The NEBB Professional

2021 – Quarter 1

Cover Story

The Future of Fume Hood Testing

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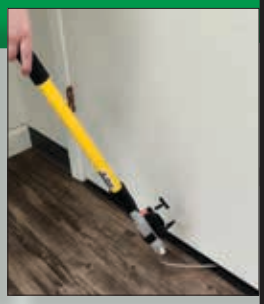

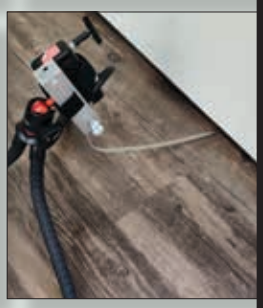

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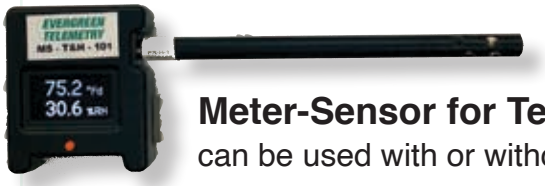

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President's Message

"Honoring Our Legacy by Strengthening Certification through Training and Education"

As I write this, 2021's first quarter is coming to a close. The first few months have flown by with nothing slowing NEBB down. NEBB is busy wrapping up the re-certification process for firms, planning for the Annual Conference in October, working on the details for the NEBB TEC Training Center and maintaining the day to day needs of all the firms, individuals, and chapters within NEBB. Covid-19 is still wreaking havoc in the world but the current CDC reports cases are starting to taper off if not drop with the assistance of vaccinations being administered. NEBB can start planning upcoming seminars with strict social distancing guidelines in place and all the proper protocol to make your seminar needs as safe as possible. This is exciting knowing we have been in a stale state for some time now. I think we are all looking forward to some normalcy.

This 50th year of NEBB is time to reflect on the history of the organization. I chose my theme, "Honoring Our Legacy by Strengthening Certification through Training and Education" because I wanted to get back to the basics with where NEBB started and where I want to see NEBB go. NEBB's roots have always been focused on education. In 1972 the emphasis of the organization was establishing the TAB program and the first 64-page edition of the NEBB Procedural Standards for Testing-Balancing-Adjusting of Environmental Systems was published. By 1974 there were 24 Chapters within NEBB, all of whom played their part in offering training classes. There were 20 NEBB schools within those Chapters and 457 students enrolled in those schools. NEBB was off and running with the focus on training and educating not only the individuals taking the exams but the industry as a whole. The Promotion Committee was hard at work educating engineers on NEBB and getting NEBB recognized in specifications. NEBB's footprint was being established in the early 70's and 50 years later we have not looked back. It is now time to focus on the future of NEBB and position NEBB by strengthening our training and education. As mentioned above, the focus of getting NEBB TEC's hands on training center built is part of that strengthening. With COVID-19 hitting we realized we need the ability to do more online training as well and soon we will be offering online classes and training modules. This is all part of our goal to have the best and most accessible training we can provide.

Another exciting aspect of my presidency is the planning of our 50th Anniversary Annual Conference. This will be a great opportunity for more exceptional training and education. We are in the midst of planning to make this a very special event and I am looking forward to celebrating NEBB and NEBB's history as well as the future of NEBB with you.

Best wishes,

Amber

Amber Ryman
NEBB President

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A message from the editor

AUDREY KEARNS

. . . will continue to make improvements to the magazine to keep it relevant.

Welcome to 2021! Hopefully this year, we continue to see more positive changes as we get a handle on the pandemic.

This is a big year for NEBB as we celebrate our 50th Anniversary! Hopefully you will all be able to join us at our big 50th Celebration in Maui, Hawaii on October 7-9, 2021. Find out more about our NEBB Annual Conference inside this magazine.

Going into 2021, I hope that you have found the substance of The NEBB Professional magazine informative and valuable. We have made many changes over the last year and will continue to make improvements to the magazine to keep it relevant.

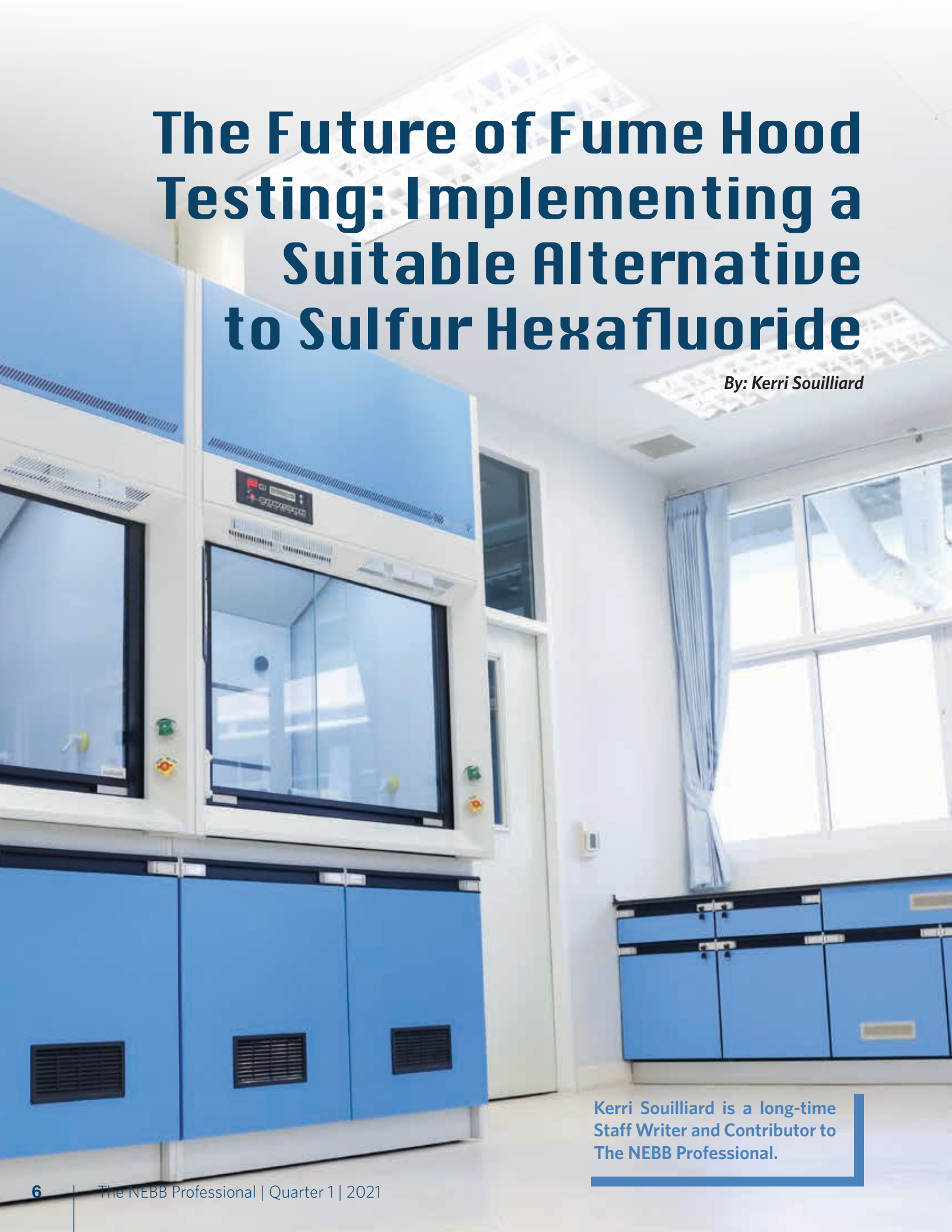
We are always looking for interesting and educational articles for The NEBB Professional. If you have an idea for an article and would like to send it to NEBB for review, I am always open to accepting all technical articles. Please reach out to me with your ideas and thoughts at www.nebb.org.

Thank you and have a safe and productive 2021!

Audrey P. Kearns
Editor

The Future of Fume Hood Testing: Implementing a Suitable Alternative to Sulfur Hexafluoride

By: Kerri Souilliard



Kerri Souilliard is a long-time Staff Writer and Contributor to The NEBB Professional.

If you work in the field of fume hood performance testing (FHT), chances are, you're already familiar with sulfur hexafluoride. More commonly known as SF_6, sulfur hexafluoride is used as a tracer gas to help determine the effectiveness of fume hood containment performance and help keep lab personnel safe.

NEBB FHT Certified Professionals (CPs) know SF_6 due to its application in Tracer Gas Containment Tests. Per NEBB FHT Procedural Standards, commercial grade SF_6, or other acceptable gas of approximately the same molecular weight, stability, and grade as SF_6 is required in order to properly test fume hood containment and offer Tracer Gas Containment Test Data Reports to clients. This standard—and its specific request for SF_6—comes directly from the ANSI/ASHRAE 110-2016, *Method of Testing Performance of Laboratory Fume Hoods* standard.

