

Heat Stress

1. Purpose

The purpose of this policy is to provide the necessary information to recognize, assess, and properly control heat stress in the workplace environment and thereby prevent heat stress related injuries and illnesses in the workplace.

2. Scope

This policy describes the associated health effects, heat-related hazards and risk factors, as well as controls for preventing heat stress for the USPL workforce. Local regulatory requirements may be different than stated in this policy; therefore Safety Coordinators should be consulted for any additional requirements.

3. Minimum Requirements

	Minimum Requirements	Supporting Documentation
1.	Supervisors are responsible for the following: <ul style="list-style-type: none"> Recognizing the hazards of working in hot environments. Mitigating the risk of heat stress by establishing and enforcing engineering controls and appropriate work practices. Providing employees with accurate verbal and written instructions, training, and other information pertaining to the prevention of heat stress. Watching for signs of heat stress and ensuring that employees interrupt their work with adequate rest periods. 	Sections 5 and 6
2.	Employees are responsible for monitoring their reaction to workplace conditions and taking basic precautions to prevent heat stress.	Sections 5 and 6
3.	Employees who are at risk for heat stress shall be familiar with the causes, predisposing factors, and symptoms of heat-related injuries.	Section 7

4. Definitions

Core body temperature—The temperature in the brain, the heart, and the abdominal organs. It changes very little (normal range: 97.6–98.8°F) and is vital for the normal functioning of these organs. The core cannot store an excessive amount of heat without upsetting its delicate temperature balance.

Evaporative cooling—Cooling that takes place when sweat evaporates from the skin. High humidity reduces the rate of evaporation and thus reduces the effectiveness of the body's primary cooling mechanism.

Heat exhaustion—A condition that occurs when the core body temperature rises above normal. It is caused by insufficient fluid intake and exposure to extreme heat for prolonged periods without rest.

Heat stress—The net heat load to which a worker may be exposed from the combined contributions of metabolic cost of work, environmental factors (i.e., temperature, humidity, air movement, and the temperature of surrounding objects [radiant heat exchange]), and clothing requirements. As the body's regulating

mechanisms attempt to maintain equilibrium, skin temperature rises and the activity of the sweat glands increases. Mild or moderate heat stress may cause discomfort and may adversely affect performance and safety, but it is not harmful to health. As the heat stress approaches human tolerance limits, the risk of heat-related disorders increases.

Heatstroke—A life-threatening emergency that occurs when the body's thermoregulatory mechanisms fail to function and core body temperature rises above 104°F. The illness has a high mortality rate and is accompanied by hot, dry skin and central nervous system abnormalities such as delirium, convulsions, or coma. Heatstroke can result from exposure to a high environmental temperatures as well as strenuous activity in hot, humid conditions. A heatstroke victim may suffer permanent brain injury as well as such complications as kidney, liver, and blood circulation disorders.

5. Roles and Responsibilities

- A. Supervisors (BP or contractor) are responsible for:
 - 1. Recognizing the hazards of working in hot environments (see Appendix I).
 - 2. Reducing the risk of heat stress by establishing and enforcing controls and appropriate work practices.
 - 3. Providing employees with accurate verbal and written instructions and other information pertaining to the prevention of heat stress.
 - 4. Ensuring that employees manage their work with adequate rest periods and fluid intake.
- B. Workforce members are responsible for:
 - 1. Being aware of the work environment and control factors that may affect their personal tolerance to heat.
 - 2. Remaining hydrated by drinking fluids frequently.
- C. Safety Coordinators are responsible for:
 - 1. Recommending additional control measures to address heat stress when traditional control measures prove ineffective.
 - 2. Consulting with the Industrial Hygienist or Health Services Advisor as appropriate.

