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HEAT STRESS



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This instruction provides guidance to commanders on heat stress. This information enables commanders to make decisions on mission requirements, work schedules, uniforms, and water intake for their personnel working outdoors. It has been developed from information in AFMAN 32-4005, *Personnel Protection and Attack Actions*, 30 October 2001 .

SUMMARY OF REVISIONS

Water intoxication warning signs and symptoms were added and the maximum recommended water intake levels were adjusted to 1.5 quarts per hour. Guidance from the latest policy on the role of sports drinks in prevention of dehydration and heat illness was also included. **A bar (|) indicates a change since the last edition.**

1. Responsibilities.

1.1. Unit Commanders. IAW AFI 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH) Standards*, 1 June 1996, commanders are ultimately responsible for the health and safety of the members of their unit. According to base policy, commanders have the authority to change uniforms (i.e., unblousing boots, rolling up sleeves, removing BDU tops, etc.) to suit the ambient conditions of the workplace. Commanders can also schedule difficult outside work for cooler hours, mandate work/rest cycles, and require acclimatization of new or TDY personnel. Commanders should use this instruction to make decisions ensuring their workers' health and safety is preserved in hot environments. The burden on the commander is to strike a balance between mission and worker risk .

1.2. Supervisors. Supervisors are responsible for the implementation of health and safety programs in their workplaces (AFI 91-301). When authorized by commanders, they should take the necessary actions to preserve health.

1.3. Workers. Workers should follow commanders' and supervisors' directives even down to water intake rates. They should report any heat stress symptoms to their supervisors and watch for heat stress symptoms in their co-workers .

1.4. Medical Group Commander (MDG/CC). The MDG/CC will ensure that heat stress is evaluated and reported to the necessary agencies for action. The MDG/CC will also provide for training of workers, commanders, supervisors, and medics as are required to implement an effective base heat stress management program .

1.5. Bioenvironmental Engineering (BE). BE will be the OPR for the heat stress management program. BE will take heat stress measurements and recommend actions for commanders and supervisors to maintain worker health and safety .

1.6. Command Post (CP). BE will notify CP of the heat stress reading. CP will disseminate the information to Maintenance Aircraft Coordination Center (MACC), Aerial Port Operations Center (ATOC) and Flight Kitchen. They will also announce reading over Giant Voice.

1.7. Base Weather. The Weather Flight will monitor the Wet Bulb Globe Temperature (WBGT) on weekends, and provide the information to the CP.

2. Heat Stress Management.

2.1. Definition. Heat stress is the thermal exposure to the body. Charleston AFB experiences conditions of hazardous heat stress on a daily basis from May through September according to historical Bioenvironmental Engineering Flight (BE) heat stress records. The high relative humidity slows the evaporation of sweat, the body's cooling defense. Increased sweating demands more water consumption to maintain the body's coolant system.

2.2. Measurement. BE measures heat stress by the Wet Bulb Globe Temperature index (WBGT). This index takes into account the dry bulb (air temperature), wet bulb (relative humidity and evaporative effectiveness of the air and wind), and black globe (heating by direct rays of the sun). This methodology is recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) as the best way to evaluate heat stress on the body.

2.3. Reporting. BE will monitor the WBGT at 0900, 1100, 1300, and 1500, Monday through Friday from 1 May to 30 Sep of each year. Base Weather will monitor the WBGT at 1100 and 1300 on weekends. The WBGT index will be reported to the Command Post everyday and on BE's Heat Stress Hotline Monday through Friday at extension 3-0007.

2.4. Guidance.

2.4.1. Occupational Heat Stress Exposure. Acclimatized personnel are better able to cope with the hot environments here at CAFB. All newly arrived personnel from cooler climates should become acclimated before attempting any strenuous activity or exercise. **Attachment 2** is a guidance chart for acclimated personnel who routinely perform their jobs while exposed to hot environments. The chart is based on the assumption that personnel are acclimated, fully rested, and hydrated, and can take breaks in areas at least 10 degrees Fahrenheit cooler than their work area. Taking breaks in the same environment as the work area is **NOT** effective in cooling the body.

