Designation: D 1827 – 92 (Reapproved 1996)ε1

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
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# Standard Test Method for Gas Content (Nonacidic) of Insulating Liquids by Displacement with Carbon Dioxide[1]

This standard is issued under the fixed designation D 1827; 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—Editorial changes were made throughout in February 1997.

## 1. Scope

1.1 This test method describes the determination of the gas content of electrical insulating liquids with a viscosity of 216 cSt or less at 100°C. Any gas that is nonreactive with a strong caustic solution may be determined.

NOTE 1—The test method has a bias for samples containing gases other than oxygen and nitrogen in atmospheric ratios due to differential solubility effects. Gases which react with KOH such as carbon dioxide will not be measured. Unsaturated hydrocarbons such as acetylene, if present, will react with KOH to a small degree and will result in an underestimation of the total gas present.

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. Referenced Documents

2.1 *ASTM Standards:*

D 831 Test Method for Gas Content of Cable and Capacitor Oils[2]

D 923 Test Method for Sampling Electrical Insulating Liquids[2]

D 1193 Specification of Reagent Water[3]

D 3613 Test Methods of Sampling Electrical Insulating Oils for Gas Analysis and Determination of Water Content[2]

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *gas content by volume*—of an insulating liquid, the volume of gas contained in a given volume of liquid. It is usually expressed as a percentage at standard atmospheric conditions of 760 mm Hg pressure and 0°C temperature.

3.1.2 *gas content by weight*—the weight of gas contained in a given weight of liquid, usually expressed in parts per million.

## 4. Summary of Test Method

4.1 This test method consists essentially of purging dissolved gases from a small liquid test specimen with pure carbon dioxide gas. The dissolved gases are then carried into a graduated buret (precision nitrometer) filled with a potassium hydroxide solution for a precise measurement. The carbon dioxide is completely absorbed by the potassium hydroxide and the volume of other gases is measured.

## 5. Significance and Use

5.1 Electrical insulating liquids, in many applications, require low gas content. This is the case with capacitors and certain types of cable, for example. This test is used as a factory control test and as a control and functional test in installation and maintenance work by utilities. This test requires care in manipulation and trained, careful personnel.

## 6. Apparatus (see Fig. 1)

6.1 *Precision Nitrometer* (*azotometer*), *A*, with a calibrated capacity of 1.5 mL and calibrated in 0.01-mL divisions. Nitrometers shall have individual calibration correction tables that give the correct volume for each 0.01-mL point on the scale when a 40 % aqueous potassium hydroxide solution is used. The gas inlet shall consist of a 12/2 socket joint. The nitrometer shall be provided with a liquid leveling bulb, *B*, of 125-mL capacity. Rubber stoppers, *K*, with a short piece of glass capillary tubing, should be placed in the top of the nitrometer and the leveling bulb, *B*, to prevent spattering of the KOH solution.

6.2 *Permanent Magnet and Steel Wire*, The small steel wire, suitably consisting of a ⅜-in. (10-mm) length of paper clip, shall be placed inside the nitrometer for manipulation by the small external permanent magnet.

6.3 *Pregl-Type Micro Stopcock*, *C*, to allow delivery of gas to nitrometer or venting the gas to the atmosphere. This stopcock shall be provided with a 12/2 ball joint at the exit side and a 12/2 socket joint at the inlet side.

6.4 *Elbow Adapter*, *D*, consisting of a 12/2 ball joint and having a drawn-down tip suitable for insertion in a small hole in the rubber stopper, *E*.

6.5 *Stopper*, *E*, of oil-resistant rubber, cut to fit the sample-purging chamber, *F*, and provided with two small holes to

[1] This test method is under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gasesand is the direct responsibility of Subcommittee D27.03on Physical Tests.

Current edition approved Aug. 15, 1992. Published October 1992. Originally published as D 1827 – 61 T. Last previous edition D 1827 – 84.

[2] *Annual Book of ASTM Standards*, Vol 10.03.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

