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An American National Standard

Standard Test Method for Deposition Tendencies of Liquids in Thin Films and Vapors[1]

This standard is issued under the fixed designation D 3711; 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.

ε[1] NOTE—Warning notes were placed in the text editorially in November 2000.

1. Scope

1.1 This test method covers the determination of the tendency of liquids in thin films and of vapors to form deposits on metal surfaces. The test method applies to both petroleum-based and synthetic lubricants, hydraulic fluids, heat-transfer fluids, and related materials.[2]

1.2 The values stated in SI units are to be regarded as the standard. In cases where materials, products, or equipment are available in inch-pound units only, SI units are omitted.

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.* For specific hazard statements, see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*

D 216 Method for Distillation of Natural Gasoline[3]

D 323 Test Method for Vapor Pressure of Petroleum Products (Reid Method)[4]

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products[5]

D 4177 Practice for Automatic Sampling of Petroleum and Petroleum Products[5]

E 230 Specification Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples[6]

2.2 *ANSI Standard:*

C 96.1 Temperature Measurement Thermocouples.[7]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *deposit tendency, n*—the deposition tendency of a thin film or vapor is an index of the propensity of a material to form carbonaceous residues on hot surfaces in contact with the liquid or vapor phase of the sample.

4. Summary of Test Method

4.1 The test specimen is allowed to flow slowly in a thin film over a steel test specimen in a constant-temperature chamber (furnace liner). Circulation of the sample from the sump to the heated surface and back to the sump is accomplished by means of a peristaltic pump. After the prescribed test period, the steel test specimen is removed from the apparatus and evaluated. The masses of deposits remaining after washing with pentane, after washing with chloroform, and after wiping with a paper tissue are reported.

4.2 An optional procedure (see Annex A1) provides a method for the determination of the tendency of sample vapors to form deposits on heated surfaces. A second test specimen is placed in the vapor space over a thin flowing film of the liquid in a constant-temperature chamber (furnace liner). After circulation of the test liquid for a specified time the deposits on the test specimen exposed to the liquid and the vapor phases are measured in the manner described in 4.1.

5. Significance and Use

5.1 The test method shall measure the deposit formation tendencies of liquids on steel surfaces in air at 101.3 KPa (1-atm) pressure. Other surfaces and other atmospheric media may be substituted for steel and air at 1 atm provided that the substitution is noted in the test report.

6. Apparatus

6.1 *Tube Furnace*, with heating chamber 305 mm (12 in.) long by 35 mm (1⅜ in.) in diameter[8] (see Fig. 1).

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.11 on Engineering Science of High Performance Fluids and Solids.

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[2] United States Patent 2,669,865. Joseph Cole and John Krawetz.

[3] Discontinued—see *1987 Annual Book of ASTM Standards*, Vol 05.01.

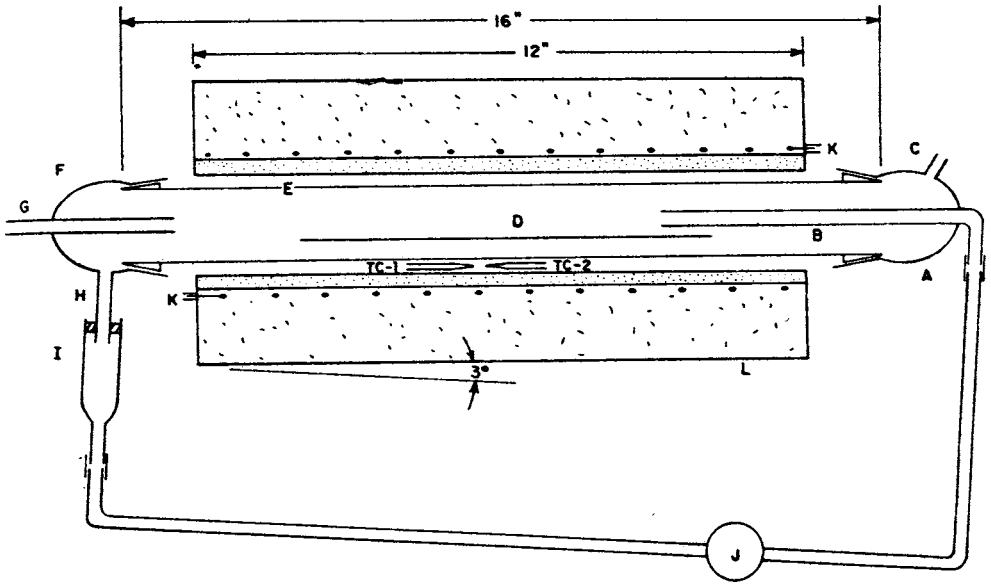
[4] *Annual Book of ASTM Standards*, Vol 05.01.

