



FOCUS ARTICLE

Completing a Dust Hazard Analysis

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National Fire Protection Association, NFPA, has released a new edition (2019) of the NFPA 652 standard on the management of combustible particulate hazards. The new edition of the NFPA 652 standard has added more information and requirements to the already existing standard, such as requirements on hybrid mixture as well as process equipment, including bulk storage enclosure size reduction, particle size separation, pressure protection systems, material feeding devices, bucket elevators, enclosed conveyor, mixers and blenders and dryers. This standard is intended to help facilities understand and apply the various existing standards on this topic and provide a general approach to the management of fire and explosion hazards associated with the manufacturing, handling, and processing of combustible particulate solids. Past dust-explosion events in the chemical process industries have resulted in catastrophic consequences, and the investigation of these events has caused some confusion in the applicability of the various codes and standards that currently exist. The NFPA 652, Standard on the Fundamentals of Combustible Dust, contains the following intent:

“**NFPA 652, Standard on the Fundamentals of Combustible Dust**, provides the general requirements for management of combustible dust fire and explosion hazards and directs the user to NFPA’s industry- or commodity-specific standards, as appropriate: NFPA 61, Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities; NFPA 484, Standard for Combustible Metals; NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and

Handling of Combustible Particulate Solids; NFPA 655, Standard for Prevention of Sulfur Fires and Explosions; and NFPA 664, Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities. This standard establishes the relationship and hierarchy between it and any of the industry- or commodity-specific standards, ensuring that fundamental requirements are addressed consistently across industries, processes, and dust types.”©

An important requirement of the standard is that covered sites that handle and process combustible particulate shall complete a Dust Hazard Analysis, DHA, for all new processes and facility compartments. For existing processes and facility compartment, a Dust Hazard Analysis shall be completed by September 7, 2020. The Dust Hazard Analysis shall be reviewed and updated at least every 5 years. The first step in the DHA process is described in the flowchart below. In order to determine the combustible solids hazards, the first requirement is to verify if the powders/dusts handled are indeed combustible or if materials are only handled in

closed containers in storage or warehousing activities (such “benign” processing is exempted from NFPA 652 application). The purpose of testing is to answer several important safety questions. A screening test can be used to determine if small particles of a material will support combustion when suspended in air. Materials that are combustible should be tested to determine the ignition sensitivity and explosion severity. Tests to determine a dust’s ignition sensitivity include the Minimum Ignition Energy, MIE, the Minimum Explosible Concentration, MEC, and the Minimum Ignition Temperature (both dust cloud and layer tests), MIT.

