



S (I-A) Tuesday, October 15, 2025; 8:30 am – 10:45 am  
Noise, Impact including Exposure to silica, Ergonomics and  
Safety Risks from Power Tools



## Part 1 of 2 Silica Exposure with Risks from using Power Hand Tools

Presentation Developed by: Mark B. Geiger, MS, MSE, CIH, CSP

Volunteer Chair, SAE International EG1B1 Committee

Power Tool Productivity, Ergonomics and Safety

Presenter: Charles Colbert, MS, CIH, CSP, PE, Retired US Army Corps of Engineers,  
PhD Candidate University of Alabama



Ergonomic Tool Safety Selection  
Utilizing Life Cycle Costs

Who's in Your Toolbox?©



Preventing the  
Power Tool Blues while  
Boosting Productivity

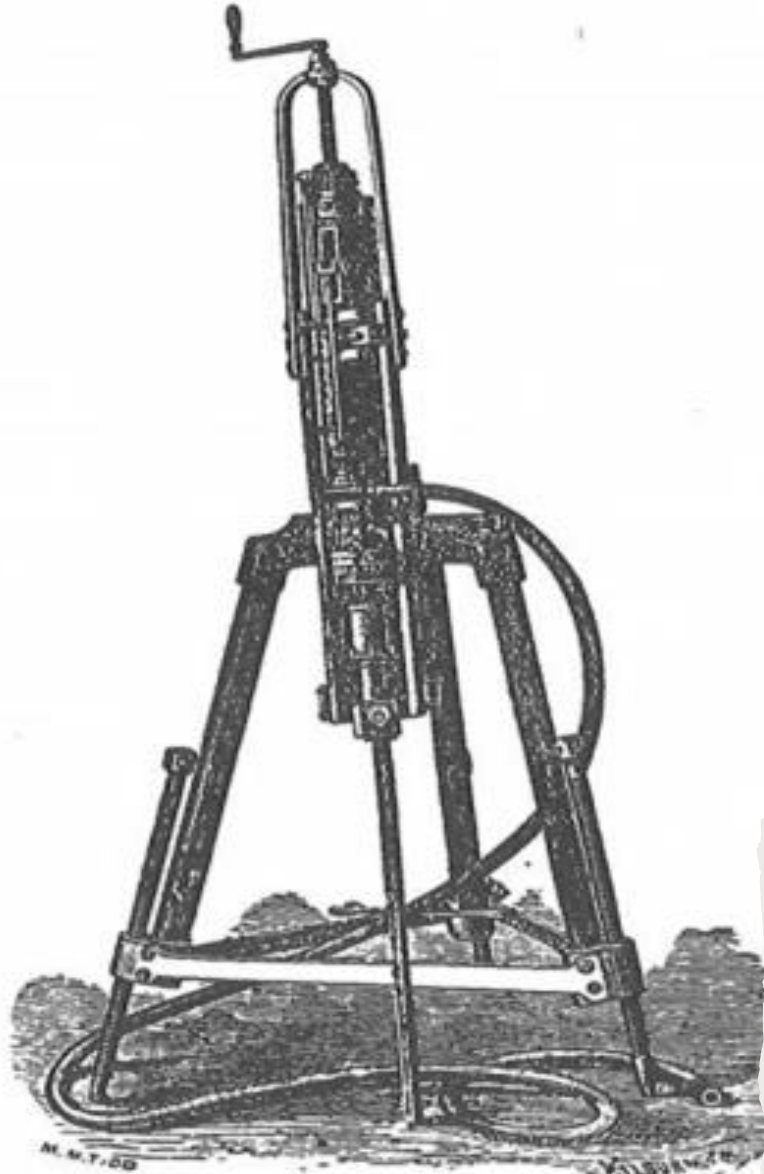
Protecting your  
employees from  
the Dangers of  
Dust and Silica

## Risks of Exposure to RCS

- The maximum exposure to respirable crystalline silica (RCS) recorded was 5,100  $\mu\text{g}/\text{m}^3$  for employees who performed dry cutting.
- Respirable Crystalline Silica (RCS) exposure to RCS can lead to serious health issues, including silicosis (a lung disease caused by inhaling silica dust), lung cancer, chronic obstructive pulmonary disease (COPD), and kidney disease. Prolonged or high-level exposure significantly increases these risks.

