

INSTRUCTION MANUAL

**No. 8312-00 Heat Stress Monitor
Model SK-170GT (JIS Conformed)**

SATO KEIRYOKI MFG.CO.,LTD.

Introduction

Thank you for purchasing the Heat Stress Monitor Model SK-170GT.

This product measures WBGT index*, air temperature, globe temperature, and humidity. Do not use it for other purposes.

* The WBGT (Wet Bulb Globe Temperature) index is a general heat stress index used in ISO 7243 *Hot environments - Estimation of the heat stress on working man, based on the WBGT index* and its application in Japan, JIS Z8504.

The WBGT index is often used in health and safety guidelines for workplaces and sporting situations.

Please read this manual thoroughly before using the instrument and keep the manual in a safe place for your future reference.



PRECAUTION

Make sure you fully understand the following facts about this instrument before use for proper usage.

- This instrument *does not* prevent heat stress.
- This instrument indicates WBGT index which can be used as guidelines for heat stress.
- Heat stress is caused not only by high temperature ambient, but also by one's health condition, one's adaptability to hot environment, etc.



WARNING



Never use this instrument in an atmosphere exposed to inflammable gases as it may explode.

* If there is anything you are not clear about this instrument, contact a dealer or us.



CAUTION

Please keep the followings for proper use of the instrument.

- Use this instrument in a normal atmosphere only.
- This instrument is not waterproof. Never let the instrument to get wet.
- Using the instrument out of its measuring range can cause malfunctions.
- Never directly touch the humidity sensor.
- If the instrument gets condensed with moisture, turn the power off immediately and let it dry naturally before using it again.
- If the instrument is used in an electrically noisy environment, the instrument could show unstable values and errors in accuracy.
- Never disassemble or alter the instrument to avoid any malfunctions and damages.
- This is a precision instrument. Be careful not to drop or give shocks to it.

- Do not wash or wipe this unit with alcohol, thinner, or any other solvents. If the instrument gets dirty, wipe it with a tightly wrung towel that has been dipped in warm detergent water.
- Remove the battery if the instrument is not in use for a long period of time. Otherwise, the battery power may be wasted and the battery fluid may leak, resulting malfunctions.
- Do not dispose the used battery into a fire.
- Keep battery out of reach of children. If swallowed, seek a medical attention immediately.
- Dispose the used battery according to your local rules and regulations.

Please contact a distributor or us for repairs or calibrations.

Overview

The SK-170GT is a portable heat stress monitor which can measure globe temperature, air temperature and relative humidity at the same time. From the measured values, this instrument can calculate the WBGT index which is used as a preventive measure for a heat stress and a guideline for proper working environment.

