North Carolina Department of Labor
Division of Occupational Safety and Health

Raleigh, NC

Field Information System Operational Procedure Notice 138

Subject: Combustible Dust Explosion Prevention Program

A. **Purpose**.

This Operational Procedure Notice (OPN) establishes and implements a special emphasis inspection program that provides guidance to Compliance Safety and Health Officers (CSHOs) for conducting inspections targeted by this OPN.

B. **Background.**

A review of the accident investigation history in the OSHA database regarding explosions revealed that since 1984 there have been 58 explosion-related incidents investigated. Recently, there have been several combustible dust explosions that have resulted in death or serious injury to workers in North Carolina. In January 2003, a catastrophic explosion destroyed the West Pharmaceutical plant. Six employees were killed and 38 people were injured.

As a result, the N.C. Department of Labor formed a combustible dust committee to discuss the hazards of combustible dust and develop a policy addressing combustible dust inspection activity. In early 2007, the committee developed an extensive OPN as a result.

On June 14, 2007, federal OSHA issued a draft compliance directive, *Combustible Dust National Emphasis Program.* The OSHNC combustible dust committee reviewed this federal draft directive against the OPN. Because much of the information contained in the draft directive was similar to the OPN, the committee decided to use the draft directive and add the state specific information as appendices to the directive.

C. **Action.**

When federal OSHA issues a final combustible dust directive, the combustible dust committee will review the directive and recommend changes to this OPN and/or adoption of the final CPL. Until that time, this OPN will serve as guidance for combustible dust inspection activity. The draft federal directive is attached along with the state-specific appendices.

D. **OSHNC Revisions.**

The following revisions have been made to the draft NEP to make it consistent with policies and procedures in OSHNC and to further assist the CSHO with evaluating combustible dust hazards.

1. References in the draft NEP to section 5(a)(1) of the Occupational Safety & Health Act (commonly referred to as the "general duty clause") will mean section 95-129(1) of the Occupational Safety & Health Act of NC.

2. Section IX.A of the draft NEP outlines inspection scheduling procedures. Paragraphs 1-3 of this section are revised to reflect procedures to be used in OSHNC. The Planning, Statistic, and Information Management (PSIM) Bureau will cross-reference establishments currently on the safety and health general schedule assignment list with the SIC/NAICS codes listed in Appendix E of the draft NEP, which represents industries with potential combustible dust explosion hazards. Assignments being shown as a possible combustible dust industry will be coded as such on the both general schedule assignment lists.

3. References in the draft NEP to the Regional Administrator will mean the OSHNC Director or Assistant Director, while references to the Area Director will mean the appropriate OSHNC Bureau Chief.

4. Section IX.E.5 of the draft NEP outlines the collection of dust samples for analysis at the SLTC laboratory. Submission of dust samples to the SLTC lab requires Bureau Chief approval due to the cost of analysis.

5. Section IX.E.9.c of the draft NEP describes the procedures for substantiating housekeeping violations. Instead of citing solely under 29 CFR 1910.22(a)(1), OSHNC compliance officers will also cite the general duty clause (NCGS 95-129(1)) "in the alternative" to address housekeeping deficiencies related to combustible dust. While historical OSHA case law supports the use of 29 CFR 1910.22(a)(1) for addressing combustible dust hazards, language in the *Federal Register* (in 2003) indicated Subpart D of 29 CFR part 1910 was designed to protect employees from slips, trips, and falls that may cause serious or fatal injuries. There is no reference to explosion or fire hazards.

   Additionally, the NFPA documents (such as NFPA 654) that would be referenced by a general duty clause citation to show the hazard is "recognized" outline many details that are not found in Subpart D – such as specific dust depths (i.e. 1/32 of an inch) that pose an explosion hazard. Citing 29 CFR 1910.22(a)(1) and the general duty clause "in the alternative" will provide OSHNC with greater legal flexibility while still remaining consistent with the NEP.

6. Appendix F is added to describe dust collection system inspection information

7. Appendix G is added to summarize items from NFPA 654 and 484 that are commonly referenced in general duty clause citations.

8. Appendix H is added to describe the justification required for Bureau Chief approval when sending combustible dust samples to the SLTC laboratory for analysis.

9. Appendix I is added to give an example of the form sent to the SLTC laboratory along with the dust sample. Taken from the USDOL Region III directive as referenced in section III.A. of the draft NEP.

10. Appendix J is added to provide the CSHO a list of additional questions for collecting information during combustible dust inspections.

11. Appendix K is added to provide information on laboratory testing of combustible dust.

12. Appendix L is added to provide information on the approval of electrical cabinets – National Electrical Manufacturers Association (NEMA) ratings.

13. Appendix M is added to provide example 1B's. Taken from the USDOL Region III Directive as referenced in section III.A. of the draft NEP.

E. **Effective Date**.

This OPN is effective on the date of signature. It will remain in effect until revised or canceled by the Director

Signed on Original
Nicole Brown
Staff Industrial Hygienist

Signed on Original
Allen McNeely
Director

9/12/2007
Date of Signature

OSHA INSTRUCTION

U.S. DEPARTMENT OF LABOR — Occupational Safety and Health Administration

DIRECTIVE NUMBER: **EFFECTIVE DATE:** June 14, 2007

SUBJECT: **Combustible Dust National Emphasis Program**

ABSTRACT

Purpose: This instruction contains policies and procedures for inspecting workplaces that create or handle combustible dusts. In some circumstances these dusts may cause a deflagration, other fires, or an explosion. 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
- Other organic dust such as sugar, paper, soap, and dried blood.
- Certain textile materials

Scope: This instruction applies OSHA-wide.

References: See paragraph III.

State Plan Impact: Notice of Intent required. See paragraph VI.

Action Offices: National, Regional, and Area Offices.

Originating Office: Directorate of Enforcement Programs.

Contact: Directorate of Enforcement Programs
200 Constitution Avenue, NW, Room N3107
Washington, DC 20210
Phone: (202) 693-1850

By and Under the Authority of

Edwin G. Foulke, Jr.
Assistant Secretary

Executive Summary

OSHA is initiating this National Emphasis Program (NEP) to address the deflagration, other fires, and explosion hazards that may exist at facilities handling combustible dust. A combustible dust hazard study conducted by the U.S. Chemical Safety and Hazard Investigation Board (CSB) found that nearly 280 dust fires and explosions have occurred in U.S. industrial facilities over the past 25 years, resulting in 119 fatalities and over 700 injuries.

The purpose of this NEP is to inspect facilities that generate or handle combustible dusts which pose a deflagration or other fire hazard when suspended in air or some other oxidizing medium over a range of concentrations, regardless of particle size or shape; deflagrations can lead to explosions. Combustible dusts are often either organic or metal dusts that are finely ground into very small particles, fibers, fines, chips, chunks, flakes, or a small mixture of these. Types of dusts include, but are not limited to: metal dust, such as aluminum and magnesium; wood dust; plastic dust; biosolids; organic dust, such as sugar, paper, soap, and dried blood; and dusts from certain textiles. Some industries that handle combustible dusts include: agriculture, chemicals, textiles, forest and furniture products, wastewater treatment, metal processing, paper products, pharmaceuticals, and recycling operations (metal, paper, and plastic).

In situations where the facility being inspected is not a grain handling facility, the lab results indicate that the dust is combustible, and the combustible dust accumulations not contained within dust control systems or other containers, such as storage bins, are extensive enough to pose a deflagration, explosion, or other fire hazard, then citations under 29 CFR 1910.22 (housekeeping) or, where appropriate, 29 CFR 1910.176(c) (housekeeping in storage areas) may generally be issued. Combustible dusts found in grain handling facilities are covered by 29 CFR 1910.272.

For workplaces not covered by 1910.272, but where combustible dust hazards exist within dust control systems or other containers, citations under section 5(a)(1) of the OSH Act (the General Duty Clause) may generally be issued for deflagration, other fire, or explosion hazards. National Fire Protection Association (NFPA) standards (listed in Appendix A of this directive) should be consulted to obtain evidence of hazard recognition and feasible abatement methods. Other standards are applicable to the combustible dust hazard. For example, if the workplace has a *Class II* location, then citations under 29 CFR 1910.307 may be issued to those employers having electrical equipment not meeting the standard's requirements.

New Directive: Significant Issues

This is a new directive describing policies and procedures regarding inspection of facilities that handle combustible dust. This directive does not replace the grain handling facility directive, OSHA Instruction CPL 02-01-004, Inspection of Grain Handling Facilities, 29 CFR 1910.272. In addition, this directive is not intended for inspections of explosives and pyrotechnics manufacturing facilities covered by the Process Safety Management (PSM) standard (1910.119). However, it does not exclude facilities that manufacture or handle other types of combustible dusts (such as ammonium perchlorate) covered under the PSM standard.

TABLE OF CONTENTS

I. **Purpose.** This instruction contains policies and procedures for inspecting workplaces that handle combustible dusts that are likely to cause dust deflagrations, other fires, or explosions. 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
- Other organic dust such as sugar, paper, soap, and dried blood.
- Certain textile materials.

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

- Agriculture
- 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.

(**Note**: OSHA Standard 29 CFR 1910.269(v)(11)(xii) addresses control of ignition sources at coal handling operations in electric power plants. The Mine Safety and Health Administration (MSHA) has authority in some areas involving coal crushing and conveying. See OSHA Instruction CPL 02-01-038 dated June 18, 2003 for additional guidance on authority)

II. **Scope.** This instruction applies OSHA-wide.

III. **References.**

A. OSHA Regional Notice (Region III), Directive Number: 2006 - 556 (CPL 04), Local Emphasis Program for Dust Explosion Prevention, October 1, 2006

B. OSHA Instruction CPL 02-00-103, Field Inspection Reference Manual, September 26, 1994

C. OSHA Instruction CPL 02-01-004, Inspection of Grain Handling Facilities, 29 CFR 1910.272, November 8, 1996

D. OSHA Instruction CPL 02-01-038, Enforcement of the Electric Power Generation, Transmission, and Distribution Standard, June 18, 2003

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

F. SHIB--Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions—July 31, 2005
G. 29 CFR 1910.399--Definitions applicable to Subpart S--Electrical
H. NFPA 61, Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities (2002 Edition)
I. NFPA 68, Guide for Venting of Deflagrations (2002 Edition)
J. NFPA 69, Standard on Explosion Prevention Systems (2002 Edition)
K. NFPA 70, National Electrical Code (2005)
L. NFPA 77, Recommended Practice on Static Electricity
M. NFPA 86, Standard for Ovens and Furnaces
N. NFPA 120, Standard for Fire Prevention and Control in Coal Mines
O. NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids (2004 Edition)
P. NFPA 484, Standard for Combustible Metals (2006 Edition)
Q. NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemicals Process Areas (2004 Edition)
R. NFPA 654, Standard for the Prevention of Fires and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids (2006 Edition)
S. NFPA 664, Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities (2007 Edition)
T. NFPA 2113, Standard on Selection, Care, Use and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire
U. United States Chemical Safety and Hazard Investigation Board (CSB) Combustible Dust Explosion Reports and website
V. ASTM E1226 – 05, Standard Test Method for Pressure and Rate of Pressure Rise for Combustible Dusts
W. ASTM E1515, Standard Test Method for Minimum Explosible Concentration of Combustible Dusts
X. FM Global, Data Sheet No. 7-76, Prevention and Mitigation of Combustible Dust Explosions and Fire (2006 Edition)
Y. National Materials Advisory Board (NMAB) 353-3-80, Classification of Combustible Dusts in Accordance with the National Electrical Code
Z. NFPA 85, Boiler and Combustion Systems Hazards Code (2007 Edition)

IV. **Action.** OSHA Regional Administrators and Area Directors must use professional judgment when ensuring that the policies and procedures set forth in this directive are followed.

V. **Application.** OSHA compliance personnel shall use professional judgment when carrying out the procedures contained in this directive are followed when conducting inspections of the facilities selected under this NEP.

VI. **Federal Program Change**. This instruction describes a Federal program change, which establishes a National Emphasis Program (NEP) for inspecting workplaces that handle

combustible dusts. State plan participation in this national emphasis effort is strongly encouraged but is not required. State response/notice of intent regarding this directive is required.

The State's response/notice of intent must indicate whether the State will initiate an emphasis program and if so, whether the State's program will be identical to or different from the Federal one. If the State's program differs from the Federal one, its implementing policies and procedures are expected to be at least as effective as those in this instruction and must be available for review. The State may either post its emphasis program on its State plan website and provide the link to OSHA or provide information on how a copy may be obtained. (OSHA will provide summary information on the State response to this instruction on its website.)

The assignment of appropriate IMIS identifier codes for State Emphasis Programs should be coordinated with the Directorate of Information Technology and the Regional Administrator.

VII. **Background**. Dust deflagration, other fire, and explosion hazards in the industries noted in Section I, Purpose, are covered by several OSHA standards and the general duty clause. A chemical dust deflagration occurs when the right concentration of finely divided chemical dust suspended in air is exposed to a sufficient source of ignition to cause ignition (combustion) of the dust. 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 that is 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.

OSHA is initiating this NEP to address the deflagration, other fire, and explosion hazards associated with most combustible dusts. It is issued in response to a number of combustible dust accidents which have resulted in deaths and serious injuries.

In 1999, a primary explosion of natural gas in an idle power boiler followed by a secondary explosion of disturbed coal dust in the facility caused six fatalities and fourteen serious injuries in a Michigan electrical power generation facility. (See Safety and Health Information Bulletin: Potential for Natural Gas and Coal Dust Explosions in Electrical Power Generating Facilities.)

In May 2002, an explosion occurred at Rouse Polymerics International, Inc., a rubber fabricating plant, in Vicksburg, Mississippi, which injured eleven employees, five of whom later died of severe burns. The explosion occurred when highly combustible rubber dust that had been allowed to accumulate ignited.

On January 29, 2003, an explosion and fire destroyed the West Pharmaceutical Services plant in Kinston, North Carolina, causing six deaths, dozens of injuries, and hundreds of job losses. The facility produced rubber stoppers and other products for medical use. The fuel for the explosion was a fine plastic powder, which accumulated above a

suspended ceiling over a manufacturing area at the plant and ignited.

On February 20, 2003, an explosion and fire damaged the CTA Acoustics manufacturing plant in Corbin, Kentucky, fatally injuring seven employees. The facility produced fiberglass insulation for the automotive industry. The resin involved was a phenolic binder used in producing fiberglass mats.

On the evening of October 29, 2003, a series of explosions severely burned three employees, one fatally, and caused property damage to the Hayes Lemmerz manufacturing plant in Huntington, Indiana. One of the severely burned men subsequently died. The Hayes Lemmerz plant manufactures cast aluminum automotive wheels, and the explosions were fueled by accumulated aluminum dust, a combustible byproduct of the wheel production process.

These explosions -- in Michigan, Mississippi, North Carolina, Kentucky, and Indiana -- resulted in the loss of 25 lives and caused numerous injuries and substantial property losses.

In opening a daylong public hearing on the combustible dust hazard on June 22, 2005, the United States Chemical Safety and Hazard Investigation Board (CSB) declared that chemical dust explosions in the United States are a "serious industrial safety problem." In November 2006, CSB issued a Combustible Dust Hazard Study Report that revealed the occurrence of nearly 280 dust fires and explosions in U.S. industrial facilities over the past 25 years, resulting in approximately 119 fatalities and over 700 injuries. In that report CSB made five recommendations to OSHA, one of which urged OSHA to conduct a special emphasis program targeting industries particularly at risk for dust explosions, such as aluminum casting, plastics, pharmaceuticals, and wood products. Details on this study and other CSB reports can be found at http://www.csb.gov.

VIII. Definitions

The following is a partial listing of definitions based on NFPA standards and 29 CFR 1910.399, the definitions provision of Subpart S—Electrical, that relate to combustible dust.

