PHEAF TRAINING SESSIONS START WITH A HISTORY

In a number of my previous articles, I have discussed the history behind mold, bacteria and indoor air quality standards. Technical history has always fascinating to me, especially when it shows that we used to know something and then somehow forgot it. The history of PHEAF device testing follows the same pattern. We might think that counting particles to test the efficiency of a HEPA filter is a new idea. In fact, the methodology has been in practice for over 50 years at NASA and the US Navy.

Since that time, other governmental facilities have also implemented their own in-house protocols to validate HEPA filtration efficiency. These organizations include Argonne National Labs, Lawrence Livermore Labs, the Federal Aviation Administration, the Department of Energy and others.

The first published article justifying the need for in-field testing of asbestos abatement HEPA filters was published in 1990 by the National Asbestos Council. Clearly, this 'historical' article was prophetic. For the past 3 years, the requirement for in-field testing of PHEAF devices has been written into project designs for asbestos abatement projects in northern California. This requirement was an outgrowth of the problems with naturally-occurring asbestos that was identified in California a number of years ago. After all, serpentine asbestos is the California State rock.

On the other side of the continent, Delano Lenard, an asbestos abatement consultant, has been drawing attention to questionable performance efficiencies of PHEAF devices on asbestos abatement projects. To prove his concerns were valid, Delano decided to test the discharge of asbestos from PHEAF devices and to document actual leakage of particles and fibers through the device. Delano presented his findings at the Maine Indoor Air Quality Conference in 2009. He also became aware of the draft PHEAF device standard and decided to share his research data with the PHEAF device standards committee.

Delano tested the exhaust of 4 PHEAF devices using standard asbestos PCM filters and analysis by phase contrast microscopy. His findings are shown in Pictures 1 through 4.

Picture 1 shows a PHEAF device that appears to be functioning properly.
Picture 2 shows a PHEAF device with a little leakage.
Picture 3 shows a PHEAF device with some leakage.
Picture 4 shows a PHEAF device with worrisome leakage.

Why is this last picture worrisome? On close examination one can see a long fiber at 1 o'clock, and 2 short ones at 7 o'clock and at 8 o'clock (outside of the annular ring). Of more concern is that this was an Amosite asbestos abatement project. Amosite asbestos is a straight amphibole fibers that have been estimated to be up to 500 times more hazardous than serpentine Chrysotile asbestos fibers. If this unit is not exhausting to the outdoors or inside a containment, it is spreading fibers into the building.

Because of they get moved from site to site, these portable high-efficiency air filtration

(PHEAF) devices often endure a lot more vibration and abuse during transport and use than fixed filters do, which can significantly compromise their effectiveness.

More recently, at least 3 manufacturers and suppliers of PHEAF devices have been using laser particle counters to test their newly-manufactured equipment as well as to check the performance of their equipment in the field. Each of these parties is looking forward to the issuance of the PHEAF device testing standard.

PHEAF Standard Training Sessions

As part of the process of development and issuance of a new ANSI standard, organizations such as ASTM, ASHRAE and AIHA have meetings and information sessions discussing the upcoming standard. Similarly, during the past year, IESO has put on three information and training sessions about the PHEAF standard and its testing method. These training sessions were held at a Chicago IAQA Section meeting, an Irvine, California IAQA Section, and in Las Vegas. We recommended that participants who own particle counters bring their particle counters to the hands-on training course.

During these information and training sessions, the first thing that we cover is how the PHEAF Device Standard was developed and derived. Next, we show how to use laser particle counters and configure their settings as required in the standard. Configuring all the particle counters in the class turns out to be surprisingly time-consuming and tedious. Participants have numerous questions on the difference between cumulative and differential sampling modes, metric versus US units, totalizing, minimum sampling time, 90% response time, significant figures, data storage, data retrieval and so on. Further, the settings menus vary by manufacturer and even by model number. Once the particle counters are properly configured we can show how they are used in the PHEAF Device Standard.

The next item on the agenda is to start testing PHEAF devices. We outfitted a 3016 Lighthouse Particle counter with a webcam, so we can capture a live video of the particle counter display and project it up on the powerpoint screen. The whole room can see the actual particle counts as they happen. Next, we demonstrate the PHEAF testing protocol.

Step 1) is to collect three background particle readings of the air in the room. These are entered into a spreadsheet and an average is calculated for each of the 6 particle size ranges. This spreadsheet is also projected live in the front of the room on a second screen.

Step 2) is to turn on the PHEAF device and let it run for about 1 minute. During this start up and pressure equalization time, the HEPA filter on some PHEAF devices can flex and release particles. This is more common on used HEPA filters and with devices that are not Class 5 devices. You can see this effect if you start measuring the particle counts as soon as the device is turned on. This is phenomena is demonstrated for the class. After a minute or two, the particle counts reaches an equilibrium level and gives relatively consistent results from test to test.

