



# Respirable Crystalline Silica for Construction

## 29 CFR §1926.1153

Frequently Asked Questions  
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### Definitions:

**RSC:** Respirable crystalline silica

**Rule:** OSHA standard for construction industry RSC exposure, 29 CFR §1926.1153

**Table 1:** Rule section (c), “Table 1: SPECIFIED EXPOSURE CONTROL METHODS WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA”, which contain a list of “equipment/tasks”, “specified engineering and work control methods”, and “required respiratory protection and minimum Assigned Protection Factor”.

**Table 1 Solution:** A task listed in Table 1 where the specified engineering controls, work practices and respiratory protection requirements are fully and properly implemented.

**TWA:** Time weighted average.

**(§Alpha/numeric) references throughout refer to the applicable section/subsection of the Rule (e.g., (§d-2) refers to 1926.1153(d)(2))**

### Disclaimer:

These answer represent Hilti’s interpretation of the Rule. It is therefore possible that OSHA may have a different position. Some topics are not explicitly addressed in the Rule. In publishing the final Rule, OSHA provided lengthy comments, justifications, and clarifications (Docket No. OSHA-2010-0034) – while this information is not part of the Rule, it provides an indication of OSHA’s intent, and was relied on in

developing the answers below. Where an answer is based on information contained in the Docket, it is denoted as “Docket”.

Answers are intended as a general overview – there are additional requirements in the Rule which are not addressed. Refer to the Rule for complete details.

### **What is silica, and what are the health risks?**

[This response is a “layperson’s” generalization. For more accurate and detailed information, consult a specialist]. Silica is arguably the most common material on the planet. It is generally considered “quartz” (although, for RSC purposes, OSHA also includes the less common cristobalite and tridymite) – and is (less-correctly) considered sand. As a result, silica is ever-present around us and in the air we breathe. Silica is present in most construction materials, such as concrete, mortar, block, brick, asphalt, stone... The percentage of silica varies by material and geographic location. When these construction materials are cut, drilled, ground..., it can generate airborne dust containing RSC.

The health risks are associated with “respirable crystalline silica”. Visible airborne dust contains particles of varying size. “Respirable” refers to a specific size distribution of airborne particulate that reaches the lungs. Larger particles either do not become airborne, or are filtered out by the body’s natural defense systems. Respirable particles are so small they are generally not visible. “Crystalline” refers to a specific subset of silica, having a crystalline shape. This is characterized by a hard, sharp-edged particle.

When RSC enters the lungs, the particles inflame and can “cut” into the lung tissue. The lung then scars over these affected areas. Because a respirable particle is very, very small, the scar is irrelevant. However, if enough particles are inhaled, at some point the “cumulative” scarring results in a noticeable diminution in lung capacity – this is “silicosis”. The damage is irreversible. Silicosis increases the risk other diseases, including tuberculosis, cancer, and chronic bronchitis.

According to the American Lung Association, silicosis can be “acute” (shows up in weeks-to-years from extremely high-level exposure), “accelerated” (shows up within 10 years of high-level exposure); or “chronic” (shows up in 10-30 years of over-exposure).

### **What do the two different exposure numbers in the Rule mean: 25 µg/m<sup>3</sup> and 50 µg/m<sup>3</sup>?**

25 µg/m<sup>3</sup> as an 8-hour TWA (see FAQ “How do you calculate the 8-hour TWA”), is the “Action Level”, or AL, for RSC (§b). If the exposure under any foreseeable condition (i.e., “can reasonably be expected” - Docket) is below this AL, the Rule does not apply, and no further action is required for compliance (§a). Note this AL-relevant exposure is assessed without use of a respirator (§b), or engineering controls / work practices (Docket).

50 µg/m<sup>3</sup> as an 8-hour TWA (see FAQ “How do you calculate the 8-hour TWA”), is the “Permissible Exposure Limit”, or PEL, for RSC (§d-1). A PEL is a level above which no employee is allowed to be exposed on any given day (see also FAQ “How does the Rule affect bystanders”). OSHA develops PELs with the expectation that an employee is considered adequately protected if they are in that environment for an entire day, every day, throughout a working career.

