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*Aerospace Medicine*

**PREVENTION OF THERMAL STRESS  
INJURIES**

**COMPLIANCE WITH THIS PUBLICATION IS MANDATORY**

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This instruction provides unit commanders and supervisors with information and guidance to safely operate continuously in a severe hot or cold environment. This instruction is to be applied in both peacetime and contingency/exercise operations. The OPR for this publication is 62 MDOS

***Summary of Revisions***

Paragraph **1**. changed to give background information. References, Abbreviations and Acronyms, and Terms were moved to **Attachment 1**. “Giant Voice” was deleted from paragraph **2.5**. and “radio” was changed to “LMR”. **Attachment 2** provides temperature range changes for moderate, caution and danger conditions to reflect current American Conference of Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) guidelines. Adjustment to wet bulb globe temperature (WBGT) for unacclimatized worker added to **Attachment 2**. A bar ( | ) indicates a change since the last revision.

**1. Background:** Operations involving high ambient temperatures, radiant heat sources, high humidity, or strenuous activities have a high potential for inducing heat stress. Heat stress can lead to injury or loss of life if unrecognized and untreated. Likewise, operations involving extreme cold, especially when combined with wet conditions, may cause cold related injury, hypothermia or death. Education and training, along with physical conditioning, is the best prevention against thermal stress injuries.

**2. Responsibilities.**

2.1. 62d Airlift Wing Commander (62AW/CC) or Forward Operating Location Commander (FOL/CC) will:

2.1.1. Be the final approval authority for implementing work/rest and work/warming cycles referenced in **Attachment 2** and **Attachment 4**.

2.2. Bioenvironmental Engineering (62 MDOS/SGOAB) will:

2.2.1. Establish recommended heat and cold stress prevention guidelines based upon 9-hour workdays or for extended periods during exercises and contingencies for personnel potentially exposed to extreme temperature environments.

2.2.2. Conduct health risk assessments in workplaces at the request of the supervisor or commander.

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

2.2.4. Perform WBGT monitoring and be responsible for its periodic maintenance and calibration.

2.3. The Public Health Office (62 MDOS/SGOAM) will:

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

2.3.2. Provide training to supervisors, as requested, for workplaces without routine occupational exposure to extreme temperature environments.

2.4. The Weather Station (62 OSS/OSW or FOL weather unit) will:

2.4.1. Begin calculating the wind chill index when the ambient temperature decreases to less than 25 °F (-4 °C).

2.4.2. Append the wind chill index to the surface weather observation when the ambient temperature decreases to less than 25 °F (-4 °C).

2.4.3. Contact the Command Post (or FOL commander) when the wind chill index passes through the following values, -15 to -24, -25 to -34, -35 to -44, and less than -45.

2.5. The Command Post (62 AW/CP) or FOL commander will implement the heat or cold stress condition and forward it via pagers, land mobile radio (LMR), or other communication method by stating the "condition" with reference to this wing instruction. 62 AW/CC will be advised on heat/cold stress conditions during peacetime. The FOL commander will be advised on heat/cold stress conditions during actual or exercise contingencies.

2.6. Supervisors will:

2.6.1. Provide drinking water convenient to the work area during times where the heat or cold stress condition is standard or above.

2.6.2. Monitor workers for signs of heat/cold stress and intervene when appropriate.

2.6.3. Ensure workers are trained on heat/cold stress symptoms and prevention and document the training in **AF Form 55, Employee Safety and Health Record**.

2.6.4. Implement work/rest and work/warming cycles in accordance with **Attachment 2** and **Attachment 3** of this instruction. These are only advisories. Supervisors should consider actual mission requirements and personnel safety when determining application of these work/rest and work/warm cycles.

2.6.5. Ensure personnel are not tasked with duties such that proper facilities (indoors or shade with air movement during hot environments and a warm place during cold environments) are not readily available to allow proper work/rest or rest/warming cycles.

### 3. Procedures.

3.1. The Weather Flight will calculate wind chill index and will report as specified in paragraph 2.3.3. Bioenvironmental Engineering will conduct WBGT monitoring and notify the Command Post of heat stress conditions when ambient temperatures reach 80 °F.

