MSU EMPLOYEE GUIDELINES FOR WORKING IN HOT ENVIRONMENTS

The Office of Radiation, Chemical and Biological Safety

May, 1999

I. BACKGROUND:

There is currently no specific Occupational Safety and Health Administration (OSHA) Standard for heat stress. However, OSHA recognizes that jobs involving operations in hot environments have the potential to induce heat stress in employees. These operations include those which involve radiant heat sources, high humidity, direct contact with hot objects, or strenuous activities. The National Institute of Occupational Safety and Health (NIOSH) the American Conference of Governmental Industrial Hygienists (ACGIH) and the Environmental Protection Agency (EPA) have promulgated recommended safety guidelines for working in hot environments. As guidance for employers of those individuals involved in these operations, OSHA has included a section on heat stress in the OSHA Technical Manual which references many of the guidelines put forth by NIOSH and ACGIH.

The effects of heat can range from a mild annoyance, such as heat rash, to death from heat stroke. Specific signs and symptoms of heat stress are described in Appendix A. With proper replacement of fluids and adherence to proper work/rest regimens, the adverse effects of working during hot weather can be prevented.

A person's risk of developing an adverse effect from heat increases with ambient temperature and humidity, increased level of work, and increased amount of clothing. Examples of MSU employees who may be at risk of developing heat related effects include, but are not limited to:

Grounds Personnel
University Farms Personnel
Greenhouse Personnel
Physical Plant (ex: personnel working in steam tunnels)
Power Plant (ex: personnel who work in the vicinity of boilers)
Employees required to wear protective clothing

Certain personal lifestyle factors make a person more susceptible to the adverse effects of heat. These factors are:

1. lack of physical fitness;
2. lack of acclimatization to heat - increased risk during initial days of a heat wave;
3. dehydration- someone who is taking a water pill, or has been having diarrhea, or drank a large quantity of alcohol the day before;
4. obesity;
5. acute or chronic disease such as, infection, diarrhea;
6. sunburn

II. HEAT HAZARD ASSESSMENT:

The potential for an employee who works in a hot environment to be affected by heat stress depends on heat combined with physical labor, loss of fluids and fatigue, in addition to the factors listed below. An assessment of each job with these factors can assist in developing a strategy to prevent heat related problems.

A. Temperature and Humidity:

Ambient temperature and humidity levels must be taken into consideration when assessing the potential for heat stress hazards. There are several different ways to evaluate heat index based on temperature and relative humidity. The ORCBS has purchased a Wet Bulb Globe Temperature (WBGT) index direct read out instrument. This temperature accounts for the effects of ambient temperature, humidity and radiant heat, and is an accepted measure of heat stress on an individual in the monitored environment. The ORCBS is complying data of WBGT for commonly preformed hot jobs on campus, and will provide heat stress monitoring as needed.

A commonly used "quick and easy" approach to determining heat stress index was developed by the National Weather Service and is known as the "General Heat Stress Index". A copy of this index is provided in Appendix B. This index can be used to determine danger levels based on temperature and humidity.

The ACGIH has established various Threshold Limit Values (TLVs) for hot environments, as expressed in WBGT. A TLV is an average level for an eight-hour work day and a 40-hour work week, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect (See Appendix C). These TLVs are valid for workers dressed in light summer clothing only. Extra caution must be exercised in establishing work practices for employees wearing personal protective equipment (PPE) that poses as a barrier to heat loss.(See Appendix C, table C-2)

B. Employee Work Rate:

The rate at which an employee works and the activities being performed will have a direct effect on their potential to experience heat stress. This work rate must be taken into consideration when establishing safe work practices for employees working in hot environments. See Appendix D for guidance in determining an employee's work rate based on the activities they perform.

C. Location of Heat Sources:

An employee who works in an environment which is generally cool, but in close proximity to hot objects may be at risk for heat stress. Sources of heat must be identified and their location in relation to the employee considered when assessing potential for heat stress.

