

WORKPLACE

Material Handling & Safety

Safety in Construction

Inside you will read about:

- Beat the Heat: Keeping Workers Safe from Extreme Temperatures
- Know the Symptoms of—and Solutions to Prevent—Fatal Falls on Construction Sites
- In Hand: How to Protect Against Hand Injuries
- Protect Workers from Falling Objects
- Heat Stress and The Workplace
- Gas Detection and Monitoring in Confined Spaces



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5 OSHA Update: Final Rule on Beryllium Exposure

To protect workers, OSHA began enforcing the beryllium standard on May 11, 2018. – Are you compliant?



Beat the Heat: Keeping Workers Safe from Extreme Temperatures

By: Barbara T. Nessinger, *Chief Editor*

Although much of the U.S. is currently experiencing winter weather, with snow, sleet and extreme cold—spring is just around the corner. And, especially for areas of the country like the South and Southwest, high heat and humidity arrives in early spring and lasts until well into what Northerners term “sweater weather.”

According to OSHA, each year, dozens of workers die and thousands more become ill while working in extremely hot or humid conditions. More than 40% of heat-related worker deaths occur in the construction industry, but workers in every field are susceptible.

So, it's important for those who employ workers who spend a lot of time outdoors to review some “best practices” for preventing heat-related illness/injuries on construction sites. Outdoor operations conducted in hot weather and direct sun, such as farming, construction, oil and gas well operations, asbestos removal, landscaping, emergency response

operations and hazardous waste site activities, increase the risk of heat-related illness in exposed workers.

However, it's not only outdoor workers that can be affected by extremely hot temperatures. Many indoor work environments also fit the bill. Operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects or strenuous

There are many commercial solutions to staying cool. Body cooling vests are made to maintain a safe temperature level in the body's core.

physical activities all contain a high potential for causing heat-related illness. Such workplaces include iron and steel foundries, brick-firing and

ceramic plants, glass products facilities, rubber products factories, electrical utilities (i.e., boiler rooms), bakeries, confectioneries, commercial kitchens, laundries, food canneries, chemical plants, mining sites, smelters and steam tunnels.

Excessive exposure to heat can cause a range of heat-related illnesses, from heat rash and/or cramps to heat exhaustion and heat stroke. Heat stroke can result in death and requires immediate medical attention.

Knowing the signs of heat-related illness is imperative for all employees—both workers and supervisors. When a person works in a hot environment, the body must get rid of excess heat to maintain a stable internal temperature. It does this mainly through circulating blood to the skin—a.k.a., sweating.

Know the Signs

When air temperatures are close to/warmer than normal body temperature, cooling the body becomes harder. Blood circulated to the skin cannot lose heat. Sweating then becomes the main way the body cools off. Sweating is effective only if the humidity level is low enough to allow evaporation, and if the body's lost fluids and salts are replaced.

If the body cannot get rid of excess heat, it will store it. When this happens, core temperature rises and the heart rate increases. As the body continues to store heat, the person loses concentration and/or has difficulty focusing on tasks; becomes irritable or sick; and—paradoxically—loses the desire to drink. The next stage involves fainting and even death if the person is not cooled down properly.

Exposure to heat can also increase the risk of injuries, because of sweaty palms, fogged-up safety glasses, dizziness, and burns from hot surfaces or steam.

How Hot is Too Hot?

OSHA names some simple guidelines for identifying if the heat conditions are dangerous. They include:



- Rising temperature/increased humidity
- The sun getting stronger
- Lack of air movement/wind
- No controls in place to reduce the impacts of heat-radiating equipment
- Protective clothing or gear is worn
- Strenuous physical work

In addition, utilizing the heat index, which takes both temperature and humidity into account, is useful for outdoor workers and employers to assess whether extra precautionary measures need to be taken.

Water. Rest. Shade. Repeat.

Under OSHA law, employers are responsible for providing a workplace that is free of known safety hazards. This includes protecting workers from extreme heat. An employer with workers exposed to elevated temperatures should establish a complete heat-illness prevention program.

Launched in 2011, OSHA's "Heat Illness Prevention" campaign strives to educate employers and workers on the dangers of working in the heat. Through training sessions, outreach events, informational sessions, publications, social media messaging and media appearances, millions of workers and employers have already taken advantage of its message and learned how to protect workers from heat.

OSHA's safety message consists of three key words: Water, rest and shade.

Employers must provide plenty of water or cool beverages, frequent work/rest cycles and abundant shade to all employees in times of extreme heat and/or humidity. They should also be sure to allow new or returning workers to acclimatize. Working in heat can take time to build a tolerance. Workers who are suddenly exposed to extreme heat face additional (but avoidable) hazards. That's why it is imperative to educate workers about the dangers of heat and to help acclimatize them. This can be accomplished by gradually increasing workloads or providing more frequent breaks.

Employers should include heat-related illness prevention steps in work-site training and plans. They should also be able to identify the symptoms of heat-related illness during hot weather. An emergency plan should be in place, so that all workers know how to treat heat-related illnesses as soon as they become apparent.

