



Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)¹

This standard is issued under the fixed designation D 4952; 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 is intended primarily for the detection of mercaptans in motor fuel, kerosine, and similar petroleum products. For example see Specification D 235.

1.2 The values stated in acceptable SI units are to be regarded as standard.

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 235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)²
- D 1193 Specification for Reagent Water³
- D 3227 Test Method for Mercaptan Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)⁴

3. Summary of Test Method

3.1 The sample is shaken with sodium plumbite solution, a small quantity of powdered sulfur added, and the mixture shaken again. The presence of mercaptans or hydrogen sulfide or both is indicated by discoloration of the sulfur floating at the oil-water interface or by discoloration of either of the phases.

4. Significance and Use

4.1 Sulfur present as mercaptans or as hydrogen sulfide in distillate fuels and solvents can attack many metallic and non-metallic materials in fuel and other distribution systems. A negative result in the doctor test ensures that the concentration of these compounds is insufficient to cause such problems in normal use.

5. Reagents and Materials

5.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.⁵ 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.

5.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Types II or III of Specification D 1193.

5.3 *Doctor (Sodium Plumbite) Solution*—(**Warning**—see Note 1)—Dissolve approximately 125 g of sodium hydroxide (NaOH) in 1 L of reagent water. Add 60 g of lead monoxide (PbO) and shake vigorously for 15 min, or let stand with occasional shakings for at least one day. Allow to settle and decant or siphon off the clear liquid. If the solution does not settle clear, filter it through filter paper. Keep the solution in a tightly sealed bottle and refilter before use if not perfectly clear. As an alternative, the lab may use a commercially prepared solution that meets the requirements of the laboratory preparation.

NOTE 1—**Warning:** Poisonous and suspect carcinogen.

NOTE 2—Alternate volumes of the solution may be prepared or purchased, provided the final solution concentration is equivalent.

5.4 *Sulfur*—Pure, sublimed, stored in a closed container.

6. Procedure

6.1 Shake vigorously together in a test tube 10 mL of the sample being tested and 5 mL of sodium plumbite solution for about 15 s. Add a small amount of pure, sublimed sulfur of sulfur so that practically all of it floats on the interface between the sample and the sodium plumbite solution after shaking. Shake again for 15 s. Allow to settle and observe within 2 min.

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.03 on Elemental Analysis.

Current edition approved Nov. 10, 1997. Published September 1998. Originally published as D 4952-89. Last previous edition D 4952-96.

² *Annual Book of ASTM Standards*, Vol 06.04.

³ *Annual Book of ASTM Standards*, Vol 11.01.

⁴ *Annual Book of ASTM Standards*, Vol 05.02.

⁵ *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 *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopoeia and National Formulary*, U.S. Pharmacopoeial Convention, Inc. (USPC), Rockville, MD.