3.2. The Command Post will notify units of initial thermal or cold stress condition and each time the condition changes.

3.3. The Command Post will notify units that the 62 AW or FOL is no longer in a Heat/Cold Stress condition only after the temperatures are mild enough to be below Condition Standard for two consecutive hours.

3.4. Supervisors will implement work/warming cycles as required for the cold stress condition. Supervisors will implement work/rest cycles as required by the existing heat stress condition. Supervisors may contact Bioenvironmental Engineering to request evaluations for special work details (requiring heavy physical activity) or conditions when thermal stress conditions are moderate or worse.

### 4. Heat Stress.

#### 4.1. Controlling Heat Stress.

4.1.1. Follow the rest/work regimen as specified in [Attachment 2](#). Guidelines for flight crews are listed in [Attachment 3](#).

#### 4.1.2. Water and Salt Replacement:

4.1.2.1. During the hot season or when personnel are exposed to artificially generated heat, drinking water should be readily available. Workers should frequently drink small amounts, i.e., one cup every 15 minutes. Water should be kept reasonably cool, but not cold.

4.1.2.2. Personnel working in hot environments should be encouraged to eat salty foods. Do not take salt tablets unless directed by a physician.

#### 4.1.3. Clothing:

4.1.3.1. Light, loose clothing made of breathable material should be worn during outdoor activities in hot conditions.

4.1.3.2. If special clothing is required for performing a particular job and it impedes sweat evaporation or has a high insulation value (firefighters, chemical warfare), the worker's heat tolerance is reduced.

#### 4.1.4. Acclimatization and Fitness:

4.1.4.1. Acclimatization to heat involves both physiological and psychological adjustments that occur in an individual during the first week of exposure to a hot environment. Workers arriving during the hot weather, from colder climates, should be given light duty for the first week.

4.1.4.2. Workers who are not fit or have a medical condition may be more susceptible to the effects of extreme heat. If member or the supervisor has any questions about fitness for duty in extreme heat, contact the member's physician.

#### 4.2. Symptoms and First Aid Measures for Heat Related Conditions.

4.2.1. Heat Cramps: Usually affect people who sweat a lot during strenuous activity, depleting the body's salt and fluids. The low salt level in the muscles causes painful cramps and spasms-usually in the abdomen, arms, or legs. Heat cramps may also be a symptom of heat exhaustion. Stop all activity and sit in the coolest available place. Drink clear juice or a sports beverage. Seek medical attention if cramps do not stop in an hour.

4.2.2. Heat Exhaustion: The body's response to an excessive loss of water and salt contained in sweat. Symptoms include heavy sweating, paleness, muscle cramps, weakness, dizziness, headache, nausea or vomiting and sometimes fainting. The skin may feel cool and moist, and the pulse rate will be fast but weak. Breathing will be fast and shallow. Untreated heat exhaustion may progress to heat stroke. Immediately provide cool beverages as tolerated, and cool the body by removing heavy clothing, giving a cool shower/bath, or wetting the clothing, and place in an air conditioned environment. Seek medical attention if the symptoms are severe or last longer than an hour.

4.2.3. Heat Stroke: Heat stroke occurs when the body is unable to control its temperature. The body's temperature rises rapidly, the sweating mechanism fails or is ineffective (as when sweat cannot evaporate), and the body is unable to cool down. Heat stroke can cause death or permanent disability if emergency treatment is not given. Warning signs include a high body temperature (above 103 degrees Fahrenheit, orally), dry skin which is red and hot, rapid strong pulse, throbbing headache, dizziness, nausea and confusion which may progress to unconsciousness.

4.2.3.1. First aid is required while immediately transporting to medical care. Start cooling the victim by any method available as described for heat exhaustion, with the addition of vigorous fanning. If uncontrollable muscle twitching or vomiting occur, protect the victim from injury and keep the airway open by turning on his or her side.

**5. Cold Stress.** The human body cannot adapt to cold except through proper clothing, shelter, and behavior changes, such as the warming cycles listed in [Attachment 4](#).

5.1. Cold weather can lower body temperature, resulting in impaired performance and cold injuries. Cold weather is often accompanied by wind, rain, snow, and ice, which can worsen the effects of cold. Inactivity for long periods increases the risk of cold injury. This is a particular concern for Defensive Fighting Positions (DFPs) or small vehicle crew compartments where movement is restricted.

