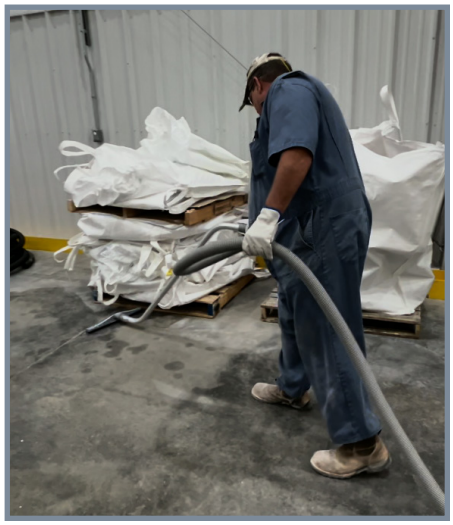
Respirable Silica: Remediating a Regulatory Risk

Summary



Respirable silica is a major challenge for manufacturers in the building products and glass industries. New government-mandated regulations require consistent filtration system implementation to greatly reduce airborne silica concentrations and protect worker health.

While vacuum systems designed for fine material removal can usually remove respirable silica dust from the workplace, many systems are limited to either an outside location or external venting, to prevent exhausted fine dust from being re-introduced into a closed environment. For installations where an external system location or exhaust venting isn't an option, HEPA filtration is a proven solution. HEPA filtration is very effective at removing even very small particle sizes. This technology does, however, create implementation challenges.

Hi-Vac's 50+ years of experience designing and building industrial vacuum systems includes extensive expertise with respirable silica remediation. By employing a plug and play multi-stage system, combining the bulk removal capabilities of a standard filter with the fine material removal of a HEPA, Hi-Vac's industrial vacuums offer a highly efficient and cost-effective solution to meet the needs of every factory or mill.

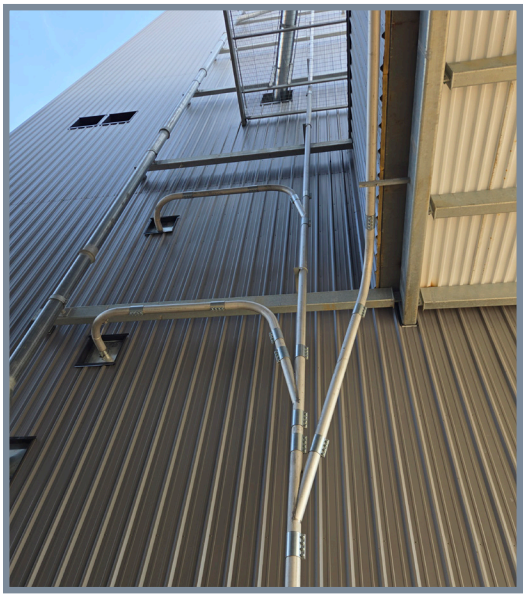
Silica's Personnel Risks

Airborne silica dust is one of the most dangerous manufacturing occupational hazards. When forming or processing materials like concrete, stone, glass, or brick, microscopic particles are released into the air, a situation which, if left unaddressed, can cause workers irreversible lung damage. In 2026, OSHA implemented updated respirable silica standards (OSHA 29 CFR 1910.1053) that significantly impact how employers must protect their workforce from related dust exposure.

OSHA's updated standards require a stringent permissible exposure limit of 50 micrograms per cubic meter ($\mu g/m^3$) of air, calculated as an 8-hour time-weighted average (TWA). Additionally, employers must ensure workers are never exposed to concentrations exceeding an action level of 25 $\mu g/m^3$. The 50 $\mu g/m^3$ limit is roughly 10 times lower than OSHA's previous standard. This dramatic reduction reflects a growing body of scientific findings showing that silica-related diseases, such as silicosis, lung cancer, and chronic obstructive pulmonary disease (COPD) can develop at exposure levels previously considered safe.

Small Particles, Big Collection Challenge

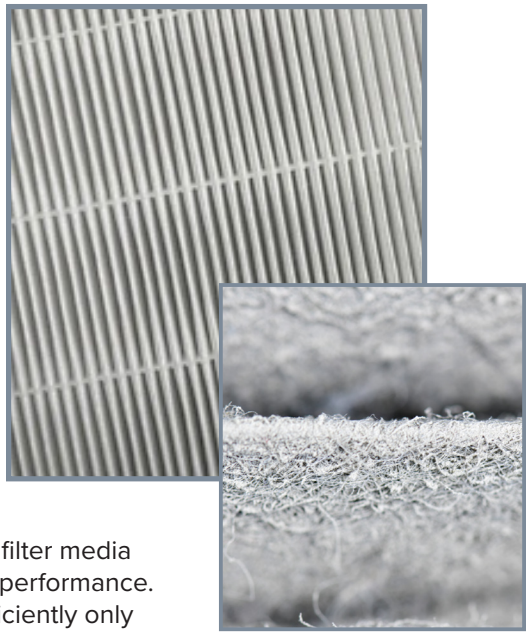
Respirable crystalline silica particles are generally defined as being sized at 10 microns or smaller. Conventional dust collection system filters are typically rated around 99% efficient for particles between 3-5 microns, but only 85% for smaller particulates in the 1–3-micron size range. Since sub-3 micron size range particles are known to penetrate deep into human lungs, failing to capture up to 15% of incoming very small material can create a potentially unacceptable concentration of airborne particulates exiting the unit exhaust into the work environment.



