

**QUESTEMP<sup>®</sup>**  
**HEAT STRESS MONITOR**  
**MODEL 32**

**USER MANUAL**





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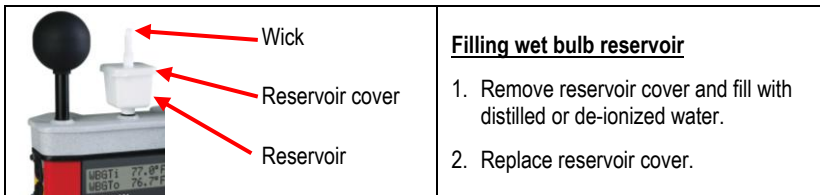
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## Up and Running

1. Make sure the wet bulb's wick is clean. Fill the reservoir with distilled water. (**DO NOT** use ordinary tap water).
2. Place the QUESTemp<sup>°</sup> in the work area in a safe location approximately 3.5 feet off the ground.
3. Turn the unit **ON**. If the battery voltage displayed during the power-on sequence is less than or equal to 6.4 volts, replace or recharge the batteries.
4. Use the arrow keys to set the display to the desired items.
5. Allow 10 minutes for the sensors to stabilize to the environment before taking readings.

## Check Wick and Fill Natural Wet Bulb

The QUESTemp 32 uses a cotton wick immersed into a reservoir containing distilled water. **DO NOT** use ordinary tap water, as the contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings. If the wick is discolored, it should be replaced. To **replace the wick**, slide the old wick off the top of the sensor. Place a new wick over the sensor, making sure that the bottom of the wick is down in the reservoir.



### Filling wet bulb reservoir

1. Remove reservoir cover and fill with distilled or de-ionized water.
2. Replace reservoir cover.

Figure 1-1: Filling wet bulb reservoir

## Measurements

### QUESTemp°32

The QUESTemp°32 portable area heat stress monitor computes the Wet Bulb Globe Temperature (WBGT). The WBGT is an accepted measurement for determining the heat stress level imposed on an individual in a given environment. The QUESTemp°32 measures three parameters: ambient or dry bulb temperature (DB), natural wet bulb temperature (WB), and globe temperature (G).

In addition to the WBGT, the QUESTemp°32 measures relative humidity (RH) and computes the Heat Index (HI) or Humidex. The QUESTemp°32, using inputs on the side of the instrument, has the ability to connect to two additional sensor arrays for monitoring up to three locations simultaneously.

### Wet Bulb Globe Temperature

The WBGT is a weighted average of the three temperature sensors using the following formulas:

<b>WBGT (indoor) = <math>0.7WB + 0.3G</math> (denoted as “WBGT<sub>i</sub>” on the display)</b>
<b>WBGT (outdoor) = <math>0.7WB + 0.2G + 0.1DB</math> (denoted as “WBGT<sub>o</sub>” on the display)</b>

- NOTE:** The resulting WBGT can be compared to indices of work-rest regimens (stay times) based upon the work loads. (See Appendix A for published heat exposure tables.)

## Heat Index / Humidex

The Heat Index is determined using the dry bulb temperature and relative humidity. Based upon charts available from the U.S. National Weather Service, Heat Index represents how an average person feels relative to climate conditions. For a constant temperature, if the humidity rises, so does the heat index.

The Heat Index is defined over a temperature range of 70°F - 120°F (21°C - 49°C) and a relative humidity range of 30% - 99%. Outside of this range, the instrument will show dashes in the display for the Heat Index.

The Humidex is used primarily in Canada and is very similar to the Heat Index. The values are slightly different. The Humidex is defined over a temperature range of 70°F - 109°F (21°C - 43°C) and a relative humidity range of 20% - 99%. Outside of this range, the instrument will show dashes in the display for the Humidex.

## Keypad Operation

The unit operates using a membrane keypad with four keys. The **I/O ENTER** key responds when the key is released while all other keys respond when the key is pressed.