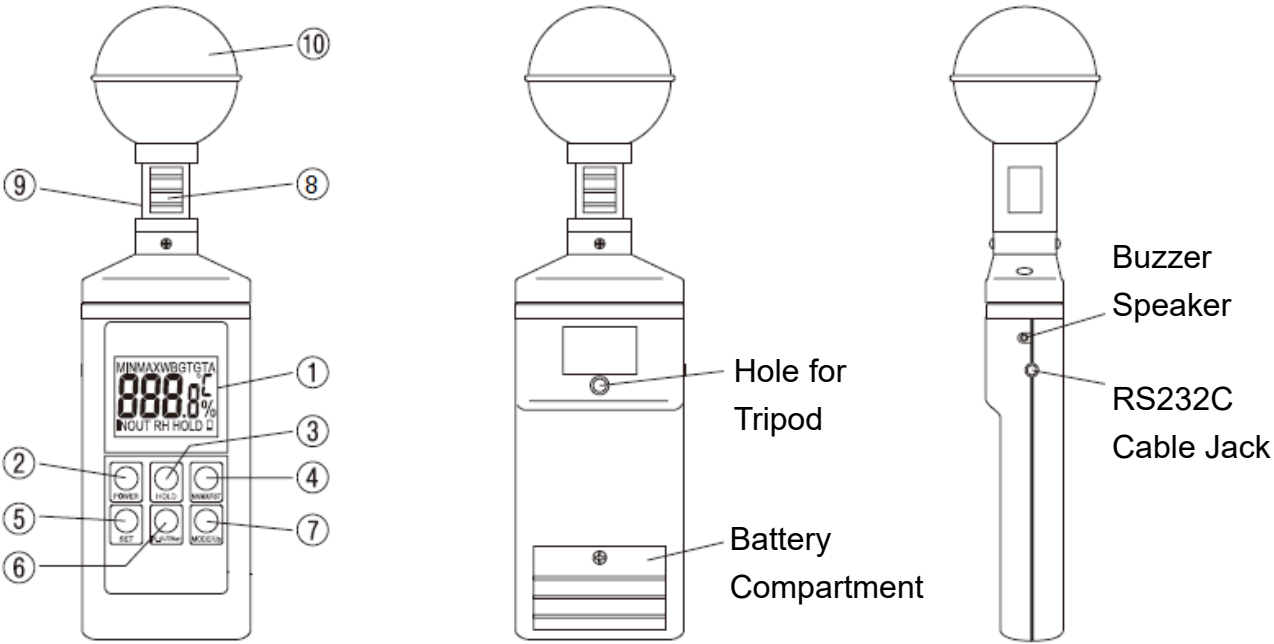
Features

- JIS B7922 class 2 compliant
Compliant with JIS B7922 class 2 (electronic Wet Bulb Globe Temperature (WBGT) index meter). It can be used as a guideline for preventing heat stress in sports activities, daily life, and labor.
- Globe equipped
The radiation heat (globe temperature) from direct sunlight can be measured.
- Displays WBGT index, air temperature, globe temperature, and humidity
A variety of application is available.
- Portable design
Useful for carrying.
- Fixable to a camera tripod
Has a screw hole to mount on a camera tripod for a stable measurement.
- Selectable from two types of WBGT measuring ambient, indoors or outdoors
The formula for calculating WBGT index differs when measured indoors and outdoors. This instrument has a function to switch between these two.
- Wind speed settable
The WBGT index and globe temperature depend on the ambient wind speed. This instrument has a function to input the wind speed so as to correct the shown values.
- Hold function
Enables easy reading.
- Minimum and maximum functions
Displays minimum and maximum values for safe monitoring.

- Alarm function
A buzzer sounds when the WBGT index reaches the limit set in advance.
- Auto power-off function
Shuts down automatically in 20 minutes to save the battery.
- Transmittable with RS232C
Optional RS232C cable is available to send data to a PC for real-time monitoring.

Names of Components

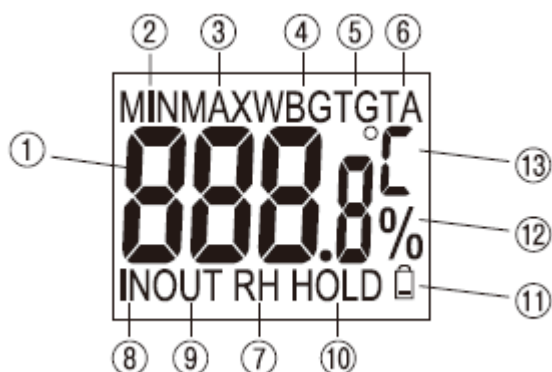
Main Unit



- | | |
|-------------------|--|
| ① Display Section | Measured values and state of the main unit are displayed.
* Refer to “LCD Display” for details |
| ② POWER | On/off key |
| ③ HOLD | Press this key to hold a measured value shown on the LCD. Press the key again to release it. |
| ④ MN/MX/RST | In measurement mode, press this key to display the minimum or maximum value. Press it for 2 seconds to reset the values. |
| ⑤ SET | Use this key to set the alarm or wind speed.
In WBGT mode, press it for 2 seconds to enter the alarm setting mode. In globe temperature mode, press the key for 2 seconds to set the wind speed. After changing them press the key again for 2 seconds to fix the value and return to measurement mode. |
| ⑥ IN_OUT/Next | Press this key for 2 seconds in WBGT mode to set WBGT measuring ambient to either indoor (IN) or outdoor (OUT).
In alarm setting mode, press it to change the focused place value to be edited.
In wind speed setting mode, press the key to decrease the value. |
| ⑦ MODE/Up | In measurement mode, press this key to switch between each mode of WBGT index (WBGT), air temperature (TA), globe temperature (TG), or humidity (RH).
In alarm setting mode or wind speed setting mode, press the key to increase the value. |

