OSHA’s Respirable Crystalline Silica Standard for Construction

Workers who are exposed to respirable crystalline silica dust are at increased risk of developing serious silica-related diseases. OSHA’s standard requires employers to take steps to protect workers from exposure to respirable crystalline silica.

What is Respirable Crystalline Silica?
Crystalline silica is a common mineral that is found in construction materials such as sand, stone, concrete, brick, and mortar. When workers cut, grind, drill, or crush materials that contain crystalline silica, very small dust particles are created. These tiny particles (known as “respirable” particles) can travel deep into workers’ lungs and cause silicosis, an incurable and sometimes deadly lung disease. Respirable crystalline silica also causes lung cancer, other potentially debilitating respiratory diseases such as chronic obstructive pulmonary disease, and kidney disease. In most cases, these diseases occur after years of exposure to respirable crystalline silica.

How are Construction Workers Exposed to Respirable Crystalline Silica?
Exposure to respirable crystalline silica can occur during common construction tasks, such as using masonry saws, grinders, drills, jackhammers and handheld powered chipping tools; operating vehicle-mounted drilling rigs; milling; operating crushing machines; using heavy equipment for demolition or certain other tasks; and during abrasive blasting and tunneling operations. About two million construction workers are exposed to respirable crystalline silica in over 600,000 workplaces.

What Does the Standard Require?
The standard (29 CFR 1926.1153) requires employers to limit worker exposures to respirable crystalline silica and to take other steps to protect workers. Employers can either use a control method laid out in Table 1 of the construction standard, or they can measure workers’ exposure to silica and independently decide which dust controls work best to limit exposures in their workplaces to the permissible exposure limit (PEL).

What is Table 1?
Table 1 matches 18 common construction tasks with effective dust control methods, such as using water to keep dust from getting into the air or using a vacuum dust collection system to capture dust. In some operations, respirators may also be needed. Employers who follow Table 1 correctly are not required to measure workers’ exposure to silica from those tasks and are not subject to the PEL.

### Table 1 Example: Handheld Power Saws
If workers are sawing silica-containing materials, they can use a saw with a built-in system that applies water to the saw blade. The water limits the amount of respirable crystalline silica that gets into the air.

<table>
<thead>
<tr>
<th>Equipment/Task</th>
<th>Engineering and Work Practice Control Methods</th>
<th>Required Respiratory Protection and Minimum Assigned Protection Factor (APF)</th>
</tr>
</thead>
</table>
| Handheld power saws (any blade diameter)| Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer’s instructions to minimize dust emissions.  
• When used outdoors.  
• When used indoors or in an enclosed area. | None  
APF 10  
APF 10 |

Excerpt from Table 1 in 29 CFR 1926.1153

In this example, if a worker uses the saw outdoors for four hours or less per day, no respirator would be needed. If a worker uses the saw for more than four
hours per day or any time indoors, he or she would need to use a respirator with an assigned protection factor (APF) of at least 10, such as a NIOSH-certified filtering facepiece respirator that covers the nose and mouth (sometimes referred to as a dust mask). See the respiratory protection standard (29 CFR 1910.134) for information on APFs.

**Alternative Exposure Control Methods**

Employers who do not fully implement the control methods on Table 1 must:

- **Determine the amount of silica that workers are exposed to** if it is, or may reasonably be expected to be, at or above the action level of 25 μg/m$^3$ (micrograms of silica per cubic meter of air), averaged over an 8-hour day;
- Protect workers from respirable crystalline silica exposures above the PEL of 50 μg/m$^3$, averaged over an 8-hour day;
- Use dust controls and safer work methods to protect workers from silica exposures above the PEL; and
- Provide respirators to workers when dust controls and safer work methods cannot limit exposures to the PEL.

**What Else Does the Standard Require?**

Regardless of which exposure control method is used, all construction employers covered by the standard are required to:

- Establish and implement a written exposure control plan that identifies tasks that involve exposure and methods used to protect workers, including procedures to restrict access to work areas where high exposures may occur;
- Designate a competent person to implement the written exposure control plan;
- Restrict housekeeping practices that expose workers to silica, such as use of compressed air without a ventilation system to capture the dust and dry sweeping, where effective, safe alternatives are available;
- Offer medical exams—including chest X-rays and lung function tests—every three years for workers who are required by the standard to wear a respirator for 30 or more days per year;
- **Train workers** on the health effects of silica exposure, workplace tasks that can expose them to silica, and ways to limit exposure; and
- Keep records of workers’ silica exposure and medical exams.

**Additional Information**

Additional information on OSHA’s silica standard can be found at [www.osha.gov/silica](http://www.osha.gov/silica).

OSHA can provide compliance assistance through a variety of programs, including technical assistance about effective safety and health programs, workplace consultations, and training and education.

OSHA’s On-Site Consultation Program offers free, confidential occupational safety and health services to small and medium-sized businesses in all states and several territories across the country, with priority given to high-hazard worksites. On-Site consultation services are separate from enforcement and do not result in penalties or citations. Consultants from state agencies or universities work with employers to identify workplace hazards, provide advice on compliance with OSHA standards, and assist in establishing and improving safety and health management systems. To locate the OSHA On-Site Consultation Program nearest you, call 1-800-321-OSHA or visit [www.osha.gov/consultation](http://www.osha.gov/consultation).

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CONTROL OF SILICA DUST IN CONSTRUCTION

Handheld Power Saws

Using a handheld power saw (also called a cut-off saw) to cut masonry, concrete, stone, or other silica-containing materials can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of dust that gets into the air when using handheld power saws with an integrated water delivery system as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153. This fact sheet does not apply to handheld saws used to cut fiber-cement board.

**Engineering Control Method:** Water applied continuously to the saw blade

**Wet Cutting**

Many handheld power saws come equipped with an integrated water delivery system designed to cool the blade by directing a continuous stream of water onto the blade where it wets the material being cut and reduces the amount of dust generated when cutting. Water can be supplied to the saw by either a pressurized container or by a constant water supply such as a hose connected to a faucet or construction site water supply. Water flow rates must be sufficient to minimize release of visible dust.

The saw must be operated and maintained in accordance with manufacturer’s instructions to minimize dust emissions. Focus on the following areas:

- **Check** that hoses are securely connected and are not cracked or broken.
- **Adjust** nozzles so that water goes to the blade and wets the cutting area.
- **Inspect** the saw blade before use to be sure it is in good condition and does not show excessive wear.
- **Maintain** and operating the saw’s dust-control equipment based on the manufacturer’s instructions.

Clean up any slurry produced to prevent the slurry from drying and releasing silica dust into the air. Wet slurry can be cleaned up using, for example, shovels or a wet vacuum equipped with a HEPA filter.

**Wet Cutting Indoors or in Enclosed Areas**

Wet cutting indoors or in enclosed areas may not reliably keep silica exposures low, so extra ventilation or a means of exhaust may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation
Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers’ breathing zones.

Electrical Safety. Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.

Respiratory Protection
In addition to using wet cutting methods, respiratory protection with a minimum Assigned Protection Factor (APF) of 10 is required on Table 1 when wet cutting with handheld masonry saws indoors or in an enclosed area, or used outdoors for more than four hours per shift.

When respirators are required, employers must put in place a written respiratory protection program in accordance with OSHA’s Respiratory Protection standard 29 CFR 1910.134.

