



Designation: D 1145 - 80

Standard Method of SAMPLING NATURAL GAS¹

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1. Scope

1.1 This method of sampling covers the procedures for the sampling of natural gas, containing different gases as contaminants such as: (1) natural gases containing primarily hydrocarbons and nitrogen, (2) natural gases containing hydrogen sulfide, or organic sulfur compounds, or other sulfur contaminants, (3) natural gas containing carbon dioxide, (4) natural gas containing gasoline and condensables. These are treated separately and special precautions stated when necessary. The differences in procedures are mainly in degree, rather than in kind.

1.2 This method of sampling is intended to correlate the size or type of sample with the analysis to be run subsequently on that sample.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. General Considerations

2.1 In collecting samples of natural gas, consideration must be given to the purposes for which the samples are to be used and the conditions under which they must be secured. Consideration must also be given to the volume of sample required for the purpose intended; to the size, design, and material of containers; and to the size, length, and material of which the sampling line and auxiliary equipment are constructed to convey gas from the source of supply into the container and subsequently from the container to the point of use. Account must be taken of the possible constituents in the gas, whether it may contain only hydrocarbons and inert gases such as nitrogen and carbon dioxide or whether hydrogen sulfide, organic mercaptans, or other sulfur contaminants may be present. The object is to obtain a representative gas

sample because any subsequent analysis, regardless of the care and accuracy in making any such analytical test, is useless unless a representative sample has been obtained.

3. Usual Sources of Samples

3.1 Samples of natural gases for test purposes may be required from one or more of the following sources: gas wells, field gathering lines, before and after field processing plant, main transmission trunk pipe line, city distribution system, storage holders, or similar piping, processing, or storage systems. The gas may exist under pressure as high as 9000 to 10 000 psi (62 000 to 69 000 kPa), as in some gas wells, or under subatmospheric pressure in others; in transmission lines from 50 to 1200 psi (345 to 8300 kPa); from 3 in. (7.6 cm) of water column pressure to 100 psi (0.7 to 700 kPa) in city distribution systems. When taking samples under such widely varying conditions special precautions should be observed, to make sure that the particular technique most suitable for the situation is employed.

4. Volume of Sample Required

4.1 Volume of sample required depends both upon the analyses to be made and the apparatus to be used. In general, the following minimum volumes of samples, including volume needed for purging the apparatus, are recommended. These quantities will normally suffice for two tests, an original and a check.

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| For chemical gas analysis | 1000 cm ³ |
| For relative density (specific gravity) with balance-type instruments | 1.0 ft ³ (0.028 m ³) |
| For heating value determination | 3 to 5 ft ³ (0.085 to 0.141 m ³) |
| For hydrogen sulfide (Tuttle method) ^a | 250 to 700 cm ³ |
| For hydrogen sulfide (cadmium sulfate method) ^a | 5 ft ³ (0.141 m ³) |
| For referee sulfur ^b | 10 ft ³ (0.283 m ³) |
| For gasoline content ^c | 5 to 10 ft ³ (0.141 to 0.283 m ³)/test (several tests/day may be needed) |
| For fractionation analysis | 5 to 10 ft ³ (0.141 to 0.283 m ³) |
| For superexpansibility tests | 10 ft ³ (0.3 m ³) approx. |

^a Sample preferably taken direct from line or well into analytical apparatus.

^b If hydrogen sulfide is involved the test should be run in the field. If organic sulfur only is involved sample may be transported to the laboratory.

^c Adsorption of the gasoline in charcoal must be done in the field. Distillation from charcoal may be done in the laboratory.

5. Descriptions of Terms

5.1 Sampling Probe—The sampling probe is that portion of the sampling line attached to and extending into the pipe or vessel containing the gas to be sampled.

5.2 Sampling Line—The sampling line is that portion of a flexible or semirigid tubing or piping used for conducting the sample from the sampling probe to the same container.

5.3 Sampling Container—The sample container is the vessel in which the gas sample is collected, stored, retained, and transported to the analytical equipment.

6. Summary of Method

6.1 The method in its broadest sense is a means of suitably conducting a flow of gas from the sampling source into a properly purged container(s) and obtaining thereby a representative sample of natural gas. To do so may require the taking of grab, spot, or snap samples. A series of grab samples, taken consecutively, may be considered as an average sample. Average samples also may be obtained by a continuous collection method. This may be done by continuous sampling direct to a recording or indicating analytical instrument or collecting a continuous sample in a portable container over a 24-h period (or other desired time).

6.2 The purging of sampling probe, sam-

pling line, and sample container may be done either by the gas to be sampled (air displacement) or by water displacement, or by application of vacuum.

6.3 Generally, natural gas is under sufficient pressure to purge and fill the container without the use of additional means; however, in instances where this is not the case, some mechanical means must be provided (see 7.4).