2.4.2. Acclimatization. Newly arriving personnel, personnel returning from TDY, or personnel leaving TDY to a different hot environment, should be allowed a two-week period to become acclimated to the new environment. Acclimatization is not a license to avoid work, but it is a seri-

ous requirement to avoid possible heat illness or injury. This means that personnel should be in the hot environment and perform typically required duties, but at a slower pace with more frequent breaks. Acclimatization is a series of physiological adjustments that occur when an individual is exposed to a hot climate. A period of acclimatization is required for all personnel regardless of each individual's physical condition. The better the individual's physical condition, the quicker the acclimatization is reached. Acclimatization is achieved through progressive degrees of heat exposure and physical exertion. Acclimatization to heat begins with the first exposure and is usually developed to 50 percent by the end of the first week. Substantial acclimatization (about 78 percent) should occur by the end of the second week.

2.4.3. **Aerobics and Exercise.** During the summer months, commanders should schedule outdoor aerobics and exercise during the morning hours (no later than 0900). Since the WBGT index consistently exceeds 88 later in the day, this scheduling will help to reduce the potential for undue heat stress. Extreme caution is warranted for any aerobics conducted when the WBGT Index exceeds 90.

2.4.4. **Wear of Personal Protective Equipment.** Personnel wearing impervious clothing such as security police body armor, rain gear at the wash rack, fire-fighting suits, paint coveralls, respirators, etc., should take special precaution as this equipment adds to the metabolic heat load and hinders the body's ability to cool itself. Supervisors should add 10 degrees to the WBGT Index when determining workplace conduct outdoors. For example, a WBGT reading of 82 should be treated as 92.

2.4.5. **Prevention of Heat Stress Illness/Injury.** The following paragraphs discuss actions to prevent heat stress disorders.

2.4.5.1. **Education.** Personnel working with and/or training in hot environments should be educated on the causes, symptoms, first aid treatment, and prevention of heat disorders. Personnel should also be educated on the following factors, which may contribute to heat illness/injury .

- | | |
|---|----------------------------|
| - Acute or chronic infection | - Previous heat injury |
| - Fever | - Recent use of alcohol |
| - Reaction to immunization | - Dehydration |
| - Vascular disease | - Lack of sleep or fatigue |
| - Conditions affecting the ability to sweat | - Overweight |
| - Heat rash, dermatitis, or acute sunburn | - Medications or drugs |

2.4.5.2. **Water.** It is best to drink small amounts of water frequently (a pint every twenty minutes) to replace water than to drink large amounts less frequently. Sudden drinking of large amounts of water stimulates urination, causing the body to lose water more quickly. Milk and coffee do not make up for water loss. Carbonated beverages, while containing water, are not as effective as water in keeping the body hydrated because of the tendency to delay gastric emptying. Alcohol is a dehydrating beverage and should not be consumed for 24 hours prior to working in a hot environment. A guideline for amount of water needed by personnel exposed to heat is contained in [Attachment 2](#). Additional information on heat stress and water intoxication warning signs and symptoms is provided in [Attachment 3](#). Note that workers can check

their hydration level by observing the color of their urine. Clear, odorless urine indicates adequate hydration. Yellow urine indicates the worker needs more water .

2.4.5.3. Sports Drinks. Under normal working conditions, cool water alone provides adequate fluid replacement and normal dietary salt intake suffices to prevent electrolyte imbalances. With prolonged moderate to heavy work in hot and humid environments, half-strength mixes of electrolyte- and carbohydrate-enhanced sports drinks provide additional benefits, including electrolyte replacement and improved compliance with fluid replacement recommendations. Organizational O&M funds may be used to procure sports drinks; however, such use is not routinely recommended. Local medical treatment facility commanders or their representatives may recommend that units procure sports drinks for consumption during the performance of official duties if medically indicated (potable water is limited or unattainable, specific units performing prolonged heavy work in extreme environments), as addressed in AFI 65-601V1, *Budget Guidance and Procedures*, 24 December 2002, paragraph 4.45.6, Sports Beverages. Specific guidelines for the use of sports drinks are provided in [Attachment 3](#) .

2.4.5.4. Salt. Some salt is lost in sweat. North American diets usually contain adequate amounts of salt and extra “salting” or supplements are not necessary. Salt tablets shall not be used except under special operating environments when ordered by a physician.

