Evaluation of a Proposed Gas Sampling Method Performance Verification Test Protocol

FINAL REPORT

Prepared by:

D. L. George
R. A. Hart
M. Nored

SOUTHWEST RESEARCH INSTITUTE®
Mechanical and Fluids Engineering Division
6220 Culebra Road
San Antonio, Texas, USA 78238-5166

Prepared for:

United States Minerals Management Service
Engineering and Research
381 Elden Street, MS-4021
Herndon, VA 20240

Sharon Buffington, Project Manager

July 2004

Disclaimer

This report was prepared by Southwest Research Institute (SwRI®) as an account of contracted work sponsored by the United States Minerals Management Service (MMS). Neither SwRI, MMS, members of these organizations, nor any person acting on their behalf:

a. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, methods, or process disclosed in this report may not infringe upon privately owned rights; or

b. Assumes any liability with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

References to trade names or specific commercial products, commodities, or services in this report does not represent or constitute an endorsement, recommendation, or favoring by SwRI or MMS of the specific commercial product, commodity, or service.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

This page is intentionally blank.

1.0 Introduction

The revision of the American Petroleum Institute (API) Manual of Petroleum Measurement Standards (MPMS) Chapter 14.1, *Collecting and Handling of Natural Gas Samples for Custody Transfer* (Reference 1), was completed in 2001. During the revision, the API Chapter 14.1 Working Group compiled a list of unresolved technical issues related to natural gas sampling methodology. An investigation into these technical issues has been ongoing at Southwest Research Institute (SwRI) since 2001, under the Gas Technology Institute (GTI) Measurement Research Program, co-funded by the Gas Technology Institute and the U.S. Minerals Management Service.

This report presents the results of experimental research to evaluate a proposed test protocol to verify the performance of natural gas sampling methods. This protocol is intended to serve as a means of assessing new gas sampling methods for the natural gas industry and should facilitate the development of new and better gas sampling methods. By providing a reliable procedure for new sampling methods to be introduced to the natural gas industry, it will be possible to more accurately determine the energy content of natural gas and reduce the magnitude of errors in natural gas measurements.

A proposed test protocol was drafted by an ad hoc committee of the API Chapter 14.1 Working Group as an addendum to Chapter 14.1. However, until the work described herein was completed, the procedure had not been experimentally validated. The present work involved applying the proposed test protocol to established sampling methods described in GPA (Gas Processors Association) Standard 2261 (Reference 2) and discussed in API Chapter 14.1, as well as to selected new sampling methods. The primary goal of this testing was to evaluate the test protocol. A secondary goal was to assess the ability of several new sampling methods to provide representative gas samples.

Per the requirements of the proposed test protocol, testing of the methods was carried out under both optimum and adverse conditions. For the purposes of this report, "optimum" conditions are considered to be situations where both the pipeline and the ambient temperatures are well above the hydrocarbon dew point (HCDP). On the other hand, "adverse" conditions are defined as situations in which the pipeline temperature is within 5ºF of the HCDP, but the ambient temperature is at least 20ºF below the HCDP. The testing under optimum conditions was performed at the Southwest Research Institute Metering Research Facility (MRF), and the adverse conditions tests were conducted at the Questar Pipeline Company metering station in Powder Wash, Colorado.

This combination of sampling methods and test conditions was chosen to determine if the protocol could distinguish between acceptable and unacceptable methods, where an acceptable method is considered to be one that produces a representative sample of the flowing gas stream. By using the verification protocol to test currently-recommended sampling methods, it could be determined whether methods known to provide accurate results when performed correctly would pass the tests in the protocol, and whether the acceptance criteria in the protocol were too strict. Including proposed new methods in the test plan allowed for an evaluation of methods that are not already included in the industry standards, but show potential as viable alternatives. The tests also helped to identify any problems with the procedure, and to determine the practicality of the procedure and its ease of implementation in field settings, especially under adverse conditions.

This report describes the testing that was done to evaluate the proposed test protocol and presents the results obtained for both established and new gas sampling methods. The proposed test protocol and the sampling methods that were tested are briefly reviewed in Chapter 2. Chapter 3 presents the results of the sampling tests. This chapter is divided into sections for each test site, and each subsection contains complete documentation of the test facility and conditions, as well as a summary of the results obtained. Chapter 4 concludes the report with a comparison of the results from all of the sampling tests and an assessment of the proposed test protocol itself. For reference purposes, several items have been included in the appendices of this report. These items include the complete text of the proposed test protocol

(Appendix A), procedures for the new sampling methods (Appendix B), gas chromatograph setup and calibration data (Appendix C), and a detailed tabulation of the results from all of the sampling tests (Appendix D).

2.0 Test Protocol and Sampling Methods

This chapter contains a brief overview of the proposed test protocol and presents the sampling methods that were considered for use in this investigation. The complete test protocol and detailed procedures for the new sampling methods may be found in Appendices A and B, respectively.

2.1 Performance Verification Test Protocol

A draft of the proposed test protocol used for the present testing may be found in Appendix A. As of the date of this report, the proposed test protocol was in the API ballot process. It is expected that the results and experience obtained from this testing will be used to revise the protocol before final publication.

The proposed test protocol requires that the gas samples be evaluated in terms of both repeatability and reproducibility. For purposes of this protocol, the API definition of repeatability is used: the comparison of back-to-back analyses using the same sample, chromatograph and operator (Reference 1). Reproducibility is defined as the comparison between the analysis of the flowing gas stream itself and the analysis of a spot or composite sample taken from the same stream. For each sampling method under evaluation, the protocol requires that a minimum of five samples be taken, and that each sample be analyzed at least three times. Repeatability and reproducibility of all gas stream components (typically C_1 through C_9, CO_2, and N_2) and the heating value are evaluated. (The methods used to analyze the data for these tests will be discussed in more detail in Section 3.1.3.) Results of successive analyses of each sample are compared to judge the repeatability of the sample; reproducibility is assessed by determining how well a sample analysis matches the analysis of the flowing gas stream, determined with an online or portable gas chromatograph, and analyzed at the same time that the sample is drawn from the flowing gas stream. The acceptance criteria for repeatability and reproducibility established by the proposed test protocol for composition and heating value are shown in Table 1 and Table 2. The values for the individual components are taken directly from API Chapter 14.1, Appendix E.

Table 1. Acceptance criteria established by the proposed test protocol for repeatability and reproducibility of sample components.

Repeatability Criteria		Reproducibility Criteria	
Mol % Concentration	Max. Allowed Deviation (± Mol %)	Mol % Concentration	Max. Allowed Deviation (± Mol %)
0 to 1	0.02	0 to 1	0.04
> 1 to 5	0.10	> 1 to 5	0.13
> 5 to 15	0.18	> 5 to 15	0.26
> 15 to 30	0.28	> 15 to 30	0.38
> 30 to 50	0.40	> 30 to 50	0.50
> 50	0.52	> 50	0.63

Table 2. Acceptance criteria established by the proposed test protocol for repeatability and reproducibility of sample heating values.

Repeatability Criteria	Reproducibility Criteria
1 Btu/scf	3 Btu/scf

Some key features and requirements of the test protocol are as follows:

- The protocol provides acceptance criteria for repeatability (of multiple samples from the same sample cylinder) and reproducibility (of the flowing stream composition by the spot samples).
- The same gas chromatograph is used to analyze the flowing gas stream itself and the spot or composite samples taken from the stream, to eliminate any bias error caused by using different chromatographs. The chromatograph, sample delivery system, and calibration procedures must comply with the requirements of API Chapter 14.1, Appendix E.
- Cleanliness of all analysis equipment must be verified before tests.
- A proposed sampling method is to be tested on at least two different gas compositions, under both optimum and adverse conditions.
- The hydrocarbon dew point of the gas stream must be measured before the tests, and equipment must be kept well above the dew point to prevent sample distortion.
- Verification that the chosen sampling location has a steady flow rate and a stable gas composition is required prior to the sampling tests.
- Specific reporting requirements are given to ensure proper documentation of the procedure and results.

2.2 Sampling Methods

The API Chapter 14.1 Working Group identified a total of nine sampling methods as candidates for testing using the protocol. Of these, five were established methods that are currently recommended in API Chapter 14.1, and the remaining four were proposed new methods. As the project progressed, it was decided not to test some of the methods, and results were ultimately obtained for three established methods and three new methods. The sampling methods that were used and those that were considered but not tested are discussed in the following sections.

2.2.1 Established Sampling Methods Tested Using the Protocol

The proposed test protocol was used to test three of the methods described in GPA 2261 (Reference 2) and listed in API Chapter 14.1 as acceptable for use. The established sampling methods that were tested as a part of the current project are as follows:

- Purging – Fill-and-Empty Method
- Helium Pop Method
- Purging – Controlled Rate Method

For these methods, the procedures given in the 2003 draft of GPA Standard 2166 were followed. As its name suggests, the Fill-and-Empty method involves alternately filling and emptying the sample cylinder a specified number of times before filling it with the final gas sample. This purging cycle serves to remove any helium blanket gas or other residual contents from the sample cylinder before the final sample is taken. For the Helium Pop method, the sample cylinder is evacuated and charged above atmospheric pressure using a small amount of helium, to prevent air leaks into the cylinder, before the cylinder is filled with the gas sample. The Controlled Rate Purge method is similar to the Fill-and-Empty procedure, except that natural gas flows continuously through the sample cylinder to purge it for a specified period of time before a gas sample is collected.

The Fill-and-Empty and Helium Pop methods were chosen for testing since they are commonly used, and since experience within the API 14.1 Working Group indicated that these methods would perform well under relatively adverse conditions. Although the Controlled Rate Purge method is listed in API Chapter 14.1 as acceptable for use, this method was expected to do poorly when used under adverse conditions, and it was included to test the ability of the verification protocol to distinguish between acceptable and unacceptable methods. Informal experience within the Working Group suggested that under adverse conditions, heavy hydrocarbons would condense in the sample cylinder as gas was purged through the cylinder, leading to samples with higher heating values than the actual flowing stream.

2.2.2 Proposed New Sampling Methods Tested Using the Protocol

The verification test procedure was also applied to three new sampling methods proposed to the API Chapter 14.1 Working Group:

- Pitot and Bypass Method - proposed by Fred Van Orsdol, SPL Corporation
- High-Pressure Helium Displacement Method - proposed by Eric Fritz, Natural Gas Pipeline Company of America
- Modified Helium Pack Method - proposed by R. Mark Haefele, BP

Detailed procedures for these three methods may be found in Appendix B. The Pitot and Bypass method is a modification of the Controlled Rate Purge method designed to eliminate venting of the purge gas to the atmosphere. In this method, the outlet of the sample cylinder is connected to a second tap on the pipeline, so that during purging, flow passes through the sample cylinder and reenters the pipeline downstream of the gas sampling point. The High-Pressure Helium Displacement method also follows a procedure similar to the Controlled Rate Purge method, except that the sample cylinder is initially charged with helium to a pressure greater than the pipeline pressure. When the valves are initially opened, the helium purges the sample probe and flows into the pipeline. The Modified Helium Pack method is also a procedure similar to the Helium Pop method, except that the sample cylinder is evacuated after attachment to the pipeline, thus eliminating the emission of gas to the atmosphere. All of these methods use a sample cylinder that is initially pressurized with helium to a pressure above the pipeline pressure so that the sample probe can be back flushed prior to sampling.

2.2.3 Sampling Methods Considered but Not Tested

Three out of the nine sampling methods that were initially proposed for testing under the verification protocol were not tested due to limitations of the project budget and schedule. The methods that were not tested are as follows:

- Water Displacement Method - GPA 2166 (Reference 2)
- Glycol Displacement Method - GPA 2166 (Reference 2)
- Two-Stage Absorption Method - proposed by Chris Cowper, EffecTech Ltd.

The two GPA methods were eliminated because they are less commonly used than the other GPA methods tested. The Two-Stage Absorption method was not tested due to its complexity, and due to the fact that the API 14.1 Working Group concluded that its purpose was not in line with the goals of this project.

3.0 Sampling Tests

The sampling tests performed to evaluate the proposed test protocol were performed at two sites. The testing under optimum conditions was performed at the SwRI Metering Research Facility, while the adverse condition tests were conducted at a Questar Pipeline metering station in Powder Wash, Colorado. One feature of the proposed test protocol is that it requires extensive documentation of the tests and results. In accordance with those requirements, this chapter contains detailed information on the facilities and conditions found at each test site, along with the results obtained from the testing. This chapter concludes with an overall comparison of the results from all of the sampling tests, and an assessment of the proposed test protocol itself.

3.1 Verification Tests Performed Under Optimum Conditions

The testing under optimum conditions was conducted at the SwRI Metering Research Facility. During this testing both the pipeline and ambient temperature were well above the HCDP. At the MRF, the Fill-and-Empty method, the Helium Pop method, and the Controlled Rate Purge method were tested. The original project plans called for the three new sampling methods to also be tested at the MRF, but equipment problems discussed below required a revision to the scope of work, and it was decided to test the new methods only at the field site. Since the conditions at the field site were far less favorable than those at the MRF, testing the new methods only at the field site still provided a worst-case evaluation of the new methods.

3.1.1 Facility and Equipment

The testing was performed in lean gas (nominally 1,050 Btu/scf) using the High Pressure Loop (HPL) at the MRF. The HPL was configured for the sampling tests by installing several existing pipe spools equipped with fittings for the sample probes in the test section of the loop. Figure 1 is a schematic of the test facility layout showing where the various pieces of equipment were installed in the HPL test section. All of the sampling locations were located at least 8 pipe diameters downstream of any component that could create a flow disturbance. A photograph of the facility taken during the tests is shown in Figure 2.

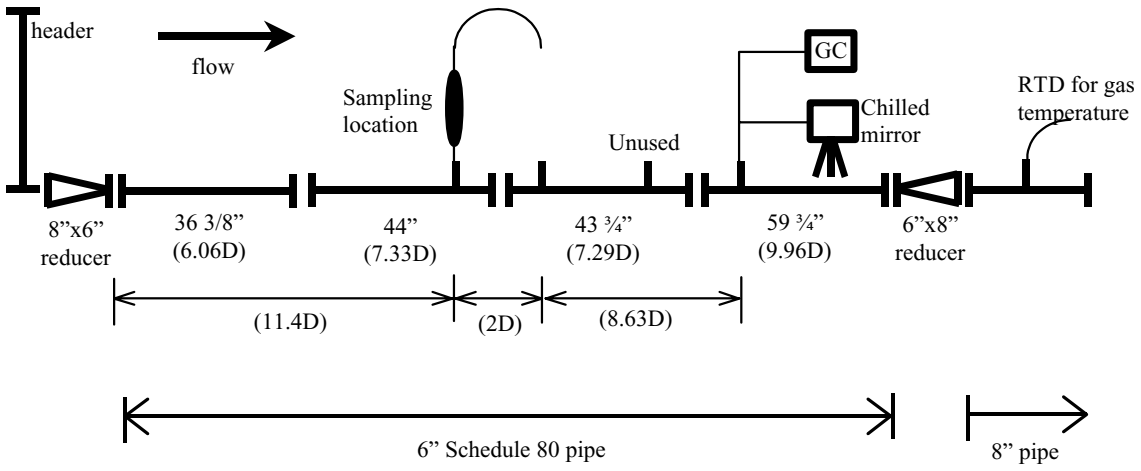


Figure 1. Schematic of the MRF test section showing the piping arrangement and spot sampling locations.

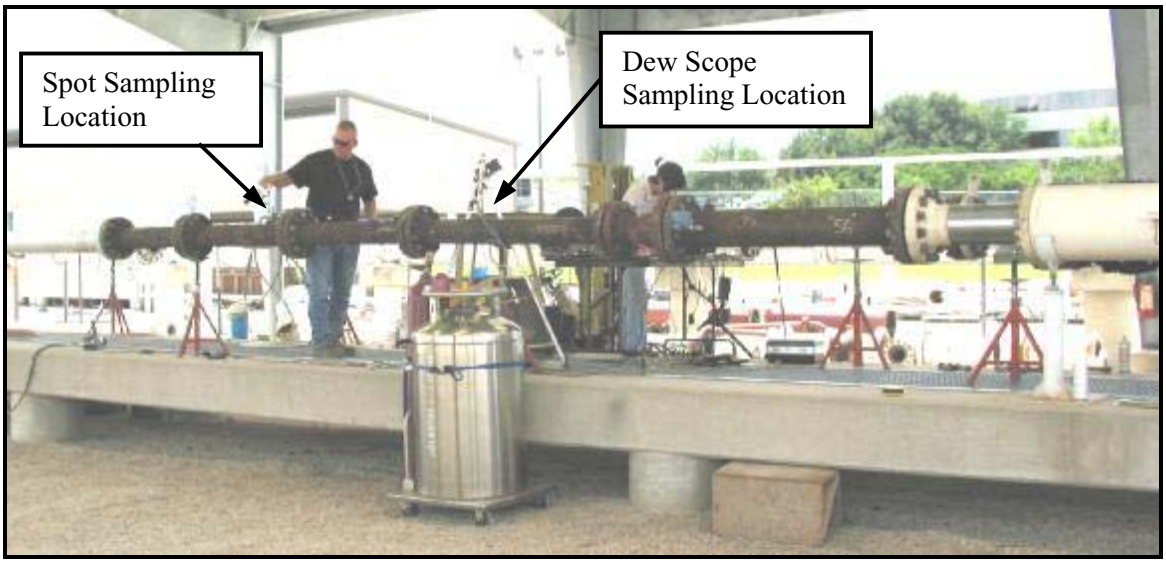


Figure 2. MRF test section piping configured for the sampling tests. The schematic for this setup is shown in Figure 1.

Figure 3 is a photograph of the sampling apparatus used for tests of the Controlled Rate Purge method. The arrangement of the equipment for the other methods was similar to the arrangement shown in this figure. The sample probes had angle-cut ends and were sized so that the tip of the probe was located in the center one-third of the pipe. Whitey® ball valves were installed on the sample probes and at the end of the pigtail. In keeping with the common practice, the API 14.1 Working Group requested that the sample cylinders used for the testing be equipped with YZ® needle valves at each end. All connections and pigtails were made with ¼" OD stainless steel tubing and ¼" NPT fittings. For the Controlled Rate Purge method, a drilled plug with a 0.02-inch diameter bore was installed at the end of the pigtail, in accordance with API Chapter 14.1. A separator [as described in GPA 2166 (Reference 2)] was not included in any of the sampling systems for this testing, since the flowing gas temperature and equipment temperatures were all well above the HCDP of the gas.

Preparation of the sampling equipment followed the procedures given in the proposed test protocol. All of the sample cylinders, valves, probes, and tubing were steam cleaned prior to use. After cleaning, all of the sample cylinders were evacuated, and cylinders to be used for the Helium Pop method were charged with helium. A total of fifteen 300-cc sample cylinders were prepared for testing, so that three different methods could be tested before cylinders had to be reused. To verify the cleanliness of the sample cylinders, two of the cylinders were charged with helium (99.999% purity) to 50 psig and heated to 180°F for 12 hours. Gas Chromatographic (GC) analysis of the contents of these cylinders showed no peaks in the chromatograms, hence, it was concluded that the cleaning process had left no residual hydrocarbons in the cylinders.