A. *Class II locations.* Class II locations are those that are hazardous because of the presence of combustible dust. The following are Class II locations where the combustible dust atmospheres are present:

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. *Hybrid Mixture*. A mixture of a flammable gas with either a combustible dust or a combustible mist.

E. *Deflagration*. Propagation of a combustion zone at a speed that is less than the speed of sound in the unreacted medium.

F. *Deflagration Isolation.* A method employing equipment and procedures that interrupts the propagation of a deflagration of a flame front, past a predetermined point.

G. *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.

H. *Detonation*. Propagation of a combustion zone at a velocity that is greater than the speed of sound in the unreacted medium.

I. *Dust-ignitionproof*. Equipment enclosed in a manner that excludes dusts and does not permit arcs, sparks, or heat otherwise generated or liberated inside of the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specified dust on or in the vicinity of the enclosure.

J. *Dusttight.* Enclosures constructed so that dust will not enter under specified test conditions.

K. *Explosion.* The bursting or rupture of an enclosure or a container due to the development of internal pressure from deflagration.

L. *Minimum Explosible Concentration (MEC)*. The minimum concentration of

combustible dust suspended in air, measured in mass per unit volume that will support a deflagration.

IX. Program Procedures.

A. Inspection Scheduling. Inspections conducted under this NEP will focus on general industry facilities where employees may be exposed to potential combustible dust hazards.

1. Using the most recently available Dunn and Bradstreet employer list, the Office of Statistical Analysis (OSA) will prepare a master list of establishments in the SIC/NAICS codes listed in Appendix D of this Instruction, which represents industries with an OSHA inspection history of combustible dust hazards. OSA will then provide to each Area Office a list of establishments in these SIC/NAICS codes within the Area Office's geographical jurisdiction.

2. Based on its familiarity with local industries, each Area Office will then make appropriate additions and deletions to its list. See OSHA Instruction CPL 02-00-025 (CPL 2.25I)-Scheduling Systems for Programmed Inspections.

   - Other facilities with a known a pattern of combustible dust hazards (with SICs/NAICS other than the ones listed in Appendix D) may be added, in alphabetical order, to the bottom of the list. The Area Office shall document the basis for any such addition.

   - Area Offices shall delete from the master list any facilities not likely to have combustible dust hazards, documenting the basis for such determinations.

   - Area Offices shall delete from the master list any establishments known to be out of business, documenting the basis for such determinations.

   - Area Offices may delete any establishment that has received an inspection addressing combustible dust hazards within the previous five Fiscal Years, provided either that no citations were issued for combustible dust hazards or that a citation(s) was issued but a follow-up inspection documented tangible appropriate and effective efforts to abate the serious hazards cited or OSHA received abatement verification that the dust hazards have been abated. An establishment with a pending contest of a citation related to combustible dust hazards will not be deleted, but the inspection will be deferred during the contest.

3. After additions and deletions have been made, each establishment on the resulting establishment list will be assigned a sequential number, starting at the top of the list with number one. A random number table (RNT) (see CPL 02-00-025) will then be applied. Inspections will be scheduled in the order called for by the RNT. Alternatively, the RNT will be used to create a first cycle of at least 5 establishments. Any subsequent cycle will be created in the same way. For inspection scheduling using cycles, see CPL 02-00-025.

4. Each Area Office shall conduct at least one NEP inspection from this list in each Fiscal Year.

5. Area Offices will ensure that they schedule and conduct enforcement activities following the guidelines set forth in CPL 02-00-051, Enforcement Exemptions and Limitations under the Appropriations Act, using the NAICS codes found in the current Appendix A of CPL 02-00-051.

6. The establishment list generated under this NEP must be maintained in the Regional/Area Offices for a period of three years after completion of the cycle~~s~~(s). (See OSHA Instruction ADM 03-01-005, OSHA Compliance Records.)

7. If cycles are not prepared, at least one establishment on the master list is to be inspected during each Fiscal Year in the order determined by the application of the Random Number Table.

B. <u>Scheduling and Resource Allocation</u>.

1. Some establishments selected for inspection under this NEP also may be selected under the current Site-Specific Targeting (SST) Plan. Whenever possible, NEP inspections should be conducted concurrently with SST inspections. If this is not possible, the SST plan inspections have priority and are to be conducted prior to NEP inspections. Refer to OSHA Notice CPL 06-01 (CPL 02), Site-Specific Targeting 2006 (SST-06), or subsequent implementing directive for later years.

2. If a formal complaint or referral is received related to a facility handling combustible dust, the complaint or referral item(s) shall be investigated in accordance with OSHA Instruction CPL 02-00-140, Complaint Policies and Procedures, and an inspection as required by this NEP should be conducted if the Area Director determines that the facility has not already been inspected as per this instruction and resources are available to conduct the NEP inspection.

3. If a nonformal complaint is received related to a facility handling combustible dust, and if an inspection is conducted to investigate the complaint based on the criteria contained in OSHA Instruction CPL 02-00-140, then an inspection as required by this NEP should be conducted if the Area Director determines that the facility has not already been inspected under this instruction and resources are available to conduct the NEP inspection.

4. Responses to accidents and catastrophes at facilities handling combustible dust shall follow the guidelines contained in CPL 02-00-137, Fatality/Catastrophe Investigation Procedures, in addition to the guidelines contained in this instruction. If a fatality or catastrophe investigation arises at a facility due to a combustible dust deflagration or explosion, the accident shall be investigated and an inspection as required under this NEP shall be conducted.

C. Opening Conference.

During the opening conference and after a preliminary walkaround of the facility, if the CSHO determines that the employer's operation does not have combustible dust explosion, deflagration, or other fire hazards, then the CSHO may terminate the inspection, or contact the Area Office on whether to continue the inspection. Additionally, if the CSHO determines that the facility has undergone an OSHA consultation visit in the past three years and verifies (through a basic walkaround and evaluation of any changes made by the employer) that the combustible dust explosion hazards have sufficiently been addressed by the employer, then the CSHO shall normally terminate the inspection.

During the opening conference, if the CSHO determines that the facility being inspected is covered under the grain handling standard (1910.272), then the CSHO shall not use the guidance provided in this instruction, but instead, shall use the guidance provided in OSHA Instruction, CPL 02-01-004, Inspection of Grain Handling Facilities, 29 CFR 1910.272, November 8, 1996.

D. Inspection Resources.

1. When possible, only CSHOs trained in recognizing the hazards associated with combustible dust shall be assigned to conduct inspections under this NEP. A training course offered by the OSHA Training Institute (OTI) in recognizing combustible dust explosion hazards may be one source of such training. The training at OTI covers various topics, including engineering controls and methodologies in preventing combustible dust deflagration, other fire, and explosion hazards. In addition the training covers several NFPA documents referenced in Section III of this directive, including NFPA 654, NFPA 68, and NFPA 69. (Note: CSHOs knowledgeable in recognition and control of combustible dust hazards and

familiar with NFPA provisions need not undergo the training at OTI). The Regional Administrators will ensure that an appropriate number of CSHOs trained in combustible dust hazard recognition are available for inspections under this NEP.

2. If appropriate, the Area Director in coordination with the Regional Office shall decide as soon as practicable whether or not expert services from outside the Agency (such as expert witnesses) will be needed to support a combustible dust case properly. If so, such services shall be involved at the earliest date practical.

3. To support inspections under this NEP, each Regional Office library shall have industry reference documents available for CSHOs to use as a resource to support research and enforcement activities during the inspection. However, Area Offices that conduct a larger number of inspections under this NEP should have these industry reference documents in their own libraries.

   At a minimum, each Regional Office shall have available for CSHOs the hard copies of the latest editions of the following documents (listed in Section III, References of this instruction):

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

   b. NFPA 484, Standard for Combustible Metals, Metal Powders, and Metal Dusts.

   c. NFPA 664, Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities.

   c. NFPA 68, Guide for Venting of Deflagrations.

   d. NFPA 85: Boiler and Combustion Systems Hazards Code

   e. NFPA 69, Standard on Explosion Prevention Systems.

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

   g. FM Global Safety Data pamphlet FM 7-76

Note: The NFPA documents are available online in readable format, without charge, at:

http://www.nfpa.org/aboutthecodes/list_of_codes_and_standards.asp

At the above web address, the following steps will allow in accessing a NFPA standard only in readable format: 1) select the standard, 2) click "Preview this Document", 3) agree to the disclaimer, and 4) open the standard.

4. CSHOs' Safety and Health:

CSHOs shall take appropriate precautionary measures for the particular hazards presented in facilities with combustible dust hazards.

a. Personal Protective Equipment (PPE): In addition to the normally required personal protective equipment, CSHOs shall wear non-spark-producing clothing such as natural fiber (e.g., cotton). It is also recommended that CSHOs be provided with flame-resistant clothing as appropriate.

b. Equipment: Cameras and video cameras shall be appropriate (for example, intrinsically safe) for the work environment. However, if such cameras are not available, then CSHOs shall take photographs or videos (using a telephoto feature) from locations within the plant that are not hazardous (classified) locations. Additionally, CSHOs shall take written statements from employees, and if possible from employers, regarding the hazardous conditions, including the alleged violative conditions (such as dust accumulations over 1/32 inch, explosion vents not directed to safe locations away from the employees working in the area, etc.)

c. Use safe practices when collecting samples, such as not generating a dust cloud while collecting a sample and using the right tools in collecting the samples. Additionally, if a means of safe access is not available, sample(s) should not be collected.

d. Equipment for collecting dust samples may include the following:

- Natural bristle hand brushes for collecting settled dust.
- Non-sparking, conductive dust pans (aluminum), for collecting settled dust.
- Non-spark producing sample container.
- Non-spark producing funnel for filling sample containers.

- Non-spark producing scoops for removing dust from cyclone containers or other ventilation equipment.

e. Care shall be taken to ensure integrity of the sample.

E. Inspection and Citation Procedures.

1. CSHOs should recognize that the following criteria must be met before a deflagration can occur:

   a. The dust has to be combustible.
   b. The dust has to be dispersed in air or another oxidant, and the concentration of this dispersed dust is at or above the minimum explosible concentration (MEC).
   c. There is 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 that is at or above the MEC.

2. CSHOs should recognize that the following criteria must be met before an explosion can occur:

   a. The above criteria for deflagration must be present.

   b. The combustible mixture is dispersed within a confined enclosure (and the confined enclosure does not contain sufficient deflagration venting capacity to safely release the pressures) such as a vessel, storage bin, ductwork, room or building. It must be noted that 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.

3. CSHOs should be able to recognize the following conditions that may indicate that a potential dust deflagration, other fire, or explosion hazard exists:

   a. **Plant History of Fires:** The plant has a history of fires involving combustible dusts.

   b. **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 MSDSs as a sole source of information because this information is often excluded from MSDSs.

c. **Dust Accumulations:** 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 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 ft^2, in which case a 1,000 ft^2 layer of dust is the upper limit. 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^3, a dust concentration of 0.35 oz/ ft 3, 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.

d. CSHOs should observe areas of the plant for dust accumulations of greater than 1/32 of an inch (approximately equal to the thickness of a typical paper clip). Likely areas of dust accumulations within a plant are:

- structural members
- conduit and pipe racks
- cable trays
- floors
- above ceiling
- on and around equipment (leaks around dust collectors and ductwork.)

e. If CSHOs find that there are potential combustible dust hazards, dust samples must be safely collected. CSHOs shall use means of access to upper levels of a facility only when this can be done safely. Dust samples shall be submitted to OSHA's Salt Lake Technical Center (SLTC) for analysis. Locations from which to collect separate samples:

- "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, sample(s) should

not be collected.

- Equipment and floors where dust has accumulated.
- The interior (i.e., bins and/or bags) of a dust collector.
- Within ductwork.

4. **SLTC Tests:** The following are a series of tests which may be performed at SLTC to determine the explosibility and combustibility parameters of the dust samples submitted. Details on these tests are found in Appendix E.

    - Percent through 40 mesh
    - Percent moisture content
    - Percent combustible material
    - Percent combustible dust
    - Metal dusts will include resistivity
    - Minimum explosive concentration (MEC)
    - Minimum ignition energy (MIE)
    - Class II test
    - Sample weight
    - Maximum normalized rate of pressure rise (dP/dt) – Kst Test
    - Minimum ignition temperature

5. **Sampling & Analytical Methods**:

    - Air sampling is not necessary.
    - Bulk samples in 1-liter plastic bottles are preferred, because several tests are conducted at SLTC. Obtain samples from several locations so that the amount can be collected in a 1-liter plastic bottle. These bottles may be obtained from the SLTC or locally purchased.
    - Affix an official sample identification seal (OSHA 21) on the container. To seal the bottle correctly apply one end of the seal to the center of the lid. Then run the seal to the edge of the lid and as far down the side of the bottle as it will reach.
    - It is preferred that these sample materials not be collected in plastic bags because they cannot be sealed tightly enough to prevent sample leakage or moisture loss. Also, these bags have a bellows effect which can make the dust airborne when handling the samples.

- CSHOs should take precautions not to contaminate the sample material. The presence of some contaminants in a sample may result in the tests' underreporting of the explosiveness of the dust being handled at the facility.

- Document the description of the operation in block 18 of the OSHA 91A form, and indicate the tests to be done on block 30 of the OSHA 91A as follows:

  - When requesting analyses for fire or explosion hazards that may result from housekeeping or 5(a)(1) violations, write Kst.

  - When requesting analyses for Class II hazardous locations, write " Potential Class II Dust". This test must be done to support a citation for Class II hazardous (classified) locations, 1910.307. (Note: This test only applies to electrical ignition sources in Class II locations.)

- Because of the resource intensive nature of the tests, SLTC requires the Area Director's concurrence for all combustibility and explosibility testing.

- Place the prepared materials and required identification papers (including an MSDS) in a box, and ship them to SLTC, following the shipping instructions provided by the shipping company or the U.S. Postal Service. (Note: Normally, no special DOT shipping requirements apply; however, when shipping metal dusts (especially when dusts involve aluminum or magnesium), CSHOs should verify with the shipping company whether any special shipping requirements apply.)

6. **Lab results:** Lab results may contain some of the results listed below, but not all, depending on particular tests that are performed:

   - Mesh size
   - Moisture content
   - Percent combustible dust
   - Sample weight
   - Explosion severity
   - Kst Value
   - MEC
   - Resistivity for metal dusts

7. **Dust collectors, ductwork, and other containers**: CSHOs should also

pay attention to the dust collectors and ductwork, as well as other containers, because they maintain a cloud of finely divided particles suspended in air. Because they maintain a cloud of combustible dust, CSHOs should determine whether the plant has a sound ignition control program that prevents introduction of ignition sources (including sparks from electrostatic discharge, open flames, or other similar sources) into them. Additionally, housekeeping problems may be exacerbated by the inefficient operation of dust collectors. As noted in NFPA 654, Annex D.2, dust collectors generally operate most effectively between limited pressure drops of between 3 inches to 5 inches of water. If the employer does not have a hot work permit system that addresses hot work on and around collection points and ductwork or in areas where hazardous levels of dust accumulations may occur, the CSHO should recommend that such a system be adopted expeditiously and rigorously implemented. In section 5(a)(1) cases a hot work permit system may be noted as a feasible abatement method. For chemicals covered by 29 CFR 1910.119 (PSM), the standard requires a hot work permit system. See 29 CFR 1910.119(k).

8. CSHOs must gather information about the employer's efforts to abate the combustible dust hazard. This information will be helpful in determining some violations, as well as the employer's good faith, a penalty factor.- CSHOs should look at dust collectors, ductwork, associated equipment, and containers, like mixers or storage bins. The following information may be gathered during the course of the inspection:

- 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 based NFPA 69).

- The dimensions of the room as well as the areas of the dust accumulations of greater than 1/32-inch depth.

