problems because the use of HEPA vacuums raises less dust than dry sweeping.

Positive Environmental Effects

Based on its review of the record, OSHA concludes that the final rule will potentially have a positive environmental impact. At least one industry commenter, in the context of the hydraulic fracturing industry, suggested that its technology, the adoption of which would presumably be hastened by the promulgation and enforcement of the final rule, would reduce potential environmental impacts (Document ID 3589, Tr. 4140). In a similar vein, as discussed in both Chapters IV and V of the FEA, the final standard actually helps construction employers' reduce fugitive and co-generated dust, aiding in their compliance with environmental standards related to the dust. (The issue of controlling fugitive dust overlaps with the issue of existing employer obligations to minimize the runoff of solid waste into public water, discussed previously in this chapter, as well as the general expectation that employers clean up their work sites after their work is completed, as discussed in Chapter V).

Conclusion

As a result of this review, OSHA has reaffirmed its conclusions in the PEA, that the silica final rule will have no significant impact on air, water, or soil quality; plant or animal life; the use of land; or aspects of the external environment. It finds that the final standard is in compliance with NEPA and will have no significant environmental impact.

XV. Summary and Explanation of the Standards

OSHA proposed two standards for occupational exposure to respirable crystalline silica—one for general industry and maritime and a second for construction. Both proposed standards were structured according to OSHA's traditional approach, including separate provisions for a permissible exposure limit (PEL), exposure assessments, and methods of compliance, which includes a requirement to follow the hierarchy of controls. The methods of compliance provision in the proposed construction standard included Table 1, which specified engineering controls, work practices, and respiratory protection for common construction operations (now referred to as tasks). Construction employers who would have chosen to fully implement engineering controls, work practices, and respirators for a task in proposed Table 1 would have been exempted from conducting exposure assessments for employees conducting that task, but would have been required to comply with the PEL.

The structure of the final standard for general industry and maritime remains generally consistent with other OSHA health standards. The most significant structural change from the proposed general industry and maritime standard is that "cleaning methods," which was under the Methods of Compliance paragraph, is now a separate paragraph called Housekeeping. The same change regarding Housekeeping was made to the standard for construction. In addition both standards include a requirement for a written exposure control plan, which is included under the Methods of Compliance paragraph in the standard for general industry and maritime but as a separate paragraph in the standard for construction. Most importantly, the structure for the construction standard is significantly different from OSHA's traditional approach to address stakeholder concerns about compliance in the construction industry.

Many stakeholders thought that construction employers who fully and properly implement the engineering controls, work practices, and respiratory protection specified in Table 1 should be considered to be in compliance with the PEL. As reflected in paragraph (c) of the standard for construction (which includes Table 1), and as discussed in more detail in the summary and explanation, OSHA agrees that construction employers who fully and properly implement the engineering controls, work practices, and respiratory protection for a task on Table 1 do not have to demonstrate compliance with the PEL for that task, because these controls provide a level of protection equivalent to that provided by the alternative approach that includes the 50 μg/m^3 PEL.

OSHA also received many comments about the challenges of conducting exposure assessments in the construction industry. OSHA expects that because of these challenges most construction employers will follow Table 1. Therefore, OSHA made major structural changes to the standard for construction to emphasize Table 1 in paragraph (c) for employers who choose to follow that approach. Paragraph (d) of the standard for construction provides alternative exposure control methods for construction employers who choose not to follow Table 1 or who perform tasks that are not included in Table 1 (e.g., abrasive blasting and underground construction (tunnel boring)). Paragraph (d) of the standard for construction contains requirements, including the PEL, exposure assessments, and methods of compliance, that follow OSHA's traditional approach.

Construction employers who choose to follow Table 1 of paragraph (c) are exempt from following paragraph (d) but must comply with provisions in all other paragraphs of the standard for construction. On the other hand, construction employers who follow the alternate exposure control methods in paragraph (d) are exempt from following the provisions in paragraph (c) but must comply with the provisions in all other paragraphs of the standard for construction.

Although the structure of the standard for general industry and maritime differs from the structure of the standard for construction, many of the requirements are the same or similar in both standards. Therefore the summary and explanation is organized according to the main requirements of the standards. It includes paragraph references to the standard for general industry and maritime, followed by paragraph references for the standard for construction. The summary and explanation uses the term “rule” when referring to both standards. Generally, when the summary and explanation refers to the term “rule,” it is referring to the final rule. To avoid confusion, the term “final rule” is sometimes used when making a comparison to or clarifying a change from the proposed rule.

Scope and Application

Separate standards for general industry/maritime and construction. OSHA proposed two separate standards addressing occupational exposure to respirable crystalline silica: one for exposures in general industry and maritime, and another for exposures in the construction industry. The proposed standards were intended to provide equivalent protection for workers while accounting for the different work activities, anticipated exposures, and other conditions in these sectors.

Commenters representing construction employers, labor unions, and governmental entities noted the intrinsic differences between construction and other industries and were generally supportive of OSHA’s decision to propose one standard for general industry and maritime and another for construction (e.g., Document ID 1955, p. 2; 2116, p. 40; 2166, p. 3; 2181, p. 4; 2262, p. 14; 2318, p. 13; 2371, p. 5; 3403, p. 3). However, some stakeholders expressed concerns about differentiation among industries.

The Association of Occupational and Environmental Clinics opposed applying occupational health protection measures differently (Document ID 3399, p. 4). Edison Electric Institute (EEI) argued that differences in the standards may create confusion, administrative burden, and ambiguity, and could ultimately frustrate good-faith compliance efforts. EEI suggested that the easiest solution would be for OSHA to have “a single regulation applicable to the electric utility industry, rather than separate General Industry and Construction requirements" (Document ID 2357, p. 17).

Commenters representing utility providers, surface mineral mining, rock crushing, railroad operations, and truck distribution expressed concerns about separate standards creating uncertainty about which requirements would apply to various activities (Document ID 2101, p. 3; 2185, pp. 4-5; 2318, p. 13; 2357, p. 4; 2366, p. 3; 3492, p. 2). Southern Company cited the installation of new power delivery lines versus the repair or maintenance of existing power delivery lines as an example, indicating that once a concrete pole is in the ground the process of mounting hardware is exactly the same, but the applicable standard may be different (Document ID 2185, p. 4).

The International Brotherhood of Teamsters (IBT) also expressed concerns about work activities where it may not be clear whether the general industry or construction standard applies. IBT noted that ready-mix concrete truck drivers frequently travel to more than one work location and may work at many different construction sites on any given day. These workers are typically covered by the general industry standard; however, they may work at construction sites and perform certain tasks that could be considered construction work (Document ID 2318, p. 13).

Several commenters requested that OSHA develop a table listing specified exposure control methods for general industry, comparable to proposed Table 1 for construction, or that OSHA add general industry tasks to Table 1 (Document ID 2116, Attachment 1, p. 3; 2212, p. 2; 2244, p. 4; 2339, p. 8; 2357, p. 1). The American Society of Safety Engineers requested that Table 1 "be considered for the general industry/maritime standard for commonly performed tasks involving high levels of silica exposure" (Document ID 2339, p. 8).

After considering the concerns raised by commenters, OSHA is issuing one standard that addresses occupational exposure to respirable crystalline silica in general industry and maritime work and another for construction work. As reflected primarily in paragraph (c) and Table 1 of the standard for construction, the Agency finds that certain conditions inherent to the construction industry, such as the transient nature of the work, warrant alternatives to protect employees that are somewhat different than those that apply to general industry and maritime work. OSHA has long recognized a distinction between the construction and general industry sectors, and has issued standards specifically applicable to construction work under 29 CFR Part 1926. The Agency has provided a definition of the term “construction work” at 29 CFR 1910.12(b), has explained the terms used in that definition at 29 CFR 1926.13, and has issued numerous interpretations over the years explaining the classification of activities as either general industry or construction work.

In issuing separate standards for general industry/maritime and construction, OSHA's intent is to ensure that employees exposed to respirable crystalline silica in construction are, to the extent feasible, provided equivalent protection to that afforded employees in general industry and maritime. Specifically, OSHA intends that Table 1 in paragraph (c) of the construction standard, while providing employers with an alternative, flexible approach to addressing exposure to respirable crystalline silica in construction, will provide the same level of protection against exposures to silica for construction employees as is provided to general industry and maritime employees; the same is true for construction employees whose employers are following the traditional exposure assessment and hierarchy of controls approach under paragraph (d) of the construction standard.

OSHA recognizes that in some circumstances, general industry activities and conditions in workplaces where general industry tasks are performed may be indistinguishable from those found in construction work. In some cases, employers whose primary business is classified as general industry may have some employees who perform construction work, and employers whose primary business is classified as construction may have some employees who perform general industry work. Given the wide variety of tasks performed in the workplace, it is inevitable that questions will arise regarding the classification of certain activities, and these questions have been and will continue to be addressed in letters of interpretation and other guidance issued by OSHA. However, the distinction between sectors is generally well understood by both OSHA enforcement personnel and the regulated community, and OSHA concludes that any attempt to create exceptions or to provide different criteria in this final rule would not improve upon the current criteria but would, rather, cause confusion.

In certain circumstances, tasks performed in a general industry setting may be indistinguishable from the tasks listed on Table 1, and, under these circumstances, OSHA intends to treat full compliance with the construction standard as full compliance with the general industry/maritime standard. Accordingly, OSHA has revised the scope provision (i.e., paragraph (a)) in the general industry and maritime standard by adding paragraph (a)(3) to permit employers to follow the construction standard rather than the general industry and maritime standard when the general industry/maritime task performed is indistinguishable from a construction task listed on Table 1 in paragraph (c) of the construction standard, and the task will not be performed regularly in the same environment and conditions.

These indistinguishable tasks should not be merely parallel or complementary to or occurring at the same time and place as the construction tasks listed on Table 1, but rather should be of the same nature and type as those construction tasks. OSHA anticipates that the option in paragraph (a)(3) will apply primarily to maintenance and repair tasks performed in general industry or maritime settings. For example, an employee using a portable masonry saw to cut brick to patch a section of an existing brick wall, which is typically maintenance, would require tools and controls that are the same as those of an employee cutting brick while building a new brick wall, which is construction work. In performing this task, the employer could follow the construction standard, including paragraph (c)(1)(ii) of Table 1, rather than the general industry and maritime standard. Similarly, the installation of new power delivery lines is considered a construction activity, while the repair or maintenance of existing power delivery lines is considered a general industry task, even though a handheld drill may be used to drill a hole in concrete during both activities. In this situation, if the employer complies with the entry on Table 1 for handheld and stand-mounted drills (paragraph (c)(1)(vii) of the construction standard), in addition to all other applicable provisions of the construction standard (e.g., paragraph (g), Written exposure control plan), the employer would not be obligated under the general industry and maritime standard to perform an exposure assessment for the employee(s) engaged in the drilling task, or be subject to citation for failure to meet the permissible exposure limit (PEL); instead, the employer would have the same accommodation that Table 1 in paragraph (c) of the construction standard affords a construction employer doing that task and following paragraph (c). However, in the event that the employer fails to fully comply with the construction standard by, for example, failing to fully and properly implement the controls on Table 1 or to fully establish and implement a written exposure control plan (e.g., by not designating a competent person to implement the plan), the employer would be subject to the general industry and maritime standard and could be cited for not having performed an exposure assessment or not having achieved the PEL with respect to the employee(s) engaged in that task.

Paragraph (a)(3)(ii) of the general industry and maritime standard provides that, in order for the employer to be able to avail itself of the option to follow the construction standard, the task must not be performed regularly in the same environment and conditions. For example, an employer that performs sanding or cutting of concrete blocks in a concrete block manufacturing plant may not follow the construction standard, because the task is performed regularly in the same environment and conditions. Likewise, an employer whose business includes chipping out concrete from inside the drums of ready-mixed concrete trucks using pneumatic chipping tools may not follow the construction standard, because that task will be regularly performed in a relatively stable and predictable environment that would not require the accommodation of Table 1, which is intended in part to accommodate situations where the tasks will be performed in different environments and conditions.

Regarding comments that exposure controls should be specified in the general industry and maritime standard in a manner similar to that of Table 1 for construction tasks, OSHA concludes that, for most general industry operations, it is not possible to develop a specification that would broadly apply to facilities that vary widely in size, process design, and complexity while being specific enough to provide reasonably objective criteria against which to judge compliance with the standard. Unlike for construction tasks, the rulemaking record does not provide sufficient information for OSHA to account for the wide variety of potential tasks across the range of manufacturing and other general industry work. In manufacturing industries such as foundries and pottery production, local exhaust specifications must be custom designed for each establishment considering its manufacturing processes, equipment, and layout. Based on its over forty years of experience in enforcing occupational safety and health standards, OSHA concludes that in general industry and maritime, employee protection is best provided through a performance-oriented standard that permits employers to implement engineering controls and work practices that best fit their situation. In contrast, the task-based operations performed in construction are uniquely suited to a specification approach since the same equipment and dust controls are generally used regardless of the nature of the construction project, making specification of an effective dust control approach possible.

[redacted]

[redacted]

[redacted]

Section 4(b)(1) of the OSH Act limits OSHA's authority; the Act does not apply to working conditions of employees with respect to which other Federal agencies exercise statutory authority to prescribe or enforce standards or regulations affecting occupational safety or health. Many of the regulatory boundaries between FRA and OSHA are documented in an FRA policy statement that outlines the respective areas of jurisdiction between FRA and OSHA with regard to the railroad industry, but the FRA has also defined some boundaries through rulemaking (Document ID 0692 (43 FR 10583-10590 (3/14/78))). In 2003, FRA amended the Railroad Workplace Safety regulations, 49 CFR part 214, to require that new and employer-designated existing on-track roadway maintenance machines be equipped with, among other things, positive pressurized ventilation systems, and be capable of protecting employees in the cabs of the machines from exposure to air contaminants, including silica, in accordance with OSHA's air contaminants standard, 29 CFR 1910.1000 (49 CFR 214.505). In that rulemaking, the FRA articulated the overlap of its authority with OSHA's concerning protection from air contaminants: "when working inside the cab, workers receive protection from FRA; when working outside the cab, workers receive protection from OSHA" (68 FR 44388, 44393-44394 (7/28/03)). Consequently, this OSHA rule applies only to those railroad activities outside the cab (e.g., ballast dumping outside cabs) over which the FRA has not exercised jurisdiction, and only those activities are included in the final economic analysis. Additional discussion of this jurisdictional issue is included in the section on the technological feasibility of railroads (see Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA)).

Forms of silica covered. OSHA received comments about which forms, or polymorphs, of silica (e.g., quartz, cristobalite, tridymite) to include within the scope of the rule. The Industrial Minerals Association – North America and Ameren Corporation supported including all forms within the scope of the rule (Document ID 1760, p. 2; 2200, p. 2; 2315, p. 2). Other commenters made recommendations regarding specific forms of silica. For example, the National Industrial Sand Association (NISA) suggested including tridymite; however, the

National Institute for Occupational Safety and Health (NIOSH) and the North American Insulation Manufacturers Association (NAIMA) did not support inclusion of tridymite due largely to its rarity in the workplace (Document ID 2195, p. 30; 2177, Attachment 2, p. 10; 4213, p. 4). Similarly, Southern Company recommended that neither tridymite nor cristobalite be included within the scope of the rule, due to their rarity in the workplace (Document ID 2185, p. 2, 6). The American Composites Manufacturers Association and Southern Company suggested that OSHA focus exclusively on quartz (Document ID 1732, p. 6; 2185, p. 6). NAIMA suggested OSHA focus on both quartz and cristobalite (Document 4213, p. 4).

As discussed in Section V of this preamble, Health Effects, OSHA has concluded, based on the available scientific evidence, that quartz, cristobalite, and tridymite have similar toxicity and carcinogenic potency. Including all three forms of crystalline silica in the scope of the rule is therefore protective of the health of employees. Coverage of quartz, cristobalite, and tridymite in the scope of the rule maintains the coverage from OSHA's previous PELs for respirable crystalline silica; to eliminate one or more forms from the scope of the rule would lessen protections, contrary to what the OSH Act contemplates (see 29 U.S.C. 655(b)(8)). Therefore, the respirable crystalline silica rule applies to occupational exposure to respirable crystalline silica, as defined in paragraph (b) of each standard to include quartz, cristobalite, and tridymite.

Some commenters contended that OSHA should differentiate between crystalline silica and amorphous silica in the scope of the rule. The Society for Protective Coatings stated that this differentiation would avoid confusion and unnecessary burden, especially for small businesses (Document ID 2120, p. 1; 3544, p. 16). NAIMA stated that NIOSH, IARC (the International

Agency for Research on Cancer), EPA (the Environmental Protection Agency), and the California Office of Environmental Health Hazard Assessment all recognize the distinction in potential hazards to workers between amorphous and crystalline silica (Document ID 3544, p. 16). However, OSHA never intended to, and did not, include amorphous silica in the proposed rule. Nor do the final standards apply to amorphous silica. In fact, each standard bears the title, "Respirable crystalline silica"; only the respirable fraction of crystalline silica, where it exists as quartz, cristobalite, and/or tridymite, is covered.

Requests for exemptions. Commenters requested exemptions from the rule for specific operations or industries, such as auto body operations, cement distribution terminals, floor covering dealers, rural electric distribution cooperatives, and painting operations, arguing that these operations involve low levels of exposure to respirable crystalline silica (e.g., Document ID 2300, p. 4; 2358, p. 15; 2359, pp. 3-7; 2365, p. 2; 3751, p. 2; 2239, pp. 4-5). For example, the National Automobile Dealers Association (NADA) said that the likelihood of worker exposure to significant respirable crystalline silica in dealership auto body operations is de minimis, largely due to product substitution, state-of-the-art work practices, and the use of respiratory protection. NADA requested that OSHA confirm this conclusion through a clear statement in the preamble of its final rule (Document ID 2358, p. 3). Similarly, the World Floor Covering Association requested that OSHA revise the rule to exempt retail flooring dealers and installers from all requirements in the standard based on the intermittent and de minimis exposure of its employees to crystalline silica (Document ID 2359, p. 11). The Portland Cement Association also requested an exemption from the silica rule, arguing that its contemporary inhalation survey and historical data show that there is no probability that respirable crystalline silica exposures can be generated above the proposed action level among employees at cement terminals.

OSHA addresses the concerns of commenters regarding situations where they believe exposures are minimal and represent very little threat to the health of workers by including in the standards' scope and application sections an exception based on the level of exposure to respirable crystalline silica. Therefore, paragraph (a)(2) of the standard for general industry and maritime provides an exception for circumstances where the employer has objective data demonstrating that employee exposure to respirable crystalline silica will remain below 25 micrograms per cubic meter of air (25 $\mu g/m^3$) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.

OSHA concludes this approach is sensible policy because providing an exception for situations where airborne exposures are less likely to present significant risk allows employers to focus resources on the exposures of greatest occupational health concern. The Agency has included a definition for “objective data” in the rule (discussed with regard to Definitions) to clarify what information and data can be used to satisfy the obligation to demonstrate that respirable crystalline silica exposures will be below 25 $\mu g/m^3$ as an 8-hour TWA under any foreseeable conditions.

When using the phrase “any foreseeable conditions” OSHA is referring to situations that can reasonably be anticipated. The Agency considers failure of engineering controls to be a situation that is generally foreseeable. Although engineering controls are usually a reliable means for controlling employee exposures, equipment does occasionally fail. Moreover, OSHA intends the requirements for training on control measures, housekeeping, and other ancillary provisions of the rule to apply where engineering controls are used to limit exposures. Without effective training on use of engineering controls, for example, it is unreasonable to expect that such controls will be used properly and consistently. Thus, the exception does not apply where exposures below 25 μg/m^3 as an 8-hour TWA are expected or achieved, but only because engineering or other controls are being used to limit exposures; in that circumstance, but for the controls, exposures above 25 μg/m^3 as an 8-hour TWA would be foreseeable, and are foreseeable in the event of control failure or misuse.

OSHA considers the exclusion from the application of the rule for exposures below the 25 μg/m^3 action level to be a reasonable point of demarcation. For workplaces or tasks for which exposures are consistently below that threshold, it should be possible for employers to develop or obtain objective data demonstrating that employee exposure will remain below that level under any foreseeable conditions. Other standards have included similar exceptions (e.g., acrylonitrile, 29 CFR 1019.1045; ethylene oxide, 29 CFR 1910.1047; 1,3-butadiene, 29 CFR 1910.1051; chromium (VI), 29 CFR 1910.1026). In order for an employer to take advantage of this exclusion, the employer must have objective data demonstrating that employee exposure to respirable crystalline silica will remain below 25 μg/m^3 as an 8-hour TWA) under any foreseeable conditions, and must provide this data to the Assistant Secretary upon request.

NADA's submission provides an example of data that can be used to meet the requirements of the standard (Document ID 4197; 4198). NADA conducted air monitoring for employees performing a variety of tasks in automobile body shops. NADA selected body shops from a random sample of members, and worked to ensure that those selected were not the most technologically advanced or cleanest in order to ensure that the results of the study were representative of typical operations. The sampling was conducted in accordance with procedures described in OSHA's Technical Manual, and techniques for controlling dust generated during sanding operations were recorded and monitored. NADA retained a consultant to review testing methodology and final results and worked with Maine's OSHA Consultation Program to gather samples. In the body shops sampled, all but one of the samples taken for respirable crystalline silica indicated that exposures were below the limit of detection. For the one sample where the level of exposure was above the limit of detection, the result was below 25 μg/m^3 as an 8-hour TWA. A body shop performing tasks in a manner consistent with that described in the NADA submission would be able to rely on these objective data to demonstrate that exposures do not exceed 25 μg/m^3 as an 8-hour TWA under any foreseeable conditions.

The construction standard, paragraph (a), also provides an exception where employee exposure will remain below 25 μg/m^3 as an 8-hour TWA under any foreseeable conditions, but it does not require the employer to have objective data to support the exception. The data presented in Chapter IV of the FEA indicate that construction tasks can and often do involve exposures that exceed 25 μg/m^3 as an 8-hour TWA. However, some construction tasks may involve only minimal exposure to respirable crystalline silica. Some commenters indicated that they believed these tasks were covered under the scope of the proposed construction standard. For example, the Construction Industry Safety Coalition (CISC) and the National Association of Home Builders indicated that they believed that mixing mortar, pouring concrete footers, slab foundation, and foundation walls, and the removal of concrete formwork would be covered by the standard (Document ID 2319, pp. 19-21; 2296, pp. 8-9). OSHA finds that these tasks, when performed in isolation from activities that do generate significant exposures to respirable crystalline silica (e.g., tasks listed on Table 1, abrasive blasting), do not create respirable crystalline silica exposures that exceed 25 μg/m^3 as an 8-hour TWA. OSHA's analysis of the rulemaking record also indicates that a substantial number of employees in the construction sector perform tasks involving occasional, brief exposures to respirable crystalline silica that are incidental to their primary work. These employees include carpenters, plumbers, and electricians who occasionally drill holes in concrete or masonry or perform other tasks that involve exposure to respirable crystalline silica. CISC estimated that 1.5 million employees in the construction industry perform such tasks (Document ID 2319, pp. 72-73). Where employees perform tasks that involve exposure to respirable crystalline silica for a very short period of time, OSHA finds that exposures for many tasks will be below 25 μg/m^3 as an 8-hour TWA. Short-term respirable crystalline silica exposures must be very high in order for those exposures to exceed 25 μg/m^3 as an 8-hour TWA; for example, if an employee is exposed for only 15 minutes, his or her exposure would have to exceed 800 μg/m^3 for that 15 minute period before the 8-hour TWA exposure would exceed 25 μg/m^3.

When performed without adequate controls, some tasks can generate such high exposures. However, for some construction tasks that may be performed occasionally, for brief periods of time, exposures would not generally be expected to exceed 25 μg/m^3 as an 8-hour TWA. For example, for hole drillers using hand-held drills, the highest result identified in OSHA's exposure profile was for a worker performing dry drilling on a wall on the lower level of a concrete parking garage where air circulation was poor (see Chapter IV of the FEA). This result showed an exposure of 300 μg/m^3 during the sampling period (Document ID 1423, p. 833). If the duration of exposure was 15 minutes, the 8-hour TWA exposure would be 19 μg/m^3, and therefore under the 25 μg/m^3 threshold (assuming no exposure for the remainder of the shift).

Rather than require construction employers to develop objective data to support an exception from the construction standard for employees who are exposed to minimal levels of respirable crystalline silica, or who are occasionally exposed to respirable crystalline silica for brief periods, OSHA is structuring the scope paragraph (i.e., paragraph (a)) for the construction standard so that the standard applies to all occupational exposures to respirable crystalline silica, except where employee exposure will remain below 25 μg/m^3 as an 8-hour TWA under any foreseeable conditions. This approach relieves construction employers of the burden of developing objective data for such situations.

In the NPRM, OSHA asked stakeholders whether the Agency should limit the coverage of the rule to materials that contain a threshold concentration (e.g., 1 percent, 0.1 percent) of crystalline silica (78 FR at 56288). Stakeholders representing industries including cement and concrete, composites manufacturing, fertilizers, and sand and gravel suggested a threshold, commonly presenting concerns regarding requirements for labels and safety data sheets (SDSs) (e.g., Document ID 1785, p. 4; 2116, Attachment 1, p. 45; 2179, pp. 3-4; 2101, pp. 8-9; 2284, p. 10; 2296, p. 44; 2312, p. 3; 2317, p. 3; 2319, p. 120; 2327, Attachment 1, p. 14; 4208, pp. 19-20). For example, TFI supported a percentage-based threshold for crystalline silica containing materials, indicating that such an approach would be consistent with OSHA's past standard-setting experience for asbestos-containing materials. TFI stated that OSHA should not set a threshold at lower than 1 percent, and recommended that OSHA consider a 5 percent threshold, noting challenges in measuring crystalline silica content in bulk materials at concentrations below 1 percent (Document ID 2101, pp. 5-9).

OSHA has not included a threshold concentration exception in these standards. The Agency has concluded that it would not be appropriate to establish a threshold crystalline silica concentration because the evidence in the rulemaking record is not sufficient to lead OSHA to determine that the suggested concentration thresholds would be protective of employee health. The Agency's exposure assessment findings show that exposures to respirable crystalline silica can exceed the action level of 25 mg/m^3 or PEL of 50 mg/m^3 even at threshold concentrations less than 1 or 0.1 percent, as demonstrated by the abrasive blasting activities investigated in a NIOSH survey report using Staurite XL in containment (Document ID 0212, p. 12). Issues with regard to requirements for labels and SDSs are addressed in the summary and explanation of requirements for Communication of Respirable Crystalline Silica Hazards to Employees in this preamble.

The Brick Industry Association (BIA) argued that its members should be exempt from compliance with the respirable crystalline silica rule, indicating that the low toxicity of crystalline silica in the brick and structural clay industry does not cause a material risk of health impairment. BIA noted that OSHA has established specific requirements for certain industries in the past, such as the pulp, paper and paperboard mill industry in 29 CFR 1910.216, and the textile industry in 29 CFR 1910.262. BIA requested that OSHA take a similar approach for the brick industry because, BIA argued, silicosis is essentially non-existent in the brick industry's workers (Document ID 2300, pp. 2-4). OSHA also received comments and testimony from stakeholders in the brick, tile, and fly ash industries who argued that in their industries, crystalline silica was most commonly shrouded or occluded within matrices of aluminosilicates, and therefore the silica was less bioavailable and exhibited reduced toxicity (e.g., Document ID 2085, p. 2; 2123, p. 1; 2267, p. 8; 2343, Attachment 1, p. 30; 3587, Tr. 3628; 3587, Tr. 3704).

As discussed in Section V of this preamble, Health Effects, OSHA has reviewed the evidence concerning potential effects on silica-related toxicity of a variety of physical factors, including the age of fractured surfaces of the crystal particle and clay occlusion of the particle. OSHA recognizes that the risk to employees exposed to a given level of respirable crystalline silica may not be equivalent in different work environments due to differences in physical factors that affect the potency of crystalline silica. OSHA also recognizes that workers in these industries (e.g., brick manufacturing) may experience lower rates of silicosis and other health effects associated with exposure to respirable crystalline silica. However, OSHA finds that these employees are still at significant risk of developing adverse health effects from exposure to respirable crystalline silica. The Agency is therefore is not excluding brick, tile, or fly ash from the scope of the rule based on physical characteristics of crystalline silica.

OSHA also received multiple studies, along with testimony and comments from the Sorptive Minerals Institute (SMI) (Document ID 2377; 4230). SMI stated that sorptive clays are limited to a specific and discreet subset of deposits in the U.S., including specifically: the Monterey formation (California), the Porters Creek formation (Mississippi Valley), the Twiggs and Meigs fullers earth (southeastern U.S.), the Wyoming or Western-type sodium bentonite deposits, the calcium bentonite deposits (north-central Florida), and the fullers earth deposits of eastern Virginia (Document ID 4230, p. 3). As discussed in Section V, Health Effects, SMI contended that silica in sorptive clays exists as either amorphous silica or as geologically ancient, occluded quartz, and that neither form poses the health risk described in OSHA's risk assessment (Document ID 4230, p. 2). After evaluation of the evidence SMI submitted to the record, OSHA finds that quartz originating from bentonite and similar sorptive clays is considerably less toxic than unoccluded quartz, and evidence does not exist that would permit the Agency to evaluate the magnitude of the lifetime risk resulting from exposure to silica in sorptive clay deposits. OSHA is therefore excluding sorptive clays from the scope of the rule, as described in paragraph (a)(1) of the general industry and maritime standard. The PEL in 29 CFR 1910.1000 Table Z-3 (i.e., the formula that is approximately equivalent to 100 μg/m^3) will continue to apply to occupational exposure to respirable crystalline silica from sorptive clays. The exemption covers exposures resulting from the processing, packaging, and distribution of sorptive clays originating from the geological deposits described above (and intended for sorptive clay-specific use such as absorbents for oil, grease, and animal waste, as a carrier for pesticides and fertilizers, or in cosmetics, pharmaceuticals, and animal feeds).

Relationship to other OSHA standards. EEI and the American Iron and Steel Institute (AISI) sought clarification from OSHA regarding how the silica rule would affect the existing coke oven emissions standard or the PEL for coal dust. EEI said that OSHA should expressly exempt coal dust from the rule (Document ID 2357, p. 4). AISI similarly stated that the rule potentially conflicts with the coal dust PEL and is duplicative of existing steel industry standards. AISI stated that OSHA's existing coke oven emissions standard protects employees working in the regulated area around metallurgical coke ovens and metallurgical coke oven batteries where exposures to emissions are of greatest concern. AISI believes that workers covered by OSHA's coke oven emissions standard are therefore already protected adequately from the dangers of crystalline silica exposure and such operations should be exempt from the rule (Document ID 3492, p. 2).

The respirable crystalline silica rule has no effect upon OSHA’s standard for coke oven emissions, the existing PEL for coal dust, or any other substance-specific standard. None of these requirements provide the full range of protections afforded by the respirable crystalline silica rule. The PEL for coal dust is only a PEL; it does not provide any additional protections, such as medical surveillance. Other requirements therefore do not provide protection equivalent to the respirable crystalline silica rule. Accordingly, the silica rule applies to these situations to the extent there is silica exposure and the conditions for excluding them from the rule's scope are not met.

Definitions

Paragraph (b) of the standard for general industry and maritime (paragraph (b) of the standard for construction) provides definitions of terms used in the standards.

"Action level" means a concentration of airborne respirable crystalline silica of 25 micrograms of respirable crystalline silica per meter cubed of air ($\mu g/m^3$), calculated as an 8-hour time-weighted average. The action level triggers requirements for exposure assessment and, in the standard for general industry and maritime, medical surveillance. The definition is unchanged from the proposal.

Because of the variable nature of employee exposures to airborne concentrations of respirable crystalline silica, maintaining exposures below the action level provides reasonable assurance that employees will not be exposed to respirable crystalline silica at levels above the permissible exposure limit (PEL) on days when no exposure measurements are made. Even when all measurements on a given day fall below the PEL but are above the action level, there is a reasonable chance that on another day, when exposures are not measured, the employee's actual exposure may exceed the PEL (Document ID 1501). The importance of the action level is explained in greater detail in the summary and explanation of <u>Exposure Assessment</u> and summary and explanation of <u>Medical Surveillance</u>.

The action level in this rule is set at one-half of the PEL. This is the same ratio of action level to PEL that has been used and been effective in other standards, including those for inorganic arsenic (29 CFR 1910.1018), ethylene oxide (29 CFR 1910.1047), benzene (29 CFR 1910.1028), methylene chloride (29 CFR 1910.1052), and chromium (VI) (29 CFR 1910.1026).

Following the publication of the proposed rule, OSHA received a number of comments pertaining to the definition of the action level. Some commenters, such as National Council for Occupational Safety and Health (NCOSH), American Federation of Labor and Congress of

Industrial Organizations (AFL-CIO), International Brotherhood of Teamsters, United Steelworkers (USW), Center for Effective Government (CEG), American Public Health Association (APHA), American Thoracic Society (ATS), and Cara Evens, a private citizen, supported OSHA's proposal to include an action level of 25 μg/m^3 (e.g., Document ID 1801, p. 2; 2173, pp. 2-3; 2175, p. 5; 2178, Attachment 1, p. 2; 2318, p. 10; 2336, p. 5; 2341, pp. 2-3; 4204, pp. 42-45, 51-52). For example, USW supported the inclusion of an action level that is half the PEL (25 μg/m^3) because:

> This action level will further reduce exposure to respirable crystalline silica by workers and will incentivize employers to implement best-practice controls keeping exposures at a minimum as well as reducing costs of monitoring and assessments. The USW believes measuring airborne concentrations of silica at 25ug/m^3 will prove feasible given current sampling techniques (Document ID 2336, p. 5).

AFL-CIO noted that action levels have long been incorporated into OSHA standards in recognition of the variability of workplace exposures and argued that the inclusion of an action level is particularly important in this rulemaking because exposures at the PEL pose a significant risk to employees (Document ID 2256, Attachment 2, p. 9). NCOSH and CEG echoed AFL-CIO's concerns about significant risk remaining at the PEL, and NCOSH, further noted that significant risk remains at the action level (Document ID 2173, p. 2; 2341, p. 2).

As discussed in more detail in the summary and explanation of Medical Surveillance, some stakeholders, such as APHA, supported an action level trigger for medical surveillance in the standard for general industry because of significant risk of disease remaining at the action level and even below (Document ID 2178, Attachment 1, p. 2).

The National Institute for Occupational Safety and Health (NIOSH) supported an action level that is lower than the PEL because it is consistent with longstanding industrial hygiene practice, and an action level is included in other OSHA standards. NIOSH did not recommend a value for the action level but cited a 1975 study by NIOSH (Leidel et al. 1975, Document ID 1501) as demonstrating that an action level provides a high level of confidence that most daily exposures will be below the PEL (Document ID 2177, Attachment B, p. 23).

Other commenters supported having an action level, but advocated a higher level (e.g., Document ID 1963, pp. 1-2; 2196, Attachment 1, pp. 1-2; 2200, pp. 1-2; 2213, p. 3; 2232, p. 1; 2233, p. 1; 2301, Attachment 1, p. 78; 2311, p. 3). For instance, the National Industrial Sand Association (NISA) recommended an action level of 50 $\mu g/m^3$, which is one half the value of the PEL they supported (100 $\mu g/m^3$). NISA recommended a higher PEL because it disagreed with OSHA that significant risk existed at the proposed PEL of 50 $\mu g/m^3$. NISA also argued that a PEL of 50 $\mu g/m^3$ would not be technologically or economically feasible. However, NISA's reasons for recommending an action level set at half of its recommended PEL mirrored many of the reasons offered by USW and AFL-CIO, including maintaining consistency with other OSHA standards, accounting for exposure variability, and providing employers with incentives to keep exposures low. In addition, NISA commented that keeping exposures well below the PEL would provide a margin of safety to protect against uncertainties in the toxicology and epidemiology data supporting a PEL (Document ID 2195, pp. 30-35). NISA also recommended that medical surveillance be triggered at the action level (although, as noted above, NISA recommended an action level of 50 $\mu g/m^3$); that recommendation is discussed in the summary and explanation of Medical Surveillance.

Southern Company asserted that OSHA set the proposed action level too low, because it believed it is difficult to measure based on current laboratory detection limits (Document ID 2185, pp. 5-6). It recommended that OSHA consider setting the action level at an achievable analysis level (though a suggested level for OSHA to consider was not provided) or conduct further cost analyses of additional sampling and ancillary provisions this may trigger. As stated further below, OSHA's conclusion that silica exposures can be measured with reasonable accuracy at the action level is discussed in the Sampling and Analysis discussion of technological feasibility in Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA).

Other commenters supported an action level but argued that the proposed action level was set too high. For example, the United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) argued that the action level would need to be set at 12.5 μg/m^3, one-fourth of a 50 μg/m^3 PEL, in order to ensure that fewer than 5 percent of exposures would exceed a PEL of 50 μg/m^3 (Document ID 2282, Attachment 3, p. 14). In support of its recommended action level, UAW cited a study by Rappaport et al. (1988), which reported that no more than 12 percent of log-normally distributed exposures are expected to exceed the PEL with an action level set at one half the PEL (Document ID 2282, Attachment 2, pp. 310, 314). Similarly, the BlueGreen Alliance (BGA) supported a lower action level, indicating that the proposed action level was not protective enough. BGA supported an action level of no higher than 25 percent of the PEL ". . . in order to provide reasonable likelihood that 95% of exposures are below the PEL" (Document ID 2176, p. 2).

Finally, some commenters opposed having any action level (Document ID 2085, p. 3; 2296, p. 40; 2305, pp. 4, 10; 2312, p. 2; 2317, p. 2; 2327, Attachment 1, pp. 13, 15-17; 2305, pp. 4, 10; 2296, p. 40; 3577, Tr. 707-708). Mercatus Center of George Mason University (Mercatus Center) asserted that OSHA did not provide adequate justification for the proposed action level, arguing that because OSHA found a PEL of 25 μg/m^3 to be infeasible, the Agency has not shown that employers would have sufficient incentives to limit exposures to the action level (Document ID 1819, p. 2). The Fertilizer Institute indicated that the action level will create a de facto 25 μg/m^3 standard because the initial and periodic monitoring requirements will be a time-consuming, expensive endeavor (Document ID 2101, pp. 7-8). The National Concrete Masonry Association and Blue Stone Block Supermarket argued that the best approach would be to remove the action level and only "require action when the PEL is exceeded" (Document ID 2279, p. 9; 2384, p. 9). They believed requiring action only when their recommended PEL of 100 μg/m^3 is exceeded would be effective in reducing silica-related illnesses and more cost-effective for industries.

OSHA considered these comments and has decided to retain an action level of 25 μg/m^3. OSHA agrees with CEG and AFL-CIO that that the inclusion of an action level of 25 μg/m^3 is particularly important in this rulemaking because employees exposed at the action level and revised PEL remain at significant risk of developing respirable crystalline silica-related diseases (see Section VI, Final Quantitative Risk Assessment and Significance of Risk). In addition, as explained in Chapter IV of the FEA, OSHA has found that the revised PEL is technologically and economically feasible. OSHA disagrees with Mercatus Center that an action level of 25 μg/m^3 is not appropriate because that level is not feasible as a PEL, and the Agency does not agree with the Fertilizer Institute that a 25 μg/m^3 action level creates a de facto standard. The action level only triggers certain requirements (i.e., a requirement for exposure assessment in general industry/maritime and construction, and medical surveillance in general industry/maritime only); employers that exceed it but remain at the PEL or below will not be in violation of the rule, so long as they comply with the requirements associated with the action level. The requirements associated with exposures at or above the action level create an incentive

– but not a requirement – for employers to reduce exposures below the action level where it is reasonably possible to do so. Although OSHA could not find that engineering controls and work practices are sufficient to reduce and maintain respirable crystalline silica exposures to a level of 25 μg/m^3 or below in most operations most of the time in affected industries, it is likely possible for some employers to reduce exposures to below the action level in some circumstances, without the use of respirators. The Agency also concludes that it is feasible to measure respirable crystalline silica levels at an action level of 25 μg/m^3 with reasonable accuracy (see Chapter IV of the FEA). Because employers are not required to reduce exposures below 25 μg/m^3, feasibility concerns are not relevant. Consequently, OSHA does not agree with NISA and Southern Company that feasibility concerns warrant revising the proposed action level upward.

OSHA agrees, however, that maintaining exposures below an action level that is half the PEL provides reasonable assurance that employees will not be exposed to respirable crystalline silica at levels above the PEL on days when no exposure measurements are made. OSHA's early standards relied, in part, on a statistical basis for using an action level of one-half the PEL (e.g., acrylonitrile, 29 CFR 1910.1045; ethylene oxide, 29 CFR 1910.1047). OSHA previously determined (based in part on research conducted by Leidel et al., 1975) that where exposure measurements are above one-half the PEL, the employer cannot be reasonably confident that the employee is not exposed above the PEL on days when no measurements are taken (Document ID 1501, pp. 5-6, 29-30, 38). Similarly, Rappaport et al. (1988) used monitoring data and applied a statistical method to estimate that no more than 12 percent of lognormally-distributed exposures would be expected to exceed the PEL if mean exposures remain below an action level set at one-half the PEL (Document ID 2282, Attachment 2).

OSHA thus agrees with UAW and BGA that an action level lower than one-half of the PEL would provide a higher degree of confidence that exposures are not likely to exceed the PEL. However, OSHA's policy is to set the action level at a value that effectively encourages employers to reduce exposures below the action level while still providing reasonable assurance that employee exposures are typically below the PEL. The Agency's experience with previous standards also indicates that an action level of one-half the PEL effectively encourages employers, where feasible, to reduce exposures below the action level to avoid the added costs of required compliance with provisions triggered by the action level.

OSHA is convinced, therefore, that an action level is needed and decided to set the action level at one-half of the PEL, based on residual risk at the PEL of 50 $\mu g/m^3$, the feasibility of measuring exposures at an action level of 25 $\mu g/m^3$, and the administrative convenience of having the action level set at one-half the PEL, as it is in other OSHA standards. OSHA's risk assessment indicates that significant risk remains at the PEL of 50 $\mu g/m^3$. OSHA therefore has a duty to impose additional requirements on employers to reduce remaining significant risk when those requirements will afford benefits to employees and are feasible (Building and Construction Trades Department, AFL-CIO v. Brock, 838 F.2d 1258, 1269 (D.C. Cir 1988)). With significant risk remaining at 50 $\mu g/m^3$, reducing that risk by incorporating an action level is necessary and appropriate. OSHA concludes that the action level will result in a real and necessary further reduction in risk beyond that provided by the PEL alone.

"Competent person" means an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must also have the knowledge and ability necessary to fulfill the responsibilities set forth in paragraph (g) of the construction standard. OSHA has not included requirements related to a competent person in the general industry and maritime standard. This definition therefore is included only in the construction standard.

In the proposal, OSHA defined competent person as one who is capable of identifying existing and predictable respirable crystalline silica hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them. OSHA received a number of comments related to this definition. Many of these commenters suggested that the definition should be expanded. For example, Building and Construction Trades Department, AFL-CIO (BCTD) recommended that OSHA revise the proposed definition to require that the competent person be capable of identifying the proper methods to control existing and predictable hazards in the surroundings or working conditions. BCTD also asked that the definition specify that the competent person be "designated by the employer to act on the employer's behalf." It proposed specific language that incorporated these suggestions (Document ID 4223, p. 112). International Union of Operating Engineers (IUOE) endorsed the BCTD definition and International Union of Bricklayers and Allied Craftworkers (BAC) agreed with BCTD that OSHA's definition needed to be more fully developed (Document ID 2262, p. 40; 2329, p. 5).

The American Society of Safety Engineers (ASSE) advocated for the following definition, which it based on that of the asbestos standard:

> Competent person means, in addition to the definition in 29 CFR 1926.32 (f), one who is capable of identifying existing respirable crystalline silica hazards in the workplace and selecting the appropriate control strategy for such exposure and for developing and overseeing written access control plans, who has the authority to take prompt corrective measures to eliminate such hazards, as specified in 29 CFR 1926.32(f), and who is trained in a manner consistent with OSHA requirements for training (Document ID 4201, pp. 3-4).

Finally, NIOSH noted the American National Standards Institute (ANSI) AIO.38 definition of competent person:

> One who, as a result of specific education, training, and/or experience, is capable of identifying existing and predictable hazards in the surroundings [or] working conditions that are unsanitary, hazardous or dangerous to employees, and who has the authorization and responsibility to take prompt corrective measures to eliminate them [emphasis omitted] (as cited in Document ID 2177, Attachment B, p. 9).

In determining if the proposed definition for competent person needed to be revised, OSHA considered these comments and the definition of competent person in the safety and health regulations for construction (29 CFR 1926.32(f)). Under 29 CFR 1926.32(f), competent person is defined as one capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees and who is authorized to take prompt corrective measures to eliminate them. OSHA concludes that its definition for competent person is consistent with 1926.32(f) but tailored to respirable crystalline silica by specifying “respirable crystalline silica hazards” instead of “unsanitary, hazardous, or dangerous” conditions. OSHA did make a few minor revisions to its proposed definition. The Agency replaced the word “one” with “individual,” which is merely an editorial change. The Agency removed the phrase “in the surroundings or working conditions” and changed it to “in the workplace” to make it specific to the workplace. The Agency removed the phrase “to eliminate them” and changed it to “to eliminate or minimize them” to denote there may be cases where complete elimination would not be feasible. OSHA also changed “predicted” to “foreseeable” to make the wording consistent with the scope of the standard (paragraph (a)).

OSHA agrees with ASSE and the ANSI definition highlighted by NIOSH that the definition for competent person must indicate that the competent person has appropriate training, education, or experience. Therefore, OSHA further revised the proposed definition for competent person to indicate that the competent person must have the knowledge and ability necessary to fulfill the responsibilities set forth in paragraph (g). Comments regarding knowledge or training for a competent person and OSHA's responses to those comments are discussed in the summary and explanation of <u>Written Exposure Control Plan.</u>

The requirement that the competent person have the knowledge and ability to fulfill the responsibilities set forth in paragraph (g) addresses BCTD's and ASSE's requests to amend the definition to specify that the competent person be capable of identifying or selecting the proper methods to control hazards in the surroundings or working conditions. It is clear from paragraph (g) that the competent person must be familiar with and also capable of implementing the controls and other protections specified in the written exposure control plan.

ASSE also requested that the definition indicate that the competent person be capable of developing and overseeing the written access control plan, which OSHA had proposed. However, the final rule does not specify a written access control plan, and instead requires a written exposure control plan. Regardless, OSHA does not agree with ASSE's suggestion that the definition should be revised to indicate capability to develop a written plan. OSHA assigns that responsibility to the employer because under paragraph (g)(4), the competent person is someone on the job site who makes frequent and regular inspections, and thus may not be involved in developing the written exposure control plan in an office environment. OSHA also disagrees with BCTD that the definition should specify that the competent person is designated by the employer to act on behalf of the employer. The employer's obligation to designate a competent person is clearly specified in paragraph (g)(4) and the definition clearly states that the competent person has authority to promptly apply corrective measures.

The competent person concept has been broadly used in OSHA construction standards (e.g., 29 CFR 1926.32(f) and 1926.20(b)(2)), particularly in safety standards. This standard does not affect the competent person provisions in these other standards.

“Employee exposure” means the exposure to airborne respirable crystalline silica that would occur if the employee were not using a respirator. This definition clarifies the requirement that employee exposure must be measured as if no respiratory protection is being worn. The definition, which is consistent with OSHA's previous use of the term in other standards, did not generate any comment and is unchanged from the proposal.

“High-efficiency particulate air (HEPA) filter” means a filter that is at least 99.97 percent efficient in removing mono-dispersed particles of 0.3 micrometers in diameter. The definition is unchanged from the proposal. HEPA filters are more efficient than membrane filters because they are designed to target much smaller particles. In the housekeeping requirements of paragraph (h)(1) of the standard for general industry and maritime (paragraph (f)(1) of the standard for construction), OSHA refers to HEPA-filtered vacuuming as an example of an appropriate cleaning method, and the Table 1 entry for handheld and stand-mounted drills requires use of a HEPA-filtered vacuum (if a commercially available hole-cleaning kit connected to a dust collector is not being used). OSHA had also proposed HEPA-filtered dust collectors as controls for some tasks listed on Table 1 of the proposed standard for construction.

The Agency received one comment related to HEPA filters from the Occupational and Environmental Health Consulting Services (OEHCS). First, OEHCS recommended that the definition be expanded to indicate that HEPA filters are effective at removing particles in the

0.3-micrometer size range, as measured by a laser particle counter. Second, it requested addition of the term “Portable High Efficiency Air Filtration (PHEAF)” device, defined as a portable device equipped with a certified HEPA filter that, when tested as a complete unit, is 99.97 percent effective in removing particles in the 0.3-micrometer size range, as measured by a laser particle counter (Document ID 1953, pp. 4-6). OEHCS advocated for a requirement that portable filtration devices (e.g., HEPA vacuums, dust collectors used on tools, and filter systems for enclosed cabs) meet the definition of PHEAF. It argued that HEPA vacuums or other portable filtration devices might not perform effectively in the field due to inadequate, damaged, or deteriorating sealing surfaces; replacement filters that do not fit correctly; filter cabinets that are damaged; or filters that are punctured. Claiming that damaged filters might not build up enough pressure differential to signal that they should be changed, OEHCS recommended a requirement for field testing the devices using a laser particle counter to ensure that HEPA filters function as intended (Document ID 1953, Attachment 1, pp. 2-4).

OSHA encourages employers to ensure that HEPA filters function in the field according to the specifications of this definition. However, the Agency concludes that it is not appropriate to include requirements for PHEAF devices, as defined by OEHCS, or laser particle counting testing, in the rule due to the lack of documented effectiveness or consistency with the definition and because of the lack of support in the record. As a result, OSHA is retaining its proposed definition for HEPA filter and is not adding PHEAF to the definitions section.

“Objective data” means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

The proposed definition of “objective data” also included “calculations based on the … chemical and physical properties of a substance” as an example of a type of objective data that might demonstrate employee exposure to respirable crystalline silica. BCTD objected to this example’s inclusion in the definition (Document ID 2371, Attachment 1, pp. 11-12). Although BCTD agreed that the chemical and physical properties of a substance are among the factors that may be relevant in determining whether data from one set of circumstances can be used to characterize the exposures in other circumstances, BCTD stated that the proposed definition suggested that the chemical and physical properties of the material could be determinative in every instance. It also maintained that on construction sites the work processes themselves are more consistently a significant predictor of ambient silica exposures than percentage of silica in the material itself. Finally, BCTD argued that it is very important to focus not only on the overall operation, but also the specific silica dust-generating task.

In including this item in the definition, OSHA did not intend to imply that it would be relevant in all circumstances. Nonetheless, OSHA has removed the phrase "chemical and physical properties" from the final definition of "objective data" because it has concluded that a substance’s chemical and physical properties are not typically relevant for demonstrating exposures to respirable crystalline silica. However, in those instances where a substance’s physical and chemical properties demonstrate employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity, an employer may use that information as objective data under this rule.

The proposed rule also stated that objective data is information demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, operation, or activity. Throughout this rule, OSHA has often replaced the word “operation” with the word “task” (see summary and explanation of Specified Exposure Control Methods for further discussion). OSHA has made the change to "task" (instead of "operation") in this definition to remain consistent with that change. This is also consistent with NIOSH’s recommendation to add specificity to the definition by including the term “task” (Document ID 2177, Attachment B, p. 12).

In addition, the proposal indicated that “objective data” needed to reflect workplace conditions closely resembling the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations. Dow Chemical Company stated that this requirement is generally appropriate, but argued that when data pertain to a more challenging work environment with higher potential for exposure, those data should be considered objective data (Document ID 2270, p. 2). It explained:

> If data from a more challenging environment demonstrate compliance with the Permissible Exposure Limit, then one may infer with confidence that workers in a less challenging environment (i.e., with less potential for exposure) are also not exposed above the PEL. Even if the two work environments are not “closely resembling,” the data are still an objective, valid method of screening workplaces that have a clearly lower risk of exposure (Document ID 2270, p. 2).

OSHA agrees with Dow that data pertaining to an environment with higher exposure potential can be used as objective data for other environments with less potential for exposure. Therefore, OSHA added “or with a higher exposure potential” to the definition.

Edison Electric Institute (EEI) requested that OSHA harmonize the definition of “objective data” throughout its regulations (Document ID 2357, p. 22). OSHA recognizes that the term has evolved over time based on the Agency's experience implementing those standards. "Objective data", as defined in this standard, is based on the record in this rulemaking and reflects an appropriate definition in the context of exposures to respirable crystalline silica. Additionally, OSHA has established a process, the Standards Improvement Project, to improve and streamline OSHA standards, including the revision of individual requirements within rules that are inconsistent. OSHA will consider reviewing the consistency of this definition in the next iteration of this ongoing effort.

Many commenters suggested that OSHA add specificity with regards to what is considered objective data and establish criteria for objective data in the definition (e.g., Document ID 2177, Attachment B, p. 11; 2181, p. 5; 2253, p. 4; 2256, Attachment 2, p. 10; 2339, p. 7; 2371, Attachment 1, p. 12; 2379, Appendix 1, pp. 54-55; 2380, Attachment 2, p. 26; 4223, p. 70). As discussed in the summary and explanation of Exposure Assessment, OSHA intends for the performance option to give employers flexibility to accurately characterize exposures using whatever processes or data are most appropriate for their circumstances. The Agency concludes it would be inconsistent to include specifications or criteria in the definition of objective data and thus has not done so here.

Commenters also provided examples of alternative exposure measurement and characterization strategies that could generate objective data, such as: area sampling (Document ID 2195, pp. 36-37); area exposure profile mapping (Document ID 2379, Appendix 1, pp. 48-49); real-time monitoring (Document ID 2256, Attachment 3, p. 12; 2357, pp. 37-38; 2379, Appendix 1, pp. 48-49, 55-56; 3578, Tr. 941-942; 3579, Tr. 161-162; 3588, Tr. 3798-3800; 4204, p. 56); and geotechnical profiling with testing for crystalline silica content (Document ID 2262, p. 13). Trolex LTD pointed to emerging methods and technologies, such as new optical methods for particle counting and identification, which might provide enhanced measurements of real-time employee exposure to respirable crystalline silica in the future (Document ID 1969, p. 2).

In addition, commenters provided specific examples of types of information and information sources that they felt should be considered objective data. For example, the American Foundry Society (AFS) commented that objective data should include data that permits reliable estimation of exposure, such as: data from real-time monitors and area exposure mapping; data from less than full-shift samples where professional judgment can be used to determine exposure levels; and exposure data where the percent of silica is calculated using a historical average for the area or operation involved (Document ID 2379, Appendix 1, pp. 54-55). The National Association of Manufacturers suggested the following as reliable sources of objective data: published scientific reports in the open scientific literature; NIOSH Health Hazard Evaluations; insurance carriers' loss prevention reports; and information that the silica in a process cannot be released because it is bound in a matrix preventing formation of respirable particles (Document ID 2380, Attachment 2, p. 26). ASSE identified industry-wide data, safety data sheets from product manufacturers, prior historical sampling data under comparable conditions, and aggregated company-wide sampling information as reliable sources of objective data (Document ID 3578, Tr. 1036). Commenters also pointed to data collected by a trade association from its members (e.g., Document ID 2181, pp. 5-6, 7; 2371, Attachment 1, Appendix A; 3544, pp. 12-13; 3583, Tr. 2394; 3585, Tr. 2905-2906; 3588, Tr. 3936-3938; 4197, pp. 1-6; 4198, pp. 1-181; 4223, pp. 68-70).

The Agency, while including specific examples in the definition (i.e., air monitoring data from industry-wide surveys and calculations based on the composition of a substance), does not intend to limit the information that can be considered objective data to the information from those sources. OSHA agrees that data developed with alternative exposure measurement and characterization strategies, both those currently available and those that become available in the future, and the types of information and information sources suggested by commenters can be used as objective data where the conditions of the definition are satisfied. Monitoring data obtained prior to the effective date of the rule can also be considered objective data if it demonstrates employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity and reflects workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operation.

Objective data is further discussed in the summary and explanation of Scope and Application (paragraph (a)(2) for general industry and maritime) and Exposure Assessment (paragraph (d) for general industry and maritime standard and paragraph (d)(2) for the construction standard).

"Physician or other licensed health care professional [PLHCP]" means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required by paragraph (i) of this section (paragraph (h) of the standard for construction). This definition is unchanged from the proposal, and is included because the standard requires that all medical examinations and procedures be performed by or under the supervision of a PLHCP.

OSHA received two comments on the definition of PHLCP, both of which addressed the scope of the PHLCP's qualifications, from APHA and ATS (Document ID 2175, p. 5; 2178, Attachment 1, p. 5). ATS agreed with OSHA's determination of who is qualified to be a PLHCP (Document ID 2175, p. 5). APHA advocated that the PLHCP:

> . . . should be licensed for independent practice. . . and have training and experience in clinical and in population/preventive health, in managing and interpreting group surveillance information, and in the care and management of respiratory illness (Document ID 2178, Attachment 1, p. 5).

APHA commented that:

> . . . different members of the health team may provide different required services through referral or other arrangements, but the designated PLHCP should have responsibility for program oversight and coordination (Document ID 2178, Attachment 1, p. 5).

As discussed further in the summary and explanation of Medical Surveillance, OSHA agrees that different tasks may be performed by various PLHCPs, according to their licenses, but has determined that requiring a license for independent practice and the extra training and responsibilities advocated by APHA are neither necessary nor appropriate for the PLHCP in OSHA standards. Any PLHCP may perform the medical examinations and procedures required under the standard when he or she is licensed, registered, or certified by state law to do so. Who qualifies to be a PLHCP is determined on a state-by-state basis by state licensing bodies. OSHA's broad definition for PLHCP gives the employer the flexibility to retain the services of a variety of qualified licensed health care professionals. Moreover, since the term PHLCP includes more than just physicians, it addresses concerns about the limited availability of medical providers in rural areas (e.g., Document ID 2116, Attachment 1, p. 43; 2365, p. 10).

OSHA has included the same definition for PLHCP in other standards and continues to find that it is appropriate to allow any individual to perform medical examinations and procedures that must be made available under the standard when he or she is appropriately licensed by state law to do so and is therefore operating under his or her legal scope of practice. PLHCP, as defined and used in this standard, is consistent with other recent OSHA standards, such as chromium (VI) (29 CFR 1910.1026), methylene chloride (29 CFR 1910.1052), and respiratory protection (29 CFR 1910.134). OSHA's experience with PLHCPs in these other standards supports the Agency's determination.

"Regulated Area" means an area, demarcated by the employer, where an employee's exposure to airborne concentrations of respirable crystalline silica exceeds, or can reasonably be expected to exceed, the PEL. The definition is unchanged from the proposed standard. This definition is consistent with the use of the term in other OSHA standards, including those for chromium (VI) (29 CFR 1910.1026), 1,3-butadiene (29 CFR 1910.1051), and methylene chloride (29 CFR 1910.1052).

OSHA proposed the inclusion of regulated areas in the standards for both construction and general industry/maritime, but has not included this provision, or the associated definition, in the final standard for construction. Construction industry stakeholders should instead refer to paragraph (g)(1)(iv) for written exposure control plan requirements to describe procedures for restricting access.

Several stakeholders, including the Construction Industry Safety Coalition (CISC) and National Association of Home Builders, requested that OSHA clarify what "reasonably expected" means (e.g., Document ID 2296, p. 25; 2319, p. 89). CISC argued that "[s]uch subjective language is not enforceable and . . . will be fraught with compliance problems . . ." (Document ID 2296, p. 25; 2319, p. 89).

As noted above, the language in the regulated areas definition has been included in a number of previous OSHA standards. Based on OSHA's experience with these standards, OSHA expects that employers will have little difficulty understanding the meaning of the phrase "reasonably be expected to exceed." One reason OSHA chooses to utilize language that has been used in previous standards, where possible, is to avoid the sort of confusion CISC describes. In addition, the basis for establishing regulated areas in general industry and maritime and the reason for omitting this requirement in the construction standard are discussed in further detail in the summary and explanation of Regulated Areas.

"Respirable crystalline silica" means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device designed to meet the characteristics for respirable-particle-size-selective samplers specified in the International Organization for Standardization (ISO) 7708:1995: Air Quality – Particle Size Fraction Definitions for Health-Related Sampling. The definition in the rule is very similar to the proposed definition with one modification. OSHA changed the wording from "means airborne particles that contain quartz, cristobalite, and/or tridymite and whose measurement is determined by a sampling device. . ." to "means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device. . ." to make it clear that only that portion of the particles that is composed of quartz, cristobalite, and/or tridymite is considered to be respirable crystalline silica.

The definition for respirable crystalline silica encompasses the forms of silica (i.e., quartz, cristobalite, and tridymite) covered under current OSHA standards and harmonizes the Agency's practice with current aerosol science and the international consensus that the ISO convention represents. The American Conference of Governmental Industrial Hygienists

(ACGIH) and the European Committee for Standardization (CEN) have adopted the ISO criteria for respirable particulate collection efficiency, and the criteria are sometimes referred to as the ISO/CEN definition. NIOSH has also adopted the ISO definition in its Manual of Sampling and Analytical Methods (Document ID 0903, p. 2). Adoption of this definition by OSHA allows for workplace sampling for respirable crystalline silica exposures to be conducted using any particulate sampling device that conforms to the ISO criteria (i.e., a device that collects dust according to the particle collection efficiency curve specified in the ISO standard). The relationship between the ISO criteria for respirable particulate collection efficiency and the ACGIH criteria is discussed in greater detail in the Sampling and Analysis discussion in Chapter IV of the FEA.

The U.S. Chamber of Commerce (the Chamber), Halliburton, and the National Rural Electric Cooperative Association (NRECA) asserted that OSHA's proposed definition of respirable crystalline silica would encompass non-respirable particles (Document ID 2288, p. 15; 2302, p. 7; 2365, p. 12). NRECA stated:

> . . . the proposed definition would include anything that gets collected onto the sampling media from respirable-particle size-selective samplers. Unfortunately, these samplers are not fool-proof and often much larger sized particles do make their way into the sampling media; that is, they collect total crystalline silica dusts rather than just the respirable portions. This definition will include all total dusts that make their way through the cyclone and into the sampling media, thus suggesting a much larger exposure than is otherwise the case. . . (Document ID 2365, p. 12).

As indicated in the discussion of the feasibility of measuring respirable crystalline silica exposures in Chapter IV of the FEA, there is currently no sampling device that precisely matches the ISO criteria in capturing respirable dust. However, available research indicates that many existing devices can achieve good agreement with the ISO criteria. When operated correctly, the sampling devices do not collect total dusts; they collect only the respirable fraction.

The Chamber and NRECA also argued that OSHA's proposed definition of respirable crystalline silica would include substances other than crystalline silica (Document ID 2288, p. 15; 2365, p. 12; 3578, Tr. 1138). NRECA stated:

> An additional concern with the definition is that it states "any particles that contain quartz, cristobalite, and/or tridymite . . ." It is possible to interpret this portion of the definition to mean that any other mineral/impurities that were able to be collected into the sampling media will be counted/weighed as opposed to just the silica portions . . . (Document ID 2365, p. 12).

In addition, American Industrial Hygiene Association (AIHA) indicated that the proposed definition would include the entirety of a sample of dust containing any miniscule but detectable quantity of quartz, cristobalite or tridymite, and recommended revising the definition (Document ID 2169, pp. 2-3).

OSHA recognizes that the proposed definition could have been misunderstood to encompass components of respirable dust particles other than quartz, cristobalite, and tridymite. This was not the Agency's intent, and, in response to these comments, OSHA has revised the definition to clarify that only the portion of the particles composed of quartz, cristobalite, or tridymite is considered to be included in the definition of respirable crystalline silica.

Ameren Corporation supported OSHA's inclusion of quartz and cristobalite and allowing the use of a sampling device designed to meet the characteristics for respirable particle size-selective samplers specified in ISO 7708:1995 in the definition, but indicated that the definition should be limited to a "percentage of 1% or greater" (Document ID 2315, p. 3). However, it did not provide a rationale for why OSHA should include this in the definition. Including such a limitation in the definition of respirable crystalline silica would have the effect of limiting coverage of the rule to situations where crystalline silica concentrations in a mixture exceed the 1 percent threshold. As discussed in the summary and explanation of Scope and Application, OSHA concludes that it is not appropriate to limit coverage of the rule to situations where concentrations of crystalline silica in a mixture exceed a 1 percent threshold.

The Society for Protective Coatings (SSPC) and the National Automobile Dealers Association recommended that OSHA distinguish between amorphous silica and crystalline silica in the definition (Document ID 2120, p. 2; 2358, p. 5). SSPC also provided a link to a webpage (http://www.crystallinesilica.eu/content/what-respirable-crystalline-silica-rcs) to guide the Agency on revising the definition. OSHA finds that the term "crystalline" is sufficiently descriptive and does not merit further explanation in the definition. However, the Agency affirms here that fused quartz and other forms of amorphous silica are not considered crystalline silica under the rule.

The SEFA Group (formerly the Southeastern Fly Ash Company) suggested adding a definition for "free respirable crystalline silica" to describe crystalline silica as an independent structure with varying surface chemistry, as distinguished from crystalline silica that is incorporated into a larger matrix of the parent mineral (Document ID 2123, p. 2). OSHA has revised the definition to clarify that respirable crystalline silica includes only the crystalline silica contained in airborne particles, i.e., the component in dust that is crystalline silica and not some other mineral. The Agency does not agree that defining the term "free respirable crystalline silica" will alter the meaning or enhance the clarity of the rule, and has not added this term.

"Specialist" means an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine. The term is used in paragraph (i) of the standard for general industry and maritime, (paragraph (h) of the standard for construction), which sets forth requirements for medical surveillance. For example, paragraph (i)(7)(i) of the standard for general industry and maritime, (paragraph (h)(7)(i) of the standard for construction) requires that the employer make available a medical examination when specialist referral is indicated in the PLHCP's written medical opinion for the employer.

The proposed rule did not include this term in the Definitions paragraph because it only allowed referral to an American Board Certified Specialist in Pulmonary disease, which was clearly addressed in the Medical Surveillance paragraph of the rule. However, several commenters recommended that OSHA expand the types of specialists to whom employees could be referred. For example, Dow Chemical requested that OSHA not require the pulmonary specialist to be board certified to expand availability of specialists and noted that several OSHA standards, such as benzene and 1,3-butadiene, do not require the specialist to be board certified (Document ID 2270, pp. 5-8). The Glass Association of America, Asphalt Roofing Manufacturers Association, North American Insulation Manufacturers Association, ATS, and BCTD requested that OSHA also allow referral to an occupational medicine specialist, with many of them specifying a board certified occupational medicine specialist (Document ID 2215, p. 9; 2291, p. 26; 2348, Attachment 1, p. 40; 3577, Tr. 778; 4223, p. 129).

OSHA is retaining the requirement for board certification to ensure a high level of competency. However, OSHA is persuaded by comments and testimony that individuals who are either American Board Certified in Occupational Medicine or American Board Certified in Pulmonary Disease are recognized specialists qualified to examine patients referred for possible respirable crystalline silica-related diseases. OSHA concludes that both pulmonary disease and occupational medicine specialists are qualified to counsel employees regarding work practices and personal habits that could affect their respiratory health, consistent with recommendations in Section 4.7.2 in ASTM standards E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica and E 2626 – 09, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities (Document ID 1466, p. 5; 1504, p. 5). OSHA therefore added the definition to allow referrals to providers who are American Board certified in pulmonary disease or occupational medicine. The addition of the term to definitions also allows OSHA to simply refer to "specialist" when referring to American Board certified pulmonary disease and occupational medicine specialists in the medical surveillance paragraph of the rule.

"Assistant Secretary," "Director," and "This section" are also defined terms. The definitions are consistent with OSHA's previous use of these terms in other health standards and have not changed since the proposal, which elicited no comments.

Finally, stakeholders suggested that OSHA define a number of new terms, including: "affected employee" (American Iron and Steel Institute (AISI) (Document ID 2261, p. 4)), "aged silica" (the Sorptive Minerals Institute (Document ID 3587, Tr. 3698-3699)), "asphalt milling" (IUOE (Document ID 2262, pp. 23-24)), "chest radiograph" (NIOSH (Document ID 2177, Comment B, pp. 40-41)), "controlling employer" (BAC and BCTD (Document ID 2329, p. 7; 2371, pp. 38-40)), "each employee" or "each affected employee" (AISI (Document ID 3492, p. 3)), "earth moving" (IUOE (Document ID 2262, pp. 6-9, 15)), "earth moving equipment" (IUOE (Document ID 3583, Tr. 2356-2360; 2262, pp. 6-9, 15)), "estimating respirable dust, excessive" (Industrial Hygiene Specialty Resources (Document ID 2285, p. 7)), "gross contamination" or "grossly contaminated" (ORCHSE, AFS, and NAHB (Document ID 2277, p. 4; 3584, Tr. 2669-2671; 3487, pp. 21-22; 2296, p. 29; 2379, Attachment B, p. 32)), "grossly" (Tile Council of

North America (Document ID 2363, p. 6)), “intermittent work” (EEI (Document ID 2357, p. 14)), “respirable dust” (AFS (Document ID 2379, Attachment B, pp. 16, 28)), “safety and health professional technician” (Dr. Bird of the Chamber (Document ID 3578, Tr. 1176-1177)), “short duration” (EEI (Document ID 2357, p. 14)), and “silica exposure” (AIHA (Document ID 2169, p. 5)).

OSHA has concluded that these terms do not need to be defined in the rule. Many of the terms were part of the proposal or were included in stakeholder’s comments on the proposal, but do not appear in the rule. For example, the proposed rule contained a provision related to protective work clothing in regulated areas that would have been triggered where there is potential for employees’ work clothing to become grossly contaminated with finely divided material containing crystalline silica. As discussed in summary and explanation of Regulated Areas, OSHA has not included a requirement for employers to provide protective work clothing or other means of removing silica dust from clothing in the rule, and the rule does not otherwise use the terms “grossly,” “gross contamination,” or “grossly contaminated.” Therefore, there is no reason to define these terms.

OSHA concludes that many of the other terms that stakeholders asked the Agency to define are sufficiently explained in the preamble or their meanings are clear. For example, OSHA explains the term “affected employee” in the summary and explanation of Exposure Assessment. Because the term only appears in paragraphs (d)(6) and (7) of the standard for general industry and maritime (paragraphs (d)(2)(vi) and (vii) for construction) and is thoroughly explained in the summary and explanation, OSHA concludes that it need not be defined in this section.

Specified Exposure Control Methods. OSHA's standard requires employers engaged in construction to control their employees' exposure to respirable crystalline silica. Paragraph (c) of the standard for construction describes the specified exposure control methods approach. This approach includes "Table 1: Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica," a table identifying common construction tasks known to generate high exposures to respirable crystalline silica and specifying appropriate and effective engineering controls, work practices, and respiratory protection for each identified task. For each employee engaged in a task identified on Table 1, the employer is required to fully and properly implement the engineering controls, work practices, and respiratory protection specified for the task on Table 1, unless the employer assesses and limits the exposure of the employee to respirable crystalline silica in accordance with paragraph (d) of the standard for construction. If the employer fully and properly implements the engineering controls, work practices, and respiratory protection specified for each employee engaged in a task identified on Table 1, the employer is not required to conduct exposure assessments or otherwise comply with a PEL for those employees. If the employer does not follow Table 1 for employees engaged in identified tasks or if the respirable crystalline silica-generating task is not identified on Table 1, the employer must assess and limit the exposure of employees in accordance with paragraph (d) of the standard for construction. Paragraph (d) of the standard for construction imposes requirements similar to OSHA's traditional approach of requiring employers to demonstrate compliance with a PEL through required exposure assessments and controlling employee exposures through the use of feasible engineering controls and work practices (i.e., the hierarchy of controls) (see the summary and explanation of Alternative Exposure Control Methods for further discussion of this approach).

The concept for the specified exposure control methods approach was included in the proposed rule. OSHA also included a version of Table 1 in the proposed rule for construction employers, identifying specific engineering controls, work practices, and respiratory protection for common construction tasks that employers could use to meet the requirement to implement engineering and work practice controls. Employers fully implementing the engineering controls, work practices, and respiratory protection on Table 1 would not have been required to conduct exposure assessments for employees performing a listed task, but would have been required to comply with the 50 μg/m^3 PEL for those employees. For tasks where respirator use was to be required, employees were presumed to be exposed above the PEL, and thus the proposed standard would have required the employer to comply with all provisions that would be triggered by exposure above the PEL (e.g., regulated areas, medical surveillance), except for exposure monitoring.

Prior to the NPRM, OSHA included this alternative compliance approach in the Preliminary Initial Regulatory Flexibility Analysis (PIRFA) provided to small business representatives during the Small Business Regulatory Enforcement Fairness Act (SBREFA) process (Document ID 0938, pp. 16-17). Participants in the SBREFA process generally supported the approach and their comments further informed the Agency in developing the proposed rule (Document ID 0937, pp. 37-39). An alternative compliance approach similar to that developed by OSHA for the SBREFA process was also included in ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities, a consensus standard issued in May 2009 developed by a committee consisting of both labor and industry representatives for crystalline silica exposures in construction (Document ID 1504). Following this, on December 10, 2009, the Advisory

Committee on Construction Safety and Health (ACCSH) recommended that OSHA include the specified exposure control methods approach in its proposed rule (Document ID 1500, p. 13).

The approach of specifying a list of tasks with a corresponding list of controls to simplify compliance in the construction industry received wide support from representatives in government, including the National Institute for Occupational Safety and Health (NIOSH); professional organizations, including the American Industrial Hygiene Association (AIHA) and the American Society of Safety Engineers (ASSE); labor, including the International Union of Operating Engineers (IUOE), the Building and Construction Trades Department of the AFL-CIO (BCTD), the Laborers' Health and Safety Fund of North America (LHSFNA), and the International Union of Bricklayers and Allied Craftworkers (BAC); and industry groups, including the Associated General Contractors of New York State, the Edison Electric Institute (EEI), and the National Asphalt Pavement Association (NAPA) (e.g., Document ID 2177, Attachment B, p. 23; 3578, Tr. 1028; 2339, p. 8; 3583, Tr. 2337-2338; 2371, Attachment 1, p. 22-23; 3589, Tr. 4192-4193; 2329, pp. 5-6; 2145, pp. 4-5; 3583, Tr. 2171; 2357, p. 26). Walter Jones, an industrial hygienist representing LHSFNA, testified that the approach "not only makes compliance . . . easier to determine, enforce, and teach, it also assures acceptable levels of healthfulness" (Document ID 3589, Tr. 4193).

Industry trade associations, such as the Construction Industry Safety Coalition (CISC), Leading Builders of America (LBA), the Mechanical Contractors Association of America, and individual construction employers, including Atlantic Concrete Cutting, Inc. and Holes Incorporated, generally supported the overall approach while being critical of the specifics of Table 1 (e.g., Document ID 4217, p. 20; 2367, p. 2; 2338, p. 3; 2269, pp. 21-22; 2143, pp. 2-3).

CISC stated that its group of employers “continues to be appreciative of OSHA’s efforts to try to make a simple compliance option . . . for construction employers” (Document ID 4217, p. 20).

One commenter, Francisco Trujillo, safety director for Miller and Long, Inc., suggested that the specified exposure control methods approach to compliance in the construction industry is not a substitute for safety professionals and industrial hygienists conducting exposure assessments and selecting the appropriate engineering controls, work practices, and respiratory protection for each task based on the results. He commented that “[t]he implication that if Table 1 is followed everything will be fine is unrealistic. . .” and recommended that Table 1 be at most non-mandatory guidance (Document ID 2345, p. 4).

OSHA agrees that safety professionals and industrial hygienists play a key role in ensuring the safety of employees exposed to silica during certain activities, including those not listed on Table 1, and can also help ensure that the engineering controls, work practices, and respiratory protection specified on Table 1 are fully and properly implemented. However, as discussed below, the Agency is not persuaded that construction employees will always be better protected by the traditional performance approach of establishing a PEL and requiring periodic exposure assessments, particularly when the tasks and tools that cause high exposures to respirable crystalline silica, and the dust control technologies available to address such exposures, can be readily identified.

Although there was general agreement among commenters that an alternative approach was needed to simplify compliance for the construction industry, commenters provided various opinions on how such an alternative compliance approach should be structured to ensure that it was workable in practice. Several commenters, including BCTD, LHSFNA, EEI, LBA, Fann Contracting, Inc., CISC, ASSE, the National Association of Home Builders (NAHB), the

Associated Builders and Contractors (ABC), and Holes Incorporated, urged OSHA to exempt employers complying with Table 1 from also complying with the PEL (e.g., Document ID 2371, Attachment 1, p. 26; 4223, p. 92-94; 4207, p. 3; 2357, p. 26; 2269, pp. 21-22; 2116, Attachment 1, p. 29; 2319, pp. 123-124; 2339, pp. 8-9; 2296, p. 41; 2289, p. 7; 3580, Tr. 1364). Holes Incorporated and ABC suggested that employers would not use an approach that required compliance with both the PEL and specified engineering controls (Document ID 3580, Tr. 1364; 2289, p. 7). The National Utility Contractors Association (NUCA) argued that not linking the actions on Table 1 directly to compliance with the regulation was confusing and would make it difficult for contactors to be certain they are in compliance (Document ID 2171, p. 2). ASSE suggested that Table 1 should constitute compliance with the PEL because the listed controls "can be viewed as akin to implementing all technologically feasible controls" (Document ID 2339, pp. 8-9). BCTD commented that the focus of OSHA's enforcement efforts should be on ensuring that employers have fully and properly implemented the controls listed on Table 1 (Document ID 2371, Attachment 1, p. 26).

Similarly, commenters from both industry and labor, including the American Federation of State, County, and Municipal Employees, Mechanical Contractors Association of America, the American Federation of Labor and Congress of Industrial Organizations, BAC, BCTD, and LHSFNA, also argued that exposure assessments should not be required where employers implement control measures specified on Table 1 for construction tasks (e.g., Document ID 2106, p. 3; 2143, pp. 2-3; 2256, Attachment 2, p. 10; 2329, pp. 5-6; 2371, Attachment 1, pp. 6-7; 4207, p. 2). LHSFNA stated that:

> . . . air monitoring is less practical in construction, where the jobsite and work is constantly changing, than in general industry where work exposures are more stable. In construction, air monitoring results often come back from the lab after the task has ended and thus are of little value . . . (Document ID 2253, p. 2).

On the other hand, other commenters, including NIOSH, argued that fully implementing the controls described on Table 1 would not automatically provide a sufficient level of confidence that exposures are adequately controlled; employers would also need to ensure that the exposures of employees performing Table 1 tasks would not exceed the revised PEL (e.g., Document ID 2177, Attachment B, p. 17). Mr. Trujillo's comment emphasizing the role of safety professionals and recommending that Table 1 be at most non-mandatory guidance was to the same effect (Document ID 2345, p. 4).

Several commenters, including Fann Contracting, IUOE, LBA, CISC, Charles Gordon, a retired occupational safety and health attorney, Arch Masonry, Inc., and NUCA argued that as proposed, the alternative compliance option would not necessarily simplify compliance for some employers, as they would still need to do exposure assessments for a variety of reasons, such as monitoring employees working in the vicinity of Table 1 tasks, complying with the PEL, providing monitoring data to controlling employers on multi-employer worksites, and complying with the rule for tasks that are not listed on Table 1 (Document ID 2116, Attachment 1, p. 3; 2262, pp. 44-45; 2269, pp. 21-22; 2319, p. 6; 3538, p. 16; 3580, Tr. 1473-1474; 3587, Tr. 3677-3679; 3583, Tr. 2243).

Other commenters supported the inclusion of exposure assessment requirements for employees performing tasks on Table 1 even where employers implement the specified engineering controls, work practices, and respiratory protection to best protect employees in the construction industry. The Center for Progressive Reform commented that:

> [t]he same principles that weigh in favor of a requirement to monitor silica exposure in other industries holds for the construction industry—monitoring gives workers, employers, OSHA, and researchers valuable information that can be used to reduce workplace hazards (Document ID 2351, p. 11).

The International Safety Equipment Association (ISEA) opined that the most protective approach for employees is for employers to take air samples of respirable crystalline silica (Document ID 2212, p. 1). AIHA argued that there remained a need for exposure monitoring to verify that the controls in place for Table 1 tasks actually reduce exposures (Document ID 2169, p. 3). NIOSH recommended periodic exposure monitoring requirements for these tasks to provide a sufficient level of confidence that exposures are adequately controlled and that the employers' selection of equipment, maintenance practices, and employee training were effective (Document ID 2177, Attachment B, pp. 17, 26). Charles Gordon proposed that when performing a Table 1 task, employers should be required to semi-annually monitor each task and keep records of that monitoring to ensure that workers are not exposed to high levels of respirable crystalline silica (Document ID 3539; 3588, Tr. 3801).

After reviewing the comments on this issue, OSHA concludes that the best approach for protecting employees exposed to respirable crystalline silica in the construction industry is to provide a set of effective, easy to understand, and readily implemented controls for the common equipment and tasks that are the predominant sources of exposure to respirable crystalline silica. OSHA is persuaded by comments and data in the record that requiring specific engineering controls, work practices, and respiratory protection for construction tasks, in lieu of a performance-oriented approach involving a PEL and exposure assessment, is justified for several reasons so long as employers fully and properly implement the engineering controls, work practices, and respiratory protection specified on Table 1.

First, the controls listed on Table 1 represent the feasible controls identified in the record for each listed task, and there is substantial evidence that demonstrates that, for most of the Table 1 tasks, exposure to respirable crystalline silica can be consistently controlled below 50 $\mu g/m^3$

using those controls (see Chapter IV of the Final Economic and Regulatory Flexibility Analysis (FEA)). As such, Table 1 provides a less burdensome means of achieving protection at least equivalent to that provided by the alternative exposure control methods that include the 50 μg/m^3 PEL, which OSHA has determined to be the lowest feasible exposure level that could be achieved most of the time for most of the tasks listed on Table 1. For example, as discussed in Section 5.7 of Chapter IV of the FEA, exposure data demonstrates that the engineering controls and work practices specified on Table 1 for stationary masonry saws (wet cutting) significantly reduce employees' exposures to respirable crystalline silica from a mean of 329 μg/m^3, when cutting masonry dry, to a mean of 41 μg/m^3. Additionally, the record developed during the rulemaking process has contributed greatly to the Agency's understanding of the effectiveness of the prescribed controls. Based on the record, OSHA is confident that exposures will be adequately controlled using the specified methods supplemented with appropriate respiratory protection for those few tasks that are very difficult to control using engineering controls and work practices alone.

Second, this approach recognizes and avoids the challenges of characterizing employee exposures to crystalline silica accurately in many construction tasks while also ensuring that employees are protected. In manufacturing settings and other more stable environments subject to the general industry standard, exposure assessment can provide an accurate depiction of the silica exposure that could be typically expected for employees in normal operating conditions. In general, such assessments need not be repeated frequently, costs are therefore minimized, and the results will be timely even if there is a delay for lab processing. In contrast, the frequent changes in workplace conditions that are common in construction work (e.g., environment, location), along with potential time-lags in the exposure assessment process, provide a compelling argument for the specified exposure control methods approach that emphasizes clear and timely guidance capable of protecting the employees during their shifts instead of relying on a minimum exposure assessment requirement to characterize employee exposures.

Third, requiring employers to implement specified dust controls absent an additional PEL requirement simplifies compliance for employers who fully and properly implement the engineering controls, work practices, and respiratory protection listed on Table 1. Simplifying compliance will also encourage employers performing tasks listed on Table 1 to use this approach, rather than the alternative of performing exposure assessments and implementing dust controls, as required by paragraph (d) of the standard for construction, and thus, will also reduce regulatory burden on construction employers of all sizes. For this reason, OSHA expects that the vast majority of construction employers will choose to follow Table 1 for all Table 1 tasks.

Fourth, this approach will also create greater awareness of appropriate controls, which may in turn facilitate better implementation and compliance, by making it far easier for employees to understand what controls are effective for a given task and what controls the employer must provide. Employees can locate the task they are performing on Table 1 and immediately see what controls are required, along with any specifications for those controls. It will, further, be clear if an employer is not providing the correct controls or ensuring that they are being used appropriately.

<u>“Fully and properly” implementing the specified exposure control methods</u>. In order for employers to comply with paragraph (c) of the standard for construction, they must “fully and properly” implement the engineering controls, work practices, and respiratory protection for each employee engaged in a task identified on Table 1. While several commenters, including BAC and BCTD, supported this requirement (<u>e.g.</u>, Document ID 2329, p. 6; 2371, Attachment 1, p.

24), BCTD also urged OSHA to clarify the meaning of “fully and properly” implementing the specified engineering controls and work practices on Table 1 to ensure that employers know what is required of them and how the standard will be enforced (Document ID 4223, p. 92; 2371, Attachment 1, p. 27-29).

Other commenters provided suggestions for what they believed should be considered “fully and properly implementing” the controls specified on Table 1. NIOSH recommended that OSHA provide checklists and require a daily evaluation of engineering controls to determine if the controls are performing as designed and to ensure that employees using the controls are trained and have the appropriate materials to operate the controls properly (Document ID 2177, Attachment B, pp. 21-22). IUOE recommended that regular inspections of engineering controls in enclosed cabs should be required (Document ID 2262, p. 29). Anthony Bodway, Special Projects Manager at Payne & Dolan, Inc., representing NAPA, testified that his paving company uses a daily maintenance checklist to ensure that the controls are functioning properly and meeting the standards set by the equipment manufacturers (Document ID 3583, Tr. 2194-2197). AIHA suggested that OSHA require employers to follow the manufacturer’s user instructions for installation, use, and maintenance of engineering controls, unless there is a written variance from the manufacturer (Document ID 2169, p. 5). Charles Gordon argued that OSHA should require a competent person to evaluate the use of the controls specified on Table 1 initially and periodically in order to ensure that they are fully and properly implemented (Document ID 4236, p. 4). In general disagreement with these comments, the National Stone, Sand, and Gravel Association (NSSGA) argued that, while employers should conduct routine maintenance of the controls, OSHA should not require an employer to complete an evaluation or inspection checklist of controls or work practices at a certain frequency (Document ID 2327, Attachment 1, p. 21).

Although the specified exposure control methods approach affords compliance flexibility for the employer, OSHA sees value in reminding employers and employees that this option will only be protective if they take steps to ensure that the engineering controls, work practices, and respiratory protection are as effective as possible. Thus, the Agency is requiring employers to fully and properly implement the specified engineering controls, work practices, and respiratory protection for each employee performing a task described on Table 1 in order to be in compliance with paragraph (c)(1) of the standard for construction. To do otherwise would undermine the entire basis for this compliance approach.

Merely having the specified controls present is not sufficient to constitute “fully and properly” implementing those controls. Employees will not be protected from exposure to respirable crystalline silica if the specified engineering controls, work practices, and respiratory protection are not also implemented effectively. In order to be in compliance with paragraph (c)(1) of the standard for construction, employers are required to ensure that the controls are present and maintained and that employees understand the proper use of those controls and use them accordingly.

While OSHA has decided not to further define “fully and properly” by providing specific checklists for employers or requiring employers to conduct inspections at set intervals, there are several readily identifiable indicators that dust controls are or are not being fully and properly implemented, many of which are discussed with regard to specific equipment and tasks in Chapter IV of the FEA and in the discussions of specific controls that appear further below in the section. For example, for dust collection systems, the shroud or cowling must be intact and installed in accordance with the manufacturer’s instructions; the hose connecting the tool to the vacuum must be intact and without kinks or tight bends that would prevent the vacuum from providing the air flow recommended by the tool manufacturer; the filter(s) on the vacuum must be cleaned or changed as frequently as necessary in order to ensure they remain effective (it may be necessary to activate a back-pulse filter cleaning mechanism several times during the course of a shift); and dust collection bags must be emptied as frequently as necessary to avoid overfilling, which would inhibit the vacuum system from operating effectively. For water-based dust suppression systems, an adequate supply of water for dust suppression must be available on site. For worksites without access to a water main, a portable water tank or water truck having enough water for the task must be provided. The spray nozzles must be working properly to produce a spray pattern that applies water at the point of dust generation and inspected at regular intervals to ensure they are not clogged or damaged. All hoses and connections must be inspected as necessary for leaks that could signal that an inadequate flow rate is being delivered.

Manufacturer's instructions can also provide information about how to fully and properly implement and maintain controls. For example, the operator's instruction manual for EDCO concrete/asphalt saws provides a pre-start checklist that includes information about the proper functioning of wet-cutting equipment (Document ID 1676, p. 5). In some cases, industry associations and employers, in collaboration with equipment manufacturers, have also developed best practices with regard to the full and proper implementation of engineering controls, work practices, and respiratory protection for their particular industry or operation. For example, NAPA and the Association of Equipment Manufacturers (AEM) provided operational guidance for water systems during milling operations that includes pre-operation inspection activities, preparations for safe operation, and other operation considerations (Document ID 2181, p. 52).

In addition, paragraph (g) of the standard for construction requires employers to establish and implement a written exposure control plan, which includes provisions for a competent person to make frequent and regular inspection of job sites, materials, and equipment in order to implement the plan (see the summary and explanation of Written Exposure Control Plan for discussion about this requirement). Thus, the requirement for a written exposure control plan and the competent person, which was added to the final standard for construction, provides additional safeguards for ensuring that employers fully and properly implement Table 1.

OSHA expects that in most instances it will be straightforward for a designated competent person to identify whether the controls have been fully and properly implemented. For example, a significant amount of visible dust being frequently or continuously emitted from the material being worked on can serve as an indication that controls are not fully and properly implemented. A small amount of dust can be expected even with new equipment that is operating as intended by the manufacturer. The amount of visible dust associated with the new dust controls should be noted when equipment is put into service and checked periodically. A noticeable increase in dust emissions would indicate that the dust control system is not operating as intended.

Employees engaged in Table 1 tasks. Commenters expressed concerns about the lack of requirements in the proposed rule to protect employees assisting with Table 1 tasks or working in the vicinity of others engaged in Table 1 tasks (e.g., Document ID 2116, Attachment 1, pp. 2-3). In response, OSHA has clarified the language in paragraph (c)(1) of the standard for construction to encompass all employees "engaged in a task identified on Table 1." This phrasing is intended to include not only the equipment operator, but also laborers and other employees who are assisting with the task or have some responsibility for the completion of the task, even if they are not directly operating the equipment. For example, where an employee is assisting another employee operating a walk-behind saw indoors by guiding the saw and making sure that the cutting is precise, that employee would be considered to be engaged in the task and would need to wear a respirator. Similarly, employees assisting a jackhammer task would be considered to be engaged in the task and would also be required to wear a respirator if they engaged in the task outdoors for more than four hours in a work shift.

It is not OSHA's intent, however, for all employees who are in the vicinity of a listed task to be considered "engaged in the task." To protect the other employees in the vicinity of a listed task, the employer must account for the potential exposures of these employees to respirable crystalline silica as part of its written exposure control plan. As discussed in the summary and explanation of Written Exposure Control Plan, paragraph (g)(1)(iv) of the standard for construction requires a description of the procedures used to restrict access to work areas, when necessary, to limit the number of employees exposed and their exposure levels. Employers must develop procedures to restrict or limit access when employees in the vicinity of silica-generating tasks are exposed to excessive respirable crystalline silica levels. Such a situation might occur in a variety of circumstances, including when an employee who is not engaged in the task, but is working in the vicinity of another employee performing a Table 1 task requiring respiratory protection, is exposed to clearly visible dust emissions (e.g., an employee directing traffic around another employee jackhammering for more than four hours in a shift). In that case, the competent person, as required under paragraph (g)(4) of the standard for construction, would assess the situation in accordance with the employer's procedures to determine if it presents a recognized hazard, and if it does, take immediate and effective steps to protect employees by implementing the procedures described in the written exposure control plan. For the above example, this could include positioning the employee directing traffic at a safe distance upwind from the dust-generating activity.

Table 1. As discussed above, paragraph (c)(1) of the standard for construction includes "Table 1: Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica," which identifies 18 common construction equipment/tasks known to generate high exposures to respirable crystalline silica. For each equipment/task identified, Table 1 specifies appropriate and effective engineering and work practice control methods. Some entries contain multiple engineering controls and work practices. In those instances, OSHA has determined that the specified combination of engineering controls and work practices is necessary for reducing exposures and requires employers to implement all of the listed engineering controls and work practices in order to be in compliance. Some entries contain multiple compliance options denoted with an "OR" (e.g., (c)(1)(ix), (c)(1)(x), (c)(1)(xii), (c)(1)(xiii), (c)(1)(xv), and (c)(1)(xviii) of the standard for construction). For those entries, OSHA has determined that more than one control strategy could effectively reduce exposures and permits the employer to decide which option could be best implemented on the worksite. Table 1 also specifies respiratory protection for those entries where OSHA has determined from its analysis of technological feasibility it is needed to ensure employees are protected from exposures to respirable crystalline silica. These respirator requirements are divided by task duration (i.e., "less than or equal to four-hours-per-shift" and "greater than four-hours-per-shift").

Table 1 in the final standard differs from Table 1 in the proposed standard in a number of respects. As proposed, "Table 1—Exposure Control Methods for Selected Construction Operations," listed 13 construction operations that expose employees to respirable crystalline silica, as well as control strategies and respiratory protection that reduce those exposures. In developing Table 1 for the proposed standard, OSHA reviewed the industrial hygiene literature across the full range of construction activities and focused on tasks where silica-containing materials were most likely to be fractured or abraded and where control measures existed to offer protection against a variety of working conditions. OSHA also included additional specifications on proposed Table 1 to ensure that the strategies listed were properly implemented and remained effective.

Table 1 was the subject of many comments in the rulemaking record. Commenters, such as BCTD, urged OSHA to reconsider its use of the proposed term “operation” to describe the activities listed on Table 1 (Document ID 2371, Attachment 1, p. 23). Kellie Vazquez, on behalf of Holes Incorporated and CISC, suggested that it would be helpful to include more specifically-defined tasks, rather than broader operations (Document ID 2320, pp. 8-9). In the same vein, BCTD suggested that OSHA “revise [Table 1] to make clear that its focus is on particular silica dust-generating *tasks,* not more broadly-defined *operations*” as “there is an important distinction between specific tasks that may generate silica dust and the employer’s overall operation, which may include different silica dust-generating tasks, requiring different controls” (Document ID 2371, Attachment 1, p. 23). BCTD also recommended that, to avoid confusion, Table 1 should specify that each task is being performed on or with a material that contains silica (Document ID 2371, Attachment 1, p. 24). Responding to both suggestions, OSHA has changed the terminology used in Table 1 from “Operation” to “Equipment/Task” to clarify that the controls apply to silica-generating activities done by employees and silica exposure generated by equipment, and has revised the title of Table 1 accordingly to "Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica."

Other commenters requested that OSHA include additional activities on Table 1. The Sheet Metal Air Conditioning Contractors National Association (SMACNA) commented that using powder-actuated tools should be added (Document ID 2226, p. 2), and the Interlocking Concrete Pavement Institute (ICPI) suggested that OSHA include compacting pavers, sweeping sand into paver joints, and compacting the aggregate base (Document ID 2246, pp. 2, 11). NAHB noted that Table 1 failed to cover hand-mixing concrete (Document ID 2334, p. 4). OSHA did not receive data showing that employees engaged in many of these additional minor tasks (pulling concrete forms, mixing concrete for post holes, etc.) experience significant routine exposure to respirable crystalline silica above the action level that would require their employers to comply with provisions of this rule. Because OSHA does not currently have data indicating that additional controls for these tasks would be needed on a regular basis or would be effective, it has determined not to include them on Table 1.

OSHA recognizes the possibility that employers may later discover that there are tasks that are not covered by Table 1 where they may have difficulty meeting the PEL. If such cases arise, OSHA can address them in several ways, including: considering technological or economic infeasibility defenses, and applying its variance process – either temporary or permanent, pursuant to which an employer can apply to exclude an industry or process from enforcement of the standard based principally on a showing that it is providing equivalent protection for its workers.

Several commenters requested that OSHA add tasks or activities and equipment to Table 1 that are associated with general industry operations such as asphalt plant operations, shale gas fracturing, and artificial stone and granite countertop work (Document ID 2212, p. 2; 2116, Attachment 1, p. 28; 2244, p. 4). OSHA is not including these in the construction standard for the reasons discussed in the summary and explanation of Scope.

NUCA requested that OSHA add underground construction, specifically excavation, onto Table 1, stating:

> The nature of excavation underground construction is continuously mobile. Exposure assessments take time to evaluate by a lab, and in that time, the jobsite conditions will change or crews will move to other sites. Test results simply could not be available in enough time to be relevant to a particular jobsite. This not only makes costly lab assessments irrelevant to particular sites, it also does nothing to protect the workers on those sites (Document ID 2171, p. 2).

OSHA's technological feasibility analysis for underground operations (Section 5.12 of Chapter IV of the FEA) indicates that employees performing activities not specific to tunneling, such as grinding, hole drilling, or chipping, receive similar exposures from their equipment as employees performing those same activities aboveground in enclosed environments (e.g., indoors). As a result, employers can comply with the dust control requirements of the standard by fully and properly implementing the dust controls specified on Table 1 of the final standard for construction for those tasks. However, as explained in the technological feasibility analysis cited above, OSHA determined that it was not possible to develop a clear control specification that would prove effective for most situations where tunnel boring machines, road headers, and similar kinds of equipment are used. Effective dust control for operations that use these kinds of equipment consists of a combination of water sprays at the tunnel face and along the conveyors that remove material from the face, general dilution ventilation through the tunnel, local exhaust ventilation for excavating equipment and conveyor transfer points, and enclosed cabs for the operators. Dust control may also require enclosures for conveyors and belt cleaning mechanisms. Designing effective and efficient dust control systems must take into account specific factors of the tunnel project and equipment being used, and are analogous to dust control strategies used in underground mines, as described in NIOSH's Handbook for Dust Control in Mining (Document ID 0887). Given the degree of complexity and project-specific considerations that should be taken into account, OSHA determined that it was not possible to devise an effective specification applicable to all tunnel projects and thus has not added an entry for tunnel boring in underground construction to Table 1.

Likewise, although abrasive blasting is a common source of silica exposure in construction, OSHA does not include an entry for abrasive blasting on Table 1 for reasons explained more fully below. As described in the Introduction to Chapter IV of the FEA, the tasks included on Table 1 of the final rule are those that have been widely recognized as high-exposure tasks in construction, and for which there has been considerable research performed on the effectiveness of dust control strategies. The record indicates that the tasks reflected in Table 1, with few exceptions such as underground construction and abrasive blasting, are the tasks that employers will most frequently need to address to ensure employee protection from crystalline silica hazards. For tasks not included on Table 1 that foreseeably generate silica exposures above the action level, construction employers will, in accordance with paragraph (d) of the standard for construction, need to conduct an exposure assessment and maintain exposures at or below the PEL through use of the traditional hierarchy of controls.

Commenters also weighed in on OSHA's general approach to selecting the engineering controls and work practices for each task. LBA argued that there was a disconnect between the feasibility evidence and the controls and work practices included on Table 1 (Document ID 2269, p. 17). NAHB urged OSHA to ensure that the protection methods included on Table 1 are based on verifiable studies that show effective solutions (Document ID 2296, p. 28). BCTD also opined that only "control measures supported by good quality evidence should be listed on Table 1" (Document ID 2371, Attachment 1, p. 24).

OSHA agrees that the engineering controls, work practices, and respiratory protection specified on Table 1 need to be consistent with the evidence presented in its technological feasibility analyses (see Chapter IV of the FEA). To that end, OSHA has based the specifications on Table 1 on extensive exposure data collected from a variety of sources including NIOSH reports, data submitted to the record, OSHA's compliance case files, and published literature.

Requirements for water delivery systems and dust collection systems. OSHA is requiring the use of an integrated water delivery system supplied by the equipment manufacturer for several types of equipment listed on Table 1: stationary masonry saws; handheld power saws (any blade diameter); walk-behind saws; drivable saws; rig-mounted core saws or drills; handheld grinders for uses other than mortar removal; and walk-behind milling machines and floor grinders. OSHA is requiring the use of systems that are developed in conjunction with the tool because they are more likely to control dust emissions effectively by applying water at the appropriate dust emission points based on tool configuration and not interfere with other tool components or safety devices.

CISC commented that the requirement for an integrated water system limited options for employers and may reduce the use of the table, stating ". . . if a construction employer finds a way to effectively deliver water through another mechanism, in the CISC's view that should be encouraged" (Document ID 2319, p. 103; 2320, p. 16). OSHA expects that most employers will use integrated water systems, as provided by manufacturers, and will follow Table 1 but its intent is not to prohibit the use of other dust suppression methods during cutting. Employers may implement other controls or wet method configurations if they determine that the alternative control is more appropriate for their intended use. However, employers who choose to use controls not listed on Table 1 will be required to conduct exposure assessments and comply with the PEL in accordance with paragraph (d) of the standard for construction.

CISC also questioned the appropriateness of requiring an integrated water delivery system when most integrated systems are intended to keep the blade cool and are not designed for dust suppression (Document ID 2319, p. 103; 2320, p. 16). In written testimony, Rashod Johnson of the Mason Contractors Association of America stated that

> the vast majority of masonry saws provide water on the blade itself. This is solely for the purpose of keeping the blade cool during cutting. A side effect, just happens to be dust suppression. Now, manufacturers of these saws are starting to explicitly state that the water used is for cooling the blade only and should not be used to suppress dust (Document ID 2286, p. 2).

However, product literature from five major saw manufacturers (Andreas Stihl, Husqvarna, Hilti, Makita USA, and Wacker Group) highlights the use of water application equipment to suppress dust in addition to blade cooling (Document ID 3998, Attachment 12a, pp. 9, 15-16; 3998, Attachment 12e, p. 3; 3998, Attachment 12f; 3998, Attachment 12g, p. 5; 3998, Attachment 12h, p. 8). For example, Stihl’s manual for the model 410 and 420 cut-off machines (handheld masonry saws) specifically recommends a water flow rate for dust suppression (Document ID 3998, Attachment 12a, pp. 9, 15-16). Furthermore, Stihl is not the only cut-off saw manufacturer to state that water used with its product is intended to suppress dust emissions. Husqvarna’s product literature for the K 3000 Wet describes the product as a power cutter for wet applications that is equipped with a dust extinguisher system (Document ID 3998, Attachment 12f, p. 1). Hilti also recognizes that water suppresses dust and recommends the use of wet cutting to reduce dust in its instruction manual for the Hilti DSH 700/DSH 900 model handheld masonry saws (Document ID 3998, Attachment 12e, p. 3).

CISC asked that OSHA clarify whether there needs to be a separate integrated water delivery system in addition to the system provided by the manufacturer to keep the blade cool (Document ID 2319, p. 104). Beamer et al. (2005) conducted experiments to observe the differences in the various wet cutting methods available and found that the greatest improvement in dust reduction occurred with freely flowing water applied at a rate of 48 gallons per hour (0.8 gallons per minute), resulting in dust reduction of about 93 percent and confirming the benefits of water flowing over the stationary saw cutting blade compared with other misting systems (Document ID 1555, p. 509). That, in addition to the manufacturer information submitted to the record, indicates that the existing water systems for blade cooling are effective at respirable dust capture and will satisfy the requirements under paragraphs (c)(1)(i) through (c)(1)(xviii) of the standard for construction where integrated water systems are required. Therefore, OSHA has determined that, where water-based dust suppression can be used with tools and equipment, those that are equipped with an integrated water delivery system are effective and the best available technology for controlling respirable crystalline silica. A separate integrated water delivery system in addition to the system provided by the manufacturer to keep the blade cool is not required.

OSHA is requiring the use of a commercially available dust collection system (i.e., local exhaust ventilation (LEV)) for several types of equipment listed on Table 1, including: handheld power saws for fiber cement board (with a blade diameter of 8 inches or less), handheld and stand-mounted drills (including impact and rotary hammer drills), jackhammers and handheld power chipping tools (as an alternative to a water delivery system), handheld grinders for mortar removal, and handheld grinders for uses other than mortar removal (as an alternative to a water delivery system). OSHA's intent is to ensure that employers use equipment that is appropriately designed for the tool being used and that will be effective in capturing dust generated from using the tool.

CISC opposed OSHA's requirement for commercially available systems, stating "[t]his specification eliminates specialty manufactured products that may be equally effective" (Document ID 2320, p. 11). However, CISC did not provide examples or describe what is meant by "specialty manufactured products." It is not OSHA's intent to prevent employers from using products that are custom made by aftermarket manufacturers (i.e., made by someone other than the original tool manufacturer) which are intended to fit the make and model of the tool and designed to meet the particular needs and specifications of the employer purchasing the product. These systems are designed to work effectively with the equipment and not introduce new hazards such as obstructing or interfering with safety mechanisms. The "commercially available" limitation is meant only to eliminate do-it-yourself on-site improvisations by the employer. An employer is free to improvise and use controls that are not commercially available. However, those systems would not meet the requirements of Table 1 and the employer will be required to conduct exposure assessments and comply with the PEL in accordance with paragraph (d) of the standard for construction.

In Table 1 of the proposed rule, OSHA would have required dust collection systems be equipped with High-Efficiency Particulate Air (HEPA) filters, which are 99.97 percent efficient in capturing particles having an aerodynamic diameter of 0.3 μm or larger. In the final standard, OSHA is not requiring the use of HEPA filters and instead is requiring the use of filters with a capture efficiency of 99 percent or greater for respirable particulate. Although OSHA received comments and testimony in support of using HEPA filters to capture silica dust (Document ID

1953, pp. 3-4; 1973, pp. 2-3), extensive comments were submitted to the record expressing concern regarding this requirement.

Occupational and Environmental Health Consulting Services, Inc. (OEHCS) noted the numerous deficiencies found with HEPA filtration from ineffective seals, deterioration of the filter, and inadequate testing prior to use, which often results in employee exposure to potentially-hazardous particles and possible recontamination of the work environment (Document ID 1953, Attachment 1). The Precast/Prestressed Concrete Institute (PCI), NUCA, and LBA noted that HEPA filters do not work well in the construction environment because filters will clog up quickly and must be changed often (Document ID 2276, p. 10; 3729, p. 3; 2269, p. 23). CISC noted that HEPA filters will typically not last an entire shift, stating that they clog up quickly and need to be monitored and changed frequently (Document ID 2320, p. 114). Consequently, CISC asserted, HEPA filters are not effective at filtering respirable dust or at reducing exposures to respirable silica (Document ID 2319, p. 95).

OSHA reached the same conclusion in its technological feasibility finding for mortar and concrete grinding as well (see Section 5.11 of Chapter IV of the FEA). Finding that best practices may counsel toward the use of HEPA-rated filters in the case of grinding, and particularly mortar grinding, OSHA nonetheless determined that under field conditions HEPA filters may rapidly clog, leading to an increase in static pressure drop and loss of the airflow needed for LEV to effectively capture silica dust at the point of generation (Document ID 0731, pp. 375, 384).

OSHA is persuaded that it should not require that dust collection systems be equipped with HEPA filters because HEPA filters in some applications will result in loss of airflow and concomitant degradation of dust-capture efficiency. In examining manufacturers' specifications for many commercially-available dust collectors, OSHA finds that most offer, in addition to HEPA filters, other filters with a 99 percent efficiency or better in the respirable-particle-size range. Many examples of products equipped with filters that do not meet HEPA specifications but nevertheless meet the requirement for 99 percent efficiency in the respirable-particle-size range were submitted to the record and include the EDCO Vortex 2000 (captures 99 percent of 0.5 µm or larger particles) (Document ID 4073, Attachment 4a, Row 55), the iQ 360x stationary saw (99.5 percent, particle size unspecified) (Document ID 4073, Attachment 4a, Row 58), a Porter-Cable vacuum (99.85 percent, particle size unspecified) (Document ID 3998, Attachment 13p), the Bosch 3931A (99.93 percent of 3 µm particles) (Document ID 3998, Attachment 10, p. 29), the CS Unitec (99.93 percent of 0.3 µm particles) (Document ID 4073, Attachment 4a, Row 99), and the Dustless 16-gallon collector ("almost HEPA," filters to 0.5 µm particles) (Document ID 4073, Attachment 4a, Row 211). A filter efficiency of at least 99 percent allows for longer tool usage, compared to one with a HEPA filter, before significant drops in airflow of the dust collection system. Furthermore, as explained above, requiring that dust collectors be equipped with HEPA filters can cause rapid airflow drop, reducing dust capture efficiency at the shroud or hood and exposing employees to high respirable dust and silica concentrations. Therefore, OSHA has decided not to require HEPA filters on Table 1 for dust collection systems and instead requires that dust collectors have a filter with 99 percent or greater particle capture efficiency. Employers should consult with their suppliers to determine the dust collection equipment that will best suit their needs for a given application.

OSHA also received many specific comments about particular changes to the notes and additional specifications, associated with the entries on Table 1, and on the specified engineering and work practice control methods identified for each entry, which are further discussed later in this section.

Notes and additional specifications on Table 1. Several commenters responded to the appropriateness of including the notes and additional specifications in the individual entries on Table 1. OSHA included these in the proposed rule to ensure that the strategies listed were properly implemented and remained effective.

Some commenters stated that the notes were too detailed, while others argued that the notes were not detailed enough (Document ID 2319, p. 6; 2262, p. 29; 3581, Tr. 1631-1632; 3585, Tr. 2924-2925, 3052-3053; 4223, pp. 95-97). Several commenters expressed concern that certain notes were unrealistic or too confusing for an employer to comply with. CISC stated that the inclusion of the notes left Table 1 “unworkable” for most employers in the construction industry (Document 2319, p. 6). Others questioned whether these additional specifications were a mandatory component of Table 1 or simply suggested guidelines to help determine the efficacy of the control (Document ID 2296, p. 28; 3441, pp. 4-5). On the other hand, some commenters asserted that the additional specifications were needed on Table 1 to ensure that controls are properly operated and effective (Document ID 3589, Tr. 4286-4287; 3581, Tr. 1631-1632; 4223, pp. 95-97).

To balance the need to clarify how the specifications apply to make Table 1 workable with the need to provide more specific information about the controls in order to ensure that they are effective, OSHA has removed most of the notes and additional specifications from the individual entries on Table 1 and has instead included revised specifications for the controls in paragraph (c)(2) of the standard for construction. This approach has the added benefit of making

Table 1 more readable because specifications that apply to multiple rows can now be addressed in a single subparagraph.

Paragraph (c)(2)(i) of the standard for construction requires employers to provide a means of exhaust as needed to minimize the accumulation of visible airborne dust for tasks performed indoors or in enclosed areas. When tasks are performed indoors or in enclosed areas, the dispersal of dust can be impeded such that concentrations can build up without the aid of forced ventilation. Flanagan et al. (2006) concluded that the degree to which a work area is enclosed is an important determinant of employee exposure based on data demonstrating increased exposures to respirable crystalline silica for enclosed environments (those with two to four walls, as well as those having walls, a roof, and windows), as compared to outdoor environments (Document ID 0677, pp. 148-149). Increased exposures to respirable crystalline silica were also demonstrated for tasks listed on Table 1 in enclosed areas, such as jackhammering inside a large pool area (Document ID 3958, Rows 1064, 1065, 1066) and handheld sawing in a large garage building open in front and closed on three sides (Document ID 3777, p. 65).

Sufficient air circulation in enclosed or indoor environments is important to ensure the effectiveness of the control strategies included on Table 1 and to prevent the accumulation of airborne dust. The "means of exhaust" necessary to minimize the accumulation of visible airborne dust could include dilution ventilation through the use of portable fans that increase air movement and assist in the removal and dispersion of airborne dust, which would otherwise remain in the enclosure and contribute to elevated exposures. To be effective, the ventilation must be implemented so that movements of employees, or the opening of doors and windows, will not adversely affect the airflow.

Paragraph (c)(2)(ii) of the standard for construction requires employers, for tasks performed using wet methods, to apply water at flow rates sufficient to minimize release of visible dust generated by the task. BCTD and LHSFNA encouraged OSHA to specify minimum flow rates for water where there are data or studies to support such a recommendation (Document ID 3581, Tr. 1632; 3589, Tr. 4286-4287). NIOSH recommended a flow rate of 0.5 L/min for handheld power saws based on experimental data and recommended that OSHA specify a minimum water flow rate of 300 mL/minute for jackhammers based on a field study of control equipment fabricated specifically for the study (Document ID 2177, Attachment B, pp. 19, 33; 0867, p. 6). Water has been proven an efficient engineering control method to reduce exposures to airborne crystalline silica-containing dust. Adequate dust capture is dependent on a variety of factors such as dust particle size, velocity, spray nozzle size and location, use of surfactants or other binders, and environmental factors (water hardness, humidity, weather, etc.) that must be considered when implementing wet methods. Water flow rates suggested by various studies, while perhaps instructive, may not be applicable to all of the different types of equipment that could be used or the conditions that may be encountered by employers following Table 1. Because the appropriate water flow rates for controlling silica dust emissions can vary, OSHA is not establishing a required flow rate for wet suppression systems or specifying a flow rate for individual Table 1 entries.

Paragraphs (c)(2)(iii)(A)-(F) of the standard for construction require employers implementing measures that include an enclosed cab or booth to ensure that the enclosed cab or booth is maintained as free as practicable from settled dust, has door seals and closing mechanisms that work properly, has gaskets and seals that are in good condition and work properly, is under positive pressure maintained through continuous delivery of fresh air, has intake air that is filtered through a pre-filter that is 95 percent efficient in the 0.3-10.0 μm range (e.g., MERV-16 or better), and has heating and cooling capabilities.

Dust can be unintentionally carried into enclosed cabs or booths through a number of routes, including on employees' boots, during the opening of doors when accessing or exiting the cab, through leaks in the system, or when employees roll down windows. IUOE, recommending that OSHA add specificity to the cab requirements (e.g., heating and air conditioning, housekeeping), argued that without greater specificity "there is a grave danger that intended safeguards become counterproductive as dust is re-circulated within the enclosures" (Document ID 2262, pp. 29-33).

Direct-reading instruments show that fine particle (0.3 micron (μm) in size) concentrations inside operator cabs can be reduced by an average of 93 percent when cabs are clean, sealed, and have a functionally adequate filtration and pressurization system (Document ID 1563, p. 1). Cecala et al. (2005) studied modifications designed to lower respirable dust levels in an enclosed cab on a 20-year-old surface drill at a silica sand operation. The study found that effective filtration and cab integrity (e.g., new gaskets, sealed cracks to maintain a positive-pressure environment) are the two key components necessary for dust control in an enclosed cab (Document ID 1563, p. 1).

OSHA determined that the requirements specified in paragraphs (c)(2)(iii)(A)-(F) of the standard for construction reduce the likelihood of respirable crystalline silica exposure in enclosed cabs or booths when employees are present by lowering the potential for dust to be re-suspended inside the enclosure, promoting the ability of the enclosed cab or booth to keep dust from entering through cracks or openings (e.g., seals, gaskets, and closing mechanisms are present, in good condition, and work properly), ensuring that the working conditions in the cab are comfortable so that employees are less likely to open the window of the cab, and ensuring that the fresh air provided to the employee does not contain silica particles.

IUOE also suggested that OSHA require employers to provide boot brushes or mudflingers to minimize the dust brought into the cab, to equip cabs with dust-resistant materials, and to affix warning labels to the interior of the cab (Document ID 2262, p. 30; 4025, p. 17). The Agency has not included these additional requirements since it expects that the specifications in paragraphs (c)(2)(iii)(A)-(F) of the standard for construction combined with frequent inspections by the competent person will be sufficient to protect employees against the potential respirable crystalline silica exposures within the enclosure.

OSHA has not included more specific requirements in paragraphs (c)(2)(i)-(c)(2)(iii) of the standard for construction (e.g., establishing a minimum face velocity, volumetric flow rate for air movement, or a required number of air changes; flow rate for wet suppression systems; or a frequency for the cleaning of cabs or booths). However, as discussed in the summary and explanation of Written Exposure Control Plan, paragraph (g)(1)(ii) of the standard for construction requires the employer to establish and implement a written exposure control plan that describes the engineering controls and work practices used to limit employee exposure to respirable crystalline silica. This description should include details such as the appropriate means of exhaust needed to minimize the accumulation of visible airborne dust for a particular task, the appropriate flow rate and droplet size needed for wet suppression systems to minimize release of visible dust, and the procedures for maintaining and cleaning an enclosed cab or booth. Paragraph (g)(4) of the standard for construction also requires a competent person to make frequent and regular inspections of the jobsite, materials, and equipment (including engineering controls) to implement the written exposure control plan.

OSHA did not include specifications on visible dust and wet slurry, included as notes in individual entries on proposed Table 1, in the standard. The Agency has determined that these issues are best addressed by other provisions of the standard, rather than as a note or additional specification included in each relevant Table 1 entry. Further discussion about these specifications is also included below.

Many commenters expressed concern with the note, contained in proposed Table 1 for all but two entries, requiring employers to operate equipment such that no visible dust is emitted from the process. Industry commenters, including the Power Tool Institute (PTI), Western Construction Group, SMACNA, the Independent Electrical Contractors, the Distribution Contractors Association, CISC, the Utility and Transportation Contractors Association of New Jersey, Atlantic Concrete Cutting, ABC, LBA, Holes Incorporated, and N.S. Giles Foundations objected to this note, stating that it was an unrealistic requirement which made Table 1 unworkable (e.g., Document ID 1973, pp. 2-9; 2183, p. 3; 2226, p. 2; 2250, p. 2; 2309, p. 4; 2319, pp. 97-98; 4217, p. 6; 2356, p. 2; 2367, p. 2; 2289, p. 7; 2269, p. 21; 3441, p. 5; 3598, pp. 1-2).

Some industry commenters asserted that it is impossible to perform tasks, such as sawing, grinding, and drilling, without generating any visible dust (Document ID 2357, pp. 27-28; 3441, p. 6; 4073, Attachment 9e, p. 1). Holes Incorporated noted that when grinding or using other hand-held pieces of equipment, the work cannot be performed with the tool flush against the impacted surface, and at times, there will be a gap and visible dust will be emitted even when local exhaust ventilation or wet methods are utilized (Document ID 3441, p. 6).

Other commenters expressed concern that there is no true dustless system, clarifying that even those tools marketed as “dustless” produce some level of airborne dust (Document ID 2345,

p. 4; 3585, Tr. 2960; 4216, pp. 2-3). Francisco Trujillo, safety director for Miller and Long, stated that:

> Every “dustless” system I have ever witnessed has produced some level of airborne dust. This fact alone should show that Table 1 sets criteria that are impossible to achieve . . . (Document ID 2345, p. 4).

On the other hand, commenters, including NAPA and BAC, noted that in their experience there is no visible dust generated when certain equipment, such as asphalt machines for milling or stationary masonry saws, is used with available dust controls (Document ID 3583, Tr. 2216; 3585, Tr. 3072). They did not, however, provide any indication that the same results could be achieved with all of the other equipment listed on Table 1.

Several commenters provided a different rationale for their objections to this note. AIHA opined that the requirement to operate equipment such that no visible dust is emitted from the process is a subjective determination and recommended it be removed from Table 1 entries (Document ID 3578, Tr. 1029-1030; 2169, p. 5). The Masonry and Concrete Saw Manufacturers Institute (SMI) noted that “[a]dding requirements for . . . avoiding visible dust have not been researched specific to respirable silica dust and may have no beneficial impact” (Document ID 2316, p. 2). NAHB and Holes Incorporated expressed concern that the requirement was a general dust rule, rather than regulating crystalline silica since Table 1 doesn’t specify whether “no visible dust” refers to visible silica dust or just dust in general (Document ID 2296, p. 29; 3580, Tr. 1355-1356).

Not all industry commenters objected to the note on visible dust contained in the proposed Table 1. ICPI supported a version of Table 1 that included the no-visible-dust requirement for nearly all of the operations listed (Document ID 2352, pp. 4-8).

Commenters from both industry and labor suggested revisions to clarify the note and make it workable. LHSFNA believed the note was needed to ensure the effective use of controls and was not too vague, but acknowledged that the language could be clarified to say something like "visible dust should be minimized" (Document ID 4207, p. 2). BCTD also provided significantly revised language for the no-visible-dust requirement. For those operations that involve cutting and grinding on silica-containing substrate, BCTD suggested that, for wet systems, Table 1 of the standard should require that water flow be "sufficient to control the dust generated so that no visible dust . . . is emitted from the process once the blade has entered the substrate being cut" and that the relevant note on Table 1 be revised to read:

> A small amount of visible dust may be present when the blade or tool initially enters the substrate and when it is being removed at the end of a task. However, if visible dust is present after the blade or tool has entered the work surface/substrate, this is a sign that the control is not working properly. The operation should be stopped and the equipment and/or workers' cutting technique checked and fixed (Document ID 4223, Appendix 1, p. 14).

PTI's suggested revisions to Table 1 include a note for many of the entries specifying that "during operation, if excessive visible dust is emitted from the process, immediately stop work and verify that the dust control system is functioning properly" (Document ID 1973, pp. 2-9).

While opinions varied widely on the utility of a no-visible-dust requirement, no commenters suggested that excessive visible dust generated from tasks abrading silica-containing materials (sawing, grinding, etc.) does not present a risk of significant employee exposure to silica. As noted above, BCTD confirmed that the presence of visible dust after the blade or tool has entered the work surface/substrate is a sign that the control method is not working properly (Document ID 4223, Appendix 1, p. 14). PTI recommended that, when excessive visible dust was present, work stop immediately until the employer could verify the proper functioning of the control (Document ID 1973, pp. 2-9).

OSHA agrees that excessive visible dust is an indication that a control's effectiveness may be compromised, but, after reviewing the entire record on this point, has decided not to include a no-visible-dust requirement for the Table 1 entries. Instead, it has concluded that the purpose of such a requirement is best achieved by bolstering other requirements in the rule, as it applies to construction. First, OSHA considers the written exposure control plan to be centrally important and expects employers to address signs that controls may not be working effectively (e.g., dust is visible) as part of their written exposure control plans required under paragraph (g) of the standard for construction (see summary and explanation of Written Exposure Control Plan for further discussion). Second, during the designated competent person's frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan, as required under paragraph (g)(4) of the standard for construction, OSHA expects that person to make routine observations of dust generated from tasks being conducted. Where increases in visible dust occur, the competent person's assigned role is to take prompt corrective action (e.g., make corrections or adjustments as needed).

OSHA finds that the difference between the small amount of dust generated when control measures are operated effectively and the large amount of dust generated during tasks when control measures are not used or not operated effectively can readily be observed. Several videos presented in the record support this conclusion (e.g., Document ID 4073, Attachment 4b). These videos demonstrate that when a task is uncontrolled or inadequately controlled, a large dust plume can be seen. When controls such as water or vacuum-based ventilation are used, little dust is observable. These significant differences in the observable dust generated during controlled and inadequately-controlled tasks provide an opportunity for employers to readily detect poorly-performing equipment and address these problems quickly. The principle concern, however, is with a lot of visible dust, rather than any visible dust, which is a concern for which the appropriate corrective action is difficult to quantify or state in objective terms. Instead, the presence of significant visible dust lends itself to a more process-oriented control approach, as exemplified by the written exposure control plan and competent person requirements. OSHA thus concludes that the issue of visible dust is best addressed by the requirement to fully and properly implement the controls specified on Table 1, and the written exposure control plan and competent person requirements, rather than as a note or additional specification included in each Table 1 entry.

Commenters also objected to the specification to prevent wet slurry from accumulating and drying when implementing wet methods, as proposed for several Table 1 entries. Both Holes Incorporated and NAHB objected to the ambiguity of the requirement and presented concerns about how employers on a construction site would comply with such a requirement (Document ID 3441, p. 9; 2296, p. 28).

Other commenters expressed concern regarding the disposal of silica slurry (Document ID 2246, pp. 9-10; 3585, Tr. 2886; 2319, p. 94). ICPI noted that employers have to expend extra effort to locate a place to dispose of dust-filled slurry, which is not possible in some conditions or locations (Document ID 2246, pp. 9-10). CISC described how slurry created using wet-cutting methods outside can flow into storm drains, potentially violating environmental regulations (Document ID 2319, p. 94). The Mason Contractors Association of America explained that in California, silica slurry produced from wet cutting is classified as a hazardous material, requiring contractors working in the state to follow hazmat procedures for its disposal (Document ID 3585, Tr. 2886).

However, NIOSH argued that since the vast majority of masonry saws provide water on the blade itself to cool and lubricate the blade and suppress dust, employers already have to deal with slurry when cutting masonry and concrete (Document ID 4233, Attachment 1, p. 6). OSHA agrees that the standard does not pose any new requirements regarding the disposal of slurry on employers who already use wet methods for sawing masonry products.

OSHA concludes that any measures necessary to manage slurry in order limit employee exposure to respirable crystalline silica (i.e., exposure that results from slurry drying and dust particles becoming airborne) are best addressed through the employer's written exposure control plan and competent person requirements, rather than as a note or additional specification included in each Table 1 entry. These requirements are discussed above and in the summary and explanation of Written Exposure Control Plan.

In several Table 1 entries, OSHA has included a requirement to operate and maintain tools in accordance with manufacturer's instructions to minimize dust emissions. This requirement is intended to ensure that the controls are implemented effectively to reduce exposures to respirable crystalline silica. Manufacturer's instructions that influence the effectiveness of the tool and controls with regard to minimizing dust emissions may include, but are not limited to, additional specifications for water flow rates, air flow rates, vacuum equipment, rotation of the blade, maintaining and changing blades, and frequencies for changing water.

Respiratory protection specified on Table 1. Industry associations, including the American Subcontractors Association (ASA), the Institute of Makers of Explosives (IME), the

General Contractors Association of New York (GCANY), and CISC, commented on the appropriateness of the respirators that OSHA proposed for Table 1 (e.g., Document ID 2213, p. 2; 2187, p. 3; 2314, p. 2; 2319, p. 102). For example, ASA stated:

> OSHA's proposed Table 1 for construction would seem to suggest that the Agency believes a construction employer can achieve the PEL with engineering and work practice controls. Yet the Agency then requires respiratory protection for 60 percent of the operations listed in Table 1. This failure is even more perplexing since OSHA failed to identify, obtain and/or cite sufficient data for its conclusions with respect to the 13 operations addressed in Table 1 (Document ID 2187, p. 3).

GCANY explained in their comments that "[c]urrent respiratory protective equipment is cumbersome to wear and to work in and would expose the worker to other hazards on a job site" (Document ID 2314, p. 2). CISC urged OSHA to "eliminate the heavy use of respiratory protection," arguing that:

> OSHA's reliance on respiratory protection is analytically inconsistent with its position that it is technologically feasible to reach the proposed PEL in most construction operations most of the time, and particularly when the control measures specified in Table 1 are used. Requiring such heavy use of respirators . . . will serve as a significant barrier to effective use of [Table 1] (Document ID 2319, p. 102).

Respirator requirements on Table 1 of the final rule are based on a review of all the evidence pertaining to exposure profiles and available controls in the rulemaking record, including an evaluation of the updated exposure profiles and evidence on available controls submitted to the rulemaking record, as described in Chapter IV of the FEA. A primary purpose of such evaluation was for OSHA to better identify those situations where exposures above the PEL are likely to persist despite full and proper implementation of the specified engineering and work practice controls and supplemental respiratory protection will therefore be necessary to ensure employees are protected from silica-related health risks. As documented in its analyses of technological feasibility for each Table 1 task, OSHA finds that most of the time employees are performing tasks on Table 1, respiratory protection will not be required. For most of the tasks or equipment on Table 1, OSHA expects that work will be performed for four hours or less and/or outdoors (see Chapter IV of the FEA). For certain tasks listed on Table 1, OSHA was able to distinguish indoor environments, where exposures are typically above 50 μg/m^3 even with the use of engineering controls and work practices, from outdoor environments, where engineering controls can typically maintain exposures below 50 μg/m^3, in order to eliminate requirements for respiratory protection where tasks are performed outdoors (e.g., using handheld grinders for uses other than mortar removal (c)(1)(xii)). Elsewhere, OSHA was able to further refine the equipment or tasks listed on Table 1 (e.g., handheld power saws (c)(1)(ii)-(iii); walk-behind and drivable masonry saws (c)(iv)-(v); milling machines (c)(1)(xiii)-(xv)) in order to eliminate previously proposed requirements for respiratory protection. In other cases, OSHA found engineering controls and work practices specified on Table 1 sufficient to maintain employee exposures at or below 50 μg/m^3 when fully and properly implemented (e.g., (c)(1)(i), (c)(1)(ix), (c)(1)(xiv)), and thus determined that a respiratory protection requirement was not necessary. Specific changes to the respiratory protection requirements for each task listed on Table 1 are discussed in more detail below.

