



Standard Test Method for Measuring the Performance of Personal Cooling Systems Using Physiological Testing¹

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INTRODUCTION

Individuals in various occupations are exposed to high heat stress resulting from increased metabolism, or the environment, or both. Environmental heat stress can be especially severe when individuals are required to wear Personal Protective Equipment (PPE), which impairs or prevents evaporation of sweat from the skin, and thus nullifies the body's principal means of removing metabolic heat. Failure to dissipate this heat can dramatically limit work capacity and heat tolerance, thereby increasing the risk of heat-related illness. To reduce this risk, workers are wearing Personal Cooling Systems (PCS) to extend their exposure time to thermal stress. These systems are intended to limit the effects of external environmental heat and the internally generated metabolic heat on the body. For this purpose, standards that objectively quantify the effectiveness of PCS are essential. Therefore, tests that measure important physiological variables, such as core temperature, are essential in evaluating PCS applications and increasing worker's health and safety.

1. Scope

1.1 This test method covers the physiological measurement of internal body core temperature, skin temperature, thermal exposure time, heart rate response, oxygen consumption, and whole body sweat rate, to assess the effectiveness of Personal Cooling Systems (PCS) in reducing the effects of thermal stress.

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

1.2 This test incorporates the use of protective clothing ensembles (outer garments) used in conjunction with or worn over top of the PCS. This scope is therefore oriented to industrial rather than athletic applications.

1.2.1 The effectiveness of different PCS will be quantified with the same protective clothing ensemble. Therefore, the physiological values obtained apply only to the cooling systems, the particular protective outer garment, and the specific test conditions.

1.2.2 When a protective outer garment is not provided, this test method requires that PCS shall be tested with the standard outer garment defined within this test method.

1.2.3 The present standard does not attempt to determine important clothing characteristics, such as thermal insulation and evaporative resistance, of the PCS or of the garments worn with the PCS. Test Methods [F1291](#) and [F2370](#) can be referenced for these clothing measurements.

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

1.4 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.

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

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

¹ This test method 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.