Heat and Cold Stress Safety
OSHAcademy Course 602 Study Guide

Heat and Cold Stress Safety

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Contact OSHAcademy to arrange for use as a training document.

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 602.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

OSHAcademy
15220 NW Greenbrier Parkway, Suite 230
Beaverton, Oregon 97006
www.oshatrain.org
instructor@oshatrain.org
+1.888.668.9079

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Course Introduction

At times, workers may be required to work in hot or cold environments for long periods of time. When the human body cannot maintain a normal temperature, temperature-related illnesses can occur and even result in death.

When exposed to cold temperatures, your body begins to lose heat faster than it can be produced. Prolonged exposure to cold will eventually use up your body’s stored energy.

According to the Center for Disease Control, more people die from extreme heat exposure than from hurricanes, lightening, tornadoes, floods, and earthquakes combined in the United States. During 1979 to 1999, more than eight thousand heat-related deaths occurred in the US.

This course offers information to employers and employees on measures they should take to prevent illness and death caused by extreme temperatures.
Module 1: Heat Stress Safety

Introduction

People suffer heat-related illness when the body’s temperature control system is overloaded. The body normally cools itself by sweating. However, in some conditions, sweating isn’t enough. In such cases, a person’s body temperature rises rapidly. Very high body temperatures may damage the brain or other vital organs.

Several factors affect the body’s ability to cool itself during extremely hot weather. When the humidity is high, sweat will not evaporate as quickly, reducing the body’s ability to release heat quickly.

Other conditions that can limit the ability to regulate body temperature include:

- old age
- obesity
- dehydration
- mental illness
- sunburn
- alcohol use
- youth (ages 0-4)
- fever
- heart disease
- poor circulation
- prescription use
- alcohol use

OSHA Regulations

Although there is not a specific OSHA standard for heat stress, employees are protected under the “General Duty Clause of the OSH Act” because heat–related illnesses are a serious hazard. The general duty clause states that employers are required to “... provide a place of employment free from recognized hazards that are causing or likely to cause death or serious physical harm to its employees.”

Sweating

For the human body to maintain a constant internal temperature, the body must get rid of excess heat. This is achieved primarily through sweating. The evaporation of sweat cools the skin, releasing large amounts of heat from the body. As surrounding temperatures reach normal skin temperature, cooling of the body becomes much
more difficult. If the air temperature is warmer than the skin, blood brought to the body surface cannot lose its heat. Sweating doesn’t cool the body unless the moisture is removed from the skin by evaporation. When there is high humidity, the evaporation of sweat from the skin is decreased and the body’s efforts to maintain a normal body temperature may be impaired.

**Risk of Heat-Related Illnesses**

Workers, who are exposed to hot and humid conditions, including the outdoors, factories and hot kitchens, are at the most risk for heat illness. Workers doing heavy work or wearing bulky protective clothing and equipment are also at risk. Some workers also might be at a greater risk than others if they haven’t built up a tolerance to hot conditions. Humans are able to adjust to the heat. Employers can reduce the chance of employees experiencing heat-related illnesses by gradually exposing them to hot environments for longer periods of time. This process usually takes about 5-7 days.

**Factors in Heat-Related Illnesses**

Excessive exposure to hot environments can cause a variety of heat-related health problems. Body temperature can rise to dangerous levels if precautions are not taken immediately. Heat illnesses can range from heat rash and cramps to heat exhaustion and heat stroke.

**Heat Rash**

Heat rash often occurs in hot, humid environments where sweat doesn’t evaporate from the skin. The sweat ducts become clogged and result in a rash. Heat rash can be very uncomfortable. Victims of heat rash will see clusters of red bumps on the skin. The rash usually appears on the neck, upper chest and folds of the skin. To prevent heat rash, employees should work in cooler and less humid environments, if possible. Also, make sure to keep the affected area dry.

