A method for assessing heat stress for people wearing non-standard clothing

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1 Introduction
Heat stress can lead to discomfort, profuse sweating, exhaustion, increased body temperatures and death. It is determined by the combined effect of air temperature, radiant heat including that from the sun, wind and humidity and is influenced by the metabolic heat produced by the activity of a person and the resistance to heat and vapour transfer between the body and the environment due to clothing. Management systems for controlling the heat stress exposures of people to avoid unacceptable thermal strain need tools to provide valid indicators of heat stress and the consequences of exposing people to that heat stress. One such tool is the thermal index and the most widely used heat stress index throughout the world is the WBGT (Wet Bulb Globe Temperature) index (Yaglou and Minard, 1957). This has been adopted by international standard ISO 7243 (1989), however the standard is limited to people wearing ‘standard clothing’. There are many contexts where people wear non-standard clothing from sport and agriculture to hospitals, construction sites and nuclear power stations. This paper presents an evaluation of a method for including non-standard (e.g. protective clothing) and standard (e.g. cotton overalls) clothing in heat stress assessment.

2 Method
Parsons (2006) proposed the use of a clothing swatch made of identical clothing material to that which people wear in the environment being assessed. The swatch is placed over the natural wet bulb sensor of the WBGT index to simulate the evaporative and insulative properties of the clothing when worn on a person. A method was developed for constructing the swatches and fitting them onto the natural wet bulb sensor in a controlled way. A WBGT sensor mount and sensors that measure air velocity and radiant temperature, were exposed to a range of conditions in a climatic wind tunnel. A comparison was made between the WBGT values obtained with and without the swatch system and also with the effects of clothing as determined by previous studies on human subjects. The independent variable was climatic condition and the dependent variables were the WBGT values.

3 Results
The data collected were WBGT values for swatch and no swatch condition for a range of air velocities from 0.2 to 5 m s\(^{-1}\). A comparison of data with that of human subjects provided a method for determining the validity of the simple swatch method. Analysis of results indicated that the swatch method for analysing heat stress using the WBGT provides a valid assessment when people are wearing standard and non-standard clothing.

4 Discussion
This study has provided a proof of concept that can be developed into a comprehensive methodology (Qareish,2014). Deaths and injuries due to heat continue to occur throughout the world, particularly when people are wearing non-standard clothing. The simple method evaluated in this study will provide a significant improvement to the assessment of heat stress.

5 References,


Yaglou and Minard (1957) Control of heat casualties at military training centers, American Medical Association Archives of Industrial Health, 16, 302-316