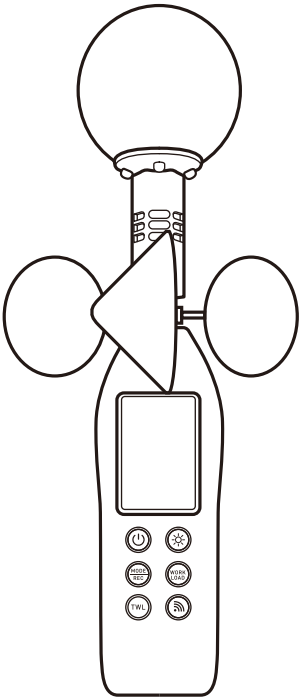
SCARLET | TECH



TWL-1S

Heat Stress Meter

User Guide

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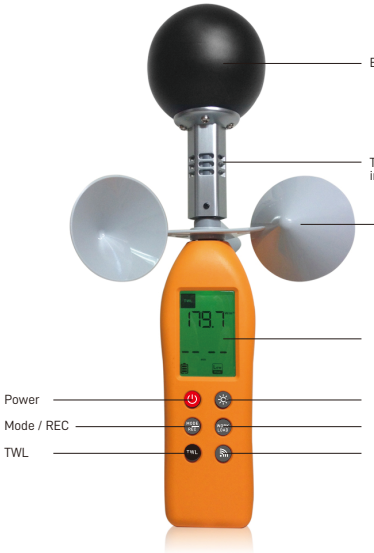
Instrument at a Glance

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 in 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.

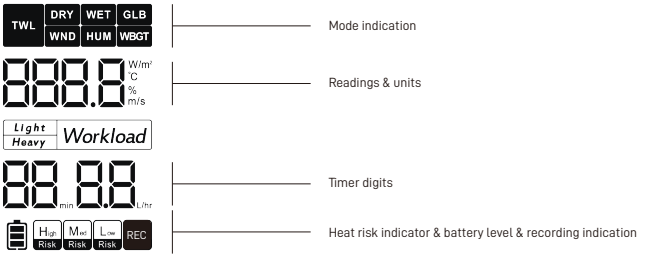
Buttons

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 REC	MODE / REC	Switch among measurements / Start data logging
TWL	TWL	Trigger a measurement of TWL heat index
☼	BACKLIGHT	Turn on the backlight.
WORK LOAD	Workload	Set up count down timer per measured TWL value.
SW	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	Dry bulb temperature (air temperature)
WET	Wet bulb temperature. Calculated from dry bulb temperature and rh%
GLB	Globe temperature
WND	Wind speed
HUM	Relative humidity
WBGT	Wet Bulb Globe Temperature. WBGT = 0.7 x WET + 0.2 x GLB + 0.1 x DRY
TWL	Thermal Work Limit. TWL is calculated according to evidence-based medicine
H_{igh} RISK	High risk indication. Displayed when TWL < 115
M_{od} RISK	Medium risk indication. Displayed when 115 < TWL < 140
L_{ow} RISK	Low risk indication. Displayed when TWL > 140
REC	Flashing when data is logging
	Battery level. Change batteries when it is empty

Getting Started

> ***NOTE:*** *Expose the meter to the environment at least 10 min to reach equilibrium for any significant changes in temperature and humidity*

Before using

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 **POWER** 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 (optional[2])

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/REC** 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.

Workload

Short pressing **WORKLOAD** button sets the timer. Long pressing **WORKLOAD** 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 (optional)

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: Connect to PC

Connect the logger with any windows computer. Computer will recognize the logger as a CD-ROM and pop up a new screen for configuration. If not, you may go to file management to click a recognized CR-ROM called "Logger"

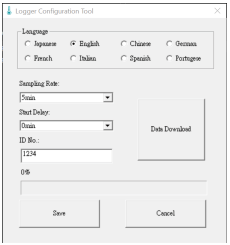
Step2: Configuration

Double click "Logger configuration tool" to setup the logger. The logger configuration screen offers 8 languages to help you setup easily. The programmable parameters are sampling rate, start delay time and Logger ID.

- The programmable sampling rate is from 5 mins to 2 hours
- The start delay time is from 0 min to 12 hours

Note: By choosing 5 mins, it means the first record will be taken into logger's memory 5 mins after pressing the MODE/REC key to start the data logging.

- Logger ID is a 4-digit number you can use to give each logger a unique property code, such as 0928.
After setting is finished, click Save button to synchronize the setting and your PC time zone to data logger. Close the setup screen and disconnect logger. Leave it where you want to monitor the WBGT.

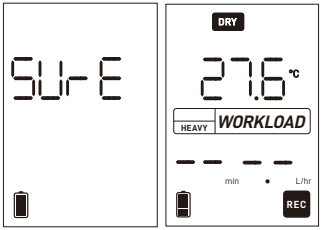


Step3: Start Data logging

Long press MODE/REC key for more than 1 second to activate the logger into standby status. You will see SUrE on display.

When SUrE is displayed, press MODE/REC key to start the data logging (The REC icon will be flashing on display) or press WORKLOAD key to cancel it.