Additional Information
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• Review records of work-related injuries and illnesses.
• File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA’s rules. OSHA will keep all identities confidential.
• Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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U.S. Department of Labor
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CONTROL OF SILICA DUST IN CONSTRUCTION

Handheld Grinders for Tasks Other Than Mortar Removal

The use of a handheld grinder to smooth or cut the surfaces of concrete, masonry or other silica containing materials can generate respiratory crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust control that can be used to minimize the amount of airborne dust when using handheld grinders for uses other than mortar removal as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

**Engineering Control Method:** Water applied continuously to the grinding wheel OR Vacuum Dust Collection System

Two methods for controlling dust when operating handheld grinders for smoothing or cutting surfaces, and uses other than mortar removal are: (1) use a grinder equipped with an integrated water delivery system (outdoors only); or (2) use a grinder equipped with a commercially available shroud and vacuum dust collection system. The grinder must be operated and maintained in accordance with the manufacturer’s instructions to minimize dust emissions.

**Wet Methods**

Grinders equipped with an integrated water delivery system can be used to control dust when cutting, grinding, or polishing granite, concrete or other materials containing crystalline silica outdoors. A water faucet or pressurized container can be used to supply a constant spray of water to the grinding wheel. When used outdoors, water-fed grinders can control dust on uneven surfaces and near corners and edges more effectively than vacuum dust collection systems.

**Electrical Safety.** Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.

Make sure to:

- **Check** that hoses are securely connected and are not cracked or broken.
- **Adjust** nozzles so that water goes to the grinding surface or cut point. Water flow rates must be sufficient to minimize the release of visible dust.
- **Set** a regular schedule for maintenance and cleaning of the tool and control.
Clean up any slurry produced to prevent the slurry from drying and releasing silica dust into the air. Wet slurry can be cleaned up using, for example, shovels or a wet vacuum equipped with a HEPA filter.

**Vacuum Dust Collection System (VDCS)**

Employers can also comply with Table 1 in the silica standard by using a VDCS to control dust when using a handheld grinder. Use a:

- Commercially available shroud and dust collection system on the grinding wheel appropriate for the grinder and wheel size.
- Vacuum that provides at least 25 cubic feet per minute (cfm) of airflow per inch of blade to capture dust at the point of grinding. For example, a 5" grinding wheel would require a rating of 125 cfm of air flow or more for effective capture.
- Vacuum equipped with a cyclonic pre-separator or filter-cleaning mechanism with a filter that has 99 percent or greater collection efficiency for respirable-sized particles.
- Vacuum exhaust hose capable of providing the airflow recommended by the tool manufacturer. A 1.5" to 2" diameter vacuum exhaust hose is typically adequate.

Make sure to:

- **Keep** the vacuum hose clear and free of debris, kinks, and tight bends.
- **Follow** the equipment manufacturer’s directions on how to reduce dust buildup on the filter.
- **Change** vacuum-collection bags as directed by the manufacturer. **Do not overfill the bag.**
- **Set** a regular schedule for maintenance and filter cleaning of the drill and VDCS.
- **Avoid** exposure to dust when changing vacuum bags and cleaning or replacing air filters.

**Respiratory Protection**

When properly used, wet methods can effectively control exposure to silica dust. Therefore, Table 1 does not require the use of respiratory protection when operating handheld grinders outdoors using wet methods.

When using a VDCS, respiratory protection with a minimum Assigned Protection Factor (APF) of 10 is required whenever handheld grinders are used indoors or in enclosed areas for more than 4 hours per shift.

When respirators are required, employers must put in place a written respiratory protection program in accordance with OSHA’s Respiratory Protection Standard 29 CFR 1910.134.

**Use of Compressed Air:** Unless there is a ventilation system that effectively captures the dust cloud, do not use compressed air or blowers to clean surfaces, clothing or filters because it can increase exposure to silica. Instead, clean only with a HEPA filter-equipped vacuum or by wet methods.

**Indoors or in Enclosed Areas**

Using a handheld grinder with a VDCS indoors or in an enclosed area may not be relied on to keep exposure low, so extra ventilation may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable fans
- Air ducts
- Other means of mechanical ventilation

Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers’ breathing zones.

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• Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Handheld Power Saws Used to Cut Fiber-Cement Board

Using a handheld circular saw to cut fiber-cement board can generate respirable crystalline silica dust. When inhaled over time, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls to minimize the amount of airborne dust when using handheld circular saws with a blade diameter of 8 inches or less to cut fiber-cement board as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

Engineering Control Method: Vacuum Dust Collection System

Fiber-cement board is a composite material made from cement, sand, and cellulose fibers. Cutting fiber-cement boards with high speed circular saws generates airborne dust that contains respirable crystalline silica. Specialty saw blades having 4–8 teeth reduce the amount of respirable dust compared to standard masonry blades. Blades with polycrystalline diamond tips are recommended for longer cutting life.

Vacuum Dust Collection System (VDCS)

A commercially-available VDCS can be used to control dust when cutting fiber-cement board outdoors with a handheld power saw equipped with a blade of 8 inches or less.

The VDCS includes:

- A handheld circular saw with a partially enclosed saw blade equipped with either an integrated dust collection port, or a commercially available adapter installed per manufacturer’s directions.
- A fiber-cement saw blade less than 8 inches in diameter.
- A vacuum that is recommended by the tool manufacturer with enough air flow to capture dust at the cutting point. Use a vacuum rated at 80 cubic feet per minute or higher for effective capture.
- Filter with a 99 percent or greater efficiency in the vacuum exhaust. HEPA filters may be used but are not required. For longer filter life, use of a disposable filter bag or cyclone pre-filter is recommended.
- A vacuum exhaust hose capable of providing the airflow recommended by the tool manufacturer. A 1.25” to 2” diameter vacuum hose is typically adequate.

A VDCS is most effective when workers are properly trained and use good work practices. Focus on the following areas:

- **Keep** the vacuum hose clear and free of debris, kinks, and tight bends.
• **Turn** the vacuum off and on regularly to reduce dust buildup on the filter, if it is not self-cleaning. For best results, use a vacuum with an actuator switch that allows the vacuum to be powered on and off using the saw.
• **Change** vacuum-collection bags at least as often as the manufacturer recommends.
• **Set up** a regular schedule for maintenance.
• **Avoid** exposure to dust when changing vacuum bags and cleaning or replacing air filters.

**Compressed Air.** Unless there is a ventilation system that effectively captures the dust cloud, do not use compressed air or blowers to clean surfaces, clothing, or filters because it can increase exposure to silica. Instead, clean only with a HEPA filter-equipped vacuum or by wet methods.

**Respiratory Protection**
When properly used, a VDCS can effectively control silica dust. Therefore, Table 1 does not require use of respiratory protection when cutting fiber-cement board outdoors using a handheld power saw with a blade 8 inches or smaller in diameter. For indoor use, or with blades larger than 8 inches, Table 1 does not apply and the employers must conduct an exposure assessment and may need to take additional action, including the implementation of a respiratory protection program.

**Additional Information**
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• Review records of work-related injuries and illnesses.
• File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA’s rules. OSHA will keep all identities confidential.
• Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Jackhammers or Handheld Powered Chipping Tools

The use of a jackhammer or handheld power chipping tools to break or demolish concrete, stone, masonry or other silica-containing materials can generate respirable crystalline silica dust. When inhaled over time, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using jackhammers or handheld powered chipping tools as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

| Engineering Control Method: Water applied continuously to the impact point OR Shroud with Vacuum Dust Collection System |

Two methods for controlling dust when using jackhammers or powered chipping tools are: (1) continuously feed water to the point of impact; or (2) use a shroud or cowling with a vacuum dust collection system.

