

Flame-Resistant Clothing:

The Forgotten Element in Combustible Dust Safety

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The safety and health hazards posed by combustible dusts such as, but not limited to organic and metal dusts are unique and extremely complex. Most employers are aware of the deflagration and explosion hazards associated with combustible dust(s). However, the flash fire hazard posed by combustible dust(s) often goes unrecognized and unmitigated.

The result of a combustible dust deflagration and/or explosion is often significant damage to equipment, processes and the facility at large. While employees can potentially be injured during a deflagration and explosion, many of the injuries and fatalities associated with combustible dust(s) are caused by direct employee exposure to flash fires.

flash fire *noun*

a fire that spreads by means of a flame front rapidly through a diffuse fuel, such as dust, gas or the vapors of an ignitable liquid, without the production of damaging pressure.¹



Flash fires associated with combustible dusts are usually short-lived, ranging from the order of 10 milliseconds inside small equipment to the order of seconds in a large room.² Flash fires from any source (including combustible dust) can also generate vast amounts of heat. Persons and objects exposed to flash fires are subjected to temperatures on the order of approximately 2,240 °F to 6,740 °F.²

Although employee exposure to a combustible dust flash fire is typically short in duration, the flame(s) generated from flash fires can be fatal to unprotected employees within and near the expanding flame(s). Employees exposed to high thermal radiation (heat) levels wearing flammable clothing can potentially experience third degree burns to bare skin and 50% lethality in less than 10 seconds.² Due to the severity of the hazards posed by a combustible dust flash fire, it is imperative that employees who are potentially

exposed to combustible dust flash fires be required to wear appropriate flame resistant clothing (FRC).

Employee Protection from Combustible Dust Flash Fires

When properly designed, installed and maintained, explosion protection and prevention systems (explosion vents, explosion suppression systems, etc.) protect employees from the explosion hazards posed by combustible dust(s). However, these systems provide little to no protection for employees who are exposed to combustible dust flash fires. FRC (also called flame-resistant garments (FRGs)) can help protect employees from thermal and other hazards associated with combustible dust flash fires. Prior to being certified as FRC, any clothing or garments must meet the various design, construction, evaluation and certification requirements listed in the National Fire Protection Association's (NFPA) *Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire* (NFPA 2112).



Most of the injuries associated with combustible dust flash fires result in employees sustaining minor to severe burns (especially on the area(s) of the body that

were directly exposed to the flash fire). In most of the incidents where employees were severely burned during combustible dust flash fires, these employees were wearing clothing that was not designed and certified as FRC. Although FRC cannot completely prevent burns sustained during a combustible dust flash fire, FRC can drastically reduce the severity of burn injuries resulting from short-duration thermal exposures or accidental exposure to combustible dust flash fires.

OSHA and Combustible Dust Flash Fire Hazards

In the last five years, the Occupational Safety and Health Administration (OSHA) has vastly increased its enforcement activities for combustible dust. OSHA is aggressively targeting any facilities that manufacture, process, blend, convey, repackage and/or handle combustible dust(s). Currently, there is not an OSHA Standard that specifically addresses all of the hazards associated with the various types of combustible dusts. Thus, OSHA is primarily using the General Duty Clause to address the fire, deflagration and/or explosion hazards associated with combustible dust(s). OSHA's General Duty Clause (Section 5(a)(1)) states that the employer must "furnish to each of his employees, employment and a place of employment which are free from recognized hazards that are causing, or likely to cause death or serious physical harm." General Duty Clause citations are frequently issued to address combustible dust hazards such as, but not limited to lack of explosion protection and isolation systems on dust collection equipment.

In addition to the General Duty Clause, OSHA also uses several current OSHA standards to address the hazards associated with combustible dust(s). Although most of these current OSHA standards do not specifically mention combustible dust, these

OSHA's Status Report on Combustible Dust National Emphasis Program states that a total of approximately 4,926 combustible dust citations were issued between October 2007 and June 2009.⁴ Approximately 11% of these combustible dust citations (226 citations) pertained to personal protective equipment (PPE) such as, but not limited to flame resistant clothing.

standards are used to address some of the safety and health hazards associated with combustible dust. One such OSHA standard that is used to address the flash fire hazard associated with combustible dust is 29 CFR 1910.132 (Personal Protective Equipment, General Requirements).

