

Why Air Temperature Alone Isn't Enough to Assess Heat Stress



The LSI LASTEM technical pills

Heat Stress: Beyond Air Temperature



During summer, it's increasingly common to hear about days that are “too hot to work”—especially for people working outdoors. In these situations, attention often focuses on thresholds and limits based on exceeding certain air temperature values.

However, it's important to clarify a key concept: air temperature alone does not fully describe the level of thermal discomfort or risk for a person.

Comfort (and in critical cases, heat stress) depends on the thermal balance between the human body and the surrounding environment, which is influenced by many variables beyond simple Degrees. For this reason, instead of reasoning only in terms of air temperature, it is more accurate to evaluate heat stress using microclimatic indices, based on the heat balance between the human body and the environment.

Indices such as Wet Bulb Globe Temperature (WBGT – ISO 7243), Predicted Heat Strain (PHS – ISO 7933), Universal Thermal Climate Index (UTCI), Predicted Mean Vote/Predicted Percentage of Dissatisfied (PMV/PPD – ISO 7730), and Required Clothing Insulation (IREQ – ISO 11079) provide a more realistic estimate of how people are exposed to their surrounding environment, because they consider both the body's thermo-physiological response and the overall climatic conditions during the activity.

Why Temperature “Doesn’t Tell the Whole Story” and Why Microclimatic Indices Are Necessary

Two days with the same air temperature can feel completely different:

- 32°C with high humidity → sweat evaporates poorly → the body cools down less effectively → heat stress increases.
- 32°C with dry air and wind → evaporation is more effective → heat dissipation improves → lower risk.

Similarly, working in direct sunlight or in the shade drastically changes the situation: solar radiation can significantly increase both perceived and actual heat load.

A More Accurate Physical and Physiological Representation

Air temperature is an important environmental variable—but it is only part of the picture. Heat-balance-based indices describe the energy exchange between the human body and the environment, taking into account:

- air temperature
- relative humidity (sweat evaporation)
- air speed (convection and ventilation)
- mean radiant temperature (sun exposure and hot surfaces)
- individual metabolism (work intensity)
- clothing insulation

The advantage is clear: assessment becomes more realistic, reflecting how the body can (or cannot) dissipate heat under real operating conditions.

Better Prediction of Health Risk

By combining environmental and personal variables, these indices make it possible to estimate critical aspects such as:

- increase in core body temperature
- dehydration
- cardiovascular strain
- risk of heat stroke (or, in winter/cold environments, hypothermia)

This information is essential because it allows us to move from “it’s hot” to “this situation may become dangerous.”

Operational Use in Safety and Regulatory Contexts

Many professional settings require structured and practical approaches, for example:

- occupational health and safety
- indoor and outdoor environment design
- planning shifts, breaks, and workload
- managing climate-related emergencies

In these cases, relying only on air temperature may lead to underestimating critical scenarios or, conversely, overestimating situations that are less risky.

A More Personalized Assessment

Microclimatic indices allow the evaluation to be adapted to the real context, considering:

- type of activity (sedentary, moderate, intense)
- clothing characteristics or PPE
- prolonged or intermittent exposure

Air temperature, on the other hand, provides a “one-size-fits-all” indicator that does not capture relevant operational differences.

Better Representation of Climate Change Scenarios

In recent years, with:

- more frequent and persistent heatwaves
- higher humidity and the “tropicalization” of temperate climates
- intense solar radiation

air temperature becomes an increasingly poor indicator of actual heat stress. For this reason, in many analyses focused on the impact of climate on health, work, and urban planning, the Universal Thermal Climate Index

(UTCI) is often considered particularly suitable, because it offers a more complete view of the combined effects of environmental variables.

Real-World Examples: What Changes in Practice

Here are typical situations where air temperature alone can be misleading:

1) Road construction site at midday

- air temperature may be “only” 30–32°C
- but direct sun exposure and hot asphalt increase mean radiant temperature

Actual heat stress can be significantly higher than what air temperature alone suggests.

2) Intense physical activity with PPE or technical clothing

- workers wearing thick clothing, gloves, or protective gear dissipate heat more slowly
- even with moderate temperatures, heat storage can rise quickly

Indices such as PHS (ISO 7933) are useful because they consider metabolism and clothing insulation, including the role of rest breaks for recovery.

3) Logistics or material handling in a semi-enclosed area

- air temperature may not be extremely high, but poor ventilation reduces heat dissipation
- humidity may increase, making sweating less effective

A microclimatic index may indicate heat stress even when temperature does not appear “extreme.”

4) Two summer days with the same temperature but different humidity

- 32°C with high humidity: higher risk
- 32°C with low humidity and wind: lower risk

This is a classic example of why air temperature alone is not enough.

What to Monitor in Practice (Useful Parameters and Measurements)

To correctly calculate heat stress indices and obtain a reliable assessment, it is helpful to monitor a set of microclimatic parameters beyond air temperature.

Key environmental parameters:

- air temperature (°C)
- relative humidity (%)
- air speed (m/s)
- mean radiant temperature (°C)
- solar radiation (W/m²)

These variables are the basis for describing the real environment a person is exposed to.

Why radiation monitoring matters: in outdoor conditions, solar radiation can be one of the main drivers of heat stress. Two locations with the same air temperature can be very different if one is in the shade and the other is under direct sunlight.

Work- and person-related parameters (when needed)

- metabolism / work intensity (sedentary, moderate, intense)
- clothing insulation and PPE
- exposure duration and recovery opportunities (breaks, shade, hydration)

Conclusion

Monitoring heat stress through heat-balance-based indices enables a scientific, more realistic, prevention-oriented assessment.

Air temperature remains an important parameter, but on its own it is insufficient and can be misleading when humidity, wind, solar radiation, physical workload, and clothing come into play.

To truly protect people—especially in occupational and outdoor environments—it is advisable to adopt an approach based on microclimatic indices.