5.1.1. For any given air temperature, the potential for body-heat loss, skin cooling and decreased body temperature is increased by wind and moisture. Any source of nicotine, such as smoking or chewing tobacco, can increase susceptibility to cold injury. An early warning sign of inadequate clothing and shelter is shivering, which increases heat production. Over the counter drugs such as aspirin, ibuprofen, and acetaminophen, can interfere with shivering.

5.1.2. Vigorous physical activity will also increase heat production, but adds to the risk of cold injury if clothes become wet with sweat. When body heat loss exceeds the body's ability to produce and retain heat, body temperature decreases. When body temperature falls below 95°F, hypo-

thermia, a life-threatening condition, follows. To reduce heat loss, the body decreases blood flow to the arms, legs, and skin. Although this protects the internal organs, the decreased blood flow increases susceptibility of hands, feet, ears, etc., to nonfreezing (trench foot) and freezing (frostbite) cold injuries.

5.2. Clean, dry, loose layers of clothing, including insulated headgear (watch caps/hoods), multiple gloves, and double socks, help prevent heat loss. The outer layer should provide wind protection. Adjust layers to minimize sweating. If clothing, including socks, becomes wet, change them immediately. Size boots to accommodate extra socks without restricting blood circulation. Cover exposed skin to help prevent frostbite, especially when wind chill temperatures are below -20°F.

5.3. Metal objects and liquid fuels left in the cold can pose a serious hazard. Fuels and solvents remain liquid at very low temperatures. Skin contact with fuel or metal at below freezing temperatures can result in nearly instantaneous freezing injury.

5.4. Minimize the risk of cold injuries in DFPs by placing pads, tree boughs, etc., inside these positions. Maintain adequate food consumption to make up for increased energy requirements in cold weather. Eat normal meals with frequent nutritious snacks between meals. Maintain adequate hydration with fluid intake of .5 to 1 liter per hour. The low absolute humidity associated with severe cold will cause dehydration with normal breathing. Avoid caffeine, tobacco, and alcohol. Keep hands, feet, and skin dry. Change socks whenever they become wet or sweaty.

5.5. Cold stress leads to reduced performance and lack of concentration. People are not always the best judge of their own condition. Supervisors must be aware of the risks of cold weather operations and enforce the buddy system to help prevent cold injuries. Individual tolerance to cold exposure varies greatly for a variety of reasons, including genetic and racial differences. Low body fat decreases tolerance, while higher body fat is protective. Use the recommended warming cycles (Attachment4) as well as the response of individuals to trigger actions to prevent cold injuries.

5.6. Symptoms of Cold Injuries.

5.6.1. Chilblain: A nonfreezing cold injury that, although painful, causes little or no permanent impairment. It appears as tender, red, swollen skin that is hot to the touch and may itch. This can worsen to an aching, prickly (“pins and needles”) sensation and then numbness. It may develop in only a few hours in skin exposed to cold.

5.6.2. Immersion or Trench Foot: Develops when feet are exposed to moisture and cold for prolonged periods (12 hours or longer). The combination of cold and moisture softens skin, causing tissue loss and, often, infection. Untreated, trench foot can eventually require amputation. Often, the first sign of trench foot is itching, numbness or tingling pain. Later the feet may appear swollen, and the skin faintly red, blue or black. Commonly, trench foot shows a distinct “waterline” coinciding with the water level in the boot.

5.6.3. Frost Nip: Involves freezing of water on the skin surface. The skin will become reddened and possibly swollen. Although painful, there is usually no further damage after re-warming. Repeated frost nip can dry the skin, causing it to crack and be sensitive. Frost nip should be taken seriously since it may be the first sign of impending frostbite.

5.6.4. Frostbite: Involves freezing of deeper layers of tissue. Ice crystal formation and lack of blood flow cause tissue damage. Skin freezes at about 28°F. The skin becomes numb and turns a gray or waxy white color, is cold to the touch and may feel stiff.

5.6.5. Hypothermia: A life threatening condition in which body temperature falls below 95°F. Generally, body temperature will not fall until after many hours of exposure to cold air or shorter exposure to cold water. Body temperature can fall even when air temperatures are above freezing if conditions are windy, clothing is wet, and/or the person is inactive. The first signs of developing hypothermia include confusion, bizarre behavior, and withdrawal from group interaction. Victims of hypothermia may be unconscious, with nearly undetectable breathing and pulse.