To gather information about the test conditions and sampling equipment, the standard instrumentation at the HPL was used, along with some additional thermocouples installed at several key locations in the gas sampling system. Exposed-junction, type T thermocouples were taped to the sample probe just above the pipeline, the tubing just below the sample cylinder inlet, the GC sample probe just above the pipeline, and the GC inlet. Surface temperature data from these sensors was read and logged by an HP Model 34970A data logger at one-second intervals. In addition to these measurements, the HPL instrumentation recorded the temperature, pressure and flow rate of the gas stream, and the ambient

temperature. The temperature and pressure of the gas stream were measured using Rosemount Model 3144 and 3051C transmitters, respectively. The flow rate was determined using the HPL critical flow nozzles, and verified using two reference turbine meters.

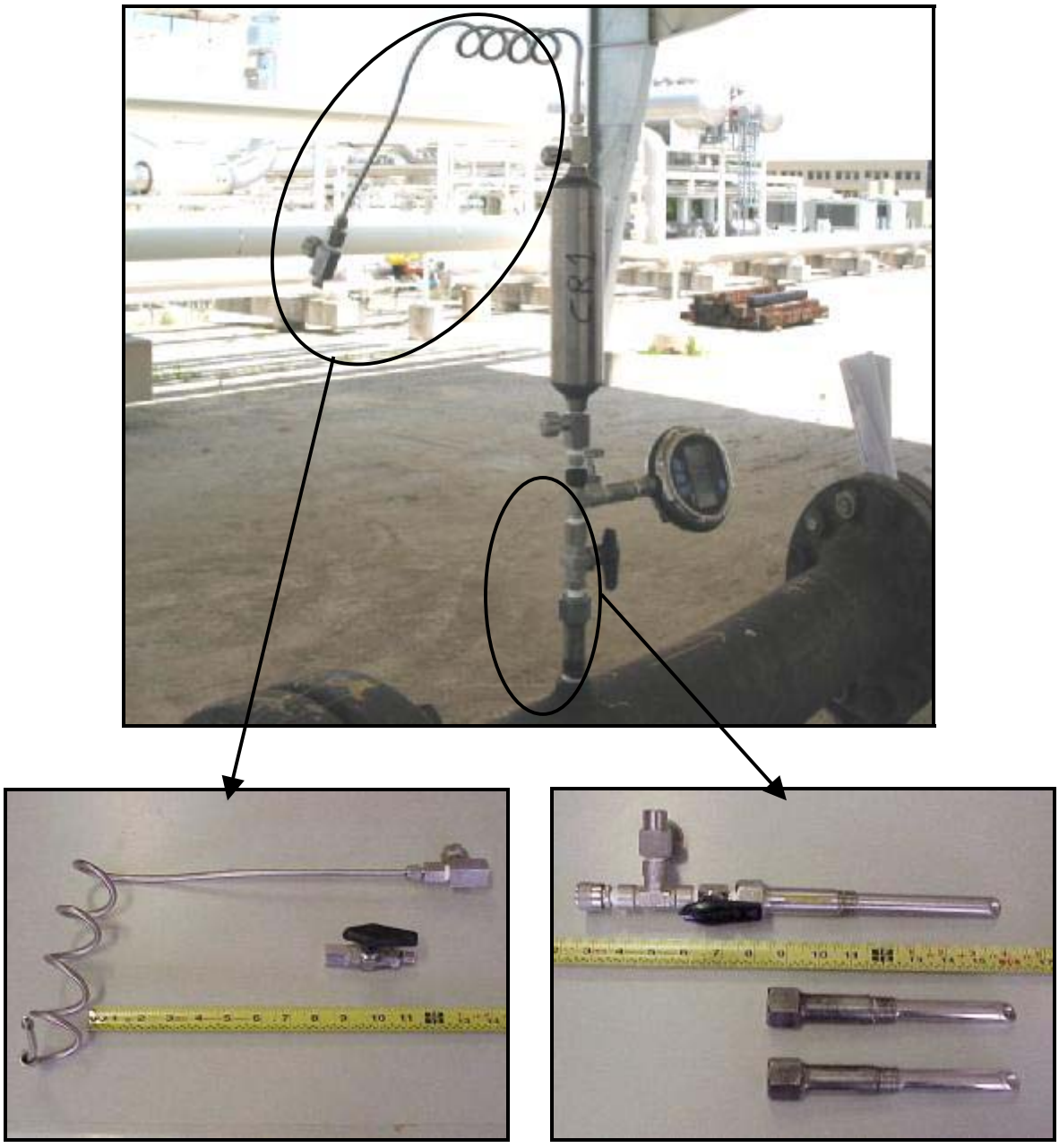


Figure 3. Sampling equipment used in tests of the Controlled Rate Purge method at the MRF. Bottom left, pigtail and end valve; bottom right, sample probes with isolation valve and pressure gauge connection. The scale on the tape measure is in inches.

As required by the proposed test protocol, the HCDP of the gas stream was determined by using a manual chilled mirror tester (dew scope) equipped with a video camera. Figure 4 shows the dew scope (Chandler Engineering Chanscope II, Model 13-1200-C-N-1) in use during the tests at the MRF. The

temperature sensor in the dew point tester was calibrated, traceable to NIST, before using the device. Measurements of the dew point were made independently by two technicians to confirm the readings.

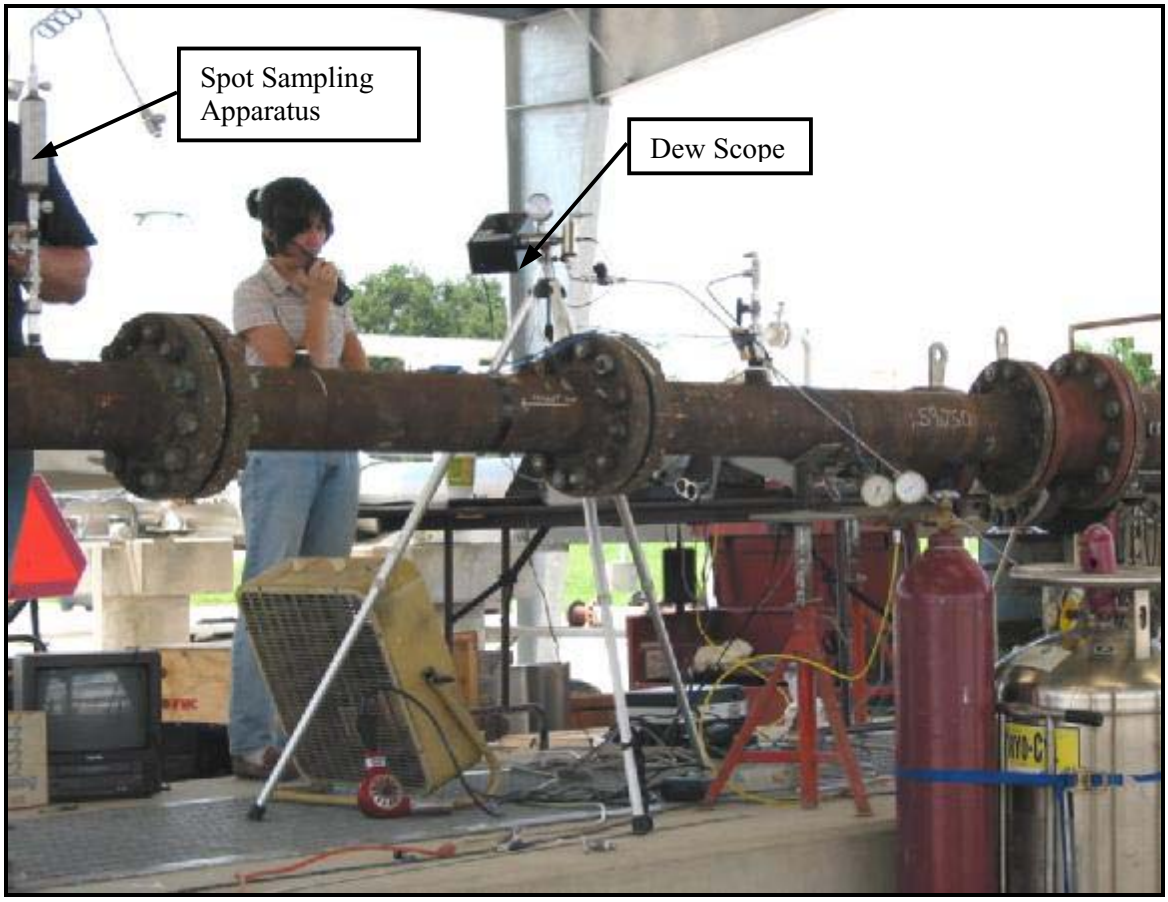


Figure 4. Dew scope connected to the MRF test section for determination of the gas stream HCDP.

It was originally planned for all of the gas composition analyses to be performed with a portable gas chromatograph that was loaned by Questar for use in this project. This GC was to be used for analyses of both the flowing gas stream and the gas samples, to eliminate any potential biases that could be caused by using different instruments for the two analyses. Prior to the start of the first sampling tests, the GC was taken to the MRF calibration laboratory and all of the preparation, calibration, and verification procedures of the proposed sampling verification protocol were performed. Although the GC met all of the requirements of the protocol, problems were encountered when the GC was moved outdoors to the HPL for the sampling tests. During these tests, the calibration drifted and the instrument failed to produce repeatable analyses of the flowing gas stream. The cause of the drift was traced to changing ambient conditions. Figure 5 contains two chromatograms, one taken in the morning, and the other taken in the afternoon, illustrating the drift that was observed.

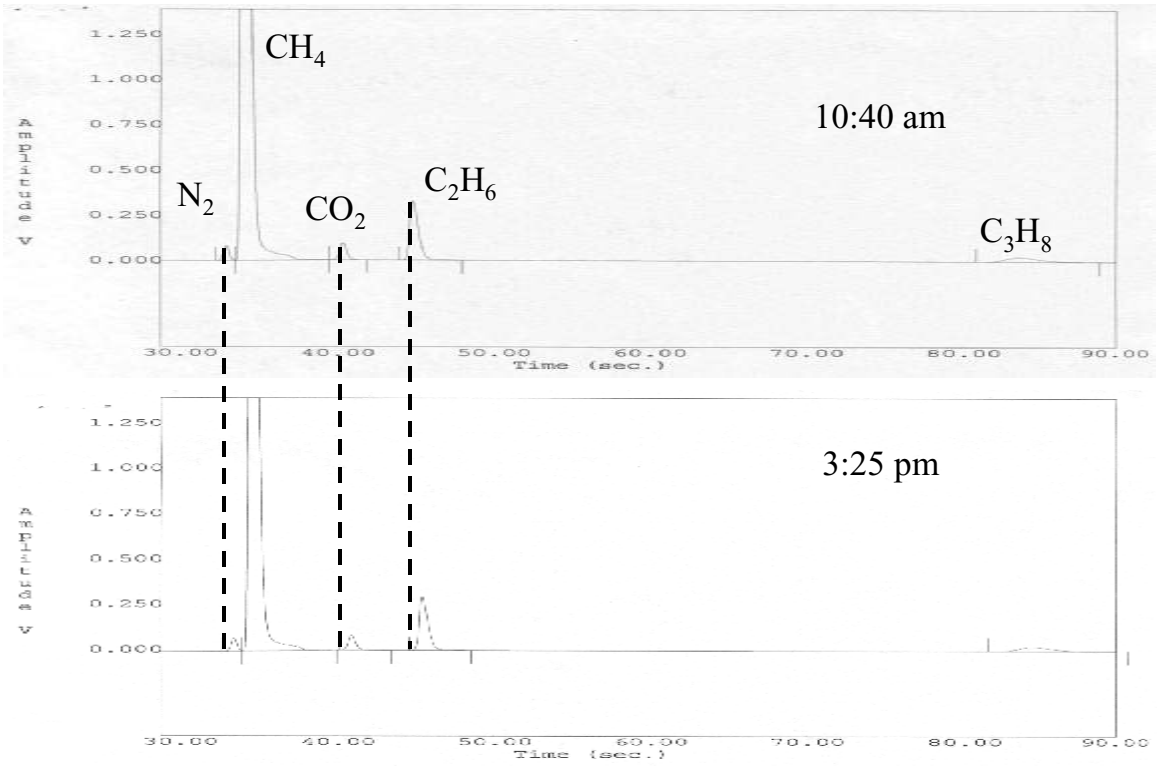


Figure 5. Stream analyses from 10:40 am and 3:25 pm on June 18, illustrating the drift that was observed in the portable GC during the MRF tests.

Instead of using the portable GC, it was decided to use the MRF on-line GC, which was also operating during the sampling tests. The MRF GC is a Daniel Model 2350 capable of analyses to C_9+, with analysis software and a sample delivery system that also complies with all of the requirements of API Chapter 14.1. The sample probe for the Daniel GC is located far downstream of the test section, and upstream of the critical flow Venturis used as the reference flow meters for the test facility. The MRF GC is located outdoors, but the columns are contained in insulated ovens for year-round stable performance. Heating of the sample cylinders or other sampling equipment was not required for these tests, as ambient temperatures were far above the HCDP. Further details of the analysis setup may be found in Appendix C of this report, which contains the API Chapter 14.1 inspection checklist for the sample analysis system.

The work to verify that the portable GC met all of the requirements of the sampling protocol was repeated for the MRF GC. The procedures given in the sampling protocol were again followed for calibration of the MRF GC. Since it is used for routine testing at the MRF, the Daniel GC is calibrated daily on a 1,030 Btu/scf gas that was prepared in accordance with the requirements of the current revision of API Chapter 14.1, Section 16. Analyses were repeatable to within 0.02 mol% for methane and to within smaller limits for the other components. The MRF chromatograph was also tested on a separate certified gas blend to determine its ability to reproduce known gas compositions. Analyses of the "unknown" gas reproduced its certified composition to within 0.05 mol% for methane and less for the other components. All repeatability and reproducibility values were within API Chapter 14.1 Appendix E limits. Detailed information on the GC calibration, including fidelity plots, is included in Appendix C.

3.1.2 Test Conditions

Tests of the Fill-and-Empty method, the Helium Pop method, and the Controlled Rate Purge

method were conducted on June 18, 2003. The specific procedures used for the testing of these methods at the MRF can be found in the 2003 draft revision of GPA 2166, which is expected to be published in 2004. The actual procedures have changed little from the 1986 edition of GPA 2166. For tests of the Fill-and-Empty method, three fill-and-empty cycles were completed before the final sample was collected. For the Controlled Rate Purge method, the sample cylinder was purged for 70 seconds prior to collection of the sample.

The gas used for the testing was obtained from the MRF storage vessels and recirculated in the flow loop to ensure a constant gas composition during the tests. Since no gas was added or removed from the loop while the sampling tests were being performed and all temperatures were significantly above the HCDP, it can be assumed that the gas composition in the system was stable during the testing.

As required by the proposed test protocol, the HCDP of the gas stream was measured immediately prior to collecting the gas samples and again at the conclusion of the testing. During attempts to measure the hydrocarbon dew point, water vapor condensed on the chilled mirror first, making determination of the HCDP difficult. In one run, water condensation was observed at 37°F, and no clear evidence of hydrocarbon liquids was found until the temperature was well below 0°F. For the test conditions, the HCDP was predicted using equations of state to be 27°F. Consequently, a dew point of 37°F was taken as a conservative estimate of the HCDP for the tests.

The flow rate and system pressure were monitored during testing to verify that they remained stable. Values of the line pressure and gas velocity during the periods that the three sampling methods were tested are shown in Figure 6. A steady flow rate of approximately 435 acfm in the loop was maintained during testing through the use of critical flow Venturis that served as the reference flow meters for the test facility. The gas stream pressure varied only slightly, between 1,009 and 1,014 psia.

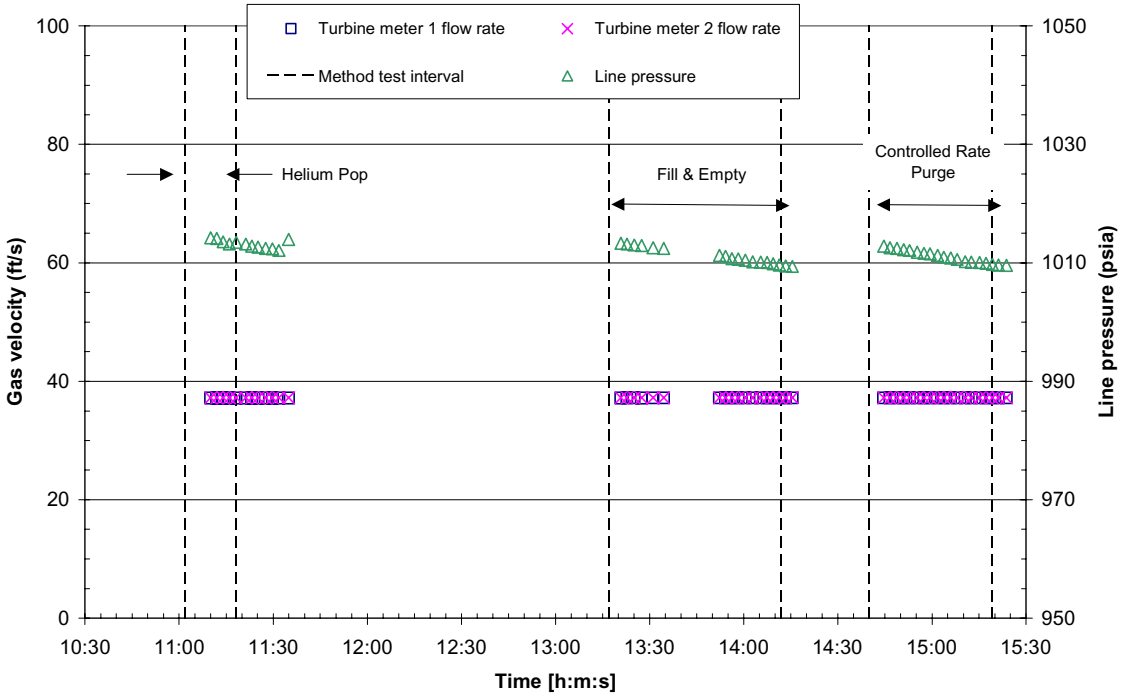


Figure 6. Gas velocity and pressure in the loop during the sampling tests conducted at the MRF. Vertical dashed lines show intervals during which samples were drawn using the various methods. Flow was in a 6" diameter Schedule 80 pipe.

The local temperatures of the sampling hardware, along with the gas stream and ambient temperature, are plotted in Figure 7 for the periods that the samples were drawn using the three test methods. These data show that none of the sampling equipment dropped below 71°F during the tests. Since the gas stream temperature and the equipment temperatures were all significantly above the HCDP (conservatively estimated to be 37°F, as discussed above), heating of the sample lines was not necessary.