In the arena of fume hood performance testing, NEBB CPs perform testing in regard to average face velocity, airflow visualization and tracer gas containment. Some clients may opt for one test while others request data reports related to all three. A Tracer Gas Containment Test, however, is the only procedure that involves SF_6. It is also the most important test when it comes to life safety.

"The ASHRAE 110 standard outlines these three tests and users can choose to do one, two, or three of them and still say 'We did an ASHRAE 110 Standard test,' but if something is leaking out of the hood, this is the only method that can catch a leak. Your face velocity can be right on and that hood can still be leaking out contaminants," explains Elizabeth Blankenship, P.E., Managing Member of BPI Testing. "Lab safety is really important. Every time I go into a lab setting, I see improper uses of fume hoods. The fact that there isn't a better tracer gas right now makes it hard for me to go out and sell clients on this type of testing."

"Lab safety is really important," *says Elizabeth Blankenship, P.E., Managing Member of BPI Testing.*

With issues related to cost, equipment, and the environment, the search for a suitable replacement to SF_6 is nothing new for veterans of FHT. In fact, attendees of the 2014 NEBB Annual Conference in Fort Lauderdale, FL may recall former NEBB Technical Director Don Fedyk giving a presentation on FM-200™ called "Proposing a New Tracer Gas for Fume Hood Testing."

Equipment Availability

Seeing that NEBB's Tracer Gas Containment Test standards are based off of the ASHRAE 110 standard, professionals must use metering equipment that records at a one-second interval and is able to detect tracer gas measurements of ten parts per billion. While reading measurements once per second may sound like a lot, it was determined necessary to ensure continuous sampling.

". . . SF_6 is the only tracer gas approved by name in the standard, NEBB CPs are left with few equipment options." *Michael Kelly, Project Manager of Air Filtration Management and Chair of NEBB's FHT Committee.*

"Back in the 1995 standard, samples were recorded every ten seconds and now the 2016 standard is every second. That's because a surge of tracer gas could escape the fume hood and if you're not measuring every second, you will miss it." Explains Michael Kelly, Project Manager of Air Filtration Management and Chair of NEBB's FHT Committee. Coupled with the fact that SF_6 is the only tracer gas approved by name in the standard, NEBB CPs are left with few equipment options.

"The toughest question I get asked by new people at the fume hood seminars I do, is what equipment they should own. There are only two meters available—the MIRAN SapphIRE which has been taken over by Thermo Fisher Scientific and the USON-Q200 Leak Detector which is now no longer made in the US," explains Kelly. "We've been talking about changing the standard for a long time, so regardless of when it hits, we know it's coming. Those meters are intended for the current standard based on SF_6, so it's very hard for businesses to make the investment today when we don't know what's going to happen tomorrow."

"The toughest question I get asked by new people at the fume hood seminars I do, is what equipment they should own."

Cost Prohibitive

"There's no good option. They are both outdated, with a minimum cost near $30,000. The USON-Q200 uses an argon tank to clean out the meter too, so then you have two tanks to lug around. The SapphIRE has an AC to DC converter that is around 6 by 4 inches to charge a 3-inch cube, making it heavy too," says Blankenship. "The MIRAN Sapphire has been discontinued. They don't make it anymore. They may still calibrate it, but they won't service it anymore, likely because it's ancient. I can't fault them for it, but it's expensive equipment and it's frustrating knowing if it breaks, you are just out of luck."

"Concerns related to the use of SF_6 range from environmental impact to cost to equipment availability for specific FHT processes and procedures."

In addition to the hefty price tag and availability issues associated with metering equipment, the cost of SF_6 itself is not exactly low. For example, filling a 40-pound high-pressure cylinder tank with commercial grade SF_6 can easily cost $550, if not more. And as with anything, the higher the material costs, the higher the cost to end users. All other issues related to SF_6 aside, a client may opt to forego a Tracer Gas Containment Test based on cost alone. Imagine a client with a hundred or so fume hoods to be tested, and it's conceivable that testing of that proportion may just not fit their budget. While manufacturers may foot the bill for some fume hood tests, it is really the 'as used' testing that is vital to the health and safety of personnel.

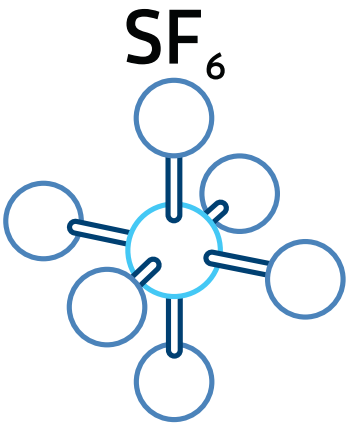
"In most cases, the lab environment is what causes a fume hood to lose containment. The characteristics of the lab like cross-airflows, a supply diffuser right above the fume hood, and other equipment can all affect the air characteristics of the lab and that is what will cause the fume hood to lose containment. That is why new installations certainly want to do this test and if the lab is retrofitted, you want to do it as well. When I do work at universities, I test 100 percent of the fume hoods in those labs. Safety should outweigh cost," recommends Kelly. "Additionally, some of our clients get a reduction in their insurance premiums to perform tracer gas containment testing."

Greenhouse Gas

Perhaps most importantly of all, SF_6 is detrimental to our environment. As the most potent greenhouse gas, the effect of SF_6 on the environment is nearly 24,000 times worse than that of carbon dioxide. According to the United States Environmental Protection Agency, SF_6 is a very stable, synthetic chemical with a lifetime of 3,200 years once emitted into the atmosphere, meaning even small traces have long-lasting effects. The environmental impact of SF_6, alone, has led to the state of California phasing out its use since 2011. While these restrictions stemmed from the energy industry—the biggest culprit of SF_6 use, with gas-insulated switchgear for electrical grids totaling 80 percent of total SF_6 consumption—leaders in the building industry are stepping up to initiate changes, too.

In fact, organizations like ASHRAE and NEBB have been changing their standards and requirements to reflect best practices in environmentalism and occupant safety for decades. In 1995, the ASHRAE 110 standard was revised to identify SF_6 for use in fume hood testing because the dichlorodifluoromethane gas (also known as refrigerant R-12) previously prescribed in ASHRAE 110-1985 was identified as a harmful pollutant.

"ASHRAE has been looking into alternatives for a while, but as far as I know, they just couldn't find a suitable gas with the same characteristics as SF_6. Some companies use nitrous oxide as an alternative right now. Neither



sulfur hexafluoride

ASHRAE nor NEBB have approved that. Nitrous oxide is also considered a greenhouse gas and it has its own safety hazards," states Kelly. "SF_6 is nonflammable, it's just a greenhouse gas. So we're protecting the environment by banning SF_6, but as a result may not know if workers are safe using their fume hood."

"When it's not good for the environment, but at the same time you have life safety issues, what is the solution?" Blankenship inquires.

Research Project 1573

"I am waiting and hopeful that the standard changes, which ASHRAE has been discussing, because SF_6 is such a terrible environmental hazard," mentions Blankenship. The search for an eco-friendly, cost-effective alternative has been tricky both due to the challenge of finding a gas with the same chemical makeup of SF_6, as well as identifying readily available equipment to eject and detect an alternate gas.

New Tracer Test for NEBB
Image by Tom Smith, President and CEO of 3Flow

Such hope, however, may lie in ASHRAE's Technical Committee 9.10, Laboratory Systems sponsored Research Project 1573 focused on determining a suitable replacement of SF_6 when used as a tracer gas in accordance with ANSI/ASHRAE Standard 110. Beginning back in March 2017, the research project was led by principal investigator Tom Smith, President and CEO of 3Flow and voting member of ASHRAE 110 for Revision of the Standard, Special Projects Committee as well as Technical Committee 9.10.

"SF_6 was great. We could control it, it was odorless, colorless, nontoxic. It just happens to be a really bad environmental hazard. And cost was also a major problem," comments Smith.

The goal of Research Project 1573 was to determine a replacement to SF_6 that produced equivalent or superior results. Zeroing in on isopropyl alcohol (IPA) as a potential replacement for SF^6, the team's investigation spanned approximately two years.

"When it's not good for the environment, but at the same time you have life safety issues, what is the solution?"

Why IPA as a possible alternate tracer gas?

"It's clean, it's green, and it serves a natural disinfectant when aerosolized. So, it has some great properties, it's easily detectable, and at the concentrations we're using it, it's relatively low hazard," explains Smith. "But essentially what gave us the idea is that it had been used previously in indoor air tracer studies, so we already knew that we could generate it, we could detect it, and it was relatively inexpensive and available."