Consequently, required respiratory protection under Table 1 is limited to situations in which OSHA has determined that exposures over 50 μg/m^3 will often occur. For example, OSHA is not requiring the use of respiratory protection when handheld power saws (any blade diameter) are used outdoors, for less than four hours, with water-based dust suppression systems because OSHA's exposure profile indicates that exposures will be below 50 μg/m^3 TWA most of the time that saws are used, given typical work patterns (e.g., outdoors for less than four hours per shift) (see Section 5.6 of Chapter IV of the FEA). Data submitted to the record by the

Concrete Sawing and Drilling Association (CSDA) (Document ID 3497) also show that wet sawing produces exposures below 50 μg/m^3 TWA with typical use patterns during the work shift. In contrast, indoor use of handheld wet power saws generates frequent exposures in excess of 50 μg/m^3 TWA with typical use patterns during the work shift; from OSHA's exposure profile, half of the exposure samples associated with using handheld power saws indoors exceed 50 μg/m^3 TWA, and two indoor samples included in the data submitted by CSDA were above a TWA of 50 μg/m^3 (Document ID 3497, p. 5). As a result, Table 1 requires supplemental respirator use when handheld power saws are used indoors or in an enclosed area with water-based dust suppression systems.

OSHA has also used the terms "indoors or in an enclosed area" rather than "indoors or within a partially sheltered area" in order to clarify that any requirement to use respiratory protection when the task is performed under these conditions is limited to those areas where the dispersal of dust can be impeded such that concentrations can build up without the aid of forced ventilation. For example, a work area with only a roof that does not impede the dispersal of dust would not be considered "enclosed," while it may have been considered by some to be a "partially sheltered area."

As a result of these modifications, OSHA expects that many fewer employees will need to use respiratory protection than was the case for the proposed rule, and respiratory protection will not be necessary for the most commonly encountered work situations and environments specified on Table 1.

ISEA suggested that OSHA make the respirator requirements on Table 1 more user-friendly and performance-oriented by listing only an APF and recommending that users consult the APF table found in the respiratory protection standard, rather than listing generic respirator types (Document ID 2212, p. 2). In response to this comment, OSHA has maintained certain requirements for respiratory protection, but has eliminated specific requirements for the type of respirator that must be used (e.g., half-mask respirator, powered air-purifying respirator (PAPR) with loose-fitting helmet or negative pressure full facepiece). Instead, OSHA includes on Table 1 only the minimum Assigned Protection Factor (APF) required. This change from the proposal provides the employer with the option of determining which respirator offers the best protection for its employees in the multitude of construction environments that may be encountered. However, this is only the minimum protection factor required for the respirator, and employers have the flexibility to provide a more protective respirator to those employees who request one or require a more protective respirator based on the employer's evaluation of the worksite. As discussed in the summary and explanation of Respiratory Protection, paragraph (d)(3)(i)(A) of the respiratory protection standard (29 CFR 1910.134), which includes a table that can be used to determine the type or class of respirator that is expected to provide employees with a particular APF, can help employers determine the type of respirator that would meet the required minimum APF specified by Table 1. In order to reflect this change to the respirator requirements, the Agency has modified the heading on Table 1 to "Required Respiratory Protection and Minimum Assigned Protection Factor (APF)."

The respirator requirements on Table 1 are divided by task duration: "less than or equal to four hours/shift" and "greater than four hours/shift." AIHA recommended that OSHA clarify what time is included when determining less than or greater than four hours (Document ID 2169, p. 6). OSHA has determined that time starts when the operator begins using the tool, and continues to be counted until he or she completes the task. This time includes intermittent breaks in tool usage and clean-up. For example, an employee cuts and places bricks, one at a time, for three hours consecutively. The employee then spends 30 minutes cleaning up the saw and empting slurry or dust collectors. All three hours spent cutting and laying bricks along with the 30 minutes for clean-up count. Tasks that are performed multiple times per day, during distinct time periods, should be counted as separate tasks, and times should be combined. For example, an employee cuts multiple bricks for 15 minutes, lays bricks for two hours and returns to cut more bricks for another 30 minutes. The two hours spent laying bricks do not count towards the total time for compliance with Table 1.

The duration of a task that generates respirable crystalline silica influences the extent of employee exposure and, in some cases, requirements for use of respirators. Some commenters suggested that OSHA modify the time breakdown for activities and respirator usage, such as BCTD’s suggestion to divide tasks on Table 1 into two hours, four hours, and eight hours. Other commenters such as CISC, Holes Incorporated, and the Mason Contractors Association of America, suggested that OSHA exclude short duration tasks (e.g., 90 minutes or less) from Table 1, and NUCA suggested that the four hour cutoff is arbitrary and had no data to support it (Document ID 4073, Attachment 14f, p. 2; 2319, pp. 100-102; 3580, Tr. 1453; 3585, Tr. 2882; 3729, p. 3).

After reviewing these comments, OSHA has decided to maintain this division in the standard. OSHA selected four hours as an appropriate division point for respirator usage because it finds that employers and employees can anticipate whether a task will take less than half of a shift or more than half of a shift (as opposed to smaller time intervals), and so can plan accordingly on the need for respirator use on a given job. In addition, OSHA selected only a single durational division for respirator tasks in all of the relevant Table 1 tasks to avoid the confusion that could result from triggering mandatory respirator use at different times for different tasks. OSHA also determined that excluding short duration tasks from Table 1, although included in the ASTM E 2625–09 consensus standard, was inappropriate, given that employees engaged in a task listed on Table 1 are best protected using the available engineering controls, work practices, and respiratory protection specified for the task and are only exempt from complying with the standard where employee exposure will remain below 25 μg/m^3 as a time-weighted average under any foreseeable conditions (see summary and explanation of Scope for further discussion of this exclusion).

Table 1 of the proposed rule used the phrase "4 hours per day" to indicate when respirators were required, but Table 1 of the final standard uses "4 hours per shift." OSHA's exposure data is largely drawn from samples of employee exposure averaged over an 8-hour period, which is a typical time for a shift. The proposed rule referred to a time period of four hours "per day" for the purpose of limiting employee's exposure during the normal 8-hour shift that most employees work during a single day. OSHA recognizes, however, that some common tasks such as jackhammering during nighttime highway construction may occur during an 8-hour period that spans two calendar days (e.g., 8 p.m. until 4 a.m.). OSHA did not intend to allow employees to be exposed to respirable crystalline silica without respiratory protection for longer than four hours in that scenario, so OSHA has specified four hours "per shift" in the final rule.

OSHA also recognizes that the form and length of a shift may vary such that an employee may have a break between work periods (e.g., four hours on, two hours off, four hours on), work shifts may be longer than eight hours, or employees may work double shifts within a single day. The work periods in each of those examples constitutes a "shift" for purposes of determining the maximum amount of time that an employee may spend on one of the applicable Table 1 tasks without respiratory protection. OSHA's exposure data is not sufficient to support the conclusion that a longer duration of exposure without respiratory protection would be safe just because that exposure is spread out over a period that is longer than the normal 8-hour shift. Thus, an employee who works a 12-hour shift from 8 p.m. to 10 a.m. with a 2-hour rest break in the middle would have to wear a respirator if engaged in an applicable Table 1 task such as jackhammering outdoors if the employee will be jackhammering from 8 p.m. to 11 p.m., taking a break from 11 p.m. until 2 a.m., and then jackhammering again from 2 a.m. until 4 a.m. for a total of five hours of jackhammering. However, assuming no other silica exposure, the employee would not require respiratory protection if the jackhammering is limited to 8 p.m. until 11 p.m. and 2 a.m. until 3 a.m. for a total of four hours, even if the employee repeats the same shift and jackhammering times every day of the week. Accordingly, the change from "per day" to "per shift" clarifies OSHA's original intention regarding when respirator use is required for Table 1 tasks.

The requirement to provide respirators for Table 1 tasks is based on the anticipated duration of the task. Some commenters, such as EEI, expressed confusion about how this requirement would apply to non-continuous work (e.g., Document ID 2357, p. 27). EEI opined that:

> The nature of non-continuous work can also make it hard to anticipate when a certain task may exceed four hours per day. Suppose, for example, a job task using a stationary masonry saw is not anticipated to last beyond four hours, so all controls listed in Table 1 are followed, and the employee does not wear a respirator. Then, due to unforeseen complications, the job lasts beyond four hours. Simply following the regulations as proposed, it is unclear whether the employee would be allowed to put on a half-mask after four hours, or if OSHA will not allow the employer to use the Table 1 option because the employee was not in a half-mask for the first four hours (Document ID 2357, p. 27).

In contrast, other commenters suggested that, despite the variable nature of the work, employers and employees generally know how long it will take to complete a particular task (e.g., Document ID 3581, Tr. 1684, 1686). OSHA recognizes, based on the comments above and the nature of construction work in general, that application of this requirement warrants some flexibility. For several Table 1 tasks, respiratory protection with the appropriate APF is required if the duration of a task is anticipated to exceed four hours, but is not required if the duration of a task is less than or equal to four hours (e.g., (c)(1)(ii), (c)(1)(x), (c)(1)(xii)). For these tasks, the Agency does not expect employers to know exactly how long it will take to perform a task. Rather, OSHA expects employers to make a good-faith judgment of the task's anticipated duration over the work shift based on previous experience and all other available information. If the employer anticipates that an employee will be engaged in a task for more than four hours, the employer must provide respirators (if required by Table 1) to the employee at the beginning of the shift. For example, in the case of an employee grinding concrete walls indoors, the employer should know, in advance, the area of surface that is to be worked on in the course of a shift. If, based on the employer's experience, the time needed to grind that area is typically less than four hours, the employer would not be required to provide respirators to the employee. If, however, using the same example, the employer experiences unforeseen difficulties that extend the task duration beyond four hours, the employer would be required under Table 1 to provide the listed respiratory protection as soon as it becomes evident that the duration of the grinding task may exceed the 4-hour limit, measured from the beginning of the task rather than the point when the need for extra time becomes evident.

Commenters, including BCTD, Fann Contracting, and IUOE, expressed confusion about whether an employee must wear a respirator for the entire duration of a task when that task is expected to last more than four hours, or rather wear the respirator for only the portion of the task that exceeds four hours (e.g., Document ID 3581, Tr. 1681; 2116, Attachment 1, p. 28;

2262, p. 27). OSHA hereby clarifies that the intent is to require respirator use throughout the duration of the task.

The objective of the silica standard is to limit an employee's average exposure over a work shift. In each of OSHA's health standards, this is accomplished by establishing a PEL expressed as an 8-hour TWA. Because a PEL is a time-weighted average, the Agency has traditionally required employees to use respirators throughout a shift when employees work on a task or in an area where exposure to a hazardous substance contributes significantly to an employee's exposure in excess of the PEL at any point during that shift. This same reasoning applies to wearing a respirator from the beginning of a shift where respirators are required on Table 1. Thus, OSHA is continuing the same approach to respirator use for tasks listed on Table 1 of the standard for construction as it has for other OSHA health standards. Under Table 1 of the final standard for construction, when a respirator is required only when a task is performed for more than four hours per shift and when the employer estimates that the duration of the task will exceed four hours, the employer must provide and ensure that a respirator is used the entire time that task is performed over the shift, not just during the time beyond the first four hours that the task is performed. For example, if an employer anticipates that an employee will operate a jackhammer outdoors for more than four hours, the employer must provide respiratory protection with an APF of 10 and require that it be used for the entire duration of the task. For tasks that are typically intermittent, employers are required to estimate at the outset the total time during the shift that the task itself will be performed and provide respirators required by Table 1 based on that estimate. If an employer knows from experience that an employee will perform a single task listed on Table 1 for four hours or less during a single shift, then the employer must ensure that the employee uses whichever respirator is specified in the "≤ 4 hr/shift" column on Table 1 (or need not provide a respirator if no respirator is required on Table 1 for that duration). As another example, if a contractor needs to cut four concrete walls using a handheld power saw (outdoors), and cutting each wall typically takes 45 minutes to complete, for a total time of 3 hours, the employer would not be required by Table 1 to provide a respirator. But if cutting each wall typically takes in excess of 60 minutes, the employer should expect that the total duration of the task will exceed four hours and provide respirators as required under Table 1. The employer is required to provide respirators as soon as it becomes evident that the duration of the task will exceed four hours. Thus, in most situations an employee will be protected by a respirator for all or the majority of a task that exceeds four hours because the rate of progress on the task will become apparent to the employer early on. An employee cannot be allowed to work more than four hours without a respirator when one is required under Table 1 because the employer will have certainty at that point that the task is exceeding four hours.

The above examples assume that employees are engaged in only one task covered by Table 1 each shift. Paragraph (c)(3) of the standard for construction requires that, where employees perform more than one task on Table 1 during the course of a shift for a combined total of more than four hours, employers must provide, for the entire duration of each task performed, respiratory protection that is consistent with that specified in the "> 4 hr/shift" column of Table 1, even if the individual duration of each task is less than four hours. If no respirator is specified for a task in the "> 4 hr/shift" column of Table 1, then respirator use would not be required for that part of the employee's shift. For example, if an employer plans to have his employee use a handheld grinder outdoors on a concrete wall for three hours and then use a chipping hammer for two additional hours, the employer would not be required to ensure that his employee uses a respirator for the three hours the employee is using the grinder, since respiratory protection is not specified on Table 1 for the use of a grinder outdoors for more than four hours per shift; however, the employer would be required to ensure that his employee uses a respirator with an APF of 10 for the two hours the employee is using the chipping hammer. This is so even though use of the chipping hammer, if performed with no grinding beforehand, would not have required a respirator for the duration that the tool was used. If the employee will be engaged in two activities that both have "None" specified for respiratory protection in both the "≤ 4hr/shift" and the "> 4 hr/shift" columns, such as driving a half-lane milling machine and then operating a walk-behind milling machine equipped with an integrated water delivery system, then respirator use would not be required for any part of an employee's shift even if the employer knows that the cumulative total of that work will exceed four hours.

When an employee performs multiple tasks that do not exceed a combined total of more than four hours, employers must provide the respiratory protection specified in the "≤ 4 hr/shift" column of Table 1 for each task. For example, if an employer plans to have his employee use a handheld grinder for mortar removal for one hour and a stationary masonry saw for an additional two hours, the employer is required to ensure that his employee uses a respirator with an APF of 10 for the one hour the employee is using the grinder. The employer would not be required to ensure that his employee uses a respirator for the two hours the employee is using the stationary masonry saw, since respiratory protection is not specified on Table 1 for the use of a stationary masonry saw.

Thus, whatever permutations may arise, the employer must estimate the duration of the task(s) to determine whether Table 1 will trigger the requirement for respiratory protection. If unforeseen conditions arise that cause the estimated duration to be revised for any of the tasks, the employer is required to provide the required respiratory protection as soon as it becomes evident that the employee will be engaged in the task for more than four hours during the shift.

Updating Table 1. Commenters, including LHSFNA, BAC, BCTD, Charles Gordon, and James Hardie Building Products, Inc., suggested that the utility of Table 1 will diminish over time if OSHA has no mechanism to include new control methods that may be developed (e.g., Document ID 4207, pp. 2-3; 4219, pp. 20-21; 4223, pp. 98-102; 3588, Tr. 3792-3793; 2322, pp. 21-23).

Commenters also provided specific recommendations for the frequency at which OSHA should update Table 1 and the process by which OSHA should do so. James Hardie Building Products, Inc. commented that additional controls demonstrated to maintain or increase employee protection should be incorporated by reference whenever they become available "without the need to undergo a formal rulemaking process" (Document ID 2322, pp. 21-22). The National Consumers League and the American Public Health Association suggested that OSHA consider updating Table 1 periodically (e.g., every five years) and publish a direct final rule to adopt a revised Table 1 when NIOSH deemed new dust control technology effective and feasible (Document ID 2373, p. 3; 2178, p. 3). Similarly, the Center for Effective Government urged OSHA to review Table 1 every five years and make revisions when new control technologies are found to be technologically and economically feasible (Document ID 3586, Tr. 3319).

Other commenters urged OSHA to consider mechanisms to update Table 1 without going through the rulemaking process. NIOSH suggested that the Agency develop a database of control technologies to supplement those on Table 1, rather than initiate rulemaking to update Table 1 (Document ID 2177, Attachment B, pp. 20-21). LHSFNA suggested that OSHA post enforcement decisions based on objective data online and permit employers performing similar tasks to use the controls specified in those decisions to meet their obligations under Table 1 (Document ID 4207, pp. 2-3). Holes Incorporated argued that Table 1 should be amendable by employers when testing proves that using such controls would ensure compliance with the PEL (Document ID 3441, p. 12; 3580, Tr. 1491).

IUOE, BCTD, and BAC argued that Table 1 should be an appendix to the rule so that it can be more easily updated (Document ID 2262, pp. 48-49; 2329, p. 6; 2371, Attachment 1, pp. 30-31). BCTD offered an approach for updating Table 1 that relied on the Agency establishing a mechanism for employers, equipment manufacturers, and others to submit data to the Agency for evaluation and subsequent inclusion in future versions of Table 1. BCTD proposed:

> OSHA could publish the criteria in a non-mandatory appendix to the standard, so employers, manufacturers and researchers would have a clear understanding of what they will have to demonstrate to get their proposed controls onto the table. Interested parties could then request that OSHA evaluate a control option, supporting their request with objective data, peer-reviewed studies, reports by NIOSH or other governmental agencies, or other reputable sources. If OSHA determined, based on the supporting data, that the technology meets its criteria for inclusion on Table 1, OSHA would issue an interpretative letter to that effect and/or issue a compliance directive advising its compliance officers that employers that fully and properly implement the particular control should be treated as if they were in compliance with the requirements of Table 1.
> This approach would enable OSHA to continually add to the options employers can utilize as new technologies come on-line, while at the same time ensuring that these additional controls meet the Agency's criteria (Document ID 4223, p. 100).

Charles Gordon also provided a detailed suggestion for the addition of regulatory text to address the issue of updating Table 1:

> Updating controls. (i)Three years from the effective date of this standard and every 3 years thereafter, OSHA shall request comments on new or improved engineering controls which can achieve the PEL or Action Level without supplementary respirator use for operations specified in Table 1 or other operations not in Table 1 that have crystalline silica exposure over the Action Level.
> (ii) If OSHA concludes that a new control will achieve the PEL without supplementary respirator use, it shall publish a notice permitting that control to be used for that Table 1 operation along with the other permitted controls or publish

> a direct final rule including that other operation in Table I and permitting the use of that control.
> (iii) If a commenter submits to OSHA an engineering control for an operation in Table 1, which can achieve the action level without supplementary respirator use based on valid studies and cost data showing it is feasible, then no later than the date specified in paragraph (f)(6)(i), OSHA shall publish a proposal, proposing that that engineering control be the required engineering control for that operation (Document ID 4236, Appendix 1, p. 1).

Based on the comments and perspective reflected in the rulemaking record, OSHA sees the value in periodically updating Table 1 and is concerned that a static Table 1 may discourage innovation in the development of control technologies for reducing silica exposure. However, while OSHA may certainly consider future updates or adjustments to Table 1 if warranted, it will likely need to accomplish substantive changes through additional rulemaking. In any event, it has no intention to bind a future Administration to such rulemaking, whether to update Table 1 in particular or the entire rule in general, according to a schedule built into this rule. Meanwhile, the need to revise Table 1 in the future should be limited since the controls specified – primarily wetting the dust or ventilating and collecting the dust – are stated in general terms that will not be rendered obsolete by, for example, design improvements to water spraying or vacuuming equipment.

Even if the proposed mechanisms are consistent with the law governing rulemaking, OSHA is unwilling to specify a mechanism for updating Table 1 for several reasons. First, the procedures outlined by BCTD and Charles Gordon would commit the Agency to spend future resources to accept a large volume of information from interested parties, evaluate it in a timely manner, and prepare the needed economic and technological feasibility analysis and other rulemaking documents. OSHA may have higher rulemaking priorities and demands on its resources at that time, however. Second, Table 1 cannot both contain enforceable means of compliance and also be contained in a non-mandatory appendix. To ensure that employers who do not conduct exposure monitoring comply fully with the Table 1 provisions, OSHA must include the control specifications of Table 1 in the final standard for construction as requirements rather than as non-mandatory recommendations. Third, the controls specified on Table 1 are flexible and not tied to existing technology. The controls specified on Table 1 provide for the use of wet methods, ventilation, and in some cases, isolation. OSHA did not provide specific criteria for ventilation systems (size, air flow rate, etc.) or water flow rates. Instead, OSHA specifies that employers must operate the tools with integrated dust controls in accordance with the manufacturer's instructions. These instructions provide flexibility to take advantage of advances in technology. For example, as manufacturers develop effective surfactants to be used with water to further reduce silica exposure, there will be no need for OSHA to update Table 1 to specifically allow employers to use them. The requirement to use wet methods would still be satisfied.

Thus, OSHA rejects the suggestions to establish a specific mechanism for updating Table 1 in the future. If significant technological advances occur that require OSHA to initiate rulemaking in order to incorporate emerging technology not already encompassed by this rule, it will do so in the context of its rulemaking priorities at that time. Of course, interested parties may petition the Agency at any time to modify the dust control specifications on Table 1 of the standard for construction, and OSHA will consider such petitions based on the likely benefit that will accrue to workers and the Agency's available resources at the time.

Comparison with consensus standards. The requirements in paragraph (c) of the standard for construction are generally consistent with ASTM E 2625 – 09, the national consensus standard for controlling occupational exposure to respirable crystalline silica in construction. The ASTM standard provides a task-based control strategy, including five tables that specify control measures and respiratory protection for common construction equipment and tasks. While the ASTM standard provides this task-based control strategy, it also applies the PEL and exposure assessment to these tasks, as OSHA did in its proposal. However, OSHA's final standard for construction, as discussed above, takes a different approach by requiring specific engineering controls, work practices, and respiratory protection for construction tasks on Table 1; where employers fully and properly implement the engineering controls, work practices, and respiratory protection specified on Table 1, compliance with Table 1 is in lieu of the performance-oriented approach involving a PEL and exposure assessment, as provided as an alternative exposure control method in paragraph (d) of the standard for construction. Additionally, there are numerous differences between the tasks listed and the engineering controls, work practices, and respiratory protection specified on OSHA's Table 1 and those included on ASTM's tables. The ASTM standard also does not divide tasks according to duration and does not apply the approach to tasks limited to 90 minutes total time. The differences between OSHA's standard and the consensus standard, including those in the overall approach to compliance and in the format of Table 1, the tasks listed, and the engineering controls, work practices, and respiratory protection specified, best reflect the evidence received into the rulemaking record and the realities of the construction industry. These differences will also enhance compliance with OSHA's standard in the construction industry and, in doing so, better effectuate the purposes of the OSH Act and protect employees in the construction industry from the significant risks posed by exposures to respirable crystalline silica.

Table 1 entries. Table 1 identifies 18 common construction equipment/tasks known to generate high exposures to respirable crystalline silica. For each kind of equipment/task identified, Table 1 specifies appropriate and effective engineering controls, work practices, and, when necessary, respiratory protection. As proposed, Table 1 listed 13 construction operations that expose employees to respirable crystalline silica and identified control strategies and respiratory protection that reduce those exposures. OSHA received many specific comments about particular entries on Table 1 and on the specified engineering controls, work practices, and respiratory protection included for each entry. The additional equipment/tasks included on Table 1 of the final rule for construction are handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less) and rig-mounted core saws and drills. Other entries on Table 1 of the final standard for construction were broken out from those proposed and added as separate entries. These include dowel drilling rigs for concrete (included under "Operating Vehicle-Mounted Drilling Rigs for Concrete" on proposed Table 1), walk-behind milling machines and floor grinders (included under "Milling" on proposed Table 1), small drivable milling machines (included under "Milling" on proposed Table 1), large drivable milling machines (included under "Milling" on proposed Table 1), heavy equipment and utility vehicles used to abrade or fracture silica-containing materials or used during demolition activities involving silica-containing materials (included under "Heavy Equipment During Earthmoving" on proposed Table 1), and heavy equipment and utility vehicles for tasks such as grading and excavating, but not demolishing, abrading, or fracturing silica-containing materials (included under "Heavy Equipment During Earthmoving" on proposed Table 1). One entry on Table 1 of the final standard for construction, vehicle-mounted drilling rigs for rock and concrete, is the result of combining two entries from proposed Table 1 ("Operating Vehicle-Mounted Drilling Rigs for Rock" and "Operating Vehicle-Mounted Drilling Rigs for Concrete"). One proposed entry, "Drywall Finishing," was not included on Table 1 of the final standard for construction. A discussion of each of the 18 Table 1 entries in the construction standard, including the comments received and the changes made from the proposed Table 1 entries, follows below in the order in which they appear on Table 1.

Stationary masonry saws. Stationary masonry saws are used in the construction industry to cut silica-containing masonry materials such as bricks, concrete blocks, stone, and tile (see Section 5.7 of Chapter IV of the FEA). They are mounted either on a table-top or a stand, and include a flat platform where the work piece (e.g., a brick) sits before the worker brings a rotating circular abrasive blade into contact with the work piece by either pressing a swing arm mounted blade onto the piece or by moving the piece on a sliding platform into contact with a fixed blade (Document ID 4073, Attachment 4a, Rows 42-48, 55-63, 179-188, 288-297, 343-351). The cutting surface is about waist-high and at arm's length from the worker's breathing zone. A nozzle for spraying water is usually attached near the blade, and is connected to a water basin of some kind via a hose.

When using stationary masonry saws, paragraph (c)(1)(i) of the standard for construction requires that saws be equipped with an integrated water delivery system that continuously feeds water to the blade and that the tool be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. Saw designs vary between manufacturers and, as with other operating parameters, manufacturer's recommendations for optimizing wet methods are likely to vary somewhat with the saw size and design. OSHA is not specifying a minimum flow rate; based on the evidence in the record, OSHA anticipates that the water flow rate specified by the manufacturer will optimize dust reduction. OSHA recognizes that the employer's best available information for reducing dust with a specific control comes from the manufacturer's operating instructions. This is why OSHA is requiring the saw be operated and maintained according to the manufacturer's instruction to minimize dust.

The language describing the required control for stationary masonry saws was revised from the proposed rule to clarify that water must be continuously applied to the blade, and language was added to require that manufacturer's instructions be followed. This reflects OSHA's intent that employers use a saw with integrated water delivery system supplied by the saw manufacturer. OSHA finds that systems that are developed in conjunction with the tool are more likely to control dust emission effectively by applying water at the appropriate dust emission points based on tool configuration, and not interfere with other tool components or safety devices. These include free-flowing water systems, with or without a pump and basin, that are designed for blade cooling, as well as manufacturer systems designed for dust suppression alone (Document ID 1555, p. 509; 3998, Attachment 12a, pp. 9, 15-16; 3998, Attachment 12e, p. 3).

The proposed entry for stationary masonry saws also included a note requiring that water be changed frequently to avoid silt build-up in water and that the blade not be excessively worn. CISC commented that terms such as these were too ambiguous and would thus prevent the table from being a realistic compliance option (Document 2319, p. 98). OSHA understands that these notes could be subject to interpretation and in response, has removed the notes from Table 1. However, these practices are often included in manufacturer's instructions, and OSHA considers these type of instructions to be part of fully and properly implementing engineering controls (e.g., Document ID 4073, Attachment 4a, Rows 59-61).

In the FEA, OSHA's exposure profile for stationary masonry saws shows that wet cutting is an effective dust control. The median 8-hour TWA exposure in the profile is 34 μg/m^3 for workers using saws with water delivery systems (Table IV-5.7-B in Section 5.7 of Chapter IV of the FEA) and the mean exposure for wet cutting is 41 μg/m^3, substantially lower than the mean of 329 μg/m^3 for dry cutting operations, a disparity that affirms that use of water on stationary saws significantly reduces exposure to respirable crystalline silica. Additional field data also show the effectiveness of water to control respirable crystalline silica exposures during cutting. Flanagan et al., in their 2006 study and 2009 data set, found that wet cutting methods (details not available) were associated with markedly lower exposure levels than were reported for all workers using table-mounted saws (Document ID 0677; 0677, Attachment 2). The silica concentrations reported by Flanagan et al. over the sampling period (ranging from 12 to 505 minutes) when wet cutting ranged from 6 μg/m^3 to 316 μg/m^3, with a mean of 73 μg/m^3 and median of 46 μg/m^3 (Document ID 0677; 0677, Attachment 2). Since most of the sample durations in this dataset were less than 360 minutes, workers' 8-hour TWA exposures were even lower. These data also included indoor work.

In addition to these field results, the record includes experimental studies that examined the effectiveness of wet dust control systems. Meeker et al. (2009) compared intensive masonry cutting done without controls to exposures while using saws with integrated water delivery systems and maximum flow rates of 2.3 and 2.4 liters per minute (0.6 and 0.63 gallons per minute) and found that wet saws were associated with a 91 percent reduction in exposure to respirable quartz (Document ID 803, p. 1; 2177, Reference 11, pp. 104, 107-108). Carlo et al. (2010) found reduction rates of 99 percent in the respirable dust exposure when water was applied at the manufacturer-recommended water flow rate, compared to dry cutting (Document ID 3612, pp. 246-247, 249). While respirable dust reductions do not always translate to exactly the same percent reduction in respirable silica levels, OSHA finds that respirable dust reductions are a reliable indicator of the capability of the control to reduce respirable silica. Therefore, OSHA anticipates that the control discussed in Carlo et al. (2010) would result in significant reductions to silica exposures.

CISC questioned the appropriateness of requiring an integrated water delivery system when most integrated systems are intended to keep the blade cool and are not designed for dust suppression (Document ID 2319, p. 109). However product literature submitted to the docket from five major saw manufacturers (Andreas Stihl, Husqvarna, Hilti, Makita USA, and Wacker Group) highlights the use of water application equipment to suppress dust in addition to blade cooling (Document ID 3620, pp. 6, 10, 24, 30; 3998, Attachment 12a, pp. 9, 15-16; 3998, Attachment 12e, p. 3; 3998, Attachment 12f; 3998, Attachment 12h; 4233, Attachment 1, p. 6). Beamer et al. (2005) conducted experiments to observe the differences in the various wet cutting methods available and found that the greatest improvement in dust reduction occurred with freely flowing water applied at a rate of 48 gallons per hour (0.8 gallons per minute), resulting in dust reduction of about 93 percent and confirming the benefits of water flowing over the stationary saw cutting blade compared with other misting systems (Document ID 1555, p. 509). Therefore, based on the evidence in the record, OSHA has determined that stationary masonry saws equipped with an integrated water delivery system are effective and the best available technology for controlling respirable crystalline silica.

Several commenters suggested that OSHA include an option for dry cutting on Table 1 (i.e., using LEV or other non-wet methods to control dust) because wet methods were not always available and certain materials are required to be cut dry. Commenters explained that freezing temperatures, lack of available water sources on new construction sites, concerns of water damage to surrounding areas during indoor work and problems with discoloration or water staining materials were all reasons why an employer may elect to cut without water (Document

ID 0861, p. iv; 1431, pp. 1-6 – 1-9; 2296, p. 31; 2319, p. 94; 2320, pp. 6-7; 3587, Tr. 3609-3610; 4220, p. 5).

OSHA addresses the issue of freezing temperatures and availability of water in the technological feasibility analysis (Chapter IV of the FEA) and has determined that these barriers can be overcome in most instances, for example by wrapping gutter heat tape around drums of water or adding environmentally-friendly antifreeze additives to water (e.g., Document ID 3589, Tr. 4214, 4230). Moreover, evidence in the record indicates that LEV is not as effective as wet methods for controlling silica dust emissions from stationary saws. In the only study available to OSHA that directly compared wet dust suppression with LEV under the same experimental conditions, Carlo et al. (2010) determined that, even though the use of LEV resulted in substantial respirable dust capture, the water application system reduced the dust to a greater extent, reducing respirable dust levels by a factor of 10 more than the LEV systems tested (Document ID 3612, pp. 247-250). Unlike for wet dust control systems, there is little evidence in the record that LEV systems have proven effective in actual field use; the database compiled by Flanagan et al. contains no sample results from using stationary saws with LEV (Document ID 0677, Attachment 2).

OSHA finds that the study by Carlo et al. indicates that LEV systems on stationary saws are not as effective as water-based dust suppression systems and that respiratory protection will likely be needed. In the PEA, OSHA acknowledged that there was some evidence that exposures could be reduced to or below 50 $\mu g/m^3$ with LEV when saws were used for typical cutting periods (15 to 30 percent of the shift) but that the effectiveness of LEV systems for stationary saws had not been widely evaluated. However, no evidence came into the record after the PEA that would allow OSHA to have greater confidence in the use of LEV when dry cutting or to consider it to be as effective as wet cutting in reducing silica dust exposure. Therefore, OSHA has not included a control alternative for the use of dry cutting with LEV in Table 1, and is only allowing integrated water systems for compliance with Table 1.

OSHA understands that there may be limited situations where the use of wet systems is not feasible for a given application. For those situations, the employer may use other means of dust control such as LEV systems, but the employer must then follow paragraph (d) rather than paragraph (c) of the standard for construction, i.e., comply with the 50 μg/m^3 PEL, perform exposure assessments to determine compliance with the PEL, and supplement the engineering and work practice controls with respiratory protection where the PEL is not being met.

Stationary masonry saws with integrated water systems are readily available from several manufacturers including EDCO, Andreas Stihl, Hilti, Makita USA, Husqvarna, Wacker Group, MK Diamond, and Bosch (for tile cutting) and are effective and the best control option available (Document ID 4073, Attachment 4a, Rows 59-63, 183-188, 292-297, 347-351, 417-419; 4073, Attachment 4b, pp. 10-12, 21; 3998, Attachment 12a; 3998, Attachment 12e; 3998, Attachment 12f; 3998, Attachment 12g; 3998, Attachment 12h). Therefore, OSHA has determined that an integrated water delivery system is the appropriate control for inclusion on Table 1.

In the proposed rule, OSHA required the use of a half-mask respirator for employees who operated stationary masonry saws for more than four hours. OSHA made this determination based on the highest exposure results included in its exposure profile. OSHA has since determined that when fully and properly implementing all of the provisions under paragraph (c), employees can operate stationary masonry saws without the use of respirators. This is supported by the exposure profile contained in Table 5.7-B in Section 5.7 of Chapter IV of the FEA, which shows a mean exposure of 41 μg/m^3, a median of 34 μg/m^3 and 75 percent of the sample results below 50 μg/m^3. Flanagan et al. reported similar exposures with a mean exposure of 48 μg/m^3 crystalline silica from four exposure samples taken while workers operated saws indoors or in enclosed areas (Document ID 0677, Attachment 2). While water use was not described in any detail, these data show that exposures can be consistently maintained at a level where respiratory protection is not needed. Therefore, the final rule does not require the use of respiratory protection when employers are using wet stationary saws in accordance with Table 1, even when stationary masonry saws are used indoors or in otherwise enclosed areas (situations which are the most likely to generate high exposures).

Handheld power saws (any blade diameter). In the proposed rule, this entry was listed as "Using Handheld Masonry Saws." OSHA has changed the title of this entry in the final rule to clarify that the requirements in Table 1 apply to any use of handheld power saws, not just those involving masonry materials. However, the tools included under this entry have not changed and include cut-off, chop, quickie, and handheld masonry saws.

Handheld power saws are used in the construction industry for cutting a variety of materials (see Section 5.6 of Chapter IV of the FEA). They usually consist of a semi-enclosed circular blade, directly adjacent to or in front of two handle grips which are perpendicular to each other. The blade enclosure covers the half (or more) of the blade directly facing the worker. A worker typically will use the blade to cut a work piece (e.g., a brick) placed on the ground by starting the device and slowly lowering the entire handheld saw with both hands to the work piece until the rotating blade makes contact and begins to cut, at which point the worker applies pressure to the work piece and cuts appropriately (Document ID 4073, Attachment 4a, Row 47). A nozzle for spraying water is usually located near the blade, and a water source is usually connected to the saw from a water source via a hose (Document ID 3998, Attachment 12e; 3998, Attachment 12f; 3998, Attachment 12h, pp. 10-11).

When using handheld power saws with any blade diameter (except saws used to cut fiber-cement board), paragraph (c)(1)(ii) of the standard for construction requires that saws be equipped with an integrated water delivery system that continuously feeds water to the blade and that it be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. Like stationary saws, designs vary between manufacturers and, as with other operating parameters, recommendations for optimizing wet methods are likely to vary somewhat with the saw size and design. In light of these variables, OSHA is not specifying a minimum flow rate. In addition, OSHA is recognizing that the employer's best available information for reducing dust with a specific control comes from the manufacturer's operating instructions, which is why OSHA is requiring the saw be operated and maintained according to the manufacturer's instructions to minimize dust. Water-fed handheld saws are commercially available from a variety of sources (Document ID 0615; 0737; 3998, Attachment 12e; 3998, Attachment 12a; 3998, Attachment 12f; 3998, Attachment 12g; 3998, Attachment 12h).

The data in the record and the studies reviewed by OSHA demonstrate that water spray suppression systems reduce respirable crystalline silica exposures substantially where the system was well designed and properly implemented and maintained (Document ID 0868; 1181; 3497; 3610; 3777; 4073, Attachment 8a). Use of an integrated water delivery system on the cut-off, chop, quickie or masonry saws has been shown to reduce respirable dust exposures by 78-96 percent (Document ID 0868, p. v; 1181, p. 443; 3610, p. 157; 3777, p. 67). Data compiled by the CSDA from member jobsites as well as NIOSH documents showed that all outdoor hand sawing using a saw equipped with a water supply produced exposure levels below a TWA of 50 μg/m^3 (Document ID 3497, p. 5).

In a laboratory study, Thorpe et al. (1999) evaluated the effectiveness of two types of water supplies commonly used with handheld saws: 1) a pressurized portable water supply and 2) a constant water supply (Document ID 1181, pp. 443, 445-447). During this evaluation, 15-minute PBZ samples were collected during uncontrolled and controlled (i.e., water-fed) cutting of concrete slabs containing 20 percent to 40 percent silica (i.e., worst-case conditions) (Document ID 1181, p. 447). The study protocol involved short sampling durations because handheld saws are typically used intermittently to make short cuts. The uncontrolled mean silica concentration during multiple 15-minute trials of intensive cutting ranged from 1,700 μg/m^3 to 4,800 μg/m^3 (reported as 1.7 to 4.8 mg/m^3) (Document ID 1181, p. 448). Reductions in exposure to respirable silica dust when cutting concrete slabs using wet methods compared with no controls were 75 percent for diamond blades and 94 percent for resin blades when using water supplied by mains, and 75 percent for diamond blades and 77 percent for resin blades when using water supplied by a portable tank. Both sources of water were effective at reducing respirable dust, however, the portable tank needed to be periodically re-pressurized to maintain the necessary flow rate, while the water supplied from the mains provided a more constant flow rate. Both types of systems used to supply water to an integrated water delivery system would be acceptable under the table.

NIOSH also evaluated the performance of a commercially available water backpack and spray attachment, pre-set by the attachment manufacturer to provide 1.4 liters per minute water consumption (0.36 gallons per minute) for handheld saws during concrete block cutting (Document ID 0868, pp. 8, 11). The handheld electric abrasive cutter was used outdoors to make cuts through concrete blocks laid lengthwise on a plank 17 inches above the ground. During the 5- to 10-minute trials with water-fed saws, the water spray attachment reduced quartz exposures by an average of 90 percent from uncontrolled levels (Document ID 0868, p. 10). Middaugh et al. (2012) conducted a workplace field study to evaluate the effectiveness of dust controls on cut-off saws (Document ID 3610, p. 158). Air sampling was conducted for 10 days at 5 job sites on 4 experienced operators using gas-powered cutoff saws with 14 inch (35.6mm) diameter blades to cut concrete curbs (Document ID 3610, p. 159). Air sampling was conducted both with and without wet methods; sampling ranged from 4 to 16 minutes and corresponded to the entire duration of the task (Document ID 3610, pp. 159-161). With wet suppression, the concentration of respirable silica levels was reduced 78 percent to 210 $\mu g/m^3$ (Document ID 3610, p. 162).

Based on the information in the record, OSHA concludes that most of the time, handheld power saw operators use the saw for two hours or less over the course of a workshift, typically using handheld saws for brief, intermittent periods repeated numerous times over the course of a shift (Document ID 1431, p. 3-63). The Mason Contractors Association of America stated that "90 minutes is actually a really long time to be cutting something. The vast majority of [cutting tasks] are under 15 minutes [total] in any given day" (Document ID 3585, Tr. 2911). The Bay Area Roofers Waterproofers Training Center agreed, clarifying that when cutting is performed as part of its work it is usually half an hour to 45 minutes a day (Document ID 3581, Tr. 1598). Information contained in research supports this as well. Thorpe et al. (1999) used 15-minute sampling durations in the study protocol because handheld saws are typically used intermittently to make short cuts (Document ID 1181, pp. 447-448). Middaugh et al. (2012) explained that concrete cutting in roadway construction is frequently performed with a handheld saw, noting that "although some applications may require cutting for an entire 8-hour workday, typical cutting is performed for less than two hours per day" (Document ID 3610, p. 162). Sample times from the Flanagan et al. database support this; the median time for using handheld portable saws was 101 minutes and the range of cutting times was from 9 to 447 minutes, indicating that saws are typically used for only a portion of the shift, although some workers cut for longer durations (Document ID 0677, Attachment 2).

Estimated TWA exposures (i.e., averaged over eight hours) using task measurements from field studies may exceed 50 μg/m^3 when workers cut with water for two or more hours per day (Document ID 3610; 4073, Attachment 8a, p. 1; 0868). Shepherd and Woskie (2013) estimated that if typical cutting conditions (intensive cutting) were performed outdoors with wet methods for two hours and no other exposure occurred for the remainder of the day, 83 percent (88 out of 106) of the saw operators' 8-hour TWA exposures would be 50 μg/m^3 or less (Document ID 4073, Attachment 8a, p. 1). In further analysis, the authors considered what would happen if operators used the water-fed saws outdoors at this same level of intensity for a full 6 hours of the shift, in which case 61 percent of operators would have 8-hr TWA exposures of 50 μg/m^3 or less (Document ID 4073, Attachment 8a, p. 1).

In the proposal, OSHA based its requirement to use respiratory protection for operating saws more than four hours per shift on the few higher exposure values in its exposure profile, which indicated that exposures would exceed 50 μg/m^3 occasionally when wet cutting with portable saws. However, OSHA concludes that the study by Shepherd and Woskie (Document ID 4073, Attachment 8a) as well as other material contained in the record and discussed above provide a better basis on which to determine the need for respiratory protection. Based on these studies, OSHA determined that outdoor wet cutting for more than four hours could result in more frequent exposures over 50 μg/m^3 than are experienced with shorter task durations. Therefore, paragraph (c)(1)(ii) of the standard for construction requires use of respiratory protection having an APF of at least 10 for employees using a handheld power saw of any blade diameter equipped with an integrated water delivery system for more than four hours per shift. When cutting for four hours or less outdoors, no respiratory protection is required.

The vast majority of samples reviewed by OSHA involve the use of handheld saws outdoors. However, employees may occasionally use handheld saws indoors. When an employee uses a water-based system indoors or within enclosed areas, elevated exposures can still occur (Document ID 0675; 0177; 0846; 3497; 3777). Data submitted by CSDA shows that almost all indoor hand sawing using wet methods produced exposure levels above 50 μg/m^3 (Document ID 3497, pp. 1-4, 6, 8). Additionally, a field study of wet sawing found that an enclosed location (in a large garage building open in front and closed on 3 sides) resulted in significantly higher exposures than when the work was done outdoors (Document ID 3777, p. 1); a separate study found levels as high as 240 and 260 μg/m^3 during indoor wet sawing (Document ID 0675, p. 1098). OSHA's exposure profile contained in Section 5.6 of Chapter IV of the FEA shows that using wet methods indoors results in higher exposures when compared to outdoor cutting with only 50 percent of the exposures in indoor environments being 50 μg/m^3 or less, compared to 80 percent of the outdoor wet sawing samples. Although wet methods substantially reduce operator exposures compared to uncontrolled dry cutting indoors, elevated exposures still occur routinely. To reduce these exposures, OSHA is requiring that work done indoors or in enclosed areas have additional general ventilation such as exhaust trunks, fans, air ducts or other means of forced air ventilation to prevent the accumulation of dust in the work area. Accordingly, for indoor work, paragraph (c)(1)(ii) requires the use respiratory protection with an APF of 10 regardless of task duration.

Representatives from the roofing industry expressed concern regarding the use of wet methods in their industry, citing primarily the potential increase in slips and falls from introducing water to elevated worksites (Document ID 2320, p. 116; 2192, p. 4; 3526, p. 7). The Tile Roofing Institute stated that in California and Arizona, rooftop operations with roofing tiles or pavers are given an exemption from the requirement to use a dust reduction system because there is no way to address both the silica and fall protection hazard (Document ID 3587, Tr. 3595). Conversely, testimony from the public hearings indicates that wet dust control systems can be used to reduce exposures to silica during cutting of roofing tiles and pavers. Dan Smith, director of training for the Bay Area Roofers and Waterproofers Training Center, testified that the roofing industry in California is starting to voluntarily cut roofing tiles and pavers wet (Document ID 3581, Tr. 1600-1601; 1638) and that use of controls may actually increase visibility, thereby reducing a potential fall hazard (Document ID 3581, Tr. 1603-1604). He also explained that dry cutting of roofing tiles is prohibited in the U.K., and that the contractors association (the National Federation of Roofing Contractors), "…provides guidance and training. They use wet saws on scaffolding at the roof level…they use a [water] mister on the tile saw. They use a system like the hytile . . . which is a tile breaking tool" (Document ID 3581, Tr. 1601).

OSHA understands the concerns expressed by representatives from the roofing industry regarding the use of wet methods and increased risk for falls; however, OSHA concludes that alternate project planning can enable employers to use wet methods by implementing some of the measures described above.

In the proposed rule, OSHA included an option under Table 1 for the use of LEV when using portable masonry saws. While including LEV as an alternative to wet methods in the table was supported by both labor and industry groups (Document ID 2296, p. 32; 4223, p. 140; 4233, Attachment 1, p. 1), OSHA has removed this option from Table 1 based on information contained in the record indicating that LEV cannot consistently maintain exposure at or below a TWA exposure level of 50 μg/m^3 (see Section 5.6 of Chapter IV of the FEA). OSHA is not prohibiting use of LEV for dry cutting, as LEV may be effective in reducing exposure to or below 50 μg/m^3 in situations where, for example, saw use is intermittent. Employers who choose to do so may still use LEV in lieu of an integrated water system; however, those employers would be required to comply with the PEL and exposure assessment requirements under paragraph (d) of the standard for construction.

Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less). These specialized saw configurations consist of blades (with four to eight teeth) specifically designed for cutting fiber-cement board (see Section 5.6 of Chapter IV of the FEA) (Document ID 2322, p. 9; 2322, Attachment B, p. 8). The blades are fitted to a circular saw (or occasionally to other saws) with dust reduction systems (Document ID 2322, p. 9; 2322, Attachment B, p. 36). These saws have been specifically designed and tested by a member of the fiber-cement siding industry and by NIOSH for controlling the silica exposure of installers who perform cutting in that industry, and the saw is intended specifically for use on fiber-cement board (Document ID 2322, pp. 5, 9; 2322 Attachment B, pp. 33, 36).

When using handheld power saws with a blade diameter of 8 inches or less for cutting fiber-cement board outdoors, paragraph (c)(1)(iii) of the standard for construction requires saws to be equipped with a commercially available dust collection system that provides the air flow recommended by the manufacturer and a filter with a 99 percent or greater efficiency, operated in accordance with the manufacturer's instructions to minimize dust emissions. OSHA is not providing an entry for use of these saws indoors on Table 1 because fiber-cement board, used as siding and fascia applied to the exterior of buildings, is usually cut outdoors and the record lacks information on exposures to silica that would result from cutting fiber-cement board indoors. Therefore, employers who choose to operate saws to cut fiber-cement board indoors must conduct exposure assessments and comply with the PEL in accordance with paragraph (d) of the standard for construction.

This entry was added to Table 1 of the final standard for construction in response to comments NIOSH and the fiber-cement board industry submitted to the rulemaking record. These submissions provided substantial data on control technology (a specially configured saw) for controlling silica exposure when saw operators cut fiber-cement board (Document ID 2177, Attachment B, pp. 17-19; 2322, Attachment B-E and H).

The James Hardie Building company submitted 75 samples for workers using specially configured circular saws (with specialty blades of less than 8 inches) for cutting fiber-cement board with LEV (Document ID 2322, pp. 19-20). These saws were all fitted with cutting blades designed for the fiber-cement board product and some form of dust collector (but not always designed with vacuum suction). Workers using these saws had a mean 8-hour TWA exposure of 11 $\mu g/m^3$ (median 7 $\mu g/m^3$), although elevated exposures (maximum exposure of 76 $\mu g/m^3$) occurred with some saw/control configurations that proved less reliable (for example, saws attached to a dust receptacle, without the benefit of a vacuum dust collection device) (Document ID 2322, pp. 19-20). Although the cutters sawed fiber-cement board products containing 15 to 50 percent silica, the respirable dust collected in the samples was 0 to 12 percent silica and percentages in the lower half of that range were most typical (Document ID 2322, Attachment D, pp. 5-10; 2322, Attachment E, pp. 5-9; 2322, Attachment F, pp. 5-10). Most of the sawyers for whom exposures were elevated cut siding for approximately half the shift (four to five hours), a duration representative of typical cutting activities during a normal day of fiber-cement siding installation (Document ID 2322, Attachment D, p. 16; 2322, Attachment E, p. 16; 2322, Attachment F, p. 18). Several NIOSH reports demonstrate that this and other saw configurations are effective in achieving exposures of 50 μg/m^3 or below when the saw is used with a vacuum dust collector (Document ID 4138; 4139, p. 11; 3998, Attachment 4a; 3998, Attachment 4b; 3998, Attachment 4c).

Based on the evidence in the record, commercially available dust collection systems for handheld power saws with a blade diameter of 8 inches or less and a dust collection device providing the air flow recommended by the manufacturer have been demonstrated to be particularly effective in controlling silica during outdoor cutting of fiber-cement board. One type of saw evaluated was a handheld, dust collecting model equipped with dust collection device rated at 200 cfm over a 7.25-inch-diameter blade (27.5 cfm per inch); however, the measured flow rate was reported to be 69 to 106 cfm. Using this configuration, all 21 exposure samples taken for siding cutters on construction sites were 41 μg/m^3 TWA or less (20 sample results were less than 25 μg/m^3) while cutting a variety of fiber-cement board siding products containing up to 50 percent silica (Document ID 3998, Attachment 4a; 3998, Attachment 4b; 3998, Attachment 4c; 4138; 4139). Accordingly, OSHA is requiring in paragraph (c)(1)(iii) that dust collectors be used with saws when cutting fiber-cement board.

Based on the evidence in the record, OSHA is not requiring the use of respiratory protection when employees are using handheld power saws with a blade diameter of 8 inches or less, for cutting fiber-cement board outdoors in accordance with Table 1 for any task duration. OSHA has determined that in such circumstances, employee exposures will be reduced to 50

$\mu g/m^3$ or less when the controls specified for this task on Table 1 are fully and properly implemented.

Walk-behind saws. When using walk-behind saws (see Section 5.6 of Chapter IV of the FEA), paragraph (c)(1)(iv) of the standard for construction requires that saws be equipped with an integrated water delivery system that continuously feeds water to the blade and that the tool be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. OSHA is specifying that the saws be used with an integrated water feed system because the Agency has identified this as the most effective means of reducing exposures to respirable crystalline silica. This requirement is essentially the same as was proposed for the entry "Using Portable Walk-Behind and Drivable Masonry Saws." As explained below, requirements in the final rule for drivable saws have been separated from those for walk-behind saws.

Saw designs vary among manufacturers, and as with other operating parameters, recommendations for optimizing wet methods are likely to vary somewhat with the saw size and design. As with other saws, OSHA is not specifying a minimum flow rate, but rather anticipates that the water flow rates specified by the manufacturer will optimize dust reduction. OSHA recognizes that the employer's best available information for reducing dust with a specific control comes from the manufacturer's operating instructions, which is why OSHA is requiring the saw be operated and maintained according to the manufacturer's instructions to minimize dust. Water-fed walk-behind saws (manual and self-propelled) are widely available from many manufacturers and construction tool distributors, such as Grainger, EDCO, MK Diamond, and CS Unitec (Document ID 0715; 1676; 1185; 0643; 0615).

CSDA stated that "nearly 100% of CSDA contractors use water on each and every job and this has to do with extending the life of the expensive diamond tools. The use of water has an additional benefit of containing silica particles that could become airborne" (Document ID 3496, p. 3). This was supported by others during the public hearings (Document ID 3580, Tr. 1438; 3585, Tr. 2885) and in written comments (Document ID 2316, p. 3). Disagreeing, both SMI and the Mason Contractors Association of America commented that most water-fed systems are designed to keep the blade cool, and their ability to suppress dust has not been sufficiently researched (Document ID 2316, p. 3; 3585, Tr. 2885). CISC similarly asked whether an additional water feed is needed for these saws or whether the one currently integrated for the purpose of cooling the saw will suffice (Document ID 2319, p. 104).

OSHA finds that considerable evidence in the record shows that water application reduces dust emissions, and several saw manufacturers state that using wet cutting will suppress dust (see discussion about requirements for water delivery systems above). Furthermore, the water delivery system described in Linch (2002) was for the purpose of cooling or protecting the blade, but was effective in suppressing respirable silica levels to below 50 $\mu g/m^3$ (Document ID 0784, p. 216). CSDA submitted exposure data collected during slab sawing with saws "equipped with water supply," presumably for blade cooling. Those data show that of 26 measurements of silica concentrations taken during outdoor work, 21 (80 percent) were less than 25 $\mu g/m^3$, and only one sample (65 $\mu g/m^3$) exceeded 50 $\mu g/m^3$ (Document ID 3497, pp. 2-4). Therefore, OSHA concludes water provided as coolant can also control silica exposure.

CISC questioned the feasibility of using wet methods in situations where there is no established water main on site (Document ID 2319, p. 112). OSHA finds that water tanks, which were used to provide water to the walk-behind saws in Linch (2002), are already commonly available on many construction sites and could provide water for a walk-behind saw (Document ID 0784, pp. 216-217).

Data contained in the record show that none of the respirable silica results associated with wet cutting outdoors using walk-behind saws exceeds 50 μg/m^3 , with the majority of these results being less than or equal to the limit of detection (Document ID 0784, p. 216-217). These results were obtained using the saw's normal water feed system intended for cooling the blade. Therefore, OSHA has determined that no respiratory protection is required when working outdoors with a walk-behind saw for any task duration.

Since walk-behind saws are used to cut pavement, they are most commonly used outdoors, though they can also be used indoors (Document ID 1431, p. 3-63). Although the data are limited, water-fed walk-behind saws used indoors or in enclosed areas may result in higher exposures than those measured outdoors. Studies by both NIOSH and Flanagan et al. (2001) noted the potential for elevated exposure when walk-behind saws with continuous water application are used indoors, with Flanagan et al. reporting four 8-hour TWA sample results between 65 to 350 μg/m^3 for four to seven hours of work (Document ID 4233, Attachment 1, p. 10; 0675, pp. 1098-1099). Additionally, the CSDA report submitted to the record shows the only exposure result from indoor slab sawing exceeded 50 μg/m^3 despite the use of equipment with water supply (Document ID 3497, pp. 2-4). These results indicate that the source for the elevated exposure is likely due to the build-up of respirable aerosol within the enclosed space, rather than direct exposure to slurry spray (Document ID 0675, p. 1099). While OSHA anticipates that the results for indoor sawing can be reduced by minimizing the build-up of dust with supplemental ventilation as required under paragraph (c)(2)(i) of the rule, OSHA is unable to conclude that exposures can be consistently reduced to 50 μg/m^3 or less for this task when performed indoors.

Therefore, when used indoors or in an enclosed area, OSHA is requiring the use of respiratory protection with an APF of 10 regardless of task duration.

Drivable saws. Paragraph (c)(1)(v) of the standard for construction requires that, when using drivable saws to cut silica-containing materials, the saw must be equipped with an integrated water delivery system that continuously feeds water to the blade and that the tool be operated and maintained in accordance with the manufacturer's instructions to minimize dust emissions. Drivable saws include those where the operator typically sits in a cab (open or enclosed) away from the pavement cut point, guiding the saw to make long cuts such as are common for utility installation along roadways. These saws are cumbersome to move and are typically only used when making long cuts. The blade housed by the vehicle can be large (e.g., 8 feet in diameter and 2 inches thick) and is usually equipped with a water-fed system to cool the blade (Document ID 1431, pp. 3-63-3-64). The requirement to use integrated water systems on drivable saws is unchanged substantively from the proposal.

In its Technological Feasibility analysis (see Section 5.6 of Chapter IV of the FEA), OSHA analyzes exposures for workers using drivable saws. The exposure profile includes three samples, two using wet methods as required by Table 1 and one operating under other conditions. The two samples taken on workers using wet saws showed TWA silica exposures of 12 $\mu g/m^3$ (i.e., below the limit of detection (LOD)) and 33 $\mu g/m^3$ over sampling times of 70 and 125 minutes, respectively. OSHA considers these exposure results to reflect typical work patterns in that operators will often operate the saw for one or two hours before moving the saw to another location. CISC questioned OSHA's use of short term samples and the assumption of zero exposure during the unsampled portion of the shift and noted that this could underestimate the exposures for these workers (Document ID 2319, pp. 51-52). While OSHA acknowledges that this situation may occur at times, there is no evidence that this is the case for these drivable saws samples. These samples were collected by OSHA inspectors, who are instructed to sample for the entire duration of silica exposure. Accordingly, OSHA concludes that these samples accurately characterize the sampled workers' exposure.

In the proposed rule, dust control requirements were specified for drivable and walk-behind saws together, and the proposed rule would have required respirator use when operating either saw in indoor or enclosed environments. In the final standard for construction, the requirements for these kinds of saws are separated on Table 1 because, unlike walk-behind saws, drivable saws are rarely, if ever, used in indoor environments. Because the requirements of Table 1 only apply to outdoor use of drivable saws, and the data available to OSHA demonstrate that the wet methods described above can consistently control exposures in that environment, Table 1 does not require the use of respiratory protection when these controls are implemented, regardless of task duration.

SMI and CISC commented that currently drivable saws use water to cool the cutting tool, and the effectiveness of cooling water for respirable crystalline silica dust mitigation has not been comprehensively researched (Document ID 2316, Attachment 1, p. 3; 2319, p. 112). SMI stated specifically that "parameters such as flow rate, volume, flow delivery characteristics, velocity, and delivery location have not been evaluated or compared" (Document ID 2316, p. 3). However, Atlantic Concrete Cutting agreed that all of its cutting services were performed with water (Document ID 2367, p. 2), and that the application of water minimized and most likely eliminated exposure to respirable crystalline silica. Atlantic Concrete Cutting also stated that the use of a "water-fed system that delivers water continuously at the cut point" would be an appropriate silica dust control for drivable saws and that respirators would not be needed to further protect employees (Document ID 2367, pp. 2-4). In light of this testimony, OSHA concludes that it is appropriate to permit employers to fully and properly implement water-based systems on drivable saws in compliance with Table 1, eliminating their need to conduct exposure assessments for employees engaged in a task using drivable saws. Moreover, as reflected in Table 1, OSHA concludes that full and proper implementation of this control will not require the use of respirators for this task even if performed for more than four hours in a shift and so has not included respiratory protection for this task.

Rig-mounted core saws or drills. Paragraph (c)(1)(vi) of the standard for construction, an entry for rig-mounted core saws or drills, was not included in proposed Table 1. Core saws or drills are used to perform core cutting (also called core drilling, boring, or concrete coring) to create round holes for pipes, ducts and conduits to pass through walls, ceilings and floor slabs made of concrete, masonry or other materials that may contain silica (see Section 5.6 of Chapter IV of the FEA). Core cutting machines (also called core drills) use a thin continuous round cutting surface on the round end of a cylindrical coring tool ("bit") (Document ID 0679, pp. 18-20). The machine is typically attached to the surface being drilled (bolted on via a rig for stability) (Document ID 3998, Attachment 13e, pp. 4, 9). When the rotating diamond core cutting bit is applied to solid material, the bit cuts away a thin circle of material. The cut separates the central "core" of material, within the circumference of the bit, from its surroundings, leaving the core generally intact as it is removed from the hole (Document ID 3501, p. 6). The cylindrical bit can range in size; for example NIOSH described a coring operation used to produce holes 2 to 31 inches in diameter in large sections of concrete conduit (Document ID 0898, p. 6).

For rig-mounted core drills, there is one specified control that consists of using a tool equipped with an integrated water delivery system that supplies water to the cutting surface, operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. Based on evidence in the record, OSHA has determined that baseline conditions for core cutting involve using wet methods and that most core cutting machines are provided with and intended to be used with a water feed system (e.g., Document ID 0675, p. 1097; 0679, pp. 18-21; 0898, p. 6; 3580, Tr. 1415, 1435; 3581, Tr. 1584; 3585, Tr. 2902). Like other saws included in Table 1, these existing systems will fulfill the requirements of Table 1.

Comments submitted by SMI expressed confusion as to whether or not core drilling was included on the table under the entry for drills and the appropriateness of using LEV as required under the proposed table during core cutting (Document ID 2316, p. 2). In the proposed rule, OSHA specifically excluded core cutters from hole drillers using handheld drills (see PEA, p. IV-403). OSHA did not include this information because OSHA lacked specific information on exposures to silica that result from core drilling or from industry's practice of using water during coring operations. Upon OSHA's review of core cutter/driller operator exposures and hearing testimony from industry, OSHA determined that there is the potential for silica exposure when employing core saws and that these saws are different enough from other drills and cutting tools to warrant the inclusion of its own separate entry on Table 1.

Kellie Vasquez of Holes Incorporated testified that the process of core drilling is much different than other types of drilling due to the different drill bits used, resulting in much less silica exposure (Document ID 3580, Tr. 1484). This is supported by OSHA's review of record data on core cutting/drilling, which shows that operators generally experience little or no silica exposure during this low-speed process, which is already performed using water-fed equipment as a standard practice (Document ID 0675, pp. 1097-1098; 0898, p. 15).

Additional exposure data compiled by CSDA from member jobsites (Document ID 3497) and other studies (Document ID 0675; 0679; 0898) show that using a core drill with wet methods results in exposure levels of less than 50 μg/m^3 (Document ID 3497). During hearing testimony, BCTD commented that core drills are always used with wet methods (Document ID 3581, Tr. 1584). This was supported by Kellie Vasquez of Holes Incorporated who stated that her concrete cutting operations employ water 100 percent of the time (Document ID 3580, Tr. 1483). Accordingly, OSHA added dust control specifications for core sawing and drilling to Table 1 of the final standard for construction. Because the available evidence described above demonstrates that using wet dust suppression systems for core cutting does not result in silica exposures exceeding 50 μg/m^3, the final standard for construction does not require the use of respiratory protection.

Handheld and stand-mounted drills (including impact and rotary hammer drills). Handheld drills are used to, among other tasks, create holes for attachments and small openings in concrete and other silica containing materials (see Section 5.4 of Chapter IV of the FEA). These drills can: 1) be electric, pneumatic, or gas-powered; 2) use rotary hammers or percussion hammers; and 3) be free-standing or stand-mounted. Handheld drills consist of a handle with a trigger button to begin drilling, a motor compartment above and perpendicular to the handle, and a socket to insert drill bits of varying lengths and styles at the end of the motor compartment. Impact and rotary hammer drills appear the same, but provide the ability to drill with extra motor-generated impacts and/or torque. The drills may have a second handle in front of the main handle for a worker to grasp with the off hand. To control dust, they may contain attachable dust collection systems where the end of the drill bit is surrounded by a vacuuming compartment which connects to the rest of the drill, allowing for dust to be removed while drilling (Document ID 4073, Attachment 4a, Row 68). Handheld drills can also be stand-mounted, in which case a drill is turned on its side and mounted to an adjustable stand, allowing the worker to drill directly into a work product with precision (Document ID 4073, Attachment 4a, Row 72).

Paragraph (c)(1)(vii) of the standard for construction requires that handheld and stand-mounted drills be equipped with a commercially available shroud or cowling with dust collection system that provides at least the minimum air flow recommended by the manufacturer. The dust collection system must include a filter cleaning mechanism and be equipped with a filter with 99 percent or greater efficiency. The dust collection system must be operated in accordance with the manufacturer's instructions to minimize dust emissions. In addition, OSHA is requiring that a HEPA-filtered vacuum be used when cleaning debris from drill holes.

The proposed Table 1 labeled this category of tools "Using rotary hammers or drills (except overhead)." In response to several comments, OSHA has revised this description to make clear that drills mounted on stands are also included and also removed the exclusion for overhead drilling. For example, SMACNA recommended expanding the entry for rotary hammers and drills to include overhead drilling, contending that overhead drilling would be just a safe as other drilling if done as directed on the table (Document ID 2226, p. 2). The Mechanical Contractors Association of America commented that overhead drilling should be included in Table 1 since overhead drilling is a common operation in several trades (Document ID 2143, p. 2). OSHA received testimony that overhead drilling along with a drill stand with a vacuum attachment addresses both ergonomic and silica exposure hazards. After review of the evidence in the record, OSHA has determined that it is appropriate to remove the exclusion for overhead drilling in the Table 1 entry for handheld and stand-mounted drills.

As proposed, Table 1 had separate entries for “Rotary Hammers or Drills” and “Jackhammers and Other Impact Drillers.” OSHA received comments from PTI suggesting that impact drills be covered by the entry for “Rotary Hammers or Drills,” rather than by the “Jackhammers and Other Impact Tools” entry (Document ID 1973, Attachment 1, p. 4). NIOSH also commented on the potential for confusion, noting that a rotary hammer or drill is technically an impact driller (Document ID 2177, Attachment B, pp. 32-33). Therefore, the entry for handheld or stand-mounted drills in final Table 1 covers activities related to the use of impact and rotary hammer drills. Chipping and breaking activities, which are associated with more intense silica exposures, are covered by the entry for jackhammers and handheld power chipping tools.

CISC commented that OSHA did not state in the proposed rule that the dust collection system needs to be “commercially available” (Document ID 2320, p. 112). In the final standard for construction, OSHA has clarified that Table 1 requires that the handheld or stand-mounted drill be equipped with a commercially available shroud or cowling with dust collection system. Several drilling equipment manufacturers sell dust extractors or dust collectors to minimize dust escaping into the work area. These systems include a vacuum with a filter cleaning mechanism and a filter with 99 percent or greater efficiency. Some examples include Bosch, DeWalt, Hilti, and Metabo (Document ID 3998, Attachment 10; 4073, Attachment 4a, Rows 15-18, 64-70, 111-119, 189-195, 289-301, 352-357). OSHA has determined that it is feasible for employers to obtain controls for handheld and stand-mounted drills that meet the specifications in Table 1.

Based on evidence in the record, OSHA finds that, for most tools, a commercial dust control system using an appropriate vacuum will provide the most reliable dust capture. Average respirable quartz levels varied among the different cowling/vacuum combinations. In one study, all commercial cowl/vacuum combinations tested resulted in personal breathing zone exposures of 28 $\mu g/m^3$ or less during drilling (Document ID 1142, p. 42). Another study reported median silica exposures of 60 $\mu g/m^3$ and 45 $\mu g/m^3$, depending on drill bit size, in a room with limited air exchange (Document ID 1391, pp. 11-12, 15-19). These findings indicate that providing a means of exhaust when working indoors or in enclosed areas, as required under paragraph (c)(2)(i) of the standard for construction, in addition to using dust collection systems, will maintain exposures below 50 $\mu g/m^3$. Based on these findings, OSHA is not requiring the use of respiratory protection when using handheld or stand-mounted drills, including overhead drilling, for any task duration.

The practice of dry sweeping or brushing debris from a hole, or using compressed air to clean holes, contributes to the exposure of employees using drills. Based on the evidence in the record, OSHA is requiring that holes be cleaned with a HEPA-filtered vacuum. Any method for cleaning holes can be used, including the use of compressed air, if a HEPA-filtered vacuum is used to capture the dust. If a HEPA-filtered vacuum is not used when cleaning holes, then the employer must assess and limit the exposure of that employee in accordance with paragraph (d) of the standard for construction.

While the paragraph on housekeeping (paragraph (f) of the standard for construction) also applies when employers are following paragraph (c) of the standard for construction, the employer must ensure that all of the engineering controls and work practices specified on Table 1 are implemented. For example, paragraph (f)(2)(i) of the standard for construction permits the use of compressed air when used in conjunction with a ventilation system that effectively captures the dust cloud. However, to fully and properly implement the controls on Table 1, an employer using compressed air when cleaning holes during tasks using handheld or stand-mounted drills or dowel drilling rigs for concrete must use a HEPA-filtered vacuum to capture the dust, as specified in paragraphs (c)(1)(vii) and (viii) of the standard for construction, not just a ventilation system as specified in paragraph (f)(2)(i) of the standard for construction.

PCI noted that anchor holes must be blown clean to obtain adequate adhesion, and recommended that the use of compressed air and dry sweeping be allowed unless exposures will exceed 50 $\mu g/m^3$ (Document ID 2276, pp. 10-11). This recommendation assumes exposure assessment, however, the construction standard does not require such assessment where the task is included in Table 1 and the employer is following Table 1. Although OSHA is allowing the use of compressed air if used in conjunction with a HEPA-filtered vacuum to capture the dust, OSHA has determined that there are a number of feasible alternatives to using compressed air. At least one tool manufacturer offers an anchor system with “no hole cleaning requirement whatsoever,” due to the use of a drill with a ventilated drill bit (Document ID 4073, Attachment 4b, Slide 12). Another manufacturer offers a “hole cleaning kit” for large hammer hole drilling, which consists of a doughnut-shaped dust collection head that attaches directly to a vacuum cleaner hose. The head is placed against the surface to be drilled and captures dust generated as the hole is drilled (Document ID 4073, Attachment 4b, Slide 17). This hole cleaning kit also includes two sizes of hole cleaning tubes. Such a control could be used with existing as well as new drills (e.g., Document ID 3998, Attachment 10, p. 42).

Data suggest that decreasing employees’ reliance on blowing or dry sweeping drilling debris can reduce exposures by approximately 50 percent (e.g., Document ID 1391, pp. 32-33).

This 50 percent reduction would bring exposure levels to 50 μg/m^3 or below for all the drill operators who are currently exposed to silica at levels between 50 μg/m^3 and 100 μg/m^3. Thus, OSHA has determined that a HEPA-filtered vacuum must be used when cleaning holes in order to reduce silica exposure.

Dowel drilling rigs for concrete. Paragraph (c)(1)(viii) of the standard for construction covers dowel drills (i.e., gang drills), which are drills with one or more drill heads used to drill holes in concrete for the placement of steel supports (see Section 5.9 of Chapter IV of the FEA). When operating dowel drills, Table 1 requires that the rig be equipped with a shroud around the drill bit and a dust collection system that has a filter with 99 percent or greater efficiency. In addition, Table 1 requires that dust collection equipment be equipped with a filter cleaning mechanism.

NIOSH found that employees using compressed air to clean the filter after dowel drilling resulted in some of the highest measured exposure to respirable dust during the task, and could cause damage to the filter (Document ID 4154, p. 26). NIOSH also pointed out that the reverse pulse feature on the dust collector should preclude the need to remove filters for cleaning (Document ID 4154, p. 26). OSHA agrees and has included the specification for a filter cleaning mechanism for dowel drills in Table 1. Finally, Table 1 requires that a HEPA-filtered vacuum is used when cleaning holes. OSHA recognizes that it may be necessary at times for employers to use compressed air to clean holes, and thus, as with handheld and stand-mounted drills, Table 1 does not preclude its use when cleaning the debris from holes caused by dowel drilling, so long as a HEPA-filtered vacuum is employed at the same time to effectively capture the dust.

In the proposed rule, OSHA included dowel drills within the entry titled "Operating Vehicle-Mounted Drilling Rigs for Concrete." However, OSHA has determined that the exposures that result from dowel drilling rigs equipped with LEV systems are substantially higher than is the case for vehicle-mounted concrete drilling rigs. Therefore, respirator requirements are different for the two kinds of equipment (see Sections 5.4 and 5.9 of Chapter IV of the FEA).

Exposure information on concrete dowel drilling in the record is limited but shows that, even with LEV, exposures are likely to exceed 50 μg/m^3. Exposure studies by NIOSH on concrete dowel drills, manufactured by both EZ Drill and Minnich Manufacturing, that were equipped with close capture hoods and a dust collection system showed that workers were often still exposed to respirable silica dust levels well above 50 μg/m^3, with 8-hour TWA exposures to respirable quartz ranging from 24 to 420 μg/m^3 with a geometric mean of 130 μg/m^3 (Document ID 4154, p. 25). NIOSH found that using an air lance and compressed air to clean holes and to clean the filter and hoses of the dust collector contributed to these high exposures, and NIOSH recommended the use of a pneumatic vacuum to clean holes and components of the dust collector (Document ID 4154, p. 26). The record contains no information on exposures that result when vacuums are used to clean holes. As stated previously, exposures that result from dowel drilling rigs equipped with LEV systems are substantially higher than is the case for vehicle-mounted concrete drilling rigs. Based on this information, OSHA has modified the respirator requirement for dowel drilling, and is requiring the use of respiratory protection with a minimum APF of 10 regardless of task duration.

Comments on OSHA's proposed requirements for dowel drilling were limited. Holes Incorporated, Atlantic Concrete Cutting and CISC all stated that outdoor concrete dowel drilling should be included on Table 1 (Document ID 2338, p. 3; 2320, p. 14; 2367, p. 4). Atlantic Concrete Cutting further suggested that the appropriate control for dowel drilling is to limit this task to outdoors only and "provide sufficient ventilation" (Document ID 2367, p. 4). As suggested, OSHA has included a separate entry for concrete dowel drilling on Table 1, but with more detailed control requirements than suggested by Atlantic Concrete Cutting based on information contained in the record. OSHA agrees with Atlantic Concrete Cutting that the entry on Table 1 should be limited to outdoor operations since there is no information in the record as to the appropriate level of respiratory protection needed when operating dowel drills in enclosed areas, and has accordingly revised Table 1 of the final rule to so indicate.

PCI commented that anchor holes must be blown clean using compressed air to obtain adequate adhesion (Document ID 2276, p. 10). In its feasibility analysis, OSHA identified this task as a significant source of exposure to respirable crystalline silica. Therefore, for the reasons previously stated, Table 1 also includes a requirement to use a HEPA-filtered vacuum when cleaning holes, with or without the use of compressed air, in connection with this task.

Vehicle-mounted drilling rigs for rock and concrete. Paragraph (c)(1)(ix) of the standard for construction requires that vehicle-mounted rock and concrete drilling rigs be equipped with a dust collection system with a close capture hood or shroud around the drill bit with a low-flow water spray to wet the dust discharged from the dust collector, or be operated from within an enclosed cab in conjunction with water applied at the drill bit for dust suppression (see Section 5.9 of Chapter IV of the FEA). The specifications of paragraph (c)(2)(iii) of the standard for construction apply to the cabs.

The proposed rule had separate entries for vehicle-mounted drilling rigs for rock and vehicle-mounted drilling rigs for concrete, both of which specified a combination of LEV and water use. OSHA has determined that, since the rigs and the approach to dust control are similar for both, they can be combined in Table 1 of the final standard for construction. OSHA has also determined that it is appropriate to allow employers the option of having the drill operator work within an enclosed cab meeting the requirements of paragraph (c)(2)(iii) of the standard for construction and to apply water at the drill bit to ensure that the operator and other employees assisting are protected when working near the drill bit.

Workers using vehicle-mounted drilling rigs position and operate the drill rigs from control panels mounted on the rigs. These workers may also perform intermittent tasks near the drilling point such as fine-tuning the bit position, moving debris away from the drill hole, and working directly or indirectly with compressed air to blow debris from deep within the holes. Workers using drilling rigs can be exposed to dust generated by the action of the drill bit and from dust raised by air movement or a compressed air nozzle. Although rig-based drilling is often a one-person job, some of the associated activities, such as fine-tuning the drill position and clearing debris from in or around the holes, can be performed by a second worker (Document ID 0908, p. 1; 1563, p. 3).

In the proposed rule, OSHA specified requirements for the dust collections systems regarding smooth ducts, transport velocities, clean-out points, pressure gauges, and activation of the LEV. These requirements came from a NIOSH evaluation of control technology for dowel-pin drilling (Document ID 1628). The final rule does not require these specific control parameters for vehicle-mounted drilling rigs for rock and concrete. OSHA has determined that dust controls for dowel drilling rigs are substantially different than vehicle-mounted rock and concrete drilling rigs; they are addressed separately in the previous section. Dust collection systems that use a hood or shroud around the drill bit have been proven effective in reducing exposures to respirable crystalline silica. NIOSH found that, when used properly, modern shroud designs now help achieve dust control objectives more consistently for rock drilling rigs than in the past (Document ID 0967, pp. 5-9). Based on information contained in the record, OSHA finds that dust collectors and shrouds are commercially available (Document ID 0669; 0813).

Although the LEV system will control dust emissions at the drill bit, there are still dust emissions at the dust collector discharge area, which can contribute to either the operator's or other employees' exposures. Organiscak and Page (1995) found that enclosing the dust collector discharge area with a shroud can reduce respirable dust levels by 80 percent (Document ID 3613, p. 11). However, evidence in the record shows that the combination of LEV at the drill bit and water application will be more effective in that water can be used to control dust emission points where drilled material is discharged. Organiscak and Page (1995) illustrated the effectiveness of combined wet methods and dust collectors in their U.S. Bureau of Mines study, which compared rock drilling using LEV with and without the addition of water for dust suppression. The addition of wet methods to the LEV system showed a 92 percent reduction in respirable dust and eliminated nearly all of the visible dust. Quartz results decreased from 143 $\mu g/m^3$ when the water was off (LEV alone) to 9 $\mu g/m^3$ when water was added. OSHA obtained sample results of 54 $\mu g/m^3$ and 35 $\mu g/m^3$ during an inspection for two workers drilling in granite that contained 30-40 percent crystalline silica (Document ID 0034, pp. 8, 23-26, 35-38). Both drillers were reportedly using water and LEV, although specific details about the configuration of the controls were not discussed (Document ID 0034, pp. 23, 89-93). A third sample that was below the limit of detection for crystalline silica was collected on the same site for a laborer who helped with positioning the drills (Document ID 0034, pp. 39-42).

OSHA received many comments related to the proposed requirements for rock and concrete drillers. CISC noted that it is more common to use wet methods when operating vehicle-mounted drilling rigs for rocks as opposed to using dust collection systems (Document

ID 2319, pp. 108-109). A number of other commenters noted the prevalence of wet methods use in the industry (e.g., Document ID 1983, pp. 1-2; 2116, Attachment 1, p. 33; 3496, p. 6). For instance, CSDA commented that nearly 100 percent of CSDA contractors use water on every job in order to prolong the life of the diamond blade (Document ID 3496, p. 6). The National Ground Water Association (NGWA) noted that it is industry practice when drilling water wells to use foam as a wet control method:

> Industry practice is to use the engineering control of soap injection where water is mixed with foam. The foam mixtures of water and foam products are effective in mitigating the hazard of dust when properly used as they can carry particles ranging from .03 mm to the size of a quarter. There are multiple manufacturers of the foam products and these products have been approved for use when drilling sanitary water wells. The foam agents are NSF approved and have also been approved for use in many states (Document ID 1983, pp. 1-2).

NGWA also explained that all rotary drilling machines have been equipped with some type of water injection system since the early 1970s (Document ID 1983, p. 2).

Historically, construction and mining investigators have reported dust control efficiencies of 96 to 98 percent through the routine use of wet dust suppression methods, depending on the methods used; however, the water flow necessary for dust control can create problems under certain working conditions (e.g., moisture shortening the life of certain drill bits (such as tricone roller bits), high-pressure water causing spalling of the drill hole wall) (Document ID 0967, p. 6). Advances in recent decades have produced equipment that permits workers to use wet methods in a wider range of circumstances. New “water separator sub” designs extend bit life beyond the previous norm and reduce spalling in a variety of rock types (Document ID 0967, p. 6). Several commenters stated that wet methods are used frequently and are effective in controlling dust (Document ID 1983, pp. 1-2; 3580, Tr. 1435; 3496, p. 6).

OSHA's exposure profile contains five sample results for workers using wet methods with no other controls while drilling. These five samples have a mean of 24 μg/m^3 and a median of 17 μg/m^3, with a high exposure of 57 μg/m^3 and two results below the LOD (Document ID 0034; 0226). A review of studies by NIOSH (2008) evaluated the use of wet methods in different types of drilling, including roof bolting (rock bolting) and surface rock drilling (Document ID 0967). NIOSH found that for roof bolting, silica dust was best controlled at its source through dust collection or wet drilling, similar to the standard practice in metal mines of using pneumatic percussion drills with water in addition to compressed air to flush the drill cuttings from the hole. This drilling method was found to be the best method of dust control, with dust reductions ranging from 86 percent to 97 percent (Document ID 0967, pp. 2, 4). The high dust reductions from wet drilling were confirmed in later studies that evaluated the use of water mists and foams injected through the drill steel and found that those controls reduced dust concentrations by 91 percent and 96 percent, respectively (Document ID 0967, p. 2). NIOSH also found that for surface drilling, wet drilling techniques provided the best dust control. Wet drilling provided dust control efficiencies of up to 97 percent at a water flow rate of 4.5 L/min (1.2 gallons per minute) (Document ID 0967, p. 6). OSHA thus finds that water directed at the material discharge point is an effective dust suppressant in vehicle-mounted rock and concrete drilling and specifies its use on Table 1 for this task.

OSHA also finds that the use of an enclosed cab can effectively reduce exposures for vehicle-mounted drill operators. Enclosed cabs, however, only benefit the operator when the operator remains in the cab, and they do not control employee exposure during positioning or hole-tending activities. Therefore additional controls are necessary to protect employees from exposure to silica dust when performing activities outside of the cab. As described above, OSHA has determined that the use of water for dust suppression on the drill bit will effectively reduce exposures in situations where employees must also perform activities outside the cab.

Based on the information discussed above, Table 1 of this standard provides the option for employees to operate a vehicle-mounted rock or concrete drill from within an enclosed cab in conjunction with water applied at the drill bit for dust suppression; wherever cabs are specified in Table 1, however, the cabs must meet the requirements of paragraph (c)(2)(iii) of the standard for construction, as discussed above. OSHA has determined that the enclosed cab will adequately protect the operator while the addition of water at the drill bit will reduce exposures for employees in the area. The alternative control option included in Table 1, a dust collection system and water sprays at the discharge point (where the system ultimately dumps extracted dust), has also been proven to reduce exposures for both the operator at the drill controls and those employees in the vicinity. When the specified dust control methods are fully and properly implemented, TWA exposure levels are expected to remain below 50 $\mu g/m^3$, and therefore, Table 1 does not require use of respiratory protection regardless of task duration for either control option. In the proposed rule, OSHA required the use of respiratory protection when the task lasted more than four hours. However, this was due to the inclusion of dowel drilling rigs within the entry for "Operating Vehicle-Mounted Drilling Rigs for Concrete." As explained above, OSHA has determined that the exposures that result from dowel drilling rigs equipped with LEV systems, for which respirators are required regardless of task duration, are substantially higher than is the case for vehicle-mounted concrete drilling rigs.

IUOE commented that Table 1 would be clearer if it specified that employers who use open cabs during concrete drilling are not exempt from exposure assessment when employers implement the other controls listed for vehicle-mounted drilling rigs for concrete (Document ID

2262, Attachment 1, p. 48). OSHA considers the rule to be clear as written: if an employer chooses to operate vehicle-mounted drilling rigs for rock and concrete from within an enclosed cab, it must follow the requirements in paragraph (c)(2)(iii) of the standard for construction and apply water for dust suppression at the drill bit. Otherwise, the employer must follow the alternative shrouded dust-collection-system compliance method in Table 1 or the requirements in paragraph (d) of the standard for construction, which allow for alternate exposure control methods provided that employee exposures are assessed and exposures are kept at or below the PEL. Additionally, IUOE suggested that OSHA explicitly state on Table 1 that the employer does not have the option of respirator use as a means to control exposures during rock crushing or rock and concrete drilling if the employer chooses not to use enclosed cabs as an engineering control (Document ID 2262, Attachment 1, p. 48). OSHA notes that Table 1 of this final standard does not require that drilling rig operators work from enclosed cabs exclusively. Because employers can choose between the two control methods listed on Table 1, employees that use open cabs during drilling activities would not be required to conduct exposure assessments if they are using a dust collection system with a close capture hood or shroud around the drill bit and are ensuring that the material at the dust collector discharge point is being wetted. If that method is followed, OSHA, having found based on the exposure profile and record evidence that exposures will consistently be at or below the PEL, has not included a respirator requirement on Table 1; where respirators are not required to satisfy compliance obligations (as is the case here if Table 1 is fully and properly implemented), OSHA does not expect employers to require the use of respirators anyway. However employers that do not follow either control strategy specified in Table 1 must comply with paragraph (d) of the standard for construction, which could require respirator use if exposures are measured at or above the PEL when using feasible engineering and work practice controls.

IME stated that the final rule should allow for the use of equivalent, alternative control methods (Document 2213, Attachment 1, p. 2). Table 1 is intended to represent the most reliable control methods available for reducing exposures, based on the evidence contained in the record. Employers who wish to implement an alternative control method can do so, but those employers must comply with paragraph (d) of the standard for construction.

IUOE, among others, urged OSHA to explore additional options for exposure controls to protect operators working outside the cab when drilling. Both IUOE and Fann Contracting asserted that Table 1 does not address protection of operators who perform construction activities outside the cab with or without remote controls (Document ID 2262, Attachment 1, p. 45; 2116, Attachment 1, p. 5). In response, Table 1 of the final standard now includes a requirement to use water for dust suppression at the drill bit when the drill is being operated from an enclosed cab to minimize the exposure to other employees outside the cab.

OSHA's proposed Table 1 entry for rock drilling would have required that employees use respirators when working under the shroud. OSHA proposed this requirement based on a determination that employees' exposures would be high given their proximity to the point of dust generation. IME suggested that respirators should not be required at all times because there are circumstances where the time spent working under the shroud is extremely brief or infrequent and potential exposures will be minimal or negligible (Document ID 2213, p. 2). NUCA commented that this requirement creates hazards for employees working under the shroud (Document ID 2171, p. 10). In response to these comments and after reviewing the record, OSHA has not retained this respirator requirement in the final standard. The Agency finds that the record contains substantial evidence that when the dust controls required by Table 1 are fully and properly implemented, TWA exposures to silica are unlikely to exceed 50 μg/m^3 (see Section 5.9 of Chapter IV of the FEA). In reviewing dust controls historically for drilling operations, NIOSH found that, when used properly, modern shroud designs now help achieve dust-control objectives more consistently than in the past (Document ID 0967, pp. 5-9). Furthermore, the record indicates that work under a shroud is periodic or intermittent and contains no evidence suggesting that this work is likely to result in silica exposures exceeding 50 μg/m^3 as an 8-hour time-weighted average. Accordingly, Table 1, unlike in the proposed rule, does not include a respiratory protection requirement for rock and concrete drillers on open (or enclosed) vehicle-mounted rigs.

NSSGA recommended that OSHA clarify the requirement for wearing respirators while working under the shroud by replacing the term "shroud" with "engineered fugitive dust control method, e.g., a shroud, water spray, etc." (Document ID 2327, Attachment 1, p. 21). Since the Agency has eliminated the requirement for using respirators under the shroud, NSSGA's suggestion is moot.

Jackhammers and handheld powered chipping tools. Hand-operated breaking and chipping power tools and equipment, commonly known as jackhammers, pavement breakers, breaker hammers, percussion or chipping hammers, and needle guns, are used in construction for fracturing materials, which often include silica (e.g., rock, concrete, asphalt, or masonry surfaces), by delivering rapid repetitive blows (see Section 5.5 of Chapter IV of the FEA). The hammers typically consist of a large compartment containing a motor, two attached handles to grip the tool, and a large socket out of which the drill or hammer-like metal breaking/chipping implement extends. A worker typically will aim the metal drill/hammer at a target surface while standing one to five feet away either directly overhead or at an angle, and press the point of contact into the surface to break, fracture, or chip away at it (Document ID 4073, Attachment 4a, Row 199).

In the proposed standard, this entry was titled "Using Jackhammers and Other Impact Drillers." OSHA had a separate entry for "Rotary Hammers or Drills." NIOSH commented on the potential for confusion with these titles, noting that a rotary hammer or drill is technically an impact driller (Document ID 2177, Attachment B, pp. 32-33). OSHA has revised the headings for the relevant Table 1 entries ((c)(1)(vii) and (x)). The revised heading for paragraph (c)(1)(x) removes the term "other impact drillers" and replaces it with "handheld powered chipping tools." This change was made to clarify that this entry applies only to handheld tools that use an impact movement to chip or fracture the material being worked on. The heading for (c)(1)(vii) was revised from "Using Rotary Hammers of Drills" to "Handheld and Stand-Mounted Drills (Including Impact and Rotary Hammer Drills)" in order to clarify that all handheld drills, including impact drilling, are covered under that entry.

When using jackhammers and other handheld powered chipping tools at construction sites to fracture silica-containing material, paragraph (c)(1)(x) of the standard for construction requires the employer to operate the tools using either a water delivery system that supplies a continuous stream or spray of water at the point of impact, or a tool equipped with a commercially available shroud and dust collection system operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. If the employer is operating a tool with the shroud and dust collection system, Table 1 requires that the dust collector (i.e., LEV) must provide at least the air flow recommended by the tool manufacturer, and have a filter with 99 percent or greater efficiency and a filter cleaning mechanism. These specified controls are essentially the same as those that were proposed, but the final standard makes clear that if a shroud and dust collector are used, it must be commercially available equipment. Unlike the use of a shrouded dust collection system, a water delivery system is not required to be commercially available but can be assembled and installed by the employer.

OSHA revised the respirator use requirements from the proposed rule by distinguishing between indoor and outdoor environments. Table 1 of the final standard for construction does not require respiratory protection if tools are used outdoors for four hours or less per shift. OSHA based this revision on record evidence showing that exposures can be maintained at or below 50 $\mu g/m^3$ using either water sprays or LEV, provided work does not exceed the median task duration (231 minutes) reported by Flanagan et al. (Document ID 0677, p. 147; 0677, Attachment 2) (see Section 5.5 of Chapter IV of the FEA). If tools are used outdoors for more than four hours per shift, Table 1 requires the use of respiratory protection having a minimum APF of 10 to ensure that employees are protected from exposures above 50 $\mu g/m^3$. If the tools are used indoors or in an enclosed area, Table 1 requires the use of respiratory protection having a minimum APF of 10 to ensure that employees are protected from exposures above 50 $\mu g/m^3$, regardless of the amount of time the tools are operated during the work shift.

NUCA testified during the hearing that jackhammering is one of the construction activities most likely to expose employees to silica (Document ID 3583, Tr. 2255). OSHA's exposure profile for this task confirms this (Table IV.5.5-B in Section 5.5 of Chapter IV of the FEA); 73 of 98 TWA sample results (74 percent) were above 50 $\mu g/m^3$ for workers using jackhammers and handheld power chipping tools operated without controls. For tools operated with water, 12 of 16 TWA sample results (75 percent) exceeded 50 $\mu g/m^3$, but information on how the water was applied and whether it was sufficient was lacking. Various studies have demonstrated that properly used wet methods can substantially reduce respirable silica levels by 90 percent and higher (Document ID 0865, p. iv; 0867, p. 3; 0838, p. 1; 0914; 1267, pp. 493-494; 2177, Attachment D, p. 19). NIOSH studies that examined water spray devices designed to optimize dust suppression (directed mist or solid cone nozzle) have found that dust and/or silica exposures are reduced by 72 to 90 percent at a flow rate of approximately 350 milliliters per minute (ml/min) (Document ID 0865; 0867; 1267, pp. 493-494). Although not commercially available at this time, the record shows a number of examples of water suppression systems that have been developed and tested and are ready for commercial introduction or can be easily assembled from readily available hardware materials and instructions from the New Jersey Laborers' Health and Safety Fund (Document ID 0741; 0838; 0914; 2177, Attachment D, pp. 4-7; 3732, Attachment 3, p. 10).

The shroud and LEV control for jackhammers and handheld powered chipping tools was found to be less effective than water suppression but still reduced exposures up to 69 percent (Document ID 1267, pp. 493-494; 0865, p. iv; 0651, p. 1; 0667, pp. 1-3; 0862, pp.10-11, 14). Also, the respirable silica levels generated by these tools are dependent on whether they are being operated outdoors, indoors, or in an enclosed area. Several powered impact tool manufacturers currently offer LEV options (e.g., Document ID 1288 p. 2; 1700, p. 1). Other companies specialize in manufacturing after-market shrouds or exhaust ventilation systems for various handheld tools such as jackhammers and chipping equipment (Document ID 0566, p. 1; 1264, pp. 4-9; 1266, pp. 9-28; 1671; 1366; 1399; 3806, pp. 272-273, 276).

OSHA received a number of comments on the jackhammer and handheld powered chipping tool entries on Table 1. CISC commented that OSHA did not indicate in the proposed Table 1 that the dust collection system needed to be commercially available and did not set parameters for the functioning of the dust collection system (Document ID 2319, p. 107). Based on comments and testimony in the record, OSHA has clarified the entry in Table 1 for jackhammers and handheld powered chipping tools to read “use tool equipped with commercially available shroud and dust collection system.” OSHA has added to Table 1 the following requirements: operate and maintain the tool in accordance with the manufacturer’s instructions to minimize dust emissions; provide at least the air flow recommended by the tool manufacturer; and use a filter with a 99 percent or greater efficiency and a filter cleaning mechanism.

CISC also expressed concern that using wet methods may raise quality issues, for example by introducing water to the base when pouring new concrete (Document ID 2319, p. 107). The water delivery system required by Table 1 must deliver a continuous stream or spray of water at the point of impact. The water delivery system evaluated by NIOSH delivered between 250 and 300 ml of water per minute and the authors observed that water applied at these flow rates did not add a substantial amount of water to the work surface nor did it result in substantial accumulation of water (Document ID 0867, pp. 8, 15). Given that a substantial amount of water is not needed, OSHA finds that proper implementation of the water delivery system is unlikely to lead to quality control issues. Furthermore, other than the hypothetical situation raised by CISC, there is no evidence in the record showing that using wet methods with jackhammers and powered chipping tools results in quality issues. Furthermore, Table 1 of the final standard provides two options for dust control of jackhammers and handheld powered chipping tools. The employer can use a tool that is equipped with a commercially available shroud and dust collection system as an alternative to using water.

Some commenters discussed that water may introduce slip hazards; however, comments and hearing testimony described current contractor practices that countered these concerns (Document ID 2171 p. 4; 3589, Tr. 4295-4296). OSHA understands the concerns about possible slip hazards from the use of water; however, NIOSH investigators noted that the relatively low water flow rates (300 ml/min) used to suppress dust during jackhammering did not result in a substantial accumulation of water on work surfaces. OSHA expects that proper implementation of the water delivery system will include taking measures to contain any runoff to prevent the accumulation of water on walking and working surfaces.

The water delivery systems described in OSHA's feasibility assessment chapter on jackhammers, chipping hammers, and other powered handheld impact tools (see Section 5.5 of Chapter IV of the FEA), include portable water tank systems that can easily be brought to a construction site by a pickup truck or trailer, even in a remote area (Document ID 0867, p. 4; 0741 p. 1). These water delivery systems can be operated by one worker and would not require a second worker to supply the water at the point of impact (Document ID 0838, p. 2).

Handheld grinders for mortar removal (i.e., tuckpointing). Handheld grinders are tools fitted with rotating abrasive grinding blades, discs, or small drums. Tuckpointers are a subset of grinders who specialize in removing deteriorating mortar from between bricks and replacing it with fresh mortar ("tuckpointing") (see Section 5.11 of Chapter IV of the FEA). Tuckpointing is most commonly performed for exterior wall maintenance and so generally occurs outdoors, but can occur indoors where there is interior masonry. The initial phase of tuckpointing involves using handheld grinders to grind old mortar from between bricks on a section of the wall. A grinder typically has two handles that can form various angles with each other and are connected to a rotating blade located between them. The worker typically holds one handle in each hand, forming an angle allowing the worker to press the rotating blade against the mortar between bricks to abrasively remove it (Document ID 4073, Attachment 4a, Row 226).

Paragraph (c)(1)(xi) of the standard for construction requires that this task be performed using a grinder equipped with a commercially available shroud and dust collection system and operated in accordance with manufacturer's instructions. Additionally, the dust collection system must be capable of providing at least 25 cfm of air flow per inch of wheel diameter and be equipped with a filter that has a 99 percent or greater efficiency and either a cyclonic pre-separator or a filter cleaning mechanism. The proposed requirement was similar but specified the air flow to be at least 80 cfm, rather than 25 cfm per inch of blade diameter, and also included a number of work practices. OSHA revised the controls for this task based on comments received in the record, as described below.

BCTD commented that "Tuckpointing," as the entry was titled in proposed Table 1, is an operation that consists of a series of tasks (chipping or cutting out old mortar, preparing replacement mortar, cleaning the joints, applying fresh mortar, and applying a sealer), while the listed control was clearly directed at the task of using a "hand-operated tuckpoint grinder" (Document ID 2371, p. 25). To clarify its intent to address the grinding of old mortar, OSHA has re-named the entry for paragraph (c)(1)(xi) of the standard for construction to be "Handheld grinders for mortar removal (i.e., tuckpointing)."

Recent dust control efforts for tuckpointing have focused on using a dust collection hood (also called a shroud) that encloses most of the grinding blade and a vacuum cleaner system that is used to suction (exhaust) air from these hoods to collect dust and debris. These shroud and vacuum combinations generally capture substantial amounts of debris. In hearing testimony, Tom Ward, representing BAC, showed a video of local exhaust engineering controls for tuckpointing and described them as “extremely effective” (Document ID 3585, Tr. 3069). However, OSHA’s exposure profile for tuckpointing shows that, even with these controls, silica exposures often exceed 100 μg/m^3 (25 percent of results exceed 250 μg/m^3 when workers use LEV for outdoor tuckpointing). An additional survey added to the rulemaking record reported results at two tuckpointing sites using vacuum and shroud systems. Air samples taken during 201 to 385 minutes of mortar grinding showed 8-hour TWA silica exposures ranging from 74 to 1,100 μg/m^3 (Document ID 4073, Attachment 9l, p. 4).

CISC questioned why employers can only use commercially available shrouds for hand-operated grinders, eliminating the use of specialty manufactured products (Document ID 2319, p. 110). OSHA is unsure of what CISC means by “specialty manufactured products” and CISC’s written comments and testimony did not provide further detail. However, it is not OSHA’s intent to eliminate the use of products that are custom made by aftermarket manufacturers (i.e., made by someone other than the original tool manufacturer) which are intended to fit the make and model of the grinder and designed to meet the particular needs and specifications of the employer purchasing the product. The "commercially available" limitation is meant only to eliminate do-it-yourself on-site improvisations by the employer. OSHA’s technological feasibility analysis provides ample evidence that exposures to silica are substantially reduced when using commercially available dust controls (see Chapter IV of the FEA). To meet the requirements of Table 1, however, any specialty manufactured product has to satisfy all the requirements for this entry.

In proposed Table 1, OSHA specified that the dust collection system used must provide at least at 80 cfm airflow through the shroud. For the final standard, Table 1 requires that dust collectors have an air flow of at least 25 cfm per inch of wheel diameter. This change is due to

OSHA's review of the evidence in the rulemaking record. Computational and laboratory studies by Heitbrink and Bennett (2006) and Collingwood and Heitbrink (2007) found that an air flow rate of 80 to 85 cfm (based on a 4- or 4.5-inch wheel) is the minimum needed to efficiently capture dust generated by angle grinders used for tuckpointing (Document ID 0728, p. 366; 0600, p. 877). ACGIH (2010) recommends 25 cfm to 60 cfm per inch of blade diameter (Document ID 3997, pp. VS-40-01-VS-40-03). For a typical 4-inch tuckpointing blade, 25 cfm/inch of diameter is equivalent to 100 cfm, higher than the 80 to 85 cfm used by Heitbrink and Bennett (2006) and Collingwood and Heitbrink (2007). Laboratory tests conducted by Heitbrink and Bennett indicate that a vacuum and shroud used by tuckpointers during grinding can reduce respirable dust emissions by a factor of more than 400 under ideal circumstances, but this reduction factor dropped to 10 when vacuum air flow was reduced to less than 80 cfm (Document ID 0728, p. 375). Furthermore, computational modeling showed that even a modest decrease in the air flow rate, from 85 cfm to 70 cfm, cuts the shroud's ability to capture dust by more than half. As a result, the estimated worker exposure level would be twice as high as it would have been if the air flow rate had remained constant at 85 cfm.

A NIOSH field trial on a vacuum that generated an air flow of 111 cfm for a grinder with a 4-inch blade showed that exposure levels for respirable dust were cut in half compared to using a 76 cfm flow rate (Document ID 0863, pp. 24-35). Based on the evidence contained in the record, OSHA has determined that the ACGIH (2010) recommendations are more protective given the variety of blade diameters, and is requiring a minimum 25 cfm of airflow per inch of grinding blade diameter instead of the 80 cfm minimum airflow (regardless of blade diameter) through the shroud.

To adequately capture debris during the grinding phase of tuckpointing, OSHA is requiring that vacuums be equipped with a cyclonic pre-separator to collect large debris before the air reaches the filters or be equipped with a filter cleaning mechanism. Cyclonic pre-separators minimize the accumulation of debris on filters in the vacuum, enhancing the ability of the vacuum to maintain the initial air flow rate. When testing a vacuum cleaner model equipped with a cyclonic pre-separator, Collingwood and Heitbrink found that the collected debris caused the average air flow rate to decrease only from 90 cfm to 77 cfm (Document ID 0600, p. 884). Heitbrink and Santalla-Elías evaluated two different brands of commercially available vacuum cleaners (Tiger-Vac and Dustcontrol) incorporating cyclonic pre-separation. Air flow rates for both of these vacuums were "largely unaffected" by debris accumulation up to 35 pounds. Debris accumulation also had very little effect on the flow rate measured before and after the filter was cleaned (Document ID 0731, pp. 377, 380). Similarly, during the Collingwood and Heitbrink field trials, the Dustcontrol vacuum with cyclonic pre-separator did not lose as much air flow as the vacuum designed with vacuum cleaner bags (bags are a more common pre-separation method but are subject to clogging) (Document ID 0600, pp.883-884). OSHA concludes that cyclonic pre-separation is an effective technology for helping to maintain air flow and vacuum system effectiveness for the duration of tuckpointing tasks by preventing the static pressure increase caused by clogging that would otherwise lead to a dramatic decrease in air flow and loss of effective dust capture at the shroud.

The accumulation of material and debris on the filter (filter caking) during work causes pressure losses that eventually limit air flows in even the most powerful vacuums. As debris accumulates, the filter becomes caked with collected dust and air flow decreases. Unless the filter is properly cleaned following manufacturer's recommendations, the air flow declines rapidly. Cooper and Susi used a Dustcontrol 2900c vacuum with ICS Dust Director shroud and Bosch tuckpointing grinder to evaluate dust control in a field experiment. The authors reported that in four hours of continuous grinding up to 130 pounds of dust was collected, and that flow rates in the vacuum dropped from 90 cfm to 80 cfm in as little as 8 minutes. Thus, regular stops to conduct the proper reverse air pulse filter cleaning procedure were crucial to successful dust control (Document ID 4073, Attachment 9M, pp. 4-5, 7-9). Therefore OSHA is requiring the use of a filter-cleaning mechanism when a cyclonic pre-separator, which removes larger debris, is not in place. To assist employees in determining when it is time to run a filter cleaning cycle, vacuums equipped with a gauge indicating filter pressure or equivalent device (e.g., timer to periodically pulse the filter) may be useful (Document ID 0731, p. 885).

PTI and OEHCS submitted comments emphasizing the importance of effective HEPA filtration in protecting employees from silica dust, and recommended that Table 1 require that dust collectors used with grinders be equipped with HEPA filters (Document ID 1953, pp. 3-4; 1973, p. 2-3). However, HEPA filters may rapidly clog during mortar grinding, leading to static pressure drop and loss of air flow needed to capture dust (see discussion about requirements for dust collection systems above). Instead, OSHA is requiring filters having at least 99 percent dust capture efficiency.

In proposed Table 1, OSHA included a specification that the grinder be operated flush against the work surface and that work be performed against the natural rotation of the blade (i.e., mortar debris directed into the exhaust). A number of commenters discussed the difficulties of complying with this specification (Document ID 2183; 2319). Western Construction Group commented that it is not possible to always keep the grinder flush with the surface because the blade will be spinning at its full speed when cutting into the wall and when the blade is extracted from the surface, and explained that it would be difficult to keep the blade flush when removing vertical mortar joints (Document ID 2183, p. 2). OSHA acknowledges there are circumstances that do not always permit the tool to be operated in this manner, and has therefore removed this provision from Table 1. However, it is OSHA's position that full and proper implementation of Table 1 controls includes keeping the blade flush with the surface whenever possible, in order to optimize the effectiveness of local exhaust capture (e.g., Document ID 0728, p. 376; 0600, p. 876).

Western Construction Group also commented that it is not always possible to operate the grinder against the natural rotation of the blade, because a wall needs to be "prepped" in order to be in sufficient condition for mortar to be placed back into the wall (Document ID 2183, pp. 2-3). Western Construction Group explained that during final preparation, the blade needs to make short passes back and forth to clean the joint and prepare it, and that if workers only operated in one direction, they would place a significant burden on their shoulders and backs by having to make more passes on the wall to clean the joint (Document ID 2183, p. 3). Similarly, CISC commented that workers must move the grinder back and forth in short, deliberate motions when detailing the joint in order to provide the necessary quality finish (Document ID 2319, p. 106). OSHA recognizes that the requirement to operate against the direction of blade rotation may have an impact on job quality and may increase ergonomic stress. While OSHA has removed this specification from Table 1, it is OSHA's expectation that full and proper implementation of Table 1 controls includes operating against the direction of blade rotation, in accordance with the manufacturer's instructions, whenever practical.

CISC commented that a significant portion of tuckpointing takes place at elevated locations on scaffolds and expressed concern about the control measures listed introducing significant trip and fall hazards at elevated locations (Document ID 2319, p. 110). Grinding related to tuckpointing does take place on scaffolds, as evidenced by one building project evaluated by Cooper et al. where dust collectors were used on scaffolds to grind mortar from the exterior walls of a 12-story building (Document ID 4073, Attachment 9l, p. 1). When mortar grinding will take place on scaffolds, the employer's written exposure control plan should include procedures to ensure that the dust collector is operated in an effective and safe manner.

In the proposed standard, OSHA required personal air purifying respirators (PAPR) with an APF of 25 to be used while tuckpointing, regardless of task duration. The proposed requirement was based on high exposures results, including a TWA measurement of 6,196 μg/m^3 for an apprentice mortar grinding with LEV (Document ID 0229, p. 12). However, it is clear from this NIOSH report that the LEV system was not fully and properly implemented in that the grinder blade was operated in a back-and-forth manner with frequent insertions, and the hose from the tool to the dust collector would frequently kink and fall off. Based on data in the record, OSHA expects that a worker engaged in mortar grinding for four hours or less per shift can experience TWA exposures of less than 500 μg/m^3, while a worker performing this task more than four hours per shift could be exposed up to nearly 1,000 μg/m^3 TWA. Among tuckpointers using LEV outdoors, 40 percent of samples contained in the exposure profile measured exposures below 50 μg/m^3, with a mean exposure of 348 μg/m^3 (see Section 5.11 of Chapter IV of the FEA). Therefore, Table 1 of the final standard is requiring the use of respiratory protection with a minimum APF of 10 for work lasting four hours or less in a shift, which is reduced from the proposed APF of 25. Based on the evidence of continuing improvements in the effectiveness of LEV as reported in the literature, the exposure information, and the requirement in paragraph (c)(2)(i) to provide a means of exhaust as needed to minimize the accumulation of visible airborne dust indoors, OSHA concludes that the reduction to an APF of 10 is appropriate for tasks of four hours or less in duration. For work lasting more than four hours per shift, OSHA is maintaining the requirement to use respiratory protection with a minimum APF of 25.

Handheld grinders for uses other than mortar removal. Handheld grinders are tools fitted with rotating abrasive grinding blades, discs, or small drums used to smooth, roughen, or reshape concrete surfaces (including forming recesses or slots) (see Section 5.11 of Chapter IV of the FEA). Grinders may also be used to remove thin layers of concrete and surface coatings (e.g., performing small-scale spot milling, scarifying, scabbling and needle-gunning). A grinder typically has two handles that can form various angles with each other and are connected to a rotating blade located between them. The worker typically holds one handle in each hand, forming an angle allowing the worker to press the rotating blade against the work surface and abrade the surface and remove the layer of target material (Document ID 4073, Attachment 4a, Row 91).

Paragraph (c)(1)(xii) of the standard for construction specifies two control options. The first control option, which applies only when grinders are used outdoors, is to use a grinder equipped with an integrated water delivery system that continuously feeds water to the grinding surface. When employers choose to use wet grinders indoors or in an enclosed area, they must comply with the requirements of paragraph (d) of the final rule. The second option is to use a dust collector equipped with a commercially available shroud and dust collection system. The dust collector must provide 25 cfm or greater of air flow per inch of wheel diameter and have a filter with a 99 percent or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism. OSHA is requiring that the control must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. The second option is identical to the option required for handheld grinders used for mortar removal.

In the proposed standard, OSHA did not specify that the water delivery system be integrated with the grinder. However, OSHA has determined that systems that are designed and developed in conjunction with the tool are more likely to control dust emissions effectively by applying water at the appropriate rate and dust emission points based on tool configuration. Further, integrated systems will not interfere with other tool components or safety devices. These include free-flowing water systems designed for blade cooling as well as manufacturers' systems designed for dust suppression alone. OSHA is not specifying a minimum flow rate, but rather anticipates that the water flow rates specified by the manufacturer will optimize dust reduction. OSHA also recognizes that using makeshift water delivery systems can pose hazards. PTI commented that the use of a water feeding system not specified by the tool manufacturer could result in serious personal injury and electric shock for tools that are electrically operated (Document ID 1973, p. 1). Due to the potential hazards from using a water delivery system not specified by the manufacturer, and to ensure the effectiveness of the system in controlling dust, OSHA has modified Table 1 to require use of integrated water systems that are operated and maintained according to manufacturer's instructions to minimize dust emissions.

OSHA received a number of comments related to the use of wet methods as a control for handheld grinders. SMI and CISC commented on the difficulties of using an integrated water system while grinding, arguing that there is a lack of options with both safety guards and water supply, that grinders equipped with a water delivery system are designed to cool the blade rather than control the dust, and that the dust mitigation effects of the water are speculative (Document ID 2316, p. 2; 2320, p. 10). However, NIOSH reported that "several manufacturers of smaller grinders do offer electric grinders with integrated water supply capability" and included the catalog of such suppliers (Document ID 4233, Attachment 1, pp. 7-8; 3998, Attachment 10). Studies by Linch et al. (2002), Akbar-Khanzadeh (2007, 2010), and Simcox et al. (1999) evaluated the use of wet methods during grinding (Document ID 0784; 0552; 3609; 1146). Although there were some differences in the effectiveness of systems tested by these investigators, all of them reduced dust levels substantially compared to dry grinding. Therefore the ability of water to control dust when grinding is not speculative and has been demonstrated in various studies throughout OSHA's technological feasibility analysis contained in Chapter IV of the FEA. In short, OSHA concludes that, based on the best available evidence, there are commercially available grinders with integrated water supply capability, and that wet methods can be an effective control for grinding in many circumstances (Document ID 0522, p. 778; 1146, pp. 578-579).

Francisco Trujillo of Miller and Long commented that wet methods often present significant slip and fall hazards and that attempting to apply wet methods to any non-horizontal surface has proven ineffective and often hazardous when using grinders (Document ID 2345, p. 2). Similarly, Stuart Sessions, an economist testifying on behalf of CISC, noted that it is difficult to use wet methods in winter in locations where the water may freeze (Document ID 3580, Tr. 1322). OSHA acknowledges that not every control option is practical in every situation, and in such situations, Table 1 of the final standard permits use of LEV systems to control dust. However, OSHA concludes that wet methods represent a feasible and effective option outdoors.

Those who do not implement the wet methods described above, or those grinding indoors, have the option to use a dust collector equipped with a commercially available shroud and dust collection system. Several rulemaking participants testified on the commercial availability of such equipment, including Gerry Scarano, Executive Vice President of BAC , Deven Johnson, director of training, health and safety for the Operative Plasterers and Cement Masons International Association, and Francisco Trujillo of Miller and Long (Document ID 3581, Tr. 1562, 1592-1593; 3585, Tr. 2962-2964). The record shows that Makita, DeWalt, Bosch, and Ostec all make grinding dust collection systems (see Chapter IV of the FEA).

The LEV-based exposure controls for surface grinding function similarly to the LEV-based controls for mortar removal described in paragraph (c)(1)(xi) of the standard for construction, as mortar removal (tuckpointing) is simply a specialized form of grinding that uses the same grinding tools. The factors that influence vacuum flow rate for mortar removal (tuckpointing) are equally important to LEV dust controls for all types of surface grinding, and for other hand-operated power tools as well. Collingwood and Heitbrink note that “vacuum cleaners will probably continue to be an important control option for respirable dust exposures in construction for dust exposure sources such as mortar removal, concrete grinding, hole drilling, and brick cutting where water application is impractical” (Document ID 0600, p. 884). Older studies of LEV effectiveness have found exposure reductions of 86-99 percent (Document ID 0611, p. 463; 0247, pp. 6, 8). A more recent study by Akbar-Khanzadeh et al. found silica dust exposure reduced by 98-99 percent, depending on the vacuum type used (Document ID 3609, p. 707). Akbar-Khanzadeh and Brillhart and Echt and Sieber both reported reduced silica exposures when workers used LEV shrouds with vacuum attachments during surface grinding, although the silica exposure results were variable and some exceeded 50 $\mu g/m^3$ even with use of the controls (Document ID 0521, pp. 344-345; 0632, pp. 459-460).

OSHA received a number of comments about the proposed entry on Table 1 for handheld (or hand-operated) grinders using LEV. The proposed entry specified use of a grinder with a commercially available shroud and dust control system. Several commenters questioned why shrouds needed to be commercially available and whether appropriate shrouds are, in fact, commercially available (e.g., Document ID 2319, p. 105; 2316, p. 2; 2171, p. 9). Francisco Trujillo from Miller and Long stated "dust collection systems used on hand grinders received very disappointing results. In fact, no hand grinder equipped with a dust collection system was capable of bringing exposure levels below the current [i.e., the preceding] PEL" (Document ID 3585, Tr. 2963). He further explained that this was due to the limited capabilities of the dust collection systems maintaining complete surface contact during the frequent grinding of columns and walls (Document ID 3585, Tr. 2963-2964). However, he found that a vacuum system designed for use with ceiling grinders "greatly reduced the amount of dust expelled from the process but did not completely eliminate it. It was a very, very dusty activity, and now it's moderately so" (Document ID 3585, Tr. 2962). He reported that although all sampling results were below the preceding PEL, three out of five samples were still above 50 $\mu g/m^3$. He also reported that none of the hand grinders with dust controls that Miller and Long evaluated were effective with columns and wall corners and that even with these LEV systems, the same number of workers were in Miller and Long's respiratory protection program (Document ID 3585, Tr. 2962-2964, 3012).

In Section 5.11 of Chapter IV of the FEA, OSHA's exposure profile shows that 60 percent of ceiling grinders who perform overhead grinding using LEV, and 50 percent of outdoor grinders using LEV or water have achieved exposures below 50 $\mu g/m^3$, while 25 percent of other grinders working indoors with LEV have achieved exposures below 50 $\mu g/m^3$. These results demonstrate that exposures of 50 $\mu g/m^3$ or below are achievable with technology available at the time of sampling. Much of the data in the exposure profile reflects samples collected over ten years ago, before many of the engineering studies described in the FEA were conducted. OSHA expects that capture technology will continue to improve in response to market demand.

In addition, Gerry Scarano, representing BAC, stated that since 2009, “the availability and effectiveness of control options have improved, adding force to OSHA’s conclusion that it is feasible to reduce the dust in most cases down to the proposed PEL” (Document ID 3581, Tr. 1562). Thus, the effectiveness of controls available today is likely higher than those that were used when the exposure samples included in the exposure profile were obtained.

SMI commented that there are no commercially available dust shrouds that currently meet American National Standards Institute (ANSI) B7.1 (and OSHA) guard design requirements (Document ID 2316, p. 2). SMI stated that available dust shrouds are plastic and are used in place of the original equipment’s steel guards but do not meet the requirements of ANSI B7.1, which is a safety design specification standard for grinding wheels (Document ID 2316, p. 2). However, NIOSH reported that several major tool manufacturers sell grinders with integrated dust shrouds designed to meet applicable safety standards, and the tools are labeled accordingly. For example, the Underwriter’s Laboratory (UL) mark carried by the products of several manufacturers signifies that their tools meet the requirements of ANSI/UL/CSA 60745-2-3, which incorporates ANSI B7.1 by reference (Document ID 4233, Attachment 1, p. 8). Catalogs of tool manufacturers submitted to the docket by NIOSH include grinders that meet this standard and other tools that bear the SA approval mark of the Canadian Standards Association, an OSHA Nationally Recognized Testing Lab (NRTL, described under 29 CFR 1910.7) (Document ID 3998, Attachment 10, pp. 7-9, 15, 45). OSHA anticipates that, once there is a market demand, additional tool manufacturers will offer shrouds meeting these machine guarding requirements. OSHA finds that compliant shrouds are already commercially available, and will not create a greater hazard.

In the proposed standard, OSHA specified that the dust collection system must have an air flow of at least 25 cfm per inch of wheel diameter. OSHA has maintained this requirement in the final standard. CISC commented that for larger blades, it may be difficult to design and operate a system that pulls air flow at 25 cfm per inch of blade diameter (Document ID 2319, p. 105). NAHB also expressed concern that a dust collector with a HEPA vacuum would need to be at least 112.5 cfm for a small, 4.5-inch grinder (Document ID 2296, Attachment 1, p. 29). PTI recommended revising the Table 1 entry for grinders to require use of vacuums equipped with a HEPA filter that operates at 80 cubic feet per minute or greater, noting that commercial dust collection systems are typically rated at approximately 130 cfm (Document ID 1973, pp. 2-3). BCTD, on the other hand, recommended that OSHA specify airflow rates for grinder LEV based on blade diameter (Document ID 2371, p. 32). As explained above in the discussion of grinders used for mortar removal, OSHA has determined that 25 cfm per inch of blade diameter is more protective and consistent with established engineering principles as reflected in the ACGIH Industrial Ventilation Manual, 28th Edition, which generally expresses minimum cfm requirements for a variety of (stationary) grinders in relation to the wheel diameter (Document ID 3883, pp. 13-147-13-152).

To adequately capture debris during the grinding, OSHA is requiring that dust collection systems used with grinders have a filter with 99-percent or greater efficiency, along with either a cyclonic pre-separator to collect large debris before the air reaches the filters or a filter-cleaning mechanism. Because the same factors that cause air flow to decline during tuckpointing affect air flow during other tasks such as surface grinding, the measures discussed in the section on grinders used for mortar removal also need to be used when surface grinding to minimize filter clogging.

Echt and Sieber reported respirable quartz concentrations ranging from 44 μg/m^3 to 260 μg/m^3 during two to three hour surface grinding tasks with LEV at a construction site. Each day, one or two 18-pound bags of debris were collected in a vacuum cleaner. The investigators measured actual air flow rates three times over the course of five sampling days, reporting an air flow range from 86 to 106 cfm (Document ID 0632, pp. 459-460). As noted in the discussion of LEV controls required for handheld grinders for mortar removal (tuckpointing), Heitbrink and Santalla-Elías also reported that air flow is affected by filter loading (Document ID 0731, p. 383). Using more extensive measurements (continuous data logging every 8 seconds), Collingwood and Heitbrink evaluated the same vacuum model used by Echt and Sieber and found that average initial air flow was 71 cfm, which declined to 48 cfm over the task-based work sessions, even with knocking the dust from filters using the manufacturer's recommended method as deemed necessary (Document ID 0600, p. 884). As previously discussed, the accumulation of material and debris on the filter (filter caking) during work causes pressure losses that eventually limit air flows in even the most powerful vacuums. As debris accumulates, the filter becomes caked with collected dust and air flow decreases. Unless the filter is properly cleaned according to the manufacturer's instructions, the air flows declines rapidly.

OSHA included three additional specifications in the proposed standard; two of these, preventing wet slurry from accumulating and drying, and ensuring that visible dust was not emitted from the process, were completely removed as described above. OSHA is retaining the third specification, which requires employers to minimize the accumulation of visible airborne dust when working indoors or in enclosed areas by providing sufficient ventilation when needed; this requirement is now located in paragraph (c)(2)(i) of the standard for construction.

In the proposed standard, OSHA required the use of a half-mask respirator with an APF of 10 during wet grinding for more than four hours. No respiratory protection was required when wet grinding for four hours or less. When using a grinder equipped with a commercially available dust collection system, OSHA required the use of a half-mask respirator with an APF of 10 regardless of task duration. In the final standard, OSHA has decided it is appropriate to distinguish between respiratory protection needed when grinding outdoors and grinding indoors or in enclosed areas. This division has allowed OSHA to more appropriately apply the use of respirators, limiting the number of tasks that requires their usage. Based on data in the record, OSHA concludes that most employees using hand-operated grinders without controls currently experience exposures above 50 μg/m^3 TWA. However, when grinders are operated with dust collection or wet systems outdoors, exposures will be reduced to or below 50 μg/m^3 most of the time. The exposure profile in Table IV.5.11-B in Section 5.11 of Chapter IV of the FEA shows that 50 percent of grinders working outdoors using water or LEV are exposed below 50 μg/m^3. These results demonstrate that silica exposures at or below 50 μg/m^3 have already been achieved for half of exposed workers with technology available at the time of sampling. Much of the data in the exposure profile reflects samples collected over ten years ago, before many of the engineering studies described in the FEA were conducted. OSHA expects that dust capture technology will continue to improve in response to market demand. When fully and properly implemented, OSHA expects that exposures to silica will be at or below 50 μg/m^3 most of the time when water-based dust suppression or LEV systems are used for outdoor grinding and that respiratory protection will not need to be relied on to protect employees.

The available data presented in Table IV.5.11-B in Section 5.11 of Chapter IV of the FEA suggest that the mean indoor grinding exposure level with dust collection systems is about twice that for grinding outdoors, with 50 percent of exposures between 100 and 250 μg/m^3. Exposures measured within a test chamber during grinding operations confirm that high exposures result from grinding concrete indoors, even with good dust collection equipment (Document ID 3609), with mean task-based sample results generally falling between 100 and 200 μg/m^3. Based on the available data for indoor grinding, OSHA concludes that, when grinding with a commercially available shroud and dust collection system for four hours or less per shift, resulting exposures should generally be no higher than grinding outdoors for a full shift and thus should not necessitate the use of respiratory protection. However, for indoor grinding tasks performed more than four hours per shift, the Agency concludes that exposures will consistently exceed 50 μg/m^3. Therefore, Table 1 requires respiratory protection with an APF of at least 10 when grinding with dust collection systems for more than four hours per shift indoors or in an enclosed area.

OSHA finds that there is inadequate evidence in the record to demonstrate that wet grinding indoors or in an enclosed area is as effective as using LEV. Accordingly, OSHA is permitting the use of water-based dust control for grinding tasks outdoors only and is not requiring the use of respiratory protection regardless of the duration of the task. OSHA notes from its exposure profile that the vast majority of exposure samples taken during indoor grinding where dust controls were used made use of LEV systems rather than water-based dust control systems (21 out of 23 samples) (see Section 5.11 of Chapter IV of the FEA). If an employer decides to use a wet method for indoor grinding, it will be operating outside of Table 1 and will have to comply with the paragraph (d) alternative method of compliance.

Walk-behind milling machines and floor grinders. Paragraph (c)(1)(xiii) of the standard for construction requires walk-behind milling machines and floor grinders used to grate or grind solid surfaces (such as concrete, asphalt, masonry walls and sidewalks, see Section 5.8 of Chapter IV of the FEA) to be equipped with an integrated water delivery system that continuously feeds water to the cutting surface, or with a dust collection system recommended by the manufacturer of the milling machine or floor grinder, a filter with 99 percent or greater efficiency, and a filter-cleaning mechanism. When using an LEV dust collector system indoors or in enclosed areas, Table 1 also requires that loose dust be cleaned with a HEPA-filtered vacuum in between passes of the milling machine or floor grinder. Both options require that the tool be operated in accordance with the manufacturer's instructions to minimize dust emissions. No respiratory protection is required by Table 1, regardless of task duration or work location.

Paragraph (c)(1)(xiii) of the standard for construction covers wheeled machines, equipped with a cutting tool, that are guided by hand with the worker positioned more than an arm's length away from the grinding action of the tool (e.g., milling machines, scarifiers, floor grinders). Laborers or construction workers operate these machines during specialty tasks such as resurfacing floors, repairing pavement, or creating grooves for electrical cables (Document ID 0036, p. 15; 3958; 3959, p. 39). In the proposed standard, walk-behind milling machines were included under the entry for "Milling" as "walk-behind milling tools." In response to commenters' recommendations, and recognizing that suitable dust control measures differ among different milling machines, OSHA has decided it is more appropriate to divide milling activities into three subgroups: walk-behind machines and floor grinders, small drivable milling machines (less than half-lane), and large drivable milling machines (half-lane and larger) (Document ID 3583, Tr. 2171, 2212-2213; 2181, pp. 4, 7, 9).

Walk-behind milling machines and floor grinders are currently available with water systems (e.g., Document ID 0524; 0642), and with dust collection systems (e.g., Document ID 1276; 0636; 0642; 4073, Attachment 4a, Rows 131-133, 150-152). Additionally, some scarifiers, particularly those intended for indoor use, are available with both a vacuum port (for connecting to a portable industrial vacuum system) and a water mist system as standard equipment (Document ID 0642).

In specifying the option for a machine equipped with an integrated water delivery system that continuously feeds water to the cutting surface, OSHA is not specifying a minimum flow rate for water used with the integrated delivery system, but rather anticipates that the water flow rates specified by the manufacturer will optimize dust reduction. Evidence in the record demonstrates the effectiveness of wet methods to control exposures when using walk-behind milling machines and floor grinders. ERG (2000) measured exposure levels below the LOD (12 $\mu g/m^3$) for workers using wet methods while milling a newly installed terrazzo floor indoors (Document ID 0200, p. 11). Echt et al. (2002) tested a custom-built water-fed system that provided a copious amount of water (15 gallons per minute) to the concrete work surface (not the cutting teeth) milled by a scabbler with an 8-inch cutting width. The investigators compared results from alternating 5-minute periods of milling with and without the water-feed activated. The water reduced average respirable dust levels by at least 80 percent. A separate NIOSH study on drivable milling machines reports that under common road milling conditions, water spray provided to the cutting drum area at 12 gallons per minute is capable of suppressing dust generated by a 7-foot wide (84 inches) drivable milling machine cutting drum (an application rate of just 0.14 gallons per minute per inch of cutting width) (Document ID 1251, pp. 7-9, 14). Based on this evidence, OSHA concludes that, with careful adjustment, water spray methods using a fraction of the water used in the Echt et al. (2002) scabbler study should prove at least as effective in reducing silica dust exposures generated by walk-behind milling machines and floor grinders.

Blute et al. (1999) evaluated silica exposures among workers using wet dust control methods for scabbling and large-scale grinding tasks at an underground construction site. In this case, rather than being walk-behind equipment, the scabblers and grinders were attached to the articulated arm of front-end loaders (Document ID 0562, p. 633). Although these workers used drivable machines (removing more material than the typical walk-behind milling machine), their work (scabbling and grinding excess concrete from tunnel walls) demonstrates the value of wet methods when these activities are performed in enclosed spaces. This is particularly relevant to walk-behind milling machines that are frequently used indoors to mill concrete surfaces. In the underground work environment, all three workers experienced task-based silica concentrations below the preceding PEL with only one of the results (79 μg/m^3) exceeding 50 μg/m^3 (Document ID 0562, p. 637). OSHA has determined that the information discussed above and in the FEA is the best available evidence and supports the use of wet methods to control silica dust while using walk-behind milling machines.

