SUBJECT: Enforcement of Permissible Exposure Limit for Silica in Construction

Purpose: To guide the enforcement of 1926.55 (a) and (b) and clarify the appropriate PEL and sampling method for exposure to crystalline silica in construction.

Cancellation: This instruction supersedes MNOSHA Instruction STD 3-2.2, Enforcement of Permissible Exposure Limit for Silica in Construction, dated June 11, 2013

Background:

Federal OSHA PELs for quartz in general industry and construction are not fixed values but are formulas based on the percent quartz in the sample. The PEL (for respirable dust containing silica (quartz)) is calculated and compared to the overall respirable dust exposure. The federal OSHA general industry PEL formula for quartz is listed in two units, milligrams per cubic meter (mg/m$^3$) and million particles per cubic foot (mppcf). The construction industry PEL formula is only listed in mppcf. The construction industry PEL formula and the general industry PEL formula in mppcf are identical. The 1971 ACGIH Documentation of the Threshold Limit Values for Substances in Workroom Air explained the basis for the formula as "based on the concept that the magnitude of the toxicity of the dust is proportional to the concentration of quartz in the dust."

OSHA’s silica standards adopted the 1968 (general industry) and 1970 (construction industry) ACGIH TLVs, which were expressed in mppcf, but contained a notification that ACGIH intended to begin to express the silica TLV in gravimetric (mg/m$^3$) terms. These early standards for respirable dust were based on a 1964 Talvite method for the collection of dust via midget impingers. The number of dust particles per cubic foot of air collected were counted (estimated) using light microscopy. Newer research and technology led to the use of cyclone separators with a given collection criteria and subsequent analysis using x-ray diffraction (XRD) to identify and quantify the crystalline quartz content. The preferred method is considered to be XRD, because it can distinguish and quantitate the different polymorphs of free silica in the widest range of industrial dust matrices. This method is therefore more accurate and offers better sensitivity than previous methods of analysis.

Today, the use of impingers and light microscope work for silica dust exposure determinations is obsolete and it is accepted practice to conduct sampling using a cyclone to determine silica exposure based on mg/m$^3$.

Federal OSHA (and MNOSHA) used the federal general industry PEL in mg/m$^3$ for construction because federal OSHA believed the limits were equivalent. Federal OSHA was challenged on this and lost at least one construction case because the exposure was compared to the general industry PEL in mg/m$^3$ instead of the construction industry PEL in mppcf.

Federal OSHA requested that NIOSH review the two units of measurement. In April, 2000, NIOSH recommended a conversion factor between the two units, but OSHA delayed its implementation until further support from outside experts was obtained. In 2001 federal OSHA reported that support was obtained and stated that the conversion factor should be applied. Transmission of this decision by federal OSHA to state offices was incomplete, therefore MNOSHA did not change its enforcement. Subsequent conversations now indicate that federal OSHA intended to require the use of the conversion factor for construction.

It is federal OSHA’s position that the 1970 TLV for cristobalite was intended to be the same as for quartz, however, the Mineral Dust Table was adopted and/or printed with a typographical error and has never been corrected. The entry in the ManComm version provided to OSHIs also contains the same error. The 1970 TLV for crystalline quartz is to be used for cristobalite as well.

MNOSHA exposure limits for construction are identical to federal OSHA and were intended to remain so. This is not related to any PEL changes that were made in 1989 because those changes did not include any PELs for Construction.
References:

09/04/01 Memorandum from federal OSHA (R. Fairfax) – Transmission of NIOSH Recommended Conversion Factor for Silica Sample Results and Favorable Appellate Court Decision on Silica Sampling

09/29/00 Memorandum from John Hermanson to Area Directors, Silica Conversion Formula approved for compliance purposes. (NIOSH report attached)

07/20/00 Memorandum from John Hermanson to Area Directors, additional information on Silica Conversion Formula

06/14/00 Memorandum from John Hermanson to Area Directors, advance copy of NIOSH report transmitted

05/11/00 Letter to Linda Rosenstock (NIOSH) from Asst Secretary of Labor Charles Jeffress acknowledging receipt of NIOSH report

04/11/00 Letter to Jeffress from Rosenstock, NIOSH recommended conversion factor

04/00 NIOSH paper – Recommended Conversion Factors

02/25/00 Letter to Rosenstock from Jeffress requesting assistance for comparing PEL formulas


OSHA TED 1-0.15A - OSHA Technical Manual, Section II: Chapter I, and Appendix II

OSHA Analytical Method ID 142 - Silica

Action: Effective immediately for Construction, MNOSHA will use the PEL formula for silica which is based on million particles per cubic foot. This PEL is for crystalline quartz as well as cristobalite. Proper collection of samples and conversion between the two units of measurement are described in this Directive.

A. COLLECTION and ANALYSIS OF RESPIRABLE SILICA SAMPLE

1. Collection of all respirable dust samples shall be done with a pre-weighed 5μ 37-mm diameter PVC filter preceded by a 10-mm nylon Dorr-Oliver cyclone (MSA or SKC), and personal sampling pump calibrated to 1.7 liters per minute. Consult the federal OSHA Technical Manual TED 1-0.15A (Section II: Chapter I Personal Sampling for Air Contaminants) and Analytical Method ID 142 for additional details. The recommended weight to be collected on the filter is 0.5 to 3.0 mg (5.0 mg dust will overload the filter).

2. Sample filters shall be post-weighed to determine the overall respirable dust collected on the filter. Filters shall be submitted for laboratory analysis of their quartz and cristobalite content. Laboratories shall use an approved x-ray diffraction method.

B. DETERMINATION OF SILICA EXPOSURE

Divide the overall net weight of dust collected on the filter (blank corrected) by the volume of air collected for that sample to determine the overall respirable dust exposure, in mg/m³. Convert this value to mppcf using the following conversion formula as determined by NIOSH:

\[ 1 \text{ mg/m}^3 = 10 \text{ mppcf} \]

C. DETERMINATION OF PERMISSIBLE EXPOSURE LIMIT

Calculate a PEL for each sample using the percent quartz determined by the laboratory for that sample. Use the following formula:
PEL = \( \frac{250 \text{ mppcf}}{\% \text{ Quartz} + 5} \)

D. DETERMINATION OF DOSE

For each sample, determine the relative dose each sample represents. Divide the values obtained in part B by the PEL determined in part C.

E. DETERMINATION OF 8-HOUR TIME-WEIGHTED AVERAGE DOSE

For each employee monitored, determine both the Time-Weighted Average (TWA) for the sampling period and the 8-Hour TWA. See OSHA Technical Manual, Section II, Appendix II.

F. DETERMINATION OF OVEREXPOSURE

8-hour TWA doses exceeding 1.0 and the errors associated with the sampling and analysis shall be considered an overexposure. Consult the OSHA Technical Manual (Section II: Appendix II:1-6, Sampling and Analytical Errors) for SAE discussion. The SAE derived from data provided by the laboratory performing quartz analysis for MNOSHA samples is 0.277.

G. RECOMMENDED CITATIONS

Cite 1926.55(a), grouped with 1926.55(b). In addition, if respirators were provided but there were deficiencies in the respiratory protection program (e.g. lack of fit testing or medical evaluation), cite separately 1910.134(a)(2) (with appropriate reference to 1926.103). The Abatement Guidelines for 1910.134 (a)(2) should include the full respiratory protection guidelines, if necessary.

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For the MNOSHA Management Team

Distribution: OSHA Compliance and WSC Director

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