Table of Contents

1.0 PURPOSE AND SCOPE ............................................................................................................ 3
  1.1 Purpose ................................................................................................................................. 3
  1.2 Scope .................................................................................................................................... 3

2.0 Information ............................................................................................................................ 3
  2.1 Terms and Definitions ........................................................................................................... 3
  2.2 General Information ............................................................................................................ 5

3.0 PRECAUTIONS AND LIMITATIONS ................................................................................. 5
  3.1 Equipment Safety .................................................................................................................. 5
  3.2 Radiation and Contamination Control .................................................................................. 5

4.0 PREREQUISITES .................................................................................................................... 7
  4.1 Special Tools, Equipment, and Supplies .............................................................................. 7
  4.2 Performance Documents ...................................................................................................... 7
  4.3 Field Preparation .................................................................................................................. 7

5.0 PROCEDURE .......................................................................................................................... 8
  5.1 Initial Equipment Inspection .................................................................................................. 8
  5.2 Perform Calibration Verification ......................................................................................... 9
  5.3 Using the QUESTemp 32 Heat Stress Monitor ................................................................. 11
  5.4 Remote Monitoring .............................................................................................................. 12
Preparation and Field Use of the QUESTemp 32™
Heat Stress Monitors

5.6 Records .................................................................................................................. 14
Attachment 1 Guidance for Establishing Work/Rest Regimens........................................... 15
1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this procedure is to ensure the proper use of the QUESTemp32™ heat stress monitors in support of field monitoring performed in accordance with TF-OPS-IHT-007, TFC-ESHQ-S_IH-C-07, and Heat Stress Mitigation Checklist.

1.2 Scope

The scope includes field calibration of the heat stress monitors and performing remote monitoring as well as multiple sensor operation.

2.0 INFORMATION

2.1 Terms and Definitions

Heat Index (HI) – a measure of the dry bulb temperature and relative humidity to help assess how the average person feels relative to climate conditions. It is a less exact method for assessing the potential for heat stress disorders.

Heat Strain - Physiological response to heat stress recognized by: increased core body temperature, increased heart rate or sweating. If these responses are uncontrolled, these symptoms may progress and result in increased incidence of heat stress disorders, increased accident rates and irreversible physiological conditions.

Heat Stress - The net heat load on the body that results from exposure to external sources and internal metabolic heat production due to physical work. It occurs when the body produces or gains more heat than it is capable of giving off or losing. Contributing environmental factors affecting the potential for heat stress include air temperature, humidity, radiant heat exchange, and air movement. As heat stress approaches a worker’s tolerance limits, the risk of heat related disorders increases.

Hot Environment – A work area where one or more of the following factors may exist, creating the potential for heat stress: high temperature/humidity, sources of significant radiant heat, use of protective clothing that insulates or impedes sweat evaporation, or dry bulb temperatures in excess of 85°F.
2.1 Terms and Definitions (Cont.)

Rest Area – An area normally located as close to the worksite as possible, where workers can periodically enter to cool down after working in hot environments. Areas should be shaded, ventilated, have drinking water available, and allow worker to sit and partially doff protective clothing when practical.

Wet Bulb Globe Temperature (WBGT) – the weighted average of three temperatures using environmental conditions to help assess the potential for heat stress disorders.

Indoor Wet Bulb Globe Temperature (WBGT<sub>in</sub>) – The weighted average of three temperatures using environmental conditions to help assess the potential for heat stress disorders utilized when a solar load (sun) is not present.

Outdoor Wet Bulb Globe Temperature (WBGT<sub>out</sub>) – The weighted average of three temperatures using environmental conditions to help assess the potential for heat stress disorders utilized when a solar load (sun) is present.

WBGT Meter – has three sensors that input data into a calculation that adjusts the temperature to represent the impact humidity, wind and radiant heat have on heat strain cooling effectiveness.
2.2 General Information

The QUESTemp 32 specifications and operating parameters:
- Temperature sensor accuracy: ± 0.9 °F from 32 to 212 °F
- Verification module accuracy: ± 0.5°C
- Operating temperature range:
  Electronics- (23 – 140 °F), Sensor Assembly (23 – 212 °F)
- Relative humidity:
  0% - 100% (extended exposure to humidity > 90% can cause a reversible shift of 3%).
- Battery life:
  140 hours, 9V alkaline
- Intrinsically safe:
  Class 1, 2, 3, Division 1, Group A, B, C, D, E, F, G atmospheres, T3.
- Weight: 2.6 lbs. with mounted sensor assembly
- Cable length: 200 feet maximum without a decrease in accuracy

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Equipment Safety

CAUTION - Improper connector pin alignment can result in damage to the connections.