#### 5.7. First Aid for Cold Injuries.

5.7.1. Chilblain and Trench Foot: Prevent further cold exposure. Remove wet or constrictive clothing. Gently wash, dry, and elevate the injured part. Cover the injured area with layers of loose warm clothing and allow to re-warm. Pain and blisters may develop. Do not pop blisters, do not apply lotions or creams, do not massage, do not expose to extreme heat, and do not allow victim to walk on injury. Seek medical attention.

5.7.2. Frostbite: Prevent further cold exposure and remove wet or constrictive clothing. Gradually re-warm the injury by direct skin-to-skin contact between injured area and non-injured skin of victim or a buddy. Evacuate for medical treatment. Victims with foot injuries should not walk, but should be evacuated by litter. Do not thaw frostbite injuries if there is a possibility of refreezing during evacuation.

5.7.3. Hypothermia: Prevent further cold exposure and remove wet clothing. Initiate cardiopulmonary resuscitation (CPR) if required. Re-warm by covering with blankets, sleeping bags or body-to-body contact if necessary. Get the victim off the ground. Handle gently during treatment and evacuation because rough handling of hypothermic victims can cause dangerous irregular heartbeats or seizures. Apparently lifeless victims are never pronounced dead, even by physicians, until they are “warm and dead”.

**6. Prevention.** Education is probably the single most effective way to reduce the incidence of heat and cold stress. The supervisor should provide routine training to all workers occupationally exposed to hot or cold environments. Supervisors may contact the 62d Medical Operations Squadron, Aerospace Medicine Flight, Public Health Element for assistance in preparing training plans.

6.1. Physical conditioning is another very important heat or cold stress prevention mechanism. A balanced diet, plenty of rest, and routine aerobic exercise will greatly assist in increasing an individual's tolerance to heat and cold. Additionally, avoiding excessive alcohol consumption, caffeine containing drinks and following a doctor's advice when taking medication will decrease an individual's susceptibility to heat and cold stress.

ROBERT R. ALLARDICE, Colonel, USAF  
Commander

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

AFMAN 32-4005, *Personnel Protection and Attack Actions*.

OSHA *Technical Manual (TED 1-0.15A) Section III Chapter 4*

*Threshold Limit Values for Chemical Substances and Physical Agents, American Conference of Governmental Industrial Hygienist, 2002.*

***Abbreviations and Acronyms***

**AF**—Air Force (as used on forms)

**ACGIH**—American Conference of Industrial Hygienists

**CPR**—Cardiopulmonary Resuscitation

**DFP**—Defensive Fighting Position

**FOLC**—Forward Operating Location Commander

**LMR**—Land Mobile Radio

**OPR**—Office of Primary Responsibility

**TLV**—Threshold Limit Value

**T.O.**—Technical Order

**WBGT**—Wet Bulb Globe Temperature

***Terms***

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

**Wet Bulb Globe Temperature (WBGT)**—A method of measuring temperature that more accurately describes how the human body perceives the relative heat of an environment. It adjusts the ambient temperature for the effect of humidity, the cooling effect of evaporation, and the warming effect of the radiant heat from the sun. For the WBGT used base wide, the following method will be used for determining the reading:

**WBGT**—(°F) = 0.7 x Natural Wet Bulb (°F) + 0.2 x Globe Temperature (°F) + 0.1 x Dry Bulb (°F) (This method considers the sun's radiant heat)

**Wind Chill Index**—The approximate cooling effect of any combination of temperature and wind. The chill is calculated using ambient temperature and wind velocity.

**Thermal Stress Condition**—A four level advisory based on the risk of injury or illness due the effects of working in extreme temperatures. Reference **Attachment 2** for the conditions and temperatures.

**Condition Standard**—The risk of thermal-related injury/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/rest or work/warming cycles as appropriate.

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

**Condition Caution**—The risk of thermal-related injury/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/rest or work/warming cycles as appropriate.

