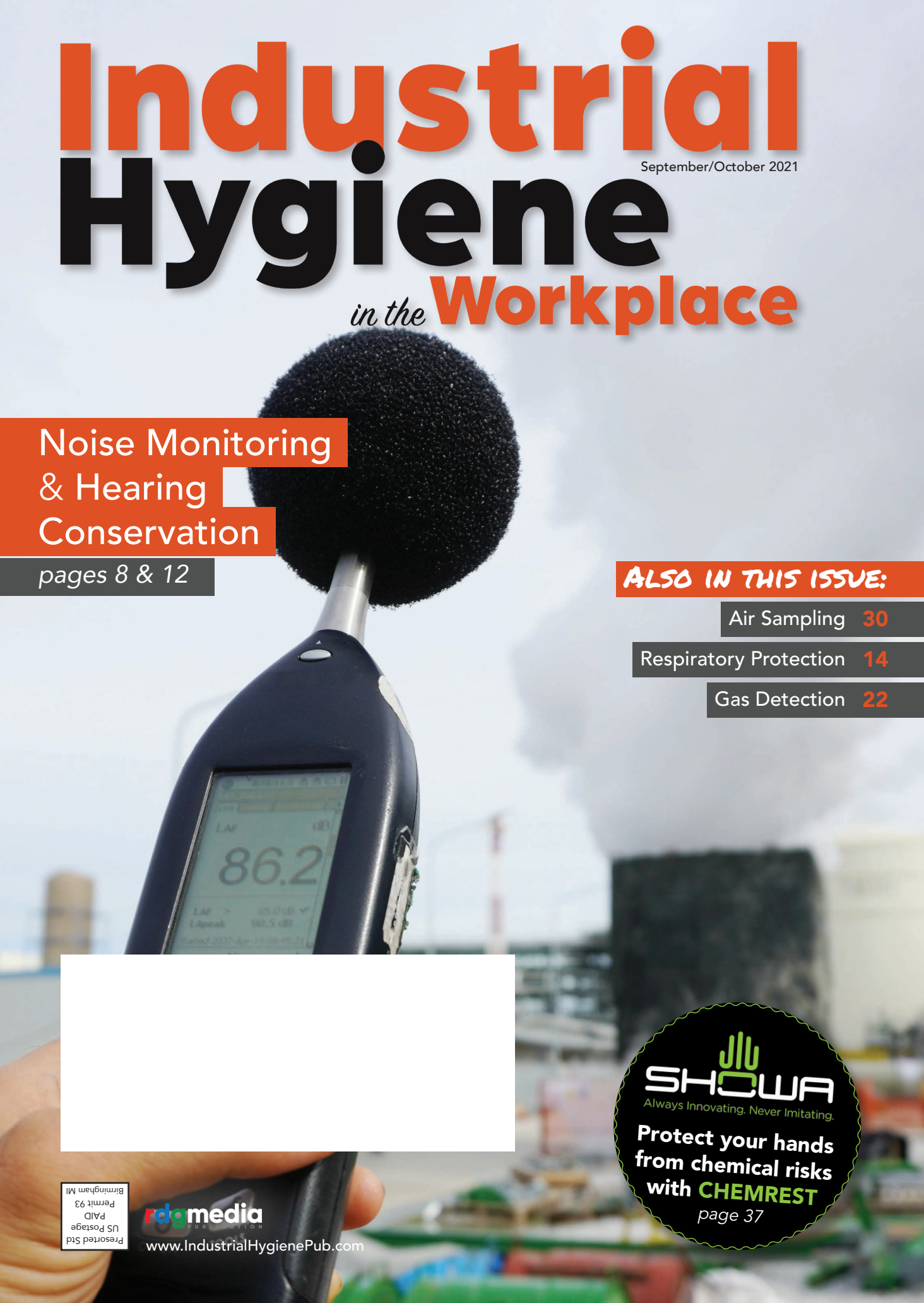
Industrial Hygiene in the Workplace

September/October 2021



Noise Monitoring & Hearing Conservation

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Note from the Editor

"The manufacturer has a vote; the bosses have votes; the foremen have votes; the inspectors have votes. The working girl has no vote. When she asks to have the building in which she must work made clean and safe, the officials do not have to listen."

–Clara Lemlich, leader of labor and suffrage movements, 1912

New York City, 1911: the setting of a devastating fire at the Triangle Shirtwaist Factory. A total of 146 workers lost their lives—primarily young, immigrant women. Their bosses had actually locked the doors, as part of company "protocol" to keep employees inside the building and working. Dozens of women jumped in desperation from the 9th floor of the burning building to the horror of onlookers below. Ms. Lemlich's comments, from a 1912 interview, stated what now seems blatantly obvious: All workers deserve the dignity of protection.

This event was the catalyst for a few changes in workplace safety—and one of the main focuses of the Women's Suffrage movement and various labor laws throughout the state and the country. In fact, the ASSP, the world's oldest workplace safety society, was founded just months after the Triangle Shirtwaist disaster. In 1911, it was formed as the United Association of Casualty Inspectors, then renamed as the American Society of Safety Engineers (ASSE) in 1914.

If these things seem like long-ago dates from history, think again. My grandparents were alive at the time of this fire. My maternal grandmother remembered when women got the right to vote a few years later, and my grandfather well remembered working in Chicago as a meat-packer in the early days of labor movements. Some of his stories sounded like testimonials from Upton Sinclair's *The Jungle*.

The topics of labor and safety go hand-in-hand. Since the nation just celebrated Labor Day in September, it behooves us to remember why the holiday exists. Far more than a reason for backyard barbeques or large retail store sales, the commemoration stands as a reminder of where workers were a little more than 100 years ago.

At *Industrial Hygiene in the Workplace*, I know our readers are dedicated to worker safety, protection and well-being. Thankfully, because of bodies like ASSP, AIHA, ISEA and others, America's workforce does not have to worry about the things employees faced a century ago. Safety professionals work tirelessly to ensure that everything from the right hearing protection to respiratory PPE to the air breathed by the workers is as safe as it can be.

This September-October *IHW* issue's cover focus is on noise monitoring and hearing protection, with two articles dedicated to the subject. We also have features on respiratory protection, air sampling, gas detection and lockdown/turnarounds—to bring a full lineup of in-depth, state-of-the-industry information to your doorstep. I hope reading it assists you in your respective positions within the industry. And, as always, if you are interested in contributing an article or "Perspectives" piece, contact me at bnessinger@workplacemhs.com.

Regards,

Barbara Nessinger, *Editor-in-Chief*

Industrial Hygiene in the Workplace

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By: **Tim Turney**, *Contributor*

Plugging the Knowledge Gap in Hearing Protection

Approximately 22 million workers are exposed to hazardous occupational noise each year[1]. Prolonged exposure to excessive noise levels can cause life-changing damage, because the harm to the sensory cells and other structures within the ears is irreversible—often resulting in permanent noise-induced hearing loss (NIHL).

NIHL is more common than diabetes or cancer[2]. It results in injuries that can seriously impair a worker's quality of life. Employers, meanwhile, run the risk of reduced productivity; rising costs due to sickness days; increased costs for training and recruitment; and catastrophic penalties and compensation claims. OSHA estimates that employers spend $242 million annually on workers' compensation for hearing loss disability[3].

Understanding Legal Requirements

To keep workers safe, OSHA sets the legal limits on noise exposure in the workplace based on a worker's time-weighted average over an 8-hour day. OSHA's maximum permissible exposure limit to noise is 90dBA (decibels) for all workers. When workers are exposed to an average noise level of 85dBA or higher for an 8-hour shift, employers must implement a hearing conservation program. These programs require employers to measure noise levels, provide free annual hearing exams and hearing protection, offer training and conduct evaluations of the adequacy of the hearing protectors in use.

The programs cost around $350 per worker each year[4], necessitating $70,000 annually for a 200-strong workforce. They are mandatory until the employer makes sufficient changes to the tools, equipment and schedules used, so that conditions are improved, and worker exposure is demonstrated to be less than the 85dBA.

Conversely, the National Institute for Occupational Safety and Health (NIOSH) recommends that all worker exposure to noise should be controlled below or equivalent to the level 85dBA for 8 hours, a decibel level comparable to the sound of a passing diesel truck. NIOSH designed its recommendations to represent the best scientific practice concerning noise exposure. On the other hand, the OSHA exposure limit is the minimum legal requirement with which employers must comply.

Using Noise Monitoring to Gather Accurate Insights

Noise monitoring provides accurate insights into the noise levels of a working environment, so businesses can identify problem areas and ensure they adhere to OSHA regulations. However, professionals undertaking the monitoring should be trained and prepared sufficiently with the right equipment, as minor errors in noise level estimates can lead to major errors in exposure calculations. Inaccurate estimates can risk employee health, employer prosecution and unnecessary expenses undertaking exposure-limiting measures based on inaccurate data.

If certain aspects of noise monitoring, protection and control are outside of a company's competencies, it is advisable to seek external consultancies, training and support in order to bridge knowledge gaps and ensure employees get critical protection. *(photo courtesy Casella)*

Two pieces of equipment essential for the assessment are the sound level meter, primarily designed as a hand-held device used by an operator; and the noise dosimeter, which a staff member wears for their working shift. A sound level meter is an ideal solution for measuring the overall noise level of a task, piece of machinery or area. On the other hand, dosimeters, which are smaller and body-mounted, are best for personal noise measurements where it is difficult or unsafe to get close to employees with a sound-level meter. For example, a dosimeter would be ideal for forklift truck drivers exposed to many different noise levels and irregular working patterns.

If an assessment establishes that noise levels pose a risk to workers, personal hearing protection should be supplied immediately—while other, more permanent solutions are executed. However, personal hearing protection should only be considered the primary solution when all other options have been exhausted, such as physically separating staff from the noisiest areas or rotating shifts to spread individual exposure.

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A noise survey will determine which employees need personal hearing protection, based on whether:

- The employee is exposed to workplace noise during an 8-hour work shift, in which the noise averages 85dBA (50% dose) or greater
- An employee has not yet had a baseline audiogram established in a work environment averaging 85dBA or greater
- An employee has experienced a standard threshold shift

Occupational standards specify a maximum allowable daily noise dose, expressed in percentages. For example, a person exposed to 85dBA per NIOSH REL or 90dBA per OSHA PEL over an 8-hour work shift will reach 100% of their daily noise dose. The noise dose is based on the sound exposure level and duration, so for each increase of 3-dB (NIOSH) or 5-dB (OSHA) in noise levels, the duration of the exposure should be cut in half.

Relationship Between Sound Exposure Levels & Durations (for NIOSH, OSHA)

Time to reach 100% noise dose	Exposure level per NIOSH REL	Exposure level per OSHA PEL
8 hours	85dBA	90dBA
4 hours	88dBA	95dBA
2 hours	91dBA	100dBA
1 hour	94dBA	105dBA
30 minutes	97dBA	110dBA
15 minutes	100dBA	115dBA

Source: Centers for Disease Control and Prevention[5]

Selecting Personal Hearing Protection

When selecting hearing protection equipment, employers should consider the relationship between hearing protection and other personal protective equipment (PPE). For example, an employee wearing prescription or safety glasses will not obtain an adequate fit from a standard earmuff, so plugs or semi-inserts may be more suitable. In working environments where hard hats are worn regularly, a hard hat with built-in hearing defenders should be considered.

Employers must also understand the process of reducing sound, known as attenuation. If a protector with too little attenuation is used, then employees will not receive enough protection. However, too much noise reduction can create feelings of isolation, and an employee may need to remove their PPE to communicate.

In addition, over-attenuation can cut out safety warnings—such as fire alarms or sirens from reversing vehicles—resulting in further risks to workers. As a general rule of thumb, businesses can avoid over-protecting workers by ensuring the level of exposure is not reduced to a level below 75dBA.

