



**Occupational  
Safety and Health  
Administration**

[www.osha.gov](http://www.osha.gov)

# Controlling Silica Exposures in Construction



OSHA 3362-04 2009





Exposure

Measure  
Amount

Compare to  
Limit

Protection

## Deaths from Silica in the Workplace

The first column is the occupational title. The second column (PMR) is the observed number of deaths from silicosis per occupation divided by the expected number of deaths. Therefore, a value of one indicates no additional risk. A value of ten would indicate a risk ten times greater than normal risk of silicosis. The first table below provides risk by occupation and the second provides risk by industry.

OCCUPATION	PMR
Miscellaneous metal and plastic machine operators	168.44
Hand molders and shapers, except jewelers	64.12
Crushing and grinding machine operators	50.97
Hand molding, casting, and forming occupations	35.70
Molding and casting machine operators	30.60
Mining machine operators	19.61
Mining occupations, *n.e.c.	15.33
Construction trades, *n.e.c.	14.77
Grinding, abrading, buffing, and polishing machine operators	8.47
Heavy equipment mechanics	7.72
Miscellaneous material moving equipment operators	6.92
Millwrights	6.56
Crane and tower operators	6.02
Brickmasons and stonemasons	4.71
Painters, construction and maintenance	4.50
Furnace, kiln, oven operators, except food	4.10
Laborers, except construction	3.79
Operating engineers	3.56
Welders and cutters	3.01



Machine operators, not specified	2.86
Not specified mechanics and repairers	2.84
Supervisors, production occupations	2.73
Construction laborers	2.14
Machinists	1.79
Janitors and cleaners	1.78

<b>INDUSTRY</b>	<b>PMR</b>
Metal mining	69.51
Miscellaneous nonmetallic mineral and stone products	55.31
Nonmetallic mining and quarrying, except fuel	49.77
Iron and steel foundries	31.15
Pottery and related products	30.73
Structural clay products	27.82
Coal mining	9.26
Blast furnaces, steelworks, rolling and finishing mills	6.49
Miscellaneous fabricated metal products	5.87
Miscellaneous retail stores	4.63
Machinery, except electrical, *n.e.c.	3.96
Other primary metal industries	3.63
Industrial and miscellaneous chemicals	2.72
Not specified manufacturing industries	2.67
Construction	1.82

\*n.e.c. - not elsewhere classified

See References 17 and 18 in the Bibliography.

# WARNING:

**Breathing Silica Dust Can Cause Silicosis**  
*-A Progressive, Sometimes Fatal Lung Disease-*  
**May Cause Cancer**

The vast majority of sorbent material used today is clay or clay based (i.e. diatomaceous earth). Clays are composed primarily of silica (SiO) and the dust from these products contains crystalline silica. Silica dust has been linked to a least two critical health problems: silicosis, a progressive and sometime fatal lung disease, and cancer. The consumer will be pleased to know that governments are starting to do something about warning the public of these dangers.

On November 4, 1989, California voters overwhelmingly approved Proposition 65, commonly referred to as the consumer protection act, consumer product warning label law, etc. As a part of this program, California now requires that consumer products containing clay and diatomaceous earth in the form allowing dust generation, will have to carry a warning label., Under #12601, b4A: WARNING: "THIS PRODUCT CONTAINS SILICA, KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER" would be the warning appropriate to clay and diatomaceous earth products.

It does not take large amounts of clay dust to create a problem. New U.S. Department of Labor, OSHA standards for silica-containing dust have been established at 0.1 milligrams per cubic meter. Based on manufacturer's data a typical clay absorbent contains approximately 0.1 percent dust by weight. Do not forget that we are talking about dust in the air which is very light material. It does not require much weight to create a respectable dust cloud.

Calculations show one 10 pound bag of clay that is 99.9% dust free includes 4 grams of silica dust. Four grams is enough to contaminate 40,000 cubic meters of space or 100 average homes. If evenly distributed, the quantity of silica-containing dust would require each person in the area to wear a dust mask in order to meet work place health standards.





# OSHA **FACT** Sheet

## Crystalline Silica Exposure Health Hazard Information

### What is crystalline silica?

Crystalline silica is a basic component of soil, sand, granite, and many other minerals. Quartz is the most common form of crystalline silica. Cristobalite and tridymite are two other forms of crystalline silica. All three forms may become respirable size particles when workers chip, cut, drill, or grind objects that contain crystalline silica.

