WORKPLACE SOLUTIONS

From the National Institute for Occupational Safety and Health

Reducing Workers' Lead Exposure during Water Service Line Removal and Replacement

Introduction

Workers who replace lead water service lines may be exposed to lead pipes and lead-contaminated soil while removing the old water lines and replacing them with lead-free lines. The United States Environmental Protection Agency (EPA) estimates that there are between 6 and 10 million lead water service lines in the United States [EPA 2019]. Lead water service lines may be in the walls of structures or underground [EPA 2022; Lee and Lunney 2021] and may supply water to businesses, schools, childcare facilities, and residential homes. Infrastructure legislation has made funding available to improve municipal water systems and protect public health by replacing lead pipes [White House 2021]. Increased efforts to replace these lines may result in an increased risk of worker exposure to lead-contaminated pipes and soil. This document provides information about occupational lead exposure and recommendations for protecting workers' health during lead pipe replacement.

Lead Exposures during Replacement of Service Water Lines

Workers potentially exposed to lead during replacement of lead water service lines include managers, line supervisors, and field workers who service water utilities (such as from plumbing companies, water utilities, and construction firms). Workers may be exposed to lead if they work in excavated pits, cut and handle lead pipe and equipment, or prepare to pull the lead line or disconnect the service line. Workers may also be exposed to lead-contaminated soil during excavation using heavy equipment such as a backhoe or manual digging using shovels [NIOSH 2021c].

Replacing a lead residential or commercial service water line may involve the following steps [NIOSH 2021c]:

- Excavate soil and create trenches using a backhoe and shovels.
- Use the trenches to find the connections between the main line, the curb stop (shut off valve), and the home or business.
- Shut off water supply to the home or business and disconnect/cut the lead service line. This may generate lead dust [Koh et al. 2015].
- Connect a new copper service line to the old lead line and pull the line through the soil.
- Disconnect and remove the old lead line and reconnect the new copper line to the water main line. Test for leaks. On occasion, a steel cable is threaded through the inside of the lead line and pulled (using the backhoe bucket) to remove the line. The rope is then attached to the steel cable and pulled through. The process is repeated until the line is removed, and a new copper line is in place. A licensed plumbing contractor makes the final connection to the home or business.
- When the line replacement is complete, backfill soil and gravel into each excavation and repair the road surface/curb/sidewalk. This last step may expose workers to lead if the soil is contaminated.

CDC NIOSH

Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

In some communities, it may be acceptable to install a new service line adjacent to the old lead line and leave the old line in its original location undisturbed. This will minimize worker exposures to lead. However, the acceptability of this installation technique may vary regionally, and is often dependent on soil type, the presence of existing underground structures (e.g., other pipes, electrical conduits), and concrete streets and sidewalks in urban municipalities.

Lead Health Effects

Lead is considered toxic to all organ systems and serves no useful purpose in the body. The routes of exposure for lead are inhalation, ingestion, skin, and/or eye contact. Lead particles or fumes could be inhaled (breathed in) during certain work operations; swallowed if they are on a person's hands while a person is eating, drinking, or smoking; or absorbed through the skin [NIOSH 2023c].

Long-term exposure to lead at work can affect the nervous system and has resulted in decreased performance in some tests that measure nervous system function. Lead exposure may also cause weakness in fingers, wrists, or ankles. Lead exposure may also causes small increases in blood pressure, particularly in middle-aged and older people. Lead exposure may also cause anemia. At high levels of exposure, lead can severely damage the brain and kidneys. High levels of exposure can result in decreased fertility in men and women, and miscarriage [ATSDR 2020a].

For more information about the health effects of lead, see the public health statement and toxicological profile on lead from the Agency for Toxic Substances and Disease Registry: **Public Health Statement for Lead** and **Health Effects of Lead** [ATSDR 2020a,b].