CAUTION - The plugs or sockets marked “SENSOR 2” and “SENSOR 3” may not be used within the hazardous area.

3.1.1 KEEP the unit away from anything that might block radiant heat or airflow.

3.1.2 PROTECT the unit if heavy rain or temperatures above 140 °F (60 °C) are expected.

3.2 Radiation and Contamination Control

3.2.1 Planned work in radiological areas must be approved by Radiological Control personnel per the Radiological Risk Screening procedure TFC-ESHQ-RP-RWP-C-01.

3.2.1.1 When performed without a formal work package or approved procedure (i.e., Level 3 or 4 work), this procedure is limited to radiological areas and work activities permitted by a low risk Radiological Work Permit (RWP).
3.2  Radiation and Contamination Control (Cont.)

3.2.2 Before conducting monitoring, contact the responsible Radiological Control personnel for the facility or area to determine any specific survey or monitoring requirements.
   - Pre, during, and post contamination survey requirements.
   - Any applicable Release Survey Plans (RSP) for your specific equipment or task.
   - Alternative survey or monitoring needs to support the radiological release survey process.

3.2.3 Comply with the requirements set forth by the RWP, HPT coverage, Release Survey Plan (RSP), and any other applicable procedures as determined above.

3.2.4 When exiting radiological areas where no HPT coverage was provided, inform the radiological control personnel of the use/history for the equipment being presented (e.g., only sampled air in the Contamination Area, No known history of contamination based on use, etc.) to aid them in properly evaluating the radiological release criteria needed.
4.0 PREREQUISITES

4.1 Special Tools, Equipment, and Supplies

The following supplies are/may be needed to perform this procedure:

- Tripod
- Wick for wet bulb
- Verification Module
- Time-keeping device (e.g., a watch or stopwatch)
- Flat head screwdriver.
- 9-volt alkaline battery
- Distilled or de-ionized water.

4.2 Performance Documents

The following documents may be needed to perform this procedure:

- QUESTemp 32 Thermal Environmental Monitor Operator’s Manual
- TFC-ESHQ-RP_RWP-C-03, “ALARA Work Planning”
- TFC-ESHQ-S_IH-C-07, “Heat Stress Control”
- Heat Stress Mitigation Checklist (A-6006-431)
- Industrial Hygiene WBGT Field Log (A-6004-079)

4.3 Field Preparation

4.3.1 **ENSURE** a review of the applicable Heat Stress Mitigation Checklist has been completed.
5.0 PROCEDURE

5.1 Initial Equipment Inspection

5.1.1 CHECK that the maintenance calibration date on sticker is current.

5.1.2 IF calibration is past due, RETURN the monitor to the equipment custodian with a completed green tag, “IH Instrument Service Tag” (BT-6004-019) indicating it needs a “Scheduled Maintenance Calibration.”

5.1.3 INSPECT the unit and sensors to ensure the equipment has no physical damage or missing pieces.

5.1.3.1 IF damage is found or unit appears unusable, RETURN the damaged component(s) to the equipment custodian with a completed green tag “IH Instrument Service Tag” (BT-6004-019), documenting the condition.

5.1.4 TURN ON the QUESTemp 32 by pressing the “I/O ENTER” key.

NOTE - The display will indicate the status of the battery during the start-up cycle.

- The QUESTemp 32 can be powered using a 9-volt alkaline battery.

5.1.5 IF the battery voltage displayed during the power-on sequence is less than or equal to 6.4 volts,

OR

IF “BAT” – low battery is displayed, REPLACE the batteries.

5.1.5.1 REPLACE the 9-volt alkaline battery as follows:

a. OPEN the battery door located in the back of the monitor AND

REPLACE the old battery with a fresh 9-volt alkaline battery.

b. ENSURE the 2-position switch located in the battery compartment on the back of the monitor is in the UP position for the 9-volt battery use.
5.2 Perform Calibration Verification

NOTE - Any active sensor assembly may follow these steps for calibration verification.

