



**UNITED STATES ARMY CORPS OF ENGINEERS  
NEW ORLEANS DISTRICT**



**Heat Stress Prevention  
Information Guide**



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# Heat Stress Information

This publication provides information and guidelines to prevent heat stress related injuries to employees assigned to the New Orleans District (NOD), U.S. Army Corps of Engineers. The information compiled in this publication was extracted from TB Med 507, Prevention, Treatment and Control of Heat Injury, and AR 40-5, Preventive Medicine.

## Environmental and Physiologic Relationships

Exposure to high environmental temperature produces stress on the body. As the body attempts to compensate, physiological strain results. This strain, usually in combination with other strains resulting from hot working environments, dehydration, and fatigue, may lead to manifestation of heat disorder and disability.

Environmental conditions, which influence the heat equilibrium of the body and its physiologic adjustments, are air temperature, the temperature of surrounding objects, humidity, and air movement. When the body cannot lose sufficient heat by conduction, convection and radiation, the skin temperature rises to a significant level and the activity of the sweat glands increases. Death can occur when the body temperature goes out of control.



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## Types of Heat Hazards.



**Sunburn** – is caused by unprotected exposure to Ultraviolet Light that is damaging to the skin. The injury is characterized by red painful skin, blisters and/or peeling. First aid treatments include applying skin lotions, topical anesthetics, and relocating to the shade.

**Heat Rash** (also known as prickly heat) - may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep and impedes a worker's performance, or it may result in temporary total disability. Treatments include relocating to a cool place and allow the skin to dry.

**Fainting** (heat syncope) - is caused by pooling of blood in the legs and skin from prolonged static posture and heat exposure. Unacclimatized workers required to stand in one position for extended periods of time are at the greatest risk. Symptoms include blurred vision (graying out) and fainting (brief black out). The body temperature will be normal. Preventive measures include moving around rather than standing still. Usually the victim will recover quickly after drinking water and lying down.

## **Heat Cramp**

Heat cramps are characterized by painful spasms of the muscles, caused by loss of electrolytes in the body. Tired muscles, those used for performing the work, are usually the muscles most susceptible to cramps. Cramps may occur during or after working hours or during resting periods. Treatments include taking liquids by mouth or saline solutions intravenously for quicker relief, if medically determined to be required. There is no evidence that muscle injury occurs as a result of cramps. There is normally no change in the patient's temperature, consciousness or vital signs. Salt tablets alone are not recommended as they often pass through the digestive system undigested and may induce vomiting.

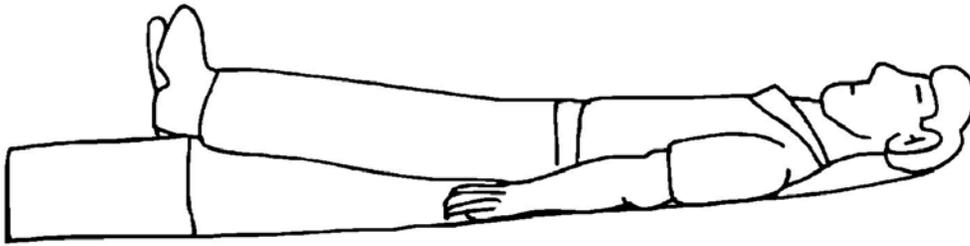
Heat Exhaustion – occurs when the core body temperature rises above normal. It is caused by insufficient fluid intake while exposed to extreme heat for prolonged periods without rest. Symptoms include sweating, extreme weakness or fatigue, giddiness, dizziness, nausea, or headache. The victim's skin will be clammy and moist; the complexion will be pale or flushed. The body temperature is usually normal or slightly higher.

*Sweating is an indication of heat exhaustion. The presence of sweat helps identify heat exhaustion from heat stroke.*

### **WARNING**

*If left untreated, heat exhaustion may progress to heat stroke.*

## Treatment For Heat Exhaustion



- ❖ Lay victim in a cool shady spot.
- ❖ Elevate feet and loosen clothing.
- ❖ Pour water on victim and fan to cool.
- ❖ Seek medical attention immediately.

