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Appendix A  Heat Stress Workplace Hazard Review
I. PURPOSE

The University of Illinois at Urbana-Champaign (U of I), through the Division of Safety and Compliance (S&C), has established this Heat Stress Policy to protect the health of university employees and to assure compliance with State and Federal occupational safety and health standards.

This Policy provides the minimum requirements for unit specific heat stress programs. It is expected that campus units utilizing this Heat Stress Policy will develop unit-specific programs and site-specific written standard operating procedures (SOPs) to complement and meet the requirements in this general policy.

II. POLICY

It is the policy of the U of I to provide its employees with a safe and healthy work environment.

III. SCOPE

The provisions of the Heat Stress Policy shall apply to all employees who have to work in a high heat stress environment on the U of I campus.

IV. REFERENCES

ACGIH Threshold Limit Values and Biological Exposure Indices, Heat Stress and Heat Strain, 2010

OSHA Technical Manual, Section III, Chapter 4, Heat Stress, 1999

V. RESPONSIBILITIES

The Division of Safety and Compliance shall:
A. Develop a written Heat Stress Policy and review it on an annual basis.
B. Conduct hazard evaluations of high heat stress environments upon request and make recommendations as to abatement to ensure adequate protection of employees.
C. Provide campus units with assistance in creating Heat Stress Programs and site-specific SOPs.
D. Assist campus units in the selection of appropriate equipment to abate high heat stress environments.
E. Provide training on heat stress warning signs, abatement tools, and/or methodologies upon request.
Deans, Department Heads, and Directors of academic/administrative units shall:
   A. Ensure that the unit-specific Heat Stress Program meets the requirements of this Heat Stress Policy.
   B. Provide fiscal and administrative resources for the implementation of their unit-specific Heat Stress Program.
   C. Ensure that all personnel within their unit affected by heat stress receive proper training.
   D. Designate a competent person that will be responsible for implementing the unit-specific Heat Stress Program.

Heat Stress Competent Person shall:
   A. Understand the requirements of this Heat Stress Policy and applicable OSHA regulations.
   B. Have the knowledge and/or experience to create, maintain, revise, implement, and enforce the unit-specific Heat Stress Program.
   C. Attend training.
   D. Identify personnel who require heat stress training.
   E. Train or arrange training for all affected personnel on the requirements of the unit-specific Heat Stress Program.
   F. Ensure that the requirements of the unit-specific Heat Stress Program are followed.
   G. Maintain a training record for all employees that have been trained in the components of the unit-specific Heat Stress Program.

Supervisors of employees who may be required to comply with the unit-specific Heat Stress Program shall:
   A. Attend training on the requirements of the unit-specific Heat Stress Program.
   B. Identify personnel who require heat stress training and ensure that they have received the proper training before allowing work to commence in a heat stress environment.
   C. Understand and follow the protocols of this Heat Stress Policy, unit-specific Heat Stress Program, and site-specific standard operating procedures.
   D. Ensure that the requirements of the unit-specific Heat Stress Program are followed.

Affected employees shall:
   A. Attend training on the requirements of the unit-specific Heat Stress Program.
   B. Know and understand the hazards and warning signs of heat stress.
   C. Understand and follow the protocols of this Heat Stress Policy, unit-specific Heat Stress Program, and site-specific standard operating procedures.

VI. DEFINITIONS

Conduction is the transfer of heat between materials that contact each other. Heat passes from the warmer material to the cooler material. For example, a worker's skin can transfer heat to a contacting surface if that surface is cooler, and vice versa.
**Convection** is the transfer of heat in a moving fluid. Air flowing past the body can cool the body if the air temperature is cool. On the other hand, air that exceeds 35°C (95°F) can increase the heat load on the body.

**Evaporative cooling** 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** is a measure of energy in terms of quantity.

**Heat collapse** is a loss of consciousness caused by excessive heat stress.

**Heat cramps** are painful muscle cramps caused by excessive sweating.

**Heat exhaustion** is a condition marked by dizziness, nausea, and weakness caused by excessive heat stress.

**Heat fatigue** is a feeling of weakness brought on by excessive heat stress.

**Heat rash** is the result of the obstruction of the sweat ducts during high heat and humidity causing a breakout on the skin.

**Heat stroke** is the loss of the body’s ability to cool itself.

**Metabolic heat** is a by-product of the body's activity.

**Radiation** is the transfer of heat energy through space. A worker whose body temperature is greater than the temperature of the surrounding surfaces radiates heat to these surfaces. Hot surfaces and infrared light sources radiate heat that can increase the body's heat load.

