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| Policy Subject: **Heat Stress Guidelines** | Effective Date: 8/1/2011 |
| Area Affected: All students, faculty and staff who work in hot environments | Reviewed/Revised: 2/15/2016 (Rev. 2) |
| Contact Information: Policy Owner: Environmental Health and Safety<br>Subject Matter Expert: EHS Director; Sr. Safety Coordinator | |

## 1.0 Purpose, Applicability, and Scope

1.1 Purpose - The purpose of this procedure is to reduce the risk of illness, injury, or death for those individuals on campus who work in hot environments and are susceptible to heat related illnesses.

1.2 Applicability – This shall apply to all students, staff and faculty on the Knoxville campus of the University of Tennessee.

1.3 Scope – This standard applies to all heat related illnesses as defined in section 2.2 below.

### 2.0 Abbreviations, Acronyms, and Definitions

2.1 Abbreviations/Acronyms

ACGIH-American Conference of Industrial Hygienists
EHS – Environmental Health and Safety
OSHA-Occupational Health and Safety Administration

2.2 Definition

**Heat Cramps** - Painful muscle spasms, as a result of exposure to excess heat. This occurs when a worker drinks a lot of water, but does not replace salts lost from sweating.

**Heat Syncope** - Weakness, fatigue and fainting due to loss of salt and water in sweat and exercise in the heat.

**Heat Exhaustion** – A condition usually caused by loss of body water because of exposure to excess heat. Symptoms include headache, tiredness, nausea, and sometimes fainting.

**Heat Rash**- skin irritation caused by excessive sweating during hot, humid weather.

**Heat Stress:** Relative amount of thermal strain from the environment.

**Heat Stroke** – A serious disorder resulting from exposure to excess heat. It results from sweat suppression and increased storage of body heat. Symptoms include hot dry skin, high temperature, mental confusion, convulsions, and coma. Heatstroke is fatal if not treated properly.

**Natural wet bulb (NWB) temperature** is measured by exposing a wet sensor, such as a wet cotton wick fitted over the bulb of a thermometer, to the effects of evaporation and convection. The term natural refers to the movement of air around the sensor.

## 3.0 Roles and Responsibilities

a. EHS shall:

i. Assist supervisors with providing annual training to employees who work in hot conditions.
ii. Ensure the Heat Stress policy is being followed and revise periodically.
iii. Assist supervisors in determining appropriate engineering and administrative controls in minimizing heat load on employees.
iv. Provide training to employees on heat risk exposure and heat related illnesses if requested by departments.
v. Upon request, can evaluate the workplace for heat stress risk and recommend ways to manage exposure to heat.
vi. Investigate any accidents that occur as a result of heat-related illnesses.

b. Supervisors shall:

i. Recognize heat stress and risk factors.
ii. Provide fluid replacement for employees working under hot conditions.
iii. Identify specific areas in which workers are exposed to or likely to experience significantly hot environments.
iv. Determine tasks and activities that require extensive physical activity in hot environments.
v. Identify those workers whose job duties place them at risk for suffering a heat-related illness.
vi. Identify personal protective equipment or specialized clothing that may increase the heat load on workers.

vii. Review the use of engineering controls such as ventilation systems, cool rest areas, or other items in place at your facility that can reduce the heat load on workers.

viii. Review the use of work practice controls such as periodic rest breaks, work scheduling, or other practices that can reduce the heat load on workers

ix. Provide training for all employees who work under hot conditions.

c. Employees shall:

i. Participate in heat stress training and learn the signs and symptoms of heat stress, as well as risk factors.

ii. Follow all instructions given to reduce risk of heat-related injury.

iii. Monitor themselves and coworkers for signs of heat-related illnesses.

iv. Promptly report any known or suspected unsafe conditions, or unsafe procedures to the supervisor.

**4.0 Procedures**

Heat related illnesses are influenced by several factors, such as: climate and environmental conditions, demands of the work, clothing and personal characteristics. Environmental factors include air temperature, air movement, humidity and radiant heat. Personal characteristics include such factors as age, weight, gender, fitness level, medical condition(s), metabolic heat, diseases, water and salt balance, and medication the employees are taking. A study conducted by NIOSH links the signs of heat stress to an increase in workplace accidents.

