



OSHA INSTRUCTION

U.S. DEPARTMENT OF LABOR

Occupational Safety and Health Administration

DIRECTIVE NUMBER: CPL 03-00-007

EFFECTIVE DATE: January 24, 2008

SUBJECT: National Emphasis Program – Crystalline Silica

ABSTRACT

- Purpose:** This instruction describes policies and procedures for implementing a National Emphasis Program to identify and reduce or eliminate the health hazards associated with occupational exposure to crystalline silica.
- Scope:** This instruction applies OSHA-wide.
- References:** OSHA Instruction CPL 02-00-103 (CPL 2.103), September 26, 1994, Field Inspection Reference Manual (FIRM).
OSHA Instruction CPL 02-00-140, June 26, 2006, Complaint Policies and Procedures.
OSHA Instruction CPL 02-00-025 (CPL 2.25I), January 4, 1995, Scheduling System for Programmed Inspections.
OSHA Instruction CPL 02-00-051(CPL 2-0.51J), May 28, 1998, Enforcement Exemption and Limitations under the *Appropriations Act*.
OSHA Notice CPL 07-03 (CPL 02), May 14, 2007, Site-Specific Targeting 2007 (SST-07).
OSHA Instruction CPL 02-00-120 (CPL 2-0.120), September 25, 1998, Inspection Procedures for the Respiratory Protection Standard.
OSHA Instruction CPL 02-02-038 (CPL 2-2.38D), March 20, 1998, Inspection Procedures for the Hazard Communication Standard.
- Cancellations:** OSHA Instruction CPL 02-02-007 (CPL 2-2.7), Crystalline Silica, October 30, 1972.
OSHA Instruction CPL 02-02-007 (CPL 2-2.7 CH-1), Removal of Obsolete Sections, June 3, 1985.
Memorandum for Regional Administrators from Joseph A. Dear, Assistant Secretary, May 2, 1996, Subject: Special Emphasis Program (SEP) for Silicosis.

Executive Summary

In 1996, the Occupational Safety and Health Administration (OSHA) issued a memorandum establishing a Special Emphasis Program (SEP) for Silicosis, which provided guidance for targeting inspections of worksites with employees at risk of developing silicosis. This instruction establishes a National Emphasis Program (NEP) that expands and builds upon the 1996 SEP. This instruction addresses targeting of worksites with elevated exposure to crystalline silica, as well as silica-related inspection procedures and compliance assistance. All Local Emphasis Programs (LEPs) for silica-related activities may remain in effect under this NEP. Any conflicts between an LEP and an NEP should be resolved in favor of the NEP.

Significant Changes

This Instruction expands the 1996 SEP to include the following changes:

- New program evaluation procedures designed to ensure that the goals of this NEP are measured as accurately as possible. The procedures require Area Offices to conduct follow-up inspections where overexposures to crystalline silica are found and to provide to the National Office-Directorate of Enforcement Programs portions of case files containing citations for crystalline silica overexposure;
- Detailed procedures for conducting silica-related inspections;
- Updated information for selecting sites for inspection, including an updated list of North American Industrial Classification System (NAICS) and Standard Industrial Classification (SIC) codes for industries with documented employee exposures to respirable crystalline silica (as described in Appendix B);
- Development of outreach programs by each Region and Area Office, emphasizing the formation of voluntary partnerships to share information on effective methods for reducing or eliminating employee exposure to crystalline silica; and
- Guidance on calculating the permissible exposure limits (PELs) for dust containing respirable crystalline silica in Construction and Maritime, using the OSHA-adopted conversion factor of 0.1 milligrams per cubic meter (mg/m^3) per 1 million particles per cubic foot (mppcf), described in Appendix E.

IX. Background.

- D.** The term “silica” refers broadly to the mineral compound silicon dioxide (SiO₂). Silica can be crystalline or amorphous. Crystalline silica is significantly more hazardous to employees than amorphous silica. In addition to causing the disabling and irreversible lung disease silicosis, crystalline silica has been classified as a Group I carcinogen - Carcinogenic to Humans by the International Agency for Research on Cancer (IARC) [IARC, 1997]. The term “silica” as it is used in this directive refers specifically to crystalline silica.

Crystalline silica is an important industrial material, and occupational exposure occurs in a variety of workplace settings, including mining, manufacturing, construction, maritime, and agriculture. Processes associated historically with high rates of silicosis include sandblasting, sand-casting foundry operations, mining, tunneling, cement cutting and demolition, masonry work, and granite cutting. Appendix A provides further information on silica, including sources, industrial uses, and adverse health effects. Appendix B provides a list of North American Industrial Classification System (NAICS) and Standard Industrial Classification (SIC) codes for industries in which silica exposure occurs frequently, based on a review of OSHA inspection data for the period 1996 to 2007.

