



Standard Test Method for Hygroscopic Sorption Isotherms of Building Materials¹

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1. Scope

1.1 This test method specifies a laboratory procedure for the determination of hygroscopic sorption isotherms of any construction materials. The method was originally developed for the ASTM Thermal Insulation committee.

1.2 For material characterization, the primary emphasis is on the adsorption isotherm (that is, sorption isotherm that describes the wetting process of the material from the oven-dry condition).

1.3 Determination of desorption isotherm, (that is, sorption isotherm that describes the drying process of a material from the state of absolute saturation with water) is performed when information on drying characteristics of construction materials is required. Typically both adsorption and desorption isotherms are required for the purpose of hygrothermal models.

1.4 *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:

- E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions²
- E 337 Test Method for Measuring Humidity with a Psychrometer (The Measurement of Wet and Dry-Bulb Temperatures)²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *adsorption isotherm*—the sorption isotherm measured exclusively during the hygroscopic adsorption process started from the oven-dry condition.

3.1.2 *desorption isotherm*—the sorption isotherm measured exclusively during the hygroscopic desorption process started from the condition of full water saturation of the material.

3.1.3 *hygroscopic adsorption*—fixation of water molecules from ambient air on surfaces of a material until equilibrium is established.

3.1.4 *hygroscopic desorption*—release of adsorbed water molecules from surfaces of a material into the ambient air until equilibrium is established.

3.1.5 *hysteresis*—a physical phenomenon which makes the desorption isotherm different from the adsorption isotherm due to the difference in the energy level of pore water.

3.1.6 *moisture content, by mass*—mass of water retained in the specimen divided by the dry mass of the specimen.

3.1.7 *moisture content, by volume*—volume of water retained in the specimen divided by the volume of the dry specimen.

3.1.8 *sorption isotherm*—relationship between the relative humidity (RH) (see E 337) and the equilibrium moisture content of the material, at a specified temperature.

4. Significance and Use

4.1 The purpose of these tests is to obtain, for a specified temperature, by means of a specified laboratory procedure, the values of the equilibrium moisture content at various levels of RH. These values are used either as means to characterize the material or as material characteristics needed as input to appropriate computer models that can simulate wetting or drying potential of individual building materials or material assemblies under specified environmental conditions.

4.2 A specified value of the equilibrium moisture content can also be used for material characterization. If this type of material characterization is called for in a material specification (for example, mineral or cellulose fiber insulation), the equilibrium at $95 \pm 3\%RH$ shall be used.

4.3 For ease and repeatability of measurements, the measurements for characterization are performed on adsorption isotherms. Though desorption is the reverse of adsorption, most porous materials reach different equilibrium levels during these two processes. Usually, the equilibrium moisture content

¹ This test method is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.33 on Thermal Insulation Finishes and Moisture.

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