# Silicosis the Inhalation of Crystalline Silica

- Silicosis associated with inhalation of crystalline silica among engineered stone countertop fabrication workers is an emerging health concern.
- Silicosis is the most prevalent pneumoconiosis worldwide. It is a fibrotic interstitial lung disease resulting from the occupational inhalation of respirable crystalline silica over decades.
- With exposure to higher dust levels, the disease can also occur in acute and accelerated forms over shorter periods of time.
- Initially, patients are often asymptomatic. Subsequently, they may develop worsening respiratory symptoms and end-stage lung disease. As there are no effective treatments, silicosis may lead to premature death or lung transplant.
- Although deaths from silicosis have declined in the US, workers in certain industries continue to be exposed to silica dust



Burleigh Drilling-machine.

From Raymond, Mines and Mining, 187

## Hand-Held Power Tools Increase Productivity and the Risk of Silicosis

- First practical pneumatic drill patented in 1866

*In fact, it wasn't long before miners, tunnelers and quarrymen would be dying young, in droves, of a disease they called miner's consumption. This deadly disease, silicosis, was caused by the razor-sharp particles of dust kicked up by machine drills that they breathed into their lungs. There were those who took the attitude that the miners worked willingly in the mines with the drills they were beginning to call "widowmakers." It wasn't as if they didn't know that the work was dangerous.\**

\*John Henry v. Charles Burleigh's Drill Doreen Chary 1994

Mining History Association 1994

[A/1/Jua/https://www.mininghistoryassociation.org/Journal/MHJ-v1-1994-Chaky.pdf](https://www.mininghistoryassociation.org/Journal/MHJ-v1-1994-Chaky.pdf)



# Objective

This man is typical of thousands of workers in the US and, perhaps millions across the world, using unnecessarily hazardous equipment without suitable control measures.

The objective of these presentations is to help you improve your understanding and effectiveness in evaluation and control of workplace hazards using power tools as a model

Photo courtesy of Earl Dotter, Photo Journalist  
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## New Technology

New levels of productivity

New or Increased old hazards

- Dust
- Noise
- Vibration
- (Hand-arm Vibration Disease)
- Mechanical hazards
- Ergonomic risk factors

Photo courtesy of Earl Dotter, Photo Journalist

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# Silica in the US-An Abbreviated History

- 1713 Ramazani describes silicotic nodules in stone cutters<sup>(1)</sup>
- 1870s Mining and stonework create high mortality from silica –greatly amplified by new pneumatic power tools <sup>(2)</sup>
- 1938 US Department of Labor identified silicosis as a severe industrial disease which could be controlled by engineering and work practices
- 2017 OSHA Silica Standard released  
Enforceable in Sept 2018 in General industry and 2019 in Construction<sup>(3)</sup>
- 1990s-to present engineered stone emerges as a new silica hazard <sup>(3)</sup>
- 2023 Approximately 2 million US construction workers and 300,000 in other industries continue to have silica exposures <sup>(3)</sup>
- Silica exposures remain high in mining 46% remain > 50 ug/m<sup>3</sup> in 2019<sup>(3)</sup>
- 12563 Active mines in the US in 2022<sup>(4)</sup> employing 585,00 in 2023 <sup>(5)</sup>
- Suggest visiting some construction sites to see the current status!
- 2023 Appendix to SAE International Standard AS6228A and AIR 6916 provides practical guidance for power tool evaluation and selection.

(1) <https://onlinelibrary.wiley.com/doi/10.1111/resp.13695>

(2) <https://www.cdc.gov/niosh/silica/about/index.html>

(3) <https://onlinelibrary.wiley.com/doi/10.1002/ajim.23451>

(4) <https://www.statista.com/topics/6980/mining-in-the-united-states/#topicOverview>

(5) <https://www.statista.com/statistics/193214/employment-in-total-us-mining-industry-since-1998/>



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# Dust Control - A Process Control Issue- Need an Exposure Control Plan

1. Dust sources and related health / safety risks
2. Identification of hazardous components of materials being “worked.”
3. Selecting the right process
4. Wet methods
4. Local Exhaust Ventilation
5. Regulations and requirements
6. Protective equipment – should augment other controls
7. Regulated areas and containment of dust
8. Minimum selection and purchasing criteria (being addressed in Part 2)
8. Other factors of concern
9. Resources (Also see back-up slides)
9. Summary