The traditional solution to this issue has been to either locate dust collection equipment outside, where it will exhaust any fine particulates directly into the air, or site it in close proximity to the edge of the building, and vent exhaust air outside through an exterior wall. While this will always be the simplest solution, it can't be applied to all locations. Facility or process layout may dictate a unit position that is more centrally located within the plant floor. In these circumstances, a more technical solution is required.

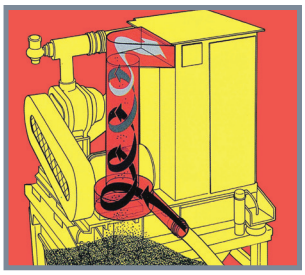
The HEPA Solution

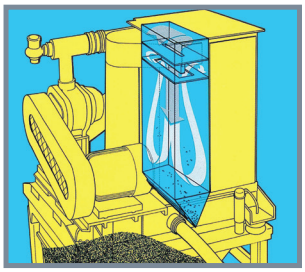
HEPA, an acronym for "High Efficiency Particulate Air" is a type of pleated mechanical air filter, comprised of a dense mat of randomly arranged fiberglass or polypropylene fibers. As officially defined by the U.S. Department of Energy, this type of filter removes at least 99.97% of 0.3 micron (µm) diameter airborne particles from the air stream. HEPA filters provide even higher capture rates for airborne particles of other sizes; the 0.3 micron specification represents a worst-case scenario for most penetrating particle size (MPPS). Particles that are larger or smaller are trapped with even higher efficiency. HEPA filtration represents a proven solution to the challenge of consistently removing high percentages of very fine material from an air stream.

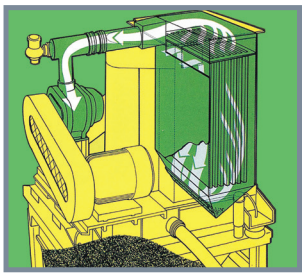


HEPA filters, however, create several implementation challenges. HEPA filters are generally more restrictive (particularly if used as the primary unit filter) to airflow than standard material collection filters, requiring either substantial filter media surface area, or a larger unit blower, to avoid reduced suction performance. Commonly used fan-based blower systems, which operate efficiently only when being fed material at a constant rate, are particularly vulnerable to system overload issues when used in this way. HEPA filters are also more easily clogged than standard filters, again reducing performance and increasing long-term cost of ownership.

The Full Filtration Implementation







Minimizing particulate load on HEPA filters is the best way to assure material collection performance over time. Centrifugal and linear material separator stages within the vacuum system main housing, which spin or drop particles out of the air stream, are key to remove and collect the vast majority of incoming material. A small percentage of incoming material is then passed on to a standard cloth dust collection filter, which collects almost all remaining particles, down into the sub-micron size range. This type of filter can also be cleaned by an automatic shaker or reverse air pulse-based filter cleaning system for continuous maximum effectiveness. Finally, after passing through the unit silencer, exhaust gas is vented through a large HEPA filter housing, removing the critical final percentages of very fine particles. Positive displacement (PD) blowers, which are able to deliver uninterrupted vacuum suction power even when under increased loads, keep air flowing and material suction high throughout the process. This multi-stage approach minimizes filter loading and extends operation between maintenance intervals.

Hi-Vac's industrial vacuum systems incorporate these essential features within a fully integrated design. The systems utilize positive-displacement blower technology to deliver high vacuum performance while maintaining reliable operation and low long-term operating costs.

Material handling is accomplished through multi-stage separator systems that remove conveyed material from the air stream prior to terminal filtration. Final air cleaning is achieved through terminal dust-collection filtration combined with an exhaust air HEPA filter, providing effective capture of fine and sub-micron particulate before discharge.

Equipping a 300, 400, or 800 Series vacuum with HEPA will not result in any loss of unit performance. Hi-Vac also builds its HEPA systems as a plug and play option, providing this key capability even for existing units not originally so equipped.

A Hi-Vac system incorporating optional HEPA filtration can be positioned anywhere within the facility, and when combined with a collection manifold system and regular housekeeping, provide the market's best solution to the problem of respirable fugitive silica dust.

Next Steps

Find out more about Hi-Vac Industrial's silica removal options at **www.hi-vacproducts.com**.

Citations

OSHA Respirable Crystalline Silica standard - https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1053

California OEHHA Respirable Silica Chronic Toxicity Summary: https://oehha.ca.gov/sites/default/files/media/downloads/air/document/silicacrelfinal.pdf

US DOE HEPA Technical Standard - https://www.standards.doe.gov/standards-documents/3000/3020-astd-2015/@@images/file