



Standard Test Method for Electrical Conductivity of Liquid Hydrocarbons by Precision Meter¹

This standard is issued under the fixed designation D4308; 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 U.S. Department of Defense.

1. Scope*

1.1 This test method covers and applies to the determination of the “rest” electrical conductivity of aviation fuels and other similar low-conductivity hydrocarbon liquids in the range from 1 pS/m to 2000 pS/m (see 3.1.2). This test method can be used in the laboratory or in the field.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Use Caution when handling mercury and mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. The potential exists that selling mercury or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific warning statements, see 8.3 and Annex A1.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.J0.04 on Additives and Electrical Properties.

Current edition approved Jan. 1, 2021. Published March 2021. Originally approved in 1983. Last previous edition approved in 2013 as D4308 – 13. DOI: 10.1520/D4308-21.

2. Referenced Documents

2.1 ASTM Standards:²

- D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation
- D2624 Test Methods for Electrical Conductivity of Aviation and Distillate Fuels
- D4306 Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
- E1 Specification for ASTM Liquid-in-Glass Thermometers

3. Terminology

3.1 Definitions:

3.1.1 *picosiemens per metre, n*—the unit of electrical conductivity is also called a conductivity unit (CU). A siemen is the SI definition of reciprocal ohm sometimes called mho.

$$1 \text{ pS/m} = 1 \times 10^{-12} \Omega^{-1} \text{ m}^{-1} = 1 \text{ cu} = 1 \text{ picomho/m} \quad (1)$$

3.1.2 *rest conductivity, n*—the reciprocal of the resistance of uncharged fuel in the absence of ionic depletion or polarization. It is the electrical conductivity at the initial instant of current measurement after a dc voltage is impressed between electrodes.

4. Summary of Test Method

4.1 A sample of liquid hydrocarbon is introduced into a clean conductivity cell which is connected in series to a battery voltage source and a sensitive dc ammeter. The conductivity, automatically calculated from the observed peak current reading dc voltage and cell constant using Ohm’s law, appears as a digital value in either a manual or automatic mode of meter operation.

5. Significance and Use

5.1 The generation and dissipation of electrostatic charge in fuel due to handling depend largely on the ionic species present

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.

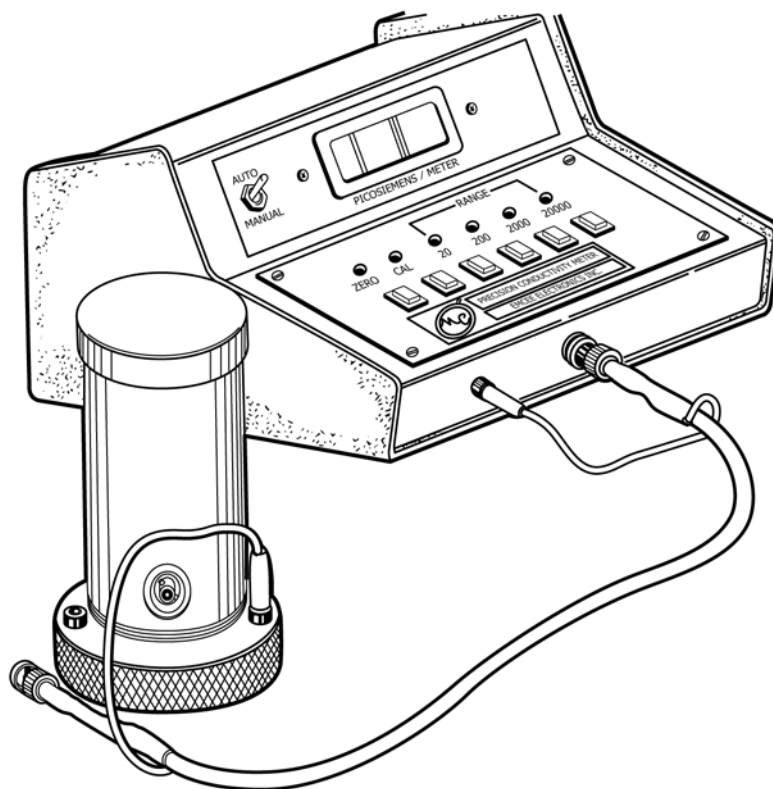


FIG. 1 Precision Conductivity Meter

which may be characterized by the rest or equilibrium electrical conductivity. The time for static charge to dissipate is inversely related to conductivity. This test method can supplement Test Method D2624 which is limited to fuels containing static dissipator additive.

NOTE 1—For low-conductivity fluids below 1 pS/m in conductivity, an ac measurement technique is preferable to a dc test method for sensing the electrical conductivity of bulk fluid.

6. Apparatus

6.1 *Conductivity Apparatus*—Components of the dc conductivity apparatus are shown in Fig. 1.³

6.1.1 The conductivity cell shown in Fig. 1 consists of an inner electrode and an outer electrode separated by an insulator. The outer electrode and cap provide a ground path and electrostatic (Faraday) shield.

6.1.2 The electrometer shown in Fig. 1 contains a battery which supplies a voltage to the cell and a bridge circuit which senses the flow of current and converts the output signal directly into conductivity units, that is, pS/m. A pushbutton selector allows selection of zero reading, calibration, and four range selections.

6.1.3 The cell and electrometer are connected by a triaxial cable as shown in Fig. 1.

³ The sole source of supply of the apparatus, Precision Conductivity Meter System, Emcee Model #1154, known to the committee at this time is Emcee Electronics, Inc., 520 Cypress Ave., Venice, FL 34285. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

6.2 *Thermometer*, general purpose type, having a range of 0 °C to 60 °C (see Specification E1). Temperature measuring devices that cover the temperature range of interest, such as an ASTM 1C thermometer, or liquid-in-glass thermometers, thermocouples, or platinum resistance thermometers that provide equivalent or better accuracy and precision than ASTM 1C thermometers may be used.

7. Reagents

7.1 *Cleaning Solvent*, isopropyl alcohol.

7.2 *Hydrocarbon*, for calibration. The dielectric constant must be known to $\pm 5\%$ at the temperature of calibration.⁴

8. Sampling

8.1 The sample volume should be at least 0.7 L.

8.2 Use a clean epoxy-lined can, a new glass bottle, a new polytetrafluoroethylene bottle, or a new high density polyethylene bottle.

NOTE 2—Test method results are known to be sensitive to trace contamination from sampling containers. For recommended sampling containers refer to Practice D4306.

NOTE 3—Bottle samples should be tested immediately, since the glass surface tends to absorb from the fuel the conductive substances that the test method is intended to measure.

8.3 Rinse the container at least three times with portions of the hydrocarbon liquid to be sampled. (When testing diesel or

⁴ A standard, such as cyclohexane, with certified dielectric constant, may be obtained from the National Bureau of Standards and Technology (NIST), Gaithersburg, Maryland.