1 Status

1.1 Update of existing policy, effective 06/03/11.

2 Purpose

2.1 To reduce team member exposure to airborne crystalline silica to below the OSHA Permissible Exposure Limit (PEL) by means of substitution, engineering controls, work methods and administrative controls.

3 Applicability

3.1 This policy applies to all subsidiary companies and departments of The Cianbro Companies.

3.2 All organizations are required to comply with the provisions of this policy and procedure. Any deviation, unless spelled out specifically in the policy, requires the permission of the Corporate Safety Officer or designee.

4 Definitions

4.1 Carcinogen: A substance that causes the development of cancerous growths in living tissue. One of the groups that rates cancer risk is the International Agency for Research on Cancer (IARC). The IARC lists materials as:
   - Group 1 - known carcinogenic to humans
   - Group 2A - probably carcinogenic to humans
   - Group 2B - possibly carcinogenic to humans

4.2 Crystalline Silica: The crystalline forms of silicon dioxide (SiO$_2$). Quartz is the most common form. Cristobalite and Tridymite are two other crystalline forms that might be encountered. These crystalline forms are the dangerous ones.

4.3 Permissible Exposure Limit (PEL): This is the OSHA allowable concentration limit in air that a team member can be exposed to for an eight-hour day.

4.4 Pulmonary Function Test (PFT): Pulmonary function test. This test is designed to determine how well your lungs are working. There are several pieces that can be part of the PFT:
   - FVC - forced vital capacity
   - FEV$_1$ - forced expiratory volume in one second,
   - DLCO - diffusion capacity for carbon monoxide, radiographic
   - TLC - total lung capacity.

4.5 Respirable: Particles small enough to be drawn deep into the lungs and that are below 10 microns in size (too small to be seen by the naked eye).

4.6 Silicosis: A progressive disease of the lungs that reduces the ability of the lungs to extract oxygen from the air. It is caused by exposure to respirable crystalline silica dust particles. The damage can not be reversed.
5 Policy

5.1 Cianbro team members, subcontractors and the public will be protected from the hazards associated with crystalline silica.

6 Responsibilities

6.1 The top Cianbro manager on the job site is responsible for the implementation of this policy on the project.

6.2 The corporate safety department is responsible for maintaining this document.
7 Crystalline Silica Protection Program Index
7.1 Scope ............................................................................................................................................... 3
7.2 Purpose ............................................................................................................................................ 3
7.3 Procedure ......................................................................................................................................... 3
7.3.1 Identifying Silica Hazards ................................................................................................................. 3
7.3.2 Planning For Silica Exposure ........................................................................................................... 4
7.3.3 Establishing a Job Specific Silica Protection Plan ........................................................................... 4
7.4 Safety At Home ................................................................................................................................9
9 Related Documents ........................................................................................................................ 9
9.1 Appendix A Table of Applicable Standards ......................................................................................... 10
9.2 Appendix B Project Specific Lead or Silica Protection Plan ................................................................ 11
9.3 Appendix C Health Effects of Crystalline Silica .................................................................................. 13
9.4 Appendix D Steps to Protect Yourself from Crystalline Silica .......................................................... 14
9.5 Appendix E MSDS on Quartz Material Safety .................................................................................. 15
9.6 Appendix F Air Sampling Worksheet ................................................................................................ 17
9.7 Appendix G Team Member Air Monitoring Notification Form ............................................................ 20

7.1 Scope

7.1.1 This safety policy and procedure covers all operations that have the potential of creating exposure for personnel (Cianbro, subcontractor, client, or general public) to dusts containing crystalline silica.

7.2 Purpose

7.2.1 Note: OSHA has released a National Emphasis Program for Crystalline Silica in 2008.

7.2.2 The program requires local OSHA offices to do the following:
- Outreach to companies.
- Develop a local emphasis program for crystalline silica by targeting specific industries and doing inspections randomly within that industry.
- Do follow up inspections whenever overexposures are found.
- During the inspection OSHA will do air sampling, review engineering and work practice controls in use, review the respiratory protection program, look for records of HAZCOM training, look at labeling of carcinogens containing products (crystalline silica is considered a carcinogen), review housekeeping practices related to crystalline silica containing materials, review hygiene practices, look at medical and exposure records retention, and look at any abrasive blasting.
- OSHA will focus specifically on crystalline silica, but will cite any other serious hazards they encounter and many other standards apply to this type of work as well (hearing conservation, respirator use, HAZCOM training, etc).

