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Recommendations from AIHA on EPA's Request for Information on Legacy Uses of Asbestos for TSCA Section 6(a) Risk Management for Asbestos, Part 2 – Topic (E), Air Sampling Methods, and Laboratory Testing Capabilities

Agency/Docket Number: EPA-HQ-OPPT-2025-0036

Dear Assistant Administrator Troutman:

The American Industrial Hygiene Association, AIHA, is an association for scientists and professionals committed to preserving and ensuring occupational and environmental health and safety. We appreciate the opportunity to provide feedback on EPA's June 2026 Request for Information (RFI) concerning legacy uses of asbestos under TSCA section 6(a). These comments address the four questions under Topic (E) of the RFI regarding air sampling methods and laboratory testing capabilities. We hope you find our feedback useful and are happy to answer any questions you may have.

Background

EPA established an occupational exposure limit (i.e., existing chemical exposure limit, ECEL) lower than the current OSHA permissible exposure limit (PEL; 0.1 fiber per cubic centimeter of air as an eight (8)-hour time-weighted average (TWA)) for conditions that broadly affect generally industrial and commercial workplaces in the United States.

Asbestos is a recognized carcinogen, and should be regulated at the lowest practical limit. OSHA established its PEL based upon available epidemiological data, and practical sampling technology and industry ability to control exposure to asbestos. The available epidemiological studies were based upon phase contrast microscopy (PCM) or impinger counts converted to PCM equivalents.

AIHA Comments

1. EPA RFI: How would setting an ECEL lower than the OSHA PEL affect laboratories' abilities to test air samples for asbestos?

AIHA Encourages EPA to Treat Low-Level Asbestos Measurement as a Sampling-and-Analysis System, Not as a Laboratory Question Alone.

Setting an ECEL below the OSHA PEL for asbestos of 0.1 fiber per cubic centimeter (f/cc) would not, by itself, necessarily be unachievable. However, as OELs approach the low-thousandths of a fiber per cubic centimeter range, the ability to make a defensible compliance determination becomes increasingly dependent on the entire sampling-and-analysis system including the volume of air collected, particulate loading on the filter, the filter background, the number of microscope fields or grid openings examined, analyst performance, and the statistical uncertainty associated with a small number of counted fibers. EPA's RFI notes that the Asbestos Part 2 risk evaluation included an occupational exposure value (OEV) of 0.004 f/cc as an 8-hour time weighted average. The RFI also recognizes that the ECEL in an EPA risk management rule may differ from the OEV after consideration of technological feasibility, costs, and other reasonably ascertainable economic consequences described in TSCA section 6(c)(2)(A).

There are two primary sampling methods for analyzing air samples for asbestos: phase contrast microscopy (PCM) and transmission electron microscopy (TEM). For PCM, EPA identifies nominal method detection levels of 0.00675 f/cc for NIOSH Method 7400 and 0.001 f/cc for OSHA ID-160. Those values should not be interpreted as assurances that routine field samples can be quantified with acceptable precision at those concentrations. In an illustrative calculation using the conventional 100-field PCM count, increasing sample volume from approximately 400 liters to 1,200 or 2,400 liters improves analytical sensitivity from roughly 0.0067 f/cc to about 0.0022 and 0.0011 f/cc, respectively. When larger sample volumes are not achievable, a laboratory can count additional fields, but this increases analyst time and cost and does not eliminate the uncertainty inherent in low fiber counts.

In the case of OSHA, the lowest value that can indicate positive presence of fiber on a sample is based upon a minimum of 4 fibers counted in 100 microscope fields at 400 X magnification (5 fibers/mm²). The NIOSH detection limit is based upon 5.5 fibers counted in 100 microscope fields at 400 X (7 fibers/mm²). The uncertainty in the measurement is significant.

Standard industrial hygiene practice uses a 95% confidence interval (error level) for asbestos measurement. For OSHA compliance, at 4 fibers counted, the error level is $\pm 100\%$

At 100 fibers counted, the error level is $\pm 22\%$

For NIOSH methods at 5.5 fibers counted, the error level is -68% to +160%

At 100 fibers counted, the NIOSH error level is -35% to 60%.

NIOSH suggests collecting sufficient volume so as to be able to collect 80 to 100 fibers in 100 fields.