### **What is “50 µg/m<sup>3</sup> as an 8-hour TWA”?**

At any moment in time, RSC-generating tasks can result in a certain amount of RCS in the air. The “50 µg/m<sup>3</sup>” number represents 50 micrograms (weight) of RCS in one cubic meter of air – i.e., the “concentration”, or “exposure”. Because the amount of RCS can change over time, the concentration is “averaged” over an 8-hour period, which is considered a typical work day, or “shift” (see FAQ “How do you calculate the 8-hour TWA”).

50 µg/m<sup>3</sup> is a very small concentration. A typical baby aspirin is 80 mg (milli-grams – 80,000 µg) – so a 50 µg/m<sup>3</sup> concentration level would represent 1/1500th of the aspirin dispersed in 1m<sup>3</sup> of air; or the entire aspirin dispersed throughout a ~7000 sq.ft. room with 8’ ceilings.

### **How do you calculate the 8-hour TWA?**

For all calculations below, use a task duration in “hours”, and a task concentration in “µg/m<sup>3</sup> of RSC”:

For a single task, the 8-hour TWA can be calculated by using the formula:

$$\text{duration} \times \text{average concentration} \div 8$$

For a single task, the time that can be spent performing that task and remain below the PEL can be calculated using the formula:

$$400 \div \text{concentration} = \text{duration}$$

For varying tasks in a given day, the 8-hour TWA can be determined using the formula:

$$([\text{task A duration} \times \text{concentration}] + [\text{task B duration} \times \text{concentration}] + \dots) \div 8$$

For times during a shift where no RSC-generating activity or RSC is present, the “task” concentration is presumed to be zero.

### **Is the “exposure time” for a task related to the “tool trigger time”?**

Not necessarily. While the general concept is “time performing the RSC-generating task”, the RSC does not necessarily dissipate as soon as the tool is stopped. If an employee is generally performing the task, but takes periodic short breaks, OSHA considers the total time (including breaks), as the “time performing the task” (Docket). Otherwise, the employer will likely need to make a good-faith estimation of the time the RSC exposure exists.

### **What options for exposure compliance are provided in the Rule?**

A Table 1 Solution (§c-1); “Performance Option” (§d-2-ii); or “Scheduled Monitoring Option” (§d-2-iii).

Table 1 Solution: OSHA considers a Table 1 Solution as being in compliance with the PEL (§e-3). No further exposure assessment is required (Docket). Note some Table 1 Solutions require use of a respirator. For tasks listed in Table 1 but not performed in compliance with Table 1, and for tasks not listed in Table 1, the Performance Option or Scheduled Monitoring Option must be used. An employer may also choose, for a task listed in Table 1, to utilize the Performance Option or Scheduled Monitoring Option instead of the Table 1 Solution.

Table 1 Solutions also require a means of exhaust as needed to minimize accumulation of airborne dust for indoor/enclosed area tasks (§c-2-i), and flow rate of water must be sufficient to minimize visible dust for wet methods (§c-2-ii).

Performance Option: assessment of exposure using any combination of air monitoring data or “objective data” sufficient to accurately characterize exposure (see FAQ, “How will ‘objective data’...be used”).

Scheduled Monitoring Option: monitoring each employee’s exposure based on breathing zone air sampling, conducted at specified intervals.

### **How will “Objective Data” under the Rule §d-2-ii Performance Option be used?**

Test data is anticipated to be available – including data an employer previously generated from their own testing, industry data, and 3rd-party data (including data from a product manufacturer). OSHA does not limit the source of the data (Docket).

