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Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities[1]

This standard is issued under the fixed designation E2625; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Silicon dioxide (silica, SiO_2) is encountered in nature and industry in a wide variety of forms. These range from essentially anhydrous types with or without a very high degree of crystallinity, to highly hydroxylated or hydrated types which are amorphous by X-ray diffraction examination. Crystalline silica[2] exists in a number of forms or polymorphs. The three major forms, quartz, cristobalite, and tridymite, pertain to this practice. Quartz (or alpha quartz) is the more common form encountered as airborne particulates. Two of the polymorphs, cristobalite and tridymite, are formed at elevated temperatures and are much less common in nature, but might be encountered in several occupations where silicas are fired (calcined) at high temperatures.[3] These silica materials have a broad range of physical and chemical properties.

1. Scope

1.1 This practice describes several actions to reduce the risk of harmful occupational exposures in environments containing respirable crystalline silica. This practice is intended for the unique conditions during construction and demolition activities.

1.2 Health requirements relating to occupational exposure to respirable crystalline silica not covered in this practice fall under the jurisdiction of Practice E1132.

1.3 Nothing in this practice shall be interpreted as requiring any action that violates any statute or requirement of any federal, state, or other regulatory agency.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[4]

D4532 Test Method for Respirable Dust in Workplace Atmospheres Using Cyclone Samplers

E1132 Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica

2.2 *ANSI Standards:*[5]

Z88.2 1992 American National Standard Practice for Respiratory Protection

ANSI/AIHA Z9.2 2001 Fundamentals Governing the Design and Operation of Local Exhaust Systems

2.3 *U.S. Code of Federal Regulations:*[6]

29 CFR 1910.134 Respiratory Protection

29 CFR 1910.1000 Air Contaminants

29 CFR 1910.1200 Hazard Communication

42 CFR 84 Title 42, Part 84 Approval of Respiratory Protective Devices, Tests for Permissibility, Fees

[1] This practice is under the jurisdiction of ASTM Committee E34 on Occupational Health and Safety and is the direct responsibility of Subcommittee E34.80 on Industrial Heath.

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[2] Smith, Deane K., "Opal, Cristobalite, and Tridymite: Noncrystallinity Versus Crystallinity, Nomenclature of the Silica Minerals and Bibliography," *Powder Diffraction*, Vol 13, 1998, pp 1–18.

[3] Miles, W. J., "Crystalline Silica Analysis of Wyoming Bentonite by X-ray Diffraction After Phosphoric Acid Digestion," *Analytical Chemistry Acta*, Vol 286, 1994, pp 97–105.

[4] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[6] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

30 CFR 56, Title 30, Subpart D Air Quality, Radiation, and Physical Agents (MSHA)

2.4 *NIOSH Publications:*[7]

Manual of Analytical Methods, 4th Ed., DHHS (NIOSH), Publication No. 94-113 August 1994.

Method 7500 for Silica, Crystalline, Respirable (XRD)

Method 7601 for Silica, Crystalline Visible Absorption Spectrophotometry

Method 7602 for Silica, Crystalline (IR)

2000 Guidelines for the Use of ILO International Classification of Radiographs of Pneumoconioses

2.5 *Other References:*

American Thoracic Society, Standardization of Spirometry—1994 Update

3. Significance and Use

3.1 These practices and criteria were developed for occupational exposures during construction and demolition activities. They are intended to (*a*) protect against clinically significant disease from exposure to respirable crystalline silica, (*b*) be measurable by techniques that are valid, reproducible, and readily available, and (*c*) be attainable with existing technology and protective practices.

4. General Requirements

4.1 *Occupational Exposure Limit:*

4.1.1 *Permissible Exposure Limit (PEL)*—U.S. Occupational Health and Safety Administration (OSHA) General Industry (see 29 CFR 1910.1000)—Workers shall not be exposed to respirable dust containing 1 % or more quartz exceeding 10/(% quartz + 2) mg/m^3 as an 8-h time weighted average in any 8-h work shift of a 40-h work week or, for total dust (respirable plus non-respirable), 30/(% quartz + 2) mg/m^3. The PEL for respirable cristobalite and tridymite is one-half the value for quartz.

$$PEL\ (mg/m^3)\ (respirable\ fraction) = 10 \div [\%\ quartz + (\%\ cristobalite \times 2) + (\%\ tridymite \times 2) + 2]$$

$$PEL\ (mg/m^3)\ (total\ dust) = 30 \div [\%\ quartz + (\%\ cristobalite \times 2) + (\%\ tridymite \times 2) + 2]$$

4.1.2 Federal OSHA PEL is approximately equivalent to a quartz level of 100μg/m^3.

4.1.3 Employer shall determine the appropriate PEL for their operation, but in no case shall the PEL be less stringent than the applicable government limit.

4.2 *Exposure Assessment and Monitoring:*

4.2.1 Risk can be assessed qualitatively based on material safety data sheets (MSDS), historical data, likelihood of dust generation, proximity of airborne dust to workers, nature of the construction process (for example, wet work—low risk; dry work—higher risk), and location of workers (for example, closed equipment cab). Note that the absence of visible dust is not a guarantee of lack of risk.