**Wet Methods**

When jackhammering, wetting must occur with a continuous stream or spray of water at the point where the jackhammer’s tip strikes the surface material. Employers may use manual spraying or water-spray systems. Under either approach, water must be applied at a flow rate sufficient to minimize the release of visible dust.

**Manual Spraying.** One option for applying water when jackhammering is to have one worker direct a stream or spray of water at the impact point while another worker operates the jackhammer or powered chipping tool. A portable sprayer with a nozzle can be used for this job.

**Electrical Safety.** Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.

Only wetting the surface is not sufficient. Continuous water application either streamed or sprayed at the point where the jackhammer or handheld powered chipping tool breaks the surface is necessary because as the tool breaks through the surface, dry materials below are disturbed, which can produce dust.

**Water-Spray Systems.** Spray nozzles aimed at the tip of the tool on jackhammers and handheld powered chipping tools can lower silica exposures. Existing equipment can be retrofitted. The

Employers are responsible for keeping equipment in good working condition to minimize dust. Workers must receive training on how to use dust suppression equipment.

- **Dust and debris can clog spray nozzles.** Check the nozzle frequently. Observe the water spray to be sure it is directed at the point of impact. Clean or change if the nozzle is dripping or spurting.
- **Take steps to provide consistent water flow.** Make sure there is an adequate supply of water. Prevent kinked hoses, heavy equipment, or other vehicle traffic from running over hoses, and identify other potential blockages and impediments that could cause a drop in water pressure.
- **The spray angle is critical.** Check the water-spray angle frequently. Make sure the spray is focused on the breakpoint and the spray is wetting the dust before it spreads away from the tip of the hammer.

Clean up any slurry produced to prevent the slurry from drying and releasing silica dust into the air. Wet slurry can be cleaned up using, for example, shovels or a wet vacuum equipped with a HEPA filter.

**Vacuum Dust Collection System (VDCS)**

Employers may use commercially available VDCSs for jackhammers and handheld powered chipping tools to reduce silica exposure. A VDCS includes a:

- hood or shroud for the tool that is recommended by the manufacturer;
- vacuum meeting the specifications recommended by the tool manufacturer, with enough suction to capture dust at the cutting point;
- dust collector equipped with a filter efficiency of 99 percent or greater and a filter-cleaning mechanism; and
- vacuum exhaust hose capable of providing the airflow recommended by the tool manufacturer. A 1.5” to 2” diameter vacuum exhaust hose is typically adequate.

The tool and VDCS must be operated and maintained in accordance with manufacturers’ instructions to minimize dust emissions. Focus on the following areas:

- **Keep** the vacuum hose clear and free of debris, kinks and tight bends.
- **Change** vacuum-collection bags as needed or at least as often as the manufacturer recommends. Do not over fill the bag.
- **Set** a regular schedule for maintenance and filter cleaning of the VDCS.
- **Avoid** exposure to dust when changing vacuum bags and cleaning or replacing air filters.

**Indoors or in Enclosed Areas**

When jackhammers or chipping tools are used indoors or in an enclosed area, wet methods or a VDCS may not reliably keep exposure low. Extra ventilation may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Ensure that air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows.

Position the ventilation to move contaminated air away from the workers’ breathing zones.
Use of Compressed Air. Unless there is a ventilation system that effectively captures the dust cloud, do not use compressed air or blowers to clean surfaces, clothing or filters because it can increase exposure to silica. Instead, clean with a HEPA filter-equipped vacuum or by wet methods.

Respiratory Protection
In addition to using wet methods or a VDCS, the use of respiratory protection with a minimum Assigned Protection Factor (APF) of 10 is required whenever jackhammers or handheld powered chipping tools are used indoors or in an enclosed area. APF 10 respirators are also required when jackhammers or handheld powered chipping tools are used outdoors for more than 4 hours per shift.

When respirators are required, employers must put in place a written respiratory protection program in accordance with OSHA’s Respiratory Protection standard 29 CFR 1910.134.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Handheld and Stand-Mounted Drills

The use of handheld and stand-mounted drills, impact and rotary hammer drills, and similar tools used to drill holes in concrete, masonry, or other silica-containing materials can generate respirable crystalline silica dust. When inhaled over time, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using handheld and stand-mounted drills as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

Engineering Control Method: Vacuum Dust Collection System

Vacuum Dust Collection System (VDCS)

When using handheld or stand mounted drills to drill into concrete or other materials that contain crystalline silica, reduce exposure to silica dust by enclosing the drill in a commercially available shroud or cowling with a vacuum attached to capture the silica dust as it is generated around the drill bit.

A VDCS is commercially available in a variety of designs that include a dust collection device (shroud or cowling), vacuum, hose, filter, and filter-cleaning mechanism. These systems are typically available integrated into the tools or as add-on systems.

The VDCS must be equipped with a:

- Shroud or cowling sized to fit around the drill bit that is compatible with the manufacturer’s vacuum system;
- Vacuum that is rated to provide the airflow recommended by the tool manufacturer or greater to remove dust at the drilling point; and
- Air filter with a 99 percent or greater efficiency and a filter cleaning mechanism.

The drill and VDCS must be operated and maintained in accordance with the manufacturer’s instructions to minimize dust emissions. Focus on the following areas:

- Keep the vacuum hose clear and free of debris, kinks and tight bends.
- Activate any non-automatic filter-cleaning mechanism as needed to reduce dust buildup on the filter.
- Change vacuum-collection bags as needed.
- Set a schedule for filter cleaning and maintenance.
- Avoid exposure to dust when changing vacuum bags and cleaning or replacing air filters.

When necessary to clean the dust and debris from the drilled holes, a HEPA-filtered vacuum system must be used to capture the dust.
**Indoors or in Enclosed Areas**

Using a VDCS indoors or in enclosed areas may not reliably keep silica exposures low, so extra ventilation may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers’ breathing zones.

**Compressed Air.** Unless there is a ventilation system that effectively captures the dust cloud, do not use compressed air or blowers to clean surfaces, clothing or filters because it can increase exposure to silica. Instead, clean with a HEPA-filter equipped vacuum or by wet methods.

**Respiratory Protection**

When properly used, a VDCS can reduce airborne dust levels to below the permissible exposure limit (PEL) of 50 μg/m³, calculated as an 8-hour time-weighted average. Therefore, respiratory protection is not required when using drills equipped with a VDCS and a filter cleaning mechanism as specified earlier.

**Additional Information**

For more information, visit [www.osha.gov/silica](http://www.osha.gov/silica) and see the OSHA Fact Sheet on the [Crystalline Silica Rule for Construction](http://www.osha.gov/silica), and the [Small Entity Compliance Guide for the Respirable Crystalline Silica Standard for Construction](http://www.osha.gov/silica).

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**How to Contact OSHA**

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Worker drilling horizontal holes in a concrete wall using two stand-mounted drills equipped with two dust collectors. Note that the shrouds around drill bits, black hose, and dust collector are attached conveniently to the stand.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Stationary Masonry Saws

Using a stationary masonry saw to cut bricks, concrete blocks, pavers, or other silica-containing materials can generate respirable crystalline silica dust. When inhaled over time, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using stationary masonry saws as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

| Engineering Control Method: Water applied continuously to the saw blade |

**Wet Cutting**

When using a stationary masonry saw, wet cutting with an integrated water delivery system that continuously feeds water to the blade is an effective way to reduce exposure to silica dust. Many stationary masonry saws come equipped with a water basin that holds several gallons of water. A pump recirculates the water through a nozzle that directs a continuous stream onto the blade where it wets the material being cut and reduces the amount of dust generated.

