

SAFETY TRAINING GOUGE #9

HEAT STRESS

May 2012

Published by the **Naval Safety and Environmental Training Center**
www.public.navy.mil/navsafecen/navsafenvtracen/

About This Training Resource

If you're an afloat safety officer or division officer, you have a challenging, important role at your command. This series of pamphlets will help you meet your bi-monthly training requirements. Modify and use them at quarters or muster. You can also check the Naval Safety Center website at

<http://www.public.navy.mil/navsafecen/Pages/safety-gouge/SafetyGouge.aspx> for the latest issues. We welcome feedback so we can continue to provide you with topics you need. Email LTJG Melissa Balint at melissa.balint@navy.mil.

This series is prepared by the Naval Safety and Environmental Training Center and the Naval Safety Center.

Introduction

Operations in hot and humid climates and material deficiencies (steam & water leaks, water in bilges, damaged insulation, degraded ventilation) increase heat stress in addition to working in high heat areas (galley, sculleries, laundries, engineering spaces and flight decks). You can also be affected off-duty by participating in sports and leisure activities, working out (PRT), and working around your house and yard.



A hospital corpsman records data as he uses an RSS-220 heat-stress monitor to measure temperature and humidity while conducting a heat-stress survey aboard an aircraft carrier. The corpsman was assigned to the medical department's preventive medicine office.

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The Basics



A damage controlman from a guided-missile cruiser dons fire-fighting gear while a hospital corpsman examines a Coast Guard fireman for heat stroke during a search and rescue exercise aboard a cutter.

Classic heat stroke develops over several days as prolonged heat exposure takes its toll on your body. Exertional heat stroke develops within hours, and can occur in athletes or anyone else who engages in intense physical effort in hot environments. The underlying cause for this condition is the sudden onset of a cooling demand that exceeds your body's internal regulatory capacities. Read more: <http://www.livestrong.com/article/369290-football-and-heat-stroke/#ixzz1rjcaJa7A>.

Around 101°F: The body is dissipating heat as fast as it can by perspiration, but the blood vessels nearest the skin begin to dilate as well. Thus, skin reddens and is hot to the touch. The pulse quickens. Blood pressure begins to drop. This is very uncomfortable. This is the beginning of heat exhaustion.

At 102°F: Dizziness, nausea, breathlessness, fainting, and headaches. The skin feels dry. The normal mechanisms for carrying away core heat are no longer sufficient.

> 103°F: Weakness, vomiting, headache. This is a medical emergency.

>104°F: Heat stroke. Confusion, dehydration and seizures are possible.

>105°F: Delirium. If not treated immediately, internal organs will begin to fail.

>106 °F: Convulsions

>107 °F: Coma

>108 °F: Death

Prevention

- Hydrate. Drink 8 to 16 cups of water a day.
- Keep a lookout for shipmates and watch for symptoms.
- A “break-in” period of about two weeks, with progressive degrees of heat exposure and physical exertion, will minimize the number of heat injuries and improve productivity in the long term.
- Eat a well-balanced diet. Salt food to taste.
- Limit how much coffee and sodas you drink.
- Don't wear coveralls over utilities during damage-control or casualty-control drills in hot and/or unventilated spaces.
- Get plenty of rest, at least 6 hours every 24 hour period.
- Report heat-stress problems (missing lagging, steam leaks, poor ventilation, etc.).
- Ensure that the recovery time is in a cool area when leaving the heat stress working space.
- Schedule drills early or late in the day.
- Avoid starch in uniforms.



Navy Heat-Related Mishaps

Year	Class A	Class B	Class C	Class D	Total
2007			39	42	81
2008			19	31	50
2009			20	67	87
2010			33	60	93
2011			40	38	78
2012			4	6	10
Total			155	244	399

DoD/Navy Instructions and Regulatory Requirements

OPNAVINST 5100.19 (series) Chapter B2, Heat Stress

Navy Safety and Occupational Health (SOH) Program Manual for Forces Afloat - Establishes policy, procedures, and actions for implementing the Navy's heat-stress program.

OPNAVINST 9640.1A

Shipboard Habitability Program - Establishes policy, procedures, and actions to ensure shipboard facilities and spaces support the needs of shipboard personnel by supporting established habitability criteria for ship design and modernization programs.

