Industrial Safety & Hygiene News

October 2017

ISHN

INSIDE this eBOOK:

Respiratory protection best practices

- Welding safety
- Confined spaces in construction
- Avoiding OSHA violations
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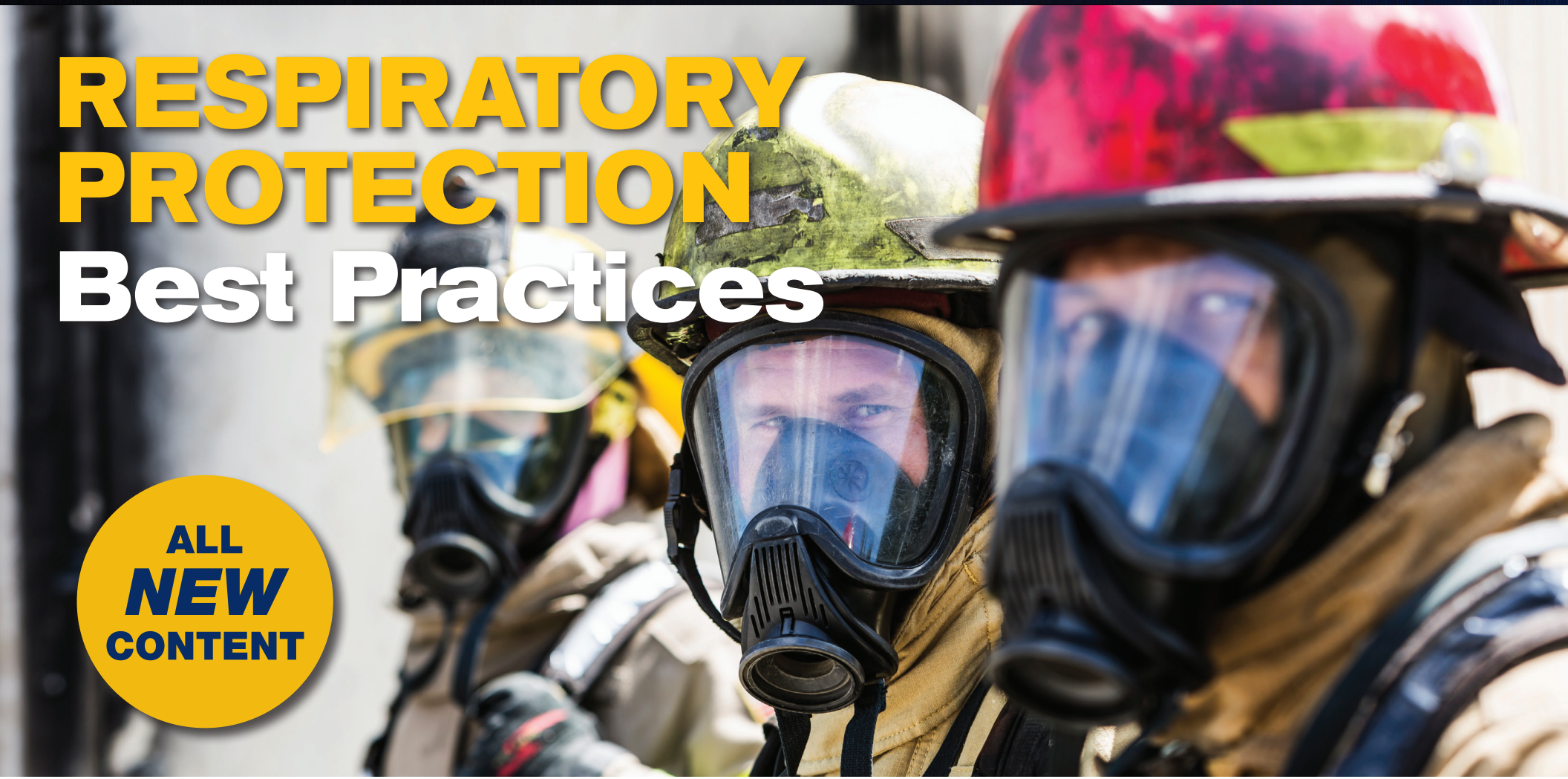
RESPIRATORY PROTECTION Best Practices



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introduction

Respiratory protection is one of the most critical jobs supervised by safety and health professionals. In situations such as confined space work and exposures to extremely toxic substances, respiratory protection can mean the difference between life and death.

An estimated five million workers are required to wear respirators in 1.3 million workplaces throughout the United States, according to OSHA.

The threats are many. Respirators protect workers against insufficient oxygen environments, harmful dusts, fogs, smokes, mists, gases, vapors, and sprays.

The stakes are high. These exposures may cause cancer, lung impairment, diseases, or death. Compliance with the OSHA Respiratory Protection Standard could avert hundreds of deaths and thousands of illnesses annually, according to the agency.

Recently, OSHA published two final standards that extend the use of respiratory protection: confined spaces in construction and the respirable crystalline silica standard.

Articles in this eBook explain how respirators protect the user in two basic ways. The first is by removing contaminants from the air. These respirators include particulate respirators, which filter out airborne particles, and air-purifying respirators with cartridges/canisters which filter out chemicals and gases. The second type of respirator supplies clean respirable air from another source. Respirators that fall into this category include airline respirators, which use compressed air from a remote source, and self-contained breathing apparatus (SCBA), which include their own air supply.

Specifically, this eBook offers you articles on cartridge change-out, welding protection, dust exposure protection, how to avoid OSHA respiratory standard violations, FAQs about respiratory protection, the importance of comfort and fit to enable productive users, and the basics of SCBAs, as well as other articles and sponsored content information.

I'm sure you'll find *ISHN*'s Respiratory Protection eBook to be an asset in addressing the array of high-stakes risks, ensuring regulatory compliance, and preventing serious incidents and fatalities.

Dave Johnson - *ISHN* Editor

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The ABCs of SCBAs

New models have "man down" alarms & biometric sensors

By LYNN FEINER

Fire captains and incident commanders are typically savvy about their department's fleet of self-contained breathing apparatus (SCBA). That's because SCBAs are critical, life-saving gear for all first responders on fire grounds, at chemical spills, in mechanical rooms, and in confined space rescues.

But staying current on new regulatory requirements and best practices – let alone new technology developments in advanced wireless communications, connectivity and the ergonomics of lightweight, highly maneuverable SCBAs – can be daunting. The reality is that today's SCBA technology can lead to improved safety and bottom-line health for first responders.

> "Today's SCBAs allow responders to focus their energy on the incident, not the equipment."

Testing SCBAs for fitness

At a minimum, an SCBA must be approved by NIOSH and meet NFPA requirements. The NFPA 1852 standard on selection, care and maintenance of SCBAs provides comprehensive guidance.

But regular maintenance and service checks of all equipment is a must, and should be assigned to an individual trained specifically for the role. It should never be "once and done" training, said Gary Smith, a retired fire chief who managed the SCBA program and fire operations for three fire departments in central California. Smith now serves as executive director for the Ammonia Safety Training Institute, which trains first responders on proper SCBA use and maintenance.

Several categories of talent are needed for different levels of training, including one for basic operation and another for specifying needs and evaluating options, such as equipment choices, communications and other considerations.

SCBAs require daily, weekly and monthly service checks depending on frequency of use. Fit testing of each respiratory protection device is critical because newer SCBAs can accommodate different sizes of facepieces. Some designs of SCBA offer a choice not only of facepiece size but also nose cup size so users can select facepiece size and nose cup size for optimum fit. A properly sized and fitted SCBA mask can help ensure a higher level of performance in toxic atmospheres.

House standards

Establishing house standards and adhering to them also can help reduce costs. Of course, each department has

The ABCs of SCBAs *continued*

its own unique needs. For a typical station with a cascade system, this means that an air system or storage vessels and cylinders must be brought onsite. A gas monitoring program for hydrocarbons and toxic gases will need to be included in the monitoring program. The person who oversees the fleet of SCBAs must log regular air readings, monitor air delivery, volume levels and temperature, and ensure that enough air supply is always made available. All maintenance, repair, and hydrostatic test results must be documented and reviewed routinely to assure air supply, air bottle, SCBA regulator, framework, and harness strap conditions meet the local and national safety standards, e.g. NFPA 1951 and NFPA 1852.

Many industrial safety managers farm out these functions, but are still accountable for the performance of their SCBAs in the field. To meet OSHA criteria for field use, an SCBA must always be at least 90 percent full at the outset of a response to an incident.

Ready for quick response

Daily checks will assure that problems with the SCBA ensemble, including the harness and other elements, are corrected immediately. If used for emergency operations and rescue it is critical that the SCBA is always in a working order should an emergency situation arise. This includes assuring the unit must never be lower than 90 percent full at the outset of a response to an incident. Small leaks at valve connections or around facepieces will result in taking the SCBA off-line for repair and testing prior to return to service. The specifications for use of an SCBA ensemble must also be clearly understood by the hazmat responders. For example, an SCBA regulator can be compromised by extreme cold; moisture from breathing into the unit regulator can contribute to regulator freeze, resulting in a bypass of air supply and a fast reduction of air supply.