7.3 Procedure

7.3.1 Identifying Silica Hazards
- Crystalline silica is a natural constituent of the earth’s crust and is a basic component of sand, concrete, brick, asphalt, granite, some blasting grit, and wall spackling materials. People may be exposed to crystalline silica hazards when around activities like:
  - Abrasive blasting
  - Jack hammering
  - Concrete crushing
  - Hoe ramming
  - Rock drilling
  - Mixing of concrete or grout
  - Concrete drilling
  - Sawing concrete, concrete blocks, or bricks
• Chipping or scarifying concrete
• Rock crushing
• Moving or dumping piles of concrete, rock, or sand
• Housekeeping activities (shoveling, sweeping, vacuuming, etc.)
• Demolition involving any of these materials
• Using coatings containing crystalline silica
• Removing coatings containing crystalline silica

Before any activity begins, project personnel must assess the work and identify possible exposures. Remember that concrete contains Portland Cement with silica and rock that contains silica. Quartz is the most common form of crystalline silica and is one of the most common minerals in the earth’s crust. Also, whenever available consult the MSDS(s) for the materials with which you are dealing. Even materials containing small amounts of crystalline silica may be hazardous if they are used in ways that produce high dust concentrations.

7.3.2 Planning For Silica Exposure
• In order to manage the silica hazard, project personnel must plan for potential team member health and environmental impacts before the work begins. Each activity with the potential for silica exposure must be addressed in a job specific activity plan (see 9.2 Appendix B) that focuses on eliminating or minimizing silica exposure through substitution, engineering controls, work practices and methods, air monitoring, effective hygiene practices, PPE, training, environmental controls, and waste disposal. Section 7.3.3 sets forth the requirements of a job specific silica plan.

7.3.3 Establishing a Job Specific Silica Protection Plan
• Training
  • Documented training will include:
    • Information about the potential health effects and symptoms of exposure to respirable crystalline silica. See 9.3 Appendix C.
    • Material safety data sheets for silica, quartz, and applicable products containing silica.
    • Purpose and set up of regulated areas marking the boundaries of work areas containing silica dust.
    • Discussion of the importance of substitution, engineering controls, work practices, good housekeeping, and personal hygiene in reducing crystalline silica exposure.
    • Use and care of appropriate PPE including respirators.
    • Expected exposures, controls in place to minimize exposure, and how to set up, use, maintain, etc. the controls to be used.
    • The contents of this safety policy and procedure.
    • Hygiene.
    • Availability of air monitoring and medical surveillance results.

• Substitution, Engineering Controls, and Work Practices
  • In order to control the hazards of crystalline silica, you must first look at alternate methods of doing the work, substitution of less hazardous materials, engineering controls, and work practice controls to reduce the exposure to crystalline silica to below the OSHA Permissible Exposure Limit (PEL). The job specific plan will contain information on what methods, substitution, engineering and work controls were considered, why or why not they are feasible, and which controls the job is going to use. 29 CFR 1926.55 requires us to use feasible engineering or work practice controls to reduce team members’ exposure to below the PEL.

• Some possible substitution or engineering controls:
  • Substituting non-silica containing materials for use while abrasive blasting.
  • Alternative methods (i.e. ordering grout from a concrete plant rather than mixing it onsite).
• Local exhaust (follow requirements of 1926.57).
• General ventilation (follow requirements of 1926.57).
• Vacuum methods with HEPA filters (vacuum shrouded tools like grinders, needle guns or saws).
• Distance (using a long handled grinder to allow standing up while grinding a floor or using a remote controlled unit like a scabbler, etc.).
• Dust control products for use on dusty roads or piles of material.
• Containment.
• Equipment with pressurized cabs and filter systems.
• Use of water hoses, spray booms, etc.
• Use of tools with dust control systems (water on saws or drill bits etc.).
• Diamond rope saw to cut concrete.
• “Chinese dynamite” e.g. slow expanding materials designed to break up concrete.

• Some possible work practice (administrative) controls:
  • Working during hours other crews are not.
  • Restricting access to the work areas.
  • Good housekeeping practices (not allowing dust to build up, etc.).
  • Specific standard operating procedures that minimizes dust produced by a task.
  • Green cutting with a hydro blaster before concrete sets up.

These are only some suggestions; there are other controls we can use. Some combination of these or other controls will allow us to reduce the exposure to below the PEL. The object is to keep the dust out of the air. Be creative and share what you learn. Remember that you must use feasible controls even if they do not completely reduce the exposure to below the PEL.

• Initial Assessment and Exposure Monitoring
  • Once all feasible engineering and administrative controls have been decided, you must determine what PPE is needed to supplement the controls. An initial assessment must be made to determine what the expected exposures will be. For respiratory protection this initial assessment will be based on either current Cianbro representative data (within the last twelve months and involving similar conditions: tools, engineering or administrative controls, area characteristics, work methods, etc.) or the following table of silica dust generating work activities that has been compiled from representative data. Either of these methods will provide a starting point for respiratory protection until you verify the exposure through ongoing air monitoring.
## Cianbro Task Assessment Guide

