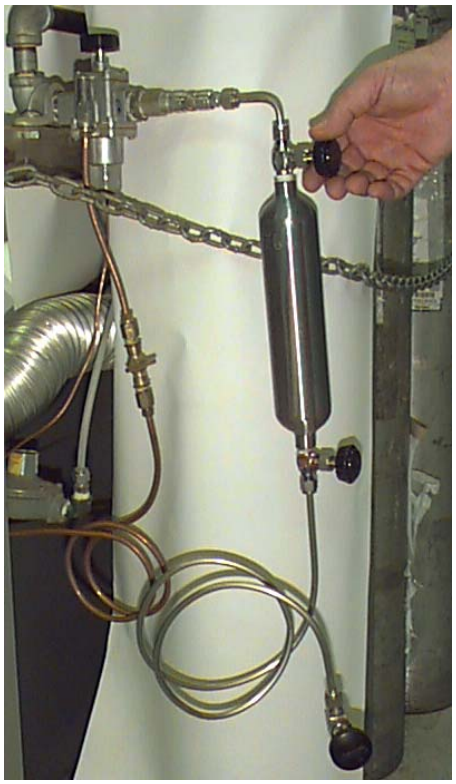
ANALYTICAL SAMPLING PROCEDURE
STAINLESS STEEL OR ALUMINUM GAS SAMPLE CYLINDER

This sampling procedure makes several references to GPA Standard 2166-05, but does not in any way purport to supplement or replace that standard procedure. These references are made here strictly to indicate an accepted standard method of good sampling techniques for natural gas.

1. Prepare to attach the gas sampling cylinder securely to the sampling line using appropriate connections. This procedure uses a flow-through sampling method requiring gas purging, so the outlet valve of the cylinder must be attached to an appropriate vent or exhaust line. In accordance with the GPA Standard 2166-05 procedure, an extension tube ("pigtail") with a separate valve installed at its outlet end must be used for flow-through sampling methods. The figure to the right shows a typical arrangement. The "Evacuated Container" method described in the GPA Standard is an acceptable alternative to the flow-through methods if the sample container construction or local safety issues place restrictions on the venting of flammable gases into the immediate area.



Note: Any sampling lines or control devices should be constructed from materials that are inert and non-sorbing. Type 316 stainless steel is preferred. Non-permeable and non-reactive plastic tubing may be used for low pressure gas sampling. All cylinders supplied by GTI for sampling are evacuated to a hard vacuum, and shipped with closed valves and plugged outlets.

2. Ensure that all components of the sampling line have been well purged and flushed with sample gas and that the line being sampled contains an adequate supply of flowing gas. The temperature of the sampling line and the cylinder should be maintained at 10°C above the gas temperature. Additional heating is required to prevent condensation resulting from the pressure reduction. The GPA standard emphasizes that "…It is difficult to write sampling instructions explicit enough to cover all cases. Natural gas samples should be obtained under conditions that will not create condensation or vaporization in the sample system during the sampling process….Pressure drops due to pressure regulators or flow control devices cause reduction in temperature due to the Joule-Thomson Effect. This can cause condensation in the sampling system. Therefore it may be necessary to heat regulators that are used to reduce the sample pressure.…Ambient cooling of the sample system can cause heavy hydrocarbons to condense out of the vapor phase. The presence of any condensation in the sample inlet system will cause the sample to be non-representative. Condensation must be avoided in the entire sample system from sample probe to sample cylinder outlet…."

3. Remove both end plugs from the cylinder valves, but do not open the valves yet. Loosely connect one of the cylinder valves to the sampling line and allow a brief purge of sample gas to flow through the line and escape through the loose fitting. (Use of a "tee" equipped with a purge valve