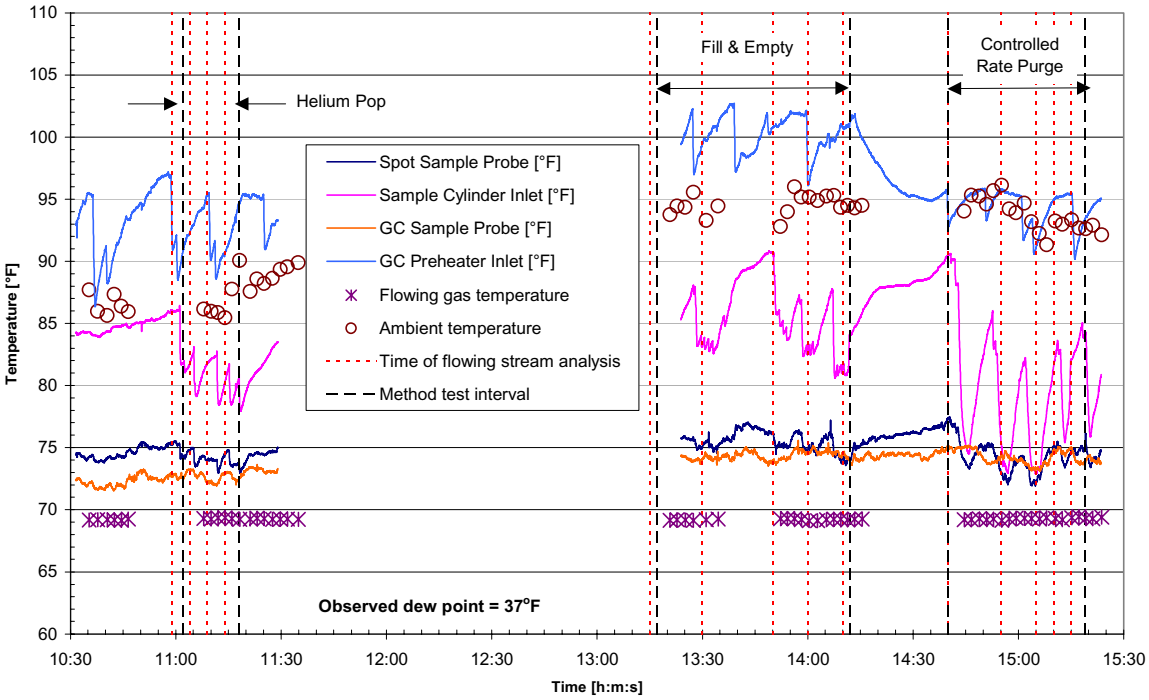


Figure 7. Equipment and gas temperatures during the sampling tests conducted at the MRF. Black vertical lines with long dashes indicate intervals during which samples were drawn using the various methods. Red vertical lines with shorter dashed lines indicate times when GC analyses of the flowing stream were obtained.

3.1.3 Results

For each sampling method tested, five gas samples were collected and analyzed. Each sample was collected in a separate 300 cc sample cylinder using the procedure appropriate for the method. After all of the samples had been collected, the gas samples were analyzed using the MRF GC. As required by the protocol, results of the analysis of each cylinder were compared to an analysis of the flowing stream, also made with the MRF GC nearest to the time that the sample was drawn. Because ambient conditions were 40°F or more above the conservative dew point of the HPL gas, and sections of the GC sample delivery lines were heat traced to 120°F, it was not deemed necessary to heat the gas samples prior to the analysis. The contents of each sample cylinder were analyzed six times. To be sure that the GC and sample delivery system had been purged of the gas sample from the previous run, only the results of the last three analyses of each cylinder were used to evaluate the method.

To illustrate the method used to evaluate the results of each sampling method, consider three successive GC analyses of a gas sample obtained using a particular sampling method. Let the analysis results obtained in order from a single sample cylinder be A_1, A_2, and A_3, where A_1, A_2, and A_3 represent

either the concentration of a single component in the analysis, or the heating value of the gas composition in the analysis. The repeatability deviation for a particular component (or the heating value) is computed as the maximum absolute difference between successive pairs of values. In terms of the notation just introduced,

$$\text{Repeatability Deviation} = max\left\{\left|A_1 - A_2\right|, \left|A_2 - A_3\right|\right\}. \quad \text{(Eq. 1)}$$

The reproducibility deviation for a particular component (or the heating value) is based on the maximum absolute difference obtained when comparing each of the three analyses to the value obtained from the GC analysis of the gas stream taken at approximately the same time as the sample. If A_{STRM} is the concentration of one component, or the heating value of the gas stream, then

$$\text{Reproducibility Deviation} = max\left\{\left|A_1 - A_{STRM}\right|, \left|A_2 - A_{STRM}\right|, \left|A_3 - A_{STRM}\right|\right\}. \quad \text{(Eq. 2)}$$

The results obtained from the three sampling methods tested at the MRF are summarized in Table 3 through Table 5. The complete results of the analyses of each sample have been included in Appendix D. In these tables, the first column identifies the sample cylinder used in testing the method. The second column identifies any component that failed to meet the repeatability criteria. If all components are within the specified limits, then the results are reported as "All OK". The actual deviations for each component may be found in the data included in Appendix D. The next column shows the maximum repeatability deviation in heating value, computed from Equation 1. The last two columns of the tables report the reproducibility results in a format similar to the repeatability results. Note, as discussed above, that the deviations reported in these tables and in Appendix D are unsigned (i.e., only the absolute value of the differences have been considered).

All of the samples taken using the three methods met the repeatability and reproducibility requirements for the components and the heating value. Thus, it may be concluded that, under optimum conditions, the three methods produced representative samples of the gas stream to within the required limits of the proposed test protocol. These results will be discussed in more detail in Section 3.3, where they will be compared to the results obtained from the other sampling tests.

Table 3. Summary of results from the tests of the Fill-and-Empty method conducted at the MRF under optimum conditions.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder FE1	All OK	0.14	All OK	0.95
Sample Cylinder FE2	All OK	0.15	All OK	0.86
Sample Cylinder FE3	All OK	0.05	All OK	0.26
Sample Cylinder FE4	All OK	0.19	All OK	0.22
Sample Cylinder FE5	All OK	0.10	All OK	0.61

Table 4. Summary of results from the tests of the Controlled Rate Purge method conducted at the MRF under optimum conditions.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder CR1	All OK	0.24	All OK	0.77
Sample Cylinder CR2	All OK	0.29	All OK	1.43
Sample Cylinder CR3	All OK	0.05	All OK	0.97
Sample Cylinder CR4	All OK	0.63	All OK	0.69
Sample Cylinder CR5	All OK	0.70	All OK	0.73

Table 5. Summary of results from the tests of the Helium Pop method conducted at the MRF under optimum conditions.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder HP1	All OK	0.07	All OK	0.96
Sample Cylinder HP2	All OK	0.04	All OK	0.99
Sample Cylinder HP3	All OK	0.60	All OK	0.87
Sample Cylinder HP4	All OK	0.03	All OK	0.80
Sample Cylinder HP5	All OK	0.21	All OK	0.84

3.2 Verification Tests Performed Under Adverse Conditions

For tests of the sampling methods under adverse conditions, a field site was desired with a rich gas stream (1,200-1,400 Btu/scf) at line conditions just above the HCDP. The field site was also required to have a stable gas composition and adequate infrastructure for performing the testing (sampling ports, pipeline instrumentation, an accessible GC, etc.). The site selection committee sent questionnaires to a number of companies, and received information on seventeen candidate sites for the field tests.

The site chosen for the field testing of the proposed test protocol is a Questar Pipeline metering station in Powder Wash, Colorado. The testing was performed under adverse conditions during which the pipeline temperature was at or just above the HCDP and the ambient temperatures were well below the HCDP. At the Powder Wash site, the following methods were tested: Fill-and-Empty, Helium Pop, Controlled Rate Purge, Pitot and Bypass, and High-Pressure Helium Displacement. An attempt was made to test the Modified Helium Pack method, but due to the cold conditions, the vacuum pump needed for this method would not function, and a second vacuum pump also failed, so that testing of this method was not possible.

3.2.1 Facility and Equipment

The testing was performed in rich gas (nominally 1,200 Btu/scf) at the Questar metering station in Powder Wash, Colorado. This is the same site used during the composite sampler tests conducted in 1999 and 2000 and discussed in Reference 3. The samples were collected from a straight section of 8-inch-diameter pipe located immediately upstream of an orifice meter. This section of pipe had four sampling locations located five pipe diameters apart. A photograph of the facility taken during the tests is shown in Figure 8. In the direction of flow, the first pair of sampling locations contained the curved probes used for the Pitot and Bypass method. The next sampling location was equipped with a straight probe that was used for the other sampling methods tested. The fourth sampling location at the downstream end of the pipe was used for the dew point tester and the gas chromatograph. The spacing between the sampling locations was sufficient to place each probe at least eight characteristic diameters downstream of any object creating a flow disturbance, where the characteristic diameter is based on the scale of the object creating the disturbance (e.g., the diameter of an upstream probe).

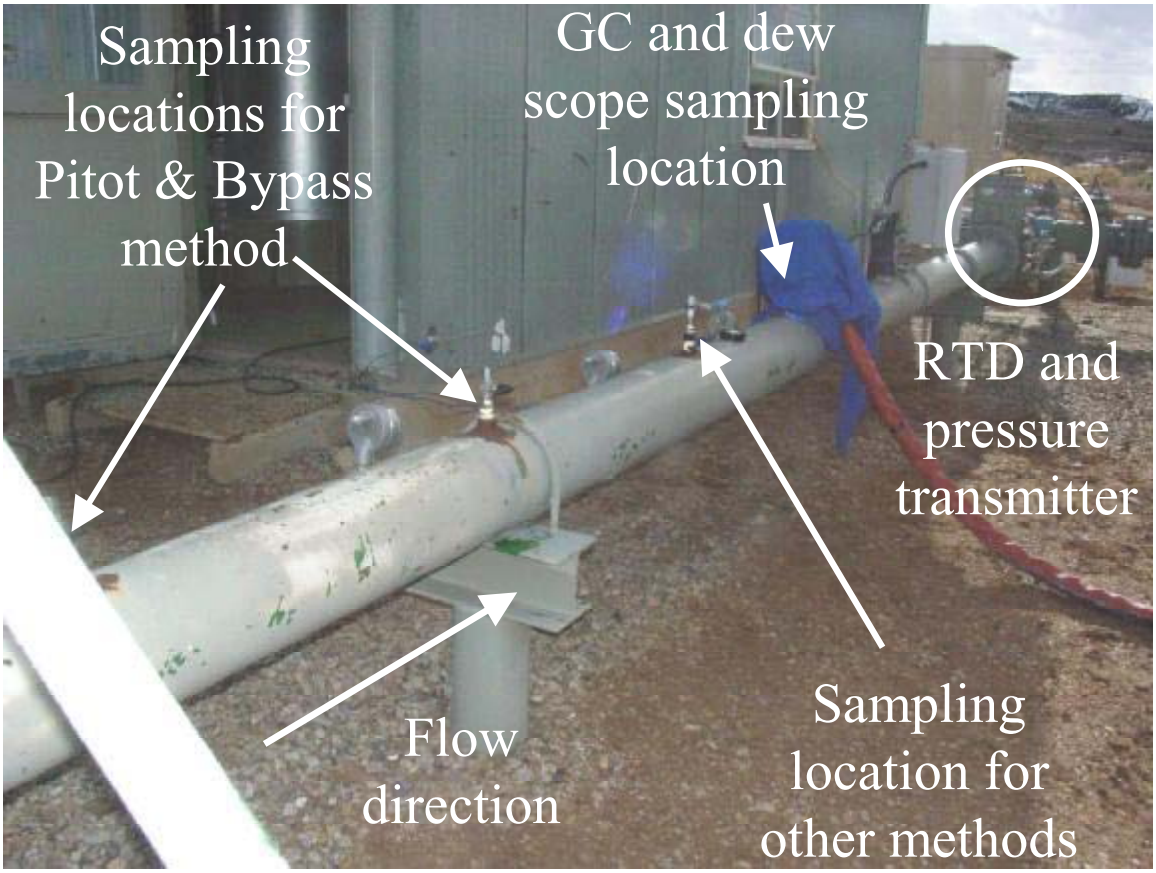


Figure 8. Pipeline and sampling locations at the Powder Wash field site.

The sampling arrangements used for most of the methods are shown in Figure 9 and Figure 10. The sampling hardware (valves, tubing, sample cylinders, etc.) from the MRF tests was also used for performing the same tests at the Powder Wash site. Questar provided some additional 300-cc sample

cylinders, valves and probes for tests of the new sampling methods. As much as practical, the configuration of the sampling equipment from the MRF tests was duplicated for the Powder Wash tests. Ball valves were installed on the sample probes and needle valves were used on the sample cylinders and at the end of the pigtail. The only exception to this was for the Pitot and Bypass method, which required ball valves on the sample cylinders and at both probes. All connections and pigtails were made with ¼" OD stainless steel tubing and ¼" NPT fittings. For the Controlled Rate Purge method and the High-Pressure Helium Displacement method, a drilled plug with a 0.02-inch diameter bore was installed at the end of the pigtail. A separator [as described in GPA 2166 (Reference 2)] was not included in any of the sampling systems, at the request of the API 14.1 Working Group.

Figure 11 shows the sampling probes that were used. The Pitot and Bypass method required a pair of curved probes. These probes were manufactured by Welker Engineering and were designed so that the curved end could be inserted through the existing fittings on the pipe. For all of the other methods, straight sample probes with angle-cut ends were used. All of the sample probes were sized so that the tip of the probe was located in the center one-third of the pipe.

Figure 9. Configuration of the equipment used for collecting samples at the Powder Wash field site. Left, Controlled Rate Purge; center, Fill-and-Empty; right, High-Pressure Helium Displacement.

Figure 10. Configuration of the equipment used for collecting samples with the Pitot and Bypass method at the Powder Wash field site.

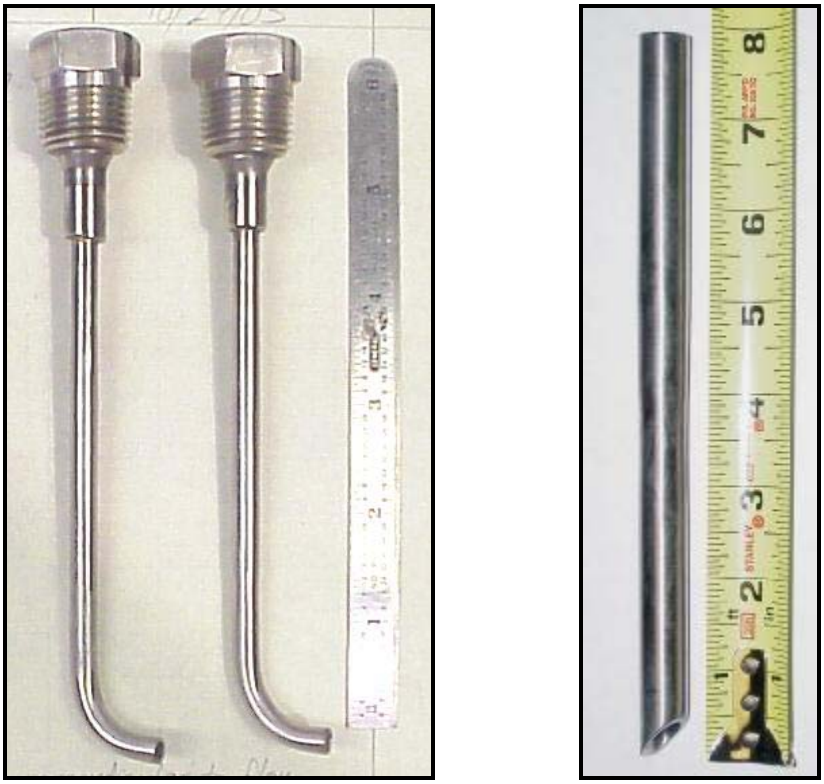


Figure 11. Sampling probes used for the Powder Wash tests. Left, curved probes for the Pitot and Bypass method; right, example of a straight probe used for the other sampling methods.

Preparation of the sampling equipment again followed the procedures given in the proposed test protocol. Enough 300 cc sample cylinders were prepared so that all six of the methods could be tested at the field site. All of the sample cylinders, valves, probes, and tubing from the MRF test were steam cleaned prior to reuse at the field site. The equipment provided by Questar was cleaned with acetone. Prior to the start of tests, a subset of cleaned sample cylinders were charged with helium (99.999% purity), and then analyzed to verify that the portable GC, sample cylinders, and sample delivery tubing were clean and free of contaminants. After cleaning, all of the sample cylinders were evacuated, and the cylinders to be used for the Helium Pop method and the three new sampling methods were pre-charged with helium as specified in their respective sampling procedures.

The HP Model 34970A data logger was again used to monitor and record (at one-second intervals) temperatures obtained with surface-mount type T thermocouples attached to the sample probe, the sample cylinder inlet, the gas chromatograph (GC) sample probe, and the GC inlet. An additional, standard Type T thermocouple was used to measure the ambient temperature. The temperature, pressure, and flow rate of the gas stream were obtained from transmitters and a flow computer permanently located at the site.

The HCDP of the gas stream was measured using a chilled mirror device provided by Questar. As required by the proposed test protocol, the dew scope had a NIST traceable temperature sensor calibration. Measurements of the dew point were made independently by two technicians to confirm the readings.

All of the gas analyses at the Powder Wash site were performed using a Varian Model CR-4900 portable gas chromatograph. This GC is capable of analyses to C_{9+} and it was verified that the chromatograph and sample delivery system complied with all of the requirements of API Chapter 14.1. The GC was connected to a sample probe located downstream of the spot sample location as shown in Figure 8. The GC was located in a heated vehicle, and the line connecting the GC to the pipeline was heat traced along its entire length. Further details of the analysis setup may be found in Appendix C of this report, which contains the API Chapter 14.1 inspection checklist for the sample analysis system.

Validation of the portable GC was carried out using the procedures given in the proposed sampling protocol. The GC was calibrated on a 1,200 Btu/scf gas that was prepared in accordance with the requirements of the current revision of API Chapter 14.1, Section 16. The chromatograph was also tested on a separate certified gas blend to determine its Warren reproducibility. All repeatability and reproducibility values were within API Chapter 14.1 Appendix E limits. As will be discussed in more detail below, some additional sampling tests were performed following the first round of tests completed in November. The portable GC was calibrated prior to these additional tests, and all values were again within the Appendix E limits, except for CO_2, which was 0.01 mol% high. Detailed information on the GC calibrations, including fidelity plots, is included in Appendix C. The calibration gases were analyzed using a separate GC to confirm their composition before they were used to calibrate the Varian GC used for the protocol analyses.

3.2.2 Test Conditions

Tests of the Fill-and-Empty, Helium Pop, Controlled Rate Purge, Pitot and Bypass, and High-Pressure Helium Displacement methods were conducted on November 10, 2003. The specific procedures used for these methods at the Powder Wash site can be found in the 2003 draft revision of GPA 2166 and in Appendix B. For the Fill-and-Empty method, three fill-and-empty cycles were completed before the final gas sample was collected. For tests of the Controlled Rate Purge method, the sample cylinder was purged for 70 seconds prior to collection of the sample. As noted in the table of results below, some Pitot and Bypass samples were taken after a 60 second purge time, while others were taken after a 90 second purge time.

The gas stream was monitored before and during the testing to determine the stability of the gas

composition and the flowing conditions in the pipeline. Figure 12 shows measurements of the stream heating value and nitrogen content at one-hour intervals taken over the course of several days around the time of the tests. The nitrogen content remained fairly constant, but the heating value exhibited a regular fluctuation of approximately ±10 Btu/scf over the course of several days, suggesting that the line temperature may have been influencing the gas composition. This was also observed during the composite sampler tests conducted in 1999 and 2000 and discussed in Reference 3. The Powder Wash metering station is located just downstream of a separation facility, so that the gas stream temperature is typically very close to the HCDP. The tandem changes in stream temperature changes and heating value reflect the fact that the gas leaving the separator is normally at or just above the HCDP temperature. However, the period of the fluctuations is very long compared with the time interval over which all samples were taken using a given test method, thus, the composition was essentially stable while tests of each sampling method were being performed.

