Physiological Monitoring with the Polar Heart Rate Sensors

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CHANGE HISTORY (LAST 5 REV-MODS)

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<td>B-3</td>
<td>07/16/2018</td>
<td>Industrial Hygiene Request</td>
<td>Inserted work directions involving the OH1 Heart Rate Sensor along with directions for usage within the field. Polar Beat Application Attachment instructions were removed from procedure. Added additional sections within procedure to elaborate on how to implement the OH-1 sensors. Modified H7 Heart Rate Sensor Field Preparation section as well as added OH1 Heart Rate Sensor Field Preparation section to procedure. Modified directions within Attachment 1 (Heat Stress Monitoring Instructions for Heart Graph Application) and Attachment 2 (Heat Stress Monitoring Instructions for Polar Team Application) of the procedure. Modified the Radiological and Contamination Controls and the Records Section.</td>
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<tr>
<td>B-2</td>
<td>10/11/2017</td>
<td>Industrial Hygiene Request</td>
<td>Modified “Radiological and Contamination Control” section to current standard.</td>
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<td>B-1</td>
<td>10/12/2016</td>
<td>Request by Records Management</td>
<td>Updated records section.</td>
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<td>06/14/2016</td>
<td>Periodic Review</td>
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<td>A-3</td>
<td>01/28/2016</td>
<td>IHT request to update procedure for clarification and incorporation of lessons learned using the equipment.</td>
<td>Added Target Heart Rate to Terms and Definitions. Replaced iPad with iPad throughout. Clarified statement in Section 4.2. Added cleaning step 4.3.3. Replaced connector with sensor. Clarified steps to replace the battery. Made using Section 5.1 - Using the Polar H7 Heart Rate Sensor With iPad and Heart Graph Application as optional. Updated Attachment 3 to make clearer steps to use Heat Stress Monitoring for Polar Team Application.</td>
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4.0 PREREQUISITES

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4.1 Special Tools, Equipment, and Supplies

4.2 Performance Documents

4.3 Field Preparation for Polar H7 Heart Rate Sensor

4.4 Field Preparation for Polar OH1 Heart Rate Sensor

5.0 PROCEDURE

5.1 Using the Polar H7 Heart Rate Sensor With iPad and Heart Graph Application (Optional)

5.2 Using the Polar H7 Heart Rate Sensor With iPad and Polar Team Application

5.3 Using the Polar OH1 Heart Rate Sensor With iPad and Heart Graph Application (Optional)

5.4 Using the Polar OH1 Heart Rate Sensor with iPad and Polar Team Application

5.5 Records

Figure 1 - OH1 Sensor/Transmitter

Figure 2 - H7 Sensor/Transmitter

Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application

Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application
1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this procedure is to ensure the proper use of the Polar H7 and OH1 Heart Rate Sensor in support of field monitoring performed in accordance with TFC-ESHQ-S_IH-C-07.

1.2 Scope

The scope includes proper operation and cleaning of the Polar H7 and OH1 Heart Rate Sensor.

2.0 INFORMATION

2.1 Terms and Definitions

- **Heart rate** – the number of heart beats per minute (bpm)
- **Recovery heart rate** – the heart rate measured at a point in time (typically 1 minute) after the worker has ended the work cycle. It is a useful tool for heat strain recognition
- **Target Heart Rate** – the maximum sustained heart rate during work calculated as 180 minus the individual’s age.

2.2 General Information

2.2.1 The Polar H7 Heart Rate Sensor specifications:

- Temperature range: (14 to 122 °F)
- Humidity range: N/A (This unit is watertight and can be used underwater)
- Range: N/A (Electrocardiogram measurements are recorded as heart beats per minute)
- Power: 3V, CR2025 lithium battery for about 350 hours of operation.

2.2.2 The Polar OH1 Heart Rate Sensor specifications:

- Temperature range: 14 to 122 °F
- Humidity range: N/A (This unit is watertight and can be used underwater)
- Range: N/A (Electrocardiogram measurements are recorded as heart beats per minute)
- Power: 45 mAh LI-pol rechargeable for 12 hours continuous operation.
2.2 General Information (Cont.)

