



Standard Test Method for Measuring Thermal Insulation of Sleeping Bags Using a Heated Manikin¹

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INTRODUCTION

Sleeping bags are used by people in outdoor environments to insulate them from the cold (that is, reduce their body heat loss to the environment). Sleeping bags often are used with ground pads and clothing inside tents that provide additional protection from the environment. The amount of insulation needed in a sleeping bag depends upon the air temperature and a number of other environmental factors (for example, wind speed, radiant temperature, moisture in the air), human factors (for example, a person's metabolic heat production that is affected by gender, age, fitness level, body type, size, position, and movement), and physical factors (for example, amount of body coverage and the quality of the insulating materials). The insulation value, expressed in clo units, then can be used for sleeping bags and sleeping bag systems.

1. Scope

1.1 This test method covers determination of the insulation value of a sleeping bag. It measures the resistance to dry heat transfer from a constant skin temperature manikin to a relatively cold environment. This is a static test that generates reproducible results, but the manikin cannot simulate real life sleeping conditions relating to some human and environmental factors, examples of which are listed in the introduction.

1.2 The insulation values obtained apply only to the sleeping bag, as tested, and for the specified thermal and environmental conditions of each test, particularly with respect to air movement past the manikin.

1.3 *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 establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

F 1291 Test Method for Measuring the Thermal Insulation of Clothing Using a Heated Manikin²

¹ This test method is under the jurisdiction of ASTM Committee F-8 on Sports Equipment and Facilities and is the direct responsibility of Subcommittee F08.22 on Sleeping Bag Standards.

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² *Annual Book of ASTM Standards*, Vol 11.03.

3. Terminology

3.1 Definitions:

3.1.1 *clo, n*—unit of thermal resistance (insulation) equal to $0.155^{\circ}\text{C}\cdot\text{m}^2/\text{W}$.

3.1.1.1 *Discussion*—A heavy men's business suit provides 1 clo of insulation.

3.1.2 *dry heat loss, n*—heat transferred from the body surface to a cooler environment by means of conduction, convection, and radiation.

3.1.3 *manikin, n*—a life-size model of the human body with a surface temperature similar to that of a human being.

3.1.4 *sleeping bag, n*—a structure made of down, synthetic fiberfill, shell fabrics, or other materials, or a combination thereof, that is designed for people to use for thermal protection when sleeping (for example, outdoors, tent, cabin).

3.1.5 *thermal insulation, n*—any material that increases the resistance to dry heat loss.

3.1.6 *total insulation (I_T), n*—the resistance to dry heat loss from the manikin that includes the resistance provided by the sleeping bag and the air layer around the manikin.

3.1.6.1 *Discussion*—Total insulation values (I_T) are measured directly with a manikin. They can be used to compare different sleeping bags, as long as each test is conducted using the same experimental procedures and test conditions.

4. Summary of Test Method

4.1 A nude, heated manikin is placed inside a sleeping bag in a cold environmental chamber.