Evaluating new options

When should you replace an SCBA? While municipal fire departments often follow a replacement calendar such as every five to eight years, industrial safety officers may operate on a 10-to-15-year replacement cycle, particularly if their SCBAs are used less frequently. With longer replacement cycles, however, parts replacement can become difficult, and older SCBAs can degrade even when not used.

Older equipment may be more prone to failure. While testing the fit of respiratory protection devices it is not uncommon for

The ABCs of SCBAs *continued*

SCBA facemasks to fail the fit test procedures. Leaks at the valve connection or pinhole leaks in the facepiece, though rare, are a dangerous risk when they expose the wearer to inhalation of deadly gases or vapors. There is no such thing as a "fit and forget" cycle for the life of SCBAs.

Newer SCBAs have several advantages over previous models that may improve the safety and endurance of first responders.

Biometric sensors

For example, a variety of additional safeguards are built into the new equipment. The SCBAs have an alarm that warns the user when air in the SCBA cylinder is getting low, so that the user knows when to replace the air cylinder. A motion alarm signals when a firefighter may be in trouble, such as a man-down situation, by activating whenever its wearer fails to move for more than thirty seconds. Biometric sensors monitor the wearer's heat and body temperature, alarming at unsafe temperatures within the device. Newer SCBAs are equipped with motion alarms in both the front and back PASS, or Personal Alert Safety System, an advantage that also helps to reduce false alarms.

Wireless connectivity allows a greater exchange of real-time information between the wearer and the safety officer. For example, it enables remote visualization of the response scene on computer software in a command center and bi-directional communications to increase safety and efficiency.

New SCBAs are also much more ergonomically friendly than older models, providing greater mobility while minimizing body stress on the wearer. The facepieces on the new SCBAs provide the user with a wider field of view. Manufacturers are developing SCBAs with more lightweight, high-performance materials and have engineered the assembly to distribute weight more evenly, away from the back and shoulders. New swivel and pivot mechanisms provide freer movement of the responder in tight situations. The whole focus is on creating SCBAs that allow responders to focus energy on the incident, not the equipment. And that, in turn will help the safety officers get more ROI from the SCBA investment.

Lynn Feiner is Respiratory Customer Marketing Manager for Honeywell Industrial Safety, based in Smithfield, Rhode Island.

Products that go beyond the normal expectations

Through innovative hearing and respiratory protection products Moldex® offers solutions to issues of cost-savings and compliance by bringing to market products that go beyond their intended purpose and address issues of comfort, durability, ease of use, low maintenance, and convenience. We achieve this through novel designs, using the latest technology, and by developing exclusive high-grade materials that outperform competitive products.

Moldex respiratory protection products have one-of-a-kind features that maximize comfort and cost savings. For example, all of our disposable respirators are made with our exclusive Dura-Mesh® shell that resists collapse in heat and humidity, keeps the filter media cleaner longer, and are lined with Softspun® lining for all-day comfort. Our line of AirWave® respirators have a patented wave design with a larger surface area which means more air flows in and out of the mask for cool comfort. Our reusable respirators – 7000/7800/9000 series – feature ultra-light weight, high visibility, and minimum parts for low maintenance.

In hearing protection Moldex has built a loyal customer base with products that emphasize ease of use, comfort, convenience and cost savings. We have our Glide earplugs that are designed to give you a custom fit every time you wear them. With an NRR of 30dB, the Glide Foam is the highest NRR of any No-Roll plug in the market. Our Flip to Listen reusable earplugs allow you to switch from a closed position (NRR 24dB), for protection from continuous noise, to an open position (NRR 4dB), when you need to communicate or hear. We also make the most popular earplug dispenser on the market, the ready to use wherever you need PlugStation®. The PlugStation gives easy, convenient access to hearing protection to maximize compliance and minimize waste. Uncorded, corded and metal detectable versions are available to fill all needs. Again, Moldex products go beyond the normal expectations.

Our products deliver unsurpassed comfort and performance to users, resulting in higher compliance levels, longer product use, and cost savings. Our environmental impact is minimized by making all of our products and packaging PVC-free and many of the products recyclable. Moldex strives to excel on all fronts.

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Comfort = productivity

Advancements in respiratory PPE

By JOSIE LARSEN

Keeping up with the ever-accelerating pace of technological advancements can be difficult. This article will look at some of the latest advancements in respiratory PPE, then analyze principles that underpin effective PPE (whether it be the latest technology or otherwise) and give your company a competitive advantage.

Padded respirators

These have been around for decades in some industries, but are very new in others. For example, the first-ever padded welding respirator was launched just this year. Padded respirators are beneficial because they are comfortable, absorb impact, ensure a snug fit so that they move easily with your head and distribute the weight over your head and shoulders to eliminate pressure points and make it feel lighter.

Helmet lights

While head-lamps have been around for years, lights that are compatible with respirators have only been introduced in the last 2-3 years. The key feature with helmet lights is that they move with your head, lighting up your field of vision.

Comfort = productivity *continued*

In-helmet communication

This is a radio system that allows your employees to safely communicate among their team, especially in noisy environments where communication is otherwise difficult. It is also beneficial for communicating with employees in remote locations that are difficult to access such as in tanks or shipyards.

Multi-purpose respirators

If your employees perform a range of tasks, these can save switching between respirators, which reduces downtime and increases productivity. An example of this is a welder/grinder where you can lift the welding visor and instantly begin grinding.

Air conditioning and climate control

For supplied-air respirators, there is a wide range of air conditioning options available to ensure your employees can operate at a comfortable temperature. Options include cold and hot air devices which cool or heat the air by a nominal amount or climate control devices which allow you to adjust the temperature to suit your preference and environment.

Comfort in PPE

One of the benefits common among many of the items mentioned above is comfort. It is important to realize that employee comfort is not about giving them luxury, but minimizing fatigue to allow them to operate at maximum efficiency. Many employees who use PPE do physical hard work, often in harsh conditions which are two of the leading causes of fatigue. Research has found that fatigue results in more errors and slower reaction time, which will reduce productivity. Therefore, in order to minimize physical strain and maximize productivity, your employees need comfortable PPE.

> "Comfort is difficult to mandate because it is very individual."

This brings us to one key point about how to ensure your investments in any new PPE are worthwhile: Ask yourself (or your employee), will this improve your comfort? Comfort in PPE doesn't just include technological advancements, it can come down to small details such as protective clothing that fits well and is made from quality materials that not only provide protection, but allow easy maneuverability, respirators that are lightweight, clothing and equipment that is lightweight or the weight is evenly distributed to eliminate pressure points.

Many benefits of comfort

Employee comfort also increases their safety which reduces accidents, reduces business disruptions and increases productivity. While there are laws that largely ensure safety, comfort is difficult to mandate because it is very individual, yet vital to ensuring your employees are safe. It has already been mentioned that that fatigue results in more errors. Some

Comfort = productivity *continued*

examples of this are not following a process correctly (further detriment to productivity) or acting in an unsafe manner. The result is lost productivity at best, but could also involve significant expense and damage to the company's reputation.

PPE is generally used in manufacturing or service and maintenance work, so the most obvious competitive advantage are productivity. Other less obvious advantages include employee safety, and increased employee morale. The good news is that these advantages are connected and result from one primary factor: comfort. Other technological advancements can also improve productivity, but comfort is significant because it is more about individual preference and requirements than product features.

Our advice to companies or individuals considering new PPE, especially with new products on the market that are unfamiliar, is consider the effect on employee comfort. While the benefits of comfort are difficult to quantify, any improvement in employee comfort will always result in increased productivity, safety and employee morale. As always, we recommend researching what products are available and trialing them when possible to ensure you have made the right choice, as comfortable PPE will always pay off.

Josie Larsen is Market Analyst, RPB Safety LLC. Established in the 1970s, RPB Safety specializes in supplied-air respirators, airline filters, monitoring equipment & safety essentials that advance your safety and increase your productivity. Contact: 866-494-4599, sales@rpbsafety.com, rpbsafety.com

5 Tips for Selecting a Half Mask

In 2016, more than 3,573 citations were given out for failing to adhere to the OSHA respiratory protection standard 1910.134. It's a well-known fact that this is one of the most common compliance issues in the industry.

That's why choosing the right respiratory equipment is critical to ensure you not only remain compliant, but safe as well. With numerous half masks available today, it's important to know how to choose the best one for your application. Here are five ways safety managers should evaluate half masks.

1. Speech intelligibility

A half mask that muffles your voice only complicates your life, so when selecting a half mask for your site, make sure that speech transmission is near the top of your list. Thinned out plastic where the voice projects is essential in ensuring you get the maximum speech intelligibility available to allow users to communicate effectively.

2. Comfort

While its true comfort can be subjective, here are some obvious—and not so obvious—ways comfort can be judged. For example, the head harness should be soft and flexible so it's more likely to mold to the structure of the wearer's head. The harness should also be designed to work around the pressure points in the head which is critical for long term wear of the mask.