Alternatively, employers following Table 1 may use a machine equipped with a dust collection system recommended by the manufacturer. The similarity between vehicular and walk-behind milling machines supports the use of vacuum dust collection (exhaust suction) methods for the smaller, walk-behind form of milling equipment. A study by TNO Bouw (2002) found that when exhaust suction methods were applied to the milling drum area of drivable milling machines, exposure levels for operators obtained over a five-day period ranged from less than 4 μg/m^3 to 28 μg/m^3. The study also found similar exposure results for machine tenders, who walked next to the machines; results ranged from less than 3 μg/m^3 to 29 μg/m^3 (Document ID 1184, p. 25). OSHA inspection data from a construction site using a scarifier and a floor grinder, both equipped with LEV, to mill a concrete floor found no silica exposure for either of the workers (Document ID 3958, Rows 209-211, 214-215). OSHA's exposure profile, contained in Section 5.8 of Chapter IV of the FEA, contains these and four other exposure results for workers using walk-behind equipment at two indoor construction sites using LEV, where only one detectable result exceeded 50 μg/m^3.

Based on the evidence in the record, OSHA has determined that employees' exposure when using walk-behind milling machines can be further reduced by cleaning up debris when work is performed indoors or in enclosed areas. During a study on exposures while operating a scabbler in a parking garage, researchers noted that the worker generated the most airborne dust when passing the machine over a previously milled area (Document ID 0633, pp. 812-813). OSHA's OIS data also contains a non-detectable silica exposure result for a helper who vacuumed behind the operator of a floor grinder and scarifier preparing an indoor concrete floor for painting where LEV was used as the dust control (Document ID 3958, Row 211). Under paragraph (c)(1)(xiii) of the standard for construction, when using a walk-behind milling machine or floor grinder indoors or in an enclosed area, milling debris in the form of loose dust must be removed with a HEPA-filtered vacuum prior to making a second pass over an area. This prevents the debris from interfering with the seal between machine and floor and minimizes the gap. Additionally, it prevents debris from being re-suspended and acting as another source of exposure. Accordingly, OSHA is requiring the use of a vacuum with a HEPA filter to clean up any loose dust prior to making additional passes over the area when work is conducted indoors or in enclosed spaces with LEV (Document ID 0633, pp. 812-813; 1391, pp. 28, 40).

In addition, the effectiveness of vacuum suction also depends on minimizing the gap between the bottom of the machine and the surface being milled, as discussed by Hallin (1983), who found that exposures to respirable dust increased when the housing around the base of the tool was removed (Document ID 1391, p. 25). To achieve acceptable dust control and ensure that the LEV system is fully and properly implemented, milling must proceed in a manner that limits the gap between the bottom of the walk-behind milling machine and the surface being milled.

Based on the data described above, OSHA concludes that most employees operating walk-behind milling machines will experience exposure levels of 50 μg/m^3 or below most of the time when employers implement the controls outlined in Table 1 under paragraph (c)(1)(xiii) of the standard for construction. OSHA finds that controls effective for driven milling machines are adaptable to the smaller walk-behind milling machines. Even in indoor environments, low exposures can be achieved for most walk-behind milling machine operators through the proper use of controls, including the use of HEPA-filtered vacuum systems intended to clear debris in between milling passes when dry grinding and the use of ventilation as required under paragraph (c)(2)(i) of the standard for construction. Therefore, OSHA concludes that exposure will remain below 50 μg/m^3 most of the time, even when working indoors for more than four hours, and is not requiring the use of respiratory protection, regardless of task duration or work location.

Small Drivable Milling Machines (less than half-lane). Employees engaged in this task use small drivable milling equipment to grate or grind solid surfaces, such as concrete floors, sidewalks, and asphalt roads. The smaller drivable machines mill a narrower strip of pavement than large milling machines (median of 20 inches compared to a minimum of 79 inches for large machines), and typically are capable of milling less depth (median 8 inches) than a large machine (median 13 inches) (Document ID 1229; 3958). Milling machinery, both large and small, often uses a rapidly rotating drum or a bit covered with nibs to abrade surfaces, although other mechanisms (including systems based on impact, shot-blast, or rotating abrasive cups) are common.

The proposed standard contained a single entry for "Milling" and treated all drivable milling machines alike, requiring them to use a water-fed system that continuously applied water at the cut point. In the final standard, OSHA has separated smaller milling machines (less than a half-lane wide) from larger ones based on comment and testimony in the record. In response to commenters, OSHA has decided it is more appropriate to divide drivable milling activities into separate entries for large milling machines (half-lane and larger) and small milling machines (less than half-lane) (Document ID, 3583, Tr. 2171, 2212-2213; 2181, pp. 4, 7, 9). IUOE and a road milling machine manufacturer categorized drivable milling machines as either small or large (half-lane or larger, with cutting drum about 79 inches or wider) (Document ID 3583, Tr. 2441; 1229). NAPA commented that large milling machines should be identified separately on Table 1 of the construction standard. Based on these comments and evidence showing that the dust control systems are different between the two classes of drivable milling machine (Document ID 3583, Tr. 2171, 2212-2213), Table 1 in the final standard treats them as two separate tasks.

Under paragraph (c)(1)(xiv) of the standard for construction, small drivable milling machines (less than a half-lane in width) must be used with supplemental water sprays designed to suppress dust. The water used must be combined with a surfactant. Manufacturers of smaller drivable milling machines currently make such systems (Document ID 1229; 4073, Attachment 4a). Unlike for larger milling machines, Table 1 does not specify as an option a water spray and exhaust ventilation combination system for small milling machines because it appears that such systems are not currently available.

Including a surfactant additive in the water is a practical way to reduce employee exposures to the lowest level achievable with this wet method (Document ID 1216, p. 3; 1217, Slides 4 and 8; 3583, Tr. 2187-2188). This is because it offers particle binding properties that are ideal for dust suppression (Document ID 1216, p. 3).

Small drivable milling machines generally produce less dust than large drivable machines, since small machines are used intermittently and have smaller cutting tools (Document ID 1229, pp. 1-3; 3583, Tr. 2213). As discussed in the technological feasibility section on millers using portable or mobile machines (see Section 5.8 of Chapter IV of the FEA), OSHA concluded that, rather than relying on the very limited (two) existing data points for workers using small drivable milling machines, the exposure profile for this group is better represented by a surrogate data set comprising the more comprehensive and wide ranging profile for the entire group of workers using drivable milling machines (including operators and tenders/helpers of both large and small drivable milling machines). Thus, the exposure profile for small drivable milling machines (n = 31) shows a median exposure of 21 μg/m^3 and a mean exposure of 48 μg/m^3, with overall exposures ranging from 5 μg/m^3 to 340 μg/m^3. Therefore, considering the ample evidence on the effectiveness of water-based dust control systems for large as well as small drivable milling machines, OSHA finds that this control is applicable to small drivable milling machines.

Water applied to the cutting drum helps reduce respirable silica exposures among milling machine operators and helpers. In a study conducted in the Netherlands, a water spray dust emission suppression system using additives reduced the PBZ respirable quartz exposures of asphalt milling machine drivers to a mean of 20 μg/m^3, with a range of 9 μg/m^3 to 30 μg/m^3 (Document ID 1216, p. 4). Milling machine tenders benefitted equally from the system, having a mean PBZ respirable quartz exposure of 8 μg/m^3 with a range of 4 μg/m^3 to 12 μg/m^3. In his comments, Anthony Bodway, representing NAPA, stated his belief that employee exposures from asphalt road milling machines will be reduced to levels below 50 μg/m^3 when milling machines are fitted with effectively designed water spray systems paired with surfactants and routine inspections to ensure the system components are working properly (Document ID 2181, p. 10). He noted that all six major road milling machine manufacturers have recently begun, or will soon be, offering dust control optimized water spray systems as standard equipment or retrofit kits (Document ID 2181, pp. 21-29). One water spray design for asphalt pavement milling evaluated by NIOSH showed more promise than others, reducing dust release by 38 to 46 percent (Document ID 4141, p. 26). Although his comment was related to large drivable milling machines, wet dust control technology is available for small drivable milling machines (Document ID 1229; 4073, Attachment 4a).

Based on information presented here and in the technological feasibility analysis (see Section 5.8 of Chapter IV of the FEA), OSHA concludes that employers using the controls required by paragraph (c)(1)(xiv) of the standard for construction can reduce exposure levels to 50 μg/m^3 or below for most employees operating or helping with small drivable milling machines most of the time. The similarities to large drivable milling machines are sufficient to indicate that the wet dust suppression control technology is transferable to the smaller drivable machines. Even if these smaller machines do not achieve the extent of dust suppression demonstrated for larger machines because they perform specialty milling operations and not flat removal of asphalt typically performed by large drivable machines prior to laying of new asphalt, the intermittent nature of operations for which small drivable milling machines are used will help to maintain 8-hour TWA exposure levels substantially lower than they would be for continuous operation (Document ID 3583, Tr. 2213-2215). Therefore, OSHA is not requiring the use of respiratory protection regardless of task duration when using small drivable milling machines (less than half-lane) equipped with supplemental water sprays combined with a surfactant.

Large drivable milling machines (half-lane or larger). Paragraph (c)(1)(xv) of the standard for construction has three control options for employers operating large (one-half lane or wider) milling machines. When making cuts of four inches in depth or less on any substrate, the control options are either to use a machine equipped with exhaust ventilation on the drum enclosure and supplemental water sprays designed to suppress dust or a machine equipped with supplemental water spray designed to suppress dust combined with a surfactant. When milling only on asphalt, Table 1 allows cuts of any depth to be made when machines are equipped with exhaust ventilation on the drum enclosure and supplemental water sprays designed to suppress dust.

These controls are currently available (Document ID 2181, pp. 11, 21-29). All of the manufacturers of large milling machines currently provide dust-suppressing water spray systems on new equipment and as retrofit kits for older machines. In addition, as discussed in the Section 5.8.4 of Chapter IV of the FEA, new machines will be equipped with both dust-suppressing water spray systems and dust collection systems by 2017 at the latest, when industry members are committed under the Silica/Asphalt Milling Machine Partnership, which includes representatives from the road construction contractors industry and major road milling machine manufacturers, NAPA, AEM, IUOE, LHSFNA, and NIOSH, to equip new machines with both dust-suppressing water spray systems and LEV (Document ID 2181, pp. 11, 21-29).

The controls included on Table 1 for large drivable milling machines are based on research on dust control technologies conducted by the Silica/Asphalt Milling Machine Partnership, which has been studying dust controls for milling machines since 2003 (Document ID 2181, pp. 1-2; 3583, Tr. 2152, 2160; 4149) with the goal to develop innovative engineering controls "that all but eliminate dust and potential silica exposure," and methods "to retrofit existing milling machines to ensure a safe workplace" (Document ID 3583, Tr. 2153). Much of the data contained in the record on the effectiveness of control strategies for large drivable milling machines come from the Partnerhip's efforts and are contained in NIOSH publications (see Table IV.5.8-B in Section 5.8 of Chapter IV of the FEA).

Based on the data in the record, exposures among large drivable milling machine operators can be reduced to 50 μg/m^3 or less most of the time. The exposure profile in Section 5.8 of Chapter IV of the FEA shows that 79 percent of all large drivable milling machine operators already experience silica levels below 50 μg/m^3 as a result of using water spray intended to cool the cutting drum. Similarly, exposure levels for 67 percent of tenders working alongside large milling machines are below 50 μg/m^3. Based on the Agency's review of studies in the record, which show that low silica exposures can be achieved for both operators and tenders across varying water spray flow rates, OSHA concludes that improvements to cooling water spray systems can help to further reduce exposures of employees currently experiencing exposures above 50 μg/m^3 (see Tables IV.5.8-D and IV.5.8-E in Section 5.8 of Chapter IV of the FEA). However, information is insufficient to confirm that the use of water alone in existing systems will reliably control all employees' exposures. Based on the Agency's review of evidence in the rulemaking record, OSHA has determined that supplementing water with a dust suppressant additive or with an exhaust ventilation on the drum enclosure (controls that were not included on proposed Table 1), will achieve levels below 50 μg/m^3 for all or almost all operators and helpers most of the time when making cuts of four inches in depth or less on any substrate (see Table IV.5.8-E in Section 5.8 of Chapter IV of the FEA) (Document ID 1216, p. 4; 4147, pp. v, 13; 4149, pp. v, 13). Additionally, OSHA has determined that when milling asphalt only, the addition of exhaust ventilation on the drum enclosure will achieve levels below 50 μg/m^3 for workers making cuts of any depth (Document ID 4149).

NIOSH recommended LEV plus water-spray dust suppression controls be included on Table 1 for drivable milling machines (Document ID 2177, Attachment B, p. 20). As discussed in Section 5.8.4 of Chapter IV of the FEA, a dust suppression system with a foam additive kept exposures below 30 μg/m^3, and the use of water sprays combined with LEV systems kept exposures under 25 μg/m^3 (Document ID 1184, pp. 5, 25; 1217, p. 4). These methods, combined with water spray systems purposefully designed to control dust at the cutting drum, transfer points, and conveyors, will control silica exposures among vehicular milling machine operators and tenders to 50 μg/m^3 or below during typical removal operations under the typical range of conditions. Manufacturers of large milling machines are committed under the Silica/Asphalt Milling Machine Partnership to equip new machines with both dust-suppressing water spray systems and LEV by 2017 (Document ID 2181, pp. 11, 21-29). Until such time that new machines equipped with LEV and water dust suppression systems are available, all six major road milling machine manufacturers have recently begun, or will soon be, offering dust control optimized water spray systems as standard equipment and/or retrofit kits, which are expected to meet the requirements for Table 1 for cuts of four inches in depth or less on any substrate (Document ID 2181, pp. 21-29).

Proposed Table 1 specified the use of a respirator (half-mask APF 10) for drivable milling machines with a water-fed system used more than four hours a day irrespective of the material milled. NAPA recommended removing the proposed requirements for use of respirators when milling asphalt (Document ID 2181, pp. 11-12, 16). Upon review of the evidence in the record, OSHA agrees that this is appropriate for all asphalt and concrete milling operations. As explained in Section 5.8 of Chapter IV of the FEA, the controls contained in Table 1 in the final standard will keep exposures below 50 $\mu g/m^3$ for most operators and tenders of large drivable milling machines most of the time. Evidence submitted to the record by NAPA and NIOSH shows both water-based dust suppression systems and combination LEV/water-based systems during asphalt milling results in employee exposures lower than 50 $\mu g/m^3$ (Document ID 2177 Attachment B, p. 20; 1184, pp. 5, 25; 1217, p. 4). Accordingly, respiratory protection is not required under Table 1 of the final standard for operating large drivable milling machines to mill asphalt. Although there is some qualitative evidence indicating that exposures when milling concrete for more than four hours may be somewhat higher, and could exceed 50 $\mu g/m^3$ some of the time, there is no hard data permitting OSHA to treat asphalt and concrete milling differently with respect to imposing a respirator requirement or to conclude that most concrete milling for that duration will be above 50 $\mu g/m^3$ most of the time. Therefore, OSHA is not including a respirator requirement in the final standard for either asphalt or concrete milling, regardless of task duration.

IUOE recommended separate treatment of operators and tenders of large milling machines since the exposures of operators are lower than the exposures of tenders. IUOE further stated that operators are located farther from the silica source than tenders, and appropriate protection varies depending upon the location of the worker from the silica source (Document ID

2262, p. 24). Evidence summarized above shows that most tenders and operators will not experience silica exposures in excess of 50 μg/m^3 when either of the control options required by Table 1 is implemented. The exposure profile in Table IV.5.8-C in Section 5.8 of Chapter IV of the FEA shows that the mean of respirable crystalline silica exposures for operators of large milling machines is 39 μg/m^3 (median 17 μg/m^3) and the slightly higher mean for tenders is 57 μg/m^3 (median 27 μg/m^3). Sample results presented in the exposure profile indicate that 79 percent of all large drivable milling machine operators already experience silica levels below 50 μg/m^3 as a result of using water spray intended to cool the cutting drum. Similarly, exposure levels for most tenders (67 percent) working alongside large milling machines are already below 50 μg/m^3 (see Tables IV.5.8-D and IV.5.8-E in Section 5.8 of Chapter IV of the FEA). Therefore, OSHA concludes that separate control measures do not need to be specified for operators and tenders.

Proposed Table 1 contained dust control specifications for all drivable milling machines, including when milling concrete. OSHA received comments from IUOE, BCTD, and NAPA recommending that Table 1 be modified to separate asphalt milling and concrete milling and require appropriate controls based on the respective exposure levels (Document ID 2262, pp. 3, 17; 2371, Attachment 1, p. 26; 2181, p. 9). Concrete milling is performed less frequently than asphalt milling (Document ID 1231; 3583, Tr. 2213-2214), but silica exposures could be higher than when milling asphalt. This difference is likely due to the potential for the silica content to be higher in some concrete compared with some asphalts (Document ID 1699), and also the softness and “stickiness” of asphalt milled warm, which likely helps reduce separation of the pavement components and perhaps limits dust release in hot weather (Document ID 1251, p. 14; 1231). In addition, cutting drums for concrete have smaller teeth, which can produce more fine dust than is the case with asphalt (Document ID 1699). Anthony Bodway, representing NAPA, also noted that silica exposures are higher for concrete milling than for asphalt milling (Document ID 2181, p. 15). In the FEA, OSHA concludes that water dust suppression and LEV systems should be equally effective for concrete and asphalt in terms of percent reduction in dust emissions when making cuts of four inches in depth or less on any substrate (see Section 5.8 of Chapter IV of the FEA). However, to the extent that milling concrete is dustier (i.e., a larger amount of respirable dust is liberated), exposures to silica during concrete milling may be somewhat higher than is the case for asphalt milling even with the use of dust controls. As previously explained, however, OSHA lacks quantitative data supporting these comments to allow it to impose more stringent requirements, specifically a requirement to use respirators, on concrete milling and not on asphalt milling or to conclude that exposures will be over the PEL for most operators most of the time doing either task.

The Silica/Asphalt Milling Machine Partnership conducted field trials for large road milling machine LEV systems making cuts up to 11 inches deep (Document ID 4147; 4149). NIOSH evaluated exposures among workers at four road construction sites (Document ID 4147, pp. v, 5-7, 13, Table 1; 4149, pp. v, 5-7, 13, Table 1). All the samples obtained during the studies for operators and tenders combined showed that exposure levels never exceeded 25 $\mu g/m^3$ when workers used machines fitted with the LEV system, even when making cuts up to 11 inches deep in asphalt (Document ID 4147, pp. v, 6-7, 13, Table 1; 4149, pp. v, 5-7, 13, Table 1). In fact, the highest sample result (24 $\mu g/m^3$ for a "groundsman" walking beside a milling machine removing 11 inches of pavement on each pass) was the only sample result to exceed 13 $\mu g/m^3$ during the two sampling dates (Document ID 4147, pp. v, 5-7, 13, Table 1; 4149, pp. v, 5-7, 13, Table 1).

Therefore OSHA is confident that when removing asphalt only, workers can make cuts of any depth without elevated exposures to silica.

However, other evidence contained in the record indicates that cutting depths of more than four inches, in one pass, reduces the effectiveness of controls (Document ID 3798, pp. 2, 14; 0555, p. 1). Therefore OSHA has determined that if an employer is using a large drivable milling machine to mill concrete, or road surface material that contains both concrete and asphalt, deeper than four inches, it is not covered by Table 1 and the employer will be required to conduct exposure assessments and comply with the PEL in accordance with paragraph (d) of the standard for construction.

IUOE also recommended excluding road demolition and asphalt reclamation from asphalt milling in Table 1. Road demolition involves removal of the road substructure in addition to the road surface material and asphalt reclamation involves deeper cuts than typical "mill and fill" cuts of four inches in depth or less. IUOE asserted that this change should eliminate the need for respirator use by operators during typical asphalt "mill and fill" operations when engineering controls are properly implemented (Document ID 2262, p. 23).

Paragraph (c)(1)(xv) of the standard for construction excludes road demolition and asphalt reclamation operations by limiting milling activities on materials other than asphalt to cuts of four inches in depth or less. The NIOSH studies of LEV for drivable milling machines were conducted using large asphalt road milling machines (half-lane or wider) and provide strong evidence that exposure levels below 50 $\mu g/m^3$ (and even below 25 $\mu g/m^3$) can be achieved for employees operating this type of equipment during typical shallow "mill and fill" type road milling (i.e., cuts of four inches in depth or less) (see Table IV.5.8-E in Section 5.8 of Chapter IV of the FEA). In one NIOSH study, the removal of excess pavement during milling machine demolition-type work (12 inches of pavement all at once), created a large gap between the road and the milling machine drum enclosure, allowing more dust to escape than during typical milling conditions (Document ID 0555, p. 1). Also, a NIOSH trial, using only drum cooling water and alternate spray nozzles, showed elevated silica exposure levels when the road milling machine intermittently ground through the asphalt layer into an aggregate and concrete underlayment (Document ID 3798, pp. 2, 14). Milling operators will rarely encounter these "worst case" conditions (Document ID 0555, p. 1).

As previously stated, when milling only on asphalt, OSHA is allowing cuts of any depth to be made when machines are equipped with exhaust ventilation on the drum enclosure and supplemental water sprays designed to suppress dust. When milling all other material to a depth of more than four inches Table 1 does not apply and employers will be required to conduct exposure assessments and comply with the PEL in accordance with paragraph (d) of the standard for construction. Additionally, road demolition, such as cutting the roadway into manageable size pieces or squares that involves equipment other than milling machines, such as saws, dowel drills, and various kinds of heavy equipment, is not covered under this entry on Table 1 (see Sections 5.3, 5.6, and 5.9 of Chapter IV of the FEA). In those instances employers will need to follow the appropriate entries on Table 1 for the equipment used or conduct exposure assessments and comply with the PEL in accordance with paragraph (d) of the standard for construction.

Crushing machines. Crushing machines are used to reduce large rocks, concrete, or construction rubble down to sizes suitable for various construction uses (see Section 5.10 of Chapter IV of the FEA). When using crushers, paragraph (c)(1)(xvi) of the standard for construction requires the use of equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., at hoppers, conveyors, sieves/sizing or vibrating components, and discharge points), and a remote control station or ventilated booth that provides fresh, climate-controlled air to the operator. In the proposed standard, OSHA listed this entry as "Rock Crushing." For the final standard OSHA has revised the title of this entry to clarify that it includes concrete crushing, which is often performed at demolition projects (Document ID 4073, Attachment 9a; 4073, Attachment 10a; 4073, Attachment 10b; 4234, Attachment 1, pp. 15-16). Proposed Table 1 would have required the use of wet methods or dust suppressants or LEV systems at feed hoppers and along conveyor belts. Information contained in the record indicates that LEV alone is not effective in reducing exposures to 50 $\mu g/m^3$ or below, and that it is necessary to require both a water spray system and either a remote control station or filtered control booth to protect the operator and employees engaged in crushing operations (see Section 5.10 of Chapter IV of the FEA).

Wet spray methods can greatly reduce the exposure levels of operators and laborers who work near crushers tending the equipment, removing jammed material from hoppers, picking debris out of the material stream, and performing other tasks (Document ID 0203, pp. 3-6, 9; 1152; 1360; 1431, pp. 3-93-3-94; 3472, pp. 61-76; 4073, Attachment 9a; 4073, Attachment 15g, p. 1). These systems are currently available and all crushers and associated machinery (conveyors, sizing screens, discharge points) can be retrofitted with water spray or foam systems (Document ID 1360; 0769; 0770; 0830; 0831; 0832). Spray systems can be installed for remote control activation (Document ID 0203, pp. 11, 12, 14; 0830). The design and application of water spray systems will vary depending on application. For airborne dust suppression, spray nozzles should be located far enough from the target area to provide coverage but not so far so as to be carried away by wind. In addition, nozzles should be positioned to maximize the time that water droplets interact with airborne dust. Droplet size should be between 10 and 150 μm (Document ID 1540, pp. 62-63). Alternatively, to prevent airborne dust from being generated, nozzles should be located upstream of dust generation points and positioned to thoroughly wet the material, and the volume and size of droplets increased to ensure that the material is sufficiently wetted (Document ID 1540, pp. 62-63). Information from IUOE, BCTD, and the U.K. Health and Safety Executive shows that water application can be expected to reduce exposure levels from 78 to 90 percent (Document ID 1330, p. 94; 4025, Attachment 2; 4073, Attachment 9a, pp. 1-4; 4073, Attachment 15g, p. 2).

The record did not contain information on exposures of tenders or other employees working near a crusher operation without dust controls. However, OSHA concludes that employees assisting with crusher operations can be exposed to elevated levels of respirable crystalline silica if water sprays are not used to control dust emissions. This conclusion is based on evidence gathered by OSHA's contractor, ERG, which visited a concrete crusher site. At the site, ERG observed a crusher operator who spent time outside of a control booth shoveling dried material from under a conveyor. The operator was exposed to 54 μg/m^3 TWA despite the time he spent in the booth where the silica concentration was non-detectable (Document ID 0203, p. 9). Thus, this operator's TWA exposure to silica can be entirely attributed to his work around the crusher, much as a tender would have been doing. Without the benefit of spending some time in the booth, and the fact that the material being crushed was wet from rain and a freeze the night before, the operator's exposure could have been even higher (Document ID 0203). This indicates that tenders assisting with crusher operations, who do not have the benefit of a booth for protection from exposure, can be exposed to excessive levels of crystalline silica-containing dust when water is not applied to areas where dust emissions occur. The potential exposure of tenders and other employees who are in the vicinity of crusher operations underscores the importance of using water spray systems to reduce dust emissions. Such systems will reduce dust exposures generally, thereby reducing exposures for tenders and other employees in the vicinity of the crusher. Moreover, as discussed below, OSHA is not specifying the use of LEV systems for crushing operations on Table 1 of the final standard because LEV has not been proven to be an effective or widely available alternative.

CISC argued that OSHA's preliminary finding that it was feasible to achieve exposures of 50 μg/m^3 for tenders was unfounded and based on no data on exposures of crushing machine tenders (Document ID 2319, pp. 62-63). However, there are data in the record that inform the Agency with respect to exposure of crushing machine tenders and the effectiveness of dust controls in reducing their exposures to silica. As described above, a crusher operator performing tasks along the conveyor belt was exposed much as a tender would be. OSHA identified one exposure measurement from an enforcement case for a laborer working near a mobile crusher at an asphalt plant; the laborer's exposure was 43 μg/m^3 (8-hour TWA) based on a half-day of sampling (Document ID 0186, pp. 60-61). In addition to assisting with the crusher operation, he also mixed a blend of sand, crushed concrete, asphalt, and soil, which likely contributed to his exposure. He was working about 50 feet from the crusher hopper where it was evident from the inspection report that his exposure was much lower than that of the operator (Document ID 0186, p. 37). Bello and Woskie found exposures of demolition workers, including those near a crushing operation, were below 50 μg/m^3 when water was used as dust controls for the demolition project (Document ID 4073, Attachment 9a, pp. 3-4). OSHA thus rejects CISC's contention that the absence of direct evidence of exposures to tenders means that OSHA cannot regulate them or draw reasonable inferences about the technological feasibility of controlling their exposures (Document ID 2319, pp. 62-63).

Crushers are currently available with remote controls as standard equipment (Document ID 0770; 0769, p. 2). The remote operation permits the operator to stand back from the crusher or move upwind of dust emissions. IUOE provided exposure data from large highway reconstruction projects (Document ID 4025, Attachment 2, p. 9). Four samples were collected where the operator platform was next to the crushing operation and the operator was directly exposed to the crusher emissions, resulting in a mean respirable crystalline silica exposure of 410 μg/m^3 (Document ID 4025, Attachment 2, p. 9). Water use was observed but no details were provided on the extent of use or the systems in place. There was an approximately 66 percent reduction in exposure to respirable crystalline silica of the crusher operator working from a remote location (the remote location mean exposure was 140 μg/m^3) (Document ID 4025, Attachment 2, p. 9). IUOE addressed the utility of remote controls in its comments on the proposed standard, and requested that OSHA evaluate remote control technologies as an exposure control method and include this type of control in Table 1 (Document ID 2262, p. 45; 3583, Tr. 2341).

An isolated and ventilated operator control booth can significantly reduce the respirable silica exposures of employees associated with crushing. At a visit to a crusher facility, ERG found non-detectable levels of respirable crystalline silica inside the operator's control booth, compared to a concentration of 103 μg/m^3 outside, despite the booth having poor door seals, using recirculated rather than fresh air, and having foam filters (as opposed to the MERV-16 or better filters required by paragraph (c)(2)(iii)(E) of the standard for construction) (Document ID 0203, pp. 12-13).

Other studies of operator cabs also reported silica or dust exposure reductions ranging from 80 percent to greater than 90 percent (Document ID 0589, p. 3; 0590, p. 54; 1431, p. 3-95). In the PEA, OSHA recognized that control booths for crushers are commercially available, although they are not commonly used on construction sites (Document ID 1720, p. IV-494). However, Kyle Zimmer, director of health and safety for IUOE Local 478, stated during the hearing that "contractors report that they are using portable crusher control booths with air conditioning to operate the plant remotely" (Document ID 3583, Tr. 2341).

Evidence indicates that operators experience high exposure levels when they must operate the crusher from above the feed hopper where dust emissions are highest (Document ID 0030; 4073, Attachment 10a). In light of this evidence, OSHA concludes that removing or isolating the operator from this high-exposure location will be effective in lowering the exposure of the operator. It is not clear that a control booth alone will be sufficient to protect the operator from exposure to silica, since operators periodically leave the booth to perform work around the crusher, and the booth does not offer any protection for other employees outside the booth such as tenders. A study of crushers used in the South Australian extraction industry found operator exposures ranged from 20 to 400 μg/m^3 (with a median of 65 μg/m^3) while crushing dry material and using control booths or cabs (Document ID 0647). Four of the eight sample results were at or below 50 μg/m^3, and at least two of the sampled workers occasionally exited the cabins to free machinery blockages (Document ID 0647).

Because providing a filtered booth for the operator will not protect other employees assisting with the operation or working nearby, OSHA finds that a water-based dust suppression system is necessary to prevent excessive exposure to silica among tenders and other employees nearby. Therefore, OSHA has determined that the combination of water use and either a remote control station or a ventilated booth for the mobile crusher operator will be effective in minimizing exposure of the operators and tenders. Summary data submitted by IUOE show that, with water use, the addition of remote control stations further reduced operator exposures by a factor of 3 (Document ID 4025, Attachment 2, p. 9). At the crusher operation visited by ERG, the operator's TWA exposure was 54 μg/m^3 while working in a booth, and his exposure would have been lower had water been applied to dried material he was shoveling from under the conveyor.

In the proposed standard, OSHA required the use of a half-mask respirator with an APF of 10 for all employees outside of the cab, regardless of task duration or whether water sprays or LEV were implemented. No respiratory protection was required for those employees who operated the crusher from within the cab. OSHA proposed to require respirator use because the data available at the time suggested that neither water spray nor LEV systems would consistently reduce exposures to 50 μg/m^3 or less, and that high exposures (even in excess of the preceding PEL) could still occur. The crushing machine entry for Table 1 in the final standard does not require respiratory protection for tenders or mobile crusher operators because the evidence described above indicates that the use of water systems, combined with a remote control station or ventilated booth, will reduce most employees' exposures to respirable silica to 50 μg/m^3 or less most of the time.

Information from IUOE, BCTD and the U.K. Health and Safety Executive show that water application can be expected to reduce exposure levels by 78 to 90 percent (Document ID 1330; 4025, Attachment 2, pp. 7-23; 4073, Attachment 9a, pp. 1-4; 4073, Attachment 15g, p. 2). Using the mid-point of this exposure control range (84 percent) and applying it to the highest value in the exposure profile (300 μg/m^3), would yield an exposure of slightly less than 50 μg/m^3

TWA for an eight-hour work day. However, other evidence suggests that wet spray methods may not consistently achieve exposures below 50 μg/m^3 (Document ID 0030; 4025, Attachment 2, pp. 7-23), although little detail was available on how water was applied. The evidence is clear that the highest exposures occur at the hopper where material is fed by front-end loaders or another conveyor, an area that is most likely to be tended by the operator (Document ID 0030; 4073, Attachment 10a; 0203). Therefore, OSHA finds that it is also necessary to use a remote control station or filtered booth to ensure the protection of crusher operators.

The use of LEV systems was discussed in the NPRM, but evidence in the record indicates that it has yet to be proven practicable for mobile construction crushing equipment and is not currently used extensively. William Turley of the Construction and Demolition Recycling Association stated, "While there are crushing operations that have used baghouses on the crusher, none use…ventilation equipment for conveyors" (Document ID 2220, p. 2). Phillip Rice of Fann Contracting contended that large crushing systems with multiple conveyor belts would make it very difficult to use LEV cost effectively (Document ID 2116, Attachment 1, p. 31). In contrast, Kyle Zimmer of IUOE testified that employers are using dust collectors with baghouses at some crushing operations (Document ID 3583, Tr. 2341). Nevertheless, the record does not contain substantial and convincing evidence that LEV alone can be applied when using mobile crushing machines to reduce exposure levels to the same extent as water-based dust suppression systems combined with the use of remote control stations or filtered control booths. Therefore, OSHA is not specifying the use of LEV systems for crushing operations on Table 1 of the final standard.

Heavy equipment and utility vehicles used to abrade or fracture silica containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials. Employees engaged in this task operate a variety of wheeled or tracked vehicles ranging in size from large heavy construction equipment, such as bulldozers, scrapers, loaders, cranes and road graders, to smaller and medium sized utility vehicles, such as tractors, bobcats and backhoes, with attached tools that are used to move, fracture, or abrade rock, soil, and demolition debris (see Section 5.3 of Chapter IV of the FEA). For example, equipment operators typically perform activities such as the demolition of concrete or masonry structures, hoe-ramming, rock ripping, and the loading, dumping, and removal of demolition debris, which may include the loading and dumping of rock, and other demolition activities (see Table IV.5.3-A in Section 5.3 of Chapter IV of the FEA).

Paragraph (c)(1)(xvii) of the standard for construction requires the operator to be in an enclosed cab, regardless of whether other employees are in the area and the cab must meet the requirements of paragraph (c)(2)(iii) of the standard for construction. When other employees are engaged in the task, water, dust suppressants, or both combined must also be applied as necessary to minimize dust emissions. Paragraph (c)(2)(iii) of the standard for construction requires enclosed cabs to be kept as free as practicable from settled dust, to have door seals and closing mechanisms that work properly, to be under positive pressure maintained through continuous delivery of fresh air, to have gaskets and seals that are in good condition and work properly, to have intake air that is filtered through a filter that is 95 percent efficient in the 0.3-10.0 μm range, and to have heating and cooling capabilities.

In the proposed Table 1, OSHA included one entry for heavy equipment and required that an enclosed cab be used. Although OSHA analyzed all types of work with heavy equipment, including demolition, in its preliminary feasibility analysis for heavy equipment, the proposed Table 1 entry described the activity as “use of heavy equipment during earthmoving activities.”

Several commenters requested clarification on what uses of heavy equipment OSHA intended to cover in the entry on proposed Table 1. IUOE requested that OSHA include a definition of the range of "activities encompassed within earthmoving," and specifically acknowledge whether or not demolition activities are intended to be encompassed within this definition of earthmoving on Table 1 (Document ID 2262, p. 7). IUOE further explained that while earthmoving activities are "dust-filled" and likely to result in some exposure to respirable silica, it was inappropriate to combine earthmoving and demolition into one entry for heavy equipment operators on Table 1 because earthmoving "does not fracture or abrade silica-containing materials, and thus, does not expose any heavy equipment operators to [a] high concentration of respirable silica." IUOE opined that treating the two tasks separately in the final rule would allow for better control of the hazards (Document ID 2262, pp. 3, 6, 9, 14). LHSFNA supported the IUOE position on demolition versus earthmoving and how it should be addressed in Table 1 (Document ID 4207, p. 3). BCTD requested that Table 1 specify that the Table 1 controls only apply when the listed task is performed on or with silica-containing materials, noting that some operations, such as earthmoving equipment, do not generate silica dust unless the material contains silica (Document ID 2371, p. 24).

OSHA agrees with these recommendations and has separated heavy equipment into two entries on Table 1: paragraph (c)(1)(xvii) of the standard for construction covers heavy equipment and utility vehicles used to abrade or fracture silica-containing materials or during demolition activities; paragraph (c)(1)(xviii) of the standard for construction covers heavy equipment and utility vehicles used for tasks such as grading and excavating (but not including demolishing, abrading, or fracturing silica-containing materials). As explained below, only heavy equipment and utility vehicles used to abrade or fracture silica-containing materials or during demolition activities require an enclosed cab at all times, whereas the employer has a choice between an enclosed cab or applying water and/or dust suppressant when these vehicles are used for tasks such as grading and excavating, provided there are no other employees engaged in the task beside the heavy equipment operator.

In the proposed standard, the only control option for heavy equipment was to operate from within enclosed cabs. Several commenters noted that enclosed cabs do not protect other employees, such as laborers, who perform tasks in the area but remain outside the cab (e.g., Document ID 2262, p. 24). Fann Contracting explained that not including laborers on Table 1 would “render the table pointless because employers would have to conduct frequent exposure assessments of those employees” (Document ID 2116, Attachment 1, p. 3). Because of the reasonable concerns raised by these commenters, OSHA has included controls (water and/or dust suppressants) on Table 1 to protect employees, other than the operator, who are engaged in the tasks. The other employees included under this entry for Table 1 are typically laborers who work nearby supporting the heavy equipment operator (i.e., applying dust suppressant, spotting, and clearing debris). When these materials contain crystalline silica, dust generated during these activities is a primary source of exposure for the equipment operators and the laborers.

NUCA expressed concern that operating from within a fully enclosed cab may reduce visibility of the work zone and impair verbal communication. and thereby pose potential safety risks (Document ID 2171, pp. 2, 4, 22). However, modern heavy equipment already come equipped with enclosed, filtered cabs that are designed with visibility in mind to allow the operator to perform the work required. Furthermore, radios or cell phones can be used for communication if necessary. Therefore, OSHA concludes that filtered, fully enclosed cabs have been and can continue to be used without compromising worker safety or the effectiveness of the cab.

The exposure profile in Table IV.5.3-B in Section 5.3 of Chapter IV of the FEA shows that approximately 8 percent (1 out of 13 samples) of heavy equipment operators performing demolition, abrading, or fracturing activities have exposures above 50 μg/m^3. OSHA also found a mean TWA exposure of 25 μg/m^3 for the six samples in the record for laborers who assisted heavy equipment operators by providing water for dust control during demolition projects. Table IV.5.3-C in Section 5.3 of Chapter IV of the FEA compares silica exposures among heavy equipment operators with the silica exposures of laborers engaged in the same task. These data are a subset of the exposure profile (Table IV.5.3-B in Section 5.3 of Chapter IV of the FEA) and provide evidence of the effectiveness of applying dust suppressants for dust control during demolition activities. The results for the six samples for laborers were less than 50 μg/m^3 and were lower than the heavy equipment operators not in an enclosed cab.

The information presented in OSHA's technological feasibility analysis for heavy equipment operators and ground crew laborers (Section 5.3 of Chapter IV of the FEA) and summarized above provides evidence that the use of enclosed cabs and water and/or dust suppressants will reduce exposures to 50 μg/m^3 or less for operators and laborers when these controls are fully and properly implemented. Therefore, OSHA is not requiring the use of respiratory protection for heavy equipment operators and laborers who assist heavy equipment operators during demolition activities involving silica-containing materials or activities where silica-containing materials are abraded or fractured, regardless of the duration of the task. Fann Contracting questioned whether operators who use enclosed cabs would be required to wear respiratory protection when exiting the equipment cab (Document ID 2116, Attachment 1, p. 23).

Since the specified control method on Table 1 for this task requires the use of an enclosed cab, the task is not being performed once the operator exits the enclosed cab and the resulting exposure will have ceased, and no respiratory protection is required in that circumstance. However, if other abrading, fracturing, or demolition work is continuing while an operator is outside the cab, that operator is considered to be an employee "engaged in the task" and must be protected by the application of water and/or dust suppressants.

Heavy equipment and utility vehicles used for tasks such as grading and excavating but not including demolishing, abrading, or fracturing silica-containing materials. When operating heavy equipment and smaller sized utility vehicles for tasks such as grading and excavating that do not involve demolition or the fracturing or abrading of silica, paragraph (c)(1)(xviii) of the standard for construction requires that the employee who will be operating the equipment operate from within an enclosed cab or that the employer applies water and/or dust suppressants as necessary to minimize dust emissions. If other employees (e.g., laborer) are engaged in the task, water and/or dust suppressants must be applied as necessary to minimize dust emissions even where the operator of the equipment is working inside an enclosed cab. However, the employer need not provide an enclosed, filtered cab for the operator of the equipment.

Employees engaged in this task operate a variety of wheeled or tracked vehicles ranging in size from large heavy construction equipment, such as bulldozers, scrapers, loaders, and road graders, to smaller and medium sized utility vehicles, such as tractors, bobcats and backhoes, with attached tools that are used to excavate and move soil, rock, and other silica-containing materials (see Section 5.3 of Chapter IV of the FEA). Typically tasks conducted with this equipment include earthmoving, grading, excavating, and other activities such as moving, loading, and dumping soil and rock (see Table IV.5.3-B in Section 5.3 of Chapter IV of the

FEA). In addition, the railroad industry uses such heavy equipment to dump and grade silica-containing ballast in track work to support the ties and rails. Such track work is generally subject to OSHA's construction standards, and the use of heavy railroad equipment for this purpose is therefore covered under this task in Table 1 of the final standard.

As discussed under the explanation of (c)(1)(xvii) of the standard for construction, OSHA included one entry for heavy equipment operators performing earthmoving activities in the proposed standard, but has divided this entry to distinguish between the controls needed when using heavy equipment for abrading, fracturing, or demolishing silica-containing material, on the one hand, and for grading and excavating silica-containing materials, on the other hand.

OSHA's exposure profile for earthmoving (i.e., excavation) operations shows that a large majority of exposures (87.5 percent) are below 25 μg/m^3 (see Section 5.3 of Chapter IV of the FEA). IUOE commented that earthmoving should not be the focus of the rule, stating that earthmoving activity "does not fracture or abrade silica-containing materials, and thus, does not expose heavy equipment operators to high concentrations of respirable silica" (Document ID 2262, p. 6). Martin Turek, assistant coordinator and safety administrator for IUOE Local 150, stated that "it is unlikely that moving soil or clay will generate respirable silica in concentrations … above the [proposed] PEL" (Document ID 3583, Tr. 2358).

Under both entries, however, the specified controls to protect laborers are the same. Thus, as when engaged in abrading, fracturing, or demolition tasks near or alongside heavy equipment or utility vehicles, OSHA has included a requirement that water and/or dust suppressants be applied as necessary to minimize dust emissions so that employees, including such laborers, who are engaged in such tasks as grading and excavating silica-containing materials in conjunction with operators of heavy equipment or utility vehicles are protected from excessive exposure to respirable crystalline silica.

Enclosed cabs are not mandated for this task. They may be used if the equipment operator is the only employee engaged in the task, as an alternative to water and/or dust suppressants. However, where enclosed cabs are used, they must meet the requirements outlined in paragraph (c)(2)(iii) of the standard for construction. Those requirements specify that enclosed cabs must be kept as free as practicable from settled dust, must have door seals and closing mechanisms that work properly, must have gaskets and seals that are in good condition and work properly, must be under positive pressure maintained through continuous delivery of fresh air, must have intake air that is filtered through a filter that is 95 percent efficient in the 0.3-10.0 μm range, and must have heating and cooling capabilities. If employees other than the equipment operator are engaged in the task, Table 1 requires the application of water and/or dust suppressants as necessary to minimize dust emissions, which protects the operator as well as the laborers from silica exposures above the PEL. As demonstrated by OSHA's exposure profile and the other evidence in OSHA's technological feasibility for heavy equipment operators and ground crew laborers (Section 5.3 of Chapter IV of the FEA), wet dust suppression methods (e.g., water or calcium chloride) are already a common and effective means for reducing exposures among heavy equipment operators and laborers to 50 $\mu g/m^3$ or below.

Other commenters were concerned about the availability of enclosed cabs on heavy equipment used for these types of earthmoving activities. NUCA, NAHB, and CISC expressed concern regarding the cab requirements; NUCA stated that the majority of earthmoving equipment is "equipped with open canopies or unpressurized cabs" (Document ID 2171, p. 3; 2296, p. 32; 2319, p. 114). OSHA understands that some equipment currently in use may not be equipped with enclosed, pressurized cabs as required by Table 1 when enclosed cabs are used. Where an employer chooses not to retrofit existing equipment for grading and excavating, it must apply water and/or dust suppressants as necessary to minimize dust emissions in order to comply with Table 1. Employers that neither choose to retrofit equipment nor suppress dust using water or other dust suppressants must comply with the requirements of paragraph (d) of the standard for construction.

Evidence in the record indicates that exposures of employees during common excavation and grading operations are likely to remain below 25 μg/m^3 most of the time. OSHA has therefore determined that respiratory protection is not needed when the employer fully and properly implements the controls on Table 1. Fann Contracting questioned whether operators who use enclosed cabs would be required to wear respiratory protection when exiting the equipment cab (Document ID 2116, Attachment 1, p. 23). As explained above, there is no requirement for respiratory protection when the employee is entering or exiting the cab since the task is not being performed at that time. However, if other grading or excavation work is continuing while an operator is outside the cab, that operator is considered to be an employee "engaged in the task" and must be protected by the application of water and/or dust suppressants

Drywall finishers. Table 1 of the final rule does not specify controls for drywall finishing. In the proposed standard, “drywall finishing (with silica-containing material)” was an entry on Table 1. The control options on proposed Table 1 were to use a pole sander or hand sander equipped with a dust collection system or to use wet methods to smooth or sand the drywall seam. However, information in the rulemaking record indicates that drywall compound currently in use does not usually contain silica (Document ID 2296, pp. 32, 36). NAHB commented that much of the drywall joint compound currently used in residential construction has no or very low silica content and members can resolve any concerns regarding silica exposure by making sure to use low silica containing product (Document ID 2296, pp. 32, 36). While CISC agreed that contractors "can utilize 'silica-free' joint compound and perform drywall installation in a manner that creates exposures below the proposed PEL," it expressed concern that "silica-free" joint compound may contain more than trace amounts of silica, which could result in exposures to silica (Document ID 2319, pp. 38, 43).

NIOSH tested bulk samples of a commercially available joint compound and found up to 6 percent quartz, although silica was not listed on the safety data sheet for the product (Document ID 0213, p. 5). However, in a more recent study, NIOSH determined that three of six drywall compounds purchased at a retail store contained only trace amounts of silica (less than 0.5 percent) (Document ID 1335, p. iii). The researchers concluded that for the most part the results of each sample analysis agreed with the composition stated in the manufacturers' material safety data sheets (Document ID 1335, pp. 3-4, 7, 10). OSHA finds that joint compound is more accurately labeled than it was in the past, and that manufacturers' labeling and SDSs are the best source for determining whether employees may be exposed to silica that could become respirable.

Additionally, the exposure profile includes 15 full-shift, personal breathing zone samples of respirable crystalline silica. The median exposure is 12 $\mu g/m^3$, the mean is 17 $\mu g/m^3$, and the range is 8 $\mu g/m^3$ (limit of detection (LOD)) to 72 $\mu g/m^3$, which was the only result above 50 $\mu g/m^3$. The 72 $\mu g/m^3$ sample was obtained for a worker performing overhead sanding directly above his breathing zone (Document ID 1335, p. 13). One other sample exceeded 25 $\mu g/m^3$ (Document ID 1335, p. 14). Therefore, because no additional controls are needed for most drywall finishers, OSHA has not included an entry for drywall finishers in Table 1 in the final standard.

In the event that the use of silica-free joint compound is not possible, or during renovation work where silica-containing joint compound might be present, OSHA has determined that there are engineering controls, as discussed in Section 5.2 of Chapter IV of the FEA, that reduce exposure to respirable crystalline silica to 50 μg/m^3 or below. In that situation employers will have to comply with paragraph (d) of the standard for construction. Johnston Construction Company commented that a requirement for air purifying respirators should be included in the rule for one of the dustiest tasks performed (Document ID 1951). OSHA agrees that sanding silica-free joint compound can potentially generate high levels of respirable nuisance dust that does not contain silica and for which respiratory protection may be needed in some situations. While high exposures to nuisance dusts may result from sanding joint compound, available evidence shows exposures to respirable crystalline silica will be low.

Abrasive blasting. Table 1 of the final standard does not specify controls for abrasive blasting; this is unchanged from the proposed rule.

The Society for Protective Coatings (SSPC) requested that abrasive blasting be included in Table 1 (Document ID 2120, p. 3). SSPC recommended the inclusion of an abrasive blasting entry which "simplifies compliance and eliminates the need for measuring workers' exposure to silica, while still ensuring adequate protection for workers" (Document ID 2120, p. 3). However, OSHA has determined that it is not appropriate to add abrasive blasting to Table 1.

There are a variety of options available to employers to control exposure to respirable crystalline silica during blasting operations. As discussed in the technological feasibility analysis (Section 5.1 of Chapter IV of the FEA), these include (1) use of abrasive media other than silica sand to reduce crystalline silica dust emissions, (2) use of wet blasting techniques, (3) use of dust suppressors, (4) use of dust collection systems, and (5) use of hydro-blasting technologies that avoid having to use abrasive media.

OSHA has decided that employees will be best protected when employers, following the traditional approach set forth in paragraph (d) in the standard for construction, choose among these dust control strategies to select the controls that best fit the needs of each job. OSHA's conclusion is based on the following additional considerations: (1) abrasive blasting operators must, separate from this rule, be provided with and wear the respiratory protection required by 29 CFR 1926.57(f), and (2) employees helping with the operation, or who otherwise must be in the vicinity of the operation, must also be adequately protected by a combination of engineering controls, work practices, and respirators. OSHA thus concluded that the Table 1 approach did not lend itself to specifying one or more controls that would be suitable for all such operations. Furthermore, based on its technological feasibility analysis for abrasive blasting (see Section 5.1 of Chapter IV of the FEA), respirators will be needed whatever engineering or work practice control the employer uses under the hierarchy of controls to lower silica exposure to the lowest level feasible. Accordingly, based on the reasons discussed above, the Agency is not mandating a particular dust control approach or approaches for abrasive blasting and has therefore not included it as an entry in Table 1 of the final standard.

Alternative Exposure Control Methods

Paragraph (d) of the standard for construction describes the requirements for the alternative exposure control methods approach, which applies for tasks not listed in Table 1 or where the employer chooses not to follow Table 1 or does not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1. The alternative exposure control methods approach is similar to OSHA's traditional approach of demonstrating compliance with a permissible exposure limit (PEL) through required exposure assessments and controlling employee exposures through the use of feasible engineering controls and work practices (i.e., the hierarchy of controls). With the exception of the option to comply with either paragraph (c) or paragraph (d), construction employers are required to comply with all other paragraphs of the standard for construction.

Paragraph (d)(1) specifies that construction employers who must or choose to follow paragraph (d) shall limit employee exposures to respirable crystalline silica at or below the PEL of 50 $\mu g/m^3$ as an 8-hour time weighted average. The PEL is fully discussed in the summary and explanation of Permissible Exposure Limit.

Paragraph (d)(2) specifies the requirements for exposure assessments, such as the types of assessments that are required under the standard (i.e., performance or scheduled monitoring options), when or how often those assessments must be conducted, methods of sample analysis, employee notification of results, and the opportunity for employees or their representatives to observe monitoring. These requirements are fully discussed in the summary and explanation of Exposure Assessment.

Paragraph (d)(3) specifies the methods of compliance, which include a requirement to reduce exposure through feasible engineering and work practice controls before using respiratory protection, and cross-references standards for abrasive blasting. These requirements are fully discussed in the summary and explanation of Methods of Compliance.

Permissible Exposure Limit (PEL)

Paragraph (c) of the standard for general industry and maritime (paragraph (d)(1) in the construction standard) establishes an 8-hour time-weighted average (TWA) exposure limit of 50 micrograms of respirable crystalline silica per cubic meter of air (50 μg/m^3). This limit means that over the course of any 8-hour work shift, exposures can fluctuate but the average exposure to respirable crystalline silica cannot exceed 50 μg/m^3. The PEL is the same for both general industry/maritime and construction. The PEL of 50 μg/m^3 applies in the construction standard for tasks not listed on Table 1 or where the employer is not fully and properly implementing the specified exposure control methods in paragraph (c) of the standard. The PEL of 50 μg/m^3 does not apply directly to tasks listed on Table 1, but the ability to achieve that PEL was the metric by which OSHA decided on the specified exposure control(s) listed and whether supplementary respiratory protection is required in some or all circumstances for a particular task.

OSHA proposed a PEL of 50 μg/m^3 because the Agency preliminarily determined that occupational exposure to respirable crystalline silica at the previous PELs, which were approximately equivalent to 100 μg/m^3 for general industry and 250 μg/m^3 for construction and shipyards, resulted in a significant risk of material health impairment to exposed workers, and that compliance with the proposed PEL would substantially reduce that risk. OSHA also preliminarily found the level of risk remaining at the proposed PEL to be significant, but considered a PEL of 50 μg/m^3 to be the lowest level that was technologically feasible overall.

The PEL was a focus of comment in the rulemaking process, revealing sharply divided opinion on the justification for and attainability of a PEL of 50 μg/m^3. Many commenters representing labor unions, public health associations, academic institutions, occupational health professionals, and others expressed support for the proposed PEL (e.g., Document ID 1785, p. 2; 1878, p. 1; 2080, p. 1; 2106, p. 3; 2145, p. 3; 2166, p. 1; 2173, p. 2; 2178, Attachment 1, p. 2; 2318, p. 10; 2339, p. 7; 2341, p. 2; 3399, p. 4; 3403, p. 2; 3478, p. 1; 3601, Attachment 2, p. 5; 3588, Tr. 3769; 4204, p. 50; 4207, p. 1). Other commenters representing a wide range of industries, including construction, foundries, concrete, brick and tile manufacturing, mineral excavation, utility providers, and others, did not believe the proposed PEL was appropriate. Stakeholders also offered opinions on the proposed alternative PELs of 25 μg/m^3 and 100 μg/m^3.

Some commenters contended that OSHA's proposed PEL was too low, arguing that the proposed limit was infeasible or not justified by the health and risk evidence (e.g., Document ID 1964; 1992, pp. 1, 8-10; 2024, pp. 1-2; 2067, p. 3; 2075, pp. 1-2; 2104, p. 1; 2119, Attachment 1; 2143, pp. 1-2; 2171, p. 1; 2185, pp. 2-4; 2191, p. 3; 2210, Attachment 1, p. 6; 2268; 2269, pp. 2-3; 2279, pp. 2, 9; 2284, p. 2; 2289, p. 3; 2296; p. 39; 2301, Attachment 1, pp. 7-9; 2305, pp. 4-5, 15; 2312, p. 2; 2348, Attachment 1, pp. 32-33; 2349, p. 3; 2350, pp. 10-11; 2384, pp. 2, 9; 2182, pp. 3-4; 2102, pp. 1, 3; 2211, pp. 3-4; 2283, p. 2; 2250, p. 2; 2288, p. 8; 2300, p. 2; 2338, p. 2; 2356, p. 2; 2376; 2379, Appendix 1, p. 53; 3275, pp. 1-2). Many of these commenters supported the adoption of the proposed alternative PEL of 100 μg/m^3.

Other commenters, including the United Automobile, Aerospace, and Agricultural Implement Workers of America and the American Public Health Association, contended that the remaining risk at 50 μg/m^3 is excessive and argued that OSHA should adopt a PEL of 25 μg/m^3 or even lower (e.g., Document ID 2163, Attachment 1, pp. 3, 13; 2176, pp. 1-2; 3577, Tr. 851-852; 3582, Tr. 1853-1854; 3589, Tr. 4165; 4236, pp. 5-6). The American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) urged OSHA to fully evaluate the evidence and set a lower PEL if deemed to be feasible (Document ID 3578, Tr. 923-924).

After considering the evidence in the rulemaking record, OSHA is establishing a PEL of 50 μg/m^3. OSHA's examination of health effects evidence, discussed in Section V, Health Effects, and Section VI, Final Quantitative Risk Assessment and Significance of Risk, confirms the Agency's preliminary conclusion that exposure to respirable crystalline silica at the previous

PELs results in a significant risk of material health impairment to exposed workers, and that compliance with the revised PEL will substantially reduce that risk. OSHA's Quantitative Risk Assessment indicates that a 45-year exposure to respirable crystalline silica at the preceding general industry PEL would lead to between 11 and 54 excess deaths from lung cancer, 11 deaths from silicosis, 85 deaths from all forms of non-malignant respiratory disease (including silicosis as well as other diseases such as chronic bronchitis and emphysema), and 39 deaths from renal disease per 1000 workers. Exposures at the preceding construction and shipyard PEL would result in even higher levels of risk. As discussed in Section VII of this preamble, Summary of the Final Economic Analysis and Final Regulatory Flexibility Analysis, these results clearly represent a risk of material impairment of health that is significant within the context of the "Benzene" decision (Indus. Union Dep't, AFL-CIO v. Am. Petroleum Inst., 448 U.S. 607 (1980)). OSHA has determined that lowering the PEL to 50 $\mu g/m^3$ will reduce the lifetime excess risk of death per 1000 workers to between 5 and 23 deaths from lung cancer, 7 deaths from silicosis, 44 deaths from non-malignant respiratory disease, and 32 deaths from renal disease.

The Agency considers the level of risk remaining at the revised PEL to be significant. However, based on the evidence evaluated during the rulemaking process, OSHA has determined a PEL of 50 $\mu g/m^3$ is appropriate because it is the lowest level feasible. As discussed in Chapters IV and VI of Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA) and summarized in Section VII of this preamble, the PEL is technologically and economically feasible for all industry sectors, although it will be a technological challenge for several affected sectors and will require the use of respirators for certain job categories and tasks. As guided by the 1988 "Asbestos" decision (Bldg & Constr. Trades Dep't v. Brock, 838 F.2d 1258, 1266 (D.C.

Cir. 1988)), OSHA is including additional requirements in the rule to further reduce the remaining risk. OSHA anticipates that the ancillary provisions in the rule will further reduce the risk beyond the reduction that will be achieved by the PEL alone.

OSHA has also determined that the proposed alternative PELs, 100 μg/m^3 and 25 μg/m^3, are inappropriate. As noted above, significant risk to employees' health exists at the previous PELs, and at and below the PEL of 50 μg/m^3. Because OSHA has determined that a PEL of 50 μg/m^3 is technologically and economically feasible, the Agency concludes that setting the PEL at 100 μg/m^3—a level the Agency knows would continue to expose workers to significant risk of material impairment to their health greater than is the case at 50 μg/m^3 —would be contrary to the mandate in the OSH Act, which requires the Secretary to promulgate a standard

> . . . which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by such standard for the period of his working life (29 U.S.C. 655(b)).

Thus, the Agency has rejected the proposed alternative PEL of 100 μg/m^3.

Even though OSHA's risk assessment indicates that a significant risk also exists at the revised action level of 25 μg/m^3, the Agency is not adopting the alternative PEL of 25 μg/m^3 because a PEL of 50 μg/m^3 is the lowest exposure limit that can be found to be technologically feasible for many of the industries covered by the rule. Specifically, OSHA has determined that the information in the rulemaking record either demonstrates that the proposed alternative PEL of 25 μg/m^3 would not be achievable for most of the affected industry sectors and application groups or the information is insufficient to conclude that engineering and work practice controls can consistently reduce exposures to or below 25 μg/m^3. Therefore, OSHA cannot find that the proposed alternative PEL of 25 μg/m^3 is achievable for most operations in the affected industries (see Section VII of this preamble and Chapter IV of the FEA). Moreover, OSHA also concludes that it would hugely complicate both compliance with and enforcement of the rule if it were to set a PEL of 25 μg/m^3 for a minority of industries or operations where it would be technologically feasible and a PEL of 50 μg/m^3 for the remaining industries and operations where technological feasibility at the lower PEL is demonstrably unattainable, doubtful or unknown.

Instead, OSHA has concluded that a PEL of 50 μg/m^3 is economically and technologically feasible for all of the affected industries and has decided to exercise its discretion to issue this uniform PEL to avoid the enormous compliance and enforcement complications that would ensue if it were to bifurcate the PEL (see Section II, Pertinent Legal Authority, discussing the chromium (VI) decision). Other issues related to OSHA's adoption of a PEL of 50 μg/m^3 are discussed below. The discussion is organized around the following topics: Coverage of quartz, cristobalite, and tridymite; the PEL as a gravimetric measurement of respirable dust; industry-specific PELs; enhanced enforcement; environmental sources of crystalline silica exposure; collection efficiency; coal dust; and CFR entries.

Coverage of quartz, cristobalite, and tridymite. As discussed in the summary and explanation of Definitions, the PEL applies to the three forms of crystalline silica (i.e., quartz, cristobalite, and tridymite) covered under previous OSHA PELs. Specifically, paragraph (b) of the rule defines the term "respirable crystalline silica" to mean

> . . . quartz, cristobalite, and tridymite contained in airborne particles whose measurement is determined by a sampling device designed to meet the characteristics for particle-size-selective samplers specified in International Organization for Standardization (ISO) 7708:1995: Air Quality - Particle Size Fraction Definitions for Health-Related Sampling.

The proposed definition of respirable crystalline silica also would have established a single PEL that would have encompassed the three forms of silica covered under the previous

OSHA silica PELs. While commenters generally supported a single PEL for respirable crystalline silica, they did not all agree on whether a single PEL should include quartz, cristobalite, and tridymite (e.g., Document ID 1731, p. 2; 2315, p. 9). Some commenters argued that the PEL should include all three forms; some suggested that the single PEL should be for only quartz and cristobalite (e.g., Document ID 2177, Attachment B, p. 10; 2196, Attachment 1, p. 5; 3403, p. 4; 4212, p. 3) or only quartz (e.g., Document ID 2185, p. 6). NIOSH noted that "tridymite is extremely rare in workplaces, so a separate PEL probably cannot be supported by epidemiologic evidence and may not be warranted for this material (Document ID 2177, Attachment B, p. 10). Southern Company argued that

> . . . the inclusion of tridymite and cristobalite are not supported by the data and, due to their rare nature, serve to unnecessarily create upward bias of the exposure evaluations due to the laboratory detection limitations (Document ID 2185, p. 2).

Halliburton Energy Services said that, given that OSHA has acknowledged that the risk to workers exposed to a given level of respirable crystalline silica may not be equivalent in different work environments, OSHA's "one size fits all" silica PEL for different forms of crystalline silica with varied physicochemical properties was unwarranted (Document ID 2302, p. 5).

As discussed in Section V, Health Effects, OSHA has concluded, based on the available scientific evidence, that quartz, cristobalite, and tridymite have similar toxicity and carcinogenic potency. The Agency therefore concludes that a single PEL is appropriate for quartz, cristobalite, and tridymite.

The PEL as a gravimetric measurement of respirable dust. The revised PEL, like OSHA's proposed PEL, is expressed as a gravimetric measurement of respirable crystalline silica. The preceding PELs were formulas that were inconsistent between industries and forms of crystalline silica. For general industry (see 29 CFR 1910.1000, Table Z-3), the PEL for crystalline silica in the form of respirable quartz was based on two alternative formulas: (1) a particle-count formula (PEL_{mppcf}=250/(% quartz + 5) as respirable dust); and (2) a mass formula proposed by the American Conference of Governmental Industrial Hygienists (ACGIH) in 1968 (PEL=(10 mg/m^3)/(% quartz + 2) as respirable dust). The general industry PELs for crystalline silica in the form of cristobalite and tridymite were one-half of the value calculated from either of the above two formulas for quartz. For construction (29 CFR 1926.55, Appendix A) and shipyards (29 CFR 1915.1000, Table Z), the formula for the PEL for crystalline silica in the form of quartz (PEL_{mppcf}=250/(% quartz + 5) as respirable dust), which requires particle counting, was derived from the 1970 ACGIH threshold limit value (TLV). Based on the formulas, the PELs for quartz, expressed as time-weighted averages (TWAs), were approximately equivalent to 100 μg/m^3 for general industry and 250 μg/m^3 for construction and shipyards. As detailed in the discussion of sampling and analysis in Chapter IV of the FEA, OSHA finds that the formula based on particle-counting technology used in the preceding general industry, construction, and shipyard PELs has been rendered obsolete by respirable mass (gravimetric) sampling.

A number of commenters supported the proposed switch from these formulas to a PEL expressed as a gravimetric measurement of respirable crystalline silica. For example, several stakeholders, including the American Foundry Society (AFS), the American Petroleum Institute, the Fertilizer Institute, and the North American Insulation Manufacturers Association, agreed that OSHA should revise the previous formulaic PELs into straightforward concentration / gravimetric-based thresholds (e.g., Document ID 2101, p. 4; 2145, p. 3; 2278, p. 2; 2301, Attachment 1, p. 4; 4213, p. 8; 4229, p. 27). Others suggested the previous formulaic PELs are confusing, complicated (e.g., Document ID 2175, p. 5; 2185, p. 2), and outdated (e.g., Document

ID 2163, Attachment 1, p. 2; 2204; 3588, Tr. 3769). Ameren Corporation also expressed support for the elimination of the PELs calculated based on the percent silica in the sample (Document ID 2315, p. 8).

After considering the record on this issue, OSHA has decided to adopt a PEL which is expressed as a gravimetric measurement of respirable crystalline silica. OSHA expects that the revised PEL will improve compliance because the PEL is simple and relatively easy to understand, and is consistent with modern sampling and analytical methods. In addition, OSHA finds that a uniform PEL will provide consistent levels of protection for workers in all sectors covered by the rule.

Industry-specific PELs. Some commenters urged OSHA to take an industry-specific approach to regulating respirable crystalline silica exposures. Southern Company urged OSHA to consider a vertical standard that addresses industries with known negative health impacts from silica-containing materials (Document ID 2185, p. 2). Battery Council International asked OSHA to set the PEL based on relevant particle size and the size distribution data and recommended that OSHA adjust the PEL for different industry segments consistent with these data (Document ID 2361, pp. 1-2). Other commenters suggested that the PEL should be lower for certain industries, such as hydraulic fracturing and dental equipment manufacturing (Document ID 2282, Attachment 3, p. 12; 2374, Attachment 1, p. 5).

OSHA considers the level of risk remaining at the new PEL of 50 $\mu g/m^3$ to be significant. Although OSHA expects the ancillary provisions of the standard to reduce this risk below what engineering and work practice controls alone can achieve, the Agency realizes that lower PELs might be achievable in some industries and operations, which would reduce this risk even further. However, as explained below, OSHA concludes that the significant costs, including opportunity costs, of devoting the resources necessary to attempting to establish and apply multiple PELs for the diverse group of industries and operations covered by the standard would undermine the value of this reduction (see Building & Constr. Trades Dep't v. U.S. Dep't of Labor, 838 F.2d 1258, 1273 (D.C. Cir. 1988) (administrative difficulties, if appropriately spelled out, could justify a decision to select a uniform PEL)).

Requiring OSHA to set multiple PELs—taking into account the feasibility considerations unique to each industry or operation or group of them—would impose an enormous evidentiary burden on OSHA to ascertain and establish the specific situations, if any, in which a lower PEL could be reached. Such an onerous obligation would inevitably delay, if not preclude, the adoption of important health standards. In addition, the demanding burden of setting multiple PELs would be complicated by the difficulties inherent in precisely defining and clearly distinguishing between affected industries and operations where the classification determines legal obligations. The definitional and line-drawing problem is far less significant when OSHA merely uses a unit of industries and operations for analytical purposes, and when it sets a PEL in the aggregate, i.e., when its analysis is limited to determining whether a particular PEL is the lowest feasible level for affected industries as a whole. If OSHA had to set multiple PELs, and assign industries or operations to those PELs, the problem would become much more pronounced as the consequences of imprecise classifications would become much more significant.

OSHA also finds that a uniform PEL will ultimately make the standard more effective by making it easier for affected employers to understand and comply with the standard's requirements. Moreover, a uniform PEL makes it possible for OSHA to provide clearer guidance to the regulated community and to identify non-compliant conditions. For these reasons, OSHA has always interpreted Section 6(b)(5) of the Act to accord the Agency substantial discretion to set the PEL at the lowest level that is feasible for industries and operations as a whole. In adopting the arsenic standard, for example, OSHA expressly declined to set different PELs, finding that "[s]uch an approach would be extremely difficult to implement" (43 FR 19584, 19601 (5/5/1978)). In that instance, OSHA explained:

> The approach OSHA believes appropriate and has chosen for this and other standards is the lowest level achievable through engineering controls and work practices in the majority of locations. This approach is intended to provide maximum protection without excessively heavy respirator use. Id.

OSHA has also rejected such an approach in rulemakings on benzene and chromium (VI) (see 43 FR 5918, 5947 (2/10/1978); 71 FR 10100, 10337-10338 (2/28/2006)).

In the case of cotton dust, where OSHA did set different PELs for certain discrete groups, the groups involved exposures to different kinds of cotton dust and different degrees of risk. Even so, OSHA did not adopt a unique PEL for every single affected sector (see 43 FR 27350, 37360-37361 (6/23/1978)); OSHA set one PEL for textile industries and a separate PEL for non-textile industries, but expressly rejected the option of adopting different exposure limits for each non-textile industry). OSHA recognizes that the exception from the scope of this rule for exposures that result from the processing of sorptive clays results in a different PEL being enforced in that sector. However, the processing of sorptive clays is a very small industry sector, and OSHA finds that this sector can be readily segregated from other industry sectors covered by the rule.

Enhanced enforcement. Several commenters suggested retaining the preceding PELs and focusing OSHA efforts on enhanced enforcement rather than on a new rule (e.g., Document ID 1741, Attachment 1; 2067, p. 4; 2183, p. 4; 2185, p. 2; 2210, Attachment 1, pp. 3, 7; 2261, pp. 2-3; 2283, p. 2; 2292, p. 2; 2344, p. 2; 2349, p. 3; 2363, p. 10; 3486, p. 1; 3496, p. 3). Some of these commenters, such as the Small Business Administration's Office of Advocacy, indicated that OSHA data show widespread noncompliance with the previous PELs and suggested that silica-related illnesses could be linked to noncompliance (e.g., Document ID 2349, p. 3). Others, such as Arch Masonry, urged OSHA to consider information and testimony about noncompliant work environments as evidence of an enforcement problem rather than evidence to support a new rule (e.g., Document ID 3587, Tr. 3651-3652). The Mercatus Center asked OSHA to explain how improved enforcement of the existing rule is not superior to a more stringent PEL (Document ID 1819, p. 9).

As discussed in Section V, Health Effects, OSHA does not find these arguments persuasive. First, many of the commenters used OSHA's enforcement data to make this point. These data were obtained during inspections where non-compliance was suspected and thus were skewed in the direction of exceeding the preceding PELs. As the Building and Construction Trades Department, AFL-CIO (BCTD) explained, OSHA data showing noncompliance with the preceding PEL is not representative of typical exposure levels, since sampling for compliance purposes targets worst-case exposure scenarios (Document ID 3581, Tr. 1634-1636).

Moreover, not all commenters agreed that overexposures were "widespread." A few other commenters (e.g., AFS) thought that OSHA substantially overstated the number of workers occupationally exposed above 100 μg/m^3 in its PEA (Document ID 2379, Attachment B, p. 25). In either case, OSHA's analysis evaluated risks at various exposure levels, as is required by the OSH Act. As noted above, the available data indicate that exposure to respirable crystalline silica at the preceding PELs results in a significant risk of material health impairment among exposed employees. Simply enforcing the preceding PELs will not substantially reduce or eliminate this significant risk.

Exposure Variability. Commenters, including the Asphalt Roofing Manufacturers Association (ARMA), argued that because OSHA PELs are never-to-be-exceeded limits, employers must maintain average exposures well below the PEL to have confidence that exposures are rigorously maintained at or below the PEL every day, for every worker (e.g., Document ID 2291, pp. 5-7). The Construction Industry Safety Coalition (CISC) made a similar argument regarding the need to control exposure levels to well below the PEL due to the variability of silica exposures on construction worksites in order to assure compliance (Document ID 4217, p. 12).

OSHA recognizes that differences in exposure can occur due to workplace variables such as fluctuations in environmental conditions or air movement. However, many of the major sources of day-to-day variability can be moderated by the consistent use of engineering controls and appropriate work practices (Document ID 3578, Tr. 971; 3589, Tr. 4251-4252; 4234, Attachment 2, pp. 31-38).

OSHA has acknowledged and discussed exposure variability in past rulemakings where the same issue was raised (e.g., benzene, 52 FR 34534; asbestos, 53 FR 35609; lead in construction, 58 FR 26590; formaldehyde, 57 FR 22290; cadmium, 57 FR 42102; and chromium (VI), 71 FR 10099). In its asbestos rulemaking, for example, OSHA found that industry's argument about uncontrollable fluctuations was exaggerated because such fluctuations could be minimized through proper inspection and maintenance of engineering controls and through proper training and supervision of employees whose work practices affected exposure levels (59 FR 40964, 40967 (8/10/94)). The Agency also noted that its enforcement policy gives employers the opportunity to show that a compliance officer's measurement over the PEL is unrepresentatively high and does not justify a citation, thus alleviating the concern employers might have that they will be cited on the basis of a single measurement that results from uncontrollable fluctuations (59 FR at 40967).

Reviewing courts have held that OSHA's obligation to show that a PEL can be achieved in most operations most of the time has been met despite the presence of random exposure variability. These courts have noted, in particular, OSHA's flexible enforcement policies, which allow the Agency to take such exposure variability into account before issuing a citation (e.g., Building & Constr. Trades Dept. v. Brock, 838 F.2d 1258 (D.C. Cir. 1988) ("Asbestos II")). In the Asbestos II case, the D.C. Circuit cited with approval OSHA's policy of allowing for a possible re-inspection if OSHA measured an asbestos exposure above the PEL during an inspection. If the employer appeared to be using, to the extent feasible, appropriate work practices and engineering controls, OSHA could agree not to issue a citation at that time based on that inspection and to re-inspect at a later time. Such a re-inspection would help determine if that over-exposure was typical or simply a random, uncontrollable fluctuation; OSHA could then determine whether or not to issue a citation accordingly (Asbestos II at 1268; 51 FR 22653 (6/20/1986)). Thus OSHA has, in the past, adopted fair and flexible enforcement policies to deal with the issue of exposure variability and will do the same for enforcement of the new silica standards.

Such an enforcement policy recognizes the possibility that OSHA may measure silica exposures on a day when exposures are above the PEL due to unforeseeable, random exposure variations. In such a case, when the employer has previously monitored the work area, OSHA inspectors would review the employer's long-term body of data demonstrating the exposure pattern for tasks/operations that are representative of those under OSHA's evaluation. After comparing the employer's exposure data with OSHA's sampling results, OSHA's determination whether to resample would be governed by the inspector's judgment of whether the OSHA sampling results are representative.

Where an employer can show, based on a series of measurements made pursuant to the sampling and analytical protocols set out in these standards or other relevant data, that the OSHA one-day measurement may be unrepresentatively high, OSHA may re-inspect the workplace and measure exposures again. If, after such a reinspection, OSHA has reason to believe that there are circumstances that account for the high exposure measurement, OSHA may decide not to issue a citation.

For OSHA to consider a reinspection rather than citation, an employer must demonstrate that the inspector's one-day sample is unrepresentative of normal exposure levels. Iin most cases, this demonstration would consist of a series of full shift measurements representative of the exposure of the employee under consideration. These measurements should consist of all valid measurements related to the employee under consideration taken within the last year and should show that only on rare occasions could random fluctuations result in TWA concentrations above the PEL.

Environmental sources of crystalline silica exposure. Some stakeholders raised concerns about the extent to which crystalline silica dust from naturally-occurring environmental sources (e.g., in southwestern regions of the United States) might contribute to employee exposures to respirable crystalline silica and artificially inflate sampling measurements (e.g., Document ID 1785, p. 4; 2116, Attachment 1, pp. 19-20; 3230, p. 1; 3533, p. 22). SMI cited an EPA study published in 1996 (Document ID 3637), and indicated that mean concentrations of ambient atmospheric respirable crystalline silica across 22 cities in the United States range from 0.9 to 8 $\mu g/m^3$ (Document ID 3533, p. 20). OSHA recognizes that there can be occasions when environmental sources of silica may affect occupational sampling results. However, OSHA notes that the data utilized in the 1996 study were originally published in an earlier (1984) journal article by Davis et al. (Document ID 3852), and the EPA report included important caveats about the environmental data that were available at the time (Document ID 3637, pp. 3-29, 3-31-3-34). For example, the section of the EPA report on "Limitations of Current Data" states:

> The lack of current, direct measures of ambient quartz concentrations is a major limitation of the data available for use in estimating U.S. ambient silica concentrations (Document ID 3637, pp. 3-31).

The report also indicated that ". . . another limitation of the available data is the fact that neither current nor dated quartz measurements were taken using PM10 samplers" (Document ID 3637, pp. 3-33).

In addition, OSHA notes that the sampling methodology used in the Davis study does not measure respirable crystalline silica, as defined in OSHA's silica rule. Rather, the Davis study presents data from dichotomous samplers that are equipped with particle size selection inlets. These samplers allow for measurement of two particle size fractions: a fine fraction with particle sizes having aerodynamic diameter less than 2.5 microns (PM2.5) and a coarse fraction designed to eliminate particles greater than about 15 microns in aerodynamic diameter (PM15). By contrast, OSHA's definition for respirable crystalline silica is tied to an International Organization for Standardization (ISO) sampling methodology that has different size-specific mass collection efficiencies. Of particular importance, the dichotomous samplers from the Davis study collect particles with aerodynamic diameters between 10 and 15 microns that are generally excluded from the ISO sampling methodology; and the dichotomous samplers likely collect a considerably higher portion of particles with aerodynamic diameters between 5 and 10 microns.

OSHA concludes that the sampling results presented in the Davis study are not comparable to respirable crystalline silica measurements, as defined in OSHA's rule. It is clear that the sampling methodology considered in the Davis study would overstate respirable crystalline silica levels measured using the ISO sampling methodology. Moreover, OSHA has demonstrated that compliance with the PEL is technologically feasible. OSHA's evaluation of the technological feasibility of the PEL involved evaluation of thousands of respirable crystalline silica samples collected in a variety of occupational settings that include contributions from environmental sources in different geographic areas. Because the exposure data considered by OSHA in its evaluation of the technological feasibility of the PEL includes contributions from environmental sources, these contributions are already taken into account in determining the feasibility of the PEL. Therefore, OSHA finds that environmental sources of respirable crystalline silica exposure, to the extent they contribute to workplace exposures, are already considered in the Agency's conclusion that the revised PEL is feasible.

Collection efficiency. In the rule, OSHA is adopting the ISO/CEN particle size-selective criteria for respirable dust samplers used to measure exposures to respirable crystalline silica. Several commenters, including U.S. Aggregates, the National Industrial Sand Association, and the U.S. Chamber of Commerce, argued that moving from the current criteria to the ISO/CEN convention effectively decreases the PEL and action level below the levels intended, since more dust would be collected by samplers that conform to the ISO/CEN convention than by those that conform to the current criteria (Document ID 2174; 2195, p. 30; 2285, pp. 3-4; 2317, p. 2; 3456, p. 10; 4194, pp. 15-16). However, as discussed in Chapter IV of the FEA, the Dorr-Oliver 10-mm cyclone used by OSHA for enforcement of respirable dust standards conforms to the ISO/CEN specification with acceptable bias and accuracy when operated in accordance with

OSHA's existing method (i.e., measurements taken using the Dorr-Oliver 10-mm cyclone following OSHA's existing method provide results that are consistent with the ISO/CEN convention, and therefore are acceptable for measuring respirable crystalline silica exposures under the rule). The change from the previous criteria to the ISO/CEN convention is therefore effectively a continuation of current practice.

Coal dust. Southern Company, the American Iron and Steel Institute, and Ameren Corporation indicated that revising the respirable crystalline silica PEL creates uncertainty with regard to the PEL for coal dust, which continues to use the previous criteria for calculation of respirable crystalline silica (Document ID 2185, p. 2; 2261, pp. 2, 5; 2315, p. 8). They urged the Agency to address how the existing coal dust PEL will interact with the new PEL and calculation for exposure to respirable crystalline silica. For example, Southern Company stated:

> . . . it is unclear to us what the expectation would be in evaluating and managing exposures to either of these substances when the effective source of these exposures is the same. If both PELs apply, this would mean duplicate or dual sampling (Document ID 2185, p. 2).

Ameren also questioned whether employers would be required to sample for both respirable crystalline silica and respirable coal dust on workers who are potentially exposed to both substances. Ameren suggested that OSHA should consider changing the PELs for amorphous silica and coal dust so that they are consistent with the revised PEL for respirable crystalline silica (Document ID 2315, pp. 2, 8).

OSHA clarifies that the respirable crystalline silica rule does not change the existing PEL for coal dust. However, as indicated previously, the Dorr-Oliver 10-mm cyclone used by OSHA for enforcement of respirable dust standards exhibits acceptable bias against the ISO/CEN specification when operated in accordance with OSHA's existing method. Employers can continue to use the Dorr-Oliver cyclone to evaluate compliance with the new respirable crystalline silica PEL, as well as with the PEL for coal dust; duplicate sampling is not necessary. Employers can also use other ISO/CEN-compliant samplers to evaluate compliance with either or both PELs.

CFR entries. The rule revises entries for crystalline silica in 29 CFR 1910.1000 Table Z-1 to cross-reference the new standard, 1910.1053. A comparable revision to 29 CFR 1915.1000 Table Z cross-references 1915.1053, which in turn cross-references 1910.1053. The entries for crystalline silica in 29 CFR 1926.55 Appendix A are revised to cross-reference 1926.1153. General industry standards are located in Part 1910; maritime standards are located in Part 1915; and construction standards are located in Part 1926.

The preceding PELs for respirable crystalline silica are retained in 29 CFR 1910.1000 Table Z-3, 29 CFR 1915.1000 Table Z, and 29 CFR 1926.55 Appendix A. Footnotes are added to make clear that these PELs apply to any sectors or operations where the new PEL of 50 $\mu g/m^3$ is not in effect, such as the processing of sorptive clays. These PELs are also applicable during the time between publication of the silica rule and the dates established for compliance with the rule, as well as in the event of regulatory delay, a stay, or partial or full invalidation by the Court.

While the preceding PELs for respirable crystalline silica in 29 CFR 1910.1000 Table Z-3 are being retained, the PELs for total crystalline silica dust are being deleted. OSHA proposed to delete the previous general industry PELs for exposure to total crystalline silica dust because development of crystalline silica-related disease is related to the respirable fraction of, rather than total, dust exposure (see Section V, Health Effects). This view is consistent with that of ACGIH, which no longer has a Threshold Limit Value for total crystalline silica dust. NIOSH does not have a Recommended Exposure Level for total crystalline silica exposure, and neither the National Toxicology Program nor the International Agency for Research on Cancer has linked exposure to total crystalline silica dust exposure to cancer, as they have with respirable crystalline silica exposure.

Exposure Assessment

Paragraph (d) of the standard for general industry and maritime (paragraph (d)(2) of the standard for construction) sets forth requirements for assessing employee exposures to respirable crystalline silica. The requirements are issued pursuant to section 6(b)(7) of the OSH Act, which mandates that any standard promulgated under section 6(b) shall, where appropriate, "provide for monitoring or measuring employee exposure at such locations and intervals, and in such manner as may be necessary for the protection of employees" (29 U.S.C. 655(b)(7)).

Assessing employee exposure to toxic substances is a well-recognized and accepted risk management tool. The purposes of requiring an assessment of employee exposures to respirable crystalline silica include: determination of the extent and degree of exposure at the worksite; identification and prevention of employee overexposure; identification of the sources of exposure; collection of exposure data so that the employer can select the proper control methods to be used; and evaluation of the effectiveness of those selected methods. Assessment enables employers to meet their legal obligation to ensure that their employees are not exposed in excess of the permissible exposure limit (PEL) and to ensure employees have access to accurate information about their exposure levels, as required by section 8(c)(3) of the Act (29 U.S.C. 657(c)(3)). In addition, exposure data enable the physicians or other licensed health care professionals (PLHCP) performing medical examinations to be informed of the extent of occupational exposures.

In the proposed standard for general industry and maritime, OSHA included a requirement for employers to assess the exposure of employees who are reasonably expected to be exposed to respirable crystalline silica at or above the action level of 25 μg/m^3. This obligation consisted of: an initial exposure assessment, unless monitoring had been performed in the previous 12 months, or the employer had objective data to demonstrate that exposures would be below the action level under any expected conditions; periodic exposure assessments, following either a scheduled monitoring option (with the frequency of monitoring determined by the results of the initial and subsequent monitoring) or a performance option (i.e., use of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures); and additional exposure assessments when changes in the workplace resulted in new or additional exposures to respirable crystalline silica at or above the action level. The proposed standard also included provisions for the method of sample analysis, employee notification of assessment results, and observation of monitoring.

The proposed standard for construction included the same requirements for exposure assessment as the proposed standard for general industry and maritime; however, employers were not required to assess the exposure of employees performing tasks on Table 1 where the employer fully implemented the engineering controls, work practices, and respiratory protection specified in Table 1. This exception to the general requirement for exposure assessment was intended to relieve the construction employer of the burden of performing an exposure assessment in these situations, because appropriate control measures are already identified.

Commenters, such as the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), the American Society of Safety Engineers (ASSE), the National Industrial Sand Association (NISA), and the International Diatomite Producers Association, supported the inclusion of an exposure assessment provision in the general industry standard (e.g., Document ID 4204, pp. 52-54; 2339, p. 4; 2195, pp. 5-6, 9-10, 33; 2196, Attachment 1, p.

4), while other commenters, including the American Public Health Association (APHA), the National Consumers League (NCL) and Dr. James Cone, more generally concurred with OSHA's proposed exposure assessment requirements (e.g., Document ID 2178, Attachment 1, p. 2; 2373, p. 2; 2157, p. 7). However, commenters from the construction industry, including the National Utility Contractors Association, the American Subcontractors Association (ASA), the Leading Builders of America (LBA), the Associated Builders and Contractors (ABC), the Associated General Contractors of America, Fann Contracting, Inc., the National Association of Home Builders (NAHB), and the Construction Industry Safety Coalition (CISC), as well as the American Fuel and Petrochemical Manufacturers (AFPM), whose members regularly perform construction tasks, contended that the proposed exposure assessment requirements were unworkable, impractical, or exceedingly expensive due to the dynamic construction environment where frequent changes in environmental conditions, materials, tasks and the amount of time tasks are performed, locations, and personnel would require constant assessment and monitoring (e.g., Document ID 2171, p. 2; 2187, p. 5; 2269, p. 6; 2289, p. 6; 2323, p. 1; 2116, Attachment 1, pp. 13-14; 2296, pp. 24-25; 2350, p. 10; 3521, p. 7; 4217, pp. 12-13). More specifically, commenters, including the Distribution Contractors Association and the Sheet Metal and Air Conditioning Contractors National Association (SMACNA), expressed concerns about the initial or periodic assessment requirements (e.g., Document ID 2309, p. 3; 2226, p. 2). Fann Contracting, ASA, and the Edison Electric Institute (EEI) argued that initial and periodic exposure assessments do not make sense for construction projects where conditions, tasks, and potential exposures are constantly changing (Document ID 2116, Attachment 1, pp. 5, 16; 2187, p. 5; 2357, p. 13).

Other commenters from both construction and general industry, including Ameren Corporation (Ameren), the Concrete Company, the Glass Association of North America, the Washington Aggregates and Concrete Association, the North American Insulation Manufacturers Association (NAIMA), EEI, the National Stone, Sand, and Gravel Association (NSSGA), the National Association of Manufacturers (NAM), Lafarge North America (Lafarge), the Asphalt Roofing Manufacturers Association (ARMA), and NAHB, argued that employers should not be required to conduct air monitoring for employees on each shift, for each job classification, and in each work area unless differences exist between shifts (e.g., Document ID 2315, p. 3; 2317, p. 2; 2215, p. 9; 2312, p. 2; 2348, Attachment 1, p. 39; 2357, p. 23; 2327, Attachment 1, p. 18; 2380, Attachment 2, pp. 26-28; 2179, p. 3; 2291, pp. 20-21). The American Foundry Society (AFS) argued that repetitious full shift sampling is also "burdensome and unnecessarily dangerous to employees who must wear heavy and awkward equipment during the sampling session" (Document ID 2379, Attachment B, p. 28). Commenters from the construction industry, including ABC, LBA, the Hunt Construction Group, and CISC argued that conducting air monitoring for employees on each shift, for each job classification, and in each work area or representative sampling of employees was not possible in constantly changing construction environments (e.g., Document ID 2289, p. 6; 2269, p. 6; 3442, pp. 2-3; 2319, pp. 83-84).

In response to these comments, OSHA restructured the exposure assessment requirements in order to provide employers with greater flexibility to meet their exposure assessment obligations using either the performance option or the scheduled monitoring option. This restructuring emphasizes the performance option in order to provide additional flexibility for employers who are able to characterize employee exposures through alternative methods. Commenters, including Arch Masonry, Inc., the Building and Construction Trades Department, AFL-CIO (BCTD), and the Precast/Prestressed Concrete Institute (PCI), strongly supported this approach (e.g., Document ID 2292, p. 3; 3587, Tr. 3655; 2371, Attachment 1, p. 10; 4223, p. 68; 2276, p. 10). However, some commenters from the construction industry, including CISC, Holes Incorporated, and ABC, considered a performance option to be unworkable in the construction industry due to variability in exposures (e.g., Document ID 2319, p. 85; 3580, Tr. 1448-1450; 4216, pp. 2-3; 2226, p. 2). SMACNA also suggested that using historical air monitoring data or objective data is not a legitimate option for small employers who do not have this type of information (Document ID 2226, p. 2).

While some small businesses and construction employers, like Holes Incorporated, noted the difficulties with utilizing this option, there were other similarly situated commenters, like Arch Masonry, that felt the performance option was necessary to fulfill their exposure assessment obligations (e.g., Document ID 3580, Tr. 1448-1450; 2292, p. 3). OSHA understands that the performance option may not be the preferred choice of every employer, but it expects it will provide many employers with substantial flexibility to meet their exposure assessment obligations. Thus, the Agency has included the performance option in the rule to complement the scheduled monitoring option.

In addition, the restructured standard for construction provides added flexibility to construction employers in another significant way. As described in the summary and explanation of Specified Exposure Control Methods, where the employer fully and properly implements the engineering controls, work practices, and respiratory protection specified on Table 1 for a task, the employer is not required to assess the exposure of employees engaged in that task or take additional measures to ensure that the exposures of those employees do not exceed the revised PEL (see paragraph (c)(1) of the standard for construction). These revisions will relieve construction employers of the burden of performing exposure assessment in many situations and will provide them with greater flexibility to meet the requirements of the standard, while still providing construction workers with the same level of protection as that provided to other workers.

The rule also includes the scheduled monitoring option in order to provide employers with a clearly defined, structured approach to assessing employee exposures. Some commenters, such as CISC and ASSE, urged OSHA to reconsider the inclusion of the scheduled monitoring option, finding it to be impractical, infeasible, and burdensome (e.g., Document ID 2319, p. 86; 3578, Tr. 1052). On the other hand, NISA and the Shipbuilders Council of America (SCA) supported the inclusion of both a performance option and a scheduled monitoring option for exposure assessment (Document ID 2195, p. 36; 2255, p. 3). AFL-CIO supported periodic exposure assessments when exposures are above the action level, with more frequent assessments required if exposures exceed the PEL, as required under the scheduled monitoring option. It also noted that similar requirements for periodic exposure assessments are included in all other health standards that include exposure monitoring and argued that they should also be included in the rule (Document ID 4204, pp. 53-54). As discussed below, the Agency finds that this option may be useful for certain employers and has retained it in order to maximize flexibility in the rule.

General requirement for exposure assessment. Paragraph (d)(1) of the standard for general industry and maritime (paragraph (d)(2)(i) of the standard for construction) contains the general requirement for exposure assessment. This provision, which remains the same as proposed except for minor editorial changes, requires employers to assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level of 25 $\mu g/m^3$ in accordance with either the performance option or the scheduled monitoring option. All employers covered by the standard for general industry and maritime must abide by this provision. However, as discussed in the summary and explanation of Specified Exposure Control Methods, employers following the standard for construction need only follow this provision, and the remainder of paragraph (d)(2), for tasks not listed in Table 1 or where the employer does not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1 (see paragraph (d) of the standard for construction).

OSHA received a number of comments on this general provision. For example, the Center for Progressive Reform (CPR) recommended that OSHA require employers to conduct exposure assessments for each employee who is or may "foreseeably" be exposed at or above the action level, rather than only for those employees "reasonably expected" to be exposed at or above the action level. They argued that "expected" exposures might be lower than "foreseeable" exposures, and cited equipment malfunctions and problems with respiratory protection programs as situations that are "foreseeable" but may not be "expected" (Document ID 4005, pp. 2-4). OSHA is not persuaded by this argument. The Agency has decided that employers should not be required to conduct assessments when employee exposures are only likely to exceed the action level during a foreseeable, but unexpected event. Therefore, an employer who reasonably expects the exposure of an employee to remain below the action level does not have to assess the exposure of that employee. However, if equipment malfunctions or other unexpected events that could affect employee exposures occur, then the employer may not be able to reasonably expect employee exposure to remain below the action level and would be required to conduct an assessment. As to CPR's comment that anticipated problems with respiratory protection programs might be foreseeable, but unexpected, OSHA reminds employers that this rule defines "employee exposure" to mean exposure that would occur without the use of a respirator, so inadequacies in an employer's respiratory protection program do not affect the requirement for exposure assessment.

OSHA also received a number of comments on whether triggering exposure monitoring at an action level of 25 μg/m^3 is appropriate. Some commenters, including the Center for Effective Government (CEG), APHA, NCL, and the Association of Occupational and Environmental Clinics (AOEC) agreed that the proposed action level trigger of 25 μg/m^3 for exposure assessment was needed (e.g., Document ID 2341, pp. 2-3; 2178, Attachment 1, p. 2; 2373, p. 2; 3399, p. 5). CEG argued that an action level trigger of 25 μg/m^3 is needed to ensure that exposures are reduced below the PEL (Document ID 2341, p. 3). AOEC commented that this trigger is needed to help protect employees from crystalline silica isomorphs that are particularly toxic (Document ID 3399, p. 5). Dr. Franklin Mirer, Professor of Environmental and Occupational Health at CUNY School of Public Health, representing AFL-CIO, and the United Automobile, Aerospace and Agricultural Implement Workers of America (UAW), supported an action level trigger, but stated that an action level below 25 μg/m^3 might be necessary in order to ensure that exposures are continuously below the PEL (Document ID 2256, Attachment 3, p. 1; 2282, Attachment 3, pp. 1, 14).

Other commenters, including NISA, the Industrial Minerals Association - North America, the Institute of Makers of Explosives (IME), and the American Petroleum Institute (API), agreed that assessing exposures at an action level was necessary, but believed the action level should be 50 μg/m^3 (with a PEL of 100 μg/m^3) (e.g., Document ID 2195, pp. 5-6; 2200, pp. 2-3; 2213, p. 3; 2301, Attachment 1, p. 4). NISA, for example, disagreed with OSHA's characterization of significant risk at the proposed PEL and action level, but argued that an action level trigger is needed in order to maintain individual employees' exposures below the PEL (Document ID 2195, p. 6). Francisco Trujillo, safety director for Miller and Long, proposed that exposure assessment should be triggered at an action level of 75 μg/m^3 (with a PEL of 100 μg/m^3) for the construction industry (Document ID 2345, p. 2). The American Exploration and Production Council (AXPC) encouraged OSHA to trigger all ancillary provisions in this rule (presumably including exposure assessment) only when exposures are at or above an action level of 50 μg/m^3 after "discount[ing] exposure levels to reflect the demonstrated effectiveness of respiratory protection. . ." (Document ID 2375, Attachment 1, p. 3). The National Institute for Occupational Safety and Health and CPR agreed that the action level should be the trigger, but did not specify where the action level should be set (Document ID 3579, Tr. 138-139; 2351, p. 10).

On the other hand, commenters including the Fertilizer Institute, NSSGA, and Acme Brick Company and others in the brick industry did not believe that an action level trigger for exposure assessment was necessary and that the PEL should be the trigger for exposure assessment (e.g., Document ID 2101, p. 10; 3583, Tr. 2303-2305; 2023, p. 6). NSSGA argued that triggering sampling at the action level is not sufficient to ensure compliance and instead, the individual employer should determine when and how much sampling should be done in order to ensure compliance with the PEL (Document ID 3583, Tr. 2303-2305). In addition, several commenters, such as Lafarge, ASA, NSSGA, AFPM, the Tile Council of North America (TCNA), the American Iron and Steel Institute, and CISC discussed the challenges of measuring exposures at an action level of 25 μg/m^3 (e.g., Document ID 2179, pp. 2-3; 2187, p. 5; 2327, Attachment 1, p. 16; 2350, p. 9; 2363, p. 4; 3492, p. 3; 2319, pp. 85-86).

OSHA concludes that an action level trigger for exposure assessment is appropriate and agrees with commenters that an action level trigger is needed in order to maintain exposures below the PEL. An action level trigger, typically set at half the PEL, is consistent with other OSHA health standards, such as the standards for 1,3-butadiene (29 CFR 1910.1051), methylene chloride (29 CFR 1910.1052), and chromium (VI) (29 CFR 1910.1026). It provides employees and employers with some assurance that variations in exposure levels will be accurately tracked and exposures above the PEL will be identified and corrective actions will be taken to protect employees. Assessment at the action level is also necessary to determine eligibility for medical surveillance in the standard for general industry and maritime. Where it is possible for employers to reduce exposures below the action level, the trigger encourages employers to do so in order to minimize their exposure assessment obligations while maximizing the protection of employees' health. As discussed in Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA), OSHA has also concluded that it is technologically feasible to reliably measure employee exposures at an action level of 25 $\mu g/m^3$.

OSHA disagrees with AXPC's suggestion to consider the effect of respiratory protection when setting the exposure assessment trigger or when triggering other provisions in this rule. Although there may be some circumstances where a breathing zone sample does not reflect the actual exposure of an employee who is being protected by a respirator, this argument overlooks the fact that exposure monitoring is not a single purpose activity. It is necessary to know employee exposure levels without the use of respiratory protection to evaluate the effectiveness of the required engineering and work practice controls and to determine whether additional controls must be instituted. In addition, monitoring is necessary to determine which respirator, if any, must be used by the employee, and it is also necessary for compliance purposes.

In addition, as discussed in the summary and explanation of Methods of Compliance, respirators will not protect employees if they are not fitted and maintained correctly and replaced as necessary or if employees do not use them consistently and properly. If any one of these conditions is not met, the protection a respirator provides to an employee can be reduced or eliminated. Thus, discounting exposure levels based on respirator use would be inappropriate. Moreover, the requirement to use respiratory protection under paragraph (f)(1) of the standard for general industry and maritime (paragraph (d)(3)(i) of the standard for construction) is triggered by employee exposures that exceed the PEL. It is unclear how AXPC believes the original exposure assessment level (to which the discount would be applied) could be derived without conducting an exposure assessment. Therefore, OSHA declines to adopt this suggestion.

EEI urged OSHA to consider exempting intermittent and short-duration work in the electric utility industry from the exposure assessment requirement where employees exposed at or above the action level wear appropriate personal protective equipment required under either 29 CFR Part 1910, Subpart I or 29 CFR Part 1926, Subpart E (Document ID 2357, pp. 13-14). While OSHA understands that conducting exposure monitoring in these situations may present challenges, it is important that employees who perform intermittent and short-duration work in the electric utility industry have their exposures assessed; the need for accurate information on exposures is no less for these employees than for other employees exposed to respirable crystalline silica at or above the action level. Where exposure assessments are required for intermittent and short-duration work, the performance option provides considerable flexibility for meeting these obligations. However, other provisions of the rule may relieve employers from conducting exposure assessments in some of these situations. For general industry and maritime, in situations where employers have objective data demonstrating that employee exposure will remain below 25 μg/m^3 as an 8-hour TWA under any foreseeable conditions, including during intermittent and short-duration work, paragraph (a)(2) exempts the employer from the scope of the rule. For construction, in situations where employee exposure will remain below 25 μg/m^3 as an 8-hour TWA under any foreseeable conditions, including during intermittent and short-duration work, paragraph (a) exempts the employer from the scope of the rule. In addition, as discussed in the summary and explanation of Scope, where tasks performed in a general industry or maritime setting are indistinguishable from construction tasks listed on Table 1, OSHA permits employers to comply with either all of the provisions of the standard for general industry and maritime or all of the provisions of the standard for construction. When this occurs and the employer fully complies with the standard for construction, the employer will not be required to conduct exposure assessments for employees engaged in those tasks. Therefore, OSHA has concluded that a specific exemption from exposure assessment requirements for intermittent and short-duration work in the electric utility industry is neither needed nor sufficiently protective.

As discussed above, paragraph (d)(1) of the standard for general industry and maritime (paragraph (d)(2)(i) of the standard for construction), unlike the general exposure assessment requirement in the proposal, provides two options for exposure assessment—a performance option and a scheduled monitoring option. The scheduled monitoring option provides a framework that is familiar to many employers, and has been successfully applied in the past. The performance option provides flexibility for employers who are able to characterize employee exposures through alternative methods. In either case, employers must assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level.

The performance option. Paragraph (d)(2) of the standard for general industry and maritime (paragraph (d)(2)(ii) of the standard for construction) describes the performance option. This option provides employers flexibility to assess the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to respirable crystalline silica. OSHA recognizes that exposure monitoring may present challenges in certain instances, particularly when tasks are of short duration or performed under varying environmental conditions. The performance option is intended to allow employers flexibility in assessing the respirable crystalline silica exposures of their employees.

Where the employer elects this option, the employer must conduct the exposure assessment prior to the time the work commences, and must demonstrate that employee exposures have been accurately characterized. To accurately characterize employee exposures under the performance option, the assessment must reflect the exposures of employees on each shift, for each job classification, in each work area. However, under this option, the employer has flexibility to determine how to achieve this. For example, under this option an employer could determine that there are no differences between the exposure of an employee in a certain job classification who performs a task in a particular work area on one shift and the exposure of another employee in the same job classification who performs the same task in the same work area on another shift. In that case, the employer could characterize the exposure of the second employee based on the characterization of the first employee's exposure.

Accurately characterizing employee exposures under the performance option is also an ongoing duty. In order for exposures to continue to be accurately characterized, the employer is required to reassess exposures whenever a change in production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the action level, or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred (see discussion below of paragraph (d)(4) of the standard for general industry and maritime and paragraph (d)(2)(iv) of the standard for construction).

When using the performance option, the burden is on the employer to demonstrate that the data accurately characterize employee exposure. However, the employer can characterize employee exposure within a range, in order to account for variability in exposures. For example, a general industry or maritime employer could use the performance option and determine that an employee's exposure is between the action level and the PEL. Based on this exposure assessment, the employer would be required under paragraph (i)(1)(i) to provide medical surveillance if the employee is exposed for more than 30 days per year. Where an employer uses the performance option and finds exposures to be above the PEL after implementing all feasible controls, the employer would be required to provide the appropriate level of respiratory protection. For example, an employer who has implemented all feasible controls could use the performance option to determine that exposures exceed the PEL, but do not exceed 10 times the PEL. The employer would be required under paragraph (g) of the standard for general industry and maritime (paragraph (e) of the standard for construction) to provide respiratory protection with an assigned protection factor of at least 10, as well as medical surveillance for employees exposed for more than 30 days per year.

Several commenters requested that OSHA provide more guidance as to how employers should implement the performance option. Commenters, including AFL-CIO, the International Union of Bricklayers and Allied Craftworkers (BAC), the United Steelworkers, BCTD, and the

International Union of Operating Engineers (IUOE), felt that clarification and guidance on the kind of data that may or may not be relied upon was needed in order to ensure that the data adequately reflected employee exposures (Document ID 2256, Attachment 2, p. 10; 2329, p. 4; 2336, p. 6; 2371, Attachment 1, pp. 11-13; 3581, Tr. 1693-1694; 3583, Tr. 2341; 4204, p. 54; 4223, p. 70). The American College of Occupational and Environmental Medicine recommended that OSHA more precisely specify the type and periodicity of collection of industrial hygiene data that would be required to assure representative exposure measurements (Document ID 2080, p. 4). The American Industrial Hygiene Association (AIHA) argued that a sufficient number of samples and a sampling strategy that is representative of the employees and tasks being sampled is needed to ensure that exposure assessments using the performance option accurately characterize employee exposure (Document ID 3578, Tr. 1049-1050). To do this, AIHA suggested that OSHA,

> . . . point to American Industrial Hygiene Association language on what an acceptable judgment of exposure can be based upon: number of samples for statistical validity, an acceptable tolerance for an error in that statistical judgment, and the connection of the sample set to a set of conditions occurring during the worker exposure measurement (Document ID 2169, p. 3).

CISC also indicated that the construction industry needed additional guidance, such as how often and when monitoring should be conducted under the performance option in order to determine whether it would be effective and viable (Document ID 2319, p. 86). Charles Gordon, a retired occupational safety and health attorney, suggested the performance option was too flexible and needed to be omitted until real-time monitoring could be incorporated into it (Document ID 2163, Attachment 1, p. 17).

OSHA has not included specific criteria for implementing the performance option in the rule. Since the goal of the performance option is to give employers flexibility to accurately characterize employee exposures using whatever combination of air monitoring data or objective data is most appropriate for their circumstances, OSHA concludes it would be inconsistent to specify in the standard exactly how and when data should be collected. Where employers want a more structured approach for meeting their exposure assessment obligations, OSHA also provides the scheduled monitoring option.

OSHA does, however, offer two clarifying points. First, the Agency clarifies that when using the term “air monitoring data” in this paragraph, OSHA refers to any monitoring conducted by the employer to comply with the requirements of this standard, including the prescribed accuracy and confidence requirements. Second, the term does not include historic air monitoring data, which are “objective data.” Additional discussion of the types of data and exposure assessment strategies that may be used by employers as “objective data” to accurately characterize employee exposures to respirable crystalline silica can be found in the summary and explanation of Definitions.

For example, trade associations and other organizations could develop objective data based on industry-wide surveys that members could use to characterize employee exposures to respirable crystalline silica. For example, the National Automobile Dealers Association (NADA) conducted air monitoring for employees performing a variety of tasks in automobile body shops (Document ID 4197; 4198). NADA worked to ensure that the results of the study were representative of typical operations. The sampling procedures and techniques for controlling dust were documented. These data may allow body shops that perform tasks in a manner consistent with that described in the NADA survey to rely on this objective data to characterize employee exposures to respirable crystalline silica.

Employers could also use portable, direct-reading instruments to accurately characterize employee exposures to respirable crystalline silica. These devices measure all respirable dusts, not only crystalline silica. But where the employer is aware of the proportion of crystalline silica in the dust, direct-reading instruments have the advantage of providing real-time monitoring results. For example, in a facility using pure crystalline silica, the employer could assume that the respirable crystalline silica concentration in the air is equivalent to the respirable dust measurement provided by the direct reading instrument. Where exposures involve dusts that are not pure crystalline silica, the employer could determine the concentration of crystalline silica by analysis of bulk samples (e.g., geotechnical profiling) or information on safety data sheets, and calculate the air concentration accordingly. In such situations, the analysis of bulk samples or safety data sheets would be part of the objective data relied on by the employer. In addition, employers could use a wide variety of other types of objective data to assess exposures, including data developed using area sampling or area exposure profile mapping approaches. Where new methods become available in the future that accurately characterize employee exposure to respirable crystalline silica, data generated using those methods could also be considered objective data and could be used by employers to assess employee exposures.

Where employers rely on objective data generated by others as an alternative to developing their own air monitoring data, they will be responsible for ensuring that the data relied upon from other sources are accurate measures of their employees' exposures. Thus, the burden is on the employer to show that the exposure assessment is sufficient to accurately characterize employee exposures to respirable crystalline silica.

CPR suggested that OSHA require an independent audit of employers' objective data calculations to ensure that they provide the same degree of assurance of accurate exposure characterization as air monitoring data (Document ID 2351, pp. 12-13). As explained above, employers using the performance option must ensure that the exposure assessment is sufficient to accurately characterize employee exposure to respirable crystalline silica. Because employers already bear the burden of ensuring accurate characterization of employee exposures, OSHA does not find that an independent audit of employers' objective data is necessary to assure proper compliance.

The Laborers' Health and Safety Fund of North America urged OSHA to collect and post all objective data that meet the definition on its website, so that it could be used by anyone performing the same task under the same conditions (Document ID 2253, p. 4). Other commenters, including BAC, BCTD, and IUOE, agreed that developing a means for collecting and sharing objective data was important (Document ID 2329, p. 4; 2371, Attachment 1, p. 13; 3583, Tr. 2394-2395). OSHA recognizes that the collection and sharing of objective data can be a useful tool for employers characterizing exposures using the performance option. OSHA anticipates that there could be a substantial volume of objective data that would require significant resources to collect, organize, present, and maintain in a way that is accessible, understandable, and valuable to employers. The Agency does not have the resources to do this; however, employers, professional and trade associations, unions, and others that generate objective data are encouraged to aggregate and disseminate this type of information.

As with the standard for chromium (VI), 29 CFR 1910.1026, OSHA does not limit when objective data can be used to characterize exposure. OSHA permits employers to rely on objective data for meeting their exposure assessment obligations, even where exposures may exceed the action level or PEL. OSHA's intent is to allow employers flexibility to assess employee exposures to respirable crystalline silica, but to ensure that the data used are accurate in characterizing employee exposures. For example, where an employer has a substantial body of data (from previous monitoring, industry-wide surveys, or other sources) indicating that employee exposures in a given task exceed the PEL, the employer may choose to rely on those data to determine his or her compliance obligations (e.g., implementation of feasible engineering and work practice controls, respiratory protection, medical surveillance).

OSHA has also not established time limitations for air monitoring results used to characterize employee exposures under the performance option. Although the proposed standard would have limited employers using air monitoring data for initial exposure assessment purposes to data collected no more than twelve months prior to the rule's effective date, there were no such time restrictions on monitoring data used to conduct periodic exposure assessments under the performance option. Nevertheless, many commenters, including Ameren, TCNA, NAM, NAIMA, Associated General Contractors of New York State, ARMA, EEI, the National Rural Electric Cooperative Association, the Glass Packaging Institute, Verallia North America, and Holes Incorporated, found the 12-month limit on the use of monitoring results for initial exposure assessments using existing data to be too restrictive (e.g., Document ID 2315, p. 3; 2363, p. 6; 2380, Attachment 2, pp. 28-29; 3544, pp. 12-13; 2145, p. 3; 2291, pp. 2, 21-23; 2348, pp. 37-39; 2357, pp. 22-23; 2365, pp. 10-11, 23; 2290, p. 4; 3493, p. 6; 3584, Tr. 2848; 3580, Tr. 1492). For example, Southern Company noted that:

> We have been collecting data on silica for several years as well as sharing within our industry group. This provision seems to be arbitrary and provides only a short window of time for data collection while eliminating the value and importance of past [efforts] we have placed on this issue (Document ID 2185, p. 7).

OSHA has been persuaded by these commenters not to establish time limitations for monitoring results used to assess exposures under the performance option, as long as the employer can demonstrate the data accurately characterize current employee exposures to respirable crystalline silica. The general principle that the burden is on the employer to show that the data accurately characterize employee exposure to respirable crystalline silica applies to the age of the data as well as to the source of the data. For example, monitoring results obtained 18 months prior to the effective date of the standard could be used to determine employee exposures, but only if the employer could show that the data were obtained during work operations conducted under workplace conditions closely resembling the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations. Regardless of when they were collected, the data must accurately reflect current conditions.

Any air monitoring data relied upon by employers must be maintained and made available in accordance with the recordkeeping requirements in paragraph (k)(1) of the standard for general industry and maritime (paragraph (j)(1) of the standard for construction). Any objective data relied upon must be maintained and made available in accordance with the recordkeeping requirements in paragraph (k)(2) of the standard for general industry and maritime (paragraph (j)(2) of the standard for construction).

NISA commented that a performance option needs to be consistently interpreted by compliance officers in order for such an approach to be truly useful to employers (Document ID 2195, p. 36). OSHA agrees. OSHA regularly establishes policies and directives to guide compliance officers in a uniform, consistent manner when enforcing standards. These policies ensure that all the provisions of OSHA standards, including performance options, are consistently applied in the field.

<u>The scheduled monitoring option</u>. Paragraph (d)(3) of the standard for general industry and maritime (paragraph (d)(2)(iii) of the standard for construction) describes the scheduled

monitoring option. This option provides employers with a clearly defined, structured approach to assessing employee exposures. Under paragraph (d)(3)(i) of the standard for general industry and maritime (paragraph (d)(2)(iii)(A) of the standard for construction), employers who select the scheduled monitoring option must conduct initial monitoring to determine employee exposure to respirable crystalline silica. Monitoring to determine employee exposures must represent the employee's time-weighted average exposure to respirable crystalline silica over an eight-hour workday. Samples must be taken within the employee's breathing zone (i.e., "personal breathing zone samples" or "personal samples"), and must represent the employee's exposure without regard to the use of respiratory protection. OSHA intends for employers using the scheduled monitoring option to conduct initial monitoring as soon as work begins. Employers must be aware of the level of exposure when work is performed to identify situations where control measures are needed.

Under the scheduled monitoring option, just as under the performance option, employers must accurately characterize the exposure of each employee to respirable crystalline silica. In some cases, this will entail monitoring all exposed employees. In other cases, monitoring of "representative" employees is sufficient. Representative exposure sampling is permitted when several employees perform essentially the same job on the same shift and under the same conditions. For such situations, it may be sufficient to monitor a subset of these employees in order to obtain data that are "representative" of the remaining employees. Representative personal sampling for employees engaged in similar work, with respirable crystalline silica exposure of similar duration and magnitude, is achieved by monitoring the employee(s) reasonably expected to have the highest respirable crystalline silica exposures. For example, this could involve monitoring the respirable crystalline silica exposure of the employee closest to an exposure source. The exposure result may then be attributed to other employees in the group who perform the same tasks on the same shift and in the same work area.

Exposure monitoring should include, at a minimum, one full-shift sample taken for each job function in each job classification, in each work area, for each shift. These samples must consist of at least one sample characteristic of the entire shift or consecutive representative samples taken over the length of the shift. Where employees are not performing the same job under the same conditions, representative sampling will not adequately characterize actual exposures, and individual monitoring is necessary.

Stakeholders offered numerous comments and suggestions about the proposed provisions that would have required employers to assess employee exposure on the basis of personal breathing zone air samples that reflect the exposure of employees on each shift, for each job classification, and in each work area. Many of these comments and suggestions involved specific concerns with the practicality and necessity of assessing employee exposure on each shift, for each job classification, and in each work area (e.g., Document ID 2315, p. 3; 2317, p. 2; 2215, p. 9; 2312, p. 2; 2348, Attachment 1, p. 39; 2357, p. 23; 2327, Attachment 1, p. 18; 2380, Attachment 2, pp. 26-28; 2179, p. 3; 2291, pp. 20-21). As discussed previously, OSHA responded to these comments by restructuring the exposure assessment requirements to allow employers to use the performance option for all exposure assessments required by this rule. Although employers utilizing the performance option must still accurately characterize the exposures of each of their employees, these employers have latitude to broadly consider the best way this can be accomplished.

NAIMA suggested that OSHA should make adjustments to exposure monitoring requirements for extended work shifts (e.g., 12-hour shifts). They proposed that

> . . .exposure assessment should follow the standard practice of measuring any continuous 8-hour period in the shift that is representative, or allow using multiple samples to sample the entire extended shift and selecting the 8 hours which represent the highest potential exposure (Document ID 3544, p. 14).

OSHA agrees that this is an appropriate way to conduct sampling for extended work shifts. This practice is already reflected in the OSHA Technical Manual, which describes the two approaches advanced by NAIMA, including sampling the worst (highest exposure) eight hours of a shift or collecting multiple samples over the entire work shift and using the highest samples to calculate an 8-hour TWA (OSHA Technical Manual, Section II, Chapter 1, 2014, https://www.osha.gov/dts/osta/otm/otm_ii/otm_ii_1.html#extended_workshifts).

CISC argued that the ASTM Standard E 2625–09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities, takes what CISC considered to be a more reasonable approach to representative air monitoring in the construction industry. The ASTM standard states that measurements “need to be representative of the worker’s customary activity and be representative of work shift exposure” (Document ID 1504). CISC argued that this approach is,

> . . . more reasonable because it inherently recognizes that an employee’s exposure would vary on any given day due to a multitude of factors and that an employer should attempt to understand the exposure levels when performing his/her customary activity (Document ID 2319, pp. 83-84).

OSHA acknowledges that variability in exposures is a concern in the construction industry. The construction standard does not require exposure assessment for employees engaged in a task identified on Table 1 where the employer fully and properly implements the specified exposure control methods presented on Table 1 (see paragraph (c) of the standard for construction). As noted above, the performance option, in paragraph (d)(2) of the standard for general industry and maritime (paragraph (d)(2)(ii) of the standard for construction), also provides flexibility to characterize employee exposures in a manner that accounts for variability, in that it allows exposures to be assessed using any combination of air monitoring data and objective data. But OSHA does not consider that it is appropriate to allow exposure assessment to include only an employee's "customary activity," because such an approach would ignore activities that may involve higher exposures to respirable crystalline silica, and the higher levels of risk associated with those exposures.

Under the scheduled monitoring option, requirements for periodic monitoring depend on the results of initial monitoring and, thereafter, any required subsequent monitoring. Paragraphs (d)(3)(ii)-(iv) of the standard for general industry and maritime (paragraphs (d)(2)(iii)(B)-(D) of the standard for construction) describe the employers' duties depending on the initial (and, after that, the most recent) monitoring results. If the initial monitoring indicates that employee exposures are below the action level, no further monitoring is required. If the most recent exposure monitoring reveals employee exposures to be at or above the action level but at or below the PEL, the employer must repeat monitoring within six months of the most recent monitoring. If the most recent exposure monitoring reveals employee exposures to be above the PEL, the employer must repeat monitoring within three months of the most recent monitoring.

Paragraph (d)(3)(v) of the standard for general industry and maritime (paragraph (d)(2)(iii)(E) of the standard for construction) provides that if the most recent (non-initial) exposure monitoring indicates that employee exposures are below the action level, and those results are confirmed within six months of the most recent monitoring by a second measurement taken consecutively at least seven days afterwards, the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring. As discussed below, reassessment is always required whenever a change in the workplace may be reasonably expected to result in new or additional exposures at or above the action level or the employer has any reason to believe that new or additional exposures at or above the action level have occurred, regardless of whether the employer has ceased monitoring because exposures are below the action level under paragraph (d)(3)(ii) or (d)(3)(v) of the standard for general industry and maritime (paragraph (d)(2)(iii)(B) or (d)(2)(iii)(E) of the standard for construction) (see paragraph (d)(4) of the standard for general industry and maritime (paragraph (d)(2)(iv) of the standard for construction)).

OSHA made a number of minor changes to the requirements for periodic monitoring under the scheduled monitoring option from the proposal based on stakeholder comments. For example, paragraph (d)(3)(i)(B) of the proposed regulatory text provided that "[w]here initial or subsequent exposure monitoring reveals that employee exposures are above the PEL, the employer shall repeat such monitoring at least every three months." Subparagraph (C) then stated: "the employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level, at which time the employer may discontinue monitoring . . ."

ARMA argued that these provisions were confusing and "might be interpreted to require employers to continue monitoring quarterly, even if two consecutive measurements are at or above the action level but at or below the PEL"—a reading that ARMA believed conflicted with the language of paragraph (d)(3)(i)(A), which provided that "[w]here initial or subsequent exposure monitoring reveals that employee exposures are at or above the action level but at or below the PEL, the employer shall repeat such monitoring at least every six months" (Document ID 2291, p. 23). ARMA added that it anticipated that OSHA intended these provisions to impose the same periodic monitoring requirements that appear routinely in other OSHA health standards. It explained: "[u]nder that approach, even if periodic monitoring must be conducted quarterly because the initial (or subsequent) assessment shows exposures in excess of the PEL, the frequency can be reduced to quarterly once two consecutive measurements more than seven days apart fall below the PEL but above the action level" (Document ID 2291, p. 23).

OSHA agrees with ARMA's comment and has revised the periodic monitoring provisions under the scheduled monitoring option to better reflect OSHA's intent—as a general rule, the most recent exposure monitoring sample determines how often an employer must monitor. OSHA has also revised proposed paragraph (d)(3)(i)(C) to clarify the circumstances under which employers who choose the scheduled monitoring option may discontinue periodic monitoring.

Stakeholders also commented on how often employers should be required to conduct exposure monitoring. Several commenters, including the National Tile Contractors Association (NTCA), Dal-Tile, Grede Holdings, ORCHSE Strategies (ORCHSE), Benton Foundry, PCI, TCNA, and NISA, disagreed with the proposed frequency of monitoring and suggested other frequencies (every 6 months, 12 months, 18 months, or as determined by a competent person) (e.g., Document ID 2267, p. 7; 2147, p. 3; 2298, p. 4; 2277, p. 3; 1972, p. 2; 2276, p. 6; 3584, Tr. 2744; 2363, p. 7; 2195, p. 36). IUOE and EEI, among others, suggested that the three or six-month intervals for follow-up exposure assessment will do nothing to protect employees on jobs of short duration (e.g., Document ID 2262, p. 11; 2357, p. 31). AFS suggested that a scheduled monitoring option "that includes quarterly and semi-annual monitoring does not gather useful information and is punitive in intent" (Document ID 2379, Appendix 1, p. 55). EEI urged OSHA to revise the scheduled monitoring option to either:

> . . . (a) permit employers to conduct subsequent exposure assessments without an arbitrary timetable of three or six months; (b) permit employers to conduct

> subsequent exposure assessments in longer, more reasonable intervals, such as annually or biennially; or (c) create an exception to periodic exposure assessment requirement when no changes in the workplace, control equipment, or work practices have occurred (Document ID 2357, p. 21).

Francisco Trujillo, representing Miller and Long, proposed that where exposures were between the action level and the PEL, exposure assessment be required at least every six months unless employers implement the same controls used to control exposures above the PEL (Document ID 2345, p. 3). OSHA recognizes that exposures in the workplace may fluctuate. Periodic monitoring, however, is intended to provide the employer with reasonable assurance the employees are not experiencing exposures that are higher than the PEL and require the use of additional control measures. If the employer installs or upgrades controls, periodic monitoring will demonstrate whether or not controls are working properly or if additional controls are needed. In addition, periodic monitoring reminds employees and employers of the continued need to protect against the hazards associated with exposure to respirable crystalline silica. Because of the fluctuation in exposures, OSHA finds that when initial monitoring results equal or exceed the action level, but are at or below the PEL, employers must continue to monitor employees to ensure that exposures remain at or below the PEL. Likewise, when initial monitoring results exceed the PEL, periodic monitoring allows the employer to maintain an accurate profile of employee exposures. Selection of appropriate respiratory protection also depends on adequate knowledge of employee exposures.

In general, the more frequently periodic monitoring is performed, the more accurate the employee exposure profile. Selecting an appropriate interval between measurements is a matter of judgment. OSHA concludes that the frequencies of six months for subsequent periodic monitoring for exposures in between the action level and the PEL, and three months for exposures above the PEL, provide intervals that are both practical for employers and protective for employees. This finding is supported by OSHA's experience with comparable monitoring intervals in other standards, including those for chromium (VI) (1910.1026), cadmium (29 CFR 1910.1027), methylenedianiline (29 CFR 1910.1050), methylene chloride (29 CFR 1910.1052), and formaldehyde (29 CFR 1910.1048). Where employers find that a different frequency of monitoring is sufficient to accurately characterize employee exposure to respirable crystalline silica, they can use that air monitoring data to meet their exposure assessment obligations under the performance option.

Commenters, including National Electrical Carbon Products, Lapp Insulators, the Indiana Manufacturers Association, ORCHSE, Murray Energy Corporation, the Motor and Equipment Manufacturers Association, IME, PCI, and NAM, urged OSHA to permit employers to cease monitoring or monitor on a reduced schedule when it has been determined it is infeasible to reduce exposures below the PEL using engineering and work practice controls (e.g., Document ID 1785, p. 5; 2130, p. 2; 2151, p. 2; 2277, p. 3; 2102, p. 2; 2326, pp. 2-3; 2213, p. 4; 2276, p. 6; 2380, Attachment 2, pp. 29-30). OSHA concludes, however, that periodic air monitoring serves as a useful tool for evaluating the continuing effectiveness of engineering and work practice controls, and can assist employers in ensuring that they have met their obligation to use all feasible controls to limit employee exposures to the PEL. Nevertheless, an employer may decide that continued monitoring does not serve to better characterize employee exposure. In these cases, as long as the air monitoring data continue to accurately characterize employee exposure, employers can use the existing data to meet their exposure assessment obligations under the performance option without conducting additional monitoring.

Reassessment of exposures. Paragraph (d)(4) of the standard for general industry and maritime (paragraph (d)(2)(iv) of the standard for construction) requires employers assessing exposures using either the performance option or the scheduled monitoring option to reassess employee exposures whenever there has been a change in the production, process, control equipment, personnel, or work practices that may reasonably be expected to result in new or additional exposures to respirable crystalline silica at or above the action level, or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred. For example, if an employer has conducted monitoring while a task is performed using local exhaust ventilation and the flow rate of the ventilation system is decreased, additional monitoring would be necessary to assess employee exposures under the modified conditions. In addition, there may be other situations that can result in new or additional exposures to respirable crystalline silica that are unique to an employee's work situation. OSHA inserted the phrase "or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred" in the rule to make clear that reassessment of exposures is required whenever there is reason to believe that a change in circumstances could result in new or additional exposures at or above the action level. For instance, an employee may move from an open, outdoor location to an enclosed or confined space. Even though the task performed and the materials used may remain constant, the changed environment could reasonably be expected to result in higher exposures to respirable crystalline silica. In order to account for these situations, the rule requires employers to reassess employee exposures whenever a change may result in new or additional exposures at or above the action level. OSHA considers this reevaluation necessary to ensure that the exposure assessment accurately represents existing exposure conditions. The exposure information gained from such assessments will enable the employer to take appropriate action to protect exposed employees, such as instituting additional engineering controls or providing appropriate respiratory protection.

Some commenters, including Southern Company, EEI, API, and AFPM, raised concerns about the requirement to conduct additional exposure assessments (e.g., Document ID 2185, p. 7; 2357, pp. 21-22; 2301, Attachment 1, p. 80; 2350, p. 10). Southern Company commented that employers should not have to reassess exposures for every personnel change, but rather only those changes that result in significant changes in employee exposure (Document ID 2185, p. 7). EEI urged OSHA to clarify what kind of change could trigger additional assessments (Document ID 2357, pp. 21-22). API presented concerns that this requirement could be interpreted to require additional assessments at unworkably frequent intervals (Document ID 2301, Attachment 1, p. 80). AFPM argued that the provision would require its members to conduct continuous monitoring given the requirement to reassess every time there is an environmental shift that would result in a new respirable crystalline silica level (Document ID 2350, p. 10).

As described above, the requirement to reassess exposures only applies where there are changes in the workplace that may reasonably be expected to result in new or additional exposures at or above the action level or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred. OSHA does not intend for employers to conduct additional monitoring simply because a change has occurred, so long as the change is not reasonably expected to result in new or additional exposures to respirable crystalline silica at or above the action level. Thus, in some of the situations highlighted by the commenters, employers may not need to reassess exposures. For example, where a personnel change does not have an expected impact on the magnitude of employee exposure to respirable crystalline silica, the employer would not have to reassess exposures. When the environmental conditions on a construction site change in ways that would not result in new or additional exposures at or above the action level, such as a change from dry, dusty conditions to wet, rainy conditions, the employer would not have to reassess exposures. Other changes that would be reasonably expected to lower exposures to respirable crystalline silica, rather than result in new or additional exposures at or above the action level, such as moving from an indoor to an outdoor location or using a product with a lower silica content than that previously used in the same process, would not require the employer to reassess exposures.

Methods of sample analysis. Paragraph (d)(5) of the standard for general industry and maritime (paragraph (d)(2)(v) of the standard for construction) requires employers to ensure that all samples taken to satisfy the monitoring requirements are evaluated in accordance with Appendix A, which contains specifications for the methods to be used for analysis of respirable crystalline silica samples. The proposed provision would also have required employers to ensure that all samples taken to satisfy the air monitoring requirements in the exposure assessment paragraph were evaluated using the procedures specified in certain analytical methods. However, in the proposal, the analytical methods were laid out in paragraph (d), rather than in a separate Appendix.

