



Thermal (Heat) Stress Training

Heat stress occurs when our bodies are overheated and our internal ‘cooling system’ cannot cool us down fast enough or properly. When our bodies fail to cool us down in intense heat the effects can include serious illness or even death. Employees need to understand how they can protect themselves against over-heating and prevent heat stress symptoms that can cause sickness and fatality.

Much of this information pertains to people working—in general—outdoors: road crews, roofers, construction workers, etc. In our environments, however, we can encounter exposure to heat in the Penthouse suites (typically intake and exhaust) and walking between buildings. So it still pays to be aware and understand the very real risk heat and overdoing it entail.

Some basic terminology to know first:

- **Heat stress**—requires immediate medical attention.
- **Heat cramps** are a symptom of heat stress and occur when fluid is lost and salt accumulates in muscle cells.
- **Heat rash** and **heat fatigue** are other serious conditions of heat stress.

Let’s begin with heat **stress**.

Heat Stress Symptoms

Heat stress symptoms, things that the person experiences when they have heat stroke, include:



- Confusion
- Difficulty thinking clearly.
- Nausea
- Thirst

In extreme cases, they can:

- Vomit
- Have a seizure
- Lose consciousness

Another sign of heat stress: co-workers may notice that the person has stopped sweating. Symptoms of both heat stress and heat exhaustion include headache, dizziness, fainting, wet skin, weakness, and irritability.

Factors That Affect Heat Stress

How can you tell who will be affected by heat stress and suffer Heat Related Illness (HRI)? The question is difficult to answer because there are many contributing factors, such as the person's age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions, such as hypertension. All of these factors affect a person's sensitivity to heat. However, even the type of clothing the worker wears must be considered. Prior heat injury predisposes an individual to additional injury. It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, and relative humidity all affect an individual's response to heat.

What Personal Protective Equipment Can Help Prevent Heat Stress?

Again, mostly for those who work outside all the time, but the point is to protect the skin from sunburn and serious injury. To prevent heating under the clothing, it should be worn as loosely as possible. Additional equipment that OSHA guidelines suggest include:

- Body cooling ice vests which are worn underneath clothes
- Wetted clothing
- Terry cloth coveralls

How To Avoid Heat Stress?

First and foremost, be aware of situations where heat stress may be a factor such as having to work outdoors for long stretches on a hot day, or the humidity during the summer. Plenty of people will walk between buildings simply for the exercise, but perhaps that's not a good idea if it's 95° outside with brutal humidity. That short walk for exercise might just be a little too taxing if you've been walking around site all morning.

If you become concerned that you or another employee are susceptible to overheating, make sure you/they are hydrated and let your supervisor know immediately. They may decide it's worth alerting Security for safety sake. Let your supervisor know if you need to rest due to potential heat-related stress.



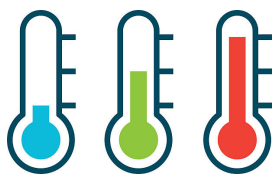
Why Does Heat Stress Matter?

In 2006, the State of California's OSHA division performed a detailed study of 25 investigations on heat-related illnesses that occurred in 2005 and that resulted in emergency room visits, hospital stays, or deaths. Their findings may be of interest:

- Death resulted in 54% of the cases

- 38% of victims required 24 hours or more of hospitalization
- Average temperature was 96 ° F
- Average humidity was 29%
- Potable water was present in 100% of cases
- 78% of cases showed inadequate fluid consumption by workers

Nasty headaches, confusion, nausea, vomiting, seizures, even potential death. Inert materials all around us, too, experience heat stress—wood, glass, metals, etc; they can only break or weaken, humans can die. So, yeah, heat stress matters.



Degrees of Heat Stress

As heat stress builds on the body it turns to heat *strain*. The hotter it gets and/or the longer you are exposed the greater the chance of heat strain developing into a Heat Related Illness (HRI)

Heat-related illnesses are the health effects seen on the body if heat strain is not brought under control. You may become dizzy, experience nausea, lose motor skills or be unable to remove heat from your body. Some severe outcomes include fainting and death. Yes, you just read that, but it bears repeating.

Uncontrolled exposure to heat can cause a number of adverse health effects as outlined below:

Heat Fatigue

Heat fatigue refers to the temporary state of discomfort and mental or psychological strain arising from prolonged heat exposure. Workers unaccustomed to the heat are particularly susceptible and can suffer, to varying degrees, a decline in task performance, coordination, alertness, and vigilance. The severity of heat fatigue will be lessened by a period of gradual adjustment to the hot environment (heat acclimatization).