With the exception of heat exhaustion or heat stroke (911 must be called immediately), most of the treatments are fairly simple and usually effective. Cooling down with ice packs/cold compresses; plentiful water; allowing a long rest in a shady, cooler area; or allowing the worker to go home for the day—these are just some of the easy fixes for heat rash, heat cramps or early signs of heat exhaustion.

In addition, there are commercial solutions to staying cool. These can include cooling base layers that absorb the body's moisture and channel it through the fabric, reducing the humidity next to the skin and lowering body temperature. Cooling bandanas can be tied around the neck or head (some with "cooling crystals" for added longevity). Body cooling vests are made to maintain a safe temperature level in the body's core. Battery-powered cooling jackets and hard hats with fans also can help mitigate the effects of heat, although one of the main challenges of the jackets is bulkiness. However, since sun exposure/skin cancer is also a problem among outdoor workers, such gear can possess UV-protection that adds a level of benefit to its use.

By providing the basic environmental safeguards, planning for emergencies and training workers on how to prevent illness/injuries, most heat-related problems can be prevented.

For OSHA's complete guide on occupational exposure to heat, go to: <https://www.osha.gov/SLTC/heatstress/index.html>



It's important for those who employ workers who spend a lot of time outdoors to review some "best practices" for preventing heat-related illness/injuries. Adequate water intake is imperative.

OSHA Update: Final Rule on Beryllium Exposure

To protect workers, OSHA began enforcing the beryllium standard on May 11, 2018. – Are you compliant?



Every year, approximately 62,000 workers are exposed to beryllium in their workplace!

The Occupational Safety and Health Administration (OSHA) issued a final rule to prevent chronic beryllium disease and lung cancer in workers. Although beryllium is widely used in many industries because of its electrical and thermal conductivity, hardness, and good corrosion resistance, it's a highly toxic metal. Developing chronic beryllium disease (CBD) or lung cancer are increased by simply inhaling the highly toxic metal.

To protect workers, OSHA began enforcing the beryllium standard on May 11, 2018.

OSHA estimates that the final rule will save 90 lives from beryllium-related diseases and prevent 46 new cases of chronic beryllium disease each year, once the effects of the rule are fully implemented. The rule is anticipated to provide net benefits of about \$560.9 million, annually.

What does OSHA say about identifying beryllium in the workplace?

Per OSHA 29 CFR1910.1024(e)(2), *"The employer must identify each beryllium work area through signs* or any other methods that adequately establish and inform each employee of the boundaries of each beryllium work area...The employer must limit access to regulated areas to - persons the employer authorizes or requires to be in a regulated area to perform work duties; persons entering a regulated area as designated representatives of employees for the purpose of exercising the right to observe exposure monitoring procedures under paragraph (d)(7) of this standard; and persons authorized by law to be in a regulated area.

In general industry, exposure to beryllium can occur in the following industries and activities:

1. Welding

2. Beryllium production
3. Beryllium oxide ceramics and composites
4. Nonferrous foundries
5. Secondary smelting, refining, and alloying
6. Precision turned products
7. Copper rolling, drawing, and extruding
8. Fabrication of Beryllium Alloy Products
9. Dental laboratories



Key Provisions Include:

- Reduces the permissible exposure limit (PEL) for beryllium to 0.2 micrograms per cubic meter of air, averaged over 8-hours.
- Establishes a new short-term exposure limit for beryllium of 2.0 micrograms per cubic meter of air, over a 15-minute sampling period.
- Requires employers to use engineering and work practice controls (such as ventilation or enclosure) to limit worker exposure to beryllium; provide respirators when controls cannot adequately limit exposure; limit worker access to high-exposure areas; develop a written exposure control plan; and train workers on beryllium hazards.
- Requires employers to make available medical exams to monitor exposed workers and provides medical removal protection benefits to workers identified with a beryllium-related disease.

New OSHA Compliance Schedule:

The final rule went into effect on May 11, 2018, and replaced a 40-year-old permissible exposure limit (PEL) for beryllium that was outdated and did not effectively protect the health of workers.

- Enforcement of the PEL and STEL in the construction and shipyard industry - May 11, 2018
- Provide required change rooms and showers - March 11, 2019
- Implement engineering controls - March 10, 2020

Responsible employers have been protecting workers from harmful exposure to beryllium for years by placing effective signs and labels, using engineering and work practice controls, and providing personal protective clothing and equipment (PPE).

Keep your workforce informed, protected, and motivated with highly effective identification products.

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Resources:

[Protecting Workers from Exposure to Beryllium and Beryllium Compounds: Final Rule Overview](#)

[Delay of Enforcement of Beryllium Standards under 29 CFR 1910.1024, 29 CFR 1915.1024, and 29 CFR 1926.1124](#)

Know the Symptoms of—And Solutions to Prevent—Fatal Falls On Construction Sites

By: Mark Stromme, Editor, J. J. Keller & Associates, Inc.

The failure to provide proper training and equipment has made fall protection one of the most frequently cited OSHA violations. Predictably then, falls are the leading cause of death among construction workers, accounting for more than 35% of all fatalities. The next leading cause, involving workers struck by objects, accounts for just under 10%.

