



Standard Test Method for Water in Phenol and Related Materials by the Iodine Reagent Method¹

This standard is issued under the fixed designation D 1631; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the determination of water in phenol and related materials such as cresols, xylenols, naphthalene, pyridine, and quinoline.

1.2 This test method has been found applicable to a variety of materials varying in water content from 100 mg/kg to solutions containing a relatively high percent of water.

1.3 The following applies to all specified limits in this standard: for purposes of determining conformance with this standard, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand digit used in expressing the specification limit in accordance with the rounding-off method of Practice E 29.

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.* For specific hazard statements, see Section 9.

2. Referenced Documents

2.1 *ASTM Standards:*²

D 1364 Test Method for Water in Volatile Solvents (Karl Fischer Reagent Titration Method)

D 3437 Practice for Sampling and Handling Liquid Cyclic Products

D 3852 Practice for Sampling and Handling Phenol, Cresols, and Cresylic Acid

D 4790 Terminology of Aromatic Hydrocarbons and Related Chemicals

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.2 *Other Document:*³

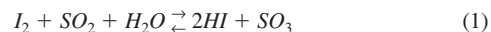
OSHA Regulations, 29 CFR, Paragraphs 1910.1000 and 1910.1200

3. Terminology

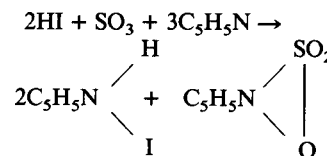
3.1 See Terminology D 4790 for definition of terms used in this test method.

4. Summary of Test Method

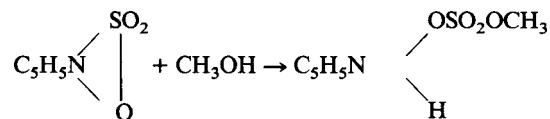
4.1 When solutions of iodine in methanol and of sulfur dioxide in pyridine are mixed in the presence of water, the following reaction occurs:



4.1.1 Sufficient pyridine is present in the reagent to consume the hydriodic acid and sulfur trioxide:



4.1.2 The pyridine sulfur trioxide salt reacts with the methanol, this preventing a second mole of water from being consumed:



4.2 When the pyridine solution contains water and the sulfur dioxide is titrated with iodine in methanol solution, the platinum electrodes remain polarized until all the water reacts.

¹ This test method is under the jurisdiction of ASTM Committee D16 on Aromatic Hydrocarbons and Related Chemicals and is the direct responsibility of Subcommittee D16.02 on Oxygenated Aromatics.

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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 U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

A slight excess of iodine depolarizes the electrodes, allowing current to flow through the microammeter which indicates the end point.

5. Significance and Use

5.1 This test method is particularly useful for determining small amounts of water in hygroscopic materials. This test method is suitable for setting specifications on materials referenced in the scope. It may also be used as an internal quality control tool and in development or research work.

6. Interferences

6.1 This test method is not applicable in the presence of mercaptans, peroxides, or appreciable quantities of aldehydes or amines.

6.2 If ketones are present in the sample, interference from them can be avoided by employing the glycol-pyridine sample solvent specified in Test Method D 1364.

7. Apparatus

7.1 The apparatus shall be assembled as shown in Fig. 1. Any suitable modification permitting equal facility and accuracy may be used. Automatic titration equipment is commercially available and may be used.

8. Reagents

8.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such

specifications are available.⁴ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

8.2 *Iodine Solution*—Dissolve 150 g of iodine (I₂) crystals in 3 L of anhydrous methanol. Place the solution in the reagent bottle connected to the buret as shown in Fig. 1.

8.3 *Methanol*, anhydrous, containing less than 0.05 % water.

8.4 *Pyridine Solution*—Place 4000 mL of refined grade pyridine in a 5000-mL distilling flask. Distill over and discard 400 mL of forecut at atmospheric pressure. Distill off 3400 mL of center cut and transfer to a suitable glass bottle fitted with a two-hole stopper. Through one hole of the stopper insert a piece of glass tubing that extends almost to the bottom of the bottle; through the other hole insert a short piece of glass tubing to serve as a vent. Through the long tube add 400 g of refrigerant-grade sulfur dioxide (SO₂) dried through concentrated sulfuric acid (H₂SO₄ sp gr 1.84), and allow the solution to cool. Fit the vent tube with a drying tube and an aspirator bulb; connect the long tube with an adapter suitable for introducing the reagent into the titration flask. For convenience in measuring, a suitable reservoir may be placed in the system.

NOTE 1—In place of the divided reagents described in 8.2, 8.3, and 8.4 it is permissible to employ the single solution reagent specified in Test Method D 1364 or commercial Karl Fischer reagents. Pyridine-free reagents are available from various laboratory suppliers and may be used if suitable for the material being tested.

8.5 When handling Karl Fischer reagent refer to Practice D 3437.

9. Hazards

9.1 Consult current OSHA regulations supplier's Material Safety Data Sheets and local regulations for all materials used in this test method.

9.2 Phenol, pyridine, and related materials are extremely toxic when ingested and corrosive to the skin. Appropriate precaution must be exercised when handling them.

10. Sampling

10.1 Sample in accordance with Practice D 3852 for proper sampling and handling of phenol and related materials analyzed by this test method (see 9.1 and 9.2.).

10.2 Precautions must be taken in sampling to preclude any possibility of contamination with atmospheric moisture adhering to the walls of the pipet.

10.3 The sample size recommended, on the basis of water content expected is as follows:

Expected Water Content, %	Size of Specimen, g
0.01 to 0.03	50
0.03 to 0.3	25
0.3 to 0.6	10

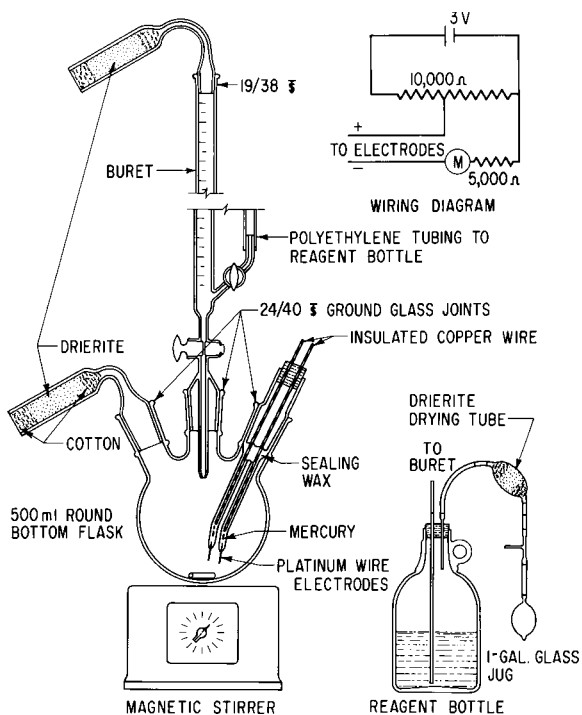


FIG. 1 Titration Assembly

⁴ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Anal. Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.