<table>
<thead>
<tr>
<th>Respirator</th>
<th>Protection Factor</th>
<th>Typical Silica Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half face with HEPA filters</td>
<td>Up to 0.5 mg/m³ for quartz cristobalite or tridymite</td>
<td>Housekeeping (wet method)</td>
</tr>
<tr>
<td>Full face with HEPA filters</td>
<td></td>
<td>Sawcutting (wet method)</td>
</tr>
<tr>
<td>PAPR with HEPA filters</td>
<td></td>
<td>Drilling concrete (wet method)</td>
</tr>
<tr>
<td>Supplied air respirator</td>
<td></td>
<td>Power tools with dust collection</td>
</tr>
<tr>
<td>SCBA</td>
<td></td>
<td>Equipment operating (open cab)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other activities not creating visible dust</td>
</tr>
<tr>
<td>Full face (quantitatively fit)</td>
<td>Up to 2.5 mg/m³ for quartz cristobalite or tridymite</td>
<td>Chipping concrete</td>
</tr>
<tr>
<td>PAPR with HEPA filters</td>
<td></td>
<td>Jack hammering</td>
</tr>
<tr>
<td>Supplied air respirator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCBA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full face (quantitatively fit)</td>
<td>Up to 5 mg/m³ quartz cristobalite or tridymite</td>
<td>Power tools without dust collection</td>
</tr>
<tr>
<td>PAPR with HEPA filters</td>
<td></td>
<td>Mixing grout (bulk)</td>
</tr>
<tr>
<td>Supplied air respirator</td>
<td></td>
<td>Vacuum abrasive blasting</td>
</tr>
<tr>
<td>SCBA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplied air respirator SCBA</td>
<td>Over 5 mg/m³ quartz cristobalite or tridymite</td>
<td>Abrasive blasting</td>
</tr>
<tr>
<td>Abrasive blasting hood respirator</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- You must perform air monitoring for each activity and for each job classification (e.g. both the hoe ram operator and the person spraying water to keep the dust down) that provides a potential exposure to crystalline silica. If methods or controls used change, further air monitoring must be done. You can use one or more persons to represent a group as long as you sample the person(s) likely to have the highest exposure. Reference the Cianbro IH manual for sampling methods and calculations or contact the manager of health and environmental hazards. Copies of field sampling data sheets must be sent to the manager of health and environmental hazards in Corporate Safety. Based on the results obtained, adjust the level of respiratory protection up or down as appropriate. For each activity, air monitoring frequency may be reduced to every six months if two consecutive tests taken at least seven days apart show results below 50% of the PEL. However if conditions, methods, activities, or controls used change then you must start air monitoring again.

- **Personal Protective Equipment**
  - PPE for work around silica containing dust includes:
    - Disposable or reusable work clothing to keep from spreading the dust or bringing the dust home.
    - Leather gloves.
    - Safety glasses (goggles may be appropriate).
    - Face shield.
    - Respiratory protection.
    - Boot covers or way to remove silica dust from boots (water hose for rubber boots, HEPA vac for leather boots).

- Until the level of team member exposure to crystalline silica is known to be below the PEL or if the use of feasible engineering and work practice controls is not sufficient to reduce the exposure to below the PEL, respiratory protection is required in accordance with 29 CFR 1910.134 and Cianbro’s respiratory protection program. See the bullet point titled Initial Assessment and Exposure Monitoring section 7.3.3.
When selecting respirators, use the following guidelines:

<table>
<thead>
<tr>
<th>Exposure Level</th>
<th>Minimum Required Respirator</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; PEL</td>
<td>Voluntary use of any approved respirator if determined by the competent person to not create any other hazard</td>
</tr>
<tr>
<td>PEL to 10xPEL</td>
<td>Half respirator with 100 efficiency (HEPA) filters</td>
</tr>
<tr>
<td></td>
<td>Full face respirator with 100 efficiency (HEPA) filters (qualitatively fit)</td>
</tr>
<tr>
<td>10xPEL to 25xPEL</td>
<td>Loose fitting PAPR with 100 efficiency (HEPA) filters</td>
</tr>
<tr>
<td>10xPEL to 50xPEL</td>
<td>Full face respirator with 100 efficiency (HEPA) filters (quantitatively fit)</td>
</tr>
<tr>
<td>50xPEL to 100xPEL</td>
<td>Full face tight fitting PAPR with 100 efficiency (HEPA) filters</td>
</tr>
<tr>
<td>&gt; 100xPEL</td>
<td>Supplied air respirator SCBA</td>
</tr>
</tbody>
</table>

Notes:
1. Any respirator on the list may be used for a lesser exposure.
2. A respirator may only be used if all feasible engineering and administrative controls can not reduce the exposure below the PEL; while verifying engineering and administrative controls are effective in keeping the exposure to below the PEL; or when the exposure is proven to be below the PEL but the team member wants to use a respirator anyway (the team member must be current in Cianbro’s respiratory protection program policy and procedure, and be using a NIOSH approved respirator and filters).
3. Abrasive blasting (except vacuum blasting) requires type CE pressure demand supplied air blasting hood.