Hilti is testing various of its systems to generate Objective Data. For a specific system, testing is performed under defined conditions, with a resulting RSC exposure level. An employer can compare their specific application to the Hilti test parameters – if the Objective Data closely resembles or has higher exposure compared to the employer’s operation (§b), and the Objective Data “accurately characterizes” the exposure (§d-2-ii), the exposure values from Objective Data can be used. In that case, if the RSC exposure level derived from the Objective Data is below the PEL, no respirator would be required – and if above the PEL, either the employee would be required to wear a respirator, or be limited in how long they could perform the task and stay below the PEL (see FAQ, “How to calculate the 8-hour TWA”).

### **If a Table 1 Solution is used for part of the day, and Objective Data for another part of the day, how is the 8-hour TWA exposure assessed, since the exposure from a Table 1 Solution is not known?**

The RSC exposure-time for all tasks performed in a day are added together to determine the 8-hour TWA exposure (see FAQ, “How do you calculate the 8-hour TWA”). OSHA considers a Table 1 Solution, which may require use of a respirator, as being in compliance with the PEL (§e-3). While OSHA has not commented on this specific issue, it would seem reasonable to assume that the RSC concentration for a Table 1 Solution is 50 µg/m<sup>3</sup>.

**Only a portion of the dust generated from working with a material is silica. What percentage of silica is Hilti's Objective Data based on, and how will an employer know what the silica percentage is in the materials they're working with?**

Hilti's testing will establish the total respirable dust exposure associated with a system under specified test parameters, and its Objective Data will assign a 20% silica content to those results for convenience (all testing is currently performed in concrete). Because the percentage of silica in materials varies significantly, the following values aren't "cast in stone": concrete is typically 5-40% silica, generally in the ≤20% range (OSHA evaluated 588 RCS samples from construction sites, with a RCS content of 1-50%, and an average of 9.1% -- Docket. Also see note below); brick is 50-60% silica (but can be close to 100%); stone is heavily dependent on the type of stone – pure quartz can be almost 100%; asphalt is 5-25%; drywall (gypsum) < 5%, and drywall joint compound – published ranges not found, but OSHA "determined that all commercially available joint compounds have no, or very low amounts of, silica and do not pose a risk to workers" from RCS (Docket). It is the employer's responsibility to assess what percentage of silica applies to their specific operation. Note: most testing, including investigation by OSHA (Docket), shows the RCS% is lower than the silica content in the material.

**What affect does wearing a respirator have?**

A respirator filters out some of the RCS from the air breathed in. OSHA classifies respirators by APF – "Assigned Protection Factor". APF 10 means the concentration can be 10 times the PEL; APF 25 means 25 times the PEL. So use of an APF 10 respirator would allow work in an environment with RCS concentrations of 500 µg/m<sup>3</sup> as an 8-hour TWA (50 µg/m<sup>3</sup> PEL x 10 APF). Note that use of a respirator alone to achieve compliance with the PEL is not allowed – see FAQ "What are the respirator requirements..."

**What are the respirator requirements in the Rule?**

A respirator is required: (1) if specified in a Table 1 Solution; or (2) for non-Table 1 Solutions where (i) exposures are above the Action Level (see FAQ, "What do the...numbers mean"), (ii) the employer has instituted all feasible engineering controls and work practices, and (iii) the exposure remains above the PEL (§d-3). Table 1 specifies the required respirator for Table 1 Solutions – for non-Table 1 Solutions, the respirator must provide the appropriate level of protection (Docket).

Under category (2), above, engineering controls and work practices must be instituted – use of a respirator alone to achieve compliance with the PEL is not allowed (§d-3). It is not clear whether engineering controls and work practices are required where exposures are below the PEL without controls/practices.

For employees who will be required to wear a respirator, under the Rule, for ≥30 days per year, Medical Surveillance requirements apply (§h). Note that days which respirators are worn for reasons other than compliance with the Rule do not count toward the ≥30-day limit.

