



THERMAL STRESS PROGRAM BASICS

NASA GLENN RESEARCH CENTER

WHAT THE BASICS COVER

- ◆ THE ILLNESSES AND INJURIES ASSOCIATED WITH HEAT STRESS
 - ACCLIMATIZATION
- ◆ THE ILLNESSES AND INJURIES ASSOCIATED WITH COLD STRESS
- ◆ ALERT COMMUNICATIONS
- ◆ PREVENTION
 - WORK/REST CYCLES FOR NATURAL AND ARTIFICIAL HOT AND COLD ENVIRONMENTS TO PROTECT THE WORK FORCE
- ◆ THE THERMAL STRESS PROGRAM
- ◆ THERMAL STRESS POINTS OF CONTACT

HEAT STRESS ILLNESSES AND INJURIES

Heat Rash
Heat Cramps
Heat Syncope
Heat Exhaustion
Heat Stroke

Mild Medical Condition



Dangerous Medical Emergency



HEAT RASH

- ◇ Red cluster of pimples or small blister
- ◇ Can happen anywhere on body
 - Neck
 - Back
 - Groin
- ◇ First Aid:
 - Work in a cooler area if possible
 - Keep area dry
 - Powders may be used for comfort



HEAT CRAMPS

- ◆ Muscle pain or spasms usually in the abdomen, arms, or legs
- ◆ Stop all activity, and sit in a cool place
- ◆ Drink water, clear juice or a sports beverage
- ◆ Do not return to strenuous work for a few hours after the cramps subside because further exertion may lead to heat exhaustion or heat stroke
- ◆ Seek medical attention if any of the following apply:
 - The worker has heart problems
 - The worker is on a low-sodium diet
 - The cramps do not subside within one hour



HEAT SYNCOPE

- ❖ Heat Syncope or fainting is a mild form of heat illness that often results from physical exertion when it is hot. It occurs when your body, in an effort to cool itself, causes the blood vessels to dilate to such an extent that blood flow to the brain is reduced
- ❖ Sit or lie down in cool place when symptoms begin
- ❖ Slowly drink water, clear juice, or a sports beverage
- ❖ Elevate the feet



HEAT EXHAUSTION IS CONSIDERED A MEDICAL EMERGENCY!

HEAT EXHAUSTION SYMPTOMS

- ◇ Pale or flushed complexion
- ◇ Muscle cramps
- ◇ Slightly elevated body temperature
- ◇ Fast and shallow breathing
- ◇ Heavy sweating
- ◇ Fatigue
- ◇ Dizziness
- ◇ Confusion
- ◇ Nausea
- ◇ Clammy, moist skin
- ◇ Weakness



HEAT EXHAUSTION IS CONSIDERED A MEDICAL EMERGENCY!

HEAT EXHAUSTION

- ◆ Heat exhaustion is the body's response to an excessive loss of the water and salt, usually through excessive sweating. Workers most prone to heat exhaustion are those that have high blood pressure, have previously been exposed, and are wearing heavy or restrictive clothing
- ◆ Call 911 and notify their supervisor
- ◆ Have them rest in a cool, shaded or air-conditioned area
- ◆ Have them drink plenty of water or other cool, nonalcoholic beverages
- ◆ Have them take a cool shower, bath, or sponge bath



HEAT STROKE IS A MEDICAL EMERGENCY!

HEAT STROKE

- ◆ Is the most serious heat-related disorder
- ◆ Occurs when the body becomes unable to control its temperature
- ◆ Body's temperature rises rapidly, sweating mechanism fails, body is unable to cool down
- ◆ When heat stroke occurs, body temperature can rise to 106 degrees Fahrenheit or higher within 10 to 15 minutes
- ◆ Heat stroke can cause death or permanent disability if emergency treatment not given