- Check that hoses are securely connected and are not cracked or broken.
- Ensuring that water flows at the rates recommended by the manufacturer. Water flow rates must be sufficient to minimize the release of visible dust.
- Adjust nozzles so that water goes to the blade and wets the cutting area.
- Rinsing or replacing water filters at recommended intervals.
- Replace basin water when it gets gritty or begins to silt up with dust.
- Inspect the saw blade before use to be sure it is in good condition and does not show excessive wear.

**Indoors or in Enclosed Areas**

Wet cutting indoors or in enclosed areas may not reliably keep silica exposures low, so extra ventilation or a means of exhaust may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers’ breathing zones.

A worker cutting masonry block on a stationary masonry saw that continuously feeds water to the blade.
**Electrical Safety.** Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.

**Vacuum Dust Collection System (VDCS)**

Some stationary masonry saws come equipped with a VDCS to capture the dust generated when sawing. For situations in which wet methods are not feasible, employers using a VDCS to control the dust must conduct an exposure assessment and may need to take additional action.

**Respiratory Protection**

When properly used, wet methods can effectively control silica dust. Therefore, Table 1 in the silica standard does not require use of respiratory protection when using wet methods for stationary masonry saws.

For stationary saws used with a VDCS by employers not utilizing Table 1 control methods, respiratory protection may be required if exposure monitoring results indicate employee exposures above the permissible exposure limit (PEL) of 50 μg/m³, calculated as an 8-hour time-weighted average. When using VDCS in these conditions, employers must put in place a written respiratory protection program in accordance with OSHA's Respiratory Protection standard 29 CFR 1910.134.

**Additional Information**

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CONTROL OF SILICA DUST IN CONSTRUCTION

Handheld Grinders for Mortar Removal (Tuckpointing)

The use of a handheld grinder to remove mortar when tuckpointing can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes control measures to minimize the amount of airborne dust when using handheld grinders to remove mortar between brick, stone, and concrete blocks as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

**Engineering Control Method:** Vacuum Dust Collection System

**Vacuum Dust Collection System (VDCS)**
A VDCS can be used to capture the dust generated when removing mortar with a handheld grinder. Employers can comply with Table 1 in the silica standard by using a:

- Commercially available shroud on the grinding wheel designed to fit the grinder and wheel size.
- Vacuum that provides at least 25 cubic feet per minute (cfm) of airflow per inch of blade to capture dust at the point of grinding and removing mortar. For example, a 5” grinding wheel would require a rating of 125 cfm of airflow or more for effective capture.
- Vacuum equipped with a cyclonic pre-separator or filter-cleaning mechanism with a filter that has 99 percent or greater collection efficiency for respirable-sized particles.
- Vacuum exhaust hose capable of providing the airflow recommended by the tool manufacturer. A 1.5” to 2” diameter vacuum exhaust hose is typically adequate.

The grinder and dust collector must be operated and maintained in accordance with the manufacturer’s instructions to minimize dust emissions. VDCSs are most effective when workers are properly trained and use good work practices, including:

- **Make sure to keep** the vacuum hose clear and free of debris, kinks, and tight bends.
- **Follow** the equipment manufacturer’s directions on how to reduce dust buildup on the filter.
- **Change** vacuum-collection bags as needed. Do not overfill the bag.
- **Set** a regular schedule for maintenance and filter cleaning of the grinder and VDCS.
- **Avoid** exposure to dust when changing vacuum bags and cleaning or replacing air filters.

Photo courtesy of OSHA

Worker grinding mortar from between bricks (tuckpointing) with a handheld grinder equipped with a shroud and dust collection system using respiratory protection.
Proper handling of the handheld grinder is very important. Ensure the following occurs:

- **Place** one side of the shroud against the working surface before inserting the blade into the mortar joint. This directs the dust into the shroud as the blade cuts into the mortar joint.
- **Keep** the shroud tight against the working surface. This cuts down on dust that would otherwise escape from the collection system.
- **Move** the grinder counter to the direction of blade rotation to minimize escaping dust.
- **Back off** the cutting pressure of the blade a short distance before removing it from the slot so the vacuum can have enough time to clear any dust buildup.
- **Do not** move the grinder back and forth along the slot, as this will create a gap that increases dust escape. For better results, move the grinder in one direction, making a second pass only if necessary.
- **Use** only enough cutting force to operate the tool effectively and keep the leading tool edge flush against the working surface. Do not leave a large gap between the shroud and uncut mortar.

**Use of Compressed Air.** Unless there is a ventilation system that effectively captures the dust cloud, do not use compressed air or blowers to clean surfaces, clothing, or filters because it can increase exposure to silica. Instead, clean with a HEPA filter-equipped vacuum or by wet methods.

**Indoors or in Enclosed Areas**

Using a VDCS indoors or in an enclosed area may not reliably keep exposure low, so extra ventilation may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers' breathing zones.

**Respiratory Protection**

In addition to using a VDCS, respiratory protection with a minimum Assigned Protection Factor (APF) of 10 is also required whenever a handheld grinder for mortar removal is used for **4 hours or less** per shift. Respiratory protection with a minimum APF of 25 is required whenever a handheld grinder for mortar removal is used for **more than 4 hours** per shift.

When respirators are required, employers must put in place a written respiratory protection program in accordance with OSHA’s Respiratory Protection standard 29 CFR 1910.134.
Additional Information
For more information, visit www.osha.gov/silica and see the OSHA Fact Sheet on the Crystalline Silica Rule for Construction, and the Small Entity Compliance Guide for the Respirable Crystalline Silica Standard for Construction.

OSHA can provide compliance assistance through a variety of programs, including technical assistance about effective safety and health programs, workplace consultations, and training and education. OSHA’s On-Site Consultation Program offers free, confidential occupational safety and health services to small and medium-sized businesses in all states and several territories across the country, with priority given to high-hazard worksites. On-Site consultation services are separate from enforcement and do not result in penalties or citations. To locate the OSHA On-Site Consultation Program nearest you, visit www.osha.gov/consultation.

Workers’ Rights
Workers have the right to:
• Working conditions that do not pose a risk of serious harm.
• Receive information and training (in a language and vocabulary the worker understands) about workplace hazards, methods to prevent them, and the OSHA standards that apply to their workplace.
• Review records of work-related injuries and illnesses.
• File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA’s rules. OSHA will keep all identities confidential.
• Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Walk-Behind Saws

Using a walk-behind saw to cut masonry, concrete, stone, or other silica-containing materials can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of dust that gets into the air when using walk-behind saws as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

**Engineering Control Method:** Water continuously fed to saw blade

**Wet Cutting**

Wet cutting is an effective method to reduce exposure to silica dust when using walk-behind saws equipped with an integrated water delivery system that directs a continuous stream of water onto the blade where it wets the material being cut and reduces the amount of dust generated. These saws have built-in water tanks, or water is supplied to the saw from a source such as a hose connected to a faucet or portable tank. Water flow rates must be sufficient to minimize the release of visible dust.

Clean up any slurry produced during wet cutting to prevent the slurry from drying and releasing silica dust into the air. Wet slurry can be cleaned up using, for example, shovels or a vacuum equipped with a HEPA filter.