- The 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.)

- Warning signs or alerts on the equipment referencing combustible dust.

- Any sources of ignition in the area, such as welding, fork truck traffic, etc.

- Information on whether the electrical equipment in the area is designed for use in a hazardous (classified) location. (Note: Do not open electrical boxes or disconnect electrical cords. Opening them could cause an electrical arc, especially in an area with metal dust.)

NOTE: Because of its spark-producing potential, no equipment, including cameras with electronic flashes or electrical equipment, shall be used in hazardous (classified) locations of the facilities, unless the equipment is intrinsically safe, approved, or safe, as defined in 29 CFR 1910.307(b), for use in these types of areas.

9. **Citations**:

a. Grain Handling Standard Violations. For violations at grain handling facilities, citations under 1910.272 shall be issued. (See OSHA Instruction CPL 02-01-004, Inspection of Grain Handling Facilities, 29 CFR 1910.272).

b. Ventilation Standard Violations. If the facility's operations are covered by 1910.94, *Ventilation*, then any violations of the standard shall be cited. Paragraph (a) of the standard covers abrasive blasting; paragraph (b), grinding, polishing, and buffing operations;

c. Housekeeping Violations. If the facility being inspected under this NEP is not a grain handling facility, the surface dust accumulations (**i.e**., **dust accumulations outside the dust collection system or other containers, such as mixers**) are over 1/32- inch deep, and such depth covers an area of at least 5% of the total area of the room, with an upper limit of 1000 ft^2, then citations for violations of 29 CFR 1910.22 (housekeeping) shall be issued. The standard provides in pertinent part: "(a) *Housekeeping*. (1) All places of employment, passageways … and service rooms shall be kept clean… (2) The floor of every workroom shall be maintained in a clean…condition."

- Citations for violations of 1910.22(a)(1) shall be issued when the conditions as set forth in the first sentence of this paragraph c. exist in places of employment (except floors of workrooms and storage areas), passageways, and service rooms.

- Citations for 1910.22(a)(2) shall be issued when the conditions

set forth in the first sentence of this subparagraph c. exist on the floors of workrooms.

However, small amounts of dust accumulations in isolated spots of the floor or other areas would not normally be classified as a violation of the housekeeping requirement under this NEP. In order to substantiate housekeeping violations, CSHOs shall take representative measurements. Thickness measurements must be made at several locations within the sampling area to determine whether the thickness is at least 1/32 inch in height. For a large area, a paint brush and dustpan can be used. For a small area, a high-volume pump pulling through a filtered cassette may be used to collect the sample. As a part of determining whether the housekeeping violation is serious, the CSHO should determine whether the dust is combustible or can cause deflagration by submitting the sample to SLTC and obtaining its analyses. In addition, the CSHO should also document the heat and ignition sources.

In coal-handling operations located in electric power generation, transmission, and distribution facilities, 29 CFR 1910.22 shall not be cited for coal dust accumulations; rather 29 CFR 1910.269(v)(11)(vii) shall be cited. See subparagraph IX.E.9.f.

NOTE: This NEP should not be construed to interfere with the application of 1910.22 or other housekeeping standards to the uncleanliness of workplaces unrelated to the combustible dust hazard.

d. Housekeeping violations in storage areas. 1910.176(c) shall be cited for housekeeping violations in storage areas. The standard provides in pertinent part: "(c) *Housekeeping.* Storage areas shall be kept free from accumulation of materials that constitute hazards from …fire, explosion…" This standard shall be cited for storage areas. The criteria for the dust hazard applicable to 1910.22(a) violations under this NEP apply in determining 1910.176(c) violations. The CSHO must document whether a reasonable person would recognize a combustible dust hazard under the circumstances. NFPA standards may be relied upon in this regard. See, e.g., NFPA 654 (2006), Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids. The CSHO must also document feasible abatement methods. See, e.g., NFPA 654.

e. Section 5(a)(1) (general duty clause) violations. A citation under section 5(a)(1) of the OSH Act (the general duty clause) may be issued

for deflagration, explosion or other fire hazards that may be caused from combustible **dust within a dust collection system or other containers or**, **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. See, e.g., NFPA 654 (2006), Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids. (See *Kelly Springfield Tire Co., Inc. v. Donovan*, 729 F.21 317 (5th Cir. 1984) (recognition of combustible dust hazard based on testimony of expert employed by dust collection equipment manufacturer.) CSHOs should also search for articles dealing with the combustible dust hazard in publications dealing with the employer's industry. CSHOs shall also look at the employer's safety manuals or other instructions to determine whether there is employer recognition of the combustible dust hazard. However, if such articles or employer documents are unavailable, CSHOs may rely upon the NFPA standards for evidence of recognition of the hazard. For evidence of feasible means of abatement CSHOs should consult relevant NFPA standards. The essence of a 5(a)(1) citation is the hazard. A separate 5(a)(1) citation shall not be issued for a failure to use a particular abatement method. The Regional Solicitor's Office should be consulted prior to issuing Section 5(a)(1) citations.

- However, when inspecting bakery equipment in a bakery covered under 1910.263, general duty clause citations shall not be issued for fire and explosion hazards in connection with sugar and spice pulverizers, covered under 1910.263(k)(2).

- Additionally, general duty citations shall not be issued with respect to explosion hazards from blower collecting and exhaust systems in sawmill operations covered under 1910.265(c)(20)(i).

5(a)(1) citations may be issued for <u>deflagration and</u> <u>explosion hazards</u> if SLTC finds Kst values of the submitted dust sample to be greater than zero. 5(a)(1) citations may also be issued for other fire hazards if SLTC determines that the dust is combustible. (See Appendix E.5 for more details on combustible dust tests, including the Kst test and its associated values relative to degree of explosion). General duty clause citations can only be issued if all elements of a 5(a)(1) violation can be documented. As a part of 5(a)(1) documentation, the CSHO should also document the heat and ignition sources.

The following are some conditions for which a general duty clause citation (See Appendix C for Sample citations) may be issued:

- Problems related to dust collectors, e.g., dust collection equipment located inside the building (however, there are some exceptions) and dust collectors returning air back inside the building.

- Ductwork-related problems, e.g., the ductwork not being grounded and ductwork 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.

(Note: If all the elements of a 5(a)(1) violation cannot be documented for the hazards noted during an inspection, then a Hazard Alert letter shall be issued to the employer for such hazards.)

f. **Housekeeping violations at coal-handling operations covered under 1910.269.** If violations of 1910.269(v)(11)(xii) (sources of ignition not eliminated or controlled where coal-handling operations may produce a combustible atmosphere from fuel sources) are identified during an inspection of a coal-fired power plant, that provision shall be cited, not 1910.22 or section 5(a)(1).

g. **Personal Protective Equipment (PPE) Violations**. Citations under 1910.132(a) (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 flash fire hazards, then citations under 1910.132(a) may be issued. A citation may be issued whether or not an accident precipitated the inspection.

The CSHO shall document whether a reasonable person familiar with the circumstances would recognize hazards from combustible dust. NFPA standards may be used for this documentation. The CSHO shall also document whether there are feasible types of personal protective equipment to deal with these hazards. It has been recognized as industry practice to require 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 1123 for a discussion on selection of flame-resistant clothing.

h. **Process Safety Management**. If the dust in question appears on the list of Highly Hazardous Chemicals (Appendix A to 29 CFR 1910.119) and is present in quantities greater than or equal to the listed threshold quantity, the PSM standard will apply. Citations under 1910.119 shall be issued for PSM violations.

i. **Electrical Violations**.

If the laboratory analysis indicates that the submitted dust meets the criteria for Class II (See Class II Test methodology in Appendix E), and if the location where the dust was present falls under any of the Class II location definitions, then 29 CFR 1910.307 will apply. See the Class II definition in 29 CFR 1910.399. However, if violations involving Class I or III locations are found in the course of conducting an inspection under this NEP, citations shall be issued. See the Class I and III definitions in 29 CFR 1910.399.

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 spelled out in 29 CFR 1910.307(b)

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 issued for electrical violations must be adequately documented in the case file. 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.)

j. **Powered Industrial Trucks**. For powered industrial truck violations, citations shall be issued under 1910.178(c)(2)(ii) and (vi)-(ix) and 1910.178(m)(11).

k. **Welding**, **cutting, and brazing**. For violations involving welding, cutting, and brazing operations, 1910.252 (general welding and cutting) (see, in particular, (a)(2)(vi)(C), prohibiting cutting and welding in explosive atmospheres, including mixtures of flammable dusts with air), 1910.253 (oxygen-fuel gas welding and cutting) (see, in particular, (c)(2)(ii) and (iv), and (f)(5)(i)(B)), and 1910.254 (arc welding) (see, in particular, (b)(2)(F)) shall be used.

l. **Warning Sign Violations**. If safety instruction signs are missing on equipment or at the entrance to places where explosive atmospheres may occur, then citations under 29 CFR 1910.145(c)(3) shall be issued.

m. **Hazard communication violations**. The hazard communication standard, 29 CFR 1910.1200, 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. See "hazardous chemicals" definition in 29 CFR 1910.1200(c), which addresses physical hazards. The definition of physical hazards includes flammable solids (see the definition in .1200(c)), and employers who do not follow the requirements of this standard shall be cited with respect to chemicals which in the course of normal conditions of use could become combustible dusts.

n**.** **Egress violations**. Citations for violations of Subpart E –Means of Egress, Part 1910, particularly 29 CFR 1910.33-37, shall be issued where violations of these provisions are found.

o**.** **Fire protection violations.** Citations for violations of 29 CFR 1910.156 (fire brigades) and 1910.157 (portable fire extinguishers)

shall be issued where violations of these standards are found. 1910.156 only applies in the context of this NEP if the employer has a fire brigade or industrial fire department. The fire extinguisher provisions of 1910.157 do not apply where the employer requires the evacuation of employees in the event of fire, has an emergency action plan meeting the requirements of 1910.38, and has a fire prevention plan meeting the requirements of 1910.39.

p. **Bakery equipment violations**. Citations for violations of 29 CFR 1910.263(k)(2) shall be issued for fire and explosion hazards in sugar and spice pulverizers.

q. **Sawmill violations**. Citations for violations of 29 CFR 1910.265(c)(20)(i) shall be issued in connection with defects in the design, construction, and maintenance of blower collecting and exhaust systems.

F. Program Evaluation.

IMIS case files coded "DUSTEXPL" can be retrieved for program evaluation purposes by the Directorate of Evaluation and Analysis (DEA) based on agency evaluation priorities. Case files will be requested from the Areas Offices by DEA as needed.

G. Outreach.

The Office of Communications and the OSHA Training Institute in conjunction with the Directorate of Enforcement Programs will develop combustible dust information and training materials. This information will be made available to the Regional Offices for distribution to the Area Offices, Consultation Program offices, and state plan offices. Area and Regional Offices are encouraged to develop outreach programs that will support their enforcement efforts. Suggested outreach products and activities include the following:

1. Letters and news releases announcing implementation of the Combustible Dust National Emphasis Program.

2. Seminars on combustible dust topics, tailored for specific audiences, such as employers, employee groups, local trade unions, apprentice programs, and equipment manufacturers. Local fire department staff may be invited to participate.

3. Partnerships and alliances, such as those involving employers within the same industry (e.g., foundries) to share successes and technical information concerning effective means of controlling or eliminating

potential dust explosion hazards at their facilities.

H. IMIS Coding Instructions.

1. All enforcement activities (inspections, complaints, accidents and referrals) and compliance assistance (OSHA 55) conducted under this NEP must be coded with the NEP code "DUSTEXPL" entered in the appropriate NEP field/item number on the respective forms.

2. All consultation activities (form 20, 30 and 66) conducted in response to this NEP must include "DUSTEXPL" in the National Emphasis Field on the forms as well.

X. Appendices. The following appendices are provided as guidance for the inspection of facilities handling combustible dust.

Appendix A: NFPA Publications Relevant to Combustible Dust Hazard Controls

Appendix B: Sample Questions

Appendix C: Sample Citations

Appendix D: Industries that May have Combustible Dusts

Appendix E: Combustible Dust Tests Conducted at SLTC

Appendix A
NFPA Publications Relevant to Combustible Dust Hazard Controls

NFPA Number	Title	Current Edition
61	Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities	2002
68	Guide for Venting of Deflagrations	2002
69	Standard on Explosion Prevention Systems	2002
70	National Electrical Code	2005
77	Recommended Practice on Static Electricity	2000
85	Boiler and Combustion Systems Hazards Code	2007
86	Standard for Ovens and Furnaces	2007
91	Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids	2004
484	Standard for Combustible Metals	2006
499	Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas	2004
654	Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids	2006
655	Standard for Prevention of Sulfur Fires and Explosions	2007
664	Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities	2007

Appendix B

Sample questions CSHOs may use during the course of an inspection. (CSHOs may refer to appropriate NFPA standards in developing additional questions.)

What types of combustible dust does the facility have?

(Note: Please see Table 4.5.2 of NFPA 499 and Table 1 in NMAB 353-3 for additional information on the various types of dust along with their properties)

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? Is there dust accumulation of 1/32 inch thick, or greater? For housekeeping violations, what are the dimensions of the room and the dimensions of the area covered with the dust?

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?

Are dust collectors greater than 8 cubic feet in volume located inside of buildings?

If dust explosion hazards exist in rooms, buildings, or other enclosures, do such areas have explosion relief venting distributed over the exterior walls of buildings and enclosures? Is such venting directed to a safe location away from employees?

Does the facility have isolation devices to prevent deflagration propagation between pieces of equipment connected by ductwork?

Does the facility have an ignition control program, such as grounding and bonding and other methods, for dissipating any electrostatic charge that could be generated while transporting the dust through the ductwork?

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

Are electrically- powered cleaning devices, such as sweepers or vacuum cleaners used in dusty areas, approved for the hazard classification, as required under 1910.307(b)?

Is smoking permitted only in safe designated areas?

Are areas where smoking is prohibited posted with “No Smoking” signs?

Is the exhaust from the dust collectors recycled?

Does the dust collector system have spark detection and explosion/deflagration suppression systems? (There are other alternative measures.)

Are all components of the dust collection system constructed of noncombustible materials?

Are ducts designed to maintain sufficient velocity to ensure the transport of both coarse and fine particles?

Are duct systems, dust collectors, and dust-producing machinery bonded and grounded to minimize accumulation of static electrical charge?

Is metal ductwork used?

In areas where a hazardous quantity of dust accumulates or is present in suspension in the air, does all electrical wiring and equipment comply with 1910.307(b) requirements?

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

Are bulk storage containers constructed of noncombustible materials?

Does the company use methods to dissipate static electricity, such as by bonding and grounding?

Are employees who are involved in operating, maintaining, and supervising facilities that handle combustible dust trained in the hazards of the combustible dust?

Are MSDSs for the chemicals which could become combustible dust under normal operations available to employees?

Appendix C
Sample Citations

The General Duty Clause Violations

Section 5(a)(l) of the Occupational Safety and Health Act of 1970: The employer did not furnish employment and a place of employment which were free from recognized hazards that were causing or likely to cause death or serious physical harm, including severe burns, to employees in that employees were exposed to dust explosion, deflagration, or other fire hazards from dust collectors being located inside a building .

(a) SMK Building - There was a dust collector located at the number 1 conveyor system which was located inside the SMK building.

(b) Day Bin Building - There was a large dust collector system located in the Day Bin Building that collected dust from the day bins.

AMONG OTHER METHODS, A FEASIBLE ABATEMENT METHOD TO CORRECT THIS HAZARD IS TO RELOCATE THE DUST COLLECTION SYSTEMS OUTSIDE THE BUILDINGS.

