

# 12.85 Enforcement and Consultation Guidance for Combustible Dust Hazards December 30, 2008

## **I. Purpose**

This directive establishes statewide DOSH enforcement and consultation policy for workplaces that generate or handle combustible dusts having the potential to cause dust deflagrations, other fires, or explosions. To reduce the risk of combustible dust incidents within Washington workplaces, enforcement and consultation of existing requirements ( i.e. standards) are being emphasized in response to Federal OSHA’s National Emphasis Program (NEP) on combustible dust, OSHA CPL 03-00-008, Combustible Dust National Emphasis Program (Reissued). DOSH has not adopted the OSHA Combustible Dust NEP, however, the guidance provided in this directive, when applied appropriately to facilities with potential combustible dust hazards, is expected to result in safer workplaces with reduced hazard potential from the dusts encountered.

## **II. Scope and Application**

This directive applies to all workplaces that generate or handle combustible dusts having the potential to cause dust deflagrations, other fires, or explosions.

This directive does not replace the DOSH grain handling facility directive, WRD 89-3b, *Grain Handling Facilities—Inspection Guidance and Standards Clarification*. In addition, this directive is not intended for inspections or consultations of explosives and pyrotechnics manufacturing facilities covered by chapter 296-67 WAC, *Process*

*Safety Management of Highly Hazardous Chemicals* (PSM). However, the directive may apply to facilities that manufacture or handle other types of combustible dusts such as ammonium perchlorate covered under the PSM standard.

### **III. References**

WRD 89-3b, Grain Handling Facilities—Inspection Guidance and Standards Clarification

WAC 296-24-95601--Definitions applicable to WAC 296-24-956 through 296-24-985.

OSHA CPL 03-00-008, Combustible Dust National Emphasis Program (Reissued)

[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=DIRECTIVES&p\\_id=3830](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=3830)

Safety and Health Information Bulletin (SHIB)--Improper Installation of Wood Dust Collectors in the Woodworking Industry—May 2, 1997.

[http://www.osha.gov/dts/hib/hib\\_data/hib19970502.html](http://www.osha.gov/dts/hib/hib_data/hib19970502.html)

SHIB--Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions—July 31, 2005.

<http://www.osha.gov/dts/shib/shib073105.html>

FM Global, Data Sheet No. 7-76, Prevention and Mitigation of Combustible Dust Explosions and Fire (2006 Edition). [Go to](#)

<http://www.fmglobal.com/fmglobalregistration/default.aspx?action=new> to register, and then access the data sheet by number

National Materials Advisory Board (NMAB) 353-4-82 Classification of Dusts Relative to Electrical Equipment in Class II Hazardous Locations.

[http://www.nap.edu/catalog.php?record\\_id=10952#toc](http://www.nap.edu/catalog.php?record_id=10952#toc)

NFPA 61, Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities (2002 Edition).

NFPA 68, Guide for Venting of Deflagrations (2002 Edition).

NFPA 69, Standard on Explosion Prevention Systems (2002 Edition).

NFPA 70, National Electrical Code (2005).

NFPA 77, Recommended Practice on Static Electricity.

NFPA 85, Boiler and Combustion Systems Hazards Code (2007 Edition).

NFPA 86, Standard for Ovens and Furnaces.

NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids (2004 Edition).

NFPA 484, Standard for Combustible Metals, Metal Powders, and Metal Dusts (2006 Edition).

NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemicals Process Areas (2004 Edition).

NFPA 654, Standard for the Prevention of Fires and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids (2006 Edition).

NFPA 664, Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities (2007 Edition).

NFPA 2113, Standard on Selection, Care, Use and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire.

#### **IV. Background**

A number of recent combustible dust incidents have resulted in deaths and serious injuries. In many cases, the employer did not recognize the hazards posed by combustible dust.

A dust deflagration occurs when the right concentration of finely divided dust suspended in air contacts a source of ignition. If the deflagration is in a confined area, an explosion potential exists. These materials can also cause other fires. Combustible dust is often either organic or metal dust finely ground into very small particles. The actual quantity of dust that may accumulate in an affected area may vary, depending upon air movement, particle size, or any number of other factors. These dusts include, but are not limited to:

- Metal dust such as aluminum and magnesium
- Wood dust
- Coal and other carbon dusts
- Plastic dust and additives
- Biosolids
- Organic dust such as sugar, flour, paper, soap, and dried blood
- Dust from certain textile materials.

