National Institutes of Health

Heat Stress Program

Division of Occupational Health & Safety

May 2013

This document provides information and guidelines for the effective prevention of injuries or illness related to heat stress activities.

Table of Contents

1.0 1.0 PURPOSE

The Heat Stress Program has been developed to provide guidance and oversight for the activities involving elevated temperatures during occupational activities at the National Institutes of Health (NIH).

2.0 SCOPE

The Heat Stress Program applies to all NIH employees, contractors and students working at official NIH facilities.

3.0 RESPONSIBILITY

3.1 Division of Occupational Health and Safety

A. Assign resources to identify and manage elevated heat work areas
B. Ensure the management of a heat stress program

3.2 Heat Stress Program Manager

A. Assist in the identification of elevated heat work areas
B. Ensure the proper testing, monitoring, and documentation for suspect and known elevated heat work areas
C. Ensure all equipment used for testing and monitoring is appropriate and in proper working condition
D. Document the program to manage the occupational activities in elevated heat work areas
E. Maintain an inventory of elevated heat work areas
F. Provide or ensure the training as necessary to/of NIH personnel required to work elevated heat work areas
G. Assist in the development of localized administrative, engineering or PPE controls and measures to reduce or eliminate heat stress conditions
H. Conduct periodic review of the NIH heat stress program to ensure it is in compliance with federal guidelines, regulations and best practices.

3.3 Supervisors

A. Assist in the identification of elevated heat work areas
B. Monitor suspect locations for elevated heat conditions
C. Notify the Heat Stress Program Manager or representative of suspect hazardous work conditions involving elevated heat conditions
D. Implement required engineering controls, instrumentation changes, or work practice changes requested to reduce heat load
E. Maintain a copy of this written program in the workplace
F. Ensure that employees required to work under suspect elevated heat conditions are trained in the heat stress program
G. Ensure that workers visit the Occupational Medical Service (OMS) upon experiencing signs and symptoms of thermal stress

3.4 Non-supervisory Employees:

A. Assist in the identification of elevated heat work areas
B. Attend required training(s) as specified by a supervisor, Heat Stress Program Manager, or Safety Officer
C. Comply with procedures as required by the Heat Stress Program, and all other heat stress related guidance as deemed appropriate by a supervisor
D. Use all personal protective equipment as specified in prescribed training or required by a supervisor, Heat Stress Program Manager, or Safety Officer.
E. Immediately notify a supervisor, Heat Stress Program Manager, or Safety Officer. of any hazards encountered.
F. Report to OMS in the event of an injury related to heat stress or other condition leading to injury, disease or impairment

3.5 Contractors / NIH Project Officers

A. Contractors must comply with all NIH programs and Federal regulations, and any stipulations as required by their respective NIH Project Officer
B. Contractors are required to ensure the safety of their employees working on NIH property
C. NIH Project Officers are required to convey all hazardous conditions to contractors working in or around those locations
D. NIH Project Officers are responsible for managing contractor work and obtaining all necessary documentation as required by the Heat Stress Program Manager or Safety Officer

4.0 REFERENCES

TED 01-00-015, (*OSHA) OSHA Technical Manual, Chapter III: Heat Stress*

29 CFR 1910.132, *Personal protective equipment*

U.S. Army Corps of Engineers: Safety and Health Requirements Manual, *Inclement Weather and Heat/Cold Stress Management*

United States Council of Governmental Industrial Hygienists (ACGIH), TLV for Chemical Substances and Physical Agents and Biological Exposure Indices, *2012*

5.0 PROGRAM

5.1 Heat Stress Safety Program

The Heat Stress Program was established to promote health and safety of occupational activities in locations where elevated temperatures and humidity exist. The heat stress program is administered by the Division of Occupational Health and Safety (DOHS) through the Heat Stress Program Manager.

Thermal heat stress includes injuries or illnesses caused when a person is working in, or exposed to elevated temperature conditions directly affecting an individual's ability to function in a

normal manner. A potential exists for thermal stress at the NIH. As an example cage wash areas associated with animal care facilities are suspect for elevated temperature due to the size and type of equipment used. These cage wash areas typically reach temperatures as high as 100°F under significantly humid conditions. These temperatures may be exacerbated at times by summer heat wave conditions.

The intent of the program is to ensure a core body temperature of individuals as close to normal (typically within 1 Celsius). The program functions by limiting the amount of work time an individual is exposed to elevated temperatures while completing specific types of work load (low, medium, high). A key element of the program involves identifying sources of heat load and planning and measures to reduce or eliminate that heat load where possible.

