



SCARLET TECH

TWL-1S

Heat Stress Meter

User Guide

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Instrument at a Glance

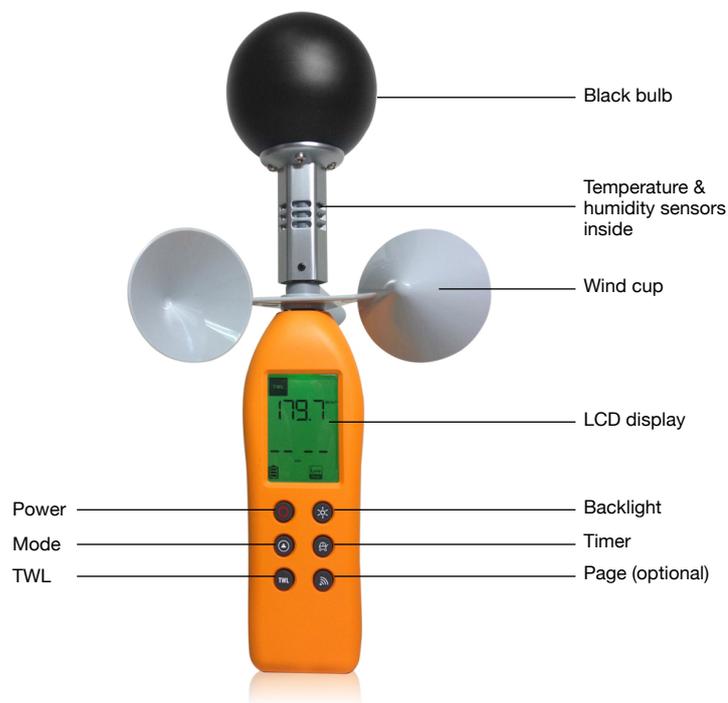
Heat stress index

Heat illnesses can be fatal. However, with proper precautions, it can be avoided. Thermal Work Limit (TWL) is a heat index calculated from environmental parameters, including dry bulb temperature, wet bulb temperature, globe bulb temperature and wind speed and accommodates for clothing factors as well as human physiological status to estimate a safe maximum continuous suitable metabolic rate. It is designed primarily for self-paced workers who are well hydrated and acclimatized in the working condition.

Instrument

TWL-1S Heat Stress Meter offers a compact-designed hardware with deliberate software and user-friendly interface. 3-color backlight based on TWL index informs users the risk level.

Work break timer reminds users the work/rest schedule and actively notifies the remote pager (optional¹) when it counts down to zero.



¹ Please contact sales representative for wireless paging function.

Sensors

There are four different types of sensors in TWL-1S.

Temperature sensor A high dynamic range NTC style thermistor is installed inside of the neck along with the humidity sensor.

Humidity sensor A capacitive humidity sensor is installed inside of the neck to be well protected by the case and the filter. See more details in the section "Polypropylene Filter".

Globe temperature A high dynamic range NTC style thermistor is located in the center of the black copper sphere to measure the radiative heat comes from heat source like sunlight or oven.

Anemometer Wind cups and high quality bearing make the anemometer very effective. Starting wind speed is as low as 0.5 m/s. Wind cups detect wind strength at all times, regardless of the orientation and position of the instrument.

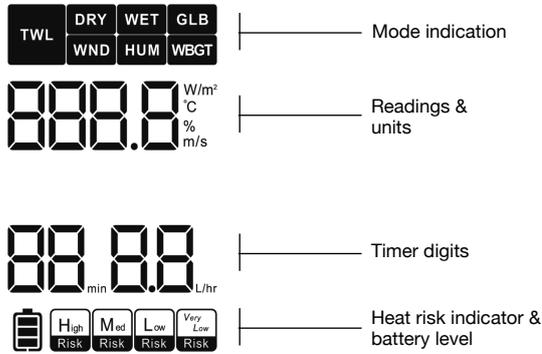
Buttons

The functionality of the TWL-1S is controlled by the buttons in the front panel.

