# Designation: D3700 – 16

## Standard Practice for Obtaining LPG Samples Using a Floating Piston Cylinder[1]

This standard is issued under the fixed designation D3700; 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 This practice covers the equipment and procedures for obtaining a representative sample of liquefied petroleum gas (LPG), such as specified in ASTM Specification D1835, GPA 2140, and comparable international standards. It may also be used for other natural gas liquid (NGL) products that are normally single phase (for example, NGL mix, field butane, and so forth), defined in other industry specifications or contractual agreements, and for volatile (higher vapor pressure) crude oils.

NOTE 1—Some floating piston cylinders have such tight piston seals that the vapor pressure of some high vapor pressure crude oils may not be sufficient to allow sampling without a handle to move the piston. An alternative sampling practice for UN Class 3 liquids (under 300 kPa at 52 °C) is Practice D8009, which utilizes a Manual Piston Cylinder (MPC) sampler.

1.2 This practice is not intended for non-specification products that contain significant quantities of undissolved gases ($N_2$, $CO_2$), free water or other separated phases, such as raw or unprocessed gas/liquids mixtures and related materials. The same equipment can be used for these purposes, but additional precautions are generally needed to obtain representative samples of multi-phase products (see Appendix X1).

1.3 This practice includes recommendations for the location of a sample point in a line or vessel. It is the responsibility of the user to ensure that the sampling point is located so as to obtain a representative sample.

1.4 The values stated in SI units are to be regarded as standard.

1.4.1 *Exception*—The values given in parentheses are for information only.

1.5 *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:*[2]

D1265 Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method

D1835 Specification for Liquefied Petroleum (LP) Gases

D8009 Practice for Manual Piston Cylinder Sampling for Volatile Crude Oils, Condensates, and Liquid Petroleum Products

2.2 *GPA Midstream Association Standards:*[3]

GPA 2140 Liquefied Petroleum Gas Specifications and Test Methods

GPA 2174 Obtaining Liquid Hydrocarbon Samples for Analysis by Gas Chromatography

## 3. Terminology

3.1 *Definitions:*

3.1.1 *floating piston cylinder (FPC), n*—a high pressure sample container, with a free floating internal piston that effectively divides the container into two separate compartments.

3.1.1.1 *Discussion*—A floating piston cylinder is used to collect a sample of liquid under pressure without the formation of a gaseous phase which can result in changes in the composition of the liquid sample.

3.1.2 *maximum fill volume (reduced fill volume), n*—the volume of a container occupied by the sample, usually expressed as a percentage of the total capacity.

3.1.2.1 *Discussion*—Some regulatory agencies use the expressions "maximum fill density" and "reduced fill density."

## 4. Summary of Practice

4.1 A liquid petroleum gas (LPG) sample is transferred as a liquid under pressure from a sample point to a floating piston cylinder. The floating piston cylinder (FPC) is designed to collect liquid samples with no vaporization by displacing a piston against a pressurizing fluid (preferably an inert gas). The piston serves as a physical barrier between the sample and the

[1] This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.H0 on Liquefied Petroleum Gas.

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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] Available from GPA Midstream Association, 6526 E. 60th St., Tulsa, OK 74145, www.gpaglobal.org

***A Summary of Changes section appears at the end of this standard**

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pressurizing fluid, at the sampling pressure. The position of the piston at the end of sampling indicates the percent fill of the sample cylinder.

4.2 It is the responsibility of the user of this practice to locate the sample point at a suitable location and orientation where the product being sampled is a representative, single phase, homogeneous liquid.

## 5. Significance and Use

5.1 This practice allows the collection of a representative sample of LPG that may contain trace volatile dissolved components such as methane, ethane, and nitrogen. Sampling by Practice D1265 can result in a small, but predictable, loss of these lighter components. Practice D1265 is suitable for collecting samples for routine specification testing, as the small loss of light components is not significant under Specification D1835 specification requirements. Practice D3700 is recommended whenever highly accurate determination of light components is required. For example, compositions determined on samples collected according to Practice D3700 may be used to establish the product value of NGL mixtures (see Appendix X1).

## 6. Interferences

6.1 An interference in a sampling procedure is anything which compromises the integrity of the sample.

6.2 Incorrect choice of a sample point location can result in a non-representative sample due to solid or liquid contaminants, two phases, storage tank stratification, and so forth.

