

APPENDIX C

GUIDELINES FOR CONTROL OF OCCUPATIONAL EXPOSURE TO CRYSTALLINE SILICA AND ABRASIVE BLASTING

1. STANDARDS.

- a. Occupational exposure limits. In accordance with Section 6, employee airborne exposure to crystalline silica shall not exceed the 8-hour TWA limit as specified by the ACGIH in their "Threshold Limit Values and Biological Exposure Indices" or by OSHA, whichever is more stringent. Table C-1 provides U.S. guidelines and limits for occupational exposure to crystalline silica established by NIOSH, OSHA, MSHA, and ACGIH as of the date of this manual.
- b. Mandatory requirements. OSHA places some mandatory requirements on employers. The first mandatory requirement is that employee exposure be eliminated through the implementation of feasible engineering controls. After all such controls are implemented and they do not control to the PEL, each employer must rotate its employees to the extent possible in order to reduce exposure. Only when all engineering or administrative controls have been implemented, and the level of respirable silica still exceeds PEL, may an employer rely on a respirator program pursuant to the mandatory requirements of 29 CFR 1910.134. Generally where working conditions or other practices constitute recognized hazards likely to cause death or serious physical harm, they must be corrected pursuant to Section 5(a)(1) of the Occupational Safety and Health Act of 1970.

TABLE C-1

**U.S. GUIDELINES AND LIMITS FOR OCCUPATIONAL
EXPOSURE TO CRYSTALLINE SILICA**

Reference	Substance	Guideline or limit (mg/m ³)
NIOSH	<u>Crystalline silica: quartz, cristobalite, and tridymite as respirable dust</u>	<u>REL = 0.05 (for up to 10-hr workday during a 40-hr workweek)</u>
OSHA [29 CFR 1910.1000, Table Z-3]	<u>Respirable crystalline silica, quartz</u>	<u>PEL = 10 / %quartz+2 (8-hr TWA)</u>
	<u>Respirable crystalline silica, cristobalite</u>	<u>PEL = half the value calculated from the formula for quartz</u>
MSHA [30 CFR 56, 57, 70, 71]	<u>Respirable quartz in underground and surface metal and nonmetal mines</u>	<u>PEL = 10 / %quartz+2 (8-hr TWA)</u>
	<u>Respirable crystalline silica present in concentrations greater than 5% in surface and under- ground coal mines</u>	<u>RDS = 10 / %quartz (8-hr TWA)</u>
ACGIH [2002]	<u>Respirable crystalline silica, quartz</u>	<u>TLV = 0.05 (8-hr TWA)</u>
	<u>Respirable crystalline silica, cristobalite</u>	<u>TLV = 0.05 (8-hr TWA)</u>
	<u>Respirable crystalline silica, tridymite</u>	<u>TLV = 0.05 (8-hr TWA)</u>

REL = Recommended Exposure Limit - NIOSH

PEL = Permissible Exposure Limit - OSHA

RDS = Respirable Dust Standard - MSHA

TLV = Threshold Limit Value - ACGIH

c. OSHA standards. OSHA does not have a substance specific standard for crystalline silica. Because there is no substance specific OSHA standard, the following recommendations are made to ensure that employee exposure to respirable silica is controlled to acceptable limits. For these guidelines, silica means crystalline silica.

2. MONITORING.

a. Each employer who has a place of employment in which silica is occupationally produced, reacted, released, packaged, repackaged, transported, stored, handled, or used should inspect each workplace and work operation to determine if any employee may be exposed to silica at or above the PEL. Indicators that an evaluation of employee exposure should be undertaken would include:

- (1) Any information or observations that would indicate employee exposure to silica or other substances;
- (2) Any measurement of airborne silica;
- (3) Any employee complaints of symptoms that may be attributable to exposure to silica or other substances;
- (4) Any production, process, or control change that may result in an increase in the airborne concentration of silica, or whenever the employer has any other reason to suspect an increase in the airborne concentrations of silica.

b. Air monitoring and analysis. Sampling and analytical methods shall be in accordance with those specified in Section 6.