**Indoors or in Enclosed Spaces**

Using wet methods indoors or in an enclosed area may not reliably keep exposure low, so extra ventilation may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers’ breathing zones.
Electrical Safety. Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.

Respiratory Protection

When properly used outdoors, wet methods can effectively control silica dust. Therefore, Table 1 in the silica standard does not require use of respiratory protection when cutting with walk-behind saws using wet methods outdoors.

However, when wet cutting with walk-behind saws indoors or in enclosed areas, Table 1 requires the use of respiratory protection with a minimum Assigned Protection Factor (APF) of 10. When respirators are required, employers must put in place a written respiratory protection program in accordance with OSHA's Respiratory Protection standard 29 CFR 1910.134.

Additional Information

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Workers’ Rights

Workers have the right to:

- Working conditions that do not pose a risk of serious harm.
- Receive information and training (in a language and vocabulary the worker understands) about workplace hazards, methods to prevent them, and the OSHA standards that apply to their workplace.
- Review records of work-related injuries and illnesses.
- File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA’s rules. OSHA will keep all identities confidential.
- Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Drivable Saws

Using a drivable saw to cut masonry, concrete, stone, or other silica-containing materials can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using drivable saws as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

**Engineering Control Method:** Water continuously fed to saw blade

**Wet Cutting**

Wet cutting is an effective method to reduce exposure to silica dust when outdoors using drivable saws equipped with an integrated water delivery system. This system directs a continuous stream of water onto the blade where it wets the materials being cut and reduces the amount of dust generated. These saws have built-in water tanks, or water is supplied to the saw from a source such as a hose connected to a faucet or portable tank. Water flow rates must be sufficient to minimize the release of visible dust.

- **Check** that hoses are securely connected and are not cracked or broken.
- **Adjust** nozzles so that water goes to the blade and wets the cutting area.
- **Inspect** the saw blade before use to be sure it is in good condition and does not show excessive wear.

Clean up any slurry produced during wet cutting to prevent the slurry from drying and releasing silica dust into the air. Wet slurry can be cleaned up using shovels or a wet vacuum equipped with a HEPA filter.

If employers operate drivable saws indoors or in an enclosed area, they must conduct an exposure assessment and may need to take additional action.

**Electrical Safety.** Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.

**Respiratory Protection**

When properly used outdoors, wet methods can effectively control silica dust. Therefore, Table 1 in the silica standard does not require use of respiratory protection when using wet methods.

![A construction worker cutting pavement using a drivable saw with an integrated water delivery system.](image_url)
for outdoor operation of drivable saws. Table 1 does not apply to drivable saws used indoors or in enclosed areas. Therefore, if drivable saws are operated indoors or in an enclosed area, employers must conduct an exposure assessment and may need to take additional action including the use of respiratory protection.

When respirators are required, employers must put in place a written respiratory protection program in accordance with OSHA’s Respiratory Protection standard 29 CFR 1910.134.

**Additional Information**

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- Receive information and training (in a language and vocabulary the worker understands) about workplace hazards, methods to prevent them, and the OSHA standards that apply to their workplace.
- Review records of work-related injuries and illnesses.
- File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA's rules. OSHA will keep all identities confidential.
- Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Rig-Mounted Core Saws or Drills

The use of rig-mounted core saws or drills to cut holes in concrete, masonry, or other silica-containing materials can generate respirable crystalline silica dust. When inhaled over time, the small particles of silica can irreversibly damage the lungs. This fact sheet describes methods to minimize the amount of airborne dust when using core saws or drills as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

Engineering Control Method: Water applied to cutting surface

Wet Methods
Wet cutting is an effective way to reduce the amount of silica dust when using a rig-mounted core saw or drill. Many types of core saws and drills come equipped with an integrated water delivery system that directs a continuous stream onto the blade/drill bit where it wets the material being drilled and reduces the amount of dust generated. Water flow rates must be sufficient to minimize the release of visible dust.

The rig-mounted core saw or drill must be operated and maintained in accordance with manufacturer’s instructions to minimize dust emissions. Focus on the following areas:

- **Check and make sure** that hoses are securely connected and are not cracked or broken.
- **Adjust** nozzles so that water goes to the blade and wets the cutting area.
- **Inspect** the saw blade/drill bit to be sure it is in good condition and does not show excessive wear.

Clean up any slurry produced to prevent the slurry from drying and releasing silica dust into the air. Wet slurry can be cleaned up using, for example, shovels or a wet vacuum equipped with a HEPA filter.

Indoors or in Enclosed Areas
Using wet methods indoors or in an enclosed area may not reliably keep exposure low, so extra ventilation may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from workers’ breathing zones.

Respiratory Protection
When properly used, wet methods can effectively control exposure to silica dust. Therefore, Table 1 does not require use of respiratory protection when operating rig-mounted core saws and drills using wet methods.
**Electrical Safety.** Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.

**Vacuum Dust Collection System (VDCS)**
For situations in which wet methods are not feasible, some rig-mounted core saws or drills come equipped with a VDCS to capture the dust generated when sawing. When operated with a VDCS instead of wet methods, Table 1 does not apply and therefore the employer must conduct an exposure assessment and may need to take additional actions such as implementing a respiratory protection program.

When respirators are required, employers must put in place a respiratory protection program in accordance with OSHA's Respiratory Protection Standard, 29 CFR 1910.134.

**Additional Information**
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- Review records of work-related injuries and illnesses.
- File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA's rules. OSHA will keep all identities confidential.
- Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Dowel Drilling Rigs for Concrete

The use of dowel drilling rigs, also known as gang drills, to drill holes in concrete can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using dowel drills outdoors to drill concrete as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

Engineering Control Method: Vacuum Dust Collection System

Vacuum Dust Collection System (VDCS)

When drilling concrete outdoors, dowel drills need to be equipped with a VDCS. A HEPA-filtered vacuum must be used when cleaning dust from holes. Use of dowel drills indoors or in an enclosed space, or drilling materials other than concrete, is not covered by Table 1.

A VDCS can reduce silica exposures when using dowel drilling rigs. VDCSs include a dust collector (hood or shroud), vacuum, hose, and filter(s). The VDCS must include:

- Filter with a 99% or greater efficiency in the vacuum exhaust with a filter cleaning mechanism; and
- Vacuum with a 1.5” to 2” diameter hose will typically provide enough air flow to capture dust at the bit and work surface.

VDCSs are most effective when workers are properly trained on the processes and equipment, and use good work practices. Focus on the following:

- **Keep** the vacuum hose clear and free of debris, kinks and tight bends.
- **Change** vacuum-collection bags as needed. Do not overfill the bags.
- **Set up** a regular schedule for maintenance.
- **Avoid** exposure to dust when changing vacuum bags and cleaning or replacing air filters.

Compressed air should not be used to clean drilled holes unless it is used in conjunction with a HEPA filter-equipped vacuum.

**Use of Compressed Air.** Unless there is a ventilation system that effectively captures the dust cloud, do not use compressed air or blowers to clean surfaces, clothing, or filters because it can increase exposure to silica. Instead, clean with a HEPA filter-equipped vacuum or by wet methods.

**Respiratory Protection**

In addition to using a VDCS, respiratory protection with a minimum Assigned Protection Factor (APF) of 10 is also required whenever dowel drilling rigs for concrete are used. When dowel drilling is conducted indoors or...
in an enclosed space, Table 1 does not apply and employers must conduct an exposure assessment and may need to take additional action, including the use of respiratory protection with a higher APF.