3. Integration with other PPE

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Typically within industrial environments a user will need protection from a plethora of items, so in addition to wearing a half mask respirator they may need PPE such as ear, eye and head gear. If the combination of these safety products do not mesh well together, the likelihood of someone wearing it is reduced and compliance is compromised. Therefore standard features such as a goggle "pinch" to allow better integration with eyewear, the placement of straps to not interfere with ear protection and a low profile head harness for compatibility with head protection should be on your checklist when selecting a half mask.

4. Easy user seal checks

According to OSHA, any individual who uses a tight-fitting respirator should perform a user seal check to ensure that an adequate seal is achieved each time the respirator is used. In reality though, performing a negative pressure leak check by covering the cartridge may be difficult in instances where the user's hands are smaller or the cartridge itself is on the larger side. Thus when evaluating half mask respirators it's necessary to choose a mask that has a positive fit check button which makes it very easy to conduct a quick leak check on demand. By ensuring a proper seal you can guarantee the user has the highest level of protection.

5 Tips for Selecting a Half Mask *continued*

5. Lower total cost of ownership

It's rare that a facility has just one type of respirator. More often than not you're responsible for half masks, cartridges, full facepieces, PAPRs, and SCBA amongst other things. When selecting a half mask consider the bigger picture such as the total cost of ownership. Make sure that the cartridge worn with the half mask is the same one that can be worn with full facepieces, which is the same facepiece that can be worn with a PAPR or SCBA. The interchangeability that comes with top down convertible products means that inventory management just got easier.

With dozens of half masks on the market the decision on what's best for you can be tough. However, with these five tips to guide you, you can breathe easier knowing you selected the right mask to keep you in compliance with OSHA.

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The new AVIVA half mask from Scott Safety is the next step forward in half mask technology. Innovative design elements such as a hybrid reflex seal, an easy-to-use leak check mechanism and goggle pinch have been integrated into the AVIVA with superior user comfort and protection in mind.

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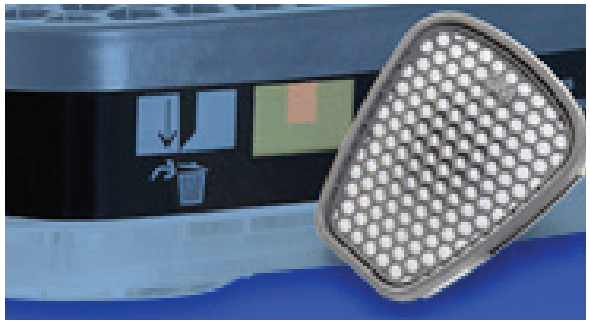
Learn more at ScottSafety.com/aviva

Cartridge change-out

Is it time to replace your schedule with an End-of-Service-Life Indicator?

By ERIK JOHNSON



For many of us, there's nothing more anticipated in the morning than a freshly brewed cup of coffee. What makes the aroma so enticing? According to the Coffee Research Institute, the smell is due to more than 800 aromatic compounds – one of which is styrene, which occurs naturally in some plants and foods, such as coffee beans.[1]

While the small amount of styrene in coffee is generally considered harmless, workers exposed to styrene as part of their job may not be as fortunate.[2] Alterations in vision, hearing loss and longer reaction times have been associated with styrene exposure in the workplace. Styrene vapor is also irritating to the eyes and respiratory tract.[3] Many workers are exposed to styrene during the manufacture of plastics, synthetic rubber, resins and insulators.

Respiratory protection is among the safeguards required to help protect employees from organic vapors, such as styrene and toluene. OSHA standard 29 CFR 1910.134 provides key guidance for developing and implementing a respirator program when harmful vapors are present.

One of the challenges that safety managers and industrial hygienists run into with respiratory protection is the proper change-out of respirator cartridges. The OSHA standard allows two methods for determining cartridge change-outs: developing a cartridge change-out schedule, or using cartridges with an end-of-service-life indicator (ESLI).

The idea of using cartridges with an ESLI is new to many safety managers and industrial hygienists because no ESLI option previously existed for broad spectrum organic-vapor exposure. Consequently, those who work with organic vapors have had only one option: change-out schedules.

But that's no longer the case in many situations. An ESLI is now available for use with certain organic vapors above certain concentration thresholds. Now that employers have a choice, it's worth examining the pros and cons of each change-out method to determine the one that best matches needs in your workplace.

Cartridge change-out *continued*

Change-out schedule

In instances where an ESLI is not available or appropriate for a workplace's conditions, OSHA requires that employers develop and implement a change-out schedule for respirator cartridges.

The change-out schedule must be based on objective information to ensure cartridges are replaced before the end of their service lives. Such information includes "the exposure assessment and information based on breakthrough test data, mathematically based estimates and/or reliable use recommendations from the employer's respirator and/or chemical suppliers."

The collected information can be used to create a change-out schedule through multiple methods. On its website, OSHA outlines three options for estimating a cartridge's service life: conducting experimental tests, using a manufacturer's recommendation, and using a math model. Some respirator manufacturers offer free online service-life calculators, which can help produce cartridge service-life estimates in minutes via math models.

Pros: A change-out schedule is the go-to and standard-compliant method when an ESLI cannot be used. This is especially applicable in instances where exposure levels may be too low that they don't register on the ESLI.

A change-out schedule can also give employers a more concrete sense of what their cartridge requirements will be for the long term. Knowing that eight workers will replace their cartridges on a weekly basis, for example, can help a safety manager or industrial hygienist understand stocking and purchasing activities across a set period of time, and thus budget accordingly. Furthermore, change-out schedules have been done for years and industrial hygienists are comfortable with how to administer them.

Cons: The biggest downside of using a change-out schedule comes in trying to apply a one-size-fits-all approach across a range of workers, all of whom have variations in how they do their jobs. Each worker will have a different exposure level based on the unique job characteristics. This can include variations in breathing rates, exposure time and work practices.

As a result, a single change-out schedule may not fully align with each individual worker. This could result in workers using a respirator cartridge beyond its actual service life, which can lead to potential exposure and safety issues, as well as potential costs in the form of OSHA fines or worker's compensation. It can also lead to workers changing their cartridges before they reach the end of their service lives, resulting in higher equipment costs.

Additionally, cartridge service life will change as factors such as work practices, contaminant levels, temperature and humidity change. As a result, even the most thorough exposure assessments become obsolete as operations evolve or as weather shifts from season to season.

The ESLI option

Cartridges with an ESLI are now available from 3M Company for use with a wide range of commonly used organic vapors,

Cartridge change-out *continued*

including toluene, styrene, MEK and xylene.

This ESLI includes an indicator bar located on the organic vapor cartridge that workers can use to monitor their cartridge's service life. The ESLI absorbs organic vapors as they enter the cartridge, which in appropriate environments with the specified vapors above certain concentrations results in visible growth of the indicator bar. The ESLI's performance is not affected by other types of gases or vapors, or by humidity or temperature changes in most workplaces.

In appropriate environments, each individual user knows it's time to change the cartridge when the indicator bar reaches the end-of-service line.

Pros: The greatest benefit an ESLI can deliver is in helping employers optimize cartridge change-out schedules. Whereas a set change-out schedule typically cannot be customized to the varying job functions and working conditions of each employee, an ESLI provides the means to adjust cartridge change-outs down to the individual level.

This can also help simplify change-out enforcement. Rather than marking cartridges with replace-by dates or regularly checking to ensure workers have changed their cartridges, safety professionals can do quick visual inspections to ensure proper change-outs are being conducted.

Cons: This ESLI cannot be used as a primary method for determining cartridge change-out in every situation. It can only be used as the primary method for certain organic vapors and exposure levels. Safety professionals must always conduct an exposure assessment and review the cartridge user instructions before relying on this ESLI as the primary method for determining cartridge change.

By design, ESLIs have a built-in safety margin of at least 10% remaining service life. In use, there will typically be even more remaining service life when cartridge change is indicated. The ESLI technology also comes at an additional upfront cost.

It's personal

An ESLI isn't a fit for every workplace. Sometimes it may work better as a backup method for determining cartridge change-out, such as in places where organic vapors are normally at low exposure levels, but may occasionally spike above normal levels.

In situations where this ESLI can be used, it can give workers greater confidence in their equipment and their own personal safety. More than that, optimizing cartridge change-out schedules to each individual user can help potentially reduce health and safety risks.

Erik Johnson is a Technical Service Specialist, 3M Company

1 Coffee Research Institute, Coffee Chemistry: Coffee Aroma
2 U.S. Public Health Service Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Styrene," pp. 5, 68-72, 89-90, November 2010 3 Environmental Protection Agency, OPPT Chemical Fact Sheets, Styrene Support Document, December 1994

Voluntary Standards Cover the Spectrum: from Good Manufacturing Practices to Ventilation Control

In an effort to communicate the vital role that standards play in daily life, the American National Standards Institute (ANSI) publishes snapshots of the diverse standards initiatives undertaken in the global and national standards arena, many of which are performed by ANSI members and ANSI-accredited standards developers. Two of the latest selections follow:

Good Manufacturing Practices for Pharmaceutical Excipients

Pharmaceutical excipients are used in pharmaceutical preparations to impact the appearance, stability, and delivery of drug products. The manufacturing process of such excipients is essential to the safety and quality of these products and must meet specifications stated by the manufacturer. Furthermore, it must meet the requirements and expectations of customers and regulatory authorities.