2.4.5.5. Clothing. Wear loose fitting clothing, especially at the neck and wrist, to allow air circulation. Wear appropriate headgear. When exposed to the sun’s rays, cover yourself to prevent sunburn. When not exposed to the sun, consideration should be given to wearing the least allowable amount of clothing.

2.4.5.6. Work Schedules. Modify work schedules to perform the heaviest work in the coolest parts of the day. When working in hot environments, establish work/rest cycles as discussed in [Attachment 2](#) . Take rest breaks in cool, shaded areas.

2.4.5.7. Diet. Eat three meals a day, but avoid greasy, fatty, or heavy foods.

2.4.5.8. Medical. Seek medical attention for illness or skin problems, including rashes.

2.4.5.9. Fitness. Physical fitness is key to avoiding heat illness. Physical training increases the body’s resistance to stresses such as metabolic and environmental heat. A fit person has better circulation and sweating mechanisms to cool the body. Workers should be encouraged to engage in strenuous physical training regimens through administrative scheduling, incentives for performance, and whatever other programs the commanders authorize .

3. Heat Stress with MOPP Gear.

3.1. Background. Mission Oriented Protective Postures (MOPP) increase heat stress dramatically by stopping evaporative cooling and increasing metabolic heat production by raising workload.

3.2. AFMAN 32-4005. IAW AFMAN 32-4005, Section A9.4.4.1.3, add 10 degrees to the WBGT reading when wearing MOPP gear. This means that conditions giving a WBGT of 82 degrees would warrant the water intake and work/rest cycle of a WBGT reading of 92 degrees. For WBGT readings above 84 degrees (adjusted to a 94 degree WBGT with MOPP), commanders should use maximum workloads instead of work/rest cycles unless the workload is very light (i.e. guard duty, lying on the ground, standing in a foxhole, driving a truck, etc.). Even with MOPP gear, workers performing very light work should continue to use the work/rest table at [Attachment 2](#) .

3.3. Maximum Work Load Guidance. If mission-essential tasks are required under extreme heat conditions, activities in the direct sun should be avoided and workers should be observed for water consumption and signs of heat illness. Medical representatives in areas requiring MOPP wear will provide further guidance depending on the existing conditions.

JULIAN C. LEVIN, Colonel, USAF, MC, CFS
Commander

Attachment 1**GLOSSARY OR REFERENCES AND SUPPORTING INFORMATION*****References***

AFI 65-601V1, *Budget Guidance and Procedures*, 24 December 2002

AFI 91-301, *Air Force Occupational and Environmental, Safety, Fire Protection, and Health (AFOSH) Standards*, 1 June 1996

AFMAN 32-4005, *Personnel Protection and Attack Actions*, 30 October 2001

Abbreviations and Acronyms

ACGIH—American Conference of Government Industrial Hygienists

ATOC—Aerial Port Operations Center

BE—Bioenvironmental Engineering

CP—Command Post

MACC—Maintenance Aircraft Coordination Center

MDG/CC—Medical Group Commander

MOPP—Mission Oriented Protective Postures

WBGT—Wet Bulb Globe Temperature

Attachment 2

HEAT STRESS GUIDANCE CHART

A2.1. The information below is designed so that it can be copied, used as a handout or put on a card. This guidance is also contained in a heat stress pamphlet that is available from Bioenvironmental Engineering. Note that all heat stress recommendations assume acclimated workers who are fully hydrated and well rested:

Table A2.1. Heat Stress Information Card for Acclimated Workers.

FLAG COLOR	CONDITION	WBGT (°F)	RECOMMENDED MAXIMUM WORK PER HOUR (Minutes)	WATER INTAKE Quarts/hour)
NONE	NONE	78-81.9	Continuous	0.5
GREEN	MINIMAL	82-84.9	50	0.5-1.0
YELLOW	MODERATE	85-87.9	45	1.0
RED	SEVERE	88-89.9	30	1.5
BLACK	EXTREME	90-Above	20	1.5

A2.2. Hourly fluid intake should not exceed 1.5 quarts. Daily fluid intake should not exceed 12 quarts. Rapid ingestion of large amounts of water (greater than 1.5 quarts per hour) may lead to hyponatremia (acute water intoxication), which is a life threatening condition that may lead to weakness, convulsions, loss of consciousness, and death if not recognized and treated promptly.