- (1) Employee exposure measurements should represent the actual breathing zone exposure conditions for each employee. Any appropriate combination of long-term or short-term respirable samples would be acceptable, but total sampling time may not be less than 7 hours. In case of

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abrasive blasting operations, substances other than silica should be sampled and analyzed.

(2) Accuracy of measurement. The method of monitoring and analysis should have an accuracy of not less than plus or minus 25% for concentrations of airborne silica equal to or greater than the PEL.

(3) Frequency of monitoring. Where the employer has determined that employees are exposed to silica or other substances in excess of the PEL, monitoring should be repeated quarterly.

3. MEDICAL SURVEILLANCE. Each employer should institute a medical surveillance program for all employees who are or will be exposed to airborne concentrations of silica or other substances above the PEL. The employer should provide each employee with an opportunity for a medical examination performed by or under the supervision of a licensed physician and should provide the examination during the employee's normal working hours without cost to the employee.

a. Medical examination.

(1) Each employer should provide a medical examination that includes a complete medical history and physical examination, an annual chest roentgenogram (x-ray), and pulmonary function tests to each employee exposed to silica in excess of the PEL. In the abrasive blasting trade, attention should be paid to potential scarring of the cornea.

(a) A chest roentgenogram (posteroanterior 14 in by 17 in (35.6 cm by 43.2 cm) or 14 in by 14 in (35.6 cm by 35.6 cm)) classified according to the most recent edition of ILO International Classification of Radiographs of Pneumoconioses. [ILO U/C International Classification of Radiographs of Pneumoconioses 1971, Occupational Safety and Health Series 22 (rev), Geneva, International Labor Office, 1972].

(b) Pulmonary function tests including forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV(1)) to provide a baseline for evaluation of pulmonary function and to help determine the advisability of the workers using negative- or positive-pressure respirators. It is recognized that providing such medical examination and recordkeeping of medical data may be difficult for those abrasive-blasting establishments employing transient workers.

(2) Medical examinations should also be made available:

(a) To employees prior to their assignment to areas in which airborne concentrations of silica are above the PEL;

(b) At least annually for each employee exposed to airborne concentrations of silica above the PEL at any time during the preceding 6 months;

(c) Immediately, upon notification by the employee that the employee has developed signs or symptoms commonly associated with chronic exposure to silica.

(3) Where medical examinations are performed, the employer should provide the examining physician with the following information:

(a) The reason for the medical examination requested;

(b) A description of the affected employee's duties as they relate to the employee's exposure;

(c) A description of any PPE used or to be used;

(d) The results of the employee's exposure measurements, if available;

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- (e) The employee's anticipated or estimated exposure level;
 - (f) Upon request of the physician, information concerning previous medical examination of the affected employee.
- b. Physician's written opinion.
- (1) The employer should obtain and furnish the employee with a written opinion from the examining physician containing the following:
 - (a) The signs or symptoms of silica exposure manifested by the employee, if any;
 - (b) A report on the findings of the chest roentgenogram and pulmonary function tests;
 - (c) The physician's opinion as to whether the employee has any detected medical condition that would place the employee at increased risk of material impairment to the employee's health from exposure to silica or other substances or would directly or indirectly aggravate any detected medical condition;
 - (d) Any recommended limitation upon the employee's exposure to silica or other substances or upon the use of PPE; and
 - (e) A statement that the employee has been informed by the physician of any medical condition that requires further examination or treatment.
- (2) The written opinion obtained by the employer should not reveal specific findings or diagnoses unrelated to occupational exposure to silica or other substances.

(3) If the employer determines, on the basis of the physician's written opinion, that any employee's health would be materially impaired by maintaining the existing exposure to silica or other substances, the employer should place specific limitations, based on the physician's written opinion, on the employee's continued exposure to silica or other substances.

