Technical Bulletin

Understanding OSHA's Crystalline Silica Rule

Introduction

In March 2016, the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) announced a final rule[1] to improve protections for workers exposed to respirable crystalline silica (RCS) dust. The final rule amended silica exposure regulations for first time since 1971.

This technical bulletin provides an overview of how the rule will likely impact concrete paving, restoration and preservation contractors. This document also includes summary results of three separate studies involving American Concrete Pavement Association (ACPA) members — a preservation contractor, a paving contractor, and an equipment company.

In general, these studies involved assessing employee exposure in typical operational environments. Summary results reported in this document are examples only and may not be indicative of all contractors or operational conditions.

The ACPA acknowledges its contractor and other members for their contribution of test results and expertise in reviewing this bulletin.

The ACPA takes worker health and safety very seriously, and in that spirit, has prepared this technical bulletin to provide general information about how OSHA's final rule for crystalline silica exposure will impact common practices in the concrete pavement industry.

At the time this information was published, questions and concerns remain about the rule itself, as well as about the impact of implementation and enforcement on construction companies. Although ACPA recognizes these questions and concerns, the focus of this document is solely to provide contractors with general information and guidance.

This guide is not a comprehensive treatise, but is intended to help concrete contractors gain a better understanding of how the rule may apply specifically to concrete pavement construction operations. It also identifies the basic steps contractors should take to comply with the ruling.

Understanding the Rule's Scope

The rule is comprised of two standards, one for Construction and one for General Industry and Maritime, according to OSHA. For purposes of this document, only the *construction standard* is addressed and considered applicable to concrete paving and preservation contractors.

Employers covered by the construction standard have until June 23, 2017, to comply with most requirements of the ruling, according to OSHA.

Cutting, drilling, chipping and breaking concrete with handheld concrete power saws, jackhammers, and dowel drilling rigs are the predominant activities in concrete pavement construction and preservation that may require engineering and work practice control measures, or required respiratory protections for workers.

Although the need for control measures may be obvious for the operations noted above, employers also should consider other operations (such as sandblasting, air-blowing joints or sweeping), as well as exposure of employees who may be working in close proximity to any operations where RCS may be present.

Air Purifying Respirators

OSHA provides guidance on air purifying respirators in its guide, "Assigned Protection Factors for the Revised Respiratory Protection Standard" (OSHA 3352-02 2009).[2]

For the applicable concrete paving operations, adequate respiratory protection can be accomplished with dust masks rated APF 10. Figure 1, which comes from the OSHA guide, illustrates two APF 10 type masks.

OSHA Table 1 Provides Additional Guidance

Table 1 of this guide (pages 5-8) is a truncated version of the complete Table 1 found in OSHA's "Regulatory Text for Construction Standard, with Table 1."[3] Table 1 in this guide only includes the equipment or tasks typically used in concrete sawing, drilling or breaking operations employed in concrete pavement construction, preservation or repair. For ease of reference the table is color coded to show the required actions applicable to the equipment or tasks listed.

Notations highlighted in green in Table 1 indicate no action is required; items highlighted in orange indicate a respirator is required.

For the full construction regulatory text and unabridged Table 1, see reference 3 listed on page 10.

For each employee engaged in a task identified in Table 1, OSHA says "*the employer shall fully and properly implement the engineering controls, work practices, and respiratory protection specified for the tasks out-*

Example 1. A Preservation Contractor's Experience

Quality Saw and Seal, Inc. an ACPA member, participated in an Industrial Hygiene Study in May 2016. Conducted by Aires Consulting, the goal of the proactive study was to assess potential employee exposures to respirable crystalline silica during wet-saw and sealing activities.

Two saw-cutting and washing employees were measured for potential exposure to RCS, and the *personal air* sample results were collected. Sample results evaluated for RSC ranged from 0.0052 mg/m^3 to 0.0075 mg/m^3. Two *area* samples also were collected. Sample results tested for RSC ranged from 0.0088 mg/m^3 to 0.0099 mg/m^3, which are below the permissible exposure limits (PEL) and action levels (AL).

Employee and area sampling was also performed on sand-blasting and blow-out operations, as well as joint sealing operations. Two employees were sampled during the sand blasting operation and three during the joint sealing operation. Generally the results were below recommended or required levels, but one sample collected during joint sealing was over the OSHA action level (AL) of 0.025 mg/m^3.