2.2.3 iPad specifications:
- Operating ambient temperature: 32° to 95° F (0° to 35° C)
- Non-operating temperature: -4° to 113° F (-20° to 45° C)
- Relative humidity: 5% to 95% noncondensing
- Operating altitude: tested up to 10,000 ft (3000 m).

2.2.4 Operating limitations:
- Bluetooth range varies from 10-30 feet. Other radio frequency generating devices may cause interference
- Use of iPad surface gestures may not work when wearing gloves. Obtain a conductive stylus when gloves must be worn in the work area where the iPad is to be used.

2.2.5 Collected data containing personally identifiable information shall be managed as “Official Use Only.”

2.2.6 This is an objective physiological measurement and not a medical or clinical procedure.

2.2.7 Heart rate data are collected based on instructions for form A-6006-433, Physiological Monitoring Data Collection Form or from the Project Industrial Hygienist. Readings are continuously transmitted via Bluetooth to a smart device such as an iPad.

2.2.8 If necessary, an iPad wrapped in a ziplock bag can be used to data-log heart rate by having it placed near where the worker is located. Do not leave iPads unattended in direct sunlight since this may cause them to overheat and shut down. iPads dim the display if the internal temperature reaches 95 °F and will turn themselves off if they reach 113 °F.
3.0 PRECAUTIONS AND LIMITATIONS

3.1 Equipment Safety

3.1.1 Do not use solvents, ammonium chloride solutions or isopropyl alcohol to clean the unit unless approved by SME.

3.1.2 These devices are not intrinsically safe and should not be used in a flammable atmosphere.

3.1.3 Clorox containing wipes & Respirator cleaning wipes contain very low concentrations of Clorox and alcohol, respectively, and can be used to clean Polar H7 & OH1 Heart Rate Sensors. Any other mode of cleaning will need IH approval.

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).

3.2.2 Before conducting sampling or 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 RSP’s 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, Health Physics Technician (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 may be needed to perform this procedure:

Polar H7
- A coin or screwdriver to open the battery cover when changing batteries
- Lithium batteries (Spec. CR2025)
- Clorox bleach wipes or equivalent sanitizing alternative
- Electrode gel
- Polar H7 Sensor or transmitter (for each person to be monitored)
- Chest Strap (for each person to be monitored)
- A smart receiving device such as an iPad and a compatible fitness application
- Conductive stylus for iPad.

Polar OH1
- Clorox bleach wipes or equivalent sanitizing alternative
- Polar OH1 Sensor or transmitter (for each person to be monitored)
- Arm Strap (for each person to be monitored)
- A smart receiving device such as an iPad and a compatible fitness application
- Conductive stylus for iPad
- USB adapter.

4.2 Performance Documents

The current revisions of the following documents may be needed to perform this procedure:
- Polar OH1 Heart Rate Sensor Instructions
- Polar H7 Heart Rate Sensor instructions
- TFC-ESHQ-S_IH-C-07, “Heat Stress Control”
4.3 Field Preparation for Polar H7 Heart Rate Sensor

4.3.1 REVIEW the heat stress mitigation checklist and any additional written instruction from the Project Industrial Hygienist.

4.3.2 WHEN performed in radiological area controlled for contamination, NOTIFY HPT prior to use of pulse rate monitoring device.

4.3.3 ENSURE electrode are clean (Clorox bleach wipes or equivalent sanitizing alternative).

4.3.4 PRIOR to field use, CHECK battery by verifying a signal is received by the iPad.

4.3.5 IF no signal is received, REPLACE battery:

4.3.5.1 REMOVE the sensor from the strap.

4.3.5.2 ROTATE and REMOVE the battery cover counterclockwise with a coin or flat-head screwdriver AND carefully REMOVE the old battery.

4.3.5.3 INSERT the new battery inside the cover with the positive side against the cover making sure the sealing ring is in the groove to ensure water resistance.

