BY ORDER OF THE COMMANDER
374TH AIRLIFT WING

YOKOTA AIR BASE INSTRUCTION 48-107

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Aerospace Medicine

HEAT STRESS MONITORING

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This instruction implements Air Force Policy Directive (AFPD) 48-1, *Aerospace Medical Program*, and describes procedures designed to protect personnel, who are exposed to severe weather while performing duties at Yokota Air Base (AB), from the adverse health effects from heat stress. This instruction applies to all personnel assigned, attached, or associated with the 374th Airlift Wing (374 AW). Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance (IAW) Air Force Manual (AFMAN) 33-363, *Management of Records*, and dispose of IAW the Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS) located at **https://www.my.af.mil/afrims/afrims/afrims/rims.cfm**. Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through their appropriate functional chain of command.

SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. Major changes include: adding responsibilities of commanders (paragraph 3.1.), updated responsibilities of supervisors & work center personnel (paragraphs 3.2. and 3.3.). Significantly changed Bioenvironmental Engineering responsibilities to ensure heat stress is based on WBGT and not dry bulb per AFPAM 48-151, *Thermal Injury*. Changed and updated 374 OSS Weather Flight responsibilities (paragraph 3.6.). Updated paragraph 4., *Heat Stress Management*, with more background information. Attachment 2, renamed to Guidelines for personnel wearing hot weather BDU and Standard Work Clothing, significantly changed with removal of dry bulb

references and renumbered to Attachment 3. Included new attachments: Sample Thermal Stress Training Aid (Attachment 2) and Guide to Determination of Workload (Attachment 4).

1. References and Terms Explained: See **Attachment 1**.

2. Concept: This instruction provides unit commanders and supervisors with information and guidance to operate continuously in a severe hot environment. This instruction is to be applied in peacetime, contingency, and exercise operations.

3. Responsibilities:

3.1. Unit Commanders are responsible for the health and safety of the members of their unit and will:

3.1.1. Ensure individuals under their command are aware of thermal stress hazards and prevention methods.

3.1.2. During training exercises when personnel wear the ground crew chemical defense ensemble, ensure supervisors and workers are trained to recognize the early signs of heat stress and the methods to minimize associated effects.

3.2. Supervisors are responsible for the implementation of health and safety in workplaces. Work center supervisors will:

3.2.1. Brief workers annually on the health hazards of thermal stress, the Wet Bulb Globe Temperature (WBGT) index, notification procedures, and appropriate preventive measures. Document this on AF Form 55, *Employee Safety and Health Record*. Supervisors may use Attachment 2 to conduct their briefings.

3.2.2. Disseminate the thermal stress index to workers when informed through Command Post of updated conditions.

3.2.3. Brief workers on the signs and symptoms of heat stress disorders and how to minimize effects of heat stress during exercises when wearing the ground crew ensemble or other similarly impermeable clothing. Make adjustments to the WBGT index as indicated in the notes to Attachment 3.

3.2.4. Ensure personnel and aircrews working outside in hot environments increase their fluid intake and implement appropriate work/rest cycles.

3.2.5. Ensure all personnel are acclimatized in accordance with paragraph 4.4.2.

3.2.6. Report all thermal stress illnesses documented on AF Form 190, *Occupational Illness/Injury Report.*

3.3. Work Center Personnel will:

3.3.1. Maintain awareness of existing or potential thermal stress situations within their workplace.

3.3.2. Understand the signs and symptoms of thermal stress and the first aid measures.

3.3.3. Follow the prevention directives of commanders and supervisors.

3.3.4. Monitor co-workers for heat stress symptoms.

3.3.5. Report all thermal stress illnesses to the work center supervisor.

3.4. 374th Aerospace Medicine Squadron Bioenvironmental Engineering (BE) (374 AMDS/SGPB) will:

3.4.1. Measure and determine the WBGT Index.

3.4.2. Report thermal stress measurements to 374 AW Command Post, 374 Operations Support Squadron Weather Flight for dissemination to base personnel.

3.4.3. Provide commanders and supervisors with risk assessments, upon request, for conducting tasks outside guidelines established in this instruction.

3.4.4. Ensure thermal stress measurements and guidance are available throughout normal duty hours during the duty week and if warranted, in support of weekend operations/exercises.

3.4.5. Conduct thermal stress evaluations upon special request or as part of routine industrial hygiene surveillance, if warranted.

3.4.6. Investigate all thermal stress illnesses documented on AF Form 190, *Occupational Illness/Injury Report.*

3.5. 374 AMDS Public Health (374 AMDS/SGPM) will:

3.5.1. Provide training information on the effects and risks of heat stress for workers routinely exposed to extreme temperature environments.

3.5.2. Provide training to supervisors, upon request, for workplaces without routine, occupational exposure to extreme temperature environments.