Keys	Explanation
I/O Enter key	The unit turns on with a single key press. The unit turns off by holding the key down while a countdown of 3-2-1 occurs in the lower right corner of the display. This key is also used to enter setup changes.  While viewing live readings, pressing and releasing the key will cause the display to view the next available sensor bar (indicated in the upper right corner of the display).
Up Arrow key	Changes which items appear in the display. Scrolls up.
Down Arrow key	Changes which items appear in the display. Scrolls down.
Setup key	Allows changing the setup parameters. Three parameters are available: Celsius or Fahrenheit, the language, and Heat Index or Humidex. Press setup to access the parameters. Use the arrow keys to switch between the two parameters. Use the enter key to change the parameters. Press setup again to exit.

## Displayed Items

The number in the upper right corner indicates which sensor bar's data is displayed. 1 indicates the sensor bar placed on (or attached to) the top of the instrument. Sensors 2 and 3 are labeled on the side of the unit. W indicates the weighted average which only appears if a WBGT is displayed and all three sensor bars are attached.



The following measurements can be accessed on the display:

**Screen 1:** WET (Wet bulb)  
DRY (Dry bulb)

<b>WET</b>	<b>80.5° F</b>	<b>▶ 1</b>
<b>DRY</b>	<b>92.2° F</b>	

**Screen 2:** GLOBE

<b>GLOBE</b>	<b>92.4° F</b>	<b>▶ 1</b>
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**Screen 3:** WBGT<sub>i</sub> (Indoors)  
WBGT<sub>o</sub> (Outdoors)

<b>WBGT<sub>i</sub></b>	<b>84.1° F</b>	<b>▶ 1</b>
<b>WBGT<sub>o</sub></b>	<b>107.5° F</b>	

**Screen 4:** RH (Relative Humidity)  
H.I. or HU  
(Heat Index or Humidex)

<b>RH</b>	<b>66.2 %</b>	<b>▶ 1</b>
<b>H.I.</b>	<b>84.3° F</b>	

## Placement for Monitoring/Testing

The QUESTemp° 32 should be placed at a height of 3.5 feet (1.1 m) for standing individuals or 2 feet (.6 m) for seated individuals. Tripod mounting is recommended to get the unit away from anything that might block radiant heat or air flow. A ¼" x 20 threaded bushing on the bottom of the instrument allows mounting to a standard photographic tripod. Do not stand close to the unit during sampling.

Make sure that the wet bulb reservoir is filled with distilled water and that the cotton wick is clean and fully wetted. After adding water or placing the unit in a new environment, allow ten minutes for the globe and wet bulb readings to stabilize.

A series of dashes appear in the display if one of the following occur:

- The Heat Index or Humidex is outside of its allowable range
- The temperature is outside of its allowable range
- A temperature sensor has failed

## Sensors

### Natural Wet Bulb Thermometer

The natural wet bulb thermometer gives an indication of the effects of humidity on an individual. Relative humidity and air flow are taken into account by measuring the amount of evaporative cooling taking place at a thermometer covered with a moistened wick. The QUESTemp° 32 uses a cotton wick immersed into a reservoir containing distilled water. **DO NOT** use ordinary tap water, as the contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings. If the wick is discolored, it should be replaced. To replace the wick, slide the old wick off the top of the sensor. Place a new wick over the sensor, making sure that the bottom of the wick is down in the reservoir.

### Globe Thermometer

The globe thermometer gives an indication of the radiant heat exposure on an individual due to either direct light or hot objects in the environment. This is accomplished by placing a temperature sensor inside a blackened copper sphere and measuring the temperature rise. The WBGT index is based on the response of a 6-inch diameter globe. The QUESTemp° 32 uses a 2-inch diameter globe for a faster response time. The temperature of the 2-inch globe is correlated to match that of a 6-inch globe.

As an option, a sensor array with a 6-inch diameter globe is available.

## **Dry Bulb Thermometer**

The dry bulb thermometer measures the ambient air temperature. This measurement is used in the outdoor WBGT calculation when a high solar radiant heat load may be present. The series of white plates surrounding the sensor shield it from radiant heat.

## **Relative Humidity Sensor**

A relative humidity sensor is located in a compartment inside of the sensor bar housing. Slots in the housing allow air to circulate around the sensor.