Table 1 exposure time columns ("≤4 hours/shift"; and "4 hours/shift"), refer to the total time of the RCS-generating task during a shift, and not the duration of the shift itself. If a respirator is required per a Table 1 Solution, it must be worn during the entire time that task is being performed during that shift. If multiple Table 1 Solution tasks are performed during a shift, their times are added together to determine the exposure time.

**How does the Rule affect "bystanders"?**

The Rule specifies a PEL for employees engaged in an RCS-generating task (see FAQ "What options for PEL compliance..."). These requirements apply to employees "engaged in the task" – the individuals actually doing, or assisting with, the task (Docket). A "bystander" is an employee who is not engaged in the task – and the Rule does not specifically state whether the PEL applies to bystanders. Never-the-less, it is presumed the PEL will be applied to all employees, including bystanders.

Each employer whose employees may be exposed to RCS concentrations above the Action Level (see FAQ, "What do the...numbers mean"), must create a Written Exposure Control Plan (WECP) (§g). Among other requirements, the WECP must contain "a description of the procedures used to restrict access to work areas, when necessary, to minimize the number of employees [which would include "bystanders"] exposed to [RCS] and their level of exposure, including exposures generated by other employers or sole proprietors [i.e., 3rd parties]" (§g-1-iv). OSHA mentions one potential option for protecting bystanders: establishing a "restricted area" to keep bystanders out (Docket). While the Rule does not state whether the

WECP must address protection of 3rd-party bystanders, OSHA has previously published guidelines addressing multi-employer worksites (e.g., OSHA Directive CPL 02-00-124).

### **What is HEPA, and how is it relevant?**

HEPA is “High-Efficiency Particulate Air”. The American standard for a HEPA filter – UL 586 – as well as (§b), defines it as a filter which is at least 99.97% efficient in collecting particles 0.3 micrometers in diameter – this is known as “efficiency” – how well it filters out particulate of a specific size. Note this requirement applies to the filter itself, not the vacuum as a whole. Also note other countries have different definitions for HEPA.

While conceptually HEPA is positive, the reality in the construction world creates a dichotomy: the more material collected by the filter and the smaller the filter pore size, the faster it clogs. A clogged filter results in: increased air bypassing the filter (dependent on the design of the overall vacuum system, which is not evaluated by the “HEPA filter” standard); and/or decreased suction. Meaning, effectively, the performance of the dust collection system is reduced over time – in some cases dramatically. So a tradeoff exists – an “initially-higher efficiency” system whose performance may deteriorate more quickly over time; or an “initially-lower efficiency” system which better maintains consistent performance. OSHA was persuaded it should not require a HEPA filter for most Table 1 Solutions because, “under field conditions HEPA filters may rapidly clog, leading to an increase in static pressure drop and loss of airflow needed...to effectively capture silica dust” (Docket). As a result, many Table 1 engineering controls specify a 99% filter efficiency for the vacuum, rather than the HEPA 99.97% filter efficiency.

### **The Rule applies to states operating under the Federal OSHA program. What is the status for state-run programs?**

28 states and US territories operate a state-run occupational safety and health plan (State Plan). These State Plans are required to revise their standards to reflect the new Rule, with the revision promulgated within six months of the Rule’s publication date of March 25, 2016. The revision must be at least as effective in protecting employees as the Rule. (Docket).

OSHA has provided a website link, indicating the status of the State Plans. [https://www.osha.gov/dcsp/osp/standards\\_fpc/20160325\\_standard.html](https://www.osha.gov/dcsp/osp/standards_fpc/20160325_standard.html). According to the website, as of the date of these FAQ’s, twenty-three states/territories have adopted the Rule verbatim; two states have adopted the Rule with changes (Oregon and Washington state); and three states have not yet reported their intentions to OSHA (Alaska, Hawaii, and Maryland). Six State Plans apply to state and governmental workers only (Connecticut, Illinois, Maine, New Jersey, New York, and the Virgin Islands).