Elevated results were also observed for truck drivers present during the sealing and sand blasting operations. To remedy the actionable results, the study recommended limiting unprotected workers access to a zone inside 25 ft from the active sand-blasting and blow-out operations. The study also recommended certain controls on trucks (e.g., closed cab windows, the use of proper air filtration, etc.) used within close proximity of these operations.

Figure 1—Major Types of Respirators

Half mask/Dust mask
APF=10
Needs to be fit-tested.

Half mask (Elastomeric)
APF=10
Needs to be fit-tested.

Source: "Assigned Protection Factors illustrations for the Revised Respiratory Protection Standard." (OSHA 3352-02), 2009. Illustrations by Attilis & Associates.

Example 2. A Paving Contractor's Experience

Cedar Valley Corp, LLC, an ACPA contractor member, participated in an on-site National Institute for Occupational Safety and Health (NIOSH)* audit in 2008. The audit was specifically targeting limits of RCS in the company's construction operations. The audit was performed during the data collection timeframe in OSHA's development of the newly passed ruling.

The end result of that audit was that all test results for RCS were below the limits of detection on the paving operations measured.

Based on the testing, Cedar Valley's Safety Director Jeffrey Bowers, concluded in an email to company President/CEO Steve Jackson: "Based on our current sawing processes, I do not believe that we would be impacted by the change in PEL [permissible exposure limits] that OSHA is proposing."

In response to some additional questions from ACPA about the details of the testing etc., Mr. Bowers provided the following comments:

"Regarding the processes that were included in the NIOSH audit conducted at the Eastern Iowa Airport, June 7th and 8th of 2008, my recollection is that we were involved in early-entry sawing and joint cleanup. A broom was in operation on the adjacent slab at some time during monitoring.

"Each day there were three employees in the saw crew. Two were operating saws and one was blowing joints, and all were fitted with body monitors. I seem to recall that the broom operator was also fitted with a body monitor, however that task and results do not appear in the final report.

"The lead auditor and signatory on the report was Mark Greskevitch (CDC/NIOSH/DRDS). He was assisted by Brent Doney, MS, MPH, RS. They supplied the monitors that were used, and instructed our employees on the scope of their use. I do not recall how many hours the monitors were worn each day. The following is taken directly from the emailed report submitted to me from Mr. Greskevitch, dated October 3, 2008."

"Air Sampling results: All results were below the limit of detection for RCS."

"Time weighted average (TWA) concentrations of respirable dust:

- OSHA PEL respirable dust = 5.0mg/m³, since silica was below the limit of detection
- Saw cutter A 7/7/08 = 0.13 mg/m³, Saw cutter A 7/8/08 = 0.08 mg/m³
- Saw cutter B 7/7/08 = 0.17 mg/m³, Saw cutter B 7/8/08 = 0.10 mg/m³
- Blower 7/7/08 = 0.13 mg/m³, Blower 7/8/08 = 0.07 mg/m³."

** The mission of NIOSH is to develop new knowledge in the field of occupational safety and health and to transfer that knowledge into practice.*[3]

lined in Table 1, unless the employer assesses and limits the exposure of the employee to respirable crystalline silica in accordance with paragraph d [in the full regulatory text]."

Paragraph d in the rule outlines alternative exposure control methods, including assessing RCS by measuring employee exposure. It is important to note that contractors who comply with Table 1 do not need to measure RCS exposure levels to comply with the permissible exposure limits.

For tasks not listed in Table 1, and for which employees are reasonably expected to be exposed to RCS, the employer needs to assess the exposure of each employee. Assessment options are based on: 1) performance (8-hour exposure for each employee using any combination of air monitoring data or objective data sufficient to characterize RCS exposure), or 2) scheduled (8-hour exposure for each employee using one or more personal breathing zone air samples that reflect the exposures of employees on each shift. Where several employees perform the same tasks on the same shift and in the same work area, the employer may sample a representative fraction of these employees.) Such assessments require hiring a consultant.

Early-Entry Dry Saws

Early entry dry saws are not specifically mentioned in the Table 1 of the rule. However, the current understanding is that these saws, which are very common in pavement construction, adequately rely on concrete mixture water for dust sup-

pression as the control. Regardless, workers still may be required to use APF 10 masks if the concrete hardens significantly and dry dust becomes present.

Recommendations

Ahead of the full implementation of OSHA's rule and periodically thereafter, contractors should evaluate their operations and offer training to employees.

Contractors should follow the recommended best practices outlined on page 9, as well as write a company-specific exposure control plan. A short outline of an exposure control plan is found in Table 2 (page 9). To the extent practical, the exposure plan should cover all operations and concrete materials anticipated in typical work by the company.