At half the environmental impact of carbon dioxide, IPA is relatively inexpensive and easy to obtain. While SF_6 may cost anywhere between $15-50 per pound, the same amount of IPA costs a mere $1.25.

After a few different trials, the research revealed that isopropyl alcohol could be vaporized and mixed with air before being discharged from an ASHRAE 110 outlet diffuser. Through this process, Smith's team also recognized the need for an alternative testing method that would reliably create a plume of similar proportions each time.

"It's clean, it's green, and it serves a natural disinfectant when aerosolized."

"That's what we're working on now. We have a new ejection system and we're going to send the specifications to a number of groups in the committee so that they can run their own tests and confirm—or dispute—the results we got with our testing methods. We're putting out a method to do that. It's looking a little more consistent now and should be closer to something that could be fabricated—and if not purchased commercially, constructed in the same way that we do it now with the ASHRAE 110," confirms Smith.

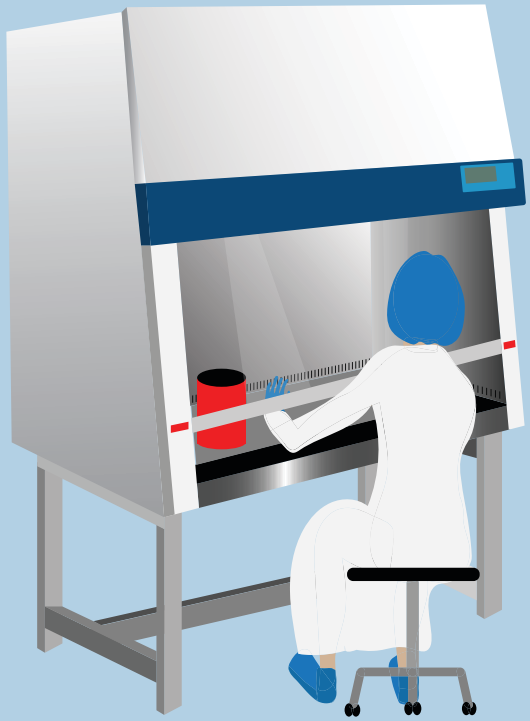
Although the ejection system is still being fine-tuned, Smith's research did identify a low-cost, readily available leak detector. Photoionization detectors (PIDs) were used to detect the IPA in tracer gas form.

"We looked at RAE PIDs as a way to detect the IPA because we've used these many, many times in indoor air quality studies and they're used for all kinds of different atmospheric detection. They're about $3,000—so nearly one tenth the cost of what we were using previously," details Smith. "They're very rugged, they're very stable and they're reliable. We hooked everything up and did comparison tests—SF_6 versus IPA."

Because the detection equipment is designed to measure total volatile organic compounds, there is a chance that PIDS could pick up trace amounts of IPA designated for other applications elsewhere in the lab. For that reason, background measurements prior to conducting the tracer gas testing is imperative. Smith states, "We've been doing air tracer tests for 30 years both as an ASHRAE 110 fume hood testing method, but also indoor air quality, odor migration, concentration migration, ventilation effectiveness studies, so there's always going to be a potential for difficulties with any air tracer. Background concentrations are always a potential cause of concern."

A Solution in Sight

"This is a method that's not perfect, but it's darn good. We still have to get over the finish line. The project and report are done, but we have to get the committee to accept it. We also must keep in mind that IPA is classified as a flammable material so caution is advised and proper training in handling and use would be required for safety. Ultimately, it will be up to the ASHRAE 110 committee to decide if IPA is suitable as a tracer for ASHRAE 110 tests," affirms Smith. "They're actually doing a parallel thing in



Although the ejection system is still being fine-tuned, Smith's research did identify a low-cost, readily available leak detector. Photoionization detectors (PIDs) were used to detect the IPA in tracer gas form.

the European Nation with [standard] EN14175, considering the use of IPA, as well. We preceded their work though, so we didn't have a path to follow, but it's nice to see it's going the same direction."

Although the ASHRAE 110 Standard is not yet revised, it appears a long-awaited change is on the horizon. For many FHT CPs uncertain about equipment investment or struggling to sell the current process of tracer gas containment testing to clients due to environmental concerns, an answer is coming.

"The solution is to find the alternative and find manufacturers that can manufacture the equipment, but that's been the case for 15 years. It's likely going to be a joint effort as they reach out to manufacturers," reasons Kelly. "As a buyer, I'd want to know if there are going to be any suppliers in the states, or how many different manufacturers would exist. It's always nice to see competition and have different purchase options."

"The standard is under revision right now. We are working on the tracer gas test methodology with SF_6 because, based on the results of our study, we learned a lot about the technique. We're updating the standard for SF_6 and we're going to provide an alternative. But the alternative won't be provided until we have some validation from others that it provides equivalent or better results. First, the research must be confirmed and, of course, we will also need specifications to ensure any necessary equipment can be machined and made available," concludes Smith. "We have a two-year timeframe in which we're looking to complete. We have our eye on 2022. That is when we would like to have the approval of the new draft."

It appears everyone in the field of fume hood performance testing is ready to say good riddance to SF_6 and the search for related detection instrumentation. With IPA as a potential tracer gas replacement and PIDs used to detect it, an eco- and budget-friendly solution may be just around the bend. Slowly but surely, fume hood testing—specifically, tracer gas containment testing—is making its way to the future, with added protection and advantages for our planet, people, and pockets along the way. ●

About the author

With over a decade of corporate marketing experience, Kerri Souilliard has the unique ability to interpret and create brand stories for even the most complicated, technical organizations in words their target audiences readily understand. Her strong business acumen and deep understanding of many complex processes and technical disciplines blend seamlessly with her extensive background in digital strategy, copywriting, and content development to serve clients' overarching business goals—without the wasteful spending of traditional agencies. For more info, visit www.kreativstrategy.com.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Meet NEBB's New Technical Director

By: Kerri Souilliard

After a dutiful search, NEBB recently selected its new Technical Director. Based in Richmond, VA, Pete Rawls, P.E., NEBB CP officially joined the NEBB leadership team on December 1, 2020. With over 25 years in the industry and a uniquely well-rounded background, he brings a fresh perspective to NEBB as well as a future-focused agenda. We reached out for an interview so that he could tell you more in his own words. Get to know Pete by checking out his interview below:

KS: What was your background prior to becoming a NEBB CP?

PR: When I graduated from Old Dominion University, with a bachelor's degree in civil engineering technology, I knew I wanted to build things. Although I didn't get on with any kind of construction manager or general contractor (GC) when I got out of college, I did happen to find an ad looking for a construction administrator at a mechanical, electrical, and plumbing engineering firm. So, that was kind of strange—I started my career doing something I'd never done before in college. I was a construction administrator for about 13 years for different engineering firms around Richmond, VA. Once I got tired of getting heat for somebody else's mistake—because I wasn't doing the design work, just dealing with the oopsies in the field—I moved on. I ended up getting the opportunity to start doing commissioning, so I went to another engineering firm and started to do commissioning on a biosafety level 4 (BSL4) lab.

KS: Wow! Did you really start your Cx career with BSL4?

PR: Sure did. That's how I got my feet wet in commissioning.

KS: Where did you go from there? When did you learn about NEBB?

PR: Well, I had to leave for personal reasons—it was killing my family being away five days per week, so I ended up going to Mechanical Systems Test and Balance in Richmond. They focused on testing, adjusting, and balancing (TAB) and commissioning and that's where I got introduced to NEBB, all the NEBB guys, and got a better foundation of TAB and building systems commissioning (BSC) and building enclosure testing (BET). At Mechanical Systems Test and Balance, that was the first time I really learned about NEBB. I had seen it before in specifications during my time on the engineering job, but never really paid much attention to it.

KS: What made you want to get NEBB certified?

PR: Jon Sheppard was my boss at that point, so he was really instrumental in getting me involved. I got my BSC certification first and then Retro-commissioning for Existing Buildings (RCx-EB) and BET. The first certifications I got were back in 2009. Of course, once I did get certified, Jon also encouraged me to get more involved, which is how I wound up on the BSC Committee at NEBB.

KS: Have you been involved with NEBB in any other capacities?

PR: I was on the BSC Committee for three years. Then, I actually switched over to the construction management side. Because I was working for a GC firm at that point, I couldn't actually continue as a true NEBB committee member, so I moved over to the Standards Committee responsible for Procedural Standards development, seminar development and instruction where I helped create the ANSI standards for BSC and RCx-EB.

KS: What do you enjoy most regarding your involvement with NEBB?

