

CHAPTER 42 – TEMPERATURE EXTREMES: HEAT

A. INTRODUCTION	1
B. CHAPTER-SPECIFIC ROLES AND RESPONSIBILITIES	1
1. Safety Coordinator	1
2. Supervisors	1
3. Employees	2
4. The Office of Safety, Health, and Environmental Management (OSHEM)	3
C. HAZARD IDENTIFICATION	3
1. General	3
2. Recognition of Heat Disorders	4
D. HAZARD CONTROL	6
1. Exposure Monitoring	6
2. Engineering Controls.....	6
3. Safe Work Practices.....	7
4. Personal Protective Equipment (PPE)	8
5. Emergency Procedures.....	8
E. TRAINING	10
F. RECORDS AND REPORTS.....	10
G. REFERENCES	11
<u>Attachment 1 – Employee Heat Stress Exposure Monitoring Form</u>	12
<u>Attachment 2 – Initial Work/Rest Monitoring Cycles</u>	13
<u>Attachment 3 – Effects on Skin in Contact with surfaces at Different Temperatures</u>	14

CHAPTER 42 – TEMPERATURE EXTREMES: HEAT

A. INTRODUCTION

1. It is the policy of the Smithsonian Institution (SI) to control employee exposure to heat temperature extremes, protect personnel from the adverse effects of working in hot environments, and protect personnel from possible heat-related disorders.
2. This Chapter applies to all SI operations where ambient temperatures exceed 90 degrees Fahrenheit (90°F) for personnel wearing regular work clothes, and where ambient temperatures exceed 70°F for personnel wearing personal protective equipment (PPE) excluding ear plugs.
3. The information contained in this Chapter is based primarily on the American Conference of Governmental Industrial Hygienists (ACGIH) “Threshold Limit Values for Chemical Substances and Physical Agents, and Biological Exposure Indices,” latest edition. The “Thermal Stress” section outlines the generally accepted standards for the evaluation and control of heat stress.
4. Replacement fluids. “Sports Fluids” are popularized in TV sporting events. These are known to be healthy, young, in-shape individuals, who are exerting themselves at maximum intensity for hours. However, the electrolytes and glucose they contain may be medically harmful to those who are trying to control their hypertension, those with borderline congestive heart failure, or diabetics. Since the supervisors don’t know these particulars about their work crew, just plain water is the safest thing to provide. It was in vogue to hand out salt tablets 25 years ago. For the above reasons, that is no longer done.

B. CHAPTER-SPECIFIC ROLES AND RESPONSIBILITIES

1. Safety Coordinators shall:
 - a. Assist supervisors with monitoring ambient temperatures and determining heat stress risk. Refer to Section D.1 of this Chapter, for threshold temperature information.
 - b. Assist supervisors with the implementation of changes recommended by OSHM to reduce employee’s potential for developing heat-related disorders.
 - c. With assistance from OSHM medical professionals, train supervisors on the detection of early signs of heat stress, and train employees on heat stress recognition, prevention, and control measures prior to working in a hot environment.
2. Supervisors shall:

- a. Identify employees who will be potentially exposed to temperature extremes to the Safety Coordinator. Employees/activities affected by hot temperatures may include (but are not limited to):
 - (1) Construction – outdoor work or performing renovation work in areas where the air-conditioning/ventilation has been turned off;
 - (2) Maintenance – outdoor work or performing renovation work in areas where the air-conditioning/ventilation has been turned off;
 - (3) Outdoor work (e.g., landscaping, outdoor pesticide application, animal care)
 - (4) Employees who must wear chemical protective clothing;
 - (5) Work in kitchens or bakeries;
 - (6) Work near boilers, heated pipelines, or in steam tunnels.
 - b. Receive initial and seasonal refresher training on the detection of early signs of heat stress and first aid for initial response to cold stress disorders.
 - c. Educate employees to the symptoms of heat stress. Conduct safety briefings regarding health hazards and control measures associated with heat stress whenever conditions require the implementation of heat stress monitoring. Permit employees to interrupt their work if they demonstrate signs of overheating or extreme discomfort.
 - d. In a heat-related emergency:
 - (1) Notifies local emergency medical services (EMS) transport to a local emergency room.
 - (2) Notifies OSHEM Occupational Health Services Division (OHSD) and Office of Protection Services (OPS) that EMS has been called.
 - (3) Provides heat stress disorder first aid until EMS arrives.
 - e. Monitor ambient air conditions to determine applicable work/rest regimens.
 - f. Encourage employees to notify OSHEM OHSD if they are taking medication that increases heat intolerance, or has an underlying medical condition that is adversely affected by heat. OSHEM OHSD will work with SI management with a need to know to explore accommodation venues.
 - g. Ensure employees have access to drinking water and.
 - h. 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.
3. Employees shall:
- a. Notify their supervisor if they believe they are being exposed to temperature extremes through regular work practices, or when a change in work practices increases exposure to temperature extremes.

