Silica and Respiratory Protection

CODE of PRACTICE

Crystalline silica is a basic component of soil, granite and other minerals.

Ordinarily, it is harmless and inert when it is in the ground or earthbound.

However, in our industry, grinding and crushing can result in an airborne dust, which can be inhaled.

This state is called "respirable" and in this form, it is a serious health threat to you and your crew.

Silica has been classified as a human lung carcinogen and inhaling silica dust can lead to silicosis, a lung disease, which can be permanently disabling or fatal.

Pause for Safety

Hazards

→ Silicosis
→ Lung cancer
→ Other respiratory diseases, such as chronic bronchitis;
→ Kidney disease

PPE

Additional PPE

Controls

→ Dust suppression / controls
→ Water spray delivery systems
→ NIOSH-approved filtration respirators
→ NIOSH-approved supplied air respirators

Strategies and Procedures

Hazard/Risk Assessment

Our crushing operations are regularly evaluated to determine the likelihood of a crystalline dust hazard and the relative risk to workers.

The results of this assessment are shared with you and are used to determine the need for measurement, hazard controls, appropriate Respiratory Protective Equipment (RPE) and worker health evaluations.

A hazard assessment is completed by a competent worker in respect to respiratory protective equipment, and reviewed with the work group before the job task can begin.

Measurement

At least one worksite is tested to determine the possibility and level of exposure to crystalline silica.

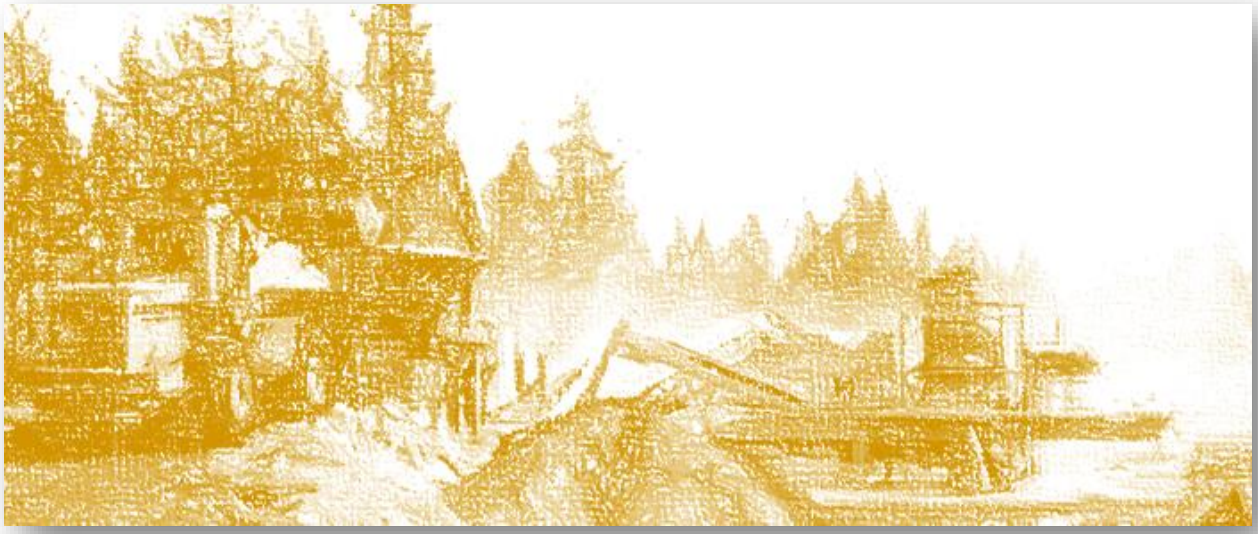
Testing is carried out by an accredited agency and the results shared with workers.

The testing results shall form the basis of establishing adequate exposure control methods.

Information

Signs will be posted in conspicuous locations advise you:

- → That silica may be present
- → that designated RPE is required in the area
- → of the possible health risks of unprotected exposure.