**Condition Danger**—The risk of thermal-related injury/illness is extreme. For heavy work in hot environments and any work in cold environments, only emergency and mission critical tasks should be conducted outdoors. Implement work/rest or work/warming cycles as appropriate.

**Forward Operating Location (FOL)**—A deployed location where 62 AW, or subordinate 62 AW units, are deployed (with command authority of the deployed unit).

## Attachment 2

## HEAT STRESS PREVENTION RECOMMENDED WORK/REST CYCLES

## A2.1. Examples of workload categories are as follows:

Table A2.1. Heat Stress Conditions/Actions.

Heat Stress Conditions/Actions				
Heat Stress Condition by WBGT Temperature	<b>STANDARD</b> 78 to 81.9°F	<b>MODERATE</b> 82 to 84.9°F	<b>CAUTION</b> 85 to 87.9°F	<b>DANGER</b> above 88°F
Workload Category	Work/Rest Cycles for 1 Hour Intervals (in minutes)			
Light	Unrestricted	Unrestricted	45/15	30/30
Moderate	Unrestricted	45/15	30/30	15/45
Heavy	45/15	30/30	15/45	Mission essential work only
Water Intake, Quarts/Hour	0.5 to 1	1 to 1.5	1.5 to 2	Above 2

A2.1.1. Light: Standing or sitting to control machines, performing light hand or arm work.

A2.1.2. Moderate: Cleaning a floor, hammering nails, moderate lifting and pushing.

A2.1.3. Heavy: Digging ditches by hand, sandbag filling and moving.

## A2.2. Adjustments:

A2.2.1. For unacclimatized workers, add 3 degrees to WBGT reading.

A2.2.2. If wearing full cotton coveralls or IPE gear, add 3.5 degrees to WBGT reading.

A2.2.3. If wearing IPE gear and chemical warfare gear (MOPP 3 or 4), add 6 degrees to WBGT reading.

**Attachment 3****HEAT STRESS GUIDELINES FOR FLIGHT CREWS**

**A3.1. Heat Stress Condition Standard:** No restriction on flying or ground time.

**A3.2. Heat Stress Condition Moderate:** No restriction on flying or ground time

**A3.3. Heat Stress Condition Caution:**

A3.3.1. Be alert for symptoms of heat stress.

A3.3.2. Drink plenty of water (see [A3.4.](#)).

A3.3.3. Limit ground operations time to 90 minutes (time outside an air-conditioned environment).

**A3.4.** Caffeine containing drinks should be limited because of their diuretic effects.

**A3.5. Heat Stress Condition Danger:** In addition to the above procedures:

A3.5.1. Limit ground operations to 45 minutes (time outside an air-conditioned environment).

A3.5.2. When possible, wait in a cool, shaded area if the aircraft is not ready to fly.

A3.5.3. Recommend a minimum of two hours time from landing to takeoff if flying more than one sortie. If this is not possible, then pilots should be in an air-conditioned environment (aircraft) for a minimum of 15 minutes prior to taxi.

## Attachment 4

## COLD STRESS PREVENTION

Table A4.1. Recommended Warming Cycles.

Cold Conditions/Actions				
Cold Stress Condition by °F (Wind Chill)	<b>STANDARD</b> -15 to -24°F	<b>MODERATE</b> -25 to -34°F	<b>CAUTION</b> -35 to -44°F	<b>DANGER</b> below -45°F
Maximum Work Without Warming (in minutes)	120	65	35	Emergency work only.
Minimum Number of Breaks in 4-hour Period*	1	2	4	Emergency work only.
Special Actions	No exposed skin.	Cease tasks requiring any ungloved work. Monitor Personnel travel.	Avoid outdoor activities. Monitor personnel travel.	Emergency work only. Limit personnel travel.
Water Intake, Quarts/Hour	0.5 to 1	0.5 to 1	0.5 to 1	0.5 to 1

**NOTE:** THIS GUIDANCE ASSUMES INDIVIDUALS ARE PROPERLY ATTIRED, WITH NO EXPOSED SKIN.

\* Warming breaks should be at least 15 minutes continuously out of the wind and in an environment at least 50 °F. Outer clothing should be removed when entering warming shelters so sweat evaporation can occur. Drinking warm sweet drinks will increase the positive effect of the warming period. Replace wet clothing with dry garments prior to reentering the cold environment.