Designation: D1071 – 83 (Reapproved 2008)

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.*

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.

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

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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

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

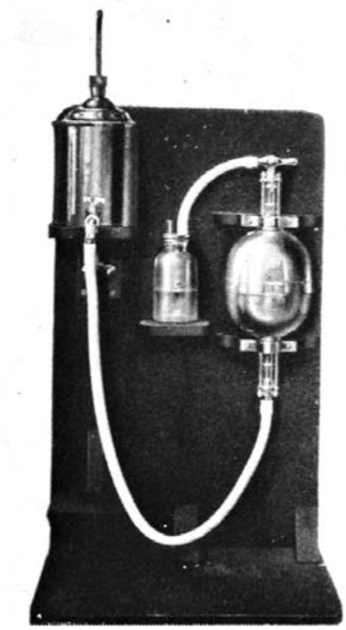

FIG. 2 One-Tenth Cubic Foot Bottle, Transfer Tank, and Bubble-Type Saturator for Testing Laboratory Wet Gas Meters

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 indicating 1 ft^3 per revolution over a 3-in. or larger dial, with additional smaller dials giving readings to 999 before repeating. On the index of consumers meters, aside from the test hand, the first dial indicates 1000 ft^3 per revolution of its hand so that the smallest volume read is 100 ft^3. The maximum reading for a consumers meter index may be 99 900 or 999 900.

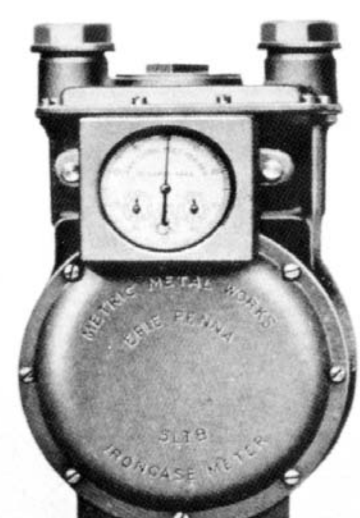

FIG. 4 Iron-Case Diaphragm-Type Gas Meter with Large Observation Index

Another minor difference is that the maximum rated capacity for the larger consumers meters may be 17 000 ft^3/h.

10. Rotary Displacement Meters

10.1 Rotary displacement gas meters are mentioned here only to have a complete coverage of meters for gas, since meters of this type are of relatively large capacity, beyond that of sample measurement (Note 4). The rated capacities of stock sizes range from about 4000 to about 1 000 000 ft^3/h. They may be used at somewhat higher temperatures than other displacement meters, probably 400 to 500°F and are available for use under line pressures up to about 125 psi.

NOTE 4—It is of course possible to use a very small meter of this type as a test or "sample" meter. See Bean, H. S., Benesh, M. E., and Whiting, F. C., "Testing Large-Capacity Rotary Gas Meters," *Journal of Research*, Nat. Bureau Standards, JRNBA, Vol 37, No. 3, Sept. 1946, p. 183. (*Research Paper RP1741*).

11. Rate-of-Flow Meters

11.1 Rate-of-flow meters, as the name implies, indicate rates of flow, and volumes are obtained only for a definite time interval. They are especially useful in those situations where the flow is steady, but are not suited for use in the measurement of specified quantities nor on flows that are subject to wide or more or less rapid variations of either rate or pressure. In the smaller sizes, they may be particularly useful for both regulating and measuring continuous samples of a gaseous fuel.

11.2 No definite limits can be set to the range of rate of flow to which these meters may be applied, nor to the range of temperatures and pressures under which they may be operated. Where meters of this type are desired, it will usually be possible to design one to meet the particular service requirements. Of particular interest for continuous sampling and sample measurement are flowmeters of the capillary tube and porous plug (for example, sintered glass filter) type. The rates of flow that they can meter satisfactorily range upward from about 0.03 ft^3/min. The pressure drop across the metering element is not only low (a few inches of water column), but its relationship to the rate of flow is very nearly linear.

CALIBRATION OF APPARATUS

12. Calibration of Primary Standards

12.1 Cubic-foot bottles and fractional cubic-foot bottles are calibrated by weighing the quantity of distilled water that will be delivered between the gage marks (Note 5), correcting for the buoyancy of the air. At the standard conditions specified in 2.2, the weight of water contained between the gage marks of a correctly adjusted cubic-foot bottle should be 62.299 lb.

NOTE 5—It is now the practice at the National Bureau of Standards to calibrate or adjust these standards "to deliver" the specified quantity of water from a *wet* condition. To do this, the standard is filled with water, then emptied slowly over a period of 3 min and allowed to drain for an additional 3 min. Next, the quantity (weight) of distilled water contained between the two gage marks is determined. The corresponding volume of this quantity of water, adjusted to a temperature of 60°F, should be 1.000 ± 0.05 %.