4.2.2 Where qualitative risk assessment indicates that a potential risk is present, initial sampling of tasks or representative workers' exposures shall be made to characterize the exposure and its variability, to determine compliance with standards given in 4.1, and to establish a baseline exposure level in all areas where workers are or have the potential to be exposed to silica. Initial task sampling would be not required for short duration or transient tasks, tasks where sampling results would not be timely, representative concentrations are already known or proven task protection is in place. Conduct exposure sampling when needed to prevent a significant and deleterious change in the contaminant generation process or the exposure controls so that overexposures do not go undetected. This is particularly true for areas or operations where conditions can change dramatically within a short span of time.

4.2.3 Recordkeeping required under this practice shall be maintained and made available for review by employees.

4.2.4 For workers with regular exposure to high silica concentrations who are placed inside of supplied air respirators or ventilated enclosures, such as in sandblasting, conduct sampling inside of the control device to determine employee exposure. The sampling line shall not interfere with the fit of the respirator. It is possible that consultation with the respirator manufacturer will be necessary to achieve the above requirement.

4.2.5 In areas where overexposures are persistent, a written exposure control plan shall be established to implement engineering, work practice, and administrative controls to reduce silica exposures to below the PEL, or other elected limit, whichever is lower, to the extent feasible. Conduct a root cause analysis for all exposures in excess of the PEL that cannot be accounted for. Root cause analysis involves investigating cause(s) for the excessive exposure, providing remedies, and conducting follow-up sampling to document that exposures are below the PEL.

4.2.6 The employer shall re-assess exposures when there has been a change in the process, equipment, work practices or control methods that have the potential to result in new or additional exposures to crystalline silica or when the employer has any reason to believe that new or additional exposures have occurred.

4.2.7 Measurement of worker occupational exposures shall be within the worker's breathing zone and shall meet the criteria of this section. Such measurements need to be representative of the worker's customary activity and be representative of work shift exposure. Use area sampling to characterize exposures and identify effective controls when appropriate to the circumstances.

4.2.8 Respirable dust samples are to be collected in accordance with accepted methods. Refer to Test Method D4532.

4.2.9 Sample data records shall include employee identification, a log of the date and time of sample collection, sampling time duration, volumetric flow rate of sampling, documentation of pump calibration, and description of the sampling location, analytical methods, and other pertinent information.

4.2.10 Analyze samples for silica content analysis by an AIHA-accredited laboratory.

[7] Available from CDC/NIOSH, 4676 Columbia Pkwy, Cincinnati, OH 45226-1998.

4.3 *Exposure Monitoring:*

4.3.1 The employer shall provide employees with an explanation of the sampling procedure.

4.3.2 Whenever exposure monitoring activities require entry into an area where the use of respirators, protective clothing, or equipment is required, the employer shall provide and ensure the use of such personal protective equipment and shall require compliance with all other applicable safety and health procedures.

4.3.3 Affected employees shall be provided with copies of their sampling results when returned by the laboratory and explanations of the data.

4.4 *Methods of Compliance:*

4.4.1 *Task-Based Control Strategies*—Where exposure levels are known from empirical data, a task-based control strategy shall be applied that matches tasks with controls. The following lists examples of this approach.

4.4.1.1 *Abrasive Blasting*—OSHA has already established standards for abrasive blasting work requiring ventilation (29 CFR 1926.57) and respiratory protection (29 CFR 1926.103). In the case of abrasive blasting operations, it is recommended that the employer provide a Type CE, pressure demand or positive-pressure, abrasive blasting respirator (APF of 1000 or 2000).

4.4.1.2 Other engineering controls with the potential to limit exposure are:

(1) Using alternative materials,

(2) Wet suppression systems, and

(3) Exhaust ventilation.

4.4.1.3 *Cutting Clay and Concrete Masonry Units*—The controls found in Tables 1-5 apply to employees cutting masonry units during a full work shift and does not apply to occasional cutting limited to 90 min total time

4.4.2 *Exposure-Based Control Strategies*—Where exposure levels are measured and known to exceed the PEL, an exposure-based control strategy shall be applied that uses the appropriate controls to lower exposure.

4.4.2.1 *Engineering Controls:*

(1) Use of properly designed engineering controls is the most desirable approach for controlling dust from crystalline silica-containing materials.

(2) Adequate ventilation or other dust suppression methods shall be provided to minimize respirable crystalline silica concentrations to below the PEL, where feasible.

(3) Enclosed workstations, such as control booths and equipment cabs, designed for protection against respirable crystalline silica dust, shall be provided with filtered air to reduce exposures.

(4) Engineering design of tools and equipment shall include, where feasible, provisions to minimize exposure of workers to respirable crystalline silica dust to the PEL or below. If ventilation systems are used, they shall be designed and maintained to prevent the accumulation and re-circulation of respirable crystalline silica dust in the working environment (see ANSI Z9.2). If wet suppression systems are used, spray nozzles and associated piping shall be maintained to ensure that adequate wetting agent is applied where needed to control respirable crystalline silica dust.