Because of the high-risk of death from falling, OSHA requires the use of fall protection when working six feet or more above a lower level at all construction jobsites. The requirements are listed under CFR 1926 Subpart M, Fall Protection.

Fall protection involves adopting and using systems and procedures designed to prevent workers from falling off, onto or through walking-working surfaces; and to protect workers from falling objects.

A walking-working surface is any surface that an employee walks on or works on. These include floors, roofs, ramps, bridges, runways, formwork and concrete-reinforcing steel. The term does not include ladders, vehicles or trailers.

Potential Hazards

The three main causes of falls are:

- Unsafe environment,
- Unsafe equipment, and
- Unsafe behavior.

Unsafe environment: Environmental factors often increase the fall hazard. Snow, mist or rain could cause a walking surface to become slippery, increasing the chance workers could fall off the edge to the surface below.

Unsafe equipment: Sometimes, the equipment itself creates a hazard. For example, a broken guardrail or damaged harness could fail to provide sufficient protection for employees. Workers must also be protected from falling when performing construction work above dangerous machinery or equipment, regardless of height.

Unsafe behavior: Improper and/or noncompliant actions pose a potential hazard. For instance, if employees don't properly tighten the leg straps of their fall protection harness, a fall could result in fatal injuries. Also, if workers fail to promptly tie off their lanyards; walk beyond warning lines; or climb over guardrails, serious consequences can result.

Fall Protection Systems

Employers determine the appropriate fall protection method or system that best suits the jobsite and type of work being done. Here are some of the most common fall protection systems.

Guardrail systems: These are commonly used on construction jobsites to protect workers from falling. They are used to protect employees from falls:

- From unprotected sides and edges;
- Through holes, including skylights;
- From ramps, runways, or other walkways;
- Into or onto dangerous equipment; and
- At hoisting areas.

Safety net systems: These are horizontal or semi-horizontal barriers that use a netting system to catch and stop falling workers, as well



“Falls are the leading cause of death among construction workers. Fall protection involves adopting and using systems and procedures designed to prevent workers from falling off, onto or through walking-working surfaces, as well as from falling objects.”

as dropped tools and equipment, before they contact the surface or structures below. Safety nets are used to protect employees from hazardous vertical drops. They can be used to protect several types of elevated walking-working surfaces, including:

- Unprotected sides and edges,
- Wall openings, and
- Low-slope (flat) roofs.



Warning line systems: This barrier alerts workers that they are approaching an unprotected roof side or the edge of a low-sloped roof. Warning lines must always be used in conjunction with another system, like guardrails, personal fall arrest equipment or safety nets. The warning line must be erected around all sides of the roof and consist of ropes, wires or chains; and posts.

Controlled access zones: A controlled access zone is an area in which certain work, like overhand bricklaying, might take place without the use of guardrail systems, personal fall arrest systems or safety net systems. Access to the zone is controlled by a barrier or control line.

Safety monitoring systems: These rely on the abilities of a competent person, designated by the employer, to recognize and warn workers of fall hazards. When on duty, this person must not be given any other responsibilities that could interfere with his or her ability to monitor the work being done. The safety monitor must be stationed on the same walking-working level and within earshot of the workers being monitoring.

Personal fall arrest systems: Such systems are used to restrain a worker during a fall. They consist of a body harness, anchorage, and connectors. They may also include a lanyard, deceleration device or lifeline.

Parting Thoughts

Although falls are among the most common causes of serious injuries and deaths on construction jobsites, methods for preventing them are well-known and readily available. By identifying potential hazards and using fall protection the right way, employers can help prevent falls from occurring, saving injuries and even lives.

About the author:



Mark Stromme joined J. J. Keller & Associates, Inc. in 1994. With a background in monitoring OSHA, EPA, and DOT regulations, he currently specializes in the OSHA 1926 construction and 1910 general industry regulations. His focus is on oil and gas safety, construction safety, electrical safety, mobile cranes, scaffolding, excavations, and fall protection. He is also an authorized OSHA Construction Outreach Trainer. Mr. Stromme is responsible for monitoring, analyzing, and summarizing 1910 and 1926 regulations for various J. J. Keller guides, manuals and newsletters. He has also written numerous trade publication articles on related topics. For more information, visit www.jjkeller.com/osh and www.jjkellerlibrary.com.

In Hand: How to Protect Against Hand Injuries

By: Barbara T. Nessinger, *Chief Editor*

According to the U.S. Bureau of Labor Statistics, some 250,000 serious injuries to fingers, hands and wrists occur annually. The year 2013 alone showed nearly 8,000 of these injuries were amputations. When analyzing data on causes for days spent away from work, hand injuries come second only to back-related injuries. Recent U.S. Bureau of labor data reports that hand injuries amount to an average of five lost workdays per injured worker.

The wearing of protective gloves is one of the most effective hand-protection safety programs a company can employ. In fact, wearing any glove reduces the risk of hand injury by 27%, reports OSHA.

Choosing the best hand protection for employees in the workplace is of extreme importance, and it must begin with an understanding of what OSHA has to say on the matter. According to OSHA's 1910.138(a) general requirements, "Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes."