| Icon | Button | Functions |
|------|-----------|---|
| | POWER | Turn on/off the device. |
| | MODE | Switch among measurements. |
| | TWL | Trigger a measurement of TWL heat index |
| | BACKLIGHT | Turn on the backlight. |
| | TIMER | Set up count down timer per measured TWL value. |
| | PAGE | Send a signal to notify remote pager. This is optional. |

Display

The large size LCD display shows the readings of sound level also the icons to present the current measure mode and the status of the instrument:



| Icon | Meaning |
|------|---|
| | Dry bulb temperature (air temperature). |
| | Wet bulb temperature. Calculated from dry bulb temperature and rh%. |
| | Globe temperature. |
| | Wind speed. |
| | Relative humidity. |
| | Wet Bulb Globe Temperature. $WBGT = 0.7 \times WET + 0.2 \times GLB + 0.1 \times DRY$. |
| | Thermal Work Limit. TWL is calculated according to evidence-based medicine. |
| | High risk indication. Displayed when $TWL < 115$. |
| | Medium risk indication. Displayed when $115 < TWL < 140$. |
| | Low risk indication. Displayed when $TWL > 140$. |
| | Very low risk indication. Displayed when $TWL > 210$. |
| | Battery level. Change batteries when it is empty. |

Getting Started

Before using

NOTE: Expose the meter to the environment at least 10 min to reach equilibrium for any significant changes in temperature and humidity (e.g. indoor to outdoor and vice versa).

Make sure your TWL-1S is in good condition and within factory calibration.

Meter setup

- › Insert 4 AAA batteries into the battery holder with proper orientation.
- › Long press **PWOER** button to turn on TWL-1S.
- › Place the meter on a tripod, preferably 1 m above the ground, for proper placement.
- › Press **MODE** key to toggle among 7 modes.
- › Press **TWL** key to calculate a TWL value.

Pager setup (optional²)

Insert 1 AA battery into the battery holder with proper orientation. The pager beeps once when it is ready.

² Please contact sales representative for wireless paging function.

Operation

For explanatory purpose, all icons are presented in the section “Display”. However, during daily operation, only part of these icons is displayed.

On/off

Long press **POWER** button to turn on or off the device. When left without any operation for 15 min, the device turns off automatically.

Measurements

Press **MODE** button to toggle among 7 modes. It shows real time value for 6 modes

- Dry bulb temperature
- Wet bulb temperature
- Globe temperature
- Wind speed
- Humidity
- WBGT

Based on TWL theory, real time value of TWL is not practical. Averaged data is more presentative to show user the condition of the environment. TWL calculation is only triggered by pressing **TWL** button.

TWL

Before any measurement, the TWL mode shows - - - . - W/m².

Trigger a measurement Press **TWL** button to calculate a TWL value. It takes 2 min to compute a TWL value because 2-min average is more representative than a snapshot.

Check out the screen When calculating a TWL value, the screen shows average wind speed from the 1st second to current moment. When calculating, TWL icon blinks and a countdown timer shows the time remains.

Finish measurement When the calculation is done, a TWL value and correspondent risk icon shows alone with the suggested work time as indicated in Table 1.

Backlight

Press **BACKLIGHT** button to turn on the colorful backlight of the LCD. The color corresponds with the TWL range and risk (Table 1). Before any TWL value is calculated, pressing **BACKLIGHT** key only flashes - - - . - twice.

Timer

Short pressing **TIMER** button sets the timer. Long pressing **TIMER** starts/ends the timer. This button only works in High Risk (Red) zone as green and yellow zones do not have work time limits.

Wireless paging (optional³)

Trigger Press **PAGE** key to call the remote pagers. Paging signal covers 200 meters on average, but the coverage varies with topology.