4.3.5.4 REPLACE the battery cover by aligning the arrow with the “open” mark and rotate to the “closed” position.

4.3.6 ATTACH the sensor to the strap.

4.3.7 ADJUST the strap length to fit tightly but comfortably.

4.3.8 DON the strap around the chest AND

ATTACH the hook to the other end of the strap.

4.3.9 ENSURE that the electrode areas are moist, firmly against skin and that the Polar logo of the sensor is in a central and upright position.
4.3 Field Preparation for Polar H7 Heart Rate Sensor (Cont.)

4.3.10 VERIFY a signal is received by the iPad.

4.3.11 IF signal is not received, TROUBLESHOOT, e.g. skin contact and placement, battery or sensor replacement.

NOTE - The Identification Number is required later to ensure pairing to the correct transmitter.

4.3.12 RECORD the Identification Number (ID#) of the sensor/transmitter located on the back of the sensor/transmitter.

4.3.13 IF using the Polar Team application that allows additional workers, REPEAT Steps 6 through 11 in Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application for each worker (player) that will be monitored.

4.4 Field Preparation for Polar OH1 Heart Rate Sensor

4.4.1 REVIEW the heat stress mitigation checklist and any additional written instruction from the Project Industrial Hygienist.

4.4.2 WHEN performed in radiological area controlled for contamination, NOTIFY HPT prior to use of pulse rate monitoring device.

4.4.3 PRIOR to use, CHECK battery either by verifying a signal is received by the iPad

OR

CONFIRM green LED is continuously on at the charging station OR blinks 5 times when powered on.
4.4 Field Preparation for Polar OH1 Heart Rate Sensor (Cont.)

NOTE - Battery is critically low if red LED blinks quickly.

4.4.4 IF battery level is low (as displayed on the receiving device, red light blinks five times when powered on, or green and red LED light alternates every other second), RECHARGE the internal battery.

4.4.5 USE the USB adapter included in the product set to charge it via a USB port.

4.4.6 INSERT the sensor into the USB adapter AND

INSERT the USB adapter into a USB port.

NOTE - The Identification Number is required later to ensure pairing to the correct transmitter.

4.4.7 RECORD the Identification Number (ID#) of the sensor/transmitter located on the side with the associated worker. (Refer to Figure 1 - OH1 Sensor/Transmitter).

4.4.8 ATTACH the sensor into the armband holder, WEAR the armband so that the sensor is on the underside of the armband fitting against skin with the lens facing up.

4.4.9 ADJUST the strap length to fit tightly, but comfortably AND

SLIDE the strap around the forearm or upper arm.

4.4.10 IF using the Polar Team application that allows additional workers, REPEAT Steps 11 through 16b in Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application for each worker (player) that will be monitored.
5.0 PROCEDURE

NOTE - The following software does not provide an audible alarm for max heart rate.

5.1 Using the Polar H7 Heart Rate Sensor With iPad and Heart Graph Application (Optional)

5.1.1 REFER to Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application.

5.1.2 ENSURE data from continuous heart rate monitoring is transcribed on the Physiological Monitoring Data Collection Form (A-6006-433) and attached as a scanned file in SWIHD in accordance with the Heat Stress Control program TFC-ESHQ-S_IH-C-07.

5.2 Using the Polar H7 Heart Rate Sensor With iPad and Polar Team Application

5.2.1 REFER to Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application

5.2.2 ENSURE data from continuous heart rate monitoring is transcribed on the Physiological Monitoring Data Collection Form (A-6006-433) and attached as a scanned file in SWIHD in accordance with the Heat Stress Control program TFC-ESHQ-S_IH-C-07.
5.3 Using the Polar OH1 Heart Rate Sensor With iPad and Heart Graph Application (Optional)

5.3.1 REFER to Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application.

5.3.2 ENSURE data from continuous heart rate monitoring is transcribed on the Physiological Monitoring Data Collection Form (A-6006-433) and attached as a scanned file in SWIHD in accordance with the Heat Stress Control program TFC-ESHQ-S_IH-C-07.