- b. Consult with OSHEM OHSD's physician or physician assistant if medications are taken or an underlying medical condition develops that is adversely affected by heat. OHSD can recommend a disposition on the employee's suitability to work in a hot environment.
 - c. Receive training on heat stress recognition, prevention, and control measures prior to working in a hot environment.
 - d. Follow safe work practices specified in this Chapter.
 - e. Wear personal protective equipment as specified in this Chapter.
4. Office of Safety, Health, and Environmental Management (OSHEM) shall:
- a. At the request from Safety Coordinators and Supervisors, initially evaluate work areas/activities that may be affected by temperature extremes.
 - b. Recommend changes to the work environment, as needed, to reduce employees' potential for developing heat-related disorders.
 - c. On request from the supervisor or employee, determine an employee's fitness for working in hot environments, considering risk factors including (but not limited to): general health, age, acclimatization, degree of hydration or water intake, alcohol/caffeine consumption, obesity, low physical work capacity, recent blood donation, pregnancy, and medications, if known. OSHEM OHSD will work with SI management with a need to know to explore accommodation venues.
 - d. When requested, OSHEM OHSD advises supervisor of medical determination. Decision to accommodate employee's condition lies with coordination of SI management official (s) with a need to know.
 - e. Provides emergency room interface after hospital evaluation.

C. HAZARD IDENTIFICATION

1. General. Supervisors will evaluate, with the assistance of Safety Coordinators, work operations to determine employee's exposure to heat and temperature extremes, as part of the Job Hazard Analysis (JHA, refer to [Chapter 4, "Safety Risk Management Program"](#), of this *Manual*).
- a. Four environmental factors affect the amount of heat stress employees face in a hot work area:
 - (1) Temperature;
 - (2) High humidity impedes evaporation and cooling;
 - (3) Direct radiant heat (e.g., from the sun or a furnace) and
 - (4) Air velocity/movement.
 - b. Five personal characteristic factors also affect the amount of stress employee's face in a hot work area:

- (1) Age;
 - (2) Weight;
 - (3) Level of physical fitness;
 - (4) Underlying medical condition(s) and/or medications; and
 - (5) Acclimatization to the heat. Acclimatization is the process by which the body adapts to heat exposure gradually; it can take 3-6 days of regular work, for at least 2 hours per day, to become acclimatized.
2. Recognition of Heat Disorders. Heat issues are medical emergencies that can quickly result in heat stroke. Symptoms must be readily identifiable and prompt first aid or referral made to reduce the temperature quickly and safely. The following information must be clear and readily accessible to those needing immediate first aid/referral directions to prevent heat stroke.
- a. Your body reacts to high heat situations by circulating blood to your skin, which increases skin temperature and allows the body to give off its excess heat through your skin. However, if muscles are being used for physical labor, less blood is available to flow to the skin and release heat.
 - b. Sweating is another method your body uses to give off its excess heat. However, sweating is effective only if the humidity levels is low enough to permit evaporation, and if body fluids lost are adequately replaced.
 - c. If your body cannot dispose of excess heat, it will store it. When heat is stored in your body your core temperature rises and your heart rate increases. As your body continues to store heat, you may begin to experience a heat-related disorder.
 - d. Heat-induced occupational illnesses, injuries, and reduced productivity may occur with excessive exposure to a hot work environment. The heat stress disorders outlined below are listed from the least serious to the most serious disorder; death is possible if the person is not removed from the heat stress situation (refer to [Attachment 3](#) for skin burns). Heat-induced disorders include:
 - (1) Heat rash – (prickly heat) may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. It occurs in skin that is persistently wetted by unevaporated sweat. It appears as red papules (elevated skin lesion), usually in areas where the clothing is restrictive. Heat rash gives rise to a prickly sensation, particularly as sweating increases. The papules may become infected unless treated.
 - (2) Transient heat fatigue – loss of concentration, difficulty focusing on a task, irritability, nausea, loss of the desire to drink.
 - (3) Fainting – (heat syncope) may be a problem for employees unacclimatized to a hot environment who stand still/in one place in the

heat. Refer to Section C.2(c) (6) of this Chapter for acclimatization information.