The HCDP of the gas stream was measured immediately prior to collecting the gas samples and determined to be 69°F, approximately the same as the flowing stream temperature. An attempt was made to measure the HCDP after tests, but the tests were concluded after sunset, and the dew scope used at the site relied on ambient lighting to illuminate the chilled mirror, so a post-test measurement was not possible.

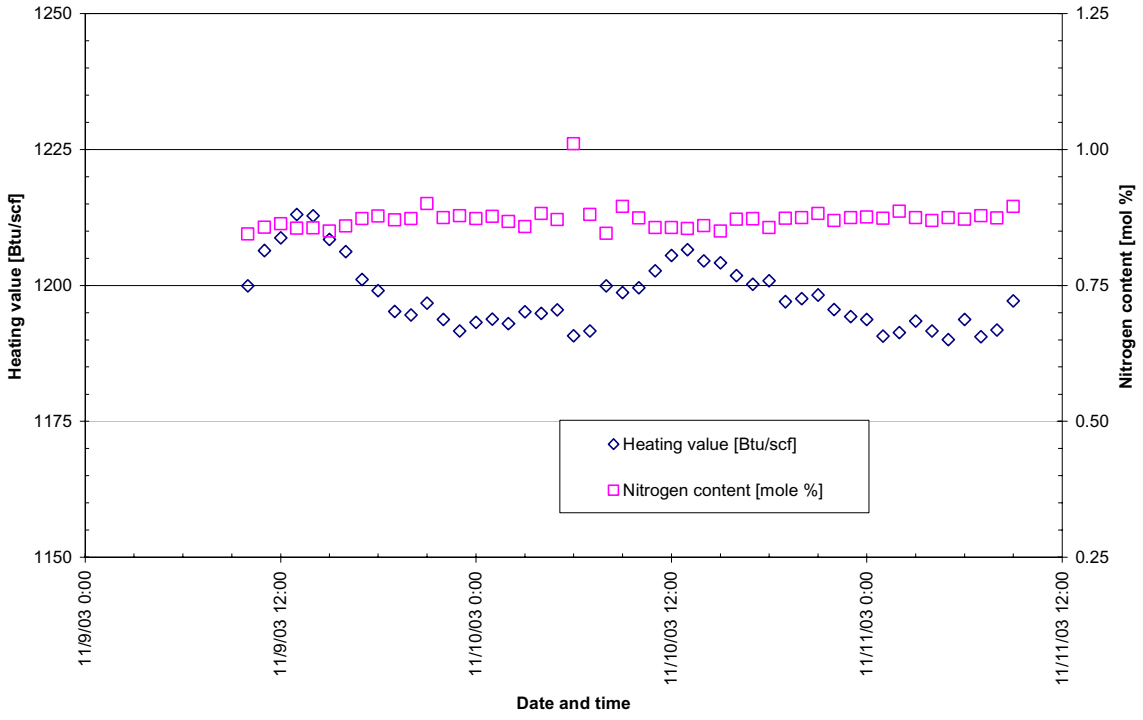


Figure 12. Long-term trends in flowing stream heating value and nitrogen content around the time of the sampling tests conducted in November at the Powder Wash field site.

Detailed records of the line pressure and flowing gas velocity during the times that the sampling methods were tested are shown in Figure 13. For this period, the line pressure remained fairly constant at approximately 580 psia, and the average flow rate was 7,670 Mscfd with a variation (maximum to minimum) of ±3.3% about this mean.

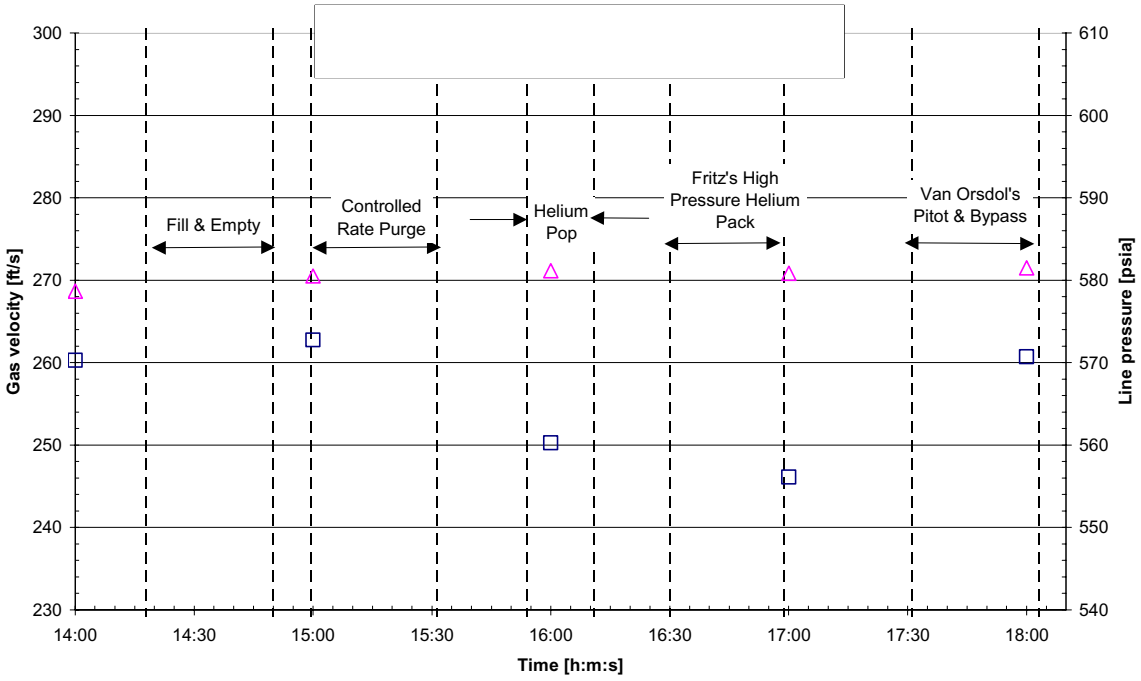


Figure 13. Gas velocity and pressure in the pipeline during the sampling tests conducted in November at the Powder Wash field site. Vertical dashed lines show intervals during which samples were taken using the various sampling methods. Flow was in an 8" diameter pipe.

Because the ambient temperature at the site was well below the HCDP of the gas stream, all of the sampling equipment was kept in heated storage containers until it was used to obtain a sample. Although the sample cylinders were insulated to keep them warm outside of the storage containers, insulation was not available during the November tests for the valves and lines connected to the cylinder, as shown in Figure 14.

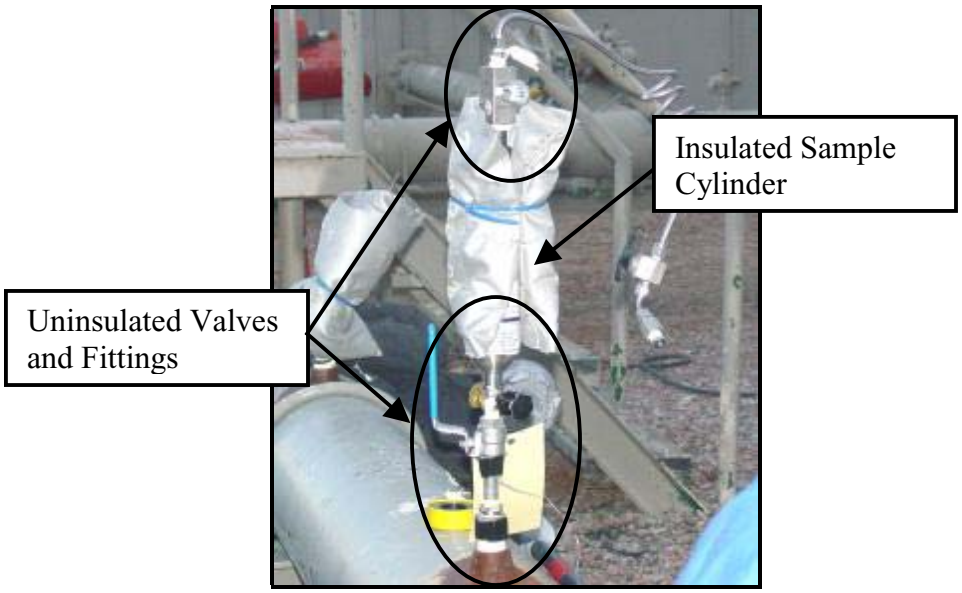


Figure 14. Typical sampling arrangement at the Powder Wash field site showing which portions of the system were not insulated during the November tests. The attached lines and valves were insulated during the December retests.

The local temperatures of the sampling hardware, along with the gas stream and ambient temperature, are plotted in Figure 15 for the periods that the samples were taken using the various methods. These data show that all of the monitored locations on the sampling equipment were below the HCDP during the tests, as might be expected, since these regions were not insulated. The use of sampling equipment with temperatures below the HCDP and the fact that the gas was likely near saturation (as this site was downstream of a separator) may have contributed to the poor performance of some of the methods tested.

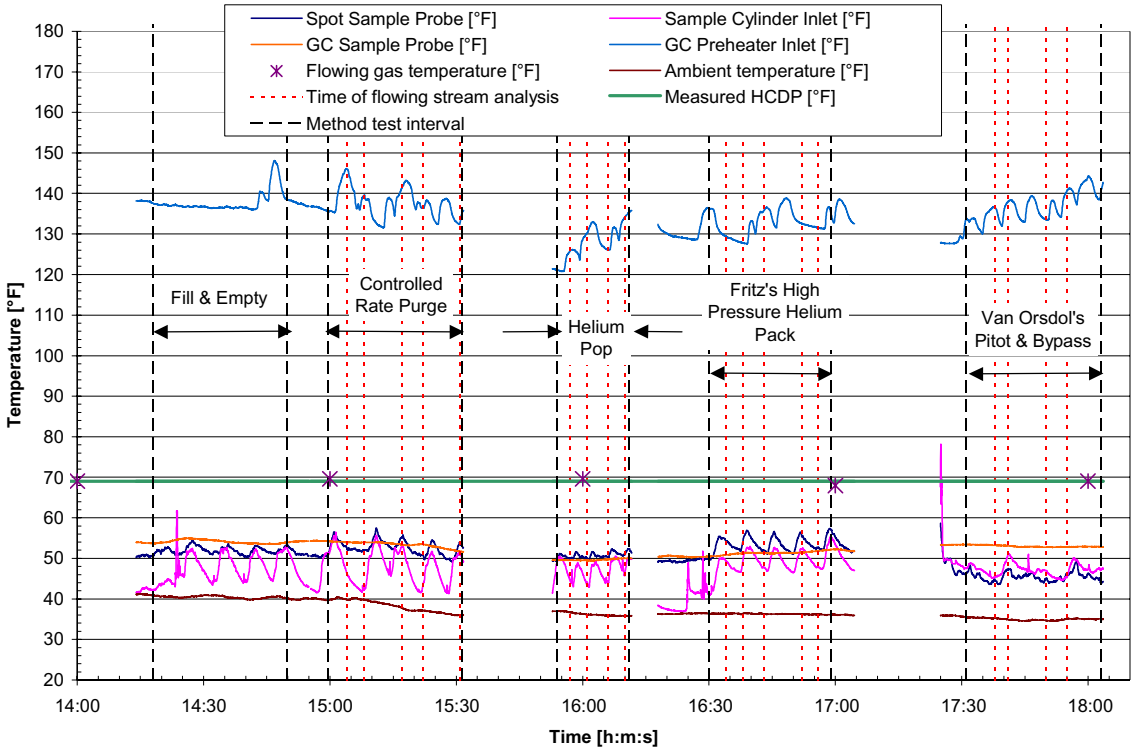


Figure 15. Equipment and gas temperatures during the sampling tests conducted in November 2003 at the Powder Wash field site. Black vertical lines with long dashes indicate intervals during which samples were drawn using the various methods. Red vertical lines with shorter dashed lines indicate times when GC analyses of the flowing stream were obtained.

3.2.3 Results

For each sampling method that was tested, five gas samples were collected and analyzed. Each sample was collected in a separate 300-cc sample cylinder using the procedure appropriate for the method. After all of the samples had been collected, the gas samples were heated to 125°F overnight at the Questar lab, and analyzed three times using the same GC that was used to analyze the flowing gas stream. Before analysis of the contents of each cylinder, helium was used to purge the GC and sample delivery system of the gas from the previous run.

During the process of analyzing the samples, an air leak was discovered in the sample delivery system. This leak was not found during the preparations specified in the proposed test protocol. As a result, all of the cylinders that had been analyzed prior to the discovery of the leak were reanalyzed after the leak was repaired. In the case of the samples obtained with the Fill-and-Empty method, there was not enough gas remaining in any of the sample cylinders to perform another analysis. For most of the other

methods, contents of only one sample cylinder were lost.

The results obtained from the sampling methods tested under adverse conditions are summarized in Table 6 through Table 9. The complete results of the analyses of each sample have been included in Appendix D. The format of these tables is identical to the tables presented and discussed in Section 3.1.3. To assist in interpreting the reproducibility results, components not meeting the criteria of the proposed test protocol have been identified as being either "high" or "low" to indicate how the values compared to the reference values of the gas stream. Values in bold red type are outside the acceptance criteria of Table 1 and Table 2. The Controlled Rate Purge and High-Pressure Helium Displacement methods failed the reproducibility tests, and some samples taken using the Helium Pop and the Pitot and Bypass methods passed, while others did not. These results will be discussed in more detail in Section 3.3, where they will be compared to the results obtained from the other sampling tests.

Table 6. Summary of results from the tests of the Controlled Rate Purge method conducted in November at the Powder Wash field site.

	Repeatability		**Reproducibility**	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder CR1	**N_2**	0.86	*high-* **N_2, C_6**	**8.78**
Sample Cylinder CR2	*No data available*		*No data available*	
Sample Cylinder CR3	**N_2**	0.25	*high-* **N_2** *low-* **CO_2**	**5.04**
Sample Cylinder CR4	All OK	0.12	*high-* **C_3**	**7.07**
Sample Cylinder CR5	All OK	0.50	*high-* **C_3, iC_4**	**6.61**

Table 7. Summary of results from the tests of the Helium Pop method conducted in November at the Powder Wash field site.

	Repeatability		**Reproducibility**	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder HP1	All OK	0.16	*high-* **N_2**	2.50
Sample Cylinder HP2	All OK	0.20	*high-* **N_2**	**3.17**
Sample Cylinder HP3	All OK	0.03	All OK	**3.82**
Sample Cylinder HP4	*No data available*		*No data available*	
Sample Cylinder HP5	All OK	0.45	*high-* **N_2**	2.79

Table 8. Summary of results from the tests of the High-Pressure Helium Displacement method conducted in November at the Powder Wash field site.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder EF1	All OK	0.51	*high-* **C_5 to C_7**	**8.50**
Sample Cylinder EF2	All OK	0.54	*high-* **iC_5, C_6, C_7**	**9.32**
Sample Cylinder EF3	All OK	0.20	*high-* **iC_4, C_5 to C_7, CO_2**	**14.26**
Sample Cylinder EF4	All OK	0.63	*high-* **C_3, iC_4, C_5 to C_7** *low-* **C_1**	**18.10**
Sample Cylinder EF5	All OK	0.23	*high-* **iC_4, C_5 to C_7**	**13.76**

Table 9. Summary of results from the tests of the Pitot and Bypass method conducted in November at the Powder Wash field site.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder PP1	*No data available*		*No data available*	
Sample Cylinder PP2*	All OK	0.18	*high-* **C_6, C_7**	**7.39**
Sample Cylinder PP3†	All OK	0.33	*low-* **C_3**	0.64
Sample Cylinder PP4†	**iC_4**	**3.28**	*low-* **iC_4**	**3.92**
Sample Cylinder PP5†	All OK	0.85	*low-* **C_3**	1.16

*90 second purge time prior to sample collection, †60 second purge time prior to sample collection.

3.2.4 Test Conditions – Repeat Tests

Due to the difficulties encountered with the analysis of the samples from the Powder Wash site, it was decided to repeat the tests of some of the methods. Repeat tests of the Fill-and-Empty, Helium Pop, and Pitot and Bypass methods were conducted on December 19, 2003 at the Powder Wash site by Questar personnel. Based on previous experience among members of the API Ch. 14.1 Working Group, these methods were expected to pass if performed correctly. The repeat tests also provided an opportunity to test these methods again under conditions in which all of the sampling equipment was insulated. Recall, as discussed in Section 3.2.2, that only the sample cylinder was insulated during the November tests. For the December tests, a second valve assembly (for use between the pipeline and the sample cylinder) was

kept in a heated storage container and was used to replace the assembly in use when its temperature dropped below the ambient temperature. Also, Questar personnel used one exposed-junction thermocouple to measure the surface temperature of the sample cylinders, rather than the tubing near the cylinder inlet, as was done in November. Other than these modifications, the procedures for the repeat tests were exactly identical to those used during the November tests.

Figure 16 shows the stability of the stream heating value and nitrogen content in the pipeline, measured at one-hour intervals over the course of several days around the time of testing. The nitrogen content remained fairly constant, but the heating value exhibited a regular fluctuation of about ±25 Btu/scf. As was the case during the November tests, the gas stream temperature was very close to the HCDP, as would be expected for the flow just downstream of a separator station, and the temperature and heating value fluctuated in tandem. However, the period of the fluctuations is very long compared with the time interval during which the samples were being taken, and thus the composition was likely stable while the sampling was being performed.

As required by the proposed test protocol, the HCDP of the gas stream was measured immediately prior to collection of the gas samples and was determined to be 65°F. Since it was dark when the testing was completed, it was not possible to measure the HCDP again at the conclusion of the tests.

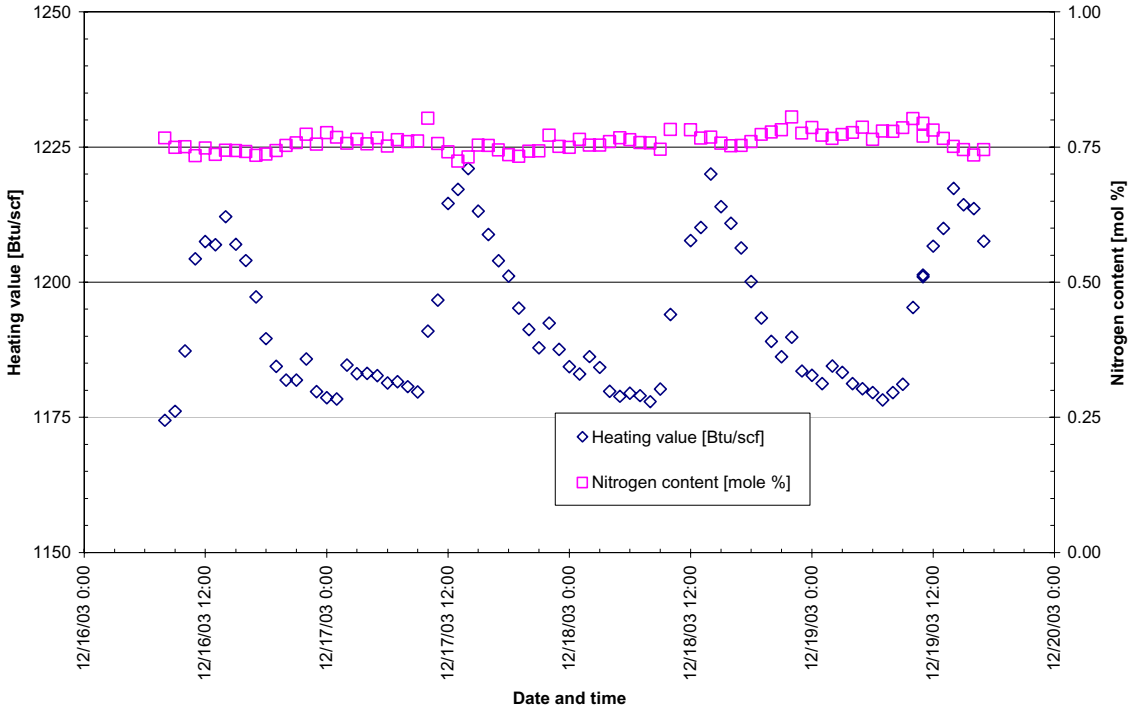


Figure 16. Long-term trends in stream heating value and nitrogen content around the time of the sampling tests conducted in December at the Powder Wash field site.