- E.** Reducing and ultimately eliminating the workplace incidence of silicosis has been a primary goal of the Agency since its inception. In 1972, OSHA issued guidelines for conducting inspections in workplaces with significant crystalline silica exposure. In the early 1980s, the Agency placed a special emphasis on the prevention of silicosis in foundry personnel, and in 1996 OSHA implemented a Special Emphasis Program (SEP) to reduce the workplace incidence of silicosis.

The 1994 Government Performance and Results Act (GPRA) mandates that federal agencies improve performance and devise a system for measuring results. To comply with the provisions of GPRA, OSHA developed a Strategic Plan for improving the safety and health of all employees. In 1998 and again in 2003, under the Strategic Plan, OSHA identified crystalline silica as one of the focused hazards.

This NEP is being implemented to direct OSHA’s field staff inspection efforts to address elevated silica exposures in the workplace, including General Industry (1910) and Construction (1926). These efforts meet the Strategic Plan goal of reducing silicosis, set forth by the Agency.

X. National Emphasis Program Goals.

The purpose of this NEP is to significantly reduce/eliminate employee overexposures to crystalline silica and, therefore, control the health hazards associated with such exposures. This goal will be accomplished by a combined effort of inspection targeting, outreach to employers, and compliance assistance.

Inspections should be targeted to work sites that likely create high silica exposures. In each Region, at least 2 percent of inspections every year must be silica-related

- d. When it is necessary to review employee medical records, ensure that they are obtained and remain confidential in accordance with 1913.10 and 1910.1020.

Citation Guidance: If violations are found, CSHOs should cite the applicable section of 1910.1020 or 1926.33. These rules do not require creation of any records, only preservation and access requirements.

Recent revisions to recordkeeping policies and procedures are described in CPL 02-00-135, Recordkeeping Policies and Procedures Manual (RKM).

7. **Abrasive Blasting:**

In addition to the program elements described above, the following procedures apply specifically to abrasive blasting operations:

- a. Conduct monitoring to determine employee exposure to metals, such as: lead, arsenic, manganese, chromium, cadmium, copper, and magnesium. (Abrasive blasters may be exposed to metals either from the surface being blasted or from non-silica abrasive media.)
- b. The air sampling device (cyclone) must be placed within the breathing zone, outside of any protective equipment including the abrasive blasting hood.
- c. Conduct exposure monitoring of potentially exposed employees not engaged in abrasive blasting but still working in the area.
- d. Conduct noise exposure monitoring as appropriate.
- e. Determine whether the ventilation systems for abrasive blasting rooms and containment structures prevent escape of dust and provide prompt clearance of dust-laden air.
- f. Determine whether each blast cleaning nozzle is properly equipped with an operating valve that must be held open manually.
- g. For supplied-air respirators, evaluate breathing air quality and use. For oil-lubricated compressors, ensure that the compressor is equipped with a high-temperature or carbon monoxide alarm, or both, to ensure that carbon monoxide levels remain below the PEL. [Note: Using an abrasive blasting hood while wearing a filtering face piece respirator violates the NIOSH approval for both respirators.]

Appendix A: Background Information on Silica

This appendix provides an overview of the following silica-related topics: the forms and sources of silica; common industrial uses of silica and workplaces with silica exposure; history of silicosis; and health effects associated with exposure. The reference list at the end of this appendix, as well as the expanded bibliography in Appendix J, provide many sources that may prove useful to those interested in a more in-depth treatment of these topics.

Introduction

“Silica,” is a term which refers broadly to the mineral compound silicon dioxide (SiO_2). Silica can be crystalline or amorphous. Crystalline silica is significantly more hazardous to employees than amorphous silica. In addition to causing the disabling and irreversible lung disease known as silicosis, crystalline silica has been classified as a human carcinogen by the International Agency for Research on Cancer (IARC) [IARC, 1997]. As it is typically used in this document, “silica” refers specifically to crystalline silica.

Crystalline silica is characterized by a large scale, repeating pattern of silicon and oxygen atoms, as distinguished from the more random arrangement found in amorphous silica. Abundant in the earth’s crust, crystalline silica is a basic component of most classes of rock. Naturally-occurring forms of amorphous silica include diatomaceous earth (the skeletal remains of marine organisms) and vitreous silica or volcanic glass [Markowitz and Rosner, 1995; Davis, 1996].