Take-Home Lead Exposures

Take-home lead exposure occurs when workers are exposed to lead at the work site and unknowingly carry the lead into their homes on their skin, clothes, shoes, and personal items (keys, phones, or lunchboxes) [NIOSH 1997b; 2019b; Piacitelli et al. 1997; CDC 2012]. Personal vehicles can also become contaminated with lead. Exposure to take-home lead is hazardous to children and other household members. No safe blood lead levels (BLLs) have been identified for children [CDC 2022b], and the Centers for Disease Control and Prevention (CDC) considers a BLL of 3.5 μg/dL or higher in a child to require public health action [CDC 2022a]. Depending on the BLL and the jurisdiction, public health action might include giving information about sources of lead exposure, investigations to identify and address sources of exposure, or clinical care and intervention. In children, lead exposure has been associated with developmental and neurological disorders [CDC 2022a]. Visit **Lead in Jobs, Hobbies, or Other Activities** for a list of jobs and tasks that may result in lead exposure [CDC 2022c].

Lead Occupational Exposure Limits and Reference Levels

To protect workers from lead exposures and reduce related health effects on the job, both the NIOSH recommended exposure limit (REL) and the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) are 50 micrograms per cubic meter of air (50 $\mu g/m^3$) as an 8-hour time-weighted average (TWA).

Lead exposure is also covered in the OSHA lead construction standard, which applies to all construction work where a worker may be exposed to lead:

- Demolition or salvaging of structures where lead or materials containing lead are present
- Removal or encapsulation of materials containing lead
- New construction, alteration, repair, or renovation of structures, substrates (or portions thereof), that contain lead, or materials containing lead [**29 CFR 1926.62**]

An OSHA action level (AL) refers to worker exposure (whether or not respirators are used) to an airborne lead concentration of 30 $\mu g/m^3$ calculated as an 8-hour TWA. If an exposure reaches the AL, the employer must take action and implement exposure control measures.

Recent research has indicated adverse health effects in adults at levels that are lower than those previously documented [NTP 2012; ATSDR 2020b; **OSHA (Lead Health Effects page)**].

Measuring lead in blood is the most effective method to detect and assess exposure. The most up to date BLL for workers is the value used by the NIOSH Adult Blood Lead Epidemiology and Surveillance (ABLES) program. The ABLES program defines an elevated BLL as 5 $\mu g/dL$. For more information about BLLs, see the **BLL Reference Guide** [NIOSH 2021b].

Case Study of Lead Exposures from Water Pipe Replacement

In 2019, NIOSH conducted a Health Hazard Evaluation (HHE) (**Exposure to Lead during Residential Water Line Replacement Activities**) among city water department employees who were replacing lead water lines servicing residential homes. The evaluation identified potential lead exposures via inhalation and ingestion among these employees (see Figure 1).

Figure 1. Photo taken at the HHE site.

Before the NIOSH evaluation, workers underwent BLL testing through their employee health services program. Two workers' blood test results indicated they had elevated BLLs (a BLL ≥ 5 μg/dL, the reference BLL for adults in the United States) [NIOSH 2021b,c]. NIOSH staff performed an exposure assessment among eight workers on two crews that worked 8-hour shifts. NIOSH collected personal air samples from workers and collected wipe samples from some workers' hands and various surfaces (truck cab components, handheld equipment, etc.). Lead was found on workers' hands, inside work gloves, and on surfaces inside trucks and inside the locker room. None of the air sampling results were above the occupational exposure limits for lead (NIOSH REL and OSHA [AL/PEL]). NIOSH also conducted medical interviews and observed work practices. They learned about and observed inadequate hand hygiene practices, improper use of lead removal wipes, and incorrect respirator use. These findings illustrate the significance of minimizing routes of exposures other than inhalation.

Recommendations to Reduce Lead Exposure in Workers

Employers and workers should take the measures outlined below to reduce occupational exposure to lead during water pipe replacement.

Reducing Lead Exposure

The hierarchy of controls states that the most effective ways of controlling a hazard are elimination or substitution (with a less hazardous substance) [NIOSH 2023a]. Although removing lead water pipes eliminates the hazard for future exposures, the process of removing the lead water lines has the potential for lead exposures. Since eliminating or substituting the lead during service line removal is not possible, the next most effective method is controlling the hazard at its source through engineering controls. Worker exposure can also be reduced through administrative controls (e.g., limiting the length of exposure). Lastly, personal protective equipment (PPE) is at the bottom of the hierarchy of controls and is used when a hazard cannot be controlled by other means.

