COMBUSTIBLE DUST PRODUCING OPERATIONS

Combustible dust producing operations occur in a variety of industries, including food production, manufacturing of pharmaceuticals, certain wood working operations, and some plastic manufacturing processes. IFC Chapter 13 addresses the prevention of dust explosions, which technically are dust deflagrations. A deflagration is an exothermic reaction (meaning it releases heat) resulting from a rapid oxidation of a combustible dust, in which the reaction progresses through the unburned material at a rate less than the velocity of sound. Deflagrations are commonly termed as "slow explosions." Deflagrations are far more common than explosions, which have burning rates greater than the speed of sound. **[Ref. 2702.1]**

To produce a dust deflagration requires a combustible dust as a source of fuel. A combustible dust is *a finely divided solid material which is 420 microns or less in diameter. When dispersed in air in the proper proportions, it can be ignited by a source of ignition. Combustible dust will pass through a U.S. number 40 sieve.* **[Ref. 1302.1]** Particle size is important. When particles become smaller, their mass is reduced, causing their surface to become proportionally larger. This increases the potential energy in a dust deflagration because the material is more easily ignited.

A dust is combustible when its particles will burn. Table salt is small enough to be considered a dust, but it is chemically noncombustible. Wood is combustible, but dimensioned lumber is not dust: it is a solid mass with a surface area large enough to make it difficult to ignite in air using an oxygen-acetylene torch.

The energy required to ignite a combustible dust is defined as the minimum ignition energy and is measured in millijoules. A typical spark created by walking across a carpeted floor and touching a metal door is about 100 millijoules. The lower the minimum ignition energy value the less energy is required for ignition to occur. Consider, for example, an agricultural dust such as wheat flour with an average particle size of 80 microns. The minimum ignition energy required to ignite such dust is approximately 95 millijoules. If the particle size is doubled to 160 microns, the required ignition energy is over 400 millijoules. Table 15-1 lists the particle size of common materials.

TABLE 15-1 Particle sizes of common materials

Material	Size (micron)
White granulated sugar	450–600
Sand	50 and greater
Talcum powder	10
Mold spores	10–30
Human hair	40–300
Wheat, corn, or soybean flour	1–100

The mechanism of a dust deflagration requires more conditions when compared to the conventional fire triangle. Along with an ignition source and proper mixing of the fuel with an oxidizer, a dust deflagration also requires the fuel be in a confined enclosure, such as a building or exhaust duct, and that it be easily dispersed within the enclosure. A deflagration can occur when enough dust particles are suspended in the enclosure; the concentration exceeds the minimum explosive concentration and the ignition source is greater than the minimum ignition energy. The burning combustible dust liberates flammable gases and it is the ignition of these gases that causes the deflagration. (See Figure 15-1)

The IFC specifies requirements for controlling sources of ignition and housekeeping to reduce the potential of a dust deflagration. The IFC adopts NFPA standards that regulate dust deflagration hazards. To prevent the ignition of the dust layer, the IFC requires strict control of ignition sources. A means of collecting the dust is required to prevent enough of a dust accumulation that can be suspended in air. The key is to ensure the dust does not accumulate at any locations where it can be suspended in air, such as on ventilation ducts, light fixtures, building trusses or purlins, cable trays, or similar locations. (See Figure 15-2) **[Ref. 1303.1 and 1303.2]**

In two of the referenced NFPA standards adopted by the IFC, one means of determining if a dust deflagration hazard exists is to measure the dust layer depth. NFPA 654, *Manufacturing, Processing and Handling of Combustible Particulate Solids* and NFPA 664, *Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities* indicate that such a hazard exists when the dust is combustible, it has a density of 75 pounds/cubic foot or less, and the area of dust layer and its depth exceed the values indicated in Table 15-2.

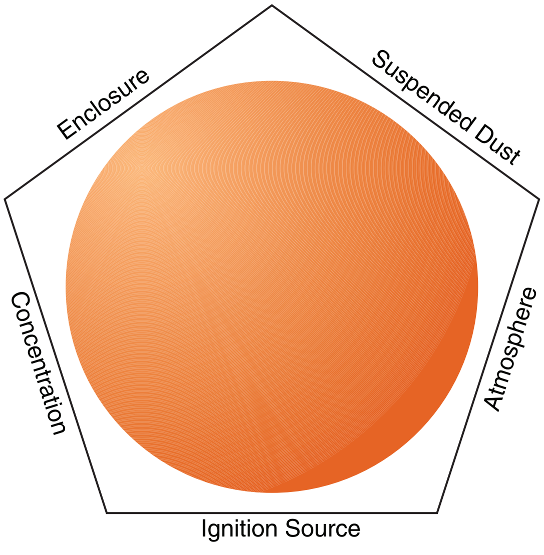

FIGURE 15-1 Dust deflagration pentagon

FIGURE 15-2 Dust collector used to capture combustible dust produced during the manufacturing of furniture

TABLE 15-2 Minimum dust layer depth and area for a dust deflagration hazard by material or facility type

Material or facility type	Dust layer depth	Dust layer area
Combustible particulate solids	1/32 inch	5% when the building area is less than 20,000 square feet, or a maximum dust layer area of 1,000 square feet when the building area is 20,000 square feet or greater.
Wood processing and woodworking facilities	1/8 inch	