Pager When triggered by TWL-1S, the pager beeps and vibrates. Press the side button to stop. Both red zone and the expiration of work timer trigger the pager 3 times with 1min interval.

Battery

Alkaline batteries can sustain more than 120 hours when operated continuously. Dry batteries and rechargeable batteries are also applicable but with shorter lifetime. Download data when the battery bar is empty, otherwise some data might be lost.

³ Please contact sales representative for wireless paging function.

Data Logger

Step1: Configuration

- › Download TWL-1S app (TWLIT) from www.scarlet.com.tw.
- › Install the app on PC or laptop following the instructions.
- › Turn on the device and connect it to the PC or laptop by the USB cable.
- › Launch the app and set logging interval (minimum 10 min).
- › Disconnect the meter from the computer, and TWL-1s is ready for data logging.

Step2: Data logging

- › Long press **MODE** key to turn on data logging mode and the meter displays *SUR*.
- › Press **MODE** key, if you agree to enter the data logging mode.
- › Press **TIMER** key, if you do NOT agree to enter the data logging mode.
- › When the screen shows *REC*, the device is collecting and recording data; *Idle* means no data are recorded.
- › Long press **TIMER** key to quit data logging mode.

Step3: Download data

- › Connect to the computer to download the data via the app you installed in the step 1.

Calibration

Calibration drift happens over time. Regular recalibration is necessary to ensure the accuracy of the measurement.

Humidity sensors can be calibrated using the RH calibration kit which includes saturated salt solutions and two sealed containers. We suggest that you have the humidity sensor calibrated every 6 months. Please contact the sales representatives for RH calibration kit, instruction and services.

Temperature sensors (dry air and globe bulb) typically do not require recalibration because the calibration drift is negligible during the product lifetime.

Wind speed is calibrated against an intermediary standard calibrated under MEASNET cup anemometer calibration procedure before it leaves the factory. However, we recommend that you have the anemometer checked every 6 month. Please contact the sales representatives for wind speed test and bearing replacement.

Accessory

Polypropylene filter

A polypropylene (PP) fiber is applied to protect the temperature and humidity sensors from dust while allowing water vapor (moist humid air) to pass through. It is suggested to replace the PP filter every 2-6 months depending on the usage condition. Please contact the sales representatives if you wish to change the filter.

USB cable

A mini-B to standard-A USB cable is in the standard package to connect the device and PC or laptop for configuring instrument and downloading data. More details are in the section "Data Logger".

Pager (optional)

Please contact sales representative for wireless paging function.

Technical Specification

Instrument

| | |
|---------------------------|---|
| Temperature sensor | Range 0...50° C Resolution 0.1° C Accuracy ±0.6° C |
| Globe bulb sensor | Range 0...80° C Resolution 0.1° C Accuracy Indoor ±1.0° C (15...40° C); ±1.5° C (others) Accuracy Outdoor ±1.5° C (15...40° C); ±2.0° C (others) |
| Humidity sensor | Range 5...95% Resolution 0.1% Accuracy ±3% (25° C, 10...90%); ±5% (others) |
| Wind speed sensor | Range 0.5...10 m/s Resolution 0.1 m/s Accuracy ±(2% of readings + 0.2) m/s |
| WBGT formula | Indoor $WBGT = 0.7 \times T_w + 0.3 \times T_g$ Outdoor $WBGT = 0.7 \times T_w + 0.2 \times T_g + 0.1 \times T_a$ |
| TWL calculation | Dynamic calculation based on T_w , T_g , T_a and ws . Safe max. $T_{core} < 38.2$ °C |
| Display | 32(W) x 50(H) mm LCD screen |
| Backlight | Yes. Color depends on TWL measurement |
| Power supply | 4x AAA batteries supply 6V |
| Power consumption | 6 mA with backlight off |
| Battery indicator | Yes |
| Battery life | 120 hr with alkaline batteries |
| Dimension | 59(W) x 37(D) x 316(H) mm Globe bulb 75 mm diameter Wind cup 91 mm rotation radius |
| Weight | 330 g |
| Enclosure | ABS |
| Standard | CE-compliant |
| Sensor protection | Polypropylene filter |
| Operating range | -10...60 °C |
| Logger memory | 2,000 readings |
| Standard accessory | Tripod x 1, AAA battery x 4, USB cable x 1, toolbox x 1 |
| Calibration kit | Optional. MgCl ₂ and NaCl O-ring sealed bottles |
| Storage condition | 20...40 °C |