NSF/IPEC/ANSI 363-2016, *Good Manufacturing Practices for Pharmaceutical Excipients*, provides a comprehensive basis for the quality management system used in the manufacture of pharmaceutical excipients. The recently revised standard is intended to define good manufacturing practices (GMP) for excipient manufacture and distribution for use in drug products. It sets minimum requirements for GMP applicable to all commercially available excipients. In addition, adherence to excipient GMP provides assurance that excipients are suitable for use in drug products.

Published by NSF International, the standard also provides guidance to allow for the determination that a pharmaceutical excipient is within the specifications stated by the manufacturer, either qualitatively or quantitatively, and that it does not contain specific undeclared contaminants. The standard was developed with participation from the pharmaceutical excipients manufacturers, public health regulators, and distributors of pharmaceutical excipients..

Ventilation Control and Fire Protection of Commercial Cooking Operations

Operative fire safety requirements can reduce the potential fire hazard of both public and private commercial cooking operations—which can range from restaurants to cafeterias to nursing homes.

The National Fire Protection Association's (NFPA's) revised NFPA 96-2017, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, provides the minimum fire safety requirements (preventative and operative) related to the design, installation, operation, inspection, and maintenance of all public and private cooking operations. Requirements include, but are not limited to, all manner of

Voluntary Standards Cover the Spectrum: from Good Manufacturing Practices to Ventilation Control

continued

cooking equipment, exhaust hoods, grease removal devices, exhaust ductwork, exhaust fans, dampers, fire-extinguishing equipment, and all other auxiliary or ancillary components or systems that are involved in the capture, containment, and control of grease-laden cooking effluent.

ANSI offers subscriptions by selecting listing of over 100 standards developing organizations or selecting from a listing of pre-defined industry collections currently available for subscription. A standards subscription provides convenient and cost-effective, multi-user access to specific standards, and subscribers can create a customized site license collection by selecting standards from a wide range of different standards developers.

Interested companies should request a standards subscription proposal online to see how much time and money they can save with an ANSI site license.

About ANSI

ANSI is a private non-profit organization whose mission is to enhance U.S. global competitiveness and the American quality of life by promoting, facilitating, and safeguarding the integrity of the voluntary standardization and conformity assessment system. Its membership is comprised of businesses, professional societies and trade associations, standards developers, government agencies, and consumer and labor organizations. The Institute represents the diverse interests of more than 125,000 companies and organizations and 3.5 million professionals worldwide.

The Institute is the official U.S. representative to the International Organization for Standardization (ISO) and, via the U.S. National Committee, the International Electrotechnical Commission (IEC), and is a U.S. representative to the International Accreditation Forum (IAF).. For more information, visit www.ansi.org.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Common mistakes

The 12 most common respiratory protection compliance violations

By NICHOLAS BOZZUTO

Respiratory protection is a perennial "Top 5" most-cited OSHA violation. In 2014, there were 3,879 violations, ranking fourth for the seventh year in a row.1 Following are the 12 most common compliance mistakes. With just a little diligence, these mistakes are all easily avoidable. Let's review each one.

1. Lack of a written program

According to 1910.134(c) and (c)(1), an employer is required to develop and implement a written respiratory program with required worksite specific procedures and elements for required respirator use in any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer.

The program must outline:

- Respirator-selection process
- Medical evaluations
- Fit testing
- Procedures for use
- Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing and discarding
- Procedures to ensure adequate air quality, quantity and flow

- Training in respiratory hazards
- Training in use limitations and maintenance
- Procedures for regularly evaluating the program's effectiveness

Even if respirators are worn voluntarily, employers must still provide a written program to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored and maintained so its use does not present a health hazard to the user. The only time written programs are not required is in the case of voluntary use of filtering facepieces (better known as "dust masks") (1910.134(c)2,(i,ii)).

Common mistakes *continued*

In this digital age, why does OSHA specifically mandate that the program be written? OSHA has found health and safety programs to be more effective if procedures are available in hard copy for study and reference. A written plan also ensures any unique characteristics of the specific worksite are considered. OSHA believes, "Developing the written program encourages [the employer] to thoroughly assess and document information pertaining to respiratory hazards posed to employees" under normal conditions or reasonably foreseeable emergencies.

Essentially, a compliant program must be: written, worksite-specific, reviewed for effectiveness regularly, and trained upon regularly.

2. Failure to fit test

Employees must be fit tested with the same make, model, style and size of respirator that will be used, according to 1910.134(f). Employees should be retested annually when there is a change in the type of respirator used, or a change in an employee's physical condition, such as an obvious change in body weight. Fit testing records must be detailed and retained until the next fit test. If an employee wears glasses, goggles or personal protective equipment, the employer must ensure that the equipment doesn't interfere with a facepiece's seal.

3. Permitting facial hair

Employers must not allow an employee with facial hair or any condition that limits a facepiece seal or valve function to wear a tight-fitting facepiece (1910.134(g)(1)(i)(A)). Loose fitting respirators – an alternative option often explored by employers – do not require fit testing.

4. Failure to air test

Employers are required to ensure that the breathing air going into a respirator meets Grade D standards described in ANSI/ Compressed Gas Association Commodity for Air, G-7.1-1989 (1910.134(i)(1)(ii)).

Requirements include:

- Oxygen content of 19.5 – 23.5%
- Hydrocarbon content of 5 milligrams per cubic meter of air or less
- Carbon Monoxide (CO) content of 10 parts per million (ppm) or less
- Carbon Dioxide (CO2) content of 1,000 ppm or less
- Lack of noticeable odor

Verification can be conducted by an air test, available from multiple sources. This is not an exhaustive list, but instead the major components. The complete standard can be purchased from the Compressed Gas Association.

5. No medical evaluations

Medical evaluations are to be provided at no cost to employees (1910.134(c)(4)). Evaluations are intended to

Common mistakes *continued*

determine the employee's ability to use a respirator. They must be completed before an employee is ever fit tested or required to use the respirator. The employee must also complete a questionnaire found in Appendix C, Part A, Sections 1 and 2 of the standard (1910.134(e)(2)(ii)).

6. Failure to calibrate CO monitors

Whenever using an oil-lubricated compressor, employers shall use high-temperature or carbon monoxide alarms in order to monitor CO levels to the respirator user(s) (1910.134(i)(7)). Several manufacturers offer CO monitors, often combined with air filtration, to help maintain the Grade D breathing air requirement discussed previously.

Sensors inside the monitors must be calibrated. This procedure will vary, depending on make and model of the unit. Some are easier to conduct than others, which is often given as an "excuse" for not being completed. Most manufacturers recommend monthly calibrations but check the manufacturer's guidelines.

7. Failure to maintain records

Part of the employer's written program needs to designate how written information will be established and retained, particularly regarding medical evaluations, fit testing, and the respirator program in general. A well-executed system will assist employers in auditing the effectiveness of their program and provide necessary evidence in the event of an OSHA visit (1910.134(m)).

8 & 9. Modifying and using non-approved respirators

Respirators must be NIOSH-approved and maintain the NIOSH compliance for which it was approved. The National Institute for Occupational Safety and Health (NIOSH) tests and certifies respirator assemblies. It is OSHA's job to enforce the proper use of NIOSH-approved respirators.

According to 1910.134(d)(1)(ii), "the employer shall select a NIOSH certified respirator. The respirator shall be used in compliance with the conditions of its certification." Substitutions of any component pieces not included in the NIOSH Approval Label supplied with each approved respirator are not permissible.

10. Using incorrect filters

Before beginning a respiratory protection program, employers must evaluate workplace hazards. When the hazards dictate that respiratory protection is required, the employer must be able to identify those hazards. When using an air purifying respirator (powered or non-powered), they must determine whether the hazard is an organic vapor, acid gas, or a particulate, in order to select the correct filter. Material Safety Data Sheets (MSDS) or the NIOSH Pocket Guide to Chemical Hazards will help with this.

Employers must ensure all filters, cartridges and canisters used in the workplace are labeled and color coded with NIOSH-approved labels, and that the labels are not removed and remain legible (1910.134(j)).

Common mistakes *continued*

11. Mixing breathing air lines

Employers shall ensure that breathing air couplings are incompatible with outlets for non-breathable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines (1910.143(i)(8)). This is the reason manufacturers offer so many different hose fitting options. Breathing air must have its own designated fitting, separate from any other air or gas on site.

12. Improper air source

Each NIOSH-approved respirator assembly is tested and assigned a permissible air source, whether it is supplied air or a powered air unit. Using a respirator assembly approved for supplied air with a powered air unit would be a violation, and vice versa.