What Employers Can Do

Employers should reduce workers' exposure to lead through the following [NIOSH 2019b, 2021c, 2023b; 29 CFR 1910.132(d)(1); **OSHA lead overview**]:

- Develop a written lead-monitoring and control program, a hazard communication program, and a job-hazard analysis for tasks that may involve exposure to lead.
- Monitor airborne exposures and ensure compliance with the OSHA lead standard.
- Engineering controls:
  - Provide portable high efficiency particulate air (HEPA)-filtered vacuums to clean up vehicles in the field, in addition to regular cleaning of work vehicles.
  - Provide and use tools that produce less dust.
- Work practices:

Training

- Provide proper training regarding lead hazards and work practices when hiring a new worker. Provide refresher training annually for all workers including maintenance, cleaning staff, and others who may come in contact with lead-contaminated equipment, vehicles, or work areas.
- Train workers on methods to keep hands clean. For example, wear appropriate disposable gloves (e.g., nitrile) and use a lead-removal soap or wipe, or hand cleaner after working with lead pipes.
- Train workers on the use of cutting techniques that produce less dust (e.g., using a pipe cutter versus a saw).
- Train workers on methods and PPE necessary to handle HEPA vacuum filter changeouts and disposal of contaminated vacuum contents.

Hygiene and housekeeping

- Require workers to follow hygiene practices pertaining to lead.
- Inform workers about potential take-home lead contamination and the risks associated with lead exposure among household members.
- Ensure that lead-removal wipes and handwashing stations are available onsite (e.g., in the field and at the water department facility) for all workers especially before eating, drinking, or smoking.
- Ensure that bathroom facilities include sinks and lead-removal soap.
- Provide a locker room (or lockers), showering facilities for workers, and laundry facilities or services when possible.
- Provide lead-removal soap (or lead-removal wipes when no lead-removal soap and water are available) in the employee locker room, as standard soap is not adequate to remove lead residue [NIOSH 2023b].
- Prohibit the use of contaminated equipment on other jobs/tasks not related to water line replacement.
- Stock work vehicles with proper materials for decontamination and exposure control in the field. Include appropriately labeled waste bags, cleaning materials, and disposal-collection bins for workers to use at the work site.
- Develop and implement clean-up procedures that prevent lead dust from contaminating the workplace, work or personal vehicles, and equipment:
  - » Wipe down surfaces using wet methods while wearing appropriate PPE (gloves) to prevent dermal absorption.
  - » Clean cable tools and equipment that have been in direct contact with lead pipe using an appropriate lead removal solution.
  - » Develop a cleaning schedule to clean "high-contact" surfaces (e.g., locker handles, doorknobs, truck cab surfaces, tools, etc.) using lead-removal wipes or lead-removal soap.
  - » Prohibit the use of compressed air to remove lead from any surface unless it is used in conjunction with a system to capture airborne lead [29 CFR 1926.62(h)(5)].

Testing

- Provide lead exposure surveillance monitoring (BLLs) for workers and monitor the results in accordance with the OSHA lead construction standard. **The Association of Occupational and Environmental Clinics** and **American College of Occupational and Environmental Medicine** have additional recommendations for testing and managing lead-exposed workers.
- Consider purchasing colorimetric wipe test kits and periodically test hands, surfaces, and tools for lead. Periodic tests will help identify potential sources of exposure and provide an indicator of the effectiveness of decontamination techniques, equipment, and personal hygiene cleaning efforts, as well as workers' use of PPE.

- PPE
  - Provide training for workers on how to properly use, store, and maintain PPE, including respirators (if they are required).
  - Provide appropriate PPE (such as gloves, coveralls, eye protection, and respirators) at no cost to workers [**29 CFR 1910.132** and **29 CFR 1926.95**; OSHA 2017].
  - Encourage frequent exchange of work gloves, especially if they are worn or heavily soiled.
  - Ensure that nitrile gloves are replaced if they become torn or loaded with soil or other debris.
  - If a job hazard assessment indicates that respiratory protection is required, implement a respiratory protection program that complies with the OSHA construction respiratory protection standard, 29 CFR 1926.103, including training, fit testing, and medical clearance.