D. Individual Risk Factors for Heat Stress:

Certain factors can put employees at greater risk for heat stress. Employees will be made aware of these risk factors, and given the opportunity for medical consolation if those risk factors apply to them. Training will consist of a video and review of this written program.

E. Physical Barriers to Heat Loss:

Extra caution must be exercised in establishing work practices for employees wearing personal protective equipment (PPE) that poses as a barrier to heat loss. This equipment could include coveralls, gloves and respirators, and chemical protective clothing. Guidelines for work-rest regimens for employees wearing PPE is provided in Appendix E.

III. EMPLOYEE HEALTH EVALUATIONS:

Employee health evaluations may be requested if an employee who has been assigned work in hot environments is aware of individual risk factors that are present and may put them at greater risk for heat stress. Health evaluations shall also be provided in the event that an employee experiences health effects that are suspected to be heat illness or injury related.

IV. HEAT STRESS PREVENTION:

The reduction of heat stress can be accomplished through the following controls:

1. Train employees to recognize heat stress.
2. Where possible, isolate, or even eliminate a source or heat and or humidity through environmental controls.
3. Allow time for employee acclimation to hot environments.
4. Supervisors should schedule tasks during cooler parts of the day, and provide for alternate tasks when possible.
5. Proper Clothing will help prevent heat stress. Employees should wear reflective clothing when appropriate, loose fitting light colored clothes when outside.
6. Encourage workers to drink adequate replacement fluids. A person should drink 1 1/2 gallons of water per day. Salt pills or sport drinks with added salt are unnecessary as the typical American has enough salt in their diet. If a person loses 1.5% of their total body weight in a workday, they are not drinking enough fluids (for example, if a 200 pound employee loses more than 3 pounds in a day, they need to drink more fluid).
7. Take breaks in a shaded, or if possible air-conditioned area following the frequency indicated in Appendix D. Cool fluids must be available during breaks.
8. Someone who develops symptoms of heat exhaustion or heat stroke should be removed to a cool area, provided fluids and be medically evaluated.
9. Use the buddy system (never working alone in hot areas) to monitor co-worker for heat stress.
10. Encourage employees to maintain physical fitness.

V. EMPLOYEE TRAINING:

Employees involved in operations which put them at risk for heat stress will be trained to recognize operations and individual risk factors that can put them at risk for heat stress. Employees will also be trained to recognize signs and symptoms of heat stress in themselves and co-workers. This training shall be conducted by the employee's department, with assistance from the ORCBS when necessary. Training will consist of a video on heat stress, and review of this written plan.

VI. RECORDKEEPING:

Departments will maintain records of heat stress training.

VII. RESPONSIBILITIES:

A. The Office of Radiation, Chemical and Biological Safety:

The ORCBS is responsible for the overall coordination and implementation of these guidelines. The ORCBS will provide technical support when needed, and provide training materials for departments.

B. Olin Health Center:

Olin Health Center is responsible for the maintenance of employee health records. It is one location where MSU employees may be evaluated for risk factors for heat stress and for the adverse effects of heat.

C. Unit Administrator:

The Unit Administrator is responsible for adherence to these guidelines within his/her area of responsibility. It is expected that each administrator will appoint a contact person to serve as a liaison with the ORCBS and Olin to coordinate heat hazard assessments and pre-placement screenings when needed.

D. First Line Supervisors:

It is the direct responsibility of an employee's supervisor to ensure appropriate safety measures are followed. This includes the recognition of the potential for heat stress hazards, enforcement of heat stress precautions, and accommodation for these guidelines to be followed. See Appendix B for a checklist to use when investigating a workplace for potential heat stress.

E. Employee:

Safety is each individual's responsibility. Utilization of the guidelines provided within this document, and precautionary measures established through training is first and foremost the individual employee's concern. It is also incumbent on each employee to follow instructions regarding heat stress prevention.