Hygiene
- Good hygiene is as important as PPE in protecting team members from toxic materials. To ensure team members protect themselves and their families, the following practices are required:
  - Do not eat, drink, or use tobacco products in work areas where silica-containing dust is present.
  - Wash your hands and face before eating, drinking, or smoking.
  - Use disposable or washable work clothing at the work site.
  - Shower if available or change into clean clothing before going home. If work clothing is to be washed, make sure to handle it in such a manner as to not put the dust back into the air. Place it into plastic bags labeled “Caution-clothing contaminated with silica dust”.
  - Provide hand-washing facilities at a minimum.
  - Park personal vehicles away from sources of silica dust.

Regulated Areas
- In operations producing dust containing or suspected of containing crystalline silica, care must be taken to also protect people and places not involved with the work. This may mean blocking off the area (with tape or plastic fencing, etc.) and posting signs or in some cases using containment with ventilation and HEPA exhaust depending on location and type of work. People without the proper PPE are not allowed in the regulated area. The size of the area should be determined by the competent person based on visible emissions, wind direction, and available sampling data.

- Signs should be posted at all possible access points:

<table>
<thead>
<tr>
<th>Danger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline Silica</td>
</tr>
<tr>
<td>Inhalation Hazard</td>
</tr>
<tr>
<td>No Smoking, Eating, or Drinking</td>
</tr>
<tr>
<td>Authorized Personnel only</td>
</tr>
</tbody>
</table>
• **Housekeeping**
  - Areas shall be kept as free from accumulated dust as possible. Use methods that do not reintroduce dust into the air (wet methods, hepa vacs, etc.).

• **Medical Surveillance**
  - All team members with potential exposure to crystalline silica must be current with Cianbro’s respirator medical surveillance.
    - They must have had the pre-placement physical including the respirator questionnaire (with the silicosis portion) and a baseline PFT.
    - The respirator and silicosis questionnaires must be completed annually.
    - The standard PFT must be performed every three years (FVC, FEV₁, and FEV₁ / FVC).

  - Follow-up examinations are ordered by Cianbro’s Medical Director after review of the above information and may be triggered by the following:
    - Signs and symptoms of silicosis not explained by any non silica related, currently existing medical condition.
    - And/or clinically significant PFT results:
      1. FVC < 70% of predicted.
      2. FEV₁/FVC and FVC < 70% of predicted.
      3. Other change deemed clinically significant by medical review.

  - The initial follow up will consist of a silica medical exam and a specialized PFT (DLCO, and /or radiographic TLC). It may include a chest x-ray if clinically indicated and not done as part of specific respiratory function testing. Please contact Cianbro’s medical director with any questions.

  - In the event that silica induced pulmonary disease is suspected, the team member must be removed from potential exposure to silica containing dusts until a final medical determination is made.

• **Waste Storage and Disposal**
  - By itself, dust containing crystalline silica is not regulated as a hazardous waste unless it is mixed with or contains something else that makes it a hazardous waste. Make sure that you do not create an additional airborne crystalline silica hazard when collecting, emptying, or disposing of the material.

• **Recordkeeping**
  - In accordance with 29 CFR 1910.20, medical records shall be maintained for at least thirty years after a team member’s termination of employment.

  - All exposure monitoring (air sampling, etc.) results shall be kept for thirty years. The results of exposure monitoring shall be reported in writing to the team members it represents or posted in a location available to the team members. Use Cianbro form SD873 to report the results. If the results are above the PEL, include the actions that will be taken to reduce the exposure.

  - All exposure monitoring worksheets, results, and other pertinent information should be kept on site and a copy sent to the manager of health and environmental hazards.

• **Subcontractors**
  - All subcontractors of Cianbro Corporation are required to meet or exceed the requirements of this safety policy and procedure when performing work that has the potential for crystalline silica exposure above the PEL.

  - All Cianbro subcontractors shall notify Cianbro Corporation of any activity with the potential for crystalline silica exposure and the methods they will employ to control the exposure.
• Cianbro team members performing work that has the potential for crystalline silica exposure to non-Cianbro employees shall, prior to beginning the activity, notify all potentially affected parties of the expected exposure, health hazards of crystalline silica, and the methods they can use to protect themselves against overexposure.

• Each contractor is responsible for the safety of their own workers, whether they create the hazard or not. A contractor is also responsible for its subcontractors. Therefore, control of silica dust must be coordinated effort. No one can say, “It’s not my problem.” Failure to protect the workers is not a viable option.

7.4 Safety At Home
Activities such as gardening, driving on dirt roads, farming, home construction, wind blown dust, and even kicking up sand on the beach cause crystalline silica to become airborne. Prolonged inhalation of particles too small to be seen can cause serious health problems for people. In activities at home, make sure to prevent ongoing exposure to high levels of dust. Follow the information in this policy to reduce or eliminate exposure to dust containing crystalline silica.

8 Budget / Approval Process
8.1 It is the responsibility of each jobsite to procure and provide all materials and PPE required and provide necessary training.