Compressors used to supply breathing air have their own requirements (1910.134(i)(5)). They must:

- Prevent entry of contaminated air into the air supply
- Minimize moisture content
- Have suitable in-line air purifying sorbent beds and filters
- Have a tag at the compressor noting the most recent filter change date and the responsible party
- Use a high-temperature or carbon monoxide alarm (for oil-lubricated units)
- Ensure breathing air couplings are incompatible with outlets for non-breathable air or gas

References

1 Industry Profile for OSHA Standard 19100134

Nicholas Bozzuto works for Bullard and holds a Bachelor of Science from the University of South Carolina and an MBA from the University of Kentucky. In his role as Respiratory Protection Product Manager for Bullard, he is responsible for the blast and industrial coatings markets, including abrasive blasting, paint, and spray foam insulation. His technical expertise is in developing blast respirators and air quality products.

Avoiding OSHA violations

Effective respirator programs make all the difference

By SALLY J. SMART

According to OSHA, an estimated five million workers are required to wear respirators in 1.3 million workplaces throughout the United States.

The primary objective of a company's respiratory protection program is to prevent excessive exposure to occupational air contaminants and oxygen deficiency. When effective engineering controls and work practice control measures are not feasible, or while they are being implemented or evaluated, respiratory protection may be required to achieve this objective.

Respiratory protection program elements

Employers must include the following procedures in the program:

- Proper respirator selection
- Medical evaluations of affected employees
- Fit-testing procedures for tight-fitting respirators
- Proper use of respirators in routine and reasonable foreseeable emergency situations
- Schedules and procedures for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators
- Methods for ensuring adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators
- Training of employees regarding the respiratory hazards that they may be potentially exposed to during routine and emergency situations
- Training of employees in the proper use of respirators – donning and doffing, any limitations on their use, and maintenance, and
- Regular evaluations of the respiratory protection program

Evaluating respiratory hazards

OSHA requires employers to evaluate respiratory hazard(s) in the workplace (contaminant and concentration), identify

Avoiding OSHA violations *continued*

relevant workplace and user factors, and base respirator selection on these factors. The respiratory hazard evaluation includes "a reasonable estimate of employee exposures to respiratory hazard(s)".

The respirator type or class is then selected by comparing the employee's exposure to the occupational exposure limit and determining the minimum necessary respirator assigned protection factor. When an employer cannot identify or reasonably estimate employee exposure, OSHA requires employers to consider the atmosphere as "immediately dangerous to life and health" (IDLH).

Medical evaluation

The medical evaluation is designed to identify medical conditions that place employees who use respirators at risk of serious medical consequences.

Medical evaluation of employees is required for mandatory use of all respirators and for voluntary use of elastomeric facepieces. Employees must be medically evaluated and found eligible to wear the selected respirator prior to fit testing.

Fit-testing

29 CFR 1910.134(f) states: "This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used."

The primary purpose of fit testing is to identify the specific make, model, style, and size of respirator best suited for each employee. In addition, fit testing reinforces respirator training by having employees review the proper methods of donning, wearing and doffing the respirator.

Fit testing must be performed before an employee first starts wearing a respirator in the work environment or whenever a different tight-fitting facepiece is used, and at least annually thereafter.

Respirator use

All respirators used must be certified by the National Institute for Occupational Safety and Health (NIOSH). Under certain conditions, OSHA may permit the use of respirators not approved by NIOSH (where no NIOSH-approved respirator exists) when documentation exists to attest to the adequacy of the respirator's effectiveness against the contaminant(s) of concern.

For protection against gases and vapors in non-IDLH atmospheres, air-purifying respirators with the appropriate cartridge/canister may be selected. When selected, a system must be in place that reliably protects the user from contaminant breakthrough. The cartridge/canister must either be equipped with a NIOSH-approved end-of-service life indicator (ESLI) or if there is no ESLI, then the established cartridges/canister change schedule must be followed (29 CFR 1910.134(d)(3)(iii)(B)(2). If there is no ESLI or established change

Avoiding OSHA violations *continued*

schedule, an air-supplying respirator must be used.

For protection against particulates in non-IDLH atmospheres, an air-purifying respirator equipped with filters certified for particulates by NIOSH as stated in 42 CFR Part 84 may be selected. Filters should be replaced when the breathing resistance becomes great enough to cause discomfort, when the filter is physically damaged or in accordance with the specific manufacturers' instructions.

All filters, cartridges and canisters are to be labeled and color-coded with the NIOSH approval label. This label must not be removed and must remain legible.

Maintenance and care

In addition to OSHA maintenance and care requirements, the respirator manufacturer's instructions for inspecting, cleaning, and maintaining should be consulted. All maintenance and care programs must include at least cleaning and disinfecting procedures, proper storage, regular inspections for defects, and repair methods.

Training

At a minimum training must cover the following:

- General requirements of the OSHA Respiratory Protection Standard
- Identification of the hazards involved, the extent of employee exposure to the hazards and the potential health effects of such exposures — the training required by OSHA's Hazard Communication Standard (29 CFR 1910.1200) meets this requirement
- Proper selection of respirators
- Procedures for inspecting the respirator(s), donning and doffing, checking the fit and seal and wearing the respirator(s)
- Discussion of the consequences of improper fit, usage or maintenance
- Capabilities and limitations of the respirator(s) including discussion of ESLI and/or cartridge/canister change schedules
- Using the respirator(s) in emergency situations
- Maintenance and storage procedures
- Recognizing medical signs and symptoms that may limit or prevent effective respirator use

Retraining should be done annually, or under some conditions, sooner. Retraining is necessary, for instance, when changes in the type of respirator assigned render previous training obsolete, or when an employee has not retained the understanding or skill to use the respirator properly.

Program evaluation

A respiratory protection program administrator is designated by the employer and is qualified by appropriate training or experience. He/she must conduct evaluations of the respiratory protection program to ensure continued program effectiveness.

Avoiding OSHA violations *continued*

Evaluations determine whether correct respirators are being used and worn properly and whether the training program is effective.

Voluntary use

For situations where respirators are not required, but are permitted by employers if requested by employees, employers may allow voluntary use if the respirator use will not in itself create a hazard. Check OSHA's respiratory protection standard for the criteria for voluntary usage.

Sally J. Smart has more than 25 years of applied environmental, health and safety experience. She is currently a Technical Safety Specialist for Grainger providing technical information on the many health and safety challenges faced by Grainger sellers and customers across North America. Prior to joining Grainger, Sally was the Director of Quality, Regulations and Safety for two chemical manufacturers and compressed gas packagers with safety being the primary focus. She is a Board Certified Safety Professional® (CSP) and a Qualified Safety Sales Professional (QSSP).

Respiratory protection FAQs

OSHA answers common compliance questions

According to OSHA, an estimated five million workers are required to wear respirators in 1.3 million workplaces throughout the U.S. Respirators protect workers against insufficient oxygen environments, harmful dusts, fogs, smokes, mists, gases, vapors and sprays. These hazards may cause cancer, lung impairment, diseases or death. Compliance with the OSHA Respiratory Protection Standard could avert hundreds of deaths and thousands of illnesses annually. Following are OSHA's answers to some frequently asked questions regarding respiratory protection.

When is respirator use required?

OSHA's respirator standard, 29 CFR 1910.134, requires the use of respirators to protect employees from breathing contaminated and/or oxygen-deficient air when effective engineering controls are not feasible, or while they are being instituted. Several other OSHA regulations also require the use of respirators.

Can any respirator be used?

No, respirators shall be selected on the basis of hazards to which the worker is exposed (i.e., particulates, vapors, oxygen-deficiency, or combination). Also, OSHA requires the use of certified respirators.

Respiratory protection FAQs *continued*

Why is a formal respirator program needed?

A respirator program increases the chances of using a respirator correctly. A respirator will only protect if it is used correctly. Also, OSHA requires a number of written elements for all respiratory protection programs.

What do employees need to know about the respirator program?

Employers must establish and implement a written respiratory protection program with worksite-specific procedures and elements for required respirator use. Provisions of the program include procedures for selection, medical evaluation, fit testing, training, use and care of respirators.

How is proper respirator size determined?

Proper respirator size is determined through a fit test. Employees using negative or positive pressure tight-fitting facepiece respirators must pass an appropriate fit test using the procedures detailed in OSHA's respirator standard.

Can employees check the fit of their own respirator?

Yes, employees using tight-fitting facepiece respirators are required to perform a user seal check each time they put on the respirator. They must use the procedures in Appendix B-1 of 29 CFR 1910.134 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as OSHA's procedures. Note that a fit test is a method used to select the right size respirator for the user. A user seal check is a method to verify that the user has correctly put on the respirator and adjusted it to fit properly.

When is respirator fit testing required?

Fit testing of all negative or positive pressure tight-fitting facepiece respirators is required prior to initial use, whenever a different respirator facepiece is used, and at least annually thereafter. An additional fit test is required whenever there are changes in the user's physical condition that could affect respirator fit (e.g., facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight). The employer must be fit tested with the same make, model, style and size of respirator that will be used.