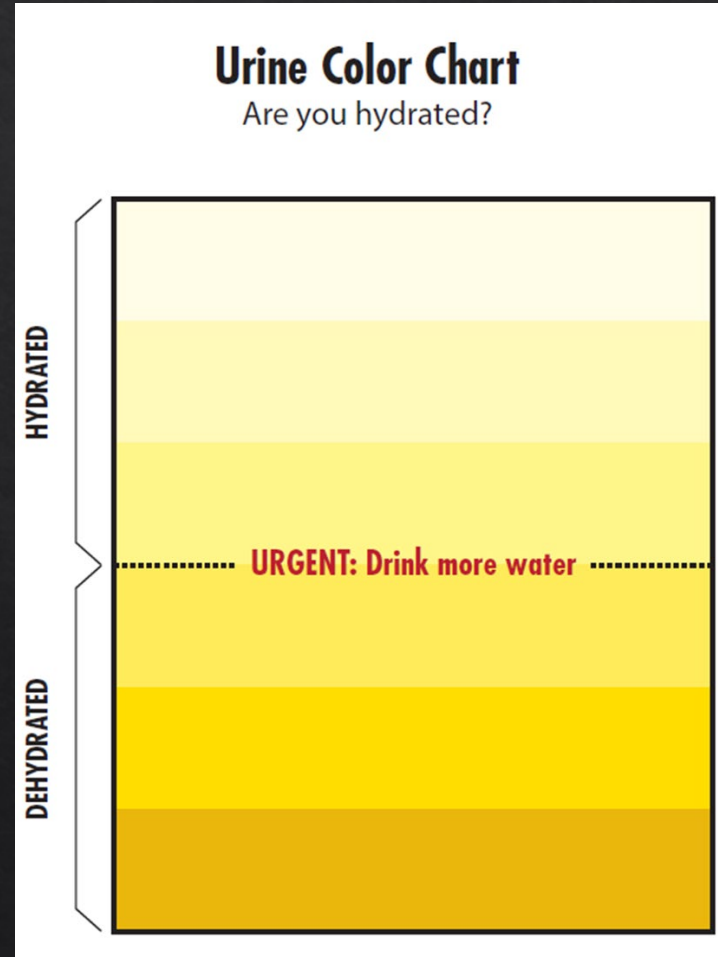
HEAT STROKE IS A MEDICAL EMERGENCY!

HEAT STROKE

- ◆ Call 911 and notify their supervisor
- ◆ Move the sick worker to a cool shaded area
- ◆ Cool the worker using methods such as:
 - ✓ Soaking their clothes with water
 - ✓ Spraying, sponging, or showering them with water
 - ✓ Fanning their body
- ◆ <https://www.youtube.com/watch?v=txQO6hAHozM>



ARE YOU HYDRATED?



ACCLIMATIZATION

- ◆ Adaptation to heat due to increased capacity to sweat, dissipate heat, and a reduction in the loss of electrolytes.
- ◆ Acclimatization requires about 1 week and should be considered for new workers and workers who have been away from work for more than two weeks.
- ◆ For new workers, the schedule should be no more than a 20% exposure on day 1 and an increase of no more than 20% on each additional day.
- ◆ For workers who have had previous experience with the job, the acclimatization regimen should be no more than a 50% exposure on day 1, 60% on day 2, 80% on day 3, and 100% on day 4.
- ◆ In addition, the level of acclimatization each worker reaches is relative to the initial level of physical fitness and the total heat stress experienced by the individual.

RISK FACTORS

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COLD STRESS ILLNESSES AND INJURIES

◆ Non-freezing cold injuries:

- Trench/immersion Foot
- Chilblains

◆ Freezing cold injuries:

- Frostbite
- Hypothermia



TRENCH/IMMERSION FOOT

- ◆ Primary injury is to nerve and muscle tissue
- ◆ High risk during wet weather, in wet areas, or when sweat accumulates in boots or gloves
- ◆ Prolonged exposure of skin to moisture (12 or more hours, days)
- ◆ Potentially crippling, nonfreezing injury (temps from 32°F-60°F)
- ◆ Keep feet clean and dry
- ◆ DO NOT break blisters, apply lotions, massage, expose to high heat, or allow to walk on injury



CHILBLAINS



- ◇ Cold and/or wet conditions (between 32-60°F, high humidity)
- ◇ Repeated, prolonged exposure of bare skin
- ◇ Can develop in a few hours
- ◇ Ears, nose, cheeks, fingers, and toes
- ◇ Initially pale and colorless
- ◇ Worsens to achy, prickly sensation then numbness
- ◇ Blistering in severe cases
- ◇ Keep dry and warm
- ◇ DO NOT break blisters, apply lotions, massage, expose to high heat, or allow to walk on injury

FROSTBITE

- ◇ Injury caused by freezing of the skin and underlying tissues
- ◇ First your skin becomes very cold and red, then numb, hard and pale
- ◇ Frostbite is most common on the fingers, toes, nose, ears, cheeks and chin
- ◇ Symptoms:
 - ◇ Cold skin and a prickling feeling
 - ◇ Numbness
 - ◇ Red, white, bluish-white or grayish-yellow skin
 - ◇ Hard or waxy-looking skin
 - ◇ Clumsiness due to joint and muscle stiffness
 - ◇ Blistering after rewarming, in severe cases



HYPOTHERMIA IS A MEDICAL EMERGENCY!