Hazard Control

Silica dust control strategies follow the hierarchy of control measures:

- → Elimination or Substitution
- → Engineering
- → Administrative
- → Personal Protective Equipment (PPE)
- → Combination of any or all of above

Elimination or Substitution (no exposure)

- → The nature of our business generally precludes this option as silica is a part of the material that is processed in the crushing operation.

Engineering (dust barriers, dust abatement systems, worker isolation, etc.)

- → HEPA filtration systems are used in our loaders, towers and office/lunch rooms to reduce the amount of dust entering these spaces.

Administrative (signage, task rotation, task scheduling, task positioning, etc.).

- → Extensive testing has identified the areas of significant exposure.
- → These areas are marked with signage and you are to avoid these areas when the plant is operating.

Additionally, a work rotation schedule is used to reduce worker exposure to the product.

Dust suppression with water spray

Water is extremely effective in eliminating dust from sand / rock.

- → If possible use proper dust control methods to minimize dust during the activities that cause the most dust,
- → When loading and unloading of materials ensure dust control (water) is used in the loading and unloading areas.
- → On aggregate crushers the use of a water spray near the infeed of the crusher cone, normally on the conveyor to wet the aggregate is very effective in reducing the overall dust / airborne silica.
- → On concrete batch plants use a water spray on the conveyor(s) feeding the individual product bins is an effective way to dramatically reduce the airborne dust / silica exposure to workers.

Personal Protective Equipment (PPE) (last consideration for control

- → Respiratory protective equipment (RPE) is available to workers for additional protection.
- → If the hazard assessment warrants, a Half face respiratory protective equipment must be worn when silica exposure cannot be effectively reduced with other controls or procedures as listed above.
- → Proper cleaning, care and storage of the respiratory masks as per the manufacturer's specifications must be maintained.
- → Wear safety glasses at all times when working in dusty environments
- → Avoid using contact lenses as dust may get under the lens and scratch the surface of the eye.
- → Wear coveralls and change clothes before going home.

Respiratory Protective Equipment (RPE)

RPE is provided you in addition to other dust control measures as a last means of defense. Your respiratory protective equipment:

- → Will reduce the concentration of silica being inhaled to at or below the OEL (Occupational Exposure Limits),
- → Is approved by NIOSH,
- → Is to be worn at all times in restricted areas.

Prior to receiving any RPE, you may require fit testing and receive appropriate training.

Performing a worksite inspection and a Hazard assessment on a regular basis and whenever conditions change will assist in being prepared to deal with silica related concerns for workers.

- → Supervisors must ensure that a worker's exposure to silica does not exceed its occupational exposure limit of 0.05 mg/cubic meter over an 8 hour time period as per Table 2-1, Part 2 of the Health, Safety & Reclamation Code for Mines in BC.
- → Health assessments must be conducted on workers routinely involved in or exposed to silica.

Medical Monitoring

- → There is no cure for silicosis therefore medical monitoring is critical to early detection of overexposure.
- → All new site workers undergo a baseline health assessment (pulmonary function) upon hiring.

→ Full time permanent workers undergo the same test regularly plus additional health assessments as required by regulation or a health professional's advice.

What can you do?

Review SDS for all materials used.

→ All silica based products used during the work scope require strict adherence to the SDS for exposure and types of respiratory protection.

When dumping or loading aggregates (gravel / sand) into bins or hoppers make sure:

→ All equipment operators have their doors and windows closed, thereby using the cab air filtration.
→ All workers on foot are out of the airborne dust clouds exposure area.
→ All exposed workers are using a half face respirator fitted with a P100 cartridge.

Avoidance

→ The preferred method to reduce exposure is to minimize the exposure by removing workers on foot from the area and utilize in cab filtration for the workers handling the products with equipment.

If you find yourself unexpectedly within a dust cloud:

→ Breath minimally and shallowly
→ Find a supply of fresh air if possible.
→ Move upwind away from the dust.

Sandblasting - Working with silica will present hazards which require a Blasting helmet, Respirator, Leather gloves, coveralls, CSA approved boots.