Several commenters, including the Korte Company, AFS, TCNA, and NAM expressed concerns that the proposal placed responsibility for laboratory performance on the employers, who are not in a position to ensure that laboratories are complying with specific analytical requirements (e.g, Document ID 3230, p. 1; 2379, Appendix 1, p. 56; 2363, p. 7; 2380, Attachment 2, p. 31). OSHA does not expect employers to oversee laboratory practices. An employer who engages an independent laboratory to analyze respirable crystalline silica samples can rely on a statement from that laboratory confirming that the specifications in Appendix A were met.

One stakeholder, Southern Company, recommended that OSHA require use of accredited laboratories and move all other laboratory requirements to an appendix as a guide for laboratories that analyze silica samples (Document ID 2185, p. 7). OSHA agrees with this suggestion and has decided to retain the substance of the proposed provisions addressing analysis of samples, but has moved these provisions to a new appendix. The Agency concludes that segregating these requirements in an appendix to each standard provides greater clarity for both employers and the laboratories that analyze samples. The specifications contained in Appendix A are discussed in the summary and explanation of Appendix A in this section.

Commenters, including NSSGA, SCA, OSCO Industries, ORCHSE, Associated General Contractors of Michigan (AGCM), and PCI expressed concern about the availability of a sufficient number of qualified laboratories capable of analyzing the increased number of air samples expected given the standard's exposure assessment requirements (e.g., Document ID 1992, p. 12; 2255, p. 1; 2265, Attachment 1, p. 2; 2277, p. 3; 2327, Attachment 1, pp. 4-6; 3589, Tr. 4357). There are approximately 40 laboratories that are accredited by AIHA Laboratory Accreditation Programs for the analysis of crystalline silica; these laboratories are already capable of analyzing samples in accordance with the laboratory requirements of this rule (Document ID 3586, Tr. 3284). While the number of accredited laboratories for the analysis of crystalline silica has declined over the last 10 or 20 years, William Walsh, the Vice Chair of the Analytical Accreditation Board of the AIHA Laboratory Accreditation Programs, testified that there is still sufficient capacity available to analyze crystalline silica samples and, in fact, "each lab's capacity has gone up" due to increased efficiency in the sample analysis process (Document ID 3586, Tr. 3311).

OSHA expects that the additional demand for respirable crystalline silica exposure monitoring and associated laboratory analysis with the rule will be modest. Most construction employers are expected to implement the specified exposure control measures in paragraph (c) of the standard for construction, and will therefore not be required to conduct exposure monitoring. The performance option for exposure assessment provided in both the standard for general industry and maritime at paragraph (d)(2) and the standard for construction at paragraph (d)(2)(ii) also serves to lessen the future volume of exposure monitoring and associated laboratory analysis for crystalline silica. As discussed in the summary and explanation of Dates, the time allowed for compliance with the standard for general industry and maritime also serves to diminish concerns about laboratory capacity by providing additional time for laboratory capacity to increase and distributing demand for sample analysis over an extended period of time.

Employee notification of assessment results. Paragraph (d)(6) of the standard for general industry and maritime (paragraph (d)(2)(vi) of the standard for construction) contains the requirements for employee notification of assessment results and corrective actions. Under paragraph (d)(6)(i) of the standard for general industry and maritime, employers must notify each affected employee of the results of the exposure assessment within 15 working days of completing the assessment. Paragraph (d)(2)(vi)(A) of the standard for construction requires this notification not more than five working days after the exposure assessment has been completed. Notification is required under both standards whenever an exposure assessment has been conducted, regardless of whether or not employee exposure exceeds the action level or PEL. Employers must either notify each individual employee in writing or post the assessment results in an appropriate location accessible to all affected employees. The term "affected" as used here means all employees for which an exposure assessment has been conducted, either individually or as part of a representative monitoring strategy. It includes employees whose exposure was assessed based on other employees who were sampled, and employees whose exposures have been assessed on the basis of objective data. As discussed with regard to the performance option, exposures can be characterized as a range, e.g., below the action level or between the action level and the PEL. The employer is notifying employees of employee exposures, i.e., exposures that would occur if the employee were not using a respirator. Any engineering and work practice controls used would be reflected in the assessment results.

The provisions in the rule are identical to the proposed provisions for both general industry and maritime and construction. A number of commenters offered opinions on these provisions. For example, some commenters, including Southern Company and EEI, objected to the differences between the general industry and construction notification requirements. These stakeholders argued that establishing different reporting requirements for general industry and construction (i.e., requiring notification within 5 working days in construction and 15 working days in general industry), would create confusion and make compliance difficult to achieve, especially for employers with blended general industry/construction operations, such as electric utilities (Document ID 2185, p. 4; 2357, p. 23). EEI urged OSHA to harmonize the requirements or clarify which section applies to the situation with blended general industry/construction operations (Document ID 2357, p. 23).

This issue is not unique to this rulemaking. In October 2002, OSHA published the second phase of its Standard Improvement Project (SIPS), which proposed to revise a number of health provisions in its standards for general industry, shipyard employment, and construction. The proposal was part of OSHA's effort to continue to remove and revise provisions of its standards that are outdated, duplicative, unnecessary, or inconsistent. One of the issues OSHA examined in Phase II of SIPS was the “variety of different time limits between receipt of employees' exposure monitoring results and notification of employees” in OSHA's substance specific standards. After a thorough review of the record, OSHA adopted a 15-day notification period for general industry and a 5-day period in construction. The Agency explained that its decision to set two different time frames was due, in part, to the general differences in the industries, i.e., general industry on average has “a more stable workforce,” while “[e]mployment at a particular location is often brief in construction. . . ” (70 FR 1112, 1126 (1/5/05)).

Some stakeholders from the construction industry, including CISC and ASA, were concerned that they could not comply with the proposed five-day notification requirement due to the often short duration of tasks and employment in this sector. They argued that employers and employees will frequently have moved to a different job before the results are available, making it difficult or impossible to reach affected employees and rendering the data irrelevant to the new project with varying conditions and circumstances (e.g., Document ID 2319, p. 87; 2187, p. 5). These comments suggest that a 5-working-day notification period would be too long for many employers in the construction industry. Thus, OSHA concludes that it would make little sense to lengthen the notification period in the construction standard to correspond to the time period proposed in general industry and maritime.

OSHA also concludes that shortening the proposed provision in general industry to mirror that in construction would likewise make little sense, especially insofar as most of OSHA’s health standards for general industry already utilize a 15-working-day period. As OSHA explained in Phase II of SIPS, “a uniform time limit for notifying employees in general industry has substantial benefits[,]” including reduced employer paperwork burdens because of simpler, uniform compliance programs and probable improvement in employee protection due to improved compliance. Therefore, OSHA finds that the reasons discussed in the SIPS rulemaking apply equally here. Consequently, OSHA has chosen to adopt the proposed 5 and 15-working-day assessment results notification periods in the rule.

OSHA has also considered commenters' concerns that the nature of construction work will make it logistically difficult to notify employees of assessment results because they may have moved on to different jobsites or employers. Employers have options available for notifying employees in such circumstances; for example, notifications could be made individually in writing by including the assessment results in the employees' final paycheck.

OSHA considers notification of assessment results to be important, even if the work conditions and circumstances have changed by the time the assessment results are available. Notification is not simply for purposes of identifying appropriate controls at the time the work is performed. The assessment results are still relevant after the exposure has occurred, to inform employees of their exposure, to provide context for future work that may be performed under similar conditions and circumstances, and to inform PLHCPs who provide medical surveillance for the employee.

NAM urged OSHA to provide flexibility as to when an assessment is deemed complete rather than obligating the employer to notify employees within five days of receiving a laboratory result (Document ID 2380, Attachment 2, p. 32). NAM argued that employers need time to perform and get the results of comprehensive surveys, perform appropriate quality assurance of those results, and meet with employees as appropriate to discuss the results. OSHA recognizes the value of these measures, but also considers the necessity of assessing exposures and notifying employees in a timely manner so that appropriate protective measures are taken.

The Agency is convinced that the required notification can be made within the required 15 or 5 day time period, which are standard in OSHA health standards. Additional information that is developed from the collection of data in comprehensive surveys, any revisions to initial results as a result of quality assurance activities, or meetings to discuss the assessment results can take place at a later date.

Where the employer follows the performance option provided in paragraph (d)(2) of the standard for general industry and maritime (paragraph (d)(2)(ii) of the standard for construction), the 15 (or 5) day period commences when the employer completes an assessment of employee exposure levels (i.e., normally prior to the time the work operation commences, and whenever exposures are re-evaluated). OSHA expects that many construction employers will follow the performance option, where they are not using the specified exposure control methods approach. Therefore, OSHA expects that it will not be difficult to reach affected employees as the assessment would take place prior to the time the work operation begins and the assessment results could then be posted in a location accessible to employees at the beginning of the job. Where the employer follows the scheduled monitoring option provided in paragraph (d)(3) of the standard for general industry and maritime (paragraph (d)(2)(iii) of the standard for construction), the 15 (or 5) day period for notification commences when monitoring results are received by the employer.

In addition, as discussed in the summary and explanation of Scope, where tasks performed in a general industry setting may be essentially indistinguishable from construction tasks listed on Table 1, OSHA permits employers to comply with either all of the provisions of the standard for general industry and maritime or all of the provisions of the standard for construction. When choosing to follow the construction standard, the employer must notify employees within five working days after completing an exposure assessment.

The notification provisions in the rule, like those in the proposal, require employers to notify "affected" employees. As noted above, the term "affected" as used here means all employees for which an exposure assessment has been conducted, either individually or as part of a representative monitoring strategy. It includes employees whose exposure was assessed based on other employees who were sampled, and employees whose exposures have been assessed on the basis of objective data. Several commenters, including Ameren and EEI, suggested that notification should only be required where air monitoring has been performed, should not be applicable to employers who choose the performance option for meeting the exposure assessment requirement, and should already be captured by training or a written safety program (e.g., Document ID 2315, p. 3; 2357, p. 23). Newmont Mining Corporation commented that notification for every exposure assessment would be excessive and should only be required when the results change (e.g., exposures above the PEL drop below PEL) (Document ID 1963, p. 4).

OSHA disagrees. Notifying employees of their exposures provides them with knowledge that can permit and encourage them to be more proactive in working to control their own exposures through better and safer work practices and more active participation in safety programs. As OSHA noted with respect to its Hazard Communication Standard: "Employees provided with information and training on chemical hazards are able to fully participate in the protective measures instituted in their workplaces" (77 FR 17574, 17579 (3/26/12)). Exposures to respirable crystalline silica below the PEL may still be hazardous, and making employees aware of such exposures may encourage them to take whatever steps they can, as individuals, to reduce their exposures as much as possible. The results of exposure assessment are not specifically required to be communicated to employees under the hazard communication and employee information and training requirements in paragraph (j) of the standard for general industry and maritime (paragraph (i) of the standard for construction) nor as a part of the written exposure control plan required in paragraph (f)(2) of the standard for general industry and maritime (paragraph (g) of the standard for construction). Exposure assessments are likely to be conducted more frequently than training and, given the differences in timing, OSHA concludes that it would not make sense to incorporate them into a written exposure control plan. Thus, it is important to separate the notification of exposure assessment results from other information and training employees are required to receive under the rule.

NAM offered its opinion on what information the notification should provide to employees and urged OSHA to provide flexibility in this area:

> Many employers require that air sampling results be accompanied by statements concerning the relationship of the results to existing standards, practices and procedures required as a result of the exposure levels, and a discussion of any steps the employer is taking in addition to further control exposures. OSHA acknowledges that employees benefit from having information about the exposures and potential control measures, including the use of PPE, to reduce their risk. OSHA should recognize that an assessment may include more than simple analytical results from a laboratory. Therefore, OSHA should propose language to make clear that the employers have this flexibility in communicating the results to employees (Document ID 2380, Attachment 2, p. 32).

The notification requirement specifies what information must be included; however, this does not limit employers from including the types of information described by NAM in the written notification to employees.

The standard also requires employers to either notify each affected employee in writing or post the assessment results in an appropriate location accessible to all affected employees. CPR urged OSHA to strengthen the notification requirements by requiring: personal notification to workers in writing; notification in a language the employee can understand; and inclusion of information about the silica standard, silica-related disease from an individual or community perspective, and available health care benefits (Document ID 2351, p. 12). The Agency has determined that the notification requirements and the training requirements in the rule adequately address these suggestions. As discussed, the rule requires employers to notify employees, either in writing or by posting in an appropriate location. The training requirements in paragraph (j)(3) of the standard for general industry and maritime (paragraph (i)(2) of the standard for construction) require the employer to ensure that each covered employee can demonstrate knowledge and understanding of the silica standard, tasks that could result in exposure to respirable crystalline silica, the health hazards associated with exposure, specific procedures the employer has implemented to protect employees from exposure, and the medical surveillance provided under the rule. OSHA intends that these requirements will ensure that employees comprehend their exposure to respirable crystalline silica, the potential adverse effects of that exposure, and protective measures that are available. This would include employee understanding of any corrective action the employer is taking to reduce exposures below the PEL that is described in the written notification. The notification requirement, however, does not require that employers provide notification in a language that the employee can understand; as with other information provided to employees (e.g., labels and safety data sheets), training ensures that the information is understood.

In addition, paragraph (d)(6)(ii) of the standard for general industry and maritime (paragraph (d)(2)(vi)(B) of the standard for construction) requires that whenever the PEL has been exceeded, the written notification must contain a description of the corrective action(s) being taken by the employer to reduce employee exposures to or below the PEL. Several commenters raised issues with the requirement to notify employees about corrective actions being taken where exposures are above the PEL. ASA and CISC suggested that in the construction environment, five days is not sufficient time to determine what caused the exposure, to research alternative solutions to limit future exposure, and to decide on the appropriate corrective action (Document ID 2187, p. 5; 2319, p. 87; 3442, pp. 3-4).

Similarly, in the general industry context, Newmont Mining Corporation argued that "[d]etermination of controls to reduce exposures when exposure assessments exceed the PEL may take more than 15 days" and suggested that OSHA revise the proposed language to allow employers 60 to 90 days to develop a corrective action plan and explain it to employees (Document ID 1963, p. 4). NAM also noted that the requirement to notify employees of the corrective actions being taken to reduce employee exposures below the PEL does not make sense for situations where it is infeasible to bring the exposure level down to the PEL (Document ID 2380, Attachment 2, p. 32).

OSHA disagrees. In OSHA's view, the requirement to inform employees of the corrective actions the employer is taking to reduce the exposure level to or below the PEL is necessary to assure employees that the employer is making efforts to furnish them with a safe and healthful work environment, and is required under section 8(c)(3) of the OSH Act (29 U.S.C. 657(c)(3)). OSHA understands that it may take more than 15 days to determine what engineering controls may be appropriate in a particular situation. However, the corrective action described in the written notification is not limited to engineering controls; when the exposure assessment indicates that exposures exceed the PEL, and the employer needs more than 15 days (or, in the case of the standard for construction, 5 days) to identify the engineering controls that will be necessary to limit exposures to the PEL, the employer is required to provide exposed employees with appropriate respiratory protection. In such a situation, respiratory protection is the corrective action that would be described in the written notification. Similarly, respiratory protection is the corrective action that would be described in the written notification in situations where it is infeasible to limit exposures to the PEL.

CEG and Upstate Medical University suggested that exposure assessment results should not only be reported to employees, but also should be reported to OSHA (Document ID 3586, Tr. 3321; 2244, p. 4). OSHA has not included such a requirement in the rule as such information would not be of practical use to the Agency. OSHA does not possess the resources to review and consider all of the material that will be generated by employers assessing employee exposures under the rule. OSHA would not have sufficient context to consider that material even if sufficient resources were available, given that only limited information is included in such assessments. Where such information would be of practical value to OSHA, such as when compliance staff conduct workplace inspections, the Agency is able to review exposure records in accordance with the standard addressing access to exposure and medical records (29 CFR 1910.1020).

Observation of monitoring. Paragraph (d)(7) of the standard for general industry and maritime (paragraph (d)(2)(vii) of the standard for construction) requires the employer to provide affected employees or their designated representatives an opportunity to observe any air monitoring of employee exposure to respirable crystalline silica, whether the employer uses the performance option or the scheduled monitoring option. When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required for any workplace hazard, the employer must provide the observer with that protective clothing or equipment at no cost, and assure that the observer uses such clothing or equipment.

The requirement for employers to provide employees or their representatives the opportunity to observe monitoring is consistent with the OSH Act. Section 8(c)(3) of the OSH Act mandates that regulations developed under section 6 of the Act provide employees or their representatives with the opportunity to observe monitoring or measurements (29 U.S.C. 657(c)(3)). Also, section 6(b)(7) of the OSH Act states that, where appropriate, OSHA standards are to prescribe suitable protective equipment to be used in dealing with hazards (29 U.S.C. 655(b)(7)). The provision for observation of monitoring and protection of the observers is also consistent with OSHA's other substance-specific health standards such as those for cadmium (29 CFR 1910.1027) and methylene chloride (29 CFR 1910.1052).

In his testimony, Shawn Ragle of UAW Local 974, in responding to Rebecca Reindel of AFL-CIO, described the importance of allowing the observation of monitoring:

> MS. REINDEL: . . . Mr. Ragle, you mentioned that there's limited air monitoring in your plant. I was wondering, as a safety rep, have you ever been allowed to observe the air monitoring that has been done?
>
> MR. RAGLE: . . . Actually, I've requested to be an observer for air monitoring, and the company has denied me that access. They've chosen to go with the employee that they put the monitor on.
>
> Really, if you're doing your job, how are you going to monitor your monitor to make sure everything is going correctly? I really think that we need to have a little more voice, or at least some validation that the monitoring is being done correctly.
>
> We shouldn't put that on the employee wearing the monitor (Document ID 3582, Tr. 1895-1896).

Similarly, James Schultz, a former foundry employee from the Wisconsin Coalition for Occupational Safety and Health, testified that he was,

> . . . heartened to see that the proposal mandates that the employer provide protective clothing and equipment at no cost to the observers that are doing the observation and the monitoring of the hazards in the workplace (Document ID 3586, Tr. 3200).

Opposing this requirement, CISC and Hunt Construction Group argued that the provision was unnecessary given that the observer will not be close enough to the silica-generated tasks to pose a risk (Document ID 2319, pp. 87-88; 3442, pp. 4-5). ASA expressed concern about the unnecessary cost of providing protective clothing to an observer (Document ID 2187, p. 5). Similarly, AGCM argued that requiring the employer to provide personal protective equipment and training is an unnecessary additional cost and requirement (Document ID 2265, Attachment 1, p. 2).

Commenters, including the Korte Company and ASA, were also concerned that this requirement burdened the employer with providing the employee's representative with protective clothing or equipment whether or not the representative is trained or qualified to be wearing the required PPE (e.g., medical evaluation or fit test to wear a respirator) (e.g., Document ID 3230, p. 1; 2187, p. 5). Commenters, including NTCA and TCNA, asked OSHA to state that it is the responsibility of the employer of the employee's representative to provide the necessary respirator and ensure that the employee's representative is medically cleared, appropriately trained, and fit tested if a respirator is needed to observe the monitoring (e.g., Document ID 2267, p. 5; 2363, p. 5). NAHB argued that this provision is "neither reasonable nor prudent" as it "needlessly impos[es] liability on covered employers by requiring them to assume responsibility for an 'observer' who may come onto a jobsite where silica may be present" (Document ID 2296, p. 25). AGCM argued that the observer's employer is already required to provide the necessary personal protective equipment and training, not the employer being observed (Document ID 2265, Attachment 1, p. 2).

Section 8(c)(3) of the OSH Act states that occupational safety and health standards which require employers to monitor or measure employee exposure to potentially toxic materials "shall provide employees or their representatives with an opportunity to observe such monitoring or measuring.” Provisions requiring employers to provide affected employees or their designated representatives an opportunity to observe any monitoring, as well as protective clothing or equipment where it is required, appear in 15 substance-specific health standards. Two substance-specific health standards (1,3-butadiene and methylene chloride) require employers to “provide the observer with protective clothing or equipment at no cost” (§1910.1051(d)(8)(ii) and §1910.1052(d)(6)(ii)), as does this rule for respirable crystalline silica.

OSHA's policy conclusion is that employers conducting monitoring must bear the cost of complying with the standard’s provisions for observer protections, even if the observer is not an employee of the employer. First, the Agency concludes that it would be an extremely rare occurrence for an observer to be unfamiliar with the use of the types of protective clothing or equipment that would be necessary for observation. In OSHA's experience, observers, whether they are another employee or a designated representative, typically have knowledge and experience such that they would already be medically cleared to use appropriate respiratory protection and may even have access to an appropriate respirator. Thus, OSHA expects the employer conducting the monitoring in these situations to communicate with the observer about what hazards are present in the workplace and what protective clothing and equipment, including medical clearances, are needed to observe the monitoring at their establishment. OSHA also expects the employer to assess whether the observer already has the necessary equipment and training to observe the monitoring. In situations where the necessary equipment is not already available to the observer, OSHA considers it to be the employer's responsibility to provide the protective clothing and equipment, as well as other training, clearance, or evaluation needed to ensure that the observer uses such clothing and equipment.

Second, OSHA recognizes that, in some situations, observers may not need to enter an area requiring the use of protective clothing or equipment in order to effectively observe monitoring. In those cases, no protective clothing or equipment is needed by the observer and OSHA would not expect or require the employer to provide such observer with any protective clothing or equipment. Some possible options to avoid exposing the observer to hazards that require the use of protective clothing or equipment include conducting the set-up for the monitoring outside of hazardous areas and ensuring that the observer can view the monitoring while remaining outside of the hazardous areas or, where exposure to respirable crystalline silica is the only hazard requiring the use of protective clothing or equipment, conducting the set-up for monitoring before the exposure-generating task is performed and ensuring that the observer can view the monitoring while remaining outside of the area of exposure.

Third, OSHA finds that employers conducting monitoring are in the best position to understand the hazards present at the workplace, including the protective clothing and equipment needed to protect against those hazards and the training, clearance, or evaluation needed to ensure that the observer is protected from those hazards. OSHA concludes that employers' familiarity with the worksite, the work, and their employees puts them in the best position to conduct exposure monitoring in a timely, effective, and safe manner. Therefore, OSHA appropriately requires the employer to bear the responsibility for ensuring that any observer in his or her establishment is adequately protected.

OSHA thus decided that employers conducting monitoring are responsible for the full costs of protecting observers, by providing the necessary equipment as well as any training, clearance, or evaluation needed to properly use the equipment, regardless of whether the observers are employees or designated representatives.

The requirements for exposure assessment in the rule are consistent with ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica, and ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities, the national consensus standards for controlling occupational exposure to respirable crystalline silica in general industry and in construction, respectively. Each of these voluntary standards has explicit requirements for exposure assessment. For general industry, the ASTM standard includes requirements for: initial sampling; periodic sampling; sampling and analytical methods; observation of monitoring; and notification of assessment results. Similarly, for construction, the ASTM standard includes requirements for: initial sampling; reassessment of exposures when changes have the potential to result in new or additional exposures; sampling and analytical methods; and notification of assessment results. It also notes the challenges of monitoring in a dynamic construction environment and suggests that employers may also use a combination of historical data, objective data, or site-specific employee exposure monitoring to assess exposures.

While OSHA's standard for respirable crystalline silica includes these elements, it includes a performance-oriented approach to exposure assessment that best reflects the realities of assessing exposures to respirable crystalline silica. The standard also includes a scheduled approach, which provides specific requirements for initial and periodic monitoring, for industries and tasks that can utilize such an option. Including both of these options maximizes the flexibility for employers to meet their exposure assessment obligations, and in doing so, better effectuates the purposes of the OSH Act and protects employees from exposures to respirable crystalline silica. OSHA thus concludes that the exposure assessment provision in the rule achieves the important purpose of assessing employee exposure, while providing sufficient flexibility for employers.

Regulated Areas

Paragraph (e) of the standard for general industry and maritime sets forth the requirements for regulated areas. In paragraph (e)(1), employers are required to establish regulated areas wherever an employee's exposure to airborne concentrations of respirable crystalline silica is, or can reasonably be expected to be, in excess of the permissible exposure limit (PEL). In paragraph (e)(2) and (e)(3), employers must demarcate regulated areas, and limit access to regulated areas to persons authorized by the employer and required by work duties to be present in the regulated area, persons observing exposure monitoring, or any person authorized by the Occupational Safety and Health (OSH) Act or regulations issued under it to be in a regulated area. Finally, paragraph (e)(4) requires employers to provide each employee and the employee's designated representative entering a regulated area with an appropriate respirator and require its use while in the regulated area.

The requirements for regulated areas serve several important purposes. First, requiring employers to establish and demarcate regulated areas ensures that the employer makes employees aware of the presence of respirable crystalline silica at levels above the PEL. Second, the demarcation of regulated areas must include warning signs describing the dangers of respirable crystalline silica exposure in accordance with paragraph (j) of the standard for general industry and maritime, which provides notice to employees entering or nearing regulated areas of the posted dangers. Third, limiting access to regulated areas restricts the number of people potentially exposed to respirable crystalline silica at levels above the PEL and ensures that those who must be exposed are properly protected, thereby limiting the serious health effects associated with such exposure.

The proposed requirements for regulated areas were included in paragraph (e) of both the proposed standard for general industry and maritime and the proposed standard for construction. Under proposed paragraph (e)(1), employers would have been required to establish and implement either a regulated area or an access control plan wherever an employee’s exposure to airborne concentrations of respirable crystalline silica is, or reasonably could be expected to be, in excess of the PEL. The substantive requirements for the regulated area option were contained in proposed paragraph (e)(2) and those for access control plans were in proposed paragraph (e)(3). In the standard for general industry and maritime, OSHA has retained the requirement for employers to establish and implement regulated areas. However, the Agency has decided against requiring regulated areas in the standard for construction; an alternate provision has been included as a component of the written exposure control plan requirements for construction.

OSHA has concluded that requirements for regulated areas are appropriate for general industry and maritime, but not for construction, because the worksites and conditions and other factors, such as environmental variability normally present in the construction industry, differ substantially from those typically found in general industry. Commenters, including the National Council of La Raza, the National Institute for Occupational Safety and Health (NIOSH), the Associated General Contractors of America, the Small Business Administration’s Office of Advocacy, and the Building and Construction Trades Department, AFL-CIO (BCTD), noted some of the differences between construction and general industry worksites, including that general industry establishments are typically more stable, are likely to be indoors, and are usually at a fixed location (e.g., Document ID 2166, p. 3; 2177, Attachment B, p. 7; 2323, p. 1; 2349, pp.

5-6; 2371, Attachment 1, p. 42). OSHA finds that these factors make establishing regulated areas generally suitable in general industry and maritime workplace settings, and their absence in construction settings makes a regulated areas requirement generally unworkable.

Some commenters, particularly those representing unions in general industry, supported the idea of regulated areas wherever an employee's exposure to airborne concentrations of respirable crystalline silica is, or reasonably could be expected to be, in excess of the PEL (e.g., Document ID 2282, Attachment 3, p. 2; 2315, p. 3; 2318, p. 10). For example, the International Brotherhood of Teamsters stated that ancillary provisions, such as regulated areas, would reduce the risk beyond the reduction that will be achieved by a new PEL alone (Document ID 2318, p. 10). Similarly, the United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) expressed concerns that workers would not receive adequate protection if OSHA did not adopt a requirement for regulated areas in general industry (Document ID 2282, Attachment 3, pp. 2, 16). The United Steelworkers said that OSHA's proposed general industry and maritime standard should be revised to require employers to establish regulated areas where processes exceed the proposed PEL for respirable crystalline silica (Document ID 2336, p. 5).

Other general industry stakeholders argued that establishing regulated areas would be unworkable and infeasible, particularly in foundries (Document ID 1992, p. 10; 2149, p. 2; 2248, p. 7; 2349, p. 5; 2379, Attachment B, pp. 30-31; 3584, Tr. 2669) and in certain other sectors of general industry (Document ID 1785, p. 6; 2337, p. 1; 2348, p. 36; 2380, Attachment 2, pp. 32-33). Some of these commenters focused on how an employer would be able to determine which parts of the facility should be designated as regulated areas. For example, the American Foundry Society (AFS) indicated that defining a regulated area would be difficult because the standard is based on employee 8-hour time weighted average (TWA) exposures, not on specific geographic areas (Document ID 2379, Attachment B, pp. 30-31). AFS explained that "[i]f the standard allowed real time monitoring and exposure mapping as an alternative to 8 hr. TWA sampling, one might be able to construct a basis for defining regulated areas" (Document ID 2379, Attachment B, pp. 30-31). AFS offered a specific example to illustrate its concern:

> . . . a maintenance worker who has an exposure above the PEL may work in many areas of the plant including the office. It does not make sense to turn the office into a regulated area because the maintenance worker spent some time there on the day of sampling (Document ID 2379, Attachment B, pp. 30-31; 3487, p. 21).

The scenario described by AFS is not consistent with the definition of the term "regulated area" that OSHA proposed nor that of the final standard. Paragraph (b) of the proposed and final standard for general industry and maritime defines regulated area to mean "an area, demarcated by the employer where an employee's exposure to airborne concentrations of respirable crystalline silica exceeds, or can reasonably be expected to exceed, the PEL." This definition makes clear that a regulated area is defined by employee exposure, not by which employee(s) might be in it. In other words, just because a particular employee's exposure assessment results indicate that the employee's exposure is above the PEL, that does not mean that employee exposure in every area that the employee visited on the day he or she was sampled exceeds, or can reasonably be expected to exceed, the PEL.

In the scenario posed by AFS, the employer would be required by paragraph (d)(1) of the standard for general industry and maritime to assess the exposure of each employee who is, or may reasonably be expected to be, exposed to respirable crystalline silica at or above the action level in accordance with either the performance option (i.e., use of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposure) or the scheduled monitoring option (i.e., one or more personal breathing zone air samples). As explained in the summary and explanation of Exposure Assessment, if real time monitoring and exposure mapping, the methods suggested by AFS, allow an employer to accurately characterize employee exposures, then the employer would be allowed to use such methods to assess employee exposures under the performance option. This exposure information would also be helpful in determining where higher exposures may be occurring.

If an employee's exposure is above the PEL, paragraph (f)(1) of the standard for general industry and maritime would require the employer to use engineering and work practices to reduce and maintain employee exposure to respirable crystalline silica. In order to control exposures, the employer would need to determine where the exposures are generated. As explained by Dr. Franklin Mirer, Professor of Environmental and Occupational Health at CUNY School of Public Health, during his testimony on behalf of the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), setting up a regulated area in a foundry is not complicated—employers must simply determine the extent of the dust cloud, possibly using measures like short-term or real-time monitoring or exposure mapping (Document ID 3578, Tr. 1003-1005).

Dr. William Bunn, who testified on behalf of the U.S. Chamber of Commerce, also offered testimony that suggests that some foundries are capable of establishing regulated areas. In response to questioning during the public hearings, Dr. Bunn spoke about the efficacy of OSHA inspections for aiding foundries in reducing silica exposures. Based on his experience as an employee of Navistar International and as a consultant to multiple automotive engine foundries, Dr. Bunn stated that there was no feasible way to attain compliance with the proposed PEL without using respiratory protection. However, Dr. Bunn emphasized that this occurred at certain specific, restricted areas that could be easily observed (Document ID 3576, Tr. 473). OSHA concludes from this testimony that where exposures above the PEL occur in foundries, they typically occur in limited areas that can be readily identified, and the provisions for establishment, demarcation, access restriction, and provision of respirators can be applied.

Edison Electric Institute stated that, given requirements for establishing regulated areas in other OSHA substance-specific standards, OSHA should consider creating uniform provisions for regulated areas, to minimize the complications that arise when multiple regulated substances begin to “stack” in one regulated area (Document ID 2357, pp. 32-33). OSHA recognizes that standards for asbestos, benzene, cadmium, chromium (VI), 13 carcinogens, methylenedianiline, and others also contain requirements for regulated areas; however, these requirements are not in conflict with one another. Where an employer establishes a regulated area for multiple substances, the employer can and must comply with the requirements for each applicable standard for that regulated area. Persons allowed access to the regulated area include employees who are performing tasks required by work duties subject to the regulated area requirements of another standard even if that exposure (e.g., to asbestos) is unrelated to tasks that generate silica exposures. But this would be a very uncommon scenario – for the most part, multiple standards apply when exposures to multiple hazardous substances result from a single source, e.g., fly ash in electric utilities contains lead, chromium (VI), silica, etc.

Other general industry commenters felt that regulated areas were unnecessary. For example, Morgan Advanced Materials asserted that regulated areas or access control programs may be appropriate for areas where the conditions may cause an immediate health effect or injury, but are not appropriate for chronic hazards like respirable crystalline silica, especially since “. . . nearly everyone is exposed to some level of crystalline silica on a daily basis” (Document ID 2337, pp. 1-2). OSHA rejects Morgan Advanced Materials’ position because, unlike "everyone" who is exposed to background levels, employees who are exposed to respirable crystalline silica at levels exceeding the revised PEL are at significant risk of developing silica-related disease; this risk cannot be ignored simply because silica exposure does not cause an immediate death or injury. Regulated areas are an effective means of limiting the risk associated with respirable crystalline silica exposure, and are therefore appropriate for protecting employees.

Paragraph (e)(2) of the standard for general industry and maritime includes requirements for demarcation of regulated areas. The proposed provision on demarcation would have required employers to demarcate regulated areas from the rest of the workplace in any manner that adequately establishes and alerts employees to the boundary of the regulated area. The proposed provision also stipulated that the demarcation minimize the number of employees exposed to respirable crystalline silica within regulated areas. In the proposed rule, OSHA did not specify how employers were to demarcate regulated areas. In the standard for general industry and maritime, because the Agency has adopted requirements for posting signs, OSHA has removed the language "in any manner that adequately establishes and alerts employees to the boundary of the regulated area."

A number of stakeholders submitted comments on the proposed provision. For example, the AFL-CIO argued that other health standards that regulate carcinogens require warning signs at regulated areas, and that OSHA provided no justification for departing from this precedent (Document ID 4204, pp. 56-57). Many other stakeholders were supportive of warning sign requirements and submitted specific language for inclusion on signs that demarcate regulated areas (Document ID 2163, Attachment 1, p. 15; 2178, pp. 2-3; 2282, Attachment 3, p. 25; 2310, Attachment 2, p. 1; 2371, Attachment 1, p. 36; 2373, p. 2; 3582, Tr. 1920-1921; 4030, Attachment 1, p. 3; 4030, Exhibit D; 4073, Exhibit 15b, p. 18). For example, BCTD and the

International Union of Operating Engineers encouraged OSHA to review the discussion of regulated areas in Ontario's Guideline on Silica Construction Projects with respect to ropes and barriers (Document ID 4073, Attachment15b; 4234, Attachment 2, p. 57). Ontario's Guideline states that:

> Ropes or barriers do not prevent the release of contaminated dust or other contaminants into the environment. However, they can be used to restrict access of workers who are not adequately protected with proper PPE, and also prevent the entry of workers not directly involved in the operation. Ropes or barriers should be placed at a distance far enough from the operation that allows the silica-containing dust to settle. If this is not achievable, warning signs should be posted at the distance where the silica-containing dust settles to warn that access is restricted to persons wearing PPE (Document ID 4073, Ex.15b).

Others identified particular topics that should be covered by the signs without proposing language. For example, Upstate Medical University argued that all regulated areas should have warning signs addressing the hazards of silica dust (Document ID 2244, p. 4).

As is further explained in the summary and explanation of Communication of Respirable Crystalline Silica Hazards to Employees, OSHA agrees with these commenters with respect to the requirement for warning signs at entrances to regulated areas. Employees must recognize when they are entering a regulated area, and understand the hazards associated with the area, as well as the need for respiratory protection. Signs are an effective means of accomplishing these objectives. Therefore, OSHA has included a requirement that employers are obligated to post all entrances to regulated areas with signs that bear the following legend:

DANGER

RESPIRABLE CRYSTALLINE SILICA

MAY CAUSE CANCER

CAUSES DAMAGE TO LUNGS

WEAR RESPIRATORY PROTECTION IN THIS AREA

AUTHORIZED PERSONNEL ONLY

The rulemaking record also indicates that use of signs is also consistent with general industry practices. For example, a plan developed by the National Service, Transmission, Exploration, and Production Safety Network (STEPS Network) for the hydraulic fracturing industry recommends signs to warn of potential silica exposure and the requirement for respirator use near exposure zones (Document ID 4024, Attachment 1, p. 1; Attachment 2, p. 1).

The Unified Abrasives Manufacturers Association argued that demarcation of regulated areas would require the construction of a complete physical separation between the regulated area and adjacent areas (Document ID 3398, p. 1). Aside from the requirement of specific language for posting signs, however, the standard does not specify the method of demarcation; cones, stanchions, tape, barricades, lines, or textured flooring may each be effective means of demarcating the boundaries of regulated areas. As in the proposed rule, therefore, so long as the demarcation is accomplished in a manner that minimizes the number of employees exposed to respirable crystalline silica within the regulated area, the employer will be in compliance, without necessarily installing a complete physical separation in the workplace.

Factors that OSHA considers to be appropriate considerations for employers when they are determining how to demarcate regulated areas include the configuration of the area, whether the regulated area is permanent, the airborne respirable crystalline silica concentration, the number of employees in adjacent areas, and the period of time the area is expected to have exposure levels above the PEL. Permitting employers to choose how best to demarcate regulated areas is consistent with OSHA's use of performance-based approaches where the Agency has determined that employers, based on their knowledge of the specific conditions of their workplaces, are in the best position to make such determinations.

The flexibility of this provision aims to address some of the concerns identified by commenters. For example, National Electrical Carbon Products commented that:

> The concept seems to be that there are hazardous areas where access must be restricted. In reality: there are hazardous exposures, where exposures must be controlled . . . Exposure to airborne crystalline silica, on the other hand, is most typically associated with intermittent activities that are not necessarily associated with a location (Document ID 1785, p. 6).

OSHA understands that for certain work processes, exposure may indeed be associated with an intermittent activity rather than a fixed location. In such cases where silica-generating activities are conducted only sporadically, employers may elect to demarcate a regulated area by means of movable stanchions, portable cones, barricade tape, and the like, as long as the required warning sign with prescribed hazard language is posted at all entrances to each regulated area. Similarly, in a case where work activity migrates to different areas of a worksite, these movable forms of demarcation could likewise be repositioned to indicate the regulated area as work progresses. This flexibility should also help employers with open-design facilities establish regulated areas when needed.

A few commenters expressed concern that provisions for demarcation of regulated areas may interfere with heat stress programs currently in place as well as the current sanitation standard in general industry (29 CFR 1910.141) (Document ID 2379, Appendix 1, p. 59; 3577, Tr. 751-752; 3586, Tr. 3370). The AFS stated that:

> Foundries often have areas with high heat exposures and encourage workers to drink water. The proposal [is] not clear on hygiene rules for regulated areas. The final rule must not be drafted in a way that could be interpreted to ban drinking water in a regulated area (Document ID 2379, Appendix 1, p. 59).

OSHA's standards addressing sanitation in general industry and maritime with respect to consumption of food and beverages are unchanged by this rulemaking. The standards in paragraphs 29 CFR 1910.141(g)(2) and 1917.127(c) prohibit consumption of food or beverage in any area exposed to a toxic material. OSHA appreciates the importance of providing access to drinking water, particularly in hot work environments, and recognizes that in many cases employees will need access to drinking water in order to remain hydrated. However, as explained in more detail below, paragraph (e)(4) of the standard for general industry and maritime requires all employees within the demarcated boundaries of a regulated area to wear a respirator continually while in the area, and thereby the consumption of water within boundaries of a regulated area is not feasible. An employee will need to leave the regulated area temporarily to access water and food, in accordance with OSHA's sanitation standards.

Paragraph (e)(3) of the standard for general industry and maritime requires employers to limit access to regulated areas. As in the proposed rule, employers are required to limit access to: (A) persons authorized by the employer and required by work duties to be present in the regulated area; (B) any person entering such an area as designated representatives of employees for the purpose of exercising the right to observe exposure monitoring procedures under paragraph (d) of this section; and (C) any person authorized by the OSH Act or regulations issued under it to be in a regulated area.

The first group, persons the employer authorizes or requires to be in a regulated area to perform work duties, includes employees and other persons whose jobs involve operating machinery, equipment, and processes located in regulated areas; performing maintenance and repair tasks on machinery, equipment, and processes in those areas; conducting inspections or quality control tasks; and supervising those who work in regulated areas. Persons allowed access to the regulated area include employees who are performing tasks required by work duties subject to the regulated area requirements of another standard even if that exposure is unrelated to tasks that generate silica exposures.

The second group is made up of persons entering a regulated area as designated representatives of employees for the purpose of exercising the right to observe exposure monitoring under paragraph (d) of the standard for general industry and maritime. As explained in the summary and explanation of Exposure Assessment, providing employees and their representatives with the opportunity to observe monitoring is consistent with the OSH Act and OSHA's other substance-specific health standards, such as those for cadmium (29 CFR 1910.1027) and methylene chloride (29 CFR 1910.1052).

The third group consists of persons authorized by law to be in a regulated area. This category includes persons authorized to enter regulated areas by the OSH Act, OSHA regulations, or any other applicable law. OSHA compliance officers fall into this group.

Some commenters expressed concerns about restricting access to regulated areas. For example, OSCO Industries argued that control of ingress and egress from regulated areas would be very problematic because of high traffic volumes, indicating, for example, that it may be necessary to reroute pedestrian and fork truck traffic outside the building in order to avoid the regulated area (Document ID 1992, p. 10). Similarly, a representative of the Non-Ferrous Founders' Society (NFFS) testified that smaller foundries would experience difficulty in establishing and restricting access to regulated areas (Document ID 3584, Tr. 2814).

Other commenters indicated that restricted areas were already in place at their workplaces. For example, Kenny Jordan, Executive Director of the Association of Energy Service Companies, testified that restricted areas with limited access are already used in hydraulic fracturing operations (Document ID 3589, Tr. 4066-4067). Mr. Jordan went on to describe how the presence of these restricted areas is communicated to other employees on the multiemployer worksite (Document ID 3589, Tr. 4079-4080).

OSHA finds that requirements for establishing and limiting access to regulated areas are reasonable and generally feasible for general industry and maritime workplaces. With regard to the concerns expressed by OSCO Industries about rerouting traffic to avoid regulated areas, the intent of the standard is to restrict unnecessary pedestrian and vehicle traffic in areas where exposures exceed the PEL; employees who would otherwise be exposed when traversing the regulated area will thus be better protected. Where work duties require these employees to enter the regulated area, the standard provides for access, with appropriate respiratory protection. OSHA also considers that the exposure assessment performed in accordance with paragraph (d) of the standard for general industry and maritime will provide a basis for establishing the boundaries of the regulated area, and thus establishment of regulated areas will not be as problematic as NFFS suggests.

Paragraph (e)(4) of the standard for general industry and maritime requires employers to provide each employee and the employee's designated representative entering a regulated area with an appropriate respirator in accordance with paragraph (g) of the standard. The provision also mandates that employers require each employee or employee representative to use the respirator while in the regulated area. The provision in the standard requiring use of respirators in regulated areas is identical to the proposed provision. The boundary of the regulated area indicates where respirators must be donned prior to entering, and where respirators can be doffed, or removed, upon exiting the regulated area. This provision was intended to establish a clear and consistent requirement for respirator use for all employees who enter a regulated area, regardless of the duration of their presence in the regulated area.

OSHA received comments from stakeholders in both construction and general industry, generally opposing this requirement (e.g., Document ID 1785, p. 7; 2267, p. 5; 2291, p. 25; 2296,

p. 26; 2319, p. 90; 2348, p. 36; 2363, p. 5; 2380, Attachment 2, pp. 32-33; 3577, Tr. 752; 3586, Tr. 3408-3417). For example, the National Association of Home Builders (NAHB) stated that the proposed requirements were overly restrictive because respiratory protection would be required even when risks are low, such as when an employee was in a regulated area for a very short period of time (Document ID 2296, p. 30). Several commenters representing general industry entities also expressed similar concerns with respect to increases in respirator usage (e.g., Document ID 1785, p. 7; 2291, p. 25; 2337, p. 1; 2348, p. 36; 2380, Attachment 2, pp. 32-33; 4229, p. 25). The Asphalt Roofing Manufacturers Association (ARMA) indicated that the proposed requirement for respirator use would place a significant and unnecessary burden on ARMA member companies (Document ID 2291, p. 25). The National Association of Manufacturers (NAM) recommended that OSHA should limit requirements for respirator use to situations where entry into the regulated area will be of such frequency and duration as to constitute a hazard (Document ID 2380, Attachment 2, pp. 32-33). National Electrical Carbon Products also expressed concerns about the requirements for respirators in regulated areas, and encouraged the adoption of a time specification. They argued that the proposed requirement was inconsistent with the concept of the 8-hour TWA PEL (Document ID 1785, p. 7).

After reviewing these comments, OSHA has decided to retain the requirement for employers to provide and require the use of respirators in regulated areas in the standard for general industry and maritime. Although OSHA recognizes that some employees entering regulated areas may not be exposed above the PEL (expressed as an 8-hour TWA), many employees who are assigned to work in these areas may remain in these locations for long enough periods of time so that they would be needlessly overexposed to respirable crystalline silica if they did not wear respirators. Furthermore, OSHA finds that allowing some employees to work in regulated areas without respiratory protection, while requiring it for others, would create confusion and compliance difficulties in the workplace. To the extent that some employees in regulated areas who may not be exposed on a particular day above the PEL are nonetheless required to wear respirators, this time-limited use of respirators should further reduce the significant risk that remains at the PEL.

In the proposed rule, OSHA also included a provision related to protective work clothing. Proposed paragraph (e)(2)(v)(A) would have required employers to either provide protective clothing or provide other means of removing excessive silica dust from contaminated clothing. Under proposed paragraph (e)(2)(v)(B), employers would have been required to ensure that clothing was removed or cleaned upon exiting a regulated area when there was potential for employees' clothing to become "grossly contaminated" by fine particles of crystalline silica that could become airborne and inhaled. The purpose was not to protect employees from dermal exposure to silica, but rather to protect the employee from those situations wherein contamination of clothing has the potential to contribute significantly to employee inhalation of respirable crystalline silica.

The proposed provision for protective clothing was more limited than similar provisions in other OSHA substance-specific standards. As noted in the preamble of the Notice of Proposed Rulemaking OSHA limited the proposed provision for protective clothing to regulated areas because dermal exposure to crystalline silica is not associated with adverse health effects. Nonetheless, OSHA solicited information from stakeholders regarding protective clothing for respirable crystalline silica, largely because a provision for protective clothing had been recommended by the Agency's Advisory Committee on Construction Safety and Health.

Several employees in silica-exposed industries described the extent of contamination to their clothing by silica dust and how this dust would even be brought home with them (Document ID 3571, Attachment 7, p. 1; 3581, Tr. 1595, 1599-1600; 3582, Tr. 1840). OSHA heard testimony from Dan Smith, Director of Training for the Bay Area Roofers and Waterproofers Training Center in Livermore, California and member of the National Curriculum Development Committee of the United Union of Roofers, Waterproofers and Allied Workers, which represents roughly 25,000 workers. Mr. Smith said:

> Some years back, one of my members walked into my office with a very unusual object: a plumbing trap. [He] handed it to me. First thing I noticed, it was pretty heavy, two to three pounds. He said, ‘That's from my shower at home.’ At the time, he had been in the tile industry, cutting tile for about 10 years. He said, ‘My drain kept getting clogged. No matter what I put in there, I couldn't get it unclogged. I called the plumber. He couldn't get it unclogged. He took it off. I looked inside. It was filled with . . . what I would call reconstituted cement.’ This came off of his body (Document ID 3581, Tr. 1599-1600).

UAW Local 523 President Jeff P’Poole spoke about making silicon metal out of granite with an electric arc furnace reduction process, “. . . people come out with like raccoon eyes . . . you'll look like a coal miner at times . . .” (Document ID 3582; Tr. 1840). Construction employee Santiago Hernandez testified that employees often have to throw away their work clothing because dust remains embedded even after washing the clothes (Document ID 3571, Attachment 7, p. 1).

OSHA received comments supporting a requirement for employer provision of work clothing, or storage, handling, removal and cleaning responsibilities for contaminated work clothing (Document ID 2212, p. 2; 2256, Attachment 2, p. 11; 2277, p. 4; 2310, Attachment 1, pp. 2-4; 2315, p. 9; 3586, Tr. 3199-3200). For example, the International Safety Equipment Association requested that OSHA require employers to provide protective garments at no cost to the employee, indicating that this would be consistent with other OSHA standards that require employers to pay for personal protective equipment (Document ID 2212, p. 2).

However, numerous comments received on the provision for protective work clothing in regulated areas were opposed to OSHA's proposed requirement for employers to either provide protective clothing or other means of removing excessive silica dust from contaminated clothing, and to ensure that clothing is removed or cleaned upon exiting a regulated area when there is potential for employees' clothing to become grossly contaminated by silica dust (Document ID 1785, p. 8; 2116, Attachment 1, p. 11; 2187, p. 6; 2195, p. 7; 2296, p. 40; 2319, pp. 90-91; 2337, p. 2; 2339, p. 8; 2357, pp. 29-30; 2363, p. 6; 3577, Tr. 713-714; 3580, Tr. 1376-1377; 3584, Tr. 2669; 4035, p. 9). Many contended that the language in the provision was vague or subjective. For example, the Tile Council of North America, the National Tile Contractors Association, and Morgan Advanced Materials argued that the term "*grossly*" is subjective, and its use in this context would subject the employer to the whim of the compliance inspector (Document ID 2267, p. 6; 2363, p. 6; 2337, p. 2).

The American Society of Safety Engineers (ASSE) indicated that no special clothing should be required, as crystalline silica does not present a hazard from skin contact. Instead, ASSE suggested that employers need to implement programs to assure employees whose clothing is contaminated with crystalline silica do not create exposure issues outside of the workplace (Document ID 2339, p. 8). NAHB argued that protective clothing such as coveralls would be difficult for workers in residential construction to use because coveralls frequently restrict movement, are often not durable enough for the conditions encountered in construction, and could contribute to heat stress (Document ID 2296, p. 40).

The evidence regarding the extent to which dust-contaminated clothing may exacerbate employee exposure to respirable crystalline silica is mixed. NIOSH stated that past studies have shown a significant increase in workers' respirable dust exposure from contaminated work clothing, referencing a Bureau of Mines study involving highly-exposed machine operators bagging mineral products into paper bags (Document ID 2177, Attachment B, p. 15). On the other hand, the National Industrial Sand Association (NISA) stated that:

> NISA member companies have years of experience conducting root cause analyses of exceedances of the PEL. In that experience, contaminated work clothing can be the source of such an exceedance, but such circumstances are uncommon (Document ID 2195, p. 37).

OSHA agrees that contaminated work clothing can contribute to respirable dust exposures in some circumstances, as NIOSH indicated. However, OSHA concludes that the evidence in the rulemaking record does not show that contaminated work clothing contributes appreciably to employee exposures to respirable crystalline silica in workplace conditions covered by this rule. OSHA is therefore not including a requirement for protective clothing in the rule because it is unable to determine that the use of protective clothing would provide appreciable protection from inhalation of respirable crystalline silica in most circumstances. OSHA understands that many of the activities covered under the rule involve generation of substantial amounts of dust. However, the dust of concern in this rulemaking is composed only of respirable crystalline silica particles – those particles small enough to penetrate deep into the lungs. OSHA proposed protective clothing requirements in regulated areas in an attempt to focus on those areas in the workplace where high exposures to respirable crystalline silica occur. However, it is not clear that measures to address dust on employees' clothing are likely to have any meaningful effect on exposures to respirable crystalline silica in most workplaces covered by the rule.

Protective clothing is primarily designed to mitigate against dermal hazards, which are not the problem here; nor is dermal exposure (as opposed to respiratory exposure) the mechanism by which silica causes its adverse health effects. Therefore, special or employer-provided protective clothing would be no more protective than ordinary clothing in this context. Moreover, OSHA understands the practical difficulty that employers would encounter in attempting to determine when clothing is sufficiently contaminated to trigger a requirement for protective measures. Therefore, OSHA has not included a requirement for employers to provide protective work clothing or other means of removing silica dust from clothing in the rule. There may be instances where providing protective clothing or other means of removing excessive silica dust from clothing are feasible methods of limiting employee exposures to respirable crystalline silica; in such cases, these methods become an option for complying with the requirement to limit employee exposures to the PEL.

OSHA has also decided not to include the proposed option to establish and implement an access control plan in lieu of a regulated area in the rule. As noted above, paragraph (e)(1) of the proposed standards for general industry/maritime and construction would have required the establishment and implementation of either a regulated area or an access control plan wherever an employee’s exposure to airborne concentrations of respirable crystalline silica is, or reasonably could be expected to be, in excess of the PEL. OSHA recognized that establishing regulated areas in some workplaces might be difficult. As such, the Agency proposed an option for establishing and implementing a written access control plan in lieu of a regulated area.

The option for a written access control plan contained provisions for: a competent person to identify the presence and location of areas where respirable crystalline silica exposures exceed the PEL; notifying employees and demarcating such areas; communicating with other employers on multi-employer worksites; limiting access to areas where exposures exceed the PEL; providing respirators; and addressing measures regarding contaminated work clothing. The proposed rule also included a requirement for an annual employer review and evaluation of the written access control plan, and the plan was to be made available upon request for examination and copying to employees, their representatives, and the Assistant Secretary and the Director.

The intent of the provision for establishing written access control plans in lieu of regulated areas was to provide employers with flexibility to adapt to the particular circumstances of their worksites while maintaining equivalent protection for employees. The option for establishing a written access control plan was thought to be best suited for changing or mobile worksites such as those found in construction and utilities.

The North American Insulation Manufacturers Association supported the option for a written access control plan, claiming that it is similar to current mineral wool industry practices for limiting access (Document ID 2348, p. 36). The National Concrete Masonry Association and approximately five of its member companies stated that access control plans may be effective for tasks in which personal protective equipment is needed (e.g., mixer cleaning), but not for operations that cannot be performed in a controlled, limited areas (e.g., general plant clean-up) (e.g., Document ID 2279, p. 10; 2388, p. 9).

Commenters including American Subcontractors Association (ASA), Leading Builders of America (LBA), NAHB, and the Construction Industry Safety Coalition (CISC), thought that a written access control plan was impractical in the construction industry, stating reasons such as uncertainty about its requirements or how such plans would differ from a regulated area (e.g., Document ID 2187, p. 5; 2269, p. 22; 2296, pp. 25-26; 2319, pp. 88-89). Additionally, the Communication Workers of America (CWA), UAW, and AFL-CIO felt that, given issues of enforceability, it did not appear the written access control plan would adequately protect workers and limit access to high-exposure work areas. Thus, CWA, UAW, and AFL-CIO recommended elimination of the option for a written access plan, and for the provision to be limited to a regulated areas requirement only (Document ID 2240, p. 2; 2282, Attachment 3, p. 16; 3578, Tr. 924-925). Fann Contracting, Inc. indicated that neither written access control plans nor regulated areas were conducive to outdoor, heavy highway and road and bridge construction where the entire worksite has potential for silica exposure (Document ID 2116, Attachment 1, pp. 26-27).

OSHA concludes that the option for a written access control plan may prove less protective and would be difficult to enforce, so has decided not to include the option for employers to develop and maintain written access control plans in lieu of regulated areas in the rule. OSHA no longer views a written access control plan to be a viable substitute for establishment and maintenance of regulated areas in the rule, especially in light of its decision not to include a regulated areas requirement in the standard for construction. The requirement for a competent person in paragraph (g)(4) of the standard for construction provides an alternate approach to restricting access to areas where high exposures can occur, and OSHA’s expectation is that it will achieve a comparable level of protection without imposing the burden of maintaining a written access control plan.

The decision not to require regulated areas in the standard for construction reflects OSHA's acknowledgment of the impracticality of establishing and demarcating regulated areas in many construction industry workplaces. However, as described in further detail in the summary and explanation of Written Exposure Control Plan, OSHA has concluded that implementing a written exposure control plan, which includes a requirement to describe procedures to restrict access to work areas, is practical in construction industry workplaces.

OSHA notes that a written access control plan as contemplated in the proposed rule is different from a written exposure control plan as mandated in the rule. Written exposure control plans are included in the industry consensus standards: ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica and ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities (Document ID 1466, p. 2; 1504, p. 2). OSHA finds that written exposure control plans provide a systematic approach for ensuring proper function of engineering controls and effective work practices that can prevent overexposures from occurring. The ASTM standards do not specifically call for procedures to restrict access; however, they do call for a description of administrative controls to reduce exposures (Document ID 1466, p. 2; 1504, p. 2). An example of such an administrative control for minimizing the number of employees exposed to respirable crystalline silica would be to schedule high-exposure tasks to be conducted when others will not be in adjacent areas (Document ID 3583, Tr. 2385-2386).

Commenters from the construction industry submitted comments on the regulated area option. Some of the comments were generally supportive (Document ID 2169, p. 4; 2177, Attachment B, p. 14; 2262, pp. 43-44; 2339, p. 4). However, other stakeholders felt that OSHA's proposed requirements for regulated areas would be unworkable and infeasible in construction (e.g., Document ID 2116, Attachment 1, p. 13; 2183, pp. 1-2; 2187, p. 5-6; 2269, p. 4; 2276, p. 5; 2319, pp. 89-90; 2323, p. 1; 2338, p. 3; 2345, p. 3). They expressed serious concerns with the proposed provisions for establishing and limiting access to regulated areas, often citing challenges posed by constantly changing work activities, multiple employers on the worksite, lack of employer control in outside construction projects, the possibility of an entire worksite needing to be classified as a regulated area (on small worksites), and the prevalence of silica in the natural environment, particularly in certain regions of the country (e.g., Document ID 2116, pp. 13-14, 22, 27 ; 2183, pp. 1-2 ; 2319, p. 89; 2323, p. 1; 2210, Attachment 1, p. 7; 2187, pp. 5-6; 2246, p. 11; 2269, p. 22; 2296, p. 26; 3230, p. 2). For example, ASA questioned a subcontractor's ability to control the environment on a multiemployer job site, stating:

> . . . even if a trade contractor were to establish a regulated area, it may not be able to limit access or operations by individuals outside of its management or control, particularly in the absence of a representative of a general contractor or construction manager (Document ID 2187, p. 6).

The Interlocking Concrete Pavement Institute indicated that other construction trade workers labor in the same area from 10 to 90 percent of the time, and that efforts by OSHA to restrict access among trades on a job site would result in chaos (Document ID 2246, p. 11). The LBA added that, although OSHA's proposed requirements might be suitable for a single-employer setting where working conditions are somewhat consistent, they were unworkable in the construction industry (Document ID 2269, p. 8).

OSHA received feedback from employee representatives and public health advocates indicating support for a requirement that employers establish and limit access to areas where high exposures may occur in the construction industry (Document ID 2177, Attachment B, p. 14; 2371, Attachment 1, pp. 17-19; 3589, Tr. 4263; 4223, p. 102). For example, the Laborers Health and Safety Fund of North America argued that regulated areas are helpful because they provide a visible indicator that a hazardous area exists for employees in different trades who may be on the worksite but would not otherwise be aware of the potential for exposure to respirable crystalline silica in that area (Document ID 3589, Tr. 4263). NIOSH supported the need to protect workers on a construction site from exposure via regulated areas and/or a written access control plan.

NIOSH also noted the importance of competent persons and how they play an integral role in establishing regulated areas (Document ID 2177, Attachment B, pp. 8-10, 14).

Several commenters representing public health organizations and unions opined that construction employers could implement regulated areas on construction sites without a great deal of difficulty (Document ID 3585, Tr. 3090-3091; 4234, Part 1, pp. 24-25). The American Industrial Hygiene Association (AIHA) suggested how an employer might determine whether a regulated area needs to be established:

> Utilization of the Table 1 as a compliance option when respirators are required means the surrounding area must be considered a regulated area or under an access control plan. This combined with the engineering controls can help address the common problem of adjacent workers being inadvertently exposed to silica particulates. The need for a regulated area or control plan would now be an objective determination by the competent person. This in turn would help identify workers or areas where inadvertent exposure may occur and consequently allow procedures to be implemented to prevent this (Document ID 2169, p. 4).

Other commenters indicated that, to an extent, regulated areas already exist on construction sites. At the public hearings, the Mason Contractors Association of America provided testimony pointing out that a vast majority of masonry work is already carried out in restricted zones, and that access to these zones by other workers is limited. They noted that access to these restricted work zones was ultimately controlled by the general contractor (Document ID 3585, pp. 2933-2934). BCTD noted that Kevin Turner of Hunt Construction Group, testifying on behalf of CISC, indicated that contractors creating a hazard on construction worksites identify their work areas to avoid putting other workers at risk, and explained how different contractors on a multi-employer site routinely establish exclusion zones to exclude other workers from hazardous areas. BCTD argued that there is no reason why such an approach would not work for areas with high silica exposure as well (Document ID 4223, p. 102-105). ASSE indicated that, while the organization recognized the potential value of establishing regulated areas where silica overexposures are anticipated, there may be valid, practical reasons for exempting short-term construction worksites from this requirement as long as alternative worker protections are in place (Document ID 3430, p. 3)

After a review of these comments submitted on the proposed rule by construction industry stakeholders, OSHA concludes that a requirement for regulated areas is not appropriate for the construction standard. OSHA proposed to require regulated areas wherever an employee's exposure to respirable crystalline silica is, or can reasonably be expected to be, in excess of the PEL. However, OSHA expects that a majority of the regulated community in construction will implement the specified exposure control methods presented in paragraph (c) of the standard for construction (i.e., the controls listed in Table 1) for the purposes of reducing occupational exposure to respirable crystalline silica and to assure compliance with the standard. Employers who implement the specified exposure control methods presented in paragraph (c) of the standard for construction will not be required to assess employee exposures to respirable crystalline silica, and thus will not necessarily be aware of situations where employee exposures exceed the PEL. Furthermore, these employers who are not necessarily required to conduct an exposure assessment would thereby not have the data necessary to establish and demarcate the boundaries of regulated areas (i.e., the point at which exposures no longer exceed the PEL). Therefore, most construction employers will not have an objective basis for establishing regulated areas.

In addition, OSHA basis its decision not to require regulated areas in the standard for construction in part on its recognition that conditions at construction worksites present challenges to establishing regulated areas for respirable crystalline silica exposure due to the varied and changing nature of construction work. Various commenters representing construction interests expressed how factors such as environmental variability normally present in construction differ substantially from those typically found in general industry and maritime workplaces. These commenters noted that construction tasks are often of relatively short duration; they are commonly performed outdoors, sometimes under adverse environmental conditions; and they are normally performed at non-fixed workstations or worksites. These factors make establishment of regulated areas impractical for many construction tasks. Silica-generating tasks in construction often involve movement to different locations during the workday, and respirable crystalline silica may be subject to changes in wind currents, meaning that exposure patterns may frequently shift. Accordingly, in the typical construction project involving silica-generating tasks, it is difficult to determine appropriate boundaries for regulated areas because the work and worksite are varied and subject to environmental influences (e.g., Document ID 2246, p. 11; 2269, pp. 4, 9-10; 2289, pp. 6-7; 2309, p. 3; 2327, p. 20).

OSHA finds the evidence of the particular and varying nature of construction work persuasive. Furthermore, the requirement for a competent person as part of the written exposure control plan requirements in paragraph (g)(4) of the standard for construction provides that a designated competent person on the worksite will have the responsibility to restrict access to work areas, where necessary, to limit exposures to respirable crystalline silica. OSHA concludes that this requirement will achieve the primary objectives of a regulated area.

OSHA realizes that in some cases general industry work tasks and work environments may be comparable to those found in construction. Although no exceptions have been carved out of the requirement in the standard for general industry and maritime, where the general industry or maritime employer can show compliance is not feasible, regulated areas will not have to be established insofar as infeasibility is a complete defense to an OSHA citation. See United

Steelworkers v. Marshall, 647 F.2d 1189 (D.C. Cir. 1980); Marshall v. West Point Pepperell, Inc., 588 F.2d 979 (5th Cir. 1979). As a general matter, however, OSHA's longstanding distinction between general industry (including, for these purposes, the maritime sector), on the one hand, and the construction sector, on the other hand, provides an appropriate line for delineating between those tasks where the employer generally is reasonably able to establish regulated areas where exposures to respirable crystalline silica exceed the PEL versus tasks where regulated areas are generally not practicable.

ASTM E 1132 – 06 and ASTM E 2625 – 09 do not include requirements for regulated areas. However, both industry consensus standards indicate that workers should not work in areas where visible dust is generated from crystalline silica-containing materials without the use of respiratory protection, unless proven protective measures are used or sampling shows exposure is below the exposure limit (see Section 4.4.3.1 in each standard) (Document ID 1466, p. 4; 1504, p. 3). OSHA considers the approach taken in its standard for construction to be consistent with the approach taken in the ASTM standards. OSHA further considers that the requirement for regulated areas in the standard for general industry and maritime better effectuates the purposes of the OSH Act because the establishment of regulated areas in those workplaces, where they are most effective, serves to limit the number of employees exposed and the level of exposure of employees who would otherwise be at significant risk of suffering adverse health effects from exposure to respirable crystalline silica. As explained above, regulated areas make employees aware of the presence of respirable crystalline silica at levels above the PEL and the need for protective measures, and serve to limit respirable crystalline silica exposure to as few employees as possible. Additionally, OSHA notes that the industry consensus standards addressing occupational exposure to respirable crystalline silica do not include requirements for protective clothing. The OSHA rule is consistent with the consensus standards in this respect also.

Methods of Compliance

Paragraph (f)(1) of the standard for general industry and maritime (paragraph (d)(3)(i) of the standard for construction) establishes a hierarchy of controls that employers must use to reduce and maintain exposures to respirable crystalline silica to or below the permissible exposure limit (PEL) of 50 $\mu g/m^3$. The rule requires employers to implement engineering and work practice controls as the primary means to reduce exposure to the PEL or to the lowest feasible level above the PEL. In situations where engineering and work practice controls are not sufficient to reduce exposures to or below the PEL, employers are required to supplement these controls with respiratory protection, according to the requirements of paragraph (g) of the standard for general industry and maritime (paragraph (e) of the standard for construction).

OSHA’s long-standing hierarchy of controls policy was supported by many commenters including the National Institute for Occupational Safety and Health (NIOSH), the American Society of Safety Engineers (ASSE), the American Industrial Hygiene Association, the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), the American Public Health Association (APHA), the National Asphalt Pavement Association (NAPA), the National Utility Contractors Association, the American Road and Transportation Builders Association (ARTBA), and the International Safety Equipment Association (ISEA) (e.g., Document ID 1757, p. 4; 1771, p. 1; 1797, p. 5; 1800, p. 5; 2106, p. 2; 2166, p. 3; 2173, p. 4; 2178, Attachment 1, pp. 3-4; 2181, p. 9; 2240, p. 2; 2256, Attachment 2, pp. 11-12; 2278, p. 3; 2313, p. 6; 2315, p. 3; 2329, p. 5; 2336, p. 7; 2371, Attachment 1, p. 22; 2373, pp. 3-4; ; 3468, p. 3; 3516, p. 3; 3577, Tr. 791; 3578, Tr. 1044-1045; 3579, Tr. 182-183; 3581, Tr. 1564, 1648-

1651; 3583, Tr.2237, 2243-2244, 2451, 2456; 3584, Tr. 2576-2577; 3955, Attachment 1, p. 2; 3585, Tr. 3112; 3586, Tr. 3162, 3200; 3589, Tr. 4147; 1759; 4203, p. 4; 4204, pp. 64-65; 4219, pp. 16, 20; 4223, p. 86; 4227, p. 1; 4233, Attachment 1, p. 14; 4235, p. 14). Tom Ward, a bricklayer and member of the International Union of Bricklayers and Allied Craftworkers (BAC) testified:

> [The hierarchy of controls] is the first thing we are supposed to do. Whenever feasible, eliminate the hazard. PPE is and always should be the last line of defense. Switching it is going backwards. . . (Document ID 3585, Tr. 3070).

Many industry commenters, including trade associations, generally objected to OSHA's proposed application of the hierarchy of controls in the rule. These commenters included the U.S. Chamber of Commerce (the Chamber), Associated Builders and Contractors, the Association of American Railroads (AAR), Battery Council International (BCI), the Motor and Equipment Manufacturers Association (MEMA), the Institute of Makers of Explosives (IME), the Association of Energy Service Companies, and the Precast/Prestressed Concrete Institute (PCI) (e.g., Document ID 1728; 1992, pp. 10-11; 2102, p. 2; 2130, pp. 1-2; 2151, p. 1; 2211, pp. 6-7; 2213, pp. 3-4; 2276, p. 3; 2288, pp. 12-13;2289, p. 7; 2325, p. 2; 2326, p. 2; 2344, p. 2; 2361, p. 3; 2366, p. 5; 4194, pp. 12-13). These commenters asked OSHA to reconsider its preference for engineering and work practice controls and permit the use of respiratory protection, such as powered air-purifying respirators (PAPRs), instead of engineering and work practice controls to reduce exposures to respirable crystalline silica to or below the PEL. For example, the Chamber urged OSHA to support

> . . . new technology and policies favoring effective, comfortable, respirators and clean filtered air helmets, which provide full protection but are not favored by OSHA's outdated 'hierarchy of control' policy (Document ID 4194, p. 4).

Similarly, the American Foundry Society (AFS) argued that:

> OSHA's preference for controls other than respirators is based on a policy that was adopted decades ago, and fails to take into account changes in respirator technology that have resulted in improved performance, improved reliability, improved worker acceptance, and increased protection (Document ID 3487, p. 25).

Greg Sirianni, an industrial hygienist testifying for the Chamber, commented that some respiratory protection, such as PAPRs, "should not be looked at as mere respirators, but as microenvironmental engineering controls" (Document ID 2364, p. 12). He described several studies demonstrating the effectiveness of PAPRs with helmets/hoods (Document ID 2364, pp. 6-7). He also referenced studies showing that PAPRs reduce physiological burdens, as well as provide increased comfort, ease of use, and improved communication, when compared to traditional air-purifying respirators (Document ID 2364, pp. 8-10). Other industry commenters, including the National Association of Manufacturers (NAM), AFS, and National Mining Association, echoed Mr. Sirianni's conclusion about the effectiveness of PAPRs (Document ID 2211, pp. 6-7; 2379, Appendix 1, p. 49; 2380, Attachment 2, pp. 22-23; 3489, p. 5;). Peter Mark, Corporate Director of Safety, Health, and Environment at Grede Holdings, testified that some respirators, such as air-supplied helmets, can also provide eye and face protection (Document ID 3584, Tr. 2685-2686). The George Washington University Regulatory Studies Center argued that OSHA's hierarchy of controls eliminates the incentive to develop more effective, lower cost, and more comfortable respirators and "distorts the development of new knowledge that could provide superior protection for employees" (Document ID 1831, p. 15).

Other commenters pointed to the disadvantages of engineering controls. The Construction Industry Safety Coalition (CISC), NAM, PCI, and AFS noted that engineering controls are subject to human error and maintenance concerns (Document ID 2319, p. 95; 2380, Attachment 2, p. 22; 3487, p. 25; 3581, Tr. 1738, 1762; 3589, Tr. 4357). The Tile Roofing

Institute (TRI), National Roofing Contractors Association (NRCA), National Association of Home Builders (NAHB), CISC, and NAM described situations where the use of engineering and work practice controls could present other hazards, such as falls (Document ID 2191, pp. 9-10; 2214, pp. 3-4; 2296, p. 28; 2319, p. 93; 3587, Tr. 3593-3594; 4225, p. 2; 4226, p. 3). OSCO Industries (OSCO) commented that where ventilation requires all doors and windows to be closed, engineering controls can put physiological and psychological strain on employees (Document ID 1992, p. 10).

NIOSH provided evidence that recent improvements in PAPRs have not eliminated all of their disadvantages. NIOSH cited several studies suggesting that psychological issues, medical disqualifications, communication impairment, hearing degradation, and visual impairment remained even for PAPRs (Document ID 4233, Attachment 1, pp. 17-20). NIOSH also noted that there are no maximum weight requirements for PAPRs, some of which can be fairly heavy (Document ID 4233, Attachment 1, p. 18). When questioned about the use of PAPRs in the brick industry, Thomas Brown, the Director of Health and Safety at Acme Brick Company, testified that:

> No, we have not used [PAPRs]. And the reason why [is] it would be almost virtually impossible to wear those type[s] of respirators and perform the tasks that they are doing (Document ID 3577, Tr. 752).

No commenter representing employees or public health organizations agreed that PAPRs have improved to the point that they have become preferable to engineering controls. For example, when asked whether PAPRs should be viewed as an alternative to engineering controls and treated on the same level in the hierarchy of controls, Frank Hearl, Chief of Staff at NIOSH, testified that, “. . .in terms of the PAPR and other respirators, it all sort of falls into the hierarchy of controls and suffers the same problems as the other respirators in that it doesn’t control the entire environment" (Document ID 3579, Tr. 233). The Building and Construction Trades Department, AFL-CIO (BCTD) testified that PAPRs are not an adequate alternative given that they do not ". . .control the hazards at the source for all workers" (Document ID 3581, Tr. 1668-1669). Similarly, ISEA commented that ". . .the association does not believe PAPRs can be used as engineering controls" since they do not remove hazards from the workplace (Document ID 4227, p. 1).

NIOSH, public health organizations, labor unions, individual employees, trade associations, public interest organizations and employers also provided additional evidence of the discomfort and difficulties experienced by employees who wear respirators (e.g., extreme temperatures, visibility restrictions, communication impairment, psychological issues, strain on respiratory and cardiac systems) (Document ID 1758; 2116, Attachment 1, p. 28; 2178, Attachment 1, p. 4; 2181, pp. 9, 12; 2262, p. 26; 2314, p. 2; 2373, p. 4; 3571, Attachment 1, p. 2; 3577, Tr. 839-841; 3579, Tr. 183-184; 3580, Tr. 1526-1527; 3582, Tr. 1872-1874, 1897, 1899-1901; 3583, Tr. 2434-2435; 3585, Tr. 3112; 3586, Tr. 3174-3175, 3180, 3250, 3252-3253; 3587, Tr. 3583-3584, 3637-3638; 4233, Attachment 1, pp. 18-19; 4235, p. 12). Other commenters, including NIOSH, the International Union of Operating Engineers (IUOE), the Brick Industry Association, TRI, NAPA, ARTBA, the Interlocking Concrete Pavement Institute, Black Roofing, the National Tile Contractors Association, Acme Brick, and iQ Power Tools also described how respirator use can exacerbate various safety and health threats to employees, such as trips, falls, "struck by" hazards, saw hazards, and heat stress (Document ID 2262, p. 25; 2293; 3529, p. 2; 3577, Tr. 714, 750-752; 3583, Tr. 2170, 2237, 2372, 2435-2437; 3586, Tr. 3341, 3406; 3587, Tr. 3583-3584, 3594; 3589, Tr. 4373; 4225, p. 6; 4233, Attachment 1, p. 18; 4234, Part 1 and Part 2, pp. 30-31; 4235, p. 12). IUOE, the Laborers' Health and Safety Fund of North America

(LHSFNA), and Arch Masonry further noted that reliance on respirators to protect employees from exposures to respirable crystalline silica could end the careers of employees who cannot pass the medical evaluation, but can do the work (Document ID 2262, p. 27; 2292, p. 4; 3587, Tr. 3656-3567; 3589, Tr. 4274-4275).

In addition, NIOSH and other public health professionals described how respirators are more prone to misuse or other human error, as they depend on human behavior to achieve beneficial results (Document ID 2374, Attachment 1, pp. 5-6; 3577, Tr. 848-849; 3579, Tr. 183-184). On the other hand, engineering controls are easier to monitor and maintain. As Dr. Celeste Monforton testified:

> It is illogical to suggest that diligently meeting all the laborious requirements necessary for an effective respiratory protection program for a whole crew of employees is easier than ensuring that a handful of silica-generating pieces of equipment are maintained (Document ID 3577, Tr. 849).

Various individuals and organizations detailed the lack of adequate fit testing and respiratory protection programs in practice, which can significantly impact respirator effectiveness. These included Dr. Monforton, ASSE, the National Council of La Raza, the National Consumers League (NCL), APHA, the National Council for Occupational Safety and Health, NRCA, and Arch Masonry as well as workers, including James Schultz and Allen Schultz (Document ID 2166, p. 3; 2173, p. 5; 2178, Attachment 1, pp. 3-4; 2373, pp. 3-4; 3577, Tr. 848-849; 3578, Tr. 1040-1041, 1042-1043; 3586, Tr. 3161, 3213-3214, 3236-3237, 3253-3254; 3587, Tr. 3625, 3680-3681; 3955, Attachment 1, p. 2). Workers, including James Schultz, Jonass Mendoza, Santiago Hernandez, Juan Ruiz, Norlan Trejo and Jose Granados described their negative experiences with respirator use, including the lack of fit testing, training, and proper maintenance (Document ID 3571, Attachment 2, p. 3; 3571, Attachment 3, p. 2; 3571, Attachment 5, p. 1; 3571, Attachment 7, p. 1; 3583, Tr. 2487; 3586, Tr. 3201-3202;). Dr. Laura

Welch, representing BCTD, testified that in her experience, respiratory protection does not prevent employees from developing lung disease, but that engineering controls are effective (Document ID 3581, Tr. 1648-1649).

Further, NIOSH, labor organizations (e.g., LHSFNA, the International Association of Sheet Metal, Air, and Rail Transportation Workers, the Operative Plasterers' and Cement Masons' International Association, the International Union of Painters and Allied Trades (IUPAT), the United Union of Roofers, Waterproofers, and Allied Workers, BAC, the United Steelworkers, BCTD, and AFL-CIO), public health organizations (e.g., APHA), public interest organizations (e.g., the Center for Biological Diversity, the Center for Effective Government, and NCL), and individual workers described how limiting exposure to respirable crystalline silica at its source through engineering and work practice controls best protects employees involved in dust-generating operations, as well as other employees and the public from these exposures (e.g., Document ID 2178, Attachment 1, p. 4; 2253, pp. 1-2; 2329, p. 4; 2373, p. 4; 2374, Attachment 1, pp. 5-6; 3516, p. 3; 3579, Tr. 184-185, 233; 3581, Tr. 1590, 1593-1594, 1649-1651,1669, 1708-1709; 3582, Tr. 1878-1879, 1881-1883; 3583, Tr. 2455-2456; 3584, Tr. 2578-2579; 3585, Tr. 3067-3069; 4204, pp. 68, 72-74; 3589, Tr. 4232-4233; 4223, pp. 86-87; 4233, Attachment 1, pp. 11-14). For example, LHSFNA noted that using controls on jackhammers, chipping guns, hand-held grinders, and drywall sanders can reduce exposures to nearby laborers (Document ID 2253, pp. 1-2). Norlan Trejo testified that when cutting ceramic and granite, wet cutting helps protect both the employee and bystanders (Document ID 3583, Tr. 2455-2456). Sean Barrett, a terrazzo worker, testified that grinding floors in the terrazzo industry exposes everyone on the worksite if controls are not used:

> Every other trade has to walk through the cloud [of dust] to get in and out of the building to use the outhouses or to go to the coffee truck or even go home at the

> end of the day. . .[T]hey have no choice but to walk through the dust (Document ID 3585, Tr. 3068).

Additionally, James Schultz, a former foundry employee from the Wisconsin Coalition for Occupational Safety and Health, provided testimony about how the lack of engineering controls creates dusty conditions that can lead to other hazards. He described how dusty conditions in a foundry led to incidents where employees were struck by forklifts (Document ID 3586, Tr. 3242-3243).

Some of the same industry commenters advocating for the use of PAPRs in place of engineering controls have acknowledged the importance of engineering controls to protect employees from exposures to respirable crystalline silica. For example, AFS, in its Guide for Selection and Use of Personal Protective Equipment and Special Clothing for Metalcasting Operations, describes the hierarchy of controls as the basis for choosing strategies for protecting employers from exposures to airborne contaminants. The guide concludes that air-supplied hoods and PAPRs are important options when choosing respiratory or personal protection, but does not support using these in lieu of engineering controls (Document ID 2379, Appendix 6). NAM noted that they were not opposed to using engineering controls where they are feasible and effective (Document ID 3581, Tr. 1753). Greg Sirianni, an expert for the Chamber, testified that:

> . . . there are obviously benefits to engineering controls, and by all means I want the use of engineering controls when they are possible. And in certain work environments . . . you need to have something that can protect all workers in all scenarios, and engineering controls are good for most cases, but there are a lot of workers out there that need [PAPRs], and I really recommend their use (Document ID 3578, Tr. 1104-1105).

Other industry groups provided additional evidence that the hierarchy of controls is embraced and applied in practice. For example, Wayne D’Angelo of the American Petroleum Institute (API) testified that the organization supports the traditional use of the hierarchy of controls to protect employees (Document ID 3589, Tr. 4065). The National Industrial Sand Association (NISA) has built the hierarchy of controls into its Practical Guide to an Occupational Health Program for Respirable Crystalline Silica (Document ID 1965, Attachment 2, pp. vii, 44). The National Stone, Sand, and Gravel Association's occupational health program, which is based on NISA's program, also supports the industrial hygiene hierarchy of controls (Document ID 3583, Tr. 2312).

OSHA concludes that requiring primary reliance on engineering controls and work practices is necessary and appropriate because reliance on these methods is consistent with good industrial hygiene practice, and with the Agency's experience in ensuring that employees have a healthy workplace. The Agency finds that engineering controls: (1) control crystalline silica-containing dust particles at the source; (2) are reliable, predictable, and provide consistent levels of protection to a large number of employees; (3) can be monitored continually and relatively easily; and (4) are not as susceptible to human error as is the use of personal protective equipment. The use of engineering controls to prevent the release of silica-containing dust particles at the source also minimizes the silica exposure of other employees in surrounding work areas who are not directly involved in the task that is generating the dust, and may not be wearing respirators. This issue of secondary exposures to other laborers and bystanders is especially of concern at construction sites (e.g., Document ID 2177, Attachment B, pp. 14-15; 2329, p. 4; 2319, p. 28, 3581, Tr. 1587-1588).

Under the hierarchy of controls, respirators can be another effective means of protecting employees from exposure to air contaminants. However, to be effective, respirators must be individually selected, fitted and periodically refitted, conscientiously and properly worn, regularly maintained, and replaced as necessary. In many workplaces, these conditions for effective respirator use are difficult to achieve. The absence of any one of these conditions can reduce or eliminate the protection the respirator provides to some or all of the employees. For example, certain types of respirators require the user to be clean shaven to achieve an effective seal where the respirator contacts the employee's skin. Failure to ensure a tight seal due to the presence of facial hair compromises the effectiveness of the respirator.

Respirator effectiveness ultimately relies on the good work practices of individual employees. In contrast, the effectiveness of engineering controls does not rely so heavily on actions of individual employees. Engineering and work practice controls are capable of reducing or eliminating a hazard from a worksite, while respirators protect only the employees who are wearing them correctly. Furthermore, engineering and work practice controls permit the employer to evaluate their effectiveness directly through air monitoring and other means. It is considerably more difficult to directly measure the effectiveness of respirators on a regular basis to ensure that employees are not unknowingly being overexposed. OSHA therefore continues to consider the use of respirators to be the least satisfactory approach to exposure control.

In addition, use of respirators in the workplace presents other safety and health concerns. Respirators can impose substantial physiological burdens on employees, including the burden imposed by the weight of the respirator; increased breathing resistance during operation; limitations on auditory, visual, and olfactory sensations; and isolation from the workplace environment. Job and workplace factors such as the level of physical work effort, the use of protective clothing, and temperature extremes or high humidity can also impose physiological burdens on employees wearing respirators. These stressors may interact with respirator use to increase the physiological strain experienced by employees.

Certain medical conditions can compromise an employee's ability to tolerate the physiological burdens imposed by respirator use, thereby placing the employee wearing the respirator at an increased risk of illness, injury, and even death. These medical conditions include cardiovascular and respiratory diseases (e.g., a history of high blood pressure, angina, heart attack, cardiac arrhythmias, stroke, asthma, chronic bronchitis, emphysema), reduced pulmonary function caused by other factors (e.g., smoking or prior exposure to respiratory hazards), neurological or musculoskeletal disorders (e.g., epilepsy, lower back pain), and impaired sensory function (e.g., a perforated ear drum, reduced olfactory function). Psychological conditions, such as claustrophobia, can also impair the effective use of respirators by employees and may also cause, independent of physiological burdens, significant elevations in heart rate, blood pressure, and respiratory rate that can jeopardize the health of employees who are at high risk for cardiopulmonary disease (see 63 FR 1152, 1208-1209 (1/8/98)).

In addition, safety problems created by respirators that limit vision and communication must always be considered. In some difficult or dangerous jobs, effective vision or communication is vital. Voice transmission through a respirator can be difficult, annoying, and fatiguing. In addition, movement of the jaw in speaking can cause leakage, thereby reducing the efficiency of the respirator and decreasing the protection afforded the employee. Skin irritation can result from wearing a respirator in hot, humid conditions. Such irritation can cause considerable distress to employees and can cause employees to refrain from wearing the respirator, thereby rendering it ineffective.

These potential burdens placed on employees by the use of respirators were acknowledged in OSHA's revision of its respiratory protection standard, and are the basis for the requirement (29 CFR 1910.134(e)) that employers provide a medical evaluation to determine the employee's ability to wear a respirator before the employee is fit tested or required to use a respirator in the workplace (see 63 FR at 1152). Although experience in industry shows that most healthy employees do not have physiological problems wearing properly chosen and fitted respirators, nonetheless common health problems can cause difficulty in breathing while an employee is wearing a respirator.

While OSHA acknowledges that certain types of respirators, such as PAPRs, may lessen problems associated with breathing resistance and skin discomfort, they do not eliminate them. OSHA concludes that respirators do not provide employees with a level of protection that is equivalent to engineering controls, regardless of the type of respirator used. It is well-recognized that certain types of respirators are superior to other types of respirators with regard to the level of protection offered, or impart other advantages like greater comfort. OSHA has evaluated the level of protection provided by different types of respirators in the Agency's Assigned Protection Factors rulemaking (68 FR 34036 (06/06/03)). Even in situations where engineering controls are not sufficiently effective to reduce exposure levels to or below the PEL, the reduction in exposure levels benefits employees by reducing the required protection factor of the respirator, which provides a wider range of options in the type of respirators that can be used. For example, for situations in which dust concentrations are reduced through use of engineering controls to levels that are less than ten times the PEL, employers would have the option of providing approved half-mask respirators with an assigned protection factor (APF) of 10 that may be lighter and easier to use when compared with full-facepiece respirators.

All OSHA substance-specific health standards have recognized and required employers to observe the hierarchy of controls, favoring engineering and work practice controls over respirators. OSHA's PELs, including the previous PELs for respirable crystalline silica, also incorporate this hierarchy of controls. The Agency's adherence to the hierarchy of controls has been successfully upheld by the courts (see Section II, Pertinent Legal Authority for further discussion of these cases). In addition, the industry consensus standards for crystalline silica (ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica, and ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities) incorporate the hierarchy of controls. NRCA also pointed out that the ANSI Z10, Standard for Occupational Health and Safety Management Systems, supports the hierarchy of controls (Document ID 2214, p. 3) and Dr. Celeste Monforton noted that the hierarchy of controls has been followed and adopted by safety and health regulatory agencies around the world, including Safe Work Australia, the country's tripartite health and safety body, and the Canadian Province of Ontario's Health and Safety Agency (Document ID 3577, Tr. 847-848).

As explained in Section II, Pertinent Legal Authority, the very concept of technological feasibility for OSHA standards is grounded in the hierarchy of controls. The courts have clarified that a standard is technologically feasible if OSHA proves a reasonable possibility,

> . . . within the limits of the best available evidence . . . that the typical firm will be able to develop and install engineering and work practice controls that can meet the PEL in most of its operations (United Steelworkers v. Marshall, 647 F.2d 1189, 1272 (D.C. Cir. 1980)).

Allowing use of respirators instead of engineering and work practice controls would be a significant departure from this framework for evaluating the technological feasibility of a PEL.

While labor groups were opposed to any exemptions from the hierarchy of controls (Document ID 3586, Tr. 3235-3237), industry commenters, including both individual employers and trade associations, urged OSHA to consider making exemptions to the hierarchy in various situations. Commenters, including the Edison Electric Institute (EEI), Dal-Tile, the Glass Association of North America (GANA), the Tile Council of North America, the Non-Ferrous Founders' Society (NFFS), PCI, and the Chamber, argued that employers need flexibility to determine when enough engineering controls have been added and when respirators can be used (Document ID 2147, p. 3; 2215, p. 6; 2276, p. 6; 2357, pp. 25-26; 2363, p. 4; 3491, p. 4; 3576, Tr. 466; 3589, Tr. 4364). NAM echoed this, arguing that employers will never know when or if they are in compliance with the requirement to incorporate all feasible engineering and work practice controls and the Agency should thus base its requirements on objective criteria, while allowing flexibility to achieve compliance (Document ID 3581, Tr. 1738). Lapp Insulators, the Indiana Manufacturing Association, Murray Energy Corporation, BCI, Rheem Manufacturing Company, MEMA, IME, CISC, AFS, NFFS, and NAM urged OSHA to permit the use of respirators to satisfy the obligation to control exposures where feasible engineering and work practice controls are insufficient to bring exposure levels to or below the PEL (Document ID 1801, pp. 3-4; 2102, p. 2; 2130, pp. 1-2; 2151, p. 1; 2213, pp. 3-4; 2319, p. 95; 2325, p. 2; 2326, p. 2; 2361, p. 3; 2380, Appendix 2, pp. 22-23; 3486, p. 2; 3491, pp. 4-5; 3581, Tr. 1752-1753; 4226, p. 2). This concern was echoed by other commenters who encouraged OSHA to permit the use of respirators in industries using large amounts of crystalline silica (e.g., oil and gas operations where hydraulic fracturing is conducted), where engineering controls alone would not be likely to reduce exposures to or below the PEL (Document ID 2283, p. 3; 3578, Tr. 1090-1091).

OSHA disagrees. Instead, the Agency considers engineering controls to be the most effective method of protecting employees and allows respiratory protection only after all feasible engineering controls and work practices have been implemented or where such controls have been found infeasible. If an employer has adopted all feasible engineering controls, and no other feasible engineering controls are available, the rule would permit the use of respirators. On the other hand, if feasible engineering controls are available that would reduce respirable crystalline silica exposures that exceed the PEL, then these controls are required. Thus, OSHA has concluded these engineering controls better protect employees.

Commenters, including CISC and OSCO, urged OSHA to permit the use of respirators for short duration, intermittent, or non-routine tasks (Document ID 1992, pp. 3, 5; 2319, pp. 95, 115; 3580, Tr. 1463-1464). Others, such as the Glass Packaging Institute (GPI) and NAM, argued that OSHA should permit the use of respirators for maintenance activities (Document ID 2290, pp. 2, 3; 2380, Attachment 2, pp. 14-15; 3493, pp. 2-3). Verallia North America recommended that respirators be allowed in all refractory repairs (Document ID 3584, Tr. 2848).

Where OSHA requires respirator use in this rule, the requirement is tied to expected or recorded exposures above the PEL, not categorically to specific operations or tasks per se. The rule permits the use of respirators where exposures exceed the PEL during tasks for which engineering and work practice controls are not feasible. Some tasks, such as certain maintenance and repair activities, may present a situation where engineering and work practice controls are not feasible. For example, GPI noted that respirators are needed to address failures of any conveyance system (elevators, conveyors, or pipes), failures of dust collecting bag systems, or section head failures at glass plant facilities (Document ID 3493, p. 3). OSCO described how engineering controls are not feasible for cupola (furnace) repair work and baghouse maintenance activities (Document ID 1992, pp. 3, 5). The Agency agrees that for tasks, such as certain maintenance and repair activities, where engineering and work practice controls are not feasible, the use of respirators is permitted.

The Chamber and the American Subcontractors Association (ASA) suggested that the hierarchy of controls is not appropriate for silica exposures in construction workplaces (Document ID 2187, p. 6; 2283, p. 3). While ASSE generally supported the hierarchy of controls, it acknowledged that there might be practical issues with implementation on short-term construction worksites (Document ID 2339, p. 4). More specifically, the Mason Contractors Association of America and Holes Incorporated urged OSHA to consider the approach taken by the ASTM standard for the construction industry (ASTM E 2625 – 09), which provides an exception to the hierarchy for brief, intermittent silica generating tasks of 90 minutes or less per day (Document ID 3580, Tr. 1453; 3585, Tr. 2882). Conversely, BCTD argued that even for silica dust-generating tasks of short duration where respiratory protection is employed, a failure to employ engineering controls could result in dangerous exposures (Document ID 4219, p. 17). They contended that:

> There is no evidence in the record that exposures of only 90 minutes a day pose a lower risk of harm, such that respirators would provide sufficient protection. Moreover . . . the industry failed to prove that it is infeasible—or even difficult—to use engineering controls in most silica-generating tasks (Document ID 4223, p. 88).

OSHA finds, as discussed above, that primary reliance on respirators to protect employees is inappropriate when feasible engineering and work practice controls are available. This is as true for the construction industry, as it is for other industries with respirable crystalline silica exposures. Even where employees are conducting intermittent silica generating tasks for 90 minutes or less per day, if the exposures are above the PEL and feasible engineering and work practice controls are available, they must be applied. Further, although an exemption for employees conducting silica generating tasks for 90 minutes or less per day is included in the ASTM standard for the construction industry, the standard also includes the hierarchy of controls, as well as task-based methods of compliance based on engineering and work practice controls that are feasible and available for many construction tasks (ASTM E 2625 – 09). This approach is consistent with the specified exposure control methods for construction in paragraph (c)(1) described in the summary and explanation of Specified Exposure Control Methods. OSHA concludes that requiring the use of all feasible engineering and work practice controls in the construction industry, even for tasks of short duration generating respirable crystalline silica, is reasonably necessary and appropriate to protect employees from exposures to respirable crystalline silica.

AFS, NISA, GANA, EEI, the North American Insulation Manufacturers Association (NAIMA), and the Asphalt Roofing Manufacturers Association urged OSHA to consider allowing employers to use respirators to achieve compliance for operations where exposures exceed the PEL for 30 days or less per year (Document ID 4229, p. 11; 2195, pp. 7, 38-39; 2215, pp. 9-10; 2291, pp. 2, 18; 2348, Attachment 1, pp. 17, 26-28, 40; 2357, p. 26; 2379, Appendix 1, pp. 48, 68-69; 3487, pp. 22-23). Similarly, NAM proposed that OSHA could establish a maximum number of days a year when respirators can be used in place of engineering controls (Document ID 2380, Attachment 2, pp. 24-25).

Many of the examples mentioned by the commenters supporting this exemption described maintenance and repair activities, such as baghouse cleaning and furnace rebuilds. As discussed above, some tasks, such as certain maintenance and repair activities, may present a situation where engineering and work practice controls are not feasible. OSHA agrees that, for tasks of this nature where engineering and work practice controls are not feasible, the use of respirators is permitted. Permitting employers to use respirators instead of feasible engineering and work practice controls for exposures occurring for 30 days or less per year does not best effectuate the purpose of the rule—to protect employees from exposures to respirable crystalline silica. Thus, the Agency concludes that the hierarchy of controls is appropriate whenever feasible engineering and work practice controls are available.

The American Composite Manufacturers Association suggested that small businesses be exempt from the hierarchy of controls (Document ID 3588, Tr. 3933-3936). Bret Smith urged OSHA to allow small entities to use respiratory protection temporarily to allow time to prepare for the costs of implementation (Document ID 2203). OSHA does not agree that there should be a distinction between the protection employees receive in a small business or a large business. Protecting the safety and health of employees is part of doing business. Thus, exposures to respirable crystalline silica above the PEL, wherever they occur, must first be controlled using all feasible engineering and work practice controls available, before turning to respiratory protection. For the reasons previously discussed, implementing and maintaining a comprehensive respiratory protection program is a considerable undertaking for many employers, and likely even more so for small businesses. If employers are unable to properly train and fit employees and maintain the equipment, respirators will not effectively protect employees from exposures to respirable crystalline silica.

NAM proposed that OSHA adopt language to allow respirators to be used when exposures are below a specified level:

> Where airborne exposures to RCS on a time-weighted-average basis are below XX milligrams per cubic meter, employers may require the use of respirators in accordance with the requirements of 1910.134. Where exposures exceed this level, employers are required to adopt engineering and administrative controls to reduce exposures (Document ID 2380, Attachment 2, pp. 24-25).

They specifically provided the example of 5 mg/m^3 (i.e., 5,000 $\mu g/m^3$), the respirable dust PEL, which would permit the use of respirators that provide a protection factor of 100 to achieve compliance with the PEL of 50 $\mu g/m^3$.

As discussed above, this approach is in conflict with the concept of technological feasibility for OSHA standards. Technological feasibility is determined based on the ability of a typical firm to develop and install engineering controls and work practice controls that can meet the PEL without regard to the use of respirators. The approach advanced by NAM would permit the use of respirators to achieve the PEL, even where exposures reached 100 times the PEL. If technological feasibility were based solely on the ability of respirators to meet the PEL, OSHA could determine that a much lower PEL would indeed be feasible. Further, a failure of respiratory protection in situations where exposures reach 100 times the PEL could result in extremely dangerous exposures.

Therefore, OSHA rejects the various comments recommending upsetting the long-established hierarchy of controls. Because engineering and work practice controls are capable of reducing or eliminating a hazard from the workplace, while respirators protect only the employees who are wearing them and depend on the selection and maintenance of the respirator and the actions of employees, OSHA holds to the view that engineering and work practice controls offer more reliable and consistent protection to a greater number of employees, and are therefore preferable to respiratory protection. Thus, the Agency continues to conclude that engineering and work practice controls provide a more protective first line of defense than respirators and must be used first when feasible.

Engineering controls. The engineering controls that are required by the standard can be grouped into four categories: (1) substitution; (2) isolation; (3) ventilation; and (4) dust suppression. Depending on the sources of crystalline silica dust and the operations conducted, a combination of control methods may reduce silica exposure levels more effectively than a single method.

Substitution refers to the replacement of a toxic material with another material that reduces or eliminates the harmful exposure. OSHA considers substitution to be an ideal control measure if it replaces a toxic material in the work environment with a non-toxic material, thus eliminating the risk of adverse health effects.

As indicated in Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA), employers use substitutes for crystalline silica in a variety of operations. For example, some employers use substitutes in abrasive blasting operations, repair and replacement of refractory materials, operations performed in foundries, and in the railroad transportation industry. Commenters, such as NIOSH, John Adams, Vice President of the American Federation of Government Employees Local 2778, Kyle Roberts, and the National Automobile Dealers Association (NADA) also identified several situations where substitute materials and products were available or used in place of silica-containing products, including: the use of plastic curbs in place of concrete curbs to repair a highway overpass; the use of materials containing aluminum oxide instead of crystalline silica in dental labs; the use of aluminum pellets instead of sand in hydraulic fracturing operations; the availability of silica-free OEM and auto-refinish paint systems; and the availability of silica-free body fillers and silica-free abrasives for auto body repair work (Document ID 1763, p. 2; 1800, p. 5; 2177, Attachment B, pp. 37-38; 2358, p. 4).

Commenters also identified many situations where no substitute materials and products were available to replace silica-containing materials and products. For example, Grede Holdings and AFS noted that there were no substitutes for sand for most foundry applications (Document ID 2298, p. 2; 2379, Appendix 1, pp. 14-16; 3486, p. 4). The General Contractors Association of New York, ASA, CISC, and NAHB noted that the construction industry cannot select alternate materials to avoid silica exposure, since nearly all construction materials and products contain silica (Document ID 2187, p. 6; 2314, pp. 1-2; 2296, pp. 7, 35; 2319, pp. 93-34). AAR and the American Short Line and Regional Railroad Association noted that substitute ballast materials with lower silica content cannot be used because they introduce safety hazards for employees and the public (Document ID 2366, pp. 5-6). GANA and NAIMA noted that silica is indispensable to the flat glass industry (Document ID 2215, p. 5; 2348, Attachment 1, pp. 8-10). NAM noted that viable alternatives of lower silica content are not available for some products made by their members (Document ID 3581, Tr. 1728). The Porcelain Enamel Institute noted that there are no proven replacements for mill-added crystalline silica for wet-applied enamel systems, given that the technical advantages offered by silica cannot be practically and economically achieved with other materials (Document ID 2281, p. 3).

The American College of Occupational and Environmental Medicine (ACOEM), the Mount Sinai-Irving J. Selikoff Centers for Occupational and Environmental Medicine, and Samantha Gouveia urged OSHA to more explicitly encourage the use of substitution where feasible (Document ID 1771, p. 1; 2080, pp. 4-5; 2208).

Commenters also expressed concerns about the safety of substitutes (Document ID 2080, pp. 4-5; 2187, p. 6; 2278, pp. 3-4). ACOEM suggested that OSHA only endorse the use of substitutes when they have been demonstrated to be safe in short- and long-term inhalation toxicology studies and urged OSHA to request that NIOSH conduct a periodic assessment that evaluates substitutes to determine which ones have been found to be safe based upon results of inhalation toxicity and epidemiologic studies (Document ID 2080, pp. 4-5). Dr. George Gruetzmacher, an industrial hygiene engineer, urged OSHA to encourage the use of alternative materials to silica when feasible, but only when the substitute has been demonstrated to be safe in short- and long-term inhalation toxicology studies or to prohibit the substitution of materials which have not been demonstrated to be less toxic by inhalation (Document ID 2278, pp. 3-4).

While OSHA finds that substitution can be an ideal control measure in certain circumstances, the Agency recognizes that this approach may not be feasible or safer in many others. Because some alternatives to silica or silica-containing materials may present health risks, OSHA is not implying that any particular alternative is an appropriate or safe substitute for silica. In its technological feasibility analyses, the Agency identified information about situations where substitution may be an available control strategy. OSHA strongly encourages employers to thoroughly evaluate potential alternatives, where available, to determine if a substitute can mitigate employees' exposure to respirable crystalline silica without posing a greater or new significant hazard to employees. Additionally, when substituting, employers must comply with Section 5(a)(1) of the OSH Act (29 U.S.C. 654(a)(1)), which prohibits occupational exposure to "recognized hazards that are causing or are likely to cause death or serious physical harm," and with applicable occupational safety and health standards. For example, with respect to chemical hazards, OSHA's hazard communication standard imposes specific requirements for employee training, safety data sheets, and labeling (see 29 CFR 1910.1200).

Isolation, i.e., separating workers from the source of the hazard, is another effective engineering control employed to reduce exposures to crystalline silica. Isolation can be accomplished by either containing the hazard or isolating workers from the source of the hazard. For example, to contain the hazard, an employer might install a physical barrier around the source of exposure to contain a toxic substance within the barrier. Isolating the source of a hazard within an enclosure restricts respirable dust from spreading throughout a workplace and exposing employees who are not directly involved in dust-generating operations. Or, alternatively, an employer might isolate employees from the hazard source by placing them in a properly ventilated cab or at some distance from the source of the respirable crystalline silica exposure.

Ventilation is another engineering control method used to minimize airborne concentrations of a contaminant by supplying or exhausting air. Two types of systems are commonly used: local exhaust ventilation (LEV) and dilution ventilation. LEV is used to remove an air contaminant by capturing it at or near the source of emission, before the contaminant spreads throughout the workplace. Dilution ventilation allows the contaminant to spread over the work area but dilutes it by circulating large quantities of air into and out of the area. Consistent with past recommendations such as those included in the chromium (VI) standard, OSHA prefers the use of LEV systems to control airborne toxics because, if designed properly, they efficiently remove contaminants and provide for cleaner and safer work environments.

Dust suppression methods are generally effective in controlling respirable crystalline silica dust, and they can be applied to many different operations such as material handling, rock crushing, abrasive blasting, and operation of heavy equipment (Document ID 1147). Dust suppression can be accomplished by one of three systems: wet dust suppression, in which a liquid or foam is applied to the surface of the dust-generating material; airborne capture, in which moisture is dispensed into a dust cloud, collides with particles, and causes them to drop from the air; and stabilization, which holds down dust particles by physical or chemical means (lignosulfonate, calcium chloride, and magnesium chloride are examples of stabilizers).

The most common dust suppression controls are wet methods (see Chapter IV of the FEA). Water is generally an inexpensive and readily available resource and has been proven an efficient engineering control method to reduce exposures to airborne crystalline silica-containing dust. Dust, when wet, is less able to become or remain airborne.

Work practice controls. Work practice controls systematically modify how employees perform an operation, and often involve employees' use of engineering controls. For crystalline silica exposures, OSHA's technological feasibility analysis shows that work practice controls are generally applied complementary to engineering controls, to adjust the way a task is performed (see Chapter IV of the FEA). For work practice controls to be most effective, it is essential that employees and supervisors are trained to be fully aware of the exposures generated by relevant workplace activities and the impact of the engineering controls installed. Work practice controls are preferred over the use of personal protective equipment, since work practice controls can address the exposure of silica at the source of emissions, thus protecting nearby employees.

Work practice controls can also enhance the effects of engineering controls. For example, to ensure that LEV is working effectively, an employee would position the LEV equipment so that it captures the full range of dust created, thus minimizing silica exposures. For many operations, a combination of engineering and work practice controls reduces silica exposure levels more effectively than a single control method.

The requirement to use engineering and work practice controls is consistent with ASTM E 1132 – 06 and ASTM E 2625 – 09, the national consensus standards for controlling occupational exposure to respirable crystalline silica in general industry and in construction, respectively. Each of these standards has explicit requirements for the methods of compliance to be used to reduce exposures below exposure limits. These voluntary standards specifically identify several controls, which include use of properly designed engineering controls such as ventilation or other dust suppression methods and enclosed workstations such as control booths and equipment cabs; requirements for maintenance and evaluation of engineering controls; and implementation of certain work practices such as not working in areas where visible dust is generated from respirable crystalline silica containing materials without use of respiratory protection. For employers in general industry and maritime, as well as those in construction following paragraph (d) for tasks not listed in Table 1 or where the employer does not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1, OSHA similarly requires the use of engineering and work practices controls to reduce employee exposures to or below the PEL; however, this is a performance requirement and does not specify any particular engineering and work practice controls that must be implemented.

Paragraph (f)(2)(i) of the standard for general industry and maritime (paragraph (g)(1) of the standard for construction) requires that employers establish and implement a written exposure control plan. Paragraphs (f)(2)(i)(A)-(C) (paragraphs (g)(1)(i)-(iv) of the standard for construction) specify the contents for written exposure control plans. Paragraph (f)(2)(ii) (paragraph (g)(2) of the standard for construction) specifies requirements for the employer to review the plan at least annually and update it as needed. Paragraph (f)(2)(iii) (paragraph (g)(3) of the standard for construction) requires the employer to make the plan available to employees, employee representatives, OSHA, and NIOSH. Details about the written exposure control plan, including comments from stakeholders and OSHA's responses to those comments, are included in the summary and explanation of <u>Written Exposure Control Plan</u>.

SECALs. In the NPRM, OSHA asked stakeholders to provide input as to whether the Agency should establish separate engineering control air limits (SECALs) for certain processes in selected industries. In OSHA's cadmium standard (29 CFR 1910.1027 (f)(1)(ii), (iii), and (iv)), the Agency established SECALs where compliance with the PEL by means of engineering and work practice controls was infeasible. For these industries, a SECAL was established at the lowest feasible level that could be achieved by engineering and work practice controls. The PEL was set at a lower level, and could be achieved by any allowable combination of controls, including respiratory protection. A similar exception was included in OSHA's chromium (VI) standard (29 CFR 1910.1026) for painting aircraft and large aircraft parts.

OSHA received feedback from several commenters who supported establishing SECALs (e.g., Document ID 2082, p. 8; 2379, Appendix 1, p. 61; 2380, Attachment 2, p. 23). For example, AFS argued for a SECAL of 150 or 200 μg/m^3 for foundries, with a PEL of 100 μg/m^3. AFS indicated that many foundries now operate under a formal or informal arrangement with OSHA that allows use of respirators as an acceptable control to achieve compliance with the current PEL after implementing all feasible engineering controls (Document ID 2379, Appendix 1, p. 61). ORCHSE Strategies stated that the use of SECALs could provide more definitive expectations for employers based on the feasibility for engineering controls in specific operations (Document ID 2277, p. 2). The United Automobile, Aerospace and Agricultural Implement Workers of America recommended that the PEL be even lower than OSHA proposed (25 μg/m^3), and suggested that SECALs could be established for those industries for which 25 μg/m^3 is not feasible (Document ID 2282, p. 16).

Other commenters did not favor establishing SECALs. CISC stated that it did not support the concept of SECALs, but that CISC would continue to examine whether a SECAL was appropriate for the construction industry (Document ID 2319, p. 128). NIOSH did not support the use of SECALs and stated that the requirement to meet the PEL for silica generating processes should be maintained (Document ID 2177, Attachment B, p. 16).

OSHA stresses that, where incorporated in a standard, a SECAL is intended for application to discrete processes and operations within an industry, rather than application to an entire industry, as some supporters of SECALs seemed to suggest. For example, in OSHA's cadmium standard, OSHA established SECALs for certain plating and other processes in a few affected industries. OSHA did not receive evidence to support establishing a SECAL for any discrete task or operation within a particular industry in the respirable crystalline silica rule. OSHA therefore has not established SECALs in the rule.

<u>Abrasive blasting</u>. Abrasive blasting requirements remain the same as proposed, except for minor editorial changes. Paragraph (f)(3) of the standard for general industry and maritime (paragraph (d)(3)(ii) of the standard for construction) requires the employer to comply with paragraph (f)(1) of the standard for general industry and maritime (paragraph (d)(3)(i) of the standard for construction) where abrasive blasting is conducted using crystalline silica-containing blasting agents, or where abrasive blasting is conducted on substrates that contain crystalline silica. Thus, for abrasive blasting, employers must follow the hierarchy of controls applicable to other tasks covered by the rule.

In this provision addressing abrasive blasting, the proposed standard referred to "where abrasive operations are conducted," but for simplicity, this standard refers to "where abrasive blasting is conducted." OSHA intends this change to be editorial only, and does not intend a substantive change from the proposed requirements.

In addition, paragraph (f)(3) of the standard for general industry and maritime indicates that the employer must comply with the requirements of 29 CFR 1910.94 (Ventilation), 29 CFR 1915.34 (Mechanical paint removers) and 29 CFR 1915 Subpart I, as applicable, where abrasive blasting is conducted using crystalline silica-containing blasting agents, or where abrasive blasting is conducted on substrates that contain crystalline silica. Paragraph (d)(3)(ii) of the standard for construction indicates that the employer must comply with the requirements of 29 CFR 1926.57 (Ventilation) in such circumstances.

OSHA's general industry (29 CFR 1910.94) and construction ventilation standards (29 CFR 1926.57), as well as the standards for mechanical paint removers (29 CFR 1915.34) and personal protective equipment for shipyard employment (29 CFR 1915 subpart I) provide requirements for respiratory protection for abrasive blasting operators and others involved in abrasive blasting. This rule includes cross-references to these standards. Employers using abrasive blasting need to consult these referenced standards to ensure that they comply with their provisions for personal protective equipment and ventilation, and other operation-specific safety requirements.

ISEA urged OSHA to add a reference to the APF table at 29 CFR 1910.134(d)(3)(i)(A) in the general industry and construction standards for ventilation, and to require that if the employer has no sampling data to support the use of an abrasive blasting respirator with an APF of 25, the employer must select a respirator with an APF of 1,000 (Document ID 2212, p. 1). The 3M Company similarly questioned the respirator requirements under the ventilation standards, arguing that without considering the performance (APF) of the respirator, some employees could be overexposed to silica (Document ID 2313, pp. 1, 5-6). Charles Gordon, a retired occupational safety and health attorney, commented that even with the reference to the ventilation standards, the provision is not protective enough. He encouraged the Agency to require the most protective abrasive blasting hood and respirators and require the best work practices (Document ID 2163, Attachment 1, p. 19).

Given the high levels of hazardous dust generated during abrasive blasting, OSHA has concluded, for reasons discussed in its technological feasibility analyses for construction and for certain general industry sectors like foundries and shipyards that perform abrasive blasting in their operations, that respiratory protection will continue to be necessary to reduce silica exposure below the PEL, even with engineering and work practice controls in place (see the discussion of abrasive blasting in Chapter IV of the FEA). This standard also takes respirator use into account by cross-referencing the specific respirator requirements already in place for abrasive blasting. Employers are also required to comply with the requirements of 29 CFR 1910.134 whenever respiratory protection is required by this section. Under 29 CFR 1910.134, the employer is required to select and provide an appropriate respirator based on the respiratory hazards to which the employee is exposed and is required to use the APF table at 29 CFR 1910.134(d)(3)(i)(A). This includes note four of the APF table, which requires the employer to have evidence to support an APF of 1000 for helmet/hood respirators. In addition, paragraph (d) of the standard for general industry and maritime and paragraph (d)(2) of the standard for construction require employers to assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level, which will provide employers with information to make appropriate respirator selection decisions. OSHA concludes that these requirements, including the referenced provisions in other OSHA standards, will adequately protect employees from exposures to respirable crystalline silica during abrasive blasting.

Many commenters, including NIOSH, labor unions, public health organizations, trade associations, occupational health medical professionals, and public interest organizations, urged OSHA to ban the use of silica sand as an abrasive blasting agent (Document ID 2167; 2173, p. 4; 2175, pp. 7-8; 2177, Attachment B, p. 37; 2178, Attachment 1, p. 3; 2212, p. 1; 2240, p. 2; 2244, p. 2; 2256, Attachment 2, pp. 12-13; 2282, Attachment 3, pp. 2, 18; 2341, p. 3; 2371, Attachment 1, p. 31; 2373, p. 3; 3399, p. 6; 3403, p. 7; 3577, Tr. 779-780, 785, 790; 3586, Tr. 3319-3320, 3163; 3588, Tr. 3752; 4204, p. 81; 4223, pp. 104-106). Some noted that 4 countries (Great Britain, Germany, Sweden, and Belgium), several U.S. military departments, and 23 state Departments of Transportation have already banned the practice (Document ID 2167; 2175, pp. 7-8; 2178, Attachment 1, p. 3; 2256, Attachment 2, pp. 12-13; 2212, p. 1; 2282, Attachment 3, p. 18; 2371, Attachment 1, p. 31; 2373, p. 3; 3399, p. 6; 4204, p. 76).

Fann Contracting, Dr. Kenneth Rosenman, an expert in occupational and environmental disease, and Novetas Solutions noted the broad trend of abrasive blasting operations moving away from sand (Document ID 2116, Attachment 1, pp. 31-32; 3577, Tr. 858; 3588, Tr. 3992-3993). The American Federation of State, County and Municipal Employees reported that several local Maryland unions no longer use silica-based blasting agents and have substituted other materials, such as aluminum shot (Document ID 2106, p. 2). Sarah Coyne, a former painter and current Health and Safety Director for IUPAT, discussed how their signatory contractors have largely transitioned from silica sand to coal slag for abrasive blasting (Document ID 3581, Tr. 1644). API noted that many oil and gas companies have limited or eliminated respirable crystalline silica exposure in sandblasting operations by using media options that do not contain silica (Document ID 2301, Attachment 1, p. 5). NADA also noted that product substitution has minimized potential exposures to airborne crystalline silica-containing media (Document ID

2358, p. 4). The Interstate Natural Gas Association of America stated that members utilize other abrasives to the extent feasible, including fused glass in limited applications (Document ID 2081, p. 2).

As OSHA indicated in its NPRM, the use of silica sand for abrasive blasting operations is decreasing (Document ID 1420). This reduction might reflect the use of alternative blasting media, the increased use of high-pressure water-jetting techniques, and the use of cleaning techniques that do not require open sand blasting. Several substitutes for silica sand are available for abrasive blasting operations, and current data indicate that the abrasive products with the highest U.S. consumptions are: coal slag, copper slag, nickel slag, garnet, staurolite, olivine, steel grit, and crushed glass. Several commenters (Adam Webster, Charles Gordon, and the Association of Occupational and Environmental Clinics) also noted the general availability of alternative abrasive blast media, including baking soda, water, dry ice, coal/copper slag, glass beads, walnut shells, and carbon dioxide (Document ID 2163, p. 19; 2167; 3399, p. 6). Additional alternatives are discussed and evaluated in Chapter IV of the FEA. On the other hand, PCI commented that the use of alternative abrasive blast media was precluded in the precast concrete structures industry, since many alternatives will not meet aesthetic requirements, are not aggressive enough to provide the desired finished, or are simply cost prohibitive (Document ID 2276, p. 9). Furthermore, CISC warned about possible hazards associated with the substitutes for silica sand (Document ID 2319, p. 37). PCI and Novetas Solutions cautioned that coal and copper slags, commonly used as a substitute for silica sand in abrasive blasting, contain hazardous substances such as beryllium that cause adverse health effects in employees (Document ID 2276, p. 9; 3588, Tr. 3992-4004). Meeker et al. (2006) found elevated levels of exposure to arsenic, beryllium, and other toxic metals among painters using three alternative blasting abrasives (Document ID 3855).

A NIOSH study compared the short-term pulmonary toxicity of several abrasive blasting agents (Document ID 1422). This study reported that specular hematite and steel grit presented less short-term in vivo toxicity and respirable dust exposure in comparison to blast sand. Overall, crushed glass, nickel glass, staurolite, garnet, and copper slag were similar to blast sand in both categories. Coal slag and olivine showed more short-term in vivo toxicity than blast sand and were reported as similar to blast sand regarding respirable dust exposure. This study did not examine long-term hazards or non-pulmonary effects.

Additionally, another NIOSH study monitored exposures to several OSHA-regulated toxic substances that were created by the use of silica sand and substitute abrasive blasting materials (Document ID 0772). The study showed that several substitutes create exposures or potential exposures to various OSHA-regulated substances, including: (1) arsenic, when using steel grit, nickel slag, copper slag and coal slag; (2) beryllium, when using garnet, copper slag, and coal slag; (3) cadmium, when using nickel slag and copper slag; (4) chromium, when using steel grit, nickel slag, and copper slag; and (5) lead, when using copper slag. Since these studies were performed, OSHA has learned that specular hematite is not being manufactured in the United States due to patent-owner specification. In addition, the elevated cost of steel has a substantial impact on the availability to some employers of substitutes like steel grit and steel shot.

Evidence in the rulemaking record indicates that elevated silica exposures have been found during the use of low-silica abrasives as well, even when blasting on non-silica substrates. For example, the use of the blasting media Starblast XL (staurolite), which contains less than one percent quartz according to its manufacturer, resulted in a respirable quartz level of 1,580 μg/m³. The area sample (369-minute) was taken inside a containment structure erected around two steel tanks. The elevated exposure occurred because the high levels of abrasive generated during blasting in containment overwhelmed the ventilation system (Document ID 0212). This example emphasizes the impact of control methods in specific working environments. In order to reduce elevated exposures to or as close as feasible to the PEL in situations like these, employers need to examine the full spectrum of available controls and how these controls perform in specific working conditions.

After considering the arguments for and against prohibition, OSHA concludes that prohibiting the use of silica sand as an abrasive blasting agent is not appropriate. In so concluding, the Agency considered whether such a prohibition is an effective risk mitigation measure, as well as the technological feasibility of substitutes. The Agency finds that many of the silica sand substitutes used in abrasive blasting can create hazardous levels of toxic dust other than silica, as documented in studies conducted by NIOSH on the toxicity of silica sand substitutes for abrasive blasting; NIOSH found that many, including coal slag, garnet, copper and nickel slags, olivine, and crushed glass, produced lung damage and inflammatory reactions in rodent lung similar to that of silica sand, indicating that use of such materials would present lung disease risks to employees (Document ID 3857; 3859). OSHA further finds that additional toxicity data are necessary before the Agency can reach any conclusions about the hazards of these substitutes relative to the hazards of silica. Given the concerns about potential harmful exposures to other substances that the alternatives might introduce in a workplace, as well as the potential for continued exposure to respirable crystalline silica, OSHA concludes that banning the use of silica sand as an abrasive blasting agent would not necessarily effectively mitigate risk. OSHA also concludes, as detailed in the FEA, that the general prohibition of silica sand in abrasive blasting is not technologically or economically feasible. Thus, the Agency has decided against a ban or limitation on the use of silica sand as an abrasive blasting agent in the rule.

BCTD urged OSHA to ban the use of silica sand as an abrasive blasting agent, but said that if banning the use of silica sand as an abrasive blasting agent was not possible, OSHA should prohibit the use of dry silica sand as an abrasive blasting agent (Document ID 2371, Attachment 1, p. 31). However, PCI noted that wet blasting with silica sand cannot be used to finish concrete surfaces (Document ID 2276, p. 9). CISC noted the problems associated with excessive water application on some worksites and argued that different environments and conditions had not been analyzed to determine the effectiveness of wet methods for abrasive blasting (Document ID 2319, p. 36).

OSHA finds that a separate requirement for the use of wet blasting methods when silica sand is used as a blasting agent is neither necessary nor appropriate. Under paragraph (f)(1) of the standard for general industry and maritime (paragraph (d)(3)(i) of the standard for construction), employers are required to use engineering and work practice controls, which include wet methods, to reduce and maintain employee exposure to respirable crystalline silica at or below the PEL, unless the employer can demonstrate that such controls are not feasible. Therefore, where employee exposures exceed the PEL from abrasive blasting with silica sand, employers must implement wet blasting methods whenever such methods are feasible and would reduce exposures, even if implementing this control does not reduce exposures to or below the PEL. By not specifically mandating the use of wet methods whenever sand is used as a blasting agent, the rule gives employers who cannot feasibly use wet methods flexibility to determine what controls to implement in order with comply with the PEL.

Charles Gordon argued for a partial ban on the use of silica sand as an abrasive blasting agent:

> Abrasive blasting with crystalline silica should be banned in confined spaces and in the maritime industry. That is where acute silicosis was most common and where it is hardest to protect adjacent workers.
>
> In all other areas and operations, the employer must consult MSDS's for substitutes for crystalline silica. If it is reasonable to conclude that a substitute for crystalline silica is a safer blasting media and will lead to a reasonable surface, then the employer must adopt the substitute. If the employer concludes that there is no safer reasonable substitute for crystalline silica, then the employer must keep a brief written record of that determination (Document ID 2163, Attachment 1, pp. 18-19).

While OSHA has declined to ban abrasive blasting with crystalline silica in any setting, the Agency considers that the process of selecting, evaluating, and adopting safer blasting agent substitutes where feasible, is consistent with the analysis required under paragraph (f)(1) of the standard for general industry and maritime (paragraph (d)(3)(i) of the standard for construction). As part of complying with this paragraph, employers must consider whether substitutes for crystalline silica abrasive blasting agents are available. Safer, effective, and feasible substitutes, where available, should be included as part of the package of feasible engineering and work practice controls required to reduce employee exposure to respirable crystalline silica to or below the PEL. The Agency expects that the requirements in the rule will incentivize employer evaluation and adoption of substitute materials where substitution is appropriate for the task and shown to be safe, while avoiding substitutions that pose comparable or greater risk and maintaining flexibility for employers to determine what controls to implement in order to comply with the PEL.

CISC questioned the application of the hierarchy of controls to abrasive blasting, given the Agency's acknowledgement that respiratory protection will still be necessary in many situations even after implementing engineering and work practice controls (Document ID 2319, p. 37). As discussed above, the Agency maintains its position that adherence to the hierarchy of controls, which includes, where appropriate and feasible, substitutes for silica sand, wet blasting, LEV, proper work practices and housekeeping practices that reduce dust emissions, is essential to help reduce the extremely high exposures to respirable crystalline silica experienced by abrasive blasting workers and workers who may be near them. The FEA describes how extremely high exposures associated with dry abrasive blasting were significantly reduced where controls, such as wet blasting and non-silica containing abrasive blast media, were used (see Chapter IV of the FEA for further discussion). By using engineering controls to reduce these exposures, employees will be able to wear less restrictive respirators and will be better protected if their respiratory protection fails. Engineering controls also help protect others on the worksite from exposure to respirable crystalline silica. Therefore, requiring the use of controls, even where respiratory protection will also be required, is reasonably necessary and appropriate to protect employees from exposures to respirable crystalline silica.

The requirements in the rule for abrasive blasting are consistent with ASTM E 1132 – 06 and ASTM E 2625 – 09, the national consensus standards for controlling occupational exposure to respirable crystalline silica in general industry and in construction, respectively. Each of these standards clarifies that the hierarchy of controls (i.e., using alternative materials, wet suppression systems, or exhaust ventilation, where feasible, to reduce exposures) applies to abrasive blasting and refers to the existing requirements under OSHA's ventilation standards (29 CFR 1910.94 and 29 CFR 1926.57).

Employee rotation. OSHA proposed, but is not including in the final rule, a provision specifying that the employer must not rotate employees to different jobs to achieve compliance with the PEL. The Agency proposed this prohibition because silica is a carcinogen, and OSHA considers that any level of exposure to a carcinogen places an employee at risk. With employee rotation, the population of exposed employees increases. A prohibition on rotation has been included in other OSHA health standards that address carcinogens, such as the standards for asbestos (29 CFR 1910.1001), chromium (VI) (29 CR 1910.1026), 1,3-butadiene (29 CFR 1910.1051), methylene chloride (29 CFR 1910.1052), cadmium (29 CFR 1910.1027), and methylenedianiline (29 CFR 1910.1050). However, other standards addressing chemicals that were associated with non-cancer health effects, such as the standards for lead and cotton dust (29 CFR 1910.1025 and 29 CFR 1910.1043), do not include a prohibition on employee rotation to achieve the PEL. In response to a recommendation by the Small Business Advocacy Review Panel, OSHA solicited comment in the NPRM on the prohibition of employee rotation to achieve compliance with the PEL (78 FR 56273, 56290 (9/12/13)).

A prohibition on employee rotation to achieve compliance with the PEL was supported by EEI, Dr. George Gruetzmacher, and James Schultz (Document ID 2278, p. 4; 2357, p. 30; 3586, Tr. 3200). However, many commenters representing employers from the concrete, brick, tile, construction, electric utility, and foundry industries, over 20 trade associations, ASSE, and academics from the George Washington University Regulatory Studies Center urged OSHA to reconsider this prohibition (e.g., Document ID 1785, p. 8; 1831, p. 15; 1992, p. 11; 2023, p. 7; 2024, p. 3; 2075, p. 3; 2102, p. 2; 2116, Attachment 1, pp. 34-35; 2119, Attachment 3, p. 7; 2145, pp. 5-6; 2147, p. 4; 2150, p. 2; 2154, Attachment 3, p. 7; 2185, pp. 6-7; 2195, p. 39; 2213, p. 4; 2215, p. 11; 2222, p. 2; 2241, p. 2; 2245, p. 3; 2255, p. 3; 2276, p. 10; 2279, p. 10; 2288, p. 12; 2296, p. 42; 2305, pp. 11, 15; 2309, p. 3; 2322, p. 14; 2326, p. 3; 2339, p. 4; 2348, Attachment 1, p. 36; 2355, p. 2; 2359, Attachment 1, p. 11; 2370, p. 2; 2379, Appendix 1, p. 69;

2380, Attachment 2, p. 21; 2384, p. 10; 2391, p. 2; 3245, p. 2; 3275, p. 2; 3489, p. 4; 3491, p. 4; 3578, Tr. 1035-1036, 1044; 3729, p. 3; 4194, p. 12; 4213, p. 7; 4226, p. 2).

Some commenters misunderstood the prohibition on employee rotation to achieve compliance with the PEL, or believed that the provision could be misunderstood by the regulated community. These commenters were concerned that the prohibition would preclude the use of rotation for other reasons, such as limiting exposure to physical hazards (e.g., noise, vibration, repetitive motion stresses), providing cross-training, improving productivity, preventing fatigue, and filling in for other employees. OSHA explained in the NPRM that the proposed provision was not intended as a general prohibition on employee rotation. However, commenters including National Electrical Carbon Products, OSCO, the Ohio Cast Metals Association, PCI, and AFS expressed concerns that using employee rotation for these other reasons could be misinterpreted as a violation of the prohibition (e.g., Document ID 1785, p. 8; 1992, p. 11; 2119, Attachment 3, p. 7; 2276, p. 10; 3489, p. 4;). NISA also asked the Agency to clarify that rotation may be performed for purposes other than achieving compliance with the PEL (Document ID 2195, p. 39).

