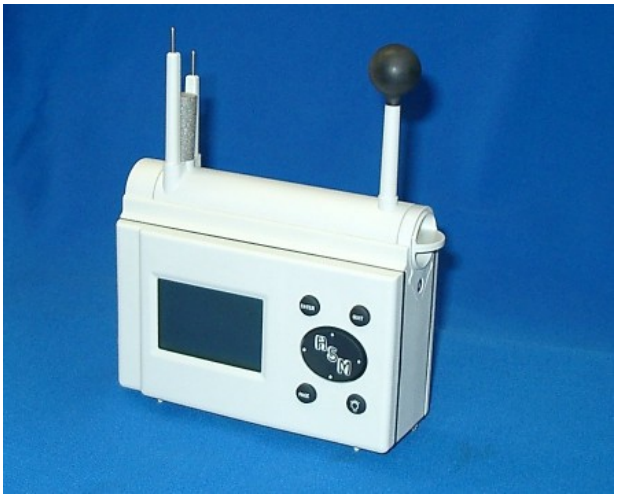
CALOR ENVIRONMENTAL INSTRUMENTS

Heat Stress Monitor



Accurate monitoring of human heat stress in the workplace and on the sports field, can reduce costs, improve performance and contribute to improved health and safety. Use either ISO 7243 WBGT or TWL.

The risk of working in a hot environment

Heat stress causes discomfort and reduced productivity and can lead to more serious health effects such as accidents, illness and even death. Prolonged exposure to high temperatures alone can lead to excessive fluid loss, shock, or heat stroke. High humidity confounds the effects of temperature by reducing the cooling effects of sweating. Extended and strenuous exercise, or labour that increases the heat produced by muscles, also contributes to the risk of illness in the form of cramps, exhaustion, or heat stroke. Internal body temperatures, normally 37°C, are considered hazardous between 39-41°C. Death is likely to occur at 42°C and above.

Beating the heat requires monitoring the full range of stress-inducing parameters. Not just the obvious ones, such as ambient temperature, radiant heat and humidity, but also such contributing factors as air flow, clothing, physical exertion, and in some instances barometric pressure.

Historically, predicting heat stress has required two actions: first, to place multiple sensing instruments needed to assess heat stress; then, to integrate the combined data and arrive at a work/stop-work decision. This approach is both cumbersome time-consuming, and prone to operator error.

We have solved the problem by transforming a "weather station" into a miniature handheld package, rugged enough to be used in the field and simple enough to be operated without specialised training. The resulting heat stress/strain monitor provides both the measurements and the computed guidelines to increase safety and maximise productivity.

Application of the HSM

The miniature heat stress monitor (HSM*) has potential applications in military training exercises and combat, as well as mining, foundries, agriculture, offshore oil operations, endurance sports, office environments and many other industrial settings. In fact any activity where accurate and rapid prediction of heat strain may be critical in preventing immediate distress or long-term damage to the human body. The pocket-sized meter can also be used by engineers and architects to measure airflow and other parameters in partitioned offices where thermal stress rather than strain is the priority. In addition Health inspectors can assess food outlets for compliance with local health regulations.

The HSM allows viewing of environmental data in real-time for monitoring purposes. Data are collected for 2 mins, averaged, and updated once per second. There is also a capability to perform unattended logging of data. The user interface is sufficiently flexible to be adapted for alternative applications, and additional sensor modules can be developed for measuring other environmental parameters.

What does the HSM measure?

The environmental parameters typically measured to identify heat stress are the dry bulb, wet bulb, and black globe temperatures. From these three readings the wet bulb globe temperature (WBGT) index is calculated. The **ISO 7243 WBGT** is currently used as an industry standard for assessing the level of heat stress within a given environment.

In addition to these parameters the HSM also measures wind speed, which significantly affects evaporative cooling, and barometric pressure. The data are combined with user inputs of clothing type and work level. The degree of acclimatisation status in a specific group under surveillance can also be factored. All data are then combined using algorithms derived from original field and laboratory studies. The output of the model provides specific guidance on selected features such as optimal work/rest cycles, the maximum safe duration of a workshift, and hourly water requirements to replace sweat loss.