COMDTINST M6260.17

Shipboard Heat Stress Program - Provides guidance for determining personnel exposure limits under conditions of high heat and humidity aboard ship; establishes procedures for routine surveys of shipboard spaces; and delineates specific reporting and corrective actions to be taken when and where such hazardous conditions are found.

NAVMED P-5010-3 REV 2, Chapter 3 Prevention of Heat and Cold Stress Injuries (Ashore, Afloat, and Ground Forces)

Other Good Information

- Naval Safety Center:
http://www.public.navy.mil/navsafecen/Pages/acquisition/heat_stress.aspx
- Allowance Equipage List 2-870003051 Meter WBGT Heat Stress

What's New with Heat-Stress Meters

The Automated Heat Stress System (AHSS) measures wet bulb globe temperature (WBGT) using a dry bulb (DB), globe temperature (GT), and relative humidity (RH) sensor. The system automatically measures the WBGT environment and calculates heat-exposure guidance for both afloat and ashore personnel. The AHSS displays the data every minute, stores the data in a file on the computer hourly, and can print out a heat-stress survey on demand.

The advantage of using an RH sensor is that the RH value gives information on the potential for evaporation of sweat to cool the body (i.e., 15 percent RH is a dry environment while 75 percent RH is a humid/wet environment). A WB value is of little use without knowing the DB value. The RH sensor does not require constant maintenance to keep the wick clean and properly wetted. A quick visual inspection of an AHSS unit should show the colors *red, green, green, green* on the indicator bulbs (see image, top right). If they do not, the sensors may have been installed incorrectly or the sensor may be faulty.

The AHSS is used afloat to provide Physiological Heat Exposure Limits (PHELs) stay-time guidance, and ashore to provide flag-condition guidance.

The AHSS has PMS coverage under MIP 4361/001 MRC 2DB3 and 2DB4.

Calibration is not required for the AHSS, but the sensors must be validated quarterly. The AHSS is currently installed on DDG 72-112 and is being back-fitted on DDG 51-71; all

LPD 17 hulls; and LHD hulls 3, 5, 6, 7 and 8.

The Model RSS-220 is the authorized meter for doing WBGT surveys but is no longer being manufactured or available in the supply system. The replacement meter is the Questemp 48N, which is available under NSN 6685-01-584-0785. It uses an RH sensor to provide the WB reading for the WBGT calculation instead of a WB thermometer. Like the Model RSS-220, the new meter must be calibrated every three years.

The QUESTemp 48N was engineered for DoD ashore and afloat operations that require hands-free monitoring in the field. It measures and calculates the DB, WB, globe, WBGT outdoors, and relative humidity. The meter provides stay-time data based on the PHEL curves in OPNAVINST 5100.19E, flag conditions used by the Navy and Marine Corps ashore, and work/rest criteria in the ACGIH TLV Handbook.

Since the 48N meter logs data, it can attach to a computer, allowing the user to download the data. Combined with more rapid measurement technology, this can reduce the time to perform heat-stress guidance procedures by 25%. Information about the new meter will be included in the next revision of OPNAVINST 5100.19E and Chapter 3 of the P5010. PMS is being developed.

The RSS-220 meter can continue to be used until the unit can no longer be repaired. Then it will need to be replaced by the QUESTemp 48N. For afloat units, the only two authorized heat-stress meters are the RSS-220 and the 48N.



Automated Heat Stress System



QUESTemp 48N
Heat Stress Monitor

Positioning the Dry-Bulb Thermometer

- A hanging dry bulb (DB) thermometer (alcohol in glass, NSN 9G-6685-00-243-9964, temperature range 0°-150°F) shall be permanently mounted at watch and workstations throughout the ship where heat-stress conditions may exist.
- A DB thermometer shall also be permanently mounted next to each Automated Heat Stress system (AHSS) unit.
- These thermometers shall be mounted in a position so they indicate the most accurate representative temperature for the area where workers and watchstanders spend most of their time.
- Place the DB thermometers in or out of the ventilation air stream, but make sure they are hung at least two feet from any supply ventilation terminal/opening.
- Thermometers shall be hung with a non-heat conducting material such as plastic tie-wrap or string (never hang with metal wire).
- Position them to minimize the influence of any adjacent or local heat or cold sources; avoid direct contact between thermometer and hot/cold structural surfaces.
- DB thermometers do not require calibration, so if found inaccurate, the hanging DB must be relocated, replaced, or validated by aligning the etch mark with the freezing point (32 degrees Fahrenheit).

