

HEAT STRESS: A COMPARISON OF SOME ESTIMATION METHODS

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INTRODUCTION

Generally, to study a severe thermal environment, analytical methods are used. We have compared four methods: the method adopted by the ISO standard 7933 /1/, the method based on the WBGT index /2,3/ and two methods that we have proposed /4,5/, modifying classic MBI and ITS indices (that have become MBI\* and ITS\*) by the most recent equations for the evaluation of heat and mass transfer between human body and environment.

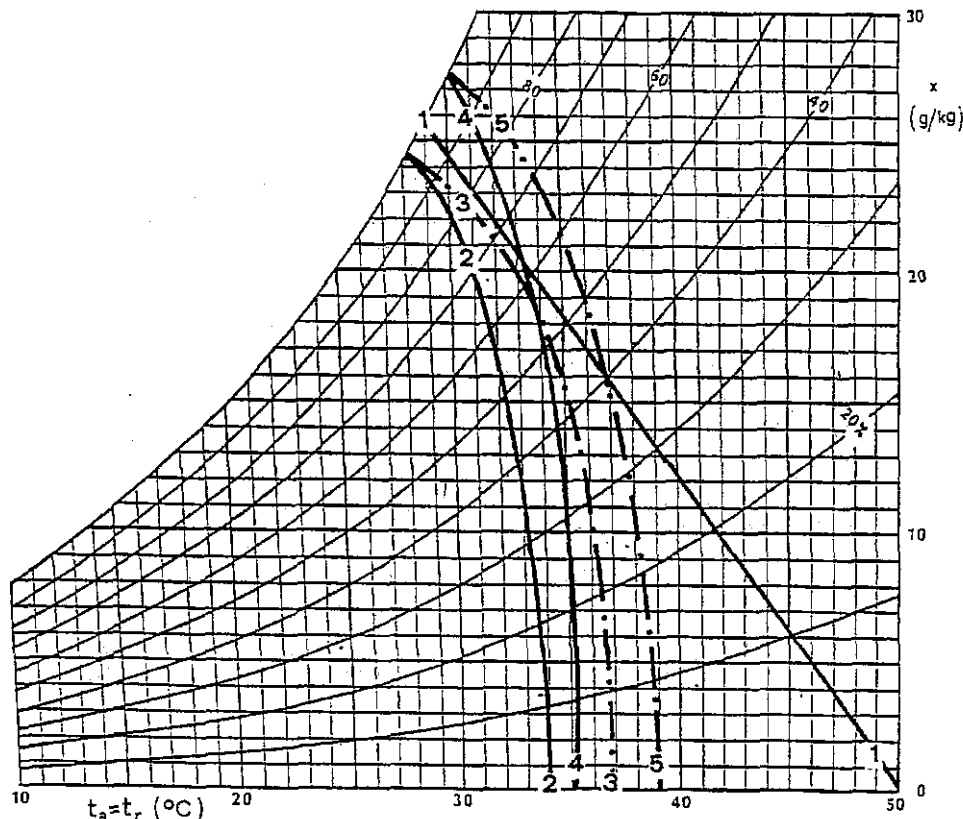
In this minipaper the most interesting obtained results are reported.

METHOD

We have prepared a computer program that gives limit conditions, for the mentioned methods, corresponding to a desired duration of the work period and to a fixed set of the independent parameters.

RESULTS and CONCLUSIONS

In Figure a psychrometric chart is shown with an example of lines representing limit conditions for a work period of eight hours.



Psychrometric diagram with lines representing limit conditions for a work period of eight hours. Line 1: WBGT = 89°C - Line 2: DLE = 480 min,  $i_p = 0.50$ , danger criterion - Line 3: DLE = 480 min,  $i_p = 0.50$ , danger criterion - Line 4: DLE = 480 min,  $i_p = 0.45$ , danger criterion - Line 5: DLE = 480 min,  $i_p = 0.45$ , danger criterion.

for a work period of eight hours. The diagram is relative to particular values of metabolic energy,  $M$ , air velocity,  $v_a$ , clothing thermal resistance,  $I_{cl}$ , and clothing vapor permeation efficiency ratio,  $i_p$ , /6,7/, to an uniform environment (air temperature equal to mean radiant temperature) and to non-acclimatized subjects.

The diagram shows two interesting results:

- it is necessary to introduce the clothing vapor permeability in the estimation of thermal stress and, therefore, to increase available data, particularly for special protective clothings /8/;
- the method based on WBGT index is not a safety method, as generally used and as explicitly written in the ISO standard 7243 /9/ (introduction, 5th paragraph).

A third result, not shown for the paper brevity, is that results obtained by methods based on WBGT and ITS indices are quite similar to those obtained by the ISO standard 7932. This result is interesting as thermal environment evaluation is easier by these methods than by ISO standard 7933.

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