# Examples of commonly machined materials and potential hazardous components

Material Being Machined or Cleaned	Common Processes	Potential Hazardous Components/ Constituents	Notes
Painted surfaces	Grinding for paint removal	Metals, particularly from paint pigments and residues of lead driers. Lead (as Pb) OSHA PEL and ACGIH TLV-TWA (0.05 mg/m <sup>3</sup> ). Chromium (includes lead chromates) Some paints have contained silica (sand) for opacity	Recent concern for nano particles Consider well-managed abrasive blasting in some cases.
Stainless steel Grinding surface finishing (often pre- or post-welding), drilling, polishing	Stainless steel Grinding surface finishing (often pre- or post-welding), drilling, polishing	Stainless steel Grinding surface finishing (often pre- or post-welding), drilling, polishing Nickel (typically as insoluble inorganic 0.2 mg/m <sup>3</sup> ).	Chrome (depends on form). Chrome is typically present in the less hazardous Cr(III) form, but likely to be oxidized to Cr(VI) by hot work such as welding.

Adapted from Table D1 – SAE Aerospace Information Report (AIR) 6916 Guide for Safety, Efficiency, and Productivity in Buying Power Hand Tools

More comprehensive list in OSHA Silica Std 29CFR1926.11153 Table 1

# Examples of commonly machined materials and potential hazardous components

Material Being Machined or Cleaned	Common Processes	Potential Hazardous Components/ Constituents	Notes
Masonry or stone (excepting limestone), concrete, sand, block, mortar, fiber cement board, engineered stone countertops	Grinding/tuck pointing  Initial cement mixing	Respirable crystalline silica. Very high silica content of engineered silica products.  Chromium in cement products	Caution for potential asbestos residues in older buildings, especially plaster. Asbestos cement/ Transite® boards, shingles
Wood and wood products	Sanding, cutting, turning	Some hardwoods and a few softwoods are suspected of causing sensitization (allergies). Wood dusts: TLV-TWA: Western Red Cedar 0.5 mg/m <sup>3</sup> , inhalable particulate matter. All other species, 1 mg/m <sup>3</sup> , inhalable particulate matter	Combustibility of wood dusts. Ensure prompt (daily) clean-up disposal of vacuumed dust to prevent spontaneous combustion in vacuum cleaners and explosion proof design ventilation system dust collectors.

Adapted from Table D1 – SAE Aerospace Information Report (AIR) 6916 Guide for Safety, Efficiency, and Productivity in Buying Power Hand Tools

# Identification of hazardous components of materials being “worked”

- Sometimes, it's not all in the name.
  - Knowing the components of materials.
  - MSDS/SDS help but may not be available or complete
- Spot testing and bulk sampling
  - Consider bulk sampling for older construction materials which might contain asbestos. (There were hundreds of uses for the “magic mineral”).
  - Metal components, especially for paints. There are some direct reading tests.
  - XRF for metals –especially lead- newer technology less susceptible to interference and might be used on some metal surfaces.
  - Silica in paints (sometimes added as an opacifier)
  - Don't' forget engineered wood products –binders and glues may release aldehydes and other irritants/ allergens



## Part 2 of 2 Silica Exposure with Risks from using Power Hand Tools



Ergonomic Tool Safety Selection  
Utilizing Life Cycle Costs

Who's in Your Toolbox?©

# Selecting the Right Process

- Wet work versus local exhaust
  - Local exhaust likely to be needed in cold, wet areas where water runoff may be an issue
  - Pneumatic equipment may be the best option in wet locations for electrical safety reasons. (despite the noise)
- Cases where dust control MUST be a part of the process.
  - Situations in which levels of non-toxic dust reach levels obscuring vision and safety, efficient process operation.
  - Highly-hazardous materials such as asbestos, beryllium
  - Combustible dusts – example wood dusts
- Clean-up must be part of the process!
  - HEPA VAC versus dry sweeping (small, non-visible particulate is the most respirable and damaging)
- Process alternatives for control dust.
  - Example - work in a glove box versus open air grinding.
  - Remove and replace lead-painted door frames and window frames
    - Don't try to sand/grind off the paint if there are alternatives.

