

# Safety Management Today



Heat Illness

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## In The News

### The heat (app) is on!

According to the Occupational Safety and Health Administration (OSHA), heat illness sickens thousands of workers every year, and severe cases can be fatal. To help keep outdoor workers cool, OSHA has developed a free app to calculate worksite heat index and risk levels, and educate users about how to respond to a heat emergency.

The app was first launched in 2011, and according to OSHA, more than 187,000 people have downloaded it. The app was recently updated. The new version is optimized for the latest iPhones. It automatically provides the current conditions and maximum heat at a location and can accept manual input if users don't have cell service.

When the app calculates the heat index for a worksite, the tool displays a risk level based on the heat index for outdoor workers. Users can also receive reminders about the protective measures that should be taken at that risk level to protect workers from heat-related illness. The protective measures include:

- Drinking enough fluids,
- Scheduling rest breaks,
- Planning for and knowing what to do in an emergency,
- Adjusting work operations,
- Gradually building up the workload for new workers,
- Training on heat illness signs and symptoms, and
- Monitoring each other for signs and symptoms of heat-related illness.

According to OSHA, working in full sunlight can increase heat index values by 15 degrees Fahrenheit. Workers should keep this in mind and plan additional precautions for working in these conditions.

The OSHA Heat Tool is also available in Spanish for Android and iPhone devices. Get the app by visiting [www.osha.gov/SLTC/heatillness/heat\\_index/heat\\_app.html](http://www.osha.gov/SLTC/heatillness/heat_index/heat_app.html). ■

## Can you recognize the signs and symptoms of heat stress disorders?

Hot environments can be found in any climate during any time of the year. However, climate (and weather) are not always factors. In addition to working outdoors, people who work in foundries, plants, mines, and bakeries are often exposed to high heat on a regular basis.

As a result, it's important to be able to recognize the signs and symptoms of the various heat stress disorders in order to implement proper preventative measures and first aid resulting from overexposure to heat.



### Heat rash

Heat rash may result from continuous exposure to heat or humid air. Body heat is released through sweating, but when it's humid the skin can remain moist. If the sweat ducts become plugged, a rash can develop.

The heat rash may disappear when a worker returns to a cooler area, but washing the area and allowing the skin to dry will help. Beyond first aid, if the rash shows signs of infection, a worker should get medical attention. Heat rashes can be prevented by being able

to rest in a cool place for part of the day and by regularly bathing and drying the skin.

### Fainting

As blood circulates to the skin to aid in cooling, it can accumulate in the lower part of the body if you are standing still. Fainting can be the result when the brain doesn't get an adequate blood supply. The victim should lay down in a cool area to recover from the fainting spell. Acclimatization to the heat reduces the chances of fainting. Moving around helps blood circulate and also helps prevent fainting.

### Muscle cramps

Muscles can develop painful cramps or spasms from salt imbalances in the body. Sweating and inadequate fluid intake can cause cramps. Heat cramps are caused by heavy sweating with insufficient electrolyte replacement. Signs and symptoms include:

- Muscle spasms.
- Pain in the hands, feet, and abdomen.

Drink plenty of water to replenish your body fluids. Don't wait until you feel thirsty. Caffeinated and alcoholic beverages should be avoided, as

### Heat stress

When a body is subjected to heat, the circulatory system reacts by increasing the amount of blood flow to the skin so the extra heat can be given off. Sweating also helps the body maintain a stable temperature. As sweat evaporates, cooling results. However, sweating is effective only if the humidity level is low enough to permit evaporation and if lost fluids and salts are replaced.

Although the body tries to maintain its temperature, hot workplace conditions can lead to harmful heat disorders ranging from transient heat fatigue to serious illness or death.

### Heat stress disorders

#### Fatigue

Muscles get tired more quickly in the heat because the body cools itself by sending more blood to the upper layers of the skin. Relatively less blood is available to provide active muscles, the brain, and other internal organs with the energy they need for peak performance. For first aid, rest in a cooler area before a more serious condition develops. Gradual adjustment to working in the heat eventually reduces heat fatigue.

they promote more fluid loss through urination. Drinking salted liquids or commercially available carbohydrate replacement liquids helps with recovery from heat cramps.

### Heat exhaustion

Heat exhaustion may result when a large amount of body fluid has been lost through sweating. The symptoms may resemble the early signs of heat stroke. Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, moist skin.
- Heavy sweating.
- Dizziness.
- Nausea.
- Fainting.