## Remote, Sensors 2 and 3

The top sensor bar (sensor 1) may be removed from the instrument and used through a remote cable. Shelter the instrument and remote the sensor bar if the measured environment is expecting heavy rain or if temperatures are above 60°C.

The sensor 2 and sensor 3 jacks on the side of the instrument allow simultaneous monitoring of up to three sensor arrays using connecting cables.

Cable lengths of up to two hundred feet (61 meters) may be used without a decrease in accuracy provided the environment does not contain strong electromagnetic fields.

The data from these arrays may be viewed separately or combined into a weighted average WBGT reading per ISO 7243. Change the displayed sensor bar by pressing and releasing the enter key. The upper right corner of the display shows the current sensor bar. 1 refers to the top sensor bar, 2 and 3 are labeled on the side of the unit, W indicates the weighted average which only appears if a WBGT is displayed and all three of the sensor bars are attached.

### Tri-Sensor Weighted Average

Per the recommendations outlined in ISO 7243:2017, when the temperature in the space surrounding a worker is not uniform, 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. It is computed using the formula:

$$\text{WBGT}_w = (\text{WBGT}_{\text{head}} + (2 \times \text{WBGT}_{\text{abdomen}}) + \text{WBGT}_{\text{ankles}}) / 4$$

The QUESTemp° 32 always assigns the top sensor bar the double weighting. This calculation is shown if a WBGT display has been selected and if 3 sensor sets are connected.

### Operational Check

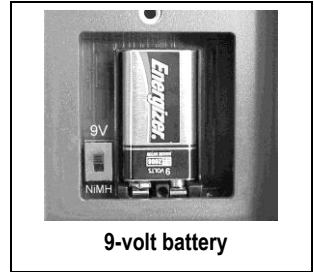
A verification module, model 054-544, may be used to check the operation of the QUESTemp. Remove the top sensor bar and plug the verification module into the top of the unit. With the QUESTemp set to read in degrees Celsius, verify that the displayed readings match those printed on the module within  $\pm 0.5^\circ\text{C}$ .

If the readings are not within the  $\pm 0.5^\circ\text{C}$  tolerance, then have the unit serviced and calibrated.

## Power Options

There are 3 options for powering the QUESTemp 32: a 9-volt alkaline battery, a NiMH (Nickel Metal Hydride) rechargeable 6-cell battery pack, and an AC adapter. A door on the back of the unit allows the user access to the 9-volt battery. The rechargeable battery pack is located inside of the unit. If the rechargeable battery pack ever needs to be replaced, it can be accessed by removing the screws from the bottom panel of the unit.

The 2-position switch located in the battery compartment must be set by the user if the power supply method is changed. The up position is for the 9 volt battery. The down position allows for either the AC adapter or the rechargeable batteries. The AC adapter will trickle charge the rechargeable batteries if they are in place or it will simply allow for line power operation of the unit.



## 9-V Alkaline Battery Replacement

**WARNING:** Replace batteries only in a non-hazardous environment.

The 9-volt battery should be replaced or the NiMH battery pack should be recharged when the voltage drops below 6.4 volts. The battery voltage is displayed when the instrument is turned on. While turned on, the battery voltage can be displayed at any time by pressing the up or down arrow keys to move through the display until the battery voltage screen appears. If, while operating, the battery voltage drops below 6.4 volts, the display will automatically switch to the display showing the battery voltage along with a low battery message. After a low battery occurs, the unit will continue to operate for approximately 8 hours. When the battery voltage falls to 6.2 volts or below, the unit will automatically turn off.

Replace only with an approved 9-volt alkaline battery.