Step 3) is to collect three particle counts of the discharge air coming out of the PHEAF device exhaust. We try to get the particle counter as close to the exhaust port of the unit as possible. Sometimes a sampling tube is necessary on vacuums with small discharge ports. With the help of our live video stream, participants see the discharge particle counts as they are being measured. These readings are then put into the spreadsheet and participants watch as the averages are calculated. The spreadsheet also calculates the particle removal efficiency at each size range and the overall PHEAF device class (from a low of a Class 0 for approximately 75% efficient rating to Class 5 for 99.97% efficient rating). For more information on the PHEAF device testing method see IEC articles from April 2009 and June 2009.

We repeat this procedure with four or five additional PHEAF devices such as air scrubbers and vacuums from various manufacturers. During this demonstration, none of the PHEAF devices achieves actual HEPA efficiency (Class 5). Some are close at Class 4 and participants start asking "are *any* devices really HEPA efficient in practice?

Then the fun begins. We roll the next device in front of the class, take the background readings again and turn on the PHEAF device. The particle counter is placed into the exhaust air stream and turned on. But the display reads all zeros. No particle counts were measured. All zeros. Is the particle counter malfunctioning? No! This is a PHEAF device that really works! *The audience is stunned.*

Needless to say, when you see a device exhaust air with zero particle counts, the importance of PHEAF device testing and the validity of the testing method is confirmed. In all three sessions, this "all zero" result was measured from an Abatement Technology "Predator." IQ Air is another manufacturer of small air scrubbers that also test all "0"s. In fact, IQ Air supplies their sales representatives with laser particle counters so that they can publicly demonstrate this result to their clients and customers. IQ Air has effectively been using the PHEAF standard methodology for years.

But wait. The fun is not over yet. We roll one more PHEAF device in front of the class for testing. In order to understand the significance of this last test of a PHEAF device, you need to know that the average background particle count in the room at the 0.3 micron particle size was approximately 20,000 particles per cubic foot. When we turn our last PHEAF device on and begin to monitor the exhaust air stream - something smells funky and the particle counter's readings go off the charts! With the air scrubber in operation, the particle level at 0.3 microns in the exhaust air shoots up to 400,000 particles per cubic foot, more than 20 times the background particle level! The audience yells, "TURN IT OFF!" Needless to say, we don't do three 20 second tests on this devices. It is very clear to that this is not an air filtration device; it is a "particle pump." This is a term we coined for a device that adds more particles to the air than it removes!

"Particle pumps" are not that uncommon in used PHEAF devices. In each seminar, we have found 1 or 2 of these devices. Considering how many PHEAF devices are used on asbestos, lead and mold jobs, "particle pumps" are worrisome. Exactly what are they discharging - especially at this 0.3 micron particle range? Are these respirable particles

hazardous? Are they asbestos, lead or mold, when used on those projects?

Next it is time for the course participants to do their own hands-on testing of PHEAF devices. Not surprisingly, no one volunteers to test "particle pumps." This hands-on training gets people familiar with both the operation of their particle counters and with the calculations in the proposed PHEAF device standard. However, calculating the average of the three tests of the 6 size ranges of background particle concentrations, then doing the same calculation for the three tests of the 6 size ranges of the device exhaust, and then calculating the device efficiency ratios for the 6 size ranges, turns out to be more time consuming than participants expected. Consequently, there was significant interest in having a software program to automatically do these calculations as was shown on the screen. As it turns out, at the IAQA conference in Tampa, one particle counter manufacturer is considering adding this software to their particle counter as soon as the PHEAF device standard is finalized.

At the end of the class, attendees expressed strong interest in a course where they could learn more about how particle counters work, how to use particle counters to assess indoor air quality particulate levels, and the potential health effects of respirable particles. At the current time, no such course exists. We discussed the development of such a course with various particle counter manufacturers and suppliers at the Tampa IAQA conference. All of them agreed that such a course would be very useful and is something that their customers have previously expressed interest in.

