Designation: D1070 – 03 (Reapproved 2017)

Standard Test Methods for Relative Density of Gaseous Fuels[1]

This standard is issued under the fixed designation D1070; 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.

1. Scope

1.1 These test methods cover the determination of relative density of gaseous fuels, including liquefied petroleum gases, in the gaseous state at normal temperatures and pressures. The test methods specified are sufficiently varied in nature so that one or more may be used for laboratory, control, reference, gas measurement, or in fact, for any purpose in which it is desired to know the relative density of gas or gases as compared to the density of dry air at the same temperature and pressure.

1.2 The procedures appear in the following sections:

	Section
Method A, Ac-Me Gravity Balance	7 – 9
Method B, Ranarex Recording and Indicating Gravitometer	10-11
Method C, UGC Gravitometer	12 – 14

NOTE 1—The test methods and apparatus described herein are representative of methods and apparatus used broadly in industry. Manufacturer's instructions for specific models should be consulted for further details and as supplements to the information presented here. In addition to instrumentation described below additional equally accurate and satisfactory instruments may be available.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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.*

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D5503 Practice for Natural Gas Sample-Handling and Conditioning Systems for Pipeline Instrumentation (Withdrawn 2017)[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *density*—mass per unit of volume of the fuel gas or air being considered.

3.1.2 *gaseous fuel*—material to be tested, as sampled, without change of composition by drying or otherwise.

3.1.3 *relative density*—ratio of the density of the gaseous fuel, under the observed conditions of temperature and pressure, to the density of dried air, of normal carbon dioxide content, at the same temperature and pressure.

3.1.3.1 *Discussion*—In these test methods the term "relative density" has replaced the term "specific gravity." The term, specific gravity, as used in a previous edition of these test methods, was used incorrectly.

3.1.4 *relative humidity*—ratio of actual pressure of existing water vapor to maximum possible pressure of water vapor in the atmosphere at the same temperature, expressed as a percentage.

4. Summary of Test Methods

4.1 *Displacement Balances*—This test method is based on the balancing of the weight of a fixed volume of gas at atmospheric pressure against the weight of dry air across the center of gravity of a balance beam. The amount of this "deflection," subject to correction, for humidity, high CO_2 content or other factor measures the relative density. Instruments of this class may be either visual or chart recording.

4.2 *Kinetic Energy*—This test method measures the ratio of the change in kinetic energy between an impeller and an impulse wheel operating in gas and a second impeller and

[1] These test methods are under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and is the direct responsibility of Subcommittee D03.03 on Determination of Heating Value and Relative Density of Gaseous Fuels.

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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] The last approved version of this historical standard is referenced on www.astm.org.

impulse wheel operating in a reference gas (generally air). The relative torque of the impulse wheels is measured and provides a value for relative density since the relative torque is proportional to the gas and air densities.

5. Significance and Use

5.1 These test methods provide accurate and reliable methods to measure the relative density of gaseous fuels on an intermittent or continuous basis. These measurements are frequently used for regulatory or contract compliance custody transfer and process control.

6. Sampling

6.1 The sample shall be representative of the gas to be measured and shall be taken from its source without change in form or composition. Sampling of natural gases should be in accordance with Practice D5503.

METHOD A—Ac–Me GRAVITY BALANCE (Four-Spring Type)

7. Apparatus

7.1 *Ac–Me Gravity Balance (Four-Spring Type),* pressure-tight cylindrical container mounted on a base board. Inside the container is a balance beam with a sealed float at the back and graduated scale at the front. The beam is suspended at the center by thin flat springs. A window for viewing the scale is provided at the front of the container. The balance beam may be locked by a cam mechanism when the instrument is not in use. Valves for introducing gas and air samples are provided.

7.2 *Carrying Case,* for transportation or storage.

7.3 *Air Dryer,* to dehydrate air samples (silica gel).

7.4 *Tripod,* to support the balance firmly.

7.5 *Pressure-Vacuum Pump,* to transfer samples and adjust pressure in the balance.

7.6 *Mercury Manometer,* 760 mm, to measure pressure in the balance.

7.7 *Aneroid Barometer,* temperature compensated to convert balance pressure readings to absolute pressures. (Absolute pressure not corrected to sea level.)

7.8 *Rubber Hose,* 6.35-mm (¼-in.) inside diameter, four lengths with brass swivel connections to join the balance to its operating accessories.

7.9 *Sampling Hose,* 6.35 mm (¼ in.) with swivel connections and two male 6.35-mm (¼-in.) pipe adapters.

7.10 *Additional Apparatus*—Refer to the manufacturer's literature for further information on sizes, assembly, and other details applicable to specific models.

8. Procedure

8.1 Assemble and set up the balance in accordance with the manufacturer's instructions, making certain that it is firmly supported, level, and is not disturbed during the entire test. Take and record the following four readings:

8.1.1 *Average Barometric Reading*—Read the aneroid barometer at the beginning and end of each test, and record the average of these two readings.

8.1.2 *Air Reading:*

8.1.2.1 Admit air through first valve and air dryer until atmospheric pressure is reached. Record temperature in the balance. Close first valve.

8.1.2.2 Open second valve and pull a vacuum of about 650 mm, then close second valve. Unlock the balance beam by turning locking level counterclockwise. The beam will then be in an unbalanced position with the zero above the hairline indicator.

8.1.2.3 Observe the scale from such a position that the reflection of your eye in the look glass is centered on the hairline. Admit air through first valve and air dryer until the beam begins to fall. Then pinch down the flow of air through first valve so that the air can be cut off at exactly the right instant to keep the beam in the balanced position. Observe the scale noting how far the zero swings above and below the hairline. The beam is balanced when the zero of the scale is swinging an equal amount above and below the hairline.

8.1.2.4 When balance is obtained, lock instrument and read and record the air vacuum shown on the manometer. Record the temperature within the balance.

8.1.3 *Gas Reading:*

8.1.3.1 Close the valve on the air dryer and close Valve 1. Then open Valve 2 and pull a vacuum of about 650 mm on the balance.

8.1.3.2 Open gas supply valve and admit gas to the balance until the pressure reads about 650 mm. (Do not exceed manometer maximum reading or the balance may be damaged.)

8.1.3.3 Repeat 8.1.3.1 and 8.1.3.2 three times. The third time will leave only about 0.05 % air in the balance. If the balance is purged by flowing gas through it, the purging should be continued until two successive readings (8.1.3.4) check.

8.1.3.4 Unlock the instrument and release gas pressure through Valve 2 until balanced position of beam is reached. Follow the same method as described for the air reading in 8.1.2.4. When balance is obtained, lock the instrument and record the gas pressure shown on the manometer. Record the temperature in the balance.

NOTE 2—When the gas supply is under a vacuum or has a high content of hydrocarbons heavier than ethane, keep the gas pressure within the balance below that in the source line or container to avoid condensation in the balance. If necessary, readjust instrument to balance on gas at a vacuum about 20 mm higher than that in the sampling source.

8.1.4 *Air Check Reading:*

8.1.4.1 Close gas supply valves. Open second valve and pull a vacuum of about 650 mm.

8.1.4.2 Admit air through the air dryer to the balance until atmospheric pressure is reached. Close first valve.

8.1.4.3 Repeat 8.1.4.1 and 8.1.4.2 at least three times or until two successive readings (8.1.4.4) will check.

8.1.4.4 Open second valve and pull a vacuum of about 650 nm, then close second valve. Unlock instrument; admit air through first valve to bring the beam to the balanced position as when taking the first air reading.