**Warning.** Only a patient who is fully alert and not nauseated should drink oral fluids. Electrolyte solution (a beverage used by athletes to quickly restore potassium, calcium, and magnesium salts) may be given. Severe cases involving victims who vomit or lose consciousness may require longer treatment under medical supervision. In most cases the patient will improve dramatically in 30 minutes. However, it is best that the patient be transferred to a medical facility for evaluation.

**Signs of heat exhaustions:** headaches, dizziness, light-headedness, weakness, mood changes (irritable, or confused/can't think straight), nausea, vomiting, decrease in urine flow, dark colored urine, fainting, and pale clammy skin.

## Sodium Depletion Exhaustion



-Similar to heat cramps in pathophysiology and presentation.

-Occurs most frequently in the first 5-10 days of activity in heat.

-Symptoms: weakness, giddiness, frontal headache, anorexia, nausea, vomiting, diarrhea, and muscle cramps.

\*\* Thirst and weight loss are absent from the symptom complex.

\*\*Signs: normal or lowered rectal temperature, muscle cramps.

\*\* After acclimatization for at least 8 days, the appearance of salt depletion heat exhaustion is rare.

\*\*Use care when drinking salted fluids, while working (i.e. Gatoraid). Sodium overload can occur. Drink plenty water (*up to 1-½ quarts per hour*), pay close attention for signs and symptoms of **depleted salt exhaustion** in yourself and other employees.

\*\*Treat by drinking salted fluids (i.e. Gatoraid, 10k), seek medical attention.

# HEAT STROKE

Heat stroke (hyperthermia) is a *life-threatening emergency* and requires immediate medical care. Heat stroke occurs when the body's thermoregulatory mechanisms fails to function and the main avenue of heat loss (cooling and evaporation of sweat) is blocked. Heat stroke develops during extreme exertion in hot, humid environments, influenced by inadequate fluid and mineral salt intake.

**Symptoms.** The lack of sweating is an important symptom of imminent heat stroke. Other symptoms include mental confusion, disorientation, unconsciousness, headache, flushed dry skin, nausea, and elevated body temperature. Deep body temperatures that may be greater than 106 Fahrenheit characterize heat stroke. The high body temperatures cause the cells of the brain, heart, and kidneys to become dysfunctional.

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## *Key Warning Signs*

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- ❖ *Hot Dry Skin*
- ❖ *Absence of Sweating*
- ❖ *Agitation & Confusion*
- ❖ *Headache*
- ❖ *Cardiac Arrest*
- ❖ *Shock*
- ❖ *Seizure*
- ❖ *Increased Respiratory*

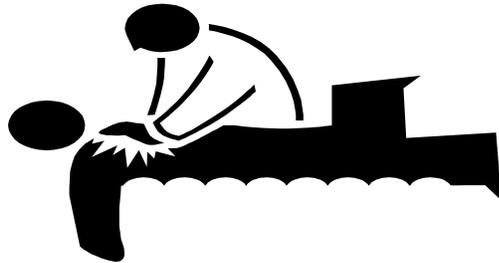
## *Other Symptoms*

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- ❖ *Full and Rapid Pulse*
- ❖ *Normal or Elevated Systolic Blood Pressure*
- ❖ *Depressed diastolic blood pressure*



*Heat stroke is a medical emergency, with a high mortality rate.*



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## Treatment for Heat Stroke:

1. Aggressively cool victim by moving to shady cool place.
2. Place in supine (on back) position unless there is active vomiting or seizures.
3. Elevate legs.
4. Remove all outer clothing.
5. Attempt to lower body temperature by soaking in ice bath or water
- 6. Get victim to a hospital as quickly as possible.**

## Managing Risk of Heat Stress

*Preventing heat stress is highly dependent on educating the work force, especially employees exposed to hot working environments and those charged with supervision*

Following a few basic precautions can prevent heat-related health problems. A variety of engineering controls including general ventilation and spot cooling by local exhaust ventilation at points of high heat production may be helpful. Shielding will also protect employees from radiant heat sources.

Other controls include:

- ❖ *Evaporative cooling*
- ❖ *Mechanical refrigeration*
- ❖ *Cooling fans*
- ❖ *Equipment modifications*
- ❖ *Use of power tools to reduce manual labor*
- ❖ *Protective clothing*



# Hydration

The human body is highly dependent on adequate fluids and minerals to function properly. Adequate water intake is the single most important factor in avoidance of heat injury. In a hot working environment, it is not unusual to lose a quart of water per hour. If the loss is not replaced, the exposed employee will most likely experience a rapid rise in body temperature and heart rate. The risk of heat injury is reduced when exposed employees periodically drink water in small amounts throughout the work period.