HYPOTHERMIA

- ❖ Hypothermia is a medical emergency that occurs when your body loses heat faster than it can produce heat, causing a dangerously low body temperature.
- ❖ Normal body temperature is around 98.6 F (37 C). Hypothermia occurs as your body temperature falls below 95 F (35 C).
- ❖ When your body temperature drops, your heart, nervous system and other organs can't work normally. Left untreated, hypothermia can eventually lead to complete failure of your heart and respiratory system and eventually to death.
- ❖ Hypothermia is often caused by exposure to cold weather or immersion in cold water.
- ❖ Primary treatments for hypothermia are methods to warm the body back to a normal temperature.



HYPOTHERMIA SYMPTOMS

- ◊ Shivering
- ◊ Slurred speech or mumbling
- ◊ Slow, shallow breathing
- ◊ Weak pulse
- ◊ Clumsiness or lack of coordination
- ◊ Drowsiness or very low energy
- ◊ Confusion or memory loss
- ◊ Loss of consciousness
- ◊ Bright red, cold skin (in infants)
- ◊ <https://www.youtube.com/watch?v=-JAXbDTIiSk>



ALERT COMMUNICATION PROTOCOL

- ❖ QSH will be utilizing the National Institute for Occupational Safety and Health (NIOSH) App for Heat Index alerts and the National Weather Service for the Wind Chill calculator.
- ❖ This information will be disseminated via the SHeD Industrial Hygiene and Contractor webpages to project and facility leaders to inform their personnel when a work/rest cycle should be utilized. QSH will evaluate artificially produced environments as needed.





PREVENTION

- ◆ The goal at NASA is to prevent thermal injuries before medical intervention is required.
 - ◆ If the Heat Index is in either the "Moderate Risk", "High Risk", or "Extreme Risk" categories be sure to offer a shaded area to rest and provide water.
 - ◆ If the Wind Chill has made frostbite possible in under an hour be sure to provide a warm, wind blocked, location for employees to rest and drink a warm beverage.
 - ◆ Be sure to monitor the SHeD Industrial Hygiene (<https://www.grc.nasa.gov/smad/industrial-hygiene/>) and the NASA GRC Contractor (<https://www1.grc.nasa.gov/glenn-construction-safety/>) pages for work/rest cycle guidance.

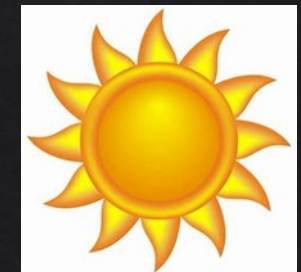
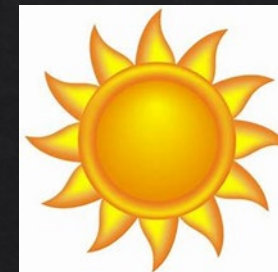
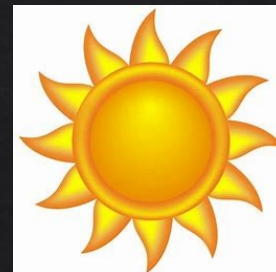