The flowing stream conditions and the temperatures of the sampling hardware, along with the gas stream and ambient temperatures, are plotted in Figure 17 and Figure 18 for the periods that the samples were taken. For these tests, the temperature of the sample cylinder was above the HCDP over almost the entire duration of the sample. This may be attributable to the use of insulation blankets around the cylinders and the fact that the valve assemblies were kept in hot storage until used. The sample probe

temperature, however, was below the HCDP, as in November. It is likely that the portion of the sample probe outside the pipe wall was still cooled by exposure to ambient conditions during the repeat tests.

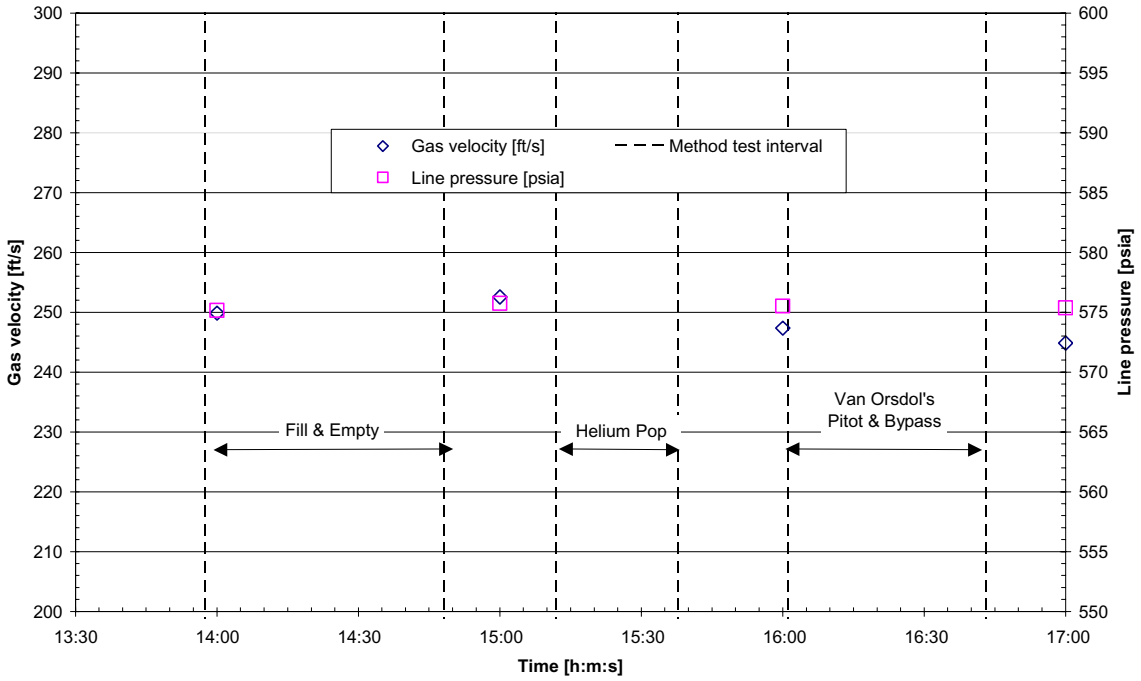


Figure 17. Flowing gas velocity and line pressure in the pipeline during the sampling tests conducted in December at the Powder Wash field site. Vertical dashed lines show intervals during which samples were taken by the various methods. Flow was in an 8" diameter pipe.

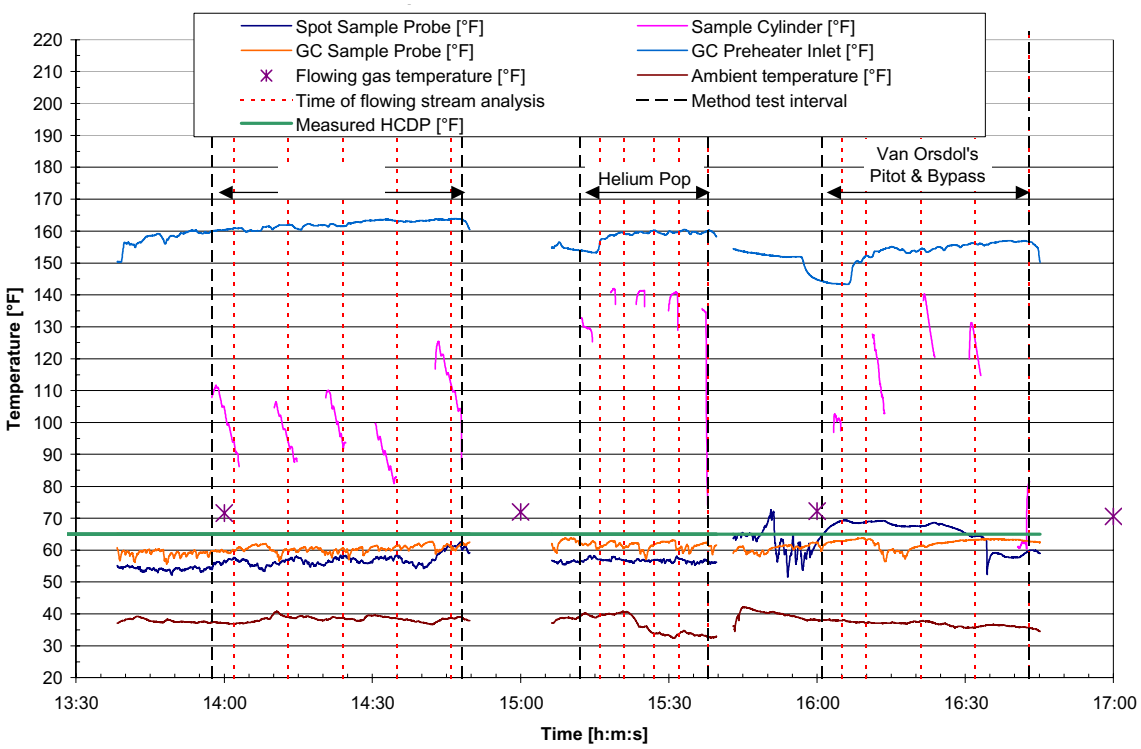


Figure 18. Equipment and gas temperatures during the sampling tests conducted in December 2003 at the Powder Wash field site. Black vertical lines with long dashes indicate intervals during which samples were drawn using the various methods. Red vertical lines with shorter dashed lines indicate times when GC analyses of the flowing stream were obtained.

3.2.5 Results – Repeat Tests

The results obtained from the repeat tests of the three sampling methods are summarized in Table 10 through Table 12, which are in the same format as those presented earlier. The procedures for analyzing the gas samples were exactly the same as those used for the November tests. The complete results of the analyses of each sample have been included in Appendix D.

Although all samples from the three methods met the repeatability criteria, at least one sample from each of the methods failed to meet one of the reproducibility requirements. For the Fill-and-Empty method, the reproducibility of the compositions was acceptable, but the heating value of one sample was greater than the 3 Btu/scf reproducibility limit set by the proposed test protocol. For the other two methods, the only reproducibility failures were high nitrogen content in some of the samples. The high nitrogen content may be the result of a small air leak that occurred at some point during the process. These results will be discussed in more detail in Section 3.3, where they will be compared to the results obtained from the other sampling tests.

Table 10. Summary of results from the retest of the Fill-and-Empty method conducted in December at the Powder Wash field site.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder FE1	All OK	0.11	All OK	0.23
Sample Cylinder FE2	All OK	0.09	All OK	0.97
Sample Cylinder FE3	All OK	0.11	All OK	**4.10**
Sample Cylinder FE4	All OK	0.07	All OK	2.14
Sample Cylinder FE5	All OK	0.10	All OK	2.47

Table 11. Summary of results from the retest of the Helium Pop method conducted in December at the Powder Wash field site.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder HP1	All OK	0.03	*high-* N_2	0.05
Sample Cylinder HP2	All OK	0.08	*high-* N_2	0.26
Sample Cylinder HP3	All OK	0.16	All OK	1.42
Sample Cylinder HP4	All OK	0.45	All OK	1.09
Sample Cylinder HP5	All OK	0.17	*high-* N_2	2.15

Table 12. Summary of results from the retest of the Pitot and Bypass method conducted in December at the Powder Wash field site.

	Repeatability		Reproducibility	
	Components not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)	Components Not Meeting Criteria	Max. Heating Value Deviation (Btu/scf)
Sample Cylinder PP1*	All OK	0.08	*high-* N_2	1.49
Sample Cylinder PP2*	All OK	0.34	All OK	1.10
Sample Cylinder PP3*	All OK	0.04	All OK	1.89
Sample Cylinder PP4*	All OK	0.03	All OK	0.33
Sample Cylinder PP5*	All OK	0.14	All OK	0.57

*90-second purge time prior to sample collection.

3.3 Assessment of the Sampling Methods

The results from all of the sampling tests are summarized in Table 13. In this table, "Passed" means that the method met all of the requirements of the proposed test protocol, while "Acceptable" indicates that the method met most of the requirements, except for some minor deviations that are noted in the table. Methods that did not meet the requirements are listed as "Failed". Among the methods tested, two of the established GPA sampling methods (Fill-and-Empty and Helium Pop) produced representative samples of the gas stream under both optimum and adverse conditions. The Pitot and Bypass method, which was tested only under adverse conditions, was the only new method to meet the requirements of the proposed test protocol. The Controlled Rate Purge method passed the protocol requirements under optimum conditions at the MRF. The Controlled Rate Purge method and the High-Pressure Helium Displacement methods failed under adverse conditions at the Powder Wash site during November, but were not included in the December retests due to project constraints.

Table 13. Comparison of results from all sampling tests performed in this project.

Line Temperature	at least 32ºF above HCDP	at HCDP	6ºF to 8ºF above HCDP
Ambient Temperature	at least 48ºF above HCDP	at least 28ºF below HCDP	at least 22ºF below HCDP
Stream HCDP	below 37ºF	69ºF	65ºF
Line Pressure	1009-1014 psia	578-582 psia	575-576 psia
Fill-and-Empty	Passed	no data available (all samples lost before air leak discovered)	Acceptable (heating value outside reproducibility limits on one sample)
Controlled-Rate Purge	Passed	Failed	*Not tested*
Helium Pop	Passed	Failed	Acceptable (N_2 outside reproducibility limits on three samples)
Pitot and Bypass Method	*Not tested*	Failed	Acceptable (N_2 outside reproducibility limits on one sample)
High-Pressure Helium Displacement Method	*Not tested*	Failed	*Not tested*
Modified Helium Pack Method	*Not tested*	*Not tested*	*Not tested*

From the comparisons shown in Table 13, it can be seen that the sampling conditions can affect how well a particular sampling method obtains a representative sample of the flowing gas stream. The Helium Pop method, which passed tests at the MRF, failed during the November field tests, but passed when it was retested in December with all equipment insulated from the ambient air. Likewise, the Pitot and Bypass method failed the November field tests, but provided acceptable samples in the December repeat tests. The likely explanation for the improvement in the repeat tests in both of these cases is that the sample lines and valves were kept at a higher temperature by the insulation and the practice of keeping the equipment in a heated container until use. Recall that although the sample cylinders themselves were insulated in both sets of tests, the valves and sample lines were only insulated during the December repeat tests. During the November tests, the portion of the sample probe outside the pipe wall was 13ºF to 25ºF below the HCDP, and only 10ºF to 20ºF above ambient temperature; during the December tests, the exposed portion of the probe was no more than 10ºF below the HCDP, yet 20ºF to 30ºF above ambient temperature. This shift of the probe temperature toward the line temperature and away from the ambient temperature suggests that the insulation added to the sampling apparatus helped to keep the equipment warm and improved the quality of the samples.

The Controlled Rate Purge method and the High-Pressure Helium Displacement method were two other methods than failed under adverse conditions with no insulation of the sample lines and valves. Since these methods were not included in the December retests, it is not possible to draw any definite conclusions about how they might have performed if the sampling equipment had been insulated to keep equipment temperatures higher. However, the Controlled Rate Purge method was successful when tested under optimum conditions at the MRF. Based on the performance of the Helium Pop and Pitot and Bypass methods, it is possible that these two failed methods would also perform better under adverse conditions if all equipment were insulated. In summary, these results indicate that attention to the sampling apparatus temperature is an important factor in obtaining representative samples under adverse conditions with any method.

4.0 Conclusions

This report presents the results of experimental research to evaluate a proposed test protocol for verifying the performance of natural gas sampling methods. The primary goal of this testing was to evaluate the test protocol itself, and a secondary goal was to determine the ability of several new sampling methods to provide representative gas samples. The protocol was evaluated by using it to test some of the sampling methods currently found in GPA 2261 that are known to provide accurate results when performed correctly. In addition, several newly-proposed methods that are not currently included in the industry standards, but show potential as viable alternatives, were also tested. Sampling methods were judged based on repeatability and reproducibility criteria for both composition and heating value, as established by the proposed test protocol. The protocol is intended to serve as a means of assessing new gas sampling methods for the natural gas industry, and should facilitate the development of new and better gas sampling methods.

Testing of the methods was carried out under both optimum and adverse conditions. For the purposes of this report, "optimum" conditions were considered to be situations where both the pipeline and the ambient temperatures are both well above the hydrocarbon dew point (HCDP), and "adverse" conditions were situations in which the pipeline temperature is at or just above the HCDP, but the ambient temperature is below the HCDP. The tests under optimum conditions were performed at the SwRI Metering Research Facility, and the adverse condition tests were conducted at a Questar Pipeline metering station in Powder Wash, Colorado. Facilities and conditions at each site were carefully documented to support the conclusions in this report.

The sampling tests that were performed helped to identify difficulties with the procedure in the proposed test protocol, and to determine the practicality of the procedure and its ease of implementation in field settings. The key conclusions obtained from this investigation regarding the proposed test protocol are as follows:

- The acceptability criteria in the proposed test protocol appear to be appropriate to distinguish between sampling methods that are acceptable and unacceptable (i.e., methods that do or do not produce a representative sample of a flowing gas stream). Established sampling methods from GPA 2166, expected to pass the protocol criteria, did produce representative samples of the gas stream to within the required limits of the proposed test protocol.
- The requirements on the gas chromatographs used in the tests are rigorous, but more attention to GC calibration and stability may be needed, especially in applications where a portable GC is used in the field. The GC should be calibrated and used in a climate-controlled environment, or calibrated in the same environment in which it is used. Checking the GC calibration during and after tests may also be advisable.
- Air leaks in the analysis equipment were not found during preparations specified by the proposed test protocol. A revision to address this issue is suggested.
- Verifying the GC calibration gas at an independent lab, as required by the proposed test protocol, may not be necessary. Since the objective is to compare sample cylinder contents to the flowing stream, the validity of the comparison depends primarily on the repeatability of the GC.
- A way to simplify the dew point measurements required by the protocol should be considered. Problems commonly encountered in chilled mirror dew point measurements, including water vapor formation and inadequate ambient lighting, posed difficulties during the tests.

- Careful documentation is required during tests. Instruments that time-stamp data, such as flow meters, gas chromatographs, and data loggers must be synchronized to avoid errors in data comparisons.
- The proposed test protocol currently states that the chosen sampling location should have a steady flow rate and a stable composition. However, it does not specify the interval over which these quantities are to be monitored nor does it give limits of acceptability for flow rate variations. These should be addressed in the revision to the proposed protocol.
- To attain representative samples from streams near the HCDP, special attention should be given to the sampling equipment temperatures. For best results, an environmental chamber may be needed around the sampling apparatus. Recent tests with composite samplers at the Powder Wash site (Reference 3) indicate that the use of a chamber to keep sampling equipment warm can produce consistent and accurate samples of a gas stream near its dew point. Also, to ensure that the GC and spot sampling apparatus obtain identical samples, the sample delivery lines and probes should be heated and conditioned identically.
- The proposed test protocol does not currently address where the GC sample location should be relative to the spot sample location. A revision to address this is suggested. The revision should discuss the relative location (upstream or downstream) of the GC probe from the spot sample location, the distance from the sample location, and permitted pipe geometry.
- The protocol is currently being amended to specify test conditions by line temperature and HCDP, rather than by heating value; guidelines for both ambient and flowing gas temperatures during tests will now be included in the protocol.

Three GPA sampling methods (Fill-and-Empty, Controlled Rate Purge, and Helium Pop) and three proposed new sampling methods (Pitot and Bypass, High-Pressure Helium Displacement, and Modified Helium Pack) were tested. The key conclusions obtained from this investigation regarding the sampling methods are as follows:

- All of the established GPA sampling methods tested using the protocol produced representative samples of the gas stream under optimum conditions. The Fill-and-Empty and Helium Pop methods were also found to produce acceptable results when used correctly under adverse conditions.
- The Pitot and Bypass method, which was tested only under adverse conditions, was the only one of the three new methods to meet the requirements of the proposed test protocol.
- The Controlled Rate Purge method and the High-Pressure Helium Displacement methods failed under adverse conditions when the sample lines and valves were not insulated. These methods were not included in the field retests.
- Both the Helium Pop and the Pitot and Bypass methods failed in adverse conditions when the sample lines and valves were not insulated, but subsequently passed when they were retested with fully insulated sampling equipment. This result demonstrates that attention to the sampling apparatus temperature is an important factor in obtaining representative samples under adverse conditions.
- The Modified Helium Pack method could not be tested, due to equipment failure related to the cold conditions at the field site.

5.0 References

1. Manual of Petroleum Measurement Standards, Chapter 14 – Natural Gas Fluids Measurement, Section 1 – Collecting and Handling of Natural Gas Samples for Custody Transfer, American Petroleum Institute, Washington, D.C., USA, 5th edition, June 2001.
2. Obtaining Natural Gas Samples for Analysis by Gas Chromatography, GPA Standard 2166-86, Gas Processors Association, Tulsa, Oklahoma, USA, 1986.
3. Kelner, E., Sparks, C. R., and Behring, K. A., Metering Research Facility Program, Natural Gas Sample Collection and Handling – Phase III: Experimental Investigation of Gas Sampling Techniques and Equipment, Gas Research Institute, Des Plaines, Illinois, USA, August 2002.

This page is intentionally blank.

Appendix A

Proposed Performance Verification Test Protocol

This page is intentionally blank.

