Protective Clothing and Heat Stress: Introduction

G. W. CROCKFORD

The Orchard, Church Lane, Bovingdon, Herts, HP3 0HS, UK

This issue presents the main papers from a meeting of the Clothing Science Group in June 1998, called to consider the then draft BSI standard on ‘Ergonomics of the thermal environment—Guide to the assessment of heat strain of workers wearing personal protective equipment’. The aim of the meeting was to bring together experts from the UK and overseas to discuss the thermal aspects of wearing protective clothing and equipment and to provide a forum for discussion of the draft standard.

In the UK and many European countries there is now a legal requirement to assess any risks that may be associated with the wearing of personal protective clothing and equipment (PPE). One risk is that the prevention of heat loss from the body may lead to injury and death from hyperthermia. The draft standard aims to provide information relevant to assessing this risk. Also of considerable importance is the economic cost of heat stress imposed by PPE and the degrading of work quality and performance. Collapse from heat stress is also very often sudden with little, if any, warning. For these reasons guidance on the evaluation of PPE imposed thermal stress is required. The thermal environment and human thermal physiology are very complex areas and the first paper by Havenith sets out to try and present in a simple way the fundamental concepts and underlying science.

At the practical level most people have experienced the feelings of discomfort and irritability associated with hot conditions and may have noticed deterioration in mental and physical performance. This heat strain is common in many areas of industry. Wearing protective clothing places the worker at greater risk because it prevents the loss of heat by convection, radiation and evaporation from the body. When the body temperature rises above about 40°C the mechanisms that normally control body temperature at around 37°C stop working with potential lethal consequences. If the body cannot lose heat, then even small amounts of heat generated by doing a physical task will cause heat strain in less than 30 minutes.

In parts of industry, where wearing protective clothing is essential, the incidence of heat-related illness is as high as 1 case for every 100 men working for 1 year; 1 case for every 1,000 to 2,000 man-years is common. In military operations and training 1 case in 500 man-years has been recorded in Hong Kong; about 80 service personnel are hospitalised each year in the UK. All these figures probably represent a considerable under-estimate of the incidence of heat illnesses, and give little clue about its role in reduced productivity, increased errors and reduced safety.

Once the body begins to store heat, incapacitation and fatal changes can be minutes away. Awareness of, and constant alertness for, the factors that can cause heat illness are therefore vital to everyone who is at risk. Frequently, the signs of heat illness—nausea, irritability, sluggishness, pallor, lack of sweating—are misunderstood, with fatal consequences. Examples are documented of heat-illness fatalities in the US and UK armed services, in industry and in sport (50 US football players are said to have died of heat illness in the 10 years to 1975).

It is usually thought that heat strain occurs only in warm or hot conditions. This is wrong. Any heat generated by working which cannot escape because protective clothing is being worn, is stored in the body, and as a consequence the body temperature rises. Heat strain therefore occurs whenever the body generates more heat than it can lose—even in cold conditions. A British soldier marching in outdoor temperatures close to 12°C died of heat-related illness.

The papers presented in this special issue deal with a number of aspects of the thermal environment relevant to the assessment of the hazards and risks associated with the wearing of PPE.
They should assist the user of PPE to comply with legal duties of risk assessment and also to gain some control of the risks, preferably without using the very expensive option of rest pauses. However, it is clear that much more information is required on control, particularly the role of convective cooling of clothed people, the use of wetted clothing and clothing designs which enable air to penetrate to remove heat from the clothing micro-environment.

Acknowledgements—G. W. Crockford and Professor K. C. Parsons acted as guest editors for this issue, and acknowledge the help of the other members of the organising committee of the meeting which gave rise to the issue: Mr D. Bethea, Dr R. Graveling, Mr L. Morris, Mr N. Thomas and Dr W.R. Wither.