Industries that may handle combustible dusts include, but are not limited to:

- Agriculture
- Food Products
- Chemicals
- Textiles
- Forest and furniture products
- Metal processing
- Tire and rubber manufacturing plants
- Paper products
- Pharmaceuticals
- Wastewater treatment
- Recycling operations (metal, paper, and plastic.)
- Coal dust in coal handling and processing facilities.

## **V. Definitions – Chapter 296-24 WAC, Part L**

**A. *Class II locations.*** Class II locations are those that are hazardous because combustible dust is present. Class II locations are divided by the source and quantity of dust into the following divisions:

**Class II, Division 1.** A location in which:

- Combustible dust is or may be in suspension in the air under normal operating conditions, in quantities sufficient to produce explosives or ignitable mixtures; or
- Mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protection devices, or from other causes; or
- Combustible dusts of an electrically conductive nature may be present.

**Class II, Division 2.** A location in which:

- Combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitable mixtures; and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus; or

- Dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment, and dust accumulations resulting may be ignitable by abnormal operation or failure of electrical equipment or other apparatus.

*Note: This classification includes locations where dangerous concentrations of suspended dust would not be likely but where dust accumulations might form on or in the vicinity of electric equipment. These areas may contain equipment from which appreciable quantities of dust would escape under abnormal operating conditions; or be adjacent to a Class II Division 1 location as described above, into which an explosive or ignitable concentration of dust may be put into suspension under abnormal operating conditions.*

Class II locations with combustible dust atmospheres further divide by the type of dust into the following 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.

**Group F.** Atmospheres containing combustible carbonaceous dusts that have more than 8 percent total entrapped volatiles (see ASTM D 3175, *Standard Test Method for Volatile Matter in the Analysis Sample of Coal and Coke*, for coal and coke dusts) or 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.

- B. Combustible dust.** A combustible particulate solid that presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations, regardless of particle size or shape.
- C. Combustible Particulate Solid.** Any combustible solid material composed of distinct particles or pieces, regardless of size, shape, or chemical composition.
- D. Deflagration.** Propagation of a combustion zone at a speed that is less than the speed of sound in the un-reacted medium.
- E. Deflagration Isolation.** A method employing equipment and procedures that interrupts the propagation of a deflagration flame front, past a predetermined point.

- F. *Deflagration Suppression.*** The technique of detecting and arresting combustion in a confined space while the combustion is still in its incipient stage, thus preventing the development of pressures that could result in an explosion.
- G. *Explosion.*** The bursting or rupture of an enclosure or a container due to the development of internal pressure from deflagration.
- H. *Minimum Explosible Concentration (MEC).*** The minimum concentration of combustible dust suspended in air, measured in mass per unit volume that will support a deflagration.

## **VI. Inspection and Consultation Procedures**

- A. Use Professional Judgment:** DOSH compliance and consultation staff must use professional judgment when evaluating facilities with potential combustible dust hazards. Also, use appropriate personal precautionary measures for the particular hazards presented in facilities with combustible dust hazards.
- B. Personal Protective Equipment (PPE):** In addition to the normally required personal protective equipment, wear non-spark-producing clothing such as natural fiber (e.g., cotton). It is also recommended that flame-resistant clothing be worn as appropriate.
- C. Photos:** Cameras and video cameras must be appropriate (i.e. intrinsically safe) for the work environment. However, if such cameras are not available, take photographs or videos using a telephoto feature from locations within the plant that are not hazardous (classified) locations.

NOTE: Because of its spark-producing potential, no equipment including cameras with electronic flashes or electrical equipment may be used in hazardous (classified) locations of the facilities unless the equipment is intrinsically safe, approved, or safe as defined in WAC 296-24-95613 for use in these types of areas.

- D. Interviews:** Take written or verbal statements from both employees and, if possible, from employers regarding the hazardous conditions including alleged violations such as dust accumulations or explosion vents not directed to safe locations away from the employees working in the area.
- E. Sampling:** Use safe practices when collecting potentially combustible dust samples, such as not generating a dust cloud while collecting a sample and using the right tools in collecting the samples. When collecting a sample from a large area, a paintbrush and dustpan can be used. Contact the DOSH Lab for advice on dust collection equipment. If a means of safe access is not available when entering potentially hazardous areas of a facility, do not collect samples.

If you have questions about collecting dust samples, contact the DOSH Lab.

Locations from which to collect separate samples include:

- "High spaces" such as roof beams, open web beams, tops of pipes and ductwork, and other horizontal surfaces located as high in the overhead as possible. Note: These are the preferred locations; however, if a means of safe access is not available, do not collect samples.
- Equipment and floors where dust has accumulated.
- The interior of a dust collector, for example a bin or bag.
- Within ductwork.