→ Operate all sandblasting and painting equipment according to manufacturer's specifications.
→ Properly identify the exposure zone: Rope off, barricade, and post signs of "No Entry" to restrict access to the area.
→ Make sure there is proper ventilation/air supply.

Emergency Procedures

Normally, exposure to respirable silica will not present an immediate medical emergency (unless there is an underlying condition).

In the event a worker complains of difficulty breathing:

→ Get the person into an area with clean air
→ Follow first aid instructions for breathing difficulties and the site emergency response plan
→ Contact EMS and get the worker to medical services as soon as possible
→

Decontamination & Personal Hygiene

Do not eat or drink in a restricted area.

Remove coveralls or outer clothing and wash up before entering the break area, before eating or drinking and before returning home.

Avoid smoking at any time as it multiplies the harmful effects of silica exposure.

Respirators

A respirator program consists of four basic components:

- → **Air sampling** assesses the concentration of contaminants.
  - It determines whether a particular job requires respiratory protection and the level of respiratory protection required.
- → **Fit testing** ensures that the respirator wearer can obtain a proper seal between his/her face and the respirator.
  - Clean shaved face required.
- → **Cleaning and maintenance** of respirators ensures that the respirator retains its original effectiveness.
- → **Worker training** ensures that personnel are aware of the proper use of various respirators and their limitations.

Only respirators approved by the Mine Safety and Health Administration (MSHA) or the National Institute for Occupational Health and Safety (NIOSH) are used.

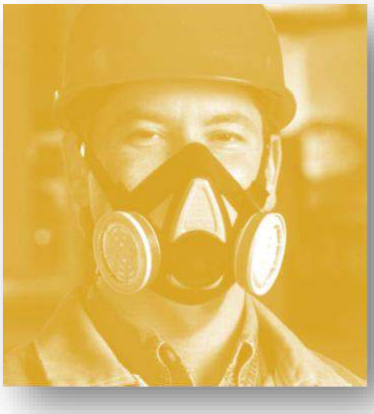
Classifications

Respirators are classified according to their mode of operation

- → Atmosphere Supplying Respirators
- → Self-Contained Breathing Apparatus
- → Supplied Air Breathing Apparatus

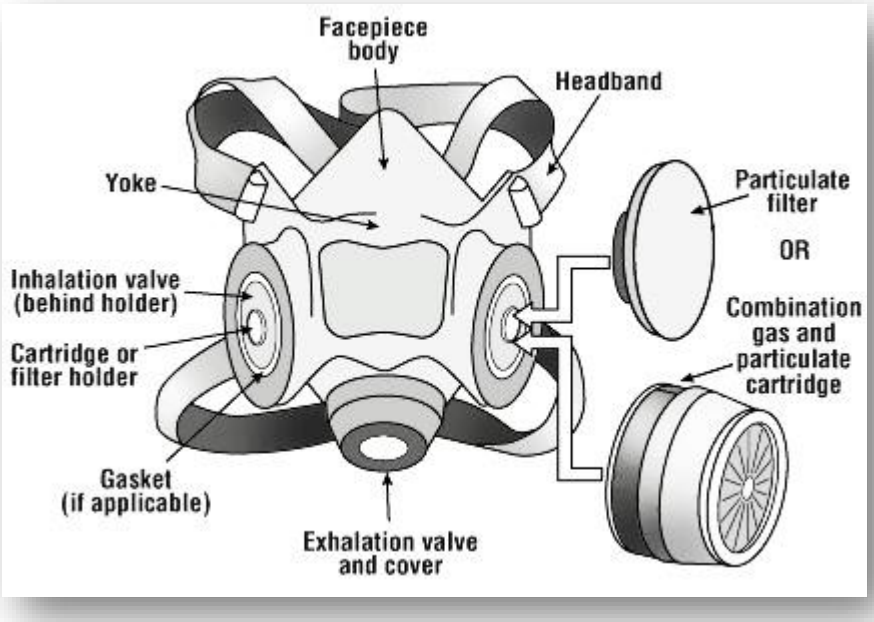
These respirators protect you from oxygen deficient and toxic atmospheres, providing you with breathable air independent of atmospheric conditions.