12.2 A Stillman-type portable cubic-foot standard is calibrated by comparison with an immersion-type cubic-foot bottle. The calibration involves adjusting the stroke of the bell so that as 1 ft^3 of air is transferred from the bottle, or the reverse, the pressure within the system does not change, provided the temperature of the entire system is maintained constant. This requires that the test should be made in a room in which the temperature can be maintained constant and uniform within less than 0.5°F. Moreover, to diminish the cooling effects of evaporation from the surfaces of the bottle and bell, the sealing fluid should be a light, low-vapor pressure oil. Other observations forming a part of this calibration are those of the time intervals required for raising the bottle and bell from their respective tanks and the intervals they are held up for drainage to take place before pressure readings are made. From these times, corrections are determined for the volumes of undrained liquid.

12.3 Burets, flasks, and so forth, are considered a part of the analytical apparatus in which they are used, and methods of calibrating them therefore are not covered here.

NOTE 6—An outline of such methods is given in National Bureau of Standards *Circular C434* NBSCA, "Testing of Glass Volumetric Apparatus," by E. L. Peffer and Grace C. Mulligan.

13. Calibration of Secondary or Working Standards (Provers), General Considerations

13.1 Gas meter provers of 2-, 5-, and 10-ft^3 capacity customarily are calibrated by comparison with a cubic-foot bottle or standard as described in Sections 14 and 15. The procedure consists of measuring air out of or into the prover by means of the standard, 1 ft^3 at a time, noting the reading of the prover scale at the start and finish of each transfer. Some general considerations to be observed are given in 13.2 and 13.3.

13.2 Provers should be located in a well-lighted room provided with some degree of temperature regulation. It is desirable that this regulation should be adequate to maintain the temperature within ±2°F of the desired average temperature. The prover tank should be raised from the floor by legs or blocks as this not only reduces the lag between the prover and room temperatures but decreases the accumulation of moisture on the underside of the tank. If water is used as the sealing fluid in the provers, the relative humidity within the room should be maintained as high as possible. However, it is recommended that the sealing fluid used in provers (and in cubic-foot bottles and standards also) should be a light oil with a low vapor pressure of about 0.25-in. Hg at 70°F (Note 7). The use of oil as a sealing fluid will decrease the cooling effect caused by evaporation, when the prover bell is raised from the tank, and will also retard any tendency of the bell to corrode.

NOTE 7—This requirement for vapor pressure will probably be met if the open cup flash point is above 330°F, since the vapor pressure at the flash point is usually about 0.3- to 0.5-in. Hg.

13.3 Before starting a calibration, the bell should be examined to see that it is clean and free of dents. It should move freely throughout its entire travel with neither binding nor excessive play within its guides at any position. To facilitate reading the prover scale to one decimal place beyond that normally used when testing meters, the regular scale pointer may be replaced with a short auxiliary scale covering a 0.2-ft^3 interval of the main scale. This scale should be divided into 10 or 20 divisions, and mounted so that its mid-point will be at about the same elevation as the regular pointer.

14. Calibration of Provers by Means of an Immersion-Type Bottle

14.1 While it is possible to measure air out of a prover into an immersion bottle under the usual prover pressure, it is difficult not to lose some air as the lower neck of the bottle is raised close to the surface of the sealing fluid in its tank. Therefore, it is advisable to make the test at atmospheric pressure. This requires increasing the counterweights until they just balance the bell. This adjustment is necessary if air is to be measured *into* a prover from an immersion bottle.

14.2 Starting with the prover bell raised and the connection between prover and bottle open, adjust the position of the prover bell to zero scale reading. Raise the bottle, thereby drawing air into it from the prover. As the lower neck of the bottle reaches the surface of the sealing fluid, proceed carefully so as to stop just short of breaking the seal and close the valve between prover and bottle. Observe and record the scale reading. Vent the air in the bottle as it is again lowered into the tank. Open the valve between prover and bottle, adjust the prover bell to a scale reading of 1.00, and repeat the process of removing another cubic foot of air from the prover.

14.3 In measuring air into the prover, reverse the procedure just described. In this case, adjust the prover bell to a scale reading at one of the even foot marks, and hold it there while lowering the bottle until the bottom of the lower neck just meets the surface of the sealing fluid. Release the prover bell and measure a cubic foot of air into it by lowering the bottle.