- (4) Heat cramps - painful spasms of the muscles caused when employees drink large quantities of water but fail to replace body electrolyte loss. Tired muscles (used for performing the work) are usually the ones most susceptible to cramps. Cramps may occur during or after working hours. Such individuals can be referred to OHS for evaluation to see if it is medically appropriate for them to use "Sports Drink" in hot weather work.
- (5) Heat exhaustion - results from loss of fluid through sweating when an employee has failed to drink enough fluids. Blood collects near the skin in an effort to rid the body of excess heat. Severe cases may require treatment under medical supervision. Symptoms of heat exhaustion include: such individuals can be referred to OHS for evaluation to see if it is medically appropriate for them to use "Sports Drinks" in hot weather work.
 - (a) Rapid and shallow breathing;
 - (b) Weak pulse;
 - (c) Cold and clammy skin, with heavy perspiration;
 - (d) Skin appears pale;
 - (e) Fatigue, weakness, and/or dizziness, and
 - (f) Slightly elevated body temperature.
- (6) Heat stroke - occurs when an individual is exposed to excessive heat and their body systems become overwhelmed by heat and begins to stop functioning. Heat stroke is the most serious form of heat stress. This condition is a *medical emergency*, requiring the immediate cooling of the victim and immediate medical attention. Heat stroke may cause brain damage and death if the victim is not cooled quickly. Calling 911 for immediate transport to the nearest E.D. is called for. The symptoms of heat stroke include one or more of the following:
 - (a) Mental confusion
 - (b) Victim has stopped sweating;
 - (c) Dry, hot, red skin;
 - (d) Body temperature approaching or above 105°F;
 - (e) Dilated (large) pupils; and
 - (f) Loss of consciousness; victim may lapse into a coma.

d. Additional Heat Stress Concerns

- (1) In addition to heat-induced disorders, heat poses the threat of injuries because of accidents caused by slippery palms as a result of sweating, fogged up safety glasses, irritability, and dizziness.
- (2) Long Term Exposure to Sun. Sunlight contains ultraviolet (UV) radiation, which causes premature aging of the skin, cataracts, and skin cancer. The amount of damage from UV exposure depends on the strength of the light, the length of exposure, and whether the skin is protected. There are no safe UV rays or safe suntans. Refer to Section C.4 (a) of this Chapter for information on UV protection measures.

D. HAZARD CONTROL

1. Exposure Monitoring

- a. The supervisor shall monitor ambient temperatures and conduct heat stress monitoring when threshold temperatures are reached. Threshold temperatures are defined as:
 - (1) When ambient temperatures exceed 90°F for personnel wearing regular work clothes, and
 - (2) When ambient temperatures exceed 70°F for personnel wearing PPE.
- b. Supervisors will oversee that employees monitor themselves for heat stress using a heart rate (pulse) or body temperature technique. All results of employee monitoring will be documented on a [Heat Stress Monitoring Form \(refer to Attachment 1\)](#). Thermometers for self-checks may be placed at work sites.

2. Engineering Controls will be implemented to reduce risk, when feasible, and will include such measures as:

- a. General ventilation and spot cooling by local exhaust ventilation at points of high heat production. Use cooling fans to reduce heat in hot conditions. Using fans, etc., in the work area will cool employees as long as the air temperature is less than the worker's skin temperature. Changes in air speed may help employees 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 employee directly to be effective. If the dry bulb temperature is higher than 95°F, hot air passing over skin may actually make the employee hotter.
- b. Evaporative cooling and mechanical refrigeration will reduce heat.

- c. Equipment modifications, such as eliminating steam leaks and shielding as protection from radiant heat sources should be considered.
 - d. The use of cooling vests to reduce core body temperature in hot conditions.
3. Safe Work Practices will be implemented to combat the effects of heat temperature extremes, such as changes in work schedules and practices will help combat the effects of exceedingly hot and humid weather. This can include:
- a. Providing plenty of drinking water, as much as a quart per employee per hour, at the workplace can help reduce the risk of heat disorders.
 - (1) Do not use “community cups;” use disposable cups.
 - (2) Drink 16 ounces of fluid prior to beginning work (e.g., at the start of the shift and after lunch), and then approximately 1 cup every 15 minutes. Do not wait until you are thirsty to drink.
 - b. Employees are to take frequent short breaks in the shade or in a cool area. Set up/provide a relatively cool, shaded area for breaks when the ambient temperatures exceed 90°F for personnel wearing regular work clothes, and when ambient temperatures exceed 70°F for personnel wearing PPE, excluding the use of ear plugs. An un-air-conditioned vehicle is not a rest area; vehicles become very hot if parked outside in hot weather.
 - c. Local work conditions and the use of personal protective clothing may produce an environment that will require restricted work schedules in order to protect employees. Adaptation of work schedules and training on recognition of heat stress conditions should help prevent heat-related illnesses from occurring.
 - (1) Establish work and rest periods with longer rest periods in a cool area. [Attachment 2 provides “Initial Work/Rest Monitoring Cycles.”](#)
 - (2) If possible, heavy work shall be scheduled during the cooler parts of the day.
 - (3) Work in the shade as much as possible or in the cooler morning or evening hours.
 - d. Avoid heavy meals, caffeine, large amounts of sugar, and alcohol.
 - e. To prevent heat rash, shower after work, dry off thoroughly, and put on clean, dry underwear and clothes.
 - f. Train first aid personnel to recognize and treat heat stress disorders. Refer to Section D.5 of this Chapter for first aid procedures.
 - g. Supervisors shall be trained to detect early signs of heat stress and should permit employees to interrupt their work if they are overheated/extremely uncomfortable.