- → Air Purifying Respirators
- → Gas and Vapour Removing
- → Particulate Removing
- → Combination Gas, Vapour, and Particulate Removing



Respirator class comparisons

Concentration	Minimum Respiratory Protection	FIT TESTING
5 x OEL or less	Any NIOSH approved dust filtering respirator	Not required
10 x OEL or less	Any NIOSH approved dust filtering except single-use or quarter-mask respirator Any NIOSH approved fume respirator or high efficiency particulate filter respirator Any NIOSH approved supplied-air respirator Any NIOSH approved SCBA	QLFT prior to initial use and annually
50 x OEL or less	Any NIOSH approved high efficiency particulate filter respirator with a full face mask Any NIOSH approved supplied-air respirator with a full face-piece helmet or hood Any NIOSH approved SCBA with a full face-piece	QNFT prior to initial use and annually
500 x OEL or less	Any NIOSH approved powered air-purifying respirator with a high efficiency particulate filter A NIOSH approved supplied-air respirator with a full face-piece helmet or hood, operating in positive pressure or continuous flow mode	QNFT prior to initial use and annually
> 500 x OEL	No exposure allowed until concentrations are controlled below 25 mg/m3	



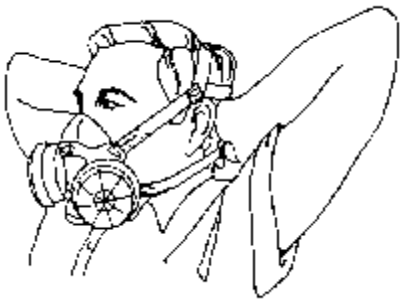
Components of a typical half-face respirator

Donning a Half-Mask Respirator

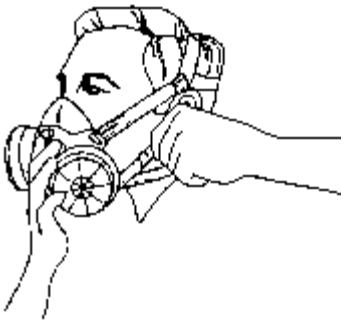
1. Fit the respirator on the bridge of your nose, making sure that you are able to breathe through your nose.

→ Then swing bottom of the face-piece into contact with your chin.

2. Position the cradle headband with the longer straps above your ears, over the crown of your head and the shorter straps below your ears, around the nape of your neck.



3. Adjust the straps for a comfortable fit by moving the adjustment slides to lengthen or shorten the straps.



→ Adjust the straps snugly so that no air leaks around the face-piece.

→ It is not necessary to pull straps so tight that the respirator digs into your face.

Donning a Full-Face Respirator

1. Pull out the headband straps, especially the "front" or the forehead strap, so that their ends are at the buckles.

2. Grip the face-piece between your thumb and fingers.

3. Insert your chin well into the lower part of the face-piece and pull the headbands back over your head.

4. Adjust the straps for a firm and comfortable fit against your face at all points:

→ Ensure the straps are lying flat against your head.
→ Tighten the neck straps.
→ Tighten the side straps; do not touch the forehead or front straps.
→ Place both hands on the headband pad and push it towards your neck.
→ Tighten the forehead or front strap a few notches if necessary.

Respirator Fit Testing

The degree of protection afforded by a respirator depends on several factors, including:

- → The effectiveness of the seal to the facial skin
- → The effectiveness and capacity of the air-purifying or air supplying element.
- → The efficiency and capacity of the air-purifying or air supplying element.
- → Inward leakage through the respirator components.

A qualified fit test should be carried out at least annually or whenever work conditions necessitate a change in the type of respirator worn,

- → Annual re-testing is required for all workers.