6. Requirements and Procedures for Controlling Heat Stress

When planning work in hot environments, Supervisors shall consider the following administrative precautions to reduce the risk of heat stress related illnesses:

- A. Hydration
 - 1. Employees shall have access to potable drinking water.
 - 2. Where the supply of water is not plumbed or otherwise continuously supplied, at least one gallon of water per employee per shift shall be provided. Employers may begin the shift with smaller quantities of water if they have effective means for replenishment during the shift.
 - 3. The frequent drinking of water shall be encouraged.
- B. Cooling mechanisms
 - 1. Employees suffering from heat illness or needing a preventative recovery period shall be provided access to an area with shade (natural shading, tents, tarps, umbrellas, etc.) that is

either open to the air or provided with ventilation or cooling for a period of no less than five minutes, or as long as needed to dispel heat overload.

2. Such access to shade shall be permitted at all times. Cooling measures other than shade (e.g., use of misting machines, air conditioned vehicles, cooling vests, etc.) may be provided in lieu of shade if these measures are at least as effective as shade.
- C. Administrative controls
1. Supervisors should consider a modified work schedule that allows earlier start times.
 2. Supervisors should consider rotating job assignments that will allow different periods of work activity and reduce the heat load.
 3. Self-pacing and extra breaks, if needed, shall be encouraged.
 4. A buddy system, with emphasis on mutual observation and good communication, shall be encouraged.
 5. In accordance with conditions, a work/rest cycle (see Appendix III) should be implemented.

7. Prevention

Specific guidelines in this section may have limited applicability in emergency response situations. However, measures to reduce the risk of heat stress shall be taken into account during all emergency response activities.

- A. Supervisors shall adopt administrative and engineering controls and work practices that help protect employees from the effects of heat stress when temperatures are 90°F or higher. Guidelines include, but are not limited to, the following:
1. Monitor current weather conditions (see the chart in Appendix II for the effects of humidity on perceived temperature).
 2. Set up a work-rest cycle (see Appendix III).
 3. Provide an adjustment or acclimation period for new employees.
- B. Employees who are at risk for heat stress shall be familiar with the causes, predisposing factors, and symptoms of heat-related injuries (see Appendix I).

8. Treatment

8.1. Heatstroke

Heatstroke is a medical emergency requiring immediate attention. On the job, collapse from heatstroke is often mistaken for heart attack or head injury. It is considered a catastrophic illness and has a high death rate. Outwardly, it may first progress through the symptoms of heat cramps and/or heat exhaustion, with a dramatically sudden onset of heatstroke symptoms followed by rapid deterioration of the victim's condition.

- A. Personnel administering first aid for heatstroke should observe the following procedures:
1. Call for emergency medical assistance immediately. *Heatstroke can be fatal.*
 2. Move the victim from the hot environment to a shady or air-conditioned location.
 3. Put the victim in a reclining position and elevate the legs and feet slightly.
 4. Gently remove the outer clothing, exposing as much skin as possible.

5. Start the cooling process without delay. Apply cool water to the victim's skin, followed by fanning to produce evaporative cooling. Apply ice packs to the armpits, neck, and groin. *Do not* immerse the victim in an ice bath.
6. Administer cool fluids if the victim can safely swallow. *Do not* give aspirin or acetaminophen to reduce body temperature.
7. Ensure that the employee observes a regiment of bed rest and follow-up medical monitoring (body temperature may fluctuate abnormally for several weeks).

8.2. Heat Exhaustion

Heat exhaustion is serious because it carries a high risk of progressing to heatstroke.

- A. Personnel administering first aid for heat exhaustion should observe the following procedures:
 1. Move the victim from the hot environment to a shady or air-conditioned location.
 2. To prevent fainting, put the victim in a reclining position and elevate the legs and feet slightly.
 3. Loosen or remove clothing.
 4. Give the victim cool (not ice-cold) water or an electrolyte replacement drink.
 5. Cool the victim by sponging the skin with cool water and fanning.
 6. Stay with the victim until medical help arrives. Monitor his or her condition until there is no danger of heatstroke, which often develops quickly from heat exhaustion.
 7. Do not allow the employee to operate machinery or perform strenuous activities until he or she has been examined by a qualified medical professional.

8.3. Heat Cramps

- A. Personnel administering first aid for heat cramps should observe the following procedures:
 1. Move the victim into the shade.
 2. Loosen clothing.
 3. Administer lightly salted liquids. Make a 0.1% saline solution by adding 1/4 teaspoon table salt to one quart of water.
 4. Massage the muscles.
 5. Have the victim seek medical aid if the cramps persist.