In serious cases, the victim may vomit or lose consciousness. Heat exhaustion can be treated by resting in a cool place and drinking plenty of fluids, but severe cases may require care for several days. Medical attention may be required.

### Heat stroke

Heat stroke is the most serious form of heat stress and is a life-threatening condition. Temperature regulation fails and the body temperature rises to critical levels of usually 103°F or higher. The victim is mentally confused or delirious and can have convulsions or become unconscious.

Signs and symptoms are:

- Red, hot, usually dry skin.
- Lack of or reduced perspiration.
- Nausea.
- Dizziness and confusion.
- Strong, rapid pulse.
- Coma.

Immediate treatment by medical professionals can prevent brain damage or death. Until help arrives, the victim should be removed to a cool area, clothing should be soaked with water, and the body should be vigorously fanned to increase cooling. No person suspected of being ill from heat stroke should be left unattended.

By first recognizing the signs and symptoms of heat disorders, you can then identify ways to prevent and handle heat exposure. ■

## Keep your cool about how to handle heat exposure

Maintaining a safe work environment may be more challenging than you think, especially if your employees are being exposed to hot temperatures. Since everyone reacts differently to heat, it is difficult to predict who will or will not be affected. Although encouraging employees to drink fluids and take frequent rest breaks is important, you can't overlook other methods to protect employees from heat exposure.



### Consider the risk factors

When evaluating a hot work environment, there are risk factors to consider. A person's sensitivity to heat can be affected by physical factors such as age, weight, degree of physical fitness, medical conditions, metabolism, etc. Environmental factors also play a powerful role, including air temperature, humidity, radiant heat, conductive heat sources, clothing, and personal protective equipment.

See **Heat**, continued on pg. 4

**Heat**, continued from pg. 3

### *Classify the work*

There's more to measuring heat exposure than simply sampling the air temperature. The type of work being performed also has an impact on the body's ability to handle heat. Work can be classified as light, moderate, or heavy depending on the amount of metabolic energy required. For example:

- Light hand work – writing
- Heavy hand work – typing
- Heavy work with one arm – hammering nails
- Light work with two arms – filing metal
- Moderate work with the body – cleaning the floor
- Heavy work with the body – digging

### *Balance the heat*

For the human body to function properly, a core body temperature of 98.6 degrees Fahrenheit (°F) must be maintained. This means that there has to be a constant exchange of heat between a person's body and their environment, which can be affected by air temperature; humidity; skin temperature; air speed; radiant temperature; and the type, amount, and characteristics of the clothing being worn.

Based on the National Institute for Occupational Safety and Health's (NIOSH) dry bulb temperature measurement — which measures ambient air with a thermometer — most people feel comfortable at 71.6°F - 77.9°F while performing light work. However, as work intensity is increased, the air



temperature needs to be decreased to maintain a comfortable temperature.

For work environments where high humidity and low air speed are factors, NIOSH determined that 86°F is the maximum temperature for light work before performance is affected. For moderate levels of physical work, 82.4°F is the upper limit. Based on these wet bulb temperature measurements — which use an instrument to measure humidity — temperatures that reach beyond these threshold values could result in decreased employee performance, increased accidents, and heat illness.

### *Use engineering controls*

You can prevent employee exposure to excessive heat, which can cause a variety of heat-induced disorders, by using a variety of engineering controls.

### *Convective heat control*

One way to increase the rate of heat a body loses is by modifying air temperature and air movement across the skin. However, the amount of heat a body loses also depends on how quickly the air moves over the skin.

Therefore, if air temperature is above 95°F (skin temperature), consider:

- Reducing air temperature by bringing in outside air or using air conditioning,
- Reducing air movement across the skin to permit sweat to evaporate freely, and
- Wearing one-layer of work clothing.

If air temperature is below the skin temperature, consider:

- Increasing air movement across the skin through ventilation, and
- Reducing the amount of clothing.

### *Radiant heat control*

Radiant heat comes from the sun and other sources such as certain high temperature manufacturing equipment (e.g., radiant ovens). The only

engineering approach that can be used to control radiant heat is shielding employees from the source.