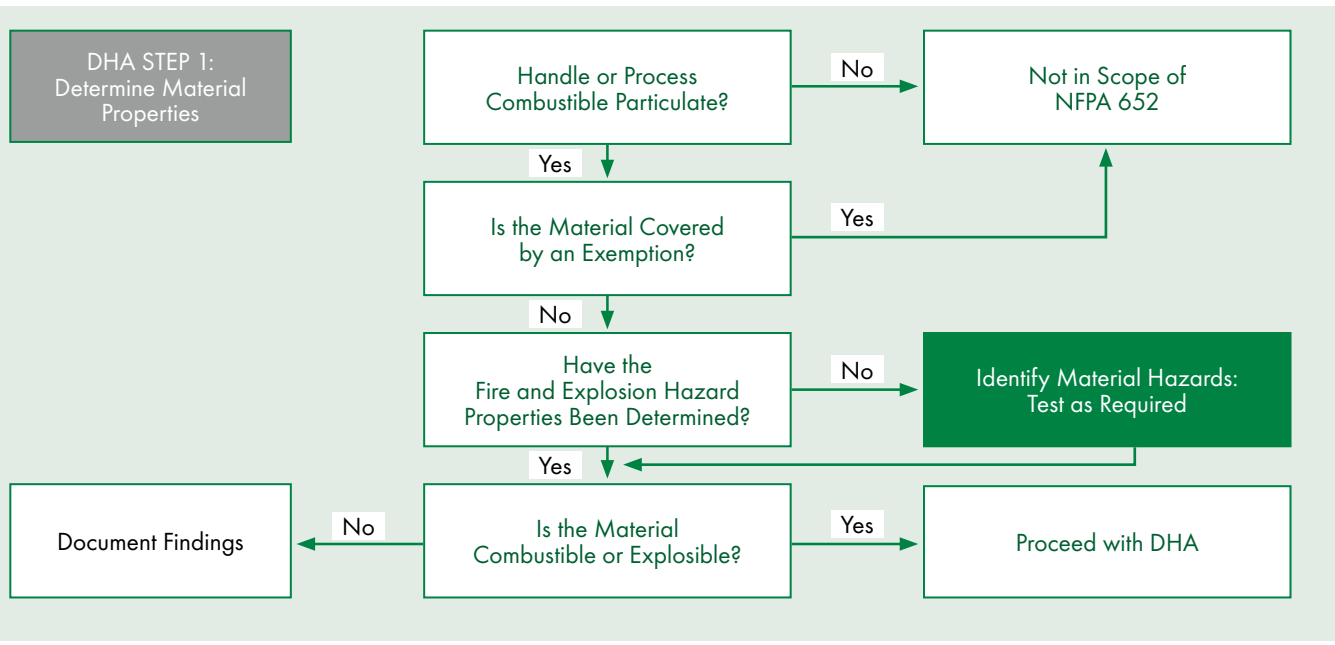


Figure 1: DHA Step 1: Determine Material Properties

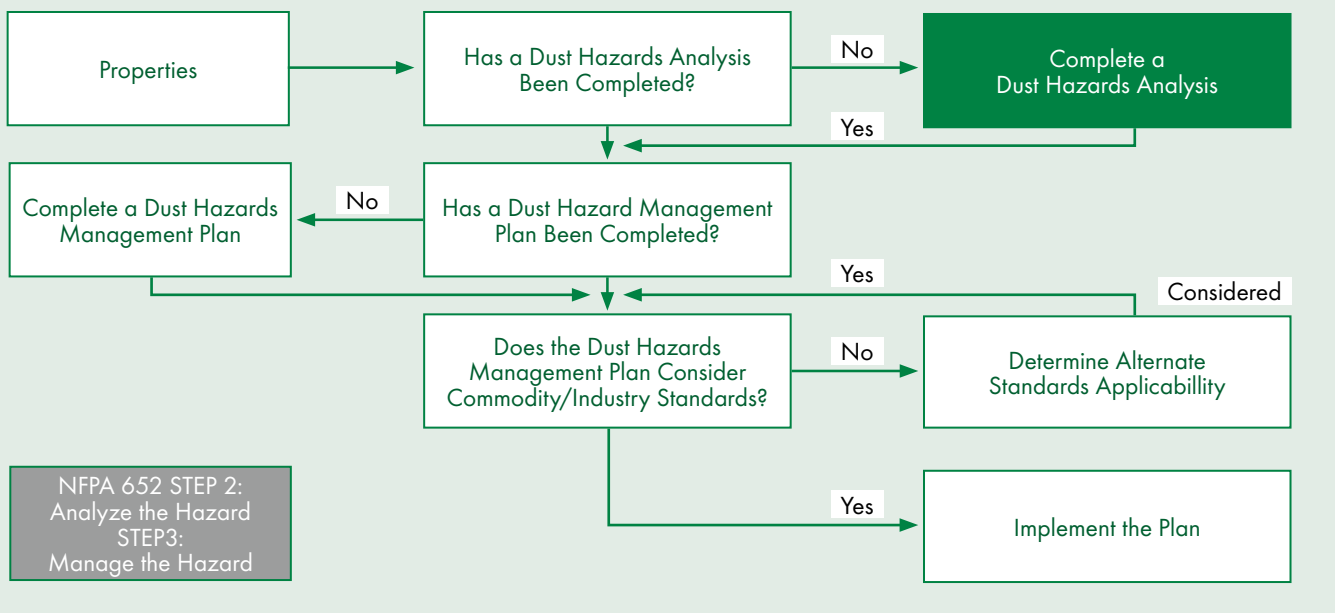


Figure 2: DHA Step 2: Analyze the Hazard + Step 3: Manage the Hazard

These tests will provide an understanding of **combustible-dust** properties and how easily dust clouds may be ignited. The test to determine a dust's explosion severity requires suspending the dust in a suitable chamber and igniting the dust cloud with a high energy source. This test provides basic information regarding the resulting explosion including peak chamber pressure and maximum rate of pressure rise. Explosion severity data are required to design explosion protections such as relief venting and allow ranking of a material's hazard. The next step in the process hazard analysis is to complete the Dust Hazard Analysis and identify areas of the process where materials could form ignitable dust suspensions or dust layers and access ignition sources. The DHA should classify potentially hazardous dust locations within the facility into one of three categories:

- > Not a hazard,
- > Possible hazard,
- > Fire or explosion hazard

The DHA answers the following key questions for all areas where powders and dusts are handled and processed:

1. Can particulate exist in a size that would allow flame propagation?
2. Is there a mechanism to initiate dust suspension?
3. Could the dust suspension concentration exceed the Minimum Explosible Concentration?
4. Could effective ignition sources exist during 1-3 above?

The DHA report documents the process-materials properties and the operating conditions and, for each potential hazard zone, answers the above four questions and establishes what hazard management methods exist or are appropriate.

SUMMARY

Whenever a manufacturing site handles and/or processes combustible particulates, a minimum standard of safety must include consideration of appropriate codes and standards. Codes and Standards represent RAGAGEP, Recommended and Generally Accepted Good Engineering Practices and should always be considered. The standard on combustible particulate hazards, NFPA 652, includes an expectation that a Dust Hazard Analysis be completed which includes:

- > Consideration of dust hazard properties;
- > Appropriate hazard expertise and experience of the DHA leader;
- > A rigorous review process; and
- > Prompt actions to correct identified deficiencies.

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DAVID E. KAELIN

David E. Kaelin, Sr., B.S.Ch.E., Mr. Kaelin has over 25 years experience in the specialty chemical manufacturing industry and 15 years specializing as a Process Safety Engineer. He has participated in the design and construction of numerous chemical processing facilities and provided support and training in all areas of PSM. As a Process Safety Engineer he has led process hazard analysis, risk assessments and facility siting reviews. At the corporate level he has created and taught courses in PSM and hazard recognition methods. Mr. Kaelin is an expert in the application of hazard recognition techniques including: HAZOP, FMEA, What-If, Fault Tree Analysis, Risk Screening and Checklist. He is an active member of AIChE, and NFPA.



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