**Heat Cramps**

Heat cramps may happen alone or with other heat-related illnesses. They are painful muscle spasms caused by dehydration while performing hard physical labor in a hot environment. The cramps may be caused either by too much or too little salt. Tired muscles are also very susceptible to heat cramps.
Treatment

If a worker experiences heat cramps, (usually caused by too much salt in the body due to sweating) employers should:

- have worker rest in shady, cool area
- worker should drink water or other cool beverages (not alcohol)
- have worker wait a few hours before returning to strenuous work
- have worker seek medical attention if cramps don’t go away

Heat Exhaustion

Heat exhaustion is caused by the loss of large amounts of fluid. This can happen by sweating and sometimes with an extensive loss of salt. An employee suffering from heat exhaustion still sweats, but may also experience the following symptoms:

- cool, moist skin
- headache
- dizziness
- weakness
- irritability
- heavy sweating
- nausea or vomiting
- light headedness
- thirst
- fast heart beat
Treatment

You will need to have the victim lie down or sit in a cool or shady area. He or she will need to drink plenty of cool liquids, preferably a sports drink with carbohydrates and electrolytes. You should also spray water or apply cool, wet cloths to the victim’s head and torso. Using a fan can also speed evaporation and lower his or her body temperature. If signs or symptoms get worse or do not improve in about an hour, the victim should be taken to a medical clinic or hospital to be evaluated by medical staff.

Real-Life Scenario

A young worker arrived for her shift at a vineyard. She was pregnant, and her job required her to spend long hours tying grapevines in the sun. As the day wore on, the temperature soared, eventually reaching triple digits. After nine hours of work, she collapsed from heat exhaustion. Two days later, she was dead. She was 17 years old.

Heat Stroke

Heat stroke is the most serious heat-related illness. It occurs when the body’s temperature-regulating system fails and sweating becomes an inadequate way of removing excess heat. **Heat stroke requires immediate medical attention and can result in death.** When heat stroke doesn’t kill immediately, it can shut down major body organs causing acute heart, liver, kidney and muscle damage, nervous system problems, and blood disorders.

Signs an employee may be suffering from heat stroke are:

- confusion
- seizures
- very high body temperature
- fainting
- excessive sweating or red, hot, dry skin
- unconscious

Treatment

There are several steps to take when you notice someone showing the signs of heat stroke. Once you have called for emergency help, lay the victim on his or her back unless he or she is unconscious. Make sure to remove any objects close by if the victim has a seizure. If the worker is conscious, provide cool water to drink. Also, place ice packs under the armpits and in the groin area to cool them down.
Real-Life Scenario

On August 1st, 2006, a 44-year-old Hispanic migrant farm worker died after succumbing to heat stroke while working in a tobacco field on a farm in North Carolina. The victim arrived on the farm from Mexico on July 21st, 2006 and he was assigned to work in the tobacco fields, where he worked for the next week. On August 1st, 2006, it was hot and humid with a heat index (a measure of the combined effects of high temperatures and high humidity on the body) between 100 and 110. He had been working in a tobacco field when around 3 pm, he complained to the crew leader that he wasn’t feeling well. The victim drank some water and was driven back to his housing and left alone to rest. A short time later, he was found unconscious on the steps of the house. Emergency medical service (EMS) personnel were immediately called and responded within five minutes. The victim was taken to the hospital where his core body temperature was recorded at 108 Fahrenheit and was pronounced dead. Heat stroke was listed as the death on the death certificate.
Real-Life Scenario

On June 27th, 2003, a 41-year-old male laborer died from heat stroke one day after being taken to the hospital. The laborer was working on an addition to a factory, sawing boards to make concrete forms. He worked until 5:00 pm that day and was in the parking lot on his way to his car when he apparently collapsed. A worker on the second shift at the factory was taking scrap material outside to a dumpster when he found the victim on the ground. The company receptionist called EMS and the supervisor went to the parking lot to administer emergency care to the laborer until EMS arrived. When paramedics arrived, they recorded the laborer’s body temperature as 107 Fahrenheit. He was transported to a local hospital where he died the next day with an internal body temperature of 108 Fahrenheit.