What Workers Can Do

Workers should take the following steps to reduce their exposure to lead:

- Work practices:
  - Through your employer or physician, take a test each year to monitor your BLL, or as frequently as required by OSHA.
  - If your family may have been exposed to lead from your job, contact their healthcare provider [CDC 2022c].
  - Clean surfaces (truck cab surfaces, tools, doorknobs) and equipment periodically throughout the workday and at the end of the shift. Use lead-removal wipes or lead-removal soap.
  - Avoid bringing personal items such as keys, water bottles, or phones into lead-contaminated areas.

- Avoid visiting office areas while wearing potentially contaminated clothing/footwear.
- Use lead-removal soap (or lead-removal hand wipes if soap is not available) after completing work and clean-up activities, before eating, drinking, or smoking, and before getting into a vehicle.
- If showers are available, shower to remove residual lead dust before leaving work.
  - » If showers are not available at work, wash as much of your skin as you can with lead-removal soap before going home.
- Change into clean clothes and boots before leaving work. Leave soiled clothing at work for laundering.
- If clothes are not washed at the workplace, follow these steps:
  - » Store work clothes in a closed plastic bag away from all other clothes.
  - » Wash and dry work clothes alone and not with any other clothes. Use a lead-removal detergent.
- Store street clothes separately from work clothes, both at work and at home.

- PPE:
  - When the job hazard assessment requires the use of a respirator, wear a respirator properly and in accordance with the OSHA respiratory protection standard when working directly with lead-contaminated soil or pipes. (Filtering facepiece respirators and elastomeric half mask respirators with N95 level protection are examples [NIOSH 2019c]*.)
  - Wear nitrile gloves under work gloves when cutting or handling lead pipes and change both sets of gloves frequently, especially if either set of gloves becomes heavily soiled.
  - Replace nitrile gloves if they become torn.

Acknowledgements

The authors would like to acknowledge the external reviewers of this document, including the American Water Works Association, for their helpful reviews of an earlier draft of this document.

The basis for this document is the NIOSH **Health Hazard Evaluation** Report entitled **Exposure to Lead during Residential Water Line Replacement Activities** (investigators: Mark Methner, PhD, CIH, Marie de Perio, MD).

*Elastomeric half mask respirators are also referred to as elastomeric half facepiece respirators. The selection of N-, R-, and P-series filters depends on the presence or absence of oil particles, as follows: if no oil particles are present in the work environment, use a filter of any series (i.e., N-, R-, or P-series). If oil particles (e.g., lubricants, cutting fluids, glycerin, etc.) are present, use an R- or P-series filter. Note: N-series filters cannot be used if oil particles are present. If oil particles are present and the filter is to be used for more than one work shift, use only a P-series filter [NIOSH 1997a].

Suggested Citation

NIOSH [2023]. Reducing workers' lead exposure during water pipe removal and replacement. By Hughes SE, Methner M, de Perio MA, Afanuh SE. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2023-141. **https://doi.org/10.26616/NIOSHPUB2023141**

Resources for Medical Management of BLLs in Workers

These resources provide a definition of lead-exposed workers who should be considered for monitoring:

- **Recommendations for Medical Management of Adult Lead Exposure:** Association of Occupational and Environmental Clinics
- **Workplace Lead Exposure:** American College of Occupational and Environmental Medicine

References

87 Fed. Reg. 38343 [2022]. Occupational Safety and Health Administration: blood lead level for medical removal; advance notice of proposed rulemaking (ANPRM).

ATSDR [2020a]. Public health statement for lead. Atlanta, GA: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. **https://www.atsdr.cdc.gov/ToxProfiles/tp13-c1-b.pdf**

ATSDR [2020b]. Toxicological profile for lead. Atlanta, GA: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. **https://www.atsdr.cdc.gov/toxprofiles/tp13.pdf**

CDC [2012]. Take-home lead exposure among children with relatives employed at a battery recycling facility—Puerto Rico, 2011. MMWR *61*(47):967–970. **https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6147a4.htm**

CDC [2021]. National Notifiable Diseases Surveillance System (NNDSS). Lead, elevated blood lead levels. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. **https://ndc.services.cdc.gov/case-definitions/lead-elevated-blood-levels-2016/**

