Designation: D1071 – 17

Standard Test Methods for Volumetric Measurement of Gaseous Fuel Samples[1]

This standard is issued under the fixed designation D1071; 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 volumetric measuring of gaseous fuel samples, including liquefied petroleum gases, in the gaseous state at normal temperatures and pressures. The apparatus selected covers a sufficient variety of types so that one or more of the methods prescribed may be used for laboratory, control, reference, or in fact any purpose where it is desired to know the quantity of gaseous fuel or fuel samples under consideration. The various types of apparatus are listed in Table 1.

1.2 *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.*

1.3 *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. Terminology and Units of Measurement

2.1 *Definitions: Units of Measurement*—All measurements shall be expressed in inch-pound units (that is: foot, pound (mass), second, and degrees Fahrenheit); or metric units (that is: metre, kilogram, second, and degrees Celsius).

2.2 *Standard Conditions,* at which gaseous fuel samples shall be measured, or to which such measurements shall be referred, are as follows:

2.2.1 *Inch-pound Units:*

(1) A temperature of 60.0°F,

(2) A pressure of 14.73 psia.

(3) Free of water vapor or a condition of complete water-vapor saturation as specified per individual contract between interested parties.

2.2.2 *SI Units:*

(1) A temperature of 288.15K (15°C).

(2) A pressure of 101.325 kPa (absolute).

(3) Free of water vapor or a condition of complete water-vapor saturation as specified per individual contract between interested parties.

2.3 *Standard Volume:*

2.3.1 *Standard Cubic Foot of Gas* is that quantity of gas which will fill a space of 1.000 ft^3 when under the standard conditions (2.2.1).

2.3.2 *Standard Cubic Metre of Gas* is that quantity of gas which will fill a space of 1.000 m^3 when under the standard conditions (2.2.2).

2.4 *Temperature Term for Volume Reductions*—For the purpose of referring a volume of gaseous fuel from one temperature to another temperature (that is, in applying Charles' law), the temperature terms shall be obtained by adding 459.67 to each temperature in degrees Fahrenheit for the inch-pound units or 273.15 to each temperature in degrees Celsius for the SI units.

2.5 At the present state of the art, metric gas provers and meters are not routinely available in the United States. Throughout the remainder of this procedure, the inch-pound units are used. Those having access to metric metering equipment are encouraged to apply the standard conditions expressed in 2.2.2.

NOTE 1—The SI conditions given here represent a "hard" metrication, in that the reference temperature and the reference pressure have been changed. Thus, amounts of gas given in metric units should always be referred to the SI standard conditions and the amounts given in inch-pound units should always be referred to the inch-pound standard conditions.

3. Significance and Use

3.1 The knowledge of the volume of samples used in a test is necessary for meaningful results. Validity of the volume measurement equipment and procedures must be assured for accurate results.

4. Apparatus

4.1 The various types of apparatus used for the measurement of gaseous fuel samples may be grouped in three classes, as shown in Table 1. References to the portions of these methods covering the capacity and range of operating conditions, and the calibration, of each type are given in Table 1.

---

[1] These test methods are under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and are the direct responsibility of Subcommittee D03.01 on Collection and Measurement of Gaseous Samples.

Current edition approved April 1, 2017. Published April 2017. Originally approved in 1954. Last previous edition approved in 2003 as D1071 – 83 (2003) which was withdrawn January 2017. DOI: 10.1520/D1071-17.

TABLE 1 Apparatus for Measuring Gaseous Fuel Samples

Apparatus	Capacity and Range of Operating Conditions Covered in Section No.	Calibration Procedure Covered in Section No.
Containers		
Cubic-foot bottle, immersion type of moving-tank type	5	12
Portable cubic-foot standard (Stillman-type)	5	12
Fractional cubic-foot bottle	5	12
Burets, flasks, and so forth, for chemical and physical analysis	6	12
Calibrated gasometers (gas meter provers)	7	13 – 16
Gas meters, displacement type:		
Liquid-sealed relating-drum meters	8	17 – 22
Diaphragm- or bellows-type meters, equipped with observation index	9	23
Rotary displacement meters	10	24
Gas meters, rate-of-flow type:		
Porous plug and capillary flowmeters	11	25
Float (variable-area, constant-head) flowmeters	11	25
Orifice, flow nozzle, and venturi-type flowmeters	11	25

CAPACITY OF APPARATUS AND RANGE OF OPERATING CONDITIONS

5. Cubic-Foot Bottles, Standards, and So Forth

5.1 The capacities of cubic-foot bottles, standards, and so forth, are indicated by their names. A portable cubic-foot standard of the Stillman type is shown in Fig. 1 and a fractional cubic-foot bottle is shown in Fig. 2. The temperatures and pressures at which these types of apparatus are used must be very close to those existing in the room in which they are located. Since these containers are generally used as standards for the testing of other gas-measuring devices, the rate at which they may be operated is of little or no importance. It will always be low, and probably nonuniform, and in any given instance will be affected by the test being made and the connections used.