Because respirators are required when dowel drilling outdoors, employers must put in place a written respiratory protection program in accordance with OSHA’s Respiratory Protection standard 29 CFR 1910.134.

Additional Information
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Workers’ Rights
Workers have the right to:
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• Review records of work-related injuries and illnesses.
• File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA’s rules. OSHA will keep all identities confidential.
• Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Vehicle-Mounted Drilling Rigs for Rock and Concrete

Using drilling rigs mounted on trucks, crawlers, or other vehicles to drill into rock or concrete can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using vehicle-mounted drilling rigs for rock and concrete as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

**Engineering Control Method:** Dust collection systems with water sprays at the discharge point OR Operator isolation in an enclosed cab with water on drill bit

**Dust Collection Systems/Wet Methods**

Dust-collecting equipment for vehicle-mounted drills includes a movable duct attached to a close capture hood or shroud around the drill bit, and a flexible rubber skirt that encloses the drill hole opening and captures cuttings that come through the hole.

Dusty air is pulled from inside the shroud through a flexible duct to primary and secondary filter media. The primary filter or dust separator often includes a self-cleaning back-pulse feature that dumps the collected particles to the ground.

Secondary release of particles to the air is minimized by a low-flow water spray at the discharge point. Equipment without these controls can be retrofitted by the manufacturer or a mechanical shop.

- **Deck Shroud Design.** Use a one-piece shroud that fully encloses the area around the drill bit. Repair or replace torn or missing pieces and make sure that gaps are sealed.
- **Adequate Airflow.** The dust collector should be designed to draw more air than the bailing air used to flush out cuttings from the drill hole. The dust collector air volume should be three times the bailing air volume.
- **Water Injection at Dust Collector Exhaust.** Adding small amounts of water into the air discharge duct can significantly reduce the release of silica dust in the dump area. When adding water to the discharge duct, slowly increase the rate until there is no visible dust. Check the duct interior daily and clear dust deposits that may form in it.
- **Fan Exhaust Placement.** Extend the dust collection system exhaust port so that the dusty air releases away from workers. Clogged ducts and filters restrict dust collector airflow. Remove dust that collects on filters and in flexible ducts.
- **Fan Maintenance.** Dust can damage the fan motor, blades, and drill bits. Replace worn parts. Check for excessive vibration in fan belts, coupling, and belt alignment, and worn or broken belts, blades, mounting bolts, and bushings. Repair and maintain as needed.
- **Filters.** Replace clogged or damaged air filters and avoid exposure to dust when cleaning or replacing filters.

The dust collection systems are most effective when good design and maintenance practices are implemented by skilled and properly trained operators.
Operator Isolation/Wet Methods
The alternative to using a dust-collection system is operator isolation in an enclosed cab or booth, along with applying water to the drill bit during cutting to reduce dust.

Drill operators using vehicle-mounted rigs with enclosed cabs can reduce their silica exposure by staying inside the cab during drilling. The cab must:

- Be well-sealed and well-ventilated using positive pressure.
- Have door jambs, window grooves, powerline entries, and other joints that work properly and are tightly sealed.
- Have heating and air conditioning so that operators can keep windows and doors closed.
- Use an intake air filter with a minimum MERV-16 rating (at least 95% in the 0.3-10.0µm range).
- Be kept free from settled dust by regular cleaning and maintenance to prevent dust from becoming airborne inside the enclosure.

In wet drilling systems that use forced air (bailing air) to flush cuttings from the hole, water is added to the bailing air at the drill head. Small particles join to form larger particles, thus reducing escaping respirable dust. The proper use of wet methods requires a trained and skilled operator. Too much water can create mud slurry at the bottom of the hole that can trap the bit, coupling, and steel extensions. Too little water will not effectively control escaping dust.

Respiratory Protection
When properly used, dust collection systems and operator isolation can effectively control exposure to silica dust.

Therefore, this Table 1 entry does not require the use of respiratory protection when operating drilling rigs equipped with a dust collection system or from within an enclosed cab.

Additional Information
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CONTROL OF SILICA DUST IN CONSTRUCTION

Walk-Behind Milling Machines and Floor Grinders

Using walk-behind milling machines and floor grinders on concrete or other silica-containing materials can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using walk-behind milling machines and floor grinders as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

**Engineering Control Method:** Wet methods OR Vacuum Dust Collection Systems

Two methods for controlling dust when using walk-behind milling machines and floor grinders are: (1) an integrated water delivery system that continuously delivers water to the cutting surface, or (2) a commercially available vacuum dust collection system. In each case the milling machine or grinder must be operated and maintained in accordance with manufacturer’s instructions to minimize dust emissions.

**Wet Methods**

Use of wet methods effectively reduces the amount of silica dust that becomes airborne when milling or grinding silica containing materials because it controls the exposure at its source. The silica standard specifies the use of walk-behind milling machines and floor grinders that are equipped with an integrated water delivery system that continuously delivers water to the cutting surface.

Employers are responsible for keeping equipment in good condition to minimize dust and for training workers on how to use the equipment. Make sure to:

- **Check** that hoses are securely connected and are not cracked or broken.
- **Adjust** nozzles so that water goes to the grinding surface or cut point. Water flow rates must be sufficient to minimize the release of visible dust.
- **Ensure** an adequate supply of water is available.

Clean up any slurry produced to prevent the slurry from drying and releasing silica dust into the air. Wet slurry can be cleaned up using, for example, shovels or a wet vacuum equipped with a HEPA filter.

**Electrical Safety.** Where water is used to control dust, electrical safety is a particular concern. Use ground-fault circuit interrupters (GFCIs) and watertight, sealable electrical connectors for electric tools and equipment on construction sites.
**Vacuum Dust Collection System (VDCS)**
Commercially available VDCSs have been shown to reduce silica exposures. The VDCS must include a:

- Hood or shroud that is recommended by the tool manufacturer.
- Vacuum that is recommended by the tool manufacturer with enough suction to capture dust at the cutting point.
- Filter with a 99 percent or greater efficiency in the vacuum exhaust and a filter cleaning mechanism.
- Vacuum exhaust hose capable of providing the airflow recommended by the tool manufacturer. A 1.5" to 2" diameter vacuum exhaust hose is typically adequate.

Proper operation should:

- **Keep** the vacuum hose clear and free of debris, kinks and tight bends.
- **Turn** the vacuum off and on regularly to reduce dust buildup on the filter, if it is not self-cleaning.
- **Change** vacuum-collection bags as needed or at least as often as recommended by the manufacturer.
- **Avoid** exposure to dust when changing vacuum bags and cleaning or replacing air filters.
- **Set** a regular schedule for maintenance as recommended by the manufacturer.

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**Use of Compressed Air:** Unless there is a ventilation system that effectively captures the dust cloud, do not use compressed air or blowers to clean surfaces, clothing or filters because it can increase exposure to silica. Instead, clean with a HEPA filter-equipped vacuum or by wet methods.

**Respiratory Protection**
When properly used, wet methods and a VDCS can effectively control exposure to silica dust. Therefore, Table 1 in the construction standard does not require the use of respiratory protection when operating walk behind milling machines and floor grinders using wet methods or a VDCS.

**Indoors or in Enclosed Spaces**
When using walk-behind milling machines or floor grinders equipped with a VDCS indoors, or in an enclosed area where dust can build up, a HEPA-filtered vacuum must be used between passes to remove loose dust.

Using wet methods or a VDCS indoors or in an enclosed area may not reliably keep exposure low, so extra ventilation may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Ensure air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers’ breathing zones.