9. Training

- A. BP employees working in outdoor locations will be assigned training through VTA at a frequency established by the HSE group.

10. References

1. OSHA, U.S. Department of Labor, *OSHA Technical Manual*, Chapter 4, "Heat Stress."

Appendix I

Heat-Stress Disorders

Human beings can function in almost all types of weather and climate because they can maintain their body temperature within a narrow range. When exposed to increasing heat loads, the body can mobilize its resources and restore the balance between heat gain and heat loss. Increasing heat loads cause changes in sweat rate, pulse rate, and body core temperature. An increase in the sweat rate is the first sign of the heat stress. When the body cannot sweat fast enough to dispel heat, the core body temperature rises, causing heat-related disorders. If unchecked, vital organs can malfunction, and disability or death can result.

Overview of Heat-Stress Disorders: Causes, Symptoms, Prevention, and First Aid Treatment

	Causes	Signs and Symptoms	Prevention	First Aid
Heatstroke	Excessive exposure to hot environments; body temperature rises to critical levels due to failure of temperature regulation mechanism.	High body temperature (> 104°F), hot, dry skin (inability to produce sweat), red face, rapid pulse, shivering, irritability; euphoria, disorientation, erratic behavior, collapse, unconsciousness, convulsions, difficulty breathing.	Become acclimated, maintain a healthy lifestyle, notice signs of heat stress.	Immediate, aggressive cooling (massage body with ice); immediate medical attention; have victim lie down, apply wet, cool compresses; give cool water if the victim is conscious.
Heat Exhaustion	Dehydration (caused by sweating, diarrhea, vomiting), distribution of blood to the periphery, low level of fitness; lack of acclimation.	Fatigue, blurred vision, dizziness, headache; high pulse rate, profuse sweating, low blood pressure, insecure gait, pale face; collapse; normal to slightly elevated body temperature; intense thirst; pale, moist, cool skin; fainting.	Drink water or other fluids frequently, add salt to food.	Lie down flat on back in shade or air-conditioned space; elevate legs; drink water; loosen clothing.
Dehydration	Excessive fluid loss caused by sweating, illness (vomiting or diarrhea), alcohol consumption.	No early symptoms, fatigue or weakness, dry mouth; loss of work capacity; increased response time.	Drink water or other fluids frequently, add salt to food.	Drink fluids, replace electrolytes.
Heat Syncope	Pooling of blood in the legs and skin from prolonged static posture and heat exposure.	Blurred vision (gray-out), fainting (brief blackout), normal temperature, brief fainting or near-fainting behavior.	Flex leg muscles several times before moving, stand or sit up slowly.	Lie back in cool environment, drink water.
Heat Cramps	Prolonged sweating without adequate fluid and salt intake.	Painful muscle cramps, especially in the abdominal muscles, arms, and legs; hot, moist skin.	Avoid caffeine, drink lots of water, eat foods rich in electrolytes (such as bananas or oranges).	Rest in cool environment, drink salted water (0.1% salt solution), massage cramped muscles, rest.
Heat Rash (Prickly Heat)	Prolonged, uninterrupted sweating, inadequate hygiene practices.	Itching skin, reduced sweating, skin eruptions.	Keep skin clean and periodically allow the skin to dry; wear 100% cotton clothing; shower often and changing into clean dry clothing.	Keep skin clean and dry; reduce heat exposure.
Sunburn	Overexposure to direct sunlight.	Painful, reddened skin; swelling and blisters in severe cases.	Limit exposure on bare skin, use sunscreen.	Topical anesthetics.

Appendix II Effects of Humidity on Perceived Temperature

The chart below shows how hot it feels when relative humidity is factored with the actual air temperature. The following ranges of Perceived Temperature can have increasingly serious effects:

- 80–89°F—Exercise is more fatiguing than normal.
- 90–104°F—Heatstroke, heat cramps, heat edema (the swelling of body tissues), and heat exhaustion are possible with prolonged exposure or strenuous activity.
- 105–129°F—Heatstroke, heat cramps, heat edema, and heat exhaustion are likely.
- 130°F and higher—Heatstroke is imminent.