Housekeeping Violations

1) 29 CFR 1910.22(a)(l): Place(s) of employment were not kept clean

(a) Grinding and Polishing Area - The area where aluminum polishing and grinding were performed had explosive aluminum dust located on the pipes in the ceiling, the roof structure, and masonry walls on or about December 17, 200X.

2) 29 CFR 1910.22(a)(2): The floor of a workroom was not maintained in a clean condition.

(a) Grinding and Polishing Area – Explosive dust was on floor of the area where aluminum polishing and grinding were performed on or about December 17, 200X.

Electrical Violations

1) 29 CFR 1910.307(b): Electrical equipment in hazardous (classified) locations was not intrinsically safe, approved for the hazardous (classified) location, or safe for the hazardous (classified) location:

(a) Robot Polishing and Grinding Area - Open motor fans, electrical outlet boxes, breaker panels, disconnect switches, normal lighting snap switches, overhead lighting, robot control panels, stand belt grinders, and portable radios in a Class II, Division 1 location, were not intrinsically safe, approved for a Class II, Division I, location, or safe for a Class II, Division I, location, on or about December 24, 200X.

(b) Half Round Area - Electrical equipment including, but not limited to, overhead lights, circuit breaker panels, disconnect switches and outlets, in Class II, Division I locations, was not intrinsically safe, approved for a Class II, Division I, or safe for a Class II, Division I, location, on or about May 7, 200X.

2) 29 CFR 1910.307(b): Electrical equipment in a hazardous (classified) location was not intrinsically safe, approved for the hazardous (classified) location, or safe for the hazardous (classified) location:

(a) Mixing Department - A vacuum used in a Class II, Division 1 location was not intrinsically safe, approved for a Class II, Division I, location, or safe for a Class II, Division 1, location.

Personal Protective Equipment Violations

29 CFR 1910.132(a): Protective equipment was not used when necessary when a hazard of processes or environment capable of causing injury or impairment of the body through physical contact was encountered:

(a) Aluminum Grinding and Polishing Area - Employees did not wear easily removable flame-retardant and non-static-generating clothing in an area where combustible aluminum dust was present on or about November 16, 200X.

AMONG OTHER METHODS, ONE FEASIBLE ABATEMENT METHOD TO CORRECT THIS HAZARD IS TO REQUIRE EMPLOYEES TO WEAR FLAME- RESISTANT, NON-STATIC-GENERATING CLOTHING, INCLUDING SAFETY SHOES THAT ARE STATIC-DISSIPATING, IN THIS AREA.

Appendix D

Industries that May have Combustible Dusts

SICS	Industry	NAICS
0723	Crop Preparation Services for Market, Except Cotton Ginning	115114, 115111
2052	Fresh cookies, crackers, pretzels, and similar "dry" bakery products.	311821
2062	Refining purchased raw cane sugar and sugar syrup.	311312
2087	Flavoring extracts, syrups, powders, and related products, not elsewhere classified.	311930
2099	Prepared foods and miscellaneous food specialties, not elsewhere classified.	311212
2221	Broadwoven Fabric Mills, Manmade Fiber and Silk	313210
2262	Finishers of Broadwoven Fabrics of Manmade Fiber and Silk	313311
2299	Textile Goods, Not Elsewhere Classified	313111
2421	Sawmills and Planing Mills, General	321113
2431	Millwork	321911
2434	Wood Kitchen Cabinets	33711
2439	Structural Wood Members, Not Elsewhere Classified	321213,321214
2452	Prefabricated Wood Buildings and Components	321992
2493	Reconstituted Wood Products	321219
2499	Wood Products, Not Elsewhere Classified	321920, 321219
2511	Wood Household Furniture, Except Upholstered	337122
2591	Drapery Hardware and Window Blinds and Shades	337920
2819	Industrial Inorganic Chemicals, Not Elsewhere Classified	325188, 325998, 331311
2821	Plastic Materials, Synthetic Resins, and Nonvulcanizable Elastomers	325211
2823	Cellulosic Manmade Fibers	325221
2834	Pharmaceutical Preparations	325412
2841	Soap and Other Detergents, Except Specialty Cleaners	325611
2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products	32551

SICS	Industry	NAICS
2861	Gum and Wood Chemicals	325191
2899	Chemicals and Chemical Preparations, Not Elsewhere Classified	325510, 325998
3011	Tires And Inner Tubes	326211
3061	Molded, Extruded, and Lathe-Cut Mechanical Rubber Goods	326291
3069	Fabricated Rubber Products, Not Elsewhere Classified	326299
3081	Unsupported Plastics Film and Sheet	326113
3082	Unsupported Plastics Profile Shapes	326121
3086	Plastics Foam Products	326140, 326150
3087	Custom Compounding of Purchased Plastics Resins	325991
3089	Plastics Products, Not Elsewhere Classified	326199
3291	Abrasive Products	327910
3313	Alumina and Aluminum Production and Processing	331312
3334	Primary Production of Aluminum	331312
3341	Secondary Smelting and Refining of Nonferrous Metals	331314
3354	Aluminum Extruded Products	331316
3363	Aluminum Die-Castings	331521
3365	Aluminum Foundries	331524
3369	Nonferrous Foundries, Except Aluminum and Copper	331528
3398	Metal Heat Treating	332811
3441	Metal Cans	332431
3469	Metal Stampings, Not Elsewhere Classified	332116
3471	Electroplating, Plating, Polishing, Anodizing, and Coloring	332813
3479	Coating, Engraving, and Allied Services, Not Elsewhere Classified	332812
3496	Miscellaneous Fabricated Wire Products	332618
3499	Fabricated Metal Products, Not Elsewhere Classified	332999
3548	Lighting Equipment, Not Elsewhere Classified	335129
3644	Noncurrent-Carrying Wiring Devices	335932
3714	Motor Vehicle Parts and Accessories	336322
3761	Guided Missiles and Space Vehicles	336414
3799	Transportation Equipment, Not	333924

SICS	Industry	NAICS
	Elsewhere Classified	
3995	Burial Caskets	339995
3999	Manufacturing Industries, Not Elsewhere Classified	321999, 325998, 326199
4221	Farm product warehousing and storage	493130
4911	Electric Services Establishments engaged in the generation, transmission, and/or distribution of electric energy for sale.	221112
4952	Sanitary treatment facilities.	221320
4953	Refuse Systems	562920
5093	Scrap and waste materials	423930
5162	Plastics materials and basic forms and shapes	424610

Appendix E

Some Tests Conducted at SLTC

1. **Percent through 40 Mesh**. An aliquot of the "as received" material is sieved through a 40 mesh (425 µm) US Standard Testing Sieve. The percent which goes through the sieve is determined using the following steps:

   a. Weigh a dust aliquot; sieve through 40 mesh.

   b. Weigh the material passed through the 40 mesh sieve.

   c. Calculate the percentage that passes through a 40 mesh via:

$$\%\,\text{through}\,40\,\text{mesh} = \frac{\text{Grams through}\,40\,\text{mesh}\,(100)}{\text{Total "as received" aliquot weight}}$$

2. **Percent Moisture Content**. Moisture content is another factor which may have an affect on dust explosibility and is an initial determination made on an aliquot of all dust samples that are received at the OSHA Salt Lake Technical Center laboratory. Moisture in dust particles raises the ignition temperature. Dusts having more than 5% moisture are dried prior to performing explosibility tests. Drying sample materials to (or less than) the 5% moisture content level is a standardized test protocol. The moisture content of the sieved material is determined by measuring the weight loss after drying. This test method must be modified when the materials being tested would be degraded at 75ºC. Percent moisture content is determined as follows.

   a. Weigh crucibles and aliquots of material which passed through a 40 mesh sieve.

   b. Dry for twenty-four hours in a drying oven set at 75ºC. Then reweigh the material.

   c. Calculate the moisture content as:

$$\%\,\text{MoistuteContent} = \frac{(\text{Wet SampleWeight} - \text{DrySampleWeight})(100)}{\text{Wet SampleWeight}}$$

   Note: "Moisture in dust particles raises the ignition temperature of the dust because of the heat absorbed during heating and vaporization of the moisture. The moisture in the air surrounding a dust particle has no significant effect on the course of a deflagration once ignition has occurred. There is however, a direct relationship between moisture content and minimum energy required for ignition, minimum explosive concentration, maximum pressure, and maximum rate of pressure rise. For example, the ignition temperature of cornstarch may increase as much as 122^{o}F, with an increase of moisture content from 1.6 percent to 12.5 percent. As a practical matter, however, moisture content cannot be considered an effective explosion preventive, since most of ignition sources provide more than enough heat to vaporize the moisture and to ignite the dust. In order for moisture to

prevent ignition of dust by common sources, the dust would have to be so damp that a cloud could not be formed." (Source: Fire Protection Handbook, 19th Edition).

3. Percent Combustible Material. Percent combustible material is determined as follows:

a. Weigh crucibles and aliquots of material which passed through a 40 mesh sieve.

b. Ash samples, uncovered, for one hour at 600ºC in a muffle furnace. Then reweigh the residue.

c. Calculate the combustible material as:

$$\% \text{ Combustible Material} = \frac{(\text{Wet Sample Weight - Ash Weight})(100)}{\text{Wet Sample Weight}}$$

4. Percent Combustible Dust. Percent combustible dust is the product of the percent of material which went through a 40 mesh sieve and the percent combustible material. This is calculated as follows:

% combustible dust= (% through 40 mesh)(% combustible material)

(Be aware of the distinction between combustible material and combustible dust.)

5. Maximum Normalized Rate of Pressure rise (dP/dt) – Kst test

Kst is the Deflagration Index for dusts, and the K_{st} test results provide an indication of the severity of a dust explosion. The larger the value for K_{st}, the more severe is the explosion (See Table below). Kst is essentially the maximum rate of pressure rise generated when dust is tested in a confined enclosure. Kst provides the best "single number" estimate of the anticipated behavior of a dust deflagration.

Dust explosion class	Kst (bar.m/s)	Characteristic
St 0	0	No explosion
St 1	>0 and <=200	Weak explosion
St 2	>200 and <=300	Strong explosion
St 3	>300	Very strong explosion

Approximately 300 grams of "as received" sample material are needed for the K_{st} test. In this test, dust is suspended in the 20-liter explosibility testing chamber (shown in Figure 1) and is ignited using a chemical igniter. The 20-liter explosibility testing chamber determines maximum pressure and rate of pressure rise if the sample explodes. These parameters are used to determine the maximum normalized rate of pressure rise (Kst). Kst is calculated with the following formula:

$Kst = (dP/dt)max \ V^{1/3}$

where:

$(dP/dt)_{max}$ = the maximum rate of pressure rise

V = the volume of the testing chamber:

The test involves the following steps:

a) The sample dust is suspended in a 20-liter explosion chamber. (Use 2500 J Sobbe igniters if using the Bureau of Mines test chamber.)

b) The dust is tested "as received" (except drying, if the moisture content is greater than 5%).

c) Test at three to five dust concentrations, from 500 g/m3 to about 2500 g/m3, plotting the found maximum normalized dp/dt values verses dust concentration, and reporting the highest value from the plateau of the plot.

6. Minimum Explosible Concentration. Minimum explosible concentration (MEC) of the sample is determined by suspending the sample in a 20-liter explosibility testing chamber and ignited with a 2500-joule chemical igniter. MEC is the lower concentration limit of explosibility for the dust. This limit is determined using test material that has been sieved through a 40-mesh sieve (425 μm particle size), dried, suspended in a 20-liter explosibility testing chamber. Approximately 200 grams of material with a particle size of 425 μm or less are needed for the MEC tests. Some analytical details include:

a. Use test material that has been sieved through 40-mesh screen.

b. Use material which has been either dried in an oven at 75ºC overnight (if the moisture content is greater than 5%) or kept in a desiccator.

c. Use 2500 J igniters.

d. Plot both the dp/dt and pressure ratio verses concentration. The minimum explosible concentration is where the Kst is greater than or equal to 1.5 and the pressure ratio is greater than or equal to 2.

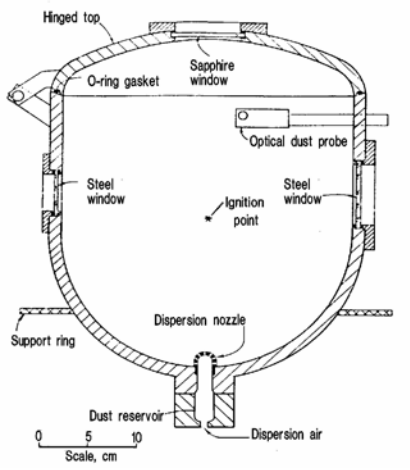


Figure 1: 20-Liter Explosibility Test Chamber

7. Class II Test

National Materials Advisory Board (NMAB) 353-3-80, *Classification of Combustible Dusts in Accordance with the National Electrical Code*, defines dusts having Ignition Sensitivity (IS) greater than or equal to 0.2 or Explosion Severity (ES) greater than or equal to 0.5 to be appreciable explosion hazards requiring electrical equipment suitable for Class II locations. This document is listed as a reference document in Appendix A to Subpart S of 29 CFR 1910. Dusts whose explosibility parameters fall below these limits are generally considered to be weak explosion hazards and need only general purpose electrical equipment.

Approximately 1 liter bulk volume with particle size less than 75 μm (200 mesh) are necessary to determine the Class II dust classification. SLTC will only characterize a sample sufficiently to prove (or disprove) that the sample meets the definition for Class II dusts, based on results of the E.S or the I.S.

E.S. tests are made by suspending dust in a Hartmann stainless steel explosion chamber and igniting it with an electrical spark. If the sample explodes, the maximum pressure and rate of pressure rise developed by the explosion are recorded. ES is the product of the maximum explosion pressure and the maximum rate of pressure rise, normalized to Pittsburgh coal dust. Mathematically it is defined as:

$$E.S. = \frac{(PxR)\ Sample}{(PxR)Pittsburgh\ Coal}$$

Where

P = Maximum Explosion Pressure
R = Maximum Rate of Pressure Rise

The I.S. is the product of the minimum ignition temperature, minimum ignition energy,

and the minimum explosion concentration normalized to Pittsburgh coal dust. It is expressed mathematically as:

$$I.S. = \frac{(TxExC)Pittsburgh\ Coal}{(TxExC)\ Sample}$$

Where T = Minimum Ignition Temperature
E = Minimum Ignition Energy
C = Minimum

If E.S. is greater than or equal to 0.5 further tests are suspended and the sample is reported to be a Class II dust. If no explosion occurs the Class II dust testing will be terminated.

8. Resistivity.

The resistivity or specific resistance is defined as the electrical resistance of a material of unit cross section and of unit length. Resistivity must be measured under conditions comparable to those to which the dust is present in the workplace. The test for resistivity must be conducted at the highest voltage to which the dust is exposed, to assure that high resistivity surface coatings don't break down when subjected to a voltage gradient in the equipment that may be higher than that used in these analyses. If the sample is combustible and conductive, then a Class II, Division 1 location is specified.

Based on the classification of dusts using the NMAB 353-3-80 resistivity guidelines, explosible dusts are classified into Groups E, F, and G through the values of electrical resistivity as follows:

Group E, $\rho \leq 10^2$ ohm-cm
Group F, $10^2 < \rho \leq 10^8$ ohm-cm
Group G, $\rho > 10^8$ ohm-cm

According to the definition for a Class II, Division 1 location as found in 1910.399, the electrical conductive nature of the dust is one of the criteria to determine if it is necessary that equipment in a dust location be approved for Class II, Division 1 location. Where group E dusts are present in hazardous quantities, there are only Division 1 locations. The NEC does not recognize any Division 2 locations for such dusts. (See NFPA 499 or NEC).

9. Minimum Ignition Energy (MIE).

The minimum ignition energy (MIE) of the sample is determined by suspending the sample in a Hartmann Lucite explosion chamber. To determine the MIE, the energy of the electrical spark used to ignite the dust is varied until the MIE is determined.