HEAT STRESS WORK/REST CYCLE

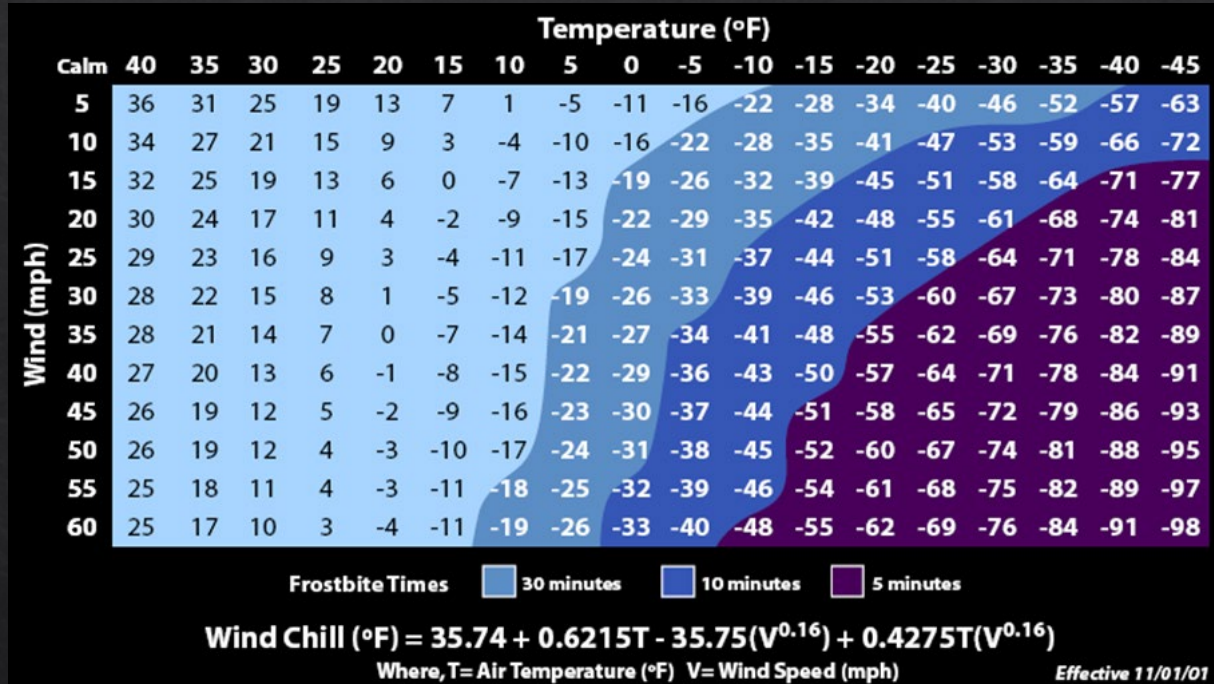
Temperature (°F)	Light Work Minutes Work/Rest	Moderate Work Minutes Work/Rest	Heavy Work Minutes Work/Rest
90	Normal	Normal	Normal
91	Normal	Normal	Normal
92	Normal	Normal	Normal
93	Normal	Normal	Normal
94	Normal	Normal	Normal
95	Normal	Normal	45/15
96	Normal	Normal	45/15
97	Normal	Normal	40/20
98	Normal	Normal	35/25
99	Normal	Normal	35/25
100	Normal	45/15	30/30
101	Normal	40/20	30/30
102	Normal	35/25	25/35
103	Normal	30/30	20/40
104	Normal	30/30	20/40
105	Normal	25/35	15/45
106	45/15	20/40	Caution
107	40/20	15/45	Caution
108	35/25	Caution	Caution
109	30/30	Caution	Caution
110	15/45	Caution	Caution
111	Caution	Caution	Caution
112	Caution	Caution	Caution

Heat Index Risk Levels

Heat Index	Risk Level
Less than 91°F	Lower (Caution)
91°F to 103°F	Moderate
103°F to 115°F	High
Greater than 115°F	Very High to Extreme



COLD STRESS WORK/REST CYCLE



Work/Warm-up Schedule for a 4-Hour Shift

Air Temperature--Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approximate)	°F (approximate)	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks
-26 to -28	-15 to -19	(Normal Breaks) 1		(Normal Breaks) 1		75 min	2	55 min	3	40 min	4
-29 to -31	-20 to -24	(Normal Breaks) 1		75 min	2	55 min	3	40 min	4	30 min	5
-32 to -34	-25 to -29	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
-35 to -37	-30 to -34	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
-38 to -39	-35 to -39	40 min	4	30 min	5	Non-emergency work should cease					
-40 to -42	-40 to -44	30 min	5	Non-emergency work should cease							
-43 & below	-45 & below	Non-emergency work should cease									

Schedule applies to any 4-hour work period with moderate to heavy work activity; with warm-up periods of ten (10) minutes in a warm location and with an extended break (e.g. lunch) at the end of the 4-hour work period in a warm location.

Adapted from ACGIH 2012 TLVs



THE THERMAL STRESS PROGRAM

- ◊ Thermal Stress training on SATERN and in person
- ◊ Review and adoption of thermal work/rest cycles
- ◊ Designated contact to monitor contractor and SHeD webpages for updates
- ◊ Understanding of the NMIS system and the requirement to report injuries, illnesses, and near misses
 - **ALL heat and cold related injuries and illnesses MUST be reported in NMIS**
- ◊ Program Lead as a resource for identifying thermal hazards and assisting in mitigating potential hazards to all employees working on a NASA center
- ◊ Indoor thermal stress will be evaluated using the Indoor Environmental Quality, chapter 12, of the Glenn Research Center Occupational Health Programs Manual

THERMAL STRESS PROGRAM CONTACT

- ◆ For additional feedback or questions, the Thermal Stress Program Lead is designated on the [GRC Safety and Health Training Matrix](#)
- ◆ Sponsoring Organization– QSH
- ◆ Thermal Stress Program is designated in the Occupational Health Programs Manual under NPR 1800.1