A business's unique working environment also impacts the best protector choice. For example, hot humid conditions can make earmuffs uncomfortable to wear, while dusty environments can cause hygiene problems. In dusty workplaces, it is crucial to keep the hands clean when inserting protective plugs to avoid ear infections. It is also advisable to ascertain any history of ear problems (i.e., irritation or earache) from employees, as earmuffs that fit over the outer ear may be preferable to avoid medical complications.

Removing PPE, even for short periods, has a significant effect on exposure. Therefore, it is crucial that hearing protection is comfortable. Providing employees with a choice of protection will encourage all-day wear and, ultimately, support their safety.

Keeping the Future Workforce Safe

Employers have a responsibility to prevent damage to their workers' health; however, skill and knowledge of measuring noise can take years to build. Therefore, the information above can only be considered a foundational introduction. If certain aspects of noise monitoring, protection and control are outside of an individual's competencies, it is advisable to seek external consultancies, training and support in order to bridge knowledge gaps and ensure employees get the critical protection. IHW

About the Author

Tim Turney is Global Marketing Manager at Casella. He graduated as an engineer from Queen Mary and Westfield in London. Since starting at Casella in 1998, Tim has been involved in the acoustics and air-sampling industry, specializing in measurement and instrumentation technologies. Casella is dedicated to reducing occupational health and environmental risks and supporting businesses in solving their monitoring and analysis needs. For more information about Casella's noise monitoring solutions visit, https://www.casellasolutions.com/us/en.html.

Footnotes:

1. https://hearingimprovementcenter.com/hearing-healthcare-news/cdc-finds-hearing-loss-is-third-most-common-chronic-condition
2. https://hearingimprovementcenter.com/hearing-healthcare-news/cdc-finds-hearing-loss-is-third-most-common-chronic-condition
3. https://www.starkey.com/blog/articles/2019/03/Exposure-to-too-much-noise
4. https://pubmed.ncbi.nlm.nih.gov/29251690/#:~:text=Hearing%20conservation%20programs%20(HCPs)%20mandated,about%20%24350%2Fworker%2Fyear
5. https://www.cdc.gov/niosh/topics/noise/reducenoiseexposure/regsguidance.html

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By: **Gregory A. Flamme and Kristy K. Deiters,** *Contributors*

Age "Correction" in Hearing Conservation Programs

Employers may elect to adjust observed hearing threshold changes as an attempt to account for typical age-related change. However, there is no guarantee that age "correction" correctly represents the influence of age, and adjusted threshold shifts are not interpretable for individuals or small groups—because age-related changes vary widely across people. Further, age adjustments are only valid if they represent longitudinal trends.

Age-adjustment tables currently included in U.S. regulations are based on differences between small groups of people in the 1970s. Thus, employers choosing to age-adjust audiograms are making an implicit assumption that 1970s cross-sectional trends represent current age-related changes. Employers should carefully consider whether this assumption is reasonable.

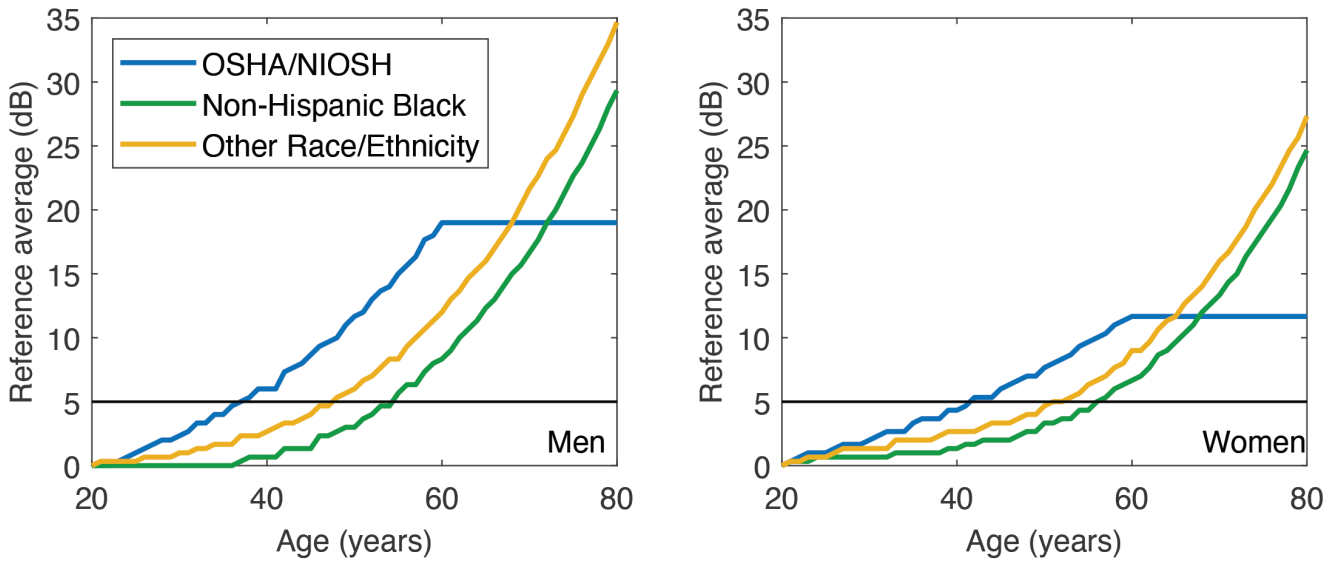
We have recently developed age-adjustment tables using nationally representative data and validated them using a large occupational hearing conservation database (Flamme et al., 2019). These tables represent current population trends; account for differences in race/ethnicity; span ages 18 to 85 years; and match (within one 5dB audiometric step) median longitudinal changes among male workers through 30 years on the job.

Shallower cross-sectional trends were observed for people identifying with non-Hispanic Black race/ethnicity, and overall trends imply substantially less age-related change in hearing thresholds than is assumed in current U.S. regulations *[see chart]*. Employers applying 1970s-based age adjustments will substantially overestimate current age-related effects, and threshold shifts due to other factors (e.g., occupational/non-occupational exposure, disease) would be missed.

Regulations have not been modified to include recent adjustment tables, so employers must either (1) use tables that do not represent current trends; or (2) forego age adjustment. NIOSH has advised against using age "corrections" for decades and recent findings support that advice. IHW

[Gregory A. Flamme and Kristy K. Deiters, are with Stephenson & Stephenson Research & Consulting Researchers are also and National Hearing Conservation Association (NHCA) Experts. Visit NHCA at: https://www.hearingconservation.org/]

COMPARISON OF AGE ADJUSTMENT VALUES



The left plot represents data for men; the right plot represents data for women. In each plot, the horizontal axis represents age and the vertical axis represents the mean tabled values across 2k 3k and 4k Hz, shifted to be equal at age 20. The blue curves represent the OSHA/NIOSH curves referenced in U.S. regulations. The green curves were derived for people reporting non-Hispanic Black race/ethnicity. The yellow curves were derived for people reporting any other race/ethnicity. The horizontal black lines at 5dB provide a reference comparison for an average of one 5dB audiometric step. *Chart reference: Flamme, G. A., Deiters, K. K., Stephenson, M. R., Themann, C. L., Murphy, W. J., Byrne, D. C., Goldfarb, D. G., Zeig-Owens, R., Hall, C. Prezant, D. J., & Cone, J. E. (2019). Population-based age adjustment tables for use in occupational hearing conservation programs.* International Journal of Audiology, *59(S1), S20-S30.*

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By: **Mark Stromme**, *Contributor*

Breathe Easy: A 10-Step Respiratory Protection Training Plan

Employees depend on a respirator to keep them safe and healthy when working in a hazardous atmosphere. Make sure they understand how to safely use the equipment.

Overview

Before you can require employees to wear respirators, the Occupational Safety and Health Administration (OSHA) requires you to take steps to prevent the hazardous atmosphere from developing in the first place. Some of these control measures can include:

- Enclosing an operation
- Substituting a less hazardous material
- Providing improved general ventilation
- Installing local exhaust ventilation

If these control measures aren't feasible or effective (or while the control measures are being put into place), employees must wear respiratory protection. Proper training is critical, because improper use of a respirator can lead to serious illness or death.

Specific Training Elements

Follow this 10-step approach to effectively train on respirator use. The rest of this article is written in a script-type format for you, the safety trainer, to deliver to company employees.

1) Introduce the Topic

Your employer takes steps to keep the air clean. You can help keep these control measures effective. There are several ways to go about doing so for an employer. For example, if a certain operation is set up so that a chemical is enclosed in tanks, piping or other containers, make sure you keep the equipment closed. If a job calls for using a certain chemical, don't substitute something else. When it comes time to turn on ventilation equipment to do a job, make sure you use the equipment; if said equipment isn't working properly, report the problem immediately.

Despite these control measures, sometimes the air still isn't safe to breathe. In this case, you'll have to wear a respirator while you work.

2) Explain Air Contaminants

Air contaminant hazards can include dusts, aerosol mists, metal fumes, evaporated vapors, released gases or oxygen-deficient atmospheres. Some particulates can cause metal fume fever, silicosis or asbestosis. In the short term, some chemical vapors can cause dizziness or nausea; in the long term, some can cause liver damage or cancer. Some gases act as asphyxiants, and overexposure can cause death. Similarly, oxygen-deficient atmospheres can be deadly.

Employees depend on respirators to keep them safe and healthy when working in hazardous atmospheres. Using the equipment properly is of paramount importance. *(photo courtesy J.J.Keller)*

OSHA sets permissible exposure limits for many contaminants to help employers determine if employee exposures are at safe levels. If control measures don't reduce exposures to these safe levels, workers must wear respirators.

3) Outline Capabilities and Limitations of Your Respirators

There are basically two types of respirators: air-purifying respirators (including dust masks, gas masks, chemical cartridge respirators and powered air-purifying respirators) clean the air as you inhale, and atmosphere-supplying respirators supply you with a separate source of clean air (through a hose or a tank you carry on your back).

The capabilities of a respirator depend a lot on the type and amount of the air contaminant and the work being done. For example, a dust mask (an air-purifying respirator) is capable of filtering hazardous particulates from the air as you breathe, but it doesn't protect you from hazardous levels of solvent vapors.

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respirator can protect you when oxygen levels are too low; in this case, you must use an atmosphere-supplying respirator.

4) Demonstrate How to Inspect, Put on and Remove, Use and Check the Seals of Your Respirators

Inspect the respirator before each time you use it. Inspect it again as you clean it. Self-contained breathing apparatus and respirators reserved for emergency use must be inspected monthly.

Each time you put on a respirator with a tight-fitting facepiece, you must perform two seal checks to be sure that the facepiece is properly seated and adjusted on your face. If you detect leaks during the seal checks, readjust the facepiece and repeat the checks.

5) Describe What to Do if a Respirator Malfunctions

It's a clear sign that something is wrong if you can smell or taste the contaminant while you work; or if your breathing becomes strained; or if you notice a respirator part isn't working properly. If your respirator stops working properly while you're in a hazardous atmosphere, immediately exit to a safe area. Don't remove the respirator until you've left the hazardous atmosphere.

6) Explain How to Use a Respirator in Case of an Emergency

If there's a sudden release of a hazardous chemical while you're working in an area that has escape-only respirators available (for example, where ammonia or chlorine are stored), put on the emergency respirator as you exit.

Some employees may be trained and authorized to perform emergency responses that require respirator use. Examples would include confined space rescue, emergency response to chemical releases and interior structural firefighting. If you aren't authorized for these emergency actions, evacuate to a safe area.

7) Outline Procedures for Proper Respirator Maintenance and Storage

Don't wear a dirty or damaged respirator. Using the wrong procedures to clean a respirator can damage it, so follow instructions. For example, never use paint thinner or other harsh solvents to clean a respirator.