5.2 ACGIH Guidelines

Table 1. Acclimatized and Non-acclimatized Work Load Type per Temperature			
Acclimatized	**Temperature for Type of Work Load (°C / °F)**	**Temperature for Type of Work Load (°C / °F)**	**Temperature for Type of Work Load (°C / °F)**
Work / Rest Ratio (per hour)	Light	Medium	High
6 / 0	3 / 88	2 / 82.5	2 / 79
4 / 15	3 / 88	2 / 84	27.5 / 81.5
3 / 30	3 / 89.5	3 / 86	2 / 84
1 / 45	32.5 / 90.5	31.5 / 89	30.5 / 89
Non-acclimatized	**Temperature for Type of Work Load (°C / °F)**	**Temperature for Type of Work Load (°C / °F)**	**Temperature for Type of Work Load (°C / °F)**
Work / Rest Ratio (per hour)	Light	Medium	High
6 / 0	2 / 82.5	2 / 77	22.5 / 72.5
4 / 15	28.5 / 83.5	2 / 79	2 / 75
3 / 30	29.5 / 85	2 / 80.5	25.5 / 78
1 / 45	3 / 86	2 / 84	2 / 82.5

Table 1: Provides the administrative method for ensuring that "typical" individuals do not over-exceed a stress level that might trigger a hazardous physiological response to elevated temperatures. Table 1 requires the use of a Wet Globe Bulb Thermometer (WBGT) to integrate various measures of heat load.

5.3 Monitoring

A. Upon notification by a NIH employee or NIH Project Officer for contractors, the Heat Stress Program Manager will complete or assign heat stress monitoring of suspect location(s).

B. To complete monitoring the completing individual will:

1. Work with an knowledgeable individual who can adequate describe the perceived sources of heat load and time periods that are both typical and worse case for the suspect location

2. Retrieve a WBGT instrument that is within calibration, see photograph below

a. WBGT components:
    i. Wet bulb (white with wick) – used to measure the effects o humidity on temperature
    ii. Dry bulb (white) – used to measure the normal "dry" air temperature
    iii. Globe bulb (black) – used to measure the effects of solar radiation on temperature

3. Setup the WBGT in the suspect location allowing for a 15 minute "warm up" period before logging values,
    a. Ensure that the reservoir for the wet bulb is full
4. Begin documenting the readings from the instrument on Appendix A: Monitoring Sheet,
5. Allow the unit to run for an appropriate period of time to adequately capture the heat intensity that is created by either natural environmental conditions or equipment/instrumentation that adds heat load,
6. Provide technical feedback to the Supervisor or representative of the work area to allow an immediate response to ensure the safety of personnel,
7. Maintain the Appendix A sheet as historical record.

5.4 Heat related conditions

A. Minor conditions:
    1. **Heat edema** presents with swelling and discomfort of the hands and feet. Individuals may complain that their shoes feel tight or are ill fitting. The exact cause is unknown but generally involves dilation of the blood vessels and shifts in fluid within the body. The condition is self-limiting and symptoms typically resolve within a few days.
    2. **Miliaria rubra**, also known as prickly heat or heat rash occurs when sweat gland pores become blocked. Sometimes a secondary infection may occur. Skin with Miliaria rubra cannot sweat effectively. Therefore the risk of heat illness is increased in proportion to the amount of skin involved.
    3. **Sunburn** impairs sweating and predisposed to heat injury from systemic effects, including fever, that influence thermoregulation. When sunburn occurs over

5% of the body surface area, the effected individual should be kept from significant heat strain until the burn has healed.

4. **Heat tetany** may result when an individual hyperventilates after being exposed to heat stress. Symptoms include muscle spasms and numbness and tingling around the mouth. It generally occurs before heat acclimatization.
5. **Syncope** is a temporary circulatory failure due to pooling of the blood in the peripheral veins. Symptoms range from lightheadedness to loss of consciousness. Victims typically recover rapidly once they sit or lay supine. Syncope occurring more than five days after heat exposure may indicate dehydration or heat exhaustion.
6. **Heat cramps** are brief, recurrent, often painful skeletal muscle cramps. The cramps are usually preceded by muscle fasciculations which may be seen or felt on the muscle surface. Cramps produce a hard lump in the muscle. There are no systemic symptoms.

B. Major conditions:
   1. **Heat Exhaustion** is the most common heat related cause of illness. It occurs when the heart cannot pump quickly enough to sustain the needs of the skin blood flow to maintain body temperature along with the metabolic needs of the body for muscle and vital organ activity. Dehydration, reduced blood volume and constricted blood vessels are all contributing factors. The signs and symptoms of heat exhaustion include:
      a. Generalized weakness
      b. Headache
      c. Nausea
      d. Fatigue
      e. Dizziness
      f. Increased heat rate and muscle cramps
      g. Sweating persists and may even be profuse, and the individual may become disoriented. Treatment should begin immediately in order to prevent progression to a more severe heat injury. The more severe assessment of heat stroke should be assumed in anyone who experiences a change in mental status such as disorientation.
   2. **Heat Stroke** is characterized by elevated body temperature (>104º F) and dysfunction of the central nervous system resulting in delirium, convulsions or coma. Two types of heat stroke may occur, exertional and classical.
      a. Exertional heat stroke occurs in physically active individuals who are producing substantial metabolic heat. It is the most common form in workers and athletes and can occur in both hot and temperate conditions.
      b. Classical heat stroke occurs in vulnerable populations such as the young, the elderly and those without potable water. This type often presents as an epidemic during summer heat waves.
      c. For up to an hour prior to the onset of heat stroke one may experience:
         i. Headache
         ii. Dizziness
         iii. Drowsiness
         iv. Restlessness
         v. Confusion