6.4 The choice of the type of sample ("spot" or "continuous"), the method of purging, the type of container, and the choice of any auxiliary pressure equipment, if necessary, will be dictated by the analysis or the analyses to be run on the sample, by the type of gas to be sampled, and by the existing equipment available.

7. Apparatus

7.1 Sampling Connection—Threaded or welded pipe connections of 1/8 or 1/4-in. diameter pipe to the side of the vessel containing the gas are satisfactory. If wall condensation may be present, the sampling probe should be extended some distance into the vessel. A distance of one sixth of the diameter of the vessel has been found satisfactory. For unusual conditions, water-cooled probes of special construction may be required.²

7.2 Sampling Lines may be made of 1/8 or 1/4-in. iron pipe; 1/32 to 1/8-in. (2.4 to 9.5-mm) outside diameter copper, brass, Type 304 stainless steel, or aluminum tubing; or 1/4-in. high-pressure hose (Note 1). Larger sizes may be used if conditions require them. Regardless of the size and length of the sampling line, flow and time of purge should be sufficiently rapid to ensure that an accurate and fresh sample is obtained from the supply source. In general, sampling lines should be as short and as small in diameter as practicable to decrease purging time and contained volume. In the case of a continuous sampling line direct from the source of supply to analytical apparatus, the above characteristics are especially desirable to permit a rapid change of sample so that the test instrument may follow closely any change in composition of the supply. Glass, quartz, or porcelain tubing may be used for sampling lines when the gas

² Altieri, V. J. "Gas Analysis and Testing of Gaseous Materials," Am. Gas Assn., pp. 76-79.

pressure is low. (For special sampling of gases containing sulfur compounds, see Section 10.)

NOTE 1—If rubber is used, it should be used to a minimum extent and should be a product that will not react with the sample and that has low permeability characteristics. Various types of flexible plastic tubing may be superior to rubber for this service. Rubber should not be considered for anything but low-pressure conditions.

7.3 Sample Containers shall be gastight and easily handled for sampling and delivering the sample to the test apparatus. They shall be of adequate size and shall be made of material that will not react with the sample (Note 2). The size of the container may vary from 250 cm³ to several cubic feet (or cubic meters). It is usually made of iron, steel, or glass, but it may be made of any metal or alloy sufficiently strong and gastight. (For special sampling of gases containing hydrogen sulfide and organic sulfur, see Section 10.) The design and type of container may take any number of forms, such as bottles, cans, tubes, cylinders, or tanks which may be sealed with stopcocks, valves, corks, or rubber clips. If the sample is to be shipped under pressure, the vessel must comply with the requirements of, and be approved by, the Interstate Commerce Commission. Except for small samples for gas analysis, it is preferable to sample natural gas without the use of confining liquids, such as water or water solutions of various chemicals. Water or mercury may be used to force the sample out of the container into the test apparatus (Caution—See Note 3.) Types of sample containers are illustrated in Fig. 1.

NOTE 2—The confining fluid should not react with the container or the sample.

NOTE 3—Mercury Precautions—Mercury is an extremely toxic metal. The concentration of vapor in equilibrium with the metal at room temperature exceeds the threshold limit value for occupational exposure. Use in a well ventilated area. Clean all spills very carefully. Neutralize fine droplets or inaccessible droplets by covering with flowers of sulfur, zinc dust, or calcium polysulfide. It is recommended that personnel, routinely exposed to mercury, be examined periodically by medical persons.

7.4 Auxiliary Pressure Equipment—In instances where the pressure of the natural gas is not sufficient to purge and fill the container the following equipment is generally employed: (1) a rubber bulb equipped with valves at each end—one for suction and one for pressure, (2) a hand pump equipped with double-acting

valves, or (3), displacing of a confining liquid in two containers such as water or mercury. These items are shown in Fig. 2.

7.5 Shipping Tags or Stickers—To properly identify and describe all samples they should be marked for identification and proper handling by the analyst. A sticker or a shipping tag attached to the container should include the following information:

- 7.5.1 Sample taken where,
- 7.5.2 Sample taken from what line,
- 7.5.3 Sample taken by,
- 7.5.4 Date of sampling,
- 7.5.5 Time of sampling,
- 7.5.6 Kind of gas, and
- 7.5.7 Remarks.

8. Procedures for Sampling Natural Gases Containing Primarily Hydrocarbons and Nitrogen

8.1 For collecting small samples in low-pressure sample containers for analysis of chemical constituents the following procedures are recommended:

8.1.1 In the cases where glass bottles are used as sample containers, blow out the gas line thoroughly until no dead gas remains. Stretch rubber tubing over a ¼ or ½-in. pipe connection made at this place, and leave a small stream of gas flowing through the tubing in order to make certain that no air will get into the sample from an outside source. Displace the air in the small-necked quart glass bottle by immersing it in a bucket of water. This can best be done by standing the bottle on the bottom of the bucket in an upright position and allowing the water to flow into the mouth of the bottle until it is entirely filled (Fig. 3 (1)). Then, without taking the bottle out of the water, invert it so that the mouth will be towards the bottom of the bucket (Fig. 3 (2)). Do not remove the bottle from under the water until the sample of gas has been collected and it has been firmly stoppered.