3.6. 374th Operations Support Squadron Weather flight (374 OSS/OSW) will:

3.6.1. Provide alternate support for reporting heat stress categories when BE is unable to disseminate information through JET and display a heat category slide on the Yokota weather channel.

3.6.2. Provide BE with training on the Joint Environmental Toolkit system.

3.7. The 374 AW Command Post (374 AW/CP) will: Only when there is a change in heat categories, notify 374 AW Maintenance Operations Center (MOC) (374 AW/CPM), group commanders, base operations, main gymnasium, 730th Air Mobility Squadron Air Mobility Command Center (730 AMS/AMCC).

3.7.1. Only when there is a change in heat categories, the 374 AW/CPM will broadcast all appropriate heat stress conditions to flight line production supervisors via the Land Mobile Radios (LMR).

4. Heat Stress Management:

4.1. Background. Heat stress is the thermal exposure to the body. Historical Bioenvironmental Engineering (BE) heat stress records indicate Yokota AB experiences conditions of hazardous heat stress from May through September. During days of high relative humidity the evaporation of sweat, the body's cooling mechanism, is slowed. Increased sweating demands more water consumption to maintain the body's cooling system.

4.2. Measurement. BES measures heat stress by the WBGT index. 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.

4.3. Reporting. BES will monitor the WBGT at 0800, 1000, 1200, 1400 and 1600, Monday through Friday, excluding holidays and down days, as appropriate for the weather conditions. This will be done between the end of May to the middle of September of each year. The last heat category at 1600 will be in effect until sunset then start over the next duty day. Heat categories/WBGT are not applicable on rainy days and after sunset. The WBGT index will be reported to the base weather, command post for dissemination to base personnel.

4.4. Guidance.

4.4.1. Occupational Heat Stress Exposure. Personnel acclimatized to the local area are better able to cope with the hot temperatures at Yokota AB. All newly arrived personnel from cooler climates should become acclimated before attempting any strenuous activity or exercise.

4.4.2. 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 requirement to avoid possible heat illness or injury. To acclimatize, personnel should perform typically required duties in the hot environment, but at a slower pace with more frequent breaks. Acclimatization is a series of physiological adjustments that occur when an individual is exposed to hot climates. A period of acclimatization is required for all personnel regardless of each individual's physical condition. 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. The better an individual's physical condition, the quicker the acclimatization is achieved.

4.4.3. Aerobics and Exercise. During the summer months, commanders should schedule outdoor aerobics and exercise during the morning hours and avoid flag conditions that exceed 88 degrees on the WBGT. 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.

4.4.4. 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 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.

4.4.5. 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, respirator, and similar attire, 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 5-15 degrees to the WBGT Index when determining workplace conduct outdoors. A guideline for the amount of WBGT index to add when wearing body armor, ground crew ensemble, etc. is contained in the notes to **Attachment 3**.

4.4.6. 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. The Bioenvironmental Engineering representative in areas requiring MOPP wear will provide further guidance depending on the existing conditions.

WILLIAM M. KNIGHT, Colonel, USAF
Commander, 374th Airlift Wing

Attachment 1

GLOSSARY OF REFEFENCES AND SUPPORTING INFORMATION

References

AFMAN 10-2503, *Operations in A Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive (**Cbrne**) Environment*, 7 July 2011

AFPD 48-1, *Aerospace Medical Program*, 23 August 2011

AFPAM 48-151, *Thermal Injury*, 18 November 2002

AFMAN 33-363, *Management of Records*, 1 March 2008

Threshold Limit Values for Chemical Substances and Physical Agents, American Conference of Governmental Industrial Hygienists, 2009.

Adopted Forms

AF Form 55, *Employee Safety and Health Record*

AF Form 190, *Occupational Illness/Injury Report*

AF Form 847, *Recommendation for Change of Publication*

Terms

Dry Bulb Temperature—The temperature of the air without regard to the effects of humidity, radiant heat of the sun, or wind.

Heat Stress Condition—A four level advisory based on the risk of injury or illness due to the effects of working in extreme temperatures.

Condition Green—The risk of heat-related injury or illness is real, but typical workloads can continue with proper hydration, clothing, and surveillance. All outdoor workers should have current training on the symptoms of overexposure and first aid measures. Implement work and rest cycles as appropriate.

Condition Yellow—The risk of heat-related injury or illness is significant. Work practices should be modified to properly manage the risks. Worker surveillance and education should be increased. Force hydration. Consider reassigning workers not acclimatized who are performing moderate and heavy tasks in hot environments to duties protected from extreme temperatures. Implement work and rest cycles as appropriate.

Condition Red—The risk of heat-related injury or illness is high. Work practices must be modified to properly manage the risks. Workers should be monitored constantly and education should be conducted at least weekly. Reassign workers not acclimatized, who are performing moderate and heavy tasks in hot environments, to duties protected from extreme temperatures. Implement work and rest cycles as appropriate.