Counting small numbers of fibers results in very high uncertainty. Counting samples at the detection limit may result in errors as high as 160%. It has been shown that counting more than 100 fields does not significantly decrease the uncertainty of the fiber count. To enforce a regulatory level, it is necessary to

have 95% confidence that the measured value is at or above the regulatory value.

The recently revised ASTM D7201-26 is useful in this context because it treats low-level PCM measurement as a quality-control challenge rather than simply a nominal instrument detection challenge. The method incorporates lower-background filter requirements, larger counting areas where needed, and proficiency considerations. Harper (2026) discusses the revised standard explaining that, under carefully controlled conditions, PCM can support lower exposure limits, but it also emphasizes that sufficient fiber counts above background are needed for confidence in a result. Thus, a regulatory limit selected at or near a method detection level can produce large relative uncertainty even when the mathematical analytical sensitivity appears adequate.

AIHA recommends that EPA define compliance in terms of validated method performance under representative field conditions, including practical quantitation and uncertainty criteria, rather than relying solely on a theoretical limit of detection. A risk management rule should allow the industrial hygienist and laboratory to select an appropriate combination of sample volume and counting effort within a validated method, while recognizing that the highest sample volumes may not be feasible in dusty work environments. When filter overloading may occur, indirect preparation methods such as ISO 13794 can provide a means to overcome the interference (ISO 2019). However, such preparation methods will add cost and can increase uncertainty because they rely on indirect preparation. EPA should therefore treat such methods as a contingency, not as a substitute for fit-for-purpose sampling.

2. EPA RFI: What challenges do the types of physical environments at sites that may be subject to an ECEL under the Part 2 rule present for testing air samples? For example, given the relatively dirty conditions associated with demolitions and renovations and the presence of other types of fiber (fiberglass, mineral wool, cellulose, etc.), is it feasible to use PCM to test air samples at these sites? What would the practical level of detection be for both PCM and TEM in such situations?

AIHA Recommends Retaining PCM Where It Is Fit for Purpose and Using TEM Strategically in Dusty or Fiber-Interference Environments.

Demolition, renovation, abatement, and similar legacy-asbestos working conditions can present unique sampling conditions that may impact analysis. Non-asbestos dust can obscure fibers on the collection filter and may render a filter uncountable; non-asbestos fibers such as fiberglass, mineral wool, cellulose, and other elongated particles may be counted (as asbestos) by PCM even though they are not asbestos. The first problem can bias a result downward or invalidate the sample, while the second can bias a PCM fiber count upward relative to the concentration of asbestos fibers. These competing effects are especially important when a compliance decision is being made at a concentration only slightly above the method's practical quantitation limit.

Feedback from our members who are experts in this area illustrates the practical conflict between the desire for high sample volume and the need to avoid overloading. One expert noted that approximately 30 percent filter coverage can substantially reduce the observed PCM count and that a meaningful fraction of abatement-industry samples may be lost to overloading even at volumes on the order of several hundred liters. Environmental particulate matter, including urban PM_{2.5}, PM₁₀, and diesel particulate, can add to the loading. Corrosive atmospheres or some organic vapors can also damage the collection medium or complicate preparation.

For that reason, AIHA does not believe there is a single practical PCM or TEM detection limit that applies across all work environments represented among the conditions of use in the Asbestos Part 2 risk

evaluation. Under relatively clean or moderately loaded conditions, a 400-liter PCM sample may have an analytical sensitivity of approximately 0.0067 f/cc with a conventional count, while 1,200- and 2,400-liter samples can reach approximately 0.0022 and 0.0011 f/cc, respectively. In a dirty demolition environment, however, the achievable sample volume may be much lower before the filter becomes obscured. The practical quantitative limit will therefore be higher than the nominal method value unless additional counting effort or a different sampling strategy is used. For TEM, EPA characterizes the NIOSH 7402 detection criterion as one confirmed asbestos fiber above 95 percent of the expected mean blank value; converting that criterion to an air concentration depends on the volume sampled, filter area, preparation, and number of grid openings examined.

TEM provides an important advantage when fiber specificity is needed because it can identify asbestos by morphology as well as the mineral's chemical and crystalline composition, rather than counting all fibers that meet PCM dimensional criteria. TEM can also be used after specialized preparation to address some overloaded samples. But TEM analytical sensitivity is still a function of the sample volume and the filter area actually examined, and conventional TEM examination covers far less filter area than a PCM count because the magnifications used by the two technologies differ by orders of magnitude. Low counts and random fiber distribution therefore remain important sources of uncertainty even though TEM has greater resolving power. Illustrative calculations supplied to AIHA indicate that, to target less than 0.004 f/cc, a roughly 400-liter sample could require examination of about 19 TEM grid openings, while much smaller sample volumes could require dozens or even hundreds of grid openings. That is analytically possible, but it converts low sample volume into substantially greater laboratory labor and cost.