Must employees see a doctor before they use a respirator?

The employer must provide a medical evaluation to determine the employee's ability to use a respirator before the employee is fit tested or required to use the respirator in the workplace. Not all workers must be examined by a doctor. A physician or other licensed health care professional must perform the medical evaluation using the medical questionnaire contained in Appendix C of 29 CFR 1910.134 or an initial medical examination that obtains the same information.

Respiratory protection FAQs *continued*

What maintenance and care is required for respirators?

The employer must provide for the cleaning and disinfecting, storage, inspection and repair of respirators used by employees according to the procedures in 29 CFR 1910.134.

Can a respirator be used by more than one person?

Disposable respirators cannot be disinfected, and are therefore assigned to only one person. Disposable respirators must be discarded if they are soiled, physically damaged, or reach the end of their service life. Replaceable filter respirators may be shared, but must be thoroughly cleaned and disinfected after each use before being worn by a different person, using the procedures in Appendix B-2 of 29 CFR 1910.134, or equally effective procedures recommended by the manufacturer.

How long can a particulate respirator be used before it must be discarded?

Respirators with replaceable filters are reusable, and a respirator classified as disposable may be reused by the same worker as long as it functions properly. All filters must be replaced whenever they are damaged, soiled, or causing noticeably increased breathing resistance (e.g., causing discomfort to the wearer). Before each use, the outside of the filter material should be inspected. If the filter material is physically damaged or soiled, the filter should be changed (in the case of respirators with replaceable filters) or the respirator discarded (in the case of disposable respirators). Always follow the respirator filter manufacturer's service-time-limit recommendations.

Employers must develop standard operating procedures for storing, reusing and disposing of respirators that have been designated as disposable and for disposing of replaceable filter elements.

What are the employer's obligations when respiratory protection is not required but employees wear respirators on their own accord?

The employer must implement those elements of the written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored and maintained so its use does not present a health hazard to the user. Also, employers must provide the voluntary respirator users with the information contained in Appendix D of 29 CFR 1910.134.

Employers are not required to include in a written respiratory program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

Is training required before a respirator is used?

Yes, training must be provided to employees who are

Respiratory protection FAQs *continued*

required to use respirators. Training must be comprehensive, understandable and recur annually and more often if necessary. At a minimum, training should include:

- Why the respirator is necessary and how improper fit, use or maintenance can compromise its protective effect
- Limitations and capabilities of the respirator
- Effective use in emergency situations
- How to inspect, put on and remove, use and check the seals
- Maintenance and storage
- Recognition of medical signs and symptoms that may limit or prevent effective use
- General requirements of OSHA's respirator standard, 29 CFR 1910.134

If employees have a beard or moustache, is their respirator still effective?

Tight-fitting facepiece respirators must not be worn by employees who have facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function. Respirators that do not rely on a tight face seal, such as hoods or helmets, may be used by bearded individuals.

Permit-Required Confined Space

1910.146

History

The Final Rule for Permit-Required Confined Spaces was published in the Federal Register on January 14, 1993, and became effective on April 15, 1993.

Scope

The standard applies to all general industry places of employment. Among them are Agricultural services, Manufacturing, Transportation and Utilities, Wholesale Trade, Food Stores, Hotels and Other Lodging, Health Services, Museums, Botanical Gardens and Zoos but to name a few.

On May 4, 2015, OSHA published a separate standard for confined spaces in construction.

Why this standard is important

Many workplaces contain spaces which are considered "confined" because their configurations hinder the activities of any employees who must enter, work in, and exit them. For example, employees who work in process vessels generally must squeeze in and out through narrow openings and perform their tasks while cramped or contorted. For the purposes of this rulemaking, OSHA is using the term "confined space" to describe such spaces.

In addition, there are many instances where employees who work in confined spaces face increased risk of exposure to serious hazards. In some cases, confinement itself poses entrapment hazards. In other cases, confined space work keeps employees closer to hazards, such as asphyxiating atmospheres or the moving parts of a mixer, than they would be otherwise.

Hazards

Asphyxiation is the leading cause of death in confined spaces. The asphyxiations that have occurred in permit

Permit-Required Confined Space *continued*

spaces have generally resulted from oxygen deficiency or from exposure to toxic atmospheres.

The failure to take proper precautions for permit space entry operations has resulted in fatalities, as opposed to injuries, more frequently than would be predicted using the applicable Bureau of Labor Statistics models. Many confined spaces are poorly ventilated - a condition that is favorable to the creation of an oxygen deficient atmosphere and to the accumulation of toxic gases.

Key Definitions

Permit-required confined spaces are confined spaces that:

- May contain a hazardous or potentially hazardous atmosphere.
- May contain a material which can engulf an entrant.
- May contain walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant.
- May contain other serious physical hazards such as unguarded machines or exposed live wires.
- Must be identified by the employer who must inform exposed employees of the existence and location of such spaces and their hazards.

You may be able to reclassify a permit-required confined space to non-permit space status if you can permanently eliminate the hazards affecting the space.

General Requirements

In general, the Permit-Required Confined Spaces Standard requires that you, the employer, evaluate the workplace to determine if any spaces are permit-required confined spaces. If permit spaces are present, and your workers ever are authorized to enter such spaces, you must develop and implement a comprehensive permit spaces program, which is an overall plan/policy for protecting employees from permit space hazards and for regulating employee entry into permit spaces.

Enforcement statistics: (October 2015 – September 2016)

Citations: 386
Inspections: 174
Penalties: $1,092,443

Most cited industries:

1. Food Manufacturing
2. Merchant Wholesales, Nondurable Goods
3. Nonmetallic Mineral Product Mfg
4. Fabricated Metal Product Mfg
5. Electrical Equipment, Appliance and Component Mfg

Procedures for atmospheric testing in confined spaces

Evaluation testing: The atmosphere within a confined space must be tested using equipment that is designed to detect the

Permit-Required Confined Space *continued*

chemicals that may be present at levels that are well below the defined exposure limits. Evaluation testing is done to:

- determine what chemical hazards are or may become present in the space's atmosphere, and
- identify what steps must be followed and what conditions must be met to ensure that atmospheric conditions are safe for a worker to enter the space.

The testing results and the decisions about what steps must be followed before entry must be evaluated by, or reviewed by, a technically qualified professional like an OSHA consultation service, a certified industrial hygienist, a registered safety engineer, or a certified safety professional. The technically qualified professional must consider all of the serious hazards in his/her evaluation or review.

A permit space is a confined space that has one or more of the following features: it has or may contain a hazardous atmosphere; it contains a material that can engulf a person who enters; it has an inside design that could trap or asphyxiate a person who enters (inwardly converging walls, or a floor that slopes downward to a smaller section); or it has any other serious safety or health hazards.

Verification Testing: Before a permit space that may have a hazardous atmosphere can be entered, the atmosphere must be tested using the steps identified on the permit (developed during evaluation testing). Verification testing is done to make sure that the chemical hazards that may be present are below the levels necessary for safe entry, and that they meet the conditions identified on the permit. Test the atmosphere in the following order: (1) for oxygen, (2) for combustible gases, and then (3) for toxic gases and vapors. The testing results -- the actual test concentrations -- must be recorded on the permit near the levels identified for safe entry.

Duration of Testing: For each test required on the permit, you must allow enough time for the air from the space to be drawn into the equipment and for the sensor (or other detection device) to react to the chemical if it is present. This is considered the "minimum response time" and it will be noted by the manufacturer in the operator's manual. Be aware that you will need to add time to this "minimum response time" if you have attached hosing or a probe extension to the inlet. The additional time is needed to allow the air from the different depths of the space to be pulled into the equipment inlet.

Testing Conditions in Spaces that May Have Layered Atmosphere: For permit spaces that are deep or have areas leading away from the entry point, the atmosphere may be layered or may be different in remote areas. For these spaces, testing must be done in the area surrounding the worker, which is considered four (4) feet in the direction of travel and to each side. If a sample probe is used to do the testing, then the worker must move slowly enough so that testing is completed, keeping the equipment "response time" in mind, before he/she moves into the new area.

Retesting the Space During Entry or Before Re-Entry: Test the

Permit-Required Confined Space *continued*

permit space routinely to make sure that the atmospheric conditions continue to be safe for entry.

Compliance assistance

- Confined Spaces Advisor. OSHA. Provides an interactive expert help for the Permit-Required Confined Spaces Standard (29 CFR 1910.146). Assists users in identifying confined spaces and deal with permit-required confined spaces.
- Permit-required Confined Spaces. OSHA QuickCard™ 3214, (2006). Also available in Spanish.
- Procedures for Atmospheric Testing in Confined Spaces. OSHA Fact Sheet, (September 2005).
- Confined Spaces. National Institute for Occupational Safety and Health (NIOSH) Workplace Safety and Health Topic.