- | | |
|-----------------------------|--|
| ⑧ Sensing Section | Temperature and humidity sensors are inside of this section. |
| ⑨ Cover for Sensing Section | This cover protects sensors from dirt and stains. Turn it to open or close the sensing section.
Be sure to open the cover when measuring. Keep it closed when not in use. |
| ⑩ Globe | Inside the globe, there is a sensor to measure the radiation heat. |

LCD Display



- | | |
|---------------------|--|
| ① 7-segment Display | Displays WBGT index (WBGT), air temperature (TA), globe temperature (TG), or humidity (RH). Also, it displays the set value in alarm or wind speed setting mode. |
| ② MIN | Indication for minimum measured value |
| ③ MAX | Indication for maximum measured value |
| ④ WBGT | Indication for WBGT value |
| ⑤ TG | Indication for globe temperature value |
| ⑥ TA | Indication for air temperature value |
| ⑦ RH | Indication for humidity value |
| ⑧ IN | Indication for indoor values in WBGT mode |
| ⑨ OUT | Indication for outdoor values in WBGT mode |
| ⑩ HOLD | Indication of held data |
| ⑪ Low Battery Mark | Indication of low battery: Replace immediately when it blinks. |
| ⑫ % | Unit for humidity (%rh) |
| ⑬ °C | Unit for air temperature, globe temperature and WBGT |

Loading and Replacing Battery

- ① Use a positive screwdriver to loosen the screw on the battery compartment.
- ② Remove the old battery if replacing the battery.
- ③ Set a new 9VDC Battery 6F22 (006P) with correct polarity (+ and -) marked inside the battery compartment.
- ④ Close the battery cover and secure it with the screw.

Note: A configured alarm value, wind speed, and measuring ambient setting (IN or OUT) will not be reset even if a battery is removed.



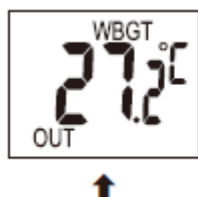
CAUTION

- Once the low battery mark starts to flash, replace with a new battery immediately.
- Under the low battery mark flashing, accurate measurement cannot be expected.
- Always use a new battery for replacement.

How to Measure

- ① Expose the sensing section by turning the cover.
- ② Turn on the power by pressing the POWER key.
- ③ Select a measurement mode by pressing the MODE/Up key. The display changes in the following order.

WBGT index (WBGT)



Humidity (RH)



Air temperature (TA)



Globe temperature (TG)



- ④ Have the instrument fully adapt to measuring ambient before measurement. Set the instrument far away from your body by holding the lower part of the unit, or use the instrument fixed onto a camera tripod, for accurate measurement.

The radiation heat may affect the environment of the sensing section and the main unit to result into inaccurate measurement when used for a long time outdoors with strong radiation heat. It is recommended to attach an external cover to protect the sensing section and the main unit except the globe from direct sunlight in such cases.

Note: Measuring conditions such as measurement height differ by purpose of use.

⑤ Press the POWER key to end the measurement.

Note: Always close the sensing section for storing.

Notice: If the LCD behaviors differently from the usual such as it blinks the measured value or switches the shown data, it is possible that the instrument is in maintenance mode. Turn off the power and reboot in such a case.

● **Setting of Measuring Ambient (IN or OUT)**

The way to calculate WBGT index differs due to its environment. Make sure to set the proper measuring ambient either IN or OUT according to the actual environment.

- ① Press the POWER key to turn on.
- ② Select the WBGT mode by pressing the MODE/Up key.
- ③ Press the IN_OUT/Next key for more than 2 seconds to select a measuring ambient.
 - IN: When measuring indoors, or outdoors without direct sunlight
 - OUT: When measuring outdoors with direct sunlight

● **Setting of Wind Speed**

The WBGT index and globe temperature depend on the ambient wind speed. This instrument enables correcting their values by assigning the wind speed to calculation. For a better measurement, set the ambient wind speed properly.