# Use of Water for Dust Control- Jackhammer example

- Practical experiences with the use of water as a dust control measure for scabbling and jackhammering concrete.
- Echt, A; American Industrial Hygiene Conference and Exposition, May 21-26, 2005, Anaheim, California. Fairfax, VA American Industrial Hygiene Association, 2005 May;
- Control of Respirable Dust and Crystalline Silica from Breaking Concrete with a Jackhammer Applied Occupational and Environmental Hygiene · August 2003
- DOI: 10.1080/10473220301453 · Source: PubMed
- Water Spray Control of Hazardous Dust When Breaking Concrete with a Jackhammer DHHS (NIOSH) Publication No. 2008–127 (Handout)
- Source of spray nozzles <https://delavan.com/>

- Spray nozzle attached to a jackhammer suppressed dust by 70 to 90%



**Figure 2.** Diagram of water-spray control used in NIOSH study



**Figure 1.** The water spray attachment, showing the method used to attach the nozzle to the tool.

# Evaluation of wet methods for dust control

- Visual evaluation
  - Issue – some particle size
  - Visual impressions may not show smaller most respirable particles.
  - Misting water can still carry particulate and deposit
- Rate of water flow relative to design criteria
  - Can use a bucket and stopwatch.
- Potential for settled dust in the mist to dry
- Air sampling (some common construction process notionally exempt ***if relevant control measures are followed***)
  - Suggest some sampling for your own peace of mind!
  - Direct reading dust monitors for rapid results



A worker chips concrete with a jackhammer using a water-spray attachment to control dust. (Photo courtesy of NIOSH).

## Electrical Safety

Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites. These features are particularly important in wet or damp areas, such as where water is used to control dust.

[https://www.ehsdb.com/resources/Images-4/Silica\\_images/Jack%20hammers.pdf](https://www.ehsdb.com/resources/Images-4/Silica_images/Jack%20hammers.pdf) (accessed 2/27/25)

# Surface Contamination Criteria for dust control

- No surface contamination criteria or quantifications for skin absorption included in OSHA standards.<sup>(1)</sup>
- Some specific OSHA standards contain housekeeping provisions that address the issue of surface contamination.<sup>(2)</sup>
- Limit contaminant generation and maintain regulated areas
- EPA Lead standards lead paint abatement 40 CFR 745 <sup>(3)</sup>
  - 10 micrograms per square foot ( $\mu\text{g}/\text{ft}^2$ ) to 5  $\mu\text{g}/\text{ft}^2$  for floors,
  - 100  $\mu\text{g}/\text{ft}^2$  to 40  $\mu\text{g}/\text{ft}^2$  for window sills, and
  - 400  $\mu\text{g}/\text{ft}^2$  to 100  $\mu\text{g}/\text{ft}^2$  for window troughs.
  - Sampling specification ASTM E1792 (Pb wipe specification) <sup>(4)</sup>
- ASTM D6966 wipe standard for metals and ASTM E1792 Wipe Specifications <sup>(4)</sup>

<sup>(1)</sup> <https://www.osha.gov/surface-contamination/standards>

<sup>(2)</sup> <https://www.osha.gov/laws-regs/standardinterpretations/1985-06-21>

<sup>(3)</sup> <https://www.epa.gov/lead/hazard-standards-and-clearance-levels-lead-paint-dust-and-soil-tsca-sections-402-and-403>

<sup>(4)</sup> Standard Surface Sampling Methods for Metals, Kevin Ashley, Ph.D. (NIOSH) <https://www.cdc.gov/niosh/docs/2009-133/pdfs/dream2008-surfacebio-ashley1-niosh.pdf>



Educating workers about the risks associated with RCS exposure. This includes informing all workers, especially those in precarious work arrangements (e.g., contract workers, day laborers, or those working for cash), about the dangers of exposure. Education can involve:

- **Training Programs:** Conducting regular training sessions on RCS hazards, safe work practices, and the importance of protective measures.
- **Awareness Campaigns:** Sharing information about the risks of RCS exposure and preventive strategies.
- **Safety Guidelines:** Providing clear instructions on using engineering controls, respiratory protection, and wet methods to reduce exposure.
- **Monitoring and Feedback:** Ensuring workers understand the results of air sampling and the importance of ongoing monitoring.