Clearing the air

Considerations when selecting a respirator for confined space

By PAULA VARSAMIS

The world of confined spaces is diverse, ranging from holds, manholes and tanks to ducts, silos, vaults and pipes— all of which can be deadly. The Bureau of Labor Statistics reports 136 people in the United States alone died in accidents when working in confined spaces and containers in 2015.[1] Not only can these accidents occur during everyday work, but also in rescue scenarios. Whether a sanitation worker loses consciousness due to oxygen-deficient atmospheres during a routine maintenance check, or a firefighter is overwhelmed by toxic gases during a rescue situation, respiratory protection is paramount to any confined space entry.

OSHA defines a confined space as an area that is large enough for workers to enter and perform certain jobs, has limited or restricted entry or exit and is not designed for continuous occupancy.[2] In confined spaces, conditions can rapidly change — toxins can accumulate, or oxygen deficient environments can cause asphyxiation. To combat — or at a minimum mitigate — these risks, the foundation of respiratory protection is built upon the recognition of these hazards and the understanding of what is necessary to protect against them.

Know your hazards

On any worksite, and particularly those that contain confined spaces, the first step should always be to conduct a risk assessment to identify potential respiratory hazards. One of the key factors influencing the final respirator decision is to address the environment's volatility — as certain locations are subject to more atmospheric changes than others.

Performing clearance measurements before operations begin allows safety managers to match a respirator's abilities to the demands of the confined space. Clearance measurement

Clearing the air *continued*

can help determine which substances are present and what preparations are required in order to perform work in the area. It is important to ascertain whether lack of oxygen is a possibility. When measuring samples, consider the physical properties of the gases and the confined space's ventilation patterns, temperature and type or shape.

Light versus heavy gases

Understanding a gas's properties, and subsequently where a gas accumulates, allows clearance measurement experts to know they've taken an accurate, representative sample. If a sample is drawn from the top of a confined space and it identifies the presence of hydrogen sulfide (H2S), this should alert immediate danger and trigger standard operating procedures. Since the molar mass of H2S (34 g/mol) is significantly heavier than air (29 g/mol), the greatest concentration of H2S would be found at the bottom of a space.

Similarly, testing for lighter gases, like methane, at the bottom of a space would be incorrect — especially since these lighter gases mix with the surrounding air. If methane were detected in this scenario, it could present an immediate risk of explosion since most of the methane may already be concentrated at the top of the container.

Ventilation patterns

Identifying where gas can flow in and out of a confined space impacts the reading. Air currents influence the position and concentration of air clouds, making it vital that a testing expert be aware of these possible manipulations and subsequent impact on the sample.

Temperatures

When heat is added to a substance, it impacts the rate at which its molecules and atoms vibrate. If the sun has been shining on the container for the majority of the day and the clearance measurement was performed prior to sunrise, it's likely that the reading no longer reflects an accurate picture given the rate of increased diffusion.

Type/shape

Factoring in the gas's physical properties plays an important role in assessing the space in which it is found. Containers may be positioned on a slope, where the highest point would be in the corner toward the top of the inclined surface. This may place worker entry closer to heavy gas accumulations (H2S). In addition, any bulges or deformities of the confined space will influence how the ventilation circulates and how the temperature varies—indicating that where the best sample is drawn may change from moment to moment.

What respirator fits the bill?

Marrying a confined space's environment to a respirator's capabilities is an important union. Regardless of everyday use or emergency escape, the right respirator selection addresses

Clearing the air *continued*

reliable protection and efficiency.

OSHA stipulates that respirator selection will be based on the maximum use concentration (MUC), which is calculated by multiplying the assigned protection factor (APF) by the recommended exposure limit (REL).[3] Referring to the H2S identified during the clearance measurement in the previous example, the following respirator types are suggested for the following specific concentrations:

> Marrying a confined space's environment to a respirator's capabilities is an important union. In confined spaces, conditions can rapidly change.

- 0-10 ppm: No respirator is needed, below REL
- 10-100 ppm: Powered Air-Purifying Respirator (PAPR), Full Face Mask Cartridge Respirator or Self-Contained Breathing Apparatuses (SCBA)
- 100-100,000 ppm: SCBA or Supplied Air in positive pressure mode

When comparing which device best suits the environment, safety managers should also weigh the equipment's ease of use, knowing that time can quickly become a precious commodity. Guiding questions include, but are not limited to:

- Is it easy to don — user friendly and light weight?
- Is it compact and transportable?
- Where would this be stored so it could easily be accessed in emergency scenarios without being damaged?
- What is the device's lifespan/required maintenance?

Selecting the right respirator is akin to selecting the right boot — not only should one conduct research and understand how the design will afford the greatest protection for the stress it will undergo, but it should slide seamlessly into one's routine. One should never waste time considering whether or not one should bring their favorite boot — or respirator — to work.

Paula Varsamis is Product Portfolio Manager, Breathing Protection at Dräger.

1 https://www.bls.gov/news.release/cfoi.nr0.htm
2 https://www.osha.gov/SLTC/confinedspaces/
3 https://www.osha.gov/Publications/3352-APF-respirators.html

7 sins of welding

Avoid the most commonly overlooked dangers

By LORI CARPENTER, CSP, TOM HANUS, CSP, and ROBERT TESSIER

Welding professionals are critical to a wide variety of industries, from the automotive and transportation industries to aerospace, manufacturing, construction and more. At times, no matter the industry where the job is performed, the perils of the occupation can also be quite dangerous. According to OSHA, welding, cutting and brazing activities pose health and safety risks to more than half a million workers in the United States. The risk from fatal injuries alone is more than four deaths per thousand workers over a working lifetime.

Fortunately, following proper safety protocols can drastically improve workplace safety for welders and others on a job site. But for welders who are dealing with a myriad of job responsibilities and daily pressures, it can be easy to forget or forgo these safety practices.

Here are seven hidden dangers in welding that often lead to preventable accidents:

1. Not wearing appropriate personal protective equipment

Wearing PPE is one of the easiest ways to improve safety while welding. PPE should be worn properly and for the entire duration of a welding job – every single time.

Eye protection is particularly important to protect welders from electromagnetic energy given off by an arc or flame. OSHA requires welders to wear safety glasses, goggles or welding helmets with the proper shade lens to protect against flash burn. A shade number indicates the intensity of light radiation that is allowed to pass through a lens. The exact shade lens needed will depend on the type of welding being done, the electrode size and arc current. When in doubt, reference OSHA's regulations to determine the appropriate shade lens for a job.

7 sins of welding *continued*

Face shields should also be used when the entire face needs protection against flying particles, metal sparks and chemical or biological splash. Even though face shields must meet ANSI Z87.1-1989 standards, they are considered secondary protection and must be used in addition to safety glasses or goggles.

Finally, it's important to ensure protection from overexposure to hazardous welding fumes and gases. According to the American Welding Society, overexposed welders have a greater chance of developing bronchitis, airway irritation, lung function changes, pneumonia and lung cancer when compared to the general working population. Whenever possible, ventilation systems should be used, but respirators may also be needed to further reduce exposure levels. Respiratory protection options can range from disposable half-face pieces to supplied-air helmets. The best option will depend on the exposure level of the work environment.

> "Wearing PPE is one of the easiest ways to improve safety while welding. Extra precautions should be taken when a job requires welding in any confined area."

2. Wearing improper attire for the job

Arc rays from welding can cause a severe burn similar to sunburn on any exposed skin. Because of this, welders should always dress appropriately for the job in accordance with ANSI Z49.1-2012 standards. This includes:

- dark colored, tightly woven clothing;
- leather sleeves and gauntlet leather welding gloves;
- pants without a cuff; and
- high-top, steel-toed boots.

3. Not considering potential electrical hazards

Another serious welding hazard that is often overlooked is the risk of electrical shock. When welding, a worker will likely come in contact with electrical equipment or metal parts. This contact can cause serious injuries or death from exposure to the high voltage and amperage. To reduce this risk, welders should always wear the proper PPE and comply with a company's lockout/tag out procedure to disable all machinery and equipment if need be. Taking all equipment to a zero energy level will prevent incidental contact with live electrical sources.

4. Not keeping workspaces tidy

While it may seem trivial, untidy workspaces are actually a leading catalyst for welding injuries. Reduce trip hazards by making sure that all hoses and cables associated with the welding machines and respirators are safely tucked away and not in walking paths. Work cables should be connected as close as possible to the weld area and should not wrap around any workers. All equipment should be properly grounded and installed according to code.

7 sins of welding *continued*

5. Working in unsafe locations

When it comes to ensuring the safety of welders, the location where welding is performed is just as important as any other safety precaution. Before a welding location is established, the work area should be carefully assessed to ensure welding operations will not cause an explosion or create a toxic environment. Worksites should not be set up near any other operations that may produce hazardous fumes.

Extra precautions should be taken when a job requires welding in any confined area. Any confined space should be tested for levels of oxygen, combustible gas and any toxic gases specific to the industry before welding operations begin. Continuous monitoring of the confined space during the entire entry is advised.