Forms and Sources of Crystalline Silica

Crystalline silica occurs in three primary mineralogical forms, or polymorphs—quartz, cristobalite, and tridymite. Silica is also called “free silica,” to distinguish it from the silicates, which are minerals containing silicon dioxide bound to one or more cations [Beckett et al., 1997].

Quartz is by far the most common form of naturally-occurring silica [Davis, 1996; IARC, 1997]. Cristobalite and tridymite, which are molecularly identical to quartz, are distinguishable by their unique crystalline structures. They are less stable than quartz, thus accounting for the dominance of the quartz form. Quartz itself exists as either of two sub-polymorphs, alpha-quartz (also known as low quartz), and beta-quartz (high quartz). Alpha-quartz is the thermodynamically stable form of crystalline silica and accounts for the overwhelming portion of naturally-occurring crystalline silica [IARC, 1997].

Quartz is a major component of soils and is readily found in both sedimentary and igneous rocks, although the quartz content varies greatly from one rock type to another. For instance, granite contains on average about 30 percent quartz, and shales contain about 20 percent quartz. Natural stone, such as beach sand or sandstone, may be nearly pure quartz [IARC, 1997; Davis, 1996].

Cristobalite and tridymite are natural constituents of some volcanic rock, and man-made forms result from direct conversion of quartz or amorphous silica that has been subjected to high temperature or pressure. Diatomaceous earth, composed of amorphous silica, crystallizes during heating (calcining), yielding a calcined product that contains as much as 75 percent cristobalite.

[Rosenman et al., 1997]. In another study, foundry employees whose lungs exhibited radiographic changes consistent with silicosis were concentrated in four primary job assignments: core making, mold making, core knockout, and cleaning/finishing. The study was conducted at a Midwestern gray iron foundry that has produced automotive engine blocks since 1949; the researchers analyzed medical records and silica exposure data for 1,072 current and retired employees with at least five years of employment as of June 1991. Radiographic readings consistent with silicosis were also correlated with the number of years at the foundry, smoking habits, and silica exposure levels [Rosenman et al., 1996].

- In the mid-1990s, there were two cases of accelerated silicosis in relatively young sandblasters following short periods of extremely high crystalline silica exposures. In 1995, a 36-year-old man who had sandblasted oil field tanks in Western Texas for 36 months died from respiratory failure, eleven years after his initial exposure to crystalline silica. A second sandblaster at the same facility, a 30-year-old man who had worked as a sandblaster from 1986 to 1990, died in 1996, ten years after his initial exposure [CDC, 1998]. Both of these sandblasters died from progressive massive fibrosis, an advanced stage of silicosis.

Adverse Health Effects of Crystalline Silica Exposure

Pulmonary silicosis has historically been the disease most well-known as being caused by the inhalation of respirable crystalline silica particles. 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 subclinical renal changes [NIOSH, 2002].

Silicosis

Silicosis is a fibrotic disease of the lungs caused by the inhalation of crystalline silica dust. It is a type of pneumoconiosis, which is a general term for chronic lung disease that occurs when certain particles are inhaled and deposited deep in the lung.

There are two main types of silicosis, *chronic silicosis* (also called “classical” or “nodular” silicosis) and *acute silicosis*, medically referred to as silico-proteinosis or alveolar lipoproteinosis-like silicosis. Chronic silicosis, by far the most common form of the occupational disease, typically appears 20 to 40 years after initial exposure and tends to progress even after exposure ceases. *Accelerated silicosis* is a variant of chronic silicosis but develops after more intense exposure to crystalline silica; it is characterized by earlier onset (within 5 to 15 years of initial exposure) and more rapid progression of disease than chronic silicosis [Weill et al., 1994].

Acute silicosis results from an overwhelming exposure to silica and the symptoms become manifest in as little time as a few weeks after exposure. Acute silicosis appears to be distinct from the other forms of silicosis, possibly involving an immune mechanism not associated with either accelerated or chronic silicosis. This disease, though rare, is invariably fatal. Outbreaks of acute silicosis have occurred among sandblasters and silica flour mill employees [Peters, 1986].

The development of silicosis is dependent on the size of the crystalline silica dust particle, the dust concentration, and the duration of exposure. Crystalline silica particles smaller than 10 micrometers (μm) in diameter, so-called *respirable* particles, are particularly hazardous, because they easily pass through the tracheobronchial tree and are deposited in the deepest recesses of the lungs, the alveolar structures. Particles larger than 10 μm in diameter are trapped in the nose or the mucous lining of the airway and are removed by the mucociliary escalator.