5.4 Using the Polar OH1 Heart Rate Sensor with iPad and Polar Team Application

5.4.1 REFER to Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application.

5.4.2 ENSURE data from continuous heart rate monitoring is transcribed on the Physiological Monitoring Data Collection Form (A-6006-433) and attached as a scanned file in SWIHD in accordance with the Heat Stress Control program TFC-ESHQ-S_IH-C-07.

5.5 Records

Data and attachments are entered into the Site-Wide Industrial Hygiene Database (SWIHD) 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.
Physiological Monitoring with the Polar Heart Rate Sensors

Figure 1 - OH1 Sensor/Transmitter
Physiological Monitoring with the Polar Heart Rate Sensors

Figure - 2 H7 Sensor/Transmitter
Physiological Monitoring with the Polar Heart Rate Sensors

Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application

1. ENSURE Sensor/Transmitter is attached per Section 4.3.
2. TURN the iPad Mini ON (Hold down the Sleep/Wake button a few seconds until the Apple Logo appears on the screen).

3. LOCATE AND TAP once on the “Settings Icon” from the iPad home screen.
Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application (Cont.)

4. **TURN ON** the Bluetooth option by moving the radio button to the right.

5. **LOCATE AND TAP** on the “Heart Graph” application (App) to open it.
6. **LOCATE AND TAP** on “SETTINGS” icon to open.

7. **SCROLL** down (swipe up with finger) to “PAIRED SENSORS” AND **TAP** on “Search for sensors.”
Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application (Cont.)

8. **IF** sensor is found as indicated by the screen display shown below for “New sensor found”, **PERFORM** the following:

8.1 **TAP** the Done button on the iPad keyboard that appears on screen.

**OR**

8.2 **ADD** survey number or identification to textbox area **AND**

**TAP** the Done button on the iPad keyboard that appears on screen.

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**Note:** The Survey ID may be added in this textbox area to match up the monitoring session to a SWHDI Survey ID.

The Polar Sensor ID# will not match what the Heart Rate Application automatically generates for the sensor ID #.

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You may add the Sensor ID that’s on the sensor plus the Survey # in SWHDI.
Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application (Cont.)

NOTE - After sensor is found and you tap “Done”, TAP Home in the upper left corner of the screen (not the iPad home button), you should be back at the main screen.

9. **TAP** the “New Simple Workout” option from the main screen.

The heart monitoring session begins automatically.

10. **Example Session**.
Attachment 1 - Heat Stress Monitoring Instructions for the Heart Graph Application (Cont.)

11. **WHEN** session has completed, **TAKE** a screen shot before pausing session as follows:

   - **TAKE A SCREEN PRINT, STOP SESSION, E-MAIL SCREEN PRINT:**
     - The Home and the Sleep/Wake keys are the two keys needed for the following instructions.

12. **TAP** the “Pause” button, **THEN**
     **TAP** “Done” button.

   - **TAP “Pause” button, THEN**
     **TAP “Done” button** will return you to the Main screen.
13. **PRESS** twice on the “Home” button.

14. **WHEN** current open apps are shown in a floating view above the app bar (see below for example), **TAP** on the floating Heart Graph app AND **SWIPE UP** to close the application.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application

1. **ENSURE** Sensor/Transmitter is attached per Section 4.3.
2. **TURN** the iPad Mini ON (Hold down the Sleep/Wake button a few seconds until the Apple Logo appears on the screen).

3. **LOCATE AND TAP** once on the “Settings Icon”.

![iPad with Settings Icon highlighted](image-url)
4. **TURN ON** the Bluetooth option by moving the radio button to the right.

![Bluetooth settings](image)

**NOTE** - The Polar H7 or OH1 sensor will not show up under Devices.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application (Cont.)

5. **LOCATE AND TAP** on the “Polar Team” application (App) to open it.

6. **WHEN** the application opens and the following message appears [“Polar Team”, Would like to Use Your Current Location], **CLICK** the OK button.

**NOTE** - Steps 6 through 10 will not be performed during every use, only the initial set up of the application. The welcome flag will disappear after the initial set up.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application (Cont.)

7. **TAP** on the “Create New Team” under the Welcome option.

8. **ENTER** which group you belong to (Production Ops, Retrieval, or Projects) for the Team Name.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application  
(Cont.)