Standard 1910.138(b) deals with the selection of such protective hand gear:

"Employers shall base the selection of the appropriate hand protection on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified."

What is the best type of hand protection for an individual workplace? There is much to consider before making that choice. There are gloves designed to resist chemicals, protect from cuts, guard against electric shock and other hazards. Some are designed to protect against extreme temperatures; others are coated, dipped and reinforced.

Materials Matter

Materials for gloves include leather, such as cowhide, deerskin, elk skin, goatskin and pigskin. These are the usual leather choices, and each has its own unique capabilities, pros and cons. Other common materials are string, canvas and jersey. Gloves also have different linings and cuffs—some of these include pinked, rolled, straight and unlined. Each safety glove is designed with a select number of features to keep the wearer protected for specific workplace tasks.



The wearing of protective gloves is one of the most effective hand-protection safety programs a company can employ. OSHA estimates that wearing gloves reduces the risk of hand injury by 27%.

There are anti-vibration work gloves that include vibration- and impact-protection and feature flame-resistant gel on both the palm and top of hand. The gel reduces vibration caused by impact tools and dampens

against unexpected impacts. Some nitrile disposable gloves are made specifically for single-use protection from chemicals and other harmful exposures. This type of glove is ideal for workers who need a tough, disposable glove for handling machine repair or work-area cleanup.

Kevlar gloves are both lightweight and strong. They will often stand up to higher cut forces. There also are ergonomically designed gloves for perfect fit and flexibility. One brand features a fish-scale pattern designed to provide the wearer with excellent grip for tasks that require it.

Speaking of tasks, what about the employee whose duties require multi-tasking? This could require multiple forms of hand protection. These workers sometimes may need double or even triple glove-wearing for protection.

Hand Protection 101

Some basic guidelines to keep in mind to prevent hand injuries include: wearing appropriate gloves when handling rough materials or when hands are lifting/moving objects; and removing protruding nails or sharp edges on materials before working with them. It's important to always use machine guards and lock machinery before reaching into it. Gloves should also never be worn around in-running nips. The glove could be caught, pulling the hand in and causing injury.

When moving material with a truck or hand cart, sufficient room through doorways, clearance, etc., should be given to avoid hands' contact with walls or doorways. It is also recommended that rings should never be worn when working. A ring can be caught in machinery or on any protuberance, causing grievous injury. And, finally, glass or other sharp objects should always be handled with gloved hands—even when sweeping.

Materials for today's hand-protection gloves are more comfortable, breathable and wearer-friendly than ever before. Gloves feature lighter coatings, plus better dexterity, touch sensitivity and oil absorbency for grip. Manufacturers have risen to the occasion and have made it easier for companies to protect their workers—and for those workers to adhere to safety standards that require them to keep their hands protected.

The good news is hand injuries can be easily prevented by on-going safety training efforts and use of proper protective equipment. It is important to assess which is the right glove for the right situation. Employers that provide proper training and equipment can help ensure the well-being of their employees—keeping hand injuries down and protecting their company from incurring expensive workman's comp costs.

Editor's note: OSHA's comprehensive guide to personal protective equipment can be found here: <https://www.osha.gov/Publications/osa3151.pdf>

Protect Workers from Falling Objects

A Tool Falling from a 100ft Construction Site Will Hit the Ground in Less Than Two Seconds!

By: John Salentine, Co-founder & Vice President, Hammerhead Industries Inc.

Correct tool tethering is a delicate balance of maximizing productivity, while safely minimizing the incidence of tools dropped from aloft. This article will help you select the proper tether—based on tool weight and usage—to provide effective tethering solutions that significantly improve productivity and safety.

In its rapid descent, a falling hammer can become an unguided missile that may seriously endanger everything and everyone below. It is a serious site-safety issue. At best, the falling object will just increase main-

tenance costs by downtime spent retrieving and repairing the dropped tool; at worst, it will cause serious injury to personnel and significant damage to equipment. It is a situation that can be easily avoided by using a properly matched tool or instrument tether.

objects falling from above cost U.S. industry more than \$5 billion last year and was the fifth-leading cost of industrial accidents. This is a staggering figure, yet this type of accident is almost completely preventable by using relatively inexpensive tethering devices. OSHA Reg #1926.759 (a) states that equipment and tools, which are not in use while aloft, shall be secured against accidental displacement.

This article addresses the three overriding objectives the safety engineer must consider when buying tethers for employees.

Employee Safety – Obviously, the objective of tethering tools is to avoid tools falling from above, but what are the factors impacting the safety of the employee using the tether?

Employee Productivity - Does the tool lanyard interfere with the duties of the job or make it easier and safer to do the job?

Employee Attitude - How can I make the worker my partner in tethering safety?