### What are the hazards of crystalline silica?

Silica exposure remains a serious threat to nearly 2 million U.S. workers, including more than 100,000 workers in high risk jobs such as abrasive blasting, foundry work, stonecutting, rock drilling, quarry work and tunneling. The seriousness of the health hazards associated with silica exposure is demonstrated by the fatalities and disabling illnesses that continue to occur in sandblasters and rockdrillers. Crystalline silica has been classified as a human lung carcinogen. Additionally, breathing crystalline silica dust can cause **silicosis**, which in severe cases can be disabling, or even fatal. The respirable silica dust enters the lungs and causes the formation of scar tissue, thus reducing the lungs' ability to take in oxygen. There is no cure for silicosis. Since silicosis affects lung function, it makes one more susceptible to lung infections like **tuberculosis**. In addition, smoking causes lung damage and adds to the damage caused by breathing silica dust.

### What are the symptoms of silicosis?

Silicosis is classified into three types: chronic/classic, accelerated, and acute.

**Chronic/classic silicosis**, the most common, occurs after 15–20 years of moderate to low exposures to respirable crystalline silica. Symptoms associated with chronic silicosis may or may not be obvious; therefore, workers need to have a chest x-ray to determine if there is lung damage. As the disease progresses, the worker may experience shortness of breath upon exercising and have clinical signs of poor oxygen/carbon dioxide exchange. In the later stages, the worker may experience fatigue, extreme shortness of breath, chest pain, or respiratory failure.

**Accelerated silicosis** can occur after 5–10 years of high exposures to respirable crystalline silica. Symptoms include severe shortness of breath, weakness, and weight loss. The onset of symptoms takes longer than in acute silicosis.

**Acute silicosis** occurs after a few months or as long as 2 years following exposures to extremely high concentrations of respirable crystalline silica. Symptoms of acute silicosis include severe disabling shortness of breath, weakness, and weight loss, which often leads to death.

### Where are construction workers exposed to crystalline silica?

Exposure occurs during many different construction activities. The most severe exposures generally occur during abrasive blasting with sand to remove paint and rust from bridges, tanks, concrete structures, and other surfaces. Other construction activities that may result in severe exposure include: jack hammering, rock/well drilling, concrete mixing, concrete drilling, brick and concrete block cutting and sawing, tuck pointing, tunneling operations.

### Where are general industry employees exposed to crystalline silica dust?

The most severe exposures to crystalline silica result from abrasive blasting, which is done to clean and smooth irregularities from molds, jewelry, and foundry castings, finish tombstones, etch or frost glass, or remove paint, oils, rust, or dirt from objects needing to be repainted or treated. Other exposures to silica dust occur in cement and brick manufacturing, asphalt pavement manufacturing, china and ceramic manufacturing and the tool and die, steel and foundry industries. Crystalline silica is used in manufacturing, household abrasives, adhesives, paints, soaps, and glass. Additionally, crystalline silica exposures occur in the maintenance, repair and replacement of refractory brick furnace linings.

In the maritime industry, shipyard employees are exposed to silica primarily in abrasive blasting operations to remove paint and clean and prepare steel hulls, bulkheads, decks, and tanks for paints and coatings.

### How is OSHA addressing exposure to crystalline silica?

OSHA has an established Permissible Exposure Limit, or PEL, which is the maximum amount of crystalline silica to which workers may be exposed during an 8-hour work shift (29 *CFR* 1926.55, 1910.1000). OSHA also requires hazard



communication training for workers exposed to crystalline silica, and requires a respirator protection program until engineering controls are implemented. Additionally, OSHA has a National Emphasis Program (NEP) for Crystalline Silica exposure to identify, reduce, and eliminate health hazards associated with occupational exposures.

## What can employers/employees do to protect against exposures to crystalline silica?

- Replace crystalline silica materials with safer substitutes, whenever possible.
- Provide engineering or administrative controls, where feasible, such as local exhaust ventilation, and blasting cabinets. Where necessary to reduce exposures below the PEL, use protective equipment or other protective measures.
- Use all available work practices to control dust exposures, such as water sprays.
- Wear only a N95 NIOSH certified respirator, if respirator protection is required. Do not alter the respirator. Do not wear a tight-fitting respirator with a beard or mustache that prevents a good seal between the respirator and the face.
- Wear only a Type CE abrasive-blast supplied-air respirator for abrasive blasting.
- Wear disposable or washable work clothes and shower if facilities are available. Vacuum the dust from your clothes or change into clean clothing before leaving the work site.
- Participate in training, exposure monitoring, and health screening and surveillance programs to monitor any adverse health effects caused by crystalline silica exposures.
- Be aware of the operations and job tasks creating crystalline silica exposures in your workplace environment and know how to protect yourself.
- Be aware of the health hazards related to exposures to crystalline silica. Smoking adds to the lung damage caused by silica exposures.
- Do not eat, drink, smoke, or apply cosmetics in areas where crystalline silica dust is present. Wash your hands and face outside of dusty areas before performing any of these activities.
- Remember: If it's silica, it's not just dust.