To prevent similar incidents from occurring, investigators made the following recommendations:

- Employers should train supervisors and employees to recognize symptoms of heat exhaustion/stroke when working in high heat index and/or humid conditions.
- To avoid dehydration and heat stress/stroke, employees should be given frequent breaks and be provided water and other hydrating drinks when working in humid and hot conditions.
- Work hours should be adjusted to accommodate environmental work conditions such as high heat index and/or high humidity.

Preventing Heat Illnesses

Remember these three simple words: water, rest, shade! Employers should educate their workers on how taking water breaks often and limiting the time in the hot weather can help prevent heat illnesses. They should also include these prevention steps in worksite training and plans. Employers should also teach employees to gradually build up to heavy work in hot conditions. This helps workers become acclimated to the heat or build a tolerance to the hot temperatures. Finally, during the first week of work, employers should gradually increase workloads and allow more frequent breaks.

Engineering Controls

The basic concept behind engineering controls is the work environment and the job itself should be designed to eliminate hazards or reduce exposure to hazards.
Engineering controls can be simple in some cases. They are based on the following principles:

- If feasible, design the facility, equipment, or process to remove the hazard or substitute something that is not hazardous.
- If removal is not feasible, enclose the hazard to prevent exposure in normal operations.
- Where complete enclosure is not feasible, establish barriers or local ventilation to reduce exposure to the hazard in normal operations.

There are several engineering controls that can be used if employees work in a hot environment. The best way to prevent heat illness is to make the work environment cooler. In outdoor situations, this may be done by scheduling activities during the cooler times of the day. However, very early starting times may result in increased fatigue. Also, humidity tends to be higher in the early morning hours. Employers can also provide air conditioned or shaded areas close to work areas and allow frequent rest breaks.

Indoor workplaces may be cooled by using air conditioning or increased ventilation, assuming that cooler air is available from the outside.

Other methods to reduce indoor temperature include:

- providing reflective shields to redirect radiant heat
- insulating hot surfaces
- use of fans

**Work Practices**

Work practice and administrative controls are closely related attempts to change behaviors. They are management-dictated work practices and policies to reduce or prevent exposures to temperature factors.

There are several work practice controls an employer can do to try and prevent heat-related health effects.

Here are some examples:
• Train workers and supervisors about the hazards leading to heat stress and ways to prevent them.

• Allow workers to get used to hot environments by gradually increasing exposure over a 5-day work period.

• Provide workers with plenty of cool water in convenient, visible locations close to the work area.

Employers need to remind workers to drink small amounts of water before they become thirsty to maintain good hydration. Simply telling them to drink plenty of fluids is not sufficient. During moderate activity, in moderately hot conditions, at least one pint of water per hour is necessary. Workers should drink about six ounces or a medium-sized glass-full every 15 minutes. Instruct workers that urine should be clear or lightly colored.
Module #1 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. According to the text, which of the following is NOT a condition that could limit the ability to regulate body temperature?
   a. old age
   b. obesity
   c. poor fitness level
   d. alcohol use

2. Sweating doesn’t cool the body unless the moisture is removed from the skin through ________________.
   a. evaporation
   b. cooler temperatures
   c. humidity
   d. dehydration

3. Heat exhaustion is the most serious heat-related illness.
   a. true
   b. false

4. Which of the following are symptoms of heat stroke?
   a. confusion
   b. fainting
   c. seizures
   d. all of the above
Module 2: Cold Stress Safety

Introduction

During emergency response activities or recovery operations, workers may be required to work in cold environments, and sometimes for extended periods of time. Cold stress is a common problem encountered in these types of situations. When the body is unable to warm itself, cold related stress may occur. This may include tissue damage and possibly death.

Cold Stress Factors

Four factors contribute to cold stress:

- cold air temperatures
- high velocity air movement
- dampness of the air
- contact with cold water or surfaces

Cold-related illnesses can slowly overcome a person who has been chilled by low temperatures, brisk winds, or wet clothing. A cold environment forces the body to work harder to maintain its temperature. Cold air, water, and snow all draw heat from the body.