**Wet Bulb Globe Temperature (WBGT)** is a composite temperature taking into account air temperature, radiant heat, air movement, and humidity to determine the level of heat stress placed upon an individual.

**VII. GENERAL REQUIREMENTS**

Preventative Measures & Mitigation Strategies

- A. These guidelines apply to acclimatized workers who are adequately hydrated, are not taking medication, and are otherwise healthy.
- B. Acclimatization
  - i. The human body can adapt to heat exposure to some extent. This physiological adaptation is called acclimatization. After a period of acclimatization, the same activity will produce fewer cardiovascular demands. The worker will sweat more efficiently (causing better evaporative cooling), and thus will more easily be able to maintain normal body temperatures.
ii. To acclimatize properly work must be performed at least 2 continuous hours under heat stress conditions on 5 of the last 7 days. De-acclimatization occurs when no heat stress work is done in the last 3 weeks.

C. Fluid Replacement
   i. Cool (50°-60°F) water or any cool liquid (except alcoholic beverages) should be made available to workers. Encourage workers to drink small amounts frequently, e.g., one cup every 20 minutes.
   ii. Ample supplies of liquids should be placed close to the work area. Although some commercial replacement drinks contain salt, this is not necessary for acclimatized individuals because most people add enough salt to their summer diets.

D. Special Considerations Controls
   i. Engineering Controls
      1. General ventilation can be used to dilute hot air with cooler air (generally cooler air that is brought in from the outside). This technique clearly works better in cooler climates than in hot ones. Portable or local exhaust systems may be more effective or practical in smaller areas.
      2. Air conditioning is a method of air cooling, but it is expensive to install and operate. An alternative to air conditioning is the use of chillers to circulate cool water through heat exchangers over which air from the ventilation system is then passed; chillers are more efficient in cooler climates or in dry climates where evaporative cooling can be used.
      3. Local air cooling can be effective in reducing air temperature in specific areas. Two methods have been used successfully in industrial settings. One type, cool rooms, can be used to enclose a specific workplace or to offer a recovery area near hot jobs. The second type is a portable blower with built-in air chiller.
      4. Convection (i.e. using fans, etc.) in the work area is another way to reduce heat stress by increasing the air flow (as long as the air temperature is less than the worker's skin temperature). Changes in air speed can help workers stay cooler by increasing both the convective heat exchange (the exchange between the skin surface and the surrounding air) and the rate of evaporation. Because this method does not actually cool the air, any increases in air speed must impact the worker directly to be effective. When the temperature exceeds 35°C (95°F) and the relative humidity is 100%, air movement will make the worker hotter. When the temperature is more than 35°C and the air is dry, evaporative cooling may be improved by air movement, although this improvement will be offset by the convective heat. Increases in air speed have no effect on the body temperature of workers wearing vapor-barrier clothing.
      5. Heat conduction methods include insulating the hot surface that generates the heat and changing the surface itself.
      6. Heat shielding can be used to reduce radiant heat, i.e. heat coming from hot surfaces within the worker's line of sight. Surfaces that
exceed 35°C (95°F) are sources of infrared radiation that can add to the worker's heat load. Flat black surfaces absorb heat more than smooth, polished ones. Having cooler surfaces surrounding the worker assists in cooling because the worker's body radiates heat toward them. With some sources of radiation, such as heating pipes, it is possible to use both insulation and surface modifications to achieve a substantial reduction in radiant heat. Instead of reducing radiation from the source, shielding can be used to interrupt the path between the source and the worker. Polished surfaces make the best barriers, although special glass or metal mesh surfaces can be used if visibility is a problem. Shields should be located so that they do not interfere with air flow, unless they are also being used to reduce convective heating. The reflective surface of the shield should be kept clean to maintain its effectiveness.

ii. Administrative Controls
1. Routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year.
2. Training employees on heat related stress hazards, symptoms, and mitigation strategies.
3. Reduce the physical demands of work by using powered tools, e.g., excessive lifting or digging with heavy objects – use backhoe, etc.
4. Use shifts, e.g., early morning, cool part of the day, or night work
5. Use intermittent rest periods with water breaks
6. Use relief workers
7. Use worker pacing; e.g. assign extra workers and limit worker occupancy, or the number of workers present, especially in confined or enclosed spaces.

iii. Personal Protective Equipment
1. **Reflective clothing** which can vary from aprons and jackets to suits that completely enclose the worker from neck to feet can stop the skin from absorbing radiant heat. However, since most reflective clothing does not allow air exchange through the garment, the reduction of radiant heat must more than offset the corresponding loss in evaporative cooling. For this reason, reflective clothing should be worn as loosely as possible. In situations where radiant heat is high, auxiliary cooling systems can be used under the reflective clothing.