CDC [2022a]. Blood lead levels in children. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Environmental Health. **https://www.cdc.gov/nceh/lead/prevention/blood-lead-levels.htm**

CDC [2022b]. Health effects of lead exposure. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Environmental Health. **https://www.cdc.gov/nceh/lead/prevention/health-effects.htm**

CDC [2022c]. Lead in jobs, hobbies, or other activities. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Environmental Health. **https://www.cdc.gov/nceh/lead/prevention/sources/jobs-hobbies-activities.htm**

CDC [2022d]. Recommended actions based on blood lead level. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Environmental Health. **https://www.cdc.gov/nceh/lead/advisory/acclpp/actions-blls.htm**

CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

EPA [2019]. LSLR Financing case studies. Washington, DC: United States Environmental Protection Agency. **https://www.epa.gov/ground-water-and-drinking-water/lslr-financing-case-studies**

EPA [2022]. EPA tools & resources webinar: identifying lead service lines in the community. By Triantafyllidou S. Washington, DC: United States Environmental Protection Agency. **https://www.epa.gov/system/files/documents/2022-11/508%20Compliant%20-%20Identifying%20Lead%20Service%20Lines_Oct%202022.pdf**

Koh D, Locke SJ, Chen Y, Purdue MP, Friesen MC [2015]. Lead exposure in US worksites: a literature review and development of an occupational lead exposure database from the published literature. Am J Ind Med *58*(6):605–616. **https://doi.org/10.1002/ajim.22448**

Lee S, Lunney K [2021]. Biden takes moonshot approach to replacing lead water pipes. Bloomberg Law, March 31. **https://news.bloomberglaw.com/environment-and-energy/biden-takes-moonshot-approach-to-replacing-u-s-lead-water-pipes**

NIOSH [1997a]. NIOSH guide to the selection and use of particulate respirators. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 96-101. **https://www.cdc.gov/niosh/docs/96-101/default.html**

NIOSH [1997b]. Protect your family: reduce contamination at home. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-125. **https://www.cdc.gov/niosh/docs/97-125/default.html**

NIOSH [2019a]. Lead. NIOSH pocket guide to chemical hazards. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. **https://www.cdc.gov/niosh/npg/npgd0368.html**

NIOSH [2019b]. Take-home exposures—reproductive health. Workplace Safety and Health Topic Page. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. **https://www.cdc.gov/niosh/topics/repro/takehome.html**

NIOSH [2019c]. Types of respiratory protection. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. **https://www.cdc.gov/niosh/npptl/pdfs/RespProtectionTypes-508.pdf**

NIOSH [2021a]. Adult Blood Lead Epidemiology and Surveillance (ABLES). Workplace Safety and Health Topic Page. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. **https://www.cdc.gov/niosh/topics/lead/ables.html**

NIOSH [2021b]. BLL reference guide. Adult Blood Lead Epidemiology and Surveillance (ABLES): understanding blood lead levels. Workplace Safety and Health Topic Page. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. **https://www.cdc.gov/niosh/topics/lead/referencebloodlevelsforadults.html**

NIOSH [2021c]. Exposure to lead during residential water line replacement activities. By Methner MM, de Perio MA. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Health Hazard Evaluation Report No. 2019–0192–3377. **https://www.cdc.gov/niosh/hhe/reports/pdfs/2019-0192-3377.pdf**

NIOSH [2023a]. Hierarchy of controls. Workplace Safety and Health Topic Page. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. **https://www.cdc.gov/niosh/topics/hierarchy/**

NIOSH [2023b]. Lead. Information for employers: lead exposure limits. Workplace Safety and Health Topic Page. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. https://www.cdc.gov/niosh/topics/lead/employerinfo.html

NIOSH [2023c]. Lead. Information for workers. Workplace Safety and Health Topic Page. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. https://www.cdc.gov/niosh/topics/lead/workerinfo.html

NTP [2012]. Health effects of low-level lead. NTP Monograph. Washington, DC: U.S. Department of Health and Human Services, National Toxicology Program. https://ntp.niehs.nih.gov/ntp/ohat/lead/final/monographhealtheffectslowlevellead_newissn_508.pdf