Heat Rash

Heat rash, also known as prickly heat, is likely to occur in hot, humid environments where sweat is not easily removed from the surface of the skin by evaporation and the skin remains wet most of the time. The sweat ducts become plugged, and a skin rash soon appears. When the rash is extensive or when it is complicated by infection, prickly heat can be very uncomfortable and may reduce work performance. You can prevent this condition by resting in a cool place and by regularly bathing and drying the skin. Employees experiencing heat rash should:

- Try to work in a cooler, less humid environment when possible
- Keep the affected area dry
- Dust powder on the skin to decrease discomfort

A Quick Science Lesson



Humidity is a measure of how much *water vapor* exists in a given volume of air. When you see humidity is at 90% that means a given volume of air, say one meter cubed, is 90% saturated with water vapor—this means it can only take on another 10% of water vapor before becoming fully saturated. When you have full saturation at the proper altitude, and there is more ‘moist’ air than ‘dry’ air, you get cloud formation.

What does this have to do with thermal (heat) stress? When the air surrounding your body is near saturation (like illustrated above) it can’t take in any more vapor (moisture), in this case human sweat. If sweat cannot be absorbed into the surrounding air—because it’s very *humid*—the skin remains wet and sweat ducts can become plugged, leading to heat rash.

What’s the fix? Every so often rinse off any exposed skin, like the forearms, hands, and face, or blot them dry if possible. Sure, the rest of your body will sweat too, but the fabric around your body will wick away a lot of that (sweat stains, anyone?). Keeping your exposed skin as free of sweat as possible on a very humid day will help reduce the risk of getting heat rash.

And most importantly, stay hydrated!

Heat Cramps

Heat cramps are painful spasms of the muscles that occur among those who sweat profusely in heat and drink large quantities of water, but do not adequately replace the body’s salt loss.

The drinking of large quantities of water tends to dilute the body’s fluids, while the body continues to lose salt through sweating. Shortly thereafter, the low salt level in the muscles causes painful cramps. The affected muscles may be part of the arms, legs, or abdomen, but tired muscles (those used in performing the work) are usually the ones most susceptible to cramps.

Cramps may occur during or after work hours and may be relieved by drinking salted liquids. Workers with heat cramps should:

- Stop all activity and sit in a cool place
- Drink clear juice or a sports beverage
- Do not return to strenuous work for a few hours after the cramps subside because further exertion may lead to heat exhaustion or heat stroke
- Seek medical attention if any of the following apply:
 - The worker has heart problems
 - The worker is on a low-sodium diet
 - The cramps do not subside within one hour

Heat Exhaustion

Heat exhaustion includes several clinical disorders having symptoms which may resemble the early symptoms of heat stroke. Heat exhaustion is caused by the loss of large amounts of fluid by sweating, sometimes with excessive loss of salt. A worker suffering from heat exhaustion still sweats but experiences extreme weakness or fatigue, giddiness, nausea, or headache. In more serious cases, the victim may vomit or lose consciousness. The skin is clammy and moist, the complexion is pale or flushed, and the body temperature is normal or only slightly elevated. In most cases, treatment involves having the victim rest in a cool place and drink plenty of liquids.

Victims with mild cases of heat exhaustion usually recover spontaneously with this treatment. Those with severe cases may require extended care for several days. There are no known permanent effects. Treat someone suffering from heat exhaustion with the following:

- Have them rest in a cool, shaded or air conditioned area
- Have them drink plenty of water or other cool, nonalcoholic beverages
- Have them take a cool shower, bath, or sponge bath

Heat Syncope (fainting)

A worker who is not accustomed to hot environments and who stands erect and immobile in the heat may faint. With enlarged blood vessels in the skin and in the lower part of the body due to the body's attempts to control internal temperature, blood may pool there rather than return to the heart to be pumped to the brain. Upon lying down, the worker should soon recover. By moving around, and thereby preventing blood from pooling, the patient can prevent further fainting.

Workers with heat syncope should:

- Sit or lie down in a cool place when they begin to feel symptoms
- Slowly drink water, clear juice, or a sports beverage

Heat Stroke

Between 2008 and 2014, OSHA documented more than 100 workplace fatalities caused by heat stress. In 2014 alone, there were 2,630 heat illnesses and 18 deaths from heat stroke reported. But heat stroke is completely preventable

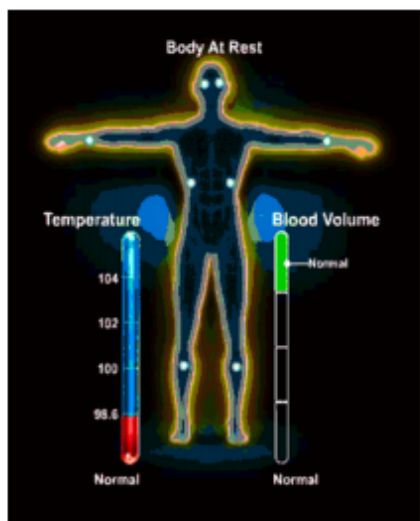
Heat stroke is the most serious of health problems associated with working in hot environments. It occurs when the body's temperature regulatory system fails and sweating becomes inadequate. The body's only effective means of removing excess heat is compromised with little warning that a crisis stage has been reached. A heat stroke victim's skin is hot, usually dry, red or spotted. Body temperature is usually 105°F or higher, and the victim is mentally confused, delirious, perhaps in convulsions, or unconscious.