..... *REMEMBER!* .....

*Thirst is not an adequate stimulus for proper water intake. Most employees with ample water supplies will frequently dehydrate by one or more quarts unless supervisors enforce the drinking of water.*

***WARNING.*** Hourly fluid intake should not exceed 1- $\frac{1}{2}$  quarts. Daily fluid intake should not exceed 12 quarts.

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## **Acclimatization To heat.**



Acclimatization is acquired by working in hot environments for gradually increasing periods of time on a daily basis over a period of two weeks. Acclimatization begins with the first exposure and is developed to 45-50 percent by the end of the first week. Full acclimatization (the ability to perform a maximum amount of strenuous work in the heat) is attained most quickly by gradually and progressively increasing work in the heat. The two-week acclimatization period should be allowed regardless of individual physical condition. Supervisors should develop work schedules that provide for increasingly longer work periods alternating with appropriate rest periods.

*(Note: The wet bulb globe temperature (WBGT) index is the key factor in assessing potential for heat stress risks.)*

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**Planning Work Schedules.** Work schedules should be tailored to complete the mission while considering the *climate* and *physical condition* of the workers. Adequate supervisory control is critical in achieving maximum work output with minimum exposure to heat stress. Considerations for developing work schedules include:

- ❖ *Being Aware that the amount of heat produced by the body increases directly with increasing work. Therefore, reduction of workload markedly decreases the total heat stress.*
- ❖ *Ensuring workloads and/or duration of physical exertion are less during the first days of exposure to heat and increasing workloads gradually to allow for acclimatization.*
- ❖ *Planning for and conducting heavy work during the cooler hours of the day such as early morning or late evening.*

- ❖ *Providing alternate work and rest periods.  
Increasing rest periods under severe heat conditions  
(> 90 Deg WBGT Index).*
- ❖ *Providing shaded rest areas when possible and  
closely monitor employees for excessive sweating.*
- ❖ *Not requiring employees to stand in static  
positions for extended periods of time.*
- ❖ *Providing overhead cover and cooling fans.*

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## *Prevention at a Glance*

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- ✓ *Provide cooling fans.*
- ✓ *Use protective shade giving tarps.*
- ✓ *Provide adequate water & fluids.*
- ✓ *Use crushed ice to assist in cooling.*
- ✓ *Apply cool compresses back of neck, armpits, wrists, and groin areas.*
- ✓ *Direct engine exhaust away from work area.*
- ✓ *Keep employees informed and Maintain awareness.*

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## Protective Clothing

Protective clothing helps in protecting the body from heat stress. Employees should wear loose fitting, light colored clothing that allow heat dissipation. The District is beginning a program of providing protective vests, which have reusable, exchangeable cooling pads. The cooling pads are located in at vital areas where blood vessels are large and near the surface of the skin. The application of cooling fluids to the body surface in these vital areas will reduce the body core temperature. The body areas include the back of the neck, wrists, under the arms, and in the groin area. Clothing that has become wet from perspiration should be changed as quickly as possible.



# SUSCEPTIBILITY

The general physical condition of an individual has a significant bearing on the reaction to heat stress. Individuals susceptibility to heat may be enhanced by a variety of conditions including:



*Acute and chronic infection*

*Febrile conditions*

*Reaction to Immunizations*

*Vascular disease*

*Diarrhea*

*Conditions affecting sweat secretion*

*Skin trauma, such as heat rash or acute sunburn*

*Previous heat injury*

*Recent use of alcohol*

*Chronic use of diuretics*

*Dehydration*

*Lack of sleep*

*Fatigue*

*Obesity*

*Poor physical condition*

*Older age*

*Drugs, which inhibit sweating*





## *Key Points for Controlling Heat Stress Risks*

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- ❖ *Learn the signs, symptoms, and treatments for heat-induced illnesses.*
- ❖ *Train the workforce about heat-induced illnesses.*
- ❖ *Perform heaviest work in the coolest part of day.*
- ❖ *Slowly build up tolerance to the heat and the work activity (Acclimatization usually takes up to 2 weeks).*
- ❖ *Use the buddy system (work in pairs).*
- ❖ *Enforce water-drinking policy.*
- ❖ *Wear light, loose-fitting, breathable (like cotton) clothing.*
- ❖ *Take frequent short breaks in cool shaded areas (allow your body to cool down).*