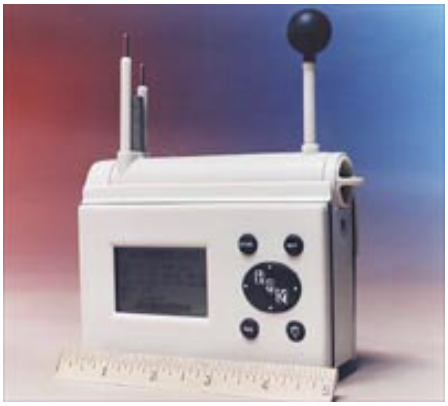
In a mining environment one of the few variables that can be adjusted to reduce thermal strain to workers is air velocity. There is an existing strain index that incorporates wind speed in its computation however in the past it has not been extensively used, as no single instrument has been able to simultaneously measure all the needed parameters. The HSM is able to perform this task and has been programmed with an updated version of the "air cooling power". The revised and altered formulation has been named the Thermal Work Limit algorithm.

The fourth use for the HSM is a stand-alone weather station. The sensor suite is the most complete yet produced (DB, WB, RH, wind speed, radiant heat and barometric pressure) and provides sensor combinations for all commonly used indices.

The HSM features:

- Removable environmental data sensor system that can be automatically deployed and stowed without difficulty.
- A liquid crystal display (LCD) with low power consumption and good contrast in sunlight as well as indoor lighting. A backlight is provided for use in very low light conditions.
- Real-time data logging with the capability of downloading to a personal computer; and a flash memory for field-upgradeable software.
- The instrument is approximately 384 cubic cm's and weighs 370gms (with batteries).
- Uses four standard AA-sized, 1.5V, alkaline batteries.
- When not in use the sensors are located in a module that extends from the body of the instrument when measurements are being taken, and rotates and stows away into the rear of the device for storage and compact packaging. The design allows the module to be deployed without danger of contamination and reduces the risk of breakage. The entire module can be removed for replacement, repair or calibration should it be required.
- The HSM is equipped with thermistor-based sensors to measure air temperature, wind speed, and solar radiation, a capacitive polymer-based sensor to measure humidity, and a piezoresistive absolute pressure sensor for measuring barometric pressure and estimating altitude.
- All calibration data and signal conditioning electronics are contained in the sensor module. A digital serial interface is used to perform data acquisition and control.
- The 119x73 pixel graphics LCD has sufficient resolution to display all the required environmental parameters without excessive paging.
- A black globe is used to measure radiant heat. It is constructed of a single piece of copper with a wall thickness of only 0.15mm. This allows for a fast response time, providing accurate measurement within two minutes.
- All environmental data used to calculate a single heat strain measurement may be displayed in real time. The instrument also performs unattended data logging with time stamping using an onboard clock with an alarm that wakes up the system to take a measurement.
- Data logging results can be viewed onscreen or downloaded to a desktop computer for analysis.
- The instrument can be tripod mounted for specific placement when in data logging mode.

Sensor specifications



Dry bulb = ± 0.2 C from 5 - 55 °C

Globe = ± 0.2 C from 5 - 70 °C

RH = ± 2% from 0 - 95% non condensing

Wind speed = ± 0.2 m/sec or 10%, whichever is the greater, from 0.1-8.0 m/sec

Pressure = ± 1.5 KPA from 40-115 KPA

The instrument comes in a carry case and can be supplied with software, tripods and accessories for data logging and downloading.

Customers

The following are some of the companies utilising the HSM in their employee Occupational Health and Safety programs.

WMC, Olympic Dam
Newcrest Mining
Western Metals
Mt Isa Mines
Beaconsfield
Anglo Coal
Roseberry
Newmont
Pasminco
Patrick
US Army

Calor Instruments Pty Ltd
37 Collingwood St,
Osborne Park, 6017
Perth, Western Australia

Ph. 61 (0)8 9244 3011
Fax 61 (0)8 9244 2649
Email: sales@calor.com.au
Web: www.calor.com.au

ABN 43 101 705 524