### Approved 9-Volt Batteries

**Eveready:** Energizer 522, EN22, 6LR61

**Duracell:** MN1604

**Panasonic:** 6LR61, 6AM6X

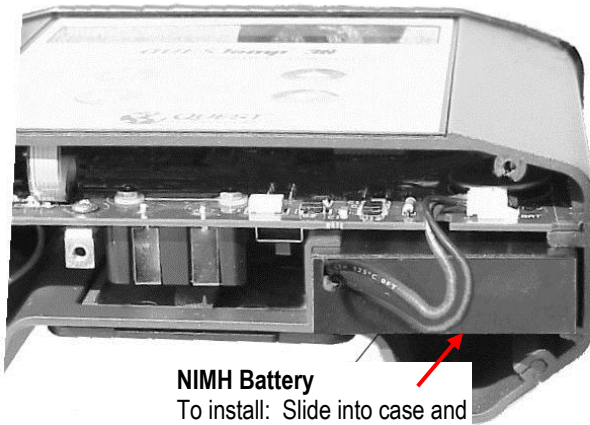
**Rayovac:** A1604

**UltraLife:** U9V

## NiMH Battery Pack

**WARNING:** Recharge batteries only in a non-hazardous environment.

The NiMH rechargeable battery pack is charged in the instrument using TSI's AC adapter #015-910. A discharged battery pack requires an "overnight" charge of 16 hours. Leaving the AC adapter plugged in for extended lengths of time or when operating the instrument will not harm the rechargeable batteries.



### NiMH Battery

To install: Slide into case and plug in connector as shown.

## Appendix A: Specifications

### Measurements

- Globe, dry bulb, wet bulb, WBGT<sub>in</sub>, WBGT<sub>out</sub>, WBGT weighted average (if 3 sensor sets), relative humidity, Heat Index, Humidex.
- Temperatures given in Celsius or Fahrenheit.

### Languages

- English, French, Spanish, Italian, German.

### Housing

- Designed water resistant to a light rain or mist. If rain is frequent, best practice would be to remote the sensor bar and keep the instrument sheltered.

### Size

- Height 9.2 in. (23.5 cm); Width 7.2 in. (18.3 mm); Depth 3.0 in. (7.5 mm)
- Dimensions include mounted sensor assembly.

### Weight

- 2.6 lbs. (1.2 kg) with mounted sensor assembly.

### Sensor Types

- Temperature: 1000 ohm platinum RTD
- Humidity: Integrated circuit with capacitive polymer sensor

### Accuracy

- Temperature:  $\pm 0.5^{\circ}\text{C}$  between  $0^{\circ}\text{C}$  and  $120^{\circ}\text{C}$
- Relative Humidity:  $\pm 5\%$  between 20 to 95% (non-condensing)

### Operating Temperature Range

- Sensor Assembly:  $-5^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$
- Electronics:  $-5^{\circ}\text{C}$  to  $60^{\circ}\text{C}$

### Remote Sensor Bars

- 2 x 15-pin D-sub jacks are located on the side of the unit for plugging in one or two additional sensor bars by using remote cables up to 200 feet (61 m). The top sensor bar can also be remote with a cable.

## Power Options

- 9V alkaline, 7.2V NiMH rechargeable pack (charged in the unit), or AC adapter wall power cube (AC adaptor will operate the unit or recharge the NiMH battery pack).

## Battery Life

- 9V alkaline: 140 hours
- Rechargeable Nickel Metal Hydride: 300 hours
- (Adding additional sensor bars reduces battery life.)

## Charge Time (NiMH Battery Pack)

- 16 hours (charge in the unit)

## Safety Approvals

- CE mark

## Product Markings

- The year of manufacture is determined by the third character in the instrument's serial number. "A" was manufactured in 2001, "B" in 2002, "C" in 2003, "D" in 2004 and so forth.

## Batteries

Only the following battery types may be used:

### Non-rechargeable battery

Type	Manufacturer
U9V	Ultralife
MN1604	Duracell
522 or EN22 or 6LR61	Energizer
A1604 or BR232	Rayovac
6LR61 or 6AM6	Panasonic

### Rechargeable battery

Integral NiMH battery pack type DC2121

The rechargeable battery may only be recharged with class 2 charger, rated 9 VDC, 1 A max.



## Appendix B: Heat Exposures Tables

### ACGIH

Screening Criteria for Heat Stress Exposure. WBGT values in °C.

- NOTE:** According to the ACGIH's guidelines, the temperature values represent a work and rest process which is explained in the standards. Refer to the ACGIH TLV's and BEIs for specific details.

