



Standard Practice for Determining the Physiological Responses of the Wearer to Protective Clothing Ensembles¹

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INTRODUCTION

Protective clothing ensembles such as firefighter turnout gear, HAZMAT suits, and bomb suits may impose a physiological strain on the wearer. This strain can take the form of heat stress and cardiovascular and respiratory strain, which can result in injury to the wearer. This practice provides information on the measurement of the physiological responses of a wearer to a protective clothing ensemble. The protocol is designed to allow comparisons of the physiological responses of subjects wearing different protective clothing ensembles of the same type (for example, firefighter turnout gear) and from different types (for example, firefighter ensemble vs. HAZMAT suit).

1. Scope

1.1 This practice specifies the test equipment and procedures for determining the physiological responses of subjects wearing a protective clothing ensemble.

1.2 This practice covers the physiological measurement of internal body core temperature, skin temperature, exposure time, heart rate response, oxygen consumption, and whole body sweat rate, to assess the physiological responses of subjects wearing a protective clothing ensemble. This practice does not measure the musculoskeletal strain on the participant imposed by the protective clothing ensemble.

1.2.1 To increase safety during physiological testing, this dynamic test requires the use of human participants who meet specific health and physical fitness requirements.

1.3 The present standard does not attempt to determine important clothing characteristics, such as thermal insulation and evaporative resistance of the protective clothing ensemble. Test Methods [F1291](#) and [F2370](#) can be used for these clothing measurements.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 It is the responsibility of the test laboratory to obtain the necessary and appropriate approval(s) required by their institution for conducting tests using human participants.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user, and the testing institution, to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use of this standard.*

2. Referenced Documents

2.1 ASTM Standards:²

[F1291](#) Test Method for Measuring the Thermal Insulation of Clothing Using a Heated Manikin

[F1494](#) Terminology Relating to Protective Clothing

[F2300](#) Test Method for Measuring the Performance of Personal Cooling Systems Using Physiological Testing

[F2370](#) Test Method for Measuring the Evaporative Resistance of Clothing Using a Sweating Manikin

2.2 Other Standards:³

[ISO 8996](#) Ergonomics—Determination of Metabolic Heat Production

[ISO 9886](#) Ergonomics—Evaluation of Thermal Strain by Physiological Measurements

The Commission for Thermal Physiology of the International Union of Physiological Sciences (IUPS Thermal Commission)—Glossary of Terms for Thermal Physiology⁴

¹ This practice is under the jurisdiction of ASTM Committee [F23](#) on Personal Protective Clothing and Equipment and is the direct responsibility of Subcommittee [F23.60](#) on Human Factors.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ *The Japanese Journal of Physiology*, Vol. 51, No. 2, 2001.