The human body regulates high temperatures by two primary mechanisms: blood flow and sweating. Blood is circulated to the skin, increasing the skin temperature and allowing the body to give off the excess heat through the skin. Sweating occurs when the body senses the heat loss due to increased blood circulation is not enough to cool the body. Evaporation of the sweat cools the skin and eliminates large quantities of heat from the body. If the body is unable to release excess heat, it will store it. When this happens, the body's core temperature rises and the heart rate increases. If the body continues to store heat the person may begin to have difficulty concentrating, may become irritable and lose the desire to drink. The next stage is often fainting which would signal a medical emergency. Listed in Table 1 are the common heat disorders with the accompanying symptoms and appropriate first aid measures.

**Table 1:**

The table below illustrates some of the signs and symptoms associated with heat stress. If an employee experiences any of these symptoms, they should be taken for medical treatment immediately.

| Condition | Signs/Symptoms | First Aid |
|---|---|---|
| Heat Cramps | Painful muscle spasms<br>Heavy sweating | Increase Water intake<br>Rest in shade/cool environment |
| Heat Syncope | Brief fainting<br>Blurred vision | Increase Water intake<br>Rest in shade/cool environment |
| Dehydration | Fatigue<br>Reduced movement | Increase Water intake<br>Rest in shade/cool environment |
| Heat Exhaustion | Pale and clammy skin<br>Possible fainting<br>Weakness, fatigue<br>Nausea<br>Dizziness<br>Heavy sweating<br>Blurred vision<br>Body temp slightly elevated | Lie down in cool environment<br>Water intake<br>Loosen clothing<br>Call 911 if symptoms continue once in cool environment. |
| Heat Stroke | Cessation of sweating<br>Skin hot and dry<br>Red face<br>High body temperature<br>Unconsciousness<br>Collapse<br>Convulsions<br>Confusion or erratic behavior<br>Life threatening condition | Medical Emergency!<br>Call University Police to summon ambulance<br>Move Victim to shade, immerse in water |

**CONTROL OF HEAT STRESS:**
The following engineering and administrative controls should be followed to prevent heat-related disorders:

1. **Engineering Controls**: Heat may be controlled through general ventilation and spot cooling by local exhaust ventilation at the point of high heat production. Shielding may be needed for protection against radiant heat sources. Other control measures include opening windows or using fans to create airflow. Outdoor work areas need to have a shaded area accessible to the employees. Shaded areas can be created by using tarps or canopies or equipping tractors with canopies or cabs.
2. **Acclimatization**: Employees need to adapt to new temperatures. This adaptation period is usually 5 days. New employees and employees returning from an absence of two weeks or more should have a 3-5 day period of acclimatization. This period should begin with 50% of the normal workload the first day and gradually build up to 100% on the last day.
3. **Weather Conditions**: Check weather conditions frequently during the day and adjust the work schedule. It might be appropriate to change the actual hours of work to minimize working during the heat of the summer months. Heavy work should be

scheduled for the cooler hours of the day. Non-essential tasks should be postponed when there is a heat warning issued.

4. **Work/Rest Cycles**: Heavy and minimal work activities should be alternated. Tasks should be rotated among workers. Employees should be allowed sufficient breaks in a cool area to avoid heat strain and promote recovery. Shade or an air-conditioned break room should be provided.
5. **Personal Protective Equipment**: During work in hot environments, workers should use the lightest weight or "breathable" protective garments that give adequate protection. This may include the wearing of shorts if this does not create a hazard for the legs. The clothing should be light colored. For work in extremely hot environments, cool vests are available from several manufacturers. These vests typically provide 1-2 hours of cooling, recharge in 20 minutes, and maintain a constant temperature of 55°F.
6. **Fluid Intake**: Fluids, such as water or electrolyte replacement drinks (i.e. Gatorade), need to be conveniently available to workers so they can drink about 8 oz. of liquids every 20 minutes. The ideal temperature for liquids should be 50°F- 60°F. For remote outdoor work locations, this means providing a cooler of liquids and ice that the workers can transport with them to the location. Alcohol, coffee, tea, and caffeinated sodas should be avoided, since these increase dehydration and interferes with heat loss.
7. **Other Administrative Controls:** The following administrative controls can be used to reduce heat stress:
    1. Reduce the physical demands of work, e.g., excessive lifting or digging with heavy objects
    2. Provide recovery areas, e.g., air-conditioned enclosures and rooms
    3. Use shifts, e.g., early morning, cool part of the day, or night work
    4. Use intermittent rest periods with water breaks
    5. Use relief workers and use the buddy system
    6. Slow down pace of work, if needed
    7. Assign extra workers and limit worker occupancy, or the number of workers present, especially in confined or enclosed spaces.
    8. Consider a worker's physical condition when determining fitness to work in hot environments. Taking certain medications, lack of conditioning, obesity, pregnancy, and inadequate rest can increase susceptibility to heat stress.