No test results were found in researching this bulletin to indicate that concrete made with different coarse or fine aggregates will result in appreciably different RSC production. However, contractors may want to consider differences based on the variety of concrete aggregates that they may encounter in their operational territory. The examples in this bulletin are primarily based on experiences with concrete containing limestone aggregates. Understanding variations based on the concrete materials and addressing these variations in the written exposure control plan could allow the plan to be applicable to a wider range of projects.

Example 3. An Equipment Manufacturer's Experience

Minnich Manufacturing Co., Inc., an ACPA member, voluntarily participated in a site survey to evaluate the ability of commercially-available dust-control systems to reduce respirable dust emissions during dowel drilling.

Conducted by the National Institute for Occupational Safety & Health's Engineering and Physical Hazards Branch (EPHB), an in-depth survey was performed in June 2010 at Minnich's factory in Mansfield, Ohio, and sought to quantify the relative extent to which the local exhaust ventilation (LEV) dust control systems were able to reduce respirable dust emissions from a dowel-drilling machine in a controlled setting. Findings from the survey report, dated March 11, are reported below.

The LEV system employed a dust collector drill-guide assembly that surrounded drill steels and bits, and were in close contact with the concrete substrate. The dust was conveyed from the hoods to a dust collection system using flexible, corrugated hose. The dust collectors also used transfer pumps to provide suction and filter air prior to discharge to the atmosphere.

The researchers used seven rounds of sampling with emissions measured during "control on" and "control off" trials. Respirable dust emissions were assessed using a personal dataram (pDR), a nephelometer that uses light scattering to measure dust over a size range of 0.1 to 10 µm and a concentration range of 0.001 to 400 mg/m^3. In all, 42 filter samples and 42 sets of pDR data were analyzed.

For each trial, five-gang dowel-pin drills, equipped with a wireless remote control were used to drill holes in concrete blocks, placed against the front of a concrete pad. Exhaust air and bailing air flow were measured using an in-line mass flow meter. To conduct the evaluation in a controlled environment (free from the effects of wind and diesel exhaust particulate), the drilling machine, slab, and block were placed inside a tent with a roll-up front door that could be closed with two zippers.

"The dust control system functioned very effectively," according to the report. "Compared with no dust control during dowel drilling in concrete, the dues-control system significantly reduced geometric mean respirable dust mass concentrations by 89% to 92% when measured with filter samples.

The report also concluded that mean respirable dust concentrations measured on filters were significantly reduced 88% to 90% by the use of the dust system. The use of the dust control also significantly reduced respirable dust emissions by 86% to 88% when measured with a nephelometer.

This study indicates manufacturer dust control systems like the one evaluated in this study can be considered as a viable engineering and control method employed by paving and preservation contractors in their written exposure control plan.

Table 1—Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		≤4 hours/shift	>4 hours/shift
(ii) Handheld power saws (any blade diameter)	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	**When Used Outdoors:**	
		None	**APF 10**
		When Used Indoors or in Enclosed Areas:	
		APF 10	**APF 10**
(iv) Walk-behind saws	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	**When Used Outdoors:**	
		None	**None**
		When Used Indoors or in Enclosed Areas:	
		APF 10	**APF 10**
(v) Drivable saws	**For Tasks Performed Outdoors Only:**		
	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	**None**	**None**
(vi) Rig-mounted core saws or drills	**For Any Operating Situation:**		
	• Use tool equipped with integrated water delivery system that supplies water to cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	**None**	**None**

Continued on page 6...

Table 1—Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica *(continued)*

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		≤4 hours/shift	>4 hours/shift
(vii) Handheld and stand-mounted drills (including impact and rotary hammer drills)	**For Any Operating Situation:**		
	• Use drill equipped with commercially available shroud or cowling with dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	**None**	**None**
(viii) Dowel drilling rigs for concrete	**For Tasks Performed Outdoors Only:**		
	• Use shroud around drill bit with a dust collection system. Dust collector must have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	**APF 10**	**APF 10**
(ix) Vehicle-mounted drilling rigs for rock and concrete	**For Any Operating Situation:**		
	• Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector, OR...	**None**	**None**
	• Operate from within an enclosed cab and use water for dust suppression on drill bit	**None**	**None**

Continued on page 7...