Know how to report damage and get repairs. Only the manufacturer's replacement parts can be used to repair a respirator. Store respirators so they will stay clean and will not be damaged.

8) Discuss Signs and Symptoms that Could Affect Employees' Safe Use of a Respirator

Even though you've passed a medical evaluation before you wear a respirator, remember that people can change. Medical changes can affect your ability to safely wear a respirator. Examples of these can include the development of shortness of breath, dizziness, coughing, wheezing, chest pain, chest injuries, lung diseases, cardiovascular conditions or heart conditions.

9) Emphasize the Consequences of Improper Respirator Use

There are many examples of improper respirator use to discuss. One example would be using the wrong type of filter or cartridge with an air-purifying respirator. Employees may also be wearing a tight-fitting facepiece too loosely, so contaminated air could potentially leak in. Lastly, employees may not leave a contaminated area before removing the respirator.

OSHA sets permissible exposure limits for many contaminants to help determine if employee exposures are at safe levels. If control measures don't reduce exposures to these safe levels, workers must wear respirators. *(photo courtesy J.J.Keller)*

10) Outline the Other Requirements in OSHA's Respiratory Protection Standard

Some of OSHA's other requirements include the following:

- The employer must identify and evaluate the respiratory hazards in the workplace
- Respirators are required when ventilation or other engineering controls aren't adequate to reduce exposures to safe levels
- The employer must have a written respiratory protection program
- The employer must provide employees with medical evaluations before they can use respirators
- Employees who must use a respirator with a tight-fitting facepiece must be fit-tested before they can use the respirator
- The employer must provide for cleaning, storing, inspecting and repairing respirators
- Atmosphere-supplying respirators must use high-purity breathing gases
- Filters, cartridges and canisters must be properly identified IHW

Mark Stromme is with J.J. Keller & Associates, Inc.

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By: **Barbara Nessinger**, *Editor-in-Chief*

Protecting Workers from Welding Hazards

According to the American Welding Society, an estimated 50% U.S. gross national product is affected by welding. Anything made of metal, no matter how big or small, can be welded. Welding is the most common method used to join metal parts in large structures and equipment, due to its strength. Soldering and brazing are similar processes to welding, but they are used on electronic and other small equipment and use lower temperatures to melt the filler metal.

Most welding today falls into one of two categories: arc welding (the use of an electrical arc to melt the work materials) and torch welding (the use of an oxyacetylene torch to melt the working material and welding rod). There are more than 100 welding processes; most involve a skilled worker using a high-heat torch; filler material that is usually in wire or stick form; and pressure to permanently bond metal pieces.

Welding, cutting, brazing and grinding all create significant fire and explosion risks. This type of work generates hot sparks and slag. Those can then come into contact with nearby combustibles and flammable gases.

Most welding safety practices and equipment are universally applicable. Welding exposes everyone to similar hazards, from a welding-intensive manufacturing company; a billion-dollar engineering and construction firm; a small independent fabricator; or someone responsible for safety-at-large in the workplace. Wearing the proper PPE equipment is extremely important to keep welders and watchers safe from multiple hazards.

Implementing good welding/hot-work safety practices can help do more than just save lives. When welding safety becomes an ingrained part of the corporate culture, there can be fewer reduced lost-time incidences and improved productivity. *[See sidebar "Preventing Hot-Work Accidents."]*

Energy is Everything

Clothed in protective gear, surrounded by flying sparks, the welder wields a powerful energy source and generates heat up to 15,000°F in order to fuse two materials together into a strong joint—called a weldment—that will be permanent once the parts cool. An economical and efficient process, welding is vital to the construction, manufacturing, aerospace, automotive, railroad and shipping industries, among others.

Many of the potential dangers of using the kinds of energy sources (electric arc, gas flame, laser, electron beam, friction or ultrasound) and extreme heat required in welding are obvious and straightforward: burns, electric shock, vision damage and exposure to ultraviolet radiation at unhealthy levels. Another risk, arising from the inhalation of hazardous fumes and gases, is more complex, in that both the types of toxins and the range of potential health effects are many.

Exposure to welding fumes and gases may be acute or prolonged. Acute exposure can cause eye, nose and throat irritation, dizziness and nausea. *(photo courtesy Adobe Stock)*

Fumes, Explained

Welding fumes are condensed into very fine particles when a metal is heated above its boiling point; they are a mixture of metallic oxides, silicates and fluorides, as well as particles from the electrode and the material being welded. Both the metals being welded and the coatings or residue on those metals can contribute toxins to welding fumes. Among the metals and gases that welding fumes can contain include aluminum, antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, silver, tin, titanium, vanadium, zinc, argon, helium, nitrogen, carbon dioxide, nitric oxide, nitrogen dioxide, ozone, phosgene, hydrogen and fluoride.

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PREVENTING HOT-WORK ACCIDENTS

According to OSHA, between 2005-2015, there were 85 fire-related deaths in the oil and gas industry. Of those, 28 occurred due to improper hot-work practices. RMI's blog, titled "Preventing fires with a Hot-Works Program," provides some general guidance on ways to prevent hot-work incidents, even for those not working in oil/gas. Here are some basic ways to prevent hot-work incidents:

Having and using a hot-work permit

A written permit is required in certain situations, but it's a good idea to use them for all your hot-work activities. The permit ensures that all necessary safety precautions are in place. It also helps lower the risk of fire or explosion.

Performing hot-work in a safe location

Remove all combustibles from the area before conducting hot-work. Whenever possible, perform the work in an area that won't interfere with other workers.

Wearing the proper PPE

Always wear FR clothing when performing hot work. It is the responsibility of the employer to provide this to the employee. Further, FR clothing should be maintained and kept in good condition.

Using fire blankets to protect equipment from sparks and slag

If you cannot move combustibles or nearby equipment out of the way, lay fire blankets over them. This will protect them and prevent them from catching fire.

Having fire extinguishers nearby and ready

Employees should always know where to find the nearest fire extinguisher. This is even more critical when performing hot-work. Hoses and other suppression equipment can work, too.

Assigning a fire watch for all hot-work activities

A fire watch should always be present for hot-work activities. The fire watch should know how to sound the alarm in the event of a fire. They should also know to only extinguish a fire when it is small and contained to one area. OSHA requires the fire watch remain in place for at least 30 minutes after the work is complete. IHW

[For the complete blog, go to: http://blog.rmiwyoming.com/fire-prevention-for-the-oil-and-gas-industry.]

The composition of fumes depends on the materials being welded. Steel welding, for instance, produces fumes that mostly contain iron, along with small amounts of chromium, nickel, manganese, molybdenum, vanadium, titanium, cobalt and copper. Fumes arising from stainless steel welds have a large amount of chromium or nickel and a small amount of iron.

Longer Exposures = Serious Health Problems

Exposure to welding fumes and gases may be acute or prolonged. Acute exposure can cause eye, nose and throat irritation, dizziness and nausea. (Workers who experience these symptoms should leave the area immediately and obtain medical attention.)

Prolonged exposure may cause lung damage; lung, larynx and urinary tract cancers; stomach ulcers, kidney damage and nervous system damage. The list, below, contains just some of the hazardous materials found in welding and the potential health effects that acute or prolonged exposure to them can cause.

- Zinc oxide → Metal fume fever
- Manganese fume → Parkinson's–like symptoms
- Helium, argon & carbon dioxide → Suffocation
- Carbon monoxide → Asphyxiation
- Hexavalent chromium → Damage to eyes, skin, nose, throat & lungs; cancer
- Ozone → Headaches, dry eyes, lung damage
- Copper → Nausea, irritation of eyes, nose & throat, metal fume fever

Factors that can affect worker exposure to welding fumes include the type of welding process used; the kind of base and filler metals used; the composition of the welding rod; the welder's work practices; the location in which the welding is done (outside or in an enclosed space); the air movement in that location; and the use of ventilation controls.

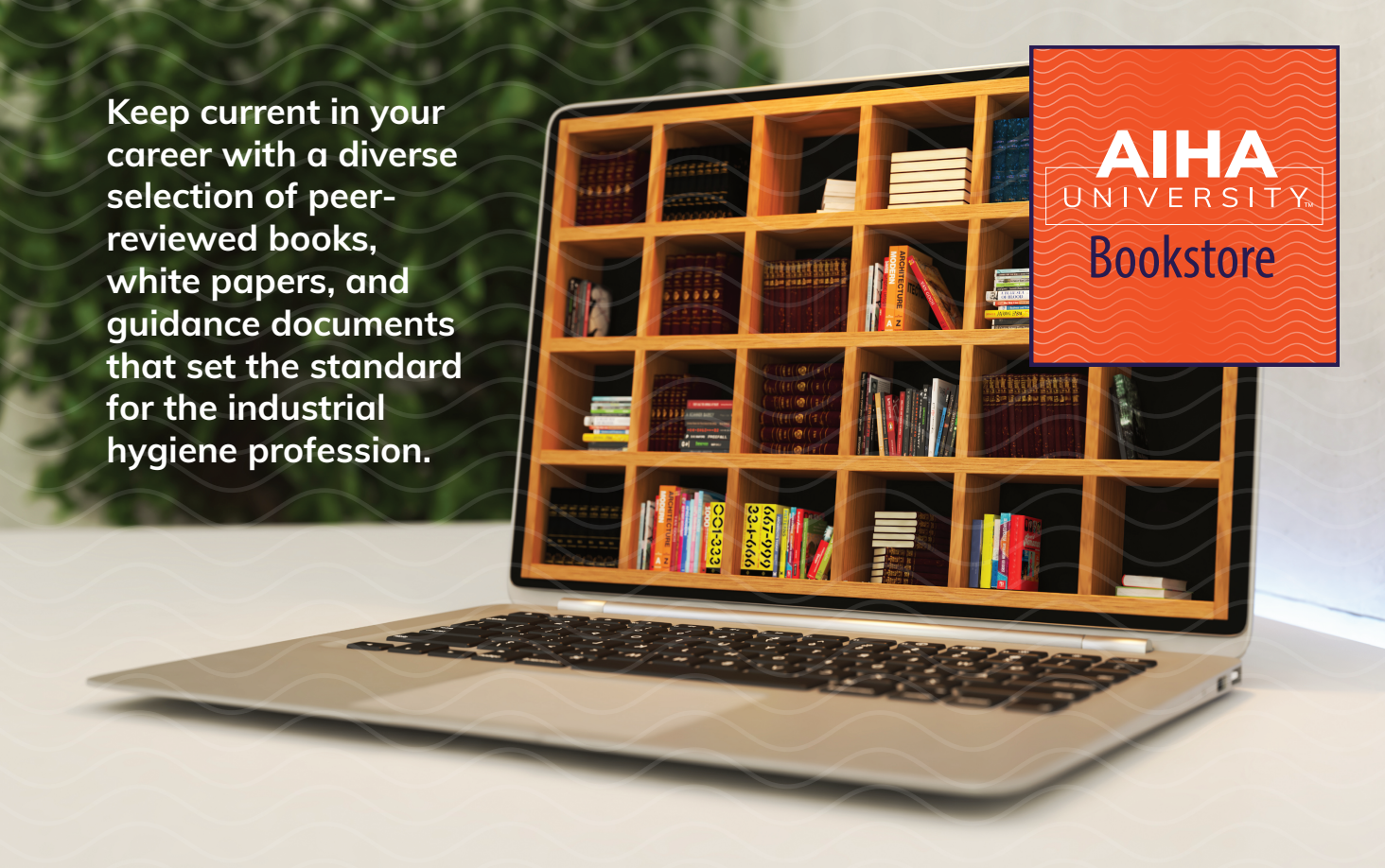
In addition to the energy sources mentioned above, a laser, an electron beam, friction and ultrasound are also used in welding.