10. Minimum Ignition Temperature (MIT).

Minimum ignition temperature (MIT) is determined by using the Godbert-Greenwald furnace. Dust is discharged through this furnace at various temperatures. The lowest temperature that ignites the dust is considered to be the MIT.

Appendix F: Inspecting Dust Collection Systems

1. Dust Collection System(s):

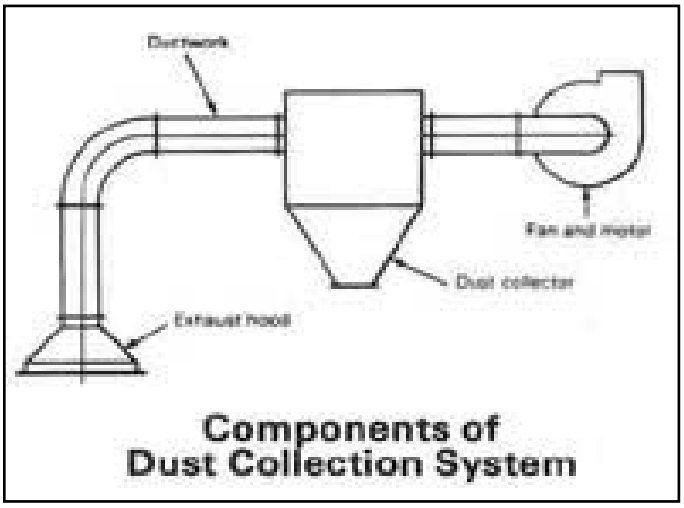
   a. When dust collection systems are used to remove combustible and explosives dust, an approved dust collection system will be required to prevent the release of the dust inside and outside the building.

      There are many different types of dust collection systems in the industry using various methods to separate the dust from the air stream. Some Dust Collectors examples are:

      - Bag Type Collectors
      - Cyclone Collectors
      - Electrostatic Precipitators
      - Wet Collectors

      A typical dust collection system consists of four major components:

      - An exhaust hood to capture dust emissions at the source
      - Ductwork to transport the captured dust to a collector
      - A dust collector to remove the dust from the air
      - A fan and motor system that supplies mechanical energy to move contaminated air from the dust-producing source to a dust collector



Components of Dust Collection System

Each of these components plays a vital role in proper operation of a dust collection system, and poor performance of one component can reduce the effectiveness of the other components. Therefore, careful design, selection, and maintenance of each component are critical.

2. Dust Collectors Locations:

Generally dust collectors will be located outside of buildings unless permitted by one of the above listed references (Note: An exemption exists for small volume collectors, i.e., volume less than 8 ft3, (dust covered under NFPA 654) in that they can be located inside buildings.

3. General Methods for Inspecting and Evaluating Dust Collection Systems

The CSHOs are responsible for inspecting dust collection systems to ensure that the system was designed, installed, and function correctly. The above references can be used to provide research data and information on the design, maintenance, and evaluation of dust collection systems. Remember, you do not have to be a professional engineer to evaluate a dust collection system to see if it is working properly. **If you can see dust particles in the air or settling on surfaces that is an indication that the housekeeping program or the dust collection system is not working properly.**

The following are a few methods and techniques you can use to inspect and evaluate the effectiveness of dust collection systems:

a. Visually inspect ducts, local exhaust hoods, and equipment housing for leaks and damages. A common problem is that when ducts are not properly maintained, damaged, or not properly connected to the machine(s) air is allowed to enter the ducts, which in turn can interfere with proper functioning and affect the performance of the system. Also air flow measurements can be taken at the local exhaust hoods to verify whether or not the design specifications are in accordance with applicable standards.

CAUTION: Only approved equipment such as anemometers and velometers should be used in a hazardous classified location because they may provide an ignition source.

b. Material being transported can obstruct the ducts and interfere with the function of the dust collection system. This is a common occurrence with dust collectors in the woodworking industry. Air flow measurements can be taken at the local exhaust hoods to verify whether or not the design specifications are in accordance with applicable standards.

c. Local exhaust hoods effectiveness can be interfered by cross-currents which are typically caused by dead spots and uncontrolled air current from equipment or general ventilation, other nearby exhaust systems, etc. Use a smoke test to determine whether or not this is occurring.

CAUTION: Ventilation smoke tubes may contain stannic oxychloride or titanium tetrachloride which produces hydrogen chloride gas, a strong mucous membrane irritant. Do not direct smoke toward an employee's eyes or breathing zone.

d. Evaluate the location and design of the exhaust hoods to determine if they are installed in accordance with proper design specifications to ensure that the hoods are capturing

and transporting the dust through ductwork, thus reducing dust settling in horizontal duct runs to ensure that the dust is captured in the dust collector.

e. Evaluate the ducts to determine whether or not there are a lot of bends and sharp elbows. The more elbows in a duct, the greater the loss of efficiency. Duct turns and bends should always be as gradual as possible. The angle of duct bends should be greater than 90 degrees so as to reduce air flow resistance. Air flow measurements can be taken at the local exhaust hoods to verify whether or not the design specifications are in accordance with applicable standards.

f. Inspect the exhaust stacks or ports of dry type dust collectors for visible particulate emission. Visible particulate emissions at the exhaust stack are typically caused by bags and/or cartridges failure due to abnormal wear or improper installation. In the case of cyclones and wet scrubbers, the condition could be attributed to internal mechanical wear caused by abrasion or abnormal operating conditions such as a higher than normal dust loading in the incoming dust stream.

g. Listen for excessive noise and vibration at the fan and pulley locations. Common sources of excessive noise and vibration are belt slipping, fan wheel unbalance, bearing deterioration, material buildup on the fan blades, loosening hardware, and etc.

Appendix G: Summary of Commonly Referenced NFPA 654 and 484 Items

In addition to internal company documents or materials (e.g. such as owner's manuals, hazard warnings on machines, safety and health programs), there are two National Fire Protection Association (NFPA) documents that are often used by CSHOs to show a particular combustible dust hazard is recognized. NFPA 654 (*Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*) and NFPA 484 (*Standard for Combustible Metals*) have long been recognized as the benchmarks for good engineering practices for handling most combustible dusts in general industry.

1. NFPA 654

NFPA 654 applies to all phases of the manufacture, processing, blending, pneumatic conveying, repackaging, and handling of combustible particulate solids or hybrid mixtures, regardless of concentration or particle size, where the materials present a fire or explosion hazard. This document is commonly referenced by CSHOs in GDC citations and contains sections dealing with General Requirements (Chapter 4), Facility and Systems Design (Chapter 6), Process Equipment (Chapter 7), Fugitive Dust Control and Housekeeping (Chapter 8), Ignition Sources (Chapter 9), Fire Protection (Chapter 10), Training and Procedures (Chapter 11), and Inspection and Maintenance (Chapter 12). Paragraphs of this document referenced in GDC citations include, but are not limited to, the following:

a. Paragraph 6.2.3.1 – When separation is used to limit the fire or dust explosion hazardous area, the hazardous area shall include areas where dust accumulations exceed 1/32 inch (0.8 mm) or areas where dust clouds of a hazardous concentration exist.

b. Paragraph 6.3.4 – Spaces inaccessible to housekeeping shall be sealed in order to prevent dust accumulation.

c. Paragraph 7.1.4.1 – Where an explosion hazard exists, isolation devices shall be provided to prevent deflagration propagation between pieces of equipment connected by ductwork. Isolation devices include, but are not limited to, the following: Chokes, Rotary valves, Automatic fast-acting valve systems, Flame front diverters, and Chemical isolating systems.

d. Paragraph 7.1.5.1 – Where an explosion hazard exists, isolation devices shall be provided to prevent deflagration propagation from air-material separators upstream to the work areas.

e. Paragraph 7.12.2.1 – Where an explosion hazard exists, systems shall be designed in such as manner that combustible particulate solids do not pass through an air moving device.

f. Paragraph 7.13.1.1.1 – Where an explosion hazard exists, air-material separators shall be located outside of buildings. Note there are three exceptions to this paragraph based on certain protection measures already installed or if the separator has a volume less than 8 cubic feet.

g. Paragraph 8.1.1 – Continuous suction to minimize the escape of dust shall be provided for processes where combustible dust is liberated in normal operations.

h. Paragraph 8.2.1.1 – Equipment shall be maintained and operated in a manner that minimizes the escape of dust.

i. Paragraph 8.2.1.2 – Regular cleaning frequencies shall be established for walls, floors, and horizontal surfaces, such as equipment, ducts, hoods, ledges, beams, and above suspended ceilings and other concealed surfaces, to minimize dust accumulations within operating areas of the facility.

j. Paragraphs 12.1.1 – 12.1.3 – An inspection, testing, and maintenance program shall be developed and implemented to ensure that the fire and explosion protection systems and related process controls and equipment perform as designed. This program will include: Fire & explosion protection and prevention equipment, Dust control equipment, Housekeeping, Potential ignition sources, Electrical, process, and mechanical equipment, Process changes, and Lubrication of bearings. Records shall be kept of maintenance and repairs performed.

2. NFPA 484

NFPA 484 applies to the production, processing, finishing, handling, storage, and use of all metals and alloys that are in a form that is capable of combustion or explosion, including operations (such as machining, sawing, grinding, buffing, and polishing) where metal or metal alloys are subjected to processing or finishing operations that produce combustible powder or dust. Metals specifically addressed by this document include aluminum, alkali metals, magnesium, tantalum, titanium, and zirconium. Other metals that exhibit combustion characteristics of the aforementioned metals will be subject to the requirements of the metal whose combustion characteristics they most closely match. Paragraphs referenced in General Duty Clause citations regarding combustible *aluminum* dust (chapter 6) have included the following:

a. Paragraph 6.3.2.2 – Hoods and enclosures shall be designed and maintained so that the fine particles will either fall or be projected into the hoods and enclosures in the direction of airflow.

b. Paragraph 6.3.2.5 – Dry-type dust collectors shall be located outside of buildings.

c. Paragraph 6.3.5.9 – The dust collector shall be arranged so that contact between dust particles and parts moving at high speed is prevented. The blower for drawing dust-laden air into the collector shall be located on the clean air side of the collector.

d. Paragraph 6.3.8.2.1 – All components of dust collection systems shall be electrically bonded and grounded.

e. Paragraph 6.4.2.1 and 6.4.2.2 – Fugitive dust shall not be allowed to accumulate. Periodic clean-up of fugitive dusts shall be accomplished by using one of the following: conductive, non-sparking scoops and soft brooms; brushes that have natural fiber bristles; and vacuum cleaning systems designed for handling combustible metal powders in accordance with 6.4.3.

f. Paragraph 6.4.4 – Compressed air blow down shall not be permitted, except in certain areas that are otherwise impossible to clean and, where permitted, shall be performed under carefully controlled conditions with all potential ignition sources prohibited in or near the area and with all equipment shut down.

Appendix H: Information to include in Sampling Proposal for Bureau Chief Approval

Due to the cost involved with analyzing dust samples for combustibility, CSHOs must obtain Bureau Chief approval. This will be done in the form of a written memorandum from the CSHO, through the Supervisor, and to the Bureau Chief.

1. Type of material
2. Size of material
3. Consistency of Material
4. Overview (to include inspection number, explanation of request, past history)
5. Sampling analysis being requested
6. Cost
7. Number of samples
8. Lab that will analyze the dust samples
9. Sufficient evidence of combustibility that is supported by MSDS
10. List of violations that will be cited if the dust is found to be explosive.

NOTE: Bureau Chief will send an email to the OSHA SLTC indicating concurrence for combustible dust samples. The lab will not analyze samples without the email concurrence from the Bureau Chief.

Appendix I: Air Sampling Worksheets

91A - Metal

Air Sampling Worksheet

U.S. Department of Labor
Occupational Safety and Health Administration

1. Reporting ID: 123700	2. Inspection Number: 123456789	3. Sampling Number: 913839601	
4. Establishment Name: Ben Fishing Tackle Mfg Co		5. Sampling Date: 3-9-05	6. Shipping Date: 3-10-05
7. Person Performing Sampling (Signature): Jim Foil	8. Print Last Name: FOIL	9. CSHO ID: F1234	
10. Employee (Name, Address, Telephone Number): John Doe (123) 456-7890 123 Main St. Hometown, PA 12345		14. Exposure Information: a. Number 5; b. Duration 2 Years c. Frequency 5 days/wk 8 hrs/day	
11. Job Title: Laborer	12. Occupation Code	15. Weather Conditions: 65° F inside	16. Photo(s): (Y) Video
13. PPE (Type and Effectiveness): None worn for this hazard.		17. Pump Checks and Adjustments: N/A - Bulk	

18. Job Description, Operation, Work Location(s), Ventilation, and Controls: Employees use a variety of electric and pneumatic hand held tools to finish metallic (mostly) aluminum) parts for fishing reels. No mechanical ventilation. Dry sweeping used as clean-up. Cont'd

19. Pump Number: D12-1346

Sampling Data						
20. Lab Sample Number						
21. Sample Submission Number	10	20				
22. Sample Type	B	B				
23. Sample Media	N/A	N/A				
24. Filter/Tube Number	BF10	BF20				
25. Time On/Off	0900	1000				
	N/A	N/A				
26. Total Time (in minutes)	N/A	N/A				
27. Flow Rate ☐ l/min ☐ cc/min	N/A	N/A				
28. Volume (in liters)	N/A	N/A				
29. Net Sample Weight (in mg)	N/A	N/A				

30. Analyze Samples for:	31. Indicate Which Samples to Include in TWA, Ceiling, etc. Calculations
1. Class II dust test, if not Class II - then do kst 2. Resistivity	

32. Interferences and IH Comments to Lab	33. Supporting Samples	34. Chain of Custody	Initials		Date
None known to be present	a. Blanks:	a. Seals Intact?	Y	N	
	b. Bulks: BF10	b. Rec'd in Lab			
	BF20	c. Rec'd by Anal.			
		d. Anal. Completed			
		e. Calc. Checked			
		f. Supr. OK'd			

Case File Page ___ of ___

OSHA-91A (Rev. 1/84)

91B – Metal

Air Sampling Report U.S. Department of Labor Occupational Safety and Health Administration.

1. Reporting ID	2. Inspection Number	3. Sampling Number
315555	123456789	142956555

4. Establishment Name: BEN FISHING TACKLE MFG CO

5. CSHO ID	6. Sampling Date	7. Shipping Date	8.Date Result Received
S6762	25 June 2006	26 June 2006	

9. Job Title	10.Occupational Code	11. Number Exposed
Not applicable		

12. Frequency of Exposure

Exposure Summary

14. Substance Code	15. Rqstd	16. Smpl Type	17.Exp Type	18.Exp Level	19. Units	20. PEL	21. Adj	22. Severity	23. Citation information: No Cit	FTA	Over Exp	Eng	PPE	Trng	Med	OTH

TWA calculated on actual time sampled
The I. H. is free to make changes on the Form 91B and submit them directly to IMIS

26.Analyst's Comments (Analytical Method) NMAB 353-3

Both sample materials are class II dusts. This means that both are explosive.

Resistivity results are reported with the units of Kohm-cm. The resistivity results place both materials as group E, conductive.

P65727 - material less than 20 mesh is 100%, less than 200 mesh is 46%.

P65728 - material less than 20 mesh is 99%, less than 200 mesh is 85%.

If you have any questions, please call Jon Rima at the OSHA Salt Lake Technical Center (801) 233-4966.