NISA and the Chamber argued that if the risks of silicosis are subject to a threshold, then rotation to maintain exposures at low levels could only be protective (Document ID 2195, p. 39; 2288, p. 12; 4194, p. 12). ASSE argued that job rotation may be warranted as an alternative to burdensome engineering and administrative controls or PPE for tasks that involve some levels of exposure to silica, but are performed on an infrequent basis (Document ID 2339, p. 4; 3578, Tr. 1035-1036, 1044). ASSE, as well as Dal-Tile, noted that since silica is a ubiquitous substance and present in many raw materials, virtually all employees would be exposed to some level of respirable crystalline silica. Therefore, they argued that a prohibition on rotation in this circumstance does not make sense (Document ID 2147, p. 4; 2339, p. 4). In addition, AFS indicated that rotation as an administrative control is permitted by Canadian provinces with exposure limits for respirable crystalline silica (Document ID 4035, p. 14). OSHA also notes that the industry consensus standards for respirable crystalline silica, ASTM E 1132 – 06 and ASTM E 2625 – 09, expressly permit employee rotation as an administrative control to limit exposures (Document ID 1466, p. 4; 1504, pp. 3, 7).

OSHA does not consider employee rotation to be an acceptable alternative to avoid the costs associated with implementation of engineering and administrative controls, nor does the Agency consider that pervasive exposures to respirable crystalline silica justify allowing rotation. OSHA has nonetheless concluded that there may be situations where employee rotation may be an acceptable measure to limit the need for respiratory protection. For example, OSHA has determined that the majority of employers covered by the rule will be in construction, and expects that most construction employers will implement the controls listed on Table 1 in paragraph (c) of the standard for construction. A number of tasks listed on Table 1 require respiratory protection, in addition to engineering and work practice controls, when performed for more than four hours per shift. Where the employer has implemented the engineering and work practice controls specified in Table 1, OSHA accepts the rationale that it may be reasonable to rotate employees to avoid exceeding the four-hour threshold that would trigger a requirement for respirator use. As discussed earlier in this section, respirator use can restrict visibility, impair communication, contribute to heat stress, strain the respiratory and cardiac systems, and exacerbate other safety and health hazards, such as trip and fall hazards. Under such circumstances, rotation of employees to limit use of respiratory protection may serve to reduce overall risks to employees. Rotation may also allow employees to continue to work if they are unable to pass the medical evaluation for respirator use, but are otherwise capable of performing the work.

OSHA also recognizes that a provision prohibiting employee rotation to achieve the PEL has little practical application for purposes of enforcement. Because the prohibition is limited to rotation for the sole purpose of achieving the PEL, an employer can provide any other reason to justify employee rotation. As described above, there are many legitimate reasons for an employer to rotate employees. As a result, OSHA has almost never cited employers for violating provisions prohibiting employee rotation for achieving the PEL. For the 7 standards that contain these provisions, which have been in effect for periods ranging from 8 to 29 years, Federal OSHA has only cited one of these provisions on one occasion.

For the reasons described above, OSHA has determined that a prohibition on employee rotation to achieve the PEL is not reasonably necessary or appropriate for the silica rule. The Agency recognizes that this determination differs from the determinations made in previous rulemakings addressing carcinogens. This is not intended as a reversal of OSHA’s prior practice of prohibiting employee rotation to achieve the PEL for carcinogens, nor a precedent that will control future rulemakings, which necessarily will be based on different rulemaking records. Nevertheless, in this rule OSHA expects that the majority of employers covered by the rule will implement all feasible engineering and work practice controls to achieve the PEL (as the rule requires), and rotation will generally be used to limit use of respiratory protection that is triggered by working more than four hours in conditions where exposures are expected above the PEL even with the full implementation of engineering and work practice controls. OSHA finds that these factors justify omitting the prohibition on rotation from this rule. Therefore, the prohibition, which was included in the proposed rule, is not included in the final rule.

Respiratory Protection

Paragraph (g) of the standard for general industry and maritime (paragraph (e) of the standard for construction) establishes requirements for the use of respiratory protection, to which OSHA's respiratory protection standard (29 CFR 1910.134) also applies. Specifically, respirators are required under the rule: where exposures exceed the PEL during periods necessary to install or implement engineering and work practice controls; where exposures exceed the PEL during tasks, such as certain maintenance and repair tasks, for which engineering and work practice controls are not feasible; and during tasks for which all feasible engineering and work practice controls have been implemented but are not sufficient to reduce exposure to or below the PEL. The standard for general industry and maritime also requires respiratory protection during periods when an employee is in a regulated area. The standard for construction also requires respiratory protection where specified by Table 1 of paragraph (c), but does not include a requirement to establish a regulated area, and thus does not contain a provision requiring the use of respirators in regulated areas.

These provisions of the rule for the required use of respirators are consistent with those proposed and are generally consistent with other OSHA health standards, such as methylene chloride (29 CFR 1910.1052) and chromium (VI) (29 CFR 1910.1026). They reflect the Agency's determination that, as discussed in the summary and explanation of Methods of Compliance, respirators are inherently less reliable than engineering and work practice controls in reducing employee exposure to respirable crystalline silica. OSHA therefore is allowing reliance on respirators to protect against exposure to respirable crystalline silica only in specific circumstances where engineering and work practice controls are in the process of being installed or implemented (and thus are not yet fully operational), are not feasible, or cannot by themselves reduce exposures to the PEL. In those circumstances, OSHA's hierarchy of controls contemplates requiring the use of respirators as a necessary supplement to engineering, work practice, and administrative controls.

Paragraph (e)(1) of the standard for construction is revised from the proposed standard in order to clarify where respiratory protection is required. Paragraph (e)(1)(i) of the standard for construction provides that, for employers following the specified exposure control methods approach set forth in paragraph (c) of the standard for construction, respiratory protection is required under the standard where specified by Table 1. Table 1 in paragraph (c) of the standard for construction specifies respirator use for certain listed tasks; employers whose employees are engaged in those tasks have the option of following Table 1 in order to comply with the standard. The specific respiratory protection and minimum assigned protection factors (APF) for the tasks listed on Table 1 are discussed in the summary and explanation of Specified Exposure Control Methods. Paragraph (e)(1)(ii) of the standard for construction establishes where respirators are required for employees who are not performing tasks listed on Table 1 or where the engineering controls, work practices, and respiratory protection described in Table 1 are not fully and properly implemented (including where the employer chooses to follow paragraph (d) rather than follow paragraph (c)). Specifically, respirators are required in each of the situations described in paragraphs (e)(1)(ii)(A)-(C).

Paragraph (g)(1)(i) of the standard for general industry and maritime (paragraph (e)(1)(ii)(A) of the standard for construction) requires the use of respirators in areas where exposures exceed the PEL during periods when feasible engineering and work practice controls are being installed or implemented. OSHA recognizes that respirators may be needed to achieve the PEL under these circumstances. During these times, employees will have to use respirators for temporary protection until the hierarchy of controls has been implemented, at which point respirators will not be needed, provided the PEL is no longer exceeded. Employers must follow the requirements for exposure assessment (see the summary and explanation of Exposure Assessment) to determine the extent of employee exposures once engineering and work practice controls are installed or implemented. While there is not an established time for exposure assessments to occur after the installation or implementation of controls, employers are required to reassess exposures whenever a change in control equipment may reasonably be expected to result in new or additional exposures above the action level. Employers must also ensure that employee exposures are accurately characterized, so they would need to reassess exposures after the installation or implementation of controls in order to meet this obligation.

OSHA anticipates that engineering controls will be in place by the dates specified in paragraphs (l)(2) and (l)(3) of the general industry and maritime standard (paragraph (k)(2) of the standard for construction) (see the summary and explanation of Dates for discussion of these requirements). However, the Agency realizes that in some cases employers may commence operations, install new or modified equipment, or make other workplace changes that result in new or additional exposures to respirable crystalline silica after the dates specified. In these cases, a reasonable amount of time may be needed before appropriate engineering controls can be installed and proper work practices implemented. When employee exposures exceed the PEL in these situations (see the summary and explanation of Exposure Assessment for an explanation of the requirements to assess employee exposure to respirable crystalline silica), employers must provide their employees with respiratory protection and ensure its use.

Paragraph (g)(1)(ii) of the general industry and maritime standard (paragraph (e)(1)(ii)(B) of the standard for construction) requires respiratory protection in areas where exposures exceed the PEL during tasks in which engineering and work practice controls are not feasible. OSHA anticipates that there will be few situations where no feasible engineering or work practice controls are available to limit employee exposure to respirable crystalline silica. However, the Agency recognizes that it may be infeasible to control respirable crystalline silica exposure with engineering and work practice controls during certain tasks, such as maintenance and repair tasks, and permits the use of respirators in these situations. For example, maintenance and repair to address temporary failures in operating systems or control systems to achieve the PEL such as failures of conveyance systems (elevators, conveyors, or pipes), failures of dust collecting bag systems, and section head failures at glass plant facilities as well as cupola (furnace) repair work and baghouse maintenance activities, may present a situation where engineering and work practice controls are not feasible and the use of respirators is permitted (Document ID 3493, p. 3; 1992, pp. 3, 5). In situations where respirators are used as the only means of protection, the employer must be prepared to demonstrate that engineering and work practice controls are not feasible.

Paragraph (g)(1)(iii) of the standard for general industry and maritime (paragraph (e)(1)(ii)(C) of the standard for construction) requires the use of respirators for supplemental protection in circumstances where feasible engineering and work practice controls alone are not sufficient to reduce exposure levels to or below the PEL. The employer is required to install and implement all feasible engineering and work practice controls, even if these controls alone cannot reduce employee exposures to or below the PEL. Whenever respirators are used as supplemental protection, the burden is on the employer to demonstrate that engineering and work practice controls alone are insufficient to achieve the PEL.

Paragraph (g)(1)(iv) of the standard for general industry and maritime requires employers to provide respiratory protection during periods when an employee is in a regulated area. Paragraph (e) of the standard for general industry and maritime requires employers to establish a regulated area wherever an unprotected employee's exposure to airborne concentrations of respirable crystalline silica is, or can reasonably be expected to be, in excess of the PEL. OSHA included the provision requiring respirator use in regulated areas to make it clear that each employee is required to wear a respirator when present in a regulated area, regardless of the duration of time spent in the area. Because of the potentially serious results of exposure, OSHA has concluded that this provision is necessary and appropriate because it would limit unnecessary exposures to employees who enter regulated areas, even if they are only in a regulated area for a short period of time. The standard for construction does not include a requirement to establish a regulated area and thus, does not contain a similar provision in the respiratory protection section of the standard. Further discussion about this can be found in the summary and explanation of Regulated Areas and Written Exposure Control Plan.

OSHA proposed to require the use of respiratory protection when specified by the written access control plan—an option given to employers in the proposed rule as an alternative to establishing regulated areas. The Agency is not including an access control plan option in the rule (see discussion in the summary and explanation of Regulated Areas). Thus, without an option for an employer to develop a written access control plan, there is no reason to require respirators pursuant to a written access control plan.

Commenters, including Charles Gordon, a retired occupational safety and health attorney, and the American Industrial Hygiene Association recommended that OSHA require employers to provide employees with respirators upon request in certain situations where they are not required under the rule (e.g., exposures below the PEL, Table 1 tasks for which respirators are not required) (Document ID 2163, Attachment 1, p. 16; 2169, p. 5). Dr. George Gruetzmacher, an industrial hygiene engineer, suggested that OSHA require respiratory protection and a respiratory protection program at the action level (Document ID 2278, p. 4).

While the Agency considers the level of risk remaining at the PEL to be significant, OSHA is not including a provision in this rule permitting employees to request and receive a respirator in situations where they are not required under the rule, nor is OSHA requiring respiratory protection and a respiratory protection program at the action level. There has been significant residual risk below the PEL in many previous health standards, but OSHA has only rarely included provisions permitting employees to request and receive a respirator to mitigate this risk (cotton dust (29 CFR 1910.1043(f)(1)(v)), lead (29 CFR 1910.1025(f)(1)(iii)), cadmium (29 CFR 1910.1027(g)(1)(v))) and the Agency has never established a requirement for respiratory protection and a respiratory protection program at a standard's action level.

OSHA anticipates that most construction employers covered by the rule will choose to implement the control measures specified in paragraph (c) of the standard for construction. Employers who implement the specified exposure control methods will not be required to assess employee exposures to respirable crystalline silica. Therefore, many employers covered by the rule will not be aware if their employees are exposed to respirable crystalline silica at or above the action level. In order to impose a requirement for employers to provide respirators to employees exposed at or above the action level, OSHA would first need to require employers to assess the exposures of all employees in order to determine which employees are exposed at or above the action level. As discussed in the summary and explanation of Specified Exposure

Control Methods, OSHA has concluded that such an exposure assessment requirement is not necessary for employers who implement the controls listed on Table 1.

With regard to permitting employees to request respirators for Table 1 tasks where respiratory protection is not specified, OSHA has relied on its technological feasibility analyses to determine which tasks can be performed at or below the PEL most of the time with the use of engineering and work practice controls only (i.e., without respirators), and has concluded that employers who implement the controls listed on Table 1 for these tasks will provide equivalent overall protection for their employees as employers who perform exposure assessment and follow the alternative exposure control methods option provided in paragraph (d). If an employer follows Table 1 and Table 1 does not require use of a respirator, the employee's exposure will generally be below the PEL. There may be exceptions, but this is no different than when monitoring is conducted – monitoring two or four times a year does not perfectly characterize exposures, and there will be situations where exposures exceed the PEL even when good faith monitoring efforts by the employer indicate that exposures would be below the PEL.

If respirators were mandated at the action level or available upon employee request in situations where they are not required under the rule, employers would need to have respirators available at all times. Moreover, they would need to establish and implement a full respiratory protection program for all employees exposed to silica—a considerable undertaking for many employers that involves not only the purchase and retention of suitable respirators but an ongoing program of training, fit-testing, and maintenance. OSHA concludes that "on request" respirator use or requiring respiratory protection at the action level is not a practical or responsible approach to occupational safety and health regulation, and requiring such an investment in respirators would divert resources from the development and implementation of engineering controls that could more effectively reduce exposure levels to or below the PEL. Thus, OSHA's approach for reducing employee exposure to respirable crystalline silica in this and all other standards for air contaminants is to focus on engineering controls, rather than additional requirements for respiratory protection. For these reasons, OSHA has determined that a requirement for employers to provide respirators to employees upon request in situations where they are not required under the rule, or a requirement to provide respirators to employees exposed at or above the action level, is not reasonably necessary and appropriate for this respirable crystalline silica rule.

At the same time, OSHA does not prohibit employers from supplying or employees from using respirators outside the requirements of the rule. Therefore, although this rule does not include a provision providing employees with a right to request and receive respirators where not required by the rule, or requiring respiratory protection at the action level, employers may continue to provide respirators at the request of employees or permit employees to use their own respirators in situations where respirator use is not required, as provided for in the respiratory protection standard (29 CFR 1910.134(c)(2)(i)). OSHA's understanding, however, is that such use beyond what is required in a comprehensive OSHA standard is not a common occurrence, and the Agency does not expect non-mandated respirator use to proliferate with respect to this rule, as might well be the case if a provision requiring employers to provide respirators “on request” was written into the rule and would certainly be the case if the action level were used as the trigger for respirator use.

Industry commenters, including the Construction Industry Safety Coalition, OSCO Industries, American Foundry Society, National Association of Manufacturers, Glass Packaging Institute, American Composite Manufacturers Association, Small Business Administration’s

Office of Advocacy, U.S. Chamber of Commerce, and American Subcontractors Association, urged OSHA to consider discarding the hierarchy of controls and permitting the use of respirators in lieu of engineering and work practices controls in various circumstances, including: during short duration tasks performed intermittently (Document ID 1992, pp. 3, 5; 2319, p. 115); where exposures exceed the PEL for 30 days or less per year (Document ID 4229, p. 11); where exposures are below the respirable dust PEL of 5 mg/m^3 (Document ID 2380, Attachment 2, p. 24); for unanticipated maintenance issues (Document ID 3493, pp. 2-3); for small businesses (Document ID 3588, Tr. 3933-3936); for construction employers (Document ID 2187, p. 6; 2283, p. 3; 2349, p. 5); and for industries using large amounts of crystalline silica (e.g., oil and gas operations where hydraulic fracturing is conducted) (Document ID 2283, p. 3; 3578, Tr. 1091). These comments are discussed in the summary and explanation of Methods of Compliance. As indicated in that section, OSHA's longstanding hierarchy of controls policy reflects the common assessment among industrial hygienists and the public health community that respirators are inherently less reliable than engineering and work practice controls in reducing employee exposure to air contaminants like respirable crystalline silica, and therefore, except in limited circumstances, they should not be allowed as an alternative to engineering and work practice controls, which are more reliable in controlling exposures. Thus, the Agency has not included additional situations where respirators are required in the respiratory protection paragraph, but as previously discussed, recognizes that, in some circumstances, such as certain maintenance and repair activities, engineering and work practice controls may not be feasible and the use of respiratory protection would be required.

Paragraph (g)(2) of the general industry and maritime standard (paragraph (e)(2) of the standard for construction) requires the employer to implement a comprehensive respiratory protection program in accordance with OSHA's respiratory protection standard (29 CFR 1910.134) whenever respirators are used to comply with the requirements of the respirable crystalline silica standard. As contemplated in the NPRM, a respiratory protection program that complies with the respiratory protection standard will ensure that respirators are properly used in the workplace and are effective in protecting employees. In accordance with that standard, the program must include: procedures for selecting respirators for use in the workplace; medical evaluation of employees required to use respirators; fit-testing procedures for tight-fitting respirators; procedures for proper use of respirators in routine and reasonably foreseeable emergency situations; procedures and schedules for respirator maintenance; procedures to ensure adequate quality, quantity, and flow of breathing air for atmosphere-supplying respirators; training of employees in respiratory hazards to which they might be exposed and the proper use of respirators; and procedures for evaluating the effectiveness of the program (78 FR 56274, 56467 (9/12/13)).

Many employers commented that they already have respiratory protection programs in place to protect employees from exposures to respirable crystalline silica (Document ID 1964; 2183, p. 1; 2276, p. 5; 2292, p. 2; 2301, Attachment 1, p. 5, 37; 2338, p. 2; 2366, p. 3; 3577, Tr. 711; 3583, Tr. 2386-2387). The International Union of Bricklayers and Allied Craftworkers and the International Union of Operating Engineers also indicated that their members' employers have established respiratory protection programs (Document ID 2329, p. 7; 3583, Tr. 2342, 2367).

The American Association of Occupational Health Nurses, Ameren Corporation, 3M Company, and Dr. George Gruetzmacher supported the reference to the respiratory protection standard (Document ID 2134; 2278, p. 3; 2313, p. 6; 2315, p. 4). For example, the 3M Company, which manufactures respirators, stated:

> 3M believes that by not requiring separate, individual respiratory protection provisions for respirable crystalline silica, the . . . rule should enhance consolidation and uniformity of the 1910.134 respirator requirements and could result in better compliance concerning the use of respiratory protection. Many of our customers use respirators to help protect workers from exposures to multiple contaminants and the reference in the respirable crystalline silica standard to the requirements of 1910.134 brings uniformity that could likely result in better compliance and protection for workers with exposures to silica and other materials (Document ID 2313, p. 6).

Expressing an opposing view, the National Stone, Sand, and Gravel Association commented that the respiratory protection paragraph was duplicative of existing requirements in 29 CFR 1910.134 (Document ID 2327, Attachment 1, p. 11).

OSHA concludes that referencing the requirements in the respiratory protection standard is important for ensuring that respirators are properly used in the workplace and are effective in protecting employees. Simply cross-referencing these requirements merely brings the applicable requirements to the attention of the employer; the cross-reference does not add to the employer's existing legal obligations, but it makes it more likely that the employer covered by this standard will meet all its obligations with regard to providing respirators when required to do so. Thus, the Agency has incorporated in the rule the reference to the respiratory protection standard that was proposed.

A representative of a local union and individual employees recommended specific respirators that they believed should be used to protect employees exposed to respirable crystalline silica (Document ID 1763, p. 3; 1798, p. 6; 2135). OSHA is not singling out silica-specific respirators but concludes instead that, for purposes of consistency and to ensure that the appropriate respirator is used, the provisions of the respiratory protection standard should apply to substance-specific standards unless there is convincing evidence that alternative respirator selection requirements are justified. The commenters who recommended specific respirators did not provide any evidence to support their recommendations. As no basis has been established for distinguishing respirator requirements for respirable crystalline silica from other air contaminants, OSHA finds it appropriate to adopt its usual policy of requiring employers to follow the provisions of the respiratory protection standard.

Paragraph (e)(3) of the standard for construction states that, for the tasks listed in Table 1 in paragraph (c), if the employer fully and properly implements the engineering controls, work practices, and respiratory protection described in Table 1, the employer shall be considered to be in compliance with paragraph (e)(1) of the standard for construction and with the requirements for selection of respirators in paragraphs (d)(1)(iii) and (d)(3) of 29 CFR 1910.134. Employers following Table 1 must still comply with all other provisions of 29 CFR 1910.134. Paragraphs (d)(1)(iii) and (d)(3) of 29 CFR 1910.134 require the employer to evaluate respiratory hazards in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. Because Table 1, in specifying the required respiratory protection and minimum APF for a particular task, has already done this, employers following Table 1 are considered to be in compliance with paragraphs (d)(1)(iii) and (d)(3) of 29 CFR 1910.134 for exposure to respirable crystalline silica. While not required for employers fully and properly implementing Table 1, paragraph (d)(3)(i)(A) of the respiratory protection standard (29 CFR 1910.134), which includes a table that can be used to determine the type or class of respirator that is expected to provide employees with a particular APF, can help employers determine the type of respirator that would meet the required minimum APF specified by Table 1. For example, Table 1 requires employers to provide employees with respiratory protection with an APF of 10 for some of the listed tasks. An employer could consult the table in 29 CFR 1910.134(d)(3)(i)(A) to find the types of respirators (e.g., half-mask air-purifying respirator) that provide at least an APF of 10.

Unions, labor groups, and others urged OSHA to include a provision in the rule that allows employees to choose a powered air-purifying respirator (PAPR) in place of a negative pressure respirator (Document ID 2106, p. 3; 2163, Attachment 1, pp. 15-16; 2173, p. 5; 2244, p. 4; 2253, p. 7; 2256, Attachment 2, pp. 13-14; 2336, p. 7; 2371, Attachment 1, pp. 33-34; 3581, Tr. 1668-1669; 3955, Attachment 1, p. 2; 4204, pp. 78-79). They asserted that employees are more likely to get better protection from PAPRs, since they are more comfortable and thus, more likely to be used. They also argued that this will allow employees who may encounter breathing resistance or other difficulty in wearing a negative pressure respirator the ability to continue working in a job where silica exposures cannot feasibly be controlled below the PEL using engineering and work practice controls, without revealing their health status or health condition to their employer. They noted that previous health standards, such as the standards for asbestos (29 CFR 1910.1001(g)(2)(ii)) and cadmium (29 CFR 1910.1027(g)(3)(ii)), include provisions that allow employees to request and obtain a PAPR without revealing their health status or health condition to their employer.

In some cases, employers are already providing PAPRs to employees who request them. The North American Insulation Manufacturers Association reported that some member companies provide PAPRs upon employee request in certain circumstances, including accommodating religious practices and where the work is physically taxing (Document ID 4213, pp. 4-5). James Schultz, a former foundry employee from the Wisconsin Coalition for Occupational Safety and Health, testified that he was able to get his employer to provide a PAPR in some, but not all, instances when he requested one (Document ID 3586, Tr. 3201).

OSHA has long understood that it is good industrial hygiene practice to provide a respirator that the employee considers acceptable. Under the respiratory protection standard, employers must allow employees to select from a sufficient number of respirator models and sizes so that the respirator is acceptable to and correctly fits the user (29 CFR 1910.134 (d)(1)(iv)). In addition, fit testing protocols under the respiratory protection standard require that an employee has an opportunity to reject respirator facepieces that the employee considers unacceptable (see 29 CFR 1910.134 Appendix A). The Agency also recognizes that in some circumstances employees may prefer PAPRs over other types of respirators. However, the rulemaking record does not provide a sufficient basis for OSHA to conclude that a requirement for employers to provide PAPRs upon request would lead to any meaningful additional benefit for employees exposed to respirable crystalline silica.

With regard to employees who have difficulty breathing when using a negative pressure respirator or cannot wear such a respirator, the respiratory protection standard requires employers to provide a PAPR if the employee's health is at increased risk if a negative pressure respirator is used (29 CFR 1910.134(e)(6)(ii)). Under the medical surveillance provisions of this rule, as well as the medical determination provisions of the respiratory protection standard (29 CFR 1910.134(e)(6)), the PLHCP's written medical opinion for the employer must contain any recommended limitations on the employee's use of respirators. Thus, including a provision in this rule that provides employees the ability to choose a PAPR in place of a negative pressure respirator would not appreciably add a benefit to what is already provided pursuant to required medical determinations. Therefore, OSHA finds that a provision specific to this rule permitting employees to request and receive a PAPR in place of a negative pressure respirator is neither necessary nor appropriate in this rule.

These requirements are consistent with ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica, and ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities, the national consensus standards for controlling occupational exposure to respirable crystalline silica in general industry and in construction, respectively. Each of these standards requires respirators to be used in work situations in which engineering and work practice controls are not sufficient to reduce exposures of employees to or below the PEL. Like the consensus standards, where the use of respirators is required, the standards that comprise this rule require employers to establish and enforce a respiratory protection program, as specified in 29 CFR 1910.134.

Housekeeping

Paragraph (h) of the standard for general industry and maritime (paragraph (f) of the standard for construction) requires employers to adhere to housekeeping practices. This is a new paragraph in the rule, but it is derived from the proposed requirements for cleaning methods (included in the Methods of Compliance paragraph in the proposed rule) and revised in response to further analysis and public comments. The requirements apply to all employers covered under this rule, including where the employer has fully and properly implemented the control methods specified in Table 1 in the standard for construction.

OSHA proposed a requirement that accumulations of crystalline silica be cleaned by high-efficiency particulate air (HEPA)-filter vacuuming or wet methods where such accumulations could, if disturbed, contribute to employee exposure that exceeds the PEL. The proposed rule would also have prohibited the use of compressed air, dry sweeping, and dry brushing to clean clothing or surfaces contaminated with crystalline silica where such activities could contribute to exposures exceeding the PEL. OSHA included these provisions in the proposed rule because evidence shows that use of HEPA-filtered vacuums and wet methods instead of dry sweeping, dry brushing and blowing compressed air effectively reduces worker exposure to respirable crystalline silica during cleaning activities. For example, a study of Finnish construction workers compared respirable crystalline silica exposure levels during dry sweeping to exposure levels when using alternative cleaning methods. Compared with dry sweeping, estimated worker exposures were about three times lower when workers used wet sweeping and five times lower when they used vacuums (Document ID 1163).

Some commenters, including the International Union of Bricklayers and Allied Craftworkers (BAC), the United Steelworkers (USW), the Building and Construction Trades Department, AFL-CIO (BCTD), the United Automobile, Aerospace and Agricultural Implement Workers of America (UAW), BlueGreen Alliance (BGA), and Upstate Medical University, expressed support for the proposed requirement to use HEPA-filtered vacuums and wet methods and to prohibit the use of compressed air and dry sweeping for cleaning activities (e.g., Document ID 2282, Attachment 3, pp. 2, 18-19; 2329, p. 6; 2336, pp. 8-10; 2371, Comment 1, pp. 32-33; 2176, p. 3; 2244, p. 4). For example, UAW stated that the prohibitions on the use of compressed air and dry sweeping constitute sound industrial hygiene and are necessary to ensure that dust is controlled (Document ID 2282, Attachment 3, p. 18). Similarly, BCTD argued that the record firmly supports the use of HEPA-filtered vacuums and wet methods in lieu of compressed air and dry sweeping. BCTD pointed to specific studies referenced in OSHA's Preliminary Economic Analysis (PEA) that it believes demonstrate that performing housekeeping duties using compressed air or dry sweeping is a major source of silica exposure in a number of work operations (Document ID 2371, p. 34). BCTD also noted and agreed with studies in the PEA that recommend reducing silica exposure by eliminating these practices and instead relying on HEPA-filtered vacuums and wet methods (Document ID 2371, p. 34). Based on this evidence, BCTD agreed with the inclusion of the cleaning provisions. However, as discussed more extensively below, BCTD, and many of the other commenters that supported these provisions, argued that OSHA should expand the requirement to apply to cleaning whenever silica dust is present, not only where employee exposure could exceed the PEL (e.g., Document ID 2240, p. 3; 2256, Attachment 2, p. 13; 2282, Attachment 3, p. 2; 4204, p. 77).

The National Institute for Occupational Safety and Health (NIOSH) also supported OSHA's proposed requirement to use wet methods and HEPA-filtered vacuums and prohibit the use of dry sweeping and compressed air during cleaning activities. In its written comments and testimony during the hearings, NIOSH cited U.S. Bureau of Mines research indicating that dry sweeping can increase respirable dust exposures, and provided several recommendations, including using water to wash down facilities that may have silica contamination, and using portable or centralized vacuum systems to clean off equipment (Document ID 2177, Attachment B, p. 38; 3579, p. 142).

Other commenters, such as Ameren, Acme Brick, the American Iron and Steel Institute (AISI), Fann Contracting, Inc., Leading Builders of America (LBA), Edison Electric Institute (EEI), the National Association of Home Builders (NAHB), Eramet and Bear Metallurgy Company, Accurate Castings, the Asphalt Roofing Manufacturers Association (ARMA), the Small Business Administration's Office of Advocacy, the Glass Association of North America (GANA), the National Association of Manufacturers (NAM), the American Foundry Society (AFS), the Ohio Cast Metals Association (OCMA), the Tile Council of North America (TCNA), the North American Insulation Manufacturers Association (NAIMA), the Non-Ferrous Founders

Society (NFFS), the National Concrete Masonry Association (NCMA), and the American Society of Safety Engineers (ASSE), objected to the proposed provisions (e.g., Document ID 2023, pp. 5-6; 2082, pp. 5-7; 2116, Attachment 1, pp. 9-10, 32-33; 2261, p. 3; 2269, pp. 4, 22-23; 2291, pp. 2, 13, 18-20, 27; 2296, pp. 9, 41-42; 2315, p. 8; 2339, p. 9; 2349, pp. 4-5; 2357, pp. 7, 24-25; 2381, p. 2; 3432, p. 3; 3492, p. 2; 2119, Attachment 3, p. 7; 2215, p. 9; 2248, p. 8; 2279, pp. 7-8; 2348, Comment 1, p. 37; 2363, p. 3; 3490, p. 3; 3581, Tr. 1726-1727; 4213, p. 5). Many of these commenters cited problems with the use of wet methods or HEPA-filtered vacuums in particular circumstances, or noted specific circumstances where they believed dry sweeping or using compressed air was necessary.

For example, AISI indicated that using wet methods in areas of steel making facilities where molten metal is present creates the potential for a significant and immediate safety hazard from steam explosions (Document ID 2261, p. 3; 3492, p. 2). The National Concrete Masonry Association argued that wet methods cannot generally be used in concrete block and brick plants:

> In general, wet methods to control dust are NOT appropriate in the concrete masonry as a replacement for dry-sweeping . . . Not only do wet floors create fall hazards, any dust or debris that contains cement dust will react and harden in the presence of water, creating additional problems in concrete block production facilities (Document ID 2279, pp. 7-8).

EEI and Ameren indicated that the use of wet methods can also cause fly ash to harden (Document ID 2357, pp. 24-25; 2315, p. 8).

NAHB indicated that use of wet methods in residential construction would damage many surfaces and could lead to structural problems, indoor air quality degradation, and the development of molds (Document ID 2296, p. 37). It argued that there are many circumstances in residential construction where dry sweeping is the only alternative for cleanup activities (Document ID 2296, pp. 41-42). LBA indicated that HEPA-filter vacuums will not collect large debris and that, during the collection process, dirt will clog the HEPA filter, preventing cleaning. It stressed that dry sweeping must be used (Document ID 2269, pp. 4, 22-23). Ameren and EEI argued that dry sweeping should be allowed because wet methods cannot be used around certain electrical equipment and when temperatures are below freezing (Document ID 2315, p. 8; 2357, pp. 7, 24-25). Fann Contracting said that it is necessary to dry sweep at the end of the milling process when milling roadways in order to clean the loose leftover material. It indicated that if water is used, it would create a thin layer of mud on the bottom of the milled trench, which would interfere with the paving process (Document ID 2116, Attachment 1, pp. 9-10, 32-33).

Commenters representing foundries argued that wet methods and HEPA-filtered vacuuming were not appropriate for cleaning in foundries. For example, Accurate Castings explained that wet methods would result in water going into the shell sand mold and would eventually lead to an explosion when molten metal enters the mold. It stressed that it must use compressed air for these applications (Document ID 2381, p. 2). Similarly, ESCO Corporation commented that it cannot use water in foundries due to potential for fire and explosion hazards. ESCO Corportation stressed that it also must use compressed air to clean castings (Document ID 3372, pp. 2-3). AFS also argued that the use of wet methods in foundries increases the likelihood of explosions as well as tripping hazards (Document ID 3490, p. 3). OCMA argued that vacuums can cause damage to molds and using wet methods would damage equipment, make floors slippery, and cause explosions (Document ID 2119, Attachment 3, p. 7). NFFS argued that compressed air is "the only viable means of cleaning complex or intricate castings" (Document ID 2247, p. 8; 2248, p. 8). AFS argued that a ban on dry sweeping would require the vacuuming of hundreds of tons per week in many foundry operations, and that collecting this amount of sand with a vacuum system is not feasible. AFS also expressed concern that the proposed rule would prohibit use of operator-driven power (dry) sweepers in foundries, arguing that power sweepers substantially reduce the release of fugitive dust from aisles and other vehicle traffic areas and that these machines cannot be replaced with wet sweepers because the quantity of material handled would gum up the sweeping mechanism with sludge (Document ID 2379, Attachment B, pp. 33-34).

Several commenters indicated that compressed air is needed to clean difficult to reach places (e.g., Document ID 2215, p. 9; 2279, pp.7- 8; 3581, Tr. 1726; 2023, p. 5; 2348, Comment 1, p. 37; 3544, pp. 15-16; 4213, pp. 5; 2119, Attachment 3, p. 7). For example, GANA stressed that it is "not technologically feasible to prohibit completely the use of compressed air for clean-up," because tight spaces and hard-to-reach crevices can only be cleaned using compressed air (Document ID 2215, p. 9). NAM testified to the need to use compressed air in space-restricted situations and where there is a potential for explosions when using water and there are no other alternatives (Document ID 3581, Tr. 1726). Acme Brick also indicated that compressed air must be used in tight spaces or under equipment because these areas cannot be accessed by brooms or vacuums (Document ID 2023, p. 5).

After reviewing the evidence in the record, OSHA concludes that use of wet methods and HEPA-filter vacuums, as proposed, is highly effective in reducing respirable crystalline silica exposures during cleaning and that compressed air, dry sweeping, and dry brushing can contribute to employee exposures. However, OSHA finds convincing evidence that wet methods and HEPA-filtered vacuums are not safe and effective in all situations. Therefore, the Agency has revised the proposed language to take these situations into account. Paragraph (h)(1) of the standard for general industry and maritime (paragraph (f)(1) for construction) allows for the use of dry sweeping and dry brushing in the limited circumstances where wet methods and HEPA-filtered vacuuming are not feasible. Paragraph (h)(2) of the standard for general industry and maritime (paragraph (f)(2) for construction) allows employers to use compressed air for cleaning where the compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air, or where no alternative method is feasible. These limited exceptions will encompass the situations described above by commenters, and give them the necessary flexibility in permitting the use of compressed air, dry sweeping, or dry brushing in situations where wet methods or HEPA-filtered vacuums are infeasible, or where the dust cloud created by use of compressed air is captured and therefore does not present a hazard to employees. Thus, in situations where wet methods or HEPA-filtered vacuuming would not be effective, would cause damage, or would create a hazard in the workplace, the employer is not required to use these cleaning methods. OSHA concludes that these limited exceptions balance the need to protect employees from exposures caused by dry sweeping, dry brushing, and the use of compressed air with stakeholder concerns about the need to use such methods under certain circumstances.

Although OSHA is allowing for dry sweeping and dry brushing and the use of compressed air for cleaning clothing and surfaces under these limited circumstances, the Agency anticipates that these circumstances will be extremely limited. The “unless” clause indicates that the employer bears the burden of showing that wet methods are not feasible in a particular situation, and OSHA expects that the vast majority of operations will use wet methods that minimize the likelihood of exposure. Where the employer uses dry sweeping, therefore, the employer must be able to demonstrate that HEPA-filtered vacuuming, wet methods, or other methods that minimize the likelihood or exposure are not feasible. Similarly, where compressed air is used to clean clothing and surfaces without a ventilation system designed to capture the dust cloud created, the employer must be able to demonstrate that no alternative cleaning method is feasible.

OSHA has also revisited the triggers for these provisions based on stakeholder comments. Some stakeholders disagreed with triggering these provisions based on the PEL. For example, the American Federation of State, County, and Municipal Employees (AFSCME), the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), BCTD, BAC, UAW, USW, and others argued that dry sweeping and use of compressed air should be prohibited at any exposure level, not just where the use of such measures contributes to exposures that exceed the PEL (e.g., Document ID 2142, p. 3; 2257, Attachment 2, p. 13; 2282, Attachment 3, pp. 18-19; 2329, p. 6; 2336, p. 10; 2371, Comment 1, pp. 32-33). AFL-CIO stated:

> OSHA has determined that exposure at the PEL still poses a significant risk to workers. All feasible efforts should be made to reduce those risks. OSHA should follow the well-established approach in its other health standard[s] and prohibit practices of dry sweeping, [use of] compressed [air] and require HEPA-filter[] vacuuming or wet methods whenever silica dust is present (Document ID 2257, Attachment 2, p. 13).

Similarly, AFSCME indicated that there is no reason why cleaning methods need to be tied to the PEL. It argued that requiring that all accumulations be dealt with in a uniform way would provide clarity for employers and employees alike (Document ID 2142, p. 3). BCTD argued that OSHA's proposed requirements would be unenforceable because they are tied to overexposure (Document ID 2371, Attachment 1, p. 33). Finally, AFL-CIO also recommended that OSHA expand the proposed requirements to require that accumulations of dust be kept as low as practicable. It noted that this requirement has appeared in previous OSHA health standards that regulate exposure to dusts, such as asbestos (29 CFR 1910.1001), lead (29 CFR 1910.1025), and cadmium (29 CFR 1910.1027).

On the other hand, the Precast/Prestressed Concrete Institute (PCI) argued that a general prohibition on the use of compressed air, dry brushing, and dry sweeping to clean areas where silica-containing material has accumulated is too broad, and not directly related to a particular exposure risk. It maintained that the use of compressed air and dry sweeping should be permitted as long as silica exposures are below the PEL (Document ID 4029, Cover Letter 1, p. 3). Similarly, the National Tile Contractors Association (NTCA) and TCNA both recommended that the proposed language be changed to read as follows:

> To the extent practical compressed air, dry sweeping, and dry brushing shall not be used to clean clothing or surfaces contaminated with crystalline silica where such activities could contribute to employee exposure to respirable crystalline silica that exceeds the PEL (Document ID 2267, p. 3; 2363, p. 3).

After consideration of these comments, OSHA has decided to revise the trigger for the housekeeping provisions in the rule to apply to situations where dry sweeping, dry brushing or use of compressed air could contribute to employee exposure to respirable crystalline silica, regardless of whether that exposure exceeds the PEL. OSHA finds this change is necessary because the risk of material impairment of health remains significant at and below the revised PEL of 50 ug/m^3, including at the new action level of 25 ug/m^3. By triggering the housekeeping provisions wherever the use of dry sweeping, dry brushing, and compressed air could contribute to employee exposures, OSHA aims to minimize this risk. The Agency concludes that the limited exceptions discussed above not only balance the concerns of employers with the need to protect employees, but align the rule with the realities of the workplace, which do not always lend themselves to the method that produces the lowest silica exposure.

OSHA has decided not to include an affirmative requirement to clean accumulations of crystalline silica that could, if disturbed, contribute to employee exposure that exceeds the PEL. In addition, the Agency has determined that it is not appropriate for the respirable crystalline silica rule to require accumulations of dust to be kept at the lowest level practicable. As noted above, OSHA recognizes that exposure to respirable crystalline silica is hazardous at concentrations below the PEL. However, crystalline silica is ubiquitous in many work environments. Crystalline silica is a component of the soil and sand at many construction sites and other outdoor workplaces, and may be present in large quantities at many other workplaces such as foundries and oil and gas drilling sites where hydraulic fracturing is performed. For purposes of cleaning, the employer may not be able to distinguish large crystalline silica particles from the fine particles which can, if airborne, be respirable. In many cases, the employer may not be able to distinguish crystalline silica particles from other workplace dusts. Because of these factors, many unique to respirable crystalline silica, OSHA is convinced that the best approach to address potentially hazardous exposures from cleaning is by requiring proper housekeeping practices to minimize exposure to respirable crystalline silica.

OSHA also received a number of miscellaneous comments on the proposed provisions, including suggestions for items the Agency should or should not include in the final rule and questions about the application of the proposed provisions to particular situations. For example, ARMA argued that OSHA should not require HEPA filters on central vacuum systems that discharge outdoors or into a non-occupied area, such as a baghouse (Document ID 2291, pp. 19-20). GPI also indicated it uses central vacuum systems, and argued that OSHA should allow for vacuum systems that discharge outside the facility (Document ID 2290, pp. 4-5). OSHA agrees that a prohibition on central vacuum systems that discharge respirable crystalline silica outside of the workplace is unnecessary, because such systems do not contribute to employee exposure. OSHA clarifies that the rule therefore allows for use of vacuum systems that discharge respirable crystalline silica outside of the workplace. These requirements are similar to housekeeping requirements in other OSHA health standards, such as the standards for lead (29 CFR 1910.1025) and cadmium (29 CFR 1910.1027). Discharge of respirable crystalline silica from such systems may be subject to environmental regulations; see Section XIV, Environmental Impacts.

Occupational & Environmental Health Consulting Services (OEHCS) urged OSHA to require vacuums that meet the definition of a Portable High-Efficiency Air Filtration (PHEAF) device (Document ID 1953, Comment 1, pp. 4-6). This suggested revision would involve a requirement for field testing of portable air filtration devices using a laser particle counter to ensure that HEPA filters function as intended. OEHCS argued that, in many cases, HEPA filters do not perform effectively in the field due to inadequate, damaged, or deteriorating sealing surfaces; replacement filters that do not fit correctly; filter cabinets that are damaged; filters that are punctured; and other problems (Document ID 1953, Comment 1, p. 2). OEHCS further indicated that it is participating in an ongoing, multi-year research effort with the National Institutes of Health to test HEPA-filtered equipment (Document ID 1953, Comment 1, p. 2). However, OEHCS did not provide documentation to support the use and effectiveness of meeting the requirements and definition of this device, nor is there other evidence in the rulemaking record supporting such a requirement. OSHA encourages employers to ensure that HEPA filters function as intended in the field. However, lacking adequate documentation and support in the record, OSHA has concluded that it is not appropriate to include a requirement that HEPA vacuums meet the PHEAF standards in the rule.

OSHA also received a few comments related to the use of compressed air, dry sweeping, and dry brushing to clean clothing. Specifically, NIOSH and ASSE maintained that there are ways that clothing can be safely cleaned using compressed air. The two organizations advocated for the use of clothes cleaning booths, also referred to as mobile air showers (Document ID 2177, Attachment B, pp. 15, 38; 3403, p. 5; 2339, p. 9). This technology uses compressed air to clean clothes by blowing dust from an employee's clothing in an enclosed booth. Dust is blown out of the employee's breathing zone and is captured by a filter. NIOSH argued that the booths adequately capture the dust and prevent exposure to employees and the environment (Document ID 3403, p. 5). OSHA recognizes that this technology may be useful for cleaning dust off of clothing, and the rule does not prohibit the use of such systems. Clothes cleaning booths that use compressed air to clean clothing are permitted under the rule, as long as the compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air. The provision has been modified from that proposed to clearly allow the use of compressed air in conjunction with a ventilation system that effectively captures the dust cloud that is created, preventing it from entering the employee's breathing zone.

In addition, the American Subcontractors Association (ASA) offered a comment related to dry brushing. It argued that the term "dry brushing" could be misunderstood, and that an employer could receive a citation if an employee reflexively brushes visible dust off clothing (Document ID 2187, p. 6). OSHA's intent in the proposed rule was to restrict dry brushing activity that was comparable to dry sweeping, such as using a brush as a tool to clean clothing or surfaces. OSHA clarifies that the rule does not prohibit employees from using their hands to remove small amounts of visible dust from their clothing.

Finally, OSHA received comments on how often or at what point employers need to clean up dust in their facility. For instance, HalenHardy, a firm that provides products and services to limit exposures to dangerous dusts, argued that there should be some visible evidence of silica dust in order to require cleaning (Document ID 3588, Tr. 3920-3922). NCMA commented that dry sweeping can produce dust and indicated that best practices suggest that it is important to prevent the dust or debris from reaching the floor. If not cleaned regularly, this can lead to buildups of dust on the floor (Document ID 2279, p. 7).

The proposed rule would have required accumulations of crystalline silica to be cleaned by HEPA-filtered vacuuming or wet methods where such accumulations could, if disturbed, contribute to employee exposure to respirable crystalline silica that exceeds the PEL. As explained above, OSHA's final rule does not require employers to clean up dust. However, OSHA agrees that housekeeping is an important work practice to be used to limit employee exposures. And, as discussed in Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis, some employers will need to perform housekeeping in order to limit employee exposures to the PEL. In recognition of this fact and because some cleaning methods can contribute to employee exposure, OSHA has included housekeeping as one of the items employers must address in their written exposure control plans (see the summary and explanation of Written Exposure Control Plan).

Moreover, for employers following the general industry and maritime standard and, in construction, for tasks not listed in Table 1, or where the employer does not fully and properly implement the control methods described in Table 1, the rule requires employers to assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level. Where exposure assessment reveals that an employee's exposure exceeds the PEL, the rule requires employers to use engineering and work practice controls to reduce and maintain employee exposure to or below the PEL, unless the employer can demonstrate that such controls are not feasible. Good housekeeping is one such work practice control that employers should consider. And, as NCMA suggests, employers may choose to clean up dust regularly as a best practice.

In addition, paragraph (c) of the standard for construction includes several housekeeping provisions that apply to employers who choose to follow Table 1. For instance, paragraphs (c)(1)(vii) and (c)(1)(viii) of the standard for construction require employers whose employees are engaged in a task using handheld or stand-mounted drills (including impact and rotary hammer drills) or dowel drilling rigs for concrete to use a HEPA-filtered vacuum when cleaning holes. Similarly, under paragraph (c)(1)(xiii), when using a walk-behind milling machine or floor grinder indoors or in an enclosed area, milling debris must be cleaned up using a HEPA-filtered vacuum prior to making a second pass over an area. This prevents the milling debris from interfering with the seal between machine and floor and minimizes the gap. Additionally, it prevents debris from being re-suspended and acting as another source of exposure.

If an employer chooses to follow paragraph (c) of the standard for construction, then the employer must implement any applicable housekeeping measures specified in Table 1. An employer who does not do so has not fully and properly implemented the controls identified on Table 1 and, thus, will be required to assess and limit the exposure of employees in accordance with paragraph (d). For example, if an employer has an employee who is using a handheld or stand-mounted drill, the employee must use a HEPA-filtered vacuum when cleaning holes. Any method for cleaning holes can be used, including the use of compressed air, if a HEPA-filtered vacuum is used to capture the dust. If a HEPA-filtered vacuum is not used when cleaning holes, then the employer must assess and limit the exposure of that employee in accordance with paragraph (d).

While the paragraph on housekeeping (paragraph (f) of the construction standard) also applies when employers are following paragraph (c), the employer must ensure that all of the engineering controls and work practices specified on Table 1 are implemented. For example, paragraph (f)(2)(i) of the construction standard permits the use of compressed air when used in conjunction with a ventilation system that effectively captures the dust cloud. However, to fully and properly implement the controls on Table 1, an employer using compressed air when cleaning holes drilled by handheld or stand-mounted drills or dowel drilling rigs for concrete must use a HEPA-filtered vacuum to capture the dust, as specified in paragraphs (c)(1)(vii) and (c)(1)(viii), not just a ventilation system as specified in paragraph (f)(2)(i).

The housekeeping requirements of the rule are generally consistent with the provisions of the industry consensus standards, ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica, and ASTM E 2626 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities. Both consensus standards specify that compressed air shall not be used 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. and 4.4.3.2, respectively). Both consensus standards also list HEPA vacuums, water spray, and wet floor sweepers among available means to reduce exposure to dust (4.4.3.6. and 4.4.3.5, respectively). In addition, ASTM E 1132 – 06 includes restrictions on dry sweeping (4.4.3.2).

<u>Written Exposure Control Plan</u>

Paragraph (f)(2) of the standard for general industry and maritime (paragraph (g) of the standard for construction) sets forth the requirements for written exposure control plans, which describe methods used to identify and control workplace exposures, such as engineering controls, work practices, and housekeeping measures. OSHA did not propose a requirement for a written exposure control plan, but raised it as an issue in the preamble of the Notice of Proposed Rulemaking (NPRM) in Question 53 under Methods of Compliance (78 FR 56273, 56289 (9/12/13)). Written exposure control plans are included in ASTM International (ASTM) standards, E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica (Section 4.2.6) and E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities (Section 4.2.5), and in a draft standard by the Building and Construction Trades Department, AFL-CIO (BCTD) (Document ID 1466, p. 2; 1504, p. 2; 1509, pp. 3-4) .

The only written plan that OSHA proposed was an access control plan, which was an alternative approach to establishing regulated areas; it described methods for identifying areas where exposures exceeded the permissible exposure limit (PEL), limiting access to those areas, communicating with others on the worksite, and providing personal protective equipment (PPE) to individuals entering those areas. Several stakeholders commented on the proposed written access control plans, whether or not the rule should contain a written plan, and their preference for the type of written plan.

A number of commenters questioned the practicality of a written access control plan in workplaces with continually changing tasks, conditions, or materials, which they argued can lead to the need for multiple plans and subsequent costs. The National Stone, Sand, and Gravel Association (NSSGA) commented that written access control plans and establishing boundaries are not feasible in many workplaces, such as aggregate facilities or large construction sites, because of varying silica amounts in materials (Document ID 2327, Attachment 1, p. 20). The

Construction Industry Safety Coalition (CISC) stated that a written access control plan is impractical in construction and especially difficult and costly for small businesses because a different plan would need to be developed for each project, as a result of changing materials, tasks, and environmental conditions (Document ID 2319, pp. 5-6, 91-92). Associated Builders and Contractors, Inc. (ABC), Associated General Contractors of America, and American Society of Safety Engineers (ASSE) expressed similar concerns about constantly changing conditions on construction sites (Document ID 2289, p. 6-7; 2323, p. 1; 4201, p. 2). The National Federation of Independent Business and Leading Builders of America also expressed concerns about time and resource burdens that a requirement for a written access control plan would impose on construction companies or small businesses (Document ID 2210, Attachment 1, p. 7; 2269, p. 22). ABC and CISC further stated that a written access control plan is not needed if employees are trained (Document ID 2289, pp. 6-7; 4217, p. 25).

CISC noted that section 4.2.5 of the ASTM standard E 2625 – 09 limits the need for a written exposure control plan to areas where overexposures are persistent, and contemplated that it is not needed when the PEL may be exceeded on a particular day because of conditions such as weather or silica content in a material. CISC stated that OSHA's requirement for a regulated area or written access control plan when exposures can reasonably be expected to exceed the PEL deviated from section 4.2.5 of the ASTM standard (Document ID 2319, p. 89; 1504, p. 2). OSHA clarifies that a written access control plan, which describes specified methods for limiting access to high-exposure areas, is different from a written exposure control plan, which can address specified protections for controlling exposure other than limiting access to high-exposure areas.

Commenters representing industry, labor, and employee health advocate groups addressed the issue of what, if any, type of written plan should be required and what level of respirable crystalline silica exposure should trigger that requirement. Some industry representatives favored a written access control plan over a regulated area, while others opposed a written exposure control plan. For example, in comparing regulated areas and the written access control plan, Edison Electric Institute favored the flexibility of the written access control plan and stated that it might use that option in larger areas or for activities that can change over time. It opposed a written exposure control plan, asserting that the training required by OSHA's hazard communication standard (HCS) was sufficient to keep employees informed (Document ID 2357, pp. 33, 37). The Non-Ferrous Founders' Society expressed concerns about costs if a consulting industrial hygienist would need to be hired to develop a written access control plan (Document ID 2248, p. 13). The National Association of Home Builders (NAHB) stated that some of its members would prefer a written access control plan over regulated areas, while other members expressed concern that developing a written access control plan might be difficult for many small companies. NAHB also commented that many small companies would not have the knowledge to develop a written exposure control plan and would have to hire a professional to develop it. NAHB opposed a written exposure control plan, stating that a standard checklist was adequate for protecting employees from exposure (Document ID 2296, pp. 40 and 41). On the other hand, National Electrical Carbon Products (NECP) commented that if OSHA required a written plan, NECP would prefer an exposure control plan rather than an access control plan. It stated that OSHA's proposed access restrictions do not relate to the goal of ensuring compliance with the PEL (Document ID 1785, pp. 6-7).

Commenters from labor organizations and employee health advocate groups supported the inclusion of a written exposure control plan. For example, BCTD stated that the proposed written access control plan could be used as a starting point for the development of a written exposure control plan, which it said should be required for every employer that has employees who may be exposed to respirable crystalline silica (Document ID 2371, Attachment 1, pp. 14-16). International Union of Operating Engineers (IUOE), Public Citizen, American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), and International Union of Bricklayers and Allied Craftworkers (BAC) also supported a requirement for a written plan for all covered employers and not just those with regulated areas or exposures exceeding the PEL (Document ID 2262, p. 42; 2249, p. 3; 4204, p. 62; 4219, p. 25-26; 4223, p. 119).

Other commenters, such as ASSE, favored a written exposure control plan for suspected or documented overexposure scenarios (Document ID 2339, p. 8). The National Industrial Sand Association (NISA) originally opposed a written exposure control program in its prehearing comments (Document ID 2195, p. 38). However, in its post-hearing comments, it supported one, stating that formulating and writing down an exposure control program would ensure that an employer thinks through the engineering and administrative controls required to achieve compliance in situations with persistent overexposures. NISA also stated that the plan would help employers defend against potential liability by documenting due care (Document ID 4208, pp. 20-21).

The American Foundry Society (AFS) disagreed with the need for a separate written exposure control plan and instead called for planning as part of other business initiatives. It supported written exposure control plans in enforcement situations. AFS favored an approach similar to that in the ASTM standard. AFS stated that the ASTM's approach, which involves identifying and analyzing dust sources in scenarios with overexposures to determine effective controls, was more effective in reducing exposures than requiring controls to be installed by a certain date (Document ID 2379, Appendix 1, pp. 61-62; 4229, p. 26).

Advocates of written exposure control plans explained why they supported those plans. The National Institute for Occupational Safety and Health (NIOSH) stated that written exposure control plans could be a simple mechanism for ensuring performance of maintenance checks and, for construction employers, maintaining Table 1 conditions (Document ID 2177, Attachment B, pp. 16-17). Dr. Paul Schulte, Director of the Education and Information Division at NIOSH, testified that ". . . a written plan would greatly improve reliability of the protection provided." (Document ID 3403, p. 5). AFL-CIO, NISA, and BCTD agreed (Document ID 4204, p. 61; 4208, pp. 20-21; 4223, p. 74). Eileen Betit, representing BCTD, testified:

> Written exposure control plans are important for identifying operations that will result in exposures, the specific control measures, and how they will be implemented and the procedures for determining if controls are being properly used and maintained. Such plans also facilitate the communication of this information to other employers on multi-employer worksites so that they, in turn, can take steps to protect their employees. Without such plans, there's no assurance that employers and employees will take a systematic and comprehensive approach to identifying, controlling, and sharing information about silica exposures on job sites (Document ID 3581, Tr. 1569-1570).

The United Steelworkers (USW), Public Citizen, the United Automobile, Aerospace and Agricultural Implement Workers of America (UAW), and AFL-CIO also supported a requirement for a written exposure control plan as a method to continually, systematically, or comprehensively identify or control exposures (Document ID 2336, p. 9; 2249, p. 2; 2282, Attachment 3, p. 17; 4204, p. 60). NIOSH, Public Citizen, and BAC also stated that written exposure control plans are a useful way to communicate protections to employees (Document ID 2177, Attachment B, pp. 16-17; 2249, p. 3; 2329, p. 5).

BlueGreen Alliance, UAW, USW, and AFL-CIO also supported a written plan because requiring the written plan would be consistent with the many other OSHA substance-specific standards that include written plans or programs (Document ID 2176, p. 3; 2282, Attachment 3, p. 17; 3584, Tr. 2540; 4204, p. 62). In addition, commenters observed that other U.S. and Canadian regulatory agencies require written plans. Frank Hearl, Chief of Staff at NIOSH, stated that the Mine Safety and Health Administration requires a dust control plan to be filed at coal mines (Document ID 3579, Tr. 235-236). In addition, AFL-CIO and BCTD noted that written dust or silica control plans are included in a proposed standard for the Canadian Province of British Columbia and a standard promulgated in the Canadian Province of Newfoundland (Document ID 4204, p. 61; 4223, p. 73 Fn. 14; 4072, Attachment 38, pp. 6-7, Attachment 41, p. 7).

BCTD stated that a requirement for a written exposure control plan would not be unduly burdensome to employers because creating such plans is an extension of planning functions in construction (Document ID 4223, pp. 74-80). In fact, several hearing participants testified that written safety or hazard control plans are already being developed and used in the construction industry (Document ID 4223, pp. 74-80; 3580, Tr. 1383-1385; 3583, Tr. 2267-2268, 2385; 3585, Tr. 3093-3094; 3587, Tr. 3560). For example, Kevin Turner, Director of Safety at Hunt Construction Group and representing CISC testified: ". . . we require a site-specific safety plan which addresses the hazards dealt with in that [particular] contractor's scope of work." (Document ID 3580, Tr. 1383).

In addition, written plans are consistent with general industry practices. For example, the National Service, Transmission, Exploration, and Production Safety Network (STEPS Network), whose members are involved in the oil and gas industry, recommends a written plan that describes how exposures to respirable crystalline silica will be reduced or prevented (Document ID 4024, Attachment 2, p. 1). Member companies of the National Ready Mix Concrete Association, who hire third-party contractors to chip out their drum mixers, follow strict written practices and procedures to ensure that exposures do not exceed the PEL. Specifically, they require the contractors to submit to them a company-approved safety and health policy and procedures and plans (Document ID 2305, pp. 8-9). AFL-CIO submitted to the record a silica dust control plan developed by Sonic Drilling (Document ID 4072, Attachment 11).

BCTD stressed that preparing a written exposure control plan does not have to be burdensome and, along with BAC and AFL-CIO, pointed to online tools that are available to help users create written exposure control plans, such as the CPWR-Center for Construction Research and Training (CPWR) tool, available free of charge, on the silica-safe.org website (Document ID 2329, p. 5; 4204, p. 61; 4223, pp. 80-81; 4073, Attachment 5a and 5b). AFL-CIO and BCTD also pointed to guidance products and model exposure control plans from the Canadian Province of British Columbia as additional resources for assisting users in developing written exposure control plans (Document ID 4204, p. 61; 4223, p. 81; 4072, Attachment 14, 19, 20). Industry associations are another resource to help employers prepare written plans. For example, Anthony Zimbelman, general contractor, representing NAHB, testified that his industry association teaches courses and helps businesses develop safety plans (Document ID 3587, Tr. 3559-3560).

OSHA finds the evidence on the benefits of a written exposure control plan – as distinct from the proposed written access control plan – convincing and has concluded that a requirement for a written exposure control plan is needed for both the standard for general industry/maritime and the standard for construction because the plan will improve employee protections. OSHA agrees with commenters who stated that a written plan should not be limited to scenarios where the PEL is exceeded. Therefore, OSHA concludes that it is appropriate for the rule to require a written exposure control plan, instead of a written access control plan that would only apply to restricting access to areas where exposures to respirable crystalline silica exceed the PEL. Requiring a written exposure control plan for all employers covered by the rule is more protective than the ASTM approach of only requiring written exposure control plans for persistent overexposures. Even if exposures are below the PEL due to the use of engineering controls or work practices, a systematic approach for ensuring proper function of engineering controls and effective work practices is crucial for ensuring that those controls and practices remain effective. Thus, OSHA finds that a written exposure control plan is integral to preventing overexposures from occurring.

OSHA agrees with NISA that requiring employers to articulate conditions resulting in exposure and how those exposures will be controlled will help to ensure that they have a complete understanding of the controls needed to comply with the rule. OSHA expects a written exposure control plan will be instrumental in ensuring that employers comprehensively and consistently protect their employees. Even in cases where employees are well trained, the written plan can help to ensure that controls are consistently used and become part of employees' routine skill sets. Employers could opt to use the plans to ensure that maintenance checks are routinely performed and optimal conditions are maintained. In addition, OSHA concludes the written plans are a useful method for communicating protections to employees.

Requiring a written plan maintains consistency with the majority of OSHA substance-specific standards for general industry and construction, such as lead (29 CFR 1910.1025 and 1926.62) and cadmium (29 CFR 1910.1027 and 1926.1127), which require written compliance plans. A requirement for a written exposure control plan is also consistent with Canadian standards. In addition, it is generally consistent with industry practices, as evidence in the record indicates that some employers in general industry and construction are already developing and using written plans. OSHA concludes that even for small businesses, preparing a written exposure control plan based on identifying and controlling respirable crystalline silica hazards will not be unduly burdensome, because of the widespread availability of tools and guidance from groups such as CPWR and the Canadian government. In addition, OSHA anticipates that industry associations will provide guidance on developing written exposure control plans for respirable crystalline silica.

Contrary to the concerns indicated by comments from representatives from the construction industry, OSHA does not intend or expect that employers will need to develop a new written plan for each job or worksite. Many of the same tasks will be conducted using the same equipment and materials at various worksites. For example, a stationary masonry saw used outdoors to cut concrete will perform similarly in any outdoor setting. Most construction employers are expected to use the specified exposure control methods in Table 1 of paragraph (c), which will help them identify tasks and controls to be included in the written exposure control plan. Table 1 does not usually specify different controls for different types of crystalline silica-containing materials, thus supporting the conclusion that a new plan does not need to be continually developed. Table 1 does list some conditions, such as time performing tasks or use of equipment in enclosed areas, that would require respirator use in addition to the specified controls; those different scenarios can be indicated in the written exposure control plan, as applicable. Therefore, the written exposure control plan does not have to be limited by materials, tasks, and conditions for a particular job site and can include all materials, tasks, and conditions typically encountered. In many cases there will be no need to modify the written plan just because the location has changed. However, the plan must address all materials, tasks, and conditions that are relevant to the work performed by a particular company. OSHA is including in the docket a sample written exposure control plan for a bricklaying company for reference.

OSHA concludes that it is appropriate to include a requirement for a written exposure control plan in the respirable crystalline silica standards for general industry/maritime and construction. Therefore paragraph (f)(2)(i) of the standard for general industry and maritime (paragraph (g)(1) of the standard for construction) requires the employer to establish and implement a written exposure control plan that contains at least the elements specified in paragraphs (f)(2)(i)(A)-(C) of the standard for general industry and maritime (paragraph (g)(1)(i)-(iv) of the standard for construction). This provision not only requires that a written exposure control plan be established but also implemented. OSHA does not consider it sufficient to develop a plan and have a copy of it on a shelf. It must be followed in the day-to-day performance of tasks identified.

OSHA considered existing written exposure control plans, such as the ASTM plans, and commenter suggestions to determine what should be included in a written exposure control plan. Section 4.2.5 of ASTM standard E 2625 – 09 concerning construction and demolition provides:

> 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 (Document ID 1504, p. 2).

The exposure control plan described in section 4.2.6 of ASTM standard E 1132 – 06 is substantively consistent with the approach described by section 4.2.5 of ASTM standard E 2625 – 09 (Document ID 1466, p. 2; 1504, p. 2).

Several stakeholders commented on what should be included in provisions for a written exposure control plan. ASSE described an approach similar to that in the ASTM standards, and AFS preferred the ASTM approach during enforcement actions (Document ID 2339, p. 8; 2379, Appendix 1, pp. 61-62).

NIOSH stated that the exposure control plan could be based on OSHA's Job Hazard Analysis approach (Document ID 2177, Attachment B, p. 16; OSHA document 3071, Revised 2002). The OSHA job hazard analysis form calls for descriptions of tasks, hazards, hazard controls, and rationale and comments (OSHA document 3071, Revised 2002, Appendix 3). Similarly, NISA recommended that written exposure control programs convey an understanding of work processes and their appropriate controls for managing exposures (Document ID 4208, p. 21).

Some labor unions, such as AFL-CIO and BCTD, recommended more extensive requirements for a written exposure control or compliance program that included identification of exposures and controls, in addition to exposure assessment methods or results, and descriptions of the respiratory protection, medical surveillance, and training programs (Document ID 2371, Attachment 1, pp. 16-17; 4204, p. 62; 4223, p. 82).

Commenters such as Public Citizen, USW, UAW, and BCTD all agreed that the value of a written exposure control plan is that it allows for consistent identification and control of respirable crystalline silica hazards (Document ID 2249, p. 2; 2336, pp. 8-9; 2282, Attachment 3, p. 17; 3581, Tr. 1569-1571; 4204, p. 60). OSHA affirms that the purpose of the written exposure control plan is the consistent identification and control of respirable crystalline silica hazards, and it is basing the requirements for a written exposure control plan on that purpose.

As discussed more fully below, the written exposure control plan required under this rule for respirable crystalline silica is similar to the ASTM standards in most, but not all, respects. The major difference between the written plans in the ASTM standards and in this rule is that written exposure control plans in this rule are not limited to overexposure scenarios.

OSHA thus considered the ASTM standards and commenter suggestions to develop requirements for a written exposure control plan. The Agency also considered which aspects of the proposed written access control plan should be retained or modified. Therefore, the requirement for a written exposure control plan evolved from comments on OSHA's proposed written access control plan and in response to OSHA raising the possible inclusion of a written exposure control plan as an issue.

Requirements for the written exposure control plan. Paragraphs (f)(2)(i)(A)-(C) of the standard for general industry and maritime (paragraphs (g)(1)(i)-(iv)) of the standard for construction) identify the elements to be addressed in a written exposure control plan. Requirements for the written exposure control plan are performance-based to allow employers to tailor written exposure control plans to their particular worksites. The following discussion describes the minimum requirements for the written exposure control plan and the evidence that supports those requirements. It also recommends general information to include for each section of the plan.

Paragraph (f)(2)(i)(A) of the standard for general industry and maritime (paragraph (g)(1)(i)) of the standard for construction) requires a description of tasks involving exposures to respirable crystalline silica. The proposed written access control plan called for identification of areas where respirable crystalline silica exposure may exceed the PEL. Communication Workers of America (CWA), Public Citizen, USW, AFL-CIO, NISA, and BCTD recommended that the written exposure control plan describe tasks, operations, or work processes that result in exposures to respirable crystalline silica (Document ID 2240, p. 2; 2249, p. 3; 2336, p. 9; 4204, p. 62; 4208, p. 21; 4223, p. 82). A description of tasks involving exposures to respirable crystalline silica is consistent with the first step of the root cause analysis in the ASTM exposure control plans, which involves investigating sources of overexposures (Document ID 1466, p. 2; 1504, p. 2). It is also consistent with the identification of tasks and hazards in the OSHA Job Hazard Analysis approach that is recommended by NIOSH as a model for a respirable crystalline silica written exposure control plan (Document ID 2177, Attachment B, p. 16; OSHA Document 3071, Revised 2002, Appendix 3).

Paragraph (f)(2)(i)(A) of the standard for general industry and maritime (paragraph (g)(1)(i) of the standard for construction) reflects OSHA's agreement with commenters that it is important for employers to consistently identify tasks resulting in exposure to ensure that appropriate employee protections are applied when needed. The identification of tasks with potential respirable crystalline silica exposure is no longer limited to exposures above the PEL, as it was in the proposed written access control plan. This is more protective because it identifies all tasks that could contribute to employee exposures, thereby furthering the purpose of the rule.

In preparing this section of the written plan, employers must list all tasks that employees perform that could expose them to respirable crystalline silica dust. This section of the written plan could include a description of factors that affect exposures, such as types of silica-containing materials handled in those tasks (e.g., concrete, tile). It could also describe factors such as weather (e.g., wind, humidity) and soil compositions (e.g., clay versus rock) (Document

ID 3583, Tr. 2350-2352, 2356-2360; 4234, Part 2, pp. 37-38). Another factor that could affect exposure and protective requirements and thus could be described in the written plan is the location of the task, for instance, whether the task is performed in an enclosed space (Document ID 2177, Attachment B, pp. 16-17). For example, the Table 1 entry for walk-behind saws with integrated water delivery systems indicates that a respirator is only required when the equipment is used indoors or in an enclosed area.

Paragraph (f)(2)(i)(B) of the standard for general industry and maritime (paragraph (g)(1)(ii) of the standard for construction) requires a description of engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task. CWA, Public Citizen, USW, AFL-CIO, NISA, and BCTD requested that the written plan describe controls for managing exposures. Engineering and work practice controls were specifically mentioned by Public Citizen, USW, AFL-CIO, and BCTD (Document ID 2240, p. 2; 2249, pp. 3-4; 2336, p. 9; 4204, p. 62; 4208, p. 21; 4223, p. 82). AFL-CIO further recommended that the written plan describe jobs where respiratory protection is required (Document ID 4204, p. 62). BCTD also requested that the written plan describe procedures for implementing the controls and for determining if the controls are being used and maintained correctly (Document ID 4223, p. 82). NIOSH stated that a written exposure control plan can be a simple mechanism for ensuring that maintenance checks are conducted and Table 1 conditions are maintained (Document ID 2177, Attachment B, pp. 16-17).

Paragraph (f)(2)(i)(B) of the standard for general industry and maritime (paragraph (g)(1)(ii) of the standard for construction) reflects OSHA's agreement that the written exposure control plan must address controls, work practices, and respiratory protection used to manage exposures for each task identified in paragraph (f)(2)(i)(A) of the standard for general industry and maritime (paragraph (g)(1)(i) of the standard for construction). The purpose of this requirement is to ensure that exposures to respirable crystalline silica hazards are consistently controlled. Therefore, written exposure control plans must include information such as types of controls used (e.g., dust collector with manufacturer's recommended air flow and a filter with 99 percent efficiency), effective work practices (e.g., positioning local exhaust over the exposure source), and if required, appropriate respiratory protection (e.g., a respirator with an assigned protection factor (APF) of 10) for each task. The requirement is consistent with the exposure control plans in the ASTM standards that address implementation of engineering controls and work practices to reduce respirable crystalline silica exposures (Document ID 1466, p. 2; 1504, p. 2). It is also consistent with OSHA's Job Hazard Analysis approach, which is recommended by NIOSH as a model for the exposure control plan and calls for a description of controls (Document ID 2177, Attachment B, p. 16; OSHA document 3071, Revised 2002, Appendix 1 and 3).

OSHA also agrees with NIOSH and BCTD about the necessity of addressing the proper implementation and maintenance of controls for each task. This is reflected in paragraph (c) of the standard for construction, in the Table 1 requirements to operate or maintain tools according to manufacturers' instructions. Proper implementation and maintenance of controls is also necessary to meet the PEL under paragraph (c) of the standard for general industry and maritime and paragraph (d)(1) of the standard for construction for construction employers who choose or are required to follow the alternative exposure control methods. Therefore, to help ensure compliance with the rule, the employer, in this section of the written exposure control plan, could indicate signs that controls may not be working effectively (e.g., dust is visible, no water is delivered to the blade). The plan could also include a description of procedures the employer uses for verifying that controls are functioning effectively (e.g., pressure checks on local exhaust ventilation) and schedules for conducting maintenance checks.

OSHA finds the written exposure control plan especially important for construction employers who use the specified exposure control methods in Table 1 of paragraph (c). For them, the description of engineering controls, work practices, and respiratory protection is especially necessary to ensure adequate protection of employees and the use of controls according to the manufacturer's instructions, since employers are not required to conduct exposure assessments to verify that controls are working properly. In cases where the employer owns a particular type of equipment and it is repeatedly used at different job sites, describing the manufacturer's instructions for operating the dust controls in a written exposure control plan will demonstrate that the employer has a complete understanding of and is applying those specifications needed to control dust emissions. Describing those specifications in the written exposure control plans will also serve as a convenient reference for employees.

As an example, in completing this section of the written plan, an employer whose employees use a Stihl® Model TS 410 saw to cut concrete could consult the user's manual to list or summarize those instructions in his or her written exposure control plan. Based on the user's manual, this section of the plan could indicate that (1) before using a Stihl® Model TS 410 saw for cutting concrete, the employee must examine the diamond cutting wheel for signs of excessive wear, damage, or "built-up edges" (i.e., a pale, grey deposit on the top of the diamond segments that clogs and blunts them) and (2) while cutting, the employee must use a water flow rate no less than 0.6 liters (20 fluid ounces) per minute, stop and rinse the screen on the water connection if no or too little water is delivered while cutting, and not cut into the ballast layer of road surfaces to avoid excessive wear on the cutting wheel (Document ID 3998, Attachment 12a, pp. 9, 21-23). The specified exposure control methods in Table 1 indicate that the employee must wear a respirator with an APF of 10 when using this saw outdoors for more than 4 hours a day, and this type of information must be included in this section, if applicable.

Paragraph (f)(2)(i)(C) of the standard for general industry and maritime (paragraph (g)(1)(iii) of the standard for construction) requires a description of the housekeeping measures used to limit employee exposure to respirable crystalline silica. BCTD requested that the exposure control plan describe housekeeping methods (Document ID 2371, Attachment 1, pp. 16-17). Similarly, CWA and USW recommended that the written plan describe procedures for preventing the migration of silica, and USW further noted that the plan should address keeping surfaces visibly clean (Document ID 2240, p. 2; 2336, p. 9). USW also requested that the written exposure control plan describe procedures for removing, laundering, storing, cleaning, repairing, or disposing of protective clothing and equipment (Document ID 2336, p. 9).

Paragraph (f)(2)(i)(C) of the standard for general industry and maritime (paragraph (g)(1)(iii)) of the standard for construction) reflects OSHA's agreement that housekeeping needs to be addressed in the written exposure control plan because some cleaning methods can contribute to employee exposure to respirable crystalline silica. OSHA intends this requirement to help ensure that employers identify and implement appropriate cleaning methods so that employees are protected from respirable crystalline silica dust that can become airborne while performing housekeeping activities. Ensuring safe housekeeping methods helps to consistently control exposures and hazards related to respirable crystalline silica. Housekeeping is another type of work practice to be used to limit employee exposures, and thus, it is consistent with the written exposure control plans in the ASTM standards, which call for implementing work practices to decrease exposures (Document ID 1466, p. 2; 1504, p. 2). It is also consistent with

OSHA's Job Hazard Analysis approach, which is recommended by NIOSH as a model for the exposure control plan and calls for a description of controls (Document ID 2177, Attachment B, pp. 16-17; OSHA document 3071, Revised 2002, Appendix 1 and 3).

OSHA concludes that requiring the written exposure control plan to include a description of housekeeping methods is important because acceptable housekeeping methods can vary among different companies. As described more fully in the summary and explanation of Housekeeping, certain housekeeping practices, such as wet sweeping, are infeasible in some work scenarios. Therefore, OSHA modified proposed prohibitions on cleaning activities, such as dry sweeping or compressed air, to indicate that those housekeeping methods can be used if there are no other feasible methods. However, to comply with the rule, employers must ensure that wet sweeping, HEPA-filtered vacuuming, or other appropriate cleaning methods are used wherever feasible, if dry sweeping or dry brushing could contribute to employee exposure to respirable crystalline silica. It is therefore important for the employer to specify in the written exposure control plan the housekeeping practices the employer uses to limit employee exposures and any special protections that are needed when a particular housekeeping method is used.

To ensure that cleaning methods used comply with paragraph (h) of the standard for general industry and maritime (paragraph (f) of the standard for construction), this section of the written plan could include a description of acceptable and prohibited cleaning methods used by the employer to minimize generation of airborne dust and special instructions regarding cleaning methods (e.g., using local exhaust ventilation if compressed air must be used). Hygiene-related subjects, such as not using compressed air to clean clothing, could also be addressed in this section of the written exposure control plan.

Paragraph (g)(1)(iv) of the standard for construction requires a description of the procedures used to restrict access to work areas, when necessary, to limit the number of employees exposed to respirable crystalline silica and the levels to which they are exposed, including exposures generated by other employers or sole proprietors. No such requirement is included in the written exposure control plan provision for general industry and maritime. The reasons for the differing requirements in the two standards are discussed below.

The proposed written access control plans for general industry and maritime and construction called for procedures for notifying employees about the presence and location of areas where respirable crystalline silica concentrations are or can be reasonably expected to exceed the PEL and for demarcating those areas from the workplace if needed. Also included in the proposed access control plan were provisions for limiting access to areas where respirable crystalline silica exposures may exceed the PEL, in order to minimize the numbers of employees exposed and employee exposure levels.

AFL-CIO and BCTD recommended that written plans describe procedures that employers will use to limit exposure to employees who are not performing respirable crystalline silica-related tasks (Document ID 4204, p. 63; 4223, p. 82). Similarly, BAC stated that the written plan should contain provisions for a regulated area (Document ID 2329, p. 5). USW requested the written plan address labeling of areas with potential respirable crystalline silica exposure (Document ID 2336, p. 14).

Paragraph (g)(1)(iv) of the standard for construction reflects OSHA's agreement that written exposure control plans must address limiting exposure to construction employees who are not engaged in respirable crystalline-silica-related tasks. However, as explained in the summary and explanation of Regulated Areas, regulated areas are not required in the standard for construction because most employers are expected to rely on the specified exposure control methods in Table 1 of paragraph (c) and, therefore, will not have air monitoring data to estimate boundaries of the regulated area. In the summary and explanation of Regulated Areas, OSHA also acknowledges the impracticality of demarcating regulated areas in many construction scenarios. Nonetheless, it remains crucial that access to high-exposure areas and employee exposure levels be limited at construction worksites. A written description of the employer's plan for limiting access is another tool the employer has that helps to consistently control hazards.

The exposure control plans in the ASTM standards do not specifically call for procedures used to restrict access. However, they do call for a description of administrative controls used to reduce exposures (Document ID 1466, p. 2; 1504, p. 2). An example of an administrative control that can be used to minimize the number of employees exposed to respirable crystalline silica is scheduling high-exposure tasks when others will not be in the area (Document ID 3583, Tr. 2385-2386). For example, Anthony Zimbelman stated that when granite countertops are being installed, silica dust may be generated when drilling holes for plumbing fixtures or grinding to make adjustments, but the installers are usually the only employees at the job site at that time (Document ID 3521, pp. 6-7). CISC stated that in lieu of developing a written access control plan, employers could instruct employees to stay out of areas where dust is generated or, if employees have to be in those areas, to avoid dust clouds (Document ID 2319, pp. 91-92). OSHA considers the CISC recommendation to be an additional example of administrative controls for limiting access or exposures that could be addressed in the written exposure control plan. Similarly, a written exposure control plan could include guidance requiring employees to maintain a safe distance from dust created by the use of explosives in demolition and to stay out of the affected area until the dust sufficiently dissipates; this would also serve as an acceptable administrative control. Therefore, a requirement for the written plan in the construction standard to address minimizing the number of employees exposed and their exposure levels is consistent with the exposure control plans in the ASTM standards.

OSHA concludes that the written exposure control plan for the construction standard must address restricting access of those employees who are not engaged in tasks that generate respirable crystalline silica (i.e., bystanders). Therefore, as noted above, paragraph (g)(1)(iv) of the standard for construction requires a description of the procedures used to restrict access to work areas, when necessary, to limit the number of employees exposed and their exposure levels, including exposures generated by other employers or sole proprietors (i.e., self-employed individuals). Restricting access is necessary where respirator use is required under Table 1 or an exposure assessment reveals that exposures are in excess of the PEL. The competent person, who is designated by the employer to implement the written exposure control plan under paragraph (g)(4) of the standard for construction, could further identify situations where limiting access is necessary. For example, limiting access may be necessary when an employer or sole proprietor exposes another company's employees to respirable crystalline silica levels that could reasonably be considered excessive (e.g., above the PEL).

Such a situation might occur when an employee engaged in a Table 1 task with fully and properly implemented controls is exposed to clearly visible dust emissions by an employee or sole proprietor who is performing a task not listed on Table 1, is not fully and properly implementing Table 1 controls, or is performing a Table 1 task requiring a higher level of respiratory protection. In that case, the competent person would assess the situation to determine if it presents a reasonably anticipated hazard, and if it does, take immediate and effective steps to protect employees by implementing the procedures described in the written exposure control plan. Actions by the competent person could include reminding employees to stay out of the areas where respirable crystalline silica is being generated or repositioning employees so that they will not be exposed to respirable crystalline silica.

This approach is consistent with current industry practices. For example, Anthony Zimbelman testified that in his experience, implementing a safety plan was sufficient to protect employees in situations where subcontractors that are not required to comply with the Occupational Safety and Health (OSH) Act are working alongside employees. Mr. Zimbelman further testified that in the home building industry, this situation does not happen often and contractors would stop working with a subcontractor who does not comply with OSHA standards (Document ID 3587, Tr. 3547-3549). OSHA expects that excessive exposures created by sole proprietors not covered by the respirable crystalline silica rule will be an infrequent occurrence because, as CISC indicated in its post-hearing brief, employers and general contractors will likely demand that everyone on the site follow regulatory requirements (Document ID 4217, Appendix B, p. 16). OSHA thus expects that the employers or their competent persons will work with general contractors of construction sites to avoid high exposures of employees working alongside others generating respirable crystalline silica. For example, the competent person could ask the general contractor to schedule high-exposure tasks when employees will not be in the area.

OSHA is not retaining the proposed requirement in the written access control plan that the employer describe how employees will be notified about respirable crystalline silica exposures and how areas will be demarcated. The requirements of the written exposure control plan are more performance-oriented to permit each employer to address unique scenarios of worksites. Demarcation (i.e., direct access control), notifying or briefing employees, and scheduling high-exposure tasks when others are not around, are likely to be the most common methods of restricting access. Demarcating areas is not required because, as noted above, it is not applicable to many construction scenarios. However, if it is possible to demarcate areas, such as by posting a warning sign, and that is the employer's chosen method for limiting access or exposures, it must be described in this section of the written exposure control plan. If notifying or briefing employees is the method chosen to limit access or exposures, the procedures for doing that must be described under this section of the written exposure control plan.

As noted above, the standard for general industry and maritime does not require the written exposure control plan to address how access to high-exposure areas or employee exposures will be limited. As described in more detail in the summary and explanation of Regulated Areas, OSHA concludes that establishing regulated areas is reasonable and generally feasible in general industry and maritime workplaces. Therefore, the standard for general industry and maritime clearly specifies establishment of regulated areas that are demarcated and have warning signs posted at the entrances to those areas (paragraph (e)(1) and (2)(i) and (ii)). With the procedure clearly laid out in the standard, there is no reason to address it in the written exposure control plan. However, employers can address more than the minimum requirements for a written exposure control plan, and general industry and maritime employers always have the option of describing methods for limiting access in their written exposure control plan.

The proposed written access control plan called for a description of the methods that employers at multi-employer sites would use to notify other employers about the presence and location of areas where respirable crystalline silica may exceed the PEL and any precautionary methods needed to protect employees. AFL-CIO, BAC, and BCTD commented that written plans should provide for a method of communication at multi-employer sites (Document ID

4204, pp. 62-63; 4219, pp. 25-27; 4223, pp. 83-84). BCTD stated that a requirement for a written plan to describe methods of communication at multi-employer sites was not sufficient and requested that employers also be required to give their written plan to a general contractor or other “controlling employer” at a multi-employer construction site. The controlling employer would be required to share that information with other employers or use the plan to coordinate activities to reduce exposures to employees (Document ID 4223, pp. 118-123). AFL-CIO and BAC endorsed BCTD’s approach and/or recommended a similar method for using the written exposure control plan to communicate at multi-employer worksites (Document ID 4204, p. 63; 4219, pp. 25-27). Similarly, ASSE stated that employers who generate respirable crystalline silica exposures at multi-employer sites should inform the general contractor or host employer about the need for access control and work cooperatively with the general contractor or host employer to ensure compliance and notify other employers at the site (Document ID 2339, p. 8).

In contrast, NSSGA commented that the HCS already requires employers to establish methods for communicating hazards to employees of other employers (Document ID 2327, Attachment 1, p. 11). NAHB commented that “. . . the imposition of multi-employer burdens in the proposed rule is inconsistent with the clear wording of §1910.12(a) requiring a construction employer to protect ‘each of his employees engaged in construction work’ (Emphasis added)” (Document ID 2296, pp. 27-28). OSHA disagrees that a requirement to communicate the presence of crystalline silica to other employers contradicts the 29 CFR 1910.12(a) requirement that employers protect their employees. Communication among employers about areas where respirable crystalline silica exposures may exceed the PEL will provide each employer with the information needed to protect its own employees.

OSHA nonetheless concludes that the written exposure control plan need not specify communication methods at multi-employer sites, or require that employers share their written exposure control plans at multi-employer sites. Communication at multi-employer worksites is already addressed in the HCS. As part of the written hazard communication program required under the HCS, employers who use hazardous chemicals in such a way that employees of other employers may be exposed must include specific information in the written hazard communication program. This includes methods the employer will use to inform the other employers of any precautionary measures that need to be taken to protect employees (29 CFR 1910.1200(e)(2)(ii)). Because the provisions for a written hazard communication program under the HCS already require employers to share relevant information on hazards and protective measures with other employers in multi-employer workplaces, OSHA does not find it necessary to restate a requirement for sharing of information between employers in the respirable crystalline silica rule. However, as discussed above, written exposure control plans are useful for communicating information, and employers may decide that they are a convenient way for sharing information with other employers at multi-employer workplaces.

Additional provisions that were part of the proposed access control plan but are not required for the written exposure control plan are procedures for providing employees and their designated representatives an appropriate respirator, protective clothing, or a means for cleaning clothing when entering areas where exposures exceed the PEL or where clothing could become grossly contaminated with finely divided material. OSHA is not requiring the written exposure control plan to address this subject because procedures related to providing employees with appropriate respirators, such as selection of respirators, medical evaluations, and training, must already be described in a written respiratory protection program (29 CFR 1910.134(c)(1)). In most cases, the designated representative, who requires entry into a regulated area or an area with restricted access for purposes such as observing air monitoring, is likely to have access to appropriate respiratory protection and be medically cleared to wear it (see summary and explanation of Exposure Assessment). As OSHA determined in the summary and explanation of Exposure Assessment, requirements of the written respiratory protection program related to providing an appropriate respirator would also apply to the designated representative in the very rare case where the representative does not have a respirator. Protective clothing is not addressed in the written exposure control plan because it is not required by the rule. Recommendations concerning cleaning of clothing, such as not using compressed air, could be addressed as part of housekeeping measures or work practice controls.

Some commenters requested that written plans address additional topics and requirements. For example, Public Citizen, BCTD, and AFL-CIO, requested that the written exposure control plan describe exposure assessment methods or programs (e.g., air monitoring or objective data) and results (Document ID 2249, pp. 3-4; 2371, Attachment 1, p. 16; 4204, p. 62; 4223, p. 82). Public Citizen indicated that this should include detailed descriptions of analytical methods and air sampling protocols or objective exposure assessment methods, and BCTD stated that employers using Table 1 could indicate the portion of Table 1 upon which they are relying (Document ID 2249, pp. 3-4; 4223, p. 82). BCTD and AFL-CIO recommended that the written plan address respiratory protection, medical surveillance, and training programs, including documentation that employees have received respiratory fit testing, medical evaluations or examinations, and training (Document ID 4204, p. 62; 4223, p. 82). Public Citizen requested that the plan be prepared by a technically qualified person if the employer lacks the expertise to prepare and implement the plan (Document ID 2249, p. 4). ASSE preferred that the plans be developed by a certified safety professional or certified industrial hygienist (CIH) (Document ID 2339, p. 8). NAHB expressed concern about costs if small companies had to hire safety consultants or industrial hygienists to develop the plan (Document ID 2296, p. 41).

OSHA disagrees with commenters that the written exposure control plan needs to address these topics. The major purpose of a written exposure control plan is to ensure that respirable crystalline silica hazards are consistently identified and controlled. OSHA concludes that this purpose is best served if the written plan is limited to information useful for the employer or the employer's designated representative who will conduct inspections on job sites to ensure that employees are adequately and consistently protected. Requiring a written exposure control plan to contain information that is not directly relevant to identifying and controlling hazards at job sites would needlessly increase the burdens to employers preparing the written plans and could make the plans cumbersome for them to use on job sites. In addition, OSHA does not see the need for including a description of the respiratory protection program because employers are already required to develop a written respiratory protection program under the respiratory protection standard (29 CFR 1910.134(c)). Recordkeeping requirements are clearly specified for fit testing and medical evaluations in the respiratory protection standard (29 CFR 1910.134) and for medical examinations and exposure assessments in this rule. The respirable crystalline silica rule does not require employers to keep training records. As explained in more detail in the summary and explanation of Recordkeeping, the rule does not require training records because employers must instead ensure that employees demonstrate knowledge and understanding of training subjects and in addition, such a requirement would increase paperwork burdens for employers and would not be consistent with the HCS and most OSHA standards.

Therefore, OSHA is neither requiring nor precluding employers to include in written exposure control plans descriptions of exposure assessment methods and results or information on respiratory protection, medical surveillance, and training programs. Requiring information, such as highly technical details on analytical methods, would increase the likelihood that small employers would need to hire a safety and health professional to develop the plans, thus increasing the costs and burdens to those employers. Although OSHA encourages companies to seek professional assistance when needed to develop the plans, requiring a plan that is so complex that many employers would not develop it themselves defeats the advantage of employers gaining an increased understanding of the rule by articulating its requirements. The additional information may be useful as part of a compliance plan, and employers have the option to develop such a plan if they find it helpful.

Paragraph (f)(2)(ii) of the standard for general industry and maritime (paragraph (g)(2) of the standard for construction) requires the employer to review and evaluate the effectiveness of the written exposure control plan at least annually and update it as necessary. A similar requirement was included in the proposed written access control plan. Public Citizen requested revisions of written exposure control plans as needed, including after annual review of exposure assessment methods (Document ID 2249, p. 4). OSHA agrees with Public Citizen that the written exposure control plan needs to be periodically reviewed and updated as needed because work conditions can change (e.g., the employer purchases a new type of equipment). As discussed above, a written exposure control plan will not likely need to be updated often because employees tend to use the same equipment to perform the same tasks at many locations. However, a yearly review is needed to ensure that all current scenarios are captured in the plan.

Paragraph (f)(2)(iii) of the standard for general industry and maritime (paragraph (g)(3) of the standard for construction) requires that the employer make the written exposure control plan readily available for examination and copying, upon request, to each employee covered by this section, his or her designated representative, the Assistant Secretary (i.e., OSHA), or the Director (i.e., NIOSH). A similar requirement was included in the proposed written access control plan. Public Citizen, USW, BCTD, and AFL-CIO requested a requirement to make written exposure control plans available upon request by employees or their representatives (Document ID 2249, p. 4; 2336, p. 9; 2371, Attachment 1, p. 17; 4204, p. 63). NIOSH, Public Citizen, and BAC also stated that written exposure control plans are a useful way to communicate protections to employees (Document ID 2177, Attachment B, pp. 16-17; 2249, p. 3; 2329, p. 5). OSHA agrees with commenters that a written exposure control plan is an effective method for communicating protections to employees and their designated representatives. Making the written plan readily available to employees and their designated representatives upon request empowers and protects employees by giving them and their representatives the information to question employers if controls are not fully and properly implemented or maintained. Similarly, making written exposure control plans readily available to OSHA or NIOSH allows them to verify effectiveness of employee protections.

BCTD also requested that the rule require employers to address in their written plans how temporary workers will be protected and that the rule require staffing agencies and employers who use temporary staff to share their written exposure control plans (Document ID 4223, pp. 83-84). OSHA disagrees with BCTD that the rule needs to include a requirement for host employers and temporary staffing agencies to share their written exposure control plans with each other. However, OSHA agrees with the importance of ensuring that temporary workers receive the protections they are entitled to under the OSH Act. As BCTD noted in its comments, OSHA addresses the issue of temporary employee protections in its July 15, 2014, memorandum titled Policy Background on the Temporary Worker Initiative (Document ID 4223, p. 84). The policy memorandum indicates that both the host and staffing agency are responsible for the health and safety of temporary employees and encourages compliance officers to review written contracts between the staffing agency and host employer to determine if they have fully addressed employee health and safety. For example, the policy memorandum indicates that host employers are well suited for assuming responsibility for compliance related to workplace hazards, while staffing agencies may be best positioned to provide medical surveillance. The memorandum also states that although the host employer has the primary responsibility for assessing hazards and complying with occupational safety and health rules in his or her workplace, staffing agencies must also ensure that they are not sending employees to workplaces where the employees would be inadequately protected from or trained about hazards. A temporary staffing agency could review a host employer’s written exposure control plan to verify that the employer has identified hazards and is implementing the appropriate controls. Staffing agencies and host employers would have the option to supplement their written contract with a written exposure control plan if that is useful for them. OSHA is not requiring that host employers and staffing agencies share written exposure control plans for respirable crystalline silica because sharing information is an issue that affects all OSHA safety and health regulations and is therefore most efficiently addressed through general policy statements.

Competent Person (Construction). In paragraph (b) of the standard for construction, OSHA defines competent person as an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The definition also specifies that the competent person have the knowledge and ability necessary to fulfill the responsibilities set forth in paragraph (g). In paragraph (g)(4) of the standard for construction, the employer is required to designate a competent person to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan.

OSHA included a competent person requirement in the draft general industry/maritime and construction standards presented for review to the Small Business Regulatory Enforcement Fairness Act (SBREFA) review panel. In the draft standards submitted for SBREFA review, duties of the competent person included evaluating workplace exposures and the effectiveness of controls, implementing corrective measures to maintain exposures at or below the PEL, establishing and maintaining boundaries of regulated areas, and evaluating alternate media for abrasive blasting operations. Small entity representatives (SERs) from the construction industry who reviewed the SBREFA draft standard found the requirements for a competent person hard to understand, reasoning that (1) the competent person required a high skill level, (2) a large proportion of their employees would need to be trained, and (3) the requirements would be costly and difficult to comply with (78 FR at 56443-56444).

OSHA's Advisory Committee on Construction Safety and Health (ACCSH), made up of representatives of employees, employers, and state and federal governments, recommended that the Agency retain a competent person requirement in the proposed construction standard because many OSHA standards include that requirement, it is an accepted approach for construction, many small construction employers do not have full-time health and safety staff, it can ensure that designated employees get training on hazards and proper use of controls, and it can increase confidence that controls and PPE are being used and maintained correctly (Document ID 4073, Attachment 14g, pp. 2-3).

OSHA included a competent person provision in the proposed standards, but the only duty that OSHA proposed for the competent person was identifying areas where respirable crystalline silica concentrations are, or could reasonably be expected to be, in excess of the PEL when the employer chose to develop a written access control plan in lieu of establishing regulated areas. OSHA proposed this limited competent person duty because the Agency thought that provisions of the proposed standard, such as requirements for engineering controls and work practices to reduce and maintain employee exposure to respirable crystalline silica at or below the PEL, would effectively communicate the requirements of the rule, without involvement of a designated competent person. However, the Agency was aware that competent person requirements have been included in other health and safety standards and that some parties thought such requirements would be useful in the silica rule (78 FR at 56443-56444). Therefore, OSHA requested comments regarding the appropriateness of the limited competent person requirement, whether a competent person provision should be included, and if the proposed duties for a competent person should be modified or deleted (78 FR at 56288).

Many commenters representing labor unions and employee health advocate groups disagreed with OSHA proposing to include only a limited role for the competent person in construction. Commenters such as NIOSH, the Laborers' Health and Safety Fund of North America (LHSFNA), ASSE, IUOE, and BCTD supported an expanded competent person role because many construction companies are small and cannot afford safety or health professionals, but as NIOSH stated, small companies can have trained and authorized employees ensure employee protections (Document ID 3403, p. 4; 3589, Tr. 4256-4257; 4201, pp. 2-3; 4025, Attachment 1, p. 2; 4223, pp. 107-109). OSHA estimates that approximately 93 percent of construction companies covered by the respirable crystalline silica standard have fewer than 20 employees (see Chapter III of the Final Economic Analysis and Final Regulatory Flexibility Analysis). In further explaining why a competent person is needed in construction, Dr. Schulte testified:

> The need for expanding the duties of the silica-competent person is especially important when employers plan to rely on Table 1 because it is less likely that an industrial hygienist will visit the project to evaluate the job, collect air samples, or check the effectiveness of controls. Effectiveness deteriorates when controls or personal protective equipment (PPE) are not maintained; this performance degradation may not be obvious to workers using the devices (Document ID 3403, p. 4).

The American Industrial Hygiene Association (AIHA), IUOE, and BCTD agreed that a competent person is needed to ensure that Table 1 controls are functioning effectively (Document ID 3578, Tr. 1030; 3583, Tr. 2347; 4223, pp. 109-110). BCTD stated:

> . . . because the technology for controlling silica exposures largely consists of equipment that is attached to or directed at the tools the workers use in their silica-generating tasks, the manner in which it is deployed and maintained is critical to its success. Thus, whether these controls are effective depends on successfully combining the engineering controls with work practices: accurately assessing the potential exposures, selecting the proper control for the job, using the equipment properly, and making sure the equipment is functioning effectively. All of this must be done on an on-going basis (Document ID 4223, p. 109).

Exposure variability in construction is another reason that commenters cited in support of expanded competent person duties. For example, ASSE commented that varying silica exposures can occur as a result of wind pattern and geological changes as contractors move from one site to another or to a new area at the same site (Document ID 4201, p. 2). LHSFNA explained that a competent person can help to reduce exposure variability by identifying major sources of variability and ensuring that controls are used and maintained effectively (Document ID 4207, p. 4). Similarly, NIOSH stated that a competent person could reduce exposure variability by recognizing sources of variability, such as tasks done in an enclosed area or equipment that is not working correctly (Document ID 3579, Tr. 175-176, 194-195). In explaining how a competent person could reduce exposure variability, Kyle Zimmer, Director of Health and Safety for IUOE Local 478, testified that the competent person could respond to changing conditions by repositioning equipment so that employees are upwind of the dust created, adjusting water controls based on environmental factors, or addressing an unexpected encounter of a concrete sub-base during asphalt milling (Document ID 3583, Tr. 2351-2352).

Commenters also addressed a competent person's role regarding bystanders (i.e., employees working nearby other employees who are engaged in tasks that generate respirable crystalline silica but are not themselves engaged in those tasks). BCTD commented that the potential for bystander exposure is another reason why competent persons are needed in construction (Document ID 4223, p. 110). Hearing participants described how a competent person could minimize bystander exposure. For example, Travis Parsons, Senior Safety and Health Specialist for LHSFNA, stated that the competent person could ensure communication about exposures being generated between employees from different trades working at the same construction site (Document ID 3589, Tr. 4232). Donald Hulk, Safety Director for Manafort Brothers, Inc. and representing IUOE, testified that a sufficiently trained competent person would be able to recognize when secondary exposures could occur, and in those situations, subcontractors might be able reschedule activities to avoid bystander exposures (Document ID 3583, Tr. 2385-2386).

Another reason why commenters stated that a competent person is needed in construction is because they thought that employers are not adequately recognizing respirable crystalline silica-related health hazards. As evidence that employers do not believe that respirable crystalline silica is an issue, Chris Trahan, CIH, representing BCTD, pointed to the volume of testimony claiming that declining silicosis mortality rates are evidence that silicosis is not a problem and that respirable crystalline silica is an “alleged carcinogen.” Ms. Trahan disagreed with these commenters and said their testimony demonstrates the hurdles that the industry must overcome before silica is recognized as a hazard and controlled (Document ID 3581, Tr. 1641-1642; 4223, pp. 108-109). LHSFNA claimed that most contactors have not adequately addressed respirable crystalline silica-related health hazards because of the long latency of silica-related disease compared to the common short tenure of employment at any one company. LHSFNA commented that this blunted the ability of workers’ compensation to provide an incentive for disease prevention (Document ID 4207, p. 3). In support of the importance of a competent person for preventing disease, LHSFNA and BCTD pointed to the following statement in the AIHA White Paper on competent persons (Document ID 3589, Tr. 4199; 4223, p. 106).

> A key component in preventing overexposure to silica and subsequent disease is to have at least one individual on the jobsite who is capable of recognizing and evaluating situations where overexposure may be occurring; who knows how to evaluate the exposure potential; and who can make an initial recommendation on how to control that exposure. This is the role of the silica competent person (Document ID 4076, p. 3).

Commenters stressed that the competent person is a well-known concept in construction. LHSFNA and BCTD commented that requiring a competent person under the silica regulation maintains consistency with 19 OSHA construction standards (Document ID 4207, p. 3; 4223, p. 107). Standards requiring a competent person include asbestos (29 CFR 1926.1101), lead (29 CFR 1926.62), and cadmium (29 CFR 1926.1127) (Document ID 4223, p. 107). In addition, NIOSH and LHSFNA commented that competent person provisions are commonly included in American National Standard Institute (ANSI) standards for construction (Document ID 2177, Attachment B, p. 8; 3589, Tr. 4200). NIOSH further said that it and its state partners routinely recommend the need for, and role of, designated competent persons in investigation reports conducted under NIOSH's Fatality Assessment and Control Evaluation program (Document ID 2177, Attachment B, p. 8).

The competent person requirement is also consistent with construction industry practices. For example, Donald Hulk testified that at Manafort Brothers construction sites, a highly trained person has the authority to ensure that best practices are implemented (Document ID 3583, Tr. 2380). Anthony Zimbelman testified that owners or competent persons of subcontracting companies conduct assessments and develop procedures for controlling dust before remodeling or construction of homes (Document ID 3587, Tr. 3538-3539). Safety Director Francisco Trujillo from Miller and Long, Inc. testified ". . . we have competent persons for almost everything . . ." and explained that competent persons are required to evaluate the adequacy of protective equipment when dust collection systems are used because of the limitations of those systems and changing site conditions (Document ID 3585, Tr. 2963-2964, 2980).

Specific duties for a competent person were recommended by a diverse group of commenters, including AIHA, NIOSH, National Asphalt Pavement Association (NAPA), IUOE, National Rural Electric Cooperative Association (NRECA), retired occupational safety and health attorney Charles Gordon, LHSFNA, and BCTD (Document ID 2169, p. 5; 2177, Attachment B, pp. 9-10, 14; 2181, pp. 10-11; 2262, pp. 38-39, 42-43; 2365, pp. 19-20; 3588, Tr. 3800-3801; 3589, Tr. 4197-4201; 4223, pp. 106-114). BCTD, which had among the most extensive recommendations, noted that OSHA standards for lead, asbestos, and cadmium specify duties for a competent person (Document ID 4223, p. 112). For the respirable crystalline silica standard, BCTD requested that the employer designate a competent person to be on site whenever work covered by the standard is being conducted to ensure that the employer's written exposure control plan is implemented, and to:

> . . . use the written exposure control plan to identify locations where silica is present or is reasonably expected to be present in the workplace prior to the performance of work. In addition the competent person's duties shall include ensuring: 1) the employer has assessed the exposures as required by this section; 2) where necessary, regulated areas are established and access to and from those areas is limited to authorized persons; 3) the engineering controls and work practices required by this standard, including all elements of Table 1 (if it is being used), are fully and properly implemented, maintained in proper operating condition, and functioning properly; 4) employees have been provided with appropriate PPE, including respiratory protection, if required; and 5) that all employees exposed to silica have received the appropriate silica training . . . (Document ID 4223, p. 113).

NIOSH recommended similar duties in addition to indicating that the competent person should assure proper hygiene to prevent employees from taking home silica dust on clothing and to conduct daily checks of engineering controls and respirators in abrasive blasting operations involving sand (Document ID 2177, Attachment B, pp. 9-10, 14). IUOE stated that the competent person could assist with employee training, ensure good housekeeping in heavy equipment cabs, and assume responsibility for exposure assessments (Document ID 2262, p. 41; 3583, Tr. 2369-2370; 3583, Tr. 2345). NISA stated that a competent person could conduct qualitative objective exposure assessments or determine frequency of exposure estimates under the performance option (Document ID 2195, pp. 35-36).

CISC opposed a requirement for a competent person and stated that thorough training eliminated the need for a competent person and access control plan (Document ID 4217, pp. 25-26). In disputing the value of expanding the competent person role in the standard, CISC claimed that the ubiquitous presence of silica in construction precluded the need for a designated person who is capable of identifying existing and predictable respirable crystalline silica hazards and has authorization to take prompt corrective actions (Document ID 2319, p. 127).

Commenters also addressed the practicality of a competent person requirement. IUOE commented that an employer would not need to hire additional personnel to serve as silica competent persons because they could designate a competent person to oversee more than one construction activity or task, as long as that person is able to identify existing and predictable hazards and is authorized to take prompt corrective action (Document ID 4234, Part 3, pp. 62-63). In contrast, CISC commented that requiring a competent person at all construction sites is not realistic for small companies and pointed to testimony from Kellie Vazquez, Vice President of Holes Incorporated, as an example (Document ID 4217, pp. 26-27). Ms. Vazquez testified:

> . . . my guys are one-man crews. So I will have one operator in a truck and that truck is loaded with his equipment to go do his multiple jobs per day. He is his own operator, his own equipment operator, his own supervisor, his own foreman. He has the right to shut down any job he feels that is not safe. I don't have a second man, or a competent person, or a supervisor go with him on site to look at the job and verify if it is safe or not. That's his responsibility. That's what he is trained to do. My operators have 30-hour OSHA [training]. They are trained in trenching and excavation. They are competent people in trenching and excavation. They are scaffold builders. They get aerial lift trained (Document ID 3580, Tr. 1389).

OSHA observes that the description of Ms. Vazquez's employees is consistent with the definition of a competent person for safety issues (i.e., extensive training on safety issues and the authority to close down a job site if they feel that it is not safe), and Ms. Vazquez admitted that her employees are already competent persons in trenching and excavation. It is likely that her employees already have the knowledge to fully and properly implement controls on the tools they use and recognize if they are not functioning properly. With the training required under paragraph (i) of the standard for construction and the authority to take corrective actions, those employees could be designated as competent persons for respirable crystalline silica. OSHA concludes there is no need to designate a separate competent person in that situation.

In addition, any prompt corrective measures that competent persons would take to eliminate or minimize respirable crystalline silica hazards would likely have minimal impact on work activities in most cases. Such measures might include briefly stopping work to clear a clogged water line on a tool with wet method controls or clean a filter on a tool with vacuum controls if the competent person sees signs that controls are not functioning effectively. OSHA concludes that even for small businesses, a competent person requirement will not be unduly burdensome because knowledgeable employees, who will already be on site, can be designated as competent persons.

OSHA concludes that the ubiquitous presence of respirable crystalline silica and the many variables that can affect employee exposure when performing construction tasks justify a requirement for a competent person in construction, who is not only trained to identify and correct respirable crystalline silica hazards, but also is authorized to take immediate corrective actions to eliminate or minimize them.

Exposures and hazards can vary according to environmental conditions such as wind and humidity, geological profile of soil, if work is performed indoors or outdoors, or how well exposure controls are maintained. Consequently, there is an obvious need for a competent person to frequently inspect the construction job site, identify respirable crystalline silica hazards, and verify that effective control measures are being used. Site assessment is a continuous process because of changing environmental and work conditions as a construction job is being completed. In cases where the competent person is the only person from his or her company on a job site, frequent inspections of the job site would equate to continuous assessment of variables associated with the job that the competent person is conducting (e.g., signs that the controls are not functioning effectively, a change in weather condition that might require an adjustment of controls, or moving from an outdoor area to an enclosed area). Therefore, paragraph (g)(4) of the standard for construction requires an employer to designate a competent person to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan. OSHA concludes that the uniqueness and complexity of scenarios on construction sites justify the designation of a competent person.

OSHA agrees with commenters that a competent person is needed in construction because employers who use the specified exposure control methods in Table 1 are not required to conduct exposure assessments and because large numbers of small construction companies do not typically employ health and safety professionals. Another reason for including a competent person provision in the construction standard is because at multi-employer worksites, the actions of one employer may expose employees of other employers to hazards. For these reasons, OSHA agrees with ACCSH and commenters from NIOSH, labor unions, and employee health advocate groups that a requirement for a designated competent person is needed and will improve employee protections in construction.

In addition, as noted above, a requirement for a competent person is consistent with OSHA substance-specific standards for construction, such as lead (29 CFR 1926.62), asbestos (29 CFR 1926.1101), and cadmium (29 CFR 1926.1127). OSHA's general safety and health provisions for construction require the employer to initiate and maintain programs for accident prevention, as may be necessary, and such programs require frequent and regular inspections of job sites, materials, and equipment by a designated competent person (29 CFR 1926.20(b)(1) and (2)). Designating a competent person is consistent with current construction industry practices because, as the record indicates, employers in the construction industry are already using competent persons.

OSHA is requiring that the competent person implement the written exposure control plan because, as discussed above, the plan specifies what must be done to consistently identify and control respirable crystalline silica hazards on a job site. In construction, a competent person is needed to ensure that the requirements of the written exposure control plan are being met under variable conditions. The subjects that must be described in the written exposure control plan for construction—tasks involving exposure to respirable crystalline silica; engineering controls, work practices, and respiratory protection; housekeeping methods for limiting exposure; and procedures for restricting access when needed to minimize exposures or numbers of employees exposed—are consistent with the duties of a competent person suggested by representatives from NIOSH, labor unions, employee health advocates, and some industries. Therefore, having the competent person implement the written exposure control plan is consistent with many of the competent person duties recommended by commenters. It also makes the competent person requirements easy to understand.

Implementation of the written exposure control plan does not address every competent person duty that was recommended by commenters, such as training or specific duties related to abrasive blasting with sand. OSHA is not mandating that the competent person conduct training because training could, in many cases, be performed by other individuals. For example, ensuring that an employee can demonstrate knowledge and understanding of health hazards, contents of the rule, and medical surveillance, and providing the employee with any needed training, may be better addressed by an individual other than the designated competent person, or at another location before the employee reports to the job site. A competent person could use the written exposure control plan to recognize employees who are not knowledgeable about full and proper implementation of controls or work practices and take appropriate action, such as reminding them of proper practices or recommending additional training to the employer.

The standard does not specify a duty for the competent person regarding abrasive blasting with sand, but unique aspects of that operation, such as more frequent checks of controls, could be specified in the written exposure control plan. OSHA reasons that evaluating alternate media for use in abrasive blasting, as was recommended in the draft standard for SBREFA, requires specialized knowledge in toxicology or a related science, and is thus beyond the knowledge of a typical employee who would be designated a competent person and unduly burdensome to employers. Also, as discussed in the summary and explanation section of Methods of Compliance, OSHA recognizes that alternative media may present health risks. Other duties that commenters recommended, such as conducting exposure assessment, are usually done by professionals such as industrial hygienists. Requiring an industrial hygienist to be on worksites daily would be very burdensome, especially to small employers. In addition, OSHA expects the need for exposure assessments in construction to be limited because most employers will likely rely on Table 1 in paragraph (c) rather than do exposure assessments, based on the number of comments OSHA received about exposure assessments being impractical in construction (see summary and explanation of Exposure Assessment).

In its prehearing comments, BCTD also requested that the exposure control plan list the identity of the competent person (Document ID 2371, Attachment 1, pp. 16-17). OSHA is not requiring that the written exposure control plan include the identity of the competent person because it is both impractical and unnecessary. Construction companies could have more than one designated competent person because they need a backup competent person or they have jobs being conducted at various construction sites. Therefore the identity of the competent person could change from day to day if employees work at different job sites, or if a backup person is sent to a particular job site. However, it is important for employees to be able to identify the competent person. Therefore, OSHA is requiring that employers covered by the standard for construction notify employees about the identity of the competent person as part of the training provision under paragraph (i)(2)(i)(E). OSHA expects this could simply involve announcing the identity of the competent person at the start of each work shift.

As stated above, paragraph (b) (Definitions) of the standard for construction specifies that the competent person have the knowledge and ability necessary to fulfill his or her responsibilities. The proposed rule did not specify particular training requirements for competent persons. Rather, the requirement for a competent person was performance-based in that the competent person needed to be capable of effectively performing the duty assigned under the standard, which was to identify, in advance, areas where exposures were reasonably expected to exceed the PEL. In the standard for construction, the duties of the competent person have been expanded, and expanded training requirements for the competent person therefore need to be considered.

OSHA received many comments regarding knowledge and competencies for a competent person. IUOE recommended inclusion of specific training requirements for competent persons in the standard for construction because it thought that without them, competent persons may not get the training needed to train employees in the implementation and maintenance of controls or understand and adjust to variables that affect exposures, smaller employers might not understand the scope of appropriate training, employers might avoid expenditures for appropriate training, and the standard would be more difficult to enforce (Document ID 4234, Part 2, p. 52). IUOE summarized one case concerning an occupational fatality resulting from inadequate training or knowledge and other cases supporting specific training for competent persons (Document ID 4234, Part 2, pp. 55-56). ASSE cautioned that many OSHA standards do not specify parameters for determining competency and referred to the challenges in judging competency when litigating citations (Document ID 4201, pp. 4-5).

NIOSH requested that OSHA require competency training, as it did for asbestos (29 CFR 1926.1101(o)(4)), and list requirements for silica-specific training and capabilities for competent persons in the standard or an appendix of the standard. NIOSH further stated that "OSHA could consider allowing appropriate experience to qualify (e.g., learning by apprenticing to a trained silica-competent person)." NIOSH noted that such an approach is consistent with the ANSI A10.38 standard that defines a competent person based on specific education, training, or experience (Document ID 2177, Attachment B, p. 9).

IUOE, ASSE, LHSFNA, and BCTD endorsed the competency objectives set forth in an AIHA White Paper as a minimum body of knowledge for a silica competent person (Document ID 4201, p. 6; 4207, p. 3; 4223, pp. 113-114). BCTD requested that the White Paper be included as a non-mandatory appendix to the rule (Document ID 4223, pp. 113-114). The AIHA White Paper indicates that a silica competent person can demonstrate competency by completing a training course addressing the criteria in the White Paper or successfully demonstrating the capabilities described in the White Paper through training or direct job experience. The competency objectives listed in the AIHA White Paper include an understanding of (a) the role of a competent person; (b) what silica is and where it is found; (c) silica hazards and exposures, occupational exposure limits, and regulations; (d) how to determine if silica is present through bulk sample analyses, safety data sheets, or material checklists; (e) exposure ranges for common construction tasks in the absence of controls and under conditions that can result in higher exposures, and recognition of situations when a qualified person needs to be called in; (f) effective use of controls to reduce exposures and basic understanding of respiratory protection; (g) understanding of need for oversight and quality assurance, including review of exposure monitoring by a qualified person and communication to other employers on a multi-employer sight; (h) understanding of OSHA standard; and (i) understanding of authority, responsibilities and procedures (e.g., resolving safety or health situations) (Document ID 4076, pp. 4-9).

Commenters further elaborated on training requirements and competencies for a silica competent person. ASSE requested that OSHA give clear guidance on what qualifies an individual to be designated a competent person, asserted that certification in safety or industrial hygiene should presume competency, recommended similar competency requirements as the AIHA White Paper, and suggested that OSHA include training competency requirements in a non-mandatory appendix. ASSE also noted that the asbestos standard, 29 CFR 1926.1101(o)(4), requires competent persons to complete an Environmental Protection Agency course, and although an equivalent course does not exist for crystalline silica, training to address competencies for a silica competent person could be added to a 30-hour course for construction (Document ID 4201, pp. 2-6).

As discussed in detail in the summary and explanation of Communication of Respirable Crystalline Silica Hazards to Employees, BCTD requested a tiered approach to training in which the competent person would receive training necessary to perform his or her duties, in addition to awareness training for all covered employees and hands-on training on engineering controls and work practices for employees performing tasks that generate silica dust (Document ID 4223, pp. 117-118). IUOE, LHSFNA, and BAC similarly advocated competent person training as part of a tiered approach and stressed that the competent person receive site-specific training on engineering controls (Document ID 2262, pp. 39-40; 4207, p. 5; 4219, p. 24). Tom Nunziata, Training Coordinator for LHSFNA, stressed that the minimum training for a competent person should be at least the training required for employees performing tasks that generate silica dust (Document ID 3589, Tr. 4221). Similar to NIOSH, Travis Parsons testified that experience can contribute to a competent person's knowledge (Document ID 3589, Tr. 4197-4198).

LHSFNA indicated that competent person training should be tailored based on needs and exposure potential (Document ID 4207, p. 5). Other commenters provided numerous examples of unique training requirements for heavy equipment operators. For example, Gary Fore, retired Vice President for Health, Safety, and Environment for NAPA, referenced best practices for inspection of controls on asphalt milling machines by competent persons and testified that those machines are very complicated and sophisticated (Document ID 3583, Tr. 2182-2183). Therefore, training is required to detect issues requiring maintenance, such as a plugged or inappropriately placed nozzle (Document ID 2181, p. 10). IUOE commented that a competent person must have the knowledge to make informed judgments about the potential for silica exposures to exceed the action level (Document ID 2262, pp. 42-43). Martin Turek, Assistant Coordinator and Safety Administrator for IUOE Local 150, and Kyle Zimmer gave several examples of variables that could affect silica exposures in earth moving tasks, such as weather (e.g., wind, humidity) and soil compositions and handling (e.g., clay versus rock, distance soil is dropped from a bucket) (Document ID 3583, Tr. 2351-2352, 2356-2359). Matt Gillen, Deputy Director of NIOSH's Office of Construction Safety and Health, testified that a competent person should be able to recognize variability issues and make changes to address them (Document ID 3579, Tr. 205-206).

NRECA commented that a competent person for rural electric utilities should be trained in setting up air monitoring, setting boundaries for control zones, physical characteristics of crystalline silica, and PPE such as respirators (Document ID 2365, pp. 19-20). Francisco Trujillo testified that a competent person should have knowledge of work processes and their associated hazards and possibly, some knowledge of previous sampling evaluations to know if employees might be overexposed (Document ID 3585, Tr. 2980-2981). Upstate Medical University recommended that the competent person be trained on the respirable crystalline silica standard, the hierarchy of controls, exposure determinants, and the written control plan (Document ID 2244, p. 4).

Ameren Corporation opposed specific training requirements for a competent person (Document ID 2315, p. 2). CISC stated that if OSHA does include a competent person requirement in the standard, the agency should not require training because:

> An individual's experience, job training, and silica awareness training, in the CISC's view, will provide the capabilities envisioned by OSHA for a competent person with respect to crystalline silica. For silica in construction, the CISC respectfully believes that no specific training for a "competent person" is required. Furthermore, the Agency has traditionally not included specific competent person training requirements in its construction standards, instead taking a performance-oriented approach to the requirements and definition. There is nothing unique about silica that would cause the Agency to deviate from this past approach (Document ID 2319, pp. 127-128).

OSHA concludes, after consideration of all the comments, that it is not practical to specify in the rule the elements and level of training required for a competent person. The Agency does not find it appropriate to mandate a "one size fits all" set of training requirements to establish the competency of competent persons in every conceivable construction setting. Therefore, the training requirement for a competent person is performance-oriented. This approach is consistent with most OSHA construction standards, such as cadmium (29 CFR

1926.1127) and lead (29 CFR 1926.62), which include a performance-based approach by not specifying training or qualifications required for a competent person.

It is evident from the comments that controlling respirable crystalline silica exposures involves tailoring controls and work practices to each particular work setting. Moreover, training is addressed by the HCS and paragraph (i) of the standard for construction. The HCS and paragraph (i) require that employees be trained on subjects that overlap with competencies listed in the AIHA White Paper. For example paragraph (h)(3)(i) of the HCS (29 CFR 1910.1200) requires training of covered employees on methods to detect the release of hazardous chemicals (in this case, respirable crystalline silica). The respirable crystalline silica standard for construction requires training on health hazards, tasks that could result in exposures, engineering and work practice controls and respiratory protection, and the contents of the standard (paragraphs (i)(2)(i)(A-D)).

OSHA concludes that successful completion of training requirements in the HCS and the standard for construction impart a high level of competency to employees. The training focuses on general requirements that apply to most construction settings and should be sufficient to provide an employee with the knowledge and ability to be designated a competent person at some companies. Competent persons might require more knowledge and training in certain circumstances, but that would vary widely among construction companies. For example, competent persons at a small residential construction company might only need training on controls for power tools that they do not typically use to perform their own tasks, so that they could assist employees with questions about or problems with dust controls on those tools. In contrast, a competent person for heavy equipment tasks may require more specialized training in heavy equipment inspection or identifying various soil types to estimate exposure potential.

Because companies covered under the construction standard conduct a wide range of tasks involving unique scenarios, training requirements will vary widely among different companies. It is, therefore, the employer's responsibility to identify and provide any additional training that the competent person needs to implement the employer's written exposure control plan.

Finally, a compliance officer could ascertain whether the employer is in compliance with the competent person requirement by asking questions to assess whether the competent person has adequate knowledge to perform his or her duties, such as an understanding of engineering controls and how to recognize if they are not functioning properly. As is the case with training of all employees, the employer is responsible for determining that a competent person is adequately trained and knowledgeable to perform his or her duties.

Competent Person (General Industry). As part of the proposed written access control plan, OSHA proposed that a competent person identify and maintain regulated areas in workplaces covered by the general industry and maritime standard. AFL-CIO and USW requested expanded competent person duties and training requirements for general industry and maritime because a competent person could recognize and take action to protect employees from high exposures (Document ID 4204, pp. 58-60; 4214, pp. 14-16). AFL-CIO urged OSHA to reinstate the competent person duties from the 2003 SBREFA draft standard (Document ID 4204, pp. 58-60). USW commented that a competent person could ensure that hazards are recognized, employees receive proper training, adequate controls and PPE are implemented, and an effective exposure control plan is developed (Document ID 4214, pp. 14-15). In describing how a competent person is relevant to general industry, AFL-CIO pointed to testimony by employees who were trained to evaluate the function of ventilation systems (Document ID 4204, p. 60). AFL-CIO also asserted that NIOSH and AIHA urged OSHA to include a competent person requirement for both general industry and construction (Document ID 4204, pp. 59-60). OSHA examined the AIHA and NIOSH comments referenced by AFL-CIO and identified only recommendations for a competent person regarding construction-related topics, such as Table 1 (Document ID 2169, pp. 4-5; 2177, Attachment B, pp. 8-10, 25-26).

OSHA is not requiring a competent person for the general industry and maritime standard. OSHA has determined that in most cases, general industry scenarios are not as variable as those in construction. For example, most work is performed indoors and therefore, not subject to variables such as wind shifts and moving exposure sources that could significantly affect exposures or complicate establishment of regulated areas. In general industry and maritime, controls are not usually built into tools that require action by the individual employees who use them to function effectively. The exposure assessments that employers in general industry and maritime are required to conduct will verify that controls are functioning effectively. Employers covered under the general industry and maritime standard are more likely to have health and safety professionals on staff who could assist with implementation of the standard. Finally, competent persons have not been included in other OSHA substance-specific standards for general industry. For example, a competent person requirement was included in the construction standard for cadmium because of environmental variability and the presence of multiple employers on the job site, but a competent person requirement was not included in the general industry standard for cadmium (29 CFR 1910.1027; 29 CFR 1926.1127; 57 FR 42101, 42382 (9/14/1992)). Moreover, as explained in the summary and explanation of Regulated Areas, establishing regulated areas is reasonable in most general industry scenarios because employers are required to conduct exposure assessment and are thus able to determine the boundaries of a regulated area. Therefore, the general industry and maritime standard requires regulated areas that are demarcated and posted with warning signs. This negates the need for a competent person to identify and maintain regulated areas. These factors explain and support OSHA's conclusion that there is no regulatory need for including a competent person requirement in the respirable crystalline silica standard for general industry and maritime.

Comparison to ASTM Standards. The written exposure control plan is comparable to the ASTM standards in some respects and different in others. Section 4.2.6 of ASTM Standard E 1132 – 06 and Section 4.2.5 of ASTM standard E 2625 – 09 recommend written exposure control plans for areas with persistent overexposures; address engineering, work practice, and administrative controls; and call for a root cause analysis to investigate the causes of the overexposure, identify remedies, and conduct follow-up sampling to verify that exposures are below the PEL (Document ID 1466, p. 2; 1504, p. 2). The major difference between the written plans in the ASTM standards and the written plans in the respirable crystalline silica rule is that the written plans for the respirable crystalline silica rule are not limited to overexposure scenarios. The ASTM standards address work practices and administrative controls, but the written exposure control plans in the respirable crystalline silica rule further explain what those practices and controls are (i.e., restricting access as needed (construction standard only), engineering controls, work practices, respiratory protection, and housekeeping methods). In addition, the written exposure control plans in the respirable crystalline silica rule are implemented by a competent person (construction standard only), are required to be reviewed and updated at least annually by the employer, and are to be made available to employees, employee representatives, OSHA, and NIOSH upon request.

The requirements of the rule for respirable crystalline silica better protect employees and, therefore, better effectuate the purposes of the OSH Act of 1970 than the ASTM standards.

Because the written plans are required for all workplaces covered by the rule, they help to maintain comprehensive and consistent controls, which can prevent overexposures from occurring. The provision for annual review ensures that the plans remain effective, and the provision for making the plans available to employees helps to make employees aware of the protections they should expect. More details about how the requirements of the rule better effectuate the requirements of the OSH Act are discussed above.

<u>Medical Surveillance</u>

Paragraph (i) of the standard for general industry and maritime (paragraph (h) of the standard for construction) sets forth requirements for the medical surveillance provisions. The paragraph specifies which employees must be offered medical surveillance, as well as the frequency and content of medical examinations. It also sets forth the information that the physician or other licensed health care professional (PLHCP) is to provide to the employee and employer.

The purpose of medical surveillance for respirable crystalline silica is, where reasonably possible, 1) to identify respirable crystalline silica-related adverse health effects so that appropriate intervention measures can be taken; 2) to determine if an employee can be exposed to respirable crystalline silica in his or her workplace without increased risk of experiencing adverse health effects, or in other words, to determine if an employee has any condition, regardless of the cause, that might make him or her more sensitive to respirable crystalline silica exposure; and 3) to determine the employee’s fitness to use respirators. The inclusion of medical surveillance in this rule is consistent with Section 6(b)(7) of the Occupational Safety and Health (OSH) Act (29 U.S.C. 655(b)(7)) which requires that, where appropriate, medical surveillance programs be included in OSHA standards to determine whether the health of employees is adversely affected by exposure to the hazard addressed by the standard. Almost all other OSHA health standards have also included medical surveillance requirements and OSHA finds that a medical surveillance requirement is appropriate for the respirable crystalline silica rule because of the health risks resulting from exposure.

General. Paragraph (i)(1)(i) of the standard for general industry and maritime requires employers to make medical surveillance available for employees who will be occupationally exposed to respirable crystalline silica at or above the 25 $\mu g/m^3$ action level for 30 or more days per year. Paragraph (h)(1)(i) of the standard for construction requires employers to make medical surveillance available to employees who will be required under this section to use a respirator for 30 or more days per year. Thus, employers are required to determine if their employees will be exposed at or above the action level of 25 $\mu g/m^3$ in general industry and maritime, or required to wear a respirator under the construction standard for 30 or more days per year (i.e., the next 365 days), and then make a medical examination available to those employees who meet these criteria under two scenarios: (1) within 30 days of initial assignment, unless the employee has had a current examination that meets the requirements of this rule within the last three years (paragraph (i)(2) of the standard for general industry and maritime, paragraph (h)(2) of the standard for construction) and (2) within three years from the last initial or periodic examination (paragraph (i)(3) of the standard for general industry and maritime, paragraph (h)(3) of the standard for construction). As in previous OSHA standards, both standards are intended to encourage participation by requiring that medical surveillance be offered at no cost to the employee and at a reasonable time and place. Under the "at no cost to the employee" proviso, if participation requires travel away from the worksite, the employer will be required to bear the cost of travel, and employees will have to be paid for time spent taking medical examinations, including travel time.

Some employers and industry representatives questioned the general need for medical surveillance or expressed their concerns with the medical surveillance requirement. For example, OSCO Industries, Inc. argued that medical surveillance would not identify many employees with silicosis and OSCO Industries and National Association of Home Builders (NAHB) emphasized the progress that has already been made in eliminating silicosis (Document ID 1992, p. 11; 2296, p. 43). Fann Contracting, Inc. stated that medical surveillance is not needed because employees exposed above the permissible exposure limit (PEL) are required to wear respirators and they should therefore be protected (Document ID 2116, Attachment 1, p. 43).