6.3 Reactivity of steel surfaces can remove or chemically alter trace reactive components such as $H_2S$, COS, and mercaptan.

6.4 A lubricant used on the floating piston or other internal wetted parts that is soluble in LPG can contaminate the sample.

6.5 Pre-charge (inert) gas can leak into the sample due to worn or damaged piston seals or poor surface finish (see 8.1).

6.5.1 Consult the manufacturer's guidelines for suitable procedures to verify a leak-free cylinder, such as pressure testing each side of the cylinder. It is also possible to analyze the sample for inert gas, or the inert gas for hydrocarbon, to detect leakage in either direction.

6.6 Failure to flush sample lines and *dead volumes* can result in contaminants in samples.

6.7 Sampling from stratified tanks, *dead* zones in flowing systems, or inappropriate time periods in composite sampling systems can result in non-representative samples.

6.8 Any material that can create carryover contamination from one sample to the next has to be removed from the cylinder and the cylinder shall be thoroughly cleaned. In addition to cleaning the interior metal surfaces and cleaning the soft parts (O-rings, for example), consideration should be given to replacing the soft parts if they might have absorbed any contamination. Examples of contaminants include glycol, amine, lubricants, sulfur species, solvents, methanol, etc.

## 7. Apparatus

7.1 *Floating Piston Cylinder (FPC):*

7.1.1 *Construction,* typically fabricated from corrosion resistant 316 stainless steel, in accordance with the pressure vessel certification requirements in the jurisdictions in which it is to be used, and through which it will be transported. Protective internal coatings or surface treatments are acceptable provided that they do not adversely affect the free movement of the piston, or effectiveness of the seals (see Fig. 1).

7.1.1.1 Users should consult with the manufacturer of these sample cylinders and sample collection systems any time ambient or product temperatures, or both, exceed the range of –29 °C (–20 °F) to 60 °C (140 °F). Extreme temperature effects upon metal, O-rings, valve seats, seals, gauges, relief devices, sample pump components and other devices and components in the system should be assessed in a hazards analysis before any sampling takes place.

NOTE 2—At present, there is no international approval process for pressure cylinders. Cylinders require appropriate approval in each jurisdiction in which they are used or transported.

7.1.2 *Volume of Sample*—The minimum volume required is determined by the combined volumes required by each of the tests to be performed, typically 400 mL (that is, 80 % of a 500 mL sample cylinder at 15 °C).

7.1.2.1 For safe handling of these cylinders under extremes of product or ambient temperatures, or both, the user shall consider the effects of thermal expansion on the volume of product in the cylinder. For example, if a product is sampled at –40 °C (–40 °F), the user shall plan for the cylinder and sample to warm considerably during transport and before analysis is performed in the laboratory. During summer months, the temperature of the cylinder and product could reasonably be expected to rise to as high as 46 °C (115 °F) in hot environments. A cylinder initially filled cold to 80 % of its capacity will, upon warming, be over-pressured and the relief device(s) will activate under these conditions. Hydrocarbon releases of this type are unexpected and dangerous. In such an extreme, but not uncommon case, the cylinder should not be filled more than approximately 60 % of its capacity during the initial fill. Users should review ASTM/API/GPA Midstream volume correction factor calculations, or data from similar samples, or both, to determine the maximum fill for the product and conditions being sampled, but should always leave at least 10 % vapor space after allowing for the worst likely case of thermal expansion.

NOTE 3—The appropriate tables for conversion of LPG volume or density as a function of temperature are: MNLTP27, Manual on Petroleum Measurement Standards, Chapter 11–Physical Properties Data, Section 2, Part 4–Temperature Correction for the Volume of NGL and LPG Tables 23E, 24E, 53E, 59E, and 60E; [2] or GPA Midstream Technical Publication TP-27.[3]

7.1.3 *Piston Position Indicator*—The FPC shall be equipped with a piston position indicator such as a magnetic follower, piston rod, or equivalent which indicates the sample volume to comply with the maximum percent fill (maximum fill volume) allowed for storage and transportation. An outage chamber with indicating level device may also be used.