**Additional Information**
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- Review records of work-related injuries and illnesses.
- File a complaint asking OSHA to inspect their workplace if they believe there is a serious hazard or that their employer is not following OSHA's rules. OSHA will keep all identities confidential.
- Exercise their rights under the law without retaliation, including reporting an injury or raising health and safety concerns with their employer or OSHA. If a worker has been retaliated against for using their rights, they must file a complaint with OSHA as soon as possible, but no later than 30 days.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Small Drivable Milling Machines (Less than Half Lane)

Using small drivable milling machines (less than half lane) on asphalt pavement, concrete, and other silica-containing materials can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using small drivable milling machines as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

Engineering Control Method: Water spray with surfactant (a dust suppressant additive)

Wet Methods

Employers must use spray systems to spray a combination of water and surfactants to control dust generated by small drivable milling machines. These systems use a pump to deliver water to the milling surface and to the conveyor, where it combines with dust and silica particles and reduces airborne levels. The keys to effective dust control are (1) water pressure and water flow rate; (2) the proper application of water amended with a surfactant; (3) nozzle location and orientation; (4) the control of droplet size; (5) the selection of the best spray pattern and spray nozzle type for the operation; and (6) the proper maintenance of nozzles and water spray application equipment.

Employers are responsible for keeping equipment in good condition to minimize dust emissions and for training workers on how to use the equipment, including ways to limit exposure. Focus on the following:

- Maintain an adequate water supply to the milling machine.
- Rinse or replace water filters according to manufacturers’ instructions to maintain water flow.
- Check that hoses are securely connected and are not cracked or broken.
- Adjust spray nozzles so that water goes to the drum and the conveyor.
- Check that spray nozzles are not clogged or damaged.
- Inspect the milling machine and cutting bits to be sure the machine is in good working condition.

Indoors or in Enclosed Areas

Using wet methods indoors or in an enclosed area may not reliably keep exposure low, so extra ventilation or a means of exhaust may be needed to reduce visible airborne dust. Extra ventilation can be supplied by using:

- Exhaust trunks
- Portable exhaust fans
- Air ducts
- Other means of mechanical ventilation

Photo courtesy of the International Union of Operating Engineers

Small drivable milling machine.
Ensure that air flow is not impeded by the movements of employees during work, or by the opening or closing of doors and windows. Position the ventilation to move contaminated air away from the workers’ breathing zones.

**Respiratory Protection**
When properly used, wet methods can effectively control exposure to silica dust. Therefore, Table 1 of the silica standard for construction does not require the use of respiratory protection when operating small drivable milling machines using wet methods.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Large Drivable Milling Machines (Half Lane and Larger)

Using large drivable milling machines (half lane or more) on asphalt pavement, concrete, and other silica-containing materials can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using large drivable milling machines as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153.

**Engineering Control Method:** Exhaust ventilation on drum enclosure with water spray **OR**
Water spray with surfactant (for cuts less than four inches)

Wet methods reduce the amount of silica dust that becomes airborne when using milling machines, because they control exposure at the source. OSHA has determined that it is necessary to supplement water sprays with a dust suppressant additive or with exhaust ventilation. Water amended with a foam additive or surfactant performs better for dust suppression (surfactants are essentially equivalent to dish soap). The soap breaks the surface tension and softens the water, which improves silica dust capture.

Large drivable milling machines can be equipped with a combination of water sprays, exhaust ventilation and surfactants to effectively control silica dust. The exact combination varies with milling depth and substrate material. For cuts of:

- **Four inches or less in depth on any substrate,** Table 1 includes two options. Employers may use a machine equipped with exhaust ventilation on the drum enclosure and supplemental water sprays designed to suppress dust; OR they may use a machine equipped with supplemental water spray designed to suppress dust. In the second option the water must be combined with a surfactant.
- **More than four inches on asphalt only,** Table 1 requires the use of exhaust ventilation on the drum enclosure and supplemental water sprays designed to suppress dust.

More than four inches in depth on substrates other than asphalt are not included on Table 1. The control techniques described above can be used to reduce dust exposures, however, the employer must conduct an exposure assessment and may need to take additional actions.
Wet Methods
Large milling machines currently come equipped with water spray systems for dust suppression. The machine must be operated and maintained to minimize dust emissions. Make sure to:

- **Rinse or replace** water filters according to the manufacturers’ instructions to ensure they are clean and not clogged.
- **Adjust** the location and orientation of spray nozzles to direct water to the front of the cutter drum, primary (collection) conveyor, secondary (loading) conveyor, discharge pipe, and transfer points.
- **Check** that nozzles are not clogged and spray patterns effectively suppress dust.
- **Conduct** routine inspections to be sure that the system components are working properly.

Exhaust Ventilation
The drum housing and conveyors on the milling machine enclose the cutter drum and conveyor belts. A well-enclosed drum housing and conveyor system can reduce workers’ dust exposure. Typical ventilation controls designed to reduce dust emissions from a piece of equipment consist of a hood, fan, ductwork, and dust collector.

Employers are responsible for keeping equipment in good working condition to minimize dust. Employers must also ensure that workers are properly trained on operating the equipment and reducing exposures through good work practices. Focus on the following:

- **Ensure** that the ventilation control has enough velocity to prevent dust from settling and plugging the flow.
- **Check** flashing placement at transfer points and making sure it is in good working condition.
- **Check to ensure** that there are no gaps or leaks around conveyor enclosures and ductwork.
- **Replace** worn cutting teeth.
- **Conduct** routine inspections to be sure that the system components are working properly.

Respiratory Protection
When properly used, wet methods and exhaust ventilation can effectively control exposure to silica dust. Therefore, Table 1 in the silica standard for construction does not require use of respiratory protection when operating large drivable milling machines equipped with the dust controls described in this fact sheet.

Additional Information
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CONTROL OF SILICA DUST IN CONSTRUCTION
Crushing Machines

Using crushing machines at construction sites to reduce the size of large rocks, concrete, or construction rubble can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using crushing machines as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction 29 CFR 1926.1153.

**Engineering Control Method:** Wet Methods AND Operator Isolation

The use of water sprays or mists for dust suppression at the points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points) can control dust exposures when operating crushers. In addition, operator isolation through the use of a remote control station or ventilated booth that provides fresh, climate-controlled air to the operator must also be used to control exposure when operating crushers at construction sites.

The crusher must be operated and maintained in accordance with the manufacturer’s instructions to minimize dust emissions. Make sure to:

- **Locate** nozzles upstream of dust generation points.
- **Position** nozzles to thoroughly wet the material.
- **Ensure** the volume and size of droplets is adequate to sufficiently wet the material (optimal droplet size is between 10 and 150 μm).
- **Ensure** nozzles provide complete water coverage but are not so far that the water is carried away by wind.

**Operator Isolation**

Operator isolation for crushing machines includes using either an enclosed booth or a remote control station. Operators using crushing machines with enclosed cabs can limit their silica exposure by staying inside the cab during crushing operations. The enclosed cab must:

- Be well-sealed and well-ventilated using positive pressure.
- Have door jambs, window grooves, power-line entries and other joints that work properly and are tightly sealed.
- Have heating and air conditioning so that operators can keep windows and doors closed.
- Use an intake air filter with a minimum MERV-16 rating (at least 95 percent in the 0.3-10.0 μm range).