Reduce Worker Exposure

Proper ventilation is important to reducing fume and gas levels in a workspace. Welding should not be done in confined spaces that lack sufficient ventilation. Even in outdoor or open workspaces, care should be taken to ensure adequate ventilation. For instance, when welding outdoors, workers should position themselves both upwind—in order to avoid breathing welding fumes and gases—and from other workers. In other scenarios, local exhaust ventilation systems can help remove toxic gases from the welder's breathing zone.[1] IHW

Want to contribute to *Industrial Hygiene in the Workplace*? Let us know if you have an interest in writing an article for an upcoming issue.
Contact: Barbara Nessinger, Editor-in-Chief, bnessinger@workplacemhs.com

1 osha.gov/Publications/OSHA_FS-3647_Welding.pdf



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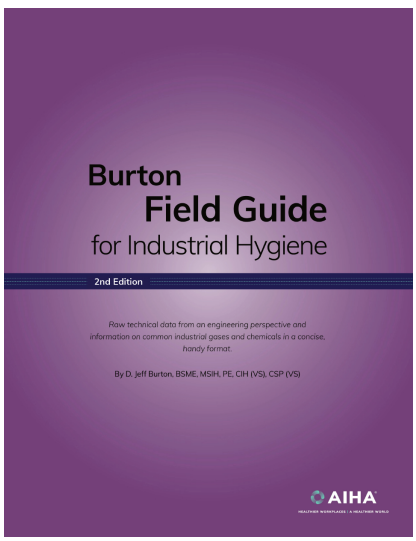

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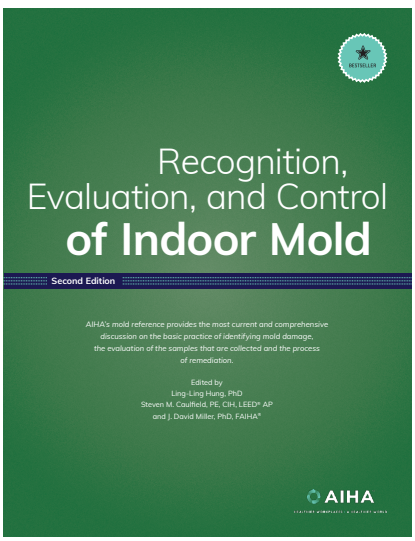

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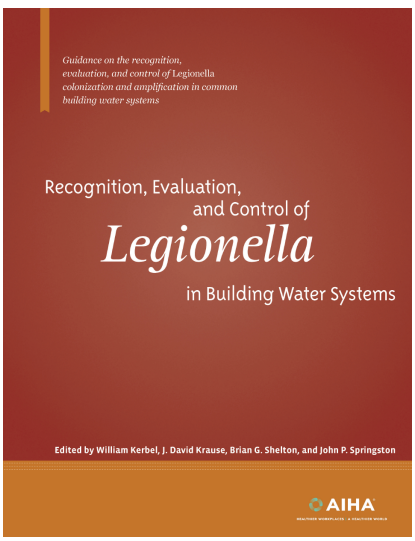

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By: **Dave Wagner**, *Contributor*

How to Use Gas Detection Data to Your Advantage

If you use gas detectors on your worksite but only look at the data they collect after an incident, you may be missing out on critical insights about your work environment; behaviors of those wearing the monitors; and the health and performance of the gas detectors themselves. Here are a few ways you can use your data to make the workplace safer and ensure your gas detection program is hitting peak performance.

Overcome Human Error & Fight Complacency

It's not uncommon for workers to doubt gas alarms, especially when doing a task with which they're already familiar. It can be tempting to ignore or turn off the alarm and continue to work just to get the job done. However, if this behavior occurs without consequences, it can desensitize workers to alarms and could lead to a major incident. Always check to make sure that your gas detection software notifies a safety manager when workers have shut off gas monitors while in alarm. Then, you can follow up with them; gather any needed information; and make sure the proper protocol is followed in the future.

If there are any doubts about the accuracy of an alarm, dock the monitor and create a full report of the gas hazards it detected, including concentration and gas type. Some gas monitors can even connect to the cloud and notify you of gas hazards in real time. You can then use this data to develop a plan to protect workers from the hazards specific to your worksite with PPE or safety procedures.

Maintain Equipment and Track Compliance

You can also track and document compliance using data by generating reports that include the most recent bump test and calibration dates. You can receive email alerts and forward them to the team as a quick reminder when you see that someone has used a monitor without it being bump-tested or calibrated. Data can bring awareness to habits your team might not even realize are endangering them and can help you move forward with the best protocols to keep everyone safe.

Some systems even allow you to create custom reports that help you assess and maintain the health of your gas monitors and equipment. For example, a report might show that a sensor in a gas detector has failed or that the calibration gas has expired. Using this data to your advantage means that your team can keep your gas detector fleet in good repair and ready to use during each shift.

Manage Exposures

Incident investigation is significantly easier when your data is stored digitally. You can trace alarms back to the individual, along with location, gas hazard type, concentration and duration. Many gas detection management programs will allow you to assign gas monitors to individual users, displaying their name along with the information about their assigned device.

By using gas detection management software, you can make the most of the data your gas monitors collect, while saving time and money. *(photo courtesy Industrial Scientific)*

It's not uncommon for workers to doubt gas alarms. Always make sure gas detection software notifies a safety manager if workers shut off gas monitors while in alarm. Be sure to follow up and make sure proper protocol is followed in the future. *(photo courtesy Industrial Scientific)*

That way, when an exposure occurs, you can tell exactly who was in the affected area. With access to this information, it's easier to determine your next step based on insight rather than guesswork, so workers exposed to gas hazards will receive the appropriate follow up.

Identify Trends to Prevent Incidents

What are the stakes of not assessing your gas detection with management software? The first thing that might come to mind is added administrative burden. When an incident occurs, it leaves you with a pile of paperwork. By using gas detection management software, you can automate reporting, so you can focus more on how to avoid a similar exposure and less on digging through data looking for the relevant information.

When you don't pinpoint the source of gas exposures, you also run the risk of repeated incidents. This leads to wasted time and money. Most importantly, workers may be exposed to an ongoing hazard. With a gas detection management system, you can more easily identify the trends in historical data that could protect your workers from running into the same exposures time and time again.

For example, an alarm summary report might show that several workers have been exposed to hazardous gases while working near the same pipe. After you examine the peak gas readings, duration and location, you determine where the problem area is and the nature of the exposure. From there, you can investigate for gas leaks and develop working practices specific to that area until the issue is fixed. Finding the root cause of the exposure through data is the best way to resolve it while keeping workers safe.

By using gas detection management software, you can make the most of the data your gas monitors collect, while saving time and money. When safety and health are involved, don't cut corners on collecting and using data to make your gas detection program perform at the highest level. **IHW**

[Dave Wagner is the Director of Applications Engineering and Product Knowledge at Industrial Scientific.]

By: **Bob Henderson**, *Contributor*

Good Communication is Critical to Confined Space Safety

Confined space entry is a team effort, and good communication is central to confined space safety. Since 1993, OSHA 1910.146, "Permit-Required Confined Spaces," has made this clear. Entry supervisors, attendants, entrants, rescue team members, employers, contractors and management all need to understand their duties and follow the rules.

What is the OSHA standard that explains "Permit-Required Confined Spaces" for general industry?

OSHA 29 CFR 1910.146, "Permit-Required Confined Spaces," contains the requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. OSHA 1910.146 is a horizontal standard that applies to a wide variety of industries and employer activities. While certain industries have their own "vertical" standards, it is 1910.146 which governs the most confined space activities and provides the most comprehensive requirements for how to structure confined space programs. If an employee is working in an industry where a vertical or industry-specific standard applies, then the entry is subject to the vertical standard. If a vertical standard not applicable, the general industry standard prevails.

What is OSHA 29 CFR 1926 Subpart AA, "Confined Spaces in Construction?"

OSHA enacted 29 CFR 1910.146, "Permit-Required Confined Spaces," in 1993. The provisions did not apply to activities that were already regulated by 29 CFR 1926, "Safety and Health Regulations for Construction." According to OSHA, the original intent was to extend 1910.146 to include construction. However, it was quickly recognized that 1910.146 did not fully address issues unique to the construction industry, such as higher employee turnover rates; worksites that change frequently; and the multi-employer business model that is common in construction. In August 2015, 29 CFR 1926 Subpart AA, "Confined Spaces in Construction," went into effect. The new standard specifies the practices and procedures to protect employees from confined space hazards during construction activities.

The "Confined Spaces in Construction" rule is similar in content and organization to the general industry confined spaces standard but incorporates additional provisions that address construction-specific hazards. The construction rule puts even greater emphasis on communication.

What is a Confined Space?

Under both rules, a confined space is characterized by the simultaneous existence of three conditions:

1. It must be large enough and so configured that it is possible for a person to bodily enter and perform work.
2. It has limited or restricted means for entry and exit.
3. It is not designed for continuous employee occupancy.

Just because a space meets the basic confined space definition, however, doesn't automatically trigger any special workplace procedures beyond those for similar activities undertaken in any other non-confined space environments. By definition, non-permit confined spaces are not associated with additional serious safety hazards.

The G999 Confined Space Gas Detector with internal pump from GfG is able to transmit monitoring data andalarms, as well as man-down and communication status in real time by means of license-free, ISM band radiofrequency (RF). *(photo courtesy GfG Instrumentation)*

What is a Permit-Required Confined Space (PRCS)?

A permit-required confined space (or permit space) is a confined space that contains hazards capable of causing death or serious physical harm. Besides the basic three conditions common to all confined spaces, a permit-required confined space (PRCS) contains at least one additional serious or recognized danger such as:

1. The potential to contain or generate a hazardous atmosphere
2. The space contains a material that has the potential for engulfing an entrant
3. An internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section

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4. Any other recognized serious safety or health hazard

It is important to remain vigilant for conditions or activities that may change the dangers associated with a confined space. Activities such as hot-work, using degreasers or painting may introduce additional potential hazards that change the classification of the space from a non-permit to a permit-required confined space (PRCS).

What are the Procedural Options for Permit Confined Spaces?

Once the space has been classified as a PRCS, the next question is what to do about it. When entry into the permit space can't be avoided, employers have three options. The numbering of the sections is different, but the options and requirements are the same in 1910.146 and 1926 AA.

1. Reclassification

If the hazards can be completely eliminated without having to enter the space, it may be possible to temporarily reclassify the PRCS as a non-permit space. Non-permit spaces are confined spaces but do not require a permit for entry, because the hazards have been eliminated. The reclassification continues only as long as the hazards remain eliminated.

2. Alternate Entry Procedures

When the only hazards are exclusively atmospheric in nature, and continuous forced air ventilation alone is sufficient to maintain the permit space safe for entry, entry may be by means of "Alternate Entry Procedures."

The alternate entry procedures require that, before employees enter, the internal atmosphere must be tested for:

1. Oxygen content,
2. Flammable gases and vapors, and
3. Potential toxic air contaminants.

Once testing has been completed, the atmosphere within the space must be periodically tested or continuously monitored, to ensure that the atmosphere remains safe for the entrants. If a hazardous atmosphere is detected during entry, employees must exit immediately; the space must be re-evaluated; and corrective measures must be taken.

When entries are undertaken by means of the Alternate Entry Procedures, there are no formal requirements for the presence of an attendant, entry supervisor or standby rescue team. Solo entries are permitted. The emphasis is squarely on use of continuous ventilation and atmospheric monitoring to ensure that atmospheric hazards are controlled—and that the atmosphere remains safe for entry.