**Measuring Burden of Heat on Workers:**

Every worker who works in extraordinary conditions that increase the risk of heat stress should be personally monitored. These conditions include wearing semi permeable or impermeable clothing when the temperature exceeds 21°C (69.8°F), working at extreme metabolic loads (greater than 500 kcal/hour), etc. Personal monitoring can be done by checking the heart rate, recovery heart rate, oral temperature, or extent of body water loss.

Heart rate is one of the most reliable indices of heat stress. The heart rate of a worker encompasses the combined demands of work level, body temperature elevation, environmental heat, and cardiovascular fitness. Heat rate increases disproportionately with heat load. A heart rate of 180 to 200 beats per minute is the maximum capacity for adults. A good rule of thumb is as follows: count the pulse rate for the last 30 seconds of the first three minutes after rest begins. If the first pulse (measured for 30-60 second) is maintained at 110 beats per minute, no increasing stress has occurred as the work progresses. If the pulse rate is higher, than 110 beats per minute after measuring the pulse during this period, then there is a possibility that the employee is experiencing some heat stress.

Oral temperature can be checked with a clinical thermometer after work but before the employee drinks water. If the oral temperature taken under the tongue exceeds 37.6°C, shorten the next work cycle by one third.

Body water loss can be measured by weighing the worker on a scale at the beginning and end of each work day. The worker's weight loss should not exceed 1.5% of total body weight in a work day. If a weight loss exceeding this amount is observed, fluid intake should increase.

**Measuring the Environment*:**

EHS can use a WBGT (wet bulb globe thermometer) to access heat stress, using the following equation:

$$WBGT = 0.7NWB + 0.3GT$$

Outdoors with solar load

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

where: WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb (air) Temperature
GT = Globe Thermometer Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer. The measurement of environmental factors shall be performed as follows:

1. The range of the dry and the natural wet-bulb thermometers should be -5°C to +50°C, with an accuracy of ±0.5°C. The dry bulb thermometer must be shielded from the sun and

the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet bulb thermometer should be kept wet with distilled water for at least one-half hour before the temperature reading is made. It is not enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillarity. The wick must be wetted by direct application of water from a syringe one-half hour before each reading. The wick must cover the bulb of the thermometer and an equal length of additional wick must cover the stem above the bulb. The wick should always be clean, and new wicks should be washed before using.

2. A globe thermometer, consisting of a 15 cm (6-inch) in diameter hollow copper sphere painted on the outside with a matte black finish, or equivalent, must be used. The bulb or sensor of a thermometer (range -5°C to +100°C with an accuracy of ±0.5°C) must be fixed in the center of the sphere. The globe thermometer should be exposed at least 25 minutes before it is read.

3. A stand should be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs and the wet-bulb and globe thermometer are not shaded.

4. It is permissible to use any other type of temperature sensor that gives a reading similar to that of a mercury thermometer under the same conditions.

5. The thermometers must be placed so that the readings are representative of the employee's work or rest areas, as appropriate.

Once the WBGT has been estimated, EHS can estimate workers' metabolic heat load and use the ACGIH method to determine the appropriate work/rest regimen, clothing, and equipment needed to control the heat exposures of workers in their facilities.

*Taken from OSHA Technical Manual on Heat Stress

## 5.0 Recordkeeping

EHS and departments will maintain a copy of all training records for a minimum of three years.

Any medical records concerning heat stress related injuries at the workplace will be maintained indefinitely by the affected departments.

## 6.0 Training and Information Requirements

After completing Heat Stress training, employees should understand:

- The seriousness and prevalence of heat stress
- How the body’s internal cooling system handles heat

- How hot environments increase the likelihood of accidents
- How and why the body's internal cooling mechanisms may fail
- The types of heat-related illness they or co-workers most likely face on the job, including their causes, common symptoms and treatment/first aid
- The environmental factors (such as air temperature, radiant heat, humidity and air movement) in a given work area which should cause heightened alert for signs of heat illness
- The work-related factors that increase the risk of heat-related illness (such as type of work, level of physical exertion required, duration of activity and required protective clothing or gear)
- Unique personal factors (such as age, weight, alcohol/caffeine use, history of heat-related illness, etc.) that can put them at increased risk
- Basic preventative measures workers can take to reduce the risk of heat stress

## 7.0 Attachments

Appendix A: Heat Index Chart

## 8.0 Associated Standards

OSHA General Industry - 29 CFR 1910.95

## 9.0 Disclaimer

The information provided in this policy is designed for educational use only and is not a substitute for specific training or experience.

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