8.1.2 If no bubble of air can be seen in the bottle after having inverted it, allow the gas to bubble slowly from the rubber hose into it while in this position (Fig. 3 (3)). The rate of flow should be such that it will take about 1 min to displace all of the water in the bottle. Allow the gas to bubble into the bottle 2 min longer.

8.1.3 After the gas has displaced all water, have a nonporous, high quality cork stopper

ready as the flexible tubing is withdrawn. As the tubing leaves the mouth, the bottle should be immediately and tightly closed. Wire or clamp the cork in place and if not to be used immediately seal with paraffin or wax. Dry the bottle and attach at once the identification tag, properly filled out.

8.1.4 When using the method employing sampling containers with valves or stopcocks on each end (displacement of water or air), blow out the line thoroughly until no dead gas remains. Stretch rubber tubing over a $\frac{1}{4}$ or $\frac{1}{8}$ -in. pipe connection made at this place, and leave a small stream of gas flowing through the tubing in order to make certain that no air will get into the sample from an outside source. Completely fill the sampling container with water by holding it vertically and allowing water to flow in through the bottom valve until it overflows from the top valve, making sure that all air has been displaced and close both valves (Fig. 4) (1)). Attach the rubber hose through which gas is slowly flowing to the top valve, open the valve, and then open the bottom valve, emptying the water into a bucket or on the ground as it flows from the container (Fig. 4 (2)). Regulate the flow so that it takes about 1 min to displace all water, close the bottom valve, and then close the top valve.

8.1.5 For air displacement follow the procedure outlined above up to the point of actually filling the cylinder. While holding the sample container vertically, attach the rubber tube through which the gas is flowing to the top valve (Fig. 5), open this valve, and then open the bottom valve. Allow the gas to flow down through the sampling container at a rapid rate displacing all air. Continue to let the gas flow at least 2 min, or until it is certain that all air has been displaced. A flow of gas equivalent to ten times the volume of the sampling container will usually suffice.

8.2 For collecting relatively large samples in high pressure sample containers for the determination of heating value, relative density (specific gravity), and analysis the following procedure is recommended:

8.2.1 Attach $\frac{1}{4}$ -in. (6.35-mm) high-pressure hose, copper tubing, Type 304 stainless steel tubing, aluminum tubing, or iron pipe to the point of sampling. Blow the gas through this sampling line until no dead gas remains. Attach

the outlet end of the sampling line to the sample container, as shown in Fig. 6, if gas pressure is sufficient to fill the tank to the desired pressure, or to the suction side of the hand pump and with another line from pressure side of pump to container if the pressure is too low; also shown in Fig. 6. Open inlet and outlet valves on the container. Open the valve on the sample line, controlling rate of flow as desired. Fill the container to the desired pressure by closing the outlet valve and regulating the valve on the sample line. Empty the tank to about atmospheric pressure. Repeat the filling and emptying of the container eight to ten times. Then fill the tank to the desired pressure, close both valves and the regulating valve, disconnect the fitting, and mark the container.

8.2.2 If it is necessary to collect large samples such as for the determination of gas law deviations or for analysis by fractionation, several sample containers may have to be filled. This can best be accomplished by a manifolding system that will permit taking the several samples simultaneously (Fig. 7). This ensures the same composition of gas at the same pressure and temperature in all tanks, and the several tanks give an adequate supply of gas at a high pressure for each test run. Satisfactory samples are best ensured by filling the sample containers slowly. After several (eight to ten) fillings at low pressure, say to 100 psi, to ensure purged tanks, the tanks should be brought up to pressure slowly.

8.3 Samples from gas lines shall be taken from a vertical connection over the center of the line, if possible, so that trapped condensables are not drawn into the sample line. To ensure the removal of any condensables, the connection should be blown at full flow for 30 s. The temperature of the gas in the line should be determined. Ground temperatures at line level will serve if the gas pressure has not been compressed or reduced nearby.

8.4 After the samples have been shut in and the valves plugged, the containers should be checked for leaks and moved to the laboratory promptly. To minimize condensation within the sample container, the tanks should be kept as warm at all times as the line temperature at which they were filled. This precaution can be neglected if the weather and laboratory temperatures are above the temperature of the gas

supply from which the samples were taken.