9 Related Documents
9.1 National Emphasis Program – Crystalline Silica – Directive CPL 03-00-007
Special Emphasis Program for Silicosis in Construction - 1996
29 CFR 1926.55 Gases, Vapors, Fumes, Dusts, and Mists
NIOSH alert “Preventing Silicosis and Death in Construction Workers”
See 9.1 Appendix A for other standards that may apply.
TABLE OF APPLICABLE STANDARDS

The following table contains OSHA standards that impact the way we handle hazards related to silica and that may be cited under the right circumstances.

<table>
<thead>
<tr>
<th>OSHA Requirement</th>
<th>General Industry Standard</th>
<th>Construction Standard</th>
<th>Maritime Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible Exposure Limit and Controls</td>
<td>1910.1000</td>
<td>1926.55 &amp; .57</td>
<td>1915.1000</td>
</tr>
<tr>
<td>Accident Prevention and Warning Signs</td>
<td>1910.145</td>
<td>1926.200</td>
<td>--</td>
</tr>
<tr>
<td>Access To Team member Exposure and Medical Records</td>
<td>1910.20</td>
<td>1926.33</td>
<td>1915.1120</td>
</tr>
<tr>
<td>OSHA 200 Forms</td>
<td>1904</td>
<td>1904, 1926.22</td>
<td>1904</td>
</tr>
<tr>
<td>Abrasive Blasting, Breathing Air, Enclosures, Controls</td>
<td>1910.94</td>
<td>1926.28, .55, .95, .100, .101, .102, .103, and .300</td>
<td>1915.131, .133, .151, .152, .153, and .1000</td>
</tr>
<tr>
<td>Hygiene</td>
<td>1910.141</td>
<td>1926.27 and .51</td>
<td>1915.97</td>
</tr>
<tr>
<td>General PPE</td>
<td>1910.132</td>
<td>1926.28, .95, .100 to .105</td>
<td>1915.151 to .154</td>
</tr>
<tr>
<td>Hazard Communication</td>
<td>1910.1200</td>
<td>1926.59</td>
<td>1915.1200</td>
</tr>
<tr>
<td>Safety and Health Program</td>
<td>--</td>
<td>1926.20</td>
<td>--</td>
</tr>
<tr>
<td>General Training</td>
<td>--</td>
<td>1926.21</td>
<td>--</td>
</tr>
</tbody>
</table>
I. Describe each activity emitting lead or silica including the hazardous material(s) and the tools, equipment, and process that create the hazard:

II. List the specific Eng./Administrative controls and studies reviewed. What controls will be used? What controls are not feasible and why?
   1. Ventilation (local/general, positioning, air flow):

   2. Shrouded/exhausted tools or local exhaust:

   3. Containment (describe):

   4. Wet methods (describe how water is used):

   5. Other (long handled torches, paint remover, etc.):

   6. Administrative controls (team member exposure time log kept for worker rotation, SOP's):

III. Air monitoring history (past/present), list or attach sampling results or other information used to make initial exposure assessment:
IV. Work practice program:

1. Hygiene plans (hand wash at minimum, showers if required, decon procedure):

2. Protective clothing/equipment:

3. Housekeeping plans (wet methods or hepavac):

4. Specific team member responsibilities:

5. Equipment operating procedures:

6. Equipment maintenance practices:

**Competent person must do frequent and regular checks of the work area.** For lead work refer to Appendix F, 034 Crystalline Silica Protection Program Policy and Procedure. Notify all other contractors in the area of potential lead exposure related to our work.
Health Effects of Crystalline Silica

Inhaling fine particles of crystalline silica containing dusts has been associated with respiratory disease, most commonly silicosis. Additionally, there is evidence that exposure to crystalline silica-containing dusts causes or is associated with the following conditions: lung cancer, tuberculosis, chronic obstructive pulmonary disease (including emphysema and bronchitis), autoimmune diseases or immunologic disorders, chronic renal disease, and sub clinical renal changes [NIOSH, 2002]. The International Agency for Research on Cancer (IARC) has classified silica as a known human carcinogen (group 1).

When fine particles of crystalline silica enter the lungs and are trapped, the lung tissue reacts by developing fibrotic nodules and scarring around the particles. As exposure continues and the condition worsens, the nodules become progressively larger and breathing becomes increasingly difficult. This fibrotic condition of the lungs is called silicosis and it reduces the lungs ability to extract oxygen from the air. Eventually the worker may even die of respiratory failure. The body’s natural defenses (mucous membranes of the nose and throat, etc.) filter out most of the particles above 5-10 microns in size from the air we breathe. Yet there is no mechanism to remove particles small enough to get deep into the lungs; these particles, such as silica, can not be broken down by the body.

The construction industry has a high risk of exposure to crystalline silica containing dusts due to the materials like concrete that we work with and the activities that are typical to the work like demolition. Many of these activities create freshly fractured crystalline silica particles and studies have shown that a worker’s lung may react more severely to silica that is freshly fractured.