Note: This instrument *does not* measure wind speed.

- ① Press the POWER key to turn on.
- ② Select the globe temperature (TG) mode by pressing the MODE/Up key. This setting cannot be done in WBGT, air temperature, or humidity mode.
- ③ Press the SET key for more than 2 seconds to show a current wind speed as below.



Example: Wind speed 0.3 m/s

- ④ Change the wind speed. The figure increases when the MODE/Up key is pressed, and decreases when the IN_OUT/Next key is pressed.

Note: The wind speed must be between 0.1 m/s and 3.0 m/s.

- If there is no wind (0.0 m/s): Set the speed to 0.1 m/s.
- If the wind reaches 3.1 m/s or more: Set the speed to 3.0 m/s.

Tip: WBGT index tends to be affected by wind speed a lot when it is slow while the index is comparatively not relied on the wind when it is fast. Examples are given below.

- A difference between the WBGT indices when the wind speed is set as 0.1 m/s and 1.0 m/s: Around 0.4°C to 0.5°C
- A difference between the WBGT indices when the wind speed is set as 3.0°C and 4.0 m/s: Less than 0.1°C

(Where the air temperature 30.0°C, globe temp. 40.0°C, humidity 70.0%rh)

⑤ Press the SET key for more than 2 seconds to fix the value and return to measurement mode.

Note: The previously set value of wind speed will be resumed when the instrument is powered off without determining the set value.

Estimating wind speeds with visual clues

Wind speed	Visual clues
Less than 0.4 m/s (1 mph)	Calm wind. Smoke rises vertically with little if any drift.
0.4 – 1.3 m/s (1 – 3 mph)	Direction of wind shown by smoke drift, not by wind vanes. Wind barely moves tree leaves.
1.8 – 3.1 m/s (4 – 7 mph)	Wind felt on face. Leaves rustle and small twigs move. Wind vanes move.
3.6 – 5.4 m/s (8 – 12 mph)	Leaves and small twigs in constant motion. Wind blows up dry leaves from the ground. Flags are extended out.
5.8 – 8.0 m/s (13 – 18 mph)	Wind moves small branches. Wind raises dust and loose paper from the ground and drives them along.

Abstracted from the reports from National Weather Service, U.S. Dept. of Commerce
<https://www.weather.gov/pqr/wind>

 CAUTION

- Never use the instrument out of its operating ambient or measuring range.
- Abrupt change of ambient temperature can affect the measurement accuracy. Have the instrument fully adapt to measuring ambient without condensing before use.
- Handle the globe with great care. Damages on the globe or its finishing can influence the measurement accuracy.

Hold Function

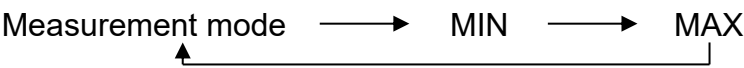
When measurement values are unstable, hold function is effective for easy reading.

- ① Press the HOLD key in the measurement mode.
HOLD indicator is lit and the measured value will be held.
- ② Press the HOLD key again to release the function.
HOLD indicator is turned off and the function will be released.

Maximum and Minimum Functions

Maximum (MAX) and minimum (MIN) measurement values can be displayed while taking measurement.

- ① Press the MN/MX/RST key in the measurement mode. The display changes cyclically.



- ② Press the MN/MX/RST key for more than 2 seconds to reset the MIN/MAX values. They can be also cleared by turning the power off.

Note: The MIN/MAX values are constantly updated in all modes, except when the hold function is activated.

Alarm Function

The alarm is triggered with sound of buzzer when the WBGT index exceeds the set value. Note that this alarm cannot be set for air temperature, globe temperature, or humidity.

Note: This instrument is automatically turned off if it is not in operation for 20 minutes. In case of using it for more than 20 minutes, release the auto power-off function.

* Refer to “Auto Power-Off Function” for details.