OSHA does not find these comments persuasive. As discussed in Section VI, Final Quantitative Risk Assessment and Significance of Risk, OSHA has found that employees exposed to respirable crystalline silica at the preceding PELs are at significant risk of material impairment of health. Although the revised PEL of 50 $\mu g/m^3$ substantially decreases risks, the risk remains significant at and below the PEL, including at the action level of 25 $\mu g/m^3$. Consequently, even employees exposed at the action level are at significant risk of developing silicosis and other respirable crystalline silica-related diseases. Based on these risk assessment findings, OSHA concludes that silicosis and other respirable crystalline silica-related illnesses are an ongoing occupational risk. OSHA expects that those illnesses are likely to be detected as part of medical surveillance, and the detection of these illnesses will benefit employees.

Even employees required to wear respiratory protection in high exposure environments are at risk of developing disease. As OSHA notes in the summary and explanation of Methods of Compliance, respirators fully protect employees only if they are properly fitted and maintained correctly and replaced as necessary; they do not protect employees if they are not used consistently and properly. The committee that developed the ASTM International (ASTM) standard, ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities, also concluded that medical surveillance is needed for employees who wear respirators to ensure that the respiratory protection is working (Document ID 3580, Tr. 1452). (This requirement is consistent with that in ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica.) Consequently, OSHA concludes that the requirement for respiratory protection for exposures exceeding the PEL does not obviate the need for medical surveillance.

Employers also expressed concern about responsibility for exposures occurring through other employment or non-occupational sources (e.g., environmental exposures) (e.g., Document ID 2116, Attachment 1, pp. 20, 36, 37, 39; 2295, p. 2; 2296, p. 31; 3531, p. 9). Construction Industry Safety Coalition (CISC) and Holes Incorporated questioned how medical surveillance would decrease exposures, and Holes Incorporated stated it would not prevent the onset of silicosis (Document ID 2319, p. 116; 2338, p. 6).

OSHA stresses that the main purposes of medical surveillance are early detection of disease related to respirable crystalline silica exposure so appropriate intervention methods can be taken, to let employees know if they have a condition that might make them more sensitive to respirable crystalline silica exposure, and to assess fitness to wear a respirator. The purpose of medical surveillance is not to identify which employer is responsible for illnesses resulting from respirable crystalline silica exposures or must offer financial compensation. OSHA agrees with the Building Construction and Trades Department, AFL-CIO (BCTD), which stated that “[e]arly detection of silica-related medical conditions will enable employees to make informed decisions about their work, their medical care and their lifestyles" (Document ID 4223, p. 123). For example, as the American College of Occupational and Environmental Medicine (ACOEM) and the National Institute for Occupational Safety and Health (NIOSH) stated, an early diagnosis allows an employee to consider employment choices that minimize or eliminate respirable crystalline silica exposure to decrease the risk of progression or exacerbation of disease (Document ID 1505, p. 3; 3579, Tr. 257). In another example, an early diagnosis of silicosis allowed bricklayer Dennis Cahill, representing the International Union of Bricklayers and Allied Craftworkers (BAC), to manage his health by getting flu and pneumonia shots, avoiding the public during cold season, and staying indoors during periods of high air pollution (Document ID 3585, Tr. 3089, 3104). OSHA finds that although medical surveillance does not reduce exposures, like engineering controls do, it is nonetheless an integral component of this (and most) occupational safety and health standards and important in its own right for safeguarding the health of employees exposed to respirable crystalline silica.

OSHA also agrees with the viewpoint expressed so well by Mr. Cahill, that employees who are knowledgeable about their health risks will take actions in response to information from medical surveillance. Such actions will likely benefit not only the employees but also employers because their employees are likely to be healthier. Members of the medical community, labor unions, employee health advocate groups, and industry groups emphasized the value of early detection for intervention purposes (e.g., Document ID 2080, p. 9; 2178, Attachment 1, p. 2; 2351, p. 15; 3541, p. 1; 3577, Tr. 570-571; 3588, Tr. 3751; 3589, Tr. 4292; 4204, p. 79; 4219, p. 28; 4223, pp. 123-124). In addition, more than 100 commenters including construction employees, employee health advocates, medical professionals, and employers or industry representatives voiced their general support for medical examinations in the respirable crystalline silica rule (e.g., Document ID 1771, p. 1; 2030; 2268; 2134, p. 10; 2403; 3294).

Some commenters representing the construction industry questioned the practicality of medical surveillance for construction employees due to a number of particular difficulties, such as the short-term nature and high turnover rate of construction jobs (e.g., Document ID 2116, Attachment 1, p. 20; 2187, p. 7; 2247, p. 1; 2276, p. 10; 2289, p. 8; 2295, p. 2; 2296, pp. 42-43; 3230, p. 1; 3442, pp. 5-6; 4029, p. 3; 4217, p. 21). For example, American Subcontractors Association and Hunt Construction Group stated that the difficulty in tracking medical surveillance in a mobile work force could result in repeated, unnecessary testing for construction employees (Document ID 2187, p. 7; 3442; pp. 5-6). Kenny Jordan, Executive Director of the Association for Energy Services Companies (AESC), which represents another industry with high turnover rates, expressed similar concerns about repeated testing, although he did not oppose medical surveillance and asked for a medical record that would follow the employee (Document ID 3589, Tr. 4063). The Laborers' Health and Safety Fund of North America (LHSFNA) supported medical surveillance, but expressed concerns about repeated testing and urged OSHA to include provisions for contractor associations and union management funds to coordinate medical examinations for employees who work for several contractors in a year to avoid unnecessary medical examinations (Document ID 4207, p. 5).

After considering these comments, OSHA concludes that the necessity for medical surveillance is not negated by the practical challenges of tracking medical surveillance in a mobile work force. OSHA has included medical surveillance in other health standards where construction has been a primary industry impacted by those rules (e.g., lead, asbestos, and chromium (VI)) and finds no reason why the respirable crystalline silica standard for construction should be an exception. Moreover, there are practical solutions for tracking medical surveillance to avoid duplicative, unneeded testing. One simple solution, which OSHA has included in this rule, is to have employers ensure that each employee receives a dated copy of the PLHCP's written medical opinion for the employer. The employee can then provide the opinion to his or her next employer as proof of up-to-date medical surveillance (Document ID 4207, p. 5; 4223, p. 125). Employers could also work with a third party, such as an industry association, union, or local medical facility, to coordinate, provide, or keep records of medical examinations (Document ID 4207, p. 5; 4236, pp. 3-4, Appendix 1, pp. 1-2). Such an approach has been used by LHSFNA to avoid unnecessary testing of employees who work for several contractors in a year (Document ID 3759, Appendix 3). The respirable crystalline silica rule does not preclude such pooled employer-funded approaches, and OSHA expects such coordination to occur in response to this rule. OSHA concludes that there are practical solutions for addressing the challenge posed by employee mobility and turnover in the construction industry, and those factors should not prevent construction employees who are eligible for medical surveillance under the standard (i.e., those who will be engaged in tasks requiring respirator use for 30 or more days in the upcoming year) from being offered such surveillance as part of the employer's compliance obligations.

In the proposed standards, OSHA specified that employers must "make medical surveillance available" to those employees who would be occupationally exposed to respirable crystalline silica above the PEL for 30 or more days a year. The Agency received a variety of comments on this provision. First, NAHB expressed concern about employees refusing to participate in medical surveillance (Document ID 2296, p. 32). OSHA emphasizes that the mandate to offer medical surveillance to eligible employees does not include a requirement for employee participation, and no liability for non-participation arises so long as the employer does not discourage such participation.

Second, OSHA received numerous comments related to the proposed triggers for determining which employees should be provided medical surveillance. Some commenters focused on the level of exposure at which medical surveillance should be triggered. For example, Ameren Corporation agreed with the proposed PEL trigger, noting that it is consistent with the asbestos standard (Document ID 2315, p. 9). Some stakeholders from industry, the medical community, and employee health advocate groups also supported a trigger based on a PEL (e.g., Document ID 1785, pp. 4-5; 2175, p. 5; 2291, p. 26; 2327, Attachment 1, p. 26; 2339, p. 5; 2379, Appendix 1, p. 71; 3577, Tr. 784-785).

Other commenters advocated that medical surveillance should be triggered on an action level. However, these stakeholders disagreed on what the action level should be. For example, some commenters, like the National Industrial Sand Association (NISA), American Petroleum Institute, and other employers and industry groups, advocated an action level trigger of 50 $\mu g/m^3$ (with a higher PEL of 100 $\mu g/m^3$) (e.g., Document ID 1963, pp. 1-2; 2196, Attachment 1, pp. 1-2; 2200, pp. 1-2; 2213, p. 3; 2232, p. 1; 2233, p. 1; 2301, Attachment 1, p. 78; 2311, p. 3; 4208, pp. 7-9). NISA did not agree with OSHA that significant risk remains at 50 $\mu g/m^3$, but stated that an action level trigger is consistent with other OSHA standards; can lead to identification of individuals who might be more susceptible to silica exposures because of factors, such as genetic variability, prior work exposures, or smoking; addresses variability in workplace exposures; and provides an economic incentive for employers to maintain lower exposures (Document ID 2195, pp. 6, 30, 32).

Other stakeholders, including representatives of labor unions, the medical community, and other employee health advocate groups, stated that the proposed action level of 25 μg/m^3, or even a lower level, should trigger medical surveillance in general industry (e.g., Document ID 2157, p. 7; 2178, Attachment 1, p. 2; 2240, p. 3; 2282, Attachment 3, p. 14; 2336, p. 11; 2256, Attachment 2, p. 9; 2351, pp. 13-15; 3516, p. 3; 3541, p. 4). Other members of the medical community and employee health advocate groups also voiced general support for an action level trigger of 25 μg/m^3 or lower (e.g., Document ID 2080, p. 5; 2176, p. 2; 3538, Attachment 1, pp. 3-4).

American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) supported an action level trigger of 25 μg/m^3 because the union agreed with OSHA about the remaining significant risk for diseases at a PEL of 50 μg/m^3 and because an action level at half the PEL would be consistent with the majority of OSHA health standards (Document ID 4204, pp. 51, 79-80). Other representatives from the medical community, labor unions, and other employee health advocate groups, who also supported an action level trigger of 25 μg/m^3 or lower, expressed similar thoughts about significant risk or consistency with past standards (Document ID 2080, p. 5; 2157, p.7; 2176, p. 2; 2178, Attachment 1, p. 2; 2282, Attachment 3, p. 22; 2336, p. 11; 3516, p. 3; 3535, p. 2; 3541, pp. 14-15). Some of those same commenters, including the United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) and ACOEM, supported an action level trigger because of the variability of workplace exposures (Document ID 2282, Attachment 3, p. 14; 3577, Tr. 766-767); the medical society Collegium Ramazzini and United Steelworkers (USW) also noted an economic benefit for employers to maintain lower exposures (Document ID 2336, p. 11; 3541, p. 15). Lastly, AFL-CIO noted that because OSHA proposed a requirement for exposure assessment in general industry, employers will know if employees are exposed above the action level; the same is not true in construction because employers may use Table 1 instead of conducting exposure assessments (Document ID 4204, pp. 80-81).

OSHA also received comments on whether medical surveillance should be triggered by a number of days of exposure at a certain level. For example, NISA objected to the proposed 30-day exposure-duration trigger for medical surveillance and stated that it should be offered to all employees with likely exposure to respirable crystalline silica above the action level (Document ID 4208, p. 8, Fn 12). The Asphalt Roofing Manufacturers Association (ARMA) supported the 30-day exposure-duration trigger for medical surveillance because some employees are only infrequently exposed above the PEL as a result of scheduled maintenance tasks performed once or twice per year or when filling in for other employees, and the 30-day trigger would exclude employees with lower average exposures (Document ID 2291, p. 26). Other commenters representing industry or the medical community also agreed with the 30-day exposure-duration trigger (e.g., Document ID 2080, p. 5; 2157, p. 7; 2175, p. 5; 2178, Attachment 1, p. 2; 2301, Attachment 1, p. 78; 2311, p. 3; 2315, p. 9; 2327, Attachment 1, p. 26; 2379, Appendix 1, p. 71; 3541, p. 14).

OSHA agrees with the majority of commenters who indicated that maintaining the 30-day exposure-duration trigger is appropriate for general industry and maritime because the health effects of respirable crystalline silica occur as a result of repeated exposures and concludes that a 30-day trigger is a reasonable benchmark for capturing cumulative effects caused by repeated exposures. Including a 30-day exposure-duration trigger also maintains consistency with other OSHA standards, such as chromium (VI) (29 CFR 1910.1026), cadmium (29 CFR 1910.1027), lead (29 CFR 1910.1025), and asbestos (29 CFR 1910.1001). OSHA also agrees with commenters who indicated that triggering medical surveillance at the action level of 25 μg/m^3 addresses residual significant risk and varying susceptibility of employees that can result in some experiencing adverse health effects at lower exposure levels. An action level trigger in the standard for general industry and maritime is also appropriate based on variability in exposure levels and the availability of exposure assessment data in general industry and maritime. However, OSHA has concluded that a delayed implementation of the action level trigger for medical surveillance is appropriate. Therefore, as indicated in the Summary and Explanation for Dates, medical surveillance will be triggered by exposures exceeding the PEL for 30 or more days per year during the first two years after medical surveillance requirements commence (i.e., beginning two years after the effective date). After that time (i.e., four years after the effective date), medical surveillance will be triggered by exposures exceeding the action level for 30 or more days per year (paragraph (l)(4)). This approach will focus initial medical surveillance efforts on those employees at greatest risk, while giving most employers additional time to fully evaluate the engineering controls they have implemented in order to determine which employees meet the action level trigger for medical surveillance.

OSHA intends to conduct a retrospective review five years after the action level trigger is fully implemented (i.e., at nine years after the effective date of the standard for general industry and maritime) to gain a better understanding of the effectiveness of the action level trigger for medical surveillance. OSHA will engage other federal agencies, such as NIOSH, and stakeholders as appropriate, and will issue a report about the findings of the evaluation.

Construction industry representatives, employee health advocates, and others also commented on OSHA's proposed use of the PEL to trigger medical surveillance in the standard for construction. The Center for Progressive Reform (CPR) and Charles Gordon, a retired occupational safety and health attorney, advocated an action level trigger for medical surveillance; Mr. Gordon also requested that conducting Table 1 activities trigger medical surveillance (Document ID 2351, p. 13; 4236, pp. 3-4). Fann Contracting supported a PEL trigger for medical surveillance (Document ID 2116, Attachment 1, p. 42). BAC and BCTD supported the PEL (as determined by monitoring) or Table 1 tasks requiring respirator use as triggers for medical surveillance in construction because employees using Table 1 would not be required to conduct exposure assessments and therefore would not know if exposures exceed the action level (Document ID 4219, p. 29; 4223, p. 124). [Note 1 for proposed Table 1 indicated that required respirator use in Table 1 presumed exposures exceeding the PEL (78 FR 56273, 56499 (9/12/13))]. In prehearing comments, LHSFNA supported a PEL trigger as a practical approach and requested that medical surveillance be triggered by tasks (Document ID 2253, p. 5). In its post-hearing comments, however, LHSFNA recommended that medical surveillance be required for employees who are required to wear a respirator since those employees would already need to undergo a medical evaluation to make sure they can safely wear a respirator (as required by the respiratory protection standard) (Document ID 4207, pp. 4-5).

After reviewing these comments, OSHA concludes that an action level trigger is not practical in the construction industry because many employers will be using Table 1, and, therefore, will not have an exposure assessment indicating if the action level is met or exceeded. OSHA acknowledges that some construction employees who are not required to use respirators for 30 or more days per year are at significant risk, but has decided that triggering medical surveillance based on respirator use is the most practical trigger for the construction standard. Triggering medical surveillance in this manner is consistent with the proposed rule, because respirator use under Table 1 is based on tasks in which exposures consistently (more often than not) exceed the revised PEL, as found in OSHA's technological feasibility analyses of the various tasks included in Table 1 (see Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA) and the summary and explanation for Specified Exposure Control Methods). OSHA expects most construction employers to be following Table 1, and therefore decided it also made the most practical sense to tie medical surveillance to required respirator use. In addition, use of the respirator trigger allows construction employers to more efficiently determine if the 30-day duration trigger is met in cases where one of their employees may be required to use respirators when doing Table 1 tasks and while doing tasks (e.g., abrasive blasting) that are not on Table 1 but are determined to have exposures above the PEL based on exposures assessments conducted under paragraph (d)(2) of the standard for construction. Finally, OSHA decided not to expand the trigger for medical surveillance to Table 1 tasks that do not require respirator use because many employees engaged in those tasks will be exposed below the action level (see Chapter III of the FEA).

Some commenters expressed concerns about the practicality of requiring employers to offer medical surveillance for exposures exceeding a trigger level for 30 days or more in the construction industry. George Kennedy, Vice President of Safety for the National Utility Contractors Association, testified that they do not know what employees are doing in the field each day and so will have to assume that they are exposed and, therefore, offer medical surveillance to every employee (Document ID 3583, Tr. 2245). BCTD questioned the feasibility of the 30-day exposure-duration trigger because the transient nature of construction work makes it difficult to predict if an employee will be exposed for 30 days; the American Industrial Hygiene Association (AIHA), AFL-CIO, and LHSFNA expressed similar views (Document ID 2169, p. 6; 4204, p. 81; 4207, p. 4; 4223, p. 125). CISC and some of its member companies questioned how an employer would know if employees were exposed above the PEL for 30 or more days a year unless they were following Table 1 or conducting near continuous monitoring (Document ID 2269, pp. 6-7; 2289, p. 8; 2319, p. 116). CISC and AIHA questioned how OSHA could verify the number of days an employee was exposed (Document ID 2169, p. 6; 2319, p. 116). Larger employers, such as Fann Contracting, expressed the challenges of tracking employee exposures due to large numbers of employees and various ongoing projects (e.g., Document ID 2116, Attachment 1, p. 11).

OSHA acknowledges that tracking exposures in construction can be challenging but observes that some employers are currently able to track employee exposures to determine which employees should be offered medical surveillance. For example, Kevin Turner, Director of Safety at Hunt Construction Group and representing CISC, testified that safety representatives on job sites keep track of exposures based on employees' schedules, and the company provides medical surveillance for employees exposed above the preceding construction PEL for 30 or more days a year (Document ID 3580, Tr. 1535-1536). Francisco Trujillo, Safety Director at Miller and Long, Inc., testified that at his company, they conduct hazard assessments based mainly on the tasks the employees will be performing, to determine which employees are likely to be exposed above the preceding PEL, and they offer those employees medical evaluations as part of the company's respiratory protection program. The company has a system that monitors participating employees' training, medical evaluations, and fit tests. The system sends email reminders to company representatives when the participating employees are due to be re-examined or re-evaluated. However, Mr. Trujillo expressed concern that if the number of employees participating in the program greatly increases, then maintaining the company's tracking program would become a more daunting task (Document ID 3585, Tr. 3008-3010).

After reviewing the comments and testimony submitted on the proposed construction trigger, OSHA concludes that the special circumstances in construction, such as lack of exposure data for employees using Table 1 or difficulties in tracking exposures for numerous short-term assignments conducted at various sites, warrant a simpler approach for triggering medical surveillance. Therefore, OSHA revised paragraph (h)(1)(i) of the standard for construction to require that employers offer medical surveillance to employees who will be required to wear a respirator under this standard for 30 or more days a year to limit exposure to respirable crystalline silica. Under the standard for construction, employees must wear a respirator when required to do so under Table 1 (paragraph (c)) or when, pursuant to the performance option or the scheduled monitoring option set forth in paragraph (d)(2), their exposures exceed the PEL (paragraph (e)(1)(ii)). Respirator use under Table 1 is equivalent to the PEL because the tasks that require respirator use are those that, in its technological feasibility analysis of the construction industry, OSHA has determined result in exposures exceeding 50 $\mu g/m^3$ a majority of the time (see Chapter IV of the FEA and the summary and explanation of Specified Exposure Control Methods). Based on the number of commenters who indicated that exposure assessment is not practical in construction because of changing tasks and conditions (see summary and explanation of Exposure Assessment), OSHA expects most employers to use Table 1 for tasks listed on the Table (i.e., most of the tasks that generate silica exposure in construction). Under any available exposure control method, however, the most convenient way for construction employers to determine eligibility for medical surveillance is by counting the number of days the employee will be required to wear a respirator. Because respirator use is tied with certain tasks in Table 1, medical surveillance based on respirator use in Table 1 is consistent with the task-based approach described by Francisco Trujillo above. It is also consistent with the task-based triggers in the cadmium construction standard (29 CFR 1926.1127) and operation-based triggers (e.g., Class I work) in the asbestos construction standard (29 CFR 1926.1101).

OSHA concludes that a trigger based on respirator use will greatly simplify determining which employees covered by the construction standard must be offered medical surveillance. Consistent with the approach described by Kevin Turner above, company personnel on site, such as supervisors, could easily record or estimate when employees perform, or will perform, tasks requiring respirator use. Such information could be conveyed to a company employee who tracks it. Despite testifying that he would have a hard time tracking a greater number of employees who may require medical surveillance if the PEL or action level in effect at that time were lowered, Francisco Trujillo, from Miller and Long, a company with approximately 1,500 field employees, indicated that his company has a system that monitors and sends emails when employees are due for another medical examination (Document ID 3585, Tr. 3008-3010). OSHA sees no reason why this system could not be applied to larger numbers of employees, and this shows that it is possible for large companies to track exposures for numerous employees. Tracking exposures or days of respirator use will likely be easier for smaller companies who have fewer employees to track; OSHA estimates from existing data that approximately 93 percent of construction companies covered by the respirable crystalline silica standard have fewer than 20 employees (see Chapter III of the FEA). In addition, compliance officers would be able to determine if employees were exposed for 30 or more days a year but not offered medical surveillance by questioning employees about how often they engage in tasks that require respirator use for that employer.

Fann Contracting asked how a trigger for medical surveillance would apply to employees, such as heavy machine operators, who may briefly use respirators, such as when outside a cab for 30 minutes (Document ID 2116, Attachment 1, p. 3). OSHA clarifies that if an employee is required to wear a respirator at any time during a given day, whether to comply with the specified exposure control methods in paragraph (c) or to limit exposure to the PEL under the construction standard for respirable crystalline silica, that day counts toward the 30-day threshold.

Commenters also questioned the appropriateness of a 30-day exposure-duration trigger for construction. For example, American Society of Safety Engineers (ASSE) voiced concerns about the standard not addressing temporary employees who are continually exposed from job to job but may never stay with an employer for a full 30 days (Document ID 2339, p. 5). Conversely, CISC questioned why OSHA diverged from the ASTM exposure-duration trigger of 120 days, which would reduce the need to make medical surveillance available for short-term employees, and stated that OSHA needed to explain how this would improve the health of employees (Document ID 2319, p. 118; 1504, pp. 4-5). Members of the ASTM committee that developed the ASTM E 2625 – 09 standard testified that a 120-day exposure-duration trigger was selected so that employers did not have to provide medical surveillance to transient employees and that even a trigger of less than 90 days was considered but would have resulted in too much pressure and cost for employers because of the transient nature of construction work (Document ID 3580, Tr. 1452-1453; 3585, Tr. 2919-2920).

OSHA understands that offering medical surveillance for a transient workforce may be challenging, especially for small companies. However, the requirement to offer periodic medical examinations every three years rather than annually will reduce the cost and burden of providing such examinations considerably (see Chapter V of the FEA). OSHA finds both the 120-day exposure-duration trigger (in the ASTM standards) and the 90-day trigger (considered by the

ASTM committee) overly exclusive and insufficiently protective. Under those longer triggers, many short-term employees (i.e., those doing tasks requiring respirator use or otherwise exposed above the PEL for 30 or more days a year but nonetheless exposed for less than 90 days with the same employer) would be deprived of the health benefits of medical surveillance, such as early detection of disease, despite being at risk due to repeated exposures with different employers. As noted above, the health effects of respirable crystalline silica are most likely to occur as a result of repeated exposures. OSHA concludes that a 30-day exposure-duration trigger strikes a reasonable balance between the administrative burden of offering medical surveillance to all employees, many of whom may not be further exposed or only occasionally exposed, and the need for medical surveillance for employees who are regularly exposed and more likely to experience adverse health effects. The 30-day trigger is also administratively convenient insofar as it is consistent with OSHA standards for construction, including asbestos (29 CFR 1926.1101), cadmium (29 CFR 1926.1127), chromium (VI) (29 CFR 1926.1126), and lead (29 CFR 1926.62).

Commenters also raised other issues regarding the 30-day exposure-duration trigger that could apply to both the general industry and maritime standard and the construction standard. One concern was that inclusion of a 30-day trigger would result in discriminatory actions by employers in order to avoid offering medical surveillance. For example, Dr. Daniel Anna, Vice President of AIHA, was concerned that employers might refuse to hire someone approaching 30 days of exposure (Document ID 3578, Tr. 1048-1049); BAC also expressed concerns about employers terminating employees approaching their 30th day of exposure (Document ID 4219, p. 29). In addition, BAC noted that employers rotating employees to maintain employee exposure below 30 days might result in more employees being exposed to silica (Document ID 2329, p. 8).

Comments indicating that an employer might refuse to hire employees approaching their 30th day of exposure are based on an interpretation that medical surveillance is triggered by a total of 30 days of exposure per year with any employer. Such an interpretation was conveyed by the Shipbuilders Council of America and ASSE who commented that employers would need to know employee exposures with past employers when determining total days of exposure above the PEL (Document ID 2255, p. 3; 3578, Tr. 1048). That is not OSHA's intent, and OSHA clarifies that exposures occurring with past employers do not count towards the 30-day-per-year exposure-duration trigger with the current employer (i.e., the trigger is for employment with each particular employer). However, the 30-day-per-year exposure-duration trigger would apply when an employer hires a particular employee for more than one short-term assignment during a year, totaling 30 days or more. An advantage of not considering total exposures with all employers in triggering medical surveillance is that it avoids creating an incentive not to hire. With regard to comments about possible discriminatory practices (e.g., termination before the 30th day) or rotating employees to avoid medical surveillance, OSHA rejects the reasoning that employers will base employment and placement decisions on the 30-day exposure-duration trigger because the cost of medical examinations is modest (i.e., the FEA estimates the average cost of each medical examination at approximately $400 every three years).

Charles Gordon suggested that employers give each departing employee a card indicating the number of days they were exposed above the trigger point so that future employers would have a better idea if the employee was eligible for another medical examination based on 30 days of exposure (Document ID 4236, pp. 3-4). Such a record of past exposure with any prior employer is not necessary because of OSHA's decision to not consider exposures with past employers when triggering medical surveillance. Requiring employers to record exposures with past employers and to give employees a card indicating the number of days they were exposed above the trigger point increases recordkeeping and paperwork burdens for employers. It also imposes a burden on employees because it gives them an additional document that they need to maintain. To avoid these added burdens and for the reasons previously given for not counting exposures with other employers towards an employee's medical surveillance requirement, OSHA rejects Mr. Gordon's suggestion.

NIOSH and Fann Contracting questioned the 30-day-per-year exposure-duration trigger because employees who have been exposed to silica for years, but are not currently exposed 30 days per year, would be at risk of developing lung diseases (Document ID 2116, Attachment 1, p. 41; 2177, Attachment B, pp. 39-40). NIOSH recommended that medical surveillance continue after an employee is no longer exposed to respirable crystalline silica but continues to work for the same employer (Document ID 2177, Attachment B, p. 39). James Schultz, safety director at Navistar Waukesha Foundry and representing the Wisconsin Coalition for Occupational Safety and Health (WisCOSH), testified that medical surveillance should continue after employees have left “this type of work environment” (Document ID 3586, Tr. 3200-3201). However, NIOSH also stated that considerations for continued medical surveillance include the number of years an employee was required to be monitored and if the employee is showing signs of silica-related illness (Document ID 2177, Attachment B, p. 39).

OSHA agrees with NIOSH that silica is retained in the lungs and can cause progressive damage after exposures end. However, the lack of clear criteria in the record for determining when continued medical surveillance would be beneficial precludes OSHA from mandating continued medical surveillance after exposure ends. In addition, OSHA policy is clear that requirements are imposed on current employers. In the benzene standard, OSHA articulated that policy in deciding not to mandate continued medical surveillance for employees who are no longer exposed above the trigger, noting administrative difficulties in keeping track of employees who had moved on to other jobs (52 FR 34460, 34550 (9/11/1987)).

CISC, American Subcontractors Association, OSCO Industries, and Holes Incorporated questioned why medical surveillance is needed for younger employees when respirable crystalline silica-related diseases take years to develop (Document ID 1992, p. 11; 2187, p. 7; 2319, pp. 116-117; 3580, Tr. 1471). CISC recommended that OSHA trigger medical surveillance after a minimum duration of exposure or when a silica-related disease is diagnosed. In contrast, Andrew O'Brien, Vice President of Safety and Health at Unimin Corporation and representing NISA, emphasized the importance of establishing a baseline for future measurement (Document ID 3577, Tr. 570). When asked if age or duration of exposures should be considered in determining frequency of medical surveillance, Dr. Laura Welch, occupational physician with BCTD, responded:

> . . . we're looking at different disease outcomes. If we were only concerned about silicosis, you could probably . . . make that argument, but silica exposure also causes [chronic obstructive pulmonary disease], and that has an earlier onset and . . . it's good to have a baseline of a couple of tests before someone develops disease so you can more clearly see an early decline (Document ID 3581, Tr. 1667).

When a BAC panel was asked if 20 years after first exposure is the appropriate time to start medical surveillance, terrazzo worker Sean Barret responded:

> According to their 20-year standard, you wouldn't even find out I was sick until next year. I was sick a year ago, and it probably showed five years before that. So, I mean, that's ludicrous (Document ID 3585, Tr. 3055).

OSHA agrees that employees' baseline findings are important for future diagnoses and notes Dr. Welch's testimony that other silica-related diseases, such as chronic obstructive pulmonary disease (COPD), develop in shorter times than silicosis. Based on such evidence, OSHA concludes that it is appropriate to start medical surveillance in young or newly exposed employees before they experience declines in health or function associated with age or respirable crystalline silica exposure.

Paragraph (i)(1)(ii) of the standard for general industry and maritime (paragraph (h)(1)(ii) of the standard for construction) requires that the medical examinations made available under the rule be performed by a PLHCP, who is defined (see summary and explanation of Definitions) as an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health services required by paragraph (i) of the standard for general industry and maritime (paragraph (h) of the standard for construction). This provision is unchanged from the proposed rule.

The American Public Health Association (APHA) requested changes to the definition of PLHCP that would require the PLHCP to be licensed for independent practice (Document ID 2178, Attachment 1, p. 5). OSHA finds that requested change to be too restrictive. To assure competency while providing for increased flexibility, OSHA continues to find it appropriate to allow any professional to perform medical examinations and procedures made available under the standard when he or she is licensed by state law to do so. In this respect, which and how a health care professional can function as a PLHCP under the rule may vary from state to state depending on each state's licensing requirements and laws governing what diagnostic examinations and procedures they are permitted to perform. In no case, however, is the authorization in this rule to use any PLHCP narrower or stricter than what is authorized in the particular state where an examination occurs.

Some commenters expressed concerned about the availability of PLHCPs or other medical professionals in certain geographical locations. For example, Fann Contracting and the National Rural Electric Cooperative Association commented that PLHCPs who can offer the required examinations or occupational health resources may not be available for employers located in rural areas or near retirement communities (Document ID 2116, Attachment 1, p. 43; 2365, p. 10). Under the rule, a PLHCP, as defined, does not have to be an occupational medicine physician or even a physician to conduct the initial and periodic examinations required by the rule, but can be any health care professional who is state-licensed to provide or be delegated the responsibility to provide those services. The procedures required for initial and periodic medical examinations are commonly conducted in the general population (i.e., medical history, physical examination, chest X-ray, spirometry test, and tuberculosis test) by practitioners with varying qualifications. Because medical examinations consist of procedures conducted in the general population and because OSHA is giving employers maximum flexibility in selecting a PLHCP who can offer these services, OSHA intends to assure that employers will not experience great difficulty in finding PLHCPs who are state-licensed to provide or be delegated the responsibility to provide these services. Even in the case of X-rays, OSHA finds that the availability of digital X-ray technology allows for electronic submission to a remotely located B Reader for interpretation, and thus does not expect a limited number of B readers in a certain geographic location to be an obstacle to employers covered by the rule.

Initial examination. Paragraph (i)(2) of the standard for general industry and maritime (paragraph (h)(2) of the standard for construction) specifies that an initial (baseline) medical examination must be made available within 30 days of initial assignment (i.e., the day the employee starts working in a job with potential exposures above the trigger point), unless the employee received an examination that meets the requirements of this section within the past three years. This provision is unchanged from the proposed rule. The requirement for an initial examination within 30 days of assignment provides a health baseline for future reference and lets employees know of any conditions that could increase their sensitivity to respirable crystalline silica exposure. For example, Dr. Tee Guidotti, an occupational medicine physician representing the Association of Occupational and Environmental Clinics (AOEC), testified that existing COPD may make an individual more sensitive to respirable crystalline silica exposure (Document ID 3577, Tr. 797-798).

Newmont Mining Corporation, Nevada Mining Association, and Distribution Contractors Association (DCA) questioned whether recent or future exposures should be considered in triggering certain aspects of the initial examination (e.g., physical examination, chest X-ray, or pulmonary function tests) and indicated that baseline examinations should only be required near the time when exposures begin (Document ID 1963, p. 2; 2107, p. 3; 2309, p. 5). The requirement is for employers to offer initial examinations to employees who "will be" occupationally exposed to respirable silica at or above the action level for 30 or more days a year in the standard for general industry and maritime (paragraph (i)(1)(i)) or who "will be" required to use a respirator under this section for 30 or more days per year in the standard for construction (paragraph (h)(1)(i)). Therefore, eligibility for medical examinations is based on expected exposure with the current employer. These triggers apply to both initial and periodic medical surveillance, and inclusion of the terms “will be occupationally exposed” or “will be required” makes it clear that requirements to offer medical surveillance are not based on past exposures. OSHA is aware that unexpected circumstances may result in employees being exposed more frequently than initially anticipated. In those cases, employers should make medical surveillance available as soon as it becomes apparent that the employee will be exposed above the appropriate trigger point for 30 or more days per year.

In the preamble of the Notice of Proposed Rulemaking (NPRM), OSHA indicated that where an examination that complies with the requirements of the standard has been provided in the past three years, an additional initial examination would not be needed (78 FR at 56468). Ameren agreed with OSHA's preliminary determination on this issue and asked the Agency to verify that examinations conducted in the last three years could be supplemented with any additional requirements of the rule, such as tuberculosis testing (Document ID 2315, p. 4). OSHA agrees that this is a reasonable approach. For example, if an employee received an examination that met all the requirements of the initial medical examination, with the exception of a tuberculosis test, within the last three years, the employer could supplement that examination by offering only the tuberculosis test. That same employer or a future employer could then offer a periodic medical examination, which does not require a tuberculosis test, three years from the last medical examination. New hires, who received medical surveillance that met the requirements of the respirable crystalline silica rule from a past employer, should have a copy of the PLHCP's written medical opinion for the employer, which the employer must ensure that the employee receives within 30 days of the examination (paragraph (i)(6)(iii) of the standard for general industry and maritime, paragraph (h)(6)(iii) of the standard for construction), as proof of a current initial or periodic medical examination that met the requirements of this section (see example of the PLHCP's written medical opinion for the employer in Appendix B). If a newly hired employee eligible for medical surveillance presents proof of an examination that met the requirements of the rule, the employer's obligation is to offer the periodic examination required by paragraph (i)(3) of the standard for general industry and maritime (paragraph (h)(3) of the standard for construction) within three years of the previous examination.

Commenting on the three year period in which the result of a prior examination can substitute for a new initial (baseline) examination, APHA, Collegium Ramazzini, and the American Federation of State, County and Municipal Employees (AFSCME) opined that three years between examinations is an excessive time period because it does not provide for an adequate baseline; Collegium Ramazzini further commented that medical findings and medical or work histories can change in three years and that spirometry performed at other locations does not provide an adequate baseline (Document ID 2178, Attachment 1, p. 4; 3541, pp. 4-5; 4203, p. 6). Dr. Celeste Monforton, from George Washington University School of Public Health, agreed with APHA (Document ID 3577, Tr. 846). OSHA disagrees. The three-year interval is consistent with the frequency of periodic examinations, and the reasons for this interval, such as the typical slow progression of respirable crystalline silica-related diseases, are discussed below.

The American Foundry Society (AFS) supported the 30-day period for offering medical surveillance, stating that it addressed the turnover rates in its industry because employees who work 30 days are likely to continue their employment (Document ID 2379, Appendix 1, p. 71). AESC requested that OSHA allow medical examinations to be provided within 90 days of assignment to address the turnover rate in its industry (Document ID 2344, p. 2). The National Stone, Sand and Gravel Association (NSSGA) noted difficulties in scheduling medical examinations within 30 days in remote locations because testing vans that offer medical examinations might not be available within that time period (Document ID 3583, Tr. 2316-2317). Because a 30-day period for offering medical examinations is reasonable for AFS, which represents an industry with high turnover rates, OSHA concludes that a 30-day period should be reasonable in most general industry settings. OSHA does not agree with AESC that the period to offer medical surveillance should be extended to 90 days in the standard for general industry and maritime. That longer time period to offer medical surveillance would exclude and leave unprotected many employees who may be exposed to significant amounts of silica while working short-term assignments, for periods up to 90 days, for numerous companies within the same industry.

Representatives from the construction industry also commented on the 30-day period to offer medical surveillance. BAC and BCTD recommended that medical examinations be made available as soon as practicable, instead of within 30 days after assignment, in the construction industry because it would be difficult for employers to predict if an employee would be exposed for 30 days or more during the upcoming year, and it could encourage employers to terminate employees before the 30-day period ends (Document ID 4219, p. 29; 4223, p. 125). Fann Contracting suggested that a better trigger would be after the employee has been exposed for 30 days instead of within the first 30 days of assignment (Document ID 2116, Attachment 1, p. 43).

OSHA rejects this reasoning, and is maintaining the requirement to offer medical surveillance within 30 days of assignment for the construction standard. The requirement better assures that medical examinations will be offered within a reasonable time period than allowing the employer to offer them "as soon as practicable." As noted above, employers can determine who will be eligible for medical surveillance based on required respirator use under Table 1 or similar task-based approaches. Even at the time of initial assignment, OSHA expects that employers will know the tasks that the employee will be performing, and in the case of short-term employees, the approximate duration the employee will be with the company. In addition, terminating employees to avoid offering medical surveillance would not be cost effective because the employer would incur more costs from constantly having to train new employees.

The Precast/Prestressed Concrete Institute commented that local union halls from which they hire employees and the Americans with Disability Act may prohibit pre-hire medical testing (Document ID 2276, p. 10). National Electrical Contractors Association expressed concern about economic burdens associated with pre- and post-employment medical evaluations in transient or temporary employees (Document ID 2295, p. 2). OSHA clarifies that no pre-hire or post-employment testing is required in the respirable crystalline silica rule, which requires that medical examinations related to respirable crystalline silica exposure be offered within 30 days after initial assignment to employees who will meet the trigger for medical surveillance.

Contents of initial medical examination. Paragraphs (i)(2)(i)-(vi) of the standard for general industry and maritime (paragraphs (h)(2)(i)-(vi) of the standard for construction) specify that the initial medical examination provided by the PLHCP must consist of: a medical and work history; a physical examination with special emphasis on the respiratory system; a chest X-ray; a pulmonary function test; a latent tuberculosis test; and other tests deemed appropriate by the PLHCP. Special emphasis must be placed on the portions of the medical and work history focusing on exposure to respirable crystalline silica, dust or other agents affecting the respiratory system, any history of respiratory system dysfunction (including signs and symptoms, such as shortness of breath, coughing, and wheezing), any history of tuberculosis, and current or past smoking. The only changes from the proposed rule are reflected in paragraphs (i)(2)(iii) and (iv) of the standard for general industry and maritime (paragraphs (h)(2)(iii) and (iv) of the standard for construction), and those revisions are discussed below.

OSHA received a range of comments related to the contents of the initial examination. Some stakeholders, including NIOSH and commenters representing the medical community, labor unions, and industry, supported the contents of medical surveillance that OSHA proposed, though some wanted to expand the contents, as addressed below (e.g., Document ID 2175, p. 6; 2177, Attachment B, pp. 38-39; 2282, Attachment 3, p. 19; 2336, p. 12; 2371, Attachment 1, p. 43; 3589, Tr. 4205; 4204, p. 82). Further, the contents of medical surveillance in this standard are fairly consistent with the recommendations in occupational health programs, such as those by NISA and NSSGA (Document ID 2195, pp. 40-41; 2327, Attachment 1, p. 23).

However, not all stakeholders agreed that the list of proposed initial examination contents was appropriate. For example, Fann Contracting favored limiting the contents of medical examinations to X-rays, while Dal-Tile Corporation, the 3M Company, and the Tile Council of North America indicated that requirements for medical examinations under the respiratory protection standard were sufficient (Document ID 2116, Attachment 1, p. 37; 2147, p. 3; 2313, p. 7; 2363, pp. 5-6). Similarly, Nevada Mining Association commented that the need to conduct physical examinations, X-rays, or pulmonary function testing should be left to the discretion of the PLHCP (Document ID 2107, pp. 3-4). Newmont Mining also said that one or more of these tests should be at the discretion of the PLHCP (Document ID 1963, pp. 2-3) .

OSHA finds that X-rays alone are not sufficient because, as explained in more detail below, some employees may have symptoms or abnormal lung function that are not detected by X-ray but may become evident by other tests, such as spirometry. The Agency also finds that the evaluations offered under the respiratory protection standard are insufficient because the information gathered under that standard is limited and may not involve examinations, while the respirable crystalline silica rule requires examinations that include objective measures, such as physical examinations, spirometry testing and X-rays, that may detect early disease in asymptomatic employees. In addition, OSHA does not agree that all required tests should be left to the discretion of the PLHCP because the Agency has determined that employees who must be offered medical surveillance are at risk of developing respirable crystalline silica-related diseases, and the required tests are the minimum tests needed to screen for those diseases. Therefore, OSHA concludes that limiting medical surveillance to only X-rays, the evaluations performed under the respiratory protection standard, or only tests selected by the PLHCP is not sufficiently protective.

The first item required as part of the initial medical examination is a medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of tuberculosis; and smoking status and history (paragraph (i)(2)(i) of the standard for general industry and maritime, paragraph (h)(2)(i) of the standard for construction). OSHA is requiring medical and work histories because they are an efficient and inexpensive means for collecting information that can aid in identifying individuals who are at risk due to hazardous exposures (Document ID 1505, p. 2; 1517, p. 25). Recording of symptoms is important because, in some cases, symptoms indicating onset of disease can occur in the absence of abnormal laboratory test findings (Document ID 1517, p. 25).

Because symptoms may be the earliest sign of disease and to allow for consistent and comprehensive data collection, Collegium Ramazzini recommended that an appendix with a standardized questionnaire be included; it also recommended that the questionnaire address non-respiratory effects, such as renal disease and connective tissue disorders (Document ID 3541, pp.

3, 6). While not going as far as this recommendation, OSHA includes in the rule an appendix for medical surveillance (Appendix B), which gives PLHCPs detailed information on what is to be collected as part of the medical history. The appendix recommends collecting information on renal disease and connective tissue disorders. OSHA intends for this approach to allow PLHCPs to easily standardize their method for gathering information for work and medical histories related to respirable crystalline silica exposure.

Newmont Mining and Nevada Mining Association objected to a requirement for a medical and work history, asserting that a personal medical history is not related to silica exposure (Document ID 1963, p. 2; 2107, p. 3). Commenters, including DCA and International Brotherhood of Teamsters, objected to employees revealing medical and work history information not related to respirable crystalline silica exposure because of privacy concerns (e.g., Document ID 2309, p. 5; 2318, pp. 13-14). Retired foundry employee, Allen Schultz, representing WisCOSH, expressed concern that information, such as smoking history, could be used against employees (Document ID 3586, Tr. 3255). As noted above, a purpose of medical surveillance is to inform employees if they may be at increased risk of adverse effects from respirable crystalline silica exposure. Personal habits, such as smoking, could lead to compromised lung function or increased risk of lung cancer, and exposure to respirable crystalline silica could compound those effects (see Section V, Health Effects). Collecting information, such as smoking habits and related medical history, allows the PLHCP to warn employees about their increased risks from exposure to respirable crystalline silica so employees can make informed health decisions.

As discussed below, OSHA is addressing employee privacy issues by reducing the information to be included in the PLHCP's written medical opinion for the employer without the employee's permission (paragraphs (i)(6)(i)(A)-(C) of the standard for general industry and maritime and paragraphs (h)(6)(i)(A)-(C) of the standard for construction); under those paragraphs, the only medically related information that is to be reported to the employer without authorization from the employee is limitations on respirator use. Personal habits, such as smoking, are not included in the medical opinion for the employer. Therefore, employees' privacy will not be compromised as a result of the information collected as part of the exposure and medical history.

The second item required as part of the initial medical examination is a physical examination that focuses on the respiratory system (paragraph (i)(2)(ii) of the standard for general industry and maritime, paragraph (h)(2)(ii) of the standard for construction), which is known to be susceptible to respirable crystalline silica toxicity. OSHA finds that aspects of the physical examination, such as visual inspection, palpation, tapping, and listening with a stethoscope, allow the PLHCP to detect abnormalities in chest shape or lung sounds that are associated with compromised lung function (Document ID 1514, p. 74; 1517, pp. 26-27). Dr. Michael Fischman, occupational and environmental physician/toxicologist and professor at the University of California, representing ACOEM, strongly endorsed a physical examination and noted that another valuable aspect is that it allows the employee to have a face-to-face interaction with the clinician to talk about symptoms or other concerns (Document ID 3577, Tr. 767). OSHA agrees and concludes that the physical examination is necessary.

The third item required as part of the initial medical examination is a chest X-ray, specifically a single posteroanterior radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems, interpreted and classified according to the International Labour

Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader (paragraph (i)(2)(iii) of the standard for general industry and maritime, paragraph (h)(2)(iii) of the standard for construction). The proposed rule specified only film X-rays but would have allowed for an equivalent diagnostic study, such as digital X-rays; OSHA also sought comment on whether computed tomography (CT) or high resolution computed tomography (HRCT) scans should be considered equivalent diagnostic tests (78 FR at 56469-56470). As discussed in greater detail below, OSHA received many comments on the proposed provision, and in response to those comments, the current provision differs substantially from the proposed rule in two main ways. First, the rule now specifically allows for chest X-rays to be recorded on either film or digital radiography systems. Second, the rule does not allow for an "equivalent diagnostic study."

Medical experts including ACOEM, the American Thoracic Society (ATS), and NIOSH recommend X-rays as part of medical examinations for employees exposed to respirable crystalline silica (e.g., Document ID 1505, p. 2; 2175, p. 6; 2177, Attachment B, pp. 38-39). The initial X-ray provides baseline data against which to assess any subsequent changes. An initial chest X-ray can be useful for diagnosing silicosis and for detecting mycobacterial disease (e.g., active pulmonary tuberculosis, which employees with latent tuberculosis infections and exposed to respirable crystalline silica are at greater risk of developing (Document ID 1514, pp. 75, 100). X-rays are important because the findings can lead to the initiation of employment choices that can reduce exposures to respirable crystalline silica and might decrease the risk of silicosis progression or allow for treatment of mycobacterial infections (Document ID 1505, p. 3).

As noted above, OSHA proposed that the required chest X-ray be interpreted and classified according to ILO International Classification of Radiographs of Pneumoconiosis by a

NIOSH-certified B Reader. The ILO system was designed to assess X-ray and digital radiographic image quality and to describe radiographic findings of pneumoconiosis in a simple and reproducible way by comparing an employee's X-ray to a standard X-ray to score opacities according to shape, size, location, and profusion (Document ID 1475, p. 1; 1511, pp. 64-68; 1514, pp. 77-78). A NIOSH-certified B Reader is a physician who has demonstrated competency in the ILO classification system by passing proficiency and periodic recertification examinations (Document ID 1498, p. 1). The NIOSH certification procedures were designed to improve the proficiency of X-ray and digital radiographic image readers and minimize variability of readings.

In 2011, the ILO made standard digital radiographic images available and published guidelines on the interpretation and classification of digital radiographic images (Document ID 1475). The guidelines included requirements for display monitors. NIOSH also published guidelines for conducting digital radiography and displaying digital radiographic images in a manner that will allow for classification according to ILO guidelines (Document ID 1513). Based on these developments, OSHA stated in the preamble of the NPRM that digital X-rays could now be evaluated according to the same guidelines as film X-rays and could therefore be considered equivalent diagnostic tests. The Agency also noted several advantages of digital X-rays: compared to film X-rays, digital imaging systems offer more consistent image quality, faster results, increased ability to share images with multiple readers, simplified storage of images, and reduced risk for technicians and the environment due to the elimination of chemicals for developing film (Document ID 1495, p. 2).

Commenters, such as Collegium Ramazzini, NIOSH, and the Dow Chemical Company, agreed with OSHA that digital radiographic images are equivalent to conventional X-rays; NIOSH and Dow Chemical suggested OSHA clarify that the proposed requirement for chest X-rays may be satisfied either with conventional film-based technology or with digital technology; and NIOSH and Collegium Ramazzini referred OSHA to an interim final regulation for coal miners that allows for digital technology (Document ID 2177, Attachment B, pp. 40-41; 2270, p. 13; 3541, p. 7). After reviewing the record evidence on this issue, OSHA reaffirms its preliminary conclusion that X-rays recorded on digital radiography systems are equivalent to those recorded on film. Therefore, OSHA has revised paragraph (i)(2)(iii) of the standard for general industry and maritime (paragraph (h)(2)(iii) of the standard for construction) to indicate that X-rays can be recorded on either film or digital systems, using language that is consistent with that in the interim final regulation for coal miners (42 CFR part 37.2 (10-1-13 Edition)).

NSSGA commented that good quality digital images reproduced on film should also be considered acceptable as equivalent to X-rays (Document ID 2327, Attachment 1, p. 23). OSHA disagrees. The Agency does not recommend classification using hard copies printed from digital images because a 2009 study by Franzblau et al. indicates that they give the appearance of more opacities compared to films or digital images (Document ID 1512). OSHA does not find hard copy printouts of digital images equivalent to conventional X-rays. Consequently, classification through the use of hard copies printed from digital images may not be used to satisfy the requirement for chest X-rays.

As indicated above, the proposed rule called for the chest X-ray to be interpreted and classified by a NIOSH-certified B reader. A number of commenters offered opinions on this requirement. For example, Dow Chemical urged OSHA to allow board certified radiologists to interpret the X-rays because it claimed that insufficient numbers of B Readers would lead to a backlog of X-ray interpretation that would make it impossible for B Readers to get their reports back to PLHCPs within the required 30 days (Document ID 2270, p. 9). Other representatives from industry, such as the Mason Contractors Association of America, ARMA, and the North American Insulation Manufacturers Association, expressed similar concerns about numbers of B Readers (e.g., Document ID 2286, pp. 2-3; 2291, p. 26; 2348, Attachment 1, pp. 39-40).

The rulemaking record contains ample evidence of sufficient numbers of B Readers and the value of B Reader interpretation according to ILO methods. CISC and NIOSH estimated demands on B Readers based on OSHA's estimate in the preamble of the NPRM that 454,000 medical examinations would be required in the first year after the rule is promulgated (78 FR at 56468). Based on the 242 B Readers accounted for as of February 12, 2013 (78 FR at 56470), CISC estimated 1,876 chest X-rays for each B Reader, requiring each B Reader to interpret more than five chest X-rays per day, which CISC claimed would result in a backlog (Document ID 2319, p. 118). However, Dr. David Weissman, Director of NIOSH's Division of Respiratory Disease Studies, indicated that a B Reader can easily classify 10 images in an hour (Document ID 3579, Tr. 196, Attachment 2, p. 1). NIOSH estimated that a B Reader working 1 hour per day, 5 days per week, 50 weeks per year can classify 2,500 images and that 182 B Readers working a minimum of 1 hour per day and 50 weeks per year would be needed to classify X-rays for 454,000 employees (Document ID 4233, Attachment 1, p. 40). As of May 19, 2014, there were 221 certified B Readers in the United States, an adequate number to meet the demands for the respirable crystalline silica rule (Document ID 3998, Attachment 15, p. 2). Based on the new triggers and more recent data on turnover rates, OSHA estimates that approximately 520,000 medical examinations will be required in the first year after the rule is promulgated. Using Dr. Weissman's assumptions, OSHA estimates that 221 B Readers would need to spend less than 1 hour a day to classify X-rays for 520,000 employees.

Dr. Weissman testified that the number of B Readers is driven by supply and demand created by a free market and that many physicians choose to become B Readers based on demands for such services (Document ID 3579, Tr. 197-198, Attachment 2, p. 1). He went on to state that NIOSH provides several pathways for physicians to become B Readers, such as free self-study materials by mail or download and free B Reader examinations. In addition, courses and examinations for certification are offered for a fee every three years through the American College of Radiology. Dr. Robert Cohen, pulmonary physician and clinical professor at the University of Illinois, representing ATS, agreed that NIOSH is able to train enough B Readers to handle any potential increase in demand (Document ID 3577, Tr. 777). Moreover, even if B Readers are scarce in certain geographical locations, digital X-rays can easily be transmitted electronically to B Readers located anywhere in the U.S. (Document ID 2116, Attachment 1, p. 43; 3580, Tr. 1471-1472; 3585, Tr. 2887; 2270, p. 13; 2195, p. 44; 3577, Tr. 817-818). Based on this information, OSHA concludes that numbers of B Readers in the U.S. are adequate to interpret X-rays conducted as part of the respirable crystalline silica rule.

Some commenters questioned the value of requiring B Readers. Dow Chemical claimed that board certified radiologists are able to provide interpretations of X-rays that are consistent with those of B Readers and that such an approach is consistent with that of the OSHA Asbestos standard (29 CFR 1910.1001, Appendix E) (Document ID 2270, pp. 9-10). Dow Chemical also stated that digital radiography has improved interpretation accuracy for radiologists who are not B Readers. American Road and Transportation Builders Association (ARTBA) commented that inadequate numbers of B Readers could result in misinterpretations of X-rays. It also cited a study by Gitlin et al. (2004), which it interpreted as showing that B Readers can be biased by exposure information; according to ARBTA, the studyreported that B Readers hired for asbestos litigation cases read 95.9 percent of X-rays as positive, while independent, blinded B readers only read 4.5 percent of those X-rays as positive (Document ID 2245, pp. 2-3).

Based on record evidence, OSHA finds that the requirement for B Readers to demonstrate proficiency in ILO methods results in more consistent X-ray interpretation. For example, guidelines by the World Health Organization (WHO) acknowledge the value of consistent, high-quality X-rays for reducing interpretation variability and note that B Reader certification may also improve consistency of X-ray interpretation (Document ID 1517, p. 21). Robert Glenn, Certified Industrial Hygienist representing the Brick Industry Association and previously in charge of the B Reader program at NIOSH, said he thought the reduced variability (i.e., lower prevalence of small opacities graded 1/0 or greater in unexposed populations) in the U.S. compared to Europe in a study by Meyer et al. (1997) could be attributed to the success of the B Reader program (Document ID 3577, Tr. 668, 670, 682; 3419, p. 404). Dr. James Cone, occupational medicine physician at the New York City Department of Health, stated that development of ILO methods for evaluating pneumoconiosis by chest X-ray has led to greater precision and sensitivity. Dr. Cone gave the example that two B Readers who evaluated X-rays performed on foundry employees as part of a NIOSH Health Hazard Evaluation identified six cases of X-rays and occupational history consistent with silicosis that had been classified as normal by company physicians (Document ID 2157, pp. 4-5). Based on the record evidence demonstrating the value of B Reader certification, OSHA rejects the suggestion that the standard should allow X-ray interpretation by board-certified radiologists.

The evidence discussed above supports OSHA's conclusions that adequate numbers of B Readers are available locally or by electronic means to interpret chest X-rays of respirable crystalline silica-exposed employees and that B Reader certification improves the quality of X-ray interpretation. OSHA concludes that standardized procedures for the evaluation of X-ray films and digital images by certified B Readers is warranted based on the seriousness of silicosis and is therefore retaining that requirement in the rule.

OSHA noted in the preamble for the NPRM that CT or HRCT scans could be considered “equivalent diagnostic studies.” CT and HRCT scans are superior to chest X-ray in the early detection of silicosis and the identification of progressive massive fibrosis. However, CT and HRCT scans have risks and disadvantages that include higher radiation doses and current unavailability of standardized methods for interpreting and reporting the results (78 FR at 56470). Because of these concerns, OSHA specifically sought comment on whether CT and HRCT scans should be considered equivalent diagnostic studies under the rule, and a number of stakeholders provided comments on this issue.

In its prehearing comments, ATS stated that despite the lack of standardized interpretation and reporting methods, CT or HRCT are reasonable “equivalent diagnostic studies” to standard chest X-rays because they are more sensitive than X-rays for early detection of diseases, such as silicosis and lung cancer; however, the group’s representative, Dr. Robert Cohen, later testified that HRCT is not ready as a screening technique but is a useful diagnostic tool (Document ID 2175, p. 6; 3577, Tr. 825). USW noted that interpretation methods are being developed for the evaluation of pneumoconiosis by CT scan and suggested approaches for the use of low dose CT (LDCT) scans to evaluate silicosis and lung cancer in some employees (Document ID 4214, pp. 9-12).

Physicians, such as those representing ACOEM, Collegium Ramazzini, and NIOSH, did not consider CT or HRCT to be equivalent diagnostic studies because of the lack of a widely-accepted standardized system of interpretation, such as the ILO method (e.g., Document ID

2080, pp. 7-8; 2177, Attachment B, p. 40; 3541, p. 7). In addition, NIOSH, APHA, Edison Electric Institute (EEI), Collegium Ramazzini, and ACOEM indicated the higher radiation doses received from CT and HRCT scans make it inappropriate to consider these methods equivalent to X-rays (Document ID 2177, Attachment B, p. 40; 2178, Attachment 1, p. 6; 2357, pp. 34-35; 3541, p.7; 3577, Tr. 768).

NIOSH and Collegium Ramazzini also commented on the increased sensitivity of CT scans in detecting abnormalities that require follow-up, which they cited as another reason why CT scans should not be considered equivalent to X-rays (Document ID 2177, Attachment B, p. 40; 3541, p. 7). NIOSH said the abnormalities can suggest lung cancer, but most are found to be "false positives" (Document ID 2177, Attachment B, p. 40). Detection of abnormalities that might suggest cancer can lead to anxiety in patients; it can also lead to follow-up with more imaging tests that increase radiation exposures or invasive biopsy procedures that have a risk of complications (Document ID 2177, Attachment B, p. 40; 3978, pp. 2423, 2427). Commenters also noted that CT scans cost more than X-rays (Document ID 2177, Attachment B, p. 40; 2178, Attachment 1, p. 6; 3541, p. 7). In addition, Collegium Ramazzini stated that chest X-rays are readily accessible in most cases, but availability of CT scanning is more limited, especially in rural areas (Document ID 3541, p. 7).

ACOEM, NIOSH, APHA, NSSGA, EEI, and AFL-CIO stated that CT scans are appropriate in some cases, such as a part of follow-up examinations or if recommended by the PLHCP (Document ID 2080, p. 8; 2177, Attachment B, pp. 40-41; 2178, Attachment 1, p. 6; 2327, Attachment 1, p. 26; 2357, pp. 34-35; 4204, p. 82). Dr. David Weissman and Dr. Rosemary Sokas, occupational physician from Georgetown University, representing APHA, indicated that if an employee happens to have had a CT scan that was conducted as part of a clinical workup or diagnosis, it should be accepted in place of X-rays (Document ID 3577, Tr. 792; 3579, Tr. 256).

After reviewing the record on this issue, OSHA has determined that CT or HRCT scans should not be considered “equivalent diagnostic studies” to conventional film or digital chest X-rays for screening of silicosis because of higher radiation exposures, lack of a standardized classification system for pneumoconiosis, increased false positive findings, higher costs, and limited availability in some areas. OSHA also agrees with commenters that CT scans may be useful for follow-up purposes, as determined on a case-by-case basis by the PLHCP. For example, the PLHCP could request a CT scan to diagnose possible abnormalities detected by X-ray or other testing done as part of surveillance, and the rule gives the PLHCP this option (paragraph (i)(2)(vi) of the standard for general industry and maritime, paragraph (h)(2)(vi) of the standard for construction). However OSHA does not agree that a CT scan conducted within the past three years can meet the requirement for an X-ray because the CT scan cannot be evaluated according to ILO methods.

OSHA also received comments on the use of CT scans to screen for lung cancer, and those comments are discussed below, as part of the Agency’s discussion of additional tests that commenters proposed for inclusion in medical examinations.

In sum, unlike the proposed rule, paragraph (i)(2)(iii) of the standard for general industry and maritime (paragraph (h)(2)(iii) of the standard for construction) specifically allows for digital X-rays, but does not allow for an equivalent diagnostic study. The rule was revised to allow for digital radiography because OSHA determined that digital X-rays are equivalent to film X-rays. The rule was also revised to remove the allowance for equivalent diagnostic studies because OSHA determined that CT scans are not equivalent to X-rays for screening purposes and no other imaging tests are equivalent to film or digital X-rays interpreted by ILO methods at this time. The provision for X-rays does not contain any other substantive changes compared to the proposed provision.

The fourth item required as part of the initial medical examination is a pulmonary function test, including forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and FEV_1/FVC ratio, administered by a spirometry technician with a current certificate from a NIOSH-approved spirometry course (paragraph (i)(2)(iv) of the standard for general industry and maritime, paragraph (h)(2)(iv) of the standard for construction). FVC is the total volume of air exhaled after a full inspiration, FEV_1 is the volume of air exhaled in the first second, and the FEV_1/FVC ratio is the speed of expired air (Document ID 3630, p. 2). OSHA proposed the inclusion of pulmonary function testing (i.e., spirometry, as required by this rule) because it is useful for obtaining information about the employee's lung capacity and expiratory flow rate and for determining baseline lung function status against which to assess any subsequent lung function changes.

Some industry representatives, such as Fann Contracting and CISC, opposed the requirement for spirometry testing because reduced pulmonary function can be related to smoking or exposures other than respirable crystalline silica (Document ID 2116, Attachment 1, Page 39; 2319, pp. 118-119). CISC further commented that OSHA did not address statements in the ASTM standard about the non-specificity of lung function changes to respirable crystalline silica exposure, and a lack of evidence that routine spirometry is useful for detecting respirable crystalline silica-related diseases in early stages.

In contrast, commenters, such as Collegium Ramazzini and NIOSH, noted that spirometry is useful for detecting lung function changes associated with COPD, a disease outcome related to respirable crystalline silica exposure (Document ID 3541, p. 8; 3579, Tr. 255). ACOEM and Collegium Ramazzini explained that respirable crystalline silica exposures can result in lung function changes in the absence of radiological abnormalities, and spirometry is important for detecting those changes in the early stages of disease; ACOEM further commented that early detection of abnormal lung function is important to fully assess employees' health and apply protective intervention methods (Document ID 2080, p. 8; 3541, p. 8).

ASSE and some industry representatives, including Newmont Mining, NISA and AFS, also supported spirometry testing (e.g., Document ID 1963, pp. 2-3; 2339, p. 9; 2379, Appendix 1, p. 70; 4208, p. 22). NISA includes spirometry testing as part of its occupational health program for respirable crystalline silica-exposed employees; it emphasized that spirometry testing: (1) allows for early detection and measurement of severity of lung function loss, the most direct symptom of silicosis or other nonmalignant respiratory disease, and (2) is useful for determining an employee's ability to safely wear a negative pressure respirator (Document ID 4208, p. 22).

After reviewing the comments submitted, OSHA reaffirms that spirometry testing should be included in the rule. OSHA concludes that even though declines in lung function may not always be related to respirable crystalline silica exposure, the test results are nonetheless useful for detecting lung function abnormalities that can worsen with further exposure to respirable crystalline silica, providing a baseline of lung function status against which to assess any subsequent changes, and assessing the health of employees who wear respirators. The requirement for lung function testing is also consistent with other OSHA standards, such as asbestos (29 CFR 1910.1001) and cadmium (29 CFR 1910.1027). Thus, OSHA decided to retain the proposed requirement for a pulmonary function test in the rule.

OSHA proposed that spirometry be administered by a spirometry technician with current certification from a NIOSH-approved spirometry course. NIOSH recommended changing "current certification" to "a current certificate" to clarify that NIOSH does not certify individual technicians (Document ID 2177, Attachment B, p. 43). OSHA agrees with NIOSH that the change provides clarity, without modifying the original meaning of the provision, and thus made the change to the proposed provision.

Some stakeholders questioned whether a certificate from a NIOSH-approved course should be required. For example, Dow Chemical recommended that OSHA follow the asbestos standard and allow for spirometry testing to be conducted by a person who has completed "a training course in spirometry sponsored by an appropriate academic or professional institution" (29 CFR 1910.1001(l)(1)(ii)(B)) (Document ID 2270, pp. 11-12). However, other stakeholders, including NIOSH and commenters from the medical community and labor unions, agreed that the standard should require a current certificate from a NIOSH-approved course (Document ID 2157, p. 6; 2177, Attachment B, pp. 38-39, 43; 3541, p. 10; 3577, Tr. 777; 4223, pp. 129-130). Dr. Robert Cohen stated:

> . . . spirometry performed by certified NIOSH technicians would be very important. We don't want garbage spirometry that we see out in the industry all the time. We want real, not what I call cosmetic or ceremonial spirometry (Document ID 3577, Tr. 777).

Dr. James Cone noted an example in which a NIOSH Health Hazard Evaluation at a foundry found that the company had recorded abnormal pulmonary function test results for 43 employees; however, spirometry testing later conducted by NIOSH found that only 9 of those same employees had abnormal pulmonary function results. Dr. Cone thought that the difference in findings most likely resulted from differences in equipment and test procedures used to motivate and elicit cooperation of employees during testing (Document ID 2157, pp. 4-5). He concluded:

> The difference does suggest that proper equipment, certification and training of pulmonary technicians, and standardized reading of pulmonary function tests are important to maintain uniformity and comparability of such tests (Document ID 2157, p. 5).

Some commenters, including Collegium Ramazzini, suggested other ways that the rule for respirable crystalline silica could improve quality of spirometry results. It recommended that the rule specify spirometry conducted according to ATS/European Respiratory Society (ERS) or similar guidelines, that spirometers meet ATS/ERS recommendations, and that the third National Health and Nutrition Examination Survey (NHANES III) reference values be used for interpretation of results (Document ID 3541, pp. 8-10). Collegium Ramazzini emphasized that quality spirometry results depend on standardized equipment, test performance, and interpretation of results, including criteria, such as acceptability and reproducibility of results (Document ID 3541, p. 8). Labor unions, such as LHSFNA and BCTD, also supported more stringent spirometry requirements (Document ID 3589, Tr. 4205; 4223, pp. 129-130). ACOEM, NIOSH, and BCTD recommended that reference values or other spirometry guidelines be added to the appendix on medical surveillance (Document ID 2080, p. 9; 2177, Attachment B, pp. 45-46; 4223, pp. 128-129).

After considering the record to determine what the rule must include to improve spirometry quality, OSHA concludes that requiring technicians to have a current certificate from a NIOSH-approved spirometry course is essential for maintaining and improving spirometry quality. The purpose of requiring spirometry technicians to have a current certificate from a NIOSH-approved spirometry course is to improve their proficiency in generating quality results that are interpreted in a standardized way. OSHA included the certification requirement in the proposed rule because spirometry must be conducted according to strict standards for quality control and results must be consistently interpreted. The NIOSH-approved spirometry training is based upon procedures and interpretation standards developed by the ATS/ERS and addresses factors, such as instrument calibration, testing performance, data quality, and interpretation of results (Document ID 3625, pp. 2-3).

NIOSH approves a spirometry training course if it meets the minimum OSHA/NIOSH criteria for performance of spirometry testing in the cotton textile industry. Since these course criteria are based on recommendations from ATS/ERS, they are applicable to spirometry testing in all industries. The curriculum of NIOSH-approved courses encompasses ATS/ERS recommendations on instrument accuracy (e.g., calibration checks); test performance (e.g., coaching, recognizing improperly performed maneuvers), and data quality with emphasis on repeatability and interpretation of results. Students taking the course use actual equipment, while supervised, and are evaluated on their spirometry testing skills (Document ID 3625, pp. 2-3). NIOSH periodically audits spirometry course sponsors who provide the courses (see http://www.cdc.gov/niosh/topics/spirometry/sponsor-renewal-dates.html). Therefore, based on the evidence in the record for this rulemaking, OSHA concludes that completing a NIOSH-certified course will make spirometry technicians knowledgeable about various issues that commenters raised regarding spirometry quality, and has determined that the best way to ensure that spirometry technicians receive the level of quality training approved by NIOSH is to require a certificate from a NIOSH-approved course.

In considering the alternative suggestions, OSHA concludes that requiring a current certificate from a NIOSH-approved course is a better approach than mandating requirements for equipment, testing procedures, reference values, and interpretation of results, which could become outdated. OSHA fully expects that the NIOSH-approved initial and periodic refresher courses required to maintain a current certificate under this rule will ensure that technicians keep up-to-date on the most recent ATS/ERS recommendations on spirometry equipment and procedures as technology and methods evolve over time.

In addition, OSHA agrees with commenters that the NHANES III reference values should be used to interpret spirometry results because they are the most widely endorsed for use in the U.S. (Document ID 3630, p. 28-29). In cross-sectional testing to evaluate lung function at a single point in time, spirometry results are compared to reference values (i.e., spirometry values for individuals of the same gender, age, height, and ethnicity as the employee being tested). Although agreeing with commenters on the value of spirometry testing and use of the NHANES III data set for cross-sectional testing, OSHA disagrees with commenters that procedures for conducting spirometry and NHANES III reference values should be included as part of an appendix. As stated above, OSHA's approach to improving spirometry quality is to require technicians to have a current certificate from a NIOSH-approved course. Describing procedures in an appendix is not necessary because spirometry guidance documents, including a comprehensive guidance document from OSHA, are widely available. The OSHA spirometry guidance is available from the OSHA website and lists the NHANES III values in an appendix. OSHA encourages individuals who conduct or interpret spirometry to review the OSHA guidance on spirometry, which is based on recommendations by ATS/ERS, ACOEM, and NIOSH (Document ID 3630; 3624; 3629; 3631; 3633; 3634).

OSHA received one comment regarding the practicality of requiring a current certificate from a NIOSH-approved course. Dow Chemical claimed that availability of NIOSH-approved courses may be limited outside of metropolitan areas (Document ID 2270, p.11). However, NIOSH's website indicates that course sponsors are located throughout the U.S. and that some sponsors will travel to a requested site to teach a course (Document ID 3625, p. 3). Moreover, Dow Chemical also reported that it and another local company had teamed up to bring in an instructor to teach a NIOSH-approved course in their geographical area (Document ID 2270, p.11). OSHA expects that this is a cost-effective means of providing NIOSH-approved training in places where none currently exists and can be replicated by other spirometry providers that provide services to companies covered by this rule. Maintaining a certificate from a NIOSH-approved course currently requires initial training and then refresher training every five years (Document ID 3625, p. 1). Because courses appear to be widely available throughout the U.S. and the required training is infrequent, OSHA concludes that the requirement for a technician to maintain a certificate from a NIOSH-approved course will not impose substantial burdens on providers of spirometry testing.

The fifth item required as part of the initial medical examination is a test for latent tuberculosis infection (paragraph (i)(2)(v) of the standard for general industry and maritime, paragraph (h)(2)(v) of the standard for construction). This provision is unchanged from the proposed rule. "Latent" refers to a stage of infection that does not result in symptoms or possible transmission of the disease to others. OSHA proposed the inclusion of a test for latent tuberculosis infection because exposure to respirable crystalline silica increases the risk of a latent tuberculosis infection becoming active (i.e., the infected person shows signs and symptoms and is contagious), even in employees who do not have silicosis (see Section VI, Final Quantitative Risk Assessment and Significance of Risk) (Document ID 0360; 0465; 0992, p.1461-1462). This places not only the employee, but also his or her coworkers, at increased risk of acquiring this potentially fatal disease.

OSHA sought comment on its preliminary determination that all employees receiving an initial medical examination should be tested for latent tuberculosis infection. A number of stakeholders, including Dr. James Cone, ATS, NIOSH, APHA, NISA, NSSGA, ASSE, BCTD, and ACOEM agreed with OSHA's preliminary conclusion that testing for latent tuberculosis infection should be part of the initial examination (e.g., Document ID 2157, p. 6; 2175, p. 6; 2177, Attachment B, pp. 38-39; 2178, Attachment 1, p. 5; 2195, p. 41; 2327, Attachment 1, p. 23; 2339, p. 9; 2371, Attachment 1, p. 43). However, other stakeholders, such as Newmont Mining, Nevada Mining Association, and EEI, recommended that testing for latent tuberculosis infection be limited to employees who have silicosis (e.g., Document ID 1963, p. 2; 2107, p. 3; 2357, p. 34). EEI specifically opposed testing for latent tuberculosis infection in the absence of radiological evidence of silicosis, arguing that there are no good methods for quantifying the benefits of that testing.

After reviewing the comments on this issue, OSHA affirms its conclusion that testing for latent tuberculosis infections is a necessary and important part of the initial examination. As noted above, evidence demonstrates that exposure to respirable crystalline silica increases the risk for developing active pulmonary tuberculosis infection in individuals with latent tuberculosis infection, independent of the presence of silicosis (Document ID 0360; 0465; 0992, pp. 1461-1462). Active tuberculosis cases are prevented by identifying and treating those with latent tuberculosis infections. Therefore, OSHA concludes it is appropriate to test for latent tuberculosis infection in all employees who will be exposed to respirable crystalline silica and are eligible for medical surveillance, for their protection and to prevent transmission of an active, potentially fatal infection to their coworkers. Any concerns about a lack of good methods for calculating benefits associated with latent tuberculosis infection testing do not negate the scientific evidence demonstrating that exposure to respirable crystalline silica increases the risk of a latent infection becoming active.

Newmont Mining, Nevada Mining Association, and Fann Contracting did not support testing for latent tuberculosis infection because employees with the infection may not have contracted it in an occupational setting (Document ID 1963, p. 2; 2107, p. 3; 2116, Attachment 1, p. 38). While that may be true, testing for latent tuberculosis infection provides another example and support for two of the main objectives of medical surveillance: (1) to identify conditions that might make employees more sensitive to respirable crystalline silica exposure; and (2) to allow for intervention methods to prevent development of serious disease. Employees with latent tuberculosis infections are at greater risk of developing active disease with exposure to respirable crystalline silica, and informing them that they have a latent infection allows for intervention in the form of treatment to eliminate the infection. Treating latent tuberculosis disease before it becomes active and can be transmitted to coworkers (and others) is in the best interest of both the employer and the affected employee.

Dr. James Cone and APHA have stated that a positive boosted or initial test for tuberculosis infection warrants medical referral for further evaluation (Document ID 2157, p. 6; 2178, Attachment 1, p. 5). Ameren commented that a positive tuberculosis test warrants medical removal (Document ID 2315, p. 9). OSHA agrees that employees who test positive for active tuberculosis should be referred to their local public health departments as required by state public health law (Document ID 2177, Attachment B, p. 50). Those employees will need treatment and, if necessary, to be quarantined until they are no longer contagious. That is the appropriate action for employees with active tuberculosis to prevent infection of coworkers and others, according to procedures established by state public health laws. In the case of latent tuberculosis, the PLHCP may refer the employee to the local public health department, where the employee may get recommendations or prescriptions for treatment. Removal is not necessary for latent tuberculosis infections because employees with latent tuberculosis infections are not contagious. More information about testing for latent tuberculosis infections is included in Appendix B.

The sixth and final item required as part of the initial medical examination is any other test deemed appropriate by the PLHCP (paragraph (i)(2)(vi) of the standard for general industry and maritime, paragraph (h)(2)(vi) of the standard for construction). This provision, which is unchanged from the proposed rule, gives the examining PLHCP the flexibility to determine additional tests deemed to be appropriate. While the tests conducted under this section are for screening purposes, diagnostic tests may be necessary to address a specific medical complaint or finding related to respirable crystalline silica exposure (Document ID 1511, p. 61). For example, the PLHCP may decide that additional tests are needed to address abnormal findings in a pulmonary function test. OSHA considers the PLHCP to be in the best position to decide if any additional medical tests are necessary for each individual examined. Under this provision, if a PLHCP decides another test related to respirable crystalline silica exposure is medically indicated, the employer must make it available. EEI commented that OSHA should clarify that additional tests must be related to occupational exposure to respirable crystalline silica (Document ID 2357, p. 35). OSHA agrees and intends the phrase “deemed appropriate” to mean that additional tests requested by the PLHCP must be both related to respirable crystalline silica exposure and medically necessary, based on the findings of the medical examination.

Finally, some stakeholders suggested additional tests to be included as part of medical examinations. OSHA did not propose a requirement for the initial examination to include a CT scan to screen for lung cancer, but a number of commenters thought the rule should contain such a requirement. UAW requested that OSHA consider LDCT scanning for lung cancer, with guidance from NIOSH and other medical experts (Document ID 2282, Attachment 3, pp. 19-20). Charles Gordon asked Dr. David Weissman if OSHA should consider CT scans for lung cancer screening of silica-exposed employees, as has been recently recommended by the U.S. Preventive Service Task Force (USPSTF) for persons at high risk of lung cancer. Dr. Weissman responded:

> Well, the recommendation that you're referring to related to very heavy cigarette smokers, people who are age 55 to 80, had a history of smoking I believe at least 30 pack-years and had smoked as recently as 15 years ago. That group has a very, very high risk of lung cancer, and as of this time, there are no recommendations that parallel that for occupational carcinogens (Document ID 3579, Tr. 159-160, Attachment 2, p. 2).

Collegium Ramazzini and USW asked OSHA to consider various scenarios for LDCT lung cancer screening of employees exposed to respirable crystalline silica; the different scenarios considered age (as a proxy for latency), smoking history, and other risk factors, such as non-malignant respiratory disease (Document ID 4196, pp. 5-6; 4214, pp. 10-12). Both groups recommended screening in non-smokers, and Collegium Ramazzini also recommended screening in employees less than 50 years of age; both groups cited National Comprehensive Cancer Network (NCCN) guidelines as a basis for one or more recommendations, and Collegium Ramazzini also cited the American Association for Thoracic Surgery (AATS) guidelines. The Communication Workers of America (CWA) requested LDCT scans every three years for silica-exposed employees over 50 years of age (Document ID 2240, p. 3). Consistent with one scenario presented by USW, AFL-CIO requested that OSHA require LDCT scans if recommended by the

PLHCP or specialist, and AFL-CIO also requested that OSHA include a provision (for employees exposed to respirable crystalline silica) to allow for regular LDCT scans if recommended by an authoritative group (Document ID 4204, p. 82). Dr. Rosemary Sokas and Dr. James Melius, occupational physician/epidemiologist for LHSFNA, requested that OSHA reserve the right to allow for adoption of LDCT scans (Document ID 3577, Tr. 793; 3589, Tr. 4205-4206). Dr. Sokas went on to say that OSHA should start convening agencies and organizations to look at levels of risk that warrant LDCT (Document ID 3577, Tr. 793).

In addition to the issues that Dr. Weissman testified about regarding the USPSTF recommendations, OSHA notes that the USPSTF recommendations are based on modeling studies to determine optimum ages and frequency for screening and the scenarios in which benefits of LDCT screening (e.g., increased survival) would outweigh harms (e.g., cancer risk from radiation exposure). The screening scenario recommended by USPSTF (55-to 80-year-olds with a 30-pack-year smoking history who have not quit more than 15 years ago) is estimated to result in a 14 percent decrease in lung cancer deaths, with a less than 1 percent risk for radiation-related lung cancer (Document ID 3965, p. 337). USPSTF stresses that LDCT screening should be limited to high-risk persons because persons at lower risk are expected to experience fewer benefits and more harm; they cautioned that starting LDCT screening before age 50 might result in increased rates of radiation-related lung cancer deaths (Document ID 3965, p. 336). USPSTF also warns about the high rate of false positive findings with LDCT, which often lead to more radiation exposure through additional imaging tests and can result in invasive procedures, which have their own risks, to rule out cancer. It cautions that lower rates of lung cancer mortality from LDCT screening are most likely to be found at institutions demonstrating accurate diagnoses, appropriate follow-up procedures for abnormal findings, and clear standards for performing invasive procedures (Document ID 3965, pp. 333, 336).

Both NCCN and AATS guidelines recommend screening scenarios that are similar to the USPSTF guideline (e.g., 55 or more years of age and at least a 30-pack-year history) (Document ID as cited in 3965, p. 338; 3976, p. 33). NCCN and AATS guidelines also recommend screening for 50-year-olds or older, who have a 20-pack-year or more smoking history and an additional risk factor. AATS specifies that the additional risk factor should result in a cumulative lung cancer risk of at least 5 percent in the next 5 years, and they identify additional risk factors, such as COPD, with an FEV_1 of 70 percent or less of predicted value, and environmental or occupational exposures, including silica (Document ID 3976, pp. 33, 35-37). Neither the NCCN nor AATS guideline recommend screening for individuals younger than 50 years of age or nonsmokers, and neither NCCN nor AATS indicates that its guidelines are based on risk-benefit analyses.

OSHA agrees that employees exposed to respirable crystalline silica are at increased risk of developing lung cancer, as addressed in Section V, Health Effects. However, OSHA has two major concerns that preclude the Agency from requiring LDCT screening for lung cancer under the respirable crystalline silica rule. The first concern is that availability of LDCT is likely to be limited. Few institutions that offer LDCT have the specialization to effectively conduct screening for lung cancer. The second major concern is the lack of a risk-benefit analysis. There is no evidence in the rulemaking record showing that the benefits of lung cancer screening using LDCT in respirable crystalline silica-exposed employees outweigh the risks of lung cancer from radiation exposure. OSHA has also not identified authoritative recommendations based on risk-benefit analyses for LDCT scanning for lung cancer in persons who do not smoke or are less than 50 years of age. OSHA concludes that without authoritative risk-benefit analyses, the record does not support mandating LDCT screening for respirable crystalline silica-exposed employees.

Periodic examinations. In paragraph (i)(3) of the standard for general industry and maritime (paragraph (h)(3) of the standard for construction), OSHA requires periodic examinations that include all of the items required by the initial examination, except for testing for latent tuberculosis infection, i.e., a medical and work history, a physical examination emphasizing the respiratory system, chest X-rays, pulmonary function tests, and other tests deemed to be appropriate by the PLHCP. Employers must offer these examinations every three years, or more frequently if recommended by the PLHCP. The frequency of periodic examinations and their requirements is unchanged from the proposed rule.

Some commenters disagreed with the proposed three-year interval for periodic medical examinations. WisCOSH and Charles Gordon thought that medical examinations should be offered more often than every three years (Document ID 3586, Tr. 3200-3201; 2163, Attachment 1, p. 14). Other commenters, including AFSCME and some employee health advocates and labor unions, requested that one or more components of medical examinations be offered annually (Document ID 1960; 2208; 2240, p. 3; 2351, p. 15; 4203, p. 6). Collegium Ramazzini recommended annual medical surveillance consisting of medical and work history and spirometry testing to better characterize symptoms, changes in health and work history that could be forgotten, and lung function changes (Document ID 3541, p. 12). CISC stated that OSHA did not explain why it found an examination every three years necessary and appropriate (Document ID 2319, p. 119).

ATS, NIOSH, USW, and AFS supported the three-year frequency requirement for medical surveillance (Document ID 2175, p. 6; 2177, Attachment B, pp. 38-39; 2336, p. 11;

2379, Appendix 1, p. 70). NSSGA, however, recommended examinations every three to five years (Document ID 2327, Attachment 1, p. 24). Although WHO guidelines recommend an annual history and spirometry test, the guidelines state that if that is not possible, those examinations can be conducted at the same frequency they recommend for X-rays (every 2-to-5 years) (Document ID 1517, p. 32). In support of triennial medical examinations, ATS commented that an examination provided every three years is appropriate to address a lung disease that typically has a long latency period (Document ID 2175, p. 6).

ACOEM agreed with a frequency of every three years for a medical examination, provided that a second baseline examination (excluding X-rays) is conducted at 18 months following the initial baseline examination; this approach was recommended to detect possible symptoms of acute silicosis and to more effectively establish a spirometry baseline since rapid declines in lung function can occur in dusty work environments (Document ID 2080, pp. 5-6). Dr. Celeste Monforton agreed with a follow-up examination at 18 months (Document ID 3577, Tr. 846).

APHA, AFL-CIO, BAC, and BCTD also agreed with ACOEM's suggestion for a follow-up examination within 18-months, adding that a three-year interval between examinations is acceptable if medical examinations are offered to employees experiencing signs and symptoms related to respirable crystalline silica exposure (Document ID 2178, Attachment 1, pp. 4-5; 4204, pp. 81-82; 4219, pp. 30-31; 4223, pp. 127-128). BlueGreen Alliance, UAW, Center for Effective Government (CEG), CPR, WisCOSH, and AFSCME also requested that medical surveillance be offered for employees experiencing symptoms (Document ID 2176, p. 2; 2282, Attachment 3, pp. 22-23; 2341, pp. 2-3; 2351, p. 15, Fn 29; 3586, Tr. 3200-3201; 4203, p. 6). The AFL-CIO and UAW stated that a symptom trigger is appropriate based on the high level of risk remaining at OSHA's proposed action level and PEL (Document ID 2282, Attachment 3, p. 22; 4204, p. 81). APHA, CEG, and BCTD also argued that employees should be allowed to see a PLHCP if they are concerned about excessive exposure levels or their ability to use a respirator (Document ID 2178, p. 5: 2341, pp. 2-3; 4223, pp. 127-128).

After considering all comments on this issue, OSHA concludes that the record supports requiring periodic examinations to be offered to employees at least every three years after the initial (baseline) or most recent periodic medical examination for employees who are eligible for initial and continued medical surveillance under the rule. Accordingly, paragraph (i)(3) of the standard for general industry and maritime (paragraph (h)(3) of the standard for construction) requires periodic examinations at least every three years, or more frequently if recommended by the PLHCP. One of the main goals of periodic medical surveillance for employees exposed to respirable crystalline silica is to detect adverse health effects, such as silicosis and other non-malignant lung diseases, at an early stage so that medical and other appropriate interventions can be taken to improve health. Consistent with the NIOSH and ATS comments, OSHA finds that medical examinations offered at a frequency of at least every three years is appropriate for most employees exposed to respirable crystalline silica in light of the slow progression of most silica-related diseases. This decision is also consistent with ASTM standards E 1132 – 06 and E 2625 – 09 (Section 4.6.5), which recommend that medical surveillance be conducted no less than every three years (Document ID 1466, p. 5; 1504, p. 5).

OSHA declines to adopt ACOEM's recommendation for a second baseline examination at 18 months. As noted above, this request was based upon detection of possible acute silicosis symptoms. Considering that acute silicosis and the rapid declines in lung function associated with it, as a result of extremely high exposures, are rare, OSHA determines that this extra examination would not benefit the vast majority of employees exposed to respirable crystalline silica. However, as noted above, paragraph (i)(3) of the standard for general industry and maritime (paragraph (h)(3) of the standard for construction) authorizes the PLHCP to recommend, and requires the employer to make available, increased frequency of medical surveillance. OSHA agrees with Dr. James Melius that more frequent medical examinations are appropriate if requested by the PLHCP based on abnormal findings or signs of possible illness, and the Agency agrees with ACOEM that the PLHCP may recommend more frequent medical surveillance based on an exposure history indicating unknown or high exposure to respirable crystalline silica (Document ID 2080, p. 6; 3589, Tr. 4203). OSHA concludes that allowing the PLHCP to determine when increased frequency of medical examinations is needed is a better approach than requiring all employees to receive annual medical examinations or a second baseline examination at 18 months.

OSHA did not include a symptom trigger because symptoms of silica-related lung diseases (e.g., cough, shortness of breath, and wheeze) are very common and non-specific, unlike symptoms resulting from exposures to some other chemicals OSHA has regulated. In addition, based on the employee health privacy concerns expressed in this rulemaking (discussed below), OSHA does not expect many employees to ask their employer for a medical examination when they experience symptoms. Furthermore, employees who are the most likely to develop symptoms are those exposed above the PEL. Those employees, who would be required to wear respirators, and also construction employees required to wear respirators under Table 1, are entitled to an additional medical evaluation under the respiratory protection standard if they report signs or symptoms that are related to ability to use a respirator (29 CFR

1910.134(e)(7)(i)). Therefore, employees at the highest risk of developing symptoms will be able to take advantage of that provision in the respiratory protection standard.

AIHA recommended that OSHA consider decreased frequency of testing in employees with less than 10 to 15 years of experience because of the small chance of finding disease, and it noted that this was done in the asbestos standard (29 CFR 1910.1001, 1926.1101) (Document ID 2169, p. 6). Medical surveillance guidelines from ACOEM, Industrial Minerals Association (IMA)/Mine Safety and Health Administration (MSHA) and NISA recommend periodic medical examinations at intervals from two to four years (with the exception of a follow-up examination in some cases), depending on age, years since first exposure, exposure levels, or symptoms (Document ID 1505, pp. 3-4; 1511, pp. 78-79; 1514, pp. 109-110). As noted by the IMA/MSHA guidelines, a compromise schedule that is easier to administer is acceptable if it is difficult to offer surveillance based on multiple considerations (Document ID 1511, pp. 78-79). OSHA agrees with the IMA/MSHA approach of choosing a schedule that is easy to administer. The Agency concludes that surveillance every three years is an administratively convenient frequency that strikes a reasonable balance between the resources required to provide surveillance and the need to diagnose health effects at an early stage to allow for interventions.

In addition to the above general comments as to the appropriate frequency of periodic examinations, some stakeholders offered comments on particular components of periodic examinations, in particular chest X-rays and pulmonary function tests. As noted above, chest X-rays are included in the periodic, as well as initial (baseline), medical examinations. Periodic chest X-rays are appropriate tools for detecting and monitoring the progression of silicosis and possible complications, such as mycobacterial disease, including tuberculosis infection (Document ID 1505, p. 3; 1511, pp. 63, 79). Safety professional Albert Condello III stated that

X-rays should be offered annually (Document ID 1960). OSHA concludes that every three years is an appropriate interval for X-ray examinations. The frequency is within ranges recommended by ACOEM, IMA/MSHA, NISA, and WHO (Document ID 1505, pp. 3-4; 1511 pp. 78-79; 1514, pp. 109-110; 1517, p. 32). Commenters representing NIOSH, the medical community, and industry agreed that a frequency of every three years is appropriate for X-rays (Document ID 2157, p. 6; 2177, Attachment B, pp. 38-39; 2315, p. 9; 2327, Attachment 1, p. 25; 2379, Appendix 1, p. 70; 3541, p. 5).

OSHA also received comments on the inclusion of pulmonary function (i.e., spirometry) tests in periodic examinations and the appropriate frequency for such tests. As noted under the discussion of tests included as part of the initial medical evaluation, some commenters questioned whether spirometry in general should be required for employees exposed to respirable crystalline silica. For the same reason that OSHA decided to include spirometry as a required element in the initial medical examination, it concludes that requiring spirometry as part of the periodic examination is appropriate; that reason is that a spirometry test is a valuable tool for detecting possible lung function abnormalities associated with respirable crystalline silica-related disease and for monitoring the health of exposed employees. Spirometry tests that adhere to strict quality standards and that are administered by a technician who has a current certificate showing successful completion of a NIOSH-approved spirometry course, are useful for monitoring progressive lung function changes in individual employees and in groups of employees.

The proposed interval of three years for spirometry testing was an issue in the rulemaking. OSHA proposed this interval because exposure to respirable crystalline silica does not usually cause severe declines in lung function over short time periods. Spirometry testing conducted every three years is within ranges of recommended frequencies, based on factors such as age and exposure duration or intensity, in guidelines by ACOEM and BCTD, although ACOEM and BCTD recommend an evaluation at 18 months following the baseline test (Document ID 1505, p. 3; 1509, p. 15; 2080, pp. 5-6; 4223, p. 128). Guidelines from WHO recommend yearly spirometry tests, but indicate that if that is not possible, spirometry can be conducted at the same frequency as X-rays (every 2-to-5 years) (Document ID 1517, p. 32).

OSHA specifically requested comment on the appropriate frequency of lung function testing, which it proposed at intervals of every three years. ASSE agreed that spirometry testing every three years is consistent with most credible occupational health programs for respirable crystalline silica exposure (Document ID 2339, p. 9). Industry stakeholders, such as Ameren, NSSGA, and AFS, also supported conducting spirometry testing every three years (Document ID 2315, p. 9; 2327, Attachment 1, pp. 24-25; 2379, Appendix 1, p. 70).

Collegium Ramazzini stated that spirometry testing should be conducted annually rather than triennially (Document ID 3541, pp. 12-13). In support of its statement, Collegium Ramazzini interpreted data from a Wang and Petsonk (2004) study to mean that an FEV_1 loss of 990 milliliters (mL) or higher could occur before detection of lung function loss with testing every three years (Document ID 3541, pp. 12-13; 3636).

The Wang and Petsonk 2004 study was designed to measure lung function changes in coal miners over 6- to 12-month intervals. The study authors reported that in the group of coal miners studied, a year-to-year decline in lung function (i.e., FEV_1) of 8 percent or 330 mL or more, based on the 5th percentile, should not be considered normal (i.e., the results did not likely occur by chance in healthy males). To understand the implications of this finding, OSHA consulted 2014 ATS guidelines. Those guidelines urge caution in interpreting early lung function changes in miners because early, rapid declines in lung function are often temporary and might occur because of inflammation. They further indicate that estimates of lung function decline are more precise as the length of follow-up increases and that real declines in lung function become easier to distinguish from background variability. In addition, ATS cautions that short-term losses in lung function can be difficult to evaluate because of variability (Document ID 3632, pp. 988-989).

OSHA notes that, in fact, Figure 1 of the Wang and Petsonk study shows that lung function loss measured over a 5-year period in that cohort of miners is much less variable than changes measured over 6- to 12-month intervals. OSHA therefore finds that this study indicates that long-term measurements in lung function are more reliable for assessing the level of lung function decline over time. Based on Table 1 of the Wang and Petsonk study, mean annual FEV_1 loss, when evaluated over a 5-year period, was 36 and 56 mL/year in stable and healthy miners, respectively. Even among rapid decliners evaluated over five years, mean decline in FEV_1 was 122 mL/year. Unlike Collegium Ramazzini, OSHA does not interpret the Wang and Petsonk study to mean that an FEV_1 loss of 990 mL or higher could occur before detection of lung function loss with testing every three years The study authors themselves conclude:

> However, even among workers in our study who met this >8% or >330 mL criterion, many did not show accelerated declines over the entire 5 years of follow up (data not shown), emphasizing that a finding of an increased year-to-year decline in an individual requires further assessment and confirmation (Document ID 3636, p. 595).

In sum, OSHA finds that the Wang and Petsonk study is not a basis for concluding that triennial spirometry testing is inadequate for assessing lung function loss in most employees exposed to respirable crystalline silica.

Collegium Ramazzini also cited a 2012 Hnizdo study that demonstrated greater stability and predictability for excessive loss of lung function with more frequent testing.

In that study, spirometry data were useful for predicting decline only after the fourth or fifth year of follow-up; Collegium Ramazzini stated that only two spirometry tests would be available in six years if employees are tested every three years (Document ID 3541, p. 13; 3627, p. 1506). OSHA notes that three spirometry reports would be available following six years of triennial testing (the initial examination, the three-year examination, and the six-year examination). In addition, Hnizdo concluded that annual spirometry was best, but even in employees tested every three years, useful clinical data were generated with five to six years of follow-up (Document ID 3627, p. 1511).

The ATS committee also reviewed the Hnizdo study and concluded that precision in determining rate of FEV_1 decline improves with greater frequency of measurement and duration of follow-up. Because chronic diseases, such as COPD and pneumoconiosis, typically develop over a span of years, the ATS committee concluded that spirometry performed every two-to-three years should be sufficient to monitor the development of such diseases (Document ID 3632, p. 988). NIOSH Division of Respiratory Disease Studies Director, Dr. David Weissman, who was on the ATS committee, also agreed that spirometry testing every three years is appropriate for respirable crystalline silica-exposed employees (Document ID 3632, p. 1; 3579, Tr. 255).

After consideration of the rulemaking evidence on this issue, OSHA concludes that spirometry testing every three years is appropriate to monitor employees' lung function and that the frequency is well supported in the record. Therefore, consistent with its proposed rule, OSHA is including a frequency of at least every three years for spirometry testing.

As discussed above in connection with the initial testing requirement, spirometry usually involves cross-sectional testing for assessing lung function at a single time point. Longitudinal spirometry testing that compares employees' lung function to their baseline levels is also useful for detecting excessive declines in lung function that could lead to severe impairment over time. OSHA did not propose a requirement to assess longitudinal changes in lung function. Commenters including Collegium Ramazzini, LHSFNA, and BCTD requested that the standard include requirements or instructions for longitudinal testing to compare an employee's current lung function value to his or her baseline value (Document ID 3541, p. 10; 3589, Tr. 4205; 4223, p. 129). As noted by Dr. L. Christine Oliver, associate clinical professor of medicine at Harvard Medical School, representing Collegium Ramazzini:

> Excessive loss of lung function may indicate early development of silica-related disease, even in the absence of an abnormal test result. So spirometry at one point in time may be normal, but compared to the baseline of that individual, there may have been a decline. So even though the test result itself is normal, it doesn't mean that there is not something going on with regard to that individual's lung function (Document ID 3588; Tr. 3855).

Both Collegium Ramazzini and BCTD requested that the standard require referral to a specialist for excessive losses of pulmonary function. Collegium Ramazzini recommended specialist referral for a year-to-year decline in FEV_1 of greater than 8 percent or 330 mL based on the study by Wang and Petsonk discussed above (Document ID 3541, pp. 3, 9-10; 3636). BCTD recommended specialist referral for a year-to-year decline in FEV_1 of greater than 10 percent based on ACOEM guidance (Document ID 4223, p. 129; 3634, pp. 579-580).

OSHA endorses in principle the value of longitudinal spirometry analyses to compare employees' lung function to their baseline values, but is not adopting the specific recommendation to incorporate it into the rule. Based on a review of the available evidence, OSHA is concerned about several challenges in determining an employee's change from baseline values, which preclude the Agency from requiring longitudinal analyses with an across-the-board trigger of 8-to-10 percent loss of baseline lung function for specialist referral. First, a lung function loss of 8-to-10 percent is more stringent than general recommendations from ACOEM and ATS. OSHA notes that the complete ACOEM recommendation for evaluating longitudinal changes in lung function states:

> When high-quality spirometry testing is in place, ACOEM continues to recommend medical referral for workers whose FEV_1 losses exceed 15%, after allowing for the expected loss due to aging. Smaller declines of 10% to 15%, after allowing for the expected loss due to aging, may be important when the relationship between longitudinal results and the endpoint disease is clear. These smaller declines must first be confirmed, and then, if the technical quality of the pulmonary function measurement is adequate, acted upon (Document ID 3634, p. 580).

The ACOEM recommendation is based on ATS guidelines indicating that year-to-year changes in lung function exceeding 15 percent are probably unusual in healthy individuals. A recent ATS committee restated that position:

> ATS recommends that a decline of 15% or more over a year in otherwise healthy individuals be called "significant," beyond what would be expected from typical variability (Document ID 3632, p. 989).

As ATS indicated, actual lung function losses must be distinguished from measurement variability. Variability in spirometry findings can occur as a result of technical factors (e.g., testing procedures, technician competence, and variations in equipment) and biological factors related to employees being tested (e.g., circadian rhythms, illness, or recovery from surgery) (Document ID 3630, p. 32). The requirement for testing by a technician with a current certificate from a NIOSH-approved course improves spirometry quality and reduces variability related to testing technique and technician competence. However, OSHA is aware that even with high quality spirometry programs, variability in results can still occur from factors such as changes in equipment and/or testing protocol.

Collegium Ramazzini noted that spirometry performed at a location other than that of the first employer may not provide an adequate baseline to evaluate lung function changes in the absence of quality control and standardized equipment, methodology, and interpretation (Document ID 3541, p. 5). OSHA is concerned about the ability to differentiate lung function changes from variability, even with standardization and quality control. ACOEM has concluded that frequent changing of spirometry providers may prevent a meaningful evaluation of longitudinal testing results (Document ID 3633, p. 1309). OSHA recognizes that changes in spirometry providers could preclude evaluating changes in lung function from baseline values and that employees in high-turnover industries, e.g., construction, could be particularly affected if they undergo spirometry testing on different types of spirometers used by different providers contracted by the different employers for whom they work.

In addressing the issue of construction employees frequently changing employers, Dr. L. Christine Oliver recommended storing spirometry results in a central database or providing them to employees to allow comparison of current results with past results (Document ID 3588, Tr. 3873-3875). As indicated above, technical quality of past spirometry should be evaluated before examining longitudinal change in lung function. Full spirometry reports should be examined for indicators of test quality (e.g., acceptability and repeatability of spirometry maneuvers). OSHA encourages PLHCPs to give employees copies of their full medical records, including spirometry reports with numerical values and graphical illustrations of expiratory curves. Employees (including former employees) also have a right to access their medical records under OSHA's access to medical and exposure records rule (29 CFR 1910.1020). Presenting past spirometry records to a new PLHCP might allow for the interpretation of lung function compared to baseline values, but the PLHCP would have to determine if this evaluation is possible based on spirometry technical quality.

In sum, OSHA recognizes the value of longitudinal analyses that compare an individual's lung function to their baseline values. Recent studies have shown that excessive decline in lung function can be an early warning sign for risk of COPD development (Document ID 1516). Therefore, identifying employees who are at risk of developing severe decrements in lung function can allow for interventions to possibly prevent or slow progression of disease and thus justifies periodic spirometry. But because of the complexities and challenges described above, OSHA is not mandating testing to compare employees' lung function values to baseline values or specifying a lung function loss trigger for referral to a specialist. OSHA concludes that spirometry conducted every three years is appropriate to detect the possible development of lung function impairment. However, the PLHCP is in the best position to determine how spirometry results should be evaluated. Under paragraph (i)(5)(iv) of the standard for general industry and maritime (paragraph (h)(5)(iv) of the standard for construction), PLHCPs have the authority to recommend referral to a specialist if "otherwise deemed appropriate," and an informed judgment or suspicion that excessive lung function loss or an actual lung function abnormality has occurred would be an appropriate reason for referral to a specialist with the necessary skills and capability to make that evaluation.

<u>Information provided to the PLHCP</u>. Paragraph (i)(4)(i)-(iv) of the standard for general industry and maritime (paragraph (h)(4)(i)-(iv) of the standard for construction) requires the employer to ensure that the examining PLHCP has a copy of the standard, and to provide the following information to the PLHCP: a description of the employee's former, current, and anticipated duties as they relate to respirable crystalline silica exposure; the employee's former, current, and anticipated exposure levels; a description of any personal protective equipment (PPE) used, or to be used, by the employee, including when and for how long the employee has

used or will use that equipment; and information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer. OSHA determined that the PLHCP needs this information to evaluate the employee's health in relation to assigned duties and fitness to use PPE.

Some of these provisions reflect minor edits from the proposed rule. In paragraphs (i)(4)(i) and (iv) of the standard for general industry and maritime (paragraphs (h)(4)(i) and (iv) of the standard for construction), OSHA changed "affected employee" to "employee." OSHA removed the word "affected" because it is clear that the provisions refer to employees who will be undergoing medical examinations. In paragraph (i)(4)(iii) of the standard for general industry and maritime (paragraph (h)(4)(iii) of the standard for construction), OSHA changed "has used the equipment" to "has used or will use the equipment" to make it consistent with the earlier part of the provision that states "personal protective equipment used or to be used." These non-substantive changes simply remove superfluous language or clarify OSHA's intent, which has not changed from the proposed rule.

OSHA received few comments regarding information to be supplied to the PLHCP. NAHB was concerned about obtaining or verifying information, such as PPE use, exposure information, and medical information, from past employers to give to the PLHCP (Document ID 2296, p. 31). Paragraph (i)(4)(iv) of the standard for general industry and maritime (paragraph (h)(4)(iv) of the standard for construction) is explicit, however, that employers must only provide the information within their control. Employers are not expected to provide information to PLHCPs on exposures experienced by employees while the employees were working for prior employers. Similarly, OSHA intends that where the employer does not have information on the employee's past or current exposure level, such as when a construction employer uses Table 1 in lieu of exposure monitoring, providing the PLHCP with an indication of the exposure associated with the task (e.g., likely to be above the PEL) fulfills the requirement.

OSHA identifies the information that the employer must provide to the PLHCP, along with information collected as part of the exposure and work history, as relevant to the purposes of medical surveillance under the rule because it can assist the PLHCP in determining if symptoms or a health finding may be related to respirable crystalline silica exposure or if the employee might be particularly sensitive to such exposure. For example, a finding of abnormal lung function caused by asthma might indicate increased sensitivity to a workplace exposure. The information will also aid the PLHCP's evaluation of the employee's health in relation to recommended limitations on the employee’s use of respirators or exposure to respirable crystalline silica. For these reasons, OSHA is retaining the proposed provisions detailing information to be provided to the PLHCP in the rule.

Written medical reports and opinions. The proposed rule provided for the PLHCP to give a written medical opinion to the employer, but relied on the employer to give the employee a copy of that opinion; thus, there was no difference between information the employer and employee received. The rule differentiates the types of information the employer and employee receive by including two separate paragraphs within the medical surveillance section that require a written medical report to go to the employee, and a more limited written medical opinion to go to the employer. The former requirement is in paragraph (i)(5) of the standard for general industry and maritime (paragraph (h)(5) of the standard for construction); the latter requirement is in paragraph (i)(6) of the standard for general industry and maritime (paragraph (h)(6) of the standard for construction). This summary and explanation for those paragraphs first discusses the proposed requirements and general comments received in response to the proposed requirements.

OSHA then explains in this subsection of the preamble its decision in response to these comments to change from the proposed requirement for a single opinion to go to both the employee and employer and replace it with two separate and distinct requirements: (1) a full report of medical findings, recommended limitations on respirator use or exposure to respirable crystalline silica, and any referral for specialist examination directly to the employee; and (2) an opinion focused primarily on any recommended limitations on respirator use, and with the employee’s consent, recommended limitations on the employee's exposure to respirable crystalline silica and referral to a specialist. The ensuing two subsections will then discuss the specific requirements and the record comments and testimony relating to those specific requirements.

OSHA proposed that the employer obtain from the PLHCP a written medical opinion containing: (1) a description of the employee’s health condition as it relates to exposure to respirable crystalline silica, including any conditions that would put the employee at increased risk of material impairment of health from further exposure to respirable crystalline silica; (2) recommended limitations on the employee’s exposure to respirable crystalline silica or use of PPE, such as respirators; (3) a statement that the employee should be examined by a pulmonary disease specialist if the X-ray is classified as 1/0 or higher by the B reader, or if referral to a pulmonary disease specialist is otherwise deemed appropriate by the PLHCP; and (4) a statement that the PLHCP explained to the employee the medical examination results, including conditions related to respirable crystalline silica exposure that require further evaluation or treatment and any recommendations related to use of protective clothing or equipment. The proposed rule would also have required the employer to ensure that the PLHCP did not include findings unrelated to respirable crystalline silica exposure in the written medical opinion provided to the employer or otherwise reveal such findings to the employer. OSHA raised the contents of the PLHCP's written medical opinion, including privacy concerns, as an issue in the preamble of the NPRM in Question 71 in the "Issues" section (78 FR at 56290).

OSHA received a number of comments on these provisions. The majority of these comments related to the proposed contents of the PLHCP's written medical opinion and its transmission to the employer. For example, Dr. Laura Welch expressed concern that the provision that would have required the PLHCP to disclose "a medical condition that puts him or her at risk of material impairment to health from exposure to silica" could be read to require disclosure of the employee's medical diagnosis (Document ID 3581, Tr. 1580). Dr. Steven Markowitz, physician and director of the Center for Biology of Natural Systems at Queens College, representing USW, explained:

> So, for example, if I were the examining healthcare provider and I saw an employee, and he had what I identified as idiopathic pulmonary fibrosis, which is diffuse scarring of the lungs with an unknown cause, in this case, not silica, is that information that I would need to turn over to the employer because further exposure to silica might impair that person's health or not? Or what if the worker has emphysema, which is a silica-related condition, and the provider believes that that emphysema is not due to silica exposure but to the employee's long-time smoking history. Is that information that the healthcare provider is supposed to turn over to the employer? It isn't at all clear (Document ID 3584, Tr. 2518-2519).

Some commenters offered suggestions to address privacy concerns regarding the content of the proposed PLHCP's written medical opinion for the employer and the proposed requirement that the opinion be given to the employer instead of the employee. One suggestion advocated by UAW, LHSFNA, AFSCME, AFL-CIO, and BCTD was for OSHA to use a model based on the black lung rule for coal miners (Document ID 2282, Attachment 3, pp. 20-21; 3589, Tr. 4207; 4203, p. 6; 4204, p. 88; 4223, p. 134). Under the coal miner regulations, miners receive the medical information and employers are prohibited from requiring that information from miners (30 CFR 90.3). Commenters including BlueGreen Alliance, CWA, USW, and Collegium Ramazzini also urged OSHA to require that findings from medical surveillance only be given to employers upon authorization by the employee (Document ID 2176, p. 2; 2240, pp. 3-4; 2336, p. 12; 3541, p. 13). UAW, AFL-CIO, and BCTD referred OSHA to ACOEM’s recommendations for workplace confidentiality of medical information (Document ID 2282, Attachment 3, p. 20; 3578, Tr. 929; 3581, Tr. 1579-1580). The ACOEM guidelines state:

> Physicians should disclose their professional opinion to both the employer and the employee when the employee has undergone a medical assessment for fitness to perform a specific job. However, the physician should not provide the employer with specific medical details or diagnoses unless the employee has given his or her permission (Document ID 3622, p. 2).

Exceptions to this recommendation listed under the ACOEM guidelines include health and safety concerns. Collegium Ramazzini, BCTD, USW, and BAC argued that providing an employer with information about an employee’s health status violates an employee’s privacy and is not consistent with societal views reflected in laws, such as the Health Insurance Portability and Accountability Act (HIPAA) (Document ID 3541, p. 13; 3581, Tr. 1578-1579; 3584, Tr. 2519; 4219, p. 31).

Although HIPAA regulations allow medical providers to provide medical information to employers for the purpose of complying with OSHA standards (Document ID 4214, p. 7), OSHA has accounted for stakeholder privacy concerns in devising the medical disclosure requirements in the rule. OSHA understands that the need to inform employers about a PLHCP's recommendations on work limitations associated with an employee's exposure to respirable crystalline silica must be balanced against the employee's privacy interests. As discussed in further detail below, OSHA finds it appropriate to distinguish between the PLHCP's recommendations and the underlying medical reasons for those recommendations. In doing so, OSHA intends for the PLHCP to limit disclosure to the employer to what the employer needs to know to protect the employee, which does not include an employee’s diagnosis. Contrary to some of the comments, it was not OSHA's intent, either in the proposed rule or in earlier standards that require information on an employee’s medical or health condition, to transmit diagnostic information to the employer; OSHA intended for the PLHCP merely to convey whether or not the employee is at increased risk from exposure to respirable crystalline silica (or other workplace hazards in other standards) based on any medical condition, whether caused by such exposure or not. In re-evaluating how to express this intent, however, OSHA concludes that the employer primarily needs to know about any recommended limitations without conveying the medical reasons for the limitations. Thus, in response to the weight of opinion in this rulemaking record and to evolving notions about where the balance between preventive health policy and patient privacy is properly struck, OSHA is taking a more privacy- and consent-based approach regarding the contents of the PLHCP’s written medical opinion for the employer compared to the proposed requirements and earlier OSHA standards. These changes, which are reflected in paragraph (i)(6) of the standard for general industry and maritime (paragraph (h)(6) of the standard for construction), and the comments that led to these changes, are more fully discussed below.

Reinforcing the privacy concerns, various stakeholders, including labor unions, physicians, and employees, were also concerned that employees’ current or future employment might be jeopardized if medical information is reported to employers (e.g., Document ID 2282, Attachment 3, p. 20; 3581, Tr. 1582; 3583, Tr. 2470-2471; 3585, Tr. 3053-3054; 3586, Tr. 3245; 3589, Tr. 4227-4228, 4294-4295; 4203, pp. 6-7; 4214, pp. 7-8). The same concerns were expressed by Sarah Coyne, a painter and Health and Safety Director from the International

Union of Painters and Allied Trades, who testified that many of her fellow union members who have silicosis refused to testify at the silica hearings because they feared they would lose their jobs if their employers found out they were ill (Document ID 3581, Tr. 1613-14). Dr. L. Christine Oliver testified that her patients do not want medical information reported to employers, and Dr. James Melius stated that LHSFNA members are leery of medical surveillance because they fear losing their jobs (Document ID 3588, Tr. 3881-3882; 3589, Tr. 4228). Deven Johnson, cement mason, described employees hiding injuries from supervisors on jobsites for fear of being blacklisted, and said that:

> The same is true with occupational illnesses, that the last thing that a worker wants is to have any information that he's somehow compromised because, even though we want to think the best of the employer, that somebody wouldn't take action against that individual, we know for a fact that it happens. It's happened to our membership (Document ID 3581, Tr. 1656).

Industry representatives indirectly confirmed that discrimination based on medical results was possible. For example, CISC noted that some employers might refuse to hire an employee with silicosis because they might have to offer workers' compensation or be held liable if the disease progresses (Document ID 4217, pp. 22-23).

Evidence in the record demonstrates that a likely outcome of employees' reluctance to let employers know about their health status is refusal to participate in medical surveillance. For example, Dr. Rosemary Sokas stated that employees who lack job security would likely avoid medical surveillance if the employer receives the results (Document ID 3577, Tr. 819-820). In discussing the Coal Workers' Health Surveillance Program, Dr. David Weissman stated that maintaining confidentiality is critical because:

> One of the biggest reasons in focus groups that miners have given for not participating in surveillance is fear of their medical information being shared without their permission (Document ID 3579, Tr. 169).

When asked if employees would participate in medical surveillance that lacked both employee confidentiality and anti-retaliation and discrimination protection, employees Sarah Coyne, Deven Johnson, and Dale McNabb stated that they would not (Document ID 3581, Tr. 1657; 3585, Tr. 3053-3054). BAC and BCTD emphasized that employees must choose to participate in medical surveillance in order for it to be successful (Document ID 4219, p. 31; 4223, p. 131).

Industry groups, such as OSCO Industries and NAHB, commented that they or employers from their member companies are reluctant to handle or maintain confidential medical information (Document ID 1992, p. 12; 2296, p. 32). NAHB indicated:

> Members have expressed strong concerns that much of [the medical information], if not all, would be covered by privacy laws and should be between a doctor and patient. . . . Moreover, the PLHCP should provide a copy of the written medical opinion to the employee directly, not the employer, once it is written (Document ID 2296, pp. 31-32).

However, other industry groups asserted that employers should receive detailed information from medical surveillance. In particular, NISA argued that reporting medical surveillance findings to employers would facilitate epidemiological studies to better understand hazards and the effectiveness of a new standard (Document ID 4208, p. 14).

OSHA agrees that epidemiology studies are important; indeed its health effects and significant risk findings in this rule are overwhelmingly based on epidemiological studies. However, as noted above, it was never OSHA's intent for the PLHCP's written medical opinion on respirable crystalline silica to contain specific diagnoses or detailed findings that might be useful for an epidemiology study. As noted in the summary and explanation of Recordkeeping, OSHA's access to employee exposure and medical records standard (29 CFR 1910.1020) requires employers to ensure that most employee medical records are retained for the duration of employment plus 30 years for employees employed more than one year. Such records obtained through appropriate legal means, and with personal identifying information omitted or masked, would be a possible avenue for conducting epidemiology studies.

CISC also noted that in past standards, the purpose of medical surveillance was to improve health practices by allowing employers to understand effects of hazards and, therefore, make changes to the worksite, such as implementing controls or removing employees from exposure (Document ID 4217, p. 24). Attorney Brad Hammock, representing CISC at the public hearing, stated that if OSHA expects employers to make placement decisions based on health outcomes and exposure, then there would be some value in an employer receiving the PLHCP’s opinion. However, Mr. Hammock further explained that if the purpose of surveillance is simply to educate employees about their health situation, then there would be arguably little value in the employer receiving the opinion (Document ID 3580, Tr. 1466-1467). Other commenters, including ACOEM, AOEC, and NISA, also noted the importance of medical surveillance for identifying adverse health effects among employees in order to make workplace changes or evaluate the effectiveness of regulations or workplace programs (Document ID 2080, pp. 9-10; 3577, Tr. 784; 4208, pp. 13, 16-17). Andrew O’Brien testified that if employers are not allowed to see medical findings, the first time they are made aware of a problem is when they receive a letter from the compensation system. Mr. O’Brien stated:

> Without access to that data, you can't . . . potentially see disease beginning and take preventative action to prevent it from actually having a negative health effect (Document ID 3577, Tr. 614).

In contrast to those views, USW questioned the value in providing employers with the PHLCP's medical opinion. It stated:

> Exactly what corrections in the workplace will the employer make based on newfound knowledge that one of his workers has a silica-related condition?

> Silicosis occurs 15 or more years following onset of exposure, so that today's silicosis is due to exposure that likely occurred decades ago. (Exceptions are acute and accelerated silicosis, which are rare and are not expected to occur at the recommended PEL.) What inference is the employer supposed to make about the magnitude or effect of current exposures under these circumstances? Indeed, to make sense of the issue, the employer would have to know about the worker's prior silica exposures, quite often at different workplaces. But the employer and, quite likely, even the worker are unlikely to have high quality data on exposures to silica that occurred decades ago. In the absence of such information, it is unclear how an employer can properly interpret current exposures as causing silicosis. By contrast, the best information on current exposures derives from current exposure monitoring, and the notion that documenting silicosis can somehow provide useful information about current exposures above and beyond what proper exposure monitoring is ill-conceived (Document ID 4214, p. 8).

Similarly, Peg Seminario, Director of Safety and Health with AFL-CIO, testified that employers should be basing their decisions on exposure levels and how well controls are working (Document ID 3578, Tr. 1008). NAHB and CISC questioned how an employer should respond if an employee has signs of lung disease and the employer has already implemented engineering controls and respirator use (Document ID 2296, p. 31; 2319, p. 117).

OSHA agrees that because of the long latency period of most respirable crystalline silica-related diseases, a diagnosis of such an illness in an employee will not provide useful information about current controls or exposure conditions. Employers should be basing their actions on exposure assessments and ensuring properly functioning controls, such as those listed and required for employers using Table 1. In the case where an employee may have disease related to respirable crystalline silica and the employer has properly implemented engineering controls, the only further action by the employer would be to follow PLHCP recommendations to protect the worker who may be especially sensitive to continuing exposure and need special accommodations. Such recommendations could include limitations on respirator use; they might also include specialist referral or limitations on respirable crystalline silica exposure (if the employee gives authorization for the employer to receive this information) (paragraph (i)(6)(i)(C) or (ii)(A) and (B) of the standard for general industry and maritime and paragraph (h)(6)(i)(C) or (ii)(A) and (B) of the standard for construction).

In taking a more consent-based approach than in the proposed rule regarding the PLHCP's written medical opinion for the employer, OSHA considered the countervailing factor that employers will not be able to report occupational illnesses to OSHA if they are not given medical surveillance information. USW refuted the utility of employer reporting of workplace illnesses, stating:

> However, this loss is minor, because few believe that such employer-generated reporting of chronic occupational conditions does, or even could, under the best of circumstances, provide proper counts of occupational illnesses (Document ID 4214, p. 8).

On a similar note, Fann Contracting and ASSE requested clarification on what information would be reportable or recordable (Document ID 2116, Attachment 1, p. 20; 2339, p. 9).

This rule does not change OSHA reporting or recording requirements, and employers who need more information on recording or reporting of occupational illnesses should refer to OSHA's standard on recording and reporting occupational injuries and illnesses (29 CFR 1904). OSHA finds that if employees do not participate in medical surveillance because of discrimination or retaliation fears, illnesses associated with respirable crystalline silica would generally not be identified. Although not disclosing medical information to employers appears inconsistent with the objective of recording illnesses, the net effect of that decision is improving employee protections due to more employees participating in medical surveillance. Also, as noted above, OSHA never intended for employers to get specific information, such as diagnoses, and this would further limit employers' ability to report disease. Although state surveillance systems are likely to underestimate silicosis cases (see Section V, Health Effects), they are still likely to be a better way to get information on trends of silicosis cases than employer reports.

Reporting of silicosis cases by health care providers is required by 25 states (see http://www.cste2.org/izenda/ReportViewer.aspx?rn=Condition+All&p1value=2010&p2value=Silicosis). PLHCPs are more likely to have the information needed to report silicosis cases to state health authorities than employers. Thus, OSHA concludes that exclusion of health-related information from the PLHCP's written medical opinion for the employer will not have a significant impact on silicosis surveillance efforts.

An additional consideration relating to what information, if any, goes to the employer is that withholding information, such as conditions that might place an employee at risk of health impairment with further exposure, may leave employers with no medical basis to aid in the placement of employees. Although NSSGA did not want to receive confidential medical records, it stressed the importance of continuing to receive information concerning how the workplace could affect an employee's condition and on recommended respirator restrictions (Document ID 3583, Tr. 2315-2316; 4026, p. 5). NISA stated that employers should receive the results of medical surveillance because employers might be held liable if employees choose to keep working in settings that might aggravate their illnesses (Document ID 4208, p. 14). However, labor unions, such as USW, BAC, and BCTD, strongly opposed employers making job placement decisions based on employees' medical findings (Document ID 4214, pp. 7-8; 4219, pp. 31-32; 4223, p. 133). USW and BCTD noted that as long as employees are capable of performing their work duties, decisions to continue working should be theirs; BCTD further noted that the employee should make such decisions with guidance from the PLHCP, and USW noted that the employee should decide because of the significance of job loss or modifications (Document ID 2371, Attachment 1, pp. 45-46; 4214, pp. 7-8). Sarah Coyne agreed that employees should make decisions about placement. Ms. Coyne stated, "I might have silicosis. I might have asbestosis. I know if I can work or not. Let me decide" (Document ID 3581, Tr. 1656).

OSHA agrees that employees have the most at stake in terms of their health and employability, and they should not have to choose between continued employment and the health benefits offered by medical surveillance, which they are entitled to under the OSH Act. OSHA agrees that employees should make employment decisions, following discussions with the PLHCP that include the risks of continued exposure. Before that can happen, however, employees need to have confidence that participation in medical surveillance will not threaten their livelihoods. After considering the various viewpoints expressed during the rulemaking on these issues, OSHA concludes that the best way to maximize employee participation in medical surveillance, therefore promoting the protective and preventative purposes of this rule, is by limiting required disclosures of information to the employer to only the bare minimum of what the employer needs to know to protect employee health—recommended restrictions on respirator use and, only with consent of the employee, the PLHCP's recommended limitations on exposure to respirable crystalline silica and specialist referrals. Thus, OSHA views this consent-based approach to reporting of medical surveillance findings critical to the ultimate success of this provision, which will be measured not just in the participation rate, but in the benefits to participating employees—early detection of silica-related disease so that employees can make employment, lifestyle, and medical decisions to mitigate adverse health effects and to possibly retard progression of the disease.

Expressing a different view, CISC stated that OSHA lacks the legal authority to require employers to pay for ongoing medical surveillance with no nexus to the workplace (Document ID 4217, p. 24). However, the medical surveillance requirement in this rule, and every OSHA rule, does have a nexus to the workplace. In the case of the respirable crystalline silica rule, the nexus to the workplace is that exposure in the workplace can result in or exacerbate disease and that medical surveillance information will allow employees to make health and lifestyle decisions that will benefit both them and the employer. In addition, medical surveillance provides the employer with information on fitness to wear a respirator, which is vitally important because of risks to employees who wear a respirator when they should not do so because of medical reasons.

NISA supported providing the proposed medical opinion to employers, partly because some employers might have a better understanding of medical surveillance results than employees, who might not have the training or understanding to make health-protective decisions based on those results (Document ID 4208, pp. 13-14). OSHA recognizes that larger companies that employ health, safety, and medical personnel may have in-house expertise to answer employee questions and stress the importance of protective measures, such as work practices or proper use of respirators. However, it is not likely that owners or management of small companies would have a better understanding than their employees or would be able to provide them any additional guidance. Consequently, OSHA does not find the fact some employers might have a better understanding of medical surveillance results than employees to be a compelling argument against limiting the information that is to be reported to the employer in the absence of employee consent. In addition, OSHA expects that the training required under the rule will give employees knowledge to understand protective measures recommended by the PLHCP.

In sum, OSHA concludes that the record offers compelling evidence for modifying the proposed content of the PLHCP's written medical opinion for the employer. The evidence includes privacy concerns expressed by both employees and employers, as well as evidence on the limited utility for giving medical surveillance findings to employers. OSHA is particularly concerned that the proposed requirements would have led to many employees not participating in medical surveillance and therefore not receiving its benefits. OSHA therefore has limited the information to be given to the employer under this rule, but is requiring that the employee receive a separate written medical report with more detailed medical information.

The requirements for the type of information provided to the employer are different from requirements of other OSHA standards, which remain in effect for those other standards. The requirements for this rule are based on the evidence obtained during this rulemaking for respirable crystalline silica, in particular that many employees would not take advantage of medical surveillance without privacy protections and because the findings of medical examinations would not likely reflect current workplace conditions in most cases. The action taken in this rulemaking does not preclude OSHA from adopting its traditional approach, or any other approach for reporting of medical findings to employers, in the future when it concludes, based on health effects information, that such an approach would contribute information that is relevant to current workplace conditions and would allow for design or implementation of controls to protect other employees.

PLHCP's written medical report for the employee. OSHA did not propose a separate report given directly by the PLHCP to the employee, but as discussed in detail above, several commenters requested that a report containing medical information only be given to the employee. OSHA agrees and in response to those comments, paragraph (i)(5) of the standard for general industry and maritime (paragraph (h)(5) of the standard for construction) requires the employer to ensure that the PLHCP explains the results of the medical examination and provides the employee with a written medical report within 30 days.

The contents of the PLHCP's written medical report for the employee are set forth in paragraphs (i)(5)(i)-(iv) of the standard for general industry and maritime (paragraphs (h)(5)(i)-(iv) of the standard for construction). They include: the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment of health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment; any recommended limitations on the employee's use of respirators; any recommended limitations on respirable crystalline silica exposure; and a statement that the employee should be examined by a specialist if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B reader, or if referral to a specialist is deemed appropriate by the PLHCP. Appendix B contains an example of a PLHCP's written medical report for the employee.

The health-related information in the PLHCP's written medical report for the employee is generally consistent with the proposed PLHCP's written medical opinion for the employer, with two notable exceptions. Because only the employee will be receiving the PLHCP's written medical report, the written medical report may include diagnoses and specific information on health conditions, including those not related to respirable crystalline silica, and medical conditions that require further evaluation or follow-up are not limited to those related to respirable crystalline silica exposure. Although the focus of the examination is on silica-related conditions, the PLHCP may happen to detect health conditions that are not related to respirable crystalline silica exposure during the examination, and could include information about such conditions in the written medical report for the employee. The employer, however, is not responsible for further evaluation of conditions not related to respirable crystalline silica exposure. A minor difference from the proposed written medical opinion for the employer and the written medical report for the employee in the rule is that it specifies limitations on respirator use rather than PPE because respirators are the only type of PPE required by the rule. The requirements for the PLHCP's written medical report for the employee are consistent with the overall goals of medical surveillance: to identify respirable crystalline silica-related adverse health effects so that the employee can consider appropriate steps to manage his or her health; to let the employee know if he or she can be exposed to respirable crystalline silica in his or her workplace without increased risk of experiencing adverse health effects; and to determine the employee's fitness to use respirators. By providing the PLHCP's written medical report to employees, those who might be at increased risk of health impairment from respirable crystalline silica exposure will be able to consider interventions (i.e., health management strategies) with guidance from the PLHCP. Dr. Laura Welch testified that her recommendations to a patient diagnosed with silicosis would include employment choices to limit exposures, using a respirator for additional protection, quitting smoking, and getting influenza and pneumonia vaccines (Document ID 3581, p. 1663).