OPNAVINST 5100.19E contains additional information on where to hang DB thermometers.

A hanging, dry bulb thermometer shall be permanently mounted at watch and workstations throughout the ship where heat-stress conditions may exist.

How To Purchase the Salt Solutions

To validate the RH sensor on the AHSS or the QUEST 48N, salt solutions are required to ensure the RH sensor stays within the required range. The salt solutions have a one-year self life.

1. Go to: <http://www.coleparmer.com/>.
2. Put the part number in on left side of screen with quantity and it spits out a quote.
EW-35612-90 = 33%
EW-35612-91 = 75%
3. The cost for each bottle is \$41.00 and each ship with the new meter only needs to have one set of salt solutions regardless of how many new meters they have.

Heat Stress Injuries

Injury	Symptoms	Treatment
Heat Rash	<ul style="list-style-type: none"> • Red raised rash • Impairs sweating and decreases effectiveness of sweating 	<p><i>Action</i></p> <ol style="list-style-type: none"> 1. Notify space supervisor/EOOW 2. Notify Medical Department <p><i>Treatment</i></p> <ol style="list-style-type: none"> 1. Best treated by keeping the skin dry for part of the day at least. 2. Cooled sleeping quarters will remedy the situation, and permit personnel to work in hot-humid conditions without developing heat rash. 3. Avoid tight clothing.
Heat Cramps	<ul style="list-style-type: none"> • Muscle cramps, pain, or spasms in the abdomen, arms or legs 	<p><i>Action</i></p> <ol style="list-style-type: none"> 1. Notify space supervisor/EOOW 2. Notify Medical Department <p><i>Treatment</i></p> <ol style="list-style-type: none"> 1. Stop all activity, and sit in a cool place. 2. Drink clear juice or a sports beverage, or drink water with food. 3. Avoid salt tablets. 4. Do not return to strenuous work for a few hours after the cramps subside. 5. Seek medical attention if you have the following: heart problems, are on a low-sodium diet, or if the cramps do not subside within one hour.
Heat Exhaustion Heat illness caused by salt depletion and dehydration	<ul style="list-style-type: none"> • Moist, clammy skin • Dilated pupils • Normal or subnormal temperature • Dizziness, confusion and/or nausea • Weak pulse • Rapid breathing 	<p><i>Action</i></p> <ol style="list-style-type: none"> 1. Notify space supervisor/EOOW 2. Notify Medical Department <p><i>Treatment</i></p> <ol style="list-style-type: none"> 1. Remove victim from hot environment 2. Stop the victim from performing strenuous activity 3. Hydrate
Heat Stroke Heat illness where the thermo-regulatory system doesn't function, so the main avenue of heat loss is blocked	<ul style="list-style-type: none"> • Dry, red, hot skin • Pupils constricted • Very high body temperature • Confusion, dizziness and/or nausea • Pulse rapid • Unconsciousness • Coma • Death 	<p><i>Action</i></p> <ol style="list-style-type: none"> 1. Notify space supervisor/EOOW 2. Notify Medical Department <p><i>Treatment</i></p> <ol style="list-style-type: none"> 1. Remove victim from hot environment 2. Stop strenuous activity 3. Hydrate 4. Lower body temperature by any means

WGBT Index and Intense Physical Exertion

Flag Color	WGBT Index (F)	Intensity of Physical Exercise
	Less than 80	Extremely intense physical exertion may cause heat exhaustion or heat stroke. Caution should be taken.
	80 – 84.9	Discretion required in planning heavy exercise for unseasoned personnel. This is a marginal heat-stress limit for all personnel.
	85 – 87.9	Strenuous exercise and activity (e.g. close order drill) should be curtailed for new and unacclimated personnel during the first 3 weeks of heat exposure.
	88 – 89.9	Strenuous exercise curtailed for all personnel with less than 12 weeks training in hot weather.
	90 and above	Physical training and strenuous exercise suspended for <i>all personnel</i> (excluding operational commitment not for training purposes).