

## INTERNATIONAL STANDARDS AND HUMAN PERFORMANCE II

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### INTRODUCTION

ISO Standards concerned with the Ergonomics of the Thermal Environment collectively cover hot, moderate and cold environments and can be used in a complimentary way as the basis for a practical environmental ergonomics assessment. Although the standards and documents are most usefully used as a set, they have been published as individual documents. Olesen (1990) (in the present proceedings) has considered a number of ISO and other standards including those concerned with moderate and cold environments, clothing and measurement of the thermal environment. The present paper will consider assessment of hot environments, physiological measurements, estimates of metabolic heat production and contact with solid surfaces. This will 'complete the set' of standards as described above and will allow a discussion of a 'unified' practical approach, and the opportunity for standards in the future. For a more comprehensive description of ISO standards and the relationship between them the reader is referred to Parsons (1989).

### HOT ENVIRONMENTS

The ISO philosophy for the assessment of hot environments is to use a simple 'fast' method for monitoring the environment, based on the Wet Bulb Globe Temperature (WBGT) index (ISO 7243 (1989)). If the WBGT values exceed the provided 'reference' values or a more detailed analysis is required then ISO 7933 (1989) provides an analytical method of assessment. This is based on a rational assessment of the environment involving the human heat balance equation, a calculation of sweat rate required in an environment to maintain heat balance and a comparison of what is required with what can be physiologically achieved. If what is required cannot be achieved over an eight hour day then allowable exposure times are calculated. Where an accurate response of individual subjects is required, for example, where subjects are exposed to extremely hot environments then ISO DIS 9886 (1989) describes methods for measuring and interpreting relevant physiological responses.

### PHYSIOLOGICAL MEASUREMENTS

ISO DIS 9886 (1989) presents the principles, methods and interpretation of measurement of relevant human physiological responses to hot, moderate and cold environments. The standard can be used independently or to compliment the use of other standards. Four physiological measures are considered; body core temperature, skin temperature, heart rates and body mass loss. Comments are also provided on the technical requirements, relevance, convenience, annoyance to the subject and cost, of each of the physiological measurements.

### METABOLIC HEAT PRODUCTION

All assessments of thermal environments require an estimate of metabolic heat produced by activity. ISO 8996 (1989) presents three types of methods for estimating metabolic heat production. The first is by use of tables,

where estimates are provided based on a description of activity. These range from a general description (e.g. light, heavy etc.) to methods of summing components of tasks (e.g. basal metabolic rate + posture component + movement component etc.).

The second method is by the use of heart rate. The total heart rate is regarded as a sum of several components and in general is linearly related to the metabolic heat production for heart rates above 120 beats per minute. The third method is to calculate the metabolic heat production from measures of oxygen consumption, and carbon dioxide production during activity and recovery.

#### CONTACT WITH SOLID SURFACES

The ISO has recently become involved in the thermal sensation and degree of damage caused by contact between naked and covered skin and hot, moderate or cold solid surfaces. The work is in an exploratory stage with some information available for hot and moderate surface temperatures but little for cold. The European standards committee for Ergonomics, CEN TC 122 has produced a draft standard for contact with hot surfaces and ISO and CEN have set up a joint working party to 'harmonize' work.

#### ISO STANDARDS - AN INTEGRATED APPROACH

Each ISO standard and document has been produced (and revised) in a self contained form and each standard can be used independently of the others. For practical assessments the 'whole' is greater than the sum of the parts. An underlying philosophy exists however further consideration is required. Integrating all standards into one document (reducing repetition) and providing a software support system (ergonomically designed) would greatly aid the practitioner.

#### FUTURE STANDARDS

Interest in the production of International Standards has stimulated applied research and has contributed to knowledge of human responses to the thermal environment. Approaches to assessment however are similar to those used over twenty years ago. Developments in knowledge of human response and its application and in the utility of the digital computer should not be overlooked in the future where computer aided environmental design and assessment 'tools' will play a significant role.

#### REFERENCES

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3. ISO 7243 Hot environments - Estimation of the heat stress on working man, based on the WBGT-Index (Wet bulb globe temperature). ISO Geneva, 1989.
4. ISO 7933 Hot environments - Analytical determination and interpretation of thermal stress using calculation of required sweat rate. ISO, Geneva, 1989.
5. ISO DIS 9886 Evaluation of thermal strain by physiological measurements. ISO, Geneva, 1989.
6. ISO 8996 Ergonomics of the thermal environment : Estimation of metabolic heat production. ISO, Geneva, 1989.