

WBGT vs PHS: methods compared for assessing heat stress in the workplace



The LSI LASTEM technical pills



WBGT vs PHS:

Methods Compared
for the Assessment
of Heat Stress



Climate change and the increase in global temperatures are making the monitoring of **heat stress in workplaces** increasingly urgent, especially in industrial environments, construction sites, and non-air-conditioned indoor spaces. Prolonged exposure to critical climate conditions can compromise **workers' health**, reduce productivity and increase the risk of accidents and heat stroke.

In this context, the **WBGT (Wet Bulb Globe Temperature)** and **PHS (Predicted Heat Strain)** methods represent two fundamental approaches to assess and prevent hazardous situations.

WBGT and PHS: Two approaches to the same goal

Both indices are recognized by international standards (ISO 7243 for WBGT and ISO 7933 for PHS) as methods for estimating **occupational heat risk**. However, they present substantial differences in terms of complexity, accuracy and scope of application.

- **WBGT** is a rapid, simple and intuitive method, ideal for **preliminary investigations**;
- **PHS** is an advanced analytical method, more suitable for in-depth analyses in **severe and complex environments**.

Using them in combination is the most effective strategy **for a complete assessment**: WBGT can serve as a first filter to identify critical situations,

while PHS can come into play for the detailed analysis of the most at-risk conditions.

How WBGT and PHS indices are calculated

1) WBGT – simplicity and immediacy

The calculation of the WBGT index is based on three fundamental environmental quantities:

- **Black globe temperature (Tg);**
- **Wet bulb temperature (Tnw);**
- **Air temperature (Ta).**

Depending on the presence or absence of direct solar radiation, different formulas are used:

- **WBGT outdoor:** $0.7 \times T_{nw} + 0.2 \times T_g + 0.1 \times T_a$
- **WBGT indoor** (or without sun exposure): $0.7 \times T_{nw} + 0.3 \times T_g$

The **WBGT index** is expressed in degrees Celsius (°C) and provides an immediate indication of the level of risk. It is possible to customize the result with **clothing** values (**CAV**) and **metabolic rate**, thus obtaining the **actual WBGT** and the **reference WBGT** for acclimatized or non-acclimatized subjects.

2) PHS – Advanced Heat Balance Analysis

The PHS method provides a more detailed **thermo-physiological model** and requires both environmental and individual parameters:

- Air temperature (Ta);
- Relative humidity;
- Air speed;
- Average radiant temperature;
- **Activity performed;**
- **Clothing insulation;**
- **Worker weight and height.**

The PHS calculates, among other things, the temporal evolution of:

- **Core body temperature;**
- **Fluid loss due to sweating;**
- **Maximum safe exposure duration (Dlim).**

This makes it an irreplaceable tool for designing **breaks**, **staff rotation**, **hydration** and other prevention strategies.

Advantages and limitations of the WBGT index

The **WBGT** index is a widely used tool for a **preliminary assessment of heat stress risk**. Its main strength is its **simplicity of application**: it requires a limited set of environmental data and returns a result expressed in °C, easily interpretable even by non-specialized personnel. The calculation is rapid and allows for the rapid identification of **potentially dangerous situations**. Furthermore, it offers useful indications for **immediate environmental interventions**, such as shielding direct heat sources.

However, the method has **limitations**, especially in complex or high-risk contexts. The WBGT is based on a **general estimate of the heat balance** and uses a standard value for clothing insulation (0.6 Clo), with the possibility of adaptations for specific technical garments. It does not consider **individual physiological variables** such as weight and height. For this reason, it is often advisable to use it as a first screening tool, to be integrated with more in-depth methods, such as the PHS, if the detected values exceed the reference thresholds.

Advantages and limitations of the PHS index

The **PHS** method is the most detailed and reliable tool for **risk assessment in hot and severe thermal environments**. It is based on an in-depth analysis of the **individual's thermal balance**, allowing for the monitoring of key variables for risk assessment over time, such as total fluid loss and core body temperature. This allows for the limitation of internal temperature increases by introducing **exposure time limits**. In addition, the method takes into account the **specific insulation of clothing** and some individual characteristics, such as weight and height, providing precise indications for optimising the organisation of the working day and limiting exposure times, also providing **strategic breaks**.

However, the PHS method is more complex, requiring a **greater commitment** in terms of time for **data collection**, **analysis** and **synthesis**. Furthermore, it does not provide immediate or simple indications on how to intervene to shield or reduce the heat source.

The synergy of the two methods in practice with LSI LASTEM

The **combined** application of **WBGT** and **PHS**, as also suggested by ISO standards, represents the **best practice** for **managing thermal stress risk**.

Thanks to solutions such as the **Heat Shield system**, **portable microclimatic stations** ([data sheet](#)) and **ISTSA stations** by LSI LASTEM, companies can monitor both indices in real time, manage alarms, send data via SCADA or use dedicated software for analysis and reporting (such as [GIDAS-TEA](#)) and **prevent critical situations before they become dangerous**.

Choosing the right tool to protect workers

In the current scenario, where **record temperatures** are increasingly frequent, it is essential to equip oneself with reliable and versatile technological tools. The integrated use of WBGT and PHS indices, supported by advanced **environmental monitoring** systems, allows to safeguard the health of workers, optimize shifts and prevent the effects of extreme heat.