**Wet Methods**

Wet spray methods can greatly reduce the silica exposure levels of operators and laborers who work near crushers, tending the equipment, removing jammed material from hoppers, picking debris out of the material stream, and performing other tasks.
• Be kept free from settled dust by regular cleaning and maintenance to prevent dust from become airborne inside the enclosed booth.

An alternative method for operator isolation is to use a remote control station located a sufficient distance upwind to limit exposure to silica containing dust.

**Respiratory Protection**
When properly used, water sprays with either ventilated booths or remote control stations can in most cases effectively limit exposure to airborne dust. Therefore, Table 1 in the silica standard for construction does not require use of respiratory protection when using crushers at construction sites when the machines are equipped with water sprays along with either control booths or remote controls stations.

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CONTROL OF SILICA DUST IN CONSTRUCTION

Heavy Equipment and Utility Vehicles Used During Demolition Activities

Using heavy equipment and utility vehicles for tasks such as demolishing, abrading, or fracturing silica-containing materials such as brick, block, and concrete can generate respirable crystalline silica dust. When inhaled, the small particles of silica can irreversibly damage the lungs. This fact sheet describes dust controls that can be used to minimize the amount of airborne dust when using heavy equipment or utility vehicles during demolition activities as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153. A separate fact sheet addresses heavy equipment use for earthmoving tasks such as grading and excavating activities.

**Engineering Control Methods:** Enclosed cab **AND** water sprays and/or dust suppressants if other workers are present

The use of an enclosed cab when operating heavy equipment and utility vehicles during demolition activities, or when fracturing and abrading silica-containing materials, can reduce operator exposures to silica dust. If other workers are present in the area, water and/or dust suppressants must be applied as necessary to minimize visible dust.

**Operator Isolation**

Operators using heavy equipment and utility vehicles must stay inside an enclosed cab with the doors and windows closed while work is in progress. The cab must:

- Be well-sealed and well-ventilated, using positive pressure.
- Have door jambs, window grooves, power line entries and other joints that work properly and are tightly sealed.
- Have heating and air conditioning so that operators can keep windows and doors closed.
- Use an intake air filter with a minimum MERV-16 rating (at least 95 percent efficient in the 0.3–10.0 µm range).
- Be kept free from settled dust by regular cleaning and maintenance to prevent dust from become airborne inside the enclosure.

Modern heavy equipment typically comes equipped with enclosed, filtered cabs that meet the requirements of the silica standard in Table 1. Retrofit equipment is available for older equipment.
Wet Methods

Wet methods for heavy equipment and utility vehicle operators include the use of any method of wet application that will suppress silica dust emissions and be compatible to the task. These include using:

- Tank trucks equipped with hoses and nozzles that spray water or other dust suppressants over large areas to wet the materials disturbed during tasks, including haul roads and job sites in general.
- A worker who assists the operator by applying water or other types of dust suppressants to materials being demolished, abraded, or fractured.
- Large atomized misting devices.
- Spray equipment attached directly to the vehicle.
- Timing the application of the water or other dust suppressants to ensure that the materials are still damp when they are disturbed.

Water must be applied at flow rates sufficient to minimize the release of visible dust. Too much water can create mud slurry that can cause hazards. Too little water will not effectively control dust emissions.

Respiratory Protection

When properly used, an enclosed cab and wet methods can effectively reduce exposure to silica dust. Therefore, the silica standard for construction does not require use of respiratory protection when employers comply fully with Table 1 of the standard.

Additional Information

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CONTROL OF SILICA DUST IN CONSTRUCTION

Heavy Equipment and Utility Vehicles
Used for Grading and Excavating Tasks

Using heavy equipment and utility vehicles for earthmoving tasks such as grading and excavating does not in most cases generate hazardous levels of respirable crystalline silica dust. However, in dry conditions hazardous exposures can occur. This fact sheet describes methods to minimize the amount of airborne dust when using heavy equipment or utility vehicles for earthmoving tasks such as grading and excavating soil, as listed in Table 1 of the Respirable Crystalline Silica Standard for Construction, 29 CFR 1926.1153. A separate fact sheet covers dust controls for heavy equipment used for abrading, or fracturing silica-containing materials during demolition activities.

### Engineering Control Methods:
Enclosed cab (when only the operator is exposed) OR water sprays and/or dust surfactants (a dust suppressant)

The application of water and/or dust suppressants can help to reduce exposure to dust when operating heavy equipment or utility vehicles for tasks such as grading and excavating. If the equipment operator is the only worker engaged in the task, the employer can choose to apply water and/or dust suppressants to minimize dust emissions or can require the operator to stay within an enclosed cab. However, if there are other workers engaged in the task, then water and/or dust suppressants must be applied as needed to minimize their exposure to airborne dust.

**Wet Methods**

Wet methods for heavy equipment and utility vehicle operators include the use of any method that will suppress dust emissions and be compatible to the job task. These include using:

- Tank trucks equipped with hoses and nozzles that spray water or other dust suppressants over large areas to wet the materials disturbed during earthmoving tasks, including haul roads and job sites in general.
- A worker who assists the operator by applying water or other types of dust suppressants to materials being moved.
- Large atomized misting devices.
- Spray equipment attached directly to the vehicle.
- Nozzles adjusted so that water spray is directed at the work areas where dust suppression is required.
- Timing the application of the water or other dust suppressants to ensure that the materials are still damp when they are disturbed.
Water must be applied at flow rates sufficient to minimize the release of visible dust. Too much water can create mud slurry that can cause hazards. Too little water will not effectively control dust emissions.

**Operator Isolation**
When operators rely on enclosed cabs for protection against silica dust, the cab must:

- Be well-sealed and well-ventilated using positive pressure.
- Have door jambs, window grooves, power line entries and other joints that work properly and are tightly sealed.
- Have heating and air conditioning, so that operators can keep windows and doors closed.
- Use an intake air filter with a minimum MERV-16 rating (at least 95 percent efficient in the 0.3-10.0 µm range).
- Be kept free from settled dust by regular cleaning and maintenance to prevent dust from become airborne inside the enclosure.

Modern heavy equipment often comes equipped with enclosed, filtered cabs that meet the requirements of the silica standard in Table 1. Retrofit equipment is available for older equipment.

**Respiratory Protection**
When properly used, an enclosed cab or wet methods can effectively control airborne silica dust. Therefore, Table 1 in the silica standard for construction does not require the use of respirators when wet methods are used for dust suppression, or for the operator when operating heavy equipment or utility vehicles from within an enclosed cab.

**Additional Information**
For more information, visit www.osha.gov/silica and see the OSHA Fact Sheet on the Crystalline Silica Rule for Construction, and the Small Entity Compliance Guide for the Respirable Crystalline Silica Standard for Construction.

OSHA can provide compliance assistance through a variety of programs, including technical assistance about effective safety and health programs, workplace consultations, and training and education. OSHA’s On-Site Consultation Program offers free, confidential occupational safety and health services to small and medium-sized businesses in all states and several territories across the country, with priority given to high-hazard worksites. On-Site consultation services are separate from enforcement and do not result in penalties or citations. To locate the OSHA On-Site Consultation Program nearest you, visit www.osha.gov/consultation.

**How to Contact OSHA**
Under the Occupational Safety and Health Act of 1970, employers are responsible for providing safe and healthful workplaces for their employees. OSHA’s role is to ensure these conditions for America’s working men and women by setting and enforcing standards, and providing training, education and assistance. For more information, visit www.osha.gov or call OSHA at 1-800-321-OSHA (6742), TTY 1-877-889-5627.