**F. Identifying Combustible Dust Hazards:** A dust deflagration occurs when the right concentration of finely divided dust suspended in air is exposed to a source of ignition. The following criteria must be met before a deflagration can occur:

- The dust must be combustible.
- The dust must be dispersed in air or another oxidant, and the concentration of dispersed dust must be at or above the minimum explosible concentration (MEC).
- There must be an ignition source, such as an electrostatic discharge, spark, glowing ember, hot surface, friction heat, or a flame that can ignite the dispersed combustible mixture.

An explosion could result if the combustible dust is dispersed within a confined enclosure such as a vessel, storage bin, ductwork, room, or building and the confined enclosure does not contain sufficient deflagration venting capacity to safely release the pressures. A small deflagration can disturb and suspend the combustible dust, which could then serve as the fuel for a secondary (and often more damaging) deflagration or explosion.

Dust in the workplace typically falls into two categories. The first category is process dust used in or generated by the workplace processes and equipment. This includes machinery and equipment that collects, transports, stores and/or disposes of the combustible dust. The second category, fugitive dust, was never "captured" by the dust collection system or was collected and subsequently "escaped" back into the workplace.

The following conditions may indicate that a potential dust deflagration, other fire, or explosion hazard exists:

- **History of Plant Fires:** The plant has a history of fires involving combustible dusts.
- **Material Safety Data Sheets (MSDS):** The MSDS may indicate that a particular dust is combustible and can cause explosions, deflagrations, or other fires. However, do not use the MSDS as a sole source of information because this information is often not included in the MSDS.
- **Dust Accumulations:** Areas of the plant with hazardous accumulations of dust. Likely areas of dust accumulations within a plant are:
  - Structural members
  - Conduit and pipe racks
  - Cable trays
  - Floors
  - Above ceilings
  - On and around equipment (leaks around dust collectors and ductwork.)

**Annex D of NFPA 654** contains guidance on dust layer characterization and precautions. It indicates that immediate cleaning is warranted whenever a dust layer of 1/32- inch thickness (approximately equal to the thickness of a typical paper clip) accumulates over a surface area of at least 5% of the floor area of the facility or any given room. The 5% factor should not be used if the floor area exceeds 20,000 square feet, in which case a layer of dust covering 1,000 square feet warrants immediate cleaning. Accumulations on overhead beams, joists, ducts, the tops of equipment, and other surfaces should be included when determining the dust coverage area. Even vertical surfaces should be included if the dust is adhering to them. Rough calculations show that the available surface area of bar joists is approximately 5 % of the floor area and the equivalent surface area for steel beams can be as high as 10%.

The material in Annex D is an idealized approach based on certain assumptions, including uniformity of the dust layer covering the surfaces, a bulk density of 75 lb/ ft<sup>3</sup>, a dust concentration of 0.35 oz/ ft<sup>3</sup>, and a dust cloud height of 10 ft. Additionally, FM Data Sheet 7-76 contains a formula to determine the dust thickness that may create an explosion hazard in a room, when some of these variables differ.

## **G. Site Evaluation**

### **1. Dust Control in Process Equipment**

Examine dust collectors, ductwork, associated equipment, and containers, like mixers or storage bins. Gather the following information during the course of the inspection or consultation:

- Explosion prevention and mitigation controls such as the isolation or segregation of dust-generating processes, building damage-limiting construction, explosion venting for dust-processing areas; process equipment relief (see NFPA 68), and process isolation and explosion suppression (see NFPA 69).
- Design information on the dust collection systems, along with model numbers and serial numbers (located on the side of the equipment along with the manufacturer and phone numbers).
- Size (volume) of dust collectors (Note: Dust collectors are referred to as "air-material separators" in NFPA 654).

### **2. Fugitive Dust Control**

Does the facility have a housekeeping program with regular cleaning frequencies established for floors and horizontal surfaces, such as ducts, pipes, hoods, ledges, and beams, to minimize dust accumulations within operating areas of the facility? Under the housekeeping program, is the dust on floors, structural members, and other surfaces removed concurrently with operations?

Document the dimensions of the work area and the areas of the dust accumulations of greater than 1/32-inch depth.

Are the dust-containing systems (ducts and dust collectors) designed in a manner that fugitive dusts are not allowed to accumulate in the work area?

### **3. Sources of Ignition**

Does the facility use grounding and bonding or other methods, for dissipating any electrostatic charge that could be generated while transporting the dust through the ductwork? Are duct systems, dust collectors, and dust-producing machinery bonded and grounded to minimize the accumulation of static electrical charge?

