Designation: E1132 – 21

Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica[1]

This standard is issued under the fixed designation E1132; 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 covers a description of several actions that should be taken to reduce the risk of harmful occupational exposures to humans in environments containing respirable crystalline silica. This practice is intended for, but not limited to, industries regulated by the U.S. Mine Safety and Health Administration (MSHA) and the U.S. Occupational Safety and Health Administration (OSHA). A separate practice designed for the unique conditions of the construction industry has been designated Practice E2625.

1.2 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.

1.3 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard.

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

E1542 Terminology Relating to Occupational Health and Safety

E2625 Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities

2.2 *ANSI Standards:*[5]

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

ANSI Z9.7 Recirculation of Air from Industrial Process Exhaust Systems

[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, D. 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.

***A Summary of Changes section appears at the end of this standard**

ANSI Z88.2 American National Standard Practice for Respiratory Protection

2.3 *Code of Federal Regulations:*[6]

29 CFR 1910.94 Ventilation

29 CFR 1910.134 Respiratory Protection

29 CFR 1910.1000 Air Contaminants

29 CFR 1910.1200 Hazard Communication

29 CFR 1926.57 Ventilation

29 CFR 1926.103 Respiratory Protection

30 CFR 47 Hazard Communication

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

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

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)

Method 7603 for Coal Mine Dust by IR

Guidelines for the Use of the ILO International Classification of Radiographs

2.5 *Other References:*

American Thoracic Society, Standardization of Spirometry

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this practice, refer to Terminology E1542.

4. Significance and Use

4.1 These practices and criteria were developed for occupational exposures. They are intended to (*1*) protect against clinical disease from exposure to respirable crystalline silica, (*2*) be measurable by techniques that are valid, reproducible, and readily available, and (*3*) be attainable with existing technology and protective practices.

5. General Requirements

5.1 *Occupational Exposure Limits (OELs):*

5.1.1 *Permissible Exposure Limit (PEL) established by 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.

5.1.1.1 PEL (mg/m^3) (respirable fraction):

$$10 \div [\%\ \text{quartz} + (\%\ \text{cristobalite} \times 2) + (\%\ \text{tridymite} \times 2) + 2]$$

5.1.1.2 PEL (mg/m^3) (total dust):

$$30 \div [\%\ \text{quartz} + (\%\ \text{cristobalite} \times 2) + (\%\ \text{tridymite} \times 2) + 2]$$

NOTE 1—Federal OSHA PEL is approximately equivalent to a quartz level of 100 µg/m^3.

5.1.2 *PEL Established by U.S. Mine Safety and Health Administration (MSHA) (non-coal)* (see 30 CFR 56.5001)—Workers shall not be exposed to respirable dust containing 1 % or more quartz exceeding the PEL as determined for a time-weighted 8-h workday and 40-h work week based on the following formula: PEL = 10/(% quartz + 2) mg/m^3. The PEL for respirable cristobalite and tridymite is one half the value for quartz.

5.1.3 Occupational exposure limits may vary country by country. Please consult the authority in the country, where the operation exists. Examples of other OELs are provided in Appendix X2.

5.1.4 Employers shall determine the appropriate OELs for their operation, but in no case shall the OEL be less stringent than the applicable government limit.

5.2 *Exposure Assessment and Monitoring:*

5.2.1 Risk can be assessed qualitatively based on Safety Data Sheets (SDS), prior information, likelihood of dust generation, proximity of airborne dust to workers, nature of the industrial process (example: wet work—low risk; dry work—higher risk), and location of workers (example: control room). Note that the absence of visible dust is not a guarantee of lack of risk.

5.2.2 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 5.1, 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 proved task protection is in place. Conduct exposure sampling when needed to detect overexposures due to significant and deleterious change in the contaminant generation process or the exposure controls. This is particularly true for areas or operations where conditions can change dramatically within a short span of time.

5.2.3 Sampling strategy should follow good industrial hygiene practice.

5.2.4 Recordkeeping required under this practice shall be maintained and made available for review by employees and consistent with federal or state requirements.

5.2.5 For workers with regular exposure to high silica concentrations that are placed inside of supplied air respirators or ventilated enclosures, such as in sandblasting, sampling should be conducted inside of the control device to determine employee exposure. The sampling line shall not interfere with the fit of the respirator. Consultation with the respirator manufacturer may be necessary to achieve the above requirement.

[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.

[7] Available from National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, 4676 Columbia Parkway, Cincinnati, OH 45226.