API MPMS Chapter 14.1
New Spot or Composite Sample Method
Performance Verification Procedure

Testing will be limited to a single-phase gas stream at or above its hydrocarbon dew point (HCDP). Multi-phase fluid sampling is not within the scope of this procedure. Laboratory practices described in this document should not be interpreted to be required procedures for normal sampling and analysis.

Procedure

1. The same chromatograph used to analyze the sample stream is to be used to analyze the spot or composite samples to eliminate the error of using different chromatographs. It is preferable to use chromatographs for testing that are capable of producing an extended analysis (C_{9+}) accurate within the API Chapter 14.1 guidelines for repeatability and reproducibility. The use of analyzers limited to a C_{6+} output may provide test results that indicate that the sampling method is acceptable for the application tested; however, method approval from such results should not be extrapolated to include applications where a more extended analysis is required.

2. Establish that the online or portable chromatograph and sample delivery system complies with API Chapter 14.1. See Appendix (E) for repeatability and reproducibility criteria and inspection checklist. The same calibration method and calibration standard is to be used for all chromatographs used for testing.

3. Calibration standards must be prepared in accordance with the requirements in API Chapter 14 Section 1 (paragraph 14.1.16), maintained in accordance with the requirements in GPA 2198-98, and verified by a laboratory independent of the blender. Verification of the calibration standard must comply with API Chapter 14.1 Appendix E repeatability and reproducibility criteria.

4. Establish that the complete sampling system (chromatograph, cylinders, tubing, etc.) is clean and free of any contaminants prior to calibrating and testing. Verify that the sample delivery system and chromatograph are clean by analyzing a sample of ultra-high purity (UHP) helium. Verify the cleanliness of the sample cylinders by charging them with 50 psig of UHP helium, heating to 125 degrees F for 2-4 hrs, and then analyzing the helium. No peaks should be produced during these procedures.

5. If the sample method is tested under controlled laboratory conditions (as in 5a below), performance verification is recommended on multiple gas blends. If the method is tested on a single flowing gas composition at an established metering location (as in 5b below), the results may not apply to a broad spectrum of gas compositions.

    a) Verify the method on at least two and preferably three gas blends that represent a broad spectrum of gas compositions commonly encountered in gas gathering and transportation

operations. For example, a three-gas test might use blends that produce gross heating values of 1000 BTU, 1175 BTU, and 1350 BTU.

b) Select a location for sampling that has a steady flow rate and a stable gas composition. Verification of stability will be established before sampling is conducted. Stability is defined as the repeatability of consecutive analyses as defined by API Chapter 14.1 Appendix E.

6. Determine the HCDP using the following steps:

   a) Use the Bureau of Mines dew scope with a NIST-traceable thermometer and a video attachment.

   b) Heat the sample line to the Bureau of Mines scope to 20-50 degrees F above the HCDP.

   c) Utilize two technicians to determine the dew point. Each technician shall run a minimum of three dew points to establish repeatability.

   d) The determined dew point must agree within two (2) degrees F to eliminate uncertainty.

   e) The dew point is to be checked before and after the sampling procedure tests.

7. Determine the composition of the flowing stream using the following steps:

   a) Verify and document the stability of the composition of the flowing gas stream using a portable or on-line chromatograph.

   b) The chromatograph is to be analyzing the stream during sampling procedures.

   c) The chromatograph software will be required to archive and Time- and Date-stamp the chromatograms, composition, and the corresponding BTU. The methods and calibration chromatograms used for each testing procedure shall be saved.

8. Also capture and record sufficient data to demonstrate the stability of the dynamic flowing conditions of the stream during the sampling tests.

9. Conduct sampling method using the following steps:

   a) A minimum of five (5) samples shall be obtained for each method tested.

10. Analysis Requirements

    a) Each cylinder shall be heated to 20–50 degrees F above the HCDP for a period of 2–4 hours before analyzing.

    b) Each cylinder is to be analyzed a minimum of three times to establish repeatability as defined by API Chapter 14.1 Appendix E.

11. Data Requirements

    a) The data shall be in tabular form and in a format that is easy to read and understand.

b) The data shall be available for public review.

c) The spot sample analysis report shall reference the corresponding online or portable gas analysis report.

d) On-line chromatograph data for comparison with composite samples shall be averaged for the same time period as the composite samples.

12. Verification of sampling procedure: Sample heating values shall agree within the greater of the tolerances described below or those defined by API Chapter 14.1 Appendix E.

a) Review the data to ensure that the accuracy of the spot or composite sample method complies with the repeatability and reproducibility for each component as stated in API Chapter 14.1 Appendix (E).

b) The three successive analyses of each test cylinder must repeat within one (1) BTU per cubic foot.

c) Each test cylinder must reproduce within three (3) BTU per cubic foot of the online or portable chromatograph.

d) Analyses of each composite sample cylinder must reproduce within (3) BTU per cubic foot of the average of the online chromatograph for that sampling period.

The following addition to Step 5 of the test protocol was submitted for ballot in June 2003:

5. c) The protocol is intended to evaluate the performance of new or proposed sampling systems and procedures under ideal conditions and under conditions when only the best current methods will succeed. For example, in a case where two gases are used during the evaluation, the lean gas may be used to verify good performance when the gas is far from its hydrocarbon dew point (HCDP) and ambient temperatures (real or induced) are higher than the flowing temperature of the stream. The richer gas, during the same evaluation, would be used to evaluate the performance of the new or proposed sampling system and procedure when the ambient temperature is colder than the flowing temperature of the stream and the measured hydrocarbon dew point of the stream, and the flowing stream is at a temperature very near its HCDP.

To fully confirm the suitability of new or proposed sampling systems and procedures, it is recommended that the flowing stream during one phase of the evaluation program be within 5ºF of its' measured HCDP and that the ambient temperature (actual or induced) be at least 20ºF colder than the flowing temperature of that stream.

Record the Following Information

Record test data on a spreadsheet and provide as much additional information as possible, including copies of analyses from labs.

- Description of the sample method
- Description of the test used to evaluate the sample method
- Date of test
- Location of the Test
- Personnel conducting the tests
- Personnel witnessing the tests
- Pipeline Pressure
- Pipeline Size
- Piping Configuration (Upstream and Downstream)
- Sample probe style and description
- Sketch or photo of the piping scheme for the test site
- Description or photo of the test method equipment and physical installation used in test
- Description of the flowing gas stream, i.e., well head, separator, distribution system, meter run, gathering system, etc.
- Ambient Temperature
- Pipeline Flowing Temperature
- Sampling Apparatus Temperature for sample method and reference analyzer. As a minimum, include the temperature at the sample probe and at the exit point of the sample delivery system.
- Description of temperature control equipment (i.e. insulation, heater, steam)
- Hydrocarbon Dew Point
- Cylinder Style
- Cylinder Size
- Sampler style (if applicable) and description
- Timed or Proportional to flow
- Sample volume size
- Approximate elevation of the test location

GC Description

- Last calibrated and how, relative to test data
- Provide records for calibrations performed immediately before, during and after the testing, including response factors and repeatability data

Appendix B

Procedures for New Sampling Methods

This page is intentionally blank.

High Pressure Helium Displacement Method

Proposed by Eric Fritz, Natural Gas Pipeline Company of America

Sample Cylinder Preparation

1. Sample cylinders must be thoroughly cleaned before samples are taken.

2. Momentarily purge the sample cylinder with helium, and then fill the cylinder to the minimum pressures according to the table below.

Sample Source Pressure (PSIA)	Helium Pre-Fill Pressure (psia)			
	Cylinder Size			
	150-cc	300-cc	500-cc	1000-cc
30	84	79	77	76
40	95	90	87	86
50	106	100	98	96
60	118	111	108	106
70	129	122	119	116
80	140	132	129	127
90	152	143	139	137
100	163	153	150	147
200	276	260	254	249
300	389	366	358	351
400	502	473	462	453
500	615	579	566	555
600	728	686	670	657
700	841	792	774	759
800	954	899	878	861
900	1067	1005	982	963
1000	1180	1112	1086	1065
1100	1293	1218	1190	1167
1200	1406	1325	1294	1269
1300	1519	1431	1398	1371
1400	1632	1538	1502	1473
1500	1745	1644	1606	1575

Note: Assume length from sample probe tip to sample inlet valve of 12" x 1/4". Do not exceed pressure rating of sample cylinder.

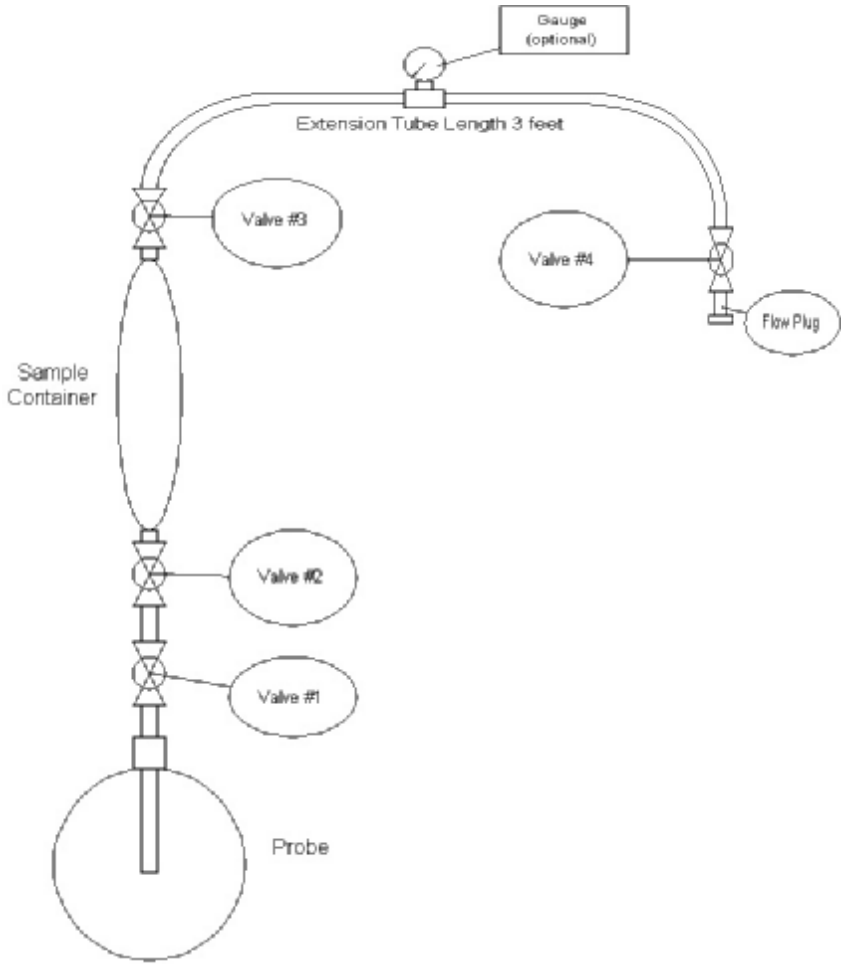
3. Remove sample cylinder from Helium source and check for leaks by immersion of the valves in water or by use of a commercial leak detection solution. Plug valves (if female) or cap valves (if male).

Sampling Method

Note: Insure that the temperature of the sample cylinder exceeds the temperature of the sample source. A minimum of 10ºF is recommended. If not, an unrepresentative sample may be obtained.

1. Open sampling source valve (Valve 1) and thoroughly blow out any accumulated material. Close valve at sampling point.

2. Install sample cylinder as shown in the Figure below. The cylinder is preferred to be in the vertical position but may be horizontal to facilitate close connection of the sample cylinder to the probe outlet (if using an angled valve).



3. Install a 3-ft. piece of ¼" diameter tubing and the extension tube valve (Valve 4) as shown.

4. With all valves closed, open the sample cylinder inlet valve (Valve 2) to allow Helium to fill the connection between the sample cylinder and sampling point valve.

5. Open the sampling point valve (Valve 1) to allow Helium to flow (back flush) through the sample probe and into the pipeline. The pressure in the cylinder will equalize with the pressure of the sample source.

6. Open the sample cylinder outlet valve (Valve 3) to fully open position.

7. Open the extension tube valve (Valve 4) fully. A ¼-turn valve works best.

8. Flow in this manner for the time specified in the following table.

Flow Plug Drill Size	Cylinder Size			
	150-cc	300-cc	500-cc	1000-cc
76 (0.0200")	35 sec	75 sec	115 sec	230 sec
79 (0.0145")	70 sec	135 sec	210 sec	450 sec

9. Close the sample valves in the following order: extension tube valve (Valve 4), cylinder outlet valve (Valve 3), cylinder inlet valve (Valve 2), and sampling point valve (Valve 1).

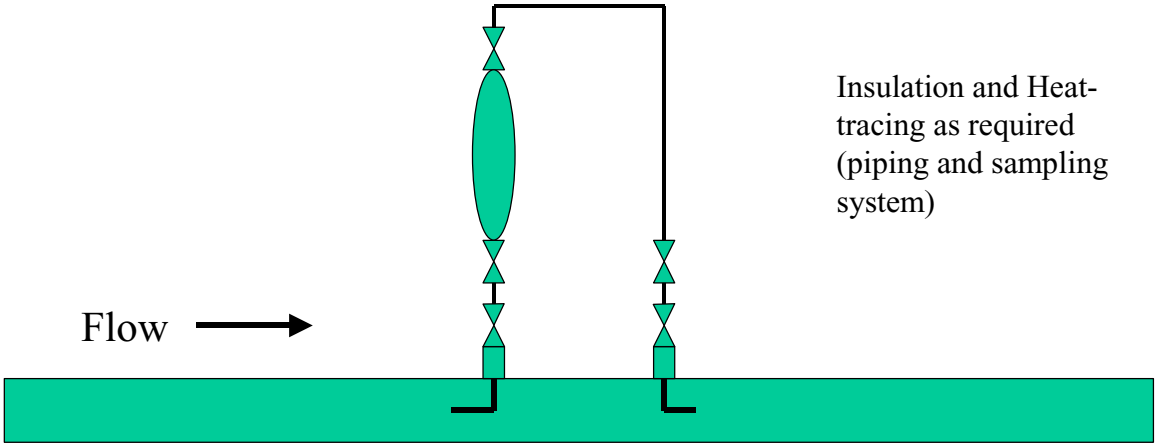
10. Open extension tube valve (Valve 4) to allow extension tube pressure to bleed off. Remove the extension tube from the sample cylinder.

11. Source pressure will exist in the close-coupled connection between the sample point valve and the cylinder inlet valve. Carefully remove the sample cylinder from the probe by bleeding off pressure, as the short coupling is unscrewed.

12. Check sample cylinder for leaks by immersion of the valves in water or by use of a commercial leak detection solution. Plug valves (if female) or cap valves (if male).

Pitot & Bypass Spot Sampling Method

Proposed by Fred Van Orsdol, SPL Corp.



This system would include a Pitot tube inside the meter run facing upstream, followed at the appropriate distance by a Pitot tube facing downstream. Both tubes would be connected to external sampling equipment via vertical couplings welded onto the top of horizontal piping.

On the outlet of the upstream coupling would be a full opening, permanently mounted valve (full opening ball valves for example – not the typical 1/8" diameter passage valves on current cylinders). Close coupled to that valve, in the vertical, would be a sample cylinder with similar full opening valves on its' inlet and outlet. From the sample cylinder outlet valve, tubing would return to the pipe and connect immediately to a full opening valve mounted on the downstream coupling.

All external (to the piping) materials would be insulated and/or heated. All metal in the sample system except the couplings would be stainless steel.

If the flowing temperature of the stream is above the hydrocarbon dew point temperature, no heat will be required – only adequate insulation. If the flowing temperature were at the dew point temperature, heat would also be required. This may limit the utility of this proposal in remote locations without a source of heat. However, even in remote locations we might be able to rig up a safe, temporary heating system, perhaps powered by a vehicle.

To prepare the system for service, a clean cylinder with a high-pressure helium blanket (higher than line pressure) would be installed. Note that a low-pressure helium blanket might be ok, but I'm concerned about the initial fill when a new cylinder is brought into service.

Except when sampling, all valves would be closed.

To purge the cylinder and begin the process of sampling, the clean, helium-pressurized cylinder would be

placed into service by opening the full opening valve on the downstream tap, then the valve on the upstream tap, then the cylinder inlet valve, then the cylinder outlet valve.

To trap a spot sample, the downstream tap valve would be closed, then the sample cylinder outlet valve. Next the cylinder inlet valve would be closed, then the upstream tap valve. The cylinder would then be removed from service, capped, checked for leaks, and then shipped to a lab for analysis.

A fresh helium pressurized cylinder would then be installed, with all valves closed until a new sample is needed.

Modified Helium Pack Spot Gas Sampling Method

Proposed by R. Mark Haefele, BP

Apparatus required:

- Pipe thread on the sample cylinder valve that mates with the pipe thread on the sample probe valve,
- Vacuum pump, and
- Pipe thread on the vacuum pump connection that mates with the pipe thread on the sample cylinder valve

Procedure:

1. Evacuate the subject sample cylinder
2. Fill the sample cylinder with ultra-high purity (UHP) helium to a pressure at least 100 psig above the anticipated line pressure.
3. Loosely thread the sample cylinder directly into the sample valve mounted above the sample probe.
4. Slowly open the bottom valve on the sample cylinder, bleeding UHP helium into the void between the sample cylinder and the sample probe valve while tightening the connection.
5. Fully open the sample probe valve, equalizing the pressure on the helium pack in the sample cylinder with the line pressure, and clearing the sample probe with UHP helium.
6. Close the sample probe valve.
7. Evacuate the helium pack from the sample probe valve and the sample cylinder through the top valve on the sample cylinder.
8. Close the top valve on the sample cylinder.
9. Open the sample probe valve, filling the sample cylinder to line pressure.
10. Close the bottom sample cylinder valve.
11. Close the sample probe valve.
12. Disconnect the sample cylinder from the sample probe valve.
13. Test cylinder valves for "bubble tight" seal using a bucket of water or leak check liquid.
14. Plug and seal valve ports, tag the cylinder, secure and transport in accordance with company safety requirements.

Purposes:

- Collect a representative spot sample of gas without emitting greenhouse gas to the atmosphere
- Clear the sample probe without emitting greenhouse gas to the atmosphere
- Eliminate the phase change problems associated with the purge Fill-and-Empty procedure

Appendix C

GC Setup and Calibration Results

This page is intentionally blank.

C.1 Laboratory Inspection Checklist

This section presents the API MPMS Chapter 14.1, Appendix E laboratory inspection checklist that was used to survey the chromatograph and sample delivery systems at the MRF and Powder Wash field sites. This checklist was used to verify that the analysis systems at these sites complied, as mandated by the proposed test protocol, with the requirements of API Chapter 14.1. Results of the survey at both locations are recorded below.

Laboratory	SwRI MRF	Questar API
Date of Survey	July 10, 2003	November 9, 2003
Survey Conducted By	Darin L. George	Darin L. George

Sample Handling & Conditioning

Are sample cylinders heated?	No (see comments)	Yes
If sample cylinders are heated, to what temperature?	---	125°F
Is the sample cylinder temperature monitored?	Ambient monitored	Temperature of storage room monitored electronically (see comments)
Is the sample heated for at least 2 hours?	---	Yes
Is time monitored for sample cylinder heating?	---	No
What is the length of time used for heating sample cylinders? (# hours)	---	At least 12 hours (overnight)
Are samples taken immediately from heater to analyzer if manually transferred?	---	See comments
What method is used to insulate heated sample cylinders during analysis?		
Insulated Blanket	---	No
Heated Cabinet	---	Yes
Other (Specify)	---	---
Comments	Ambient temperature 40°F above dew point; heating not required	Cylinder is placed in a room heated to 125°F and left overnight. Cylinders are connected to a manifold within the room, and samples are drawn through the manifold to a GC outside the room.

