

Heat Stress



OSHA Technical Manual

Overview



Physiology of Heat Stress



Causal factors



Heat Disorders & Health Effects



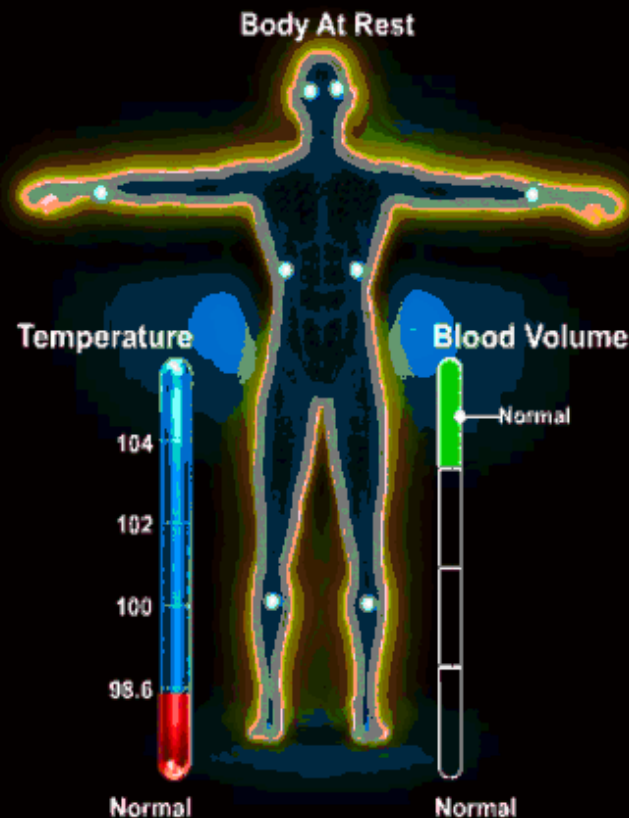
Work-load assessment



Control

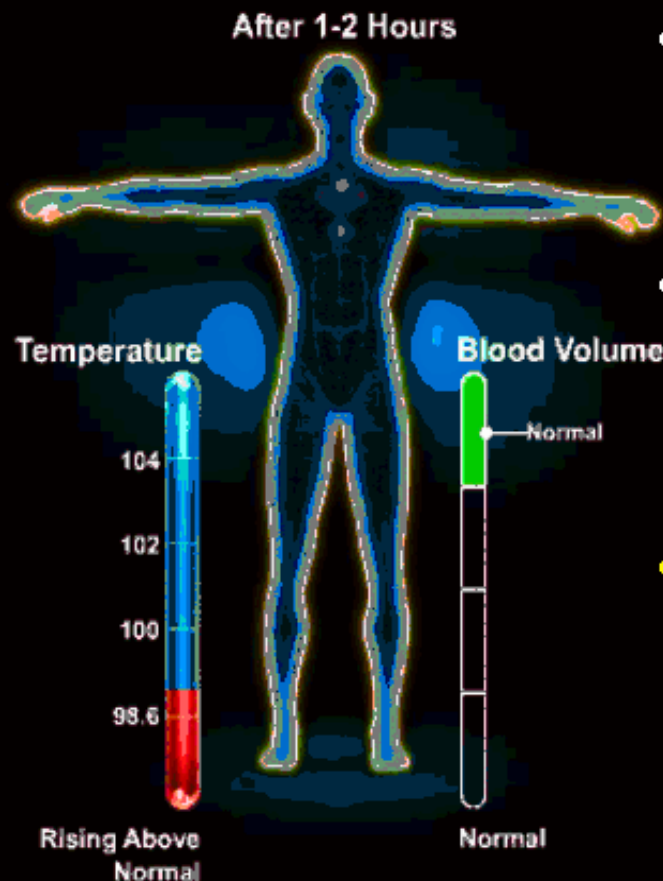


Physiology of Heat Stress



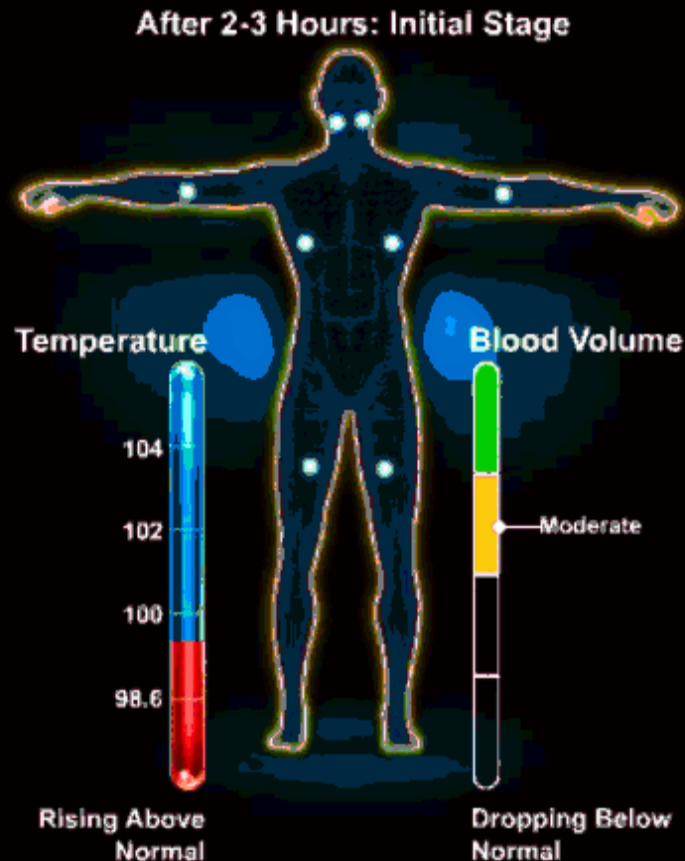
During both rest and activity, the human body tries to maintain an internal temperature of 98.6 F.

