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An American National Standard

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Standard Test Method for Gum Content in Fuels by Jet Evaporation[1]

This standard is issued under the fixed designation D 381; 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 test method was issued as a joint ASTM-IP standard in 1965.
This method has been adopted for use by government agencies to replace Method 3302 of Federal Test Method Standard No. 791b.

1. Scope

1.1 This test method covers the determination of the existent gum content of aviation fuels, and the gum content of motor gasolines or other volatile distillates in their finished form, (including those containing alcohol and ether type oxygenates and deposit control additives) at the time of test.

1.2 Provisions are made for the determination of the heptane insoluble portion of the residue of non-aviation fuels.

1.3 The accepted SI unit of pressure is the Pascal (Pa); the accepted SI unit for temperature is degrees Celsius.

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 6.4, 7.4, and 9.1.

2. Referenced Documents

2.1 *ASTM Standards:*

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products[2]

E 1 Specification for ASTM Thermometers[3]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification[4]

2.2 *IP Standard:*

Standard Methods for Analysis and Testing of Petroleum Products[5]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *existent gum*—the evaporation residue of aviation fuels, without any further treatment.

3.2 For non-aviation fuels, the following definitions apply.

3.3 *solvent washed gum content*—the residue remaining when the evaporation residue (see 3.4) has been washed with heptane and the washings discarded.

3.3.1 *Discussion*—For motor gasoline or non-aviation gasoline, solvent washed gum content was previously referred to as existent gum.

3.4 *unwashed gum content*—the evaporation residue of the product or component under test, without any further treatment.

4. Summary of Test Method

4.1 A measured quantity of fuel is evaporated under controlled conditions of temperature and flow of air or steam. For aviation gasoline and aviation turbine fuel, the resulting residue is weighed and reported as milligrams per 100 mL. For motor gasoline, the residue is weighed before and after extracting with heptane and the results reported as milligrams per 100 mL.

5. Significance and Use

5.1 The true significance of this test method for determining gum in motor gasoline is not firmly established. It has been proved that high gum can cause induction-system deposits and sticking of intake valves, and in most instances, it can be assumed that low gum will ensure absence of induction-system difficulties. The user should, however, realize that the test method is not of itself correlative to induction-system deposits. The primary purpose of the test method, as applied to motor gasoline, is the measurement of the oxidation products formed in the sample prior to or during the comparatively mild conditions of the test procedure. Since many motor gasolines are purposely blended with nonvolatile oils or additives, the heptane extraction step is necessary to remove these from the

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricantsand is the direct responsibility of Subcommittee D02.14 on Stability and Cleanliness of Liquid Fuels.

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In the IP, this test method is under the jurisdiction of the Standardization Committee.

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

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

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] Available from Institute of Petroleum, 61 New Cavendish St., London, W.I., England.

evaporation residue so that the deleterious material, gum, may be determined. With respect to aviation turbine fuels, large quantities of gum are indicative of contamination of fuel by higher boiling oils or particulate matter and generally reflect poor handling practices in distribution downstream of the refinery.

6. Apparatus

6.1 *Balance*, capable of weighing test specimens to the nearest 0.1 mg.

6.2 *Beakers*, of 100-mL capacity, as illustrated in Fig. 1. Arrange the beakers in sets, the number in each set depending upon the number of beaker wells in the evaporating bath. Mark each beaker in the set, including the tare beaker, with an identifying number or letter.

6.3 *Cooling Vessel*—A tightly covered vessel, such as a desiccator without desiccant, for cooling the beakers before weighing.

NOTE 1—The use of a desiccant could lead to erroneous results.