PR: With NEBB, the thing I like the most is the people I get to meet. The number of truly intelligent people that we have is just amazing. And the number of people that have volunteered their expertise to help with things like standards, the magazine, you name it—a lot of our people

have executed some really cool projects. That's really my favorite part—just meeting new people and getting new experiences. I definitely value the peer learning and all the other learning opportunities that we have.

KS: What attracted you to the Technical Director role?

PR: I really like teaching. I can't say I'm great at it, but I like being the go-to guy to get the answer. I want to learn as much as I possibly can. I'm also not an expert in all the NEBB disciplines, but I want to be, so this role gave me the opportunity to: 1) learn more, and 2) teach more. I look forward to passing my expertise onto others with that same thirst for knowledge. And with the different backgrounds I have had, I'd say I'm pretty well-rounded. I think I've been on all different sides of the fence at this point.

KS: Do you foresee any challenges in your path as Technical Director?

PR: My challenge is going to be learning all the disciplines I've never actually touched before like cleanrooms and fume hood testing. I want to be the expert in the room. I want to know everything about everything that we do, so learning those things is essential—but also probably going to be a little bit of a challenge because it's new territory for me. My goal is to take anything anybody will let me take. If I can get certified without any type of conflict of interest doing it, I would love to. Otherwise, I'll still take the class and take the test to make sure I know it and to help me in my position.

Pete and Kathy Rawls on a trip to Glacier Bay, Alaska

KS: What are some of your best memories of NEBB?

PR: The conference in Hawaii was always nice. I also remember taking a BSC course out in Arizona that was pretty cool with great instructors—Jim Bochat was out there. He's just an awesome instructor. And engineer. His teaching style and the stories from the classes were interesting, which made all the difference to keep everyone engaged in a class that wasn't hands-on, no playing with tools. Plus, NEBB's always been known for having good lunches at training—it was always interesting to see what they would have.

KS: NEBB is celebrating its golden anniversary this year. Where do you want to see NEBB venture in the next 50 years? Is there anything in particular you hope to accomplish?

PR: I definitely want to see NEBB excel at virtual training. That's going to be one of my main goals—getting that rolling, or to help do it anyway.

My goal is to also have more engineers know who NEBB is. A lot of engineers out there have us in their specs, but have no clue who we are, what we are, or why we even exist. I'd really love to press them to try and understand who we are and how we can actually help them on the design side. We need to make them understand we're not just subcontractors once the building's built because we've got a lot of knowledge and a lot of things we can help them with during design. Getting involved early is key. Planning is everything. During my time at W.M. Jordan Company, we were doing lean construction (and they still are of course), which was something that I really, really enjoyed.

Another thing I'll be helping with is the fit-out of NEBB TEC in Gaithersburg, MD so we can get the lab space up and running. We have some equipment being donated and already have some on-site that was donated years ago. Now we need to finalize the floor plans and the mechanical plans to get our contractors to go ahead and build it. I'm hoping sooner than later. Jeff Schools is actually in charge of the committee for NEBB TEC, but my hope is to be very involved and help move it along as quickly as possible. We're going to have some nice stuff there—it's going to be really nice. With the classroom we already have, plus the hands-on lab next to it, it's going be a pretty awesome learning set up.

KS: Do you foresee any major changes being applied to NEBB's learning environment or working style as an effect of the pandemic?

PR: The virtual training will be a big one, but it's important to note that we're still going to be hands-on. There's no way we can get away from doing any kind of hands-on training because that's who we are. But being able to offer, not necessarily our certification classes, but other classes and any tidbits of information we can give to architects, engineers, our members, and anybody in the industry—that's kind of my goal for the virtual part. We are still going to need people in front of us in the class to truly teach them and make sure they know what they're doing.

KS: Are you as actively involved with any other organizations or associations?

PR: No, NEBB was pretty much the only one. Once I learned what NEBB was and got involved, I didn't bother with anybody else. But I also really don't like the competition between various organizations because I feel like we ought to be working together to do everything right for the industry, but I don't know if that's possible or not. If I can somehow work with those other organizations and make things better for all of us, I'd much rather do that. There's no reason anyone needs to be excluded from job specifications—all of these organizations exist for the good of everyone. I'd like to make in-roads with those organizations, but that's up to them, I guess.

KS: Ok, let's get personal. What do you do in your spare time outside of work?

PR: I wish I knew! It's all been kind of a blur this past year. I'm country at heart. I live on 25 acres with my wife and two boys—one of whom will be driving shortly. We have some chickens, a couple of dogs, and a hawk that won't seem to go away. Recently, I've been starting to get into amateur radio, too. I just recently passed my Technicians exam, so I'm KO4MGE on the radio. ●

About the Author

With over a decade of corporate marketing experience, Kerri Souilliard has the unique ability to interpret and create brand stories for even the most complicated, technical organizations in words their target audiences readily understand. Her strong business acumen and deep understanding of many complex processes and technical disciplines blend seamlessly with her extensive background in digital strategy, copywriting, and content development to serve clients' overarching business goals—without the wasteful spending of traditional agencies. For more info, visit www.kreativstrategy.com.

Got an Article Idea?

Contact The NEBB Professional magazine (*communications@nebb.org*) with your story idea.

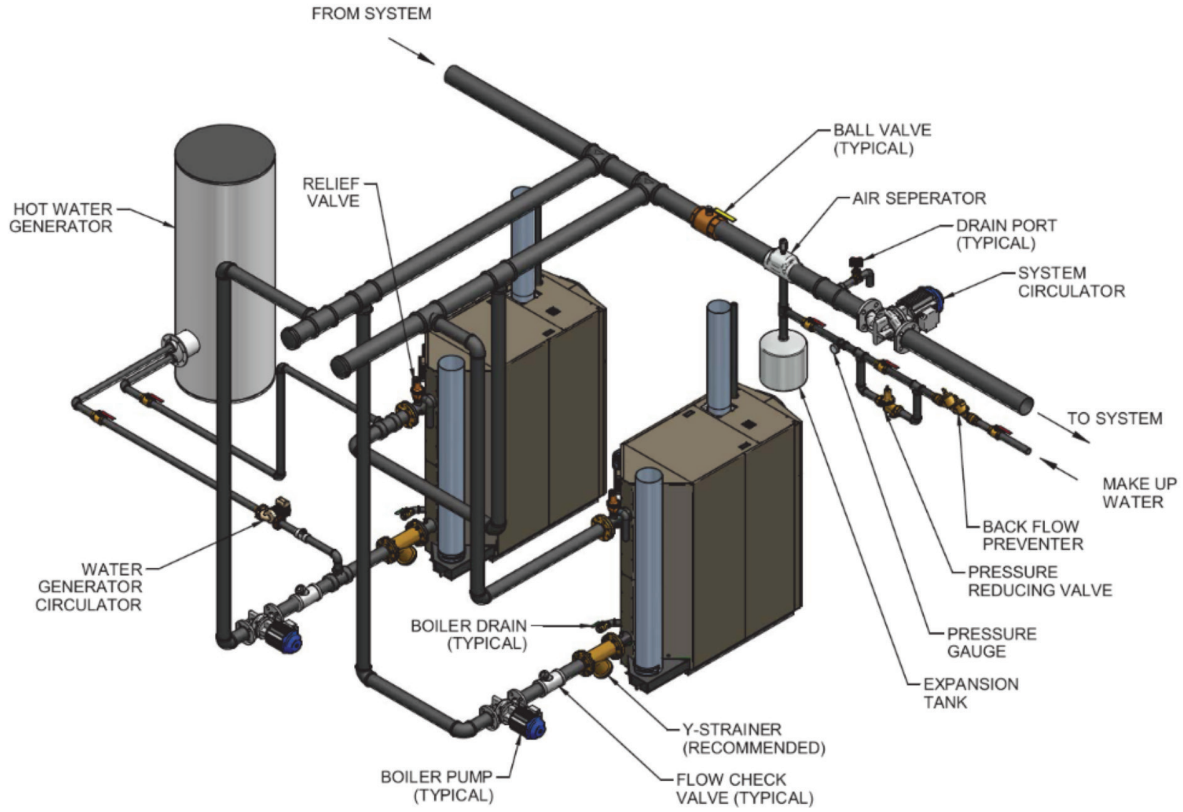
You don't have to write a word; just talk with the staff writer and your story will be put together for you. Ask any of the NEBB professionals who have appeared in this section how easy their story was to write.

NEBB War Story

By William Bailey

This is a war story concerning a problematic Hydronic Heating system. It really had us stumped at first, but we eventually found the very unusual issue. The Hydronic Heating system was a Primary / Secondary system that served as a hot water injection to a Water Source Heat Pump (WSHP) loop. There were two in-line pumps in parallel that served the Primary Loop to the boilers. Additionally, two secondary pumps in parallel served the Water Source Heat Pumps and were controlled by VFD's. The Water Source Heat Pumps have two-way control valves.