Symptoms of silicosis may not develop for many years but as the exposure continues symptoms appear such as shortness of breath with exertion (the most common symptom), coughing, and fever due to infectious disease of the lung (such as tuberculosis). Because these symptoms can be caused by a lot of things, silicosis is often misdiagnosed as bronchitis, emphysema, and tuberculosis. It is important however, to accurately identify silicosis, as the disease can only be stopped, not cured!

NIOSH has classified three types of silicosis:

- **Chronic Silicosis**, which occurs after ten or usually more years of exposure to crystalline silica at relatively low concentrations.
- **Accelerated Silicosis**, which results from exposure to high concentrations of crystalline silica and develops five to ten years after the initial exposure.
- **Acute Silicosis**, which occurs where exposure concentrations are the highest and can cause symptoms to develop within a few weeks to four or five years after the initial exposure.

Not everyone will contract silicosis at the same rate if at all. The development of silicosis will depend on the following factors:

- **Particle size**: when the silica crystals are broken down into dust sized or respirable particles (smaller than 10 microns) they are small enough to be inhaled deep into the lungs and become deadly.
- **Percentage of crystalline silica**: the higher the percentage of crystalline silica present that is small enough to get deep into the lungs, the more damage that will occur.
- **Length of exposure**: the longer a person is exposed to respirable crystalline silica, the more likely they are to develop silicosis.
- **Severity of exposure**: the higher the concentration a person is exposed to the more likely they are to develop silicosis.
- **Individual susceptibility**: certain individuals will be more prone to develop silicosis and its associated complications due to the person’s health.

Smoking: smoking increases a person’s chance to contract silicosis by inhibiting the ability to filter particles out of the air before they reach the lungs.
Steps to Protect Yourself from Crystalline Silica

Take the following steps to protect yourself against exposure to crystalline silica:

- Know the health effects of crystalline silica and that smoking adds to the damage.
- Participate in any medical surveillance, air monitoring, or training programs offered.
- Substitute less hazardous materials and/or methods.
- If substitution is not possible, use engineering controls such as dust collectors, wet methods, and local exhaust ventilation to minimize exposures to silica containing dust.
- Always use dust control systems when available and keep them well maintained.
- Use wet methods whenever possible.
- Be aware that the highest silica concentrations may occur inside enclosed areas during concrete or masonry sawing or abrasive blasting.
- Change into disposable or washable work clothes at the jobsite.
- Do not eat, drink, use tobacco, or apply cosmetics in dusty areas.
- Wash hands and face before eating, drinking, or smoking outside dusty areas.
- Shower, if possible, and change into clean clothes before leaving the jobsite.
- Park in a location away from dusty operations, preferably upwind.
- Use type CE pressure demand abrasive blasting respirators when abrasive blasting.
- When cleaning up or disposing of silica containing materials, use a method that does not reintroduce dust into the air.
Section 1. Material Identification
Quartz Description: Occurring widely in nature, this crystallized silicon dioxide is also grown by man production methods under carefully regulated temperature and concentration. Used in electronic components, radio and TV components, and wave filters; as a barrel-finishing abrasive; as a piezoelectric control in filters; in oscillators; and in frequency standards. Exposure to quartz occurs in sandblasting, granite-cutting and tombstone-making; in manufacturing pottery and porcelain; in hard rock mining; in polishing and grinding operations which use natural abrasive wheels; in foundries; in manufacturing silica firebrick, and in the spraying of vitreous enamels.
Other Designations: CAS No. 14808-69-7; SiO₂; silicon dioxide; sand; rose quartz; silicic anhydride; amethyst.
Manufacturer: Contact your supplier or distributor. Consult the latest Chemicalweek Buyers' Guide® for a suppliers list.

Section 2. Ingredients and Occupational Exposure Limits
Quartz (respirable)
OSHA PELs
8-hr TWA: 10 mg/m³ divided by (6%SiO₂ + 2)*
8-hr TWA: 30 mg/m³ divided by (8%SiO₂ + 2)*
    (total dust)  
ACGIH TLV, 1989-90  
TLV-TWA: 0.1 mg/m³  
NIOSH REL, 1987  
10-hr TWA: 50 µg/m³  
Toxicity Data:
Human, inhalation, TC₅₀: 16 mppcf of air administered intermittently during 8-hr periods over 17.9 years produces pulmonary fibrosis, cough, and difficult breathing. Human, inhalation, LC₅₀ : 300 µg/m³ administered intermittently over a 10-year period affects the liver.

* The formula’s percentage of quartz is the amount determined from air-borne samples. By the use of site-selective sampling devices, a fraction of dust is collected and the weight concentration of airborne quartz is the fine fraction correlated to the degree of health hazard.
† See NIOSH, RTECS (VV733000), for additional data on nontoxic and toxicity effects.