6. Failure to use proper fall protection

Because any walking or working surface can be a potential fall hazard, the risk of falls is present at almost every workplace. Approximately 70,000 serious injuries a year result from falls — and more than 11 percent of work-related fatalities in all industries are the result of falls from an elevated position.

So, how can welders protect themselves from falls? According to OSHA, anytime a worker is at a height of six feet or more (construction industry) or four feet or more (general industry), the worker must have fall protection equipment. A welder must be attached to a safe anchorage connector, preferably with a shock-absorbing lanyard attached properly to an approved safety harness.

7. Neglecting to protect other employees

Understandably, welding safety precautions are often focused on those who will be performing hazardous operations, but it's important to take steps to protect other employees who may be in the work area as well. When possible, shade curtains should be used to create a contained area for the welders and to keep all non-welders outside of the active work area.

Reducing risk

While it's impossible to completely eliminate the risks associated with welding, it is possible to greatly reduce the chance for accidents and injury by following proper safety protocols. Welders — as well as their managers, supervisors and employers — must work together to make safety the number one priority on the worksite, above even productivity and work quality.

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Dusts, fumes & mist

How to control beryllium exposures

By JON LADWIG

OSHA has issued a final rule that updates regulation established 40 years ago to prevent chronic beryllium disease and lung cancer in American workers by limiting their exposure to beryllium and beryllium compounds. The new rule will reduce the permissible exposure limit and establish a new short-term exposure limit. It will also require employers to use engineering and work practice controls to limit exposure.

The new rule, which currently has an effective date of May 20, 2017, contains standards for general industry, construction and shipyards. This article focuses on the standard for general industry and highlights the most important aspects of the new standard; means of exposure and hazardous health effects; how to determine risk; and the use of high efficiency dust, fume and mist collection as a recognized engineering control to achieve compliance and keep workers safe.

What is beryllium and how it is used in industry?

Beryllium is a lightweight but extremely strong metal used in the aerospace, defense, telecommunications, automotive, electronics and medical specialty industries. Beryllium-copper alloys are widely used because of their electrical and thermal conductivity, hardness and good corrosion resistance. Welding provides the highest strength bond when joining copper beryllium to itself or to other metals.

Another form is beryllium oxide, which provides heat conductivity, high strength and hardness and electrical insulation. Pure beryllium metal is used in a range of products such as X-ray transmission windows, nuclear reactor neutron reflectors, precision instruments and computers.

How are workers exposed to beryllium?

Exposures occur when beryllium and beryllium-containing materials are processed in a way that releases airborne beryllium dust, fume or mist into the workplace air. Occupational exposure

Dusts, fumes & mist *continued*

to beryllium can also occur from skin, eye and mucous membrane contact with beryllium particulate or solutions.

What are the health risks of beryllium?

Inhaling or contacting beryllium can cause an immune response that results in an individual becoming sensitized to beryllium. Individuals with beryllium sensitization are at risk for developing a debilitating disease of the lungs called chronic beryllium disease (CBD) if they inhale airborne beryllium after becoming sensitized. Beryllium-exposed workers may also develop lung cancer.

Key provisions and significant aspects

Facilities affected by the standard must comply with most of the requirements by March 12, 2018, which is one year from the original effective date. They have two years to provide any required change rooms and showers and three years to implement engineering controls.

Requirements of the standard: The new rule reduces the OSHA permissible exposure limit (PEL) for beryllium to 0.2 micrograms per cubic meter of air (µg/m3) over an eight-hour time-weighted average (TWA) work shift. It establishes a short-term exposure limit (STEL) for beryllium of 2.0 µg/m3 over a 15-minute sampling period. Employers must use engineering and work practice controls to prevent excessive beryllium from becoming airborne where workers can breathe it in.

In addition, they must limit access to high-exposure areas, provide respiratory protection when necessary and provide personal protective clothing when high exposures or skin contact is possible. Employers will also be required to assess exposures, develop and implement written exposure control plans and provide workers with training specific to beryllium. Medical examinations must be available to certain exposed workers.

> Facilities affected by the standard must comply with most of the requirements by March 12, 2018.

How to determine if you are compliant

Wherever a process releases airborne beryllium dust, fume or mist into the workplace air, OSHA states employers must assess the airborne exposure of each employee who is or may reasonably be expected to be exposed to airborne beryllium. The rule provides two assessment methods:

Performance option: Employer to assess the eight-hour TWA exposure and the 15-minute short-term exposure for each employee on the basis of any combination of air monitoring data and objective data sufficient to accurately characterize airborne exposure to beryllium.

Scheduled monitoring option: Employer to perform initial monitoring to assess the eight-hour TWA exposure and 15-minute short-term exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the airborne exposure of employees on each shift, for each job classification and in each work area.

Dusts, fumes & mist *continued*

Collection systems

Dry cartridge filtration collection system: A dry cartridge filtration collection system is a recommended engineering control for operations where beryllium dust or beryllium fume is created. Because OSHA's beryllium PEL of 0.2 micrograms per cubic meter of air is an extremely low acceptable level, reaching compliance will include using higher efficiency primary cartridge filter media and a secondary HEPA filter system. Applications that include light loading dry dust can utilize PTFE membrane coated filter media (EN filter class E10/85 percent on MPPS) for the primary filters. For applications with heavier loading, a high efficiency nanofiber media (EN filter class F9) can be a good option.

Secondary filters are recommended for use downstream of the primary filtration system utilizing HEPA filters (EN filter class H13). They are used when handling hazardous dusts, preventing them from discharging to the atmosphere. Currently, designs are available in which the safety filter is mounted on top of the collector, reducing installation costs and saving floor space.

Fume control in welding operations: A well-designed cartridge system will properly filter welding fumes and other hazardous contaminants. These systems use self-cleaning mechanisms that pulse dirt off the filters, allowing units to run for extended periods between changing filters.

Mist collectors: Operations that use metalworking fluids (MWFs) where beryllium is present can cause exposure through mist. There are two general categories of MWFs used in machining processes: water-based (emulsion) and oil-based coolants/lubricants. A high-efficiency mist collector designed especially for removal of wet coolants uses two stages of long-life coarse and fine filter demisters followed by a HEPA secondary filter.

When designing equipment for mist removal, the best solution is a source capture collection system that will contain mist at the machine to keep workers safe from hazardous beryllium emissions and to comply with OSHA's new standard.

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Everyone is exposed

Radiation health risks depend on dose & type of exposure

By BENITA MEHTA, *ISHN* Managing Editor

Everyone is exposed to radiation every day and sources of radiation often surround us. Some are natural and some are man-made, but we can't see or feel radiation's presence. It is used in medical treatments and traces can be found during air travel and in nature.

But there are very few situations where an average person is exposed to uncontrolled sources of radiation beyond typical environmental exposure. Still, it's wise to be prepared and know what to do in case of dangerous levels.

Doses of radiation

The term "radiation" is broad, and includes light and radio waves. Ionizing radiation is the one that most people are concerned with. Ionizing radiation passes through matter, which can cause it to become electrically charged or ionized. Radiation can be detected and measured in the tiniest quantities with radiation measuring instruments.

The biological effects of ionizing radiation vary with the type and energy. A measure of the risk of biological harm is the dose of radiation that the tissues receive. The unit of absorbed radiation dose is the sievert (Sv). Since one sievert is a large quantity, radiation doses normally encountered are expressed in millisievert (mSv) or microsievert (μSv) which are one-thousandth or one millionth of a sievert. For example, one chest X-ray will give about 0.2 mSv of radiation dose.[1]

On average, our radiation exposure due to all natural sources amounts to about 2.4 mSv a year, though that can vary, depending on the geographical location. By far the largest source of natural radiation exposure comes from varying amounts of uranium and thorium in the soil around the world.

Everyone is exposed *continued*

In case of emergency

The Centers for Disease Control and Prevention developed the Radiation Hazard Scale to be a tool during emergencies.[2]

The scale provides a frame of reference for relative hazards of radiation in simple terms without using radiation measurements that may be unfamiliar to most people. It is designed specifically for use in radiation emergencies and it has been tested. It goes from levels one to five, with five being the most dangerous and lethal.

Category 1 means that radiation levels are within the normal range of natural background radiation in the environment for a geographic area. Category 3 is when radiation doses are becoming high enough where they might be increased risk of cancer to those who are exposed. To learn more about the radiation hazard categories, visit www.emergency.cdc.gov

Contamination vs. exposure

The CDC has an infographic detailing the differences between radiation contamination and exposure.[3] External contamination occurs when radioactive material comes into contact with a person's skin, hair or clothing,

> There are very few situations where an average person is exposed to uncontrolled sources of radiation.

through the air or in solid or liquid form. Internal contamination can occur when radioactive material is swallowed or breathed in. Internal contamination can also occur when radioactive material enters the body through an open wound. Different radioactive materials can accumulate in different body organs.

A person exposed to radiation is not necessarily contaminated with radioactive material. For a person to be contaminated, radioactive material must be on or inside of a person's body.

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