



Standard Test Method for Measuring the Thermal Insulation of Clothing Using a Heated Manikin¹

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INTRODUCTION

The type of clothing worn by people directly affects the heat exchange between the human body and the environment. The heat transfer is both sensible (conduction, convection, and radiation) and latent (evaporation). The insulation provided by a clothing ensemble is dependent upon the designs and materials used in the component garments, the amount of body surface area covered by clothing, distribution of the fabric layers over the body, looseness or tightness of fit, and the increased surface area for heat loss. Insulation measurements made on fabrics alone do not take these factors into account. Measurements of the resistance to dry heat loss provided by clothing can be used to determine the thermal comfort or stress of people in cold to comfortable environments (see Practice [F2732](#), ASHRAE 55-1992, and ISO 7730). However, the moisture permeability of clothing is more important in environmental conditions where heat balance can only be achieved by the evaporation of sweat.

1. Scope

1.1 This test method covers the determination of the insulation value of clothing ensembles. It describes the measurement of the resistance to dry heat transfer from a heated manikin to a relatively calm, cool environment. Information on measuring the local thermal resistance values for individual garments and ensembles is provided in [Annex A1](#).

1.1.1 This is a static test that provides a baseline clothing measurement on a standing manikin.

1.1.2 The effects of body position and movement are not addressed in this test method.

1.2 The insulation values obtained apply only to the particular ensembles evaluated and for the specified environmental conditions of each test, particularly with respect to air movement.

1.3 The values stated in either clo or SI units are to be regarded separately as standard. Within the text, the SI units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other.

1.4 The evaporative resistance of a clothing ensemble can be measured in accordance with Test Method [F2370](#).

1.5 *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 of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

[D1518](#) Test Method for Thermal Resistance of Batting Systems Using a Hot Plate

[E691](#) Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

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

[F2732](#) Practice for Determining the Temperature Ratings for Cold Weather Protective Clothing

2.2 ASHRAE Standards:³

[ASHRAE 55-1992](#) Thermal Environmental Conditions for Human Occupancy

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.

³ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.