Work and recovery (TLV)	Light	Moderate	Heavy	Very Heavy
75% to 100%	31.0	28.0	26.0*	23.5*
50% to 75%	31.0	29.0	27.5	25.5*
25% to 50%	32.0	30.0	29.0	28.0
0% to 25%	32.5	31.5	30.5	30.0

Work and recovery (Action Limit)	Light	Moderate	Heavy	Very Heavy
75% to 100%	28.0	25.0	22.5*	20.0*
50% to 75%	28.5	26.0	24.0	22.5*
25% to 50%	29.5	27.0	25.5	24.5
0% to 25%	30.0	29.0	28.0	27.0

\*Values not specified by ACGIH have been estimated for continuity.

Cited from "American Conference of Governmental Industrial Hygienists - Threshold Limit Values and Biological Exposure Indices for 2008"; Reprinted with permission from ACGIH

## United States Navy

Physiological Heat Exposure Limits (PHEL) Time Table  
 (Without the presence of fuel combustion gases/fuel vapors) is displayed on the following page.

The recommended working hours are shown based on a maximum of eight hours. Naval personnel will follow a category, I - VI, based upon their function.

### PHEL Curves (Total Exposure Time in Hours: Minutes)

WBGT(F)	I	II	III	IV	V	VI
80.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
81.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
82.0	>8:00	>8:00	8:00	7:05	5:25	3:40
83.0	>8:00	8:00	7:45	6:25	4:55	3:20
84.0	>8:00	8:00	7:05	5:55	4:30	3:05
85.0	8:00	7:45	6:30	5:20	4:05	2:50
86.0	8:00	7:05	5:55	4:55	3:45	2:35
87.0	7:25	6:30	5:25	4:30	3:25	2:20
88.0	6:45	5:55	4:55	4:05	3:10	2:10
89.0	6:10	5:25	4:30	3:45	2:50	2:00
90.0	5:40	5:00	4:10	3:25	2:40	1:50
91.0	5:15	4:35	3:50	3:10	2:25	1:40
92.0	4:50	4:10	3:30	2:55	2:15	1:30
93.0	4:25	3:50	3:15	2:40	2:00	1:25
94.0	4:05	3:35	3:00	2:25	1:50	1:15
95.0	3:45	3:15	2:45	2:15	1:45	1:10
96.0	3:25	3:00	2:30	2:05	1:35	1:05
97.0	3:10	2:45	2:20	1:55	1:25	1:00
98.0	2:55	2:35	2:10	1:45	1:20	0:55
99.0	2:40	2:20	2:00	1:40	1:15	0:50
100.0	2:30	2:10	1:50	1:30	1:10	0:45
101.0	2:20	2:00	1:40	1:25	1:05	0:45
102.0	2:10	1:50	1:35	1:15	1:00	0:40
103.0	2:00	1:45	1:25	1:10	0:55	0:35
104.0	1:50	1:35	1:20	1:05	0:50	0:35
105.0	1:40	1:30	1:15	1:00	0:45	0:30

<b>WBGT(F)</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>
106.0	1:35	1:25	1:10	0:55	0:45	0:30
107.0	1:30	1:15	1:05	0:50	0:40	0:25
108.0	1:20	1:10	1:00	0:50	0:35	0:25
109.0	1:15	1:05	0:55	0:45	0:35	0:25
110.0	1:10	1:00	0:50	0:40	0:30	0:20
111.0	1:05	1:00	0:50	0:40	0:30	0:20
112.0	1:00	0:55	0:45	0:35	0:25	0:20
113.0	0:55	0:50	0:40	0:35	0:25	0:15
114.0	0:55	0:45	0:40	0:30	0:25	0:15
115.0	0:50	0:45	0:35	0:30	0:20	0:15
116.0	0:45	0:40	0:35	0:25	0:20	0:15
117.0	0:45	0:40	0:30	0:25	0:20	0:10
118.0	0:40	0:35	0:30	0:25	0:15	0:10
119.0	0:35	0:35	0:25	0:20	0:15	0:10
120.0	0:35	0:30	0:25	0:20	0:15	0:10
121.0	0:35	0:30	0:25	0:20	0:15	0:10
122.0	0:30	0:25	0:20	0:15	0:15	0:10
123.0	0:30	0:25	0:20	0:15	0:10	0:10
124.0	0:25	0:25	0:20	0:15	0:10	0:05

## Electrical power research institute (EPRI)

The recommended working hours are shown based on a maximum of four hours. A time of 4:01 indicates greater than 4 hours.