5.2.1 OBTAIN a verification module.

5.2.2 REMOVE the sensor assembly from the top of the monitor as follows:

5.2.2.1 PRESS AND UNSCREW (counterclockwise) the screws located on the top of the monitor.

5.2.2.2 PULL the sensor assembly (mast) straight up from the base of the monitor.

5.2.3 CHANGE the instrument (body) temperature reading unit as follows:

5.2.3.1 PRESS the “Setup” key until a temperature selection is displayed.

5.2.3.2 PRESS “I/O Enter” to change from Fahrenheit to Celsius.

5.2.4 PRESS the “Setup” key to exit the setup mode.

CAUTION
Improper connector pin alignment can result in damage to the connections.

5.2.5 PLUG the verification module into the 15-pin connector located on top of the unit.

5.2.6 PRESS the UP or DOWN arrow AND

VERIFY that the readings on the monitor match the tolerance levels printed on the side of the verification module within ±0.5°C.

5.2.7 IF the readings are not within the 0.5°C tolerance, REPEAT calibration verification

5.2.8 IF calibration verification is not successful, SELECT another verification module and repeat steps 5.2.5 through 5.2.6.

5.2.9 IF third attempt at calibration verification is not successful, THEN
RETURN the monitor to the equipment custodian with a completed green tag “IH Instrument Service Tag” (BT 6004-019) indicating “Function Check Failure.”
5.2 Perform Calibration Verification (Cont.)

5.2.10 REMOVE the verification module from the top of the monitor.

5.2.11 RE-ATTACH the sensor assembly as follows:

5.2.11.1 PUSH the sensor assembly (mast) straight down on the base of the monitor.

5.2.11.2 PRESS AND SCREW (clockwise) the screws located on the top of the monitor

5.2.12 RESET the instrument to Fahrenheit as follows:

5.2.12.1 PERFORM steps 5.2.3.1 and 5.2.3.2 to change to Fahrenheit.

5.2.13 ENSURE that the wet bulb’s wick is clean.

5.2.14 IF the wet bulb wick is discolored, REPLACE the wick as follows:

5.2.14.1 SLIDE the old wick off of the sensor.

5.2.14.2 PLACE a new wick over the sensor ensuring that the bottom of the wick is down in the reservoir.

NOTE - Do not use tap water. The contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings.

5.2.15 FILL the reservoir with distilled or de-ionized water.

5.2.16 ENSURE the wet bulb’s wick is fully wetted.
5.3 Using the QUESTemp 32 Heat Stress Monitor

NOTE - Steps 5.3.1 through 5.3.4 can be performed in any logical order.

5.3.1 TURN the monitor on.

5.3.2 PLACE the monitor in a location in the work area at a height of about 3 ½ feet for standing individuals or 2 feet for seated individuals.

5.3.3 CONFIRM the monitor display is set for the appropriate monitoring environment, either WBGT<sub>in</sub> or WBGT<sub>out</sub>.

5.3.4 ALLOW 10 minutes for sensors to stabilize before taking reading when the following conditions occur:
- After adding water to the reservoir
- When moving the monitor to a new environment.

5.3.5 KEEP the wick of the wet bulb thermometer wet with distilled water for at least 10 minutes before a temperature reading is made.

NOTE - Standing close to the unit during monitoring could affect readings.

5.3.6 PERFORM heat stress monitoring in accordance with TFC-ESHQ-S_IH-C-07.

5.3.6.1 RECORD the indoor or outdoor wet bulb globe temperature in accordance with TFC-ESHQ-S_IH-C-46.

5.3.6.2 RECORD readings once each hour unless a different frequency is directed by IH or the Heat Stress Mitigation Checklist.

5.3.7 ENSURE the wick is kept wet with distilled or de-ionized water.

5.3.8 WHEN monitoring is complete, TURN off the monitor

5.3.8.1 PRESS AND HOLD the “I/O ENTER” key while the unit goes through a three second countdown and shuts off.

5.3.9 AFTER the survey, PERFORM a post-calibration verification by performing Steps 5.2.1 through 5.2.10.

5.3.10 PROVIDE the completed field records to the IH within 2 working days.
5.4 Remote Monitoring

NOTE - Remote monitoring may be desired when it is necessary to protect the unit or surveyor from but not limited adverse weather, radiological or logistical conditions.

- The order of extension cable attachments to the sensor bar and monitor does not matter.
- The QUESTemp 32 will operate with up to 200 feet of cable with no loss of accuracy provided the environment does not contain a strong electromagnetic field, which may cause interference.