FIG. 1 Stillman-Type Portable Cubic-Foot Standard

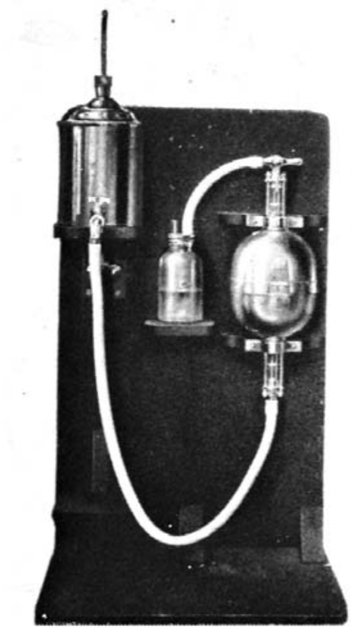

FIG. 2 One-Tenth Cubic Foot Bottle, Transfer Tank, and Bubble-Type Saturator for Testing Laboratory Wet Gas Meters

6. Burets, Flasks, and So Forth

6.1 The capacities of burets, flasks, and so forth, will depend upon their function in the equipment and service in which they are to be used. The range of temperatures and pressures under which they may be used, which will be affected by their function, will depend upon the material of construction and may be relatively high (for example, 1000°F and 10 000 psi) if suitable materials are used.

7. Calibrated Gasometers

7.1 The stock capacities of calibrated gasometers (gas meter provers) are 2, 5, and 10 ft^3. The temperature and pressure at which they can be operated must be close to the ambient temperature and within a few inches of water column of atmospheric pressure. The equivalent rates of flow that may be attained, conveniently, are as follows:

Size, ft^3	Equivalent Rate, ft^3 of air/h
2	990
5	2250
10	5000

NOTE 2—Gasometers having volumetric capacities up to several thousand cubic feet have been made for special purposes. Their use is limited to temperatures close to the ambient temperature, although some may be operated as pressures slightly higher than mentioned above. These large gasometers can hardly be classed as equipment for measuring gaseous

samples, and are mentioned only for the sake of completeness.

8. Liquid-Sealed Rotating-Drum Meters

8.1 The drum capacities of commercial stock sizes of liquid-sealed rotating-drum meters range from 1⁄20 (or litre) to 7.0 ft^3 per revolution. A 0.1-ft^3 per revolution meter is shown in Fig. 3. The operating capacities, defined as the volume of gas having a specific gravity of 0.64 that will pass through the meter in 1 h with a pressure drop of 0.3-in. water column across the meter, range from 5 to 1200 ft^3/h. Liquid-sealed rotating-drum meters may be calibrated for use at any rate for which the pressure drop across the meter does not blow the meter seal. However, if the meter is to be used for metering differing rates of flow, a calibration curve should be obtained, as described in Section 20, or the meter should be fitted with a rate compensating chamber (see Appendix X1).

8.2 The temperature at which these meters may be operated will depend almost entirely upon the character of the sealing liquid. If water is the sealing liquid, the temperature must be above the freezing point and below that at which evaporation will affect the accuracy of the meter indications (about 120°F). Outside of these limits some other liquid will be required.

8.3 While the cases of most meters of this type may withstand pressures of about 2-in. Hg column above or below atmospheric pressure, it is recommended that the maximum operating pressure to which they are subjected should not exceed 1-in. Hg or 13 in. of water column. For higher pressures, the meter case must be proportionally heavier or the meter enclosed in a suitable pressure chamber. For pressures more than 1-in. Hg (13 in. of water) below atmospheric pressure, not only must a heavier case or a pressure chamber be used, but a sealing fluid having a very low vapor pressure must be used in place of water.

FIG. 3 Liquid-Sealed Rotating-Drum Gas Meter of 0.1 ft^3 per Revolution Size

9. Diaphragm-Type Test Meters

9.1 The displacement capacities of commercial stock sizes of diaphragm-type test meters range from about 0.05 to 2.5 ft^3 per revolution (of the tangent arm or operating cycle). The operating capacities, defined as the volume of gas having a specific gravity of 0.64 that a meter will pass with a pressure drop of 0.5 in. of water column across the meter, range from about 20 to 1800 ft^3/h. Usually these meters can be operated at rates in excess of their rated capacities, at least for short periods. A meter having a capacity of 1 ft^3 per revolution is shown in Fig. 4.

9.2 The temperature range under which these meters may be operated will depend largely upon the diaphragm material. For leather diaphragms, 0 to 130°F is probably a safe operating range. At very low temperatures, the diaphragms are likely to become very stiff and cause an excessive pressure drop across the meter. At higher temperatures, the diaphragms may dry out rapidly or even become scorched causing embrittlement and leaks.

9.3 The pressure range (line pressure) to which these meters may be subjected safely will depend upon the case material and design. For the lighter sheet metal (tin case) meters, the line pressure should not be more than 3- or 4-in. Hg column above or below atmospheric pressure. For use under higher or lower line pressures, other types of meter cases are available, such as cast aluminum alloy, cast iron, or pressed steel.

NOTE 3—The diaphragm-type test meter and the diaphragm-type consumers meter are similar in most respects. The principal difference is the type of index or counter. The test meter index has a main hand

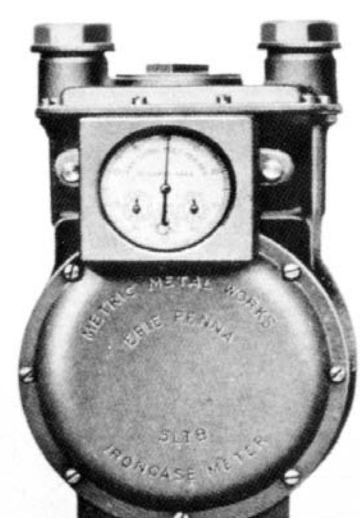

FIG. 4 Iron-Case Diaphragm-Type Gas Meter with Large Observation Index