## How can I get more information on safety and health?

OSHA has various publications, standards, technical assistance, and compliance tools to help you, and offers extensive assistance through workplace consultation, voluntary protection programs, strategic partnerships, alliances, state plans, grants, training, and education. OSHA's *Safety and Health Program Management Guidelines* (*Federal Register* 54:3904-3916, January 26, 1989) detail elements critical to the development of a successful safety and health management system. This and other information are available on OSHA's website.

- For one free copy of OSHA publications, send a self-addressed mailing label to OSHA Publications Office, 200 Constitution Avenue N.W., N-3101, Washington, DC 20210; or send a request to our fax at (202) 693-2498, or call us toll-free at (800) 321-OSHA.
- To order OSHA publications online at [www.osha.gov](http://www.osha.gov), go to **Publications** and follow the instructions for ordering.
- To file a complaint by phone, report an emergency, or get OSHA advice, assistance, or products, contact your nearest OSHA office under the U.S. Department of Labor listing in your phone book, or call toll-free at **(800) 321-OSHA (6742)**. The teletypewriter (TTY) number is (877) 889-5627.
- To file a complaint online or obtain more information on OSHA federal and state programs, visit OSHA's website.

This is one in a series of informational fact sheets highlighting OSHA programs, policies, or standards. It does not impose any new compliance requirements. For a comprehensive list of compliance requirements of OSHA standards or regulations, refer to *Title 29 of the Code of Federal Regulations*. This information will be made available to sensory-impaired individuals upon request. The voice phone is (202) 693-1999. See also OSHA's website at [www.osha.gov](http://www.osha.gov).

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# General Housekeeping and Use of Dust Suppressants

This section covers dust control methods for general housekeeping activities at construction sites, including site cleaning, material handling and the use of dust suppressants. The term "silica" used in this document refers to respirable crystalline silica.

## Introduction

Exposure to fine particles of silica has been shown to cause silicosis, a serious and sometimes fatal lung disease. Construction employees who inhale fine particles of silica may be at risk of developing this disease. Silica dust can be generated when materials such as ceramics, concrete, masonry, rock and sand are mixed, blasted, chipped, cut, crushed, drilled, dumped, ground, mixed or driven upon. Employees at construction sites may be exposed to silica dust during general housekeeping activities such as sweeping, emptying vacuum cleaners and using compressed air for cleaning. Silica exposures may also occur whenever silica-containing dusts are disturbed, such as during material handling. The small particles generated during these activities easily become suspended in the air and, when inhaled, penetrate deep into employees' lungs.

### Examples of Construction Materials that Contain Silica

- Concrete
- Brick, tile and other masonry
- Mortar
- Asphalt
- Sand
- Many stone products (such as granite, slate and sandstone) and rock aggregate<sup>1</sup>

In several studies of construction sites, silica exposure levels rose when employees engaged in general construction cleaning activities such as dry sweeping, using backpack blowing equipment and emptying vacuums used to collect concrete dust.<sup>2</sup> For example, the National Institute for Occupational Safety and Health (NIOSH) determined that a concrete finisher handling a vacuum bag containing concrete dust was exposed to approximately 0.79 mg/m<sup>3</sup> (milligrams of silica per cubic meter of air) (NIOSH, 2001b).<sup>3</sup> This level is more than five times higher than the finisher's average silica exposure for

the day, which already exceeded the Occupational Safety and Health Administration's (OSHA) benchmark of 0.1 mg/m<sup>3</sup> (milligrams per cubic meter of air) as an 8-hour time-weighted average (TWA), an exposure approximately equivalent to OSHA's general industry permissible exposure limit (PEL).<sup>4</sup> While most employees do not handle vacuum bags for their full shifts, this activity presents a significant source of exposure for employees who may also be exposed to silica from other sources.