4. TRAINING.

- a. Each employee who may be potentially exposed to silica or other substances should be apprised at the beginning of his/her employment or assignment to such an exposure area of the hazards, relevant symptoms, appropriate emergency procedures, and proper conditions and precautions for safe use or exposure.
- b. Instruct affected employees to advise the employer of the development of the signs and symptoms of prolonged exposure to silica and other substances.
- c. Inform employees of the specific nature of operations that could result in exposure to silica or other substances above the PEL, as well as safe work practices for the handling, use, or release of the silica and the types and function of engineering controls.
- d. Instruct employees in proper housekeeping practices.
- e. Instruct employees as to the purpose, proper use, and limitations of respirators.
- f. Provide employees with a description of, and explain the purposes for, the medical surveillance program.
- g. Inform employees where written procedures and health information are available on the premises.

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- h. Advise employees of the increased risk of impaired health due to the combination of smoking and silica dust exposure.

5. PERSONAL PROTECTIVE DEVICES.

- a. Personal protective devices program. Engineering controls shall be used to maintain silica dust exposures below the prescribed limit. When the limits of exposure to silica cannot be met by limiting the concentrations of silica in the work environment by engineering and administrative controls, an employer must use a program of respiratory protection to protect every employee exposed.
- b. Respirator selection and usage.

(1) The employer shall select and employees shall use only respirators approved by the NIOSH under 42 CFR 84 to protect employees from dust produced during abrasive-blasting operations. When abrasive blasting is done, the type C supplied-air, positive pressure, demand type abrasive-blasting respirator (a respirator constructed so that it covers the wearer's head, neck, and shoulders to protect from rebounding abrasive) shall be worn according to 29 CFR 1910.94 (a). In addition, see 05.E (in Section 5 of this manual) for selection and use of respiratory protective equipment. Abrasive-blasting respirators shall be worn when working inside of blast-cleaning rooms; when using silica sand in manual blasting operations where the nozzle and blast are not physically separated from the operator in an exhaust ventilated enclosure; where concentrations of toxic dust dispersed by the abrasive blasting may exceed the limits set in 29 CFR 1910.1000; and where the nozzle and blast are not physically separated from the operator in an exhaust-ventilated enclosure. Properly fitted particulate-filter respirators, commonly referred to as dust-filter respirators, may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point when it is not feasible to control the dust by enclosure, exhaust

ventilation, or other means. The respirators used must be approved by NIOSH under 42 CFR 84 for protection against the specific type of dust encountered. Dust-filter respirators may be used to protect the operator of outside abrasive-blasting operations where non-silica abrasives are used on materials having low toxicities. Dust-filter respirators shall not be used for continuous protection where silica sand is used as the blasting abrasive, or toxic materials are blasted.

(2) Employees experiencing frequent and continuous breathing difficulty while using respirators should be evaluated by a physician to determine the ability of the worker to wear a respirator.

(3) A respiratory protective program meeting the requirements of 29 CFR 1910.134 shall be established and enforced by the employer.

(4) A respirator specified for use in higher concentrations of airborne silica may be used in atmospheres of lower concentrations.

(5) Employees shall be given instructions on the use of respirators assigned to them, on cleaning respirators, and on testing for leakage.

(6) When employees are exposed to other toxic substances in addition to silica, appropriate combinations of respiratory protection shall be provided.

c. Only those respiratory protection devices shall be used that have a "Tested and Certified" number issued by the NIOSH to the manufacturer of the device.

d. There should be an established in-plant procedure and means and facilities provided to issue respiratory protective equipment, to return used contaminated equipment, to decontaminate and disinfect the equipment, and to repair or

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exchange damaged equipment. Recordkeeping of these activities is mandatory.

6. PROTECTIVE CLOTHING. Where exposure to airborne silica or other substances is above the PEL, work clothing should be vacuumed before removal unless it is wet. Clothes should not be cleaned by blowing or shaking.

7. HOUSEKEEPING.

- a. All exposed surfaces should be maintained free of accumulation of silica dust, which, if dispersed, would result in airborne concentrations in excess of the PEL.
- b. Dry sweeping and the use of compressed air for the cleaning of floors and other surfaces should be prohibited. If vacuuming is used the exhaust air should be properly filtered to prevent generation of airborne respirable silica concentrations. Gentle washdown of surfaces is preferable if practical.
- c. Emphasis should be placed upon preventive maintenance and repair of equipment, proper storage of dust producing materials, and collection of dusts containing silica. Sanitation shall meet the requirements of 29 CFR 1910.141.