OSHA developed an in-house procedure to use the TEM to obtain the ratio of PCM-countable asbestos and NIOSH 7400 countable fibers. OSHA and NIOSH collaborated to produce NIOSH Method 7402. The ratio obtained using this method is applied to a NIOSH 7400-counted result. Both results are to be reported.

NIOSH Method 7402 specifically states that it should not be used to directly provide quantitative results. Use of TEM is very important in establishing the presence and species of asbestos as well as other interfering materials. The use of the TEM to quantify the amount of asbestos in air or other samples is problematic.

The TEM can resolve very fine fibers. Amphibole fibrils may be as small as 0.1 μm in diameter while chrysotile fibrils may be as small as 0.05 μm . For reference, the PCM used for asbestos can only resolve fibers as thin as 0.2 μm . Correlations between TEM and PCM exist but are not sufficiently consistent across the existing work environments.

TEM measurements have a very large uncertainty. Due to:

- Small sub-sample size – a few picograms on a grid.
- Observed area. PCM analyzes about 0.785 mm^2 while the TEM analyzes about 0.01 mm^2
- For the larger area observed by PCM, the distribution of fibers on the filter can be assumed to be at least pseudo-random.
- Mixed cellulose filters (MCEF) do not have a consistent, uniform surface. There are relatively large areas where no fiber is collected.
- A prepared PCM filter may have more than 100 mm^2 available for examination (1/4 filter)
- A 3 mm TEM grid has about 6 mm^2

- Because the TEM sample is so much smaller, it is more susceptible to the non-uniformity of the MCEF grid)

AIHA further cautions against treating a direct TEM fiber concentration as automatically interchangeable with the PCM exposure metric as the development of asbestos OEL is based on the relationship observed between disease and fiber burdens as measured using PCM as an index of exposure. ASTM D7201-26 includes a TEM option that is particularly useful when significant interference from non-asbestos fibers is anticipated: TEM is used to determine what proportion of the PCM-counted fiber population is asbestos. Harper (2026) notes that there is no science-based single conversion factor between PCM and electron microscopy measurements and that a direct TEM count is not, without additional validation, the same exposure metric on which the historical occupational risk relationships were established. EPA should therefore define the compliance metric explicitly if TEM is incorporated into a Part 2 rule.

3. EPA RFI: If the ECEL was set at a level that necessitated the use of TEM to test air samples, do testing laboratories currently have sufficient TEM instruments and staff to perform the testing? If not, how long would it take laboratories to increase their capacity, and what would this cost them?

AIHA Recommends That EPA Assess National TEM Capacity Before Requiring TEM for Routine ECEL Compliance.

It is important to note that TEM methods are intended for verifying the presence and species of asbestos in PCM counts, not as a direct method for counting of asbestos fibers in air samples. Moreover, information available to AIHA does not support an assumption that current U.S. TEM capacity would be sufficient if a Part 2 ECEL caused a large share of routine compliance samples from demolition, renovation, abatement, maintenance, and other legacy-use activities to shift from PCM to TEM. The Industrial Hygiene Laboratory Accreditation Program (IHLAP) of the AIHA Laboratory Accreditation Programs lists 14 laboratories in the United States that it has accredited under the Asbestos/Fiber Microscopy Core category for use of Transmission Electron Microscopy to measure asbestos fibers using NIOSH 7402.¹ In addition, there are 100 laboratories that are accredited by IHLAP for use of phase contrast microscopy to measure asbestos fibers using NIOSH 7400 or similar method. In addition, the National Institute of Standards and Testing (NIST) has a National Voluntary Laboratory Accreditation Program (NVLAP) that includes an Asbestos Fiber Analysis Laboratory Accreditation Program (LAP). Many of the IHLAP accredited laboratories hold NIST-NVLAP accreditation for TEM methods, and additional TEM capacity is available internationally. That capacity serves many existing environmental and occupational programs and cannot be assumed to be fully available for a new national compliance workload.