Note: The buzzer does not work when MIN/MAX values are displayed.

● How to Set Alarm Function

- ① Press the MODE/Up key to switch to the WBGT mode.
- ② Press the SET key for more than 2 seconds to start the alarm setting mode.
- ③ Press the MODE/Up key to increase the value of the blinking digit.
Press the IN_OUT/Next key to change the digit to be edited.

Note: Set the alarm within the range of 20.0 to 49.9°C.

It is not possible to disable the alarm function.

- ④ Press the SET key for longer than 2 seconds to confirm the setting.

Notice: If you turn the power off before confirming the alarm setting, the instrument recalls the last fixed value for the alarm.

Auto Power-Off Function

If the instrument is not in use for more than 20 minutes, the power is automatically turned off for power saving purpose.

- **How to Release Auto Power-Off Function**

- ① When the instrument is turned off, press the POWER and HOLD keys simultaneously.
- ② Release the buttons once the power turns on and “n” is shown on the LCD. The “n” mark disappears and the measurement mode starts, meaning the auto power-off function is successfully released.

Note: The release setting is no longer effective once the power is turned off. Do the same procedure whenever the auto power-off function is not needed.

Real-Time Communication

The SK-170GT outputs measured data with RS232C signals in real time under the measurement mode. An optional RS232C cable enables to download the measured data (WBGT, air temperature, globe temperature, and humidity) to a PC for saving and analyzing.

Note: There is no communication or analysis software exclusively made for this product. Provide software by yourself when needed.

- **How to Connect**

- ① Plug the RS232C cable into the connection jack on the right side of the unit.
- ② Connect the 9-pin connector of the cable to the serial port of your computer.
- ③ Turn the power on to activate the measurement mode. The data will be transmitted to the computer in real time.

- **Requirements for Communication on a PC**

Transmission speed: 9600 bps

Transmission data length: 8 bits

Stop bit: 1 bit

Parity check: None

- **Example of Communication Protocol**

W28.6C: T29.6C: T31.2C: H83.2%f1

Where the WBGT 28.6°C, air temperature (TA) 29.6°C, globe temperature (TG) 31.2°C, and humidity (RH) 83.2%rh

* The last two characters are a checksum which depends on measured data.

Note: WBGT and globe temperature data are calculated based on the measuring ambient setting (IN or OUT) and the wind speed. Make sure you have configured the correct ambient either IN or OUT and the wind speed before connecting to your computer.

Reference

The Wet Bulb Globe Temperature (WBGT) is a composite temperature used to estimate the effect of temperature, humidity and solar radiation (globe temperature) on humans. It is used by industrial hygienist, athletes and the military to determine appropriate exposure levels to high temperatures. It is derived from the following formulas.

$WBGT\ (Indoors) = 0.7\ WB + 0.3\ TG$

$WBGT\ (Outdoors) = 0.7\ WB + 0.2\ TG + 0.1\ DB$

Where WB = wet bulb temperature, TG = globe temperature, DB = dry bulb temperature.

Error Displays

If there is a malfunction detected, one of the following error codes will be displayed.

Mode	Code	Description	Solution
WBGT	E04	The globe is missing.	Attach the globe to the main unit properly.
		One of the measured values other than WBGT is over or under the display range.	Use within the measuring range.
		E33 is displayed in the other measurement mode.	Refer to the solution for E33.
TA TG	E02	The measured value is under the display range.	Use within the measuring range.
		The globe is missing. (In globe temperature (TG) mode)	Attach the globe to the main unit properly.
	E03	The measured value is over the display range.	Use within the measuring range.
RH	E04	Air temperature (TA) is over or under the display range.	Use within the measuring range.
	99.9%	The measured value is over the display range.	Use within the measuring range.
TA TG RH	E33	The internal electrical circuit is malfunctioning.	Stop using the product and contact a dealer of your purchase or us for further assistance.
	Other		