### **Can I use a solution made of components from different manufacturers?**

The majority of the engineering controls in the Table 1 Solutions specify an “integrated” water supply or “commercially available” shroud and dust collection system. In the Docket, OSHA indicated the intent of these qualifiers was to “eliminate do-it-yourself on-site improvisations”. There is, however, no requirement in Table 1 that all system components be provided by the same manufacturer. For tasks performed relying on other than a Table 1 Solution (i.e., “performance option” [§d(2)(ii)], or “scheduled air monitoring” [§d(2)(iii)]), the exposure data will be based on the specific system components used during the testing. Since the effectiveness of each manufacturer’s components vary, additional analysis may be required if the system configuration is changed.

### **Can I use a splitter on my vacuum hose?**

A splitter effectively divides the air flow of the vacuum. The only Table 1 Solutions which specify a minimum air flow are: (xi) “handheld grinders for mortar removal (i.e., tuckpointing)”; and (xii) “handheld grinders for other than mortar removal”. Presumably, unless the vacuum manufacturer specifies otherwise, this would allow a splitter if the vacuum satisfies the air flow requirements with the splitter in place (e.g., has twice the specified air flow if a single splitter is used). For other Table 1 Solutions, the general requirement is that the system be used “in accordance with manufacturer’s instructions to minimize dust emissions” – so review the manufacturer’s instructions for guidance. Separately, while OSHA has not yet issued field enforcement directives, the Docket states that a “significant amount of visible dust being frequently or continuously emitted...can be an indication that controls are not fully and properly implemented.” It is therefore reasonable to expect OSHA to question use of a splitter if it results in significant visible dust emission. For tasks performed relying on other than a Table 1 Solution, (i.e., “performance option” [§d(2)(ii)], or “scheduled air monitoring” [§d(2)(iii)]), the exposure data will be based on the specific system components used during the testing. This data would not be applicable if the testing were performed without a splitter.



## **Can I add an extension to my vacuum hose beyond the standard length?**

Table 1 Solutions generally require the system be used “in accordance with manufacturer’s instructions to minimize dust emissions” – so review the manufacturer’s instructions for guidance. Separately, while OSHA has not yet issued field enforcement directives, the Docket states that a “significant amount of visible dust being frequently or continuously emitted...can be an indication that controls are not fully and properly implemented.” It is therefore reasonable to expect OSHA to question use of a hose extension if it results in significant visible dust emission. For tasks performed relying on other than a Table 1 Solution, (i.e., “performance option” [§d(2)(ii)], or “scheduled air monitoring” [§d(2)(iii)]), the exposure data will be based on the specific system configuration used during the testing. This data may not be applicable if the testing was performed without a hose extension.

## **Your objective data doesn’t match my jobsite scenario. How can I utilize it?**

See Hilti’s published document, “How to utilize Hilti ‘Objective Data’”. Fundamentally, to use Objective Data an assessment must be performed, starting with comparing the jobsite and Objective Data test conditions – if the jobsite conditions are no more severe than the Objective Data test conditions, the Objective Data can be used. If some aspect of jobsite conditions is more severe, then the assessment must determine whether a reasonable extrapolation can be made.

## **How do I perform my own jobsite testing conditions?**

Under the §d(2)(iii) scheduled monitoring option, the exposure of a specific task is assessed based on personal breathing zone air samples. This sampling is performed per methods such as NIOSH 7500. In simplistic terms, portable monitoring equipment (i.e., a sampler [comprised of a cyclone and filter], and pump), is placed on the employee during the task/shift, which draws surrounding air through the filter. The filter sample is then evaluated by a laboratory in accordance with Appendix A of the Rule. The sampling must reflect each shift, job classification, and work area. Where more than one employee is performing the same task on the same shift, a representative fraction of the employees may be sampled, as long as the employee(s) sampled are expected to have the highest exposure. The Rule specifies the frequency of the testing, which is dependent on the results of the testing. Note that data from the scheduled monitoring testing can later be used for assessment under the §d(2)(ii) “performance option”.