Instrument acquisition is only one constraint to increasing capacity. A new TEM equipped for asbestos analysis with energy-dispersive spectroscopy and digital imaging has been estimated at approximately \$600,000 to \$900,000 per instrument, exclusive of sample-preparation equipment, laboratory space and utilities, installation, service contracts, quality-assurance systems, and the time required to recruit and train qualified staff. Manufacturing lead times and the availability of experienced microscopists may be as important as capital cost. Based on the technical input provided, doubling existing TEM capacity within two to three years should not be assumed to be feasible.

Throughput would also decline as the required analytical sensitivity becomes more demanding. Conventional PCM analyses can often be completed at a substantially higher rate than TEM analyses. TEM sample preparation adds time, and counting additional grid openings to compensate for low sample

¹ <https://www.aihaaccreditedlabs.org/lab-accreditation-programs/industrial-hygiene>

volume can reduce throughput further. A requirement designed around the assumption of only a few grid openings per sample could therefore underestimate the capacity needed for compliance at a very low ECEL.

Before proposing a requirement that effectively makes TEM the default compliance method, AIHA recommends that EPA conduct a targeted capacity survey of accredited asbestos laboratories, TEM instrument manufacturers, and relevant proficiency-testing programs. The survey should quantify existing instruments, trained analysts, current utilization, realistic sample throughput at the analytical sensitivity EPA would require, expected equipment lead times, and the time needed to qualify new analysts. EPA should also monitor ongoing ASTM and ISO standards-development work involving machine-learning-assisted automated image analysis for PCM fiber counting and for qualitative and quantitative TEM characterization. These technologies may improve laboratory productivity and economics over time, but their contribution to compliance capacity will depend on validation, standardization, quality assurance, and laboratory adoption. If TEM is required broadly, the rule should include an implementation period tied to demonstrated laboratory capacity.

4. EPA RFI: If the use of TEM was needed to analyze air samples for compliance with an ECEL, what would the impact of the increased cost and turnaround time for TEM testing be on persons subject to the ECEL?

A TEM-Dependent ECEL Would Increase Compliance Costs and Turnaround Times and Could Delay Work

A shift from PCM to TEM for routine compliance would increase both direct analytical costs and indirect project costs. TEM analysis is more expensive and slower than PCM under ordinary conditions. The cost differential becomes larger when dusty conditions force a lower sample volume, and the laboratory must examine substantially more grid openings to reach the required analytical sensitivity. Illustrative calculations provided to AIHA suggest that TEM costs can remain near current environmental-analysis rates when a high-volume sample permits only a few grid openings but can rise to several hundred dollars per sample at intermediate volumes and into the thousands of dollars per sample at very low volumes.

Method	NIOSH 7400 (1)	NIOSH 7400	NIOSH 7402 (2)	NIOSH 7402	Typical Cost (3)
Purpose	fiber count (4)	fiber count (4)	optically visible fraction (5)	optically visible fraction (5)	---
Technology	PCM	PCM	TEM	TEM	---
Magnification	400x	400x	10-20kx	10-20kx	---
Volume	Current AS Achieved	ECEL Target <0.004 f/cc (6)	Current AS Achieved	ECEL Target <0.004 f/cc	TEM Pricing Std \$/ECEL \$
30L	0.09 f/cc [100]	more FoV	0.20 f/cc, [5]	<0.004 f/cc [250]	\$4000 / \$4000
60L	0.045 f/cc [100]	more FoV	0.099 f/cc [5]	<0.004 f/cc [125]	\$2100 / \$2100
120L	0.022 f/cc [100]	more FoV	0.049 f/cc [5]	<0.004 f/cc [63]	\$840 / \$840
*400L	0.0067 f/cc [100]	more FoV	0.015 f/cc [5]	<0.004 f/cc [19]	\$280 / \$280
1200L	0.0022 f/cc [100]	less FoV	0.0049 f/cc [5]	<0.004 f/cc [7]	\$120 / \$120
2400L	0.0011 f/cc [100]	less FoV	0.0025 f/cc [5]	<0.004 f/cc [5]	\$100 / \$100

(1) or related such as OSHA ID160, UK's HSE MDHS 100/3 (formerly MDHS 39/4), ASTM D7201, etc., typically 100 fields and analyst might prep/analyze 8-12/hour.