Condition Black—The risk of heat-related injury or illness is severe. For heavy work in hot environments, only emergency and mission critical tasks should be conducted outdoors. Implement work and rest cycles as appropriate.

Wet Bulb Globe Temperature (WBGT)—A method of measuring temperature to more accurately describe how the human body perceives the relative heat of an environment. It adjusts the dry bulb temperature for the effect of humidity, the cooling effect of evaporation, and the warming effect of the radiant heat from the sun.

Attachment 2

SAMPLE THERMAL STRESS TRAINING AID

A2.1. Heat Stress

A2.1.1. Personnel working and/or training in hot environments can prevent heat injury by understanding the risk factors and causes, taking practical preventive measures, recognizing the symptoms, and knowing the appropriate first-aid treatment for common heat injuries and heat-related illnesses.

A2.1.2. Individual Risk Factors for Heat Injury. There is wide variation in human tolerance to heat stress. Consider the following personal factors when assessing individual heat injury risk:

A2.1.2.1. Obesity.

A2.1.2.2. Lack of physical fitness and/or lack of sleep.

A2.1.2.3. Recent alcohol intake.

A2.1.2.4. Concurrent mild illness e.g., diarrhea, viral illness, fever.

A2.1.2.5. Dehydration.

A2.1.2.6. Medication or illegal drugs.

A2.1.2.7. The presence of a heat rash or acute sunburn.

A2.1.3. Precautionary Measures. Apply the following general precautionary measures when working in a hot environment:

A2.1.3.1. Water. Adhere to the hydration requirements for the current heat category and work rate. Drink small amounts of water more frequently and avoid caffeinated drinks like soda and coffee. Dilute sports drinks to half strength (1 part water: 1 part beverage or 2 parts water: 1 part beverage powder) for optimal fluid replacement.

A2.1.3.2. Sodium Intake. Some salt is lost in perspiration. Maintain a normal diet, season food to taste, and don't skip any meals. Do not use salt tablets except under special operating conditions when ordered by competent medical authority.

A2.1.3.3. Clothing. Wear loose fitting clothing, especially at the neck and wrist, to allow air circulation. Military wear the hot weather Battle Dress Uniform (BDU). Wear appropriate headgear. Cover yourself and apply a sun-blocking lotion to prevent sunburn when exposed to the sun's rays.

A2.1.3.4. Work Schedules. Modify work schedules to perform the heaviest work in the coolest parts of the day. Adhere to the work/rest cycles appropriate to the current heat category and work rate.

A2.1.3.5. Food. Avoid eating greasy, fatty, or heavy foods. Don't perform heavy work in the heat after eating a glucose or high carbohydrate meal.

A2.1.3.6. Medical Treatment. Seek medical treatment for illnesses and skin problems, including rashes.

A2.1.3.7. Other. Avoid the use of sweat inhibiting deodorants.

A2.1.4. Recognizing and Treating Heat Stress Disorders. Recognition of heat illness is the key principle in treatment and management. In general, treat any individuals with the following signs or symptoms during physical activity in a hot environment or while wearing protective clothing as if they are suffering from heat illness:

A2.1.4.1. Dizziness or confusion.

A2.1.4.2. Nausea or vomiting.

A2.1.4.3. Staggering.

A2.1.4.4. Blurred vision.

A2.1.4.5. Confusion, collapse or loss of consciousness.

A2.1.5. Common Heat Stress Disorders and Treatment.

A2.1.5.1. Sunburn. Unprotected exposure to sun can cause sunburn, accelerate skin aging, may cause drug photosensitization and depress skin immune responses. Sunburn also increases the risks of skin cancer. Altitude and reflective surfaces such as fresh ice, snow, sand, metal, concrete and wind increase the risk and severity of sunburn.

A2.1.5.1.1. Sunburn Prevention and Treatment. Clothing and sunscreens according to skin type can prevent sunburn. *Sunscreens are to protect against ultraviolet (UV) A and UV B and provide a minimum sun protective factor of 15.* Severe sunburn (blistering) requires immediate medical treatment. Treat mild sunburn as follows:

A2.1.5.1.1.1. Avoid further exposure.

A2.1.5.1.1.2. Cool soak with tap water.

A2.1.5.1.1.3. Apply emollients.

A2.1.5.1.1.4. Use Aspirin and other non-steroidal anti-inflammatory drugs.

A2.1.5.1.1.5. Apply topical steroids.