In addition, the article will ask and answer the questions safety engineers must know:

- Depending on the application, what is better choice for the worker's safety: a retractable tool tether or tool lanyard tether?
- What are the safety implications of tethering when the job entails climbing, crawling or repelling?
- What are the optimum methods of safely attaching the tether to the worker...tool...or instrument?
- How do you safely tether tools or instruments that don't have fittings for attachment?
- Does the tether have a quick release option to easily change tools and how does this impact the safety of the worker?



tenance costs by downtime spent retrieving and repairing the dropped tool; at worst, it will cause serious injury to personnel and significant damage to equipment. It is a situation that can be easily avoided by using a properly matched tool or instrument tether.

According to a recent Liberty Mutual's Safety Index, accidents caused by

- Can you rely on the manufacturer's "load limit" designation of the tether?
- Where can you find custom tethering solutions for special applications or tools?

The safety engineer's goal in correct tethering procedures is to make sure the tool, application and recoil/retraction force are in balance. Ideally, when the tool is extended for use, only minimal force should be necessary, so as to prevent worker fatigue or, in the reverse, cause a "kick" when retracted. The challenge to the safety engineer is to provide a tether that is both friendly to the user and appropriate for the work environment. Equally important, the tether or lanyard must have ample safety margins, beyond the weight rating of the tether, to mitigate the drop force in the event of a dropped tool.

With such a high risk to workers' safety, here is a simplified guide to help you select tethers for tools weighing up to 25 pounds.

Tool and instrument tethers fall into five broad categories:

A) Retractable Lanyards, B) Wrist Lanyards, C) Personal Tethers, D) Personal Tether, and E) Anchor Tether w/Anchor Strap

Step 1. Determine tool tether type based on tool weight and usage

The most common tool tethers and lanyards for tools up to 25lbs generally fall into five categories: Retractable Lanyards; Wrist Lanyards; Personal Tethers; Personal Tethers with Anchor Strap; and Anchored Tethers.

For tools up to 2lbs, the following options are best:

- Retractable Lanyards provide an ultra-low profile to keep the tool close to the body. This is important for working in confined-space

and/or when climbing is required. They are also ideal for multiple tether use. (Photo A)

- Wrist Lanyards are low-profile tethers that provide a short drop length for easy retrieval of a dropped hand tool. (Photo B)
- Personal Tool Tethers are best for single-use tools that moves with the worker. (Photo C)
- Personal Tool Tether w/Anchor Strap for single-use tools attached to a structure for additional security or ease of use. (Photo D)

For tools up to 15lbs, the following options are best:

- Personal Tool Tethers are best for a single-use tool that moves with the worker. (Photo C)
- Personal Tool Tether w/ Anchor Strap for a single-use tool that is attached to a structure. (Photo D)
- Anchored Tether System that attaches a heavy tool (5lbs or more) to a structure. (Photo E)

For tools up to 25lbs, the following options are best:

- Personal Tool Tether w/ Anchor Strap for a single-use tool that is attached to a structure. (Photo D)
- Anchored Tether System that attaches a heavy tool to a structure. (Photo E)

Note: Generally, any tool over 5lbs should always be anchored to a structure to transfer the "dropped tool" shock load from the person to the structure.



Step 2. Determine if tether is for single tool or multi-tool use

- A) A Fixed Lanyard System is acceptable when you don't need to remove a tool from the lanyard. (Photo F)
- B) When easy tool change-out is required a Side Release Lanyard System or Carabiner Clip are the best options. (Photo G)

Step 3. Determine the tool attachment point

- A) Tool has lanyard loop. Attach lanyard to loop.
- B) Tool has large ends. Ends must be large enough to allow a lanyard to be looped and cinched securely without slipping off.
- C) Tool has small ends or no lanyard loop. If tool does not have large enough ends (looped lanyard would slide off) or lacks a lanyard loop, you must attach a ring.
- D) Tool modification. If none of the above works, the tool must be modified by a safety engineer or the tool manufacturer.

In conclusion, when choosing tethers, here are nine points to keep in mind:

1. Choose your tethers based on all factors of use. There are thousands of tethering choices available from manufacturers specializing in tool, gear and instrument tethers to tool manufacturers.
2. When tool tethers are ordered without specifications beyond the weight of the tool, chances are good that the tether may not be appropriate. Unlike fall-protection devices, there are no universal specifications governing tool tethers. As such, the safety engineer has no real basis for choosing proper tethers and may arbitrarily determine tether selection—based solely on the weight of the tool, i.e., “I need a tether for a 3lb tool.” Without additional specifications, this may be creating a potentially dangerous situation.
3. An improperly mated tool and lanyard can inherently lead to reduced productivity and exposure to injury.
4. Tethering heavy tools to a person (generally over 5lbs), is a significant safety concern, and safety engineers should instead consider using anchor tethers. Anchored tethering safely transfers the shock load produced by a dropped tool from the worker to the structure.

5. For very heavy tools (over 10lbs), structure anchoring should be mandatory.

6. When choosing an “Anchored Tethering System” choose one that offers up to a 10ft working length for maximum safety and efficiency.

7. Modular tethering systems offer the most options for safe tool tethering

8. When employees are using a group of small hand tools (under 2lbs), Quick Connect tethers offer easy tool change-out and avoid the entanglement danger of having multiple tethers.