APPENDIX A

SIGNS AND SYMPTOMS OF HEAT STRESS

Adapted from "Extreme Heat: A prevention Guide to Promote you Personal Health and Safety", Office of Public Affairs, Center for Disease Control and Prevention 6/01/96 and the OSHA Technical Manual, Section III: Chapter 4, Heat Stress

Illness	Signs and Symptoms
Early Heat Illness	Mild dizziness, fatigue or irritability; decreased concentration; impaired judgment
Heat Rash ("Prickly Heat")	Tiny blister-like red spots on the skin; pricking sensation, commonly found on clothed areas of the body
Heat Cramps	Painful spasms of leg, arm, or abdominal muscles Heavy sweating, thirst occur during or after hard work
Heat Exhaustion	Fatigue, headache, dizziness, muscle weakness, loss of coordination, fainting, collapse Profuse sweating, pale, moist, cool skin; excessive thirst, dry mouth, dark yellow urine Fast pulse, if conscious Low or normal oral temperature May also have heat cramps, nausea, urge to defecate, rapid breathing, chills, tingling of the hands or feet, confusion, giddiness, slurred speech, irritability
Heat Stroke	LIFE THREATENING MEDICAL EMERGENCY Often occurs suddenly Headache, dizziness, confusion, irrational behavior, coma Sweating may slow down or stop Fast pulse, if conscious Rapid breathing Rectal Temperature 104° F and over May also have convulsions, nausea, incoherent speech, very aggressive behavior

APPENDIX B

GENERAL HEAT STRESS INDEX

From the National Weather Service

General Heat Stress Index		
Danger Category	**Apparent Temp. (°F) (Humiture)**	**Heat Syndrome**
IV. Extreme Danger	**>130°**	**Heatstroke or sunstroke imminent**
III. Danger	105°-130°	Sunstroke, heat cramps, or heat exhaustion likely. Heatstroke possible with prolonged exposure and physical activity
II. Extreme Caution	90°-105°	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and physical activity.
I. Caution	80°-90°	Fatigue possible with prolonged exposure and physical activity

***Note: Degree of heat stress may vary with age, health, and body characteristics**

		Relative Humidity								
		10%	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
Temp °F	**104**	98	104	110	120	**>130**	**>130**	**>130**	**>130**	**>130**
	102	97	101	108	117	125	**>130**	**>130**	**>130**	**>130**
	100	95	99	105	110	120	**>130**	**>130**	**>130**	**>130**
	98	93	97	101	106	110	125	**>130**	**>130**	**>130**
	96	91	95	98	104	108	120	128	**>130**	**>130**
	94	89	93	95	100	105	111	122	128	**>130**
	92	87	90	92	96	100	106	115	122	128
	90	85	88	90	92	96	100	106	114	122
	88	82	86	87	89	93	95	100	106	115
	86	80	84	85	87	90	92	96	100	109
	84	78	81	83	85	86	89	91	95	99
	82	77	79	80	81	84	86	89	91	95
	80	75	77	78	79	81	83	85	86	89
	78	72	75	77	78	79	80	81	83	85
	76	70	72	75	76	77	77	77	78	79
	74	68	70	73	74	75	75	75	76	77

Example: The temperature stands at 94°F and the RH is now 62%. The heat stress temperature is over 111°F, in the **Danger** area

APPENDIX C
ACGIH THRESHOLD LIMIT VALUES
FOR HOT ENVIRONMENTS, AS MEASURED IN WET BULB GLOBE TEMPERATURE INDEX
From OSHA Technical Manual, Section III: Chapter 4, Heat Stress

Table C-1:

ACGIH THRESHOLD LIMIT VALUES FOR HOT ENVIRONMENTS

	Work Load		
Work-Rest Regimen	**Light**	**Moderate**	**Heavy**
Continuous Work	86 °F	80 °F	77 °F
75% Work 25% Rest, each hour	87°F	82°F	78°F
50% Work 50% Rest, each hour	89°F	85°F	82°F
25% Work 75% Rest, each hour	90°F	88°F	86°F

These TLV's are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4° F). They are also based on the assumption that the Wet Bulb Globe Temperature Index (WBGT) of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area, a time-weighted average should be used (consult the ACGIH *1992-1993 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* (1992).