A2.1.5.2. The following table lists the most common heat stress disorders, symptoms, and first aid treatment:

Table A2.1. Symptoms and First-Aid Treatment for Heat Stress Disorders

Disorder	Symptoms	First Aid
Heat Syncope	Brief fainting or near-fainting when standing erect and immobile, normal temperature.	Remove to cool, shaded environment, allow to recline, and provide cool water
Heat Cramps	Painful spasms, usually in muscles of legs and abdomen, and heavy sweating.	Remove to cool area. Apply firm pressure on cramping muscles or gently massage to relieve spasm. Give sips of water. If nausea occurs, discontinue use.
Heat Exhaustion	Cramps in abdomen or limbs. Pale face, dizziness, faintness, and weakness. Loss of appetite, nausea or vomiting, profuse sweating, moist, cool skin, and weak pulse. Normal body temperature.	Treat for shock. Lay person down in cool area, give cool water, and cool body by sprinkling with water or fanning (not to point of shivering). Loosen clothing; seek medical attention.
Heatstroke MEDICAL EMERGENCY	Headache, dizziness, red face/skin, hot, dry skin (no sweating), and rapid pulse. High body temp (hot to touch) and possible unconsciousness.	**Call medical facility first.** Treat for shock; lay person down in cool area and raise legs. DO NOT give fluids; cool body by sprinkling with warm or tepid water or fanning (not to point of shivering). DO NOT use ice packs, cold sponging, or blow cold air. Loosen or remove clothing.
Hyponatremia MEDICAL EMERGENCY	**Condition in which the level of sodium in the blood is markedly lowered as a result of sodium lost in sweat, coupled with fluid replacement using only large volumes of plain water (greater than 1 ½ quarts per hour).** Confusion, fatigue, muscle cramps, and nausea early on, followed later by vomiting, unconsciousness, seizures, and death if not recognized and treated promptly.	**Call medical facility first.** This condition is difficult to distinguish from heat exhaustion and heat stroke, and if suspected should be treated immediately in a medical facility.

Attachment 3

GUIDELINES FOR PERSONNEL WEARING HOT WEATHER BDU AND STANDARD WORK CLOTHING

Table A3.1. Guidelines for Average Acclimatized Individual Wearing BDU, Hot Weather or Standard Clothing

Heat Category	WBGT Index (°F)	LIGHT WORK		MODERATE WORK		HEAVY WORK	
		Work/Rest (min/min)	*Water Intake (Qt/hr)	Work/Rest (min/min)	*Water Intake (Qt/hr)	Work/Rest (min/min)	*Water Intake (Qt/hr)
1 (None)	78 – 81.9	No Limit	½	No Limit	¾	40/20	¾
2 (Green)	82 – 84.9	No Limit	½	50/10	¾	30/30	1
3 (Yellow)	85 – 87.9	No Limit	¾	40/20	¾	30/30	1
4 (Red)	88 – 89.9	No Limit	¾	30/30	¾	20/40	1
5 (Black)	≥ 90	50/10	1	20/40	1	10/50	1

NOTES

1. Work/rest cycle recommendations are based on personnel who are fully acclimatized, optimally conditioned, hydrated, and rested.

2. Rest means minimal physical activity (sitting or standing) and should be accomplished in the shade if possible.

3. Drink small amounts of water throughout the work period, not all at once. Individual water need will vary +/- 1/4

4. These values will sustain performance and hydration for at least 4 hours of work in the specified heat category. (Values are based on US Army Research Institute for Environmental Medicine recommendations; US Army policy.)

5. When performing activities with ground crew ensemble, fire-fighting gear, or other restrictive or impermeable clothing, add 10^{o} F to the measurement (add 15^{o} F if also wearing body armor). These adjustments account for the clothing and equipment effects on evaporative cooling (increased barrier) and any increase in work due to the additional load.

***CAUTION:** Hourly fluid intake should not exceed 1 1/2 quarts; daily fluid intake should not exceed 12 quarts.

Rapid ingestion of large amounts of water (greater than 1 1/2 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.

Attachment 4

GUIDE TO DETERMINATION OF WORKLOAD

Table A4.1. Guide to Determination of Workload

LIGHT WORK	MODERATE WORK	HARD WORK
--Walking on hard surface @ 2.5 mph with < 30 lb load --Weapon maintenance --Manual arms --Marksmanship training --Drill and ceremony --Tower operations --Operations NCOs/officers --Pilot ground activities --Command post and unit control center activities	--Walking on hard surface @ 3.5 mph < 40 lb load --Walking on loose sand at 2.5 mph with no load --Patrolling --Low crawl, high crawl --Defensive position construction --Calisthenics --Refueling --Avionics shop --Aircraft maintenance --Unit post attack reconnaissance	--Walking on hard surface @ 3.5 mph with > 40 lb load --Walking on loose sand @ 2.5 mph with load --Armament crew --Heavy aircraft repair --Specialized teams such as NBC Reconnaissance, Search and Rescue, Rapid Runway Repair, CCA, Fire Protection, Decontamination, Medical, Damage Assessment and Repair, EOD