8. PERSONAL HYGIENE FACILITIES AND PRACTICES.

- a. All food, beverages, tobacco products, nonfood chewing products, and unapplied cosmetics should be discouraged in work areas.
- b. Employers shall provide an adequate number of lavatories, maintained and provided with soap and towels.
- c. Where employees wear protective clothing or equipment, or both, in-plant change rooms should be provided in accordance with 29 CFR 1910.141(e).

9. ENGINEERING CONTROLS.

- a. Dust suppression. Moisture, mists, fogs, etc., should be added where such addition can substantially reduce the exposure to airborne respirable silica dust.
- b. Ventilation. Where a local exhaust ventilation and collection system is used in a building, it should be designed and maintained to prevent the accumulation or recirculation of airborne silica dust into the workplace. The system should be inspected periodically. Adequate measures should be taken to ensure that any discharge will not produce health hazards to the outside environment.
- c. Additional control measures. When mobile equipment is operated in areas of potential silica exposure, engineering controls should be provided to protect the operator from such exposure.

10. ITINERANT WORK. When employees are exposed to airborne silica at temporary work sites away from the plant, emphasis should be placed on respiratory protection, protective clothing, portable engineering controls, and provisions for personal hygiene and sanitation. Training of employees should be provided to protect them as well as others from airborne silica dust exposure to the extent practical.

11. ABRASIVE BLASTING.

- a. Introduction.
 - (1) Consult standards listed in 29 CFR 1910.94(a).
 - (2) The nature of dust generated in any abrasive-blasting process is the combination of the fragmentation of blasting media and the material dislodged from the surface treated. Where fragmentable abrasives such as sand, shells, alumina, glass bead, or metal shot is used, or where a fragmentable surface such as sand casting, a painted or

scaly surface, or masonry is blasted, the airborne dust generated will vary in particle size and chemical composition. Noise associated with abrasive-blasting operations is also a significant hazard. Heat stress may also be a potential hazard.

(3) Engineering controls for noise and dust should be considered even if they cannot reduce the exposures to PEL but will significantly reduce noise and dust exposure to the employees.

(4) Maximum respiratory protection should be provided when silica sand is used as the abrasive agent or when sand castings are cleaned by blasting.

(5) All production and control systems used in a stationary abrasive-blasting process should be designed or maintained to prevent escape of airborne dust or aerosols in the work environment and to assure control of the abrasive agents.

b. General.

(1) Selection and maintenance of protective equipment.

(a) Select and use respirators in accordance with paragraph 4.b. above and 05.E in Section 5 of this manual.

(b) Air-supplied helmets, ricochet hoods, dust respirators, ear muffs, and safety glasses should be an individual issue item, identified with and used by one employee only. Such equipment should be reissued to another employee only after complete cleaning, repair, and decontamination.

(c) Means should be provided to vacuum, clean, and store air-supplied respiratory equipment after each shift of use. Storage should be in a clean enclosure such as locker, footlocker, or plastic container. The employees

should be trained to maintain the issued equipment in clean condition for their own protection.

(d) Replacement of prescription or plano safety glasses should be made if multiple pitting or etching is visible in the center of the lenses.

(e) Replacement of faceplates in air-supplied helmets, ricochet hoods, or full face masks should take place when a side-on light source produces obscuring visible reflections and glare from the etched spots and pit holes in the faceplate. Mylar coating, or similar transparent plastic material, is recommended to protect the glass or plastic faceplate.

(f) Length of air hose may not be altered from the manufacturer's specifications.

(g) The condition of protective equipment should be checked daily by the employee. Rips, tears, and openings that expose skin to abrasive agents, should be mended. Functional tests for leaks, proper respiration, and good connections should be performed on the complete air-supply system.

(2) Air supply -- portable.