There are two methods to fit testing respirators:

- → *Quantitative respirator fit testing* measures the actual leakage of the respirator face-piece.
  - It does not depend on the sense of smell to tell whether the face-piece fits or not.
- → *Qualitative respiratory fit testing* ensures that an effective seal is being attained assuming that the wearer knows the proper procedures for fitting and wearing the face-piece.
  - Irritant smoke or isoamyl acetate are usually for qualitative fit testing.

Under no circumstances shall a person wear a respirator for which a satisfactory facial fit has not been obtained.

Respirator Seal Testing

Each respirator must be subjected to one of the following tests prior to use:

- → **Negative Pressure Sealing Test**
  - This test consists of closing off the inlet opening of the respirator by putting the palms of the hands on the cartridges so that there is no passage of air, inhaling gently, and holding the breath for at least ten seconds.
  - If the face-piece remains deflated, the fit is satisfactory.

- → **Positive Pressure Sealing Test**
  - This test is conducted be closing off the exhalation valve or the breathing tube or both and exhaling gently.
  - The fit is satisfactory if a slight positive pressure can be built up inside the face-piece without any outward leakage of air.

Respirator Inspection and Maintenance

A respirator maintenance program has the following components:

- → Inspection for defects.
- → Routine cleaning and disinfecting
- → Repair and replacement as requires.
- → Proper storage of equipment.

Each respirator is inspected be the user immediately before and after use to ensure that it is in proper working condition.

Respirators are used and maintained in accordance with the manufacturer's specifications.

There is no easy way to determine when a cartridge should be replaced.

The service life of a cartridge is dependent upon:

- → The concentration of the contaminant.
- → The breathing rate
- → Relative humidity

It's time for cartridge replacement when there is:

- → a detectable odor in the face-piece
- → eye, nose or throat irritations
- → excessive breathing resistance breathing in

Reusable air-purifying respirators should be checked as follows:

Examine the face-piece for:

- → Excessive dirt.
- → Cracks, tears, holes, or physical distortion of shape from improper storage.
- → Inflexibility of the rubber face-piece.
- → Cracked or badly scratched lenses in full face-pieces.
- → Incorrectly mounted full-face-piece lenses, broken or missing mounting clips.
- → Cracked or broken air cartridge holders, badly worn threads or missing gaskets.
- → A nose cap.

Examine the head straps or head harness for:

- → Breaks.
- → Loss of elasticity.

- → Broken or malfunctioning buckles and attachments.
- → Excessively worn serrations on head harness, which might permit slippage.

Examine the exhalation valve, after removing its cover for the following:

- → Foreign material such as detergent residue and dust particles under the valve.
- → Cracks, breaks, or chips, in the valve body, particularly on the sealing surface.
- → Missing or defective valve cover
- → Improper installation of the valve in the valve body.

Examine the air-purifying element for:

- → Incorrect cartridge or filter for the hazard.
- → Incorrect installation, loose connections, missing or worn gaskets, or cross threading in the holder.
- → Cracks or dents in the outside case of the cartridge

Supplied air respirators should be examined using the procedure for air purifying respirators, except those pertaining to the air purifying elements.

If the device has a corrugated breathing tube, examine it for:

- → Deterioration by stretching the tube and looking for cracks

Examine the air supply system for:

- → Integrity and condition of the air supply lines and hoses, including attachment and end fittings.
- → Correct operation and condition of all regulators.

Self-contained breathing apparatus inspections should include all of the above items as well as the following:

- → Cylinders should be maintained at a minimum of 70% capacity except while being depleted during use.
- → The regulator and any warning device must be tested to ensure they are functioning properly.
- → A SCBA cylinder must be recharged when they air pressure drops below 2000 psi.
- → Cylinders must be checked for integrity and hydrostatic test date.
- → Hoop-wrapped and fully wrapped composite cylinders must be hydrostatically tested every 3 years. Steel and seamless aluminum cylinders must be hydrostatically tested every 5 years.

Respirator Cleaning

A respirator issued for anything other than continuous personal use including routine, non-routine, emergency, or reserve use, must be leaned and sanitized after each use.