We had issues with one of the primary pumps that circulated a single boiler. The single boiler would experience symptoms indicating no flow when requested to operate. We confirmed all isolation and balance valves were open and verified the Y-strainers were clean. The initial testing performed on the pumps indicated one pump was meeting the design GPM to the single boiler, but the other identical pump was moving no water. Rotation of pumps was confirmed along with verification that impeller was spinning. A shut-off head test was performed on both pump packages that showed both pumps did indeed plot on the pump curve as specified. We were at a loss as to what was taking place. One pump would test great serving the single boiler but the other pump, in parallel next to it, would not have any water flow. The manufacturer was brought in to review the problem. The manufacturer representative repeated our testing and had the same results. A decision was made to remove the problematic pump motor and impeller assembly from the housing. All items were intact, and the impeller was free of debris. The pump assembly was reinstalled and tested again. The pump did not generate any GPM or differential pressure in full flow condition. With frustrations running high, and still no flow, we decided to remove the complete pump assembly for a more detailed inspection. Once we removed the entire pump assembly, we finally found the issue. The casting from the manufacturing on the inlet of the pump was obstructed with only a ¼" diameter hole being open to the pump inlet. The restriction was not caught by the manufacturers Quality Control Team before being shipped out to the supplier for distribution. The restriction could only be seen by removing the complete assembly and looking into the pump inlet. What made the situation unusual was the pump plotted out correctly on the pump curve on the Dead-Head/Shut-off Head testing but did not show any differential pressure or GPM flow when all valves were 100% open.



This was a Mind Teaser and thought this would be a story to send out to see if any other TAB CP's had experienced this. ●

About the Author

William Bailey has had over 42 years' experience in the HVAC industry. He has multiple trade knowledge in areas such as sheet metal, pipe installation, controls and TAB in both Air and Hydronics. William has worked with various types of controls such as DDC, Pneumatics, and standard HVAC control systems. He also has experience in various types of systems such as variable volume, constant volume both DX, Chilled, and Hot Water hydronic systems. He has a universal classification in refrigeration certification and is presently NEBB certified in TAB, BSC and Retro-Cx. William has taught 3rd and 4th year adult education HVAC classes for Associated Builders Contractors, Inc. since 1997. He has been a member of Nashville Chapter of ASHRAE since 2003 and is currently TEBB Chapter Coordinator. His hobbies are Bass fishing and working on small engines.

NEBB Required Instruments vs Having the Right Tools

By Pete Rawls

> "A NEBB Certified TAB Firm (CF) will, at minimum, own the instrumentation listed in the NEBB TAB Required Instrumentation List. Respective instruments will be applied in accordance with and maintained to properly perform in accordance with manufacturer recommendations.[1]"

Every updated NEBB Procedural Standard will have these statements or something very similar. What makes an efficient NEBB firm is knowing when to use these tools and when to use common sense. The Required Instrumentation Lists have been produced by a large group of volunteer committee members encompassing all the NEBB disciplines. A lot of time and effort has been put into researching the instruments available and the standard of care and accuracy that NEBB believes we owe our clients and our industry. These instruments are a minimum that need be in the firm's possession and calibrated, but they are not the only tools in the shed. They are for gathering and recording measurements that will be placed on a NEBB Certified Report. But often, field activities, trouble shooting, and quick verifications do not need the accuracy or resolution called for in our requirements. In many instances, a reference is needed more than a true measurement.

For instance, analog instruments do not meet NEBB standards for accuracy or resolution. However, an analog hood is excellent when needing to "watch" flows fluctuating in a system to troubleshoot or demonstrate non-steady flows (building pressure issues, systems that affect each other, doors opening and closing, etc.). Small analog pressure gauges for water systems are inexpensive and helpful. Calibration of these gauges can be verified with the required water meter each day before use. The gauges are light and quick to install on readily available ports in water systems. Multiple gauges can be temporarily installed at several points in a system to monitor pressures concurrently during operation. Monitor pump head, chiller bundle, and main coil drop all at once which can be important when troubleshooting or looking for a quick "blip" type issue. Otherwise, you are moving your heavy expensive meter all over the place for one reading at a time.

Electrical meters need to be accurate, true RMS meters to take measurements around a VFD, however, the procedural standards allow for using the VFD unless the need for manual measurement is present, such as multiple motors connected to the same VFD. Although not a required instrument, an electrical meter with remote/wireless head capabilities to take readings inside a pressurized fan chamber is useful. Otherwise, opening the door to take the reading changes airflow for example when electronically commutate motors (ECM) are involved.

Temperature is a measurement most often used for troubleshooting and evaluating systems. NEBB requires a very accurate and calibrated temperature meter with multiple probes to meet minimum require-

1 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Section 4, 4.1 Minimum Instrumentation

ments. However, having a few quick and easy reference gauges for grabbing snap shots in real time makes the process more efficient. The coveted "Blue Box" is an excellent meter. Reasonably priced, very accurate, easy to use and calibrate. But it has a downfall of being relatively slow compared to alternative methods. The certified firm is required to own an approved instrument but save it for field calibration verifications and situations that require certification. The more affordable and fast acting instruments can be purchased in multiples and used quickly. For example, when looking for a quick verification that a system is in HEATING or in COOLING. Having an instrument that can differentiate between a discharge temp of 110.2°F and 110.9°F does not make a difference when you are trying to read a rising temperature to know if the hot water control valve is opening. Likewise, in cooling, the need is for a wet and cool coil. Exact temperatures are not required, only that it is below dew point and providing a wet coil for proper total TAB airflows.

WHAT MAKES AN EFFICIENT NEBB FIRM IS KNOWING WHEN TO USE THESE TOOLS AND WHEN TO USE COMMON SENSE.

Not unlike temperature measurement instruments, in Retro Cx, a highly accurate and calibrated set of data loggers is required to meet NEBB minimum standards. But when troubleshooting, the need to see changes in half a degree is not required. Status such as ON/OFF or HEAT/COOL do not require accuracy or resolution. Having multiple less accurate and less expensive data loggers on hand will provide the data that is needed. The required data loggers are needed for verification, in house calibrations, and to meet the instrument requirements, but are not always the best tool for the job.

Improvise, adapt, overcome. Learn the tricks and be creative when doing your job. A piece of surveyor tape, a paper towel or piece of toilet paper is a valuable tool for TAB and Commissioning. Sometimes all that is needed is a visual representation of flow or pressure. When in front of a group of 5 or 6 people showing a neutral airflow at the filter intake of a fan powered VAV Box, the flag method has always been the best way to show it. When you decrease the box fan speed enough for the toilet paper to fall off, or even blow off, everyone watching knows what just happened without the need for an instrument. Building or Room Pressure can be demonstrated by a ping pong ball in a tube between spaces. Balancing Hoods are required and one of the more expensive packages that a firm must purchase. However, when the project is missing an inexpensive ceiling tile installed around a grill that is not the standard 24x24 lay-in, the expensive hood becomes useless by itself. Although not standard or desired, cutting a piece of cardboard to form a blank off in the field is solid theory. Keeping the flow contained within and through the hood instead of escaping around the grille is the goal, even if it is a piece of cardboard instead of a ceiling tile. Velgrids are often larger than required for smaller openings. Even though engineers frown upon this and question its validity, all 16 holes are not always needed. Seal off the holes not in the airstream so only the affective area of airflow is measured. Some manufacturers have now started selling half and quarter grids based on this same principle.

Finally, an unwritten requirement for a NEBB Certified Firm is common sense. Unfortunately, so the saying goes, common sense is not all that common some days. But it is the most valuable tool and instrument to have. Do what makes the most sense to get the job and the project completed accurately and efficiently and know that these suggestions do not necessarily work for all projects. Approaches to small vs large projects or complex vs simple will differ. Do not perform tasks just because it is required and not do others because it is not specified. Some specifications state TAB work should not begin until systems are 100% ready and complete. TAB can do lots of testing before final building enclosure is ready. In construction, comple-

Improvise, Adapt, Overcome

Learn the tricks and be creative when doing your job. A piece of surveyor tape, a paper towel or piece of toilet paper is a valuable tool for TAB and Commissioning.

tion is a relative term. If TAB waits until the project is truly complete, it may be well into occupancy before it can be finished, or possibly even started. Worse yet, when work during occupancy is not allowed or it is by escort only, your efforts can be drawn out well past your budgets. Not only will this disrupt TAB fees, but also potentially scheduled manpower for other projects. Pre-Balance work and set-up includes items that can be done before completion. Everything that is done before "complete" are tasks that do not have to be done after. Drilling holes for traverse locations or pressure readings in air handlers can be done at any time. In a system that is operating, with proper investigation, risers can be proportionally balanced to each floor before the project is complete. Investigation before the ceilings are closed in allows the firm to find missing or damaged dampers, grilles that are missing ductwork, outlets/inlets that have been covered up by sheetrock and a multitude of additional items that will be put on a deficiency list. Finding those items while the mechanical and finish contractors have manpower on-site gives the project team time to plan and finish, rather than just react to your list while you wait, or waste work already completed. There is always a way to be productive and proactive that help the process in the long run. ●

DO WHAT MAKES SENSE:

1. Approaches to small vs large projects or complex vs simple will differ.
2. Do not perform tasks just because it is required.
3. Do not ignore tasks because it is not specified.