9. Procedures for Obtaining Representative Average Samples

9.1 Average samples consist of samples taken over a designated period of time, from a few minutes to several hours, representing the average composition of the gas over a given time at a particular place. Where the gas composition may vary and a sufficient number of grab samples cannot be obtained for use as an average sample for a given period of time, the following procedures are recommended for securing a representative sample:

9.1.1 For continuous sampling direct to a recording or indicating analytical instrument, small-diameter copper, iron, or aluminum sampling lines as short as possible are most satisfactory. The line should be of such size as to permit a complete change of sample in the sampling line in 15 min or less. If this cannot be done, a portion of the gas should be bled from the line and burned or returned to another line, or a circulating pump should be installed in the sampling line to ensure rapid change of gas in it.

9.1.2 For collecting average samples in portable containers the following two procedures are recommended, with the method illustrated in Fig. 8 available if required:

9.1.2.1 When starting with an empty sample container such as a gas holder as illustrated in Fig. 9, it is necessary to adjust the pressure regulator outlet and orifice size to permit continuous flow of gas into the holder to completely fill it in the time desired for taking an average sample. Purge the sample line and holder thoroughly with the gas being sampled, then start the sampling period with the holder either completely filled with water, or the small section of the holder crown sheet, which may extend above the water, filled with the same gas as it is intended to sample.

9.1.2.2 Starting with sample container filled with water, control the rate of taking in the gas sample by the rate of discharge of water from the tank, as shown in Fig. 10.

10. Sampling Natural Gas Containing Hydrogen Sulfide, or Organic Sulfur Compounds or Other Sulfur Contaminants

10.1 It is advisable to sample natural gas containing hydrogen sulfide, or organic sulfur,

or both, directly from the source, such as a natural gas well head or gas line, into the test apparatus through a minimum length of either aluminum, stainless steel tubing, or glass tubing joined with rubber sleeves with the ends of the tubing butted together so that no rubber is exposed to the flowing gas. When using metal tube fittings, use those made of the same materials as the tubing. If this cannot be done, dry glass containers and the displacement of air method may be used to collect the samples. Sampling lines and sample containers made of iron, steel, copper, or brass must not be used as the sulfur will combine with these materials, causing a decrease in the sulfur content of the sample. Water must not be used as a confining liquid in the container as it will dissolve a portion of the gaseous sulfides and possibly other sulfur compounds. To collect a sample of the natural gas containing sulfides, use a clean, dry, glass bottle and sampling tube. For a large sample, an aluminum tank of ample size for the sample required may be employed. The temperature of the air in the container should be about the same as the temperature of the sample to be introduced. Connect a flexible tube to the vessel from which the sample is to be taken and allow gas to flow through this tube to replace the air therein. Insert the free end of the tube into the open mouth of the glass sample bottle (or connect it to one end of the glass sampling container) and extend it to the bottom of the bottle. The gas to be sampled should now be passed briskly through the tube and glass bottle for a period of not less than 10 min. If the gas to be sampled is lighter than air, the bottle should be supported in an inverted position during this operation; if the gas is heavier than air, the bottle should be in its normal upright position (see 8.1.3). The sample should be displaced from the bottle to the analytical apparatus with a minimum of contact with acidified water.

11. Sampling Natural Gas Containing Carbon Dioxide

11.1 Natural gas containing more than 0.5 % carbon dioxide should be collected in dry containers because carbon dioxide is very soluble in water. Sampling of such gases must proceed in accordance with the dry methods listed in 8.1.5. Displacement from the container to the test apparatus should be done with mer-



D 1145

cury or release of pressure. Gas containing less than 0.5 % carbon dioxide should also be sampled in dry containers, but because of the very low percentage and less chance of absorption with a minimum of contact with water, it may be sampled by the water displacement method previously described unless unusual accuracy in the carbon dioxide determination is required. The dry and wet methods described in 8.1 may be used for this purpose. Displacement of the sample from the container to the test apparatus may be done with mercury, water, or by release of pressure.

12. Sampling Natural Gas Containing Gasoline and Condensables

12.1 For determining the gasoline content of a natural gas the sampling should be done in the field. It is usually done by adsorption of the gasoline in charcoal from a measured volume of gas. The charcoal containing the gasoline

may then be taken to the laboratory for distillation. The gasoline content of gases varies and therefore several tests are necessary:

12.1.1 To establish the richness of the gas before check tests can be made, and

12.1.2 The gasoline content frequently varies over a 24-h period, making several tests over the day necessary.

NOTE 4—Care should be taken not to permit condensate to accumulate in the sampling tube.

12.2 For determining other characteristics of a natural gas containing gasoline and condensables, the gas should be sampled in dry containers maintained at practically the same temperature as the gas. Any of the dry procedures outlined previously may be used. When the sample is removed from the container a dry procedure should be used and the container should be at a temperature equal to or higher than that at which the sample was taken.