Unless a heat stroke victim receives quick and appropriate treatment, death can occur. Heat stroke is a 911 EMERGENCY! Any person with signs or symptoms of heat stroke requires immediate hospitalization. However, first aid should be administered immediately. This includes removing the victim to a cool area, thoroughly soaking the clothing with water or ice, and vigorously fanning the body to increase cooling.

Early recognition and treatment of heat stroke are the only means of preventing permanent brain damage or death, which occurs in 50% of heat stroke victims. Take the following steps to treat a person with heat stroke:

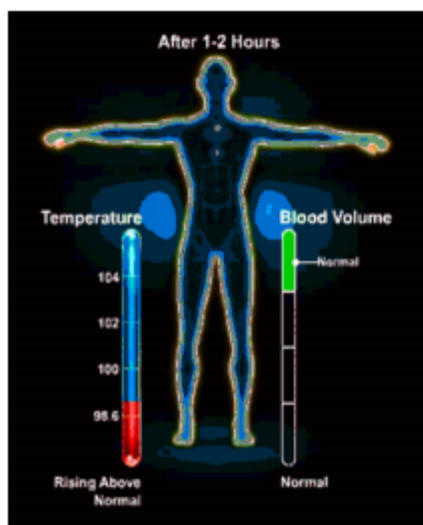
- Call 911 and notify their supervisor
- Move the sick worker to a cool shaded area
- Cool the worker using methods such as: • Soaking their clothes with water • Spraying, sponging, or showering them with water • Fanning their body

The Physiology of Heat Stress



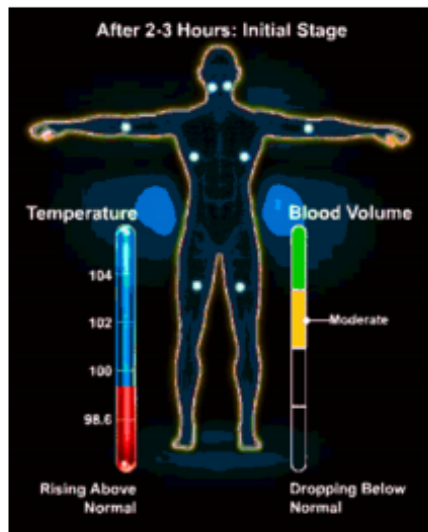
Physiology of heat stress #1.

During both rest and activity, the human body tries to maintain an internal temperature of 98.6 F.



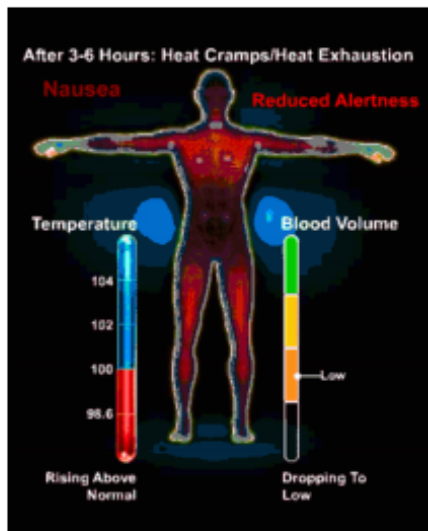
Physiology of heat stress #2.

- Hot weather, heat sources, and hard work raise the body's core temperature.
- Heated blood is pumped to the skin's surface, where body heat transfers to the environment, if cooler.
- If heat has to be shed faster, sweat carries it outside skin and evaporates to aid cooling.



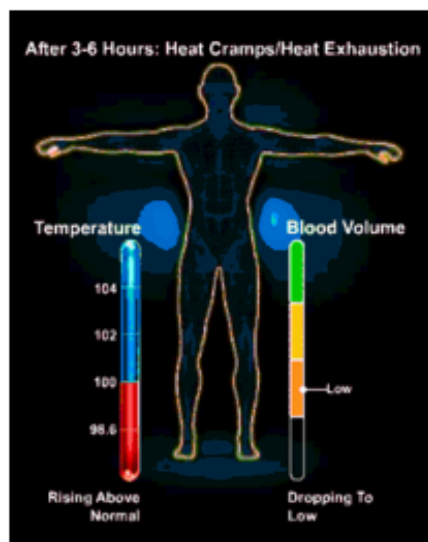
Physiology of heat stress #3.

- During heavy work, a body can lose 1-2 liters of water per hour.
- After 2-3 hours of fluid loss, a person is likely to:
 - Lose endurance
 - Become uncomfortable
 - Feel hot
 - Become thirsty



Physiology of heat stress #4.

- Water is key to cooling body and combatting heat stress.
- Without fluid replacement during an extended period of work, the body is at risk of exhaustion.
- Untreated heat exhaustion may lead to heat stroke.



Physiology of heat stress #5.

- The longer the body sweats, the less blood there is to carry excess heat to skin or oxygen and nutrients to muscles.
- After 3 hours, a dehydrated worker may experience:
 - Headaches
 - Muscle fatigue
 - Loss of strength
 - Loss of accuracy and dexterity
 - Heat cramps
 - Reduced alertness
 - Nausea