This can be accomplished by:

- Relocating, insulating, or cooling the heat source;
- Placing line-of-sight radiant reflective shielding between the heat source and your employees; or
- Changing how much heat is emitted from the hot surface by applying a coating over the material.

When considering these alternatives, radiant reflective shielding is usually the easiest and most inexpensive solution. Shielding can reduce the heat load by as much as 80 to 85 percent, according to NIOSH.

### *Evaporative heat control*

Heat is lost from the body when sweat is evaporated from the skin's surface. How a body naturally reduces heat depends on air movement over the skin and the amount of humidity in the air.

The use of engineering controls can help this natural process. Although fans and blowers are often used, air conditioning equipment is usually required. Also, look at eliminating additional sources of water vapor. Possible sources from manufacturing processes that could be eliminated include steam leaks from valves and lines and evaporation of water from wet floors. Eliminating these sources can help reduce the overall vapor pressure in the air and increase the evaporation of sweat from the surface of skin.

### *Use alternative controls*

Where the use of engineering controls may be impossible or impractical, or where the level of environmental heat stress may be unpredictable, other solutions should be considered.

Work practices and administrative controls can also be effective ways to reduce the level of heat stress on employees. You could:

- Limit or modify employee exposure to the heat through shift rotation or modified work schedules;

- Slowly acclimate employees to the heat through a work-hardening program;
- Train employees in safety and health procedures for work in hot environments, including how to recognize warning signs of heat illness; and
- Screen employees for heat intolerance.

### *Conclusion*

Hot environments can be found in most workplaces during any time of the year. It is how you handle employee exposure to the heat that will make the difference. Engineering controls, work practices, and administrative controls can play a key role in keeping your employees cool when the heat is on. ■



## Acclimatization critical to preventing heat illness

A worker's ability to function in heat is dependent on several factors, including high temperature and humidity, low fluid intake, heavy workload, physical fitness, etc. One of the most critical factors, however, is acclimatization. The degree to which a worker's body has physiologically adjusted or acclimatized to working in hot conditions affects his or her ability to do work.

### *Risk factors*

A recent Centers for Disease Control and Prevention report reviewed 20 OSHA heat-related enforcement cases. Of the 13 cases that involved worker fatalities, nine of the deaths occurred in the first three days of working on the job, and four of them occurring on the worker's first day. In all 20 cases, heat illness prevention programs were found to be incomplete or absent, and no provision was made for acclimatizing new workers to the heat.

### *Physiology*

On the first day of work in a hot environment, the body temperature, pulse rate, and general discomfort of a worker are higher. With each succeeding daily exposure, all of these responses gradually decrease. As a result, acclimatized individuals generally have lower heart rates and body temperatures than unacclimatized individuals, and they sweat sooner and more profusely.

In turn, this enables them to maintain lower skin and body temperatures at a given level of environmental heat and workload than unacclimatized workers. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss. This makes it possible to perform work with less strain and distress.

### *Acclimatization*

For new workers, adjustment to heat takes time. The body needs to undergo a series of changes that make continued exposure to heat more endurable. This timeframe varies, but can occur in just several days if done correctly.

The National Institute for Occupational Safety and Health (NIOSH) recommends a progressive, six-day acclimatization period for new workers before allowing him or her to do full work on a hot job. Under this regimen, new workers should be exposed to 50% on day one, with a 10% increase in exposure each additional through day six. For workers who have had previous experience in jobs where heat levels are high enough to produce heat stress, the acclimatization period may be shortened two or three days.

OSHA recommends allowing workers to get used to hot environments by gradually increasing exposure over a five-day work period beginning with 50 percent of the normal workload and time spent in the hot environment, and then gradually building up to 100 percent by the fifth day. New workers and those returning from an absence of two weeks or more should have a five-day adjustment period.

Be aware that when enclosed in an impermeable suit, fit acclimatized individuals sweat more profusely than unfit or unacclimatized individuals. Therefore, they may actually face a greater danger of heat exhaustion due to rapid dehydration. This can be prevented by consuming adequate quantities of water. ■



## Employee training: Expose common misconceptions about heat illness

Exposure to heat is not a new occurrence for most people. Whether they've experienced hot, humid temperatures while performing outside work in the sun or the thermal conditions of indoor environments, heat exposure has and will continue to be a threat to the safety and health of employees.