[5] *Annual Book of ASTM Standards*, Vol 05.02.

[6] *Annual Book of ASTM Standards*, Vol 14.03.

[7] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

[8] Type FD303A combustion furnace manufactured by Hoskins Manufacturing Co., Detroit, MI 48232, has been found satisfactory.

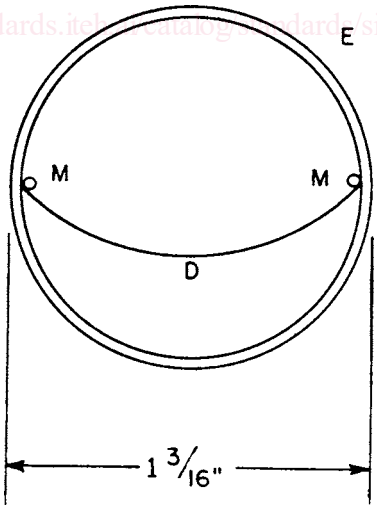


in.	mm
12	304.8
16	406.4

A—Inlet end cap
B—Sample delivery tube
C—Gas atmosphere outlet
D—Metal test piece for thin liquid films
E—Furnace liner (with standard taper male end joints)
F—Outlet end cap
G—Gas atmosphere inlet
H—Sample outlet tube
I—Sample sump
J—Peristaltic pump
K—Insulated terminals of furnace heater element
L—Tube furnace
TC1—Control thermocouple for furnace controller
TC2—Thermocouple for test temperature read out

FIG. 1 Tube Furnace

6.2 *Furnace Liner* (constant-temperature chamber)—See Fig. 2.



1 3/16 in. = 30.1 mm
D—Metal test piece for thin liquid films
E—Furnace liner (with standard tape male end joints)
M—Longitudinal aligning rods

FIG. 2 Furnace Liner

6.3 *Temperature Controller.*[9]

6.4 *Potentiometer*, direct-temperature readout.[10]

6.5 *Thermocouples*, for temperature control and read-out in accordance with ANSI C96.1 (see Specification E 230).

6.6 *Pump*, peristaltic or kinetic clamp type capable of delivering 50 ± 5 mL of sample per hour.[11]

6.7 *Tubing*[12] for use with pump.

6.8 *Steel Test Specimens*—See Fig. 3.

6.9 *Analytical Balance* capable of measuring mass of test specimen to the nearest 0.1 mg.

7. Reagents and Materials

7.1 *Chloroform* (**Warning**—Can be fatal if swallowed. Harmful if inhaled. May produce toxic vapors if burned. See A2.1.) technical grade.

[9] A Model 520 Solid State Controller manufactured by Barber Colman Co., Rockford, IL, has been found satisfactory.

[10] A Model 400A digital temperature indicator manufactured by Doric Scientific, San Diego, CA has been found satisfactory.

[11] Any peristaltic pump capable of delivering the sample at the prescribed rate is satisfactory. Any tubing compatible with the sample may be used. It is recognized that, due to viscosity and compatibility phenomena, no single pump and tubing combination will be acceptable for use with all samples.

[12] Kimwipes, Type 900M manufactured by Kimberly Clark Corp., Neenah, WI, have been found satisfactory.