Heat Index

Relative Humidity (%)	Actual Temperature (°F)														
	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108
	Perceived Temperature (°F)														
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137	
55	81	84	86	89	93	97	101	106	112	117	124	130	137		
60	82	84	88	91	95	100	105	110	116	123	129	137			
65	82	85	89	93	98	103	108	114	121	128	136				
70	83	86	90	95	100	105	112	119	126	134					
75	84	88	92	97	103	109	116	124	132						
80	84	89	94	100	106	113	121	129							
85	85	90	96	102	110	117	126	135							
90	86	91	98	105	113	122	131								
95	86	93	100	108	117	127									
100	87	95	103	112	121	132									

	Caution
	Extreme Caution
	Danger
	Extreme Danger

Source: National Weather Service, NOAA.

Appendix III Work-Rest Guidelines

The goal of heat stress prevention is to keep the core body temperature below 100.4°F. The following indicators can be used to determine excessive heat strain:

- Sustained heart rate during several minutes of heavy exertion exceeds 180 bpm minus the individual's age (in years).
- Recovery heart rate after one minute exceeds 110 bpm.
- Symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness.

To simplify work-rest guidelines, the following table is based on Heat Index values (see Appendix II). These guidelines, which are general and do not take into account individual tolerances to heat, are derived from a review of the literature and the professional judgment of industrial hygienists.

Recommended Work-Rest Schedule Based on Heat Index

Heat Index Values (°F)	Inside Vessels, with FRC	Outdoors in Sun, with FRC	Outdoors in Sun, without FRC
90–104°F	45 min. / 15 min.	60 min. / 15 min.	90 min. / 15 min.
105–130°F	30 min. / 30 min.	45 min. / 15 min.	60 min. / 15 min.
130°F and higher	Discontinue work. Contact HSE for further evaluation.	Discontinue work. Contact HSE for further evaluation.	Discontinue work. Contact HSE for further evaluation.

Note: The schedule may need adjusting after individuals have checked their own heart rate.

Appendix IV

Personal Factors Contributing to Heat Stress

Age:	The older a person is, the more susceptible he or she is to heat stress.
Weight:	The heavier a person is, the greater the layer of insulation through which body heat must be dissipated.
Physical Fitness:	The more physically fit a person is, the more efficient the circulatory system and thus the better he or she will be in handling the heat.
Acclimation:	Acclimation (or acclimatization) is a major factor in heat stress. It can take seven to ten days to become 90% acclimated to the heat. This advantage can also be lost if the person goes on vacation for a few days.
Water Intake:	Sufficient water intake helps prevent heat stress. In hot environments a worker may need a pint of water every 15 to 30 minutes, depending on various factors. It is not uncommon for people to be on the verge of dehydration even before they start working in a hot environment.
Fatigue:	As the fatigue level increases, the body's ability to handle heat is reduced—dramatically, in some cases.
Alcohol:	Alcohol dehydrates the body, and the rate of dehydration increases with the increase in alcohol consumption. Alcohol also flushes valuable electrolytes out of the body.
Caffeine, Nicotine:	Caffeine dehydrates the body and flushes out valuable electrolytes. Nicotine restricts circulation to the extremities, hampering the body's ability to cool itself efficiently. This effect is produced by both cigarettes and smokeless tobacco, although the latter causes a quicker response in the circulatory system.
Medical Conditions and Medications:	Medical conditions and medication (prescription as well as over-the-counter) can play a large role in the body's ability to handle heat. For example, amphetamines and decongestants constrict blood vessels, decrease circulation to the extremities, and increase heart rate.

Appendix V Additional resources

Additional heat stress resources such as the Heat Safety Tool are available from OSHA:
https://www.osha.gov/SLTC/heatillness/heat_index/heat_app.html

The Heat Safety Tool can be used to assist with heat-related risk and mitigation assessments.