27.Chain of Custody	Init.	Date
a. Seals Intact	Y	
b. Rec'd In Lab	LLD	11 MAR 2005
c. Rec'd by Anal.	JR	25 MAR 2005
d. Anal. Completed	JR	31 MAR 2005
e. Calc. Checked	SRJ	31 MAR 2005
f. Supr. OK'd	RD	31 MAR 2005

28 Submission number	10	20
29 Lab Sample No.	P65727	P65728
(Minutes/Type)	B	B

30. Analyte	31. Analysis Results/ 32. Sample included in calculations of	
8430 Resistivity	1.2000	16.0000
E101 Explosion Severity	0.8100	4.0000

Because the results for air samples are used in further calculations, the number of figures reported in section 31 may not reflect the actual precision of the analysis. Calculated confidence limits (UCL & LCL) should be rounded to no more than three significant figures.
The precision of analysis for wipe samples and for bulk material samples justify rounding results to no more than two significant figures.

The Sampling and Analytical Error (SAE) is the current value for the specific chemical(s) and should be used for the calculations.
Blank values are reported for reference only. Appropriate blank corrections have been applied to the samples by the Salt Lake Technical Center. Blank results are less than the reporting limit(s) unless otherwise noted.

33. Analyte Code	SAE Value
8430	
E101	

Sampling Number:

91A – Plastic

Air Sampling Worksheet

U.S. Department of Labor
Occupational Safety and Health Administration

1. Reporting ID: 123700	2. Inspection Number: 987654321	3. Sampling Number: 913839619
4. Establishment Name: Bright American Co.		5. Sampling Date: 12-22-04 / 6. Shipping Date: 12-22-04
7. Person Performing Sampling (Signature): Tim Foil	8. Print Last Name: FOIL	9. CSHO ID: F1234
10. Employee (Name, Address, Telephone Number): Jane Doe (123) 456-7890, 123 Main St., Hometown, PA 12345		14. Exposure Information: a. Number 5 / b. Duration 3 years; c. Frequency 8 hrs/day 5 days/wk
		15. Weather Conditions: 65°F inside / 16. Photo(s): (Y) video
11. Job Title: Laborer	12. Occupation Code:	
13. PPE (Type and Effectiveness): None worn for this hazard		17. Pump Checks and Adjustments: N/A – Bulk

18. Job Description, Operation, Work Location(s), Ventilation, and Controls: Employees used various electrical and pneumatic hand tools to finish the plastic parts. No mechanical ventilation. Dry sweeping used for clean-up. Cont'd

19. Pump Number: D12-3456

	Sampling Data					
20. Lab Sample Number						
21. Sample Submission Number	R3EH656	R EH657				
22. Sample Type	B	B				
23. Sample Media	N/A	N/A				
24. Filter/Tube Number	BA001	BA002				
25. Time On/Off	0900	1000				
	N/A	N/A				
26. Total Time (in minutes)	N/A	N/A				
27. Flow Rate ☐ l/min ☐ cc/min	N/A	N/A				
28. Volume (in liters)	N/A	N/A				
29. Net Sample Weight (in mg)	N/A	N/A				

30. Analyze Samples for:	31. Indicate Which Samples to Include in TWA, Ceiling, etc. Calculations			
1. Class II	dust test, if not	Class II then do	Kst	

32. Interferences and IH Comments to Lab	33. Supporting Samples	34. Chain of Custody	Initials		Date
None known to be present	a. Blanks:	a. Seals Intact?	Y	N	
	b. Bulks: BA001	b. Rec'd in Lab			
	BA002	c. Rec'd by Anal.			
		d. Anal. Completed			
		e. Calc. Checked			
		f. Supr. OK'd			

Case File Page / of

OSHA-91A (Rev. 1/84)

91B – Plastic – Page 1

Air Sampling Report U.S. Department of Labor Occupational Safety and Health Administration.

Page 1 of 2

1. Reporting ID	2. Inspection Number	3. Sampling Number
315555	213456789	142967890

4. Establishment Name: BRIGHT AMERICAN CORP

5. CSHO ID	6. Sampling Date	7. Shipping Date	8.Date Result Received
S6762	8 August 2006	8 August 2006	

9. Job Title	10.Occupational Code	11. Number Exposed
Not applicable		

12. Frequency of Exposure

Exposure Summary

14. Substance Code	15. Rqstd	16. Smpl Type	17.Exp Type	18.Exp Level	19. Units	20. PEL	21. Adj	22. Severity	23. Citation information: No Cit	PTA	Over Exp	Eng	PPE	Trng	Med	OTH

TWA calculated on actual time sampled
The I. H. is free to make changes on the Form 91B and submit them directly to IMIS

26.Analyst's Comments (Analytical Method) NMAB 353-3

These materials are NOT Class II dusts. The material did not react during testing.

The materials were tested for KsT in a BoM 20 liter chamber. For comparison the KsT for Pulverized Pittsburgh Coal dust is approximately 25 bar meters per second in this equipment.

If there are questions regarding these results please telephone Jon Rima or Robert Douglas at the Salt Lake Technical Center. 801-233-4900

27.Chain of Custody a. Seals Intact	Init.	Date Y
b. Rec'd In Lab	LLD	27 DEC 2004
c. Rec'd by Anal.	RD	07 JAN 2005
d. Anal. Completed	RD	11 JAN 2005
e. Calc. Checked	SRJ	12 JAN 2005
f. Supr. OK'd	DTC	12 JAN 2005

P62214 E100 The results of the sieve size analysis were:
Less than 20 mesh - 92 %
Less than 40 mesh - 85 %
Less than 200 mesh - 29 %
The Moisture Content was 1.3 %

The KsT for sample P62214 was 23 bar meters per second. This means that the material is explosive.

P62215 E100 The results of the sieve size analysis were:
Less than 20 mesh - 96 %
Less than 40 mesh - 82 %
Less than 200 mesh - 29 %
The Moisture Content was 0.8 %

The KsT for sample P62215 was 25 bar meters per second. This means that the material is explosive.

28 Submission number	R3EH656	R3EH657
29 Lab Sample No. (Minutes/Type)	P62214 B	P62215 B
30. Analyte	31. Analysis Results/ 32. Sample included in calculations of	
E100 Explosibility	SEVR	SEVR

Sampling Number: 914295597

91B – Plastic – Page 2

Air Sampling Report U.S. Department of Labor Occupational Safety and Health Administration.

28 Submission number	R3EH656	R3EH657
29 Lab Sample No. (Minutes/Type)	P62214 B	P62215 B

30. Analyte	31. Analysis Results/ 32. Sample included in calculations of	
M102 MAXIMUM NORMALIZED DP/DT	23.0000 bm/s	25.0000 bm/s
M104 Moisture Content	1.3000 % MOIS	0.8400 % MOIS

The Sampling and Analytical Error (SAE) is the current value for the specific chemical(s) and should be used for the calculations: Blank values are reported for reference only. Appropriate blank corrections have been applied to the samples by the Salt Lake Technical Center. Blank results are less than the reporting limit(s) unless otherwise noted.

33. Analyte Code	SAE Value
E100	
M102	
M104	

L	MILLIGRAMS PER LITER (URINE)	D	MICROGRAMS PER DECILITER (BLOOD)
C	PICO CURIES PER LITER (RADON GAS)	P	PARTS PER MILLION
F	FIBERS PER CUBIC CENTIMETER	X	MICROGRAMS
M	MILLIGRAMS PER CUBIC METER	%	PERCENT
Y	MILLIGRAMS	E	FIBERS PER MM2
N	NONE	G	MILLION PARTICLES PER CUBIC FOOT (MPPCF)
BM/S	Bar Meters per Second		

Bulk samples are analyzed to provide an estimate of the composition of the material submitted. The results reported should be considered semi-quantitative only. Reporting limit for quartz in bulk samples is 1%

Analyte codes are chosen by the laboratory. The I. H. should review them for applicability. if there are any questions call the laboratory for appropriate analyte codes (ie. ICP uses fume analyte codes when the IH may have sampled for dust).

Sampling Number: 914295597

Appendix J: What to Look for During a Combustible Dust Inspection

1. LOOK UP: Look for the presence of dust that may be adhering to motors, walls and that may have settled out onto horizontal surfaces including light fixtures, piping, tops of electrical enclosures, beams, ledges, etc.

2. Note the thickness of the dust and try to safely measure (Is it a light dusting paper thin, the thickness of a dime, quarter etc.).

3. Note the size of the dust (Is it like dry cake mix, flour, granular, chips, etc.).

4. Try to take a sample of the dust (In the past, Salt Lake has wanted about a liter of dust.).

5. Look for leaks in dust collection and handling systems.

6. What preventative maintenance does the employer perform?

7. Where is the dust collection system exhausted?

8. Ask about the frequency of housekeeping and the clean-up methods utilized (Dry sweeping, compressed air, etc.).

9. Look at the electrical equipment. Is it approved for the class and location? Are there openings where dust could enter (check the tops of boxes and enclosures)? Is there evidence of charring? Is the dust warm or hot to touch?

10. Do the electrical enclosures contain dust (really watch this one; it may not be safe to open these)?

11. How large of an area does the dust cover?

12. Is the dust confined in certain areas? (Examples: equipment, hoppers, ducts, cyclones where an initial explosion could occur. This could cause your settled dust, which is in an open area, to become airborne and lead to a secondary explosion).

13. Is the dust unconfined and housekeeping methods, equipment etc. could dislodge the dust and cause it to become airborne?

14. What ignition sources are in the area (Normal equipment, electrical, grinding, welding, etc.)?

15. Does the employer and any contractors have a hot work program and are employees familiar with it?

16. If available, check the MSDS for the type of dust.

Appendix K: Laboratory Testing of Combustible Dust

<table>
<tr><th>Elements</th><th>Properties</th><th>Significance</th></tr>
<tr><td>Fuel</td><td>Explosion Severity</td><td>Explosion Severity (ES) is a relative measurement of energy of the dust explosion.
<table>
<tr><th>Explosion</th><th>ES</th></tr>
<tr><td>Weak</td><td><0.5</td></tr>
<tr><td>Moderate</td><td>0.5 to 1.0</td></tr>
<tr><td>Strong</td><td>1.0 to 2.0</td></tr>
<tr><td>Severe</td><td>>2.0</td></tr>
</table></td></tr>
<tr><td></td><td>Moisture content</td><td>“Moisture in dust particles raises the ignition temperature of the dust because of the heat absorbed during heating and vaporization of the moisture. There is, however, a direct relationship between moisture content and minimum energy required for ignition, minimum explosion concentration, maximum pressure, and maximum rate of pressure rise. As a practical matter, however, moisture cannot be considered an effective explosion preventive, since ignition sources provide more than enough heat to vaporize the moisture and to ignite the dust. In order for moisture to prevent ignition of dust by common sources, the dust would have to be so damp that a cloud could not be formed.”

Source: Fire Protection Handbook, 18th Edition</td></tr>
<tr><td>Ignition</td><td>Minimum ignition Energy (MIE)</td><td>Provides information on the lowest energy required to ignite the most readily ignitable dust/air mixture at atmospheric pressure and room temperature; a combustible dust with a low MIE is easily ignited. Ignition energies for dust clouds are usually higher than for gases or vapors.
Dust cloud ignition temperatures for the most part fall between 572 and 1,112°F (300 and 600 °C).</td></tr>
<tr><td>Oxygen</td><td>Oxygen content</td><td>Less oxygen in the air reduces explosion severity by limiting rate of combustion and increases ignition energy.</td></tr>
<tr><td>Suspension/ confinement</td><td>Degree of dispersion</td><td>Usually dependent on the way dust is dispersed and level of turbulence. An evenly suspended and less turbulent dust cloud is more easily ignited and burns more easily</td></tr>
<tr><td></td><td>Minimum explosive concentration (MEC)</td><td>A dust explosion is very similar to a gas or vapor cloud explosion, when a volume of a flammable mixture is ignited, resulting in a rapid pressure increase and fire moving through the cloud. Dusts form explosive clouds only if dust concentration lies between certain limits, known as the lower (LEL) and upper explosive limit. For dusts, LEL is also commonly referred to as MEC.</td></tr>
</table>

Appendix L: Electrical Cabinets – Approval in Classified Areas

National Electrical Manufacturers Association (NEMA) Ratings

NEMA Enclosure Type	NEMA definition
1	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt.
2	Same as NEMA 1 including protection against dripping and light splashing of liquids.
3	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust; and that will be undamaged by the external formation of ice on the enclosure.
3R	Same as NEMA 3 excluding protection against windblown dust.
3S	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow and windblown dust; and in which the external mechanism(s) remain operable when ice laden.
4	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, and hose directed water; and that will be undamaged by the external formation of ice on the enclosure.
4X	Same as NEMA 4 including protection against corrosion.
5	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against settling airborne dust, lint, fibers, and flyings; and to provide a degree of protection against dripping and light splashing of liquids.
6	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against hose-directed water and the entry of water during occasional temporary submersion at a limited dept; and that will be undamaged by the external formation of ice on the enclosure.
6P	Same as NEMA 6 including protection against the entry of water during prolonged submersion at a limited depth.
7	Enclosures are for indoor use in locations classified as Class 1, Groups A, B, C or D and shall be capable of withstanding the pressures resulting form an internal explosion of specified gases, and contain such an explosion sufficiently that an explosive gas-air mixture existing in the atmosphere surrounding the enclosure will not be ignited. Enclosed heat generating devices shall not cause external surfaces to reach temperatures capable of igniting explosive gas-air mixtures in the surrounding atmosphere. Enclosure shall meet explosion, hydro-static, and temperature design tests.
9	Enclosures are intended for indoor use in locations classified as Class II, Groups E, F, or G, and shall be capable of preventing the entrance of dust. Enclosed heat generating devices shall not cause external surfaces to reach temperatures capable of igniting or discoloring dust on the enclosure or igniting dust-air mixtures in the surrounding atmosphere. Enclosures shall meet dust penetration and temperature design tests, and aging of gaskets (if used).
12	Enclosures constructed (without knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against circulating dust, lint, fibers, and flyings; and against

	dripping and light splashing of liquids.
12K	Same as NEMA 12 including enclosures constructed with knockouts.
13	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against circulating dust, lint, fibers, and flyings; and against the spraying, splashing, and seepage of water, oil, and non-corrosive coolants.

Appendix M: Example 1Bs for Combustible Dust Violations

U. S. Department of Labor
Occupational Safety and Health Administration

Worksheet

Mon Jul 31, 2006 11:33am

Inspection Number	18
Opt. Insp. Number	

Establishment Name	**Bolie's Metal Finishing**				
Type of Violation	**S Serious**	Citation Number	**01**	Item/Group	**001**
Number Exposed	**3**	No. Instances	**2**	REC	**C Complaint**
Std. Alleged Vio.	**5.a(1)**				

Abatement Period	MultiStep Abatements			Final Abatement	Action Type/Dates
	PPE Period	Plan	Report		
30					

Substance Codes	

AVD/Variable Information:

Section 5(a)(1) of the Occupational Safety and Health Act of 1970: The employer did not furnish employment and a place of employment which were free from recognized hazards that were caused or likely to cause death or serious physical harm in that employees were exposed to the hazard of potential fire and explosion because methods were not utilized to contain combustible, organic dusts created by manufacturing, handling, and processing operations from becoming airborne and combining with an ignition source:

a) M2 Room - Bagging room equipment including the material hopper, and transfer auger were not maintained under continuous suction, thus allowing the escape of dust during normal operation, on or about July 11, 2006.

b) M3 Room - Bagging room equipment including the material hopper, and transfer auger were not maintained under continuous suction, thus allowing the escape of dust during normal operation, on or about July 11, 2006.

ABATEMENT NOTE - Among other methods, one feasible and acceptable abatement method to correct these hazards is to comply with National Fire Protection Agency (NFPA) 654, "Standard for the Prevention of Dust Explosion from the Manufacturing, Processing and Handling of Combustibles Particulate Solids" (2006), including, but not limited to:

* Install a ventilation system that will provide for the continuous suction and ensure the capture and control of the combustible dusts generated in the operations as listed in Paragraph 6.3.6.2 of NFPA 654.