5.4.1 OBTAIN a shielded extension cable.

5.4.2 REMOVE the top sensor from the monitor as follows:

5.4.2.1 PRESS down AND UNSCREW (counterclockwise) the screws located on the top of the monitor

5.4.2.2 PULL the sensor assembly straight up from the base of the monitor.

CAUTION
Improper connector pin alignment can result in damage to the connections.

5.4.3 ATTACH the extension cable(s) to the desired port(s) on the monitor (e.g., ports 1 through 3) and the 15-pin connector on the bottom of the sensor bar(s).

NOTE - Re-calibration of the WBGT is not required, this check is for continuity.

5.4.4 PLUG the verification module into the end of the extension cable to ensure that the cord and sensor are working as a coupled unit.

5.4.5 REMOVE the verification module after determining the monitor, sensor assembly and extension cord are responding.

NOTE - Be sure the tripod with sensor bar is in the area most representative of the workforce being monitored.

5.4.6 Multiple tripods will be required when conducting remote monitoring; SCREW the base of the monitor to a tripod using the threaded bushing on the bottom.

5.4.7 SCREW the base of the sensor bar to another tripod using the threaded bushing on the bottom.
5.5 Perform Multiple Sensor Operations

NOTE - Multiple sensors can be used in environments when the temperature in the space surrounding a worker does not have a constant value and it is necessary to determine the WBGT index at three heights, corresponding to the worker’s ankles, abdomen and head, and perform a weighted average on those values.

- When more than one location is monitored during the same work evolution, multiple sensors may be used e.g. inside a tent with sensor 2 and outside of the tent with sensor 1.

- Only selected QUESTemp 32 heat stress monitors are configured to perform multiple sensor operations and must be obtained from the equipment custodian on an “as needed” basis.

5.5.1 CONSULT the responsible Industrial Hygienist (IH) for heat stress limits and controls in this condition.

5.5.2 PLACE sensors, locating top sensor #1 at the abdomen level.

5.5.3 OBTAIN additional remote cables and sensor assemblies to attach to the sensor ports located on the side of the monitor.

CAUTION
Improper connector pin alignment can result in damage to the connections.

5.5.4 ENSURE that calibration verification has been performed on all active sensor assembly locations per steps 5.2.1 through 5.2.10 prior to attaching cables.

5.5.5 ATTACH cables to “SENSOR “2” and SENSOR “3” located on the side of the instrument, THEN
ATTACH the opposite end of the cable to the additional sensor assemblies.

5.5.6 ATTACH the opposite end of the cable to the additional sensor assemblies.

5.5.7 INFORM employees working in the area being monitored what is being measured and to be careful when moving and/or working around the monitor.
5.5 Perform Multiple Sensor Operations (Cont.)

NOTE - The screen will display a 1, 2, or 3 on the right side of the temperature reading to indicate which sensor port has been selected. A “W” indicates the weighted average which only appears if a WBGT is displayed and all three of the sensor assemblies are attached. The QUESTemp 32 will always assign “SENSOR 1” (the top sensor bar) the double weighting using the following formula:

$$WBGT_w = \frac{(WBGT_{head} + (2 \times WBGT_{abdomen}) + WBGT_{ankles})}{4}.$$

5.5.8 PRESS the “I/O Enter” key to select the desired sensor.

5.5.9 PRESS the “Setup” key.

5.5.10 PRESS the “I/O Enter” key to select the temperature setting for the selected sensor port.

5.5.11 PRESS the “Setup” key again to exit the setup mode.

5.5.12 PRESS the up or down arrow to select the measurement to be displayed.

5.5.13 PERFORM heat stress monitoring in accordance with TFC-ESHQ-S_IH-C-07 and steps 5.3.6 through 5.3.9.

5.5.14 PROVIDE the completed field records to the IH within 2 working days.

5.6 Records

Data and attachments are entered into the Site-Wide Industrial Hygiene Database and when reviewed and completed by the Industrial Hygienist, are uploaded to IDMS via an automated interface. The record custodian identified in the Company Level Records Inventory and Disposition Schedule (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.
Attachment 1 Guidance for Establishing Work/Rest Regimens

NOTES:

- Protective clothing that restricts air movement, evaporation or which provides thermal insulation. The clothing adjustment factors estimate the relative degree of heat stress expected to be experienced when wearing the protective clothing. Clothing factor adjustments for specific clothing ensembles may be determined after technical review by the industrial hygienist.

