



Designation: D 3277 – 95

Standard Test Methods for Moisture Content of Oil-Impregnated Cellulosic Insulation¹

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1. Scope

1.1 These test methods cover the determination of the weight percent of water in new or aged, oil-impregnated electrical insulation. These test methods depend on solvent extraction of the water at room temperature. The range from 0.1 to 7.0 % water has been explored.

1.2 There are four test methods, A, B, C, and D. Methods A and B for thin paper and dense materials, respectively, are manual methods for solvent extraction of water from the specimens. Titration is used to determine the amount of water. Method C uses automatic titration to determine the amount of water. Method D is a direct automated method for extraction and detection of the water.

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:

D 1533 Test Methods for Water in Insulating Liquids (Karl Fischer Reaction Method)²

3. Summary of Test Methods

3.1 These test methods depend on solvent extraction of the moisture at room temperature and Karl Fischer titration (see Test Methods D 1533). For paper insulation 0.010 in. (0.25 mm) thick and less, extraction is accomplished by stirring the solvent with small pieces of insulation. In the special case of dense, thick sections, such as pressboard, the extraction rate is increased by delaminating thick sections and pulping the sample in a blender.

4. Significance and Use

4.1 Moisture has an adverse effect on the dielectric strength, dielectric loss, d-c resistivity, and aging characteristics of oil-impregnated cellulosic insulating materials.

4.2 When cellulosic insulation such as paper and pressboard are impregnated with and immersed in oil, there is an interchange of moisture between the cellulose and oil until they attain equilibrium with respect to their relative saturations with moisture.

4.3 Considerable care should be taken in using these test methods to measure the water content of dry (<0.5 %) paper and board. Contamination of material by water from the surroundings during sampling and handling may be both rapid and significant in the case of dry test specimens. This is an even greater concern with cellulose insulation prior to oil impregnation.

5. Apparatus

5.1 *Karl Fischer Electrometric Titration Apparatus.*

5.2 *Magnetic Stirrer and TFE-Fluorocarbon Coated Stirring Bars.*

5.3 *Erlenmeyer Flasks, glass-stoppered, 250-mL.*

5.4 *Graduate, glass, 100-mL.*

5.5 *Büchner Funnel, small porcelain.*

5.6 *Micro-Syringe, total capacity 0.2 mL, 0.01-mL divisions.*

5.7 *Blender, industrial type.*

5.8 *Syringe, 10 mL, ground glass.*

5.9 *Drying Oven, 110 ± 5°C.*

5.10 *Laboratory Desiccator.*

5.11 *Analytical Balance.*

6. Reagents

6.1 *Karl Fischer Reagent*—Commercially available stabilized solution, diluted from approximately 5 mg of water per 1 mL to 2.5 to 3.0 mg of water per 1 mL by adding absolute acetone-free methanol (Methods A and B). For Methods C and D, prepare commercially available solutions for use in automatic titrators in accordance with the manufacturer's instructions.

6.2 *Titration Solvent*—Mix 2 volumes of acetone-free methanol and 1 volume of dry chloroform. Keep the solution tightly capped to prevent moisture absorption from the atmosphere.

6.3 *Purity of Reagents*—Use reagent grade chemicals in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided that it is first

¹ These test methods are under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.06 on Chemical Test.

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² *Annual Book of ASTM Standards*, Vol 10.03.