6.4 *Evaporation Bath* (**Warning**—If a liquid-filled evaporation bath is used, care must be taken that the flash point of the liquid used is at least 30°C higher than the highest bath temperature expected.) Either a solid metal block bath or a liquid bath, electrically heated, and constructed in accordance with the general principles shown in Fig. 1 may be used. (Although all dimensions are given in SI units, older baths conforming to Test Method D 381 – 94, or earlier, are suitable.) The bath should have wells and jets for two or more beakers. The rate of flow from each outlet when fitted with the conical adapters with 500 to 600 micron copper or stainless steel screens should not differ from 1000 mL/s by more than 15 %. A liquid bath, if used, shall be filled to within 25 mm of the top with a suitable liquid. Temperature shall be maintained by means of thermostatic controls or by refluxing liquids of suitable composition.

6.5 *Flowmeter*, capable of metering a flow of air or steam equivalent to 1000 mL/s for each outlet.

NOTE 2—Alternatively, a pressure gage may be used to meter the flow of air or steam equivalent to 1000 ± 150 mL/s for each outlet.

6.6 *Sintered Glass Filtering Funnel*, coarse porosity, 150-mL capacity.

6.7 *Steam*—Supply by suitable means capable of delivering to the bath inlet the required amount of steam at 232 to 246°C.

6.8 *Temperature Sensor*, liquid-in-glass thermometer conforming to the requirements in the specification(s) for ASTM 3C/IP73C, or another temperature measuring device or system, or both, of at least equivalent accuracy and precision over a temperature range from –5 to 400°C.

6.9 *Graduated Cylinders*, with spout, capable of measuring 50 ± 0.5 mL.

6.10 *Forceps*, stainless steel, spade ended.

7. Materials

7.1 *Air*—Supply of filtered air at a pressure not more than 35 kPa.

7.2 *Gum Solvent*—A mixture of equal volumes of toluene and acetone.

7.3 *Heptane*—Minimum purity of 99.7 %.

7.4 *Steam*—Supply of steam free of oily residue and at a pressure not less than 35 kPa. (**Warning**—If a steam superheater is used, there may be exposed hot surfaces on the steam superheater. Avoid contact with exposed skin by use of protective equipment as required.)

8. Assembly of Air-Jet Apparatus

8.1 Assemble the air-jet apparatus as shown in Fig. 1. With the apparatus at room temperature, adjust the air flow to give a rate of 600 ± 90 mL/s for the outlet under test. Check the remaining outlets for uniform air flow.

NOTE 3—A flowmeter reading of 600 mL/s for each outlet on a flowmeter calibrated at room temperature and atmospheric pressure will ensure delivery of 1000± 150 mL/s at the temperature of 155 ± 5°C, provided the back pressure of the flowmeter is less than 1 kPa.

8.2 Apply heat to the evaporation bath (see 6.4) until the temperature of the bath is between 160 and 165°C. Introduce air into the apparatus at a rate indicated on the flowmeter (see 6.5) from the exercise carried out in 8.1. Measure the temperature in each well with the temperature sensor (see 6.8) placed with the bulb or sensor tip resting on the bottom of the beaker in the well. Do not use any well having a recorded temperature outside the range from 150°C to 160°C.

9. Assembly of Steam-Jet Apparatus

9.1 Assemble the steam-jet apparatus as shown in Fig. 1

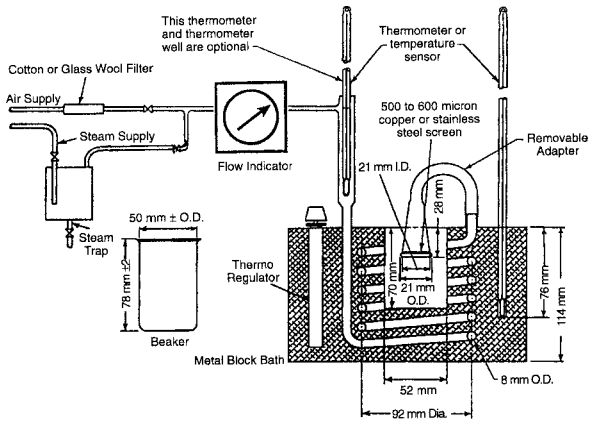

FIG. 1 Apparatus for Determining Gum Content by Jet Evaporation