

APPENDIX C

WET-BULB GLOBE TEMPERATURE INDEX (WBGTI) SYSTEMS

C-1. *Installation.* This appendix describes the materials required to assemble a WBGT station. Certain items, such as clamps, stoppers, and flasks, have not been addressed but are required to assemble this station. Refer to Marine Corps Order 6200.1 series, Subj: Heat Casualties, Appendix A. Included in this appendix also are two heat stress instruments that are currently available in the stock system.

C-2. *Use.* A copy of instructions for the appropriate instrument must be prominently displayed at each WBGT station.

C-3. *Instrument Procurement.* Most instruments have been provided on a one-time basis. Additional instruments may be obtained locally so long as specifications are the same. Sources of the three sets are provided as follows:

a. *Shelter Instrument Thermoscreen.* This item is listed in section L of the Naval Aviation Supply table 00-34-QL-22 under Meteorological Equipment for Aerological Units. The stock number is 5410-00-267-8898, ML-41 (medium standard cotton region-type).

b. *Globes.* These are copper hemispheres, 6 inches in diameter and obtained in pairs. The manufacturer is Arthur Harris and Company, 210-218 North Aberdeen Street, Chicago, Illinois 60607.

c. *Mercury Thermometers.* These instruments are ordinary thermometers of about 30 cm overall length. The range of thermometer is from 30° to 150° F in one increment. The manufacturer is Nurnberg Thermometer Company, Inc. 127 Merrick Road, Rockville Center, New York 11570.

C-4. *Distribution* Those commands in receipt of instruments will install and maintain instrument sites, as required, and provide the readings to subordinate commands for use in the regulation of training when temperatures exceed 80° F.

C-5. *The WBGTI.* This index is a single number derived mathematically from three distinct temperature measurements: wet bulb temperatures, dry bulb temperatures, and globe temperatures. Training programs in warm weather should be planned provisionally on the basis of the WBGTI. Readings are to be taken every hour on the hour from 0800-1700 (local time) or until training is completed. Readings of all thermometers must be taken and recorded at the same time.

a. INSTRUMENTS

(1) *The Wet Bulb Thermometer*

(a) The natural Wet-bulb thermometer is an ordinary mercury thermometer, 30° to 150° F, with a wet wick around the bulb and exposed in an unshaded position to natural air movement and to solar radiation. The natural wet-bulb is cooled by natural convection but at the same time is warmed by solar radiation; and therefore, for the same air movement, its reading will be higher than a shaded wet-bulb.

(b) The natural wet-bulb thermometer is

suspended from a horizontal arm support by the same upright used to mount the globe thermometer.

(2) *The Dry Bulb Thermometer* This is an ordinary thermometer which measures air temperature and is the only instrument kept inside the thermoscreen shelter.

(3) *The Globe Thermometer*

(a) The Globe thermometer consists of a 6-inch sphere of copper painted matte black on the outside. In to the neck of the globe is inserted an ordinary mercury thermometer, 12 inches long and graduated from 30° to 150° F. The thermometer is held in place with a tight-fitting, one-hole rubber stopper; the bulb of the thermometer being centered at the midpoint of the globe.

(b) The Globe thermometer should be mounted from a 6-foot vertical support with a horizontal arm about 36 inches long. The globe is suspended by a sturdy braided flexible wire from the outboard end of the horizontal arm. The center of the globe should be 48 inches from the ground. The arm must point south to avoid a shadow of the upright from falling on the globe.

(c) The purpose of the globe thermometer is to combine the thermal effects of the radiation from the sun and hot surfaces in the environment into a single reading. This reading, when related to humidity, will provide a means of estimating total heat stress in the environment.

(d) To perform reliably, the globe must be situated in a widely open area where it will not be shielded in any way from the sun and wind. The ground below should be either grass or gravel. Asphalt surfaces are not desirable.

(e) The globe requires no attention except that the surface should be kept free of dust and streaks and must be repainted each year. After rain, the thermometer should be removed and the globe turned upside down to empty any water that may have leaked in.

(4) *Results.* It can readily be seen that the three instruments described above take into account all four variables of the normal environment; temperature, humidity, radiation, and air circulation.

b. *Formula* The WBGTI is calculated as follows:

Dry-Bulb Temperature	x 0.1
Wet-Bulb Temperature	x 0.7
Globe Temperature	x 0.2
Total	WBGTI

C-6. *Wet Bulb Globe Temperature Kit-NSN 6665-00-159-2218.* The WBGT Kit is enclosed in an aluminum case that contains three different thermometers. The threaded hole in the bottom of the case is used to attach the case to a standard lightweight photographers tripod that is not supplied with this kit. Place the kit with the thermometers toward the sun, with the "black globe" thermometer closest to the sun.

a. A stationary wet bulb thermometer exposed to the sun and prevailing wind.

b. A similarly exposed "black globe" thermometer with a black sheath over the bulb. The sheath and bulb

are inside a transparent perforated plastic shield.

c. A dry bulb thermometer with its bulb shielded from the direct rays of the sun by a shield painted white.

d. The WBGTI is determined by utilizing the attached slide rule and readings from the three different thermometers.

C-7. Wet-Bulb Globe Temperature (WBGT) Meter, NSN 7G 6685-01-055-5298

a. This instrument is also known as the Heat Stress Meter. It is a compact electronic instrument that independently measures the dry-bulb, wet-bulb, and globe temperatures. The instrument displays each of these values as well as computes and displays the

WBGTI.

b. It is lightweight, self-contained, and equipped with a rechargeable power supply.

c. A ventilating fan is included in the shielded dry and wet-bulb sensor assembly to obtain aspirated wet-bulb temperatures.

d. The entire unit can be adapted for remote monitoring and reading.

C-8. WBGTI Log Sheet. The provided WBGTI Log Sheet may be locally reproduced, and maintained at each instrument site or a log book may be utilized with the same information. All the readings from each instrument site must be maintained for 1 year.

WBGTI LOG SHEET

Date

Time (Local)	Instrument Inside Shelter	<u>A</u> Enter Dry-Bulb Reading x 0.1 =	Instrument Outside Shelter Globe Thermometer Reading	<u>B</u> Enter Globe Thermometer Reading x 0.2 =	Instrument Outside Shelter Natural Wet-Bulb Thermometer Reading	<u>C</u> Enter Natural Wet-Bulb Thermometer Reading x 0.7 =	Columns A + B + C = WBGTI	Enter Flag Color
0800								
0900								
1000								
1100								
1200								
1300								
1400								
1500								
1600								
1700								

Note: This log sheet may be locally reproduced, maintained at the instrument site, and disposed of after 1 year.

FLAG COLORS AND CORRESPONDING TEMPERATURES

White Flag	Green Flag	Yellow Flag	Red Flag	Black Flag
<80° F	80 to 84.9°F	85 to 87.9° F	88 to 89.9° F	>90° F