Chronic silicosis has an early manifestation of a dry or non-productive cough when there is continued exposure to the inhaled irritant. The cough then becomes prolonged and distressing, with sputum production as the disease advances. Initially, breathlessness occurs while exercising, but progresses to shortness of breath during normal activity [Porth, 1994]. Wheezing typically only occurs when conditions such as chronic obstructive bronchitis or asthma are also present. Advanced states of silicosis include pneumothorax and respiratory failure. Respiratory symptoms increase with the progression of silicosis [Wang, 1999].

A rapid increase in the rate of synthesis and deposition of lung collagen has also been seen with the inhalation of crystalline silica particles. The collagen formed is unique to silica-induced lung disease and is biochemically different from normal lung collagen [Olishifski and Plog, 1988].

Silicosis in all its forms is incurable and causes significant impairment or death. Therefore, eliminating or controlling occupational exposure to respirable crystalline silica is critical to prevention of the disease.

→ Lung Cancer

The International Agency for Research on Cancer [IARC, 1997] classifies crystalline silica inhaled in the form of quartz or cristobalite from occupational source as “carcinogenic to humans (Group 1).” However, in making the overall evaluation, the IARC Working Group noted “that carcinogenicity in humans was not detected in all industrial circumstances studied.” The Working Group also stated: “Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs.”

The IARC analysis included studies of U.S. gold miners, Danish stone industry employees, U.S. granite shed and quarry employees, U.S. crushed stone industry employees, U.S. diatomaceous earth employees, Chinese refractory brick makers, Italian refractory brick makers, U.K. pottery makers, Chinese pottery makers and cohorts of registered silicotics from North Carolina and Finland. Most of these studies found a statistically significant association between occupational exposure to crystalline silica and lung cancer.

→ Tuberculosis

Epidemiologic studies have firmly established the association between TB and silicosis. Some studies have indicated that employees who do not have silicosis but who have had long exposures to silica dust may also be at increased risk of developing TB [NIOSH, 2002].

Individuals with chronic silicosis are more susceptible to developing active tuberculosis than the general population. However, it is not clear whether low-level exposure to silica, in cases where silicosis has not developed, also predisposes employees to tuberculosis [Davis, 1996].

→ **Chronic Obstructive Pulmonary Disorder**

Epidemiologic studies have shown that occupational exposure to respirable crystalline silica is associated with chronic obstructive pulmonary disease, including bronchitis and emphysema. The findings from some of these studies suggest that emphysema and bronchitis may occur less frequently or not at all in nonsmokers. Epidemiologic studies have also found significant increases in mortality from nonmalignant respiratory disease, a category that includes silicosis, emphysema, and bronchitis, as well as some other related pulmonary diseases [NIOSH, 2002].

→ **Immunologic Disorders and Autoimmune Diseases**

Several epidemiologic studies have found statistically significant increases in mortality from or cases of immunologic disorders and autoimmune diseases in employees exposed to silica. These disorders and diseases include scleroderma (a rare multisystem disorder characterized by inflammatory, vascular, and fibrotic changes usually involving the skin, blood vessels, joints, and skeletal muscle), rheumatoid arthritis, systemic lupus erythematosus (lupus), and sarcoidosis (a rare multisystem granulomatous disease characterized by alterations in the immune system) [NIOSH, 2002].

→ **Renal Disease**

Epidemiological studies report statistically significant associations between occupational exposure to silica dust and several renal diseases or effects, including end-stage renal disease morbidity (including that caused by glomerular nephritis, chronic renal disease mortality, and Wegener's granulomatosis (systemic vasculitis often accompanied by glomerulonephritis) [NIOSH, 2002].

→ **Stomach and Other Cancers**

There is some evidence from studies of various occupational groups exposed to crystalline silica of statistically significant excesses of mortality from stomach or gastric cancer. However, most of these studies did not adjust for confounding factors and possible exposure-response relationships were not assessed. Similar issues with confounding and lack of exposure-response assessment exist for the infrequent reports of statistically significant numbers of excess deaths or cases in silica-exposed employees of other nonlung cancers such as nasopharyngeal or pharyngeal, salivary gland, liver, bone, pancreatic, skin, esophageal, digestive system, intestinal or peritoneal, lymphopoietic or hematopoietic, brain, and bladder [NIOSH, 2002].

Summary

As these health findings indicate, crystalline silica exposure is associated with a number of diseases, in addition to silicosis. **Silica exposure continues to pose substantial risks to employees, centuries after it was first identified as an occupational hazard. The only way to prevent disease is to eliminate exposure to crystalline silica or reduce crystalline silica exposure to safe levels.**

References

Appendix B: Industries with Potential Overexposure to Crystalline Silica

This appendix contains a list of industries in which employees may be exposed to elevated levels of crystalline silica. The list is based on a review of inspection data from OSHA's Integrated Management Information System (IMIS) for crystalline silica (quartz), for the period January 1996 through March 2007. This table is intended to show the range of industries in which crystalline silica exposure may occur, but should not be considered to be an exhaustive listing. Employee exposure to crystalline silica may occur in industries not listed here. Likewise, crystalline silica exposure does not occur in all establishments encompassed within these North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes.