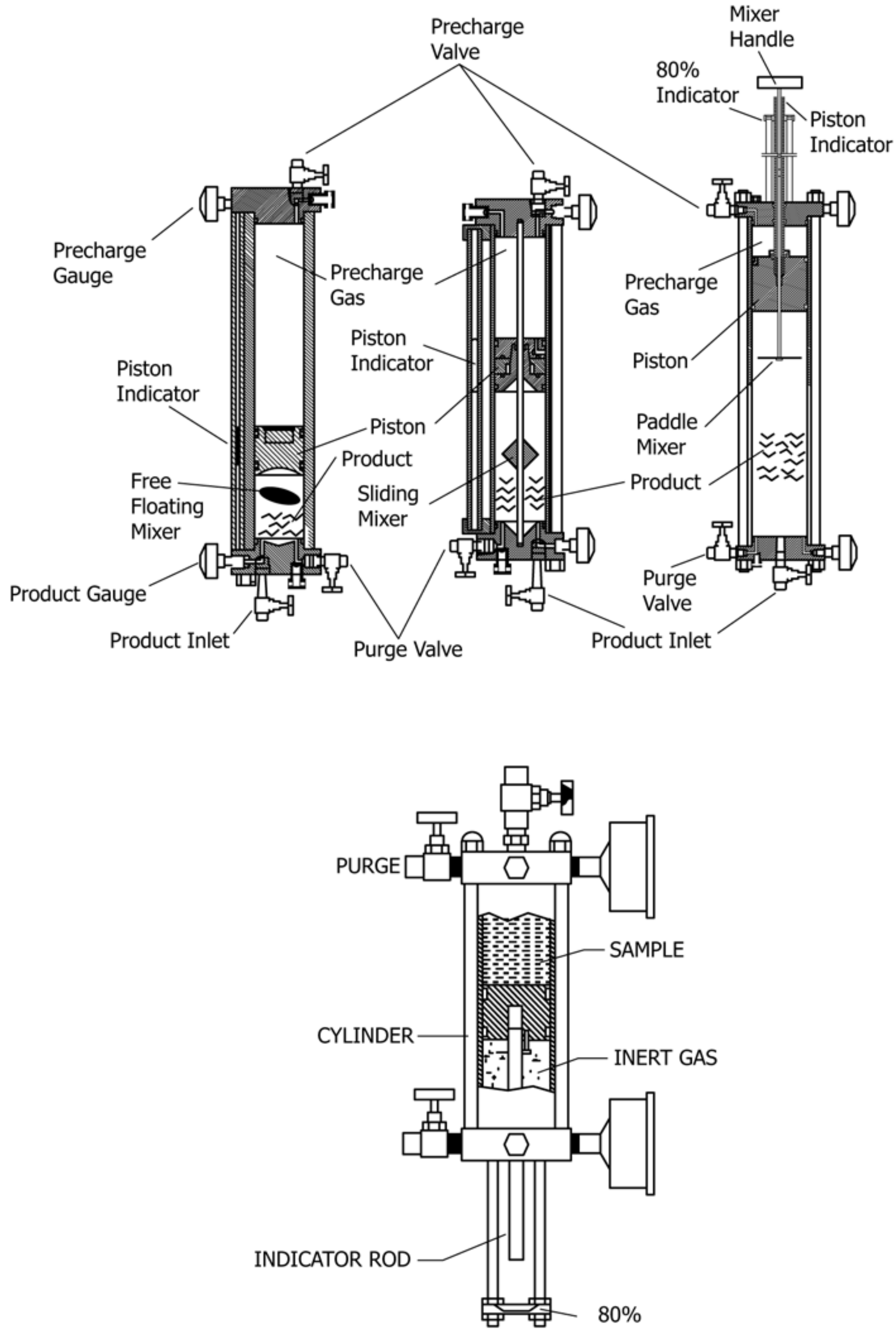


**FIG. 1 Typical Floating Piston Cylinder Designs**

7.1.3.1 Floating piston cylinders that are not equipped with a piston position indicator shall not be used without a procedure to allow the operator to verify fill volume immediately after sampling and prior to transport. Consult the authority having jurisdiction for acceptable procedures.

7.1.4 The cylinder shall include a mechanism to mix the sample in the sample chamber in case of stratified mixtures or water haze that can settle after sampling. This mechanism may be a mechanical mixer/vortex plate on a movable rod, a freely moving rolling ball or slider, magnetically coupled stirrer, or