VERIFICATION REQUIRED

Penalty Calculations				Adjustment Factors			Proposed Adjusted Penalty
Severity	Probability	Gravity	GBP	Size	Good Faith	History	
H High	**G Greater**	**10**	**7000.00**	**60**	**0**	**10**	**2100.00**
Repeat Factor		**0**					

Employee Exposure:					
Occupation	**Bagger**	Employer	**Bolie's Metal Finishing**		
Nr of Employees	**3**	Duration	**several years**	Frequency	**daily**
Employee Name	**Jim Doe**				
Address	**456 Main Street Harrisburg, PA 17105**		Phone	**(717)985-1234**	

Instance Description:	A. Hazard	B. Equipment	C. Location	D. Injury/Illness	E. Measurements

OSHA-1B/1BIHprint(Rev. 9/93)

4. Date/Time
7-11-06/1200

20. Instance Description - Describe the following:

a) Hazards-Operation/Condition-Accident - In the Stearate Area M2 reactor and bagger rooms had many conditions that exposed employees working in that area to fire and explosion hazards. The material manufactured in this area is organic solid sodium stearate. This solid often is further processes by milling to a fine powder than can be finer than a 200 mesh. The dusts laying on the surfaces have been tested and found to be CLASS II dusts. The employer did not implement the controls as outlined in NFPA 654. The employees exposed to this hazard were the operators, maintenance, and superintendent. The knowledge of the hazard is shown via MSDS which state "possibility of dust explosion". On the TTS-30 product, the employer has identified is as "unusual fire and explosion hazard" and "high airborne dust levels with an ignition source may present an explosion hazard". See NFPA 654 for safe handling procedures. The employer had been cited for similar hazards in citation 1 of OSHA 1 # 123456789. Dust problems and accumulations were in plain view.

M2 Room - The bagger room fire door that separated the bagging and reactor room was not closed during the bagging operation. The door was damaged and could not be closed. The condition of the door did not allow the room to maintain a negative pressure; thus allowing the dust to escape. There was also a conveyor belt entering the room which contributed to the lack of suction (negative pressure) for the room (required in NFPA 654 (2006) 6.3.6.2). The auger used to transfer the material was not designed to maintain a constant suction to reduce the dusts generated (required in NFPA (2006) 654 8.1.1) allowing for visible dust cloud to be generated. These dust clouds may settle on equipment and building surfaces leading to or contributing to fire and deflagration. The materials hopper was not designed to create the negative pressure for the continuous suction required in NFPA 654 (2006) 6.3.6.2. A visible dust cloud was observed by the CSHO. This dust cloud could settle on surrounding equipment and building surfaces contributing to or causing fire and/or deflagration.

M3 Room - Combustible dusts were produced, processed, handled, and collected in this area. The fire door in this area was normally kept open thus, not allowing the area to remain under continuous suction (required in NFPA 654 (2006) 6.3.6.2). This condition would allow the dusts to escape the room and exposing adjacent employees to fire and deflagration hazards. In addition, the auger used to transfer the material went through the wall creating another opening in the room's suction. Lastly, the auger conveyor was not designed as to create a negative pressure to reduce the amount of dust escaping from the conveyor and dust clouds were noted by the CSHO. The materials hopper in this area was not designed to allow for the continuous suction (required in NFPA 654 (2006) 6.3.6.2) and the dust cloud released was observed by the CSHO. These dusts could cause or contribute to fire or deflagration.

These conditions exposed the adjacent employees to fire, deflagration, and serious injury. The requirements applicable here are found in NFPA 654 6.3.6.2. See photos 1,2,3,4, 5,6,7,8,9, and 10.

b) Equipment - see instance descriptions above
c) Location - M2 and M3 areas of the production plant
d) Injury/Illness - 2nd and 3rd degree burns. Trauma from explosions. Death.
e) Measurements - see OSHA 91A/B, visual, MSDS, safety meeting notes, employee interviews, and steel tape

21. Photo Number	Location on Video
	see instance descriptions

23. Employer Knowledge : The employer had a copy of NFPA 654. The employer mentions NFPA 654 in their MSDS to ensure the end user follows the guidelines. The employer was previously cited for similar hazards and provided with NFPA 654 guidance at that time. The company had an Industrial Hygienist who had evaluated the dust exposures on several occasions. Several of the company's Safety Committee minutes mention concerns about the fire and explosion hazards of the dusts.

24. Comments (Employer, Employee, Closing Conference) : Mr. John Doe stated "We will do whatever you tell us to do. We don't want to hurt any of our employees".

25. Other Employer Information :

26. Classification:				
Serious	Knowledge	S or O	Repeat?	Willful?
y	y	s	y	n

First Repeat	Second Repeat	Repeat Penalty

Event Date	Event Code	Action Code	Citation Type	Penalty	Abate Date	Final Order
	Z Add transaction	**A Add**	**S Serious**	**2100.00**		

U. S. Department of Labor
Occupational Safety and Health Administration

Worksheet

Mon Jul 31, 2006 11:33am

Inspection Number	18
Opt. Insp. Number	

Establishment Name	**Bolie's Metal Finishing**				
Type of Violation	**S Serious**	Citation Number	**01**	Item/Group	**002 (a)**
Number Exposed	**3**	No. Instances	**2**	REC	**C Complaint**
Std. Alleged Vio.	**5.a(1)**				

Abatement Period	MultiStep Abatements			Final Abatement	Action Type/Dates
	PPE Period	Plan	Report		
30					

Substance Codes	

AVD/Variable Information:

Section 5(a)(1) of the Occupational Safety and Health Act of 1970: The employer did not furnish employment and a place of employment which were free from recognized hazards that were caused or likely to cause death or serious physical harm in that employees were exposed to the hazard of potential fire and explosion because fixed bulk storage units and air material separators (dust collectors) were not designed to minimize damage that would occur in the event of a dust explosion inside the machines:

a) M2 Room - The product hopper was located inside the building and did not meet the protection, venting, or size requirements for inside bulk storage, on or about July 11, 2006.

b) M3 Room - The product hopper was located inside the building and did not meet the protection, venting, or size requirements for inside bulk storage, on or about July 11, 2006.

ABATEMENT NOTE: Among other methods, one feasible and acceptable abatement method to correct these hazards is to comply with National Fire Protection Agency (NFPA) , "Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids" (2006), including, but not limited to:

* Relocate the product hopper to the outside of the building,

* Develop and implement policies that meet the protection, venting and size requirements listed in Paragraph 7.2.3.2.2 of NFPA 654.

VERIFICATION REQUIRED

Penalty Calculations				Adjustment Factors			Proposed Adjusted Penalty
Severity	Probability	Gravity	GBP	Size	Good Faith	History	
H High	**G Greater**	**10**	**7000.00**	**60**	**0**	**10**	**2100.00**
Repeat Factor		**0**					

Employee Exposure:					
Occupation	**Bagger**	Employer	**Bolie's Metal Finishing**		
Nr of Employees	**3**	Duration	**several years**	Frequency	**daily**
Employee Name	**Jim Doe**				
Address	**456 Main Street** **Harrisburg, PA 17105**		Phone	**(717)985-1234**	

Instance Description:	A. Hazard	B. Equipment	C. Location	D. Injury/Illness	E. Measurements

OSHA-1B/1BIHprint(Rev. 9/93)

4. Date/Time
7-11-06/1200

20. Instance Description - Describe the following:

a) Hazards-Operation/Condition-Accident - In the Stearate Area M2 reactor and bagger rooms had many conditions that exposed employees working in that area to fire and explosion hazards. The material manufactured in this area is organic solid sodium stearate. This solid often is further processes by milling to a fine powder than can be finer than a 200 mesh. The dusts laying on the surfaces have been tested and found to be CLASS II dusts. The employer did not implement the controls as outlined in NFPA 654. The employees exposed to this hazard were the operators, maintenance, and superintendent. The knowledge of the hazard is shown via MSDS which state "possibility of dust explosion". On the TTS-30 product, the employer has identified is as "unusual fire and explosion hazard" and "high airborne dust levels with an ignition source may present an explosion hazard". See NFPA 654 for safe handling procedures. The employer had been cited for similar hazards in citation 1 of OSHA 1 # 123456789. Dust problems and accumulations were in plain view.

M2 Room - The bagger room had many surfaces which accumulated dusts generated in the area. These surfaces included, but were not limited to, equipment, piping, hoods and building members. In addition, the walls of the room were constructed of rough concrete blocks that were not coated with a paint to reduce the accumulation of dusts on them. The CSHO noted dust accumulation on all the surfaces noted above. There was also a transfer auger going through the wall and the breach of the wall had visible accumulations of dust on it. The hopper for the bagging operation was greater than 8 cubic feet and it did not contain; deflagration venting to the outside, oxidant concentration reduction, deflagration containment, deflagration suppression system, dilutions with noncombustible dusts or deflagration venting through a listed dust retention and flame arresting device. The walls in the room did not go directly to the roof and were not designed with blow-out sections. These conditions exposed the operators, and adjacent employees to fire and deflagration hazards. The requirements for design are mentioned in NFPA 654 (2006) 7.2.3.2.2 and are important for the protection of the employee in the case of a fire or deflagration. Photos used to support these potential hazards include; 11, 12, 13, 14, and 15.

M3 Room - The bagging operation room. The hopper for the bagging operation was greater than 8 cubic feet and it did not contain; deflagration venting to the outside, oxidant concentration reduction, deflagration containment, deflagration suppression system, dilutions with noncombustible dusts or deflagration venting through a listed dust retention and flame arresting device. The walls in the room did not go directly to the roof and were not designed with blow-out sections. These conditions exposed the operators, and adjacent employees to fire and deflagration hazards. The requirements for design are mentioned in NFPA 654 (2006) 7.2.3.2.2 and are important for the protection of the employee in the case of a fire or deflagration. The photos documenting these hazards are; 16, 17, 18, 19 and 20.

b) Equipment - see instance descriptions above
c) Location - M2 and M3 areas of the production plant
d) Injury/Illness - 2nd and 3rd degree burns. Trauma from explosions. Death.
e) Measurements - see OSHA 91A/B, visual, MSDS, safety meeting notes, employee interviews, and steel tape

21. Photo Number	Location on Video
	see instance descriptions

23. Employer Knowledge : The employer had a copy of NFPA 654. The employer mentions NFPA 654 in their MSDS to ensure the end user follows the guidelines. The employer was previously cited for

similar hazards and provided with NFPA 654 guidance at that time. The company had an Industrial Hygienist who had evaluated the dust exposures on several occasions. Several of the company's Safety Committee minutes mention concerns about the fire and explosion hazards of the dusts.

24. Comments (Employer, Employee, Closing Conference) : Mr. John Doe stated "We will do whatever you tell us to do. We don't want to hurt any of our employees".

25. Other Employer Information :

26. Classification:				
Serious	Knowledge	S or O	Repeat?	Willful?
y	y	s	y	n

First Repeat	Second Repeat	Repeat Penalty

Event Date	Event Code	Action Code	Citation Type	Penalty	Abate Date	Final Order
	Z Add transaction	**A Add**	**S Serious**	**2100.00**		

U. S. Department of Labor
Occupational Safety and Health Administration

Worksheet

Mon Jul 31, 2006 11:33am

Inspection Number	18
Opt. Insp. Number	

Establishment Name	**Bolie's Metal Finishing**				
Type of Violation	**S Serious**	Citation Number	**01**	Item/Group	**002 (b)**
Number Exposed	**3**	No. Instances	**2**	REC	**C Complaint**
Std. Alleged Vio.	**5.a(1)**				

Abatement Period	MultiStep Abatements			Final Abatement	Action Type/Dates
	PPE Period	Plan	Report		
30					

Substance Codes	

AVD/Variable Information:

Section 5(a)(1) of the Occupational Safety and Health Act of 1970: The employer did not furnish employment and a place of employment which were free from recognized hazards that were caused or likely to cause death or serious physical harm in that employees were exposed to the hazard of potential fire and explosion because metal materials are allowed to enter the milling machines creating a potential for the grinding of the metal to produce sparks, leading to a dust explosion inside the machines:

a) M2 Room - Foreign materials were not excluded or removed before the material was processed by size reduction, on or about July 11, 2006.

b) M3 Room - Foreign materials were not excluded or removed before the material was processed by size reduction, on or about July 11, 2006.

ABATEMENT NOTE: Among other methods, one feasible and acceptable abatement method to correct these hazards is to comply with National Fire Protection Agency (NFPA) 654, "Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids" (2006) including, but not limited to:

* Provide some means of filtering or separating the foreign materials from the combustible product to reduce the possibility of a spark as listed in Paragraph 7.15.1 of NFPA 654.

VERIFICATION REQUIRED

Penalty Calculations				Adjustment Factors			Proposed Adjusted Penalty
Severity	Probability	Gravity	GBP	Size	Good Faith	History	
H High	**G Greater**	**10**	**7000.00**	**60**	**0**	**10**	**0.0**
Repeat Factor		**0**					

Employee Exposure:					
Occupation	**Bagger**	Employer	**Bolie's Metal Finishing**		
Nr of Employees	**3**	Duration	**several years**	Frequency	**daily**
Employee Name	**Jim Doe**				
Address	**456 Main Street** **Harrisburg, PA 17105**		Phone	**(717)985-1234**	

Instance Description:	A. Hazard	B. Equipment	C. Location	D. Injury/Illness	E. Measurements

4. Date/Time

OSHA-1B/1BIHprint(Rev. 9/93)

7-11-06/1200

20. Instance Description - Describe the following:

a) Hazards-Operation/Condition-Accident - In the Stearate Area M2 reactor and bagger rooms had many conditions that exposed employees working in that area to fire and explosion hazards. The material manufactured in this area is organic solid sodium stearate. This solid often is further processes by milling to a fine powder than can be finer than a 200 mesh. The dusts laying on the surfaces have been tested and found to be CLASS II dusts. The employer did not implement the controls as outlined in NFPA 654. The employees exposed to this hazard were the operators, maintenance, and superintendent. The knowledge of the hazard is shown via MSDS which state "possibility of dust explosion". On the TTS-30 product, the employer has identified is as "unusual fire and explosion hazard" and "high airborne dust levels with an ignition source may present an explosion hazard". See NFPA 654 for safe handling procedures. The employer had been cited for similar hazards in citation 1 of OSHA 1 # 123456789. Dust problems and accumulations were in plain view.

M2 Room - The operation did not include a system or procedure to remove foreign material from the process before they entered the processing system. These materials could include, but, are not limited to conveyor or auger wear (tramp metal parts). These metal parts could then produce a fire and/or deflagration when they were sent into the milling machine which reduced the size of the material through milling. The requirements to remove foreign materials is noted in NFPA 654 (2006) 7.15.1. The hazard is documented in photos 26, 27, 28, and 29.

M3 Room - There was no system of removal or separation of foreign materials (such as tramp metal) that could enter into the processing system. These materials could also include conveyor or auger wear. The material was sent then to the milling process to reduce it's size. During the milling process these metal parts could produce sparks which could ignite a fire or cause a deflagration. These requirements are covered in NFPA 654 (2006) 7.15.1. Please refer to photos 21, 22, 23, 24, and 25 for details.

b) Equipment - see instance descriptions above
c) Location - M2 and M3 areas of the production plant
d) Injury/Illness - 2nd and 3rd degree burns. Trauma from explosions. Death.
e) Measurements - see OSHA 91A/B, visual, MSDS, safety meeting notes, employee interviews, and steel tape

21. Photo Number	Location on Video
	see instance descriptions

23. Employer Knowledge : The employer had a copy of NFPA 654. The employer mentions NFPA 654 in their MSDS to ensure the end user follows the guidelines. The employer was previously cited for similar hazards and provided with NFPA 654 guidance at that time. The company had an Industrial Hygienist who had evaluated the dust exposures on several occasions. Several of the company's Safety Committee minutes mention concerns about the fire and explosion hazards of the dusts.