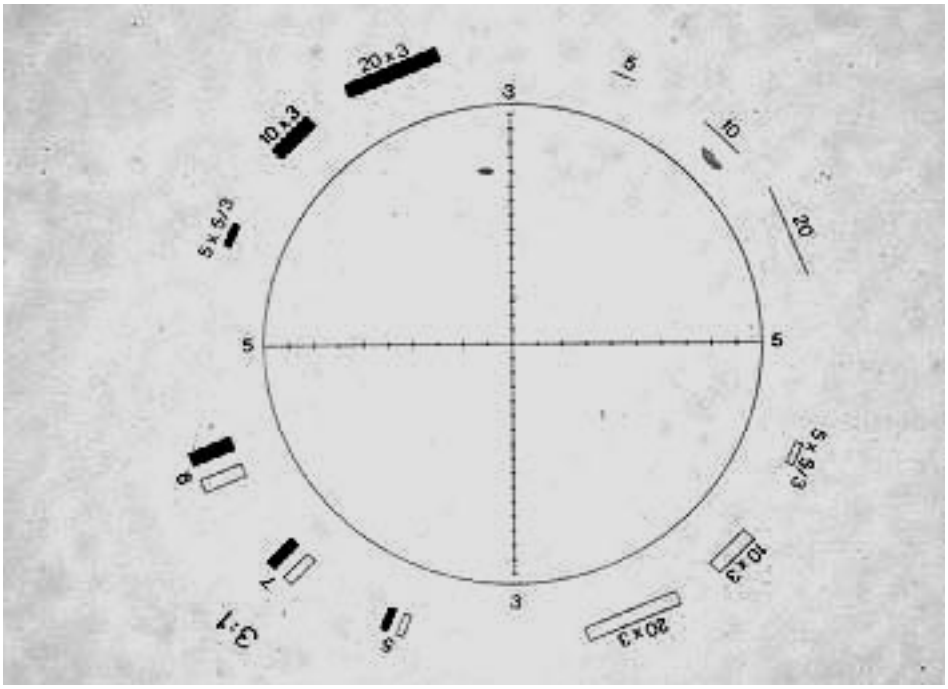
Consequently, a course on "Laser Particle Counter Use and Operation for Assessing Indoor Particulate Levels" is in the planning and development stages. This course will be presented in Las Vegas later this year. You can see an initial draft of the agenda for the course at www.OEHCS.com. If you would like to be notified about the dates for the course, send me an email.

The Value of Hands-On Training

The PHEAF device training session has been developed to present this new information in a fun and unique way. The training is designed to be memorable so that skill set is retained and immediately applicable. The effectiveness of in-person, hands-on training and the ability to ask questions of the instructors face-to-face cannot be equaled. Just reading about it in a manual or being told how to do it via a webinar aren't the same. In addition, PHEAF device training sessions qualify for continuing education credits. This is something that may interest many local IAQA sections.

What does it take to put on a PHEAF device training seminar in your area? It takes a a lot of coordination and planning. First, there is the need for a large presentation room, particle monitoring equipment, and PHEAF devices of various types and conditions. Then there is advertising, course materials, projection equipment, projection screens, portable computers and audio equipment (to be able to project a voice over the noise of the PHEAF devices.) Next there is the staff to handle registration, legal agreements with the hotel and travel costs for the training staff. Depending on how much you charge for