The requirement for a verbal explanation in paragraph (i)(5) of the standard for general industry and maritime (paragraph (h)(5) of the standard for construction) allows the employee to confidentially ask questions or discuss concerns with the PLHCP. The requirement for a written medical report ensures that the employee receives a record of all findings. As noted by BCTD, giving the employee the written report will ensure the employee understands medical conditions that require follow-up and could affect decisions of where and how to work; BCTD also noted that employees would be able to provide the PLHCP's written medical report to future health care providers (Document ID 2371, Attachment 1, p. 48); this would include PLHCPs conducting subsequent periodic examinations under the rule.

PLHCP's written medical opinion for the employer. As discussed in detail above, many commenters objected to OSHA's proposed content for the PLHCP's written medical opinion for the employer based on employee privacy concerns. OSHA agrees with these privacy concerns and is thus revising the contents of the written medical opinion. In developing the contents of the PLHCP's written medical opinion for the employer, OSHA considered what type of information needs to be included to provide employers with information to protect employee health, while at the same time protecting employee privacy. Commenters representing labor unions and the medical community stated that the only information that employers need to know is limitations on respirator use (Document ID 2178, Attachment 1, p. 5; 2240, pp. 3-4; 2282, Attachment 3, p. 21; 2336, p. 12; 3589, Tr. 4207; 4196, p. 6; 4203, p. 6; 4204, p. 89; 4219, pp. 31-32; 4223, p. 133). Dr. Laura Welch stated that giving the employer information on an employee's ability to use a respirator, but not specific medical information, strikes the appropriate balance between the employee's privacy and the employer's right to know; she noted that employees who are not fit to wear a respirator and then do can be at risk of sudden incapacitation or death (Document ID 3581, Tr. 1582, 1662).

BCTD further noted that the medical surveillance model it is recommending for respirable crystalline silica presents a different circumstance than what it advocated for regarding asbestos in Industrial Union Department, AFL-CIO v. Hodgson. There, the union was not granted its request for results of medical examinations to be given to the employer only with the employees' consent under the asbestos standard. The court ruled that employers needed the medical results because the asbestos standard requires employers to reassign employees without loss of pay or seniority if the employee was found unable to safely wear a respirator. For respirable crystalline silica, BCTD has concluded that providing employers with information regarding limitations on respirator use and nothing else that is medically related is reasonable if the employee is not requesting accommodations or additional examinations from the employer (Document ID 4223, pp. 134-135).

Based on record evidence, OSHA has determined that for the respirable crystalline silica rule, the PLHCP's written medical opinion for the employer must contain only the date of the examination, a statement that the examination has met the requirements of this section, and any recommended limitations on the employee's use of respirators. These requirements are laid out in paragraphs (i)(6)(i)(A)-(C) of the standard for general industry and maritime (paragraphs (h)(6)(i)(A)-(C) of the standard for construction). OSHA is persuaded by arguments to include limitations on respirator use, and no other medically-related information, in the PLHCP's written medical opinion for the employer. The Agency notes that the limitation on respirator use is consistent with information provided to the employer under the respiratory protection standard (29 CFR 1910.134). OSHA concludes that only providing information on respirator limitations in the PLHCP's written medical opinion for the employer is consistent with the ACOEM confidentiality guidelines that recommend reporting of health and safety concerns to the employer (Document ID 3622, p. 2). The date and statement about the examination meeting the requirements of this section are to provide both the employer and employee with evidence that requirements for medical surveillance are current. Employees would be able to show this opinion to future employers to demonstrate that they have received the medical examination, as was recommended by LHSFNA and BCTD **(**Document ID 4207, p. 5; 4223, p. 125).

Paragraphs (i)(6)(ii)(A)-(B) of the standard for general industry and maritime (paragraphs (h)(6)(ii)(A)-(B) of the standard for construction) state that if the employee provides written authorization, the written medical opinion for the employer must also contain either or both of the following: (1) any recommended limitations on exposure to respirable crystalline silica; (2) a statement that the employee should be examined by a specialist if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP. OSHA intends for this provision to allow the employee to give authorization for the PLHCP's written medical opinion for the employer to contain only the recommendation on exposure limitations, only the recommendation for specialist referral, or both recommendations. The Agency expects that the written authorization could easily be accomplished through the use of a form that allows the employee to check, initial, or otherwise indicate which (if any) of these items the employee wishes to be included in the PLHCP's written medical opinion for the employer. An example of an authorization form is included in Appendix B.

OSHA is convinced that routinely including recommended limitations on respirable crystalline silica exposure and specialist referrals in the PLHCP's written medical opinion for the employer could adversely affect employees' willingness to participate in medical surveillance. The requirements for this paragraph are consistent with recommendations from labor unions. For example, UAW, BAC, and BCTD suggested letting the employee decide to forward the recommendation for an examination by a specialist if the employee wanted the employer to cover the costs of that examination (Document ID 3582, Tr. 1909; 4219, p. 32; 4223, pp. 133-134). BAC and BCTD also stated the employee should decide whether recommended accommodations (i.e., recommended limitations on exposure) should be reported to the employer. As both BAC and BCTD emphasized, information given to the employer should only indicate that a referral is recommended and the nature of the limitation on exposure, not an underlying diagnosis. OSHA considers this reasonable. Appendix B contains an example of a PLHCP's written medical opinion for the employer.

OSHA finds that this new format for the PLHCP's medical opinion for respirable crystalline silica will better address concerns of NAHB and Dow Chemical, who feared they would be in violation if the PLHCP's written medical opinion for the employer included information that OSHA proposed the PLHCP not report to the employer, such as an unrelated diagnosis (Document ID 2270, p. 4; 2296, pp. 31-32). OSHA finds that removing the prohibition on unrelated diagnoses and instead specifying the only information that is to be included in the PLHCP's written medical opinion for the employer remedies this concern because it makes the contents of the opinion easier to understand and less subject to misinterpretation. The new format also addresses NAHB's request that PLHCPs' opinions be standardized so that employers could understand the results (Document ID 2296, pp. 31-32).

OSHA recognizes that some employees might be exposed to multiple OSHA-regulated substances at levels that trigger medical surveillance and requirements for written opinions. The PLHCP can opt to prepare one written medical opinion for the employer for each employee that addresses the requirements of all relevant standards, as noted in preambles for past rulemakings, such as chromium (VI) (71 FR 10100, 10365 (2/28/06)). However, the combined written medical opinion for the employer must include the information required under each relevant OSHA standard. For example, if the PLHCP opts to combine written medical opinions for an employee exposed to both chromium (VI) and respirable crystalline silica in a workplace covered by construction standards, then the combined opinion to the employer must contain the information required by paragraphs (i)(5)(A)-(C) of the chromium (VI) standard for construction (29 CFR 1926.1126) and the information required by paragraphs (h)(6)(i)(A)-(C) (and paragraphs (h)(6)(ii)(A)-(B), with written authorization from the employee) of the respirable crystalline silica standard for construction.

Other commenter recommendations for information to be included in the PLHCP's written medical opinion for the employer were not adopted by OSHA. Collegium Ramazzini and BCTD requested that the PLHCP's written medical opinion for the employer contain a statement that the employee was informed that respirable crystalline silica increases the risk of lung cancer, and Collegium Ramazzini also requested that the opinion indicate that the employee was told that smoking can compound the risk of developing lung cancer with exposure to respirable crystalline silica (Document ID 3541, p. 14; 4223, p. 137). On a similar note, Collegium Ramazzini also requested that employers establish smoking cessation programs (Document ID 3541, p. 4). OSHA notes that training provisions in paragraph (j)(3)(i)(A) of the standard for general industry and maritime (paragraph (i)(2)(i)(A) of the standard for construction) already require employers to ensure that each employee can demonstrate knowledge of the health hazards associated with exposure to respirable crystalline silica, which include lung cancer. OSHA concludes that the training required under the respirable crystalline silica rule is sufficient to inform employees about lung cancer risk.

Labor unions including UAW, CWA, USW, AFL-CIO, and BCTD requested that the rule prohibit employers from asking employees or the PLHCP for medical information (Document ID 2282, Attachment 3, p. 21; 2240, pp. 3-4; 2336, p. 12; 4204, p. 90; 4223, p. 134); as most of these commenters noted, a similar prohibition is included in the black lung rule for coal miners (30 CFR 90.3). OSHA is not including such a prohibition in the rule because employers may have legitimate reasons for requesting medical information, such as X-ray findings, to conduct epidemiology studies, and if employees are not concerned about discrimination or retaliation, they could authorize the employer to receive such information.

The proposed written medical opinion for the employer called for a statement that the PLHCP had explained to the employee the results of the medical examination, including findings of any medical conditions related to respirable crystalline silica exposure that require further evaluation or treatment, and any recommendations related to use of protective clothing or equipment. As noted above, OSHA has retained the requirement that the employer ensure that the PLHCP explains the results to the employee in paragraph (i)(5) of the standard for general industry and maritime (paragraph (h)(5) of the standard for construction), but no longer requires the PLHCP to include a statement of this fact in the written medical opinion for the employer. OSHA is not mandating how the employer ensures that the employee gets the required information because there are various ways this could be done, such as in a contractual agreement between the employer and PLHCP. PLHCPs could still include the verification in the PLHCP's written medical opinion for the employer if that is a convenient method for them to do so.

Paragraph (i)(6)(iii) of the standard for general industry and maritime (paragraph (h)(6)(iii) of the standard for construction) requires the employer to ensure that employees receive a copy of the PLHCP's written medical opinion for the employer within 30 days of each medical examination performed. OSHA is requiring that employees receive a copy of the PLHCP's written medical opinion for the employer because they can present it as proof of a current medical examination to future employers. This is especially important in industries with high turnover because employees may work for more than one employer during a three-year period and this ensures that tests, such as X-rays, are not performed more frequently than required.

As indicated above, the rule requires that employers ensure that employees get a copy of the PLHCP's written medical report and opinion and that they get a copy of the PLHCP's opinion within 30 days of each medical examination (paragraphs (i)(5), (6)(i), and (6)(iii) of the standard for general industry and maritime, paragraphs (h)(5), (6)(i), and (6)(iii) of the standard for construction). By contrast, the proposed rule would have required that the employer obtain the PLHCP's written medical opinion within 30 days of the medical examination and then provide a copy to the employee within 2 weeks after receiving it. Dow Chemical expressed concern about compliance if a PLHCP took more than 30 days to deliver the PLHCP's written medical opinion, which is a situation that is out of the employer's control (Document ID 2270, p. 4). Ameren and EEI requested 30 days for the employer to give the employee a copy of the PLHCP's written medical opinion (Document ID 2315, p. 4; 2357, p. 35).

The purpose of these requirements is to ensure that the employee and employer are informed in a timely manner. To ensure timely delivery and demonstrate a good faith effort in meeting the requirements of the standard, the employer could inform PLHCPs about the time requirements and follow-up with PLHCPs if there is concern about timely delivery of these documents. Similar 30-day requirements are included in other OSHA standards, such as chromium (VI) (1910.1026) and methylene chloride (1910.1052). Because the PLHCP will be providing the employee with a copy of the PLHCP's written medical report, he or she could give the employee a copy of the written medical opinion at the same time. This would eliminate the need for the employer to give the employee a copy of the PLHCP's written medical opinion for the employer, but the employer would still need to ensure timely delivery.

Additional examinations with a specialist. Paragraph (i)(7)(i) of the standard for general industry and maritime (paragraph (h)(7)(i) of the standard for construction) requires that the employer make available a medical examination by a specialist within 30 days of receiving the written medical opinion in which the PLHCP recommends that the employee be examined by a specialist. As is the case with the PLHCP's examination, the employer is responsible for providing the employee with a medical examination by a specialist, at no cost, and at a reasonable time and place, if the employer receives a PLHCP's referral recommendation.

OSHA proposed referral to a specialist under two circumstances: (1) where a B reader classifies an employee's chest X-ray as 1/0 or higher and (2) where the PLHCP determines referral is otherwise appropriate. The first trigger point for specialist referral relates to the interpretation and classification of the chest X-ray employees receive as part of their initial or periodic medical examination. The second trigger point empowers the PLHCP to refer the employee to a specialist for any other appropriate reason. After considering the comments on the proposed rule (discussed below), OSHA retained the triggers for referral in Paragraphs (i)(5)(iv) and (i)(6)(ii)(B) of the standard for general industry and maritime (paragraphs (h)(5)(iv) and (h)(6)(ii)(B) of the standard for construction).

As discussed above, paragraph (i)(2)(iii) of the standard for general industry and maritime (paragraph (h)(2)(iii) of the standard for construction) requires that X-rays be interpreted according to the ILO classification system. The ILO's system is a standardized manner of classifying opacities seen in chest radiographs. It describes the presence and severity of pneumoconiosis on the basis of size, shape, and profusion (concentration) of small opacities, which together indicate the severity and extent of lung involvement (Document ID 1475). The profusion of opacities seen on chest radiographs is compared to standard X-rays and classified on a 4-point category scale (0, 1, 2, or 3), with each category representing increasing profusion of small opacities. Each category is divided into two subcategories, giving a 12-subcategory scale between 0/- and 3/+. The first subcategory value represents the B Reader's first choice for profusion rating and the second subcategory value represents the B Reader's second choice for profusion rating. CDC/NIOSH considers a category 1/0 X-ray to be consistent with silicosis (Document ID 1711, p. 41).

The respirable crystalline silica rule’s 1/0 category trigger point for referral is lower than in the ASTM standards, which recommend that employees with profusion opacities greater than 1/1 be evaluated at a frequency determined by a physician qualified in pulmonary disease (Section 4.7.1 of E 1132 – 06 and E 2625 – 09) and receive annual counseling by a physician or other person knowledgeable in occupational safety and health (Section 4.7.2 of E 1132 – 06 and E 2625 – 09) (Document ID 1466, p. 5; 1504, p. 5). CISC questioned what medical evidence OSHA had that a specialist is necessary at this stage and stated that OSHA did not explain why it deviated from the ASTM standard (Document ID 2319, p. 120). However, ACOEM agreed with a cut-off point of 1/0 for abnormality, and ATS agreed with specialist referral at a category of 1/0 (Document ID 2080, p. 7; 2175, p. 6).

Other evidence in the record also weighs in favor of referral where an employee’s X-ray is classified as 1/0 or higher. For example, a study by Hnizdo et al. (1993) compared X-rays read by B Readers to autopsy findings and demonstrated that a classification of 1/0 is highly specific for radiological silicosis, with 89 percent of 1/0 readings of radiological silicosis found to be true positives (Document ID 1050, pp. 427, 440). Based on the high level of specificity for 1/0 readings, i.e., the low probability of a false positive reading, OSHA concludes it is appropriate to address silicosis at that stage to allow for earlier intervention to possibly slow disease progression and improve health. Therefore, based on the evidence in the record, OSHA decided to retain the 1/0 or higher trigger point for referral to a specialist.

OSHA also decided to retain the second referral trigger point contained in the proposed rule: referral to a specialist if otherwise deemed appropriate by the PLHCP. Such referrals based on a PLHCP's written medical opinion for the employer allow potential findings of concern to be investigated further. Together, the two triggers for specialist referral in this rule are intended to ensure that employees with abnormal findings can be given the opportunity to be seen by an American Board Certified Specialist with expertise in pulmonary disease or occupational medicine, who can provide not only expert medical judgment, but also counseling regarding work practices and personal habits that could affect these individuals' respiratory health.

As indicated above, the employee must provide written authorization before the PLHCP's written medical opinion for the employer may include a recommendation for specialist examination (paragraph (i)(6)(ii)(B) of the standard for general industry and maritime, paragraph (h)(6)(ii)(B) of the standard for construction). If the employer's opinion contains a recommendation for specialist referral, then paragraph (i)(7)(i) of the standard for general industry and maritime (paragraph (h)(7)(i) of the standard for construction) requires the employer to make available a medical examination by a specialist within 30 days after receiving the PLHCP's written medical opinion. If the employer does not receive the PLHCP's referral because the employee did not authorize the employer to receive it, then the employer is not responsible for offering additional examinations and covering their costs.

Although the criteria for referral, i.e., X-ray classification or PLHCP's opinion that a referral is appropriate, have not changed since the proposed rule, the professional to whom the employee would be referred has changed. Specifically, the proposed rule would have required the employer to provide the referred employee with a medical examination with a pulmonary disease specialist. As discussed further in the summary and explanation of Definitions, OSHA agreed with a number of commenters that an occupational medicine specialist is qualified to examine employees referred for a possible respirable crystalline silica-related disease (Document ID 2215, p. 9; 2291, p. 26; 2348, Attachment 1, p. 40; 3577, Tr. 778; 4223, p. 129). Therefore, the Agency has added the term "specialist" to the definitions in paragraph (b) of the rule and defined the term to mean an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine. Paragraphs (i)(5)(iv) and (i)(6)(ii)(B) of the standard for general industry and maritime (paragraphs (h)(5)(iv) and (h)(6)(ii)(B) of the standard for construction) were also revised to specify referral to a "specialist."

Paragraph (i)(7)(i) of the standard for general industry and maritime (paragraph (h)(7)(i) of the standard for construction) sets time limits for additional examinations to be made available. Specifically, it requires that the employer make available a medical examination by a specialist within 30 days of receiving a written medical opinion in which the PLHCP recommends that the employee be examined by a specialist. This requirement is unchanged from the proposed rule. Some commenters, including Dow Chemical, Ameren, and EEI, commented that it might take more than 30 days to get an appointment with a specialist (e.g., Document ID 2270, p. 5; 2315, p. 4; 2357, p. 36). OSHA does not expect this will be the case based on the numbers of available specialists in the U.S. As of March 10, 2015, the American Board of Internal Medicine (ABIM) reported that 13,715 physicians in the U.S. had valid certificates in pulmonary disease (see http://www.abim.org/pdf/data-candidates-certified/all-candidates.pdf). ABIM does not report how many of these physicians are practicing. However, ABIM does report that more than 400 new certificates in pulmonary disease were issued per year from 2011 to 2014 and a total of 4,378 new certificates in pulmonary disease were issued in the period from 2001 to 2010 (see http://www.abim.org/pdf/data-candidates-certified/Number-Certified-Annually.pdf). Because physicians are likely to practice for some time after receiving their certification, the numbers indicate that a substantial number of pulmonary disease specialists are available in the U.S. The American Board of Preventative Medicine reports that between 2001 and 2010, 863 physicians passed their examinations for board certification in occupational medicine (see https://www.theabpm.org/pass_rates.cfm). In a comparison with total numbers of physicians who were board certified in pulmonary disease during 2001 to 2010, the addition of board certified occupational medicine physicians will likely increase specialist numbers by approximately 20 percent. The expansion of the specialist definition to board certified occupational medicine physicians will mean that more physicians will be available for referrals, making appointments easier to get. Consequently, OSHA considers the 30-day period to be reasonable, and expects that this deadline will ensure that employees receive timely examinations.

Under paragraph (i)(7)(ii) of the standard for general industry and maritime (paragraph (h)(7)(ii) of the standard for construction), the employer must provide the specialist with the same information that is provided to the PLHCP (i.e., a copy of the standard; a description of the employee's former, current, and anticipated duties as they relate to respirable crystalline silica exposure; the employee's former, current, and anticipated exposure level; a description of any PPE used, or to be used, by the employee, including when and for how long the employee has used or will use that equipment; and information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer). The information the employer is required to give the specialist is largely unchanged from the proposed rule. The few changes and the reasons why the specialist should receive this information are the same as those for the PLHCP and are addressed above.

Under paragraph (i)(7)(iii) of the standard for general industry and maritime (paragraph (h)(7)(iii) of the standard for construction), the employer must ensure that the specialist explains medical findings to the employee and gives the employee a written medical report containing results of the examination, including conditions that might increase the employee’s risk from exposure to respirable crystalline silica, conditions requiring further follow-up, recommended limitations on respirator use, and recommended limitations on respirable crystalline silica exposure. The reasons why the specialist is to give the employee this information and the changes from the proposed rule are discussed above, under the requirements for the PLHCP’s written medical report for the employee. For the same reasons as addressed above, paragraph (i)(7)(iv) of the standard for general industry and maritime (paragraph (h)(7)(iv) of the standard for construction) requires the specialist to provide the employer with a written medical opinion indicating the date of the examination, any recommended limitations on the employee’s use of respirators, and with the written authorization of the employee, any recommended limitations on the employee’s exposure to respirable crystalline silica.

The rule does not address further communication between the specialist and the referring PHLCP. OSHA expects that because the PLHCP has the primary relationship with the employer and employee, the specialist may want to communicate his or her findings to the PLHCP and have the PLHCP simply update the original written medical report for the employee and written medical opinion for the employer and employee. This is permitted under the rule, so long as all requirements and time deadlines are met.

Medical removal protection. Some OSHA standards contain provisions for medical removal protection (MRP) that typically require the employer to temporarily remove an employee from exposure when such an action is recommended in a written medical opinion. During the time of removal, the employer is required to maintain the employee's total normal earnings, as well as all other employee rights and benefits. MRP provisions vary among health standards, depending on the hazard, the adverse health effects, medical surveillance requirements, and the evidence presented during the particular rulemaking. Although virtually every previous OSHA substance-specific health standard includes provisions for medical surveillance, OSHA has found MRP necessary for only six of those standards. They are lead (1910.1025), cadmium (1910.1027), benzene (1910.1028), formaldehyde (1910.1048), methylenedianiline (1910.1050), and methylene chloride (1910.1052).

OSHA did not include a provision for MRP in the proposed rule because the Agency preliminarily concluded that there would be few instances where temporary removal and MRP would be useful. However, OSHA asked for comment on whether the rule should include an MRP provision, which medical conditions or findings should trigger temporary removal, and what should be the maximum period for receiving benefits (78 FR at 56291).

Labor groups, industry representatives, the medical community, and other employee health advocates offered comments on this issue. NIOSH, ASSE, and some employers and industry groups agreed with OSHA's preliminary findings that MRP or temporary removal from exposure is not appropriate for the respirable crystalline silica rule (e.g., Document ID 2116, Attachment 1, pp. 44-45; 2177, Attachment B, p. 39; 2195, p. 44; 2319, p. 129; 2327, Attachment 1, p. 27; 2339, p. 10; 2357, p. 35; 2379, Appendix 1, p. 72). Among the reasons noted were an inability to relocate employees to different positions, interference with workers' compensation systems, or the permanent nature of silica-related health effects.

CWA, UAW, USW, and AFL-CIO advocated for the inclusion of MRP (in the general industry and maritime standard) with provisions for multiple physician review, similar to MRP in cadmium (Document ID 2240, p. 4; 2282, Attachment 3, pp. 23-24; 3584, Tr. 2541-2546; 4204, pp. 91-98). None of the labor groups requested an MRP provision for the construction standard. According to Collegium Ramazzini and AFL-CIO, benefits of MRP include: encouraging employees to participate in medical surveillance and allowing for transfer when an employee is unable to wear a respirator (e.g., cadmium, asbestos, cotton dust); they further indicated that MRP is appropriate for the respirable crystalline silica rule because it can be applied when employees are referred to a specialist (e.g., benzene) and it is not limited to permanent conditions in other OSHA standards. AFL-CIO further commented that MRP gives employers time to find other positions involving lower exposures for at-risk workers, and indicated that it is widely supported by physicians (Document ID 3541, pp. 16-17; 4204, pp. 94-97). Physicians representing employee health advocate or public health groups testified or commented that removal from exposure can prevent or slow progression of silicosis or benefit employees during short-term periods of COPD exacerbation, which can be further exacerbated with continued exposure to respirable crystalline silica (Document ID 2244, p. 4; 3577, Tr. 830-832; 3541, p. 16).

OSHA did not propose MRP for respirable crystalline silica because the adverse health effects associated with respirable crystalline silica exposure (e.g., silicosis) are chronic conditions that are not remedied by temporary removal from exposure. In contrast, removal under the cadmium standard (29 CFR 1910.1027) could allow for biological monitoring results to return to acceptable levels or for improvement in the employee's health. The evidence submitted during the rulemaking has led OSHA to conclude that its preliminary reasoning was correct and that for the reasons discussed below, there will be few instances where temporary removal from respirable crystalline silica exposures would improve employee health.

OSHA has declined to adopt MRP provisions in other health standards under similar circumstances. For example, in its chromium (VI) standard, OSHA did not include an MRP provision because chromium (VI)-related health effects are either chronic conditions that will not be improved by temporary removal from exposure (e.g., lung cancer, respiratory or dermal sensitization), or they are conditions that can be addressed through proper application of control measures (e.g., irritant dermatitis) (71 FR at 10366). OSHA did not include MRP provisions in the ethylene oxide (EtO) standard, concluding that,

> . . . the effects of exposure to EtO are not highly reversible, as evidenced by the persistence of chromosomal aberrations after the cessation of exposure, and the record contains insufficient evidence to indicate that temporary removal would provide long-term employee health benefits (49 FR 29734, 25788 (6/22/1984)).

Similarly, the 1,3-butadiene standard, which primarily addresses irreversible effects, such as cancer, does not include MRP provisions (61 FR 56746 (11/4/96)).

OSHA recognizes that some employees might benefit from removal from respirable crystalline silica exposure to possibly prevent further progression of disease. However, the health effects evidence suggests that crystalline silica-related diseases are permanent (Document ID 2177, Attachment B, p. 39). Thus, to be beneficial, any such removals would have to be permanent, not temporary. Even in cases where employees might benefit from temporary removal, such as to alleviate exacerbation of COPD symptoms, COPD itself is not reversible. In response to commenters indicating that temporary removal might alleviate COPD symptoms, OSHA anticipates that periods of exacerbation will continue to recur absent permanent removal from respirable crystalline silica exposure. OSHA views MRP as a tool for dealing with temporary removals only, as reflected in the Agency's decisions not to adopt MRP in the chromium (VI), ethylene oxide, and 1,3-butadiene standards. Workers' compensation is the appropriate remedy when permanent removal from exposure is required.

When the D.C. Circuit Court reviewed OSHA's initial decision not to include MRP in its formaldehyde standard, it remanded the case for OSHA to consider the appropriateness of MRP for permanently removed employees (see UAW v. Pendergrass, 878 F.2d 389, 400 (D.C. Cir. 1989)). OSHA ultimately decided to adopt an MRP provision for formaldehyde. However, as discussed below, the Agency did not rely on a need to protect employees permanently unable to return to their jobs. Indeed, OSHA expressly rejected that rationale for MRP, noting that ''[t]he MRP provisions [were] not designed to cover employees . . . determined to be permanently sensitized to formaldehyde'' (57 FR 22290, 22295 (5/27/92)). An important objective of MRP is to prevent permanent health effects from developing by facilitating employee removal from exposure at a point when the effects are reversible, and that objective cannot be met where the effects are already permanent.

Given that MRP benefits apply only to a temporary period, it is logical that eligibility be limited to employees with a temporary need for removal, as has been done in a number of standards, such as cadmium (1910.1027(l)(12)), benzene (1910.1028(i)(9)) and methylene chloride (1910.1052(j)(12)). Temporary wage and benefit protections may address the concerns of employees who fear temporary removal, but employees who fear permanent removal are unlikely to be persuaded by a few months of protection. The evidence in the record does not demonstrate that affected employees are unlikely to participate in medical surveillance absent wage and benefit protection. In contrast, extensive evidence in the record demonstrates that lack of confidentiality regarding medical findings would more likely lead to employees refusing medical examinations (e.g., Document ID 3577, Tr. 819-820; 3579, Tr. 169; 3581, Tr. 1657; 3585, Tr. 3053-3054); OSHA has remedied that situation by strengthening confidentially requirements for medical examinations.

A major reason for inclusion of MRP in the formaldehyde standard is that medical surveillance depends on employee actions. The formaldehyde standard does not have a medical examination trigger, such as an action level, but instead relies on annual medical questionnaires and employee reports of signs and symptoms. Thus, the approach is completely dependent on employee cooperation (57 FR at 22293). Unlike the formaldehyde standard, respirable crystalline silica medical surveillance programs for the general industry/maritime and construction standards are not entirely dependent on employee reports of signs and symptoms. The respirable crystalline silica standard for general industry and maritime requires that regular medical examinations be offered to employees exposed at or above the action level for 30 or more days per year, and the construction standard requires that medical examinations be offered to employees required to wear a respirator for 30 or more days a year. Both standards mandate that those examinations include a physical examination, chest X-ray, and spirometry testing. Independent of any subjective symptoms that may or may not be reported by the employee, PLHCPs conducting these examinations can make necessary medical findings based on objective findings from the physical examination, X-ray, and spirometry tests.

Lead is another example of a standard in which medical surveillance findings may be influenced by employee actions. In the lead standard, OSHA adopted an MRP provision in part due to evidence that employees were using chelating agents to achieve a rapid, short-term reduction in blood lead levels because they were desperate to avoid economic loss, despite the possible hazard to their health from the use of chelating agents. In the case of the lead standard, successful periodic monitoring of blood lead levels depends on employees not attempting to alter their blood lead levels (43 FR 54354, 54446 (11/21/78)). Unlike the lead standard, in which blood lead levels are reported to employers, the respirable crystalline silica rule has privacy protections that do not allow information other than limitations on respirator use to be communicated to the employer, in the absence of employee authorization. With the privacy protections, it is unlikely that employees will try and take actions to sabotage medical findings.

Other reasons OSHA has cited for needing to include MRP in its health standards are similarly inapplicable to respirable crystalline silica. In lead, for example, OSHA explained that the new blood lead level removal criteria for the lead standard were much more stringent than criteria being used by industry at that time. Therefore, many more temporary removals would be expected under the new standard, thereby increasing the utility of MRP (43 FR at 54445-54446). There are no criteria in this new rule that are likely to increase the number of medical removals that may be occurring.

OSHA adopted MRP in the lead standard because it ''. . . anticipate[d] that MRP w[ould] hasten the pace by which employers compl[ied] with the new lead standard'' (43 FR at 54450). OSHA reasoned that the greater the degree of noncompliance, the more employees would suffer health effects necessitating temporary medical removal and the more MRP costs the employer would be forced to incur. OSHA thought that MRP would serve as an economic stimulus for employers to protect employees by complying with the standard. With respect to respirable crystalline silica, its disease outcomes (e.g., silicosis, COPD, lung cancer) generally take years to develop. Because of the latency period of most respirable crystalline silica-related diseases, the costs of MRP would not serve as a financial incentive for employers to comply with the requirements of the respirable crystalline silica rule. For example, most current high exposures would not result in adverse health effects until years later and most health effects requiring medical removal likely resulted from exposures that occurred years earlier, and in some cases, before the eligible employee worked for the current employer.

In addition, although OSHA required medical removal in the benzene standard after referral to a specialist (1910.1028 (i)(8)(i)), the circumstances there are also distinguishable from respirable crystalline silica. MRP was required in the benzene standard because some benzene-related blood abnormalities could rapidly progress to serious and potentially life threatening disease, and continued benzene exposure could affect progression (52 FR at 34555). With the exception of acute silicosis, which is rare, silica-related diseases progress slowly over a span of years. Thus, in most cases, there is no urgent need for removal from respirable crystalline silica exposure while awaiting a specialist determination.

OSHA also notes that there are three health standards that provide limited MRP under their requirements for respiratory protection. They are asbestos, (1910.1001(g)(2)(iii)), cotton dust (1910.1043(f)(2)(ii)), and cadmium (29 CFR 1910.1027(l)(ii)). These standards require MRP when a medical determination is made that an employee who is required to wear a respirator is not medically able to wear the respirator and must be transferred to a position with exposures below the PEL, where respiratory protection is not required. OSHA has determined that such a provision is unnecessary for the respirable crystalline silica rule because OSHA has since revised its respiratory protection standard to specifically deal with the problem of employees who are medically unable to wear negative pressure respirators by requiring the employer to provide a powered air-purifying respirator (29 CFR 1910.134(e)(6)). Such an approach has been used by employers who are unable to move employees to jobs with lower exposure (Document ID 3577, p. 610). In this rule, OSHA requires employers to comply with 29 CFR 1910.134, including medical evaluations mandated under that standard.

In summary, OSHA finds MRP to be neither reasonably necessary nor appropriate for the respirable crystalline silica rule. In other health standards, OSHA has stated that the purpose of MRP is to encourage employees to participate in medical surveillance by assuring them that they will not suffer wage or benefit loss if they are temporarily removed from further exposure as a result of findings made in the course of medical surveillance. OSHA's primary reason for not including MRP in the respirable crystalline silica rule is that the Agency does not expect a significant number of employees to benefit from temporary removal from their jobs as a result of medical surveillance findings. In addition, the medical surveillance program in the respirable crystalline silica rule is less dependent on employee action that could influence medical surveillance findings than the programs in some other health standards that include MRP, such as lead and formaldehyde. Other considerations that have led OSHA to use MRP in the past are also not applicable in the context of respirable crystalline silica. OSHA expects that respirable crystalline silica-related health effects would result in very few temporary medical removals, and the evidence demonstrates that any removals that would occur would likely need to be permanent. OSHA concludes that the evidence in the record, relevant court decisions, and the criteria OSHA has previously applied to determine necessity for MRP do not support a finding that MRP is reasonably necessary or appropriate for the respirable crystalline silica rule.

Requests for anti-discrimination/retaliation clause. Labor groups and other employee health advocates requested that OSHA add a clause to prohibit employers from retaliating or discriminating against employees for participating in medical surveillance or because of the findings of medical surveillance (e.g., Document ID 2176, p. 2; 2282, Attachment 3, p. 21; 2336,

p. 12; 3577, Tr. 879; 3589, Tr. 4207; 4204, p. 90; 4219, pp. 33-36; 4223, p. 139). USW, BAC, and BCTD also requested that the anti-retaliation or anti-discrimination provisions address OSHA activities beyond medical surveillance (e.g., reporting unsafe working conditions), and in addition, BAC requested formal procedures for filing a complaint (Document ID 3584, Tr. 2548; 4219, pp. 33-38; 4223, p. 139). Employees, unions, and employee health advocates reported instances where employees were afraid to ask for protections or file complaints; some reported employer threats or retribution in response to such actions (e.g., Document ID 2124; 2173, p. 3; 3571, Attachment 3, p. 2, Attachment 4, p. 3; 3577, Tr. 816-817; 3581, Tr. 1787, 1796; 3583, Tr. 2464; 3584, Tr. 2567-2568; 3585, Tr. 3101; 3586, Tr. 3168).

To address the possibility that some employees may decline to participate in medical surveillance because of fear of retaliation or discrimination, NISA suggested that OSHA require employee participation in medical surveillance, as well as include a prohibition on discrimination in the rule or clarify that Section 11(c) of the OSH Act applies to discrimination based on medical surveillance findings. NISA requested that OSHA at least confirm that employers are free to require medical surveillance as a condition of employment (Document ID 4208, pp. 15-18).

As indicated in the NISA comments, Section 11(c) of the OSH Act prohibits discharge or discrimination against any employee for exercising any right afforded by the Act (29 U.S.C. (660(c)(1)). OSHA observes that these rights include filing an OSHA complaint, participating in an inspection or talking to an inspector, seeking access to employer exposure and injury records, reporting an injury, and raising a safety or health complaint with the employer. Medical surveillance and the other requirements provided under the respirable crystalline silica rule are also rights afforded under the Act. Therefore, an employer may not discharge or otherwise discriminate against any employee because the employee participates in medical surveillance offered under the rule. This includes discharge or discrimination based on medical findings for an employee who is able to perform the essential functions of the job.

Although acknowledging that the 11(c) protections are important because they establish that employees cannot be discriminated against for exercising their rights under the Act, Peg Seminario, on behalf of the AFL-CIO, stated that the enforcement mechanisms are very weak. Ms. Seminario pointed to the lack of an administrative process through the Review Commission, such as exists for compliance violations under standards, and she also stated that very few 11(c) cases are moved forward. In addition, Ms. Seminario testified that 11(c) deals with individual cases but does not address broad practices (Document ID 3578, Tr. 981-982). BCTD pointed to testimony given by Professor Emily Spieler before a Senate Subcommittee on Employment and Workplace Safety that described weaknesses of 11(c) and gave recommendations for improving it (Document ID 4072, Attachment 27; 4223, p. 138). BCTD concluded that an anti-discrimination/retaliation provision might provide employees with "an alternative, and potentially quicker, mechanism for gaining the Act's protections" (Document ID 4223, p. 139).

OSHA recognizes that Section 11(c) of the Act has been an imperfect avenue for preventing retaliation and addressing employee complaints of discharge or discrimination for exercising rights afforded by the Act. For this reason, separate from this rulemaking, OSHA has made considerable efforts in recent years to enhance the effectiveness of its Section 11(c) program to protect employees from retaliation for exercising their rights under the OSH Act and other anti-retaliation statutes enforced by OSHA. These efforts include administrative restructuring to create a separate Directorate of Whistleblower Protection Programs as one of eight Directorates in OSHA; adding additional investigators; and providing additional training for investigators and Labor Department solicitors who work on whistleblower cases. The Agency's Whistleblower Investigations Manual updated procedures and provided further guidance to help ensure consistency and quality of investigations (see https://www.osha.gov/OshDoc/Directive_pdf/CPL_02-03-005.pdf), and OSHA's memo to whistleblower enforcement staff on Employer Safety Incentive and Disincentive Policies and Practices, clarified that employer policies that discourage reporting of injuries and illnesses constitute violations of section 11(c) (see https://www.osha.gov/as/opa/whistleblowermemo.html). In addition, the Department of Labor has established a Whistleblower Protection Advisory Committee to advise, consult with, and make recommendations to the Secretary of Labor and the Assistant Secretary of Labor for Occupational Safety and Health on ways to improve the fairness, efficiency, effectiveness, and transparency of OSHA's administration of whistleblower protections (77 FR 29368 (5/17/12)). OSHA concludes that the Agency's limited resources will be best utilized by continuing to focus on strengthening enforcement of Section 11(c), rather than creating, on an ad hoc basis, a separate and alternative enforcement mechanism in the respirable crystalline silica rule. OSHA emphasizes that, in response to commenters' concerns about privacy and the possibility for retaliation based on employers' knowledge of employee medical information, it has made changes to the medical surveillance disclosure requirements of the rule, discussed above, in order to both encourage participation in medical surveillance and discourage discriminatory or retaliatory actions. Retaliation based on other activities, such as reporting injuries and illnesses or noting the failure of engineering controls, is not unique to the silica rule and thus does not, in OSHA's judgment, warrant a silica-specific response.

In response to the suggestion that OSHA prohibit employees from opting out of medical surveillance, OSHA observes that Section (6)(c)(7) of the OSH Act specifies that medical examinations or other tests "be made available," not that they be required. OSHA considers the medical surveillance offered under the rule to offer important protections for employees, and the Agency encourages all eligible employees to take advantage of these protections. However, the Agency recognizes that employees may choose not to take advantage of medical surveillance for a variety of reasons. OSHA does not find it appropriate to require all eligible employees to receive medical surveillance simply to preclude the possibility that an employer might discriminate against those who receive medical surveillance. The Agency also notes that Section 20(a)(5) of the OSH Act generally precludes OSHA from requiring medical surveillance for those who object on religious grounds. At the same time, nothing in the rule precludes an employer from requiring participation in medical surveillance programs as appropriate under applicable laws and/or labor-management contracts.

ASTM standards. Most medical surveillance requirements in the respirable crystalline silica rule are generally consistent with ASTM standards for addressing control of occupational exposure to respirable crystalline silica (Section 4.6 and 4.7 in both E 1132-06 and E 2625-09) (Document ID 1466, p. 5; 1504, p. 5). Commenters noted differences between the ASTM standards and the respirable crystalline silica rule (i.e., 120- versus 30-day exposure duration trigger, optional versus mandatory spirometry testing, and referrals based on a 1/1 versus 1/0 category X-ray). As explained above, the requirements of the rule better protect employees and therefore better effectuate the purposes of the OSH Act than the ASTM standards. There are additional differences between the ASTM standards and the rule, which are discussed briefly below.

The ASTM standards require that medical surveillance be triggered by the PEL or other occupational exposure limit, but for the general industry and maritime standard, OSHA is triggering medical surveillance at the action level because of remaining significant risk, exposure variability, and increased sensitivity of some employees. The ASTM standards recommend medical examinations before placement but OSHA allows the examinations to be conducted within 30 days to offer more flexibility.

The ASTM standards recommend tuberculosis testing for employees with radiographic evidence of silicosis, but the rule requires tuberculosis testing in the initial examination for all employees who qualify for medical surveillance. OSHA's requirement is based on evidence that exposure to respirable crystalline silica increases the risk for a latent tuberculosis infection becoming active, even in the absence of silicosis. The ASTM standards do not specifically mention a specialist, but the requirement for specialist referral in the respirable crystalline silica rule is conceptually consistent with the provision in the ASTM standards for counseling (by a physician or other person qualified in occupational safety and health) regarding work practices and personal habits that could affect employees' respiratory health.

Lastly, the E 1132-06 standard allows the health provider to report information to the employer, such as if the employee has a condition that might put him or her at risk for health impairment or if limitations on respirator use are related to medical or emotional reasons. Under the rule for respirable crystalline silica, medical findings are withheld from the employer and only reported to the employee because of privacy concerns and discrimination/retaliation fears that might prevent participation in medical surveillance. Both ASTM standards require the employer to follow the physician's placement or job assignment recommendations; the OSHA rule differs from the ASTM standards in this respect by allowing employees to make their own placement decisions if they are able to do the work.

Communication of Respirable Crystalline Silica Hazards to Employees

Paragraph (j) of the standard for general industry and maritime (paragraph (i) of the standard for construction) sets forth requirements intended to ensure that the dangers of respirable crystalline silica exposure are communicated to employees. Employees need to know about the hazards to which they are exposed, along with associated protective measures, in order to understand how they can minimize potential health hazards. As part of an overall hazard communication program, training serves to explain and reinforce the information presented on labels and in safety data sheets (SDSs). These written forms of communication will be effective and relevant only when employees understand the information presented and are aware of the actions to be taken to avoid or minimize exposures, thereby reducing the possibility of experiencing adverse health effects. Numerous commenters, including industry stakeholders and dozens of construction employees and concerned individuals, generally supported inclusion of a hazard communication requirement in the rule (e.g., Document ID 2039; 2113; 2116, Attachment 1, p. 45; 2302, p. 1; 2315, p. 4; 2345, p. 3; 3302, p. 1; 3295; 4217, p. 25).

Paragraph (j)(1) of the standard for general industry and maritime (paragraph (i)(1) of the standard for construction) requires the employer to (1) include respirable crystalline silica in the program established to comply with the hazard communication standard (HCS) (29 CFR 1910.1200); (2) ensure that each employee has access to labels on containers of crystalline silica and SDSs, and is trained in accordance with the provisions of the HCS and the provisions on employee information and training (contained in paragraph (j)(3) of the standard for general industry and maritime, paragraph (i)(2) of the standard for construction), and (3) ensure that at least the following hazards are addressed: cancer, lung effects, immune system effects, and kidney effects. These requirements remain unchanged from the proposed rule, after OSHA considered comments addressing these requirements (discussed below).

The approach in paragraph (j)(1) of the standard for general industry and maritime (paragraph (i)(1) of the standard for construction) is consistent with other OSHA substance-specific health standards, which were revised as part of the 2012 update of the HCS to conform to the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS). The 2012 update of the substance-specific standards involved revising the hazard communication requirements to refer to the HCS requirements for labels, SDSs, and training, and to identify the hazards that need to be addressed in the employer's hazard communication program for each substance-specific standard. In applying the approach described in paragraph (j)(1) of the standard for general industry and maritime (paragraph (i)(1) of the standard for construction), OSHA intends for the hazard communication requirements in the respirable crystalline silica rule to be substantively as consistent as possible with the HCS, while including additional specific requirements needed to protect employees exposed to respirable crystalline silica. A goal of this approach is to avoid a duplicative administrative burden on employers who must comply with both the HCS and this rule.

Some stakeholders agreed with OSHA that additional hazard communication provisions are needed in this rule. For example, the National Industrial Sand Association (NISA) generally agreed with OSHA's approach for communication of hazards to employees and indicated that the generic training elements of the HCS alone are insufficient (Document ID 2195, p. 45). In addition, labor unions such as the United Automobile, Aerospace and Agricultural Implement Workers of America (UAW), International Union of Operating Engineers (IUOE), American

Federation of Labor and Congress of Industrial Organizations (AFL-CIO), International Union of Bricklayers and Allied Craftworkers (BAC), and Building and Construction Trades Department, AFL-CIO (BCTD) generally agreed that employees exposed to respirable crystalline silica need additional information and training (Document ID 2282, Attachment 3, p. 24; 3583, Tr. 2367; 4204, p. 98; 4219, p. 22; 4223, p. 114).

However, other stakeholders expressed the view that OSHA's existing HCS requirements are sufficient, and that hazard communication provisions in this rule are not warranted. For example, the National Stone, Sand, and Gravel Association (NSSGA) asserted that requiring information and training under the respirable crystalline silica rule would be duplicative and unnecessary because OSHA's existing HCS adequately addresses communication of hazards and training of employees (Document ID 2327, Attachment 1, p. 11). The Portland Cement Association and National Association of Home Builders (NAHB) expressed similar views (Document ID 2284, p. 6; 2296, p. 44).

OSHA understands that the HCS already addresses communication of hazards but, after reviewing rulemaking record comments, reaffirms that employees exposed to respirable crystalline silica need additional training and information. Therefore, OSHA has decided to include in the rule the approach set forth in the proposed rule. The rule thus requires compliance with the HCS and the additional requirements that address aspects of employee protection that are not specified in the HCS but are relevant to these standards; examples of these provisions include health hazards specific to respirable crystalline silica, signs at entrances to regulated areas, training on medical surveillance, and training on engineering controls. Specific comments on these requirements and OSHA's rationale for their inclusion in the rule are discussed below. OSHA expects this approach will reduce the administrative burden on employers who must comply with both the HCS and this rule, while providing employees with adequate information and effective training on respirable crystalline silica hazards.

Which hazards should be addressed in employers' HCS programs was a matter of debate among commenters. For example, the American Coatings Association (ACA) asserted that OSHA's listing of health effects associated with crystalline silica was contrary to the revised HCS, which ACA argued allows qualified health professionals to established hazard classifications based on actual data (Document ID 2239, p. 2). Associated Builders and Contractors, Inc. and the Construction Industry Safety Coalition (CISC) did not support the inclusion of cancer, immune system effects, and kidney effects on the list of hazards to be addressed, asserting that OSHA did not meet its burden of showing a link between these diseases and exposure to crystalline silica (Document ID 2289, p. 8; 2319, p. 120).

OSHA does not find these arguments persuasive. As discussed in Section V, Health Effects, OSHA evaluated the best available published, peer-reviewed literature on respirable crystalline silica and considered comments from stakeholders to determine that exposure to respirable crystalline silica is associated with silicosis and other non-malignant respiratory disease, lung cancer, immune system effects, and kidney effects. Inclusion of a minimum list of health effects to address as part of hazard communication, based primarily on information from OSHA's rulemakings, is consistent with the 2012 revision of all substance-specific standards (77 FR 17574, 17749-17751, 17778-17785 (3/26/2012)). Therefore, the Agency concludes that including a list of hazards to be addressed, and the specific hazards listed, are appropriate.

Commenters such as the United Steelworkers (USW) and the American Federation of State, County, and Municipal Employees (AFSCME) requested that the rule require training on tuberculosis (Document ID 2336, pp. 14-15; 4203, p. 7). OSHA did not specifically list tuberculosis as a health hazard to be addressed because initial tuberculosis infection is not related to respirable crystalline silica exposure. In addition, the HCS describes health hazards in terms of target organs affected, such as lungs, or specific endpoints, such as carcinogenicity. Tuberculosis is not an endpoint listed in the HCS; thus, listing it in this rule would be inconsistent with the HCS. Consequently, OSHA has decided not to add tuberculosis to the list of hazards that must be addressed. However, because respirable crystalline silica exposure increases the risk of a latent tuberculosis infection becoming active, OSHA encourages employers to address tuberculosis as part of their hazard communication program.

Paragraph (j)(2) of the standard for general industry and maritime requires employers to post signs at all entrances to regulated areas. Although OSHA proposed a requirement for demarcating regulated areas, the Agency did not propose a requirement for warning signs at entrances to regulated areas, and instead noted that the areas could be effectively demarcated by signs, barricades, lines, or textured flooring (78 FR at 56273, 56450 (9/12/13)). The AFL-CIO argued that warning signs are an important method of making employees aware of potential hazards and noted that warning signs are required at entrances to regulated areas by many OSHA standards (Document ID 4204, pp. 100-101). A number of commenters, including the Communication Workers of America (CWA), Upstate Medical University, the American Public Health Association (APHA), UAW, and HalenHardy, agreed that warning signs must be required at regulated areas (e.g., Document ID 2240, p. 4; 2244, p. 4; 2178, Attachment 1, p. 2; 2282, Attachment 3, p. 25; 4030, Exhibit A, pp. 5-6). Similarly, USW commented on the need for warning signs in areas with potential respirable crystalline silica exposure (Document ID 2336,

p. 14). Charles Gordon, a retired occupational safety and health attorney, argued that the absence of a requirement for warning signs was inconsistent with Section 6(b)(7) of the Occupational Safety and Health (OSH) Act, which requires labels or other warnings to inform employees of hazards (Document ID 3588, Tr. 3797). Evidence in the rulemaking record indicates that inclusion of warning signs is also consistent with general industry practices. For example, a plan developed by the National Service, Transmission, Exploration, and Production Safety Network (STEPS Network) for the hydraulic fracturing industry recommends signs to warn of potential silica exposure and the requirement for respirator use near exposure zones (Document ID 4024, Attachment 2, p. 1).

OSHA finds these arguments persuasive and agrees that it is appropriate to require signs at entrances to regulated areas, which are required only in the general industry and maritime standard (see summary and explanation for Regulated Areas). Employees must recognize when they are entering a regulated area and understand the hazards associated with the area, as well as the need for respiratory protection. Signs are an effective means of accomplishing these objectives. Therefore, paragraph (j)(2) of the standard for general industry and maritime requires that regulated areas be posted with signs that bear the exact cautionary wording specified in the standard. The required legend, which begins with the word “Danger”, warns that respirable crystalline silica is present and may cause cancer, states that it causes damage to lungs, states that respiratory protection is required, and indicates authorized personnel only are permitted to enter. The purpose of these signs is to minimize the number of employees in a regulated area by alerting them that they must be authorized by their employer to enter, and to ensure that employees take appropriate protective measures when entering. The signs will warn employees who may not know they are entering a regulated area or may not know of the hazards present in the area. They will supplement the training that employees are to receive under other provisions of paragraph (j) of the standard for general industry and maritime because even trained employees need to be reminded of the locations of regulated areas and of the necessary precautions they must take before entering these dangerous areas.

The required language for the signs is consistent with labeling requirements in Appendix C of the HCS, which specifies standardized language to communicate information to employees. The revised HCS requires the use of one of two signal words – “Danger” or “Warning” – on labels of hazardous chemicals. The word “Danger” is used for more severe hazard categories, such as carcinogens. OSHA is requiring the word "Danger" based on the evidence of lung toxicity and carcinogenicity of respirable crystalline silica. "Danger" is used to alert employees that they are in an area where the permissible exposure limit (PEL) is or can reasonably be expected to be exceeded and to emphasize the importance of the message that follows.

Charles Gordon requested that warning signs also warn about kidney hazards (Document ID 4236, p. 6). The hazard statements about cancer and lung damage required on signs are the minimum requirements and focus on the most prominent adverse health effects associated with respirable crystalline silica exposure. OSHA concludes that it is unnecessary to list every relevant hazard warning on signs at entrances to regulated areas because other sources of information, such as SDSs and training, will provide more comprehensive information to employees. In addition, addressing cancer and lung damage is conceptually consistent with specific wording suggestions from APHA, National Consumers League, BCTD, HalenHardy, and AFL-CIO (Document ID 2178, Attachment 1, pp. 2-3; 2373, p. 2; 2371, Attachment 1, pp. 36-37; 4030, Exhibit D; 4204, p. 101). Including an abbreviated list of health hazards on signs is also consistent with other OSHA standards such as lead (29 CFR 1910.1025), benzene (29 CFR

1910.1028), and vinyl chloride (29 CFR 1910.1017). Therefore, OSHA has decided not to add a requirement to include warnings about kidney hazards on warning signs. Employers may choose to include a warning about kidney hazards on the signs required under this standard, provided that the additional information included is not confusing or misleading and does not detract from warnings required by the standard.

The warning sign must include notice about the need for respiratory protection in regulated areas required under the general industry and maritime standards. As explained in the summary and explanation of Regulated Areas, employers covered by the standard for general industry and maritime are required to provide each employee and his or her designated representative entering a regulated area with an appropriate respirator and require the employee and designated representative to use the respirator while in the regulated area. APHA, National Consumers League, and Charles Gordon requested that warning signs also indicate that protective clothing is required (Document ID 2178, Attachment 1, p. 3; 2373, p. 2; 4236, p. 6). As discussed in the summary and explanation of Regulated Areas, protective clothing is not required in this rule, and therefore no corresponding notice is required on signs.

Some labor unions that represent construction employees, such as BCTD, IUOE, and BAC, asked OSHA to include requirements for warning signs in the construction standard to warn employees about health hazards or requirements for control measures (e.g., Document ID 2371, Attachment 1, pp. 36-37; 4025, Attachment 1, pp. 24-25; 4219, p. 27). Some employers, like construction company Miller and Long, Inc., opposed requiring barricades and signs at construction sites (e.g., Document ID 3585, Tr. 2967).

As discussed in the summary and explanation of Regulated Areas, OSHA is not requiring regulated areas in the standard for construction because of the impracticality of establishing regulated areas in many construction settings. Employers using specified exposure control methods in Table 1 of paragraph (c) of the standard for construction are not required to conduct exposure assessments and therefore will not have the information necessary to establish the boundaries for the regulated area (i.e., the point at which exposures would no longer exceed the PEL). Even though regulated areas with warning signs are not required for the construction standard, the employer may choose to include procedures for posting warning signs in its written exposure control plan as a method to restrict access to work areas, when necessary, to limit the numbers of employees exposed to respirable crystalline silica and the levels to which they are exposed, including exposures generated by other employers or sole proprietors (paragraph (g)(1)(iv) of the standard for construction). Because of the unique and often-changing work areas at construction sites, OSHA concludes that a universal requirement for regulated areas with signs is unwarranted, and the construction employer is in the best position to determine when warning signs should be posted.

IUOE requested a requirement to affix warning labels listing the health hazards of respirable crystalline silica on enclosed cabs to remind operators not to work with windows open (Document ID 2262, pp. 34-35). Where enclosed cabs are used to limit exposures to respirable crystalline silica, the employer must ensure that these controls are properly implemented (paragraph (c)(1) of the standard for construction) and that employees can demonstrate knowledge of the controls (paragraph (i)(2)(i)(C) of the standard for construction). Therefore, OSHA concludes that a general requirement to affix warning labels to cabs is unwarranted and construction employers are in the best position to determine if there is a need for warning labels in their workplaces as a reminder to properly implement controls. As a result, OSHA has not included such a requirement in the standard.

Proposed paragraph (i)(2)(i) included the requirements related to employee information and training. The proposed rule called for the employer to ensure that each "affected employee" can demonstrate knowledge of the specified training elements discussed below. OSHA defined "affected employee" as any employee who may be exposed to respirable crystalline silica under normal conditions of use or in a foreseeable emergency. OSHA received several comments related to a trigger for training requirements. For example, the American Iron and Steel Institute (AISI) commented that the terms "each employee" and "each affected employee" were used interchangeably in the proposed rule and that OSHA needed to clarify which employees needed to receive training; both Newport News Shipbuilding and AISI commented that training should be limited to those employees who could foreseeably be exposed above the PEL (Document ID 2144, p. 2; 3492, p. 3). Southern Company was concerned that training would be required for all employees potentially exposed to silica, and although disagreeing with an action level of 25 micrograms per cubic meter of air ($\mu g/m^3$), requested an action level-based trigger for training (Document ID 2185, p. 5). In contrast, CISC supported training for all employees potentially exposed to respirable crystalline at a construction site (Document ID 4217, p. 25). A number of other employers and industry representatives expressed views on exposure levels that should trigger training, such as action levels or PELs (e.g., Document ID 2196, Attachment 1, p. 11; 2279, p. 9; 2301, Attachment 1, p. 4; 2357, pp. 31-32; 2379, Appendix 1, p. 54). BCTD requested that, in addition to employees performing work covered by this section, OSHA require training for supervisors and on-site managers who are responsible for, or who supervise, employees who perform work covered by the standard (Document ID 4223, p. 117).

OSHA has clarified the trigger for training requirements in the rule by aligning these requirements with the scope of the rule. Paragraph (j)(3)(i) of the standard for general industry and maritime (paragraph (i)(2)(i) of the standard for construction) requires training for each employee covered by the rule. Consistent with the scope provision in paragraph (a)(2) of the standard for general industry and maritime, training is required for each employee, unless the employer has objective data demonstrating that exposures will remain below 25 μg/m^3 as an 8-hour time-weighted average under any foreseeable conditions. Consistent with the scope provision in paragraph (a) of the standard for construction, training is required for all employees who are or could foreseeably be exposed to respirable crystalline silica at or above the action level of 25 μg/m^3 as an 8-hour time-weighted average. Therefore, actual or foreseeable exposure at or above the action level is used to determine which employees are covered by the rule, and covered employers are required to provide training for any employee covered by the rule. OSHA concludes that it is appropriate to train employees covered by the rule because they will benefit from receiving information such as the role of controls in reducing exposures and illnesses associated with respirable crystalline silica.

Stakeholders also offered comments on the proposed requirement that employers ensure that affected employees can "demonstrate knowledge" of the training subjects in proposed paragraphs (i)(2)(i)(A)-(D). The proposed rule did not specify precisely how training should be accomplished. Instead, it defined the hazard communication requirements in terms of objectives meant to ensure that employees are made aware of the hazards associated with respirable crystalline silica in their workplace and how they can help to protect themselves. The proposed rule's performance-oriented approach was consistent with the HCS and many of OSHA's substance-specific standards.

Some stakeholders commented on OSHA's performance-based approach to training. For example, Diane Matthew Brown, Health and Safety Specialist from AFSCME, testified that training should be as interactive as possible to allow for different learning styles (Document ID 3585, Tr. 3115). CISC supported the performance-oriented approach to training but also stated it would support a requirement that employees be able to ask questions during training (Document ID 4217). IUOE recommended interactive training so that employees could have their questions answered during the training (Document ID 3583, Tr. 2369). Although agreeing with the importance of a knowledgeable person to answer trainee questions, Ameren Corporation considered it burdensome to have someone immediately available to answer questions (Document ID 2315, p. 4). The Laborers' Health and Safety Fund of North America (LHSFNA) indicated that hands-on training is the best approach to training an employee who performs tasks that generate dust in the proper operation of a tool and associated engineering controls (Document ID 3589, Tr. 4220-4221).

After considering the comments on this issue, OSHA has decided that the training requirements under the respirable crystalline silica rule, like those in the HCS, are best accomplished when they are performance-oriented. OSHA concludes that the employer is in the best position to determine how the training can most effectively be accomplished. Hands-on training, videotapes, slide presentations, classroom instruction, informal discussions during safety meetings, written materials, or any combination of these methods may be appropriate. However, to ensure that employees comprehend the material presented during training, it is critical that trainees have the opportunity to ask questions and receive answers if they do not fully understand the material that is presented to them. OSHA reiterates that when videotape presentations or computer-based programs are used, this requirement may be met by having a qualified trainer available to address questions after the presentation, or providing a telephone hotline so that trainees will have direct access to a qualified trainer. Although it is important that employees be able to ask questions, OSHA finds that the employer is in the best position to determine whether an instructor must be available for questions during training or if a trainer can answer questions after the training session. Such performance-oriented requirements are intended to encourage employers to tailor training to the needs of their workplaces, thereby resulting in the most effective training program for each workplace.

In addition to asking about how training should be accomplished, stakeholders posed questions about how employers can determine that they have fulfilled the training requirements. For example, the American Foundry Society stated that the term “demonstrate knowledge” is vague and requested that the rule include language to specify when a training requirement is met (Document ID 2379, Appendix 1, p. 72). OSHA concludes that employers can determine whether employees have the requisite knowledge through methods such as discussion of the required training subjects, written tests, or oral quizzes. Retired industrial hygienist Bill Kojola, testifying on behalf of the National Council for Occupational Safety and Health (NCOSH), suggested that compliance officers could question employees to determine if they know about medical surveillance and work practices or engineering controls to reduce exposures (Document ID 3586, Tr. 3259). Similarly, UAW coordinator, Andrew Comai, and a private citizen, Cara Ivens, opined that compliance officers could ask employees if they are aware that they are working with hazardous chemicals or know about the health effects of respirable crystalline silica (Document ID 1801, p. 4; 3582, Tr. 1869). OSHA concludes that employers can similarly assess their employees’ knowledge and understanding of training topics.

The proposed rule did not include a provision that required training to be conducted in a language and manner that the employee understands. A number of labor unions and employee advocate groups requested that the rule include a requirement for training to be conducted in a language and manner that employees understand (e.g., Document ID 2240, p. 4; 2282, Attachment 3, p. 25; 3585, Tr. 3115; 3955, Attachment 2, p. 2; 3583, Tr. 2451; 4204, p. 99; 4025, Attachment 1, p. 2; 4219, p. 24).

OSHA agrees. Paragraph (j)(3)(i) of the standard for general industry and maritime (paragraph (i)(2)(i) of the standard for construction) requires the employer to ensure that each employee covered by the standard demonstrates knowledge and understanding of the required training subjects. The requirement for employers to ensure that the employee demonstrates knowledge in the training subjects obligates the employer to provide training in a language and manner that the employee understands. The employee must understand training in order to demonstrate knowledge of the specified training elements. To clarify this requirement, OSHA has revised the proposed text to require the employer to ensure that employees demonstrate understanding, in addition to knowledge. This requirement is consistent with Assistant Secretary David Michaels' memorandum to OSHA Regional Administrators (Document ID 1499). The memorandum explains that because employees have varying educational levels, literacy, and language skills, training must be presented in a language, or languages, and at a level of understanding that accounts for these differences in order to ensure that employees understand the training. As stated by Assistant Secretary Michaels:

> . . . an employer must instruct its employees using both a language and vocabulary that the employees can understand. For example, if an employee does not speak or comprehend English, instruction must be provided in a language that the employee can understand. Similarly, if the employee's vocabulary is limited, the training must account for that limitation. By the same token, if employees are not literate, telling them to read training materials will not satisfy the employer's training obligation (Document ID 1499, p. 2).

This may mean, for example, providing materials, instruction, or assistance in Spanish rather than English if the employees being trained are Spanish-speaking and do not understand English.

However, the employer is not required to provide training in the employee's preferred language if the employee understands the language used for training.

Proposed paragraphs (i)(2)(i)(A)-(D) specified the contents of training for affected employees. The proposed list included training on operations that could result in exposures and methods for protecting employees from exposure, the contents of the respirable crystalline silica rule, and the purpose and a description of the employer's medical surveillance program. The proposed rule did not contain a provision requiring training on health effects. However, under the HCS, employers would have to train employees on the health hazards associated with chemicals in the work area (29 CFR 1910.1200 (h)(3)(ii)). In addition, the preamble to the proposed rule mentioned that training on medical surveillance under proposed paragraph (i)(2)(i)(D) should cover the signs and symptoms of respirable crystalline silica-related health effects (78 FR at 56474).

OSHA asked for comments on the scope and depth of the proposed training requirements and whether additional training provisions needed to be added (78 FR at 56291). Stakeholders offered a number of comments on these proposed provisions. For example, concerned individuals, a medical school, and labor unions requested that training address the health effects associated with respirable crystalline silica exposure (e.g., Document ID 1771, p. 1; 2188; 3479, p. 1; 4025, Attachment 1, p. 2; 4203, p. 7). Training on health hazards of respirable crystalline silica is consistent with stakeholder practices. For example, health hazards are addressed in training plans or modules by the National Precast Concrete Association, IUOE, and the STEPS Network (e.g., Document ID 2067, pp. 2-3; 3583, Tr. 2414; 4024, Attachment 2, p. 1).

Several commenters stated that employees would not ask for or use appropriate protection without knowledge of health hazards (e.g., Document ID 2166, p. 3; 3571, Attachment 1, pp. 2-3, 3585, Tr. 2976). For example, in discussing her experience with overhead drilling of concrete, Sandra Darling-Roberts commented:

> I had a dust mask and a pair of safety glasses for my protection. . . .We were not offered better personal protection gear and did not request any as we were not made aware of the risks of silica exposure (Document ID 1758).

Operating engineer Keith Murphy, representing IUOE, testified that employees will wear respirators if informed that they are exposed to dangerous concentrations of respirable crystalline silica (Document ID 3583, Tr. 2375-2376). In testifying about her experiences in training construction employees, Marién Casillas Pabellón, Director of New Labor, stated:

> [Seventy percent] of these workers were not able to say what silica was or if they were . . . exposed to it. When they learned about the long term effects to their health many were alarmed. Training has been key in getting workers to demand . . . the right equipment and tools to complete their task safely. Always after trainings we follow up with the participants to measure the impact of the trainings. [Fifty-five percent] of the workers that received training around these issues expressed that they have demanded personal protective equipment and other tools to do their work safely after the training (Document ID 3571, Attachment 6, p. 2).

In addition, several employees indicated that neither they nor their coworkers had received adequate or even any training on silica's health effects (e.g., Document ID 3582, Tr. 1892-1893; 3589, Tr. 4299-4300; 4032, Attachment 1, p. 1; 3477, p. 1).

Based on the evidence showing the need for and positive impact of health hazard training and to ensure that covered employees receive that training, OSHA is requiring training on health hazards specifically associated with respirable crystalline silica. The requirement is contained in paragraph (j)(3)(i)(A) of the standard for general industry and maritime (paragraph (i)(2)(i)(A) of the standard for construction).

Proposed paragraph (i)(2)(i)(A) required that employees be trained on specific operations in the workplace that could result in exposure to respirable crystalline silica, especially operations where exposures may exceed the PEL. BCTD recommended that “tasks” rather than “operations” be used, because operations could include various tasks; it also requested that OSHA remove the statement “especially operations where exposure may exceed the PEL” (Document ID 2371, Attachment 1, pp. 23, 35). OSHA agrees that “tasks” is the more appropriate term. The Agency also agrees that employers and employees must understand all sources of potential respirable crystalline silica exposure and, therefore, removed the phrase “especially operations where exposure may exceed the PEL.” Therefore, OSHA has revised the proposed language so that paragraph (j)(3)(i)(B) of the standard for general industry and maritime (paragraph (i)(2)(i)(B) of the construction standard) now requires training on specific workplace tasks that could result in exposure to respirable crystalline silica.

Proposed paragraph (i)(2)(i)(B) required that employees be trained on procedures implemented by the employer to protect them from respirable crystalline silica exposure, including appropriate work practices and use of personal protective equipment (PPE), such as respirators and protective clothing. Labor unions and employee advocate groups, such as CWA, UAW, USW, NCOSH, AFSCME, IUOE, and BCTD, requested that OSHA also specify training on engineering controls (Document ID 2240, p. 4; 2282, Attachment 3, p. 24; 2336, p. 15; 3955, Attachment 2, p. 2; 4203, p. 7; 4025, Attachment 1, p. 2; 4223, p. 118). The value of training on engineering controls is demonstrated by the testimony of construction employee and New Labor Safety Liaison, Norlan Trejo, who stated that because of his training, he is aware of the types of engineering controls needed on job sites and he requests such controls if the employer does not provide them (Document ID 3583, Tr. 2462-2463).

Because engineering controls are a vital aspect of reducing exposures, OSHA has concluded that employees covered by this rule must understand how they work in order to use the appropriate work practices to fully and properly implement those controls and to be able to recognize if engineering controls are malfunctioning. Therefore, OSHA has revised the proposed provision to also require training on engineering controls. OSHA has also removed the term “appropriate” because it is implicit that any work practice or other methods used to protect employees be appropriate. In addition, “personal protective equipment” and “protective clothing” were removed from the paragraph because respirators are the only type of PPE required by the rule. Thus, paragraph (j)(3)(i)(C) of the standard for general industry and maritime (paragraph (i)(2)(i)(C) of the standard for construction) requires training on specific measures implemented by the employer to protect employees from respirable crystalline silica exposure, including engineering controls, work practices, and respirators to be used.

Several labor unions that represent employees in the construction industry highlighted additional training that they thought necessary for some construction employees. For example, BCTD requested that OSHA establish tiered training requirements in the construction standard to include: (1) basic awareness training for all employees potentially exposed to respirable crystalline silica, (2) additional equipment-specific training for employees who perform tasks that generate respirable crystalline silica, and (3) training for a competent person. BCTD noted that similar approaches were taken in other OSHA standards, such as asbestos (29 CFR 1926.1101(k)(9)) (Document ID 4223, pp. 114, 116-117). The tiered approach to training recommended by BCTD was also supported by IUOE, LHSFNA, and BAC (Document ID 3583, Tr. 2367-2368; 4207, p. 5; 4219, pp. 22-24).

In supporting a tiered approach, BCTD noted “the effectiveness of the standard and the engineering controls used to limit silica exposure depend heavily on how the controls are used.” (Document ID 4223, p. 117). Dr. Paul Schulte, Director of the Education and Information

Division at the National Institute for Occupational Safety and Health, testified that engineering controls listed in Table 1 are only effective if they are maintained and employees are trained on their correct use (Document ID 3403, p. 6). Similar views regarding training and effectiveness of controls were expressed by Joel Guth, President of iQ Power Tools, Bill Kojola, and Tom Nunziata, instructor/training coordinator for LHSFNA; Mr. Nunziata also noted the importance of hands-on training (Document ID 3585, Tr. 2982-2983; 3586, Tr. 3204-3206; 3589, Tr. 4220-4221).

Evidence in the record further demonstrates knowledge of work practices that employees must have for controls to function effectively. For example, the user's manual for Stihl's gasoline-powered hand-held portable saws recommends training of operators, and it indicates that operators need to know minimum water flow rates, how to control flow rate to ensure an adequate volume of water to the cutting area, and to rinse the screen if no or little water is fed to the cutting wheel during use (Document ID 3998, Attachment 12a, pp. 3, 15, 23). Similarly, the effectiveness of local exhaust ventilation systems, another common method used to control exposures to respirable crystalline silica, is often enhanced by the use of proper work practices. For instance, when tuckpointing, employees should ensure that the shroud surrounding the grinding wheel remains flush against the working surface, when possible, to minimize the amount of dust that escapes from the collection system. Operating the grinder in one direction (counter to the direction of blade rotation) is effective in directing mortar debris into the exhaust system, and backing the blade off before removing it from the slot permits the exhaust system to clear accumulated dust (78 FR at 56474). Employees using vacuum controls also need to be aware of appropriate ways to clean the filter, such as using a valve on the vacuum to clean the filter with backpressure instead of pounding the filter on a surface (Document ID 3998, Attachment 13b, p. 460).

The record also contains evidence demonstrating the importance of employees understanding how to effectively operate and maintain controls on heavy equipment to prevent exposures to respirable crystalline silica in the construction industry. For example, IUOE noted that the role of operating engineers in ensuring integrity of enclosed cabs includes keeping windows and doors closed, maintaining good housekeeping practices, cleaning dust from boots before entering the cab, and reporting malfunctioning seals and air conditioning (Document ID 2262, pp. 35-36). In addition, IUOE noted that operator control of water flow rates for dust suppression is important for protecting employees from exposure and preventing excessive water runoff into the environment (Document ID 4234, Part 1, pp. 27-28). Anthony Bodway, Special Projects Manager at Payne & Dolan, Inc., representing the National Asphalt Pavement Association (NAPA), noted that all Payne & Dolan's operators have been trained to conduct daily maintenance checks of their equipment (Document ID 3583, Tr. 2194-2195). A best practices bulletin developed in part by NAPA requires machine operators to demonstrate knowledge of the machine's dust suppression system including flow rates, maintenance, troubleshooting, and visual inspections; in addition a letter from manufacturer Wirtgen America stressed the importance of operator training on operating and maintaining machines to minimize respirable dust (Document ID 2181, pp. 25, 52).

OSHA agrees that actions, such as controlling water flow rates, ensuring integrity of controls, addressing a non-functioning control, and proper housekeeping in cabs, are work practices that promote effectiveness of controls. However, the Agency does not agree that construction employees who perform tasks that generate respirable crystalline silica dust require training beyond what paragraph (i)(2)(i)(C) of the standard for construction already requires. As noted above, paragraph (i)(2)(i)(C) of the standard for construction requires employers to ensure that employees covered by the standard can demonstrate knowledge and understanding of specific measures the employer has implemented to protect them from respirable crystalline silica exposure, including engineering controls, work practices, and respirators to be used. Under this provision, the knowledge required of each employee depends on the tasks he or she performs. That was the intent of the proposed standard and it has not changed in the standard. OSHA concludes that this provision, as written, requires employers to provide employees with the different types and levels of training they need, depending on the types of tasks they conduct. For example, laborers who do not operate equipment that generates respirable crystalline silica dust would only need to be aware of the general types of controls used, such as water and local exhaust. However, those laborers would need to know about work practices for tasks they perform, such as appropriate clean-up of respirable crystalline silica dust accumulations. On the other hand, employees who operate tools with built-in controls, such as saws with integrated water delivery systems, would need to demonstrate knowledge and understanding of the full and proper implementation of the controls on those tools.

OSHA is also not mandating additional training for a competent person in paragraph (i) of the standard for construction. As discussed in more detail in the summary and explanation of Written Exposure Control Plan, the training requirements mandated by this standard already impart a high level of competence. OSHA recognizes that there may be situations in which an employee needs additional training in order to ensure that he or she has the knowledge, skill, and ability to be a designated competent person, but because of unique scenarios in construction environments, those training requirements would vary widely. OSHA concludes, therefore, that it is the employer's responsibility to identify and provide any additional training that the competent person would need to implement the written exposure control plan.

AFL-CIO and USW requested that the standard for general industry also mandate a tiered approach that includes a higher level of training for employees who perform silica dust-generating tasks and training of a competent person; both those groups and UAW noted the importance of workplace- or job-specific training on engineering controls and work practices (Document ID 2282, Attachment 3, p. 24; 4204, p. 99; 4214, p. 14).

OSHA concludes that employees are already required to demonstrate workplace-and job-specific knowledge and understanding of work practices associated with the tasks they conduct under paragraph (j)(3)(i)(C) of the standard for general industry and maritime. That was the intent of the proposed standard and it has not changed in the standard. Engineering controls in general industry commonly involve measures such as ventilation systems that protect several employees, and are often not subject to the direct control of the employee performing the task (see Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis). In those cases, training would include a description of the specific types of engineering controls used at that facility, including signs that the controls may not be working effectively (e.g., visible dust emission). Training would also address any work practices needed for the controls to function effectively (e.g., not opening windows near local exhaust sources, positioning the local exhaust hood directly over the exposure source). If employees covered by the general industry and maritime standard operate equipment with built in controls that are under their control, those employees are required to demonstrate knowledge and understanding of the full and proper implementation of those controls. Therefore, OSHA is not requiring additional training for general industry and maritime employees who perform tasks that generate respirable crystalline silica dust because it is already required by paragraph (j)(3)(i)(C) of the standard for general industry and maritime.

Training of a competent person is not applicable to the general industry and maritime standard because OSHA is not requiring a competent person. As explained in the summary and explanation of Written Exposure Control Plan, OSHA is not requiring a competent person because reasons for designating a competent person in construction are not applicable to most general industry worksites. For example, general industry worksites usually have less environmental variability and it is reasonable and generally feasible to establish regulated areas to limit access and perform exposure assessments to verify effective control of exposure.

OSHA has retained the proposed requirement for training on the contents of the respirable crystalline silica rule in paragraph (j)(3)(i)(D) of the standard for general industry and maritime (paragraph (i)(2)(i)(D) of the standard for construction). This paragraph parallels the HCS requirement to inform employees about the requirements of the HCS section (29 CFR 1910.1200(h)(2)(i)), and similar paragraphs have been included in all OSHA substance-specific standards.

Proposed paragraph (i)(2)(i)(D) required employers to train employees about the purpose and description of the medical surveillance program, and OSHA has retained that requirement in the rule under paragraph (j)(3)(i)(E) of the standard for general industry and maritime (paragraph (i)(2)(i)(F) of the standard for construction). Paragraph (i) of the standard for general industry and maritime (paragraph (h) of the standard for construction) describes the requirements of the medical surveillance program, such as the examinations that must be offered to qualifying employees. OSHA finds that employees will benefit from learning about the purpose of medical surveillance and symptoms associated with respirable crystalline silica-related diseases, as described in the summary and explanation of Medical Surveillance. OSHA recommends that employers in construction or other high-turnover industries inform employees to keep their copy of the physician or other licensed health care professional's written medical opinion for the employer as proof of a current medical examination and that proof of a current examination could ensure that employees get timely examinations or spare employees from unnecessary testing, such as X-rays. OSHA also recommends that employers inform employees that they cannot be retaliated against for participating in medical surveillance. This information will help to ensure that employees are able to effectively participate in medical surveillance.

The proposed rule did not require employees to be trained on the identity of the competent person. Several labor unions, including IUOE, LHSFNA, BAC, and BCTD requested that employees receive training on the written exposure control plan or identity of the competent person (Document ID 3583, Tr. 2367-2368; 3589, Tr. 4222; 2329, p. 5; 4223, p. 118). Paragraph (g)(4) of the standard for construction requires employers to designate a competent person to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan. The written exposure control plan in the construction standard describes tasks in the workplace that involve exposure to respirable crystalline silica; engineering controls, work practices, and respiratory protection used to limit employee exposures; housekeeping methods used to limit employee exposures; and procedures used to restrict access, when necessary, to minimize employees exposed and their level of exposure, including exposures generated by other employers or sole proprietors (paragraph (g)(1)(i)-(iv)). OSHA is not requiring the identity of the competent person to be listed in the written exposure control plan because it could change daily. However, construction employees must be able to identify the competent person in situations where they have a question or concern about the subjects covered in the written exposure control plan. For example, if an engineering control is not working properly, an employee may need to contact the competent person for help in addressing the problem. Therefore, paragraph (i)(2)(i)(E) of the standard for construction requires employees to be informed of the competent person's identity. However, OSHA is not specifying training on the written exposure control plan because the contents of that plan, including its availability to employees, is already addressed by training on the contents of this section under paragraph (i)(2)(i)(D) of the standard for construction.

Some stakeholders requested that OSHA provide greater specificity on training requirements. For example, Fann Contracting, Inc. asked OSHA to spell out what training is required for different industries (Document ID 2116, Attachment 1, p. 46). NAHB stated that specifying training requirements would simplify training for construction employers (Document ID 2296, p. 44). John Scardella, Program Administrator for USW, testified that training should not be left to the discretion of employers because they might not prioritize employee health and safety (Document ID 3479, p. 2). USW and LHSFNA requested more detailed training requirements, such as those of the asbestos standard (29 CFR 1910. 1001; 1926.1101) that specify what is to be addressed under each major training topic (Document ID 2336, pp. 14-15; 3589, Tr. 4219).

Although OSHA agrees with these commenters that comprehensive training is a key part of hazard communication, the Agency recognizes that it is difficult to provide more specificity as a result of unique scenarios among different employers and industries. However, to help employers develop training programs that are comprehensive for general training subjects that apply to most covered industries, OSHA has developed a number of guidance products that are already available through its website. In addition, the Agency is planning to develop guidance products specific to the rule, as has been suggested by NAHB (Document ID 2296, p. 39). Numerous governmental and other organizations have already developed guidance products for training (e.g., Document ID 1722; 4025, Attachment 2; 4053, Exhibit 3a-3e and 4; 4073, Attachment 8i). As has been the case with all OSHA standards, OSHA expects that the private sector will develop training products and programs, which will further help ensure comprehensive training.

Commenters also argued that OSHA should include requirements for training on other topics. For example, IUOE requested training on topics such as SDSs, signs, use and care of respiratory protection, and work practices for heavy machine operators (Document ID 2262, pp. 36-38; 4025, Attachment 1, p. 2). LHSFNA and BCTD requested training on exposure assessment (Document ID 3589, Tr. 4222; 4223, p. 118). AFSCME requested training on personal hygiene (Document ID 4203, p. 7).

OSHA concludes, however, that the employee information and training provisions in the respirable crystalline silica rule and the HCS are sufficiently informative. For example, the HCS requires employers to provide training on SDSs and on the signal words and hazard statements that are used on the signs required by the general industry and maritime standard. Under the HCS, employers must also train employees about the location and availability of the written HCS program, including the required list(s) of hazardous chemicals and SDSs. The HCS also requires employers to train employees on the methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area; in the case of respirable crystalline silica, this could include a description of the employer’s exposure assessments methods (e.g., objective assessments, personal breathing zone air sampling, direct readings of respirable dust) and warnings that visible dust emissions might indicate a problem.

Because employers must meet the requirements of the HCS, OSHA does not find it necessary to repeat the training requirements of that standard in their entirety in the respirable crystalline silica rule. Moreover, even if all training requirements of the HCS were repeated in the respirable crystalline silica rule, most employers would still have to consult the hazard communication requirements of other hazardous chemicals, because they have employees exposed to other chemicals in their workplace. Consequently, OSHA concludes that these provisions, and the other requirements of the HCS and this standard, are sufficient.

OSHA also concludes that additional training on respiratory protection or personal hygiene is unnecessary. Training on the use and care of respiratory protection is already required under the respiratory protection standard (29 CFR 1910.134). OSHA similarly concludes that training in personal hygiene is not needed as a required training topic in this rule because personal hygiene measures relevant to respirable crystalline silica exposure, such as avoiding use of compressed air as a method to clean dust off of clothing, are adequately addressed by other requirements of the rule and are covered by training on work practices. Some training topics suggested by commenters, such as communication methods for employees in enclosed cabs, are specific to certain work scenarios. OSHA has concluded that employers are in the best position to determine which additional, unique training requirements are relevant to their type of industry. For example, in construction, the competent person might be able to identify situations where employees need more training because they are not demonstrating knowledge and understanding of a specific measure the employee has implemented to protect them.

OSHA's proposed rule required the employer to make a copy of the standard readily available without cost to each employee covered by the respirable crystalline silica rule, and OSHA has retained this requirement in paragraph (j)(3)(ii) of the standard for general industry and maritime (paragraph (i)(2)(ii) of the standard for construction). This is a common requirement in OSHA standards such as chromium (VI) (29 CFR 1910.1026), acrylonitrile (29 CFR 1910.1045), and cotton dust (29 CFR 1910.1043). The provision leaves employers free to determine the best way to make the standard available, such as a printed or electronic copy in a central location that employees can easily access. OSHA concludes that employees need to be familiar with and have access to the respirable crystalline silica standard for general industry and maritime or construction, as applicable, and be aware of the employer’s obligations to comply with it.

OSHA did not propose a requirement for labels or signs in languages other than English. Ameren requested the rule include a requirement that labels include appropriate languages for employees who do not understand English (Document ID 2315, p. 4). Charles Gordon and BAC requested that warning signs be presented in a language or manner that employees can understand, and, as noted by BAC, the method could include graphics (Document ID 3588, Tr. 3805; 4219, p. 27). Requirements for labels on hazardous chemicals are set forth in paragraph (f) of the HCS, which does not require languages other than English. However, the HCS requires the inclusion of certain information on labels on shipped containers, including pictograms (29 CFR 1910.1200 (f)(1)(iv)), and mandates that containers in the workplace be labeled either in accordance with the rules for shipping containers or with product identifier and combinations of words, pictures, or symbols to warn of hazards. OSHA has concluded that with training required under the HCS (29 CFR 1910.1200 (h)(3)(iv)), even employees who are not literate in English will have sufficient knowledge of respirable crystalline silica hazards. Likewise, with training, employees will be able to recognize the meaning of signs at the entrances to regulated areas and the need for respiratory protection in these areas.

OSHA's proposed rule did not specify when and how often employees must be trained. Some stakeholders offered opinions about when an employer's obligation to train covered employees should begin. For example, USW, NCOSH, and LHSFNA requested that the rule for respirable crystalline silica require training before or at the time employees are assigned or placed in a job with respirable crystalline silica exposure (Document ID 3479, p.1; 3955, Attachment 2, p. 1; 3589, Tr. 4222). CWA, Upstate Medical College, UAW, AFSCME, AFL-CIO, and BCTD requested that the rule for respirable crystalline silica require training before employees are assigned to or placed in a job or task with respirable crystalline silica exposure (Document ID 2240, p. 4; 2244, p. 4; 2282, Attachment 3, pp. 24-25; 4203 p. 7; 4204, p. 99; 4223, p. 117).

OSHA agrees that each employee needs to be trained sufficiently to understand the specified training elements at the time of initial assignment to a position involving exposure to respirable crystalline silica. The rule requires the employer to ensure that each employee can demonstrate knowledge and understanding of the specified training elements; this requirement applies from the time that the employee is covered by the rule. This requirement is consistent with the HCS, which requires that employers provide employees with effective information and training on hazardous chemicals in their work area at the time of their initial assignment (29 CFR 1910.1200(h)(1)).

Stakeholders also commented on how often employers should be required to train their employees. CWA, Upstate Medical College, UAW, NCOSH, AFSCME, and LHSFNA recommended periodic refresher training and additional training if methods, equipment, or controls change (Document ID 2240, p. 4; 2244, p. 4; 2282, Attachment 3, pp. 24-25; 3955, Attachment 2, p. 2; 4203 p. 8; 3589, Tr. 4222). Similarly, USW and AFL-CIO asked that OSHA require periodic refresher training (Document ID 3479, p.1; 4204, p. 99). In addition, BCTD recommended additional training when the employer believes an employee requires more training because of a lack of skill or understanding (Document ID 4223, p. 117).

OSHA agrees with commenters that additional or repeated training may be necessary under certain circumstances but does not consider it appropriate to impose a fixed schedule of periodic training. Therefore, the requirement for training is performance-oriented in order to allow flexibility for employers to provide training as needed to ensure that each employee can demonstrate the knowledge and understanding required under the rule. For example, if an employer observes an employee engaging in activities that contradict knowledge gained through training, it is a sign to the employer that the employee may require a reminder or periodic retraining on work practices.

Because paragraph (j)(3)(i)(C) of the standard for general industry and maritime (paragraph (i)(2)(i)(C) of the standard for construction) requires training on the specific measures the employee has implemented to protect employees, additional training is already required after new engineering controls are installed, new work practices are implemented, or employees are given new types of respirators. Because this provision requires employers to provide additional training following changes in protective measures or equipment, they ensure that employees are able to properly use the new controls, implement work practices relating to those controls, and properly use respirators to actively protect themselves under the conditions found in the workplace, even if those conditions change.

OSHA did not include a requirement for employees to be certified as having received training in the proposed rule. Commenters including Dr. Ruth Ruttenberg, representing the AFL-CIO, have voiced support for a portable training record or certification-based approach; Dr.

Ruttenberg noted that this would reduce costs by avoiding the need for each new employer to conduct full training (Document ID 1950, pp. 11-12; 2256, Attachment 4, p. 5; 4235, p. 14). OSHA is not including a requirement for a portable training record in the rule. This approach is consistent with the HCS, which neither requires nor precludes a training record that could be portable. Employee training requirements might be partially fulfilled by training obtained through trade associations, unions, colleges, or professional schools. However, the employer is always ultimately responsible for ensuring that employees are adequately trained, regardless of the method relied upon to comply with the training requirements.

OSHA concludes that a portable training record is unlikely to eliminate the need for employer-specific or site-specific training. For example, Barbara McCabe, Program Manager for IUOE, testified that IUOE local unions train employees but employees would need site-specific training when they report to the worksite (Document ID 3583, Tr. 2368). An example of a case where site-specific training is needed was noted by BAC, who commented that an employee who operated a saw with water controls at one site may be given a saw with vacuum controls at another site (Document ID 4219, p. 23).

OSHA concludes that some site-specific or employer-specific training is always necessary, such as training on specific tasks that could result in exposures, controls or work practices that the employer has implemented, or the identity of the competent person (paragraphs (j)(3)(i)(B) and (C) of the standard for general industry and maritime and paragraphs (i)(2)(i)(B),(C), and (E) of the standard for construction). Full training would not be required if an employee is already able to demonstrate knowledge in health hazards, the contents of the respirable crystalline silica rule, or medical surveillance for respirable crystalline silica (paragraphs (j)(3)(i)(A), (D), and (E) of the standard for general industry and maritime, paragraphs (i)(2)(i)(A), (D) and (F) of the standard for construction). Site-specific training is unlikely to be costly or time-consuming. OSHA concludes that assessing an employee's knowledge to determine the type and level of additional training required is more meaningful than simply accepting a certificate of training.

Bill Kojola requested that the rule specify that training be provided at no cost to the employee and during work hours (Document ID 3955, Attachment 2, p. 2). In addition, Norlan Trejo from New Labor testified that he never saw an employer pay for training (Document ID 3583, Tr. 2469). As stated above, an employer may rely on an employee's previous training, if the employee can demonstrate knowledge in training requisites. Any training provided by the employer to meet the requirements of the rule must be provided at no cost to the employee. Employees must also be paid for time spent in training. This is consistent with other OSHA standards that do not include an explicit requirement for employer payment for training in the regulatory text, e.g., the HCS requires training (1910.1200(h)(3)) but does not mention cost; the compliance directive (CPL 02-02-079 says "Training is required to be provided at no cost to the employees. Employees must be paid for the time they spend at training.)"

In the Notice of Proposed Rulemaking, OSHA asked whether labeling of substances containing more than 0.1 percent crystalline silica was appropriate, as required by the HCS, or if the threshold for labeling should be greater than 1 percent crystalline silica (78 FR at 56291). A number of industry groups suggested a threshold for including respirable crystalline silica on labels or SDSs. With the exception of NISA, who favored a 0.1 percent threshold, the commenters requested a threshold of 1 percent or greater or thought that a 0.1 percent threshold could be problematic (Document ID 1785, p. 4; 2179, pp. 3-4; 2101, pp. 8-9; 2284, p. 10; 2296, p. 44; 2312, p. 3; 2317, p. 3; 2319, p. 120; 2327, Attachment 1, p. 14; 4208, pp. 19-20). The

International Diatomite Producers Association agreed with NISA that the threshold for hazard communication should be 0.1 percent for respirable crystalline silica but requested an exception for respirable crystalline silica in natural (uncalcined) diatomaceous earth, according to OSHA's current policy (Document ID 4212, pp. 6-7).

The classification of hazardous chemicals, including chemicals containing silica, is determined by the HCS. As explained in Section V, Health Effects, OSHA has determined, consistent with the National Toxicology Program and International Agency for Research on Cancer classifications, that respirable crystalline silica is a carcinogen. Under the HCS, a mixture that contains a carcinogen must itself be classified as a carcinogen when at least one ingredient in it has been classified as a Category 1 or Category 2 carcinogen and is present at or above the appropriate cut-off value/concentration limit specified in HCS Table A.6.1 (29 CFR 1910.1200, Appendix A, A.6.3.1). Table A.6.1 sets the cut-off value at greater than or equal to 0.1 percent. Footnote 7 to 1910.1200, Appendix A, A.6.3 notes that the cut-off value is the primary means of classification of carcinogens and may only be modified on a case-by-case evaluation based on available test data for the mixture as a whole. Classification of a chemical under the HCS triggers labeling requirements under that standard, and OSHA does not find it appropriate to impose different requirements in this rule. To do so would be at odds with the concept of harmonizing national and international requirements for classification and labelling of chemicals that is the basis of the GHS and HCS.

OSHA also did not propose requirements related to the creation and retention of training records, but some commenters expressed opinions on this issue. For example, CISC commented that they would agree to document that employees completed training and demonstrated knowledge (Document ID 4217, p. 25). Consistent with the HCS, employers are not required to keep records of training under the rule for respirable crystalline silica, but employers may find it valuable to do so. Comments on this issue and OSHA's rationale for this decision are discussed in the summary and explanation of Recordkeeping.

ASTM standards. The training requirements in the respirable crystalline silica standards are generally consistent with but differ slightly from ASTM International (ASTM) standards ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica and ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities (Section 4.8 in both E 1132 – 06 and E 2625 – 09) (Document ID 1466, p. 6; 1504, p. 6). The E 1132 – 06 standard requires training for employees exposed at any level and the E 2625 – 09 standard for construction and demolition requires training for employees potentially exposed to high levels. The ASTM standards also include: (1) more specificity on training requirements such as annual training (E 1132 – 06 only), training when employees demonstrate unsafe work practices, training in an appropriate language and manner, and documentation of training (certification in the case of E 1132 – 06); (2) training on tuberculosis and relationships between smoking and silica exposure in both standards and no training for autoimmune and kidney hazards in E 2625 –09; (3) training on respirator use and hygiene; and (4) warning signs for construction and demolition workplaces in E 2625 – 09.

OSHA is requiring that each employee covered by the rule receive training; employees may be at significant risk even if they are not exposed to "high levels" of respirable crystalline silica. In comparison to the ASTM standards, the requirements for training under the respirable crystalline silica rule are more performance-based in terms of when training is required. The health hazards addressed in the rule are based upon OSHA's health effects assessments and consistency with health hazard classification in the HCS. OSHA already requires training on respirator use under its respiratory protection standard (29 CFR 1910.134). The rule does not specify training on hygiene because personal hygiene is addressed by other requirements of the rule and training on work practices. OSHA is not requiring warning signs in the standard for construction because employers are in the best position to determine if and when signs are appropriate for restricting access to work areas to limit employee exposure to respirable crystalline silica. For the reasons described above, OSHA concludes that the requirements of the rule better effectuate the purposes of the OSH Act of 1970 than the ASTM standards.

Recordkeeping

Paragraph (k) of the standard for general industry and maritime (paragraph (j) of the standard for construction) requires employers to make and maintain air monitoring data, objective data, and medical surveillance records. The recordkeeping requirements are in accordance with section 8(c) of the Occupational Safety and Health (OSH) Act (29 U.S.C. 657(c)), which authorizes OSHA to require employers to keep and make available records as necessary or appropriate for the enforcement of the OSH Act or for developing information regarding the causes and prevention of occupational accidents and illnesses.

Paragraph (k)(1)(i) of the standard for general industry and maritime (paragraph (j)(1)(i) of the standard for construction) is substantively unchanged from the proposed rule. It requires the employer to make and maintain accurate records of all exposure measurements taken to assess employee exposure to respirable crystalline silica, as prescribed in paragraph (d) of the standard for general industry and maritime (paragraph (d)(2) of the standard for construction). OSHA has added the words “make and” prior to “maintain” in order to clarify that the employer’s obligation is to create and preserve such records. This clarification has also been made for other records required by the silica rule. In addition, OSHA now refers to "measurements taken to assess employee exposure" rather than "measurement results used or relied on to characterize employee exposure." This change is editorial, and is intended to clarify OSHA's intent that all measurements of employee exposure to respirable crystalline silica be maintained. Paragraph (k)(1)(ii) of the standard for general industry and maritime (paragraph (j)(1)(ii) of the standard for construction) requires that such records include the following information: the date of measurement for each sample taken; the task monitored; sampling and analytical methods used; the number, duration, and results of samples taken; the identity of the laboratory that performed the analysis; the type of personal protective equipment, such as respirators, worn by the employees monitored; and the name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored.

OSHA has made one editorial modification that differs from the proposed rule in paragraph (k)(1)(ii)(B) of the standard for general industry and maritime (paragraph (j)(1)(ii)(B) of the standard for construction) and that is to change "the operation monitored" to "the task monitored." Both "task" and "operation" are commonly used in describing work. However, OSHA uses the term "task" throughout the rule, and the Agency is using "task" in the recordkeeping provision for consistency and to avoid any potential misunderstanding that could result from using a different term. This editorial change neither increases nor decreases an employer's obligations as set forth in the proposed rule.

The recordkeeping provision that received the most comments was proposed paragraph (j)(1)(ii)(G) (now paragraph (k)(1)(ii)(G) of the standard for general industry and maritime, paragraph (j)(1)(ii)(G) of the standard for construction), which, consistent with existing recordkeeping requirements in OSHA health standards, requires the employer to include in the standard's mandated records the employee's social security number. Morgan Electro Ceramics, National Electrical Carbon Products, Inc. (NECP), Southern Company, the National Tile Contractors Association (NTCA), Dow Chemical Company, the Asphalt Roofing Manufacturers Association (ARMA), the American Petroleum Institute (API), the Marcellus Shale Coalition, Ameren Corporation, the North American Insulation Manufacturers Association (NAIMA), Edison Electric Institute (EEI), the Tile Council of North America (TCNA), the American Foundry Society (AFS), the Nevada Mining Association (NMA), Newmont Mining Corporation (NM), and others opposed the requirement (e.g., Document ID 1772, p.1; 1785, pp. 9-10; 2185, pp. 8; 2267, p. 7; 2270, p. 3; 2291, p. 26; 2301, Attachment 1, pp. 80-81; 2311, p. 3; 2315, p. 7; 2348, Attachment 1, p. 39; 2357, pp. 36-37; 2363, p. 7; 2379, Appendix 1, p. 73; 2107, p. 4; 1963, p. 3). The commenters, citing employee privacy and identity theft concerns, wanted to be allowed to use an identifier other than the social security number, such as an employee identification number, an employee driver's license number, or another unique personal identification number. For example, NAIMA stated "Using social security numbers is a dangerous threat to personal privacy and identify theft that OSHA should affirmatively discourage" (Document ID 2348, Attachment 1, p. 39). Commenters acknowledged that social security numbers must be used for some reports to the government and thus are present in some employer records, but that access to these records is usually more restricted than to air monitoring records.

OSHA has considered the comments it received on this issue and has decided to retain the requirement for including the employee's social security number in the recordkeeping requirements of the rule. The requirement to use an employee's social security number is a longstanding OSHA practice, based on the fact that it is a number that is both unique to an individual and is retained for a lifetime, and does not change as an employee changes employers. The social security number is therefore a useful tool for tracking employee exposures, particularly where exposures are associated with diseases such as silicosis that generally have a long latency period and can develop over a period of time during which an employee may have several employers.

OSHA is cognizant of the privacy concerns expressed by commenters regarding this requirement, and understands the need to balance that interest against the public health interest in requiring the social security identifier. Instances of identity theft and breeches of personal privacy are widely reported and concerning. However, OSHA has concluded that this rule should adhere to the past, consistent practice of requiring employee social security numbers on exposure records mandated by every OSHA substance-specific health standard, and that any change to the Agency's requirements for including employee social security numbers on exposure records should be comprehensive. Some employers who are covered by this rule, such as employers who perform abrasive blasting on surfaces coated with lead, cadmium, or chromium (VI), will be covered by more than one OSHA standard. OSHA examined alternative forms of identification in Phase II of the Agency's Standards Improvement Project, but did not revise requirements for the use of social security numbers (70 FR 1111-1144 (1/5/2005)). Nevertheless, given increasing concerns regarding identity theft and privacy issues, as evidenced by stakeholder comments in this rulemaking record, OSHA intends to examine the requirements for social security numbers in all of its substance-specific health standards in a future rulemaking. In the meantime, the requirement to use and retain social security numbers to comply with this rule remains.

The remaining requirements of paragraph (k)(1)(ii) of the standard for general industry and maritime (paragraph (j)(1)(ii) of the standard for construction) are generally consistent with those found in other OSHA standards, such as the standards for methylene chloride (29 CFR 1910.1052) and chromium (VI) (29 CFR 1910.1026). The additional requirement to include the identity of the laboratory that performed the analysis of exposure measurements is for the reason stated in the preamble to the Notice of Proposed Rulemaking (NPRM), which is that analysis of crystalline silica samples must conform with the requirements listed in the rule (i.e., in Appendix A), and that can only be determined by knowing the identity of the laboratory that performed the analysis.

Fann Contracting, Inc. commented that OSHA's proposed rule would create a "recordkeeping nightmare" and raised concerns about the difficulties of managing air monitoring data for over 200 employees scattered around the state, with 7 to 8 ongoing projects and 12 to 15 total projects per year (Document ID 2116, Attachment 1, p. 11). The American Subcontractors Association expressed concerns about the high costs of transferring data to new technology or keeping records in paper format (Document ID 2187, p. 7).

OSHA understands that, as with any recordkeeping requirement in a comparable rule, there will be time, effort, and expense involved in developing and maintaining records. However, OSHA expects that even employers who manage multiple projects will have a system for maintaining these records, just as they do for their other business records. As for high expenses of transferring data to new technology, the Agency understands that there are multiple ways to maintain these records and there are expenses involved in doing so. Therefore, the Agency is allowing employers the option to use whatever method works best for them, paper or electronic.

Paragraph (k)(1)(iii) of the standard for general industry and maritime (paragraph (j)(1)(iii) of the standard for construction) is unchanged from the proposed rule. It requires the employer to ensure that exposure records are maintained and made available in accordance with

OSHA's access to employee exposure and medical records standard, which specifies that exposure records must be maintained for 30 years (29 CFR 1910.1020(d)(i)(ii)). Commenters addressed the issue of how long an employer should maintain exposure records. The National Industrial Sand Association (NISA) noted that its occupational health program requires NISA members to retain employee air monitoring records indefinitely (Document ID 2195, p. 35). NISA supported the proposed requirement that air monitoring records be retained for 30 years (Document ID 2195, p. 46). Other commenters advocated recordkeeping durations ranging from 10 years to 40 years (e.g., Document ID 2210, Attachment 1, p. 8; 2319, p. 122; 2339, p. 10; 4025, pp. 8-9). The American Society of Safety Engineers (ASSE) recommended that air monitoring records should be retained for 40 years or the duration of employment plus 20 years, whichever is longer, due to latency periods of some silica-related illnesses (Document ID 2339, p. 10). The International Union of Operating Engineers indicated that 10 years is more than adequate time to retain air monitoring data; it commented that British Columbia, Canada requires retention for 10 years (Document ID 4025, pp. 8-9). The Construction Industry Safety Coalition and the National Federation of Independent Business (NFIB) expressed the view that 30 years is too long, but did not make recommendations for what they considered a suitable duration (Document ID 2319, pp. 121-122; 2210, Attachment 1, p. 8). NFIB alleged that employers will have to maintain and make available records of all activities relating to each requirement of the rule if the company wants to ensure it can show a good-faith effort to comply, and indicated that keeping records for 30 years would lead to a "staggering" amount of paperwork (Document ID 2210, Attachment 1, p. 8).

After reviewing the comments in this record, OSHA has concluded that the best approach is to maintain consistency with 29 CFR 1910.1020 and its required time period for retention of exposure records of 30 years. OSHA explained in that rulemaking that it is necessary to keep exposure records for this extended time period because of the long latency period between exposure and development of silica-related disease (45 FR 35212, 35268-35271 (5/23/80)). For example, silicosis is often not detected until 20 years or more after initial exposure. The extended record retention period is therefore needed because establishing causality of disease in employees is assisted by, and in some cases can only be made by, having present and past exposure data (as well as any objective data relied on by the employer and present and past medical surveillance records, as discussed below).

In retaining the 30-year retention period, OSHA does not agree with commenters who recommended extending it to at least 40 years, or even indefinitely. The Agency concludes that the 30-year retention period specified in 29 CFR 1910.1020 represents a reasonable balance between the need to maintain exposure records and the administrative burdens associated with maintaining those records for extended time periods. Because the 30-year records-retention requirement is included in 29 CFR 1910.1020, this duration is consistent with longstanding Agency and employer practice. Other substance-specific rules are also subject to the retention requirements of 29 CFR 1910.1020, such as the standards addressing exposure to methylene chloride (29 CFR 1910.1052) and chromium (VI) (29 CFR 1910.1026). The Agency also disagrees that the 30-year retention requirement will lead to a “staggering” amount of paperwork. as NFIB commented (Document ID 2210, Attachment 1, p. 8). Electronic recordkeeping has become commonplace. Commenters such as the Association of Energy Service Companies and ASSE support the use of electronic or digital records to ease paperwork burdens (Document ID 2344, p. 2; 2339, p. 5). Thus, OSHA finds that the 30-year retention period is necessary and appropriate for air monitoring data.

Paragraph (k)(2)(i) of the standard for general industry and maritime (paragraph (j)(2)(i) of the standard for construction) is substantively unchanged from the proposed rule. It requires employers who rely on objective data to keep accurate records of the objective data. Paragraph (k)(2)(ii) of the standard for general industry and maritime (paragraph (j)(2)(ii) of the standard for construction) requires the record to include: the crystalline silica-containing material in question; the source of the objective data; the testing protocol and results of testing; a description of the process, task, or activity on which the objective data were based; and other data relevant to the process, task, activity, material, or exposures on which the objective data were based. Paragraphs (k)(2)(ii)(D) and (E) of the standard for general industry and maritime (paragraphs (j)(2)(ii)(D) and (E) of the standard for construction) have been modified from the proposed rule to substitute the word "task" for "operation" and to clarify the requirements for records of objective data. These changes are editorial, and do not affect the employer's obligations as set forth in the proposed rule.

Since the rule allows objective data to be used to exempt the employer from monitoring requirements and to provide a basis for selection of respirators, OSHA considers it critical that the use of objective data be documented. As authorized in the rule, reliance on objective data is intended to provide the same degree of assurance that employer monitoring of employee exposures by taking air samples does. The specified content elements are required to ensure that the records are capable of demonstrating to OSHA a reasonable basis for the conclusions drawn by the employer from the objective data.

OSHA considers objective data to be employee exposure records that must be maintained. Paragraph (k)(2)(iii) of the standard for general industry and maritime (paragraph (j)(2)(iii) of the standard for construction) is unchanged from the proposed rule. It requires the employer to ensure that objective data are maintained and made available for 30 years in accordance with 29 CFR 1910.1020(d)(1)(ii)).

The National Asphalt Pavement Association recommended that OSHA clarify that ". . . for an operation provided the controls outlined in Table 1, no further records of objective data would be required" (Document ID 2181, p. 13). OSHA confirms that an employer who fully and properly implements the control measures in Table 1 does not need to have objective data since no exposure assessment (including those based on objective data) is required when the employer is following Table 1. Therefore, following Table 1 does not trigger a recordkeeping or retention requirement.

Associated Builders and Contractors, Inc. (ABC) and ASSE addressed the issue of retaining objective data records for 30 years (Document ID 2289, p. 8; 2339, p. 10). ABC expressed concerns that data could be lost or destroyed during the 30-year period, and thought it would be difficult to enforce this provision. Furthermore, it commented that there is a ". . . large and burdensome amount of records that an employer would need to store and maintain" (Document ID 2289, p. 8). ABC did not make a recommendation on how long employers should maintain objective data records. ASSE commented that 30 years is too short and recommended that objective data records be retained for 40 years or the duration of the employment plus 20 years, whichever is longer, due to latency periods of some silica-related illnesses (Document ID 2339, p. 10). For the same reasons noted in the explanation above for retaining air monitoring data pursuant to paragraph (k)(1)(iii) of the standard for general industry and maritime (paragraph (j)(1)(iii) of the standard for construction), OSHA finds that the 30-year retention period is necessary and appropriate for objective data.

Paragraph (k)(3)(i) of the standard for general industry and maritime (paragraph (j)(3)(i) of the standard for construction) requires the employer to make and maintain an accurate record for each employee subject to medical surveillance under paragraph (i) of the standard for general industry and maritime (paragraph (h) of the standard for construction). Paragraph (k)(3)(ii) of the standard for general industry and maritime (paragraph (j)(3)(ii) of the standard for construction) lists the categories of information that an employer is required to record: the name and social security number of the employee; a copy of the PLHCPs' and specialists' written medical opinions for the employer; and a copy of the information provided to the PLHCPs and specialists where required by paragraph (i)(4) of the standard for general industry and maritime (paragraph (h)(4) of the standard for construction). The information provided to the PLHCPs and specialists includes the employee's duties as they relate to crystalline silica exposure, crystalline silica exposure levels, descriptions of personal protective equipment used by the employee, and information from employment-related medical examinations previously provided to the employee (paragraph (i)(4) of the standard for general industry and maritime, paragraph (h)(4) of the standard for construction).

In paragraph (k)(3)(ii)(B) of the standard for general industry and maritime (paragraph (j)(3)(ii)(B) of the standard for construction), OSHA has changed the "PLHCP's and pulmonary specialist's written opinions" to the "PLHCPs' and specialists' written medical opinions." The change, consistent with paragraph (i) of the standard for general industry and maritime (paragraph (h) of the standard for construction), is made to reflect the revised definition for the term "specialist" included in the rule.

Paragraph (k)(3)(iii) of the standard for general industry and maritime (paragraph (j)(3)(iii) of the standard for construction) is unchanged from the proposed rule. It requires that medical records must be maintained for at least the duration of employment plus 30 years in accordance with 29 CFR 1910.1020(d)(1)(i), which governs application of the retention requirements in this rule. Pursuant to 29 CFR 1910.1020(d)(1)(i)(C), medical records of employees who have worked for less than one year for the employer need not be retained beyond the term of employment if they are provided to the employee upon the termination of employment. This exception allows employers flexibility and the option not to retain medical records in these circumstances (53 FR 38140, 38153-38155 (9/29/88)). This provision greatly reduces the recordkeeping burden on employers of short-term employees, including many construction employees covered by this rule. Of course, neither this rule nor 29 CFR 1910.1020 prohibits employers from keeping the medical records of employees who worked less than one year, and some employers may choose to keep the records. As indicated earlier, employers have the option to keep records in electronic or paper form.

The employer is responsible for the maintenance of records in his or her possession (e.g., the PLHCP's written medical opinion for the employer described in paragraph (i)(6) of the standard for general industry and maritime (paragraph (h)(6) of the standard for construction)). The employer is also responsible for ensuring the retention of records in the possession of the PLHCP (e.g., the written medical report for the employee described in paragraph (i)(5) of the standard for general industry and maritime (paragraph (h)(5) of the standard for construction)) that are created pursuant to this rule's medical surveillance requirements. This responsibility, which derives from 29 CFR 1910.1020(b), means that employers must ensure that the PLHCP retains a copy of medical records for the employee's duration of employment plus 30 years. The employer can generally fulfill this obligation by including the retention requirement in the agreement between the employer and the PLHCP.

Commenters objecting to the recordkeeping requirements for medical records were concerned with privacy and costs. OSCO Industries asserted that the medical recordkeeping provisions would be subject to the Health Insurance Portability and Accountability Act (HIPAA), and thus employers would be denied access to the records (Document ID 1992, p. 12). The National Electrical Contractors Association (NECA) also expressed concerns about the application of HIPAA (Document ID 2295, p. 2). NECA indicated that the recordkeeping requirements would ". . . inundate most businesses with paperwork . . ." and would be ". . . an economic burden to employers in the construction industry . . ." (Document ID 2295, p. 2). Fann Contracting and Leading Builders of America said that medical records would be very expensive and difficult to maintain (Document ID 2116, Attachment 1, p. 11; 2269, p. 19). Fann Contracting commented that they have multiple projects, as many as 7 to 8 ongoing and 12 to 15 per year, with over 200 employees scattered around the state, which makes the new requirements "a recordkeeping nightmare" (Document ID 2116, Attachment 1, p. 11).

As to the expense and difficulty of maintaining the medical records, OSHA recognizes that there will be time, effort, and expense involved in maintaining medical records. However, as stated earlier, OSHA expects that employers who manage multiple projects will have a system for maintaining these records, just as they do for their other business records. The adverse health effects associated with crystalline silica are very serious, and OSHA has concluded that the recordkeeping requirements are necessary to ensure that records are available to assist PLHCPs in identifying health conditions that may place employees at increased risk from exposure, as well as identifying and treating adverse health effects that may develop among employees. Therefore, OSHA concludes that the requirements for making and maintaining medical records are reasonable, and are essential for the health and safety of employees.

As to the concerns expressed regarding the application of HIPAA, the requirement for retention of medical records in this standard (like those in other OSHA standards) is consistent with HIPAA. HIPAA allows for disclosure of certain health information to an employer where needed to comply with OSHA requirements for medical surveillance (45 CFR 164.512). Moreover, this standard's requirement that medical surveillance reports be provided to workers rather than to employers eliminates much of this concern.

Morgan Electro Ceramics, NECP, Southern Company, NTCA, Dow Chemical, ARMA, API, the Marcellus Shale Coalition, Ameren, NAIMA, EEI, TCNA, AFS, NMA, NM and others also questioned the requirement that the employee's social security number be included in medical records (Document ID 1772, p. 1; 1785, pp. 9-10; 2185, pp. 8; 2267, p. 7; 2270, p. 3; 2291, p. 26; 2301, Attachment 1, pp. 80-81; 2311, p. 3; 2315, p. 7; 2348, Attachment 1, p. 39; 2357, pp. 36-37; 2363, p. 7; and 2379, Appendix 1, p. 73; 2107, p. 4; 1963, p. 3).

As noted above in the discussion on air monitoring data, OSHA finds the privacy and security issues associated with the required use of social security numbers are of concern. However, for the same reasons discussed above with regard to employee exposure records, the Agency has decided to retain the requirement for use of social security numbers in medical records. As stated above, OSHA intends separately from this rulemaking to examine the requirements for social security numbers in all of its substance-specific health standards in order to address the issue comprehensively and ensure consistency among standards.

In total, the recordkeeping requirements fulfill the purposes of Section 8(c) of the OSH Act, and help protect employees because such records contribute to the evaluation of employees' health and enable employees and their healthcare providers to make informed health care decisions. These records are especially important when an employee's medical condition places him or her at increased risk of health impairment from further exposure to respirable crystalline silica. Furthermore, the records can be used by the Agency and others to identify illnesses and deaths that may be attributable to respirable crystalline silica exposure, evaluate compliance programs, and assess the efficacy of the standard. OSHA concludes that medical surveillance records, like exposure records, are necessary and appropriate for protection of employee health, enforcement of the standard, and development of information regarding the causes and prevention of occupational illnesses.

Commenters, such as NISA and ASSE, addressed the issue of duration of retention of medical records (Document ID 2339, p. 10; 2195, p. 35). NISA indicated that 30 years is an appropriate retention period (Document ID 2195, p. 35). ASSE indicated that medical records should be retained for 40 years or the duration of the employment plus 20 years, whichever is longer, due to latency periods of some silica-related illnesses (Document ID 2339, p. 10).

As with exposure records and objective data records, OSHA has concluded that the best approach is to maintain consistency with 29 CFR 1910.1020 and its required retention period for medical records; that period is the duration of employment plus 30 years. It is necessary to keep medical records for this extended time period because of the long latency period between exposure and development of silica-related disease (45 FR at 35268-35271). OSHA recognizes that in some cases, the latency period for silica-related diseases may extend beyond 30 years. However, the Agency concludes that the retention period specified in 29 CFR 1910.1020 represents a reasonable balance between the need to maintain records and the administrative burdens associated with maintaining those records for extended time periods. Because the duration of employment plus the 30-year records retention requirement is currently included in

29 CFR 1910.1020, this time period is consistent with longstanding Agency and employer practice.

Charles Gordon, a retired occupational safety and health attorney, advocated for a provision for trade associations, unions, and medical practices to provide medical exams and keep medical records (Document ID 2163, Testimony 1, p. 14). After considering this suggestion, OSHA decided not to incorporate it into the rule. OSHA anticipates that, in some cases, employers may be able to work with unions or trade associations to ensure that medical examinations are provided that meet the requirements of the rule, and that records are maintained. However, in many cases, unions and trade associations will not be available to provide such services. And in any case, the employer is ultimately responsible for ensuring that medical examinations are provided in accordance with the rule. Consistent with OSHA's access to employee exposure and medical records standard (29 CFR 1910.1020), the rule therefore requires the employer to maintain such records, and the employer must ensure the PLHCP retains the medical records for the employee's duration of employment plus 30 years. As stated earlier, the employer can generally fulfill this obligation by including the retention requirement in the contractual agreement between the employer and the PLHCP.

Commenters such as the International Union of Bricklayers and Allied Craftworkers (BAC) and ASSE stated that records should be made available to the employee and the employee's designated representative(s), at the request of the employee (e.g., Document ID 2329, p. 8; 2339, p. 5). OSHA agrees, and employees and their representatives are permitted to obtain a copy of exposure and medical records pursuant to 29 CFR 1910.1020(e)(iii).

Commenters such as the Building and Construction Trades Department, AFL-CIO (BCTD) and BAC requested the addition of a provision for retaining training records in the rule (e.g., Document ID 2371, Attachment 1, p. 50; 2329, p. 8). BAC recommended that employers in the construction industry could use a portable training management system that is designed to track employees' training throughout their career (Document ID 4053, Attachment 1 and Exhibit 2). To keep track of training records, BCTD recommended that employers could use the same portable training management system recommended by BAC or use a portable database, as described in a report by the Mount Sinai Irving J. Selikoff Center for Occupational and Environmental Medicine (Document ID 4223, p. 126; 4073, Attachment 2b).

OSHA is not including a provision for retaining training records in the rule because the Agency has concluded that requiring such records is not necessary. The performance-oriented requirements for training in paragraph (j) of the standard for general industry and maritime (paragraph (i) of the standard for construction) specify that employees must be able to demonstrate knowledge of the health hazards associated with exposure to respirable crystalline silica; tasks that could result in exposure; procedures to protect employees from exposure; as well as the silica standard and the medical surveillance program it requires. These requirements will be sufficient to ensure that employees are adequately trained with regard to recognizing silica hazards and taking protective measures. Moreover, adding a provision for retention of training records would involve additional paperwork burdens for employers. The absence of a requirement for retention of training records in the rule is consistent with OSHA's hazard communication standard (29 CFR 1910.1200), addressing training for all hazardous chemicals, as well as the most recent OSHA substance-specific health standards, addressing exposure to 1,3-butadiene (29 CFR 1910.1051), methylene chloride (29 CFR 1910.1052), and chromium (VI) (29 CFR 1910.1026).

The recordkeeping requirements of the rule are also generally consistent with the recordkeeping provisions of the industry consensus standards, ASTM E 1132 – 06, Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica and ASTM E 2625 – 09, Standard Practice for Controlling Occupational Exposure to Respirable Crystalline Silica for Construction and Demolition Activities. The main substantive differences are related to the use of social security numbers and duration of retention of records. ASTM E 1132 – 06 and ASTM E 2625 – 09 specify that the employer should include an identification number for each employee monitored for dust exposure, but do not indicate that the number must be a social security number, whereas OSHA's rule requires the employer to include the employee's social security number. As noted above, although OSHA intends to reconsider this policy for all standards in a future rulemaking, the Agency has determined that the use of social security numbers is appropriate for this rule. ASTM E 1132 – 06 specifies that medical and exposure records should be retained for 40 years or the duration of employment plus 20 years, whichever is longer. ASTM E 2625 – 09 does not specify a duration for retaining exposure or medical records. OSHA has determined that the retention requirements of 29 CFR 1910.1020 are appropriate for exposure and medical records collected under this rule, because the requirements represent a reasonable balance between the need to maintain records and the administrative burdens associated with maintaining those records, and are consistent with longstanding practice by the Agency with which employers are familiar and to which they are accustomed; changing the duration of retention requirement for this one rule could therefore cause confusion.

Dates

Paragraph (l) of the standard for general industry and maritime (paragraph (k) of the standard for construction) sets forth the effective date of the standard and the date(s) for compliance with the requirements of the standard. OSHA proposed identical requirements for both standards: an effective date 60 days after publication of the rule; a date for compliance with all provisions except engineering controls and laboratory requirements of 180 days after the effective date; a date for compliance with engineering controls requirements, which was one year after the effective date; and a date for compliance with laboratory requirements of two years after the effective date.

The United Steelworkers supported the proposed effective and start-up dates, arguing that they provide adequate time for employers to come into compliance with the rule (Document ID 2336, p. 16). Employers and industry representatives such as the American Exploration and Production Council, the Tile Council of North America, and Ameren requested that the effective date of the rule be extended (e.g., Document ID 2147, p. 2; 2267, p. 7; 2315, p. 4; 2375, Attachment 1, p. 3; 2363 p. 7).

OSHA sets the effective date to allow sufficient time for employers to obtain the standard, read and understand its requirements, and undertake the necessary planning and preparation for compliance. Section 6(b)(4) of the OSH Act allows the effective date of a standard to be delayed for up to 90 days from the date of publication in the Federal Register. Given the requests by commenters, OSHA's interest in having employers implement effective compliance efforts, and the minimal effect of an additional 30 day delay, the Agency has decided that it is appropriate to set the effective date at 90 days from publication, rather than at 60 days. Accordingly, the rule will become effective 90 days after publication in the Federal Register.

Paragraphs (l)(2), (3) and (4) of the standard for general industry and maritime (paragraphs (k)(2) and (3) of the standard for construction) establish dates for compliance with the requirements of the standard. Employers and industry representatives such as the American Petroleum Institute, the National Industrial Sand Association, Dow Chemical Company, the Glass Association of North America (GANA), and the American Foundry Society (AFS) contended that substantially more time was needed to implement engineering controls than the one year from the effective date that had been proposed (e.g., Document ID 2195, pp. 8, 22; 2147, p. 1; 2267, p. 3; 2149, p. 2; 2277, p. 1; 1992, pp. 4, 12; 2023, p. 4; 2315 pp. 4, 9; 2137; 2047; 2215, p. 10; 2311, p. 3; 2291, p. 16; 2105. p. 1; 2348, Attachment 1, p. 40; 2357, p. 18; 2365, pp. 10-22; 2301, Attachment 1, pp. 64, 82; 2302, p. 9; 2327, Attachment 1; 2270, p. 1; 2279, pp. 6, 11; 2290, pp. 3-4; 2296, p. 36; 2384, p. 6; 2493, p. 5; 2379, Appendix 1, pp. 22, 73-74; 2544, p. 11).

General industry employers and trade associations were concerned with the length of time needed for the design, approval, and installation of engineering controls. For example, the AFS provided examples of how implementation of engineering controls could take longer than one year for foundries:

> The proposed compliance period fails to account for the substantial time required for a comprehensive engineering evaluation of the overall silica exposure at the facility and the design of a proposed engineering control system. The engineering phase alone for a 10,000 cfm or larger system typically takes 4 to 6 months -- longer for large or complex exposure problems. This issue is further complicated by the fact that the current national economy has substantially reduced the number of firms offering these environmental services, and all of the affected foundries will be competing for these limited services. The compliance period also fails to take into effect the fact that to attempt to meet the proposed PEL with local exhaust ventilation would require custom control equipment (primarily baghouses) which are not stock items and are custom built for each application. These control systems typically require a minimum of 2 to 4 months for manufacture after the completion of the engineering specifications and

> submission of an order. This period is significantly longer for specialized or large orders (Document ID 2379, Attachment B, p. 37).

Another issue raised by general industry representatives and employers such as Morgan Electro Ceramics, the Asphalt Roofing Manufacturers Association, the Fertilizer Institute, and the National Association of Manufacturers, was the potential length of time involved in environmental permitting processes (e.g., Document ID 1772, p. 1; 1992, Attachment 1, p. 4; 2291, Attachment 1, pp. 16-17; 3487, pp. 26-27; 3492, Attachment 1, pp. 5-6; 3584, Tr. 2845; 2290, Attachment 1, p. 3; 2380, Attachment 2, p. 20). The AFS testified on the permitting issue:

> Because many of the controls involve additions or changes to ventilation systems, OSHA must recognize the additional time required for modelling and permitting by state or federal EPA authorities. The proposed one year compliance period is totally unrealistic. In some states, the mandatory permitting requirement for both new and modified systems requires up to 18 months, and this does not include the design and modelling work necessary to prepare the permit application, or the construction and installation time after approval. For foundries which have a Title V permit, the approval includes an additional time period for the US EPA to review and make comments, and if the facility is subject to the federal Prevention of Significant Deterioration (PSD) or Lowest Achievable Emission Rate (LAER) rules the permit approval can take an additional 6 to 18 months for the detailed review and approval necessary (Document ID 3487, p. 26).

OSHA is persuaded that the concerns expressed by commenters regarding the time needed to implement engineering controls are reasonable, and is extending the compliance deadline for general industry and maritime to allow two years from the effective date for employers to comply with the standard. In extending the proposed compliance date for engineering controls in the general industry and maritime standard by one year, OSHA has concluded that engineering controls can be implemented within two years of the effective date in most general industry and maritime workplaces. However, because permit requirements and application processes vary by jurisdiction, OSHA is willing to use its enforcement discretion in situations where an employer can show it has made good faith efforts to implement engineering controls, but has been unable to implement such controls due to the time needed for environmental permitting.

OSHA understands that some general industry employers may face difficulties in implementing engineering controls due to continuous operation of facilities in particular industries. Trade associations such as the North American Insulation Manufacturers Association (NAIMA) and the GANA noted that their industries have plants that run constantly and shut down only on rare occasions, making installation of engineering controls, which would require a shutdown, unusually difficult and expensive (e.g., Document ID 2348, Attachment 1, p. 40; 2215, Attachment 1, p. 10). OSHA is willing to provide latitude and work with such employers on an individual basis to schedule implementation of engineering controls during shutdowns, provided they are working in good faith toward compliance and that they provide and assure employees use appropriate respirators until engineering controls are installed.

Paragraph (l)(3)(ii) of the standard for general industry and maritime allows five years from the effective date – four years more than the proposed standard – for employers to comply with obligations for engineering controls in hydraulic fracturing operations in the oil and gas industry. Additional time is provided to implement engineering controls in this industry to allow employers to take advantage of further development of emerging technologies discussed in Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA). Paragraph (l)(3)(iii) specifies that obligations for medical surveillance in paragraph (i)(l)(i) commence in accordance with paragraph (l)(4) for hydraulic fracturing operations in the oil and gas industry. Paragraph (l)(4) is discussed below.

Paragraph (k)(2) of the standard for construction allows one year after the effective date to come into compliance with all obligations other than the requirements for methods of sample analysis. This extends the time (one year compared to 180 days) for compliance with the standard's ancillary provisions and retains the one year period after the effective date for engineering controls. Commenting on the proposed compliance dates for construction work, several stakeholders raised issues that might impact the ability of employers to implement engineering controls within one year after the effective date (e.g., Document ID 2296, Attachment 1, p. 36; 2357, p. 18). OSHA expects that the vast majority of construction employers will choose to implement the controls specified in paragraph (c) of the construction standard. These controls are generally commercial products that are readily available and can be purchased and put into use in a very short period of time. For the limited number of construction tasks that require more sophisticated controls (e.g., enclosed cabs on heavy equipment used during the demolition of concrete or masonry structures), the controls are already either commonly in use or could be implemented within one year. Moreover, by implementing the controls specified in paragraph (c) of the construction standard, employers will not be required to assess employee exposures to respirable crystalline silica, so no time will be needed for assessing employee exposures prior to implementing engineering controls. OSHA finds that the ready availability of engineering controls for construction will enable construction employers to implement engineering controls within one year of the effective date, and the Agency is therefore requiring that construction employers implement engineering controls required by the standard within one year of the effective date.

In requiring that general industry and maritime employers comply with most obligations of the standard two years after the effective date, and in requiring that construction employers comply with all ancillary and engineering controls one year after the effective date, OSHA has aligned the compliance dates for other provisions of the standards with the compliance dates for engineering controls. This will allow employers to focus their efforts on implementation of engineering controls. OSHA decided that staggering the compliance dates for some provisions of the rule could serve to divert attention and resources away from the implementation of engineering controls. For example, if respiratory protection were to be required six months after the effective date (as OSHA proposed), employers would need to assess employee exposures, and would need to develop a respiratory protection program and provide appropriate respirators to employees exposed above the PEL, while simultaneously working to implement engineering controls. A requirement for respiratory protection prior to implementation of engineering controls would be particularly problematic where construction employers implement the controls specified in paragraph (c) of the construction standard. This is because those employers would not otherwise be required to assess employee exposures.

In determining the compliance dates for provisions other than engineering controls, OSHA considered the relatively short time period before engineering controls must be implemented in construction work. The Agency recognizes the longer time period allowed for general industry and maritime employers to implement engineering controls. However, general industry employers must comply with a PEL that is approximately equivalent to 100 $\mu g/m^3$ during the period before compliance with the revised PEL of 50 $\mu g/m^3$ is required, whereas construction work will be subject to a higher PEL of approximately 250 $\mu g/m^3$. The lower PEL of approximately 100 $\mu g/m^3$ that will apply to general industry will mitigate respirable crystalline silica exposures in this sector to some extent during the interim period. Moreover, because employers will be using this time to implement engineering controls, OSHA expects that exposures will continue to decline during this period. Construction will continue to be subject to the higher PEL of approximately 250 $\mu g/m^3$ during this interim, but that period will only be one year from the effective date, compared to two years from the effective date for general industry and maritime. OSHA finds that establishing consistent compliance dates for engineering controls and other provisions of the standards is less confusing, more practical, and will better enable employers to focus their time and resources on implementing the control measures that will best protect employees. For hydraulic fracturing operations in the oil and gas industry, OSHA is providing an extra three years– a total of five years from the effective date – for employers to implement engineering controls for hydraulic fracturing operations. During these additional three years, employers must comply with all other requirements of the standard, including requirements for respiratory protection to protect employees exposed to respirable crystalline silica at levels that exceed the revised PEL of 50 $\mu g/m^3$.