3. Permit-Required Confined Space Entry Procedures

If the hazard cannot be eliminated or controlled, the only remaining option for entry is the implementation of a

comprehensive permit space program. The written program includes specific details regarding how the employer will comply with each of the requirements. Employer obligations include (but are not limited to):

1. To secure permit spaces to prevent unauthorized entry
2. To evaluate and identify PRCS hazards before entry
3. To implement operation procedures that ensure safe entry
4. To provide and maintain the necessary equipment
5. To provide attendant(s)
6. To designate the roles and responsibilities of all active PRCS entry team personnel
7. To develop and implement effective rescue and emergency procedures
8. To develop and implement an entry permit system
9. To develop and implement procedures to coordinate entry operations when employees of more than one employer will enter a PRCS
10. To develop and implement procedures for concluding an entry
11. To periodically review entry operations
12. To periodically review the permit space system

Construction Confined Space Employer Responsibilities

Employers engaged in construction work must (1) identify any confined spaces in which their workers will be working; and (2) determine whether any such spaces are permit spaces.

When workers work in permit spaces, they must be protected against the hazards in those spaces. The construction standard imposes specific duties on "entry employers," "host employers" and "controlling contractors." Employers must inform workers of the location and dangers posed by all known confined spaces at the worksite. Confined spaces should be posted and secured against entry by unauthorized persons. Where an employer's workers have no work to do in the space, the employer must ensure that its workers stay out.

1. Entry Employer

An entry employer is an employer who decides that an employee it directs will enter a permit space. There may be more than one entry employer if the employees of multiple employers must enter the space. Each entry employer is responsible for complying with all provisions in the standard—except those specifically imposed on the controlling contractor and host employer.

2. Controlling Contractor

A controlling contractor is the employer with overall responsibility for construction at the worksite. The controlling contractor is responsible for coordinating entry operations when there is more than one entry employer and when other activities on the site could foreseeably result in a hazard. Once again, the standard here is emphasizing communication! In addition, controlling contractors must provide any information

they have about any permit space hazards and precautions previously used in the space.

3. Host Employer

A host employer is the employer that owns or manages the property where the construction work is taking place. The host employer must share information about confined space hazards on the site with the controlling contractor, who is then responsible for sharing it with the other employers on the site.

Canceling Entry Permits

A special condition of construction site confined spaces is that the status, contractors and entry team members can change from one day to the next, as construction activities move from one phase to the next. It is critically important that workers understand who has responsibility for authorizing entry into the confined space. Responsibility for on-going permit space entry must be clearly designated.

The employer must make sure that the entry supervisor cancels entry permits when an assignment is completed or when new conditions exist. Once a permit is cancelled, entry under it is no longer permitted. New conditions must be noted on the canceled permit and used in revising the permit space program. The employer must keep all canceled entry permits for at least one year.

Suspending Entry Permits

An entry supervisor may suspend an entry permit, instead of cancelling it, if a temporary condition has occurred in or near the space that, once corrected, is not expected to reoccur. The permit may be reinstated, and entry may occur under the permit if the entry supervisor has determined that the conditions in the space match the allowable conditions listed on the permit.

Duties of the Entry Team Members

One of the most important goals of the confined space program is to clarify the responsibilities of the confined space entry team members. Employers must assign clear roles and duties to persons involved in PRCS entry and provide training to allow employees to carry out their duties, and how to communicate vital information.

Duties of the Authorized Entrant

Authorized entrants are employees who are authorized by the employer to enter a permit space. The authorized entrant must stay in communication with attendants as necessary to enable the attendants to monitor the entrant's status and alert the entrant to evacuate when necessary. The authorized entrant must:

1. Know the hazards associated with confined space entry, and in particular, the hazards associated with the PRCS being entered
2. Know how to use all required equipment
3. Know the procedures for communication with the attendant
4. Know how to alert the attendant of hazardous or prohibited conditions
5. Know how to exit the space if necessary, (that is, self-rescue)

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Duties of the Attendant

At least one attendant must be present outside the PRCS during the entry. It is especially important for the attendant to keep an accurate account of workers entering or leaving the permit space and to maintain communication with the entrants. The attendant must:

1. Know the hazards
2. Identify if a prohibited condition exists in the space
3. Identify if a condition outside the confined space could endanger entrants
4. Know the behavioral effects of the hazards
5. Be able to identify the authorized entrants
6. Remain outside until relieved
7. Communicate with entrants
8. Monitor and evacuate entrants if necessary
9. Summon rescue
10. Warn away unauthorized persons
11. Be able to perform non-entry rescues

The attendant may not undertake any additional duties that might interfere with these primary safety-related duties.

Duties of the Entry Supervisor

The entry supervisor is responsible for determining whether acceptable entry conditions exist; authorizing the entry; overseeing entry operations; terminating the entry; and canceling the entry permit. The entry supervisor represents the employer and is accountable for entry operation safety. If the entry supervisor is properly trained and equipped, he or she may also serve as an authorized entrant or attendant. Also, the role of entry supervisor can be passed from one individual to another during an entry operation. The entry supervisor must:

1. Know the hazards
2. Verify safe entry conditions
3. Terminate entry and cancel permit
4. Verify availability and effectiveness of rescue services
5. Remove unauthorized persons
6. Ensure that acceptable entry conditions are maintained

Duties of Persons Who Test or Monitor the Atmosphere

Although this important role is not specifically called out in the standard, OSHA has suggested guidelines for the responsibilities of this individual as well. They are responsible for:

1. Correctly using the instruments used to monitor or verify that the atmosphere of the PRCS is safe for entry
2. Verifying that the instrument(s) used are calibrated and maintained in accordance with manufacturer and written PRCS program procedures
3. Verify that the instruments used to monitor the PRCS are functioning properly
4. Taking appropriate measures if a hazardous or prohibited condition is detected

Duties of the Rescue Team

Communication becomes particularly urgent during an emergency. Communication requirements need to be planned and practiced well in advance of any emergency.

The safest outcome, if conditions begin to become hazardous, is for entrants to "self-rescue" and leave the space in a deliberate, but normal manner. Emergency procedures should focus on methods such as use of harness and retrieval systems that make it possible to perform a rescue without having to enter the space. Deliberate entry into the confined space to perform a rescue may be necessary, but it requires the most planning, training, equipment and personnel and is the least desirable and hardest to successfully execute response. It is also highly dependent on communication between all affected parties.

Employers are required to develop and implement procedures for summoning rescue or emergency services in permit-required confined spaces. An employer who relies on local emergency services for assistance is still required to have a plan for meeting the requirements for performing a successful rescue. The emergency responder must agree to it, as well as to be capable of responding in the event of an emergency. It is not adequate to simply dial 911 once an emergency has occurred!

Training and Communication Are Keys to Success

Confined space entry teams can only function effectively and safely when they fully understand their duties, responsibilities and communication requirements. Thorough training is essential. Permit spaces are inherently dangerous, and mistakes are "not permitted!" IHW

By: **Tim Turney**, *Contributor*

The Dos and Don'ts of Using Air-Sampling Pumps

Best practice advice to protect your workforce from exposure to hazardous substances

It is estimated that every 30 seconds, somewhere in the world, one worker dies as a result of exposure to toxic chemicals, pesticides, radiation and other hazardous substances.[1] The effects of exposure can develop quickly or take years to develop, leaving workers vulnerable to asthmatic and allergic reactions and longer-term illnesses, such as cancer and cardiovascular, respiratory and nervous system disorders. While the cost to human health can be devastating, the financial costs to businesses through reduced productivity, employee absences, recruitment and compensation claims can be substantial.

Taking practical steps can help keep employees protected by ensuring air-sampling pumps identify hazardous amounts of fumes, dust and gases that can increase the risk of long-term damage to worker health. *(photo courtesy Casella)*

OSHA issues citations and penalties if businesses violate permissible exposure limits (PEL). PELs are legal limits designed to control employee exposure to hazardous substances in an 8-hour period to prevent health risks. However, employers are also advised to monitor recommendations from industrial hygiene experts and manufacturers, because it is estimated that 90% of OSHA's PELs have not been updated since the 1960s.[2] Consequently, OSHA may issue citations under the general duty clause of the Occupational Safety and Health Act (OSH Act) if exposure limits exceed industry-wide standards and pose a threat to employee health.

Industrial hygiene methods are geared towards measuring personal exposure using personal air-sampling pumps, because the tried-and-tested method can quantify personal exposure and ensure compliance with regulatory limits. To support effective monitoring and compliance with safety standards, here are some of the dos and don'ts of using air-sampling pumps.

The Dos

Safety Many pumps are intrinsically safe (IS) rated as standard, but it is worth checking that your pump's IS rating is still appropriate for your facility to avoid any safety issues.

The Design Size, weight and accessibility are critical design elements. Pumps should allow freedom of movement, as well as be unobtrusive, robust and not prone to leakage. Selecting a smaller, lightweight, low-flow pump (0.05-1L) for sampling vapors and gases, over a medium-flow pump (1-5L) equipped with a low-flow adaptor, is more user-friendly for workers. When using a sorbent tube, managers need to check that the smaller (backup) section is nearer to the pump.

Calibration All pumps should be calibrated with representative sampling media before use. It is also necessary to calibrate the pump before use; be sure to check again at the end of the day to make sure to make sure flow has not deviated by more than 5%. Of course, make sure you are calibrating the whole sample train, not just the pumps, to ensure accurate measurement.

The Don'ts

Standards It is vital to check that your pump meets the latest international standard for air-sampling pumps. Compliance to ISO 13137 ensures accurate flow performance amongst other performance criteria, ensuring accurate sampling and meaning you won't have to repeat measurements.

Pulsation If you are using a cyclone, do not assume that your pump has sufficiently low pulsation. The ISO standard states that this should not exceed 10% of the flow rate. A large pulsation value means that the size cut performance of cyclones used can be affected, because their performance is flow-rate dependent. Consequently, pumps that generate significant pulsation will collect smaller samples, meaning less data to analyze. Updates in some of the latest electronic flowmeter mean pulsation can be measured.

Pump usage Don't leave your pump unused and uncared-for. If you don't use your pump regularly, charge or cycle the battery, so when you do need it, the battery will last. Pump care

1 https://chemicalwatch.com/70252/worker-exposure-to-hazardous-chemicals-is-a-global-health-crisis

2 https://cen.acs.org/safety/industrial-safety/Former-OSHA-head-David-Michaels/99/i24

is critical, so after sampling, check for damage and get your pump serviced at the prescribed interval.

Save Time, Increase Confidence

The latest generation of Bluetooth®-enabled pumps and flow calibrators can automate the calibration process and save valuable time, increasing confidence in the calibration results, which can be saved and/or emailed for reporting. Pulsation, once tested in a laboratory, can now be checked in the field at the same time as a normal flow rate calibration, through an airflow calibrator equipped with Bluetooth. As advances in technology continue to develop, remote methods can avoid disturbing workers and improve the validity and reliability of sample data.

Air-sampling pumps can identify hazardous amounts of fumes, dust and gases that can increase the risk of long-term damage to worker health. *(photo courtesy Adobe Stock)*

Skill and knowledge of air sampling can take years to build, so the information above can only be considered a foundational introduction. If certain aspects of air sampling are outside of an individual's competencies, external consultancies, training and support can be sought to bridge knowledge gaps and ensure employees get the critical protection they need. However, these practical steps will help keep employees protected throughout the working day by ensuring air-sampling pumps identify hazardous amounts of fumes, dust and gases that can increase the risk of long-term damage to worker health. IHW

[Tim Turney is Global Marketing Manager at Casella and graduated as an engineer from Queen Mary and Westfield in London. Since starting at Casella in 1998, Tim has been involved in the acoustics and air sampling industry, specializing in measurement and instrumentation technologies. www.casellasolutions.com]

By: **Doug Niemtschk, CIH, CSP**, *Contributor*

Industrial Hygiene and Job Planning During Turnarounds

I graduated with a master's degree in industrial hygiene in 1997. My first job out of school was working for a small consulting firm doing industrial hygiene monitoring at a turnaround in the Houston area. It was in the dead of summer, and the heat was unbearable, but I had to monitor workers nonetheless for the process chemicals to which they were potentially exposed. One chemical of concern was acrylonitrile, a chemical that was part of the process that made the company's final product. Workers wore full chemical-protective clothing and were constantly at risk of heat stress—not to mention the chemical exposure itself.