the class, the economics work out to be break even with around 35 attendees. So if you are interested in a PHEAF device test training session in your area, you can use this number as a planning point.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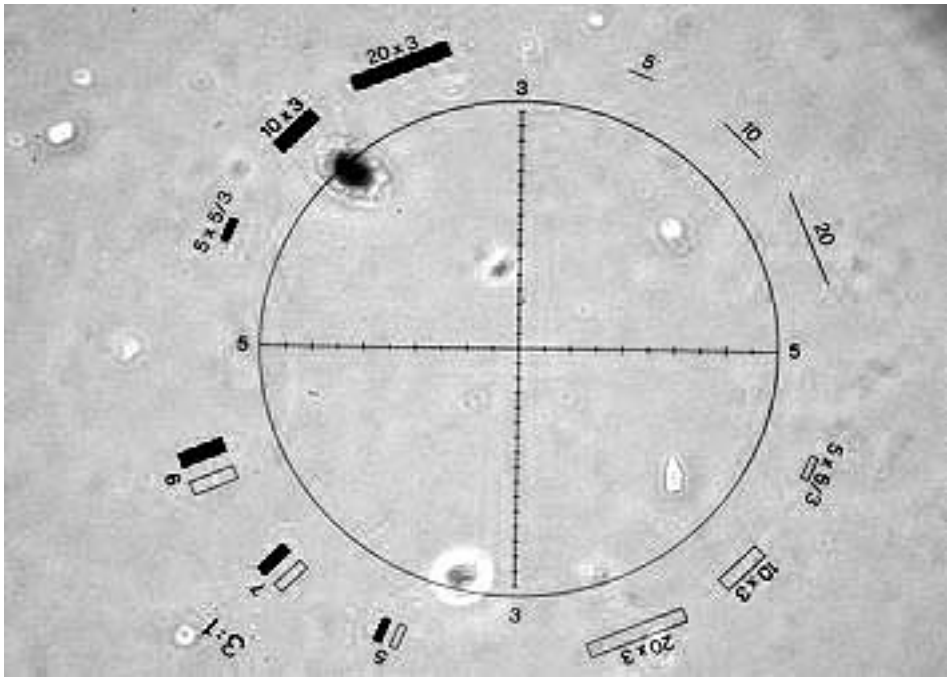
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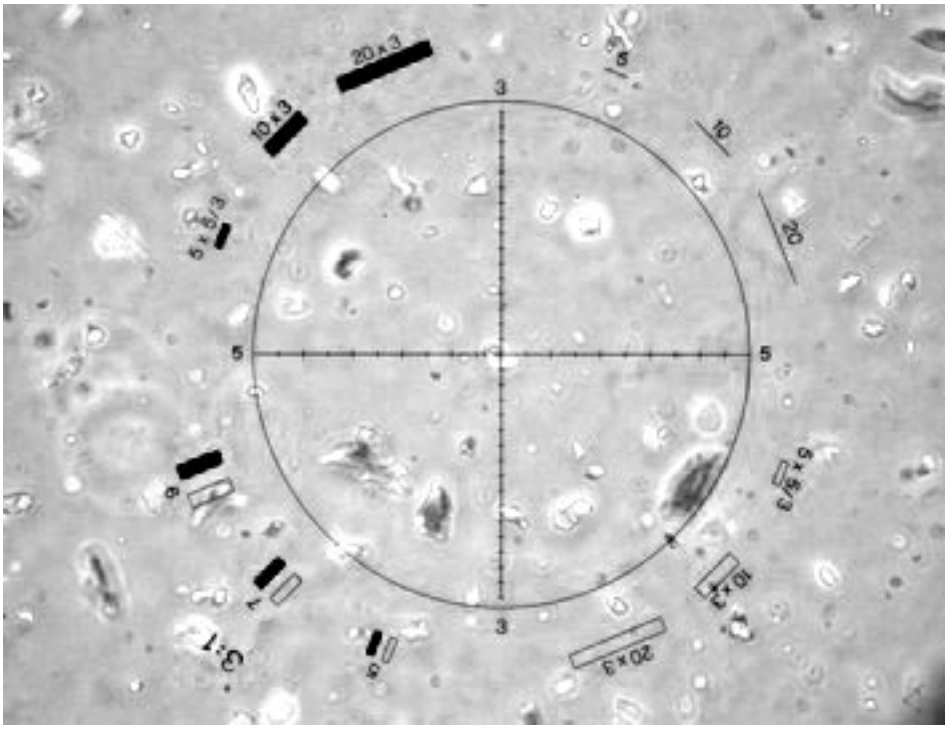
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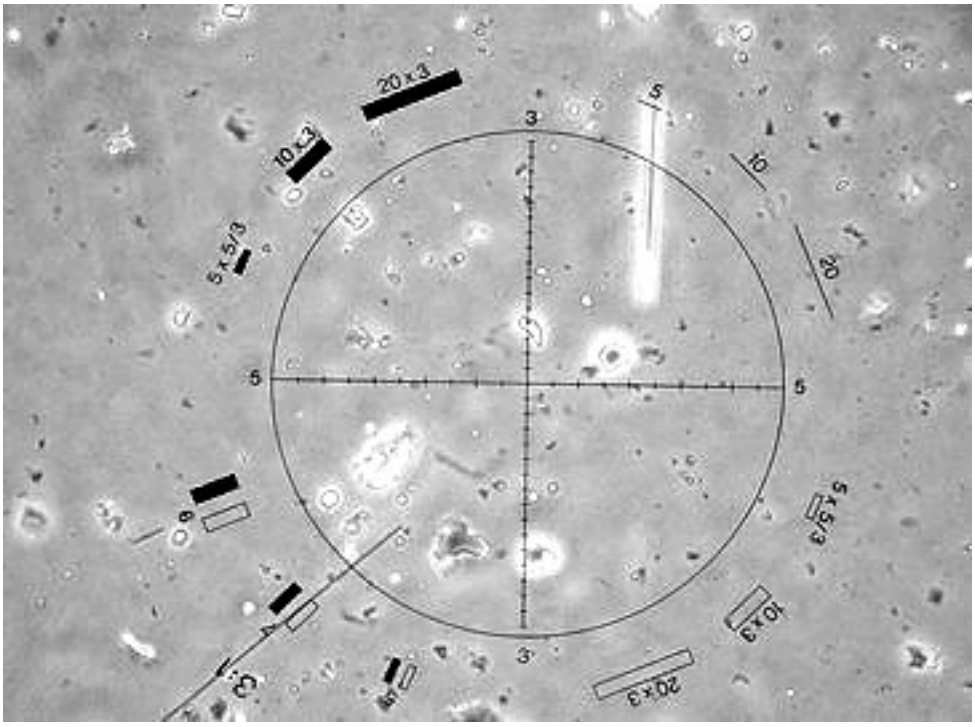
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