(5) All engineering controls shall be properly maintained and periodically evaluated and brought up to specifications, when needed.

4.4.3 *Work Practices and Administrative Controls:*

4.4.3.1 Ensure that workers do not work in areas of visible dust generated from materials known to contain a significant percentage of respirable crystalline silica without use of respiratory protection, unless proven task protection is in use or air sampling shows exposures less than the PEL.

4.4.3.2 Workers shall not use compressed air to blow respirable crystalline silica-containing materials from surfaces or clothing, unless the method has been approved by an appropriate regulatory agency.

4.4.3.3 Employers shall instruct workers about specific work practices that minimize exposure to respirable crystalline silica.

4.4.3.4 Workers shall utilize good housekeeping practices to minimize the generation and accumulation of dust.

4.4.3.5 Workers shall utilize available means to reduce exposure to dust, including the use of respirators, rest areas, ventilation systems, high efficiency particulate air (HEPA) vacuum cleaners or water spray, wet floor sweepers, and rotation of personnel to minimize individual exposure.

4.5 *Respiratory Protection:*

TABLE 1 Cutting Masonry Units

Operation/Task	Control Measures	Respiratory Protection
Cutting masonry units— (Using stationary or portable saws)	*Wet Method*: Continuously apply stream or spray at the cutting point.	Not Required
	OR *Dry Method*: Enclose saw within a ventilated enclosure operated with a minimum face velocity of 250 feet-per-minute. Saw blade must be contained entirely within the booth and exhaust must be directed away from other workers or fed to a dust collector with a HEPA filtration system.	100 series filtering face piece (disposable dust mask) OR ½ face respirator with 100 series filters
* Additional control measures for consideration: Ventilation (natural and mechanical), dust collection methods, architectural design, use special-shaped products, job rotation and demarcation of specific cutting areas.		

TABLE 2 Mixing Concrete, Grout, and Mortar

Operation/Task	Control Measures	Respiratory Protection
Mixing Concrete, Grout or Mortar	Natural ventilation and demarcation of mixing areas	Not Required

TABLE 3 Tuck Pointing

NOTE 1—The following control measures have the potential to be useful in reducing exposure levels, but are not necessarily adequate to reliably reduce exposures below the PEL.

Operation/Task	Control Measures	Respiratory Protection
Tuck Pointing	The following control measures may be useful in reducing exposure levels but may not be adequate to reliably reduce exposures below the PEL. Ventilation Natural Mechanical Dust collection/vacuum Shroud Gauge/Guide for Equipment Wet methods	These types of respiratory protection will be necessary to provide adequate protection in the absence of control methods that demonstrate compliance with the PEL: Full face respirator with 100 series filter OR Supplied air respirator

TABLE 4 Concrete Cutting

Operation/Task	Control Measures	Respiratory Protection
Outdoor Slab Sawing	Use water-fed system that delivers water continuously at the cut point with natural ventilation OR Early entry sawing OR Dry cutting with integrated vacuum system	Not Required
Indoor Slab Sawing	Use water-fed system that delivers water continuously at the cut point with natural ventilation. OR Mechanical ventilation (fans)	100 series filtering face piece respirator 100 series filtering face piece respirator
	OR Early entry sawing OR Dry cutting with integrated vacuum system	100 series filtering face piece respirator
Outdoor Wire Sawing w/ remote Outdoor Wire Sawing w/o remote	Use water-fed system that delivers water continuously on wire, operated via remote control with natural ventilation.	Not Required
Outdoor Wall Sawing	Use water-fed system that delivers water continuously on blade with natural ventilation.	Not Required
Indoor Wall Sawing	Use water-fed system that delivers water continuously on blade, operated via remote control with natural ventilation.	100 series filtering face piece respirator
Outdoor Hand Sawing	Use water-fed system that delivers water continuously on blade with natural ventilation.	Not Required
	OR Use vacuum system at point of operation with natural ventilation.	Not Required
Indoor Hand Sawing	Use water-fed system that delivers water continuously on blade with natural ventilation.	100 series filtering face piece respirator

TABLE 5 Core Drilling

Operation/Task	Control Measures	Respiratory Protection
Core Drilling	Use water-fed system that delivers water continuously at the cut point with natural ventilation	Not Required
	OR *Dry Method*: Use vacuum system at point of operation with natural ventilation.	None OR 100 series filtering face piece respirators
Handheld tools with core drilling bits	Use water-fed system that delivers water continuously at the cut point with natural ventilation.	None OR 100 series filtering face piece respirators
	OR Use vacuum system at point of operation with natural ventilation.	None OR 100 series filtering face piece respirators

4.5.1 Respirators shall be required in work situations in which engineering and work practice controls are not sufficient to reduce exposures of employees to or below the applicable PEL or company-adopted level. Where the use of personal respiratory protection is required under this practice, the employer shall establish and enforce a program.

4.5.2 The employer shall institute a respiratory protection program that includes: individual medical clearance for respirator usage, worker training in the use and limitations of respirators, routine air monitoring, and the inspection, cleaning, maintenance, selection, and proper storage of respirators. This training shall be done at first employment and