### Housekeeping Activities that Can Release Airborne Dust Containing Silica

- Dry sweeping
- Using blowers or compressed air for cleaning
- Dumping bags of raw material
- Dumping wheelbarrow loads
- Breaking or crushing materials
- Spreading crushed materials (concrete, aggregate)
- Dropping, tossing, or pouring dusty materials
- Operating a vacuum with the air discharge near a source of dust
- Emptying vacuums
- Driving over piles of dust or debris
- Other actions that disturb or create dust

This section describes several methods available to reduce employees' silica exposure during housekeeping and related activities. These methods include general measures to suppress the creation of dusts (use of water and other dust suppressants), vacuuming, using cabs and enclosures, and modification of work practices. Many of these methods can be used to reduce exposures to silica in a broad range of construction activities in addition to housekeeping tasks.

### Visible and Respirable Dust

Visible dust contains large particles that are easy to see. The tiny, respirable-sized particles (those that can get into the deep lung) containing silica pose the greatest hazard and are not visible. Most dust-generating construction activities produce a mixture of visible and respirable particles.

Do use visible dust as a general guide for improving dust suppression efforts. If you see visible dust being generated, emissions of respirable silica are probably too high. Measures that control tool-generated dust at the source



require less suction power to move air through filters with larger areas. Manufacturers often provide information about filter surface area.

### Cabs and Enclosures

Use material handling equipment for moving large amounts of silica-containing dusty material. Select equipment with enclosed cabs and positive pressure ventilation systems (to isolate operators from dust) and air conditioning (to encourage operators to keep windows and doors closed, so dust stays out). Many cabs can be retrofitted to add a filtered ventilation system and air conditioning.<sup>10</sup>

Put the cab on a regular maintenance schedule. Check for leaking seals around windows, doors and electrical wiring. Change ventilation system filters on schedule. For maximum protection from exposure to small particles, use the most efficient filter recommended by the cab manufacturer.

Clean the cab interior daily so that dust does not accumulate and is not dispersed by the cab ventilation system.

### Compressed Air

The use of compressed air to clean surfaces or clothing is strongly discouraged. Using compressed air to clean work surfaces or clothing can significantly increase employee exposure, especially in enclosed and semi-enclosed spaces. Cleaning should be performed with a HEPA-filtered vacuum or by wet methods.

### Work Practices

Common sense work practices can help employees limit their exposure to silica. Examples include:

- Clean up spills and waste before dust can spread.
- Wear a rubber apron to keep wet dust off clothing. When it dries, the dust can become airborne.
- Whenever possible, work upwind of any dust sources. This can be as simple as working from the other side of the pile when shoveling debris.
- Keep roadways damp at sites where the surface includes high silica aggregate or crushed concrete.
- Wet down silica-containing debris and rock spoil piles prior to removal or disturbance.

Encourage employees to watch for dust sources containing silica and make adjustments or use dust control methods to reduce their silica exposure.

### Dumping or Pouring Materials

The farther objects fall when dropped, the more dust they will generate on impact. When dumping or pouring materials (for example, debris into a dumpster or raw materials into a mixer), minimize drop distances by releasing materials close to their destination level. Support the bag, bin, or barrow just above the top of the pile and slowly add materials onto the pile. When a long drop is unavoidable, use enclosed disposal chutes or slides.

Use wheelbarrow ramps of appropriate height (not too tall for a small dump pile).

Moisten the dumpster contents, floors and walls prior to adding any debris to reduce dust released upon impact.

Spray the debris stream with water mist to help suppress dust.

### Sweeping

Take steps to limit the use of dry sweeping. Reduce the quantity of debris and the distance and frequency of sweeping. Use a vacuum or wet mop, or moisten the material and scrape it into position.

Collect and transport debris by bucket or wheelbarrow from smaller local piles rather than pushing it for longer distances to a central pile.

Avoid dry sweeping debris with sweeping compounds that contain quartz sand (crystalline silica) as the grit.

### Removing Debris from Slots or Uneven Surfaces

Use a vacuum instead of a blower. Use vacuum hose attachments sized for the situation. For example, remove tailings from handheld drill holes using a HEPA-filtered vacuum.

Flush cracks with water instead of using compressed air.

### Vacuums

Use vacuums with self-cleaning features (back-pulse). Make sure that employees are fully trained in vacuum operation.

Handle vacuum bags carefully and have a disposal receptacle nearby.

Avoid overfilling vacuum canisters or bags. The extra weight makes bags difficult to handle and subject to tearing.

Avoid shaking or jarring the vacuum. Follow the manufacturer's instructions for recommended handling.