About the Author

Pete Rawls is NEBB's new Technical Director. Based in Richmond, VA, Pete Rawls, P.E., NEBB CP, with over 25 years in the industry and a uniquely well-rounded background, officially joined the NEBB leadership team on December 1, 2020.

2021 NEBB Annual Conference

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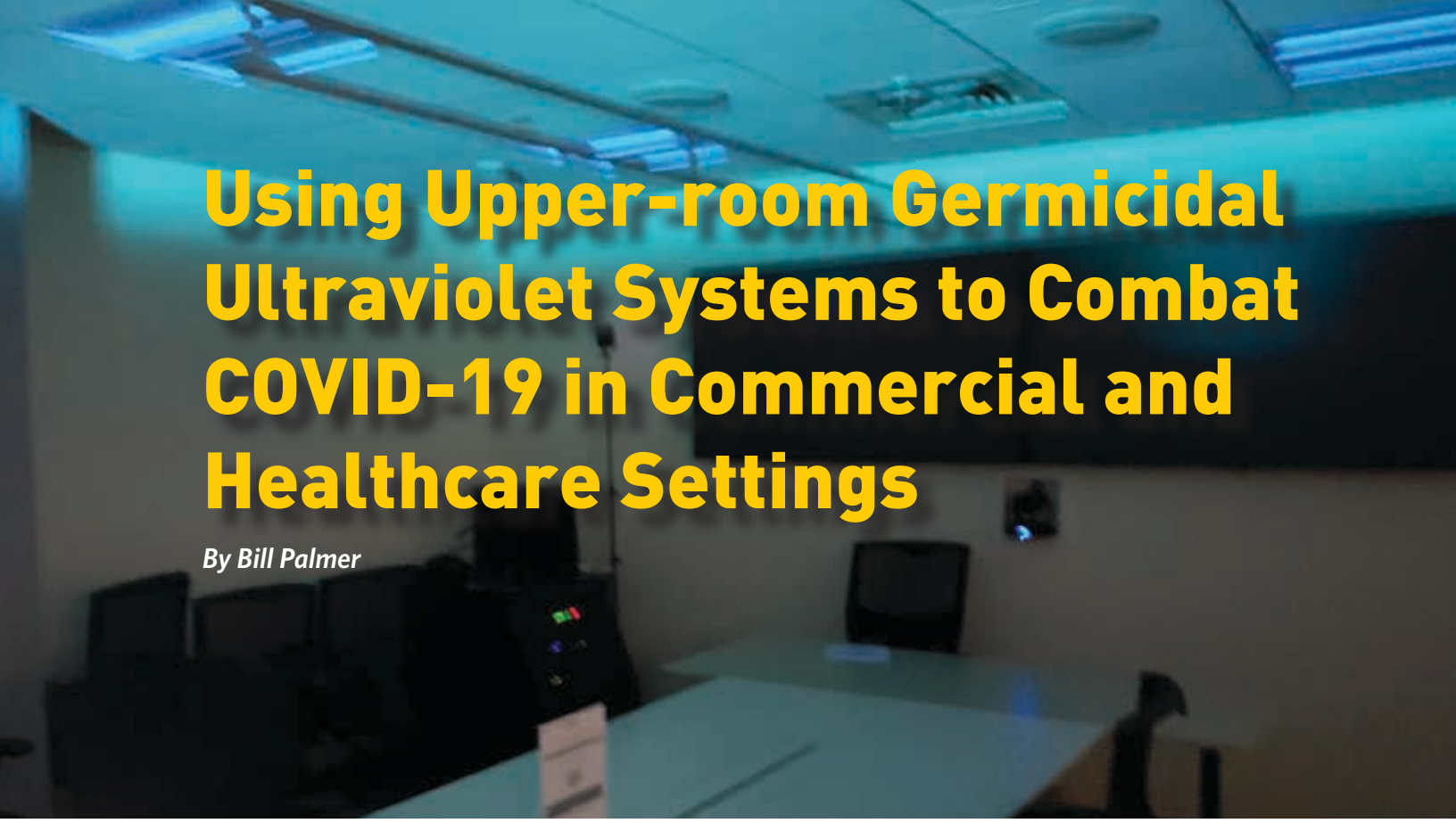


Using Upper-room Germicidal Ultraviolet Systems to Combat COVID-19 in Commercial and Healthcare Settings

By Bill Palmer

The COVID-19 pandemic is a watershed event which has changed the focus on infection prevention and control (IPC) for commercial buildings and healthcare settings, probably forever! While the initial focus was on surface disinfection, further research revealed that the primary mode of coronavirus transmission was through the air. The need for interventions to protect building occupants became clear and has spurred a huge reaction from opportunists looking to help solve this problem. Unfortunately, many of these opportunists not only lack experience in airborne IPC, they also do not have the benefit of historical lessons learned.

In our attempts to protect staff, visitors, clients, patients, and residents in our commercial and healthcare settings, it is important, to rely on interventions that are tested, tried and true. This is not the time to prey on the fears of the masses and to experiment with their health.

Upper-room germicidal ultraviolet (UR GUV) systems have been used for decades as an intervention in hospitals, schools, and diverse commercial settings as a cost-effective way to reduce the risk of airborne infection from multiple diseases. First used in schools in the 1940s to protect students from influenza, measles and chickenpox, UR GUV creates a disinfection zone above the room occupants. As convection and ventilation air currents within a space create air mixing between the lower and upper portions of the room, airborne microbes become exposed to the GUV rays in the upper portion. The DNA of the bacteria, as well as the DNA and RNA of viruses, are damaged by the GUV light which prevents them from reproducing or causing infection. This lowers the concentration of infectious microbes in the air and therefore reduces the risk of infection.

UR GUV has often been used for IPC of pulmonary tuberculosis (TB). TB bacteria are spread through the air. To show its effectiveness as an intervention against TB, studies were done in South Africa and Peru, in active TB wards. Air was exhausted from the active TB ward to one of two animal rooms containing Guinea pigs (which are very susceptible to TB). On alternating days, the UR GUV fixtures would be turned off or on. When on, the air would be exhausted to one guinea pig room, and when off, the air would be exhausted to the other guinea pig room. Both studies showed an 80% reduction in TB infection in the guinea pigs receiving air treated by the UR GUV systems.

Based on these results and other historical information, the WHO published their 2019 guidelines for tuberculosis IPC in which they recommended the use of UR GUV systems for airborne IPC in TB settings. Since then, some

studies have shown that SARS-CoV-2 (the virus responsible for COVID-19) is more susceptible to GUV than TB, which would imply that UR GUV systems should provide similar if not better protection for this virus. The US CDC has recommended the use of UR GUV in its tuberculosis guidelines for several decades.

Is UR GUV the only tool that I should use against SARS-CoV-2 in buildings? Absolutely not! There are many solutions that will be helpful in reducing risk. The key is to know which ones to apply and when, as well as knowing the anticipated benefits and costs. Several interventions are listed below with pros and cons of each.

HVAC Filter Upgrades

Upgrading the filter efficiency on your HVAC unit may be one of the easiest and least costly things to do. An upgrade to MERV 13 may dramatically increase the particle removal efficiency within the system. However, an increase in filter efficiency will lead to a rise in filter resistance and a decrease in airflow through the system. Diminished airflow, even with higher filter efficiency, could have a negative impact on IPC in occupied spaces (insufficient pressure control and ACH).

In-duct GUV

Installing in-duct GUV for "on the fly" disinfection of airborne microbes can be quite effective without leading to a decrease in airflow. In-duct GUV may increase HVAC airflow back to design state depending on how it is installed. If installed near coils it could decrease bioburden on the coils and improve air flow and energy efficiency. Achieving disinfection on the fly requires a high level of GUV irradiation and the system should only be designed by a trained and certified professional.