24. Comments (Employer, Employee, Closing Conference) : Mr. John Doe stated "We will do whatever you tell us to do. We don't want to hurt any of our employees".

25. Other Employer Information :

26. Classification:				
Serious	Knowledge	S or O	Repeat?	Willful?
y	y	s	y	n

First Repeat	Second Repeat	Repeat Penalty

Event Date	Event Code	Action Code	Citation Type	Penalty	Abate Date	Final Order
	Z Add transaction	**A Add**	**S Serious**	**0.0**		

U. S. Department of Labor
Occupational Safety and Health Administration

Worksheet

Mon May 1, 2006 11:36am

Inspection Number	18
Opt. Insp. Number	100

Establishment Name	**Bolie's Metal Finishing**				
Type of Violation	**S Serious**	Citation Number	**01**	Item/Group	**002**
Number Exposed	**2**	No. Instances	**1**	REC	
Std. Alleged Vio.	**1910.0022(a)(1)**				

Abatement Period	MultiStep Abatements			Final Abatement	Action Type/Dates
	PPE Period	Plan	Report		
30					

Substance Codes	

AVD/Variable Information:

29 CFR 1910.22(a)(1): Places of employment were not kept clean and orderly, or in a sanitary condition:

(a) Dispensing Area - Accumulations of polyethylene resin dust, a Class II Group G combustible dust, generated during dispensing and mixing process had settled on floor areas, equipment sufaces. electrical conduit, breaker panel boxes, and disconnects, on or about April 28, 2006.

VERIFICATION REQUIRED

Penalty Calculations				Adjustment Factors			Proposed Adjusted Penalty
Severity	Probability	Gravity	GBP	Size	Good Faith	History	
M Medium	**L Lesser**	**02**	**2000.00**	**40**	**15**	**10**	**700.00**
Repeat Factor		**0**					

Employee Exposure:					
Occupation	**Go-Fer**	Employer	**Bolie's Metal Finishing**		
Nr of Employees	**2**	Duration	**several years**	Frequency	**daily**
Employee Name	**Tami Bole**				
Address	**123 Main Street Hometown, PA 17109**		Phone	**(717)847-5309**	

Instance Description: A. Hazard B. Equipment C. Location D. Injury/Illness E. Measurements

4. Date/Time
4-28-06/1130

20. Instance Description - Describe the following:

a) Hazards-Operation/Condition-Accident: Accumulations of polyethylene resin dust, a Class II Group G combustible dust, liberated during dispensing and mixing operations had settled on horizontal surfaces such as; equipment, floor, electrical conduit, breaker panel boxes, and disconnects.

b) Equipment: Three 11,000 pound powder resin silos (located outside the shop), three screw conveyors (one per silo); mixer with a scissors jack; rotary molding machines; power industrial trucks; electrical disconnects; breaker panel; duplex receptacle; scale

OSHA-1B/1BIHprint(Rev. 9/93)

c) Location: Powder Dispensing Area

d) Injury/Illness: Various, including, but not limited to, burns and other injuries associated with a fire and/or explosion

e) Measurements: On 4/25/06, Matt Bole, Plant Manager, collected a bulk sample of the polyethylene resin powder from a hopper on the plant floor. CSHO witnessed the collection of the sample. Also on 4/25/06, Mr. Bole gave CSHO an approximately one pound bag of yellow pigment from the pigment storage area. CSHO sent both of these samples to the OSHA lab in Salt Lake City for analysis. The results for the pigment (sampling number 123456789) indicated that the pigment did not react during the Class II test and that insufficient sample existed for conducting further testing (i.e., the Kst). The results for the resin powder (sampling number 123456789) indicated that it was a Class II explosive dust.

On 4/26/06, CSHO took the following measurements: dimensions of the dispensing area from the edge of the 5,000 gallon rotary molding machine to the edge of the pigment storage area was 8 feet 10 inches and from the exterior wall to the aisleway was 8 feet 6 inches (measured with a laser meter); the distance from the nearest burner on the 5,000 gallon rotary molding machine to the nearest resin powder dispensing hose (marked 1234) was 8 feet (measured with a steel tape); the screw conveyors had 6 feet of length outside the building and 2.5 feet of length inside the building (measured with a laser meter) plus about 1 foot for exterior wall thickness (estimated by Tami Bole, Corporate Facilities Manager).

On 4/26/06, as the inspection video shows (10:25AM-10:26AM, 10:30AM, and 10:35AM), surfaces in the dispensing area had dust accumulations that obscured the colors of the surfaces, and in some areas (for example, on the electrical conduit) had a thickness of about .25 inches.

On 4/26/06, CSHO asked Tami Bole, Corporate Facilities Manager, the capacity of the silos. Ms. Bole said that each silo had a 11,000 pound capacity.

21. Photo Number	Location on Video
None	1/5/06 10:25AM-10:26AM, 10:30AM, 10:35AM shows dispensing area and dust accumulations; 1/5/06 10:35AM shows open flames on the rotary molding machinery; 2/1/06 10:35AM hopper that bulk sample came from; 2/1/06 11:13AM, 11:14AM-11:15AM shows dust dispersed during dispensing and mixing

23. Employer Knowledge: Matt Bole, Plant Manager, and Tami Bole, Corporate Facilities Manager, said that they have been trying to find a way to minimize the dust generated during dispensing of resin powder. On 4/25/06, Mr. Bole showed CSHO a lid type device that he had tried at the end of the dispensing hoses. Mr. Bole said that the lid seemed to help some but that it no longer got used. (Note: The lid did not involve any kind of ventilation. It simply covered the top of the container into which employees dispensed the resin powder.) The fact that Mr. Bole and Ms. Bole said they want to find a way to minimize the dust generated during dispensing indicates that they know that the dust becomes suspended during dispensing.

On 4/26/06, CSHO asked if the employer had a written housekeeping program which described the frequency and methods for cleaning up dust. Mr. Bole said that employees use brooms to sweep the area down daily. Both Mr. Bole and Ms. Bole said that employees did not use compressed air to clean, not even on high surfaces. Mr. Bole said that the employer periodically rents a lift and employees use brooms and brushes to sweep down the higher surfaces while working out of the lift.

On 4/26/06, Matt Bole, Plant Manager, gave CSHO a copy of the material safety data sheet (MSDS) for the polyethylene resin powder (copy included in the case file). The top right column on the first page of the MSDS under "General Hazard" says "...airborne dust may explode if ignited." The right column on the first page of the MSDS under item 6 "Storage and Handling" says, "Do NOT handle or store near an open flame, heat or other sources of ignition." Additionally, near the top of the right column on page two of the MSDS

says, "National Fire Protection Association standards, NFPA 654 and 68 indicate possible explosion hazard of dust particles. Conform accordingly. Avoid accumulation of dust or dust clouds; operate handling and storage systems leak free, practice good housekeeping. Keep from sources of ignition. Do not store near heat, flame or strong oxidants. Assure proper electrical grounding of all handling equipment."

On 4/26/06, CSHO asked Ms. Bole and Mr. Bole if the employer had any other MSDSs for the resin besides the one that Mr. Bole had given to CSHO on 4/26/06. Ms. Bole said no. CSHO also asked if the resin in the hopper had a resin different from that out of the silos. Ms. Bole and Mr. Bole said no.

24. Comments (Employer, Employee, Closing Conference): CSHO did observe some push brooms in the area.

The employer had cleaned the powder dispensing area between the day of the first site visit (1/5/06) to the day of the site visit (4/26/06). As the video shows, the electrical conduit along the back wall of the dispensing area did not have the same amount of accumulated dust on 4/26/06. Also, the surfaces of equipment, such as the red metal covering the screw conveyors showed visibly on 4/26/06.

25. Other Employer Information: None

26. Classification:				
Serious	Knowledge	S or O	Repeat?	Willful?
Y	Y	S	N	N

First Repeat	Second Repeat	Repeat Penalty

Event Date	Event Code	Action Code	Citation Type	Penalty	Abate Date	Final Order
	Z Add transaction	**A Add**	**S Serious**	**700.00**		

U. S. Department of Labor
Occupational Safety and Health Administration

Worksheet

Mon May 1, 2006 11:36am

Inspection Number	18
Opt. Insp. Number	100

Establishment Name	**Bolie's Metal Finishing**				
Type of Violation	**S Serious**	Citation Number	**01**	Item/Group	**003**
Number Exposed	**2**	No. Instances	**1**	REC	
Std. Alleged Vio.	**1910.0307(b)**				

Abatement Period	MultiStep Abatements			Final Abatement	Action Type/Dates
	PPE Period	Plan	Report		
30					

Substance Codes	

AVD/Variable Information:

29 CFR 1910.307(b): Equipment, wiring methods, and installations of equipment in hazardous (classified) locations were not intrinsically safe, or approved for the hazardous (classified) location, or safe for the hazardous (classified) location:

(a) Powder Area - Employees mixed and dispensing polyethylene resin powder, a Class II Group G combustible dust. The dispensing and mixing created the release of the resin powder in suspension intermittently throughout the day. General purpose wiring, breaker panel boxes, disconnect switches, receptacles, and electric motors were not dust-tight ignitionproof and approved for Class II Division 1 locations, on or about April 28, 2006.

VERIFICATION REQUIRED

Penalty Calculations				Adjustment Factors			Proposed Adjusted Penalty
Severity	Probability	Gravity	GBP	Size	Good Faith	History	
M Medium	**L Lesser**	**02**	**2000.00**	**40**	**15**	**0**	**900.00**
Repeat Factor		**0**					

Employee Exposure:					
Occupation	**Go-Fer**	Employer	**Bolie's Metal Finishing**		
Nr of Employees	**2**	Duration	**several years**	Frequency	**daily**
Employee Name	**Tami Bole**				
Address	**123 Main Street Hometown, PA 17109**		Phone	**(717)847-5309**	

Instance Description: A. Hazard B. Equipment C. Location D. Injury/Illness E. Measurements

4. Date/Time
4-28-06/1300

20. Instance Description - Describe the following:
a) Hazards-Operation/Condition-Accident: Employees mixed and dispensing polyethylene resin powder, a Class II Group G combustible dust. The dispensing and mixing caused the release of the resin powder in suspension intermittently throughout the day. General purpose wiring, breaker panel boxes, disconnect switches, receptacles, and electric motors were not dust-tight ignitionproof and approved for Class II Division 1 locations.

OSHA-1B/1BIHprint(Rev. 9/93)

b) Equipment: Three 11,000 pound bulk powder resin silos (located outside the facility), three screw conveyors (one per silo); mixer with scissors jack; rotary molding machines; two power industrial trucks; electrical disconnects; breaker panel; duplex receptacle; scale, electric motors on the mixer and screw conveyors

c) Location: Powder Dispensing Area

d) Injury/Illness: Various, including, but not limited to, burns and other injuries associated with a fire and/or explosion.

e) Measurements: On 4/25/06, Matt Bole, Plant Manager, collected a bulk sample of the polyethylene resin powder from a hopper on the plant floor. CSHO witnessed the collection of the sample. Also on 4/26/06, Mr. Bole gave CSHO an approximately one pound bag of yellow pigment from the pigment storage area. CSHO sent both of these samples to the OSHA lab in Salt Lake City for analysis. The results for the pigment (sampling number 123456789) indicated that the pigment did not react during the Class II test and that insufficient sample existed for conducting further testing (i.e., the Kst). The results for the resin powder (sampling number 123456789) indicated that it was a Class II explosive dust.

The resin powder had accumulated directly on the general purpose wiring, breaker panel boxes, disconnect switches, receptacles, and electric motors. See video 4/26/06 10:25AM-10:26AM, 10:35AM and 2/1/06 10:38AM, 10:42AM, 10:43AM.

None of the electrical in the powder dispensing area had markings showing approval for use in Class II Division 1 locations.

21. Photo Number	Location on Video
None	1/5/06 10:25AM-10:26AM, 10:35AM and 2/1/06 10:38AM, 10:42AM, 10:43AM shows dispensing area and dust accumulations on electrical equipment; 2/1/06 11:13AM, 11:14AM-11:15AM shows dust dispersed during dispensing and mixing

23. Employer Knowledge: Matt Bole, Plant Manager, and Tami Bole, Corporate Facilities Manager, said that they have been trying to find a way to minimize the dust generated during dispensing of resin powder. On 4/26/06, Mr. Bole showed CSHO a lid type device that he had tried at the end of the dispensing hoses. Mr. Bole said that the lid seemed to help some but that it no longer got used. (Note: The lid did not involve any kind of ventilation. It simply covered the top of the container into which employees dispensed the resin powder.) The fact that Mr. Bole and Ms. Bole said they want to find a way to minimize the dust generated during dispensing indicates that they know that the dust becomes suspended during dispensing.

On 4/26/06, Matt Bole, Plant Manager, gave CSHO a copy of the material safety data sheet (MSDS) for the polyethylene resin powder (copy included in the case file). The top right column on the first page of the MSDS under "General Hazard" says "...airborne dust may explode if ignited." The right column on the first page of the MSDS under item 6 "Storage and Handling" says, "Do NOT handle or store near an open flame, heat or other sources of ignition." Additionally, near the top of the right column on page two of the MSDS says, "National Fire Protection Association standards, NFPA 654 and 68 indicate possible explosion hazard of dust particles. Conform accordingly. Avoid accumulation of dust or dust clouds; operate handling and storage systems leak free, practice good housekeeping. Keep from sources of ignition. Do not store near heat, flame or strong oxidants. Assure proper electrical grounding of all handling equipment."

On 4/26/06, CSHO asked Ms. Bole and Mr. Bole if the employer had any other MSDSs for the resin besides the one that Mr. Bole had given to CSHO on 4/26/06. Ms. Bole said no. CSHO also asked if the resin in the hopper had a resin different from that out of the silos. Ms. Bole and Mr. Bole said no.

Both Mr. Bole and Ms. Bole know the configuration of the equipment and processes in the production area, so Mr. Bole and Ms. Bole know the type of wiring and electrical equipment in the powder dispensing area.

24. Comments (Employer, Employee, Closing Conference): On 4/26/06, Ms. Bole said that it would cost a lot if the employer had to install "explosion proof" wiring and motors in the powder dispensing area. Ms. Bole said that having to install such equipment would have implications throughout the rotational molding industry because he said that he did not think that most rotary molders had "explosion proof" electrical. (Note: CSHO explained to Ms. Bole that explosion proof applied to flammable gases and vapors and that dust-tight ignitionproof applied to Class II locations which had explosive dusts.)

Industry recognition of the fire and explosion hazard of plastic dust clearly exists. NFPA has a standard, NFPA 654-2000, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids which specifically addresses this hazard. According to the section of this standard titled "Origin and Development of NFPA 654," "NFPA 654 was initiated by the Committee on Dust Explosion Hazards in 1943 and originally applied only to the prevention of dust explosions in the plasticize industry."

NFPA 499, Recommended Practice for the Classification of Combustible Dusts and Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, 2004 edition, says in Chapter 4, Sections 4.3.3.3 and 4.3.3.4, "...if a dust cloud is present at any time, it is assumed to be ignitible, and all that is necessary for electrical ignition is failure of the electrical system, " the area should be classified as Division 1. Also, Chapter 5, Section 5.2.1 says, "Where a dust cloud is likely to be present under normal conditions, the location should be classified as Division 1."

25. Other Employer Information: None

26. Classification:				
Serious	Knowledge	S or O	Repeat?	Willful?
Y	Y	S	N	N

First Repeat	Second Repeat	Repeat Penalty

Event Date	Event Code	Action Code	Citation Type	Penalty	Abate Date	Final Order
	Z Add transaction	**A Add**	**S Serious**	**900.00**		