Physiology of Heat Stress



- 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



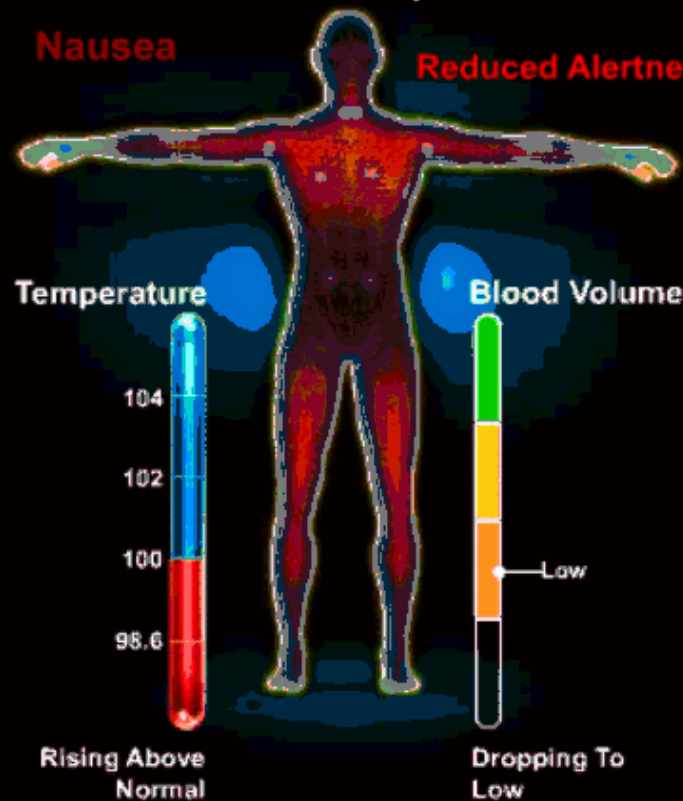
- During heavy work, a body can lose 1-2 liters of water per hour.
- After 2-3 hours of fluid loss, a person is likely to:
 - Lose endurance
 - Become uncomfortable
 - Feel hot
 - Become thirsty