OSHA [no date]. Lead: health effects. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. https://www.osha.gov/lead/health-effects

OSHA [no date]. Lead: overview. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. https://www.osha.gov/lead

OSHA [no date]. Personal protective equipment. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. https://www.osha.gov/personal-protective-equipment/payments

OSHA [no date]. OSHA technical manual (OTM) Section V: Chapter 3. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. https://www.osha.gov/otm/section-5-construction-operations/chapter-3

OSHA [2017]. Employers must provide and pay for PPE (Handout #2). Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. https://www.osha.gov/sites/default/files/Handout_2_Employers_Must_Provide_and_Pay_for_PPE.pdf

Piacitelli GM, Whelan EA, Sieber WK, Gerwel B [1997]. Elevated lead contamination in homes of construction workers. Am Ind Hyg Assoc J *58*(6):447–454. https://doi.org/10.1080/15428119791012694

The White House [2021]. Fact sheet: The Biden-Harris lead pipe and paint action plan. Statements and Releases, December 16. Washington, DC: The White House. https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/16/fact-sheet-the-biden-harris-lead-pipe-and-paint-action-plan/

For More Information

More information about workers' lead exposure and the HHE program is available on the NIOSH website:
https://www.cdc.gov/niosh/topics/lead/default.html
https://www.cdc.gov/niosh/hhe/default.html

Find NIOSH products and get answers to workplace safety and health questions:

1-800-CDC-INFO (1-800-232-4636)

TTY: 1-888-232-6348

CDC/NIOSH INFO: cdc.gov/info | cdc.gov/niosh

Monthly *NIOSH eNews*: https://www.cdc.gov/niosh/enews/

Mention of any company or product does not constitute endorsement by NIOSH. In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites.

As part of the Centers for Disease Control and Prevention, NIOSH is the Federal agency responsible for conducting research and making recommendations to prevent work-related illnesses and injuries. All ***Workplace Solutions*** are based on research studies that show how worker exposures to hazardous agents or activities can be significantly reduced.

DOI: https://doi.org/10.26616/NIOSHPUB2023141

DHHS (NIOSH) Publication No. 2023-141

September 2023

COMBUSTIBLE DUST FLOWCHART

FAUSKE & ASSOCIATES

www.Fauske.com

IS MY DUST COMBUSTIBLE?

STEP 1: Perform a screening test (such as a Go/No-Go or VDI for layer ignition)

If Test is a "NO-GO"

You do not have a combustible dust. **However**, you may need to consider other hazards (i.e., fire, UN transport concerns, etc.)

If Test is a "GO"

STEP 2: QUESTIONS

Is my **Equipment** appropriately protected?

Identify hazards and compliance issues based on NFPA and other relevant regulations? (IBC, NEC, etc.)

Do I need a **Dust Hazard Analysis (DHA)?** *A DHA is required per NFPA 652*

Is there a system in place for managing the identified hazards?

STEP 3: RATIONALE

Obtain test data from a lab for vendors to appropriately design explosion protection/mitigation.

Compare current practices against the prescriptive approach outlined in NFPA standards.

Identify if normal or upset conditions could lead to a flash fire or dust explosion.

Evaluate training, housekeeping, management of change and current practices against industry standards and Recognized And Generally Accepted Good Engineering Practices **(RAGAGEP)**

STEP 4: ACTION

Test for Explosion Severity (K_{St} and P_{max}). ***(Collect Relevant Data)***

Test for Minimum Ignition Energy (MIE) and Minimum Explosible Concentration (MEC). Also consider Volume Resistivity and Powder Chargeability for systems where static could be present. ***(Collect Relevant Data)***

Perform an onsite assessment to review your facility to relevant regulations. ***(Conduct a Walkthrough)***

Conduct a DHA to identify areas of highest risk, prioritize mitigation and control efforts, and adjust resources.

Implement a system to ensure that all hazard and upset conditions have been considered and mitigated to achieve a tolerable risk level.

THIS CHART IS A GUIDE ONLY

It is not a comprehensive plan for dust management and is not a replacement for professional counsel. Please contact our experts at dust@fauske.com (630) 323-8750 with questions.