Does the facility have separator devices to remove foreign materials capable of igniting combustible dusts?

Are electrically-powered cleaning devices used in dusty areas, such as sweepers or vacuum cleaners, approved for the hazard classification as required under WAC 296-24-95613?

In areas where a hazardous quantity of dust accumulates or is in suspension in the air, does all electrical wiring and equipment comply with WAC 296-24-95613?

Does the facility allow hot work only in safe, designated areas?

## **VII. Enforcement and Consultation Policy**

**A. Vertical Standards.** If a vertical standard addresses a hazard caused by combustible dust, cite that standard if a violation is discovered.

**B. Housekeeping Violations.** If the facility being evaluated is not a grain handling facility, and the surface dust accumulations (i.e., those outside the dust collection system or other containers, such as mixers) can create an explosion, deflagration or other fire hazard, then violations of WAC 296-800-22005 (housekeeping) shall be issued. The standard requires:

“Keep all areas of your workplace, passageways, storage rooms, and service rooms in a clean, orderly and sanitary condition to the extent the nature of the work allows.”

Small amounts of dust accumulations in isolated spots of the floor or other areas is not normally classified as a violation of the housekeeping requirement. Take representative measurements to substantiate housekeeping violations. Thickness measurements of the dust layer must be made at several locations within the area covered by dust.

As a part of determining whether the housekeeping violation is serious, it is necessary to determine whether the dust is combustible or can cause deflagration. Also document heat and ignition sources.

NOTE: This directive does not affect the application of WAC 296-800-22005 or other housekeeping standards to correct the general cleanliness of workplaces for conditions unrelated to a combustible dust hazard.

**C. Housekeeping violations in storage areas.** Cite WAC 296-800-22035 for housekeeping violations if the problem exists only in storage areas. The standard requires:

“Keep workplace storage areas free from accumulation of materials that could create hazards from tripping, fire, or explosion.”

Use the dust hazard criteria applicable to WAC 296-800-20005 violations when determining storage area violations. Document whether a reasonable person would recognize a combustible dust hazard under the circumstances. NFPA standards may be used in this regard. The CSHO must also document feasible abatement methods. For examples, see NFPA 654 (2006), Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids.

If the dust accumulations outside of the storage areas are also being cited, then WAC 296-800-22005 should be used for the entire workplace.

**D. Process machines and equipment violations.** A citation under WAC 296-800-11010 (safe place) may be issued for deflagration, explosion or other fire hazards that may be caused by combustible dust within a dust collection system or other containers, such as mixers. The NFPA standards, which represent the opinions of experts familiar with combustible dust hazards, are useful in providing evidence of industry recognition of the hazard. For example, see NFPA 654 (2006), Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids. Look at the employer's safety manuals or other instructions to determine whether there is employer recognition of the combustible dust hazard. Consult relevant NFPA standards for feasible means of abatement. The essence of a safe place citation is the hazard; do not issue a separate violation for a failure to use a particular abatement method. Heat and ignition sources should also be documented.

The following are some conditions for which a safe place violation may be issued:

- Problems related to dust collectors, e.g., dust collection equipment located inside the building without proper explosion protection systems, such as explosion venting or explosion suppression systems and dust collectors returning air back inside the building.
- Ductwork-related problems, e.g., the ductwork is not grounded and ductwork is not constructed of metal.
- Improperly designed deflagration venting (venting to areas where employees are likely to be exposed to explosion/deflagration hazards).
- Processing and material handling equipment, such as, mixers, blenders, pulverizers, mills, dryers, ovens, filters, dust collectors, pneumatic conveyors, and screw conveyors, not protected by deflagration suppression systems.

- Equipment connected by pipes and ducts not protected by deflagration isolation systems, such as flame arresters, flame front diverters, spark detection, spark extinguishing equipment, and rotary valves.

**E. Personal Protective Equipment (PPE) Violations.** Citations under WAC 296-800-160 (the general requirement to provide and assure the use of protective equipment, including *protective clothing*) may be issued if an employee exposure to potential burn injuries can be documented. For example, if employees are not wearing protective clothing, such as flame-resistant clothing, in areas of the plant (e.g., bagging areas) where employees may be exposed to potential combustible dust flash fire hazards, then citations may be issued. Another example where citations may be issued, would be a situation where employees (not wearing flame resistant clothing) cleaning out a piece of equipment containing combustible dust may be exposed to a flash fire propagated through the cleanout door. A citation may be issued whether or not an accident precipitated the inspection.