WBGT°C	Light	Moderate	Heavy
28	4:01	4:01	3:00
29	4:01	4:00	2:00
30	4:01	3:00	1:30
31	4:01	2:00	1:15
32	4:00	1:30	1:00
33	3:30	1:15	0:45
34	3:00	1:00	0:40
35	2:30	0:53	0:35
36	2:00	0:45	0:30
37	1:45	0:40	0:25
38	1:30	0:35	0:20
39	1:15	0:33	0:18
40	1:00	0:30	0:15
41	0:53	0:28	0
42	0:45	0:25	0
43	0:38	0:23	0
44	0:30	0:20	0
45	0:28	0:18	0
46	0:25	0:15	0
47	0:23	0	0
48	0:20	0	0
49	0:18	0	0
50	0:15	0	0

## Appendix B: Accessories

Sensor array with 2-inch globe.....	056-795
Sensor array with 6-inch globe.....	056-780
6-foot shielded remote sensor cable.....	053-924
25-foot shielded remote sensor cable.....	053-925
100-foot shielded remote sensor cable .....	053-926
200-foot shielded remote sensor cable .....	053-927
120 VAC to 9 VDC adapter .....	015-910
220 VAC to 9 VDC adapter .....	015-680
Verification module .....	053-923
Tripod.....	059-045
Replacement wicks.....	056-679
Water bottle 2 oz. ....	056-068
User's manual .....	056-661

## Contact/Service information

This section gives directions for contacting TSI Incorporated for technical information and directions for returning the QUESTemp<sup>®</sup> 32 for service.

### Technical Support Contacts

If you have any difficulty setting or operating the instrument, or if you have technical or application questions about this system, contact TSI's Technical Support.

<p><b>North America and Asia Pacific</b></p> <p><b>Telephone:</b> 1-800-680-1220 (USA); +1 651-490-2860 (Outside USA)</p> <p><b>Fax:</b> +1 651-490-3824</p> <p><b>E-mail:</b> <a href="mailto:technical.services@tsi.com">technical.services@tsi.com</a></p>	<p><b>Europe, Middle East, and Africa</b></p> <p><b>Telephone:</b> +49 241-52303-0</p> <p><b>Fax:</b> +49 241 52303-49</p> <p><b>E-mail:</b> <a href="mailto:tsigmbh@tsi.com">tsigmbh@tsi.com</a></p>
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### Service Contact Information

If your instrument does not operate properly, or if you are returning the instrument for service, visit our website at <http://rma.tsi.com> for a Return Material Authorization, or contact Customer Service.

<p><b>North America and Asia Pacific</b></p> <p><b>TSI Incorporated</b> 1060 Corporate Center Drive Oconomowoc, WI 53006-4828</p> <p><b>Telephone:</b> 1-800-680-1220 (USA); +1 651-490-2860 (Outside USA)</p> <p><b>E-mail:</b> <a href="mailto:technical.services@tsi.com">technical.services@tsi.com</a></p>	<p><b>Europe, Middle East, and Africa</b></p> <p><b>TSI Instruments Ltd.</b> Stirling Road Cressex Business Park High Wycombe, Bucks HP12 3ST United Kingdom</p> <p><b>Telephone:</b> +44 (0) 149 4 459200</p> <p><b>E-mail:</b> <a href="mailto:tsiuk@tsi.com">tsiuk@tsi.com</a></p>
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## Returning for Service

Visit our website at <http://rma.tsi.com> and complete the on-line "Return Merchandise Authorization" form or call TSI at 1-800-680-1220 (USA) or (651) 490-2860, or 001 651 490 2860 (International) for specific return instructions.