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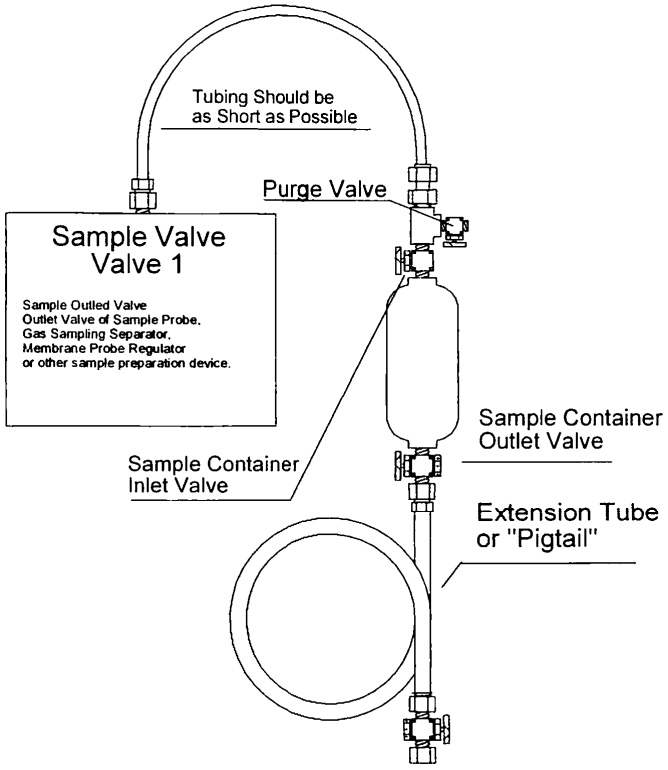
between the sampling valve and the cylinder is recommended by the GPA procedure.) After the cylinder connection has been purged of any residual air, tighten the connection to the cylinder. Open the sample line valve fully and check all fittings for leakage. Correct any leaks found. Attach the extension tube ("pigtail") to the outlet end of the cylinder, ensuring that its own outlet valve is closed securely. The purpose of the pigtail is to isolate the effects of the Joule-Thompson cooling during the cylinder purging process from the cylinder itself. This piece of tubing is typically ¼" in diameter and at least 36 in length. If it is coiled, the user is cautioned to leave enough air gaps between coils to prevent thermal coupling of the coils. It is suggested that the final configuration of the sampling tubing, cylinder, pigtail, etc., be similar to that in the following diagram.



4. Carefully open the valve at the inlet end of the cylinder, and allow the cylinder to gradually fill to line pressure. Open the cylinder outlet valve to allow the pigtail to fill to line pressure. Close the inlet valve and cautiously open the pigtail outlet valve after allowing a few moments for the sample pressure to equilibrate. The cylinder should slowly bleed down to ambient pressure through the pigtail line. Close the pigtail valve and open the inlet valve again. Repeat the fill-and-purge cycle a minimum of three times to ensure that a representative sample is obtained. The following table, taken directly from GPA Standard 2166-05, should be used to determine the appropriate number of purging cycles.

Fill and Empty Purge Cycles

Maximum Gas Pressure in Container, psig (kPa guage)	Number of Fill And Empty Cycles
15-29 (100-200)	13
30-59 (200-405)	8
60-89 (405-615)	6
90-149 (615-1025)	5
150-500 (1025-3450)	4
>500 (>3450)	3

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Note: The gas should be allowed to fill and vent from the cylinder at a manageable and safe rate that is lower than the rate the sample gas normally flows through the process system.

5. After the final purge, close the pigtail valve securely. Open the inlet valve and allow the cylinder to fill with the sample to full line pressure. Close the cylinder's outlet valve, its inlet valve, then the sample line shut-off valve. Cautiously loosen the tubing connection at the cylinder inlet valve and allow the residual gas in the sampling line to bleed off.

Note: There will still be gas at full system pressure trapped in the interconnecting tubing.

6. Disconnect the tubing from the inlet valve and the pigtail tubing from the outlet valve and replace the cylinder's end plugs. Securely attach a label to the filled cylinder, indicating the date, time, and any other relevant descriptive information of the gas or the sampling event for later identification.

7. Repack the cylinder in an appropriate shipping container, and return it to GTI for analysis. Follow appropriate IATA packing instructions for any gases deemed to be dangerous goods.

NOTES: This sampling procedure is provided only as a guide to sampling gas from a sampling port. It assumes a representative sample flow of the source gas can be obtained. It is the sampler's responsibility to ensure a representative sample. Any historical information regarding the sample would aid us in better analyzing your sample. This would include previous results of laboratory or field screening analyses.

It is the sampler's responsibility to ensure sampling is performed in a safe manner. Neither GTI nor any person acting on behalf of GTI assumes any liability with respect to the use of, or for damages resulting from the use of, any information presented in this procedure.

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