Although many employees are aware of the heat hazards they face in their workplaces, they may not understand "why" behind the safety measures being instituted. As a result, these employees may choose not to be safe. Addressing the misconceptions that employees may have about heat exposure is one way to get them to be safe about heat illness.

### *Misconception: A body is made to handle the heat*

For a body to function normally, the core temperature must be maintained within the range of 96.8° to 100.4°F, according to researchers for the National Institute for Occupational Safety and Health (NIOSH). To accomplish this, a body automatically varies the rate and amount of blood circulation through the skin to facilitate an exchange of heat with the environment. Depending on the conditions of the environment that an employee is working in (e.g., dry, humid, direct or indirect heat) various factors may add stress to a body and lead to heat-induced illnesses, disorders, and accidents.

If environmental temperatures rise and/or heat produced by the body increases due to the work or activity being performed, the body automatically sweats to get rid of the excess heat. However, sweat does not cool the body unless the moisture is removed from the skin by evaporation. Air temperature and humidity; skin temperature; air velocity; evaporation rate; radiant temperature; and type, amount, and characteristics of clothing worn all affect the rate of heat exchange with the environment.

This is where a misconception may exist. Employees may think that as long as their bodies sweat they are protected from overheating. They may not

realize that under certain conditions such as high humidity, the evaporation of sweat from the skin is decreased and the body's efforts to maintain an acceptable body temperature may be significantly impaired. If this occurs, employees not only are at greater risk for heat-induced illnesses, but also strength, alertness, and mental capacity may be affected because relatively less blood goes to the active muscles, brain, and other internal organs. Employees who must perform delicate or detailed work may find their accuracy suffering and others may find their comprehension and retention of information lower, putting them at risk for accidents.

Another risk is dehydration, if heat loss is not adequate, the brain will continue to signal the sweat glands in the skin to shed larger quantities of sweat onto the skin's surface, which can lead to more water leaving the body than is being taken in.

### *Misconception: A body will signal when fluid is needed*

According to NIOSH, most workers exposed to hot conditions drink fewer fluids than necessary because of a lack of thirst. Since it is essential to intake as much water as the sweat being produced — which can be as much as 2 to 3 gallons — the amount and timing of fluid consumption should not be dependent on thirst. It is recommended that in the course of a day's work in the heat, workers should drink 5 to 7 ounces of fluids every 15 to 20 minutes to replenish the necessary fluids in the body.

OSHA requires that potable drinking water be provided in all places of employment under 1910.141(b). This can either be done through plumbed facilities or water dispensers. As such, employees should be instructed to drink fluids throughout the day when exposed to heat as part of training.

See **Misconception**, continued on pg. 8

**Misconception**, continued from pg. 7

### *Misconception: Clothing protects a body against heat*

It's true that clothing is a barrier between the skin and the environment, especially when it comes to protection against exposure to chemical, physical, and biological hazards. However, clothing can also prevent the exchange of heat exposing employees to the risk of heat-related injuries and illnesses. The type, amount, and characteristics of the clothing being worn must be considered in determining the risk of heat stress.

Research shows that, in general, the thicker the clothing, whether it due to layering, and/or air and vapor impermeability, the greater the interference with heat exchange. In other words, each added layer of clothing, if not compressed by pressure from other clothing, will increase the total insulation factor affecting the body's ability to exchange heat with the environment. On the flipside, differences in fibers or fabric weave, unless these directly affect the thickness or the vapor or air permeability of the fabric, have only very minor effects on insulation.

A biological factor to be aware of is that when skin temperature increases dramatically and core body temperature reaches 102.6°F, the risk of heat-exhaustion collapse is higher. Similarly, if it is elevated to 104°F, most individuals are in imminent danger of heat-induced illness. Finally, levels above 105.8°F are associated with heatstroke, a life-threatening major medical emergency.

The proper type of clothing depends on the specific circumstances of the work environment. This may require insulated gloves, insulated suits, reflective



clothing, infrared reflecting face shields or another type of personal protective equipment. As such, evaluating the conditions and taking the necessary steps to protect employees is critical. Providing thermally-conditioned clothing, self-contained air conditioners in backpacks or instituting engineering controls are just a few options available to employers.

### *Conclusion*

Employers need to provide employees the tools they need to stay safe and healthy in hot work environments through training. Be certain to address common misconceptions about heat exposure. In doing so, you are helping employees understand “why” they need to be safe about heat illness. ■

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