These measures help workers recognize the risks and adopt safer practices.

# Local Exhaust?



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Could reduce clean-up, avoid fire hazards and reduce dust exposure

# Local Exhaust Ventilation

- The ACGIH Ventilation Handbooks and other bibles
- Enclose the process as much as possible
- Static pressure measurements
  - SP as easier than velocity measurements in many cases.
  - Dwyer Instruments (a major manufacture of manometers) <http://www.ipscustom.com>.
- Smoke tubes and visual airflow indicators.
- Dust disposal and control (especially flammable dusts)
- High velocity/ low volume local exhaust versus “ordinary” local exhaust.
  - Air velocity must be greater than the particle velocity and/or speed of the cutting wheel

## Correlating Ventilation Level with Dust Concentrations

Tool	Ventilation CFM	Respirable Dust Level mg/m <sup>3</sup>
4-inch grinding wheel	0	~ 20
4-inch grinding wheel	86	<0.2
Router	0	~ 20
Router	35	<0.2
EDCO Masonry Saw	0	13
EDCO Masonry Saw	206	0.05

## Ventilation Technical Notes

- Total dust measured with time-of flight aerosol spectrometer.
  - Mortar commonly contains about 25% silica (see notes)
- Minimum exhaust rate 20 CFM/inch of blade or grinding wheel diameter
  - Corelates with ACGIH criteria of 25 CFM/ inch of blade
- Grinder exhaust needs to exceed air flow speed and quantity induced by mechanical motion of particles ejected from the grinder.
- Typical grinding wheels have a rotational speed as high as 1200 rpm and surface speeds of 12,000 to 15,000 fpm

# Regulations and requirements

- OSHA Silica standard
  - Model for dust control programs
  - Some ability to utilize standard control measures in certain construction operations with limited sampling
  - References and information sources
  - <https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.1153>
  - <https://silica-safe.org/>
- Standards for other carcinogens, especially those involving regulated areas.
  - Some wood dusts are considered known or suspect carcinogens
  - Some wood dusts are suspect respiratory sensitizers (Appen D, 2025 TLVs)
- Lead OSHA Construction 29 CFR 1926.62 and General Industry Standard 29 CFR 1910.1025
  - <https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.62>
  - <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1025>

# OSHA Guidance for Engineered Stonework

<https://www.osha.gov/laws-regs/standardinterpretations/2023-09-22> (accessed 2-23-25)

Methods of Compliance (29 CFR § 1910.1053(f) and 29 CFR § 1926.1153(d)(3)).o CSHOs should verify the dust controls and safer work methods employers use to protect workers from silica exposures above the PEL. According to the OSHA and NIOSH [Hazard Alert](#), the following are control options for countertop manufacturing and finishing operations:

- Using water spraying systems and remote-controlled tools at the impact site where a saw or grinder generates dust.
- Large bridge or gantry-like saws usually use water sprays and can be remote-controlled for dust control and cooling.
- Hand-held angle grinders can be modified to deliver water to the point of contact with the stone.
- Wet-edge milling machines or stone routers can replace dry grinders in shops. They provide a clean edge profile with a diamond wheel.
- Using hand tools (e.g., drills, masonry saws, grinders) equipped with a shroud and a vacuum with a high efficiency particulate air (HEPA)-filter when wet methods are not practicable.
- Installing local exhaust ventilation (LEV) systems at fixed locations to capture dust at its point of origin.
- Using a combination of both water and ventilation controls, if necessary.
- Using wet sweeping or HEPA-filtered vacuuming instead of dry sweeping or compressed air.
- Replacing water and air filters as needed in accordance with manufacturer's instructions to control dust.
- Adjusting water flow as necessary to control dust, following manufacturers' recommendations for water flow rates.
- Pre-washing stone slabs prior to cutting.
- Implementing regular and thorough housekeeping procedures for water slurry and settled dust.
- In high exposure areas, such as where cutting or polishing work generates silica dust, provide HEPA filtered vacuums for cleaning worker clothes and water for hand, face, and hair cleaning.



## Feedback Survey



Your feedback is important to me!