Health exposures are like that; they rarely travel alone. Protecting workers takes upfront planning. Planning must identify various exposure risks, such as welding fumes, carbon monoxide from generators and mobile equipment, dust from handling refractory brick, radiation, hydrocarbon exposures from crude oil and its distillates—and the list goes on. It is up to the industrial hygienist (IH) to identify all of the potential exposures and have a practical plan for monitoring them. It is up to the job planner to work with the IH and make sure the necessary resources are in place to prevent overexposures from occurring.

The IH Monitoring Plan

The final objective of the IHs monitoring plan is to prevent workers from experiencing adverse health effects. This takes upfront job planning from both operations and safety. In this article, I will discuss some of the practical aspects that an operations manager, construction supervisor or a turnaround planner can take to work with an IH specialist in developing a sound monitoring plan for turnarounds, along with a detailed control plan.

Practical is key when it comes to controlling health exposures and planning for preventing exposures. It means integrating into the overall job plan a method that will enable the work crews to accomplish their tasks at hand in a safe and effective manner.

Let's use the example of heat stress. As mentioned, heat stress is always a concern during a turnaround. Most turnarounds are done in the warmer times of the year, and workers typically have to wear PPE, such as flame retardant clothing (FRC). FRC is a necessity for preventing burns in the event of a flash-fire or arc-flash; however, it comes with a price.

It is important for industrial hygienists and job planners to work together, as a critical part of worker safety. *(photo courtesy Adobe Stock)*

FRC is typically a heavy fabric that may or may not breathe properly. Combine that with other outer protective clothing, such as Tyvek®, and workers can heat up if they don't take the necessary precautions. Practically, you don't have a choice but to wear it. Therefore, it is important to develop a heat stress prevention program prior to the turnaround.

In preventing heat stress, the job planner must integrate work-rest cycles into his planning efforts. There must be places they can cool off throughout the day. There may be the need to have cooling fans and overhead shelter, such as a tent. The job planner, along with the industrial hygienist, must determine what safe and practical looks like.

How to Mitigate Risks

Challenge yourself and recognize that most employers accomplish these types of control plans and overcome any barriers to safety. However, you do have a

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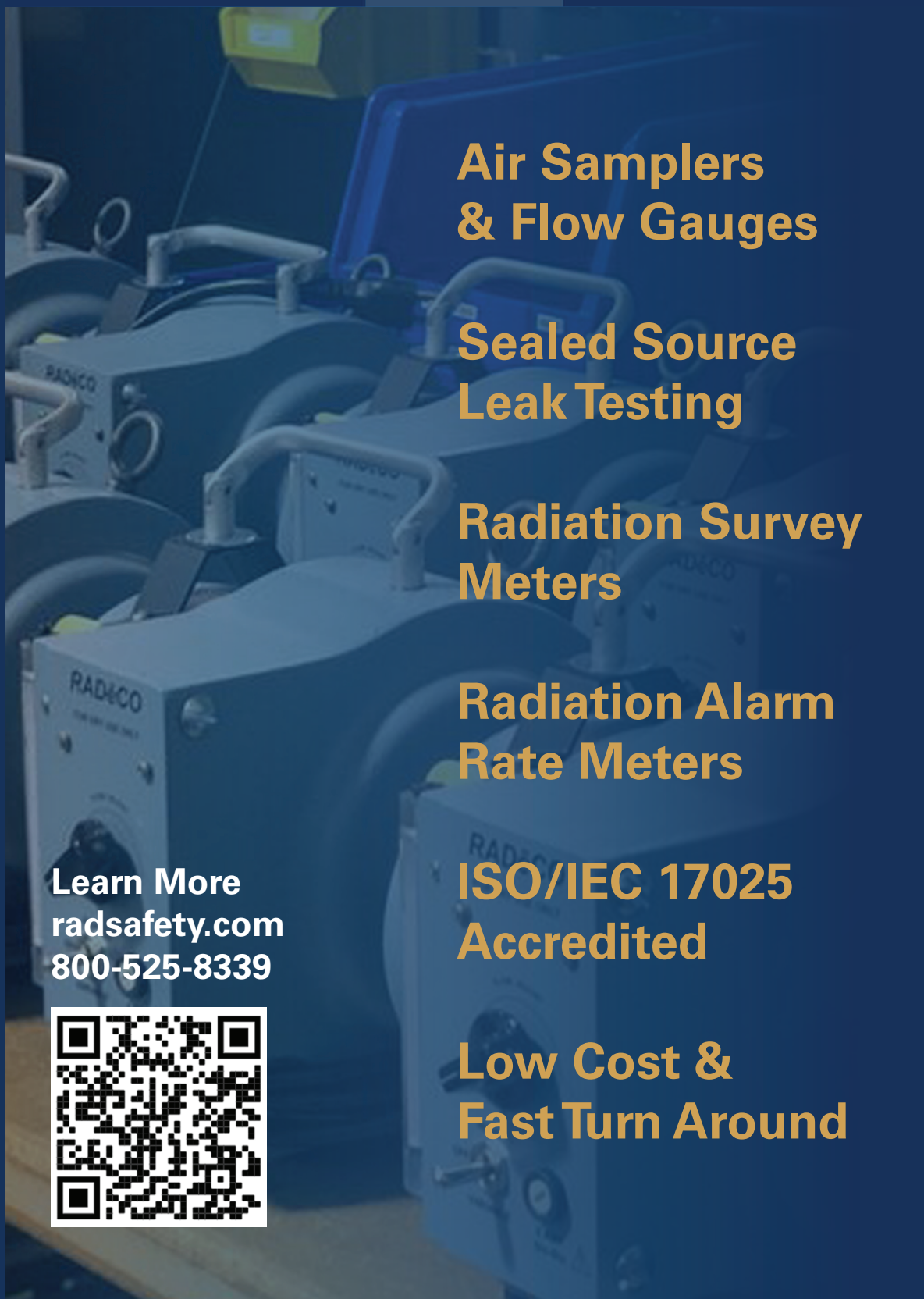

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TURNAROUND 411

Turnaround Definition

A turnaround, also known as an outage, is a time when an industrial plant or manufacturing facility stops all operations for an extended period of time as part of routine maintenance. This maintenance can only be done when the machinery and equipment that are part of the overall manufacturing process are out of service. Typically, they require a large number of contractors. The facility is typically highly motivated to complete the turnaround in a timely manner, since the facility loses money the longer operations is out of service. Safety and efficiency are the keys for ensuring on-time startups of the process.

The turnaround planner, scheduler or job planner is responsible for ensuring the jobs required to complete a turnaround are completed safely, efficiently and on-time. *(photo courtesy Adobe Stock)*

Role of a Turnaround Planner

The turnaround planner, scheduler or job planner is responsible for ensuring the jobs required to complete a turnaround are completed safely, efficiently and on-time. They do this by involving other disciplines, such as contractor supervisors, maintenance managers, and safety or industrial hygiene professionals, in a structured planning process. Without this level of planning, many jobs would not be completed safely and efficiently. This ultimately results in the failure to have an injury-free and on-time start-up. IHW

choice to determine how you will control the risk of exposure to the heat.

I once talked with a veteran welder who described to me a time he not only had to deal with the intense summers during a turnaround, but also the risk of developing welding fume fever—another health exposure risk. Welding fume fever is a very serious health effect that can occur during a turnaround. In this case, the welder's employer did not have a plan for controlling the exposure. He knew this, but he felt pressured to weld, nonetheless. The job planner should have had respirators for these welders, but he didn't. What should the job planner have done differently?

First, the job planner should have involved an IH in implementing a respirator program. However, there is a barrier that must be overcome in accomplishing this. The welder must be medically qualified to wear a respirator. Second, fit-testing the respirator and having them available on the job site, with the right cartridges or supply of breathing air, must be done. The job planner must incorporate this into his job plan and purchase or budget for all the necessary supplies and equipment. For my veteran welder, none of this was done, and he had to miss work with a fever, headache, fatigue and other common symptoms of welding fume fever. If you are the IH, make sure you are plugged into the planning process, so the controls for preventing these type incidents are implemented.

Hopefully, this article helped everyone understand some of the practical challenges faced by industrial hygienist and job planners. Their ability to work together is a critical part of worker safety. Recognize that health risks are many times overlooked until it is too late, so take the time to talk with your local IH and start planning now for the next turnaround. IHW

[Doug Niemtschk, CIH, CSP, is Health and Safety Manager at Holly Energy Partners.]

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ANSI 105/EN 388 Standards for Hand Protection Cut Resistance

Photos courtesy of stock.adobe.com

Important to Know:

Two global standards are used to evaluate the protection levels of work gloves: the ANSI/ISEA 105 (U.S.) and EN 388 (EU). EN 388 is also commonly cited in other parts of the world (i.e., Canada, AUS/NZ and South America).

A cut is usually considered to be a wound caused by a sharp object (knife or glass shard). A laceration implies a torn or jagged wound. Lacerations tend to be caused by sharp objects. Cuts and lacerations are terms often used interchangeably for the same condition or wound.

ANSI/ISEA 105-2016 & EN 388 are voluntary standards where manufacturers can choose the attributes they would like to make claims, perform testing and label classifications accordingly. The standards address the classification and testing of hand protection for specific performance properties related to chemical and industrial applications. Within these standards, hand protection includes gloves, mittens, partial gloves or other items covering the hand or a portion of the hand that are intended to provide protection against, or resistance to, a specific hazard. Performance ranges are provided for:

- Mechanical protection (cut-resistance, puncture-resistance and abrasion-resistance)
- Chemical protection (permeation resistance, degradation)
- Other performance characteristics, such as ignition-resistance and vibration reductions, based on standardized test methods

Standard Requirements:

Gloves are classified to performance levels based upon their performance when evaluated against set industry test methods. The ratings can assist users in selecting appropriate hand protection for known specific hazards in the workplace. Performances are rated in Chemical and Mechanical Protection categories, as well as "Other" protections.

Chemical Protection

Permeation testing is done in accordance with ASTM Method F 739 standards. In this method, a specimen is cut from the glove and clamped into a test cell as a barrier membrane. The exterior side of the specimen is then exposed to a hazardous chemical. At timed intervals, the unexposed interior side of the test cell is checked for the presence of the permeated chemical and the extent to which it may have permeated the glove material.

Mechanical Protection

- Cut-resistance—In an effort to reduce variation for purposes of classifying a glove to ANSI/ISEA 105, a single test method (ASTM F2992-15 for TDM) was selected to help provide consistent meaning of the ratings, from the end-user perspective. The number of classification levels has also been expanded in the latest standard update to address the gap among certain levels seen in earlier versions and to model the approach used in similar international standards. ISEA and EN cut levels will be determined with the same piece of test equipment.
- Puncture resistance—The standard puncture test remains the same, using the EN388 puncture probe. An additional update is the inclusion of a needlestick puncture test, recognizing that this is a common potential exposure for the medical, sanitation and recycling industries. The standard EN388 probe is quite large. There is a segment of users who need protection from smaller hypodermic needles, requiring a significantly different puncture device—very thin and sharp—and calling for using a new testing method and rating scale. The new method uses a 25-gauge needle as a probe. The normal industrial puncture test is done in accordance with clause 6.4 of EN 388:2003 (updated in 2016). A circular test specimen, cut from the glove palm, is mounted in a holder and punctured with a stylus of specified sharpness attached to a tensile tester. The force required to puncture the specimen to failure is measured. Results are classified into five performance levels: The higher the result, the better the performance. The average of 12 specimens (minimum) are used to determine the classification level.
- Abrasion resistance—These ASTM test methods (D3389-10 and D3884-09) shall be followed using H-18 abrasion wheels with a 500g load for levels 0-3

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and a 1,000g load for levels 4-6. The test method has a 4in circular test specimen mounted on a horizontal axis platform, while being abraded to failure under a specified vertical weight load (500 or 1,000g) by the sliding rotation of two vertically oriented abrading wheels. The abrading wheels are comprised of vitrified clay and silicon carbide abrasive particles.