15. Calibration of Provers by Means of a Moving-Tank Type of Bottle or a Stillman-Type Portable Cubic-Foot Standard

15.1 With either a moving-tank type of bottle or a Stillman-type portable cubic-foot standard the calibration may be carried out under the usual prover pressure. This requires, when using a moving-tank type of bottle, that the valves in the connections between the bottle and prover shall be open while adjusting the quantity of water in the tank and the positions of the stops so that the water will come to rest in the planes of the gage marks about the upper and lower necks of the bottle. Also, since the transfer of air to or from the prover takes place within a completely closed system, there is no possibility of losing a small amount of air at one end of the transfer, as with an immersion-type bottle.

15.2 The procedure followed with either type of standard is very simple. After the connections have been checked for leaks, and with the valves between prover and standard open, bring an even foot mark on the prover scale in line with the index zero. Transfer a cubic foot of air to the standard, and note and record the prover scale reading. Discharge the air in the standard from the system and repeat the cycle.

15.3 If so desired, several transfers each may be made for the same 1-ft^3 interval of the prover scale before going on to the next interval. In doing this, the prover scale reading should be readjusted to the even foot mark before a transfer in either direction is started being careful to have the connection between prover and standard open so that both are under the full prover pressure.

NOTE 8—*Example*—The observations and calculations involved in the calibration of a 5-ft^3 gas meter prover with a Stillman-type standard are shown in Table 2. The average delivery capacities of the 0- to 1- and 1- to 2-ft^3 intervals, from the five determinations on each interval, are 1.008 and 1.004, respectively. This means that if a correctly adjusted gas meter is tested against the 0- to 2-ft^3 interval, the final prover scale reading would be 1.99.

16. Calibration of Large Provers

16.1 The method to be used in calibrating gasometers of over 10-ft^3 capacity will depend upon the capacity, design, and mode of operation of the gasometer. If it is not too large (100 ft^3 or less), it may be most convenient to use a cubic-foot standard or a 5- or 10-ft^3 prover that has been calibrated. For other gasometers, it will probably be necessary to determine the capacity from a measurement of the dimensions. The procedure usually followed is to measure the outside circumference of the prover bell at several sections. From these measurements and the metal thickness, the average inside cross-sectional area and capacity per unit height are computed. In making this calculation, it may be necessary to take account of changes of the sealing fluid height produced by raising and lowering of the bell.

17. Calibration of Small Water-Sealed Rotating Drum Meters, Especially for Use with Water-Flow Calorimeters (General Considerations)

17.1 The objective of the calibration of a rotating-drum gas meter may be:

17.1.1 To establish that relative elevation of the sealing water (that is, the amount of sealing water) with which the meter will indicate correctly (for example, within 0.2 %) the volume of gas, at the outlet conditions, that passes through it, or

17.1.2 With a given quantity of sealing water, to determine the factor (calibration factor) by which the indications of the meter are to be multiplied to give the correct volumes of gas, at outlet conditions, that have passed through the meter.

17.2 The two procedures described in Section 19 are intended for the routine calibration of a 0.1-ft^3 wet test meter that is to be used in conjunction with a water-flow calorimeter in the determination of the heating valve of a fuel gas. Furthermore, it is recommended that these calibrations be made with the meter in the position in which it will be used in the calorimetric determinations. When the conditions under which the meter will be used are such that the rate of flow through the meter will be less than 8 ft^3/h, the procedure described in 19.1 – 19.3, using a 0.1-ft^3 bottle, may be followed. If the rate of flow through the meter, when in use, will exceed 8 ft^3/h, the aspirator method of calibration described in Section 20 should be followed.

17.3 The average rate of flow at which the calibration is performed should be adjusted and maintained as nearly as possible the same as that at which the meter will operate when

TABLE 2 Sample Data Sheet from Calibration of Bell Prover[A]