9. Before you purchase a tool or instrument tethering system, make sure that the tethers and lanyards are dynamically load tested for the tool weight specified. Confirm that the tool tether weight ratings indicated have a safety margin beyond the break point, so the tether or lanyard can safely handle the shock load of a dropped tool or instrument.

Editor's note: John Salentine co-founded and is Vice President of Hammerhead Industries Inc., manufacturers of the Gear Keeper tethering systems. For almost two decades, they have been the world's leading manufacturer of retractable tethers and lanyards exclusively for tools, gear and instruments. The company looks forward to assisting safety engineers with their tethering needs and offers a free 12-page “Safety Engineer's Tool and Instrument Tethering Guide.” gearkeeper.com/guide

Heat Stress and The Workplace

By: Barbara T. Nessinger, *Chief Editor*

Every year, according to OSHA, thousands of workers fall ill to heat exhaustion or heat-related illness, while dozens die of heat stroke. The outdoor construction industry is most susceptible to this hazard, of course, but many indoor work environments are also affected by the heat.

Operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects or strenuous physical activities all have potential for causing heat-related illness in workers. Some of these workplaces include iron and steel foundries, brick-firing and ceramic plants, glass products facilities, rubber products factories, boiler rooms, commercial kitchens, laundries, food canneries, chemical plants, mining sites, smelters, steam tunnels and more.

Excessive exposure to heat can cause a range of heat-related illnesses—from the not-so-serious, i.e., heat rash and/or cramps—to the very serious (and potentially deadly) heat exhaustion and heat stroke.

Last month, Workplace Material Handling & Safety listed the warning signs of heat-related illnesses and heat stroke, as well as OSHA's specific guidelines for how to identify dangerous heat conditions. (See "Beat the Heat: Keeping Workers Safe from Extreme Temperatures," WMHS, March 2018.)

Scientific Evidence & Heat Measurement

There is a great body of scientific study on the effects of heat stress on the body, and even more specifically, its effects on workers. Evidence of cognitive function/performance show,

first of all, that heat stress affects cognitive performance differentially, depending on the type of cognitive task. The same study shows an apparent relationship between the effects of heat stress and deep body temperature (Hancock & Vasmatazidis, "Effects of heat stress on cognitive performance: the current state of knowledge").

Other studies have assessed the potential impact on occupational health and work capacity for people exposed at work to increasing heat due to climate change (Kjellström, et al, "Workplace heat stress, health and productivity"). This study found that, in countries with very hot seasons, workers are already affected by working environments hotter than that with which human physiological mechanisms can cope. Therefore, to protect workers from excessive heat, a number of heat exposure indices have been developed.

One that is commonly used in occupational health is the Wet Bulb Globe Temperature (WBGT). WBGT can be used to assess "the proportion of a working hour during which a worker can sustain work and the proportion of that same working hour that (s)he needs to rest to cool the body down and maintain core body temperature below 38C [approximately 104F]." Using this proportion, a work-capacity estimate can be calculated for selected heat exposure and work-intensity levels. (Kjellström, et al.)

Because occupational exposure to heat can result in injuries, disease, reduced productivity and death, the National Institute for Occupational Safety and Health (NIOSH) has evaluated the scientific data on heat stress and hot environments and has updated the "Criteria for a Recommended Standard: Occupational Exposure to Hot Environments." This was last updated in 1986; in recent years, including during the Deepwater Horizon oil spill response of 2010, questions were raised regarding the need for revision to reflect recent research and findings. The revision includes additional information about the physiological changes that result from heat stress; updated information from relevant studies, such

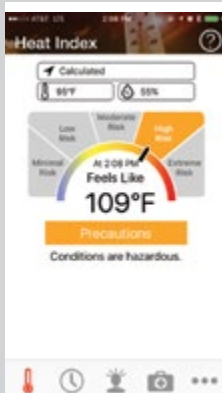


Photo courtesy:
Breezer Mobile
Cooling

Many companies produce mobile cooling units to help avoid heat stress in the workplace—indoors or out. The Power Breezer, by Breezer Mobile Cooling, is an effective solution for cooling outdoor and partially covered spaces. It can quietly cool over 3,000 sq ft by up to 27°F.

THE OSHA-NIOSH HEAT SAFETY TOOL FEATURES:

- A visual indicator of the current heat index & associated risk levels specific to your current geographical location
- Precautionary recommendations specific to heat index-associated risk levels
- An interactive, hourly forecast of heat index values, risk level and recommendations for planning outdoor work activities in advance
- Editable location, temperature and humidity controls for calculation of variable conditions
- Signs and symptoms and first aid information for heat-related illnesses
- A useful resource for planning outdoor work activities based on how hot it feels throughout the day



For more information on this tool or how to download the app onto most smartphones/devices, go to: www.cdc.gov/niosh/topics/heatstress/heatapp.html

as those on caffeine use; evidence to redefine heat stroke and associated symptoms; and updated information on physiological monitoring and personal protective equipment and clothing that can be used to control heat stress. **[Editor's note: a complete PDF of this report can be found at: <https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf>.]**

OSHA has also provided extensive information on how to protect workers from heat stress. The OSHA-NIOSH Heat Safety Tool is a useful resource for planning outdoor work activities based on how hot it feels throughout the day. It features real-time heat index and hourly forecasts, specific to one's location, as well as occupational safety and health recommendations from OSHA and NIOSH. (See sidebar "OSHA-NIOSH Heat Safety Tool.")