A2.3. If individual protective equipment (IPE) is worn, add 10 °F to the WBGT index. Judgment may be used to make other adjustments. For example, if cotton coveralls are worn over clothes, add 2 °F to the index.

A2.4. When WBGT > 90, all non-mission essential tasks should stop until the WBGT drops again. Unit Control Centers will determine mission essential tasks.

A2.5. These numbers are based on moderate work. Subtract 5 minutes from the max work times for heavy workloads.

A2.6. To Maintain Physical Performance:

A2.6.1. Heat symptoms take priority. This information **is not** a substitute for common sense.

A2.6.2. For the WBGT index, call Bioenvironmental Engineering Flight at ext. 6289.

Table A2.2. Heat Stress Symptoms and First Aid.

HEAT STRESS SYMPTOMS	FIRST AID
Muscle cramps, headache, dizziness, and/or nausea	Remove to shaded area, loosen clothing, drink cool water, cool body with water
Vomiting and/or confusion	Transport to clinic or call "911"

A2.7. To Avoid Heat Stress:

- A2.7.1. Replace salt by eating 3 meals a day. Do not take salt tablets.
- A2.7.2. Medication and illness may affect how your body takes the heat.
- A2.7.3. Workers with heat injury history are at a higher risk.
- A2.7.4. Vigorous exercise, eating well, enough sleep, and hydrating are the best defense.
- A2.7.5. Rest areas should be in a shaded, cool area.
- A2.7.6. The body uses water better every 20 minutes than all at once.
- A2.7.7. Avoid dehydrating beverages: coffee, alcohol, and caffeinated soft drinks. Generally, clear odorless urine indicates good hydration .

Attachment 3

HEAT STRESS AND WATER INTOXICATION WARNING SIGNS AND SYMPTOMS

<p>EARLY SIGNS/SYMPTOMS</p> <p>Dizziness Headache Dry mouth Unsteady walk Weakness Muscle cramps</p>	<p>ACTIONS</p> <p>Move to a shaded area Allow casualty to rest in shade Take sips of water If signs or symptoms do not improve in 15-30 minutes, transport to medical facility If signs or symptoms worsen, call ambulance</p>
<p>LATER SIGNS/ SYMPTOMS</p> <p>Hot body, high temperature Confusion, unresponsiveness, coma Vomiting Involuntary bowel movement Convulsions Weak or rapid pulse</p>	<p>IMMEDIATE ACTIONS</p> <p>Call “911” for immediate transport to a hospital Lay person down in shade with feet elevated until ambulance arrives Give <i>sips</i> of water while waiting for ambulance Begin active cooling, if skin is hot to touch Undress as much as possible Pour cool water over person and fan</p>

Attachment 4**GUIDELINES FOR THE USE OF SPORTS DRINKS FOR FLUID REPLACEMENT****A4.1.** The following guidelines apply:

A4.1.1. Sports drinks may be indicated when the wet bulb globe temperature (WBGT) is greater than 85° F (yellow flag or higher) or if prolonged moderate to heavy work is planned for longer than two hours. Specific recommendations for fluid intake and work/rest cycles are based on the work level, WBGT, MOPP level and acclimatization.

A4.1.2. No particular brand of sports drink is recommended; however, the carbohydrate content should not exceed 15% prior to dilution. Sports drinks should be diluted half strength (1 part water:1 part beverage or 2 parts water: 1 part beverage powder) for optimal fluid replacement .

A4.1.3. The half-strength sports drink should be kept cool (60-70° F) or shaded if possible. The beverage must be disposed of after 8 hours if refrigerated, or within 4 hours if allowed to warm. Sports drinks should not be added directly to canteens or bulk water storage (such as water buffaloes or tanks); they should be added to personal drinking cups or larger washable containers for group access. Re-usable containers must be washed and sanitized at the end of every work shift, as the sugar content can provide good growth medium for bacteria. Unless they are in powdered form, undiluted portions of open sports drink containers should be refrigerated.

A4.1.4. Potable cool water must always be available and collocated with the sports drink.