2. **Ice vests**, though heavy, may accommodate as many as 72 ice packets, which are usually filled with water. Carbon dioxide (dry ice) can also be used as a coolant. The cooling offered by ice packets lasts only 2 to 4 hours at moderate to heavy heat loads, and frequent replacement is necessary. However, ice vests do not encumber the worker and thus permit maximum mobility. Cooling with ice is also relatively inexpensive.

3. **Wetted clothing** is effective when reflective or other impermeable protective clothing is worn. The clothing may be wetted terry cloth coveralls or wetted two-piece, whole-body cotton suits. This
approach to auxiliary cooling can be quite effective under conditions of high temperature and low humidity, where evaporation from the wetted garment is not restricted.

4. **Water-cooled garments** range from a hood, which cools only the head, to vests and "long johns," which offer partial or complete body cooling. Use of this equipment requires a battery-driven circulating pump, liquid-ice coolant, and a container. Although this system has the advantage of allowing wearer mobility, the weight of the components limits the amount of ice that can be carried and thus reduces the effective use time. The heat transfer rate in liquid cooling systems may limit their use to low-activity jobs; even in such jobs, their service time is only about 20 minutes per pound of cooling ice. To keep outside heat from melting the ice, an outer insulating jacket should be an integral part of these systems.

Heat Disorders and Health Effects

A. Heat Cramps
   i. Causes
      1. Heat cramps have been attributed to an electrolyte imbalance caused by sweating. Cramps can also be caused by both too much and too little salt.
   ii. Signs and Symptoms
      1. Muscle spasms in the abdomen, arms, and calves.
   iii. Treatment
      1. 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.
      2. Under extreme conditions, recent studies have shown that drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

B. Heat Collapse ("Fainting")
   i. Causes
      1. The brain does not receive enough oxygen because blood pools in the extremities. The onset of heat collapse is rapid and unpredictable.
   ii. Signs and Symptoms
      1. Loss of consciousness.
   iii. Treatment
      1. The worker should gradually become acclimatized to the hot environment. Work at least 2 consecutive hours under heat stress on 5 of the last 7 days for proper acclimatization.

C. Heat Exhaustion
   i. Causes
      1. Exposure to heat stress for prolonged periods of time without sufficient recovery periods and/or mitigation strategies.
   ii. Signs and Symptoms
      1. Include headache, nausea, vertigo, weakness, thirst, and giddiness.
   iii. Treatment
1. This condition responds readily to prompt treatment. Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, a medical emergency.

2. Workers suffering from heat exhaustion should be removed from the hot environment and given fluid replacement. They should also be encouraged to get adequate rest.

D. Heat Fatigue
   i. Causes
      1. Lack of acclimatization.
   ii. Signs and Symptoms
      1. Impaired performance of skilled sensorimotor, mental, or vigilance jobs.
   iii. Treatment
      1. The use of a program of acclimatization and training for work in hot environments is advisable. There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops.

E. Heat Rash
   i. Causes
      1. Heat rash (prickly heat) is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated.
   ii. Signs and Symptoms
      1. Marked by small and itchy rash on the skin.
   iii. Treatment
      1. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

F. Heat Stroke
   i. Causes
      1. 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.**
   ii. Signs and Symptoms
      1. Confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature.
   iii. Treatment
      1. **If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately.**
Heat Stress Guidelines

2. The worker should be placed in a shady area and the outer clothing should be removed.
3. 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.
4. Fluids should be replaced as soon as possible.
5. Regardless of the worker's protests, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.
6. Overall, the medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment. Seek professional medical treatment immediately.

Investigative Guidelines to Determine the Severity Hazard of Heat Stress
A. The investigator shall review the campus unit's OSHA 300 Log for indications of prior heat stress problems.
B. The investigator shall conduct employer/employee interviews.
C. Employer interview questions:
   i. What type of action has the campus unit taken to prevent heat stress problems?
   ii. What are the potential sources of heat?
   iii. What employee complaints have been made concerning heat stress?
D. Employee interviews:
   i. What heat stress problems have been experienced?
   ii. What type of action has the employee taken to minimize heat stress?
   iii. What is the campus unit's involvement in the mitigation of heat stress?
   iv. Does employee training include information on heat stress?
E. During the walk around inspection, the investigator shall:
   i. Verify information obtained from the employer and employee interviews.
   ii. Perform heat stress measurements using the WBGT and make other determinations to identify potential sources of heat stress. The walk around inspection should cover all affected areas.
   iv. The checklist in APPENDIX A should be used as a supplement to the other investigative methods listed above in evaluating heat stress hazards in work environments.

