locations must be explicitly rated (dust-ignition proof) for those areas or be totally enclosed pipe ventilated (TEPV) with approved maximum surface temperatures.

Explosion-proof motors for Class I areas (flammable gases and vapors) are different from motors for Class II areas, although some manufacturers have dual Underwriters Laboratories (UL) approvals on them.

Motors in Class II-Division 2 locations are required to be TEPV, totally enclosed non-ventilated (TENV), totally enclosed fan cooled (TEFC) or dust-ignition proof with approved maximum external temperatures when operating at full load in free air.

Motors manufactured after February 1975 are marked to show all classes, groups and temperature ranges of the approval. The temperature code identifies the maximum motor surface temperature that could develop under all operating conditions — from overload to motor burnout.

When a manufacturer specifies a TENV or TEFC motor for use in a Division 2 location, it may increase the motor frame size and/or limit the motor to a 1.0 service factor in order to meet the maximum full-load surface temperature requirements.

An alternate (and recommended) method is to attach a thermostat to the motor to shut down the motor when the surface temperature exceeds the acceptable level. This ensures maximum efficiency and life of the motor.

These thermostats are standard on dust-ignition-proof motors but must be specified as an option on TEFC motors. If the motor comes supplied with a thermostat, UL requires that the thermostat be electrically connected to the motor controller in order to maintain UL approval.

Light fixtures purchased for Class II areas are usually dual listed for both Division 1 and Division 2. For all practical purposes, there is very little difference between these two requirements.

The most important thing to consider is the temperature rating. A light fixture may be listed for Class II areas, but that doesn't mean it can be installed in all of them. This especially applies to Group G areas.

Group G has an NEC temperature

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code of T3B (165°C). The lowest rating is T6, which is 85°C. Light fixtures in hazardous dust areas must have a rating of T3B or less (meaning T3B to T6 is acceptable). The reason for this requirement is similar to that for motors: Dust accumulating on the light fixture can ignite if the surface temperature of the fixture is too high.

The most cost-effective solution for dealing with transformers and capacitors is to just keep these pieces out of hazardous areas.

When necessary, transformers containing flammable liquid in Division 1 areas must be stored in approved vaults. Any openings to a hazardous area must be protected by double, tight-fitting, self-closing fire doors. Ventilation and pressure relief openings should communicate only to outside air.

If the equipment does not contain flammable liquid, it can either be installed in an approved vault or be identified as a complete assembly, including terminal connections, for Class II locations.

Division 2 areas also require that transformers containing flammable liquid be stored in approved vaults. However, dry-type transformers not more than 600 volts may also be installed in a tight metal housing without ventilation or other openings.

Class II instruments, meters and relays must be installed in a dust-ignition-proof enclosure or use intrinsically safe wiring for Division 1. A dust-tight enclosure is required for Division 2.

All switches, circuit breakers, fuses and similar devices, which are intended to interrupt current during normal operation, should be installed in an identified dust-ignition-proof enclosure when located in a Class II-Division 1 area. However, isolation switches or disconnecting switches with no fuses located in Division 1 areas can be installed in dust-tight enclosures since this equipment does not cause an arc or spark when operating.

Switches, circuit breakers, fuses and similar devices may be installed in dust-tight enclosures when located in Division 2 areas.

## Wiring

There are many different wiring methods that can be used in Class II areas. Division 1 methods are more stringent due to the higher explosion risk, and greater concern is taken to make sure that the wiring is not a potential ignition source. This risk is minimized in Division 2 areas, and therefore, the equipment and wiring requirements are reduced.

The conduit system provides protection for the wiring, but it also keeps the hazardous dust from a possible source of ignition.

Conduit in Division 1 areas must be rigid metal conduit or intermediate metal conduit with threaded fittings to ensure a sealed system to keep out the dust. In some cases, metal clad cable may also be used. Flexible conduit or cords may be used where flexible connections are required but must have listed connectors for the terminations.

Division 2 areas allow all Division 1 wiring methods as well as electrical metallic tubing and dust-tight wireways. The intent is still to keep dust out of the conduit system and away from a possible ignition source. Cable tray is also allowed in a Division 2 area.

There are also sealing issues to consider when dealing with dust-ignition-proof enclosures. A proper seal can be achieved using one of three methods.

The first is an effective seal in the conduit system by putting sealing putty or a similar substance inside the conduit to keep dust from entering the enclosure. (Note that this method is different from using a fitting that has a poured "plaster" type seal, which is for a Class I location.)

Another sealing method is to use at least 10 ft. of horizontal conduit between the dust-ignition-proof enclosure to a non-dust-ignition-proof enclosure or fitting. Finally, an effective seal can be created by using 6 ft. of vertical conduit below the enclosure.

Class II receptacles are also different from standard receptacles. Receptacles in a Division 1 area must be specifically rated for that area, ensuring that they have an internal switch so the plug cannot be inserted or removed while it is energized and, also, that they are UL listed for the area.

Division 2 areas do not require a listed receptacle but do require an internal switch. Since only Division 1 receptacles meet this requirement, in all practicality, there is no difference between Division 1 and Division 2 receptacles.

## Grounding

Grounding is also an important part of ensuring safety in hazardous areas.

A grounding system makes sure that under a fault condition, the breaker or fuse will disconnect the power from the circuit before any more damage can be done or a hazardous environment ignited. Since hazardous areas increase this risk, their grounding requirements are more stringent.

A standard locknut is not adequate for maintaining the grounding path between the conduit and the enclosure. A bonding jumper, bonding locknut or listed bonding hub is required. However, a common misunderstanding is that this type of grounding is only required in hazardous areas. It must be carried all the way through to the service equipment or other separately derived system and maintained in the non-hazardous areas of the plant from where the power is fed.

More stringent hazardous area grounding is also required where flexible connections are made. Liquid-tight, flexible, nonmetallic conduit is often used in this situation, and a grounding jumper must be run either internally or externally across the flex and connected to the conduit system and the original piece of equipment.

This is commonly accomplished by installing a wire on the outside of the liquid-tight conduit and connecting it to a bonding fitting on either end.

This concludes our series on preventing grain dust explosions. It is the owner's responsibility that all areas within grain-handling facilities be properly designated and documented to ensure safety for the plant personnel.

For help, contact a licensed electrical engineer, your local electrical inspector or ask your insurance carrier to provide a professional to determine the proper area classification in your facility and to examine if the classification requirements are being met. ■