The facility-wide impact of in-duct GUV and increased filter efficiencies in HVAC units will be limited by the air flow of the HVAC system. If the HVAC system is not designed for an adequate amount of airflow, increasing the microbe removal efficiency will have a limited benefit.

Room Air Purifiers (portable and fixed)

Room air purifiers usually consist of a fan to move the air and a series of filters, usually including a HEPA filter. These devices are available in portable, ceiling-mount, in-duct, and wall-mount configurations. These devices, if properly designed and applied may be able to help meet IPC goals within a space as they can usually achieve the airflow and removal efficiencies required. However, drawbacks include high energy usage, periodic replacement of expensive high-efficiency filters and potentially expensive installation, which give them a high cost of ownership when used as a facility-wide solution. They are often best used for specific areas where other methods of control are not a viable option.

Increased Ventilation

Ventilation is often misunderstood. True ventilation is the replacement of building air with air from outside. Ventilating a space that has perfect air mixing, at an air

Conference rooms at Utica College shows the optimal placement of a UR GUV system.

This dark room was taken at Parkview Community Church and shows how the UV light irradiates the upper portion of the room. The blue light isn't actually a UV light, it comes from argon gas in the lamp. The blue light shows where the UV light (which is invisible) goes in the space and serves as a reminder to its presence.

change rate of 12 air changes per hour (ACH), is said to remove 99.999% of airborne contaminants in one hour. Most commercial spaces are designed with much lower ventilation rates and do not have perfect mixing. In most cases, increasing outside air volumes would dramatically increase the cost of energy required to heat or cool a space. Increasing the volume of air moved through a building would likely require the installation of larger duct work to facilitate the higher airflow rates. While ventilation is considered the best control method, the expense of retrofitting is usually prohibitive.

Upper Room Germicidal UV (UR GUV)

UR GUV systems (that are properly designed, installed operated and maintained) have been shown to inactivate airborne microbes at a rate that is equivalent to 10-24 ACH of exhaust ventilation. These highly effective systems are relatively easy to install and require little if any change to existing systems. As such, they have a low to moderate cost of purchase, installation, operation, and maintenance. With a low energy impact on a facility and a low cost of long-term maintenance, these UR GUV systems have a very low cost of ownership.

Proper Implementation of UR GUV Systems

While the installation process of UR GUV systems in relatively simple, there is a great amount of planning that must precede the installation. Like all the systems mentioned above, these systems must be designed by experienced UR GUV experts. The development of a national training and certification program for technicians and consultants working with GUV systems would help to ensure that the experts have the proper knowledge and technical expertise to provide this function.

Proper dosing

The first step in designing a UR GUV system is to determine the dose of GUV required within a space for the system to be effective. There is currently discussion within the ASHRAE GPC-37 subcommittee on UR GUV on the most accurate formula for determining dosing. One formula currently used considers the volume of a space (up to 3 m [10'] in ceiling height) and then multiplies that volume (in meters) by 0.012 W of UV. This will determine the total watts of GUV output from a fixture(s) required for an effective system. It is important to note that the GUV output of a fixture is very different from the nominal or GUV rating of a lamp. The GUV output of a fixture should be determined by an independent laboratory such as Intertek or UL, that has experience conducting these tests.

Fixture Selection

Fixtures should be UL1598 listed for electrical safety, UL867 or UL2998 listed for zero ozone generation, and be tested by an independent laboratory for GUV output. Fixtures should also have built-in capability to adjust the angle of GUV output for safety considerations.

Fixture Placement

Once the number of fixtures required for proper dosing is determined, the next step is to identify optimal fixture

placement. Fixture locations should avoid obstructions within the space that could block or reflect the GUV energy. Spreading the fixtures throughout the space to reduce the overlap of GUV and minimizing GUV energy losses to walls and ceilings is also important.

Safety Certification

The last step in the installation process is the final acceptance safety test. Unlike UVA and UVB which can cause skin cancer and cataracts, there are no known long-term health consequences from accidental exposure to UVC energy. GUV is within the UVC region which can cause temporary health consequences, such as photokeratitis (eye irritation) and skin erythema (like sunburn), when improperly installed. These undesirable health outcomes can be avoided by proper installation and testing for GUV levels in the occupied space. Many systems can be adjusted so that safety in the occupied space can be maintained without sacrificing the GUV output required for effectiveness.

When measuring levels of GUV in occupied spaces, it is imperative to use appropriate devices that are capable of accurately measuring very low levels of GUV. These tests should only be performed by individuals who have gone through a training process specific to UR GUV systems.

Conclusion

UR GUV systems are not the only tool that we can use to protect building occupants from airborne infectious diseases such as COVID-19 and tuberculosis However, they are a cost-effective risk reduction tool which, when properly installed and tested, can play a significant role for IPC within commercial and healthcare settings. ●

About the Author

Bill has spent 41 years in the ventilation and air purification industry, the last 29 years solely dedicated to creating and implementing products and services in support of airborne infection control for use both domestically and abroad. He has designed and brought over 20 HEPA filtration ventilation products to market for healthcare facilities.

Through the American Council for Accredited Certification (ACAC) he has met the criteria for a Certified Environmental Infection Control Consultant (CEICC) from 2012 through present.

NEBB®

YPN

Young Professionals Network

TIPS AND TRICKS

Jeff Schools, NEBB CP, Fisher Balancing Company, had the opportunity to talk to the first ever winner of the Tips and Tricks Contest, PJ Carnochan, Sr. Project Manager at Quality Test and Balance of Pasadena, Maryland and here's what he has to say.

PJ Carnochan

JS: How long have you been working in the balancing industry?
PJC: I started balancing in July of 2003, so 18 years.

JS: When did you become a Certified Technician?
PJC: I became NEBB certified in 2014.

JS: How did you hear about the Tips and Tricks contest?
PJC: The NEBB website.

JS: Was it easy to make your winning video?
PJC: Very easy.

JS: Did you have anyone else help you with the filming?
PJC: No just me

JS: What kind of camera did you use?
PJC: My phone camera.

JS: Do you have any advice for someone who is thinking about submitting a video?
PJC: Yeah, just because all the guys in your company know the trick it doesn't mean that other firms do. So, send them all of them.

JS: What did you do with your winnings? New car? New boat? New Harley?
PJC: Bought my wife a new watch for Valentine's day.

JS: There you have it straight from the First Tips and Tricks winner. A smart guy who spent his winnings very wisely!

I just want to remind everyone that the YPN Tips and Tricks Contest is still open and accepting submissions for the next quarter.

ALL ENTRIES MUST

- Meet eligibility and deadline requirements
- Conform to defined submission requirements
- Conform to all copyright laws
- Be submitted digitally (via email)

ENTRY CRITERIA ELIGIBILITY

1. The YPN 2-Minute Tips & Tricks Video Contest is open to anyone who is a NEBB CT or CP, or affiliated with a NEBB Firm, between the ages of 18 and 39 and whose message is directed at, geared toward or meant for professionals in any of the NEBB disciplines.
2. NEBB is international, so let's hear from all over the world!

HOW TO ENTER

1. Complete the entry form and send it with your video to ypn@nebb.org.
2. All submissions must be original work by the person or team responsible for creating the video.
3. You can enter the contest as an individual or as a team of up to three (3) members.

If you want more information on the contest, please visit the NEBB website and look under Featured News.

Chapter News

MAEBA Chapter

Trish Casey, Chapter Coordinator

MAEBA firms have been very busy in the past twelve months trying to help customers protect their facilities from COVID-19. Like many chapters, MAEBA had to cancel all seminars and practical exams in 2020. We are hopeful that the MAEBA 2021 Recertification Seminar will be held. It is scheduled to take place at the Hershey Lodge, in Hershey, PA on September 19-20, 2021. Notices for the seminar will go out this summer. Stay safe everyone!

The Hershey Lodge

Mid-South EBB Chapter (MEBB)

Ginger Slaick, Chapter Coordinator

The Battle House Renaissance Mobile Hotel & Spa

MEBB will host the 2021 Recertification Seminar and Vendor Expo September 18th-19th at the Battle House Renaissance Hotel & Spa in Mobile, AL. Part of the technical agenda for this year's seminar is a field trip to Gulf Quest National Maritime Museum where attendees will be divided into small groups to learn about the uniquely designed system specific to the facility.

Attendees will also have the chance to learn about the latest industry specific technology as well as information on a variety of instruments, software, and products by attending the Vendor Expo. This event is a vital part of the two-day meeting, providing Certified Professionals, Technicians, and others in attendance the opportunity to interact directly with industry representatives. MEBB appreciates the continued support of the vendors and looks forward to another successful event.

For additional information on the 2021 MEBB Recertification Seminar and Vendor Expo or how to become a valued vendor, please contact MEBB at 678-407-2754 or info@midsouthebb.com.