Physiology of Heat Stress

After 3-6 Hours: Heat Cramps/Heat Exhaustion

Nausea

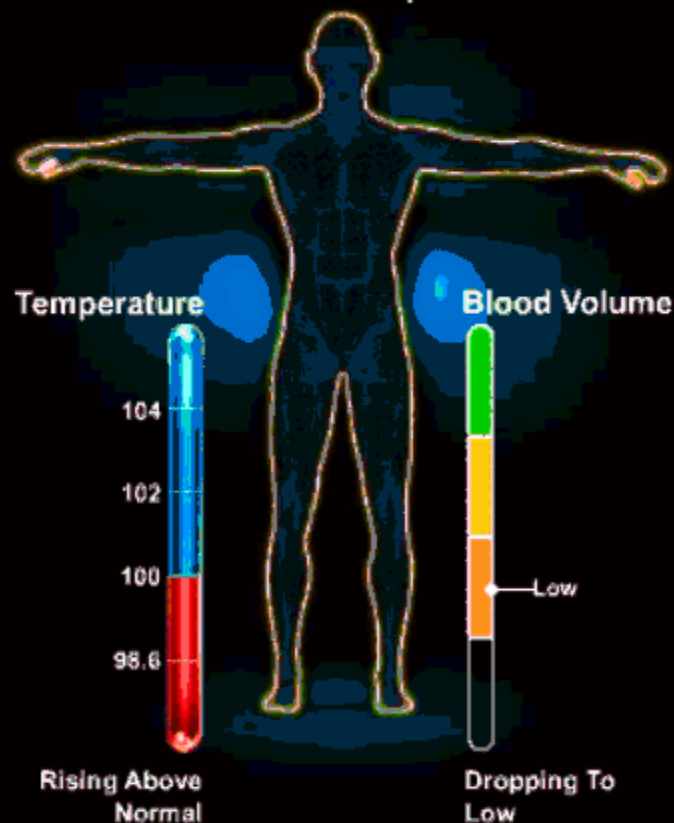
Reduced Alertness



- The longer a 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

Physiology of Heat Stress

After 3-6 Hours: Heat Cramps/Heat Exhaustion



- 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.

Causal Factors



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 affect a person's sensitivity to heat

Causal Factors



The type of clothing worn must be considered



Prior heat injury predisposes an individual to additional injury.

Heat Disorders & Health Effects



Heat Stroke



Heat Exhaustion



Heat Cramps



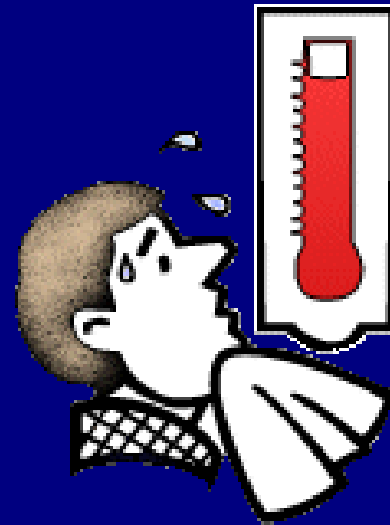
Heat Collapse



Heat Rashes



Heat Fatigue



Heat Stroke



Occurs when the body's system of temperature regulation fails and body temperature rises to critical levels



This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict



Heat stroke is a medical emergency

Stroke - Primary Signs & Symptoms



Confusion; irrational behavior; loss of consciousness; convulsions



Lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., an internal temperature of 105.8°F



If body temperature is too high, it causes death

Stroke - Treatment



Professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed.



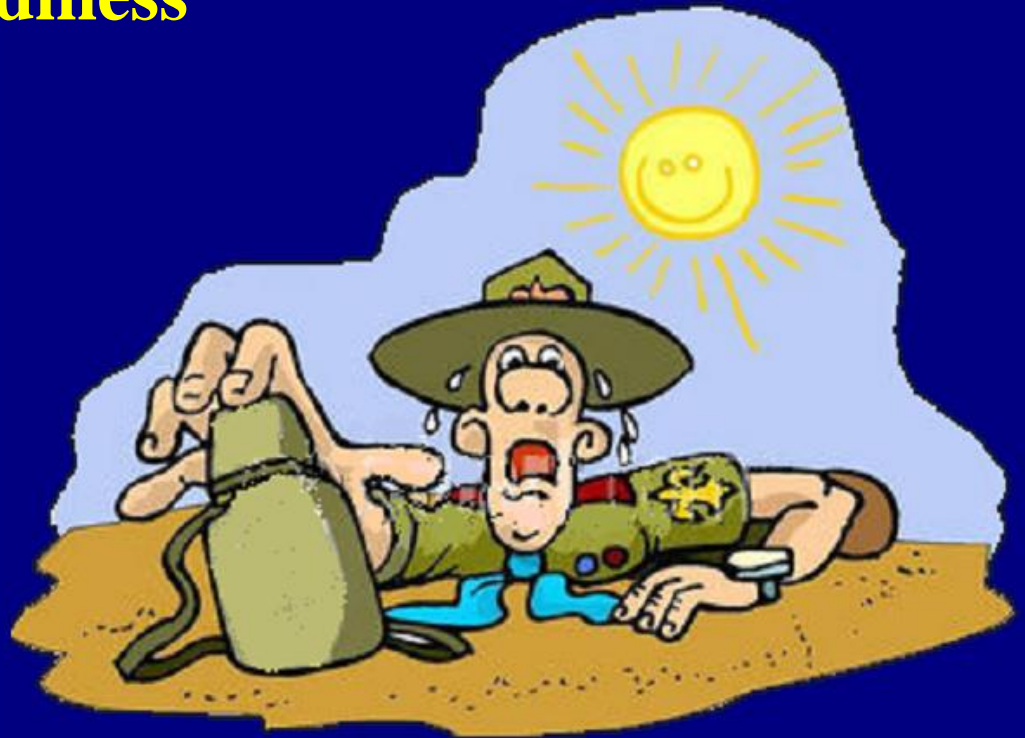
The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible

Heat Exhaustion



Signs and symptoms

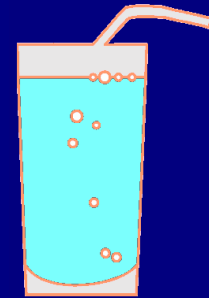
- Headache, nausea, vertigo, weakness, thirst, and giddiness



Heat exhaustion - Treatment



Removed from the hot environment and given fluid replacement



They should also be encouraged to get adequate rest

Heat exhaustion - Concerns



Heat exhaustion should not be dismissed lightly for several reasons



Fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation



Victim may be injured when he or she faints

Heat Cramps



Caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating



It is important to understand that cramps can be caused by both too much and too little salt

Heat Cramps



Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments

Heat cramps - Treatment



Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur



Recent studies have shown that drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery

Heat collapse 'Fainting'



In heat collapse, the brain does not receive enough oxygen because blood pools in the extremities



the onset of heat collapse is rapid and unpredictable

Heat collapse - Prevention



The worker should gradually become acclimatized to the hot environment

Heat Rashes



Most common problem in hot work environments



Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive

Heat Rashes



Prickly heat occurs in skin that is persistently wetted by unevaporated sweat,



Heat rash papules may become infected if they are not treated



In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat Fatigue



A factor that predisposes an individual to heat fatigue is lack of acclimatization

Heat fatigue Signs & Symptoms



The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, mental, or vigilance jobs

Heat fatigue - Treatment



There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops.

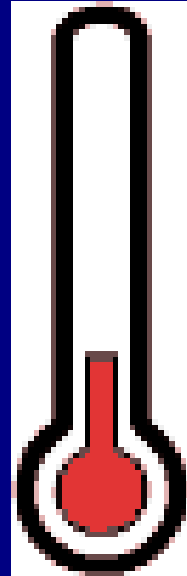


Control



The five major types of engineering controls

- Ventilation
- Air cooling
- Fans
- Shielding
- Insulation



Engineering Controls



General ventilation is used to dilute hot air with cooler air (generally cooler air that is brought in from the outside)



Air treatment/air cooling differs from ventilation because it reduces the temperature of the air by removing heat (and sometimes humidity) from the air

Engineering Controls



Air conditioning is a method of air cooling, but it is expensive to install and operate







Local air cooling can be effective in reducing air temperature in specific areas

Engineering Controls






- Heat conduction methods include**
insulating the hot surface that generates
the heat and changing the surface itself
- **Shields, can be used to reduce radiant heat,**
i.e. heat coming from hot surfaces within
the worker's line of sight

Administrative Controls & Work Practices

-  **Knowledge of the hazards of heat stress**
-  **Recognition of predisposing factors, danger signs, and symptoms**
-  **Awareness of first-aid procedures for, and the potential health effects of, heat stroke**
-  **Employee responsibilities in avoiding heat stress**

Administrative Controls & Work Practices

-  **Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments**
-  **Use of protective clothing and equipment**
-  **Coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs**



Temperature (F) versus Relative Humidity (%)

°F	90%	80%	70%	60%	50%	40%
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95		133	122	113	105	98
100			142	129	118	109
105				148	133	121
110						135

HI

Possible Heat Disorder:

80°F - 90°F	Fatigue possible with prolonged exposure and physical activity.
90°F - 105°F	Sunstroke, heat cramps and heat exhaustion possible.
105°F - 130°F	Sunstroke, heat cramps, and heat exhaustion likely, and heat stroke possible.
130°F or greater	Heat stroke highly likely with continued exposure.

Output & Productivity

NASA Report CR01205-1

Temp	75	80	85	90	95	100	105
Loss In Work Output	3%	8%	18%	29%	45%	62%	79%
Loss In Accuracy		5%	40%	300%	700%		

Summary

- **Have an Administration program in place**
- **Have engineering controls in place**
 - **Ventilation**
 - **Air cooling**
 - **Fans**
 - **Shielding**
 - **Insulation**

Heat Stress Info Web Sites

OSHA Technical Manual – Heat Stress

http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html

Heat Stress Power Point Briefing - Agriculture

<http://are.berkeley.edu/heat/battleheat.AZ.sept02.ppt>

Department of Labor – Heat Stress

<http://are.berkeley.edu/heat/heatadvisory.html>

NIOSH links on CDC's site

<http://www.cdc.gov/niosh/topics/heatstress/>