Other Protection

- Ignition resistance–Testing in accordance with ASTM F1358-16, the glove material's ignition-resistance and burning behavior should be classified against the levels provided in the standard. In order to be classified at a specific level, the glove material needs to meet each of the criteria at that specific level.
- Vibration reductions–The glove's vibration-reduction is classified as "pass" or "fail," when testing in accordance with ANSI S2.73-2002 (ISO 10819). A glove can only be considered an anti-vibration glove, if it fulfills both of the following criteria: TRM < 1.0 and TRH < 0.6, according to this standard.

Increase Your Knowledge:

- The ANSI/ISEA 105-2016 standard is available for purchase at: https://webstore.ansi.org/Standards/ISEA/ANSIISEA1052016.

Did You Know?

New cut-resistance standards from the American National Standards Institute (ANSI) and International Safety Equipment Associations (ISEA) became effective in March 2016. The standards include changes to the ratings scale and the standardization on a testing methodology. The European Standard for Protective Gloves-EN 388 was updated in November 2016. EN 388 is similar to ANSI/ISEA 105 and is used to evaluate mechanical risks for hand protection. Gloves with a EN 388 rating are third-party tested and rated for abrasion-, cut-, tear- and puncture-resistance. Cut resistance is rated 1-5, while all other physical performance factors are rated 1-4. Up until this update, the EN 388 standard used only the Coup Test* to test for cut resistance. The new EN 388 2016 standard uses both the Coup Test and the TDM-100 Test to measure cut resistance for a more accurate score. Also included in the updated standard is a new Impact Protection test. In North America, you can find the EN 388 marking on many cut-resistant gloves. IHW

**Coup Test: The cut protection is tested when a knife is passed over the glove material until it cuts through. Protection level is a number between 1-5; 5 indicates the highest cut protection.*

As originally seen in the January 2021 issue of Workplace Material Handling & Safety.

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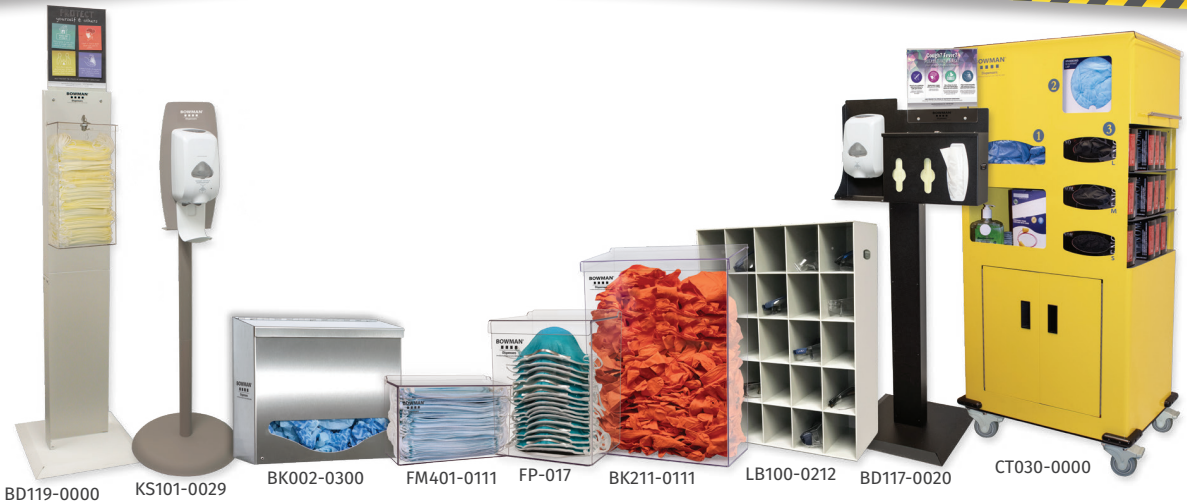

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By: **Edward Stern**, *Contributor*

The Amazing Hazard Awareness Advisor

Overview

The Amazing Hazard Awareness Advisor (webapps.dol.gov/elaws/oshahaz.htm) is a very bold title. I would not say it, if it were not true. The official name, OSHA Hazard Awareness Advisor, does not reveal its power.

Imagine if I could arrange for a panel of occupational safety and health (OSH) professionals and doctors, board-certified in OSH medicine, and lawyers specializing in OSHA regulations to meet with you for a short time. They would ask you questions about your work environment; then ask expert follow-up questions (as needed) and give a detailed, written report of what they think are your workplace safety and health issues.

Based on your answers to the questions, the panel's report would tell you which OSHA standards apply to your work and give you brief guidance on the issues. The report might be from 5-35 pages; it all depends on what happens at your work site. The price remains the same: free. How can this be?

I doubt you could get such free expert advice from a panel of live OSH experts. But, if the decision-logic of the expert panel to identify safety and health hazards (and applicable standards) and their knowledge were captured into expert interactive, diagnostic software, you could get that advice. OSHA did that with the Hazard Awareness Advisor "expert system." It contains the panel's problem-identification talent.

Flexibility and Coverage

This expert Advisor is focused on general industry. It can still help those in construction and agriculture, however, because they often have general industry issues, e.g., warehouses.

Consider simple workplaces. A dress shop or law office might need guidance on railings for stairs and fire exits. Next, move up to restaurants. They have sharp tools, slippery surfaces, fire suppression and fire exits, and strong cleaning chemicals.

Now, move up to a small manufacturing site, with issues of ventilation, fire protection, eye and face protection, pinch points on machinery, hazard communication for dangerous chemicals and a paint spray-booth. (A dear uncle was upset that I worked for OSHA, but he still let me walk through his plant.)

OSHA focused particularly on small businesses, because we thought they were most likely to need the help—but we got a surprise. Consultants on occupational safety and health for major companies told me they alerted their clients to the OSHA Expert Advisors.

I asked a senior consultant with a Ph.D. in Industrial Hygiene why they alerted their clients to these tools. (I had spoken with OSH professionals at Dow, Alcoa, IBM, John Deere and the like, and I thought they were extremely knowledgeable.) He told me, "You were speaking to experts at corporate headquarters, but these companies do not have those experts at each of their sites. So, they also need help."

OSHA's Hazard Awareness Advisor uses the decision-logic of an expert panel to identify safety and health hazards (and applicable standards) using expert interactive, diagnostic software. *(photo courtesy Adobe Stock)*

The Hazard Awareness Advisor can evaluate sites in general industry, from a dress shop to a huge manufacturing site plant. For example, for bigger industry it asks:

There are areas in your workplace where: (Select all that apply and press Continue.)

- ☐ People have to shout to be heard over background noise
- ☐ Workers may have to stand in water because of a wet process or washdown
- ☐ Workers are in physical contact with chemical solutions, solvents or vapors
- ☐ Flying or airborne debris, dust, chips or other particles are generated
- ☐ Workers are exposed to mists, fumes, gases, smokes, sprays or fogs
- ☐ Visitors comment about strange odors… (this is a subset of the questions)

The last question recognizes that people become accustomed to odors in their environments (olfactory fatigue), but visitors notice strange odors.

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Also, I checked "Flying or airborne debris, dust, chips or other particles are generated." The Advisor will react to that in the "Details." Now, let us look at materials handling equipment.

Which types of mechanical materials handling equipment do you use at your facility? (Select all that apply and press Continue.)

☐ Fork-lift or other powered industrial trucks
☐ Overhead or gantry cranes
☐ Slings used for materials handling
☐ None of the above

Checking "fork-lift or other" prompts this follow-up:

Do you have a formal, periodic evaluation of the on-the-job performance of your powered industrial truck operators?

☐ Yes
☐ No

Follow-up Questions & Your Inputs

Keep in mind that you only see follow-up questions triggered by your answers about your workplace. Some readers who use this Advisor will not see the questions in this article. Instead, they will see other questions appropriate to the workplaces that they describe to the system.

You may wonder what, if anything, will OSHA do with the users' input into the Advisor. The answer is nothing. OSHA does not see responses to the questions. The Hazard Awareness Advisor is maintained by the Office of the Assistant Secretary for Policy, which does not collect users' input into the Advisors. The whole point is to help employers make their workplaces healthier and safer.

What's in the Advisor's Report?

The first section of the Report contains "Highlights." Most are on one line. Here are some based on my answers. They do not cover every issue.

Highlights

- Evaluate the exposure to chemicals in your workplace.
- Your site needs a hazard communication program.
- Keep isles and loading areas clear of unneeded materials.
- Listen when visitors say they smell strange odors.

Details

This section has detailed responses to users' input. I said I had powered industrial trucks. So, the Advisor produced a brief overview of the related hazards and identified applicable OSHA standards. And it addressed flying particles. Here is part of it:

Materials Handling and Storage
Your answers indicate that mechanical materials handling equipment is present in the workplace. This equipment can cause injury to workers by trapping them between the equipment and materials or structures and by colliding with stacked materials causing overturn of heavy objects onto workers. Equipment can also block exit in the event of fire.

1910.176 Handling materials, general: Provides requirements for use of mechanical handling equipment, and for materials storage.

Eye and Face Protection
Your answers indicate that your employees may require eye or face protection equipment. Safety glasses, goggles or face shields are useful for controlling a variety of common workplace hazards, including flying particles. Many workers suffer eye injuries after issuance of safety glasses, because they wear them only in their shirt pockets.

The OSHA Hazard Awareness Advisor (webapps.dol.gov/elaws/oshahaz.htm) can help businesses doing many kinds of work and using many different materials. It will spot the most likely safety and health issues in your workplace. Maybe you are good, or maybe you have more work to do. Why not find out before federal or state OSHA shows up? Lastly, OSHA did not do this all by itself. Our contractor, Alex Botkin, designed it with many good ideas from OSHA, business, labor and the State Plans. IHW

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- ☑ Particulate ID
- ☑ Combustible Dust
- ☑ Radon
- ☑ Formaldehyde
- ☑ Identification of Unknowns

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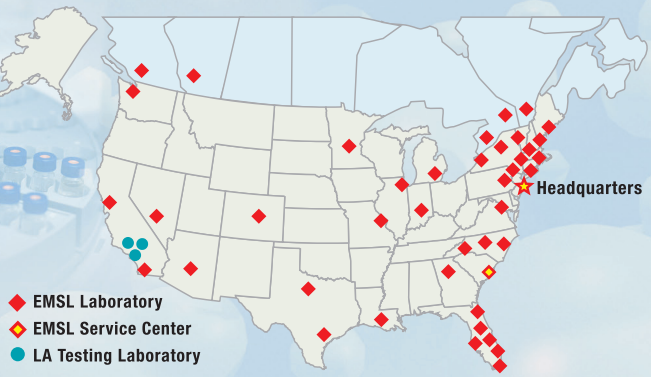

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By: **Maureen Paraventi**, *Chief Editor, Workplace Material Handling & Safety*

Hazard Training: Safety Data Must Be 24/7

It's not enough to have a safety data sheet (SDS) for each hazardous chemical in your workplace—one that describes the physical, health and environmental health hazards of the substance and provides information about how it should be safely handled and stored. Employers must make sure that employees are able to access the SDSs they need, around the clock, during any shift.

That was one of the points emphasized by Phil Molé, during a presentation entitled "Avoiding Incompatible Chemicals: HazCom Tips for COVID-19 and Beyond," during VPPPA's 2021 Next Level Safety event in April 2021. Molé, who is Environmental Health & Safety (EHS) and Sustainability Expert at Velocity EHS, brings 25 years of EHS experience to the subject.