To clean a respirator:

1. Remove filters and cartridges.
2. Disassemble face-piece.

3. To make a suitable respirator cleaning solution, dilute CaviCide liquid with water 100:1 ratio.

→ CaviCide is a detergent and germicide.
→ Diluted 100:1, CaviCide should not cause any skin irritations.
→ Lukewarm water should be used.

4. Immerse the respirator in the solution.

5. Scrub gently with a soft brush.
6. Rinse in lukewarm water.

7. Dry the respirator with either a clean paper towel or air dry.

Respirator Storage

When not in use, new or cleaned and dried respirators must be stored in a clean dry plastic bag to retain their effectiveness.

→ Disposal cartridge respirators are good for one shift only and are discarded after use.

New cartridges must be kept in their plastic bags until ready to be used.

All RPE stored for emergencies are inventoried on a monthly basis.

Education and Training

Training is provided to anyone who may be exposed to crystalline silica. At a minimum this training includes education and experience in:

- → Identifying where hazardous concentrations of crystalline silica is likely to be present in the worksite
- → The possible effects of unprotected exposure to crystalline silica,
- → respiratory protection equipment including
  - limitations of each respirator type
  - proper selection
  - correct use
  - sanitary care
  - storage
  - maintenance,
- → the requirements for maintaining the respirator (gas tight) seal.
- → Practicing proper fitting, wearing, adjusting, and checking the seal.
- → handling the respirator and to wear it in a safe atmosphere for an adequate period, to ensure that you become familiar with the characteristics of the respirator.
- → how to deal with emergency situations involving the use or malfunction of different respirators.
- → The provisions and requirements of the medical monitoring program.
- → Personal hygiene strategies.

Records are kept on the dates and types of training everyone has received.

Responsibilities

Your **safety rep** coordinates the respirator policy. He or she will ensure that:

- → The required hands-on training is provided.
- → An adequate supply of respirators, cartridges, filters, breathing air, etc. Is readily available.
- → Each worker who will be wearing a respirator is quantitatively fit tested.
- → Adequate records are kept on worker training and equipment maintenance.
    - Worker safety training records are maintained by the HSE department.
- → Identifying the jobs/tasks/operations that require respiratory protection or upgrading of respiratory protection.

Your **supervisor** ensures that the entire crew:

- → has read and understands this code of practice.
- → observes the requirements of this code of practice including annual fit testing.
- → knows how to fit test a respirator and has hands-on training.
- → Wears the proper respiratory protective equipment for work requiring respiratory protection.
- → is informed of any changes or additions to this code or practice.
- → has received the required training.

You and your crew are responsible for:

- → Knowing and observing all instructions and regulations in this code of practice.
- → Using the respirator equipment that is appropriate for the hazard.
- → Positive/Negative leak testing prior to using a respirator.
- → Inspecting and storing respirators properly.
- → Being clean shaven at all times.
- → Reporting any defective equipment.
- → Performing hazard assessment before performing a task requiring respirator equipment.

Crystalline silica

Crystalline silica is a naturally occurring mineral composed primarily of silicon dioxide (crushed rock).

- → "Respirable crystalline silica" is a crystalline silica particle less than 10 micrometers in size that can be inhaled deeply into the gas-exchange region of the lungs. It is this small, airborne size particle which poses the greatest concern for human health.
- → Crystalline silica is found in a wide variety of products, however the activities where exposure to airborne respirable silica dust are of most concern include:
  - Crushing, excavation or disruption of rock, sand, dirt or soil.
  - Cutting, grinding, sanding, jackhammering, chipping or blasting of silica containing materials (concrete, cement, asphalt, brick, etc.)
  - Abrasive blasting with silica-containing material
- → The highest potential for exposure to respirable crystalline silica occurs in areas where heavy equipment work and windy conditions give rise to rock dust.