Wind Chill

Wind chill is the combination of air temperature and wind speed. For example, when the air temperature is 35 degrees Fahrenheit, and the wind speed is 30 miles-per-hour, your exposed skin receives conditions equivalent to the air temperature being a mere 22 degrees Fahrenheit. While it is obvious that below freezing conditions combined with inadequate clothing could bring about cold stress, it is also important to understand it can also be brought on by warmer temperatures (such as 50 degrees Fahrenheit) combined with some rain and wind.
Body Reactions to Cold Temperatures

When in a cold environment, most of your body’s energy is used to keep your internal temperature warm. Over time, your body will begin to shift blood flow from your extremities (hands, feet, arms and legs) and outer skin to the core (chest and abdomen). This allows exposed skin and the extremities to cool rapidly and increases the risk of frostbite and hypothermia. Combine this with cold water, and trench foot may also be a problem.

Common Cold-Induced Problems

Hypothermia

Hypothermia means “low-heat,” which is a potentially serious health condition. This occurs when body heat is lost faster than it can be replaced. When the core body temperature drops below the normal 98.6 degrees Fahrenheit to around 95 degrees Fahrenheit, you will see the following symptoms:

- uncontrollable shivering
- slow speech
- memory lapses
- frequent stumbling
- drowsiness
- exhaustion
Treatment

Without early recognition and active care, hypothermia can be deadly. Here are some things you can do, if you recognize someone who is dealing with hypothermia:

- gently move the victim to a warmer place
- remove wet clothing
- cover the victim with something dry and warm
- If available, contact Emergency Medical Services. If you are far from professional medical care, start re-warming the person. Place him near a heat source and put containers of warm water in contact with the skin.

**Fact:** Drinking alcohol increases your risk of becoming hypothermic: Although it may give your face a warm flush, drinking alcohol on a cold day does not warm you up. It can actually lower your body's core temperature.

Scenario

On January 4th, 2008, an employee and co-worker were securing a large tug boat that broke loose during a storm and was drifting towards waterfront homes. The two employees off-boarded the work boat and boarded the tug boat. At some point, the work boat became detached from the tug boat and drifted away. One of the employees dove into the frigid water to catch the work boat. However, he couldn’t reach it and re-boarded the tug boat. He found another smaller vessel on board the tug boat and boarded it. He was going to float out to get the work boat. The small boat capsized and the employee was hanging onto the boat, waiting for rescue workers. The rescue took about 45 minutes. He was transferred to a hospital and later died from complications related to hypothermia.

Frostbite

Frostbite is a severe reaction to cold exposure that causes freezing in the deep layers of skin and tissues. Frostbite can cause permanent damage and even cause amputation of the affected area. While frostbite usually occurs when temperatures are 30 degrees Fahrenheit or lower, wind chill factors can allow frostbite to occur in above freezing temperatures.

Frostbite usually affects the extremities, particularly the feet and hands. (see picture) However, frostbite can also affect the ears and nose. The affected body part will be cold, tingling, stinging
or aching followed by numbness. The skin color turns red, then purple, then white, and is cold to the touch. There may also be blisters in severe cases.

**Treatment**

Early recognition and care for a frostbitten victim can reduce or even eliminate future complications. **Minor** frostbite can be treated by simply re-warming the area using skin-to-skin contact, such as a warm hand. If more serious, get the person to a warmer place.

Here are some more treatment tips:

- Remove any jewelry from the affected areas.
- Place clean pads between frostbitten fingers and toes.
- Wrap the affected part with a clean towel or pad.

**Fact:** Rubbing frostbitten fingers or toes can cause further damage. Frostbitten skin must be warmed slowly. Do not rub or pour hot water directly on the affected area. Instead, immerse the body part in warm water (105 degrees Celsius maximum). Do not warm the skin if there is a chance it will become cold again. Large crystals may form in the tissues, causing further damage.