Florida EBB Chapter

Terry Wichlenski, Chapter Coordinator

Florida EBB's 40th Recertification Seminar & Annual Chapter Meeting is scheduled for April 29 & 30, 2021. The meeting will take place at the Omni Championsgate Hotel and Resort Orlando. We have exciting plans for our 40th

The Omni Championsgate Hotel and Resort

anniversary and look forward to welcoming everyone. We will have our annual Corn Hole Fundraiser on Thursday morning to help a Florida college student in the engineering field. Please contact the Chapter Coordinator, at 727-240-4254 or Febbcoordinator@gmail.com for more details and the registration form.

Our next NEBB TAB Practical Exam will be conducted on May 7th and/or 8th, 2021 at either the Jacksonville, Largo or Deerfield Beach testing sites. Depending on the candidates we may or may not use all three test sites. For additional information, please contact the FEBB Chapter Coordinator at 727-240-4254 or by email at Febbcoordinator@gmail.com.

TEBB Chapter

William Bailey, Chapter Coordinator

Congratulations go out to Dan Jackson and Cru Stracener for passing the NEBB Certified Technicians exam. Both Dan and Cru work for Nashville Machine Company and have dedicated a lot of time studying to pass this exam. The Chapter is looking forward to seeing them become active with the Chapter.

The TEBB Chapter has approved and seated the following Chapter Board members: Chris Palmer, President; Andrew Tittle, Vice-President; and Wayne Ayer, Secretary Treasurer.

Special thanks go out to both Rob Ratliff and Roger Wehby. Both are working with NEBB to support the Marketing Committee and the Chapter Affairs Committee and we appreciate the time they have given.

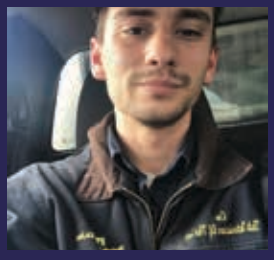
The TEBB Chapter is working on a training class for April in Nashville, Tennessee. An exciting agenda has been put together with more details to be released soon. The Chapter will offer the option to attend or zoom. Stay tuned for meeting registration information. ●

Chris Palmer
TEBB Chapter President

Andrew Tittle
TEBB Chapter Vice-President

Wayne Ayers
TEBB Secretary Treasurer

Dan Jackson
NEBB Technician



Cru Stracener
NEBB Technician

NEBB 2021 Technical Seminars Schedule

Sound and Vibration Measurement Seminar

April 12th - 16th, 2021 at NEBB TEC in Gaithersburg, Maryland

Learning Objectives

- Learn how to satisfy specification and customer requirements and know how to perform accurate repeatable sound and vibration measurements.
- Learn basic troubleshooting and diagnostic knowledge.
- Learn how to make simple recommendations and to guide appropriate parties towards possible remediation solutions.

Registration is now open!

Seminar Registration Deadline: March 29, 2021
For questions about technical seminars, please email training@nebb.org.
Applications for Candidacy Deadline: April 1, 2021
For questions about the NEBB Certification process, please email certification@nebb.org.

Building Enclosure Testing Seminar

April 26th - 27th, 2021 at NEBB TEC in Gaithersburg, Maryland

Learning Objectives

- Discussions of air barrier enclosures from design to material selection and installation.
- Review of various testing methods and procedures currently specified and their correct application.
- Basic operation of the blower door equipment, respective applications and features will be presented.
- How to analyze and trouble shoot enclosure test issues.
- Trouble shooting air barrier leakage issues and problem resolution focusing on the use of thermal imaging.

Registration is now open!

Seminar Registration Deadline: April 12, 2021
For questions about technical seminars, please email training@nebb.org.
Applications for Candidacy Deadline: April 12, 2021
For questions about the NEBB Certification process, please email certification@nebb.org.

Testing, Adjusting and Balancing Seminar

June 3rd - 6th, 2021 at NEBB TEC in Gaithersburg, Maryland

Learning Objectives:

This seminar will cover engineering principles, charts, diagrams, problem solving and techniques, along with reviewing HVAC principles involved with TAB work and HVAC testing.

Registration is now open!

Seminar Registration Deadline: May 20, 2021
For questions about technical seminars, please email training@nebb.org.
Applications for candidacy Deadline: May 20, 2021
For questions about the NEBB Certification process, please email certification@nebb.org.

Fume Hood Performance Testing Seminar

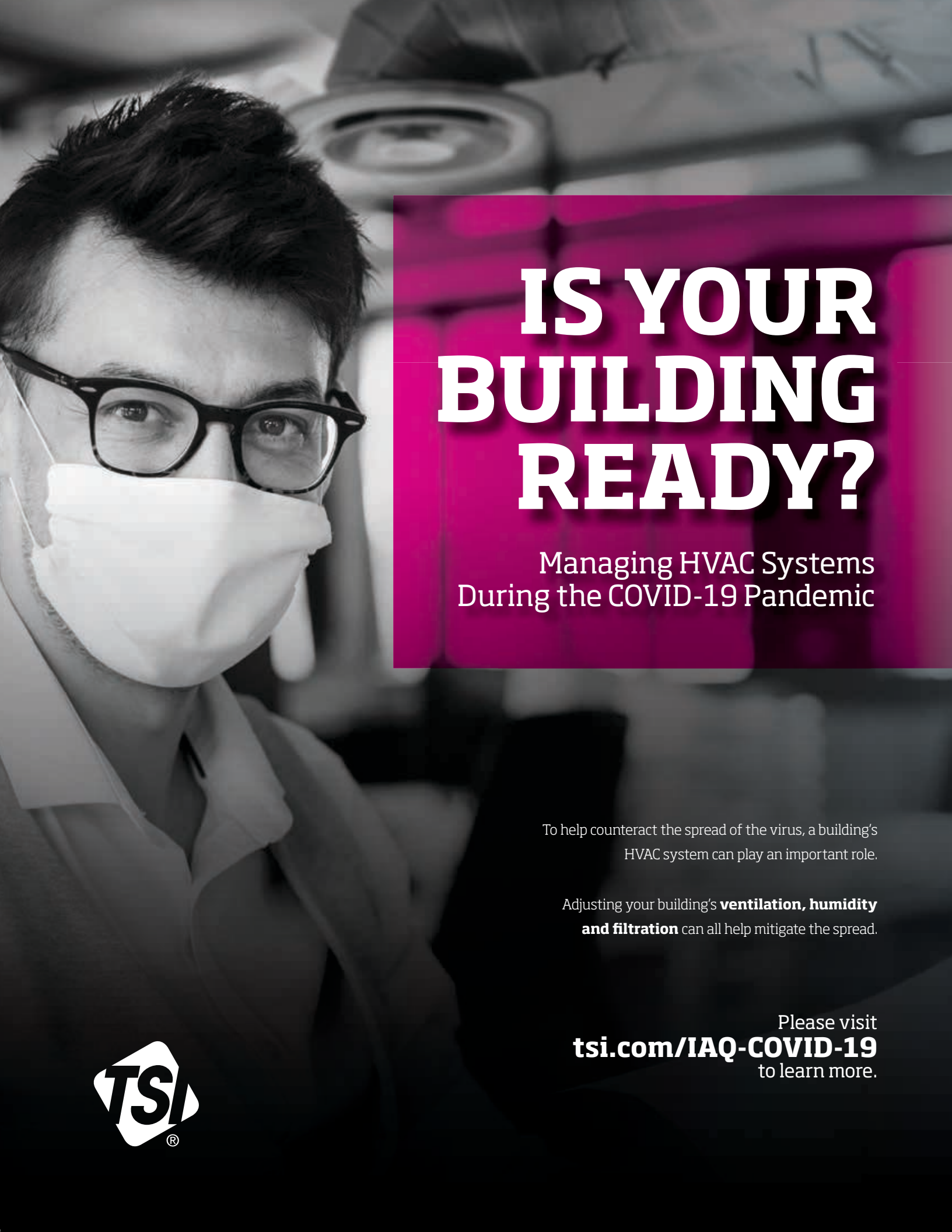
June 7th - 8th, 2021 at Labconco in Kansas City, Missouri

Learning Objectives:

The seminar will provide attendees with an overview of laboratory HVAC concepts, including discussions of environmental safety enclosures, such as fume hoods, biological safety cabinets and other containment enclosures. Instructors will review various HVAC systems currently employed in laboratory design. The basic operation of fume hoods and other containment enclosures and their respective applications and features will be presented.

Registration is now open!

Seminar Registration Deadline: May 24, 2021
For questions about technical seminars, please email training@nebb.org.
Applications for candidacy Deadline: May 24, 2021
For questions about the NEBB Certification process, please email certification@nebb.org.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