Help Workers Keep Their Cool

By providing the basic environmental safeguards, planning for emergencies and training workers on how to prevent illness/injuries, most heat-related problems can be prevented.

Luckily, there are many commercial solutions available that can be used to beat the heat and keep workers cool. These can include cooling base layers that absorb the body's moisture and channel it through the fabric—thus reducing humidity next to the skin and lowering body temperature. Cooling bandanas; body cooling vests that maintain a safe temperature level in the body's core; battery-powered cooling jackets; and hard hats with fans—all are designed to help mitigate the effects of heat.

One simple solution is to have a targeted heat-stress first aid kit available at all times. First Aid Only produces a Heat Stress First Aid Kit made of a weather-proof plastic case that is portable and can be wall-mounted. It contains such essentials as cold



Photo courtesy:
First Aid Only

A targeted heat-stress first aid kit is a simple, low-cost solution to helping workers treat heat-related issues. First Aid Only's Heat Stress First Aid Kit has a weather-proof plastic case that contains such essentials as cold packs, disposable thermometers, oral electrolyte supplements and more.

packs, disposable thermometers, oral electrolyte supplements, an emergency blanket, etc.

Some cooling machines are engineered to cool outdoor environments. For example, the Power Breezer, by Breezer Mobile Cooling, is an effective solution for cooling outdoor and partially covered spaces. It can quietly cool over 3,000 sq ft by up to 27°F, according to the company.

There are many commercial companies that make such coolers. They can be used in large warehouses; to relieve personnel from heat when working or training outdoors; or as a low-cost solution to augment electronic control units (ECUs) with cool air.

Additionally, portable air conditioners not only cool the air, but they also dehumidify it. This can be a crucial factor in calculating heat index and assessing the danger of heat-related stress, as humidity adds greatly to the body's ability to have the sweat it produces evaporate on the skin. Moreover, a portable evaporative cooler can effectively cool areas and equipment where air conditioning is cost-prohibitive, impractical or unavailable.

Gas Detection and Monitoring in Confined Spaces

By: Barbara T. Nessinger, *Chief Editor*

Employees of industrial firms often find themselves, for a multitude of reasons, working in a confined space. Worker health and safety is critically important in these situations. To that end, the U.S. Occupational Health and Safety Administration (OSHA) has many regulations which focus on providing a safe working environment for workers who must work in these confined enclosures.

Having adequate gas-detection equipment is a big part of maintaining awareness and compliance regarding confined spaces. Gasses present a particular risk for workers with little maneuvering room, because they are often odorless and colorless. Therefore, without the proper detection tools, workers can be unknowingly exposed. Such hazards can be mitigated by sufficient personal gas-detection systems.

However, before acquiring solutions, companies should be fully informed on what is required and what is available to help meet the requirements and secure their employees' safety.

What is a Confined Space?

According to OSHA's definition, a confined space:

- Has adequate size and configuration for employee entry;
- Has limited means for access or egress; and
- Is not designed for continuous employee occupancy.

A few examples of confined spaces include underground vaults in the telecommunications industry, aeronautical fuel tanks, sewers, silos or coal mines, and other places where it is difficult for employees to enter and exit.

The term "permit-required confined space," as defined by OSHA, is one that meets the definition of a confined space, above, and has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere;

- Contains a material that has the potential for engulfing the entrant;
- Has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section; and/or
- Contains any other recognized serious safety or health hazards.

Gas Detection

Per OSHA's rules, companies need to monitor enclosed spaces for gases before allowing workers to step into these areas. OSHA standards require that before an employee enters the space, internal atmosphere must be tested with a calibrated direct-reading instrument for the following conditions: oxygen content, flammable gases and vapors, and potential toxic air contaminants. Additionally, there may be no hazardous atmosphere within the space whenever any employee is inside. This standard is the impetus for using a multi-gas monitor to perform atmospheric testing, prior to entering a confined space.



Photo courtesy: Industrial Science Corporation

A "permit-required confined space," as defined by OSHA, may have no hazardous atmosphere within the space whenever any employee is inside. This is the impetus for using a multi-gas monitor to perform atmospheric testing, prior to entering a confined space.

Employers can install gas-detection machines to measure the level of air contaminants. Proper air monitoring is an OSHA

requirement for permit-required confined spaces, because of the potential presence of atmospheric hazards.

Companies can use single-gas monitors or multi-gas monitors to ensure hazardous gases are not present in enclosed spaces, before workers enter. In fact, OSHA clearly dictates that employers perform continuous gas monitoring.

Choosing the Right Monitor and System

When choosing a monitor to test and continuously monitor a confined space, several attributes should be considered. The most important thing is to have a multi-gas monitor that is capable of monitoring for all OSHA-required hazards (oxygen, flammable gases and potential toxic air contaminants that may be present as a result of the processes that take place in or around the confined space). Next, consider a monitor that has either an internal or external pump that is capable of properly drawing the air sample back to a fresh air-monitoring point during initial testing of the space. The monitor also should have the capability of continuously monitoring the occupied space to ensure workers' continued safety. Other equipment/accessories, such as sampling probes, durable carrying cases and rechargeable batteries, can be complementary and useful.