Section 3. Physical Data
Boiling Point: 4064 °F/2230 °C  Molecular Weight: 60.09 g/mol
Melting Point: 3110 °F/1710 °C  Specific Gravity (H₂O = 1 at 39 °F/4 °C): 2.65
Vapor Pressure: 10 µm at 3150 °F/1732 °C  Water Solubility: Insoluble
Mohs Hardness: 7  Appearance and Odor: If quartz is pure, it is a white powder or colorless crystals. No odor.

Section 4. Fire and Explosion Data
Flash Point: None reported  Autoignition Temperature: None reported  LEL: None reported  UEL: None reported
Extinguishing Media: Since this material is noncombustible, use extinguishing media appropriate to the surrounding fire.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Be aware of run-off from fire control methods. Do not release to sewers or watery ways.

Section 5. Reactivity Data
Stability/Polymerization: Quartz is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Quartz dissolves readily in hydrofluoric acid, forming silicon tetrafluoride, a corrosive gas. It reacts violently with powerful oxidizers such as chlorine trifluoride (ClF₃), manganese trifluoride (MnF₃), oxygen difluoride (OF₂), vinylacete, and certain other fluorine-containing compounds. It is attacked by strong alkalis. Upon heating at high temperatures, quartz combines chemically with many metallic oxides.
Hazardous Products of Decomposition: When exposed to high temperatures, quartz (amorphous silica) can change crystal structure to form tridymite (above 158 °F/870 °C) or cristobalite (above 2678 °F/1470 °C), which have greater health hazards than quartz.

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Section 6. Health Hazard Data

Careinogenicity: Although neither the NTP nor OSHA lists quartz as a carcinogen, the IARC states that there is "sufficient evidence for the carcinogenicity of crystalline silica to experimental animals" and "limited evidence" with respect to humans.*

Summary of Risks: Prolonged exposure to respirable crystalline quartz may cause a delayed chronic lung injury (silicosis). Simple silicosis occurs after 20 years exposure, accelerated silicosis after 5 to 15 years, and acute silicosis occurs after 1 to 3 years. Acute silicosis may occur among sandblasters and tunnel workers, who are exposed to heavy concentrations of respirable crystalline quartz. Silicosis symptoms include the formation of nodules of scar tissue in the lungs. This chronic scarring leads to a progressive massive fibrosis, often accompanied by increased susceptibility to pulmonary tuberculosis and other respiratory infections. Progressive massive fibrosis may be accompanied by right heart enlargement, heart failure, and pulmonary failure. Continued exposure to quantities of free-silica-containing dust, advancing age, and smoking accelerate the disease's progression. If tuberculosis does not prove fatal, eventual cardiac failure or destruction of lung tissue with anoxemia will.

Medical Conditions Aggravated by Long-Term Exposure: A disabling, progressive, and sometimes fatal pulmonary fibrosis that often aggravates other pulmonary conditions and respiratory infections may result from long-term exposure.

Target Organs: Respiratory system, skin.

Primary Entry Routes: Inhalation.

Acute Effects: Acute silicosis is manifested by dyspnea, fever, cough, and weight loss. In cases of exposure to very high concentrations in short periods of time, severe respiratory symptoms may lead to death. Exposure to both crystalline and amorphous quartz dust has a drying effect on the skin and mucous membranes.

Chronic Effects: The chronic symptoms include cough, dyspnea, wheezing, increased susceptibility to tuberculosis, decreased chest expansion, and repeated nonspecific chest illnesses. Chronic exposure may also cause fissures, thickening, and general breakdown of the skin. Pulmonary function impairment may be progressive with pulmonary infections and cardiac decompensation. As the disease progresses, shortness of breath worsens, the cough more productive, extreme dyspnea and cyanosis, marked fatigue, loss of appetite, pleuritic pain, and total incapacity to work.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flowing amounts of running water for at least 15 min.

Skin: Quickly remove contaminated clothing. After rinsing affected skin with flowing amounts of water, wash it with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a conscious person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.

After first aid, get appropriate in-plant, paramedic, or community medical support.


Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of large spills. Provide adequate ventilation. Cleanup personnel need protection against eye contact and dust inhalation. Use dustless systems (vacuum or wet sweeping) for cleanup so that airborne dust does not exceed the PEL. Do not dry sweep. Carefully clean up spills without generating dust clouds and place waste into disposable containers. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.33): Not listed

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-3)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Any dust respirator is efficient for a particular concentration of 5X PEL or less. Any dust respirator (except single-use) is efficient for 10X PEL or less. A high-efficiency particulate filter respirator with a full facepiece is necessary for 50X PEL or less. A powered air-purifying respirator with a high-efficiency particulate filter is necessary for 500X PEL or less. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks) or if the particulate concentration is greater than 500X PEL, wear an SCBA.

Warning: Air-purifying respirators do not protect workers in oxygen-depletion atmospheres.

Wear impermeable gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELS, ACIGH TLV, and NIOSH REL. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source (footnote 130)

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area; soft lenses may absorb and, all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store respirable crystalline quartz in closed containers in a dry, well-ventilated area.