(a) The breathable air supplied to the helmet or ricochet hood should be drawn from an oil and CO free air compressor. In itinerant work, it should be located upwind from the main air compressor to prevent entry of combustion gases into breathable air.

(b) Breathable air-supply system should be equipped, if possible, with audible alarm at the helmet or hood to warn the user of low air pressure.

(3) Hearing protection. Suitable hearing protection, providing at least 20 dB(A) reduction in noise level

experienced, should be worn inside the helmet or ricochet hood unless hearing protection is an integral part of such helmet or hood.

(4) Heat stress. Cooling of breathable air, supplied to the blasting helmets or ricochet hoods, should be considered depending on season and exposure of the employee to heat sources.

c. Work practices.

(1) Indoors blasting cabinets and glove boxes.

(a) Negative pressure should be maintained inside during blasting.

(b) The enclosure should be as complete as practical.

(c) When the inside of the blasting cabinet is cleaned, respiratory protection should be used.

(d) If blasting creates excessive noise, a change of nozzle configuration or application of noise control materials to the enclosure should be considered.

(e) Cabinets should be maintained in good repair including the presence of gaskets.

(2) In-plant blasting rooms.

(a) Negative pressure should be maintained inside during blasting. The room should have exhaust capacity of 1 air change per minute.

(b) Minimum recommended protective equipment of an abrasive blaster working inside a blasting room, in the open, in enclosed space, or outdoors is: safety boots or toe guards; durable coveralls, closeable at wrists, ankles,

and other openings to prevent entry of abrasive dust and rubbing of such; respiratory, eye, and hearing protection; and gauntlet gloves.

- (c) If abrasive blasting is automated, the room should not be entered before at least 6 air changes have occurred, as respirable-size dust particles stay airborne for a considerable length of time.
- (d) In the room, a cleanup method other than broom sweeping or compressed air blowing should be used to collect the abrasive agent after blasting (e.g., vacuum cleaning). If the blasting agent is removed manually, respiratory protection should be used.

(3) In-plant work area.

- (a) If occasional but regular abrasive blasting must be performed inside a building without enclosures, respiratory protection should be provided for all employees in the area. Portable engineering control devices should be used at the location to collect all of the used abrasive agent as it is applied.
- (b) When airborne abrasive-blasting dust becomes sufficiently heavy in an area to cause a temporary safety hazard by reduced visibility, or a marked discomfort to the unprotected employees not engaged in abrasive blasting, such operations in the affected area should be discontinued until the airborne dust is removed by exhaust ventilation and the settled dust has been removed from the horizontal surfaces in the area. If such operations have to continue, appropriate respiratory protection should be provided to those employees remaining in the area, provided visibility is adequate.
- (c) If wet blasting is employed, airborne dust hazard may exist after evaporation of water.

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(4) Confined space. A confined space is a compartment or tank or similar enclosed space in which abrasive blasting, or a preexisting atmosphere, may cause the employee to be overcome by conditions hazardous to life and where egress may be difficult if normal body functions are impaired.

- (a) Before starting work, open all access hatches, trap doors, etc., to aid natural ventilation. Mechanical ventilation should be used, picking up air at the furthest point away from the opening if natural ventilation will not cause a complete air change. Consider the other potentially hazardous materials present, such as solvents, crusts of chemicals, or old paint, with regard to explosion or fire potential when blasted.
- (b) A "buddy system" should be used -- for each employee inside a confined space; another employee should be available to assist in a potential emergency.
- (c) For respiratory protection, a SCBA or air-supplied hood should be used.
- (d) Adequate lighting that meets the requirements of NEC 502 should be provided.
- (e) If the space is mechanically ventilated, means should be provided to collect dust before release to the open atmosphere.

(5) Outdoors.

- (a) Blaster should be protected in a manner equivalent to that mentioned in 29 CFR 1910.94(a)(5).
- (b) The pot man should wear the same protective devices available to the blaster, depending on the distance and wind conditions relative to the blasting location.

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- (c) Prudent care should be taken to prevent the dust cloud from spreading to other work areas.
- (d) Hearing protection and respiratory protection should be available to all other employees in the area if their presence is required.