Most modern monitors are equipped with bright visual and loud audible alarms to warn of potential hazards. An internal datalogger helps employers comply with the documentation of the spaces' hazards. A datalogger is a device containing a microprocessor; it stores information electronically taken from an instrument. The levels of all hazards being monitored can be downloaded from the datalogger to a computer or printed, for reference and record-keeping.

An automated instrument docking system is also extremely helpful when working with confined spaces. Such systems provide a myriad of benefits, including automated calibration/bump-testing (OSHA requires a "calibrated direct reading instrument" to safely detect a hazardous atmosphere); record-keeping; datalogging; and recharging. (Docking systems can be used to charge monitors when not in use. This ensures the monitor is fully charged for its next use). In addition, many automated maintenance systems include technology that helps diagnose potential problems/issues with the monitor.

Portable gas-monitoring systems may be designed for a single substance, or they can be fitted with multiple sensors. Some measure up to six gases and include piercingly audible, attention-getting, 360-degree visual alarms.

An alternative or addition to personal monitors is a transportable area monitor. Many have area monitoring, via diffusion or with a sampling pump; wireless communications capabilities; and a waterproof housing with continuous operation of approximately 60 hours. Extra

CHOOSING THE RIGHT GAS-DETECTION SYSTEM

Deciding which gas-detection system to use for your specific company needs can be daunting, due to the alternative technologies and the number of products available. The more you know about the hazardous conditions in your workplace, the better equipped you will be to select the right gas detector or system. Here are some basic selection criteria:

- **Understand Site Risks:** Before researching the diverse types of gas-detection equipment, a risk assessment needs to be conducted. This gives you a basis upon which to work.
- **Identify the Objectives:** Since every site is unique, so are its needs. Be sure to know the purpose of the product's intended use. For example: Does it need to have an alarm, and what type of alarm is required; where will the data be read (locally or will it be transmitted to a BMS off-site); and will the detector need to activate other processes, such as ventilation systems.
- **Questions to Consider:** Where are the gases detected and where might they come from? Is the location accessible/what are the environmental conditions? How will the equipment be serviced?
- **Identify the Area(s) of Concern:** Are there several areas of concern in the workplace, and which gas hazards are present in each area? It's important to identify potential

run time helps increase productivity by minimizing new checks of the atmosphere for each shift change or when the space may be unattended. Portable gas monitors are lightweight and can be as small as a cellphone. They run on either rechargeable or replaceable batteries.

Another important aspect of managing confined space gas-monitoring programs is on-going maintenance. The best way to be certain a monitor is in peak shape is to utilize the services of a manufacturer's factory service center. Using factory-trained service technicians ensures the monitor will be repaired or serviced by qualified individuals. Some of the key services to look for include in-house calibration and service; maintenance and warranty repair; and on-site mobile service/repair. Leasing or renting an instrument is also an attractive option, especially in cases of shutdowns or planned maintenance, where more instruments might be needed to perform the work within a specific timeframe.

sources of a gas release, as this helps determine the number and location of gas-detecting sensors required.

Finally, OSHA released a Safety and Health Information Bulletin on the proper way to calibrate and test gas-detection monitors. This bulletin is advisory in nature; informational in content; and is intended to assist employers in providing a safe and healthful workplace. See "Calibrating and Testing Direct-Reading Portable Gas Monitors" safety bulletin at: <https://www.osha.gov/dts/shib/shib093013.html>.



Photo courtesy: Industrial Science Corporation

Having adequate gas-detection equipment is a big part of maintaining awareness and compliance regarding confined spaces. Gasses present a particular risk for workers with little maneuvering room, because they are often odorless and colorless.

Way of the Future

The global market for gas detection systems has seen notable growth recently, something that Transparency Market Research (TMR) claims will continue into the 2020s. In a recent report, TMR said the worldwide gas-detection equipment market will grow at a compounded annual growth rate of 5.6% to \$5.6 billion by 2024. In 2015, the market value was \$3.4 billion. TMR cited the rising tide of rule-making and worker safety-focused regulations being enacted—not only in the U.S., but also in the developing world.

The shift toward natural gas is one more factor that is causing greater demand for gas-detection systems. Coal has seen significant declines in recent times (despite recent U.S. promises to "bring coal back"), and natural gas has risen to the top of many consumers' preferences for heating and energy. The increased number of gas-powered installations multiplies the chances where workers might be in enclosed spaces—and increases the possibilities of gas leaks.

Persistence Market Research also found considerable opportunities for market expansion, given the high rate of infrastructure projects in the developing world. Researchers highlighted India and Brazil as countries undertaking particularly large projects that will elevate demand for gas-detection systems.

More companies than ever are investing in gas-detection systems. It's important to choose the system that is right for a company's needs to safeguard the health of all employees working in confined spaces.

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