Customer Service will need the following information:

- The instrument model number
- The instrument serial number
- A purchase order number (unless under warranty)
- A billing address
- A shipping address

Use the original packing material to return the instrument to TSI. If you no longer have the original packing material, seal off any ports to prevent debris from entering the instrument and ensure that the display and the connectors on the instrument front and back panels are protected. This instrument is very fragile and must be packed in a manner appropriate for a precision instrument.

## Calibration

The QUESTemp<sup>0</sup> 32 Heat Stress Sensor should be examined regularly by the factory. An annual calibration is recommended. (See Service Department above.)

## Warranty

(For country-specific terms and conditions outside of the USA, please visit [www.tsi.com](http://www.tsi.com).)

Seller warrants the goods, excluding software, sold hereunder, under normal use and service as described in the operator's manual, to be free from defects in workmanship and material for **12 months**, or if less, the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions and exceptions:

- a. Hot-wire or hot-film sensors used with research anemometers, and certain other components when indicated in specifications, are warranted for 90 days from the date of shipment;
- b. Pumps are warranted for hours of operation as set forth in product or operator's manuals;
- c. Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment;
- d. Seller does not provide any warranty on finished goods manufactured by others or on any fuses, batteries or other consumable materials. Only the original manufacturer's warranty applies;
- e. This warranty does not cover calibration requirements, and seller warrants only that the instrument or product is properly calibrated at the time of its manufacture. Instruments returned for calibration are not covered by this warranty;
- f. This warranty is **VOID** if the instrument is opened by anyone other than a factory authorized service center with the one exception where requirements set forth in the manual allow an operator to replace consumables or perform recommended cleaning;
- g. This warranty is **VOID** if the product has been misused, neglected, subjected to accidental or intentional damage, or is not properly installed, maintained, or cleaned according to the requirements of the manual. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller.

The foregoing is **IN LIEU OF** all other warranties and is subject to the LIMITATIONS stated herein. **NO OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. WITH RESPECT TO SELLER'S BREACH OF THE IMPLIED WARRANTY AGAINST INFRINGEMENT, SAID WARRANTY IS LIMITED TO CLAIMS OF DIRECT INFRINGEMENT AND EXCLUDES CLAIMS OF CONTRIBUTORY OR INDUCED INFRINGEMENTS. BUYER'S EXCLUSIVE REMEDY SHALL BE THE RETURN OF THE PURCHASE PRICE DISCOUNTED FOR REASONABLE WEAR AND TEAR OR AT SELLER'S OPTION REPLACEMENT OF THE GOODS WITH NON-INFRINGEMENT GOODS.**

TO THE EXTENT PERMITTED BY LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF SELLER'S LIABILITY FOR ANY AND ALL LOSSES, INJURIES, OR DAMAGES CONCERNING THE GOODS (INCLUDING CLAIMS BASED ON CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) SHALL BE THE RETURN OF GOODS TO SELLER AND THE REFUND OF THE PURCHASE PRICE, OR, AT THE OPTION OF SELLER, THE REPAIR OR REPLACEMENT OF THE GOODS. IN THE CASE OF SOFTWARE, SELLER WILL REPAIR OR REPLACE DEFECTIVE SOFTWARE OR IF UNABLE TO DO SO, WILL REFUND THE PURCHASE PRICE OF THE SOFTWARE. IN NO EVENT SHALL SELLER BE LIABLE FOR LOST PROFITS, BUSINESS INTERRUPTION, OR ANY SPECIAL, INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES. SELLER SHALL NOT BE RESPONSIBLE FOR INSTALLATION, DISMANTLING OR REINSTALLATION COSTS OR CHARGES. No Action, regardless of form, may be brought against Seller more than 12 months after a cause of action has accrued. The goods returned under warranty to Seller's factory shall be at Buyer's risk of loss, and will be returned, if at all, at Seller's risk of loss.

Buyer and all users are deemed to have accepted this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended, modified or its terms waived, except by writing signed by an Officer of Seller.

### Service Policy

Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call TSI's Customer Service department at 1-800-874-2811 (USA) or +001 (651) 490-2811 (International).





**TSI Incorporated** – Visit our website [www.tsi.com](http://www.tsi.com) for more information.

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