Wireless paging (optional)

By installing RF transmitter, TWL-1S will be able to send signal to remote pagers. 433 MHz technology is used to achieve 200 meters range in an open space. Following table is the pager specification.

| | |
|-----------------|--------------------------|
| Pager frequency | 433 MHz |
| Pager dimension | 51(L) x 74(W) x 28(H) mm |
| Pager weight | 76g |
| Alarm loudness | 85db @ 10 cm |
| Pager power | 1x AA batteries |

Standard

CE certificate Instrument is certified by CE mark following the EN 61326-1:2006 Electrical Equipment for Measurement, Control and Laboratory Use.

SGS test report A third party certification for its temperature and humidity sensors from SGS, a globally renowned company for inspection, verification, testing and certification.



Thermal Work Limit (TWL)

Safety, Handling, & Maintenance

Important safety information

WARNING: Failure to follow these safety instructions could result in fire, electric shock, or other injuries, or damage to sound level meter or other property. Read all the safety information below before using the instrument.

Operate Avoid using instrument in the rain. Avoid using meter in presence of explosive gas, combustible gas, steam or excessive dust. Be sure to turn it off after use. If you expect not to use the instrument for a long period remove batteries to avoid leakages of battery liquid which could damage the its inner components.

Handling Handle the meter with care. It is made of sensitive electronic components. The meter can be damaged if dropped, burned, punctured, or crushed, or if it comes in contact with liquid. Don't use a damaged meter, such as one with a cracked screen, as it may cause injury.

Important handling information

WARNING: Do not hold and twist the black bulb. The neck part of the instrument will be damaged and the temperature and humidity sensors inside of the neck will be broken.

Do not twist black ball The neck part of the instrument will be damaged if one twist the black ball.

Battery replacement Low battery icon showed on LCD indicates users to replace batteries:

- Turn off the instrument.
- Remove the battery cap.
- Insert new batteries and then put the cap back.
- Process the waste batteries accordingly.

Standard packing

- Heat Stress Meter x1
- User guide x1
- Tripod x1
- Certificate of Conformity x1
- USB cable x1
- AAA battery x4

Warranty & Services

Warranty conditions

This instrument is guaranteed for one year against material or production defects, in accordance with our general sales conditions. During the warranty period the manufacturer reserves the right to decide either to repair or replace the product.

Should you need for any reason to return back the instrument for repair or replacement take prior agreements with the local distributor from whom you bought it. Do not forget to enclose a report describing the reasons for returning (detected fault). Use only original packaging. Any damage occurred in transit due to non-original packaging will be charged anyhow to the customer.

The warranty doesn't apply to:

Accessories and batteries (not covered by warranty)

Repairs made necessary by improper use (including adaptation to particular applications not foreseen in the instructions manual) or improper combination with incompatible accessories or equipment.

Repairs made necessary by improper shipping material causing damages in transit.

Repairs made necessary by previous attempts for repair carried out by non-skilled or unauthorized personnel.

Instruments for whatever reason modified by the customer himself without explicit authorization of our Technical Dept.

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Our products are patented. The logotypes are registered. We reserve the right to modify characteristics and prices as part of technological developments which might require them.

Services

Shouldn't the instrument work properly, before contacting your distributor make sure that batteries are correctly installed and working, check the test leads and replace them if necessary.

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