Companies must have a method for managing both shipping labels and secondary container labels. *(photo courtesy Adobe Stock)*

Most chemical manufacturers, distributors and importers understand the importance of having SDSs, which are required under OSHA's 2012 revision of the Hazard Communication Standard (HazCom) (29 CFR 1910.1200(g)). Formerly known as MSDSs or Material Safety Data Sheets, SDSs have much of the same information as MSDSs, but in a 16-section format OSHA describes as more "user-friendly."

Challenges of Information Availability

Keeping SDSs available to all relevant employees can be problematic in the best of times, but Molé said the pandemic has made it even more challenging at some facilities—particularly those who were using physical, on-site SDS information stations or have workforces that are geographically separated. In response to the pandemic, some companies closed or restricted access to certain areas or moved workstations in order to increase the distance between employees.

"We may have people who are not in the usual locations they work in," Molé said. "If we don't have ways that people can access SDSs from anywhere, then we're not meeting our obligations under the standard. Remember: There can't be any barriers to access."

Even if SDSs are in digital (rather than physical) form, getting to a computer may prove difficult. "If they're in a supervisor's office and that door is locked when he or she goes on a lunch break, then we're not meeting our obligations, because that barrier is keeping employees from accessing that information."

He noted that companies must be able to print hard copies of the SDSs upon request. If the SDSs are online, there must be a backup system in place, in case of an emergency. A cloud-based SDS system is fine–as long as employees know how to do it. Companies should not advise employees to "google it" when looking for chemical hazard information. Molé said a 2015 OSHA interpretation letter sent in response to a query from a company made it clear that an online search was not acceptable under the regulation. "There is no guarantee–and very little chance–that they're going to find the documents for your chemicals that are in your locations," he added.

Employers' Responsibilities

In addition to discussing SDSs and Right-to-Know access, Molé outlined other HazCom responsibilities of employers who are the end-users of chemicals. They include:

- Having a written, site-specific HazCom plan for their chemicals, their hazards and their methods of providing access to safety data sheets to their employees
- Compiling a chemical inventory list
- Implementing a management method for labels, including both shipping labels and secondary container labels
- Training employees about the general requirements under the HazCom standard, as well as all of the specific aspects of HazCom management at the facility

As for the last item, Molé said it's a good idea to make sure that every employee can recognize the HazCom pictograms that

OSHA requires on labels for hazardous materials. The skull and crossbones pictogram, for instance, indicates acute toxicity (fatal or toxic), while an exclamation mark warns of a whole range of dangers, from skin, eye and respiratory tract irritation to an environmental effect: hazardous to the ozone layer.

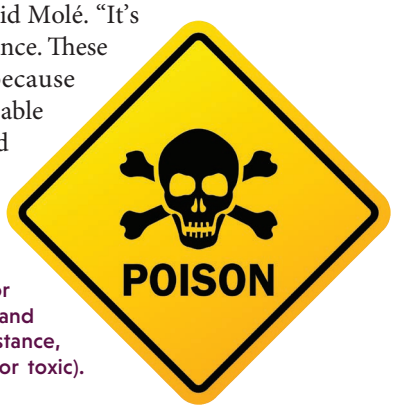
To illustrate the importance of compliance with the HazCom standard, Molé told a story from when he was a graduate student. He had to go to a hospital and listen to cases of people coming in to talk about their previous work experiences and how those affected subsequent conditions and health problems.

Of the many people he met, Molé said, "There was one gentleman whose story I never forgot. His job, for 35 years, was to take greasy parts and dip them in a tank that was filled with solvent. He did this by hand, and he did this repeatedly, every day for 35 years. Because there was no HazCom standard for most of the time he had this job, he did not even know the identity of the chemical he was working with, so he definitely didn't know the right precautions, like what type of ventilation was adequate; what types of personal protective equipment he needed; or how he should be storing and using this chemical on a day-to-day basis."

The solvent contained a chemical that—in the case of long-term exposure to it—caused brain damage, including short-term memory loss.

"It became evident during this interview that while he could remember all of these details from the past, he couldn't remember how he got to the interview that day," said Molé. The man's wife, who was with him, was evidently also his caretaker. He was unable to live independently because of the chemical exposures that he'd experienced.

"That's really the reason why all of these regulations and requirements exist. It's not just a bookkeeping exercise we have to do," said Molé. "It's not just a matter of compliance. These things are important, because employees need them to be able to get home safe at the end of every day." IHW



It's a good idea to make sure every employee recognizes the HazCom pictograms OSHA requires on labels for hazardous materials. The skull and crossbones pictogram, for instance, indicates acute toxicity (fatal or toxic). *(photo courtesy Adobe Stock)*

[Editor's Note: This article first appeared in Workplace Material Handling & Safety*'s July 2021 issue.]*

No Chest Strap, No Problem

The purpose-built, BioTrac Band provides heart rate, core temperature and TLV in real-time for large teams. Joining advanced analytics and durable design, it's the most robust wearable armband ever built. Worldwide, first responders, industrial workers and the military wear BioTrac Bands as a connected-safety tool-of-choice to prevent injuries like heat stress and overexertion.

FireHUD, Inc., 678-506-2998, info@firehud.co,

Low-Oxygen Safety Monitor

Gaslab Inc. has released a new, low-oxygen safety monitor that holds a sensor capable of measuring potentially dangerous oxygen levels in freezers and other low-temperature applications. The RAD-0002-ZR Low Oxygen Monitor and Alarm provides cryogenic facilities, laboratories, food industry freezers and similar low-temperature environments with the ability to monitor oxygen levels down to -40°C (-33.8°F) in enclosed areas without calibration or maintenance for up to 10 years.

Gaslab, Sales@Gaslab.com

Improved Modular Storage Kit

Milwaukee Tool is adding to their PACKOUT™ Modular Storage System with two new PACKOUT First Aid Kits: the 204-piece Class B Type III Kit 76-piece Class A Type III Kit. Both kits are packed with first aid essentials tailored to the most common injuries users encounter on the jobsite. These kits are included in the most versatile and durable modular storage system in the industry and are certified to the ANSI/ISEA Z308.1-2015 Standard and feature an impact-resistant body that keeps contents safe from drops and bumps. IP65-rated weather seals protect essential medical supplies from rain and jobsite debris. The first aid kit's no-travel bin seals keep contents secure and in their proper place by preventing shifting during transport, while the transparent lid allows for easy identification of contents.

Milwaukee® Tool, 1-800-SAWDUST, www.milwaukeetool.com

Touch-Free Earplug Dispensers

Moldex-Metric, Inc. has launched two innovative new products to their line of EcoStation and PlugStation Earplug Dispensers. The two products address today's enhanced concerns over workplace hygiene and worker comfort. The first 100% hands-free earplug dispenser is the TouchFree EcoStation. Continuing the theme of a more hygienic way to dispense earplugs, Moldex has also launched an antimicrobial earplug dispenser, EcoStation Copper. All come ready-to-go, with no set-up or assembly needed, just insert batteries.

Moldex, www.moldex.com

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Good Goggle Fit

Dentec's SenTec line has a new, replaceable foam insert that will add protection against dust and debris. The SenTec™ DX provides a true goggle fit without the discomfort and appearance of a goggle. Its low-profile, removable insert, intended to prevent foreign particles from entering the eyes, features a foam material providing an effective seal around the eye. The unique shape also allows it to provide an excellent fit when wearing a respirator, particularly the Dentec family of reusable respirators: Comfort-Air® and disposable respirators Comfort-Ease®.

Dentec Safety Specialists, 888-533-6832, www.dentecsafety.com

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The dBadge2 brings the latest technology to personal noise dosimeters. Measuring multiple parameters at once, it is ideal for a variety of workplace noise assessments, ensuring peace of mind that results are accurate and reliable.

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Casella, www.CasellaSolutions.com

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Monitor Core Temperature

Kenzen, the innovator of monitoring industrial workers' core body temperatures to predict and prevent heat stress, has announced the results of its most recent research. New data collected from a recent study with three research universities to compare and validate Kenzen's continuous core body temperature-monitoring technology against existing methodologies, has now made the company's dataset the largest one on continuous core body temperature monitoring in the world. It includes over 75 unique subjects monitored for >24 h, totaling >100,000 minutes of ground truth core temperature data (while wearing the Kenzen device). The research validated that the Kenzen wearable device algorithm can now accurately measure workers' body temperature at rest and during physical activity, in cool, hot and humid conditions.

Kenzen, www.Kenzen.com

Multi-Faceted Hand Protection

Protective Industrial Products, Inc. (PIP) launched its new line of G-Tek® VR-X™ gloves featuring a proprietary new coating technology that introduces a new category of multi-faceted hand protection for workers. The new G-Tek VR-Xline was designed as the first (patent-pending 63/119,080) reusable work glove tested and certified to the EN 374 standard for permeation and microbe penetration to deliver advanced barrier protection against liquids and microbes. Its touchscreen compatibility enables workers to work confidently in most industrial and construction work applications by eliminating the need to remove gloves to operate machinery or devices, helping provide ongoing protection against cross-contamination.

Protective Industrial Products, Inc., 678-506-2998, www.pipusa.com

Hand-Held Scintillation Detector

The Radiation Alert ® GammaView® , by S.E. International, is compact, light and user-friendly. It's paired with a 1x1 Nal scintillation detector that accurately measures gamma contamination and exposure. Whether it's environmental monitoring, health physics or scrap metal; GammaView's levels of accuracy and sensitivity make it the superior choice for a range of applications. Its features include multiple modes for units of measure, selectable alarm settings and data logging giving the operator a range of functionality. The graphic LCD and easy-to-navigate membrane switch grant an ease of use not afforded by all instruments.

S.E. International, Inc., https://seintl.com/

Compressed Air Line Monitor for Medical Air

Monitoring the dew point in compressed air lines is critical in medical and hospital air systems because of the possible risk for the growth of microorganisms. If dew point levels go unchecked in medical air/gas systems, bacterial growth in water droplets can contain *legionella* germs. This can cause serious, deadly lung infections. When moisture levels are too high, water in medical air systems can shut down patient ventilators and may cause serious physiological harm. Medical air quality monitoring requirements in the NFPA 99 Standard Medical Air System Guidelines require dew point and carbon monoxide monitoring of medical air. ENMET's MedAir 2200 compressed air line monitor is designed specifically to help hospitals and medical facilities meet these guidelines. The instrument is UL- and CSA-certified and can monitor dew point, carbon monoxide, oxygen deficiency and carbon dioxide.

ENMET, www.enmet.com

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BioFit , https://www.biofit.com/category/industrial

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Miller Electric Mfg. LLC, www.millerwelds.com/t94

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CleanSpace Technology, Sales@cleanspacetechnology.com IHW

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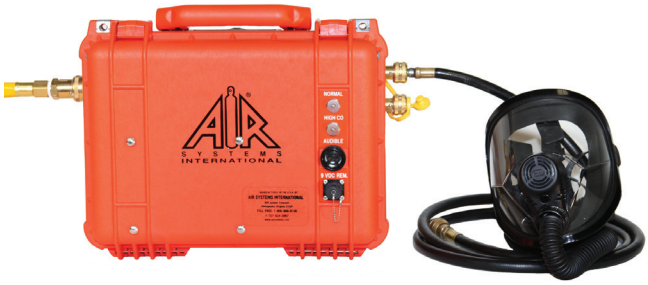

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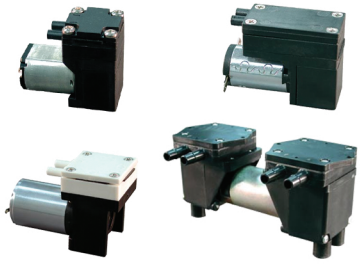

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