The review will consider the usefulness of the technique to the designer of work wear and protective clothing and its potential for improving the thermal comfort of clothing. Finally, the potential of the trace gas technique, with its speed and sensitivity, to provide the basis of a garment performance standard for work wear and protective clothing will be considered.

12 Description and evaluation of equipment for protection from hot environments: An overview

S.A. Nunneley, USAF School of Aerospace Medicine, San Antonio, Texas USA

Heat stress arises from some combination of environment, work rate and clothing - the latter often required for protection from nonthermal hazards. Equipment to alleviate unacceptable heat stress can take various forms, which may be divided into two basic types: 1) Passive - primarily useful where external heat load predominates; examples are thin clothing to prevent insulation while allowing airflow, reflective and/or insulating layers to exclude extreme environmental heat, and a wetable external cover to cool the outer surface of clothing; 2) Active - the microclimate is controlled by means of ventilated or liquid-cooled clothing. Air systems may use ambient, dehumidified or cooled air; problems include providing the necessary volume of air and distributing it within the clothing. Liquid conditioning has several engineering advantages and can provide much stronger cooling. Either type of microclimate control requires an external heat sink whose action may be used continuously (man-mounting or tethering) or intermittently (tethering only during rest breaks). Optimal selection of thermal protective equipment requires analysis of the causes of the problem, determination of possible cooling options, and selection of the best alternative for the particular setting. This evaluation process requires expertise from a variety of disciplines and may include manikin testing, computer modeling, laboratory experiments and field trials.

13 The effect of enhanced respiratory heat loss on exercising subjects under heat stress

N. Geladas and *E.W. Banister*, School of Kinesiology, Simon Fraser University, Burnaby, British Columbia, Canada

This study was designed to explore the contribution of the respiratory system to body heat balance during exercise under hot (37.7°C) and humid (90 - 95% RH) environmental conditions. Eight male subjects cycled twice at 45 - 50% of their maximum workrate until exhaustion. In random order, they inspired either cool (3.6 $\pm$ 6.4°C) or ambient air. The expired air temperature was 20.2 $\pm$ 6.5°C and 38.1 $\pm$ 0.6°C under cool and hot air inspiration, respectively. During cool air inspiration the expired air was 40 - 50% saturated with water vapor while during ambient air inspiration the expired air was almost fully saturated (90 - 100% RH). Analysis by partial calorimetry indicated that under ambient air inspiration 89% of the total heat loss occurred via sweat evaporation and 11% through respiration. Comparison with cool air inhalation treatment showed that Respiratory Heat Loss (RHL) accounted for 55% of the total heat loss while sweat evaporation made up the remaining 44%. This change in proportion was mediated by an 8.3-fold increase in RHL during cool air inhalation.

Mean body temperature was calculated from partial calorimetry and the prediction equation of Hardy and Dubois (1937) based on changes of skin and core temperature. Both methods of analysis showed that a diminished elevation of the mean body temperature of 0.4°C occurred by increasing RHL eightfold during 23 minutes of exercise while breathing cool air. However, only 45% of the diminished elevation of mean body temperature was directly attributed to the increased RHL.

Data from this investigation suggest that the respiratory system is an important component in the human body heat balance during cool gas inhalation during work in a hot alien environment. This idea has implications in vocations such as mining and foundry labour.