- h. Acclimatization is the process by which the body adapts to heat exposure gradually. It can take 3-6 days of regular work, for at least 2 hours/day to become acclimatized. Acclimatization to the heat through short exposures, followed by longer periods of work in the hot environment, can reduce heat stress.
 - (1) Allow new employees and employees returning from an absence of one week or more to become acclimatized to the heat (three to six days).
 - (2) This period should begin with 50 percent of the normal workload and time exposure the first day and building up to 100 percent of the normal workload by the last day of acclimatization.
- 4. Personal Protective Equipment (PPE) if work is performed in an environment exceeding 90°F, employees are to wear appropriate clothing and other measures to prevent heat stress. These are to include, but are not limited to:
 - a. BLOCK OUT UV RAYS
 - (1) Cover up - wear light colored tightly-woven clothing that blocks out light. Place your hand between a single layer of the clothing and a light source. If you can see your hand through the fabric, the garment offers little protection.
 - (2) Use sunscreen - a sun protection factor (SPF) of at least 15 blocks 93 percent of UV rays. Block both UV-A and UV-B rays to guard against skin cancer. Follow the sunscreen application directions.
 - (3) Wear a loose fitting hat - a wide brim non-constricting hat (not a baseball cap) is best because it protects the neck, ears, eyes, forehead, nose, scalp and promotes sweat evaporation to cool the head.
 - (4) Wear UV-absorbent shades - sunglasses should block 99 to 100 percent of UV-A and UV-B radiation.
 - (5) Limit exposure - UV rays are most intense between 10 a.m. and 4 p.m.
 - b. PPE for USE in HOT ENVIRONMENTS - Supervisors should consider the use of personal cooling devices as another way of reducing the hazards of heat exposure to employees.
- 5. Emergency Procedures. Heat related disorders can escalate into medical emergencies quickly. When in urban areas where Emergency Medical Services (EMS) is readily available to transport victims of heat related disorders to a hospital facility, immediate first aid cooling measures until EMS arrives are imperative. Move to shade or cool indoor environment. Loosen or remove clothing. Pour cool, not cold, water over body. Prohibit shivering. If victim begins to shiver, cover body until shivering subsides and then remove cover. Hospital facilities have current protocols, procedures, and equipment for dealing effectively with life-threatening emergencies.

- a. HEAT RASH
 - (1) Rest in a cool, shaded area
 - (2) Loosen or remove heavy clothing and PPE.
 - (3) Allow the skin to dry.
 - (4) Seek medical attention for treatment of rash.
- b. TRANSIENT HEAT FATIGUE and FAINTING (HEAT SYNCOPE)
 - (1) Rest lying down in a cool, shaded area
 - (2) Loosen or remove heavy clothing and PPE.
 - (3) Drink water and/or electrolyte replacement fluids (e.g. Gatorade, Squincher, or 10K) if the individual does not have a hypertension, borderline congestive heart failure or diabetes.
 - (4) The individual should recover within an hour.
- c. HEAT CRAMPS
 - (1) Rest in a cool, shaded area
 - (2) Loosen or remove heavy clothing and PPE.
 - (3) Drink water and/or electrolyte replacement fluids (e.g. Gatorade, Squincher, or 10K) if the individual does not have a hypertension, borderline congestive heart failure or diabetes.
 - (4) Gently massage the cramped muscle.
 - (5) The individual should recover within half an hour.
- d. HEAT EXHAUSTION
 - (1) Leave the hot work area immediately.
 - (2) Rest lying down in a cool, shaded area
 - (3) Loosen or remove heavy clothing and PPE.
 - (4) Drink water and/or electrolyte replacement fluids (e.g. Gatorade, Squincher, or 10K) if the individual does not have a hypertension, borderline congestive heart failure or diabetes.
 - (5) Do not attempt to return to work that day.
- e. If the individual has not recovered within half an hour, then transport the victim to the hospital for medical attention.
- f. HEAT STROKE
 - (1) Heat stroke is a medical emergency, requiring the immediate cooling of the victim, and transport to the hospital for medical treatment immediately. Contact emergency response personnel immediately, and while waiting for medical assistance:

- (a) Move the victim from the hot work area immediately.
- (b) Have the victim rest lying down in a cool (inside), or nearby shaded outside area.
- (c) Loosen or remove heavy clothing and PPE.
- (d) Fan and mist the victim with water, or place wet towels on them.
- (e) Place an ice bag on the victim's forehead.
- (f) Stay with the victim until EMS arrives. Do not leave the victim unattended at any time.

E. TRAINING

1. On request, employees shall be trained by OSHEM OHSD in heat stress recognition, prevention, and control measures prior to working in a hot environment. Employee training is important so that employees are aware of the need to replace fluids lost through sweating, and can recognize dehydration, heat rash, exhaustion, fainting, heat cramps, heat exhaustion, and heat stroke as heat disorders.
2. Supervisors who task employees in extremes of heat and cold shall be trained by OSHEM to monitor ambient temperatures, and to conduct first aid, to be aware of early signs of heat stress in their employees and conduct heat stress monitoring.
3. Supervisors shall conduct safety briefings regarding health hazards and control measures associated with heat stress whenever conditions require the implementation of heat stress monitoring.
4. Include supervisor and employee initial and seasonal refresher training as well as supervisor monitoring for cold stress in the Job Hazard Analysis (JHA).

F. RECORDS AND REPORTS

1. Records of training are to be maintained for 5 years, per [Chapter 8, "Program Reporting and Recordkeeping Procedures"](#), of this *Manual*.
2. Employee health monitoring results should be maintained in the electronic medical record database.
3. Include supervisor and employee training as well as supervisor monitoring for heat stress in the Job Hazard Analysis (JHA).

G. REFERENCES

1. ACGIH, "Threshold Limit Values for Chemical Substances and Physical Agents, and Biological Exposure Indices," 2006, "Physical Agents - Thermal Stress"
2. NIOSH Safety and Health Topic, "[Heat Stress](#),"
3. OSHA Fact Sheet No. OSHA 95-16, "[Protecting Workers in Hot Environments](#),"
4. OSHA Publication 3166-06R, "[Protecting Yourself in the Sun](#)," 2003,
5. OSHA Publication 3154, "[OSHA Quick Card: Protect Yourself – Heat Stress](#)," 2005,
6. OSHA Fact Sheet, "[Working Outdoors in Warm Climates](#)," 09/2005.
7. OSHA Technical Manual, Section III: Chapter 4.

Employee Heat Stress Exposure Monitoring Form

DATE:
 MONITOR:
 EMPLOYEE'S NAME:
 WORK ACTIVITY:

Time	Oral Temperature (°F)	Pulse (BPM)	Comments

DATE:
 MONITOR:
 EMPLOYEE'S NAME:
 WORK ACTIVITY:

Time	Oral Temperature (°F)	Pulse (BPM)	Comments

DATE:
 MONITOR:
 EMPLOYEE'S NAME:
 WORK ACTIVITY:

Time	Oral Temperature (°F)	Pulse (BPM)	Comments

Initial Work/Rest Monitoring Cycles

Ambient Temperature	How Often to Rest Wearing Regular Work Clothes	How Often to Rest Wearing PPE	How Long to Rest
90°F or above	After each 45 minutes of work	After each 15 minutes of work	15 minutes
87.5°F - 90°F	After each 60 minutes of work	After each 30 minutes of work	15 minutes
82.5°F - 87.5°F	After each 90 minutes of work	After each 60 minutes of work	15 minutes
77.5°F - 82.5°F	After each 120 minutes of work	After each 90 minutes of work	15 minutes
72.5°F - 77.5°F	After each 150 minutes of work	After each 120 minutes of work	15 minutes

Effects On Skin In Contact With Surfaces At Different Temperatures

<u>Temperature (°F)</u>	<u>Sensation or Effect</u>
212	Second degree burn on 15-second contact
180	Second degree burn on 30-second contact
160	Second degree burn on 60-second contact
140	Pain; tissue damage (burns)
120	Pain; "burning heat"
91 (+ or - 4)	Warm; "neutral" (physiological zero)
54	Cool
37	"Cool heat"
32	Pain
Below 32	Pain; tissue damage (freezing)