❖ *Avoid eating large meals before working in hot environments.*

❖ *Avoid caffeine and alcoholic beverages (these beverages make the body lose water and increase the risk for heat illnesses).*

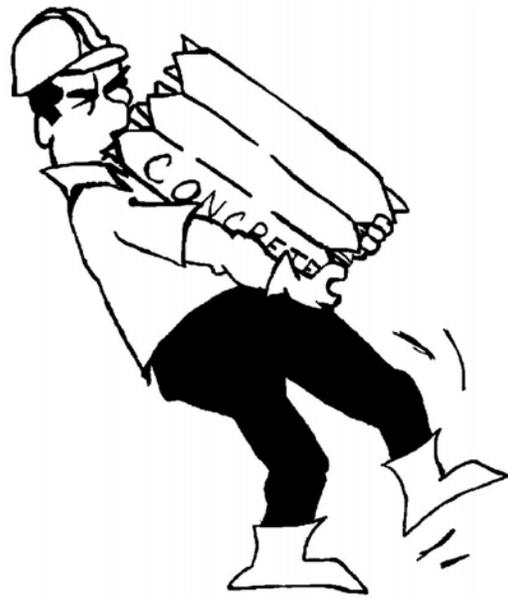
❖ *Identify workers who are highly susceptible to heat stress injuries.*

❖ *Wear the proper protective clothing.*

❖ *Develop work schedule around the local heat risk.*

❖ *Closely monitor the WBGT index at the worksite.*

❖ *Establish heat risk guidelines for subordinates.*



# HEAT INDEX

RELATIVE AIR TEMPERATURE (FAHRENHEIT) *WHAT IT IS*  
 HUMIDITY 70 75 80 85 90 95 100 105 110 115 120

%	APPARENT TEMPERATURE (FAHRENHEIT) <i>WHAT IT FEELS LIKE</i>										
0	64	69	73	78	83	87	91	95	99	<b>103</b>	107
10	65	70	75	80	85	90	95	100	<b>105</b>	111	116
20	66	72	77	82	87	93	99	<b>105</b>	112	120	130
30	67	73	78	84	90	<b>96</b>	<b>104</b>	113	123	135	148
40	68	74	79	86	93	<b>101</b>	110	122	137	151	
50	69	75	81	88	96	<b>107</b>	120	135	150		
60	70	76	82	90	<b>100</b>	114	132	149			
70	70	77	85	93	106	124	144				
80	71	78	86	97	113	136	157				
90	71	79	88	<b>102</b>	122	150	170				
100	72	80	<b>91</b>	108	133	166					

# Outline

## Heat Stress

### 1. INTRODUCTION: (2 minutes)

- a. Objective: (Explain the objective of briefing.)
- b. Reasons: (State why employees need to know about heat stress).
- c. Standards: (State what the employees are expected to learn from the briefing.)

### 2. EXPLANATION: (22 minutes)

- a. Definition of heat stress
- b. Types of heat injuries:
  - (1) Sunburn
  - (2) Heat rash
  - (3) Fainting
  - (4) Heat Cramps
  - (5) Heat Exhaustion (can lead to heat stroke)
  - (6) Heat Stroke (can be fatal)
- c. Prevention, recognition, and treatments (sunburn, heat rash, fainting, heat cramps, heat exhaustion, heat stroke, etc.).

d. Key points for controlling heat hazards

- (1) Knowledge & awareness
- (2) Proper water intake
- (3) Acclimatization to heat
- (4) Developing and enforcing work schedule
- (5) Supervisors & workers team efforts
- (6) Use of proper protective clothing
- (7) Identification of high-risk workers
- (8) Use of Wet bulb globe temperature (WBGT) index

e. Responsibilities

- (1) Supervisors
- (2) Individual workers

3. SUMMARY: (1 minute)

- a. Ask for questions on materials presented.
- b. Summarize key briefing points.
- c. Make closing statement

Briefer \_\_\_\_\_ Location \_\_\_\_\_ No. Attendance \_\_\_\_\_ Time Allotted \_\_\_\_\_