Physical Facility

Is the analyzer room heated?	No	Yes
Is the analyzer room air-conditioned?	No	Yes
Comments	Analyzer is installed outside, as designed. Columns are in insulated ovens	---

Filters, Connections, and Hardware

Are filters used between sample and analyzer?	Yes	When liquids are suspected in sample
Type:	NuPro SS-4TF-15	---
Size:	15 µm sintered filter	20 µm filter
Replacement Interval:	No regular interval	---
What are the size, length and material of sample line and fittings?	1/8” diameter stainless steel tubing, 51 to 60” long; SS fittings	1/8” stainless steel tubing, 10 ft long; SS fittings
Are connections, lines, and hardware between sample cylinder and analyzer insulated?	No (ambient temperature 40°F above dew point during use)	Yes
Are connections, lines & hardware between sample cylinder and analyzer heated?	No (ambient temperature 40°F above dew point during use)	Yes
Sample loop size:	Loop 1: 0.1648 cc Loop 2: 0.7524 cc	Variable injector
Comments	---	Analyzer regulator is heated to 200°F

Injection System

Is the sample system a vacuum injection system?	No	Yes
Is the sample system a purge injection system?	Yes	Yes
If purge injection system, is there backpressure?	Yes	Yes
Can the purge rate be read or measured?	No (see comments)	No (see comments)
What is the purge rate?	---	400 cc/min
Comments	Back pressure can be monitored; pressure is 85 psig, within specs	Analyzer typically uses vacuum injection, then purge injection. Back pressure adjustable but not measurable; flow rate measurable.

Analyzer

What is the analyzer brand?	Daniel	Varian
What is the analyzer model?	Daniel 2350 GC	Varian 4900 Quad GC
What is the analyzer's serial number?	384073	4910070
Is this an isothermal run?	Yes	Yes
If "YES," record temperature in °C. If "NO," secure a copy of the temperature program.	82°C	Channel A: 103°C Channel B: 87°C
Are the columns configured per GPA 2261?	Yes	Yes
If "NO," list the configuration.	---	---
Integration method:		
Peak height	No	No
Area	Yes	Yes
Data logging method:		
Manual	No	No
Electronic	Yes	Yes (Star software)
Highest carbon number component analyzed is:	C_9+	C_9+
Calibration schedule is:	Daily	Daily
Analysis frequency is:	5-minute intervals	Weekly

Carrier Gas

What is used as the carrier gas?	Helium	Helium
What is the purity of the carrier gas?	99.999%	99.999%
Is the carrier gas pressure monitored?	Yes	Yes
Is the carrier gas flow rate monitored?	Yes	No
If yes, carrier gas flow rate in cc/minute:	0.55 to 0.65 sccm	---
Is a carrier gas drier used?	No	No (dry environment)
If yes, type of drier material used:	---	---
Replacement interval of carrier gas drier material:	---	---

Calibration Standard Gas

Manufacturer of calibration standard	Scott Specialty Gas	DCG Partnership
Is calibration standard age less than a year old?	Yes	Yes
If "NO", list the date blended	---	---
Is the calibration standard heated continuously?	No	Yes
If no, list the length of time heated before use:	Not heated (see comments)	---
To what temperature is the calibration standard heated?	Not heated (see comments)	125°F
Is an insulation blanket or heated cabinet used for the calibration standard?	No	Yes (heated room)
Can the cylinder pressure of the calibration standard be monitored?	Yes	Typically yes, though the standard used for these tests was not monitored
If yes, record the pressure in PSIG before and after each test.	95 psig	---
Does the lab have calibration standards required for the test program?	Yes	Yes
Is the hydrocarbon dew point for the calibration standard available?	Yes	Yes
If yes, hydrocarbon dew point:	Cricondentherm = 27°F	Cricondentherm = 84.9°F
Has or could the calibration standard ever been exposed to a temperature below the hydrocarbon dew point?	No	Yes (see comment)
Comments	Calibration standard is kept in a climate-controlled room at 70°F; transfer lines to GC are heated to 120°F. The dew point of the standard is computed before use to confirm that the room temperature is not below dew point.	Standard was placed in a heated room at 125°F for two weeks before use.

Calculation

Are the component constants used in accordance with the latest GPA 2145?	No	No
If "NO," what constants are used?	GPA 2145-95	GPA 2145-00
Can the constants be verified?	Yes	Yes
Are the calculations performed in accordance with the latest version of GPA 2172?	Yes (GPA 2172-96)	Yes (GPA 2172-96)
Other methods used:	None	None
Values for C_6+ or other heavy fraction:		
C_6	As given in GPA 2145	As given in GPA 2145
C_6+	---	---
C_7	As given in GPA 2145	As given in GPA 2145
C_7+	---	---
Other (Specify)	C_8 as given in GPA 2145; all heavier components assigned values for C_9	C_8 as given in GPA 2145; all heavier components assigned values for C_9
Composition of fraction:		
C_6	As measured	As measured
C_7	As measured	As measured
C_8+	C_8 as measured	C_8 as measured
Other (Specify)	C_9 and heavier components treated as C_9	C_9 and heavier components treated as C_9

Quality Control Program

Does a Quality Control Program exist?	Yes	Yes
Can a copy of the Quality Control Program be obtained?	No (currently under revision)	Not available
Comments	QC program includes statistical process control, checks of standards	QC program includes regular audits, tests of helium blank samples, different standards, records kept for 2 years

NOTE: Rating by Team

Documentation

Secured area counts and response factors?	Yes	Response factors only
Secured chromatograms and results?	Yes	Yes
Secured copy of analysis report for calibration standards?	Yes	Yes
Secured relative density?	Yes	Specific gravity recorded
Secured HV - saturated and unsaturated, both real and ideal?	Real heating values only	Real heating values only
Secured mol% both normalized and un-normalized?	Yes	Yes
Secured starting and ending pressures for both lab's calibration standard and audit group's standards?	Pressure recorded for lab standard (no audit standard used)	No (not available for lab standard, no audit standard used)

C.2 GC Calibrations

The following sections present the details of the chromatograph calibrations that were performed for the tests conducted at the MRF, the Powder Wash field site, and the repeat tests at the Powder Wash field site.

C.2.1 MRF GC

The MRF GC was calibrated on a 1,030 Btu/scf gas. Figure C-1 is a plot of the calculated dew point curve for the calibration gas. This plot confirms that it is not necessary to heat the calibration gas, since the gas is kept in a climate controlled room which maintains the gas at a temperature at least 50°F above the computed cricondentherm. The fidelity plots for the two columns in the GC are shown in Figure C-2 and Figure C-3. The relative response factors for both columns follow a linear trend, as expected.

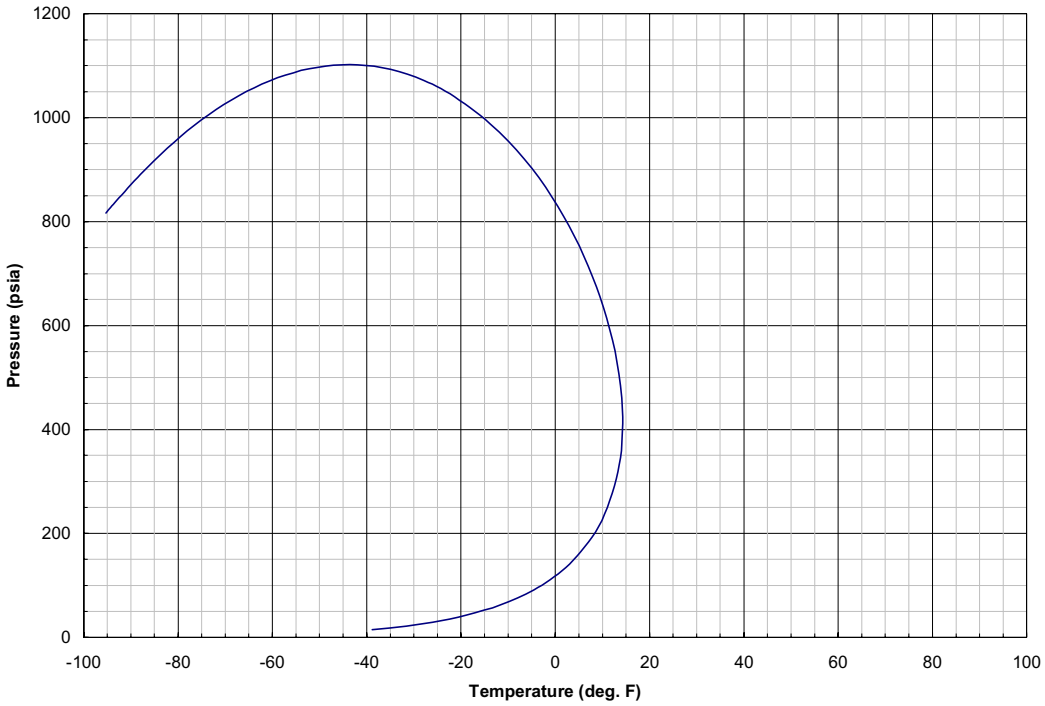


Figure C-1. Dew point curve for gas used to calibrate the Daniel 2350 GC at the MRF. Curve computed from SRK equation of state.

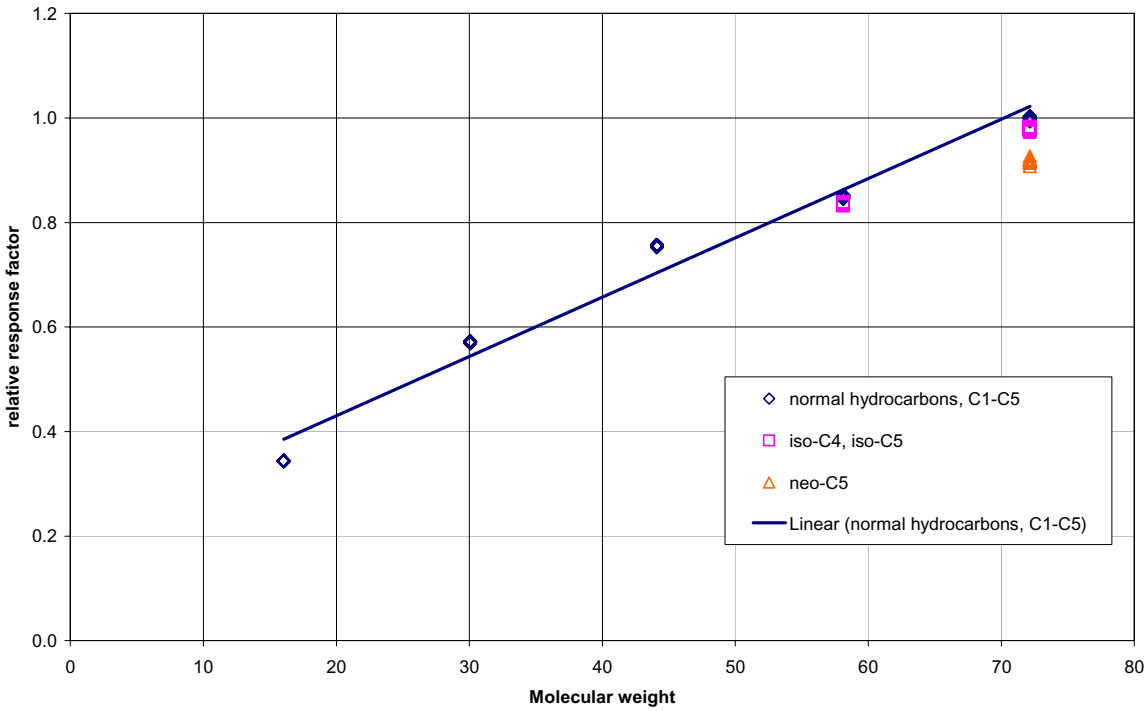


Figure C-2. Fidelity plot for column A of the MRF Daniel 2350 GC. June 2003 calibration runs on Scott gas #XL002396.

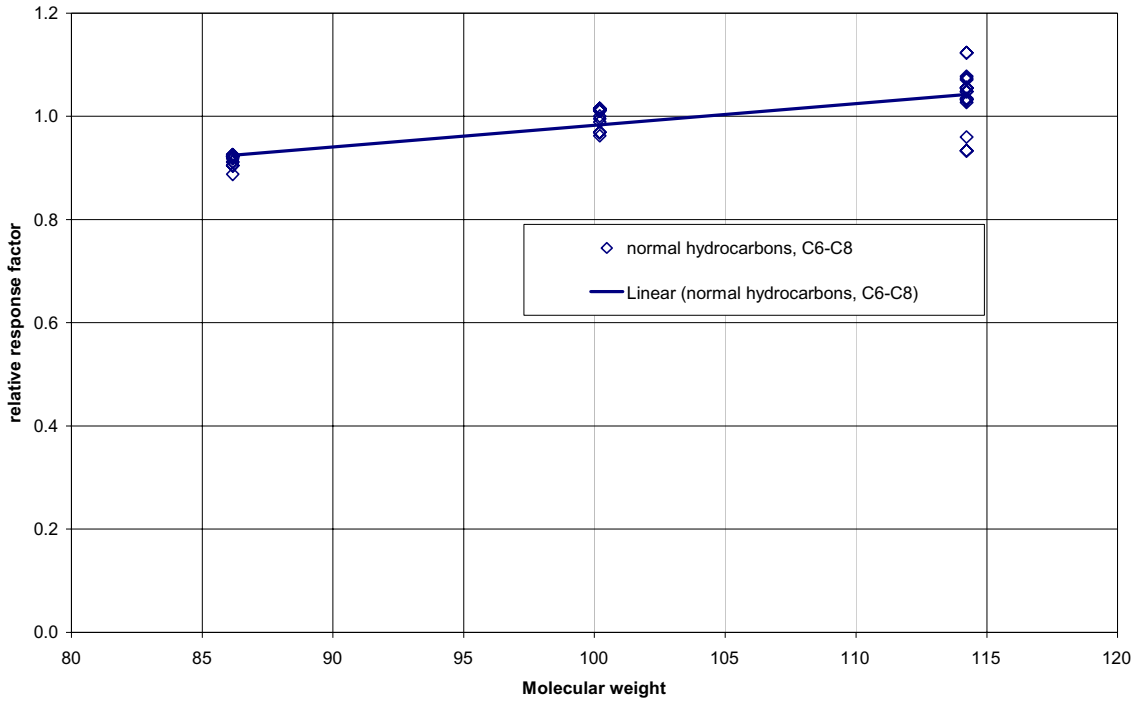


Figure C-3. Fidelity plot for column B of the MRF Daniel 2350 GC. June 2003 calibration runs on Scott gas #XL002396.

C.2.2 Powder Wash GC

The portable GC at the Powder Wash site was calibrated on a 1,200 Btu/scf gas. Figure C-4 is a plot of the calculated dew point curve for the calibration gas. The gas was maintained at 125°F, which was 40°F above the computed cricondentherm. The fidelity plots for the two columns in the GC are shown in Figure C-5 and Figure C-6. The relative response factors for column A are linear, but not for column B. As a further check on the GC operation, the GC was calibrated on a second gas and showed linear response factors for both columns. The fidelity plots for the second calibration are shown in Figure C-7 and Figure C-8. The acceptable calibration on the second gas suggests that there were no problems with the operation of the GC, but rather that the stated composition of the first gas blend was not correct.

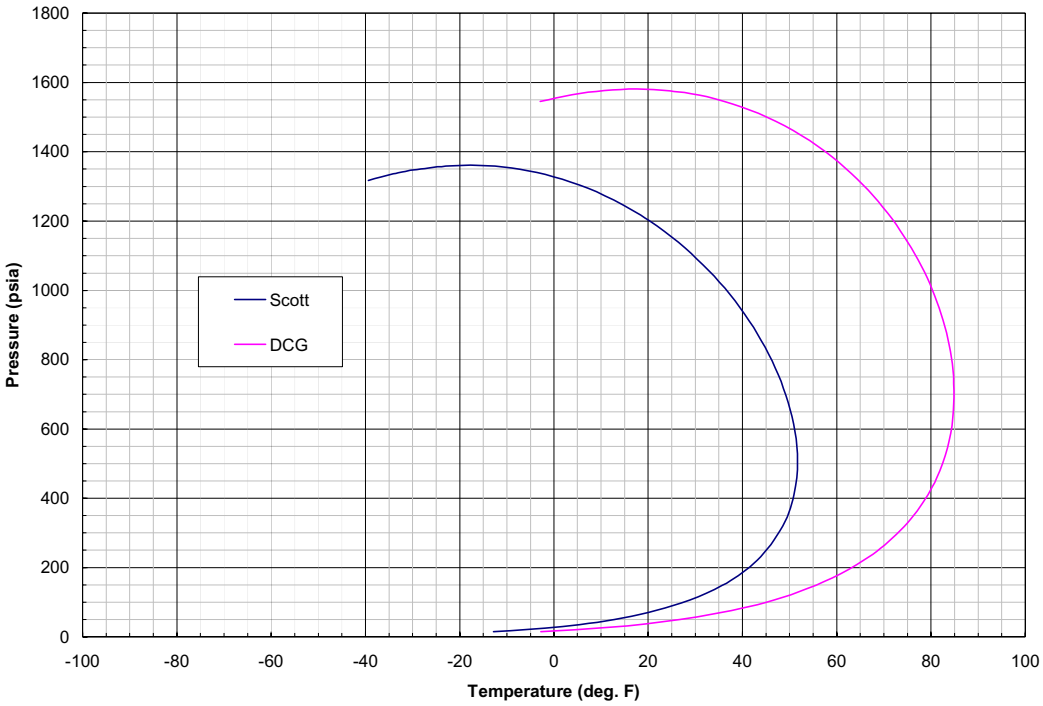


Figure C-4. Dew point curves for gases used to calibrate the Varian CP-4900 GC at the Powder Wash site. Curves computed from SRK equation of state.

