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Development and Evaluation of Standards Governina Human - Exposure to Hot Environments Abstracts 62-65

62 Standards for human exposure to heat

R.F. Goldman. Multi-Tech Corporation, Natick. Massachusetts, USA

Heat stress does not begin at any specific combination of temperature/humidity; it has occurred at temperatures near –5°C. It results from a mismatch between six factors:

1) the worker's heat production (usually a key factor)
2) a humidity (or more precisely, ambient vapor pressure) too high to allow sufficient sweat evaporation for the required cooling (E_{req})
3) radiant heat, in effect adding up to PC to the air temperature in direct sun, more in steel mills, etc.
4) clothing which limits the maximum obtainable sweat evaporative cooling (E_{max}), almost invariably the case for any type of protective clothing even if its moisture permeability is normal ($i_m \simeq 0.5$) as its insulation (clo) increases the sweat evaporative path thus limiting a key E_{max} parameter (i_m/clo)
5) low air motion which contributes even more insulation **(~0.8** clo) than the intrinsic 0.6 clo insulation provided by a typical, long-sleeved shirt and trousers
6) the air temperature, seldom the problem in heat stress.

A variety of indices (ET, CET, P4SR, WGT, WBGT), combining two or more of these six factors into a single number, simplify dealing with so many factors by providing a guideline. albeit imprecise, but no index considers all six factors. If more than GEGU (Good Enough for Government Use) guidance is required, modeling can adequately handle all six factors simultaneously and predict comfort vote, heart rate, sweat production and skin and deep body temperatures, while also handling the variables of worker:

1) acclimatization to heat (equivalent to reducing the heat stress by about 2°C), and
2) dehydration (which simply, albeit dramatically **i**ncreases the rate at which the
Five levels of Standards can be established, but the last three are applicable only for Select, fit, young workers:

I) no risk and little or no discomfort
II) some discomfort, but little or no performance decrement
III) risk of some decrement but little or no exposure limit
IV) low risk with exposure times limited (15' to >4 hrs)
V) significant risk even if exposure times are limited

Generically these five levels equate roughly to physical, physiological and/or psychological DEMANDS upon the workers' corresponding CAPACITIES of <20% (Level I), 20 to 40%, 40 to ***60%.*** 60 to 80% or **>80%** (Level. V) of their maximum bpm heart rate increase [(220-age) – resting], sweat production (~1 L/hr),core temperature rise 41-37°), dehydration (~10%), comfort vote (~9), skin wetness (100%), VO_{2max}, RPE [(0 to 15) +6], etc.