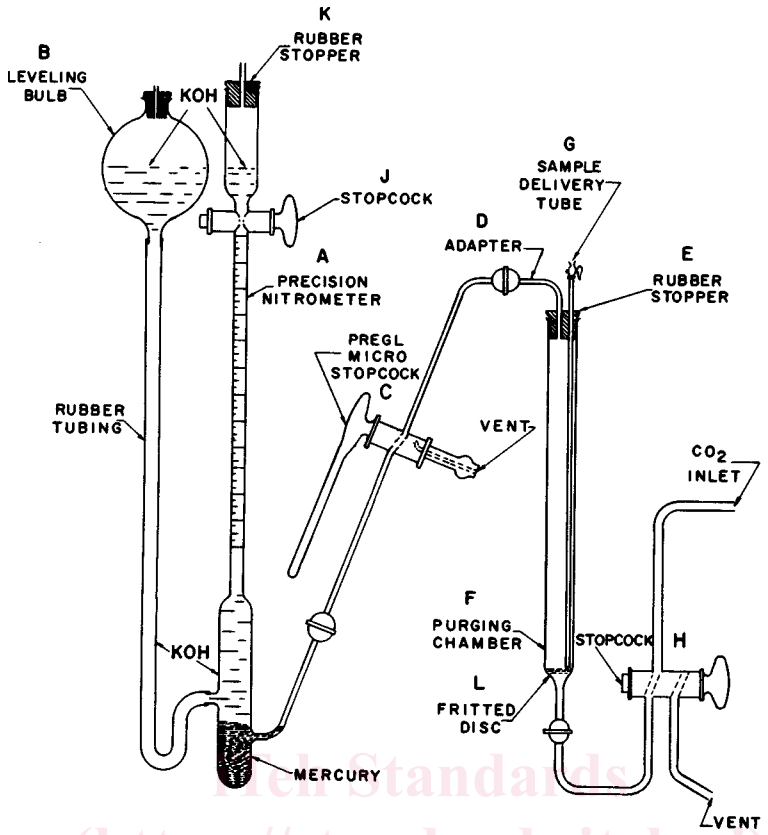


**FIG. 1 Semimicro Apparatus for Determination of Gas Content of Insulating Liquids**

allow tight fitting of the elbow adapter, *D*, and sample delivery tube, *G*.

6.6 *Sample-Purging Chamber, F*, with a 10-mm diameter fritted-glass disk, *L*, of medium porosity and a capacity of 15 mL above the disk for 10-mL test specimens, or with a 25-mm diameter fritted glass disk of medium porosity and a capacity of 75 mL above the disk for 50-mL test specimens. The gas inlet shall be cut straight to fit the stopper, *E*. A flexible heating tape, wrapped around the purging chamber, is necessary for holding constant temperature when test specimens are purged at temperatures in excess of room temperature.

6.7 *Sample Delivery Tube, G*, made of a length of 1⁄16-in. (1.6-mm) inside diameter stainless steel tubing, tightly inserted into one of the holes in the stopper, *E*, and extending to the fritted-glass filter. A small syringe stopcock shall be soldered to permit the delivery of an accurate volume of liquid and subsequent sealing of the purging chamber.

6.8 *Sampling Device*, consisting of a calibrated glass medical syringe fitted with a syringe stopcock for sealing of the test specimen during transfer or storage. The syringe for 10-mL test specimens shall have a calibrated capacity of 10 mL, and for 50-mL test specimens, a calibrated capacity of 50 mL. It shall be capable of accurately delivering a liquid volume within the accuracy required for the method.

6.9 *Ball-and-Socket Clamps*, size 12, for tightly securing all joints to prevent leakage.

6.10 *Two-Way Stopcock, H*, fitted to the inlet side of the purging chamber and having a 12/2 socket joint. The single-tube end of the stopcock shall be connected to the low-pressure carbon dioxide supply to control the entry of this gas to the apparatus.

6.11 *Low-Pressure Source* of very pure carbon dioxide ($CO_2$) gas. [4] If gas of sufficient purity is not available, one of the following mechanisms utilizing solid $CO_2$ shall be used:

6.11.1 A high-pressure cylinder having an opening large enough to insert pieces of solid $CO_2$ and capable of withstanding 800 to 1000 psi (5.5 to 7 MPa) pressure when the solid evaporates. The cylinder should be provided with a pressure-reduction valve capable of delivering gas at a gage pressure as low as 3 to 5 psi (20 to 34 kPa). A pressure-relief valve set at about 1200 psi (8 MPa) should be included, and care should be exercised to limit the quantity of solid $CO_2$ placed in the cylinder due to the greater volume occupied by the gas.

6.11.2 A vacuum bottle that can be charged with solid $CO_2$. The bottle may be closed with a large rubber stopper fitted with a pressure-bleed regulator, a mercury relief valve, a nichrome heating element, and a gas delivery tube to the apparatus.

6.11.3 A 12-qt (12-L) aluminum pressure cooker that can be charged with solid $CO_2$. It should be fitted with a suitable pressure-relief device and gas delivery tube. A minimum length of heavy-wall rubber or plastic tubing should be used in connecting the source of $CO_2$ gas to the purging chamber.

[4] Cylinders of 99.99 % minimum purity liquified carbon dioxide fitted with two stage regulator with stainless steel diaphragms have been found satisfactory. Cylinders of “Instrument Grade” carbon dioxide and regulators (Model No. 18-5, CGA 320) may be obtained from Airco Rare and Specialty Gases, 575 Mountain A, Murray Hill, NJ 07974.