The number of OSHA citations issued to address employee protection from combustible dust flash fire hazards (i.e. lack of appropriate flame resistant clothing) may surprise some employers. In terms of citations related to combustible dust hazards, the only OSHA standards (including the General Duty Clause) that were cited more frequently than 29 CFR 1910.132 (PPE) were 29 CFR 1910.1200 (Hazard Communication (HazCom)) and 29 CFR 1910.22 (Housekeeping).

How Hazard Assessments Relate to FRC

Although there are no specific OSHA standards for FRC in terms of combustible dust, OSHA's Personal Protective Equipment



Assessing the need for FRC in the workplace:

Combustible dust flash fire hazards are difficult to recognize and are often misunderstood by employers, so it is important to consider the following during a PPE hazard assessment:

- Combustible dust flash fire hazards are difficult to recognize and are often misunderstood by employers
- Determine airborne combustible dust concentrations
- Measure accumulation of combustible dust on floors and surfaces
- Investigate previous history of fires and explosions

(PPE) Standard (29 CFR 1910.132(d)(1)) requires employers to

“assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of PPE.”

29 CFR 1910.132(d)(1) further states that

“if such hazards are present, or likely to be present, the employer shall select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment.”

Although 29 CFR 1910.132(d)(1) requires each employer to perform a PPE hazard assessment, the standard does not specifically describe how this assessment should be performed, or what information should be examined and documented during

the assessment. Thus, employers tend to focus on requiring employees to wear PPE that protects them from easily recognized hazards (safety glasses, hearing protection, gloves, etc.). Although combustible dust flash fire hazards should be examined during the PPE hazard assessment, these hazards are often overlooked or ignored because these hazards are not easily recognized or understood by most employers.

When Is FRC Required to be Worn?

NFPA's *Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire* (NFPA 2113-2012) recommends that employees wear FRC in facilities or areas where combustible dust is present during normal operation. However, the decision to

require employees to wear FRC depends on many factors including, but not limited to the airborne combustible dust concentrations, amount of accumulated combustible dust on floors and surfaces, and previous history of fires and explosions. Prior to determining the need (or lack thereof) for FRC, all of these and other factors should be thoroughly examined during the PPE/workplace hazard assessment.

There are certain jobs and processes that are prevalent throughout many industries where FRC should be required to be worn. In addition to posing a significant flash fire hazard during normal operation, all of these jobs and processes have been shown to have the potential to produce significant airborne combustible dust concentrations (sometimes inside of the fixed volume of an enclosure). One of the primary jobs and processes that pose a combustible dust flash fire hazard are operations involving cleaning and removing of accumulated combustible dust from surfaces, floors, equipment, etc. Due to the inherent flash fire hazard present, FRC should be required to be worn whenever these cleaning operations are performed. However, the use of FRC is not exclusive to these cleaning operations alone. In order to determine if FRC is required for other jobs or processes, the

employer must thoroughly evaluate each job or process where employees are directly or indirectly exposed to combustible dust(s).

Summary:

Combustible dust fires and explosions continue to occur on a regular basis. The benefits of explosion protection methods such as, but not limited to explosion venting and explosion suppression systems are relatively well known. However, FRC continues to be overlooked by most industries and employers because the flash fire hazard posed by combustible dust(s) is not fully recognized or understood. Although often overlooked, FRC can help protect employees from the thermal and other hazards associated with combustible dust flash fires. Compared to other methods for mitigating combustible dust hazards, FRC is cost effective and relatively easy to implement. FRC has and will continue to save the lives of employees who are exposed to combustible dust flash fires. However, this will only happen if more employers begin to understand the flash fire hazard posed by combustible dust.

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