- (2) or related ASTM D7201, typically a lab technician will prep 10-20 of the archived filters from PCM and after 45-90 minutes be able to analyze 5-ish samples an hour (based upon 4-6 grid openings).
- (3) based upon \$100 for a TEM 40CFR763 AHERA clearance analysis of five grid openings with sensitivity targeted for <0.005s/cc
- (4) NIOSH publications by Barron (News of Governmental Agency and Departmental Activities, 1987) and HSE by Ogden lay out quality of these methods and their validations
- (5) % of PCM fibers that are truly asbestos.
- (6) now with added fields of view (FoV) for counting in [##] bracket and [###] added grid openings for counting.
- AS = Analytical Sensitivity

These figures are not a market survey or a proposed fee schedule; they demonstrate the strong relationship between achievable sample volume, counting effort, and cost.

Turnaround time is equally important. Compliance sampling is often connected to decisions about whether work may continue, whether controls are adequate, whether an area can be released, or whether workers must remain in respiratory protection. Longer laboratory turnaround times can extend equipment rental, containment, worker protection, and project-management costs and can delay demolition or renovation schedules. An initial surge in TEM demand could produce particularly long turnaround times and higher prices until laboratories are able to add capacity. Small contractors, building owners, and entities performing short-duration or emergency work could be disproportionately affected. The operational consequences are magnified if overloaded or otherwise unusable samples must be recollected. Recollection may not reproduce the original task conditions, particularly for one-time demolition or maintenance activities, and the need for confirmatory analysis can extend a project even when appropriate controls were used. For these reasons, EPA's economic analysis should evaluate not only the laboratory unit price for PCM versus TEM, but also the expected rate of invalid or overloaded samples, the cost of extended controls and respiratory protection while results are pending, and the potential for construction or maintenance delays.

AIHA suggests that EPA consider the AIHA Asbestos Analyst Registry (AAR) program. The Asbestos Analysts Registry (AAR) program, offered by the AIHA Registry Programs, was designed to recognize organizations, and their affiliated analysts, involved in fiber counting of air samples outside of established laboratory locations, primarily on the job site or in the field. The program is also used by laboratory locations that desire documentation of their ability to do quality work, but that may not be required by federal or state regulations to be accredited. Registered Organizations and Registered Analysts have met the qualifications for inclusion on the registry:

- Personnel training,
- Adherence to an established and documented quality system that is based on the most current versions of the [NIOSH 7400 Method](#) and the [AAR Policy](#), and
- Successful participation in the [Asbestos Analysts Testing \(AAT\) proficiency program](#).

All enrolled analysts must be affiliated with a Registered Organization that oversees the Quality Assurance and Quality Control program that monitors the analyst. More information on this program can be found on the AIHA registries website (<https://www.aiharegistries.org/asbestos-analysts-registry>).

AIHA also recommends a performance-based approach that preserves PCM for routine occupational exposure monitoring where it can produce a defensible result, uses TEM or a validated PCM/TEM approach when fiber interference makes asbestos specificity necessary, and defines quality-control and uncertainty requirements that are appropriate for the ECEL selected. If EPA determines that a lower ECEL cannot be reliably implemented without routine TEM, the Agency should pair that requirement with a capacity assessment, realistic phase-in period, and explicit consideration of the resulting analytical and project-level costs.

Conclusion

AIHA supports the use of exposure limits and analytical methods that protect workers while producing results that are scientifically interpretable and practically achievable in real workplaces. For asbestos Part 2 risk management, EPA should distinguish nominal analytical sensitivity from routine field quantitation, account for sample overloading and non-asbestos fiber interference, and avoid assuming that direct TEM measurements are automatically equivalent to the PCM exposure metric used in the historical risk evidence.

If you have any questions about AIHA's comments on this rulemaking or other matters, please contact AIHA.

Thank you for your time and consideration.

Sincerely,

The American Industrial Hygiene Association



Michele Twilley, DrPH, CIH
AIHA Chief Science Officer

About AIHA

AIHA is the association for scientists and professionals committed to preserving and ensuring occupational and environmental health and safety in the workplace and community. Founded in 1939, we support our members with our expertise, networks, comprehensive education programs, and other products and services that help them maintain the highest professional and competency standards. More than half of AIHA's nearly 8,500 members are Certified Industrial Hygienists, and many hold other professional designations. AIHA serves as a resource for those employed across the public and private sectors as well as to the communities in which they work. For more information, please visit www.aiha.org.

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