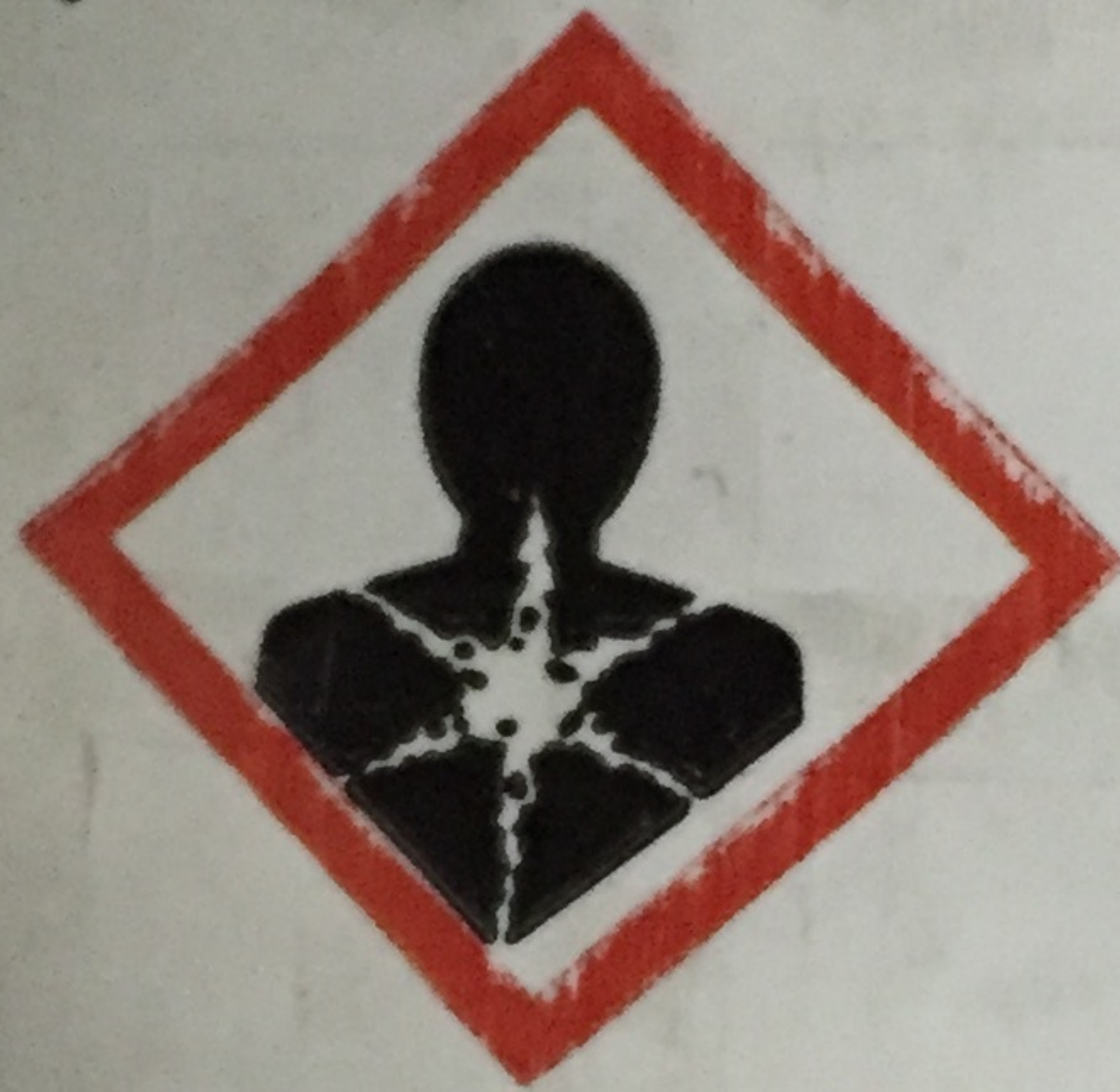
Avoid depositing or storing collected debris where it will be disturbed or run over and become a source of dust exposure for another employee.



**OIL-DRI PREMIUM ABSORBENT**  
E 558 Bentonite (calcium montmorillonite type)

**Manufacturer:**  
Oil-Dri Corporation of America  
410 N. Michigan Ave.  
Chicago, IL 60611  
312-321-1515

**CHEMTREC (EMERGENCY):**  
US and Canada: 800-424-9300  
International (Call Collect): 703-527-3887



**DANGER**

May cause cancer if inhaled.  
Causes damage to the lungs through prolonged  
or repeated inhalation exposure.

**PREVENTION:**

- Do not breathe dust.
- Wash exposed skin thoroughly after handling.
- Do not handle until all safety precautions have been read and understood.
- Wear protective gloves and clothing.

**RESPONSE:**

If exposed or...