- These factors are added to WBGT values and then used as input when using Attachment A for establishing work rest regimens.

- Modesty clothing shall be worn under work garments.

Table A-1, Clothing Adjustment Factors (CAF) per TFC-ESHQ-S-IH-C-07

<table>
<thead>
<tr>
<th>Example Clothing Ensembles</th>
<th>CAF in °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level D work clothes (e.g., blue coveralls)</td>
<td>0</td>
</tr>
<tr>
<td>Single-layer ProTech Plus® 2000 coveralls with attached hood⁴</td>
<td>0</td>
</tr>
<tr>
<td>Hood</td>
<td>+1.8</td>
</tr>
<tr>
<td>Single layer coveralls (e.g., anti-contamination clothing over modesty clothing)</td>
<td>+3.5</td>
</tr>
<tr>
<td>Double layer coveralls (e.g., 2 layers of anti-contamination clothing over modesty clothing)</td>
<td>+5</td>
</tr>
<tr>
<td>Flame Retardant (FR) Clothing (e.g. Electrical (Orange) single pair over modesty clothing, face shield and flame retardant hood)³</td>
<td>+5</td>
</tr>
<tr>
<td>Polyethylene coated Tyvek® w/hood¹</td>
<td>+18.0</td>
</tr>
<tr>
<td>Vapor-barrier coveralls (e.g., vinyl rain suits)²</td>
<td>+19.8</td>
</tr>
<tr>
<td>Tyvek Coveralls (Kimberly 1422/1424) w/o hood over modesty clothing</td>
<td>+3.0</td>
</tr>
</tbody>
</table>

Attachment 1 Guidance for Establishing Work/Rest Regimens (Cont.)

- In accordance with interpretive guidance from the American Conference of Government Industrial Hygienists, no correction factors will be applied to workers wearing air purifying or air-line respirators.

- Self-contained breathing apparatus (SCBA) usage increases the Work Demand (work load) one category for the proposed work activity.

- Workers are assumed to be un-acclimated to the environment unless direct by the IH or the Heat Stress Mitigation Checklist.

Table A-3. Screening Criteria for Heat Stress Exposure (WBGT values in °F) per per TFC-ESHQ-S-IH-C-07.

<table>
<thead>
<tr>
<th>Work Demands</th>
<th>Unacclimated</th>
<th></th>
<th>Acclimated</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Light</td>
<td>Moderate</td>
<td>Heavy</td>
<td>Very Heavy</td>
</tr>
<tr>
<td>100% Work</td>
<td>≤81.5</td>
<td>≤77.0</td>
<td>≤72.5</td>
<td>*</td>
</tr>
<tr>
<td>75% Work 25% Rest</td>
<td>81.6 - 84.2</td>
<td>77.1 - 79.7</td>
<td>72.6 - 76.1</td>
<td>*</td>
</tr>
<tr>
<td>50% Work 50% Rest</td>
<td>84.3 - 86.0</td>
<td>79.8 - 82.4</td>
<td>76.2 - 79.7</td>
<td>≤77.0</td>
</tr>
<tr>
<td>25% Work 75% Rest</td>
<td>86.1 - 87.8</td>
<td>82.5 - 84.2</td>
<td>79.8 - 82.4</td>
<td>77.1 - 79.7</td>
</tr>
</tbody>
</table>

* Because of the physiological stress associated with Very Heavy work among less fit workers regardless of WBGT, criteria values are not provided for continuous work and for 75% work in an hour. The screening criteria are not recommended, and a detailed analysis and/or physiological monitoring shall be used.

- Table values assume:
  - Eight-hour work days in a five day work week with conventional breaks;
  - Rest is in a shaded, ventilated environment
  - Protective equipment used to reduce heat exposure is not worn.
- The Work-Rest regimen:
Attachment 1 Guidance for Establishing Work/Rest Regimens (Cont.)

Starts with the work phase followed by the rest phase (i.e., progress from 100% work to 75% work, followed by 25% rest).
- Is evaluated hourly and adjusted as necessary (i.e., the work-rest phases, shall total no more than 1 hour in length).
• Rest areas should allow for a decrease in body core temperature via shade, cooling mechanisms, removal of PPE, seating, fans, etc. when possible, in addition to proper hydration.