Engineering Controls: Avoid dust inhalation and contact with eyes. Adequate ventilation is essential. Minimize dust in the work area and maintain air concentrations below the TLV (Sec. 2). Practice good housekeeping. Do not allow dust to collect on walls, floors, sills, ledges, machinery, or equipment. Fit test respirators in accordance with OSHA regulations. Provide preplacement and annual physical exams for exposed workers, with emphasis on respiratory and cardiovascular systems. Prevent exposing those individuals with pulmonary disease.

Transportation Data (49 CFR 172.101, 102): Not listed

MSDS Collection References: 1, 2-12, 19, 24-27, 31, 34, 37, 38, 71, 73, 87-89, 100, 103, 123, 126, 127

Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CHI; Medical Review: MJ Hardies, MD

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<table>
<thead>
<tr>
<th>Date of sample</th>
<th>Pump voltage above 5</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Job number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM name</td>
<td>TM ID#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM job classification</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Activity performed by TM (s):**

**TM exposure monitoring represents:**

<table>
<thead>
<tr>
<th>TM name</th>
<th>TM ID #</th>
</tr>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature fahrenheit</th>
<th>Humidity percentage</th>
<th>Wind speed</th>
<th>Wind direction</th>
<th>Atmospheric pressure (in. Hg)</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

**Area characteristics (indoors/outdoors, boiler cavity, 2,000 sq. ft. tank, etc.):**

**Equipment/tools used (please be specific):**

**Respiratory protection used & other personal protective equipment:**

**Engineering/admin. controls (ventilation, HEPA units, wet methods, containment, etc.):**

<table>
<thead>
<tr>
<th>Make</th>
<th>Model</th>
<th>Flow rate</th>
<th>Equipment positioning</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

**TM’s work location, duration, exposure & activities while not wearing sample pump:**

<table>
<thead>
<tr>
<th>Length of shift</th>
<th>Total length of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminant testing for</td>
<td>Sample code</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------</td>
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Total Volume (Liters) = Total Time (Min) x Avg. Cal. Flow Rate (LPM)

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<table>
<thead>
<tr>
<th>Sample coordinator (print)</th>
<th>Date of last calibration</th>
<th>Initials</th>
<th>TM ID #</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Results: results must be completed for all air samples, this includes PEL, TWA and AL.

<table>
<thead>
<tr>
<th>Contaminant(s)</th>
<th>Sampling type (personal or area sample)</th>
<th>Lab results</th>
<th>Units</th>
<th>Permissible Exposure Limit (PEL)</th>
<th>Time Weighted Average (TWA)</th>
<th>Action Level (AL)</th>
</tr>
</thead>
<tbody>
<tr>
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Note: Make sure to adjust PEL and AL for shift length using the formula: adjusted PEL or AL = 8 HR PEL or AL x 8 / Actual shift length

(This formula can be used to adjust TLV’s also)
Calculations (show all work):

To calculate the TWA for the person tested:

\[
\text{TWA} = \frac{(C_1 \times T_1) + (C_2 \times T_2) + \ldots + (C_n \times T_n)}{T \text{ (total time)}}
\]

C= Concentration (mg/m3)
T= Time
n= Number of different concentrations

For silica: calculate the % of quartz, cristobalite and tridymite (three forms of crystalline silica) present in the sample.

\[
\% \text{ Quartz} = \frac{\text{mg of Quartz}}{\text{mg of respirable dust}} \times 100
\]

Use the same formula for cristobalite and tridymite. Usually quartz will be the only form present. The others will be reported as below detection limits and considered to be 0%.

Calculate the PEL:

\[
\text{PEL} = \frac{10 \text{ mg/m3}}{\% \text{ Q} + 2(\% \text{ T}) + 2(\% \text{Cr}) + 2}
\]

Compare the PEL to the TWA.

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Team Member Air Monitoring Notification

Note: Written notification is required by the standard within five days of receiving the results.

On, __________________________ air sampling was performed for the following tasks/activities. The crew consisted of the following people:

________________________________________  ______________________________________
________________________________________  ______________________________________
________________________________________  ______________________________________
________________________________________  ______________________________________

Below are the results of the air monitoring; the calculated PEL based on the shift length and the time weighted average of team member exposure.

<table>
<thead>
<tr>
<th>Task/Activity</th>
<th>Lab Result</th>
<th>TWA</th>
<th>Calculated PEL</th>
</tr>
</thead>
</table>

Check one of the following:

☐ Team member exposure (allowable PEL must be based on shift duration [8, 10, 12 hour shift]) was below the allowable PEL of ____________________.

☐ Team member exposures were at or above the allowable PEL of ____________________ and the following corrective action were taken to reduce the exposure to below that level.

Corrective Action (must complete the section if TWA is above the PEL).

Date posted or given to team member(s): ____________________.

Email this form to corporate safety department corpsafety@cianbro.com.