9. **SELECT** “Other” from the Primary Sport drop-down list.

10. **TAP** on the ADD TEAM button located at the top, right-hand corner of the screen.
11. If adding players, **click** on the MANAGE PLAYERS button.

12. **Tap** MANAGE PLAYERS button.

13. **Tap** in the “First Name” text box **and** 
**enter** the sensor number.

14. **Tap** in the “Last Name” text box **and** 
**enter** the initials or first name of the worker.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application  
(Cont.)

15. **ENTER** the Target Heart Rate (180-age).

16. **TAP** on the “PAIR HR SENSOR”, to connect.
   a. **IF** pairing is successful, **OBSERVE** the following:
      - “CONNECTED” appears on screen
      - The Sensor # will appear under the Heart Rate Sensor
      - The PAIR HR SENSOR button will change to say “REMOVE PAIRING”
   b. **IF** pairing is not successful as indicated by “SEARCHING SENSOR” staying on screen, **ENSURE** the Sensor is strapped on and operating correctly.
      **OR**
      **TAP** on the PAIR HR SENSOR, **CHOOSE** MANUAL, AND **ENTER** the corresponding sensor identification number.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application (Cont.)

17. **IF** additional workers are to be added, **CLICK** on “ADD NEW PLAYER” **AND** **REPEAT** Steps 11 through 16.b until all workers have been added (See Screen Example below).

**Screen Example**

In this example, 5 people have been added. When a player is selected, the font turns red in the list to the right. In the left part of the screen, the selected participants information is displayed.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application (Cont.)

18. **WHEN** all workers have been added, **TAP** on the “DONE” button in the upper right corner.

19. **IF** it is desired to see a list of participants added, **TAP** on the “PLAYER LIST” button. (See Player List View Example below. Error! Reference source not found.)

   a. **IF** you need to edit information on the participant, **SELECT** the “MANAGE PLAYERS” button. (See Player List View Example below. Error! Reference source not found.)

**Player List View Example**

In this list, you can see the number of the of participant, the Sensor #, and the initials of the participant.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application (Cont.)

Starting a Session

20. TAP on the House icon from the left menu. (See Starting a Session Example Image below)
21. TAP on “NEW SESSION” button.

Starting a Session Example

![Starting a Session Example Image]

22. TAP on “START” to begin session.
Attachment 2 - Heat Stress Monitoring Instructions for the Polar Team Application (Cont.)

Example Session Screen

If the NEW SESSION button was clicked, then a screen similar to this one should be displayed. You should see the participants that were previously entered. The heart rate can be seen for 3 of the Example participants or players. This means that the Sensors are connected. The one that does not show a sensor # (e.g. #5) is not paired. It may need to be paired again. Click on the red triangle at the bottom right-hand corner of the Sensor box.

![Example Session Screen]

NOTE - Time duration of the session is also displayed at the bottom of the screen.

23. **WHEN** the session has started, **CHECK** at the top of the screen that the timer is running.
   a. **IF** a session needs to stop, **TAP** Pause button at any time.
   b. **IF** a session needs to resume, **TAP** on PLAY button at any time.

24. **ENSURE** screenshot or readings are taken at appropriate intervals per procedure or IH direction.
25. **REFER** to Player Views Example (below) to see different views that may be selected when running a session (Comparison View is not used). **SWIPE** left or right to change from List or Whole Team views.

**Players Views Example**

![Players Views Example](image)

26. **WHEN** the session has ended, **TAP** “Pause.”

27. **TAP** “END”.

28. **TAP** “SAVE.”
29. **TAP** on the chart icon at any time to go to the “SESSION SUMMARY” screen.

**Session Summary Screen**
30. **WHEN** the Session is complete, **DELETE** the session from the application.
   a. **TAP** on the SESSIONS Tab.
   b. **TAP** on the Box where it says Session Name (white box on the right side of screen) and you will notice you can now see the option to delete session in the top bar.
   c. **TAP** “DELETE SESSION” AND **CONFIRM** by tapping **DELETE**.