**Real-Life Scenario**

On August 4th, 2004, a worker was wearing a thermo-insulated jacket, overalls, and gloves and began work in the freezer department of a supermarket chain warehouse. His work consisted of selecting produce off warehouse shelves and delivering the product to the designated freezer truck. At the completion of the eight-hour work shift, he went home and soon realized that he was in unbearable pain and the toes on both his feet were black and blistering. He immediately left the house and went to the hospital where his feet were treated for frostbite and he was hospitalized.

**Trench Foot**

Trench foot, or immersion foot, is caused by having feet immersed in cold water at temperatures above freezing for long periods of time. It is similar to frostbite, but considered less severe. Symptoms usually consist of tingling, itching or burning sensation. Blisters may also be present.
Treatment

When possible, air-dry and elevate your feet, and exchange wet shoes and socks for dry ones to help prevent the development of trench foot.

Treatment for trench foot is similar to the treatment for frostbite. Take the following steps:

- Thoroughly clean and dry your feet.
- Put on clean, dry socks daily.
- Treat the affected part by applying warm packs or soaking in warm water (102° to 110° F) for approximately 5 minutes.
- When sleeping or resting, do not wear socks.
- Obtain medical assistance as soon as possible.

If you have a foot wound, your foot may be more prone to infection. Check your feet at least once a day for infections or worsening of symptoms.

Protective Clothing

Protective clothing is the most important way to avoid cold stress. The type of fabric also makes a big difference. Cotton loses its insulation value when it becomes wet. Wool, silk and most synthetics, on the other hand, retain their insulation even when wet.

Workers should wear at least three layers of clothing. There should be an inner layer of wool, silk or synthetic to pull moisture away from the body. The middle layer should include a layer of wool or synthetic to provide insulation, even when wet. Then, an outer wind and rain protection layer is needed to allow some ventilation to prevent overheating.

Here are some other protective clothing recommendations:

- Wear a hat or hood. Up to 40% of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
Work Practice Measures

There are several work practice measures to protect workers in cold environments.

- Recognize the environmental and workplace conditions that may be dangerous.
- Learn the signs and symptoms of cold-induced illnesses and injuries and what to do to help workers.
- Train workers about cold-induced illness and injuries.
- Encourage workers to wear proper clothing for cold, wet and windy conditions, including layers that can be adjusted to changing conditions.
- Be sure workers in extreme conditions take a frequent short break in warm, dry shelters to allow their bodies to warm up.
- Try to schedule work for the warmest part of the day.
- Use the buddy system-work in pairs so that one worker can recognize danger signs.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.

Engineering Controls

Engineering controls can be effective in reducing the risk of cold stress. Radiant heaters may be used to warm workers. Shielding work areas from drafts or wind will reduce the wind chill. Use insulating materials on equipment handles, especially metal handles, when temperatures drop below 30 degrees Fahrenheit.

Training

Training in recognition and treatment of cold stress is important. Supervisors, workers and co-workers should watch for signs of cold stress and allow workers to interrupt their work if they are extremely uncomfortable. Supervisors should also ensure work schedules allow appropriate rest periods and make sure liquids are available. They should use appropriate engineering controls, personal protective equipment and work practices to reduce the risk of cold stress. All of these measures should be incorporated into the relevant health and safety plans.
Module #2 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. Wind chill is the combination of _______ and ______________.
   a. air temperature, wind speed
   b. humidity, wind speed
   c. freezing temperatures, air temperature
   d. wind, rain.

2. Hypothermia occurs when body heat is lost faster than it can be replaced.
   a. true
   b. false

3. According to the text, which of the following is NOT a treatment for SEVERE frostbite?
   a. re-warm the frostbitten area
   b. remove any jewelry from the affected areas
   c. wrap the affected part with a clean towel or pad
   d. place clean pads between frostbitten fingers and toes

4. Which of the following are symptoms of frostbite?
   a. body part will be cold
   b. body part will be tingling
   c. stinging or numbness
   d. all of the above

5. Blisters may be present in trenchfoot.
   a. true
   b. false