vi. Irrational or aggressive behavior

5.5 Heat measures for employees

A. Administratively rotating the workload among workers
B. Shortening the duration of exposure
C. Increasing rest time or frequency of rest periods (rest periods should be in a cooler shaded area in relation to the work area)
D. Utilizing air conditioned rest areas
E. Minimizing direct heat sources by insulation or installing reflective screening
F. Using additional fans in the work area
G. Providing cool drinking water

5.6 Heat Stress Safety Training

All supervisors of employees who work in elevated heat areas should ensure that heat stress training is available. Types of training include a formal presentation by the Heat Stress Program Manager, DOHS personnel, or OMS personnel; "Tool-box talks" led by the supervisor, or computer based training. Training should incorporate both identifying heat related conditions and measure to overcome elevated heat conditions.

5.7 Medical Surveillance

Employees who routinely work under heat stress conditions should be required to have an annual physical – Contact Occupational Medical Services (OMS) for specific requirements. Factors that must be considered before assigning an employee to work under heat stress conditions include:

A. Acclimatization
    1. Adaptation to new surroundings or conditions
    2. Under heat stress conditions, gradually increase the work time over the first two weeks. (Individuals are most susceptible to heat stress during their initial two week period of work in hot and humid conditions).
    3. Acclimatization can be affected by:
        a. **Medical condition or Prescription Medication**, inform your supervisor or the OMS prior to beginning work under heat stress conditions.
        b. **Allergy medicine** (prescription or non-prescription
        c. **Sunburn** – likely to reduce work capacity under heat stress conditions.
B. Muscular activity and work capacity
C. Age / physical condition
D. Prescription drug use

Individuals who believe that they require a medical evaluation concerning their work in elevated temperature conditions should make a request through their respective supervisor. All medical evaluations will be conducted by OMS. In the event of any accidents or incidents the user must undergo and immediate evaluation by OMS located on the sixth floor of building 10, Room 6C306. The phone number for OMS is (301) 496-4411.

6.0 DEFINITIONS

Acclimatization- A physiologic adjustment process occurring when a healthy worker accustomed to a temperate environment begins to work in a hot environment. These adjustments may occur over a period of days to several weeks. During this time period time spent in an area may be gradually increased.

Action Limit – In evaluating thermal stress at the NIH, Action Limits are used. These are temperature cutoffs, or temperature index cutoffs which, when reached, require a supervisor to initiate action to prevent thermal illness or injury.
(See Appendix C – Thermal Hazard Assessment)

American Conference of Government Industrial Hygienists (ACGIH) – A professional society consisting of government employees and academia. This organization has developed the Wet Bulb Globe Temperature (WBGT) Index as a threshold limit value which is used to establish guidelines for working under heat stress conditions. In cold stress situations, the ACGIH wind chill index can be used. The NIH uses these values to determine appropriate action limits.

Apparent Temperature - A measure of relative discomfort due to combined heat and high humidity. It was developed by R.G. Steadman (1979) and is based on physiological studies of evaporative skin cooling for various combinations of ambient temperature and humidity.

Heat Index – The heat stress index is a specialized temperature / humidity index. It is also called the apparent temperature, and is a measure of how hot weather is perceived by the average person at varying temperatures and relative humidity.

Heat Wave – A Heat Wave occurs when the apparent temperature exceeds 108 F° or is 15 to 20 degrees higher than the noon, midsummer apparent temperature.

APPENDIX

Appendix A: Monitoring Sheet

Appendix A: Monitoring Sheet

Location:_____ Date:_____

WORK/REST GUIDELINES IN INDUSTRIAL ENVIRONMENTS							
		Light Work		Moderate Work		Heavy Work	
Heat Category	*WBGT Temperature Range in Degrees Fahrenheit (^{o}F)	**Work/Rest Cycle (Min./Hour)	***Water Intake in (Qts./Hour)	Work/Rest Cycle in (Min./Hour)	Water Intake (Qts./Hour)	Work/Rest Cycle (Min./Hour)	Water Intake (Qts./Hour)
Caution	77.0 – 86.9	No limit	0.5	45/15	0.75	40/20	0.75
Danger	87.0 – 89.9	No Limit	0.75	30/30	0.75	20/40	1.0
Extreme Danger	Above 90	50/10	1.0	15/45	1.0	10/50	1.0

NOTE: *Follow the guidelines for (choose either light/moderate/heavy) Work/Rest Cycles*

Temperatures should be read hourly starting at the beginning of shift and commence at the end of shift

WBGT Temperature_____ Heat Category:_____ Time:_____ Initials_____
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