Table 1—Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica *(continued)*

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		≤4 hours/shift	>4 hours/shift
(x) Jackhammers and handheld powered chipping tools	• Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact, OR...	**When Used Outdoors:**	
		None	**APF 10**
		When Used Indoors or in Enclosed Areas:	
		APF 10	**APF 10**
	• Use tool with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning	**When Used Outdoors:**	
		None	**APF 10**
		When Used Indoors or in Enclosed Areas:	
		APF 10	**APF 10**
(xv) Large drivable milling machines (half-lane and larger)	**For Cuts of any Depth on Asphalt Only:**		
	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. • Operate and maintain machine to minimize dust emissions	**None**	**None**
	For Cuts of Four inches in Depth or Less on any Substrate:		
	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. • Operate and maintain machine to minimize dust emissions, OR...	**None**	**None**
	• Use a machine equipped with supplemental water spray designed to suppress dust. Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.	**None**	**None**

Continued on page 8...

Table 1—Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica *(continued)*

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		≤4 hours/shift	>4 hours/shift
(xiv) Small drivable milling machines (less than half-lane)	**For Any Operating Situation:**		
	• Use a machine equipped with supplemental water sprays designed to suppress dust. Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.	**None**	**None**
(xvi) Crushing machines	**For Any Operating Situation**		
	• Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (*e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points).* • Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions. • Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station.	**None**	**None**
(xvii) Heavy equipment and utility vehicles used to abrade or fracture silica-containing material (*e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing material*	**For Any Operating Situation**		
	• Operate equipment from within an enclosed cab. • When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.	**None**	**None**

Table 2 — Written Exposure Control Plan

Regardless of which exposure control methods are selected, all construction employers covered by the OSHA standard are required to establish and implement a written exposure control plan that contains at least the following elements:

1) A description of the tasks in the workplace that involve exposure to RCS;
2) A description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to RCS for each task;
3) A description of the housekeeping measures used to limit employee exposure to RCS; and
4) A description of the procedures used to restrict access to work areas, when necessary, to minimize the number of employees exposed to RCS and their level of exposure, including exposures generated by other employers or sole proprietors.

— Source: OSHA

Recommended Best Practices

Regardless of the types of work or the degree to which RCS-causing operations are used, ACPA interprets that the new rule will require contractors to generate some additional plans and records[4]. The following are interpreted as best practices under the OSHA ruling:

- Establish and implement a written exposure control plan that identifies tasks that involve RCS exposure potential and methods used to protect workers. *(See Table 2.)* The plan should:
  - *1)* Be developed around compliance with Table 1.
  - *2)* Include procedures to restrict employee access to work areas where high exposures may occur.
  - *3)* Address monitoring for silica if Table 1 controls are deemed inadequate to comply with the permissible exposure limits spelled out in the regulation.
- Designate a competent person to write and implement the written exposure control plan.
- Restrict housekeeping practices that expose workers to silica where feasible alternatives are available.
- Offer medical exams—including chest X-rays and lung function tests—performed by a physician or other licensed health care professional every three years for workers who are required by the standard to wear a respirator for 30 or more days per year.
- Keep accurate records of workers' silica exposure and medical exams.
- Provide information and training for workers on operations that result in silica exposure and ways to limit their exposure.

References

1. "OSHA's Final Rule to Protect Workers from Exposure to Respirable Crystalline Silica," https://www.osha.gov/silica. Accessed 5 June 2016.
2. "Assigned Protection Factors for the Revised Respiratory Protection Standard," Occupational Safety and Health Administration U.S. Department of Labor (OSHA 3352-02), 2009. Accessed 6 June 2016.
3. "Regulatory Text for Construction Standard, with Table 1," https://www.osha.gov/silica/SilicaConstructionRegText.pdf/. Accessed 5 June 2016.
4. "About NIOSH." Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health (NIOSH) website, http://www.cdc.gov/niosh/about/default.html. Accessed 5 June 2016.

Other Helpful Resources

- "OSHA's Crystalline Silica Rule: Construction," OSHA Fact Sheet. https://www.osha.gov/Publications/OSHA3681.pdf.
- Final Rule (29 CFR 1926.1153): "Occupational Exposure to Respirable Crystalline Silica: A Rule by the Occupational Safety and Health Administration on 03/25/16. https://www.federalregister.gov/articles/2016/03/25/2016-04800/occupational-exposure-to-respirable-crystalline-silica
- Appendix A to § 1926.1153 – Methods of sample analysis. https://www.osha.gov/silica/AppendixAtosect1926.1153.pdf
- Appendix B to § 1926.1153 – Medical Surveillance Guidelines. https://www.osha.gov/silica/AppendixBtosect1926.1153.pdf

Recommended OSHA documents available online for download.