These TLV's apply to physically fit and acclimatized individuals wearing light summer clothing. If heavier clothing that impedes sweat or has a higher insulation value is required, the permissible heat exposure TLV's in Table C-1 must be reduced by the corrections shown in Table C-2

Table C-2

WBGT CORRECTION FACTORS IN °F

Clothing type	Clo* value	WBGT correction
Summer lightweight working clothing	1.08	0
Cotton coveralls	1.8	-3.6
Winter work clothing	2.5	-7.2
Water barrier, permeable	2.1	-6.9

*Clo: Insulation value of clothing. One clo = 5.55 kcal/m2/hr of heat exchange by radiation and convection for each degree °C difference in temperature between the skin and the adjusted dry bulb temperature.

APPENDIX D

DETERMINATION OF EMPLOYEE WORK RATES

From EPA "A Guide to Heat Stress in Agriculture", 1993

APPROXIMATE WORKLOAD LEVELS	
Light	Sitting at ease, writing/typing, sorting light materials, inspecting crops, driving mobile equipment on paved roads, piloting spray aircraft
Moderate	Using a chain saw, off-road operation of mobile equipment, periodic handling of moderately heavy materials, weeding, hoeing, picking fruits or vegetables, air blast and boom spraying, knapsack spraying on level ground, pushing or pulling light-weight carts or wheelbarrows, washing vehicles, walking 2-3 mph
Heavy	Transferring heavy materials, shoveling, digging, hand mowing, loading sacks, stacking hay, planting seedlings, hand-sawing wood, pushing or pulling loaded hand carts or wheelbarrows, moving irrigation pipe, laying cinder blocks, knapsack spraying on rough ground or an incline, walking 4 mph
Very Heavy	Heavy shoveling or digging, ax work, climbing stairs, ramps, or ladders, lifting more that 44 pounds at 10 lifts per minute, walking faster that 4 mph, jogging, running

APPENDIX E

APPROACH FOR SETTING WORK/REST PERIODS AND AMOUNT OF DRINKING WATER FOR WORKERS WEARING CHEMICAL-RESISTANT SUITS

From *Internal Report: Heat Stress Management Protocol,* Office of Research and Development, U.S. EPA, November 1989, Author Ralph Goldman

	Work/Rest Periods									
	Light Work			**Moderate Work**			**Heavy Work**			
Air Temp.	**Full Sun**	**Partly Cloudy**	**No Sun ‡**	**Full Sun**	**Partly Cloudy**	**No Sun ‡**	**Full Sun**	**Partly Cloudy**	**No Sun ‡**	**Minimum Water to Drink**
75° F	Normal Schedule	Normal Schedule	Normal Schedule	Normal Schedule	Normal Schedule	Normal Schedule	35/25‡‡	Normal Schedule	Normal Schedule	One half pint every 30 minutes
80° F	30/30	Normal Schedule	Normal Schedule	20/40	Normal Schedule	Normal Schedule	10/50	40/20	Normal Schedule	One to one and a half pints every 30 minutes
85° F	15/45	40/20	Normal Schedule	10/50	25/35	Normal Schedule	Caution **	15/45	40/20	One pint or more every 15 minutes
90° F	Caution **	15/45	40/20	Caution **	Caution **	25/35	Stop Work	Caution **	15/45	Same as above
95° F	Stop Work	Stop Work	15/45	Stop Work	Stop Work	Stop Work	Stop Work	Stop Work	Stop Work	Same as above

* This table is based on values for heat-acclimatized adult workers under the age of 40 who are physically fit, sell-rested, and fully hydrated; with the assumptions of tyvek coveralls, gloves, boots, and a respirator being worn; adequate water intake; and air temperature readings taken in the shade. Cooling vests may enable workers to work for longer periods. Adjustments must be made when additional protective gear is worn.

‡ No shadows are visible or work is in the shade or at night

‡‡ 35/25 = 35 minutes work and 25 minutes rest each hour.

** Indicates very high levels of heat stress