Troubleshooting

Trouble	Possible cause	Solution
The power cannot be turned on.	The battery is exhausted.	Replace with a new battery.
The buzzer sounds.	WBGT exceeds the set alarm value.	Refer to “Alarm Function.”
	An error code is displayed in one of the measurement modes.	Refer to “Error Displays.”
The displayed value is not stable, or an Abnormal value is displayed.	The instrument does not adapt in the ambient.	Let the instrument adapt to the ambient before use.
	Electric noises generated from the environment affects the state.	Do not use the unit in the circumstances where electric noises are generated.
A value around 0.0°C blinks in TG mode.	The instrument is in maintenance mode.	Press the POWER key to turn off, then press it again to reboot. If an irregular value is still shown after doing such, stop using the product and contact a dealer of your purchase or us.
A value of 30.0% blinks or is constantly shown in RH mode.		
Values in TA, TG, RH modes are shown cyclically.		
If the above-mentioned solutions do not work, contact a dealer of your purchase or us for further assistance.		

Specifications

Catalog No.:	No. 8312-00		
Model:	SK-170GT		
Measuring Range:	WBGT Index:	0.0 to 50.0°C	
	Air Temperature:	0.0 to 50.0°C	
	Globe Temperature:	0.0 to 80.0°C	
	(Converted to temperature of a globe with a diameter of 150 mm)		
	Humidity:	10.0 to 95.0%rh	
Accuracy:	WBGT Index:	±2.0°C	
	Air Temperature:	±0.6°C	
	Globe Temperature:	±1.2°C (20.0 to 60.0°C)	
	±2.0°C (other than above)		
	Humidity:	±3.0%rh (30.0 to 90.0%, 20 to 40°C)	
±5.0%rh (other than above)			
Resolution:	WBGT, Air Temperature, Globe Temperature:	0.1°C	
	Humidity:	0.1%rh	
Sampling Time:	Approx. 2 seconds		
Sensing Material:	Air Temperature, Globe Temperature:	Thermistor	
	Humidity:	Electrostatic capacitance sensor	
WBGT Alarm Setting Range:	20.0 to 49.9°C (0.1°C step, no deactivation)		
Wind Speed Setting Range:	0.1 to 3.0 m/s (0.1 m/s step)		
Conformed Standard:	JIS B7922 Class 2		
	< Approved measuring range within Class 2>		
	WBGT Index:	15.0 to 45.0°C	
	Air Temperature:	20.0 to 40.0°C	
	Globe Temperature:	20.0 to 60.0°C	
	Humidity:	30.0 to 90.0%rh	
	Wind Speed:	0.3 to 3.0 m/s	
Operating Ambient:	0 to 50°C, less than 95%rh without condensation		
Storage Ambient:	-10 to 50°C without condensation		
Power Requirement:	9VDC Battery 6FF22 (006P) × 1		
Battery Life:	Approx. 600 hr. in continuous use without activating alarm function		
Materials:	Main Unit:	ABS resin	
	Globe:	Copper	
Dimensions:	Main Unit:	(W) 71 × (H) 275 × (D) 30 mm (without globe)	
	Globe:	Diameter of 60 mm	
Weight:	Approx. 240 g (including battery)		
Standard Accessories:	9VDC battery 6FF22 (006P) × 1, Hard case × 1		

Optional Accessories

No. 7687-90	RS232C cable 1.5 m (Model PH33)
No. 8310-10	Spare globe (Model GTS-01)
No. 8310-20	Shield plate from radiant
No. 8310-90	Tripod (Model ZF-400WSH)

Warranty Policy

Our products are warranted to be free from defects in materials and workmanship for a period of one year from the date of shipment. If repair or adjustment is necessary and has not been the result of abuse or misuse within the one-year-period, please return the units on freight prepaid basis and correction of the defect will be made without charges. We alone will determine if the product problem is due to deviations or customer misuse.

Out-of-warranty products will be repaired on charge basis.

Warranty during transportation

The warranty during transportation only applies to the products that we arrange the shipment. The case that the products had been purchased in domestic and were sent to overseas by the purchaser is out of warranty.

Return of items

Authorization must be obtained from us before returning items for any reason. When applying for authorization, please include data regarding the reasons the items are to be returned.

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<https://www.sksato.co.jp/en/>