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

Chronic/classic silicosis — the most common condition that occurs after 15-20 years of moderate to low exposures to respirable crystalline silica. Symptoms of chronic silicosis may or may not be obvious so an x-ray is required to determine if there is lung damage. As the disease progresses the person may experience shortness of breath upon exercising, and show clinical signs of poor oxygen/carbon dioxide exchange. In later stages the person 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 two years following exposures to extremely high concentrations of respirable crystalline silica. Symptoms of acute silicosis include sever disabling shortness of breath, weakness and weight loss, which often leads to death.

The development of silicosis appears to depend on:

- → The amount and kind of dust inhaled,
- → The percentage of free silica in the dust,
- → The form of the silica,
- → The size of the particles inhaled,
- → The duration of the exposure
- → The powers of resistance of the person,
- → The presence or absence of complications (e.g. infection)

Terms you may encounter…

Chemical Cartridge Respirator

An air purifying respirator designed to protect against low concentrations of vapours, acid and alkaline gases, mercury vapours , pesticides, and combinations of these contaminates, provided that the appropriate chemical cartridge and or filter is used.

Crystalline Silica and/or Silica

A basic component of soil, granite and other minerals with quartz being the most common form. Can be present in respirable size when industrial operations chip, cut, drill, grind or crush objects containing crystalline silica.

Dust Solids

Mechanically procured particles of filters.

Exposed Worker

A worker who may be expected to work in a restricted area at least 30 days in a 12 month period. OEL — Occupational Exposure Limit

The maximum concentration of a substance as designated by regulation (e.g. AB OH&S Code) or other accepted standard, to which an unprotected worker is permitted to be exposed in an 8-hour period. The OEL for silica is expressed in mg/m3 (milligrams of material per cubic meter of air).

Fumes

Solid particles generated by condensation from the gaseous state generally after volatilization from melted substances (e.g. welding) and often accompanied by a chemical reaction, such as oxidation.

Gases

Substances that are in the gaseous state at the ambient temperature and pressure.

High-Efficiency Particulate Air Filter (NEPA)

A filter that has been tested to assure efficiency is equal to or exceeding 99.97% for removal of particulates having a mean aerodynamic diameter of 0.3 um from the air

Immediately Dangerous to Life or Health (IDLH)

A condition in any worksite, space, or area where a hazardous atmosphere exists to such an extent that a person without appropriate respiratory prediction could be fatally injured or suffer immediate, irreversible, of incapacitating health effects.

Particulate Filter Respirator

Protects against airborne particulate matter with dusts, mists, metal fumes and smokes.

mg/m3

Milligrams (of air contaminate) per cubic meter of air.

Occupational exposure limits (OEL)

Airborne concentrations of substances under which it is believed that nearly all workers may be repeatedly exposed without adverse effect.

8-hour OEL's

The time- weighted average concentration for an 8 hour workday and a 40 hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Oxygen deficiency

An atmosphere containing less than 19.5% oxygen.

PPM

The concentration of a gas or vapour in the air, and indicates the volume present per million volumes of air.

Respirable

In the case of crystalline silica means particles less than 10 microns in diameter that can be inhaled and deposited in the lungs.

RPE (Respiratory Protective Equipment)
Restricted Area

An area of the worksite where there is a reasonable chance that the airborne concentration of silica exceeds or may exceed the OEL. Wind direction and worksite conditions must be considered when defining a restricted area. Only trained workers with adequate RPE may enter and work in a restricted area.

Self-Contained Breathing Apparatus (SCBA)

Provides respiratory protection in oxygen-deficient environments and in situations where high or unknown concentrations of toxic gases, vapours, or particulates are present.

STEL (short-Term Exposure Limit)

Defined as a 15-minute TWA exposure, which should not be exceeded at any time during a workday, even if the 8hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes and should not occur more than four (4) times per day. There should be at least 60 minutes between successive exposures in this range.

Threshold Limit Value — Ceilings (TLV-C)

The concentration that should not be exceeded during any part of the working exposure.

Vapours

The gaseous state of a material that is solid or liquid at normal temperature.