Heat Stress Load Assessment
These guidelines apply to acclimatized workers who are adequately hydrated, are not taking medication, and are otherwise healthy. For workers who do not meet these conditions, special evaluation is needed.
A. Normal Work Clothes - The WBGT levels given below are for workers in long-sleeve shirt and long pants. For clothes other than normal work clothes, add to the measured WBGT reading:
   i. Coveralls – add 2°F (1°C)
   ii. Double-layers – add 5°F (3°C)
iii. Waterproof coveralls – add 20°F (11°C)

B. Workload Examples - Workload levels given in the table correspond to the following examples:
   i. Light work: sitting or standing with easy arm work, driving, minimal walking
   ii. Moderate work: arm or leg work, pushing a light load, normal walking
   iii. Heavy work: work involves the trunk, such as shoveling, sawing, pulling heavy loads
   iv. Very heavy work: fast, heavy activity, such as continuous shoveling of heavy materials

<table>
<thead>
<tr>
<th>WBGT °C</th>
<th>WBGT °F</th>
<th>Work Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Light</td>
</tr>
<tr>
<td>27.5</td>
<td>81</td>
<td>15 min of rest per hour</td>
</tr>
<tr>
<td>28</td>
<td>82</td>
<td>15 min of rest per hour</td>
</tr>
<tr>
<td>29</td>
<td>84</td>
<td>30 min of rest per hour</td>
</tr>
<tr>
<td>30</td>
<td>86</td>
<td>45 min of rest per hour</td>
</tr>
<tr>
<td>30.5</td>
<td>87</td>
<td>15 min of rest per hour</td>
</tr>
<tr>
<td>31</td>
<td>88</td>
<td>45 min of rest per hour</td>
</tr>
<tr>
<td>31.5</td>
<td>89</td>
<td>30 min of rest per hour</td>
</tr>
<tr>
<td>32</td>
<td>90</td>
<td>45 min of rest per hour</td>
</tr>
<tr>
<td>32.5</td>
<td>91</td>
<td>45 min of rest per hour</td>
</tr>
</tbody>
</table>

C. Worker Monitoring
   i. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.
   ii. The recovery heart rate can be checked by comparing the pulse rate taken at 30 seconds ($P_3$) with the pulse rate taken at 2.5 minutes ($P_2$) after the rest break starts. The two pulse rates can be interpreted using the following table:

<table>
<thead>
<tr>
<th>Heart rate recovery pattern</th>
<th>$P_3$</th>
<th>Difference between $P_1$ and $P_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfactory recovery</td>
<td>&lt;90</td>
<td>--</td>
</tr>
<tr>
<td>High recovery (Conditions may require further study)</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>No recovery (May indicate too much stress)</td>
<td>90</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>

D. Special Considerations - When WBGT limits cannot be met by work/rest routines alone, special considerations must be used, such as those listed above under “Special Considerations Controls.”
# APPENDIX A
## HEAT STRESS WORKPLACE HAZARD REVIEW

### General Information

**Area Description:**

**Heat stress incidents from OSHA 300 log:**

**Previous history (if any) of heat-related problems:**

**Weather at Time of Review:**

**Day typical of recent weather conditions?** □ Yes □ No

**Outside WBGT:**

**Inside WBGT:**

**Heat-producing equipment/processes:**

**Type of heat source(s):**

**At "hot" spots:**

- Is the heat steady or intermittent? __________________
- Number of employees exposed? ______________________
- For how many hours per day? ________________________

### Heat Stress Controls

**Ventilation operating?** □ Yes □ No □ N/A

**Air conditioning operating?** □ Yes □ No □ N/A

**Fans operating?** □ Yes □ No □ N/A

**Shields/insulation between heat and employees?** □ Yes □ No □ N/A

**Are reflective faces of shields clean?** □ Yes □ No □ N/A

**Acclimatization program?** □ Yes □ No

**Work/rest schedule?** □ Yes □ No

**Liquid replacement program?** □ Yes □ No

**Work scheduling (cooler parts of shift, etc.)** □ Yes □ No

**Cool rest areas?** □ Yes □ No

**Heat monitoring program?** □ Yes □ No

**Ice and/or water-cooled garments in use?** □ Yes □ No □ N/A

**Wetted undergarments (used with reflective or impermeable clothing) in use?** □ Yes □ No □ N/A

**Reflective clothing in use?** □ Yes □ No □ N/A

**Other heat-reducing engineering controls:**

**Procedures for getting medical attention?** □ Yes □ No

**Are supervisors trained in heat stress?** □ Yes □ No

**Employees trained in heat stress?** □ Yes □ No

**Suggested heat stress control measures:**

**Inspector:** ___________________________  **Date:** __________________