Industries with Crystalline Silica Exposure, 1996–2007		
1987 SIC Code ¹	1987 SIC Industry Title	2002 NAICS Code ²
1521	General Contractors–Single Family Houses	236115, 236118
1522	General Contractors–Residential Buildings Other Than Single-Family	236115, 236118
1541	General Contractors–Industrial Buildings and Warehouses	236210, 236220
1611	Highway and Street Construction, Except Elevated Highways	237310
1622	Bridge, Tunnel, and Elevated Highway Construction	237310, 237990
1623	Water, Sewer, Pipeline, and Communications and Power Line Construction	237110, 237120, 237130
1629	Heavy Construction, n.e.c.	236210, 237110, 237120, 237130, 237990
1721	Painting and Paper Hanging*	237310, 238320
1741	Masonry, Stone Setting, and Other Stone Work	238140
1742	Plastering, Drywall, Acoustical, and Insulation Work	238310
1761	Roofing, Siding, and Sheet Metal Work	238160, 238170, 238390
1771	Concrete Work	238110, 238140, 238990
1794	Excavation Work	238910
1795	Wrecking and Demolition Work	238910
1799	Special Trade Contractors, n.e.c.	236220, 237990, 238150, 238190, 238290
3251	Brick and Structural Clay Tile	327121, 327331
3253	Ceramic Wall and Floor Tile	327122
3255	Clay Refractories	327124

Industries with Crystalline Silica Exposure, 1996–2007		
1987 SIC Code ¹	1987 SIC Industry Title	2002 NAICS Code ²
3261	Vitreous China Plumbing Fixtures and China and Earthenware Fittings and Bathroom Accessories	327111
3262	Vitreous China Table and Kitchen Articles	327112
3264	Porcelain Electrical Supplies	327113
3269	Pottery Products, n.e.c.	327112
3271	Concrete Block and Brick	327331
3272	Concrete Products, Except Block and Bricks	327332, 327390, 32799
3273	Ready-Mixed Concrete	327320
3281	Cut Stone and Stone Products	327991
3291	Abrasive Products	327910, 332999
3299	Nonmetallic Mineral Products, n.e.c.	327112, 327420, 327999
3312	Steel Works, Blast Furnaces (Including Coke Ovens), and Rolling Mills	324199, 331111, 331221
3321	Gray and Ductile Iron Foundries	331511
3322	Malleable Iron Foundries	331511
3325	Steel Foundries, n.e.c.	331513
3334	Primary Production of Aluminum	331312
3365	Aluminum Foundries	331524
3366	Copper Foundries	331525
3369	Nonferrous Foundries, Except Aluminum and Copper	331528
3431	Enameled Iron and Metal Sanitary Ware	332998
3441	Fabricated and Structural Metal*	332312
3443	Fabricated Plate Work (Boiler Shops)*	332313, 332410, 332420
3444	Sheet Metal Work*	332321, 332322, 332439, 333415
3471	Electroplating, Polishing, Anodizing, and Coloring*	332813
3479	Coating, Engraving, and Allied Services, n.e.c.*	332812, 339911, 339912, 339914
3531	Construction Machinery and Equipment*	333120, 333923, 336510

Industries with Crystalline Silica Exposure, 1996–2007		
1987 SIC Code ¹	1987 SIC Industry Title	2002 NAICS Code ²
3599	Industrial and Commercial Machinery and Equipment*	332710, 332813, 332999, 333319, 333999, 334519, 336399
3715	Truck Trailers*	336212
5032	Brick, Stone, and Related Construction Materials ³	423320, 425110, 425120, 444190
7532	Top, Body, and Upholstery Repair Shops and Paint Shops*	811121
*Crystalline silica exposure primarily from abrasive blasting operations		
¹ <i>Standard Industrial Classification Manual</i> , 1987. Executive Office of the President, Office of Management and Budget.		
² <i>North American Industry Classification System</i> , United States, 2002. Executive Office of the President, Office of Management and Budget.		
³ This industry may be subject to OSHA Instruction CPL 02-00-051 - Enforcement Exemptions and Limitations under the Appropriations Act (or a subsequent version).		
Source: Federal OSHA Inspection Data for Silica (Code 9010–Quartz) compiled in the OSHA Integrated Management Information System (IMIS), from 01/01/1996 through 03/31/2007.		