Document whether a reasonable person familiar with the circumstances would recognize hazards from combustible dust. NFPA standards may be used for this documentation. Also, document whether there are feasible types of personal protective equipment to deal with these hazards. Recognized industry practice requires flame-resistant clothing when employees may be exposed to flash fire hazards. National Fire Protection Association (NFPA) 2113, *Standard on Selection, Care, Use and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire* is a national consensus standard which applies to, among others, chemical, refining, and terminal facilities with flash fire hazards. Among other provisions, NFPA 2113 has requirements for when flame-resistant clothing must be used by industrial personnel exposed to flash fire hazards. See Chapter 4 of NFPA 2113 for a discussion on selection of flame-resistant clothing.

**F. Process Safety Management.** If the dust in question appears on the list of Highly Hazardous Chemicals, Toxics, and Reactives (Appendix A to chapter 296-67 WAC) and is present in quantities greater than or equal to the listed threshold quantity, the PSM standard will apply. Violations under chapter 296-67 WAC shall be cited for PSM violations.

**G. Electrical Violations.** If the location meets the criteria for Class II, and if the location where the dust was present falls under any of the Class II location definitions, then WAC 296-24-95613 will apply. See the Class II definition in WAC 296-24-95601.

Equipment, wiring methods, and installations of equipment in hazardous (classified) locations shall be: 1) intrinsically safe, 2) approved for the hazardous (classified) location, or 3) safe for the hazardous (classified) location. The meaning of these terms is detailed in WAC 296-24-95613(2).

If the employer chooses the third option of providing equipment that is "safe for the hazardous location," then the employer must demonstrate that the equipment is of a type and design that will provide protection from the hazards involved. Compliance with the guidelines contained in the National Electrical Code (NEC) constitutes one means, but not the only means, of demonstrating that the electrical equipment is safe for the hazardous location.

Citations and consultation reports issued for electrical violations must be adequately documented in the case file or consultation report. Such documentation must include the location and type of potential electrical ignition sources, the type and condition of electrical equipment located in the area, and information indicating that the equipment is not approved or safe for the location. (See NEC and NFPA 499 for more details.)

- H. Powered Industrial Trucks.** If powered industrial trucks without the appropriate designation are used in hazardous (classified) locations, citations shall be issued under WAC 296-863-50005.
- I. Welding, cutting, and brazing.** For violations involving welding, cutting, and brazing operations in explosive atmospheres, including mixtures of flammable dusts with air, cite the appropriate standard. For example, WAC 296-24-69503(6)(c) would be cited for cutting and welding in an explosive atmosphere (including combustible dust).
- J. Hazard communication violations.** The hazard communication standard, WAC 296-800-170, requires all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets, and information and training. The "hazardous chemicals" definition encompasses physical hazards, which includes flammable solids. Employers who do not follow the requirements of this standard shall be cited with respect to chemicals that in the course of normal conditions of use could become combustible dusts.

Chapter 296-839 WAC, *MSDS and Label Preparation*, requires chemical manufacturers, distributors, and importers to develop or obtain a material safety data sheet for each hazardous chemical they produce or import.

Evaluate whether there is compliance by examining a sample of MSDSs. If MSDSs are not updated when new information becomes available, they are deficient.

- K. Egress violations.** Where violations of WAC 296-800-310, Exit Routes and Employee Alarm Systems are found, issue citations for them.
- L. Fire protection violations.** Citations for violations of chapter 296-811 WAC (fire brigades) and WAC 296-800-300 (portable fire extinguishers) shall be issued where violations of these standards are found. Chapter 296-811 WAC only applies in the context of this directive if the employer has a fire brigade or industrial fire department. The fire extinguisher provisions of WAC 296-800-300 do not apply where the employer requires the evacuation of employees in the event of fire and has an emergency action plan and a fire prevention plan meeting the requirements of WAC 296-24-567.
- M. Bakery equipment violations.** Issue citations for violations of WAC 296-806-42584 for fire and explosion hazards in sugar and spice pulverizers. WAC 296-806-42582 addresses dust hazards in sifters and WAC 296-806-42544 covers flour dust in dumpbins and blenders.
- N. Sawmill violations.** Issue citations for violations of WAC 296-78-71019 in connection with defects in the design, construction, and maintenance of blower collecting and exhaust systems.
- O. Combustible dust that creates a health hazard.** If dust poses a health hazard to employees as an airborne contaminant, cite under chapter 296-841 WAC, Airborne Contaminants.



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