Note: If the logger is programmed as start delay 5 mins, after pressing MODE/REC key, the REC icon will show a consistent display and then turn into flashing mode after 5 mins.
It will take 15 ~20 mins to make the WBGT logger to reach equilibrium with testing environment.



Step4: Stop Data Logging

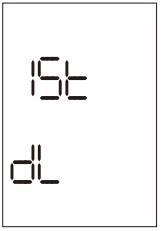
To stop recording before memory is full, long press WORKLOAD key and the REC icon will disappear from display. There are 12000 records memory space. If memory is full, FULL icon will appear on display.

Step5: Data Output

Connect the logger with any windows computer (same as Step 1). Pressing Download button on setup screen and choose where the logged file to save on this PC. The read-out csv report can be opened with Office Excel.

The saved report contains Configuration Time, Start Time, Start delay, Sampling rate, ID no. and Total records number.

Note: If you want to start a new data logging, you have to clean the memory first by doing data output (The display will show **ISt dL**(Instant download).



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 nemometer calibration procedure before it leaves the factory. However, we recommend that you have the nemometer 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 x Tw + 0.3 x Tg Outdoor WBGT = 0.7 x Tw + 0.2 x Tg + 0.1 x Ta
TWL calculation	Dynamic calculation based on Tw, Tg, Ta and ws. Safe max. Tcore < 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
Enslosure	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. MgCl2 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)

The TWL guidelines have been implemented in Abu Dhabi Emirate, UAE and Australian mines and have produced a substantial decrease in the number of heat related illness cases.

TWL (W/m2)	Backlight	Work Limit Time	Risk
>= 140	Green	Safe for self-paced work	Low
115...139	Yellow	Safe for self-paced work	Medium
< 115	Red	20 min	High

Safety, Handling, & Maintenance

> ***WARNING:*** *Failure to follow these safety instructions could result in fire, electric shock, or other injuries, or damage to sound level meter or other*

Important safety information

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.

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

Important handling information

Battery replacement Low battery icon showed on LCD indicates users to replace batteries:
- Turn off the instrument and 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

Workload Definition

Based on the TWL, Abu Dhabi Environment, Health and Safety Management System (EHSMS) has recommended a schedule for work, rest and hydration.

TWL (W/m^2)	Risk Level	Workload	Hydration (l/hr)	Work/Rest Time (min)
TWL ≥ 140	Low Risk	Light/Heavy	0.6-1	Unrestricted
115 ≤ TWL < 140	Medium Risk	Light	1-1.2	Unrestricted
		Heavy	1.2	45/15
TWL < 115	High Risk	Light	1.2	45/15
		Heavy	1.2	20/40

And here is the LCD backlight and buzzer behavior for different value of TWL after doing measurement:

TWL	LCD Backlight	Buzzer
>140	Green	Off
115-140	Yellow	Off
<115	Red	On

If the measurement result shows “High Risk”, you can stop the buzzer beeping by following two actions:

1. Long press WORKLOAD button: The timer will start to countdown from 40/20/15 to zero.
2. Short press PAGE button: The buzzer will stop beeping for a while. There will be two other buzzer reminders per 30 seconds, each will beep for 8 seconds. The buzzer will completely stop after the second reminder.

If you do nothing when it is “High Risk”, the buzzer will keep beeping until device powers-off automatically (15 minutes).

Trouble Shooting

Please make sure the batteries are inserted correctly. If any error code were displayed in the LCD screen, please refer to the following error code table to find out the solutions.

Sensor	Error	Defect	Solution
DRY	E02	DRY is lower tha specified range	Leave the device in regular air for 30 min.
	E03	DRY is higher than specified range	Leave the device in regular air for 30 min.
	E31	Circuite AD defect	Send back for repair.
GLB	E02	GLB is lower than specified range	Leave the device in regular air for 30 min.
	E03	GLB is higher than specified range	Leave the device in regular air for 30 min.
	E31	Circuite AD defect	Send back for repair.
HUM	E04	DRY error causes the defect	Refer to DRY error code
	E11	Humidity calibration error	Calibration is needed.
	E33	Humidity circuite error	Send the instrument back for repair.
WET	E02	WET is lower than specified range	Leave the device in regular air for 30 min.
	E03	WET is higher than	Leave the device in regular air for 30 min.
	E04	specified range	Refer to DRY and HUM error code.
WND	E31	Caused by DRY/HUM error	Send back for repair.
WBGT	E02	Hardware defect	Leave the device in regular air for 30 min.
	E03	WBGT is lower than	Leave the device in regular air for 30 min.
	E04	specified range	Refer to DRY/HUM/GLB error code.
TWL	E02	WBGT is higher than specified range Caused by DRY/HUM/GLB error	Leave the device in regular air for 30 min.
	E03	TWL is lower than specified range TWL is higher than specified range	Leave the device in regular air for 30 min.
	E04	Caused by DRY/HUM/GLB/ WND error	Refer to DRY/HUM/GLB/WND error code.

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.

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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