Prover Serial #272					Calibration Standard				Date: 4/30/47
S_i	R_b	R_s	ΔV_s	ΔV_c	ΔS_c	K	Temperatures, °F		
Major Scale Interval Calibrated	Prover Scale Readings, ft³ Begin	Stop	Scale Indicated Vol, ft³ (ΔR)	Standard Transferred Vol, ft³	Calculated Transferred Vol, ft³ (for *Si*)	Algebraic Correction of Proof N_s, %	Room Air	Standard Oil	Prover Oil
0 to 1	0.000	0.991	0.991	1.000	1.009	...	81.9	82.0	82.7
1 to 0	1.000	0.008	0.992	1.000	1.008	...	...	...	...
0 to 1	0.000	0.992	0.992	1.000	1.008	...	...	...	...
1 to 0	1.000	0.008	0.992	1.000	1.008	...	...	...	...
1 to 2	1.000	1.999	0.999	1.000	1.001	...	...	...	...
2 to 1	2.000	1.006	0.994	1.000	1.006	...	...	...	...
1 to 2	1.000	1.998	0.998	1.000	1.002	...	...	...	...
2 to 1	2.000	1.005	0.995	1.000	1.005	...	...	...	...
2 to 3	2.000	3.003	1.003	1.000	0.997	...	...	...	...
3 to 2	3.000	2.000	1.000	1.000	1.000	...	...	...	...
2 to 3	2.000	3.005	1.005	1.000	0.995	...	...	...	...
3 to 2	3.000	1.999	1.001	1.000	0.999	...	...	...	...
3 to 4	3.000	3.998	0.998	1.000	1.002	...	...	...	...
4 to 3	4.000	3.008	0.992	1.000	1.008	...	...	...	...
3 to 4	3.000	3.996	0.996	1.000	1.004	...	...	...	...
4 to 3	4.000	3.007	0.993	1.000	1.007	...	...	...	...
4 to 5	4.000	4.999	0.999	1.000	1.001	...	81.9	82.7	83.0
5 to 4	5.000	4.003	0.997	1.000	1.003	...	...	...	...
4 to 5	4.000	4.999	0.999	1.000	1.001	...	...	...	...
5 to 4	5.000	4.002	0.998	1.000	1.002	...	...	...	...
0 to 1	...	...	0.992	1.000	1.008	+ 0.8	...	...	...
1 to 2	...	...	0.996	1.000	1.004	+ 0.4	...	...	...
2 to 3	...	...	1.002	1.000	0.998	−0.2	...	...	...
3 to 4	...	...	0.995	1.000	1.005	+ 0.5	...	...	...
4 to 5	...	...	0.998	1.000	1.002	+ 0.2	...	...	...
0 to 2	0.000	1.988	1.988	2.000	2.012	+ 0.6	...	...	...
2 to 4	2.000	1.997	1.997	2.000	2.003	+ 0.2	...	...	...
0 to 5	0.000	4.983	4.983	5.000	5.017	+ 0.3	...	...	...

[A] The meanings and use of the identified columns in Table 2 are:

S_i This is the *major* scale interval calibrated *or* the "normal operating" scale interval used in a normal proving cycle. Ordinarily, a normal operating scale interval has appropriate *scale subdivisions* above and below the "upper" major graduation mark. Also, a normal operating scale interval may consist of one or more adjacent major scale intervals. Scale *subdivisions* normally are *not* directly calibrated. The suitability or "accuracy" of subdivisions are usually determined by visual inspection and measurement. Subdivisions must be *proper and uniform* proportions of the intended normal operating scale interval. (Note—S_i is a *designation* of a specific *portion* of the scale and is *not a numerical volume quantity.*)

R_b The scale reading at which the calibration *began*.

R_s The carefully *estimated or measured* scale reading *after* the bottle or Stillman standard has transferred 1 ft³ or as many multiple cubic feet as is represented by the normal operating scale interval calibrated.

ΔV_s This is the scale *indicated* transferred volume and is the absolute difference between R_s and R_b such as $\Delta V_s = R_s - R_b$.

ΔV_c This is the "correct" transferred volume per the bottle or Stillman corresponding to the ΔV_s.

ΔS_c This is the "correct" or calculated delivery or displaced volume of the bell corresponding to bell movement over S_i. This is calculated thus:

$$\Delta S_c = \frac{(\Delta V_c)^2}{\Delta V_s}$$

K Correction to apply algebraically to the observed scale proof, N_s, to obtain the "correct" or calculated proof, N_c, thus:

$$N_c = N_s + K$$

in use. In no event should the difference between the test rate and the use rate exceed 30 % of the use rate. This is because the volume of gas delivered per revolution of a liquid-sealed rotating-drum meter increases slightly with increasing rate of flow. In this connection, note that, by proper adjustment of the rate during calibration, the aspirator procedure may be followed when the meter is to be used at rates below 8 ft³/h.

17.4 The calibration procedures are applicable when either fuel gas or air is used as the testing medium. If gas is used, the discharge from the meter must be vented or burned. If air is used, the meter water must be resaturated with gas before its use in subsequent calorific value tests.

17.5 When the purpose of the test is to determine the correct amount of sealing water for the meter (17.1.1), and this has been done by one of the test procedures described in Section 19, bring the metering drum to a position about midway between two of the seal-off positions, preferably with the long index hand nearly over the large dial zero and open both the inlet and outlet of the meter to atmosphere. Without altering the leveling adjustment of the meter, set the water level gage to the height of the bottom of the water meniscus in the gage glass. If the gage is the yoke type, the plane of the yoke top should coincide with that of the bottom of the meniscus. If the gage is the pointer type, start with the tip *below* the water surface and raise it until the tip appears to just meet its image in the water surface as viewed from below. Lock the gage in the position