The issue of how much time to allow for laboratories to come into compliance with respect to methods of sample analysis received considerable comment during the rulemaking. Employers and trade and professional associations such as the National Tile Contractors Association, the Fertilizer Institute, OSCO Industries, Edison Electric Institute, and Fann Contracting, Inc. expressed concerns about the proposed rule's provisions that gave all employers one year to implement engineering controls and allowed two years before employers would be required to follow requirements for methods of sample analysis (e.g., Document ID 2267, pp. 6-7; 2149, p. 2; 1992, pp. 10, 12; 2179, p. 3; 2312, p. 2; 2317, p. 2; 2314, p. 3; 2357, pp. 18-19; 2365, p. 22; 2116, Attachment 1, p. 48; 2327, p. 29; 2368, p. 3; 2379, Attachment B, p. 37; 3398, pp. 1-2; 3487, p. 27; 3491, p. 5; 2363, p. 6). For example, Andy Fulton of ME Global stated:

> OSHA is giving laboratories 2 years to improve their procedures for accurate silica analysis. However, OSHA is requiring foundries to install expensive engineering controls within one year, before accurate exposure levels are available. This does not make sense, especially when it could involve millions of

dollars (Document ID 2149, p. 2).

In proposing to require employers to implement engineering controls and comply with other provisions of the rule before the laboratory requirements came into effect, OSHA intended to allow time for laboratory capacity to develop. As indicated in Chapter IV of the FEA, OSHA finds that it is feasible to measure exposures to respirable crystalline silica at the revised PEL and action level with a reasonable degree of accuracy and precision using methods that are currently available. Many laboratories are capable of analyzing samples in accordance with the laboratory requirements of the silica rule; OSHA encourages employers to follow these requirements prior to the time that they are mandated. There are approximately 40 laboratories that are accredited by AIHA Laboratory Accreditation Programs for the analysis of crystalline silica (Document ID 3586, Tr. 3284). These laboratories are already capable of analyzing samples in accordance with the laboratory requirements of the silica rule.

OSHA anticipates that the additional demand for respirable crystalline silica exposure monitoring and associated laboratory analysis with the rule will be modest. Most construction employers are expected to implement the specified exposure control measures in paragraph (c) of the construction standard, and will therefore not be required to assess employee exposures, thus placing no demands on laboratories. The performance option for exposure assessment provided in both the general industry and maritime standard at paragraph (d)(2) and the construction standard at paragraph (d)(2)(ii) also serves to lessen the anticipated volume of exposure monitoring. The additional time allowed for compliance with the general industry and maritime standard further serves to diminish concerns about laboratory capacity by providing additional time for laboratory capacity to increase and distributing demand for sample analysis over an extended period of time. OSHA therefore concludes that the compliance date for methods of sample analysis of two years after the effective date is reasonable in both the general industry/maritime and construction standards. OSHA also anticipates that construction employers who perform air monitoring before the laboratory requirements go into effect (see paragraph (k)(3) of the construction standard) will be able to obtain reliable measurements of their employees' exposures to respirable crystalline silica.

Paragraph (l)(4) of the standard for general industry and maritime specifies that obligations in paragraph (i)(1)(i) regarding medical surveillance take effect for employees who will be occupationally exposed to respirable crystalline silica above the PEL for 30 or more days per year beginning two years after the effective date. Obligations in paragraph (i)(l)(i) for employees who will be occupationally exposed to respirable crystalline silica at or above the action level (but at or below the PEL) for 30 or more days per year will commence four years after the effective date. In other words, medical surveillance will be triggered by exposures above the PEL for 30 or more days per year, beginning two years after the effective date and continuing through four years after the effective date, and will then be triggered by exposures at or above the action level for 30 or more days per year beginning four years after the effective date. As indicated in the Summary and Explanation for Medical Surveillance, this approach focuses initial medical surveillance efforts on those employees who are at greatest risk, while giving most employers additional time to fully evaluate the engineering controls they have implemented in order to determine which employees meet the action level trigger for medical surveillance.

Commenters such as NAIMA and the National Concrete Masonry Association voiced concerns about the proposed rule's effects on small businesses, and asked for compliance extensions for small businesses (e.g., Document ID 2348, Attachment 1, p. 41; 2279, Attachment

1, p. 10). OSHA has considered these concerns, and has found that the compliance dates set forth in this section are reasonable for employers of all sizes. Therefore, OSHA has not created exceptions extending the compliance period for specific business classes or sizes.

OSHA also considered comments from the U.S. Chamber of Commerce and the National Stone, Sand, and Gravel Association, among others, expressing concern that the rule would create increased demand for health and safety professionals and for medical professionals; they alleged there are not enough professionals in those fields to service the demand that would be created by the rule (e.g., Document ID 2365, Attachment 1, p. 10; 2237, Attachment 1, p. 4; 3578, Tr. 1127). The Agency does not find these arguments convincing. Most of the provisions of the rule do not generally require the involvement of a health or safety professional, or require only limited oversight from a health or safety professional. For example, exposure monitoring does not need to be performed by certified industrial hygienists; technicians and other trained employees can perform this task. Employer compliance with the specified exposure control methods in paragraph (c) of the construction standard can generally be accomplished without the involvement of a health or safety professional. Compliance with other obligations, such as housekeeping and training requirements, can also be achieved without the involvement of a health or safety professional or with minimal oversight from them. There are a sufficient number of medical professionals available for employers to implement the medical surveillance provisions of the rule. The availability of medical professionals is confirmed and discussed in detail in the summary and explanation of Medical Surveillance in this preamble. Therefore, the Agency finds no evidence in the record that a shortage of available health and safety professionals, or a shortage of medical professionals, will preclude employers from complying with the rule by the dates set forth in this paragraph.

Thus, the effect of changes made to the proposed rule is that: (1) all obligations (i.e., exposure assessment and other ancillary provisions, engineering controls) for general industry and maritime employers (other than hydraulic fracturing operations in the oil and gas industry and an action level trigger for medical surveillance for all general industry and maritime employers) will become enforceable two years after the 90-day effective date of the rule; (2) all obligations for hydraulic fracturing operations in the oil and gas industry (except obligations for engineering controls and an action level trigger for medical surveillance) will become enforceable two years after the 90-day effective date; (3) obligations for engineering controls for hydraulic fracturing operations in the oil and gas industry will become enforceable five years after the 90-day effective date; (4) obligations for an action level trigger for medical surveillance in the standard for general industry and maritime, including hydraulic fracturing operations in the oil and gas industry, will become enforceable four years after the 90-day effective date; (5) all obligations (other than requirements for methods of sample analysis) for construction employers will become enforceable one year after the 90-day effective date; and (6) requirements for methods of sample analysis, applicable to laboratories covered by paragraph (d)(2)(v) of the standard for construction, become enforceable two years after the effective date, i.e., one year after the other requirements in the construction standard and on the same date as all obligations in general industry and maritime (other than hydraulic fracturing).

Appendix A to § 1910.1053 and § 1926.1153 – Methods of sample analysis

Appendix A, which specifies methods of sample analysis, is included as part of each standard, 29 CFR 1910.1053 and 29 CFR 1926.1153. Employers must ensure that all samples taken to satisfy monitoring requirements of the standards are evaluated by a laboratory that analyzes air samples for respirable crystalline silica in accordance with the procedures in

Appendix A (paragraph (d)(5) of the standard for general industry and maritime and paragraph (d)(2)(v) of the standard for construction).

OSHA proposed analysis requirements that it had included as part of paragraph (d) of both standards. The Southern Company recommended that OSHA require use of accredited laboratories and move all other laboratory requirements to an Appendix as a guide for laboratories that analyze silica samples (Document ID 2185, p. 7).

OSHA has retained the substance of the proposed provisions addressing analysis of samples, but has moved these provisions to a new appendix in each standard. The Agency has decided that segregating these specifications in an appendix to each final standard provides greater clarity for both employers and the laboratories that analyze samples.

Appendix A specifies procedures for the laboratories conducting the analysis, but employers must ensure samples taken to satisfy the monitoring requirements of the standard are analyzed by an accredited laboratory using the methods and quality control procedures described in this Appendix. Putting the requirements in a separate appendix, rather than in the regulatory text, facilitates the communication of these requirements to the laboratory analyzing samples. The appendix approach is also meant to clarify that an employer who engages a laboratory to analyze respirable crystalline silica samples may rely on an assurance from that laboratory that the specified requirements were met. For example, the laboratory could include a statement that it complied with the requirements of the standard along with the sampling results provided to the employer, or the employer could obtain the information from the laboratory or industrial hygiene service provider.

Appendix A to the final standards describes the specific analytical methods to be used, as well as the qualifications of the laboratories at which the samples are analyzed. As discussed in greater detail in Chapter IV of the Final Economic Analysis and Final Regulatory Flexibility Analysis (FEA), the sampling and analysis methods required by the rule are technologically feasible in that they are widely used and accepted as the best available methods for measuring individual exposures to respirable crystalline silica. The Agency has determined that the provisions in Appendix A are needed to ensure the accuracy of monitoring required by the rule to measure employee exposures.

OSHA has typically included specifications for the accuracy of exposure monitoring methods in substance-specific standards, but has not always specified the analytical methods to be used or the qualifications of the laboratory that analyzes the samples. Exceptions are the asbestos standards for general industry (29 CFR 1910.1001, Appendix A) and construction (29 CFR 1926.1101, Appendix A), which specify the sampling and analytical methods to be used, as well as quality control procedures to be implemented by laboratories.

Consistent with the evaluation of sampling and analysis methods in the FEA, under the Appendix (A.1), all samples taken to satisfy the monitoring requirements of this section must be evaluated using the procedures specified in one of the following analytical methods: OSHA ID-142; NMAM 7500, NMAM 7602; NMAM 7603; MSHA P-2; or MSHA P-7. OSHA has determined based on inter-laboratory comparisons that laboratory analysis by either X-ray diffraction (XRD) or infrared (IR) spectroscopy is required to ensure the accuracy of the monitoring results. The specified analytical methods are the XRD or IR methods for analysis of respirable crystalline silica that have been established by OSHA, NIOSH, or MSHA.

To ensure the accuracy of air sampling data relied on by employers to achieve compliance with the standard, the standard requires that employers must have air samples analyzed only at laboratories that meet requirements listed in A.2 through A.6.3. The requirements were developed based on recommendations for quality control procedures to improve agreement in analytical results obtained by laboratories (Eller et al., 1999, Document ID 1688, pp. 23-24). According to Dr. Rosa Key-Schwartz, NIOSH's expert in crystalline silica analysis, NIOSH worked closely with AIHA Laboratory Accreditation Programs to implement a silica emphasis program for site visitors who audit accredited laboratories to ensure that these quality control procedures are being followed (Document ID 3579, Tr. 153). As discussed in the FEA, analysis of recent data from the AIHA Proficiency Analytical Testing (PAT) program showed that laboratory performance has improved in recent years, resulting in greater agreement between labs, and this has been attributed to improvement in quality control procedures (Document ID 3998, Attachment 8; see also Section IV of the FEA).

A.2 requires employers to ensure that samples taken to monitor employee exposures are analyzed by a laboratory that is accredited to ANS/ISO/IEC Standard 17025 "General requirements for the competence of testing and calibration laboratories" (EN ISO/IEC 17025:2005) by an accrediting organization that can demonstrate compliance with the requirements of ISO/IEC 17011 "Conformity assessment – General requirements for accreditation bodies accrediting conformity assessment bodies" (EN ISO/IEC 17011:2004). ANS/ISO/IEC 17025 is a consensus standard that was developed by the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC) and approved by the American Society for Testing and Materials (ASTM). This standard establishes criteria by which laboratories can demonstrate proficiency in conducting laboratory analysis through the implementation of quality control measures. To demonstrate competence, laboratories must implement a quality control (QC) program that evaluates analytical uncertainty and provides employers with estimates of sampling and analytical error (SAE) when reporting samples. ISO/IEC 17011 establishes criteria for organizations that accredit laboratories under ISO/IEC 17025. For example, the AIHA accredits laboratories for proficiency in the analysis of crystalline silica using criteria based on the ISO 17025 and other criteria appropriate for the scope of the accreditation.

Appendix A.3-A.6.3 contain additional quality control procedures for laboratories that have been demonstrated to improve accuracy and reliability through inter-laboratory comparisons. The proposed rule would have required that laboratories participate in a round robin testing program with at least two other independent laboratories at least every six months. OSHA deleted this requirement in the final rule since accredited laboratories must participate in the AIHA PAT program. The laboratory must use the most current National Institute of Standards and Technology (NIST) or NIST-traceable standards for instrument calibration or instrument calibration verification (Appendix A.3). The laboratory must have an internal quality control (QC) program that evaluates analytical uncertainty and provides employers with estimates of sampling and analytical error (Appendix A.4). The laboratory must characterize the sample material by identifying polymorphs of respirable crystalline silica present, identifying the presence of any interfering compounds that might affect the analysis, and making the corrections necessary in order to obtain accurate sample analysis (Appendix A.5). The laboratory must analyze quantitatively for respirable crystalline silica only after confirming that the sample matrix is free of uncorrectable analytical interferences, and corrects for analytical interferences (Appendix A.6). The laboratory must perform routine calibration checks with standards that bracket the sample concentrations using five or more calibration standard levels to prepare calibration curves, and use instruments optimized to obtain a quantitative limit of detection that represents a value no higher than 25 percent of the PEL (Appendix A.6.1 – A.6.3).

Several stakeholders commented that requiring employers to analyze samples for all polymorphs (e.g., quartz, cristobalite, tridymite) would be unnecessarily burdensome, especially where the employer knows that some polymorphs are not present in its operations (Document ID 2215, p. 9; 2291, p. 24; 2348, Attachment 1, pp. 33-34; 4213, p. 4; 3588, Tr. 3968). OSHA does not intend for A.5 to require analysis for all polymorphs for every sample. Employers can consult with their laboratories or industrial hygiene service providers to determine which polymorphs are likely to be present in a sample given the nature of the material and processes employed. For example, if a material used by an employer is known to contain only quartz, and that material is not subjected to high temperatures, it is unlikely that cristobalite is present. Likewise, if prior sampling results failed to find cristobalite in airborne dust, there would be no need to analyze samples for cristobalite on a continuing basis. OSHA expects that laboratories and industrial hygiene service providers will be able to guide employers on the sample analyses necessary to ensure compliance with the rule without having to incur unnecessary analytical costs.

Appendix B to § 1910.1053 and § 1926.1153 – Medical Surveillance

Appendix B of each standard, 29 CFR 1910.1053 and 29 CFR 1926.1153, contains medical surveillance guidelines to assist in complying with the medical surveillance provisions and provides other helpful recommendations and information. Appendix B is for informational and guidance purposes only and none of the statements in Appendix B should be construed as imposing a mandatory requirement on employers that is not otherwise imposed by the standard. In addition, this appendix is not intended to detract from any obligation that the rule imposes. American College of Occupational Medicine (ACOEM), National Institute for Occupational Safety and Health (NIOSH), American Public Health Association, and the National Consumers

League supported the inclusion of an appendix for medical surveillance guidelines (Document ID 2080, p. 2; 2177, Attachment B, p. 41; 2178, Attachment 1, p. 4; 2373, p. 4).

The medical surveillance guidelines were in Appendix A of each proposed standard but were moved to Appendix B of the final standards, following the addition of Appendix A for methods of sample analysis. OSHA received some comments recommending corrections or clarifications to Appendix B. For example, NIOSH and the National Industrial Sand Association requested that OSHA update the discussion of digital radiography to include the most recent International Labour Office policy, as was done in the preamble, and NIOSH suggested several clarifications to the discussions on silicosis, specialists and specialist referrals, and tuberculosis (Document ID 2177, Attachment B, pp. 41, 48-50; 2195, pp. 44, 46). OSHA considered those comments and made changes as needed. In addition, OSHA revised Appendix B to make it consistent with the updates to the rule.

American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) requested that the appendix discuss medical confidentiality and provide guidance on information that may be provided to the employer without the employee’s informed consent (Document ID 4204, p. 90). OSHA agrees that it is important to discuss this type of information in Appendix B because the information that the physician or licensed health care professional (PLHCP) is to provide to the employer under the standards has changed substantially from the proposal, and Appendix B may serve as the PLHCP's primary source of information about medical surveillance under the standards. Therefore OSHA has included a discussion on medical confidentiality. In addition, OSHA has included examples of the PLHCP’s written medical report for the employee, the PLHCP’s written medical opinion for the employer, and an authorization form to allow limitations on respirable crystalline silica exposure or recommendations for a specialist examination to be reported to the employer. OSHA expects the example report, opinion, and authorization form will greatly clarify the type of information that is to be reported to the employer.

Some commenters requested that additional information be added to the appendix. ACOEM, NIOSH and Building and Construction Trades Department, AFL-CIO requested that the appendix include spirometry guidelines or reference values (Document ID 2080, p. 9; 2177, Attachment B, pp. 45-46; 4223, pp. 128-130). Collegium Ramazzini requested that the appendix include a standardized medical and exposure history (Document ID 3541, pp. 3, 6). AFL-CIO recommended that the appendix include a discussion on low dose computed tomography (LDCT) screening for lung cancer (Document ID, 4204, p. 82). OSHA is not including the information requested by these commenters in Appendix B for reasons discussed more fully in the summary and explanation for Medical Surveillance. OSHA is not including spirometry guidance because of the widespread availability of useful guidance, including an OSHA spirometry guidance available through OSHA's website. Instead of including a standardized medical and exposure history form, Appendix B includes a discussion of the information to be collected as part of a history that will allow PLHCPs to easily update their current history forms. Appendix B also does not include a discussion about LDCT screening for lung cancer because too little is currently known about the risks and benefits of such screening for employees exposed to respirable crystalline silica.

List of Subjects in 29 CFR Parts 1910, 1915, and 1926

Cancer, Chemicals, Cristobalite, Crystalline silica, Hazardous substances, Health, Lung Diseases, Occupational safety and health, Quartz, Reporting and recordkeeping requirements, Silica, Silicosis, Tridymite.

Authority and Signature

This document was prepared under the direction of David Michaels, Ph.D., MPH, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue, NW, Washington, DC 20210.

The Agency issues the sections under the following authorities: sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); section 107 of the Contract Work Hours and Safety Standards Act (the Construction Safety Act) (40 U.S.C. 3704); section 41 of the Longshore and Harbor Worker's Compensation Act (33 U.S.C. 941); Secretary of Labor's Order 1-2012 (77 FR 3912 (1/25/2012)); and 29 CFR part 1911.

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David Michaels,
Assistant Secretary of Labor for Occupational Safety and Health.

Amendments to Standards

For the reasons set forth in the preamble, 29 CFR parts 1910, 1915, and 1926, of the Code of Federal Regulations are amended as follows:

PART 1910 - OCCUPATIONAL SAFETY AND HEALTH STANDARDS

Subpart Z - [Amended]

1. The authority citation for subpart Z of part 1910 is revised to read as follows:

Authority: Secs. 4, 6, 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), 1-90 (55 FR 9033), 6-96 (62 FR 111), 3-2000 (65 FR 50017), 5-2002 (67 FR 65008), 5-2007 (72 FR 31160), 4-2010 (75 FR 55355), or 1-2012 (77 FR 3912), as applicable; and 29 CFR part 1911. All of subpart Z issued under section 6(b) of the Occupational Safety and Health Act of 1970, except those substances that have exposure limits listed in Tables Z-1, Z-2, and Z-3 of 29 CFR 1910.1000. The latter were issued under section 6(a) (29 U.S.C. 655(a)).

Section 1910.1000, Tables Z-1, Z-2 and Z-3 also issued under 5 U.S.C. 553, but not under 29 CFR part 1911 except for the arsenic (organic compounds), benzene, cotton dust, and chromium (VI) listings.

Section 1910.1001 also issued under section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704) and 5 U.S.C. 553.

Section 1910.1002 also issued under 5 U.S.C. 553, but not under 29 U.S.C. 655 or 29 CFR part 1911.

Sections 1910.1018, 1910.1029, and 1910.1200 also issued under 29 U.S.C. 653.

Section 1910.1030 also issued under Pub. L. 106-430, 114 Stat. 1901.

Section 1910.1201 also issued under 49 U.S.C. 1801-1819 and 5 U.S.C. 553

2. In § 1910.1000, paragraph (e):

a. Amend Table Z-1–Limits on Air Contaminants by:

i. Revising the entries for “Silica, crystalline cristobalite, respirable dust”; “Silica, crystalline quartz, respirable dust”; Silica, crystalline tripoli (as quartz), respirable dust”; and “Silica, crystalline tridymite, respirable dust”; and ii.. Adding footnote 7.

b. Amend Table Z-3–Mineral Dusts by:

i. Revising the entries for “Silica: Crystalline Quartz (Respirable)”, “Silica: Crystalline Cristobalite”, and “Silica: Crystalline Tridymite”;

ii. Removing entries in columns 1, 2, and 3 for “Silica: Crystalline Quartz (Total Dust)” and

iii. Adding footnote f.

The revisions and addition read as follows:

§ 1910.1000 Air contaminants.

*   *   *   *   *

The revisions and addition read as follows:

§1910.1000 Air contaminants.

*   *   *   *   *

TABLE Z-1 – LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm(a)[1]	mg/m^3(b)[1]	Skin designation
* * *	*	*	*	*
Silica, crystalline, respirable dust				
Cristobalite; see 1910.1053[7]	14464-46-1			
Quartz; see 1910.1053[7]	14808-60-7			
Tripoli (as quartz); see 1910.1053[7]	1317-95-9			
Tridymite; see 1910.1053[7]	15468-32-3			

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[1]The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit. They are to be determined from breathing-zone air samples.

(a) Parts of vapor or gas per million parts of contaminated air by volume at 25 °C and 760 torr.

(b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

(c) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound, measured as the metal, the CAS number for the metal is given—not CAS numbers for the individual compounds.

(d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Table Z-2 apply. See 1910.1028 for specific circumstances.

(e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cottom waste processing operations of waste recycling (sorting, blending, cleaning and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.

(f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Table Z-3.

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[3]See Table Z-3.

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[7] See Table Z-3 for the exposure limit for any operations or sectors where the exposure limit in § 1910.1053 is stayed or is otherwise not in effect.

*   *   *   *   *

TABLE Z-3–MINERAL DUSTS

Substance	mppcf [a]	mg/m[3]
Silica:		
Crystalline		
Quartz (Respirable)[f]……………………………	250[b]	10 mg/m[3] [e]

$\%SiO_2+5$ $\% SiO_2+2$

Cristobalite: Use ½ the value calculated from the count or mass formulae for quartz[f]
Tridymite: Use ½ the value calculated from the formulae for quartz[f]

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[a]Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.

[b]The percentage of crystalline silica in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

* * * * *

[e]Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

Aerodynamic diameter (unit density sphere)	**Percent passing selector**
2	90
2.5	75
3.5	50
5.0	25
10	0

The measurements under this note refer to the use of an AEC (now NRC) instrument. The respirable fraction of coal dust is determined with an MRE; the figure corresponding to that of 2.4 mg/m^3 in the table for coal dust is 4.5 mg/m^{3K}.

[f] This standard applies to any operations or sectors for which the respirable crystalline silica standard, 1910.1053, is stayed or is otherwise not in effect.

4. Add **§** 1910.1053 to read as follows:

§1910.1053 Respirable Crystalline Silica

(a) Scope and application. (1) This section applies to all occupational exposures to respirable crystalline silica, except:

(i) Construction work as defined in 29 CFR 1910.12(b) (occupational exposures to respirable crystalline silica in construction work are covered under 29 CFR 1926.1153);

(ii) Agricultural operations covered under 29 CFR part 1928; and

(iii) Exposures that result from the processing of sorptive clays.

(2) This section does not apply where the employer has objective data demonstrating that employee exposure to respirable crystalline silica will remain below 25 micrograms per cubic meter of air (25 $\mu g/m^3$) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.

(3) This section does not apply if the employer complies with 29 CFR 1926.1153 and:

(i) The task performed is indistinguishable from a construction task listed on Table 1 in paragraph (c) of 29 CFR 1926.1153; and

(ii) The task will not be performed regularly in the same environment and conditions.

(b) Definitions. For the purposes of this section the following definitions apply:

Action level means a concentration of airborne respirable crystalline silica of 25 $\mu g/m^3$, calculated as an 8-hour TWA.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Director means the Director of the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, or designee.

Employee exposure means the exposure to airborne respirable crystalline silica that would occur if the employee were not using a respirator.

High-efficiency particulate air [HEPA] filter means a filter that is at least 99.97 percent efficient in removing mono-dispersed particles of 0.3 micrometers in diameter.

Objective data means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

Physician or other licensed health care professional [PLHCP] means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required by paragraph (i) of this section.

Regulated area means an area, demarcated by the employer, where an employee’s exposure to airborne concentrations of respirable crystalline silica exceeds, or can reasonably be expected to exceed, the PEL.

Respirable crystalline silica means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device designed to meet the characteristics for respirable-particle-size-selective samplers specified in the International Organization for Standardization (ISO) 7708:1995: Air Quality – Particle Size Fraction Definitions for Health-Related Sampling.

Specialist means an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine.

This section means this respirable crystalline silica standard, 29 CFR 1910.1053.

(c) Permissible exposure limit (PEL). The employer shall ensure that no employee is exposed to an airborne concentration of respirable crystalline silica in excess of 50 μg/m^3, calculated as an 8-hour TWA.

(d) Exposure assessment—(1) General. The employer shall assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level in accordance with either the performance option in paragraph (d)(2) or the scheduled monitoring option in paragraph (d)(3) of this section.

(2) Performance option. The employer shall assess the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to respirable crystalline silica.

(3) Scheduled monitoring option. (i) The employer shall perform initial monitoring to assess the 8-hour TWA exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the exposures of employees on each shift, for each job classification, in each work area. 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 in order to meet this requirement. In representative sampling, the employer shall sample the employee(s) who are expected to have the highest exposure to respirable crystalline silica.

(ii) If initial monitoring indicates that employee exposures are below the action level, the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring.

(iii) Where the most recent exposure monitoring indicates that employee exposures are at or above the action level but at or below the PEL, the employer shall repeat such monitoring within six months of the most recent monitoring.

(iv) Where the most recent exposure monitoring indicates that employee exposures are above the PEL, the employer shall repeat such monitoring within three months of the most recent monitoring.

(v) Where the most recent (non-initial) exposure monitoring indicates that employee exposures are below the action level, the employer shall repeat such monitoring within six months of the most recent monitoring until two consecutive measurements, taken 7 or more days apart, are below the action level, at which time the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring, except as otherwise provided in paragraph (d)(4) of this section.

(4) Reassessment of exposures. The employer shall reassess exposures whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the action level, or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred.

(5) Methods of sample analysis. The employer shall ensure that all samples taken to satisfy the monitoring requirements of paragraph (d) of this section are evaluated by a laboratory that analyzes air samples for respirable crystalline silica in accordance with the procedures in Appendix A to this section.

(6) Employee notification of assessment results. (i) Within 15 working days after completing an exposure assessment in accordance with paragraph (d) of this section, the

employer shall individually notify each affected employee in writing of the results of that assessment or post the results in an appropriate location accessible to all affected employees.

(ii) Whenever an exposure assessment indicates that employee exposure is above the PEL, the employer shall describe in the written notification the corrective action being taken to reduce employee exposure to or below the PEL.

(7) Observation of monitoring. (i) Where air monitoring is performed to comply with the requirements of this section, the employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to respirable crystalline silica.

(ii) When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required for any workplace hazard, the employer shall provide the observer with protective clothing and equipment at no cost and shall ensure that the observer uses such clothing and equipment.

(e) Regulated areas—(1) Establishment. The employer shall establish a regulated area wherever an employee’s exposure to airborne concentrations of respirable crystalline silica is, or can reasonably be expected to be, in excess of the PEL.

(2) Demarcation. (i) The employer shall demarcate regulated areas from the rest of the workplace in a manner that minimizes the number of employees exposed to respirable crystalline silica within the regulated area.

(ii) The employer shall post signs at all entrances to regulated areas that bear the legend specified in paragraph (j)(2) of this section.

(3) Access. The employer shall limit access to regulated areas to:

(A) Persons authorized by the employer and required by work duties to be present in the regulated area;

(B) Any person entering such an area as a designated representative of employees for the purpose of exercising the right to observe monitoring procedures under paragraph (d) of this section; and

(C) Any person authorized by the Occupational Safety and Health Act or regulations issued under it to be in a regulated area.

(4) Provision of respirators. The employer shall provide each employee and the employee's designated representative entering a regulated area with an appropriate respirator in accordance with paragraph (g) of this section and shall require each employee and the employee's designated representative to use the respirator while in a regulated area.

(f) Methods of compliance—(1) Engineering and work practice controls. The employer shall use engineering and work practice controls to reduce and maintain employee exposure to respirable crystalline silica to or below the PEL, unless the employer can demonstrate that such controls are not feasible. Wherever such feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the PEL, the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level and shall supplement them with the use of respiratory protection that complies with the requirements of paragraph (g) of this section.

(2) Written exposure control plan. (i) The employer shall establish and implement a written exposure control plan that contains at least the following elements:

(A) A description of the tasks in the workplace that involve exposure to respirable crystalline silica;

(B) A description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task; and

(C) A description of the housekeeping measures used to limit employee exposure to respirable crystalline silica.

(ii) The employer shall review and evaluate the effectiveness of the written exposure control plan at least annually and update it as necessary.

(iii) The employer shall make the written exposure control plan readily available for examination and copying, upon request, to each employee covered by this section, their designated representatives, the Assistant Secretary and the Director.

(3) Abrasive blasting. In addition to the requirements of paragraph (f)(1) of this section, the employer shall comply with other OSHA standards, when applicable, such as 29 CFR 1910.94 (Ventilation), 29 CFR 1915.34 (Mechanical paint removers), and 29 CFR 1915 Subpart I (Personal Protective Equipment), where abrasive blasting is conducted using crystalline silica-containing blasting agents, or where abrasive blasting is conducted on substrates that contain crystalline silica.

(g) Respiratory protection—(1) General. Where respiratory protection is required by this section, the employer must provide each employee an appropriate respirator that complies with the requirements of this paragraph and 29 CFR 1910.134. Respiratory protection is required:

(i) Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls;

(ii) Where exposures exceed the PEL during tasks, such as certain maintenance and repair tasks, for which engineering and work practice controls are not feasible;

(iii) During tasks for which an employer has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the PEL; and

(iv) During periods when the employee is in a regulated area.

(2) Respiratory protection program. Where respirator use is required by this section, the employer shall institute a respiratory protection program in accordance with 29 CFR 1910.134.

(h) Housekeeping. (1) The employer shall not allow dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.

(2) The employer shall not allow compressed air to be used to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:

(i) The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or

(ii) No alternative method is feasible.

(i) Medical surveillance—(1) General. (i) The employer shall make medical surveillance available at no cost to the employee, and at a reasonable time and place, for each employee who will be occupationally exposed to respirable crystalline silica at or above the action level for 30 or more days per year.

(ii) The employer shall ensure that all medical examinations and procedures required by this section are performed by a PLHCP as defined in paragraph (b) of this section.

(2) Initial examination. The employer shall make available an initial (baseline) medical examination within 30 days after initial assignment, unless the employee has received a medical

examination that meets the requirements of this section within the last three years. The examination shall consist of:

(i) A medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of tuberculosis; and smoking status and history;

(ii) A physical examination with special emphasis on the respiratory system;

(iii) A chest X-ray (a single posteroanterior radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems), interpreted and classified according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader;

(iv) A pulmonary function test to include forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1) and FEV_1/FVC ratio, administered by a spirometry technician with a current certificate from a NIOSH-approved spirometry course;

(v) Testing for latent tuberculosis infection; and

(vi) Any other tests deemed appropriate by the PLHCP.

(3) Periodic examinations. The employer shall make available medical examinations that include the procedures described in paragraph (i)(2) of this section (except paragraph (i)(2)(v)) at least every three years, or more frequently if recommended by the PLHCP.

(4) Information provided to the PLHCP. The employer shall ensure that the examining PLHCP has a copy of this standard, and shall provide the PLHCP with the following information:

(i) A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

(ii) The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

(iii) A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

(iv) Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

(5) PLHCP's written medical report for the employee. The employer shall ensure that the PLHCP explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

(i) A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

(ii) Any recommended limitations on the employee's use of respirators;

(iii) Any recommended limitations on the employee's exposure to respirable crystalline silica; and

(iv) A statement that the employee should be examined by a specialist (pursuant to paragraph (i)(7) of this section) if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

(6) PLHCP's written medical opinion for the employer. (i) The employer shall obtain a written medical opinion from the PLHCP within 30 days of the medical examination. The written opinion shall contain only the following:

(A) The date of the examination;

(B) A statement that the examination has met the requirements of this section; and

(C) Any recommended limitations on the employee's use of respirators.

(ii) If the employee provides written authorization, the written opinion shall also contain either or both of the following:

(A) Any recommended limitations on the employee's exposure to respirable crystalline silica;

(B) A statement that the employee should be examined by a specialist (pursuant to paragraph (i)(7) of this section) if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

(iii) The employer shall ensure that each employee receives a copy of the written medical opinion described in paragraph (i)(6)(i) and (ii) of this section within 30 days of each medical examination performed.

(7) Additional examinations. (i) If the PLHCP's written medical opinion indicates that an employee should be examined by a specialist, the employer shall make available a medical examination by a specialist within 30 days after receiving the PLHCP's written opinion.

(ii) The employer shall ensure that the examining specialist is provided with all of the information that the employer is obligated to provide to the PLHCP in accordance with paragraph (i)(4) of this section.

(iii) The employer shall ensure that the specialist explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of the examination. The written report shall meet the requirements of paragraph (i)(5) (except paragraph (i)(5)(iv)) of this section.

(iv) The employer shall obtain a written opinion from the specialist within 30 days of the medical examination. The written opinion shall meet the requirements of paragraph (i)(6) (except paragraph (i)(6)(i)(B) and (i)(6)(ii)(B)) of this section.

(j) Communication of respirable crystalline silica hazards to employees—(1) Hazard communication. The employer shall include respirable crystalline silica in the program established to comply with the hazard communication standard (HCS) (29 CFR 1910.1200). The employer shall ensure that each employee has access to labels on containers of crystalline silica and safety data sheets, and is trained in accordance with the provisions of HCS and paragraph (j)(3) of this section. The employer shall ensure that at least the following hazards are addressed: Cancer, lung effects, immune system effects, and kidney effects.

(2) Signs. The employer shall post signs at all entrances to regulated areas that bear the following legend:

DANGER

RESPIRABLE CRYSTALLINE SILICA

MAY CAUSE CANCER

CAUSES DAMAGE TO LUNGS

WEAR RESPIRATORY PROTECTION IN THIS AREA

AUTHORIZED PERSONNEL ONLY

(3) Employee information and training. (i) The employer shall ensure that each employee covered by this section can demonstrate knowledge and understanding of at least the following:

(A) The health hazards associated with exposure to respirable crystalline silica;

(B) Specific tasks in the workplace that could result in exposure to respirable crystalline silica;

(C) Specific measures the employer has implemented to protect employees from exposure to respirable crystalline silica, including engineering controls, work practices, and respirators to be used;

(D) The contents of this section; and

(E) The purpose and a description of the medical surveillance program required by paragraph (i) of this section.

(ii) The employer shall make a copy of this section readily available without cost to each employee covered by this section.

(k) Recordkeeping—(1) Air monitoring data. (i) The employer shall make and maintain an accurate record of all exposure measurements taken to assess employee exposure to respirable crystalline silica, as prescribed in paragraph (d) of this section.

(ii) This record shall include at least the following information:

(A) The date of measurement for each sample taken;

(B) The task monitored;

(C) Sampling and analytical methods used;

(D) Number, duration, and results of samples taken;

(E) Identity of the laboratory that performed the analysis;

(F) Type of personal protective equipment, such as respirators, worn by the employees monitored; and

(G) Name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored.

(iii) The employer shall ensure that exposure records are maintained and made available in accordance with 29 CFR 1910.1020.

(2) Objective data. (i) The employer shall make and maintain an accurate record of all objective data relied upon to comply with the requirements of this section.

(ii) This record shall include at least the following information:

(A) The crystalline silica-containing material in question;

(B) The source of the objective data;

(C) The testing protocol and results of testing;

(D) A description of the process, task, or activity on which the objective data were based; and

(E) Other data relevant to the process, task, activity, material, or exposures on which the objective data were based.

(iii) The employer shall ensure that objective data are maintained and made available in accordance with 29 CFR 1910.1020.

(3) Medical surveillance. (i) The employer shall make and maintain an accurate record for each employee covered by medical surveillance under paragraph (i) of this section.

(ii) The record shall include the following information about the employee:

(A) Name and social security number;

(B) A copy of the PLHCPs' and specialists' written medical opinions; and

(C) A copy of the information provided to the PLHCPs and specialists.

(iii) The employer shall ensure that medical records are maintained and made available in accordance with 29 CFR 1910.1020.

(l) Dates. (1) This section is effective June 23, 2016.

(2) Except as provided for in paragraphs (l)(3) and (4) of this section, all obligations of this section commence June 23, 2018.

(3) For hydraulic fracturing operations in the oil and gas industry:

(i) All obligations of this section, except obligations for medical surveillance in paragraph (i)(1)(i) and engineering controls in paragraph (f)(1) of this section, commence June 23, 2018;

(ii) Obligations for engineering controls in paragraph (f)(1) of this section commence June 23, 2021; and

(iii) Obligations for medical surveillance in paragraph (i)(1)(i) commence in accordance with paragraph (l)(4) of this section.

(4) The medical surveillance obligations in paragraph (i)(1)(i) commence on June 23, 2018, for employees who will be occupationally exposed to respirable crystalline silica above the PEL for 30 or more days per year. Those obligations commence June 23, 2020, for employees

who will be occupationally exposed to respirable crystalline silica at or above the action level for 30 or more days per year.

Appendix A to § 1910.1053– Methods of sample analysis

This appendix specifies the procedures for analyzing air samples for respirable crystalline silica, as well as the quality control procedures that employers must ensure that laboratories use when performing an analysis required under 29 CFR 1910.1053 (d)(5). Employers must ensure that such a laboratory:

1. Evaluates all samples using the procedures specified in one of the following analytical methods: OSHA ID-142; NMAM 7500; NMAM 7602; NMAM 7603; MSHA P-2; or MSHA P-7;

2. Is accredited to ANS/ISO/IEC Standard 17025:2005 with respect to crystalline silica analyses by a body that is compliant with ISO/IEC Standard 17011:2004 for implementation of quality assessment programs;

3. Uses the most current National Institute of Standards and Technology (NIST) or NIST traceable standards for instrument calibration or instrument calibration verification;

4. Implements an internal quality control (QC) program that evaluates analytical uncertainty and provides employers with estimates of sampling and analytical error;

5. Characterizes the sample material by identifying polymorphs of respirable crystalline silica present, identifies the presence of any interfering compounds that might affect the analysis, and makes any corrections necessary in order to obtain accurate sample analysis; and

6. Analyzes quantitatively for crystalline silica only after confirming that the sample matrix is free of uncorrectable analytical interferences, corrects for analytical interferences, and uses a method that meets the following performance specifications:

6.1 Each day that samples are analyzed, performs instrument calibration checks with standards that bracket the sample concentrations;

6.2 Uses five or more calibration standard levels to prepare calibration curves and ensures that standards are distributed through the calibration range in a manner that accurately reflects the underlying calibration curve; and

6.3 Optimizes methods and instruments to obtain a quantitative limit of detection that represents a value no higher than 25 percent of the PEL based on sample air volume.

Appendix B to § 1910.1053 – Medical Surveillance Guidelines

Introduction

The purpose of this Appendix is to provide medical information and recommendations to aid physicians and other licensed health care professionals (PLHCPs) regarding compliance with the medical surveillance provisions of the respirable crystalline silica standard (29 CFR 1910.1053). Appendix B is for informational and guidance purposes only and none of the statements in Appendix B should be construed as imposing a mandatory requirement on employers that is not otherwise imposed by the standard.

Medical screening and surveillance allow for early identification of exposure-related health effects in individual employee and groups of employees, so that actions can be taken to both avoid further exposure and prevent or address adverse health outcomes. Silica-related diseases can be fatal, encompass a variety of target organs, and may have public health consequences when considering the increased risk of a latent tuberculosis (TB) infection becoming active. Thus, medical surveillance of silica-exposed employees requires that PLHCPs have a thorough knowledge of silica-related health effects.

This Appendix is divided into seven sections. Section 1 reviews silica-related diseases, medical responses, and public health responses. Section 2 outlines the components of the medical surveillance program for employees exposed to silica. Section 3 describes the roles and responsibilities of the PLHCP implementing the program and of other medical specialists and public health professionals. Section 4 provides a discussion of considerations, including confidentiality. Section 5 provides a list of additional resources and Section 6 lists references. Section 7 provides sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization.

1. Recognition of Silica-related Diseases.

1.1. Overview. The term "silica" refers specifically to the compound silicon dioxide (SiO_2). Silica is a major component of sand, rock, and mineral ores. Exposure to fine (respirable size) particles of crystalline forms of silica is associated with adverse health effects, such as silicosis, lung cancer, chronic obstructive pulmonary disease (COPD), and activation of latent TB infections. Exposure to respirable crystalline silica can occur in industry settings such as foundries, abrasive blasting operations, paint manufacturing, glass and concrete product manufacturing, brick making, china and pottery manufacturing, manufacturing of plumbing fixtures, and many construction activities including highway repair, masonry, concrete work, rock drilling, and tuck-pointing. New uses of silica continue to emerge. These include countertop manufacturing, finishing, and installation (Kramer et al. 2012; OSHA 2015) and hydraulic fracturing in the oil and gas industry (OSHA 2012).

Silicosis is an irreversible, often disabling, and sometimes fatal fibrotic lung disease. Progression of silicosis can occur despite removal from further exposure. Diagnosis of silicosis requires a history of exposure to silica and radiologic findings characteristic of silica exposure.

Three different presentations of silicosis (chronic, accelerated, and acute) have been defined. Accelerated and acute silicosis are much less common than chronic silicosis. However, it is critical to recognize all cases of accelerated and acute silicosis because these are life-threatening illnesses and because they are caused by substantial overexposures to respirable crystalline silica. Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies current high exposure and a very marked breakdown in prevention.

In addition to silicosis, employees exposed to respirable crystalline silica, especially those with accelerated or acute silicosis, are at increased risks of contracting active TB and other infections (ATS 1997; Rees and Murray 2007). Exposure to respirable crystalline silica also increases an employee's risk of developing lung cancer, and the higher the cumulative exposure, the higher the risk (Steenland et al. 2001; Steenland and Ward 2014). Symptoms for these diseases and other respirable crystalline silica-related diseases are discussed below.

1.2. Chronic Silicosis. Chronic silicosis is the most common presentation of silicosis and usually occurs after at least 10 years of exposure to respirable crystalline silica. The clinical presentation of chronic silicosis is:

1.2.1. Symptoms - shortness of breath and cough, although employees may not notice any symptoms early in the disease. Constitutional symptoms, such as fever, loss of appetite and fatigue, may indicate other diseases associated with silica exposure, such as TB infection or lung cancer. Employees with these symptoms should immediately receive further evaluation and treatment.

1.2.2. Physical Examination - may be normal or disclose dry rales or rhonchi on lung auscultation.

1.2.3. Spirometry - may be normal or may show only a mild restrictive or obstructive pattern.

1.2.4. Chest X-ray - classic findings are small, rounded opacities in the upper lung fields bilaterally. However, small irregular opacities and opacities in other lung areas can also occur. Rarely, "eggshell calcifications" in the hilar and mediastinal lymph nodes are seen.

1.2.5. Clinical Course - chronic silicosis in most cases is a slowly progressive disease. Under the respirable crystalline silica standard, the PLHCP is to recommend that employees with a 1/0 category X-ray be referred to an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine. The PLHCP and/or Specialist should counsel employees regarding work practices and personal habits that could affect employees' respiratory health.

1.3. Accelerated Silicosis. Accelerated silicosis generally occurs within 5-10 years of exposure and results from high levels of exposure to respirable crystalline silica. The clinical presentation of accelerated silicosis is:

1.3.1. Symptoms - shortness of breath, cough, and sometimes sputum production. Employees with exposure to respirable crystalline silica, and especially those with accelerated silicosis, are at high risk for activation of TB infections, atypical mycobacterial infections, and fungal superinfections. Constitutional symptoms, such as fever, weight loss, hemoptysis (coughing up blood), and fatigue may herald one of these infections or the onset of lung cancer.

1.3.2. Physical Examination - rales, rhonchi, or other abnormal lung findings in relation to illnesses present. Clubbing of the digits, signs of heart failure, and cor pulmonale may be present in severe lung disease.

1.3.3. Spirometry - restrictive or mixed restrictive/obstructive pattern.

1.3.4. Chest X-ray - small rounded and/or irregular opacities bilaterally. Large opacities and lung abscesses may indicate infections, lung cancer, or progression to complicated silicosis, also termed progressive massive fibrosis.

1.3.5. Clinical Course - accelerated silicosis has a rapid, severe course. Under the respirable crystalline silica standard, the PLHCP can recommend referral to a Board Certified Specialist in either Pulmonary Disease or Occupational Medicine, as deemed appropriate, and referral to a Specialist is recommended whenever the diagnosis of accelerated silicosis is being considered.

1.4. Acute Silicosis. Acute silicosis is a rare disease caused by inhalation of extremely high levels of respirable crystalline silica particles. The pathology is similar to alveolar proteinosis with lipoproteinaceous material accumulating in the alveoli. Acute silicosis develops rapidly, often, within a few months to less than 2 years of exposure, and is almost always fatal. The clinical presentation of acute silicosis is as follows:

1.4.1. Symptoms - sudden, progressive, and severe shortness of breath. Constitutional symptoms are frequently present and include fever, weight loss, fatigue, productive cough, hemoptysis (coughing up blood), and pleuritic chest pain.

1.4.2. Physical Examination - dyspnea at rest, cyanosis, decreased breath sounds, inspiratory rales, clubbing of the digits, and fever.

1.4.3. Spirometry - restrictive or mixed restrictive/obstructive pattern.

1.4.4. Chest X-ray - diffuse haziness of the lungs bilaterally early in the disease. As the disease progresses, the “ground glass” appearance of interstitial fibrosis will appear.

1.4.5. Clinical Course - employees with acute silicosis are at especially high risk of TB activation, nontuberculous mycobacterial infections, and fungal superinfections. Acute silicosis is immediately life-threatening. The employee should be urgently referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation and treatment. Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies a profoundly high level of silica exposure and may mean that other employees are currently exposed to dangerous levels of silica.

1.5. COPD. COPD, including chronic bronchitis and emphysema, has been documented in silica-exposed employees, including those who do not develop silicosis. Periodic spirometry tests are performed to evaluate each employee for progressive changes consistent with the development of COPD. In addition to evaluating spirometry results of individual employees over time, PLHCPs may want to be aware of general trends in spirometry results for groups of employees from the same workplace to identify possible problems that might exist at that workplace. (See Section 2 of this Appendix on Medical Surveillance for further discussion.) Heart disease may develop secondary to lung diseases such as COPD. A recent study by Liu et al. 2014 noted a significant exposure-response trend between cumulative silica exposure and heart disease deaths, primarily due to pulmonary heart disease, such as cor pulmonale.

1.6. Renal and Immune System. Silica exposure has been associated with several types of kidney disease, including glomerulonephritis, nephrotic syndrome, and end stage renal disease requiring dialysis. Silica exposure has also been associated with other autoimmune conditions, including progressive systemic sclerosis, systemic lupus erythematosus, and rheumatoid arthritis. Studies note an association between employees with silicosis and serologic markers for autoimmune diseases, including antinuclear antibodies, rheumatoid factor, and immune complexes (Jalloul and Banks 2007; Shtraichman et al. 2015).

1.7. TB and Other Infections. Silica-exposed employees with latent TB are 3 to 30 times more likely to develop active pulmonary TB infection (ATS 1997; Rees and Murray 2007). Although respirable crystalline silica exposure does not cause TB infection, individuals with latent TB infection are at increased risk for activation of disease if they have higher levels of respirable crystalline silica exposure, greater profusion of radiographic abnormalities, or a diagnosis of silicosis. Demographic characteristics, such as immigration from some countries, are associated with increased rates of latent TB infection. PLHCPs can review the latest Centers for Disease Control and Prevention (CDC) information on TB incidence rates and high risk populations online (See Section 5 of this Appendix). Additionally, silica-exposed employees are at increased risk for contracting nontuberculous mycobacterial infections, including Mycobacterium avium-intracellulare and Mycobacterium kansaii.

1.8. Lung Cancer. The National Toxicology Program has listed respirable crystalline silica as a known human carcinogen since 2000 (NTP 2014). The International Agency for Research on Cancer (2012) has also classified silica as Group 1 (carcinogenic to humans). Several studies have indicated that the risk of lung cancer from exposure to respirable crystalline silica and smoking is greater than additive (Brown 2009; Liu et al. 2013). Employees should be counseled on smoking cessation.

2. Medical Surveillance.

PLHCPs who manage silica medical surveillance programs should have a thorough understanding of the many silica-related diseases and health effects outlined in Section 1 of this Appendix. At each clinical encounter, the PLHCP should consider silica-related health outcomes, with particular vigilance for acute and accelerated silicosis. In this Section, the required components of medical surveillance under the respirable crystalline silica standard are reviewed, along with additional guidance and recommendations for PLHCPs performing medical surveillance examinations for silica-exposed employees.

2.1. History.

2.1.1. The respirable crystalline silica standard requires the following: A medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of TB; and smoking status and history.

2.1.2. Further, the employer must provide the PLHCP with the following information:

2.1.2.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

2.1.2.2. The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

2.1.2.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

2.1.2.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

2.1.3. Additional guidance and recommendations: A history is particularly important both in the initial evaluation and in periodic examinations. Information on past and current medical conditions (particularly a history of kidney disease, cardiac disease, connective tissue disease, and other immune diseases), medications, hospitalizations and surgeries may uncover health risks, such as immune suppression, that could put an employee at increased health risk from exposure to silica. This information is important when counseling the employee on risks and safe work practices related to silica exposure.

2.2. Physical Examination.

2.2.1. The respirable crystalline silica standard requires the following: A physical examination, with special emphasis on the respiratory system. The physical examination must be performed at the initial examination and every three years thereafter.

2.2.2. Additional guidance and recommendations: Elements of the physical examination that can assist the PHLCP include: an examination of the cardiac system, an extremity examination (for clubbing, cyanosis, edema, or joint abnormalities), and an examination of other pertinent organ systems identified during the history.

2.3. TB Testing.

2.3.1. The respirable crystalline silica standard requires the following: Baseline testing for TB on initial examination.

2.3.2. Additional guidance and recommendations:

2.3.2.1. Current CDC guidelines (See Section 5 of this Appendix) should be followed for the application and interpretation of Tuberculin skin tests (TST). The interpretation and documentation of TST reactions should be performed within 48 to 72 hours of administration by trained PLHCPs.

2.3.2.2. PLHCPs may use alternative TB tests, such as interferon-γ release assays (IGRAs), if sensitivity and specificity are comparable to TST (Mazurek et al. 2010; Slater et al. 2013). PLHCPs can consult the current CDC guidelines for acceptable tests for latent TB infection.

2.3.2.3. The silica standard allows the PLHCP to order additional tests or test at a greater frequency than required by the standard, if deemed appropriate. Therefore, PLHCPs might perform periodic (e.g., annual) TB testing as appropriate, based on employees' risk factors. For example, according to the American Thoracic Society (ATS), the diagnosis of silicosis or exposure to silica for 25 years or more are indications for annual TB testing (ATS 1997). PLHCPs should consult the current CDC guidance on risk factors for TB (See Section 5 of this Appendix).

2.3.2.4. Employees with positive TB tests and those with indeterminate test results should be referred to the appropriate agency or specialist, depending on the test results and clinical picture. Agencies, such as local public health departments, or specialists, such as a pulmonary or infectious disease specialist, may be the appropriate referral. Active TB is a nationally notifiable disease. PLHCPs should be aware of the reporting requirements for their region. All States have TB Control Offices that can be contacted for further information. (See Section 5 of this Appendix for links to CDC's TB resources and State TB Control Offices.)

2.3.2.5. The following public health principles are key to TB control in the U.S. (ATS-CDC-IDSA 2005):

(1) Prompt detection and reporting of persons who have contracted active TB;

(2) Prevention of TB spread to close contacts of active TB cases;

(3) Prevention of active TB in people with latent TB through targeted testing and treatment; and

(4) Identification of settings at high risk for TB transmission so that appropriate infection-control measures can be implemented.

2.4. Pulmonary Function Testing.

2.4.1. The respirable crystalline silica standard requires the following: Pulmonary function testing must be performed on the initial examination and every three years thereafter. The required pulmonary function test is spirometry and must include forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and FEV_1/FVC ratio. Testing must be administered by a spirometry technician with a current certificate from a National Institute for Occupational Health and Safety (NIOSH)-approved spirometry course.

2.4.2. Additional guidance and recommendations: Spirometry provides information about individual respiratory status and can be used to track an employee's respiratory status over time or as a surveillance tool to follow individual and group respiratory function. For quality results, the ATS and the American College of Occupational and Environmental Medicine (ACOEM) recommend use of the third National Health and Nutrition Examination Survey (NHANES III) values, and ATS publishes recommendations for spirometry equipment (Miller et al. 2005; Townsend 2011; Redlich et al. 2014). OSHA's publication, Spirometry Testing in Occupational Health Programs: Best Practices for Healthcare Professionals, provides helpful guidance (See Section 5 of this Appendix). Abnormal spirometry results may warrant further clinical evaluation and possible recommendations for limitations on the employee's exposure to respirable crystalline silica.

2.5. Chest X-ray.

2.5.1. The respirable crystalline silica standard requires the following: A single posteroanterior (PA) radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems. A chest X-ray must be performed on the initial examination and every three years thereafter. The chest X-ray must be interpreted and classified according to the

International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader.

Chest radiography is necessary to diagnose silicosis, monitor the progression of silicosis, and identify associated conditions such as TB. If the B reading indicates small opacities in a profusion of 1/0 or higher, the employee is to receive a recommendation for referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.

2.5.2. Additional guidance and recommendations: Medical imaging has largely transitioned from conventional film-based radiography to digital radiography systems. The ILO Guidelines for the Classification of Pneumoconioses has historically provided film-based chest radiography as a referent standard for comparison to individual exams. However, in 2011, the ILO revised the guidelines to include a digital set of referent standards that were derived from the prior film-based standards. To assist in assuring that digitally-acquired radiographs are at least as safe and effective as film radiographs, NIOSH has prepared guidelines, based upon accepted contemporary professional recommendations (See Section 5 of this Appendix). Current research from Laney et al. 2011 and Halldin et al. 2014 validate the use of the ILO digital referent images. Both studies conclude that the results of pneumoconiosis classification using digital references are comparable to film-based ILO classifications. Current ILO guidance on radiography for pneumoconioses and B-reading should be reviewed by the PLHCP periodically, as needed, on the ILO or NIOSH websites (See Section 5 of this Appendix).

2.6. Other Testing. Under the respirable crystalline silica standards, the PLHCP has the option of ordering additional testing he or she deems appropriate. Additional tests can be ordered on a case-by-case basis depending on individual signs or symptoms and clinical judgment. For example, if an employee reports a history of abnormal kidney function tests, the PLHCP may want to order a baseline renal function tests (e.g., serum creatinine and urinalysis). As indicated above, the PLHCP may order annual TB testing for silica-exposed employees who are at high risk of developing active TB infections. Additional tests that PLHCPs may order based on findings of medical examinations include, but is not limited to, chest computerized tomography (CT) scan for lung cancer or COPD, testing for immunologic diseases, and cardiac testing for pulmonary-related heart disease, such as cor pulmonale.

3. Roles and Responsibilities.

3.1. PLHCP. The PLHCP designation refers to “an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required” by the respirable crystalline silica standard. The legally permitted scope of practice for the PLHCP is determined by each State. PLHCPs who perform clinical services for a silica medical surveillance program should have a thorough knowledge of respirable crystalline silica-related diseases and symptoms. Suspected cases of silicosis, advanced COPD, or other respiratory conditions causing impairment should be promptly referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.

Once the medical surveillance examination is completed, the employer must ensure that the PLHCP explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The written medical report must contain a statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment. In addition, the PLHCP’s written medical report must include any recommended limitations on the employee's use of respirators, any recommended limitations on the employee's exposure to respirable crystalline silica, and a statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational medicine if the chest X-ray is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate by the PLHCP.

The PLHCP should discuss all findings and test results and any recommendations regarding the employee's health, worksite safety and health practices, and medical referrals for further evaluation, if indicated. In addition, it is suggested that the PLHCP offer to provide the employee with a complete copy of their examination and test results, as some employees may want this information for their own records or to provide to their personal physician or a future PLHCP. Employees are entitled to access their medical records.

Under the respirable crystalline silica standard, the employer must ensure that the PLHCP provides the employer with a written medical opinion within 30 days of the employee examination, and that the employee also gets a copy of the written medical opinion for the employer within 30 days. The PLHCP may choose to directly provide the employee a copy of the written medical opinion. This can be particularly helpful to employees, such as construction employees, who may change employers frequently. The written medical opinion can be used by the employee as proof of up-to-date medical surveillance. The following lists the elements of the written medical report for the employee and written medical opinion for the employer. (Sample forms for the written medical report for the employee, the written medical opinion for the employer, and the written authorization are provided in Section 7 of this Appendix.)

3.1.1. The written medical report for the employee must include the following information:

3.1.1.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

3.1.1.2. Any recommended limitations upon the employee's use of a respirator;

3.1.1.3. Any recommended limitations on the employee's exposure to respirable crystalline silica; and

3.1.1.4. A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine, where the standard requires or where the PLHCP has determined such a referral is necessary. The standard requires referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for a chest X-ray B reading indicating small opacities in a profusion of 1/0 or higher, or if the PHLCP determines that referral to a Specialist is necessary for other silica-related findings.

3.1.2. The PLHCP's written medical opinion for the employer must include only the following information:

3.1.2.1. The date of the examination;

3.1.2.2. A statement that the examination has met the requirements of this section; and

3.1.2.3. Any recommended limitations on the employee's use of respirators.

3.1.2.4. If the employee provides the PLHCP with written authorization, the written opinion for the employer shall also contain either or both of the following:

(1) Any recommended limitations on the employee's exposure to respirable crystalline silica; and

(2) A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate.

3.1.2.5. In addition to the above referral for abnormal chest X-ray, the PLHCP may refer an employee to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for other findings of concern during the medical surveillance examination if these findings are potentially related to silica exposure.

3.1.2.6. Although the respirable crystalline silica standard requires the employer to ensure that the PLHCP explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the PLHCP has explained the results of the medical examination to the employee.

3.2. Medical Specialists. The silica standard requires that all employees with chest X-ray B readings of 1/0 or higher be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine. If the employee has given written authorization for the employer to be informed, then the employer shall make available a medical examination by a Specialist within 30 days after receiving the PLHCP's written medical opinion.

3.2.1. The employer must provide the following information to the Board Certified Specialist in Pulmonary Disease or Occupational Medicine:

3.2.1.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

3.2.1.2. The employee’s former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

3.2.1.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

3.2.1.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

3.2.2. The PLHCP should make certain that, with written authorization from the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has any other pertinent medical and occupational information necessary for the specialist’s evaluation of the employee’s condition.

3.2.3. Once the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has evaluated the employee, the employer must ensure that the Specialist explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The employer must also ensure that the Specialist provides the employer with a written medical opinion within 30 days of the employee examination. (Sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization are provided in Section 7 of this Appendix.)

3.2.4. The Specialist’s written medical report for the employee must include the following information:

3.2.4.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

3.2.4.2. Any recommended limitations upon the employee's use of a respirator; and

3.2.4.3. Any recommended limitations on the employee's exposure to respirable crystalline silica.

3.2.5. The Specialist's written medical opinion for the employer must include the following information:

3.2.5.1. The date of the examination; and

3.2.5.2. Any recommended limitations on the employee's use of respirators.

3.2.5.3. If the employee provides the Board Certified Specialist in Pulmonary Disease or Occupational Medicine with written authorization, the written medical opinion for the employer shall also contain any recommended limitations on the employee's exposure to respirable crystalline silica.

3.2.5.4. Although the respirable crystalline silica standard requires the employer to ensure that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the Specialist has explained the results of the medical examination to the employee.

3.2.6. After evaluating the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine should provide feedback to the PLHCP as appropriate, depending on the reason for the referral. OSHA believes that because the PLHCP has the primary relationship with the employer and employee, the Specialist may want to communicate his or her findings to the PLHCP and have the PLHCP simply update the original medical report for the employee and medical opinion for the employer. This is permitted under the standard, so long as all requirements and time deadlines are met.

3.3. Public Health Professionals. PLHCPs might refer employees or consult with public health professionals as a result of silica medical surveillance. For instance, if individual cases of active TB are identified, public health professionals from state or local health departments may assist in diagnosis and treatment of individual cases and may evaluate other potentially affected persons, including coworkers. Because silica-exposed employees are at increased risk of progression from latent to active TB, treatment of latent infection is recommended. The diagnosis of active TB, acute or accelerated silicosis, or other silica-related diseases and infections should serve as sentinel events suggesting high levels of exposure to silica and may require consultation with the appropriate public health agencies to investigate potentially similarly exposed coworkers to assess for disease clusters. These agencies include local or state health departments or OSHA. In addition, NIOSH can provide assistance upon request through their Health Hazard Evaluation program. (See Section 5 of this Appendix)

4. Confidentiality and Other Considerations.

The information that is provided from the PLHCP to the employee and employer under the medical surveillance section of OSHA's respirable crystalline silica standard differs from that of medical surveillance requirements in previous OSHA standards. The standard requires two separate written communications, a written medical report for the employee and a written medical opinion for the employer. The confidentiality requirements for the written medical opinion are more stringent than in past standards. For example, the information the PLHCP can (and must) include in his or her written medical opinion for the employer is limited to: the date of the examination, a statement that the examination has met the requirements of this section, and any recommended limitations on the employee's use of respirators. If the employee provides written authorization for the disclosure of any limitations on the employee's exposure to respirable crystalline silica, then the PLHCP can (and must) include that information in the written medical opinion for the employer as well. Likewise, with the employee's written authorization, the PLHCP can (and must) disclose the PLHCP's referral recommendation (if any) as part of the written medical opinion for the employer. However, the opinion to the employer must not include information regarding recommended limitations on the employee's exposure to respirable crystalline silica or any referral recommendations without the employee's written authorization.

The standard also places limitations on the information that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine can provide to the employer without the employee's written authorization. The Specialist's written medical opinion for the employer, like the PLHCP's opinion, is limited to (and must contain): the date of the examination and any recommended limitations on the employee's use of respirators. If the employee provides written authorization, the written medical opinion can (and must) also contain any limitations on the employee's exposure to respirable crystalline silica.

The PLHCP should discuss the implication of signing or not signing the authorization with the employee (in a manner and language that he or she understands) so that the employee can make an informed decision regarding the written authorization and its consequences. The discussion should include the risk of ongoing silica exposure, personal risk factors, risk of disease progression, and possible health and economic consequences. For instance, written authorization is required for a PLHCP to advise an employer that an employee should be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation of an abnormal chest X-ray (B-reading 1/0 or greater). If an employee does not sign an authorization, then the employer will not know and cannot facilitate the referral to a Specialist and is not required to pay for the Specialist's examination. In the rare case where an employee is diagnosed with acute or accelerated silicosis, co-workers are likely to be at significant risk of developing those diseases as a result of inadequate controls in the workplace. In this case, the PLHCP and/or Specialist should explain this concern to the affected employee and make a determined effort to obtain written authorization from the employee so that the PLHCP and/or Specialist can contact the employer.

Finally, without written authorization from the employee, the PLHCP and/or Board Certified Specialist in Pulmonary Disease or Occupational Medicine cannot provide feedback to an employer regarding control of workplace silica exposure, at least in relation to an individual employee. However, the regulation does not prohibit a PLHCP and/or Specialist from providing an employer with general recommendations regarding exposure controls and prevention programs in relation to silica exposure and silica-related illnesses, based on the information that the PLHCP receives from the employer such as employees' duties and exposure levels. Recommendations may include increased frequency of medical surveillance examinations, additional medical surveillance components, engineering and work practice controls, exposure monitoring and personal protective equipment. For instance, more frequent medical surveillance examinations may be a recommendation to employers for employees who do abrasive blasting with silica because of the high exposures associated with that operation.

ACOEM's Code of Ethics and discussion is a good resource to guide PLHCPs regarding the issues discussed in this section (See Section 5 of this Appendix).

5. Resources.

5.1. American College of Occupational and Environmental Medicine (ACOEM):

ACOEM Code of Ethics. Accessed at: http://www.acoem.org/codeofconduct.aspx

Raymond, L.W. and Wintermeyer, S. (2006) ACOEM evidenced-based statement on medical surveillance of silica-exposed workers: medical surveillance of workers exposed to crystalline silica. J Occup Environ Med, 48, 95-101.

5.2. Center for Disease Control and Prevention (CDC)

Tuberculosis webpage: http://www.cdc.gov/tb/default.htm

State TB Control Offices web page: http://www.cdc.gov/tb/links/tboffices.htm

Tuberculosis Laws and Policies webpage: http://www.cdc.gov/tb/programs/laws/default.htm

CDC. (2013). Latent Tuberculosis Infection: A Guide for Primary Health Care Providers. Accessed at: http://www.cdc.gov/tb/publications/ltbi/pdf/targetedltbi.pdf

5.3. International Labour Organization

International Labour Office (ILO). (2011) Guidelines for the use of the ILO International Classification of Radiographs of Pneumoconioses, Revised edition 2011. Occupational Safety and Health Series No. 22: http://www.ilo.org/safework/info/publications/WCMS_168260/lang--en/index.htm

5.4. National Institute of Occupational Safety and Health (NIOSH)

NIOSH B Reader Program webpage. (Information on interpretation of X-rays for silicosis and a list of certified B-readers). Accessed at:

http://www.cdc.gov/niosh/topics/chestradiography/breader-info.html

NIOSH Guideline (2011). Application of Digital Radiography for the Detection and Classification of Pneumoconiosis. NIOSH publication number 2011-198. Accessed at:

http://www.cdc.gov/niosh/docs/2011-198/

NIOSH Hazard Review (2002), Health Effects of Occupational Exposure to Respirable Crystalline Silica. NIOSH publication number 2002-129: Accessed at http://www.cdc.gov/niosh/docs/2002-129/

NIOSH Health Hazard Evaluations Programs. (Information on the NIOSH Health Hazard Evaluation (HHE) program, how to request an HHE and how to look up an HHE report). Accessed at: http://www.cdc.gov/niosh/hhe/

5.5. National Industrial Sand Association:

Occupational Health Program for Exposure to Crystalline Silica in the Industrial Sand Industry. National Industrial Sand Association, 2nd ed. 2010. Can be ordered at: http://www.sand.org/silica-occupational-health-program

5.6. Occupational Safety and Health Administration (OSHA)

Contacting OSHA: http://www.osha.gov/html/Feed_Back.html

OSHA's Clinicians webpage. (OSHA resources, regulations and links to help clinicians navigate OSHA's web site and aid clinicians in caring for workers.) Accessed at: http://www.osha.gov/dts/oom/clinicians/index.html

OSHA's Safety and Health Topics webpage on Silica. Accessed at: http://www.osha.gov/dsg/topics/silicacrystalline/index.html

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7. Sample Forms.

Three sample forms are provided. The first is a sample written medical report for the employee. The second is a sample written medical opinion for the employer. And the third is a sample written authorization form that employees sign to clarify what information the employee is authorizing to be released to the employer.

WRITTEN MEDICAL REPORT FOR EMPLOYEE

EMPLOYEE NAME: ____________________________________ **DATE OF EXAMINATION**: _______________

TYPE OF EXAMINATION:
[ ] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: ____

RESULTS OF MEDICAL EXAMINATION:

Physical Examination –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Chest X-Ray –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Breathing Test (Spirometry) –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Test for Tuberculosis –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Other:___________________	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed

Results reported as abnormal: ____
____

[ ] Your health may be at increased risk from exposure to respirable crystalline silica due to the following:
____

RECOMMENDATIONS:
[ ] No limitations on respirator use
[ ] Recommended limitations on use of respirator: ____
[ ] Recommended limitations on exposure to respirable crystalline silica: __________________________
____

Dates for recommended limitations, if applicable: _______________ to _____________
MM/DD/YYYY MM/DD/YYYY

[ ] I recommend that you be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine

[ ] Other recommendations*:
____
____

Your next periodic examination for silica exposure should be in: [ ] 3 years [ ] Other: ___________________
MM/DD/YYYY

Examining Provider: ____ Date: ______________________
(signature)

Provider Name: ____
Office Address: ____ Office Phone: ___________________

*These findings may not be related to respirable crystalline silica exposure or may not be work-related, and therefore may not be covered by the employer. These findings may necessitate follow-up and treatment by your personal physician.

Respirable Crystalline Silica standard (§ 1910.1053 or 1926.1153)

WRITTEN MEDICAL OPINION FOR EMPLOYER

EMPLOYER: ____

EMPLOYEE NAME: _______________________________________ **DATE OF EXAMINATION:** _______________

TYPE OF EXAMINATION:
[ ] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: ____

USE OF RESPIRATOR:
[ ] No limitations on respirator use
[ ] Recommended limitations on use of respirator:____

Dates for recommended limitations, if applicable: _______________ to _______________
MM/DD/YYYY MM/DD/YYYY

The employee has provided written authorization for disclosure of the following to the employer (if applicable):

[ ] This employee should be examined by an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine
[ ] Recommended limitations on exposure to respirable crystalline silica:_______________________________________
____

Dates for exposure limitations noted above: _______________ to _______________
MM/DD/YYYY MM/DD/YYYY

NEXT PERIODIC EVALUATION: [ ] 3 years [ ] Other: ______________
MM/DD/YYYY

Examining Provider: ______________________________________ Date: ___________
(signature)

Provider Name: ____ Provider's specialty:________________________

Office Address: ____ Office Phone: ______________

[ ] I attest that the results have been explained to the employee.

The following is required to be checked by the Physician or other Licensed Health Care Professional (PLHCP):
[ ] I attest that this medical examination has met the requirements of the medical surveillance section of the OSHA Respirable Crystalline Silica standard (§ 1910.1053(h) or 1926.1153(h)).

AUTHORIZATION FOR CRYSTALLINE SILICA OPINION TO EMPLOYER

This medical examination for exposure to crystalline silica could reveal a medical condition that results in recommendations for (1) limitations on respirator use, (2) limitations on exposure to crystalline silica, or (3) examination by a specialist in pulmonary disease or occupational medicine. Recommended limitations on respirator use will be included in the written opinion to the employer. If you want your employer to know about limitations on crystalline silica exposure or recommendations for a specialist examination, you will need to give authorization for the written opinion to the employer to include one or both of those recommendations.

I hereby authorize the opinion to the employer to contain the following information, if relevant (please check all that apply):

☐ Recommendations for limitations on crystalline silica exposure

☐ Recommendation for a specialist examination

OR

☐ I do not authorize the opinion to the employer to contain anything other than recommended limitations on respirator use.

Please read and initial:

___ I understand that if I do not authorize my employer to receive the recommendation for specialist examination, the employer will not be responsible for arranging and covering costs of a specialist examination.

____
Name (printed)

______________________________ ______________________________
Signature Date

PART 1915 - OCCUPATIONAL SAFETY AND HEALTH STANDARDS FOR SHIPYARD EMPLOYMENT

5. The authority citation for part 1915 is revised to read as follows:

Authority: Section 41, Longshore and Harbor Workers' Compensation Act (33 U.S.C. 941); Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), 1-90 (55 FR 9033), 6-96 (62 FR 111), 3-2000 (65 FR 50017), 5-2002 (67 FR 65008), 5-2007 (72 FR 31160), 4-2010 (75 FR 55355), or 1-2012 (77 FR 3912), as applicable; 29 CFR part 1911.

Sections 1915.120 and 1915.152 of 29 CFR also issued under 29 CFR part 1911.

6. In §1915.1000, amend Table Z by:

a. Revising the entries for “Silica, crystalline cristobalite, respirable dust”, “Silica, crystalline quartz, respirable dust”, “Silica, crystalline tripoli (as quartz), respirable dust”, and “Silica, crystalline tridymite, respirable dust”;

b. Under the “MINERAL DUSTS” heading of the table, revising the entry for “Silica: Cystalline Quartz”;

c. Adding footnote 5; and

d. Add footnote p.

The revisions and additions should read as follows:

§1915.1000 Air contaminants.

* * * * *

TABLE Z – SHIPYARDS

Substance	CAS No.[d]	ppm [a*]	mg/m[3 b*]	Skin designation

*   *   *   *   *   *   *

Silica, crystalline, respirable dust	
Cristobalite; see 1915.1053	14464-46-1
Quartz; see 1915.1053[5]	14808-60-7
Tripoli (as quartz); see 1915.1053[5]	1317-95-9
Trydimite; see 1915.1053	15468-32-3

*   *   *   *   *   *   *

MINERAL DUSTS

Substance	mppcf [(j)]
SILICA: Crystalline Quartz. Threshold Limit calculated from the formula [(p)]………	$\frac{250^{(k)}}{\% SiO^2+5}$

*   *   *   *   *   *   *

*   *   *   *   *

[5] See Mineral Dusts table for the exposure limit for any operations or sectors where the exposure limit in § 1915.1053 is stayed or is otherwise not in effect.

* The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit. They are to be determined from breathing-zone air samples.

[a]Parts of vapor or gas per million parts of contaminated air by volume at 25 °C and 760 torr.

[b]Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

*   *   *   *   *

[p] This standard applies to any operations or sectors for which the respirable crystalline silica standard, 1915.1053, is stayed or otherwise is not in effect.

7. Add **§** 1915.1053 to read as follows:

§ 1915.1053 Respirable crystalline silica.

The requirements applicable to shipyard employment under this section are identical to those set forth at § 1910.1053 of this chapter.

PART 1926 - SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

Subpart D—Occupational Health and Environmental Controls

8. The authority citation for subpart D of part 1926 is revised to read as follows:

Authority: Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704); Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); and Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), 1-90 (55 FR 9033), 6-96 (62 FR 111), 3-2000 (65 FR 50017), 5-2002 (67 FR 65008), 5-2007 (72 FR 31160), 4-2010 (75 FR 55355), or 1-2012 (77 FR 3912), as applicable; and 29 CFR part 1911.

Sections 1926.58, 1926.59, 1926.60, and 1926.65 also issued under 5 U.S.C. 553 and 29 CFR part 1911.

Section 1926.61 also issued under 49 U.S.C. 1801-1819 and 6 U.S.C. 553.

Section 1926.62 also issued under section 1031 of the Housing and Community Development Act of 1992 (42 U.S.C. 4853).

Section 1926.65 also issued under section 126 of the Superfund Amendments and Reauthorization Act of 1986, as amended (reprinted at 29 U.S.C.A. 655 Note), and 5 U.S.C. 553.

9. In §1926.55, amend appendix A:

a. By revising the entries for “Silica, crystalline cristobalite, respirable dust”, “Silica, crystalline quartz, respirable dust”, “Silica, crystalline tripoli (as quartz), respirable dust”, and “Silica, crystalline tridymite, respirable dust”;

b. Under the “MINERAL DUSTS” heading of the table, by revising the entry for “Silica: Cystalline Quartz” in column 1;

c. Adding footnote 5; and

d. Adding footnote p .

The revisions and additions read as follows:

§1926.55 Gases, vapors, fumes, dusts, and mists.

* * * * *

Appendix A to §1926.55 – 1970 American Conference of Governmental Industrial Hygienists’ Threshold Limit Values of Airborne Contaminants

Threshold Limit Values of Airborne Contaminants for Construction

Substance	CAS No.[d]	ppm [a*]	mg/m^3 [b]	Skin designation
* * * * * * *				
Silica, crystalline, respirable dust				
Cristobalite; see 1926.1153	14464-46-1			
Quartz; see 1926.1153[5]	14808-60-7			
Tripoli (as quartz); see 1926.1153[5]	1317-95-9			
Trydimite; see 1926.1153	15468-32-3			
* * * * * * *				

MINERAL DUSTS

SILICA:
Crystalline
Quartz. Threshold Limit calculated from the formula [(p)]……… $\frac{250^{(k)}}{\% \ SiO2+5}$

* * * * * * *

Footnotes

* * * * *

[5] See Mineral Dusts table for the exposure limit for any operations or sectors where the exposure limit in § 1926.1153 is stayed or is otherwise not in effect.

* * * * *

[a]Parts of vapor or gas per million parts of contaminated air by volume at 25 °C and 760 torr.

[b]Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

* * * * *

[d]The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound, measured as the metal, the CAS number for the metal is given—not CAS numbers for the individual compounds.

* * * * *

[p] This standard applies to any operations or sectors for which the respirable crystalline silica standard, 1926.1153, is stayed or otherwise is not in effect.

Subpart Z—Toxic and Hazardous Substances

10. The authority for subpart Z of part 1926 is revised to read as follows:

Authority: Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704); Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); and Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), 1-90 (55 FR 9033), 6-96 (62 FR 111), 3-2000 (65 FR 50017), 5-2002 (67 FR 65008), 5-2007 (72 FR 31160), 4-2010 (75 FR 55355), or 1-2012 (77 FR 3912), as applicable; and 29 CFR part 1911.

Section 1926.1102 not issued under 29 U.S.C. 655 or 29 CFR part 1911; also issued under 5 U.S.C. 553.

11. Add § 1926.1153 to read as follows:

§1926.1153 Respirable crystalline silica.

(a) Scope and application. This section applies to all occupational exposures to respirable crystalline silica in construction work, except where employee exposure will remain below 25 micrograms per cubic meter of air (25 $\mu g/m^3$) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.

(b) Definitions. For the purposes of this section the following definitions apply:

Action level means a concentration of airborne respirable crystalline silica of 25 $\mu g/m^3$, calculated as an 8-hour TWA.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Director means the Director of the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, or designee.

Competent person means an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge and ability necessary to fulfill the responsibilities set forth in paragraph (g) of this section.

Employee exposure means the exposure to airborne respirable crystalline silica that would occur if the employee were not using a respirator.

High-efficiency particulate air [HEPA] filter means a filter that is at least 99.97 percent efficient in removing mono-dispersed particles of 0.3 micrometers in diameter.

Objective data means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

Physician or other licensed health care professional [PLHCP] means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required by paragraph (h) of this section.

Respirable crystalline silica means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device designed to meet the characteristics for respirable-particle-size-selective samplers specified in the International Organization for Standardization (ISO) 7708:1995: Air Quality – Particle Size Fraction Definitions for Health-Related Sampling.

Specialist means an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine.

This section means this respirable crystalline silica standard, 29 CFR 1926.1153.

(c) Specified exposure control methods. (1) For each employee engaged in a task identified on Table 1, the employer shall fully and properly implement the engineering controls, work practices, and respiratory protection specified for the task on Table 1, unless the employer assesses and limits the exposure of the employee to respirable crystalline silica in accordance with paragraph (d) of this section.

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
(i) Stationary masonry 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.	None	None
(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 an enclosed area.	APF 10	APF 10
(iii) Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less)	For tasks performed outdoors only: Use saw equipped with commercially available 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.	None	None

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**
(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 an enclosed area.	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	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

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**
(vii) Handheld and stand-mounted drills (including impact and rotary hammer drills)	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

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**
(ix) Vehicle-mounted drilling rigs for rock and concrete	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.	None	None
	OR		
	Operate from within an enclosed cab and use water for dust suppression on drill bit.	None	None

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**
(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.		
	– When used outdoors.	None	APF 10
	– When used indoors or in an enclosed area.	APF 10	APF 10
	OR		
	Use tool equipped 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 mechanism.		
	– When used outdoors.	None	APF 10
	– When used indoors or in an enclosed area.	APF 10	APF 10

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**
(xi) Handheld grinders for mortar removal (i.e., tuckpointing)	Use grinder equipped 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 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	APF 10	APF 25
(xii) Handheld grinders for uses other than mortar removal	For tasks performed outdoors only: Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. OR	None	None

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**
	Use grinder equipped 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 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.		
	– When used outdoors.	None	None
	– When used indoors or in an enclosed area.	None	APF 10

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**
(xiii) Walk-behind milling machines and floor grinders	Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
	OR		
	Use machine equipped with dust collection system recommended by the manufacturer. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.	None	None

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**
(xiv) Small drivable milling machines (less than half-lane)	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

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**
(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.	None	None
	OR 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

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**
(xvi) Crushing machines	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 materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	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	None None

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**
(xviii) Heavy equipment and utility vehicles for tasks such as grading and excavating but not including: demolishing, abrading, or fracturing silica-containing materials	Apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
	OR		
	When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.	None	None

(2) When implementing the control measures specified in Table 1, each employer shall:

(i) For tasks performed indoors or in enclosed areas, provide a means of exhaust as needed to minimize the accumulation of visible airborne dust;

(ii) For tasks performed using wet methods, apply water at flow rates sufficient to minimize release of visible dust;

(iii) For measures implemented that include an enclosed cab or booth, ensure that the enclosed cab or booth:

(A) Is maintained as free as practicable from settled dust;

(B) Has door seals and closing mechanisms that work properly;

(C) Has gaskets and seals that are in good condition and working properly;

(D) Is under positive pressure maintained through continuous delivery of fresh air;

(E) Has intake air that is filtered through a filter that is 95% efficient in the 0.3-10.0 µm range (e.g., MERV-16 or better); and

(F) Has heating and cooling capabilities.

(3) Where an employee performs more than one task on Table 1 during the course of a shift, and the total duration of all tasks combined is more than four hours, the required respiratory protection for each task is the respiratory protection specified for more than four hours per shift. If the total duration of all tasks on Table 1 combined is less than four hours, the required respiratory protection for each task is the respiratory protection specified for less than four hours per shift.

(d) Alternative exposure control methods. For tasks not listed in Table 1, or where the employer does not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1:

(1) Permissible exposure limit (PEL). The employer shall ensure that no employee is exposed to an airborne concentration of respirable crystalline silica in excess of 50 $\mu g/m^3$, calculated as an 8-hour TWA.

(2) Exposure assessment—(i) General. The employer shall assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level in accordance with either the performance option in paragraph (d)(2)(ii) or the scheduled monitoring option in paragraph (d)(2)(iii) of this section.

(ii) Performance option. The employer shall assess the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to respirable crystalline silica.

(iii) Scheduled monitoring option. (A) The employer shall perform initial monitoring to assess the 8-hour TWA exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the exposures of employees on each shift, for each job classification, in each work area. 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 in order to meet this requirement. In representative sampling, the employer shall sample the employee(s) who are expected to have the highest exposure to respirable crystalline silica.

(B) If initial monitoring indicates that employee exposures are below the action level, the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring.

(C) Where the most recent exposure monitoring indicates that employee exposures are at or above the action level but at or below the PEL, the employer shall repeat such monitoring within six months of the most recent monitoring.

(D) Where the most recent exposure monitoring indicates that employee exposures are above the PEL, the employer shall repeat such monitoring within three months of the most recent monitoring.

(E) Where the most recent (non-initial) exposure monitoring indicates that employee exposures are below the action level, the employer shall repeat such monitoring within six months of the most recent monitoring until two consecutive measurements, taken seven or more days apart, are below the action level, at which time the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring, except as otherwise provided in paragraph (d)(2)(iv) of this section.

(iv) Reassessment of exposures. The employer shall reassess exposures whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the action level, or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred.

(v) Methods of sample analysis. The employer shall ensure that all samples taken to satisfy the monitoring requirements of paragraph (d)(2) of this section are evaluated by a laboratory that analyzes air samples for respirable crystalline silica in accordance with the procedures in Appendix A to this section.

(vi) Employee notification of assessment results. (A) Within five working days after completing an exposure assessment in accordance with paragraph (d)(2) of this section, the employer shall individually notify each affected employee in writing of the results of that assessment or post the results in an appropriate location accessible to all affected employees.

(B) Whenever an exposure assessment indicates that employee exposure is above the PEL, the employer shall describe in the written notification the corrective action being taken to reduce employee exposure to or below the PEL.

(vii) Observation of monitoring. (A) Where air monitoring is performed to comply with the requirements of this section, the employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to respirable crystalline silica.

(B) When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required for any workplace hazard, the employer shall provide the observer with protective clothing and equipment at no cost and shall ensure that the observer uses such clothing and equipment.

(3) Methods of compliance—(i) Engineering and work practice controls. The employer shall use engineering and work practice controls to reduce and maintain employee exposure to

respirable crystalline silica to or below the PEL, unless the employer can demonstrate that such controls are not feasible. Wherever such feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the PEL, the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level and shall supplement them with the use of respiratory protection that complies with the requirements of paragraph (e) of this section.

(ii) Abrasive blasting. In addition to the requirements of paragraph (d)(3)(i) of this section, the employer shall comply with other OSHA standards, when applicable, such as 29 CFR 1926.57 (Ventilation), where abrasive blasting is conducted using crystalline silica-containing blasting agents, or where abrasive blasting is conducted on substrates that contain crystalline silica.

(e) Respiratory protection—(1) General. Where respiratory protection is required by this section, the employer must provide each employee an appropriate respirator that complies with the requirements of this paragraph and 29 CFR 1910.134. Respiratory protection is required:

(i) Where specified by Table 1 of paragraph (c) of this section; or

(ii) For tasks not listed in Table 1, or where the employer does not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1:

(A) Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls;

(B) Where exposures exceed the PEL during tasks, such as certain maintenance and repair tasks, for which engineering and work practice controls are not feasible; and

(C) During tasks for which an employer has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the PEL.

(2) Respiratory protection program. Where respirator use is required by this section, the employer shall institute a respiratory protection program in accordance with 29 CFR 1910.134.

(3) Specified exposure control methods. For the tasks listed in Table 1 in paragraph (c) of this section, if the employer fully and properly implements the engineering controls, work practices, and respiratory protection described in Table 1, the employer shall be considered to be in compliance with paragraph (e)(1) of this section and the requirements for selection of respirators in 29 CFR 1910.134(d)(1)(iii) and (d)(3) with regard to exposure to respirable crystalline silica.

(f) Housekeeping. (1) The employer shall not allow dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.

(2) The employer shall not allow compressed air to be used to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:

(i) The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or

(ii) No alternative method is feasible.

(g) Written exposure control plan. (1) The employer shall establish and implement a written exposure control plan that contains at least the following elements:

(i) A description of the tasks in the workplace that involve exposure to respirable crystalline silica;

(ii) A description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task;

(iii) A description of the housekeeping measures used to limit employee exposure to respirable crystalline silica; and

(iv) A description of the procedures used to restrict access to work areas, when necessary, to minimize the number of employees exposed to respirable crystalline silica and their level of exposure, including exposures generated by other employers or sole proprietors.

(2) The employer shall review and evaluate the effectiveness of the written exposure control plan at least annually and update it as necessary.

(3) The employer shall make the written exposure control plan readily available for examination and copying, upon request, to each employee covered by this section, their designated representatives, the Assistant Secretary and the Director.

(4) The employer shall designate a competent person to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan.

(h) Medical surveillance—(1) General. (i) The employer shall make medical surveillance available at no cost to the employee, and at a reasonable time and place, for each employee who will be required under this section to use a respirator for 30 or more days per year.

(ii) The employer shall ensure that all medical examinations and procedures required by this section are performed by a PLHCP as defined in paragraph (b) of this section.

(2) Initial examination. The employer shall make available an initial (baseline) medical examination within 30 days after initial assignment, unless the employee has received a medical examination that meets the requirements of this section within the last three years. The examination shall consist of:

(i) A medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system;

any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of tuberculosis; and smoking status and history;

(ii) A physical examination with special emphasis on the respiratory system;

(iii) A chest X-ray (a single posteroanterior radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems), interpreted and classified according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader;

(iv) A pulmonary function test to include forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1) and FEV_1/FVC ratio, administered by a spirometry technician with a current certificate from a NIOSH-approved spirometry course;

(v) Testing for latent tuberculosis infection; and

(vi) Any other tests deemed appropriate by the PLHCP.

(3) Periodic examinations. The employer shall make available medical examinations that include the procedures described in paragraph (h)(2) of this section (except paragraph (h)(2)(v)) at least every three years, or more frequently if recommended by the PLHCP.

(4) Information provided to the PLHCP. The employer shall ensure that the examining PLHCP has a copy of this standard, and shall provide the PLHCP with the following information:

(i) A description of the employee’s former, current, and anticipated duties as they relate to the employee’s occupational exposure to respirable crystalline silica;

(ii) The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

(iii) A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

(iv) Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

(5) PLHCP's written medical report for the employee. The employer shall ensure that the PLHCP explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

(i) A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

(ii) Any recommended limitations on the employee's use of respirators;

(iii) Any recommended limitations on the employee's exposure to respirable crystalline silica; and

(iv) A statement that the employee should be examined by a specialist (pursuant to paragraph (h)(7) of this section) if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

(6) PLHCP's written medical opinion for the employer. (i) The employer shall obtain a written medical opinion from the PLHCP within 30 days of the medical examination. The written opinion shall contain only the following:

(A) The date of the examination;

(B) A statement that the examination has met the requirements of this section; and

(C) Any recommended limitations on the employee's use of respirators.

(ii) If the employee provides written authorization, the written opinion shall also contain either or both of the following:

(A) Any recommended limitations on the employee's exposure to respirable crystalline silica;

(B) A statement that the employee should be examined by a specialist (pursuant to paragraph (h)(7) of this section) if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

(iii) The employer shall ensure that each employee receives a copy of the written medical opinion described in paragraph (h)(6)(i) and (ii) of this section within 30 days of each medical examination performed.

(7) Additional examinations. (i) If the PLHCP's written medical opinion indicates that an employee should be examined by a specialist, the employer shall make available a medical examination by a specialist within 30 days after receiving the PLHCP's written opinion.

(ii) The employer shall ensure that the examining specialist is provided with all of the information that the employer is obligated to provide to the PLHCP in accordance with paragraph (h)(4) of this section.

(iii) The employer shall ensure that the specialist explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of the examination. The written report shall meet the requirements of paragraph (h)(5) (except paragraph (h)(5)(iv)) of this section.

(iv) The employer shall obtain a written opinion from the specialist within 30 days of the medical examination. The written opinion shall meet the requirements of paragraph (h)(6) (except paragraph (h)(6)(i)(B) and (ii)(B)) of this section.

(i) Communication of respirable crystalline silica hazards to employees—(1) Hazard communication. The employer shall include respirable crystalline silica in the program established to comply with the hazard communication standard (HCS) (29 CFR 1910.1200). The employer shall ensure that each employee has access to labels on containers of crystalline silica and safety data sheets, and is trained in accordance with the provisions of HCS and paragraph (i)(2) of this section. The employer shall ensure that at least the following hazards are addressed: Cancer, lung effects, immune system effects, and kidney effects.

(2) Employee information and training. (i) The employer shall ensure that each employee covered by this section can demonstrate knowledge and understanding of at least the following:

(A) The health hazards associated with exposure to respirable crystalline silica;

(B) Specific tasks in the workplace that could result in exposure to respirable crystalline silica;

(C) Specific measures the employer has implemented to protect employees from exposure to respirable crystalline silica, including engineering controls, work practices, and respirators to be used;

(D) The contents of this section;

(E) The identity of the competent person designated by the employer in accordance with paragraph (g)(4) of this section; and

(F) The purpose and a description of the medical surveillance program required by paragraph (h) of this section.

(ii) The employer shall make a copy of this section readily available without cost to each employee covered by this section.

(j) Recordkeeping—(1) Air monitoring data. (i) The employer shall make and maintain an accurate record of all exposure measurements taken to assess employee exposure to respirable crystalline silica, as prescribed in paragraph (d)(2) of this section.

(ii) This record shall include at least the following information:

(A) The date of measurement for each sample taken;

(B) The task monitored;

(C) Sampling and analytical methods used;

(D) Number, duration, and results of samples taken;

(E) Identity of the laboratory that performed the analysis;

(F) Type of personal protective equipment, such as respirators, worn by the employees monitored; and

(G) Name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored.

(iii) The employer shall ensure that exposure records are maintained and made available in accordance with 29 CFR 1910.1020.

(2) Objective data. (i) The employer shall make and maintain an accurate record of all objective data relied upon to comply with the requirements of this section.

(ii) This record shall include at least the following information:

(A) The crystalline silica-containing material in question;

(B) The source of the objective data;

(C) The testing protocol and results of testing;

(D) A description of the process, task, or activity on which the objective data were based; and

(E) Other data relevant to the process, task, activity, material, or exposures on which the objective data were based.

(iii) The employer shall ensure that objective data are maintained and made available in accordance with 29 CFR 1910.1020.

(3) Medical surveillance. (i) The employer shall make and maintain an accurate record for each employee covered by medical surveillance under paragraph (h) of this section.

(ii) The record shall include the following information about the employee:

(A) Name and social security number;

(B) A copy of the PLHCPs' and specialists' written medical opinions; and

(C) A copy of the information provided to the PLHCPs and specialists.

(iii) The employer shall ensure that medical records are maintained and made available in accordance with 29 CFR 1910.1020.

(k) Dates. (1) This section shall become effective June 23, 2016.

(2) All obligations of this section, except requirements for methods of sample analysis in paragraph (d)(2)(v), shall commence June 23, 2017.

(3) Requirements for methods of sample analysis in paragraph (d)(2)(v) of this section commence June 23, 2018.

Appendix A to § 1926.1153 – Methods of sample analysis.

This This appendix specifies the procedures for analyzing air samples for respirable crystalline silica, as well as the quality control procedures that employers must ensure that laboratories use when performing an analysis required under 29 CFR 1926.1153 (d)(2)(v). Employers must ensure that such a laboratory:

1. Evaluates all samples using the procedures specified in one of the following analytical methods: OSHA ID-142; NMAM 7500; NMAM 7602; NMAM 7603; MSHA P-2; or MSHA P-7;

2. Is accredited to ANS/ISO/IEC Standard 17025:2005 with respect to crystalline silica analyses by a body that is compliant with ISO/IEC Standard 17011:2004 for implementation of quality assessment programs;

3. Uses the most current National Institute of Standards and Technology (NIST) or NIST traceable standards for instrument calibration or instrument calibration verification;

4. Implements an internal quality control (QC) program that evaluates analytical uncertainty and provides employers with estimates of sampling and analytical error;

5. Characterizes the sample material by identifying polymorphs of respirable crystalline silica present, identifies the presence of any interfering compounds that might affect the analysis, and makes any corrections necessary in order to obtain accurate sample analysis; and

6. Analyzes quantitatively for crystalline silica only after confirming that the sample matrix is free of uncorrectable analytical interferences, corrects for analytical interferences, and uses a method that meets the following performance specifications:

6.1 Each day that samples are analyzed, performs instrument calibration checks with standards that bracket the sample concentrations;

6.2 Uses five or more calibration standard levels to prepare calibration curves and ensures that standards are distributed through the calibration range in a manner that accurately reflects the underlying calibration curve; and

6.3 Optimizes methods and instruments to obtain a quantitative limit of detection that represents a value no higher than 25 percent of the PEL based on sample air volume.

Appendix B to § 1926.1153 – Medical Surveillance Guidelines.

Introduction

The purpose of this Appendix is to provide medical information and recommendations to aid physicians and other licensed health care professionals (PLHCPs) regarding compliance with the medical surveillance provisions of the respirable crystalline silica standard (29 CFR 1926.1153). Appendix B is for informational and guidance purposes only and none of the statements in Appendix B should be construed as imposing a mandatory requirement on employers that is not otherwise imposed by the standard.

Medical screening and surveillance allow for early identification of exposure-related health effects in individual employee and groups of employees, so that actions can be taken to both avoid further exposure and prevent or address adverse health outcomes. Silica-related diseases can be fatal, encompass a variety of target organs, and may have public health consequences when considering the increased risk of a latent tuberculosis (TB) infection becoming active. Thus, medical surveillance of silica-exposed employees requires that PLHCPs have a thorough knowledge of silica-related health effects.

This Appendix is divided into seven sections. Section 1 reviews silica-related diseases, medical responses, and public health responses. Section 2 outlines the components of the medical surveillance program for employees exposed to silica. Section 3 describes the roles and responsibilities of the PLHCP implementing the program and of other medical specialists and public health professionals. Section 4 provides a discussion of considerations, including confidentiality. Section 5 provides a list of additional resources and Section 6 lists references. Section 7 provides sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization.

1. Recognition of Silica-related Diseases.

1.1. Overview. The term "silica" refers specifically to the compound silicon dioxide (SiO_2). Silica is a major component of sand, rock, and mineral ores. Exposure to fine (respirable size) particles of crystalline forms of silica is associated with adverse health effects, such as silicosis, lung cancer, chronic obstructive pulmonary disease (COPD), and activation of latent TB infections. Exposure to respirable crystalline silica can occur in industry settings such as foundries, abrasive blasting operations, paint manufacturing, glass and concrete product manufacturing, brick making, china and pottery manufacturing, manufacturing of plumbing fixtures, and many construction activities including highway repair, masonry, concrete work, rock drilling, and tuck-pointing. New uses of silica continue to emerge. These include countertop manufacturing, finishing, and installation (Kramer et al. 2012; OSHA 2015) and hydraulic fracturing in the oil and gas industry (OSHA 2012).

Silicosis is an irreversible, often disabling, and sometimes fatal fibrotic lung disease. Progression of silicosis can occur despite removal from further exposure. Diagnosis of silicosis requires a history of exposure to silica and radiologic findings characteristic of silica exposure.

Three different presentations of silicosis (chronic, accelerated, and acute) have been defined. Accelerated and acute silicosis are much less common than chronic silicosis. However, it is critical to recognize all cases of accelerated and acute silicosis because these are life-threatening illnesses and because they are caused by substantial overexposures to respirable crystalline silica. Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies current high exposure and a very marked breakdown in prevention.

In addition to silicosis, employees exposed to respirable crystalline silica, especially those with accelerated or acute silicosis, are at increased risks of contracting active TB and other infections (ATS 1997; Rees and Murray 2007). Exposure to respirable crystalline silica also increases an employee's risk of developing lung cancer, and the higher the cumulative exposure, the higher the risk (Steenland et al. 2001; Steenland and Ward 2014). Symptoms for these diseases and other respirable crystalline silica-related diseases are discussed below.

1.2. Chronic Silicosis. Chronic silicosis is the most common presentation of silicosis and usually occurs after at least 10 years of exposure to respirable crystalline silica. The clinical presentation of chronic silicosis is:

1.2.1. Symptoms - shortness of breath and cough, although employees may not notice any symptoms early in the disease. Constitutional symptoms, such as fever, loss of appetite and fatigue, may indicate other diseases associated with silica exposure, such as TB infection or lung cancer. Employees with these symptoms should immediately receive further evaluation and treatment.

1.2.2. Physical Examination - may be normal or disclose dry rales or rhonchi on lung auscultation.

1.2.3. Spirometry - may be normal or may show only a mild restrictive or obstructive pattern.

1.2.4. Chest X-ray - classic findings are small, rounded opacities in the upper lung fields bilaterally. However, small irregular opacities and opacities in other lung areas can also occur. Rarely, “eggshell calcifications” in the hilar and mediastinal lymph nodes are seen.

1.2.5. Clinical Course - chronic silicosis in most cases is a slowly progressive disease. Under the respirable crystalline silica standard, the PLHCP is to recommend that employees with a 1/0 category X-ray be referred to an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine. The PLHCP and/or Specialist should counsel employees regarding work practices and personal habits that could affect employees’ respiratory health.

<u>1.3. Accelerated Silicosis.</u> Accelerated silicosis generally occurs within 5-10 years of exposure and results from high levels of exposure to respirable crystalline silica. The clinical presentation of accelerated silicosis is:

1.3.1. Symptoms - shortness of breath, cough, and sometimes sputum production. Employees with exposure to respirable crystalline silica, and especially those with accelerated silicosis, are at high risk for activation of TB infections, atypical mycobacterial infections, and fungal superinfections. Constitutional symptoms, such as fever, weight loss, hemoptysis (coughing up blood), and fatigue may herald one of these infections or the onset of lung cancer.

1.3.2. Physical Examination - rales, rhonchi, or other abnormal lung findings in relation to illnesses present. Clubbing of the digits, signs of heart failure, and cor pulmonale may be present in severe lung disease.

1.3.3. Spirometry - restrictive or mixed restrictive/obstructive pattern.

1.3.4. Chest X-ray - small rounded and/or irregular opacities bilaterally. Large opacities and lung abscesses may indicate infections, lung cancer, or progression to complicated silicosis, also termed progressive massive fibrosis.

1.3.5. Clinical Course - accelerated silicosis has a rapid, severe course. Under the respirable crystalline silica standard, the PLHCP can recommend referral to a Board Certified Specialist in either Pulmonary Disease or Occupational Medicine, as deemed appropriate, and referral to a Specialist is recommended whenever the diagnosis of accelerated silicosis is being considered.

1.4. Acute Silicosis. Acute silicosis is a rare disease caused by inhalation of extremely high levels of respirable crystalline silica particles. The pathology is similar to alveolar proteinosis with lipoproteinaceous material accumulating in the alveoli. Acute silicosis develops rapidly, often, within a few months to less than 2 years of exposure, and is almost always fatal. The clinical presentation of acute silicosis is as follows:

1.4.1. Symptoms - sudden, progressive, and severe shortness of breath. Constitutional symptoms are frequently present and include fever, weight loss, fatigue, productive cough, hemoptysis (coughing up blood), and pleuritic chest pain.

1.4.2. Physical Examination - dyspnea at rest, cyanosis, decreased breath sounds, inspiratory rales, clubbing of the digits, and fever.

1.4.3. Spirometry - restrictive or mixed restrictive/obstructive pattern.

1.4.4. Chest X-ray - diffuse haziness of the lungs bilaterally early in the disease. As the disease progresses, the “ground glass” appearance of interstitial fibrosis will appear.

1.4.5. Clinical Course - employees with acute silicosis are at especially high risk of TB activation, nontuberculous mycobacterial infections, and fungal superinfections. Acute silicosis is immediately life-threatening. The employee should be urgently referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation and treatment. Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies a profoundly high level of silica exposure and may mean that other employees are currently exposed to dangerous levels of silica.

1.5. COPD. COPD, including chronic bronchitis and emphysema, has been documented in silica-exposed employees, including those who do not develop silicosis. Periodic spirometry tests are performed to evaluate each employee for progressive changes consistent with the development of COPD. In addition to evaluating spirometry results of individual employees over time, PLHCPs may want to be aware of general trends in spirometry results for groups of employees from the same workplace to identify possible problems that might exist at that workplace. (See Section 2 of this Appendix on Medical Surveillance for further discussion.) Heart disease may develop secondary to lung diseases such as COPD. A recent study by Liu et al. 2014 noted a significant exposure-response trend between cumulative silica exposure and heart disease deaths, primarily due to pulmonary heart disease, such as cor pulmonale.

1.6. Renal and Immune System. Silica exposure has been associated with several types of kidney disease, including glomerulonephritis, nephrotic syndrome, and end stage renal disease requiring dialysis. Silica exposure has also been associated with other autoimmune conditions, including progressive systemic sclerosis, systemic lupus erythematosus, and rheumatoid arthritis. Studies note an association between employees with silicosis and serologic markers for autoimmune diseases, including antinuclear antibodies, rheumatoid factor, and immune complexes (Jalloul and Banks 2007; Shtraichman et al. 2015).

1.7. TB and Other Infections. Silica-exposed employees with latent TB are 3 to 30 times more likely to develop active pulmonary TB infection (ATS 1997; Rees and Murray 2007). Although respirable crystalline silica exposure does not cause TB infection, individuals with latent TB infection are at increased risk for activation of disease if they have higher levels of respirable crystalline silica exposure, greater profusion of radiographic abnormalities, or a diagnosis of silicosis. Demographic characteristics, such as immigration from some countries, are associated with increased rates of latent TB infection. PLHCPs can review the latest Centers for Disease Control and Prevention (CDC) information on TB incidence rates and high risk populations online (See Section 5 of this Appendix). Additionally, silica-exposed employees are at increased risk for contracting nontuberculous mycobacterial infections, including Mycobacterium avium-intracellulare and Mycobacterium kansaii.

1.8. Lung Cancer. The National Toxicology Program has listed respirable crystalline silica as a known human carcinogen since 2000 (NTP 2014). The International Agency for Research on Cancer (2012) has also classified silica as Group 1 (carcinogenic to humans). Several studies have indicated that the risk of lung cancer from exposure to respirable crystalline silica and smoking is greater than additive (Brown 2009; Liu et al. 2013). Employees should be counseled on smoking cessation.

2. Medical Surveillance.

PLHCPs who manage silica medical surveillance programs should have a thorough understanding of the many silica-related diseases and health effects outlined in Section 1 of this Appendix. At each clinical encounter, the PLHCP should consider silica-related health outcomes, with particular vigilance for acute and accelerated silicosis. In this Section, the required components of medical surveillance under the respirable crystalline silica standard are reviewed, along with additional guidance and recommendations for PLHCPs performing medical surveillance examinations for silica-exposed employees.

2.1. History.

2.1.1. The respirable crystalline silica standard requires the following: A medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of TB; and smoking status and history.

2.1.2. Further, the employer must provide the PLHCP with the following information:

2.1.2.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

2.1.2.2. The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

2.1.2.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

2.1.2.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

2.1.3. Additional guidance and recommendations: A history is particularly important both in the initial evaluation and in periodic examinations. Information on past and current medical conditions (particularly a history of kidney disease, cardiac disease, connective tissue disease, and other immune diseases), medications, hospitalizations and surgeries may uncover health risks, such as immune suppression, that could put an employee at increased health risk from exposure to silica. This information is important when counseling the employee on risks and safe work practices related to silica exposure.

2.2. Physical Examination.

2.2.1. The respirable crystalline silica standard requires the following: A physical examination, with special emphasis on the respiratory system. The physical examination must be performed at the initial examination and every three years thereafter.

2.2.2. Additional guidance and recommendations: Elements of the physical examination that can assist the PHLCP include: an examination of the cardiac system, an extremity examination (for clubbing, cyanosis, edema, or joint abnormalities), and an examination of other pertinent organ systems identified during the history.

2.3. TB Testing.

2.3.1. The respirable crystalline silica standard requires the following: Baseline testing for TB on initial examination.

2.3.2. Additional guidance and recommendations:

2.3.2.1. Current CDC guidelines (See Section 5 of this Appendix) should be followed for the application and interpretation of Tuberculin skin tests (TST). The interpretation and documentation of TST reactions should be performed within 48 to 72 hours of administration by trained PLHCPs.

2.3.2.2. PLHCPs may use alternative TB tests, such as interferon-γ release assays (IGRAs), if sensitivity and specificity are comparable to TST (Mazurek et al. 2010; Slater et al. 2013). PLHCPs can consult the current CDC guidelines for acceptable tests for latent TB infection.

2.3.2.3. The silica standard allows the PLHCP to order additional tests or test at a greater frequency than required by the standard, if deemed appropriate. Therefore, PLHCPs might perform periodic (e.g., annual) TB testing as appropriate, based on employees' risk factors. For example, according to the American Thoracic Society (ATS), the diagnosis of silicosis or exposure to silica for 25 years or more are indications for annual TB testing (ATS 1997). PLHCPs should consult the current CDC guidance on risk factors for TB (See Section 5 of this Appendix).

2.3.2.4. Employees with positive TB tests and those with indeterminate test results should be referred to the appropriate agency or specialist, depending on the test results and clinical picture. Agencies, such as local public health departments, or specialists, such as a pulmonary or infectious disease specialist, may be the appropriate referral. Active TB is a nationally notifiable disease. PLHCPs should be aware of the reporting requirements for their region. All States have TB Control Offices that can be contacted for further information. (See Section 5 of this Appendix for links to CDC's TB resources and State TB Control Offices.)

2.3.2.5. The following public health principles are key to TB control in the U.S. (ATS-CDC-IDSA 2005):

(1) Prompt detection and reporting of persons who have contracted active TB;

(2) Prevention of TB spread to close contacts of active TB cases;

(3) Prevention of active TB in people with latent TB through targeted testing and treatment; and

(4) Identification of settings at high risk for TB transmission so that appropriate infection-control measures can be implemented.

2.4. Pulmonary Function Testing.

2.4.1. The respirable crystalline silica standard requires the following: Pulmonary function testing must be performed on the initial examination and every three years thereafter. The required pulmonary function test is spirometry and must include forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and FEV_1/FVC ratio. Testing must be administered by a spirometry technician with a current certificate from a National Institute for Occupational Health and Safety (NIOSH)-approved spirometry course.

2.4.2. Additional guidance and recommendations: Spirometry provides information about individual respiratory status and can be used to track an employee's respiratory status over time or as a surveillance tool to follow individual and group respiratory function. For quality results, the ATS and the American College of Occupational and Environmental Medicine (ACOEM) recommend use of the third National Health and Nutrition Examination Survey (NHANES III) values, and ATS publishes recommendations for spirometry equipment (Miller et al. 2005; Townsend 2011; Redlich et al. 2014). OSHA's publication, Spirometry Testing in Occupational Health Programs: Best Practices for Healthcare Professionals, provides helpful guidance (See Section 5 of this Appendix). Abnormal spirometry results may warrant further clinical evaluation and possible recommendations for limitations on the employee's exposure to respirable crystalline silica.

2.5. Chest X-ray.

2.5.1. The respirable crystalline silica standard requires the following: A single posteroanterior (PA) radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems. A chest X-ray must be performed on the initial examination and every three years thereafter. The chest X-ray must be interpreted and classified according to the

International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader.

Chest radiography is necessary to diagnose silicosis, monitor the progression of silicosis, and identify associated conditions such as TB. If the B reading indicates small opacities in a profusion of 1/0 or higher, the employee is to receive a recommendation for referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.

2.5.2. Additional guidance and recommendations: Medical imaging has largely transitioned from conventional film-based radiography to digital radiography systems. The ILO Guidelines for the Classification of Pneumoconioses has historically provided film-based chest radiography as a referent standard for comparison to individual exams. However, in 2011, the ILO revised the guidelines to include a digital set of referent standards that were derived from the prior film-based standards. To assist in assuring that digitally-acquired radiographs are at least as safe and effective as film radiographs, NIOSH has prepared guidelines, based upon accepted contemporary professional recommendations (See Section 5 of this Appendix). Current research from Laney et al. 2011 and Halldin et al. 2014 validate the use of the ILO digital referent images. Both studies conclude that the results of pneumoconiosis classification using digital references are comparable to film-based ILO classifications. Current ILO guidance on radiography for pneumoconioses and B-reading should be reviewed by the PLHCP periodically, as needed, on the ILO or NIOSH websites (See Section 5 of this Appendix).

2.6. Other Testing. Under the respirable crystalline silica standards, the PLHCP has the option of ordering additional testing he or she deems appropriate. Additional tests can be ordered on a case-by-case basis depending on individual signs or symptoms and clinical judgment. For example, if an employee reports a history of abnormal kidney function tests, the PLHCP may want to order a baseline renal function tests (e.g., serum creatinine and urinalysis). As indicated above, the PLHCP may order annual TB testing for silica-exposed employees who are at high risk of developing active TB infections. Additional tests that PLHCPs may order based on findings of medical examinations include, but is not limited to, chest computerized tomography (CT) scan for lung cancer or COPD, testing for immunologic diseases, and cardiac testing for pulmonary-related heart disease, such as cor pulmonale.

3. Roles and Responsibilities.

3.1. PLHCP. The PLHCP designation refers to "an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required" by the respirable crystalline silica standard. The legally permitted scope of practice for the PLHCP is determined by each State. PLHCPs who perform clinical services for a silica medical surveillance program should have a thorough knowledge of respirable crystalline silica-related diseases and symptoms. Suspected cases of silicosis, advanced COPD, or other respiratory conditions causing impairment should be promptly referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.

Once the medical surveillance examination is completed, the employer must ensure that the PLHCP explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The written medical report must contain a statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment. In addition, the PLHCP's written medical report must include any recommended limitations on the employee's use of respirators, any recommended limitations on the employee's exposure to respirable crystalline silica, and a statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational medicine if the chest X-ray is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate by the PLHCP.

The PLHCP should discuss all findings and test results and any recommendations regarding the employee's health, worksite safety and health practices, and medical referrals for further evaluation, if indicated. In addition, it is suggested that the PLHCP offer to provide the employee with a complete copy of their examination and test results, as some employees may want this information for their own records or to provide to their personal physician or a future PLHCP. Employees are entitled to access their medical records.

Under the respirable crystalline silica standard, the employer must ensure that the PLHCP provides the employer with a written medical opinion within 30 days of the employee examination, and that the employee also gets a copy of the written medical opinion for the employer within 30 days. The PLHCP may choose to directly provide the employee a copy of the written medical opinion. This can be particularly helpful to employees, such as construction employees, who may change employers frequently. The written medical opinion can be used by the employee as proof of up-to-date medical surveillance. The following lists the elements of the written medical report for the employee and written medical opinion for the employer. (Sample forms for the written medical report for the employee, the written medical opinion for the employer, and the written authorization are provided in Section 7 of this Appendix.)

3.1.1. The written medical report for the employee must include the following information:

3.1.1.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

3.1.1.2. Any recommended limitations upon the employee’s use of a respirator;

3.1.1.3. Any recommended limitations on the employee’s exposure to respirable crystalline silica; and

3.1.1.4. A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine, where the standard requires or where the PLHCP has determined such a referral is necessary. The standard requires referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for a chest X-ray B reading indicating small opacities in a profusion of 1/0 or higher, or if the PHLCP determines that referral to a Specialist is necessary for other silica-related findings.

3.1.2. The PLHCP’s written medical opinion for the employer must include only the following information:

3.1.2.1. The date of the examination;

3.1.2.2. A statement that the examination has met the requirements of this section; and

3.1.2.3. Any recommended limitations on the employee’s use of respirators.

3.1.2.4. If the employee provides the PLHCP with written authorization, the written opinion for the employer shall also contain either or both of the following:

(1) Any recommended limitations on the employee’s exposure to respirable crystalline silica; and

(2) A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate.

3.1.2.5. In addition to the above referral for abnormal chest X-ray, the PLHCP may refer an employee to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for other findings of concern during the medical surveillance examination if these findings are potentially related to silica exposure.

3.1.2.6. Although the respirable crystalline silica standard requires the employer to ensure that the PLHCP explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the PLHCP has explained the results of the medical examination to the employee.

3.2. Medical Specialists. The silica standard requires that all employees with chest X-ray B readings of 1/0 or higher be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine. If the employee has given written authorization for the employer to be informed, then the employer shall make available a medical examination by a Specialist within 30 days after receiving the PLHCP's written medical opinion.

3.2.1. The employer must provide the following information to the Board Certified Specialist in Pulmonary Disease or Occupational Medicine:

3.2.1.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

3.2.1.2. The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

3.2.1.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

3.2.1.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

3.2.2. The PLHCP should make certain that, with written authorization from the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has any other pertinent medical and occupational information necessary for the specialist's evaluation of the employee's condition.

3.2.3. Once the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has evaluated the employee, the employer must ensure that the Specialist explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The employer must also ensure that the Specialist provides the employer with a written medical opinion within 30 days of the employee examination. (Sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization are provided in Section 7 of this Appendix.)

3.2.4. The Specialist's written medical report for the employee must include the following information:

3.2.4.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

3.2.4.2. Any recommended limitations upon the employee’s use of a respirator; and

3.2.4.3. Any recommended limitations on the employee’s exposure to respirable crystalline silica.

3.2.5. The Specialist’s written medical opinion for the employer must include the following information:

3.2.5.1. The date of the examination; and

3.2.5.2. Any recommended limitations on the employee’s use of respirators.

3.2.5.3. If the employee provides the Board Certified Specialist in Pulmonary Disease or Occupational Medicine with written authorization, the written medical opinion for the employer shall also contain any recommended limitations on the employee’s exposure to respirable crystalline silica.

3.2.5.4. Although the respirable crystalline silica standard requires the employer to ensure that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the Specialist has explained the results of the medical examination to the employee.

3.2.6. After evaluating the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine should provide feedback to the PLHCP as appropriate, depending on the reason for the referral. OSHA believes that because the PLHCP has the primary relationship with the employer and employee, the Specialist may want to communicate his or her findings to the PLHCP and have the PLHCP simply update the original medical report for the employee and medical opinion for the employer. This is permitted under the standard, so long as all requirements and time deadlines are met.

3.3. Public Health Professionals. PLHCPs might refer employees or consult with public health professionals as a result of silica medical surveillance. For instance, if individual cases of active TB are identified, public health professionals from state or local health departments may assist in diagnosis and treatment of individual cases and may evaluate other potentially affected persons, including coworkers. Because silica-exposed employees are at increased risk of progression from latent to active TB, treatment of latent infection is recommended. The diagnosis of active TB, acute or accelerated silicosis, or other silica-related diseases and infections should serve as sentinel events suggesting high levels of exposure to silica and may require consultation with the appropriate public health agencies to investigate potentially similarly exposed coworkers to assess for disease clusters. These agencies include local or state health departments or OSHA. In addition, NIOSH can provide assistance upon request through their Health Hazard Evaluation program. (See Section 5 of this Appendix)

4. Confidentiality and Other Considerations.

The information that is provided from the PLHCP to the employee and employer under the medical surveillance section of OSHA's respirable crystalline silica standard differs from that of medical surveillance requirements in previous OSHA standards. The standard requires two separate written communications, a written medical report for the employee and a written medical opinion for the employer. The confidentiality requirements for the written medical opinion are more stringent than in past standards. For example, the information the PLHCP can (and must) include in his or her written medical opinion for the employer is limited to: the date of the examination, a statement that the examination has met the requirements of this section, and any recommended limitations on the employee's use of respirators. If the employee provides written authorization for the disclosure of any limitations on the employee's exposure to respirable crystalline silica, then the PLHCP can (and must) include that information in the written medical opinion for the employer as well. Likewise, with the employee's written authorization, the PLHCP can (and must) disclose the PLHCP's referral recommendation (if any) as part of the written medical opinion for the employer. However, the opinion to the employer must not include information regarding recommended limitations on the employee's exposure to respirable crystalline silica or any referral recommendations without the employee's written authorization.

The standard also places limitations on the information that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine can provide to the employer without the employee's written authorization. The Specialist's written medical opinion for the employer, like the PLHCP's opinion, is limited to (and must contain): the date of the examination and any recommended limitations on the employee's use of respirators. If the employee provides written authorization, the written medical opinion can (and must) also contain any limitations on the employee's exposure to respirable crystalline silica.

The PLHCP should discuss the implication of signing or not signing the authorization with the employee (in a manner and language that he or she understands) so that the employee can make an informed decision regarding the written authorization and its consequences. The discussion should include the risk of ongoing silica exposure, personal risk factors, risk of disease progression, and possible health and economic consequences. For instance, written authorization is required for a PLHCP to advise an employer that an employee should be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation of an abnormal chest X-ray (B-reading 1/0 or greater). If an employee does not sign an authorization, then the employer will not know and cannot facilitate the referral to a Specialist and is not required to pay for the Specialist's examination. In the rare case where an employee is diagnosed with acute or accelerated silicosis, co-workers are likely to be at significant risk of developing those diseases as a result of inadequate controls in the workplace. In this case, the PLHCP and/or Specialist should explain this concern to the affected employee and make a determined effort to obtain written authorization from the employee so that the PLHCP and/or Specialist can contact the employer.

Finally, without written authorization from the employee, the PLHCP and/or Board Certified Specialist in Pulmonary Disease or Occupational Medicine cannot provide feedback to an employer regarding control of workplace silica exposure, at least in relation to an individual employee. However, the regulation does not prohibit a PLHCP and/or Specialist from providing an employer with general recommendations regarding exposure controls and prevention programs in relation to silica exposure and silica-related illnesses, based on the information that the PLHCP receives from the employer such as employees' duties and exposure levels. Recommendations may include increased frequency of medical surveillance examinations, additional medical surveillance components, engineering and work practice controls, exposure monitoring and personal protective equipment. For instance, more frequent medical surveillance examinations may be a recommendation to employers for employees who do abrasive blasting with silica because of the high exposures associated with that operation.

ACOEM's Code of Ethics and discussion is a good resource to guide PLHCPs regarding the issues discussed in this section (<u>See</u> Section 5 of this Appendix).

5. Resources.

5.1. American College of Occupational and Environmental Medicine (ACOEM):

ACOEM Code of Ethics. Accessed at: http://www.acoem.org/codeofconduct.aspx

Raymond, L.W. and Wintermeyer, S. (2006) ACOEM evidenced-based statement on medical surveillance of silica-exposed workers: medical surveillance of workers exposed to crystalline silica. J Occup Environ Med, 48, 95-101.

5.2. Center for Disease Control and Prevention (CDC)

Tuberculosis webpage: http://www.cdc.gov/tb/default.htm

State TB Control Offices web page: http://www.cdc.gov/tb/links/tboffices.htm

Tuberculosis Laws and Policies webpage: http://www.cdc.gov/tb/programs/laws/default.htm

CDC. (2013). Latent Tuberculosis Infection: A Guide for Primary Health Care Providers. Accessed at: http://www.cdc.gov/tb/publications/ltbi/pdf/targetedltbi.pdf

5.3. International Labour Organization

International Labour Office (ILO). (2011) Guidelines for the use of the ILO International Classification of Radiographs of Pneumoconioses, Revised edition 2011. Occupational Safety and Health Series No. 22: http://www.ilo.org/safework/info/publications/WCMS_168260/lang--en/index.htm

5.4. National Institute of Occupational Safety and Health (NIOSH)

NIOSH B Reader Program webpage. (Information on interpretation of X-rays for silicosis and a list of certified B-readers). Accessed at: http://www.cdc.gov/niosh/topics/chestradiography/breader-info.html

NIOSH Guideline (2011). Application of Digital Radiography for the Detection and Classification of Pneumoconiosis. NIOSH publication number 2011-198. Accessed at: http://www.cdc.gov/niosh/docs/2011-198/

NIOSH Hazard Review (2002), Health Effects of Occupational Exposure to Respirable Crystalline Silica. NIOSH publication number 2002-129: Accessed at http://www.cdc.gov/niosh/docs/2002-129/

NIOSH Health Hazard Evaluations Programs. (Information on the NIOSH Health Hazard Evaluation (HHE) program, how to request an HHE and how to look up an HHE report). Accessed at: http://www.cdc.gov/niosh/hhe/

5.5. National Industrial Sand Association:

Occupational Health Program for Exposure to Crystalline Silica in the Industrial Sand Industry. National Industrial Sand Association, 2nd ed. 2010. Can be ordered at: http://www.sand.org/silica-occupational-health-program

5.6. Occupational Safety and Health Administration (OSHA)

Contacting OSHA: http://www.osha.gov/html/Feed_Back.html

OSHA's Clinicians webpage. (OSHA resources, regulations and links to help clinicians navigate OSHA's web site and aid clinicians in caring for workers.) Accessed at: http://www.osha.gov/dts/oom/clinicians/index.html

OSHA's Safety and Health Topics webpage on Silica. Accessed at: http://www.osha.gov/dsg/topics/silicacrystalline/index.html

OSHA (2013). Spirometry Testing in Occupational Health Programs: Best Practices for Healthcare Professionals. (OSHA 3637-03 2013). Accessed at: http://www.osha.gov/Publications/OSHA3637.pdf

OSHA/NIOSH (2011). Spirometry: OSHA/NIOSH Spirometry InfoSheet (OSHA 3415-1-11). (Provides guidance to employers). Accessed at http://www.osha.gov/Publications/osha3415.pdf

OSHA/NIOSH (2011) Spirometry: OSHA/NIOSH Spirometry Worker Info. (OSHA 3418-3-11). Accessed at http://www.osha.gov/Publications/osha3418.pdf

5.7. Other

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(This article reviews not only silica and lung cancer but also all the known silica-related health effects. Further, the authors provide guidance to clinicians on medical surveillance of silica-exposed workers and worker counselling on safety practices to minimize silica exposure.)

6. References.

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7. Sample Forms.

Three sample forms are provided. The first is a sample written medical report for the employee. The second is a sample written medical opinion for the employer. And the third is a sample written authorization form that employees sign to clarify what information the employee is authorizing to be released to the employer.

WRITTEN MEDICAL REPORT FOR EMPLOYEE

EMPLOYEE NAME: ____________________________________ **DATE OF EXAMINATION**: _______________

TYPE OF EXAMINATION:
[ ] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: ____

RESULTS OF MEDICAL EXAMINATION:

Physical Examination –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Chest X-Ray –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Breathing Test (Spirometry) –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Test for Tuberculosis –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Other:___________________	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed

Results reported as abnormal: ____
____

[ ] Your health may be at increased risk from exposure to respirable crystalline silica due to the following:
____

RECOMMENDATIONS:
[ ] No limitations on respirator use
[ ] Recommended limitations on use of respirator: ____
[ ] Recommended limitations on exposure to respirable crystalline silica: _______________________________________
____

Dates for recommended limitations, if applicable: _______________ to _____________
MM/DD/YYYY MM/DD/YYYY

[ ] I recommend that you be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine

[ ] Other recommendations*:
____
____

Your next periodic examination for silica exposure should be in: [ ] 3 years [ ] Other: ___________________
MM/DD/YYYY

Examining Provider: ____ Date: _____________________
(signature)

Provider Name: ____
Office Address: ____ Office Phone: ___________________

*These findings may not be related to respirable crystalline silica exposure or may not be work-related, and therefore may not be covered by the employer. These findings may necessitate follow-up and treatment by your personal physician.

Respirable Crystalline Silica standard (§ 1910.1053 or 1926.1153)

WRITTEN MEDICAL OPINION FOR EMPLOYER

EMPLOYER: ____

EMPLOYEE NAME: _______________________________________ **DATE OF EXAMINATION:** _______________

TYPE OF EXAMINATION:
[ ] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: ____

USE OF RESPIRATOR:
[ ] No limitations on respirator use
[ ] Recommended limitations on use of respirator:____

Dates for recommended limitations, if applicable: _______________ to _______________
MM/DD/YYYY MM/DD/YYYY

The employee has provided written authorization for disclosure of the following to the employer (if applicable):

[ ] This employee should be examined by an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine
[ ] Recommended limitations on exposure to respirable crystalline silica:_______________________________________
____

Dates for exposure limitations noted above: _______________ to _______________
MM/DD/YYYY MM/DD/YYYY

NEXT PERIODIC EVALUATION: [ ] 3 years [ ] Other: ______________
MM/DD/YYYY

Examining Provider: ______________________________________ Date: ___________
(signature)

Provider Name: ____ Provider's specialty:________________________

Office Address: ____ Office Phone: ______________

[ ] I attest that the results have been explained to the employee.

The following is required to be checked by the Physician or other Licensed Health Care Professional (PLHCP):
[ ] I attest that this medical examination has met the requirements of the medical surveillance section of the OSHA Respirable Crystalline Silica standard (§ 1910.1053(h) or 1926.1153(h)).

AUTHORIZATION FOR CRYSTALLINE SILICA OPINION TO EMPLOYER

This medical examination for exposure to crystalline silica could reveal a medical condition that results in recommendations for (1) limitations on respirator use, (2) limitations on exposure to crystalline silica, or (3) examination by a specialist in pulmonary disease or occupational medicine. Recommended limitations on respirator use will be included in the written opinion to the employer. If you want your employer to know about limitations on crystalline silica exposure or recommendations for a specialist examination, you will need to give authorization for the written opinion to the employer to include one or both of those recommendations.

I hereby authorize the opinion to the employer to contain the following information, if relevant (please check all that apply):

☐ Recommendations for limitations on crystalline silica exposure

☐ Recommendation for a specialist examination

OR

☐ I do not authorize the opinion to the employer to contain anything other than recommended limitations on respirator use.

Please read and initial:

___ I understand that if I do not authorize my employer to receive the recommendation for specialist examination, the employer will not be responsible for arranging and covering costs of a specialist examination.

____
Name (printed)

_______________________________ _______________________________
Signature Date

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