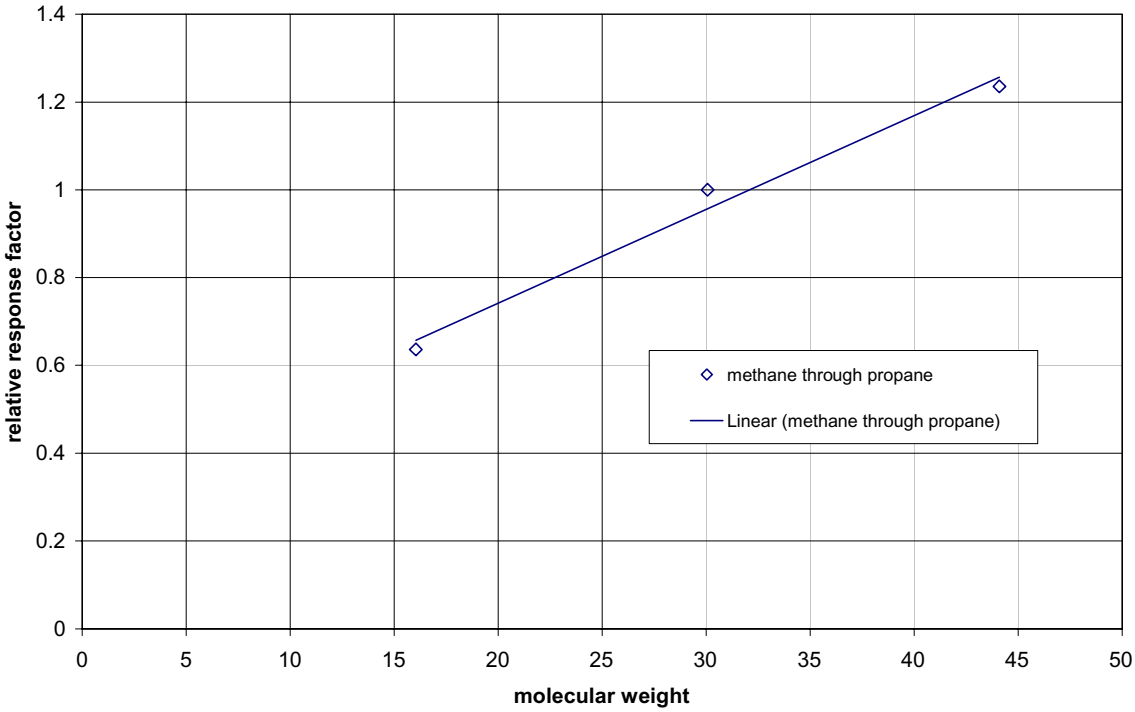


Figure C-5. Fidelity plot for column A of the Varian CP-4900 GC at the Powder Wash site. November 11 calibration run on DCG gas #22933AW.

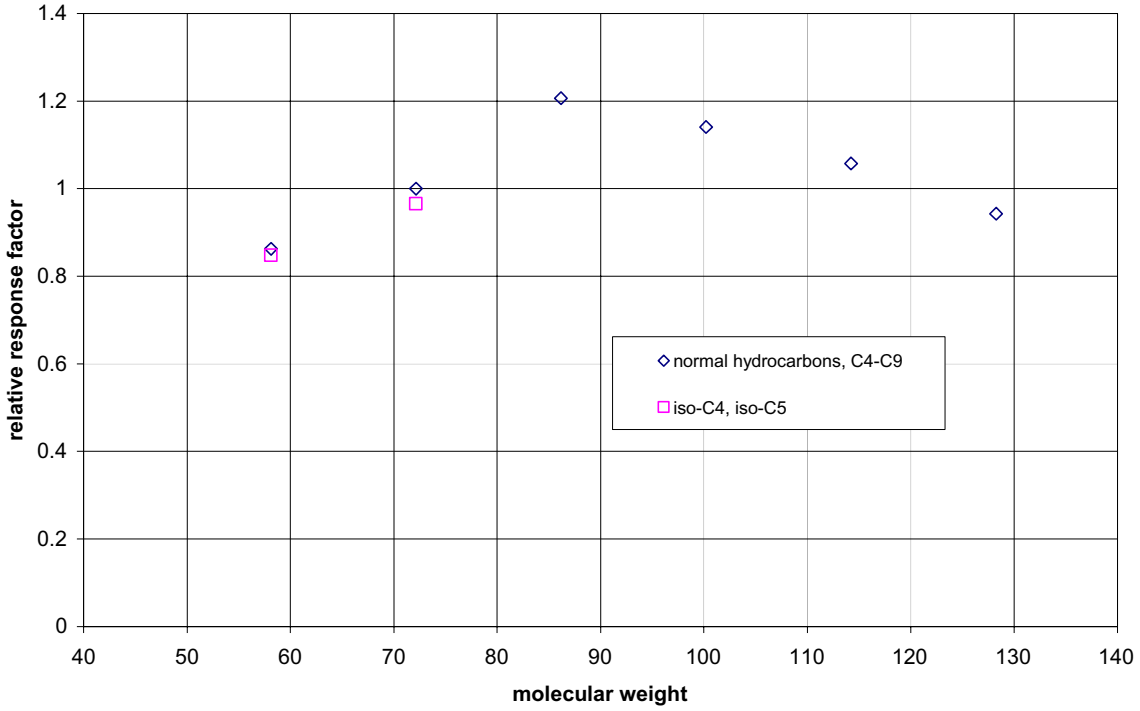


Figure C-6. Fidelity plot for column B of the Varian CP-4900 GC at the Powder Wash site. November 11 calibration run on DCG gas #22933AW.

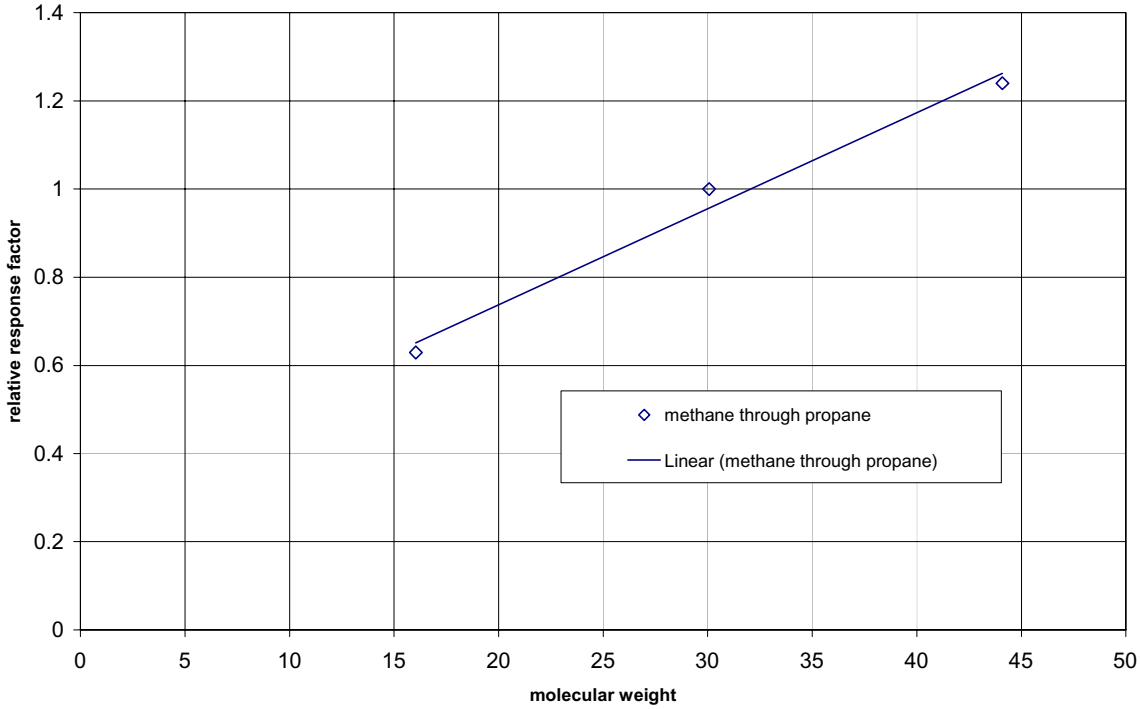


Figure C-7. Fidelity plot for column A of the Varian CP-4900 GC at the Powder Wash site. November 12 calibration run on Scott gas #ALM051559.

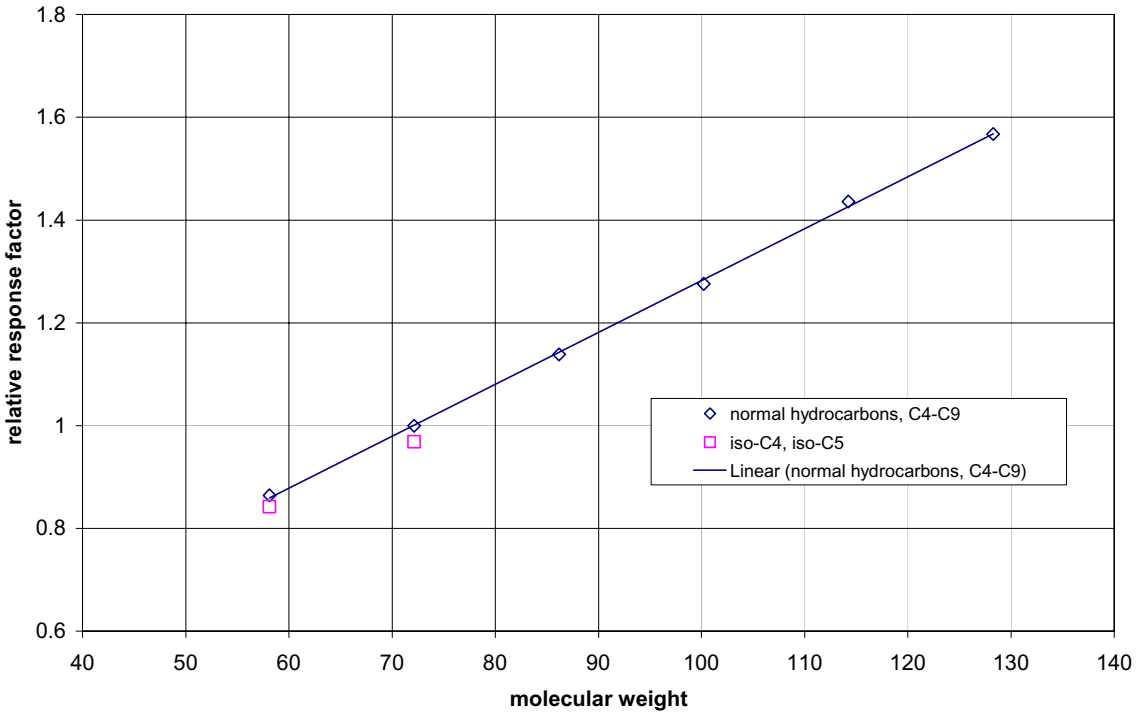


Figure C-8. Fidelity plot for column B of the Varian CP-4900 GC at the Powder Wash site. November 12 calibration run on Scott gas #ALM051559.

C.2.3 Powder Wash GC - Repeat Tests

The portable GC at the Powder Wash site used for the retests was calibrated on the same 1,200 Btu/scf gas as used previously. The fidelity plots for the two columns in the GC are shown in Figure C-9 and Figure C-10. As in the calibration for the November tests, the relative response factors for column A are linear, but not for column B.

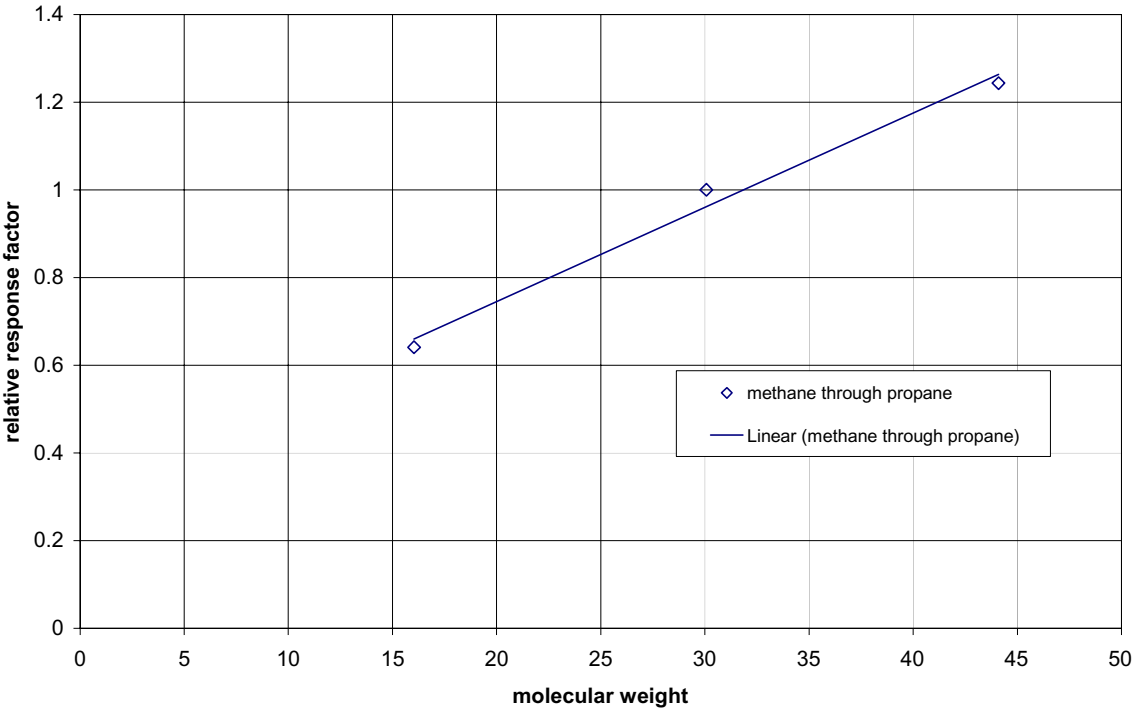


Figure C-9. Fidelity plot for column A of the Varian CP-4900 GC at the Powder Wash site. December 18 calibration run on DCG gas #22933AW.

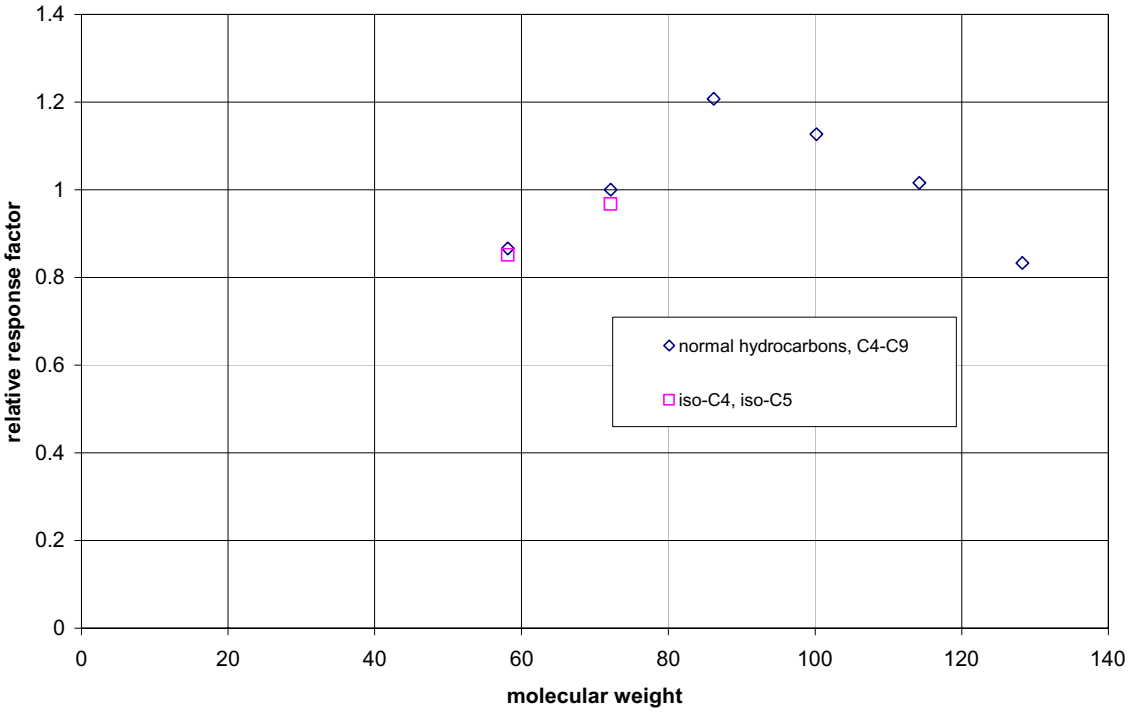


Figure C-10. Fidelity plot for column B of the Varian CP-4900 GC at the Powder Wash site. December 18 calibration run on DCG gas #22933AW.

Appendix D

Detailed Test Results

The following tables compare the analyzed compositions of each sample with an analysis of the flowing gas stream taken at approximately the same time as the sample. The contents of each sample cylinder were analyzed three times to assess the repeatability of the sample method. The results of each cylinder analysis were compared to the flowing stream analysis to assess the ability of the sampling method to reproduce the stream composition.

This page is intentionally blank.

Table D-1. Detailed results from MRF sampling tests, June 18, 2003: Fill-and-Empty method.

Sample FE1	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	13:17 - 13:20	92.212402	4.389621	1.091977	0.828406	1.072227	0.110845	0.169599	0.042013	0.037194	0.017102	0.018488	0.009868	0.000361	1055.613159
Sample Bottle GC Analysis-2 [Mol%]			92.208473	4.38994	1.093146	0.828025	1.072543	0.110857	0.168907	0.041805	0.037351	0.017408	0.018637	0.012784	0.000126	1055.754395
Sample Bottle GC Analysis-3 [Mol%]			92.210625	4.390337	1.093292	0.827576	1.072385	0.111003	0.16929	0.041877	0.03728	0.01667	0.0186	0.010676	0.000392	1055.64563
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	13:15	92.192986	4.388204	1.092315	0.825647	1.073966	0.111211	0.169009	0.042439	0.037822	0.029614	0.022916	0.011663	0.002212	1056.5625
Max. Absolute Deviation [Mol%]			0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.95
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample FE2	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	13:28 - 13:33	92.201973	4.393844	1.094091	0.827652	1.074487	0.111378	0.170047	0.042141	0.03754	0.017336	0.018561	0.010808	0	1055.750488
Sample Bottle GC Analysis-2 [Mol%]			92.205505	4.391288	1.093449	0.828085	1.074445	0.11129	0.169848	0.042254	0.037519	0.01718	0.018492	0.010545	0	1055.701294
Sample Bottle GC Analysis-3 [Mol%]			92.20282	4.393759	1.093504	0.8263	1.074601	0.111155	0.169707	0.042115	0.037386	0.01706	0.018431	0.013161	0	1055.85437
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	13:30	92.19136	4.389372	1.092742	0.82569	1.07427	0.111113	0.168943	0.042405	0.037619	0.029661	0.023098	0.011449	0.002274	1056.562744
Max. Absolute Deviation [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.86
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample FE3	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	13:48 - 13:54	92.200264	4.394859	1.093965	0.826863	1.074673	0.111184	0.169947	0.04212	0.037687	0.017477	0.018656	0.011306	0.0009	1055.850342
Sample Bottle GC Analysis-2 [Mol%]			92.202886	4.393884	1.093884	0.826368	1.074293	0.111096	0.169882	0.04252	0.037826	0.017337	0.018478	0.010517	0.000919	1055.803467
Sample Bottle GC Analysis-3 [Mol%]			92.205528	4.392563	1.093616	0.825564	1.074095	0.111304	0.170068	0.042488	0.037812	0.017468	0.018733	0.010759	0	1055.781616
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Max. Absolute Deviation-Overall [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	13:50	92.210426	4.391073	1.092795	0.827225	1.074885	0.111385	0.169124	0.04246	0.037841	0.015516	0.016503	0.008821	0.001943	1055.593994
Max. Absolute Deviation [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample FE4	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	13:58 - 14:02	92.208801	4.388804	1.093304	0.827908	1.072934	0.111061	0.168464	0.042034	0.037301	0.017248	0.018474	0.011362	0.000282	1055.696923
Sample Bottle GC Analysis-2 [Mol%]			92.210197	4.392003	1.093658	0.826233	1.073769	0.111093	0.168656	0.042105	0.037368	0.013109	0.018658	0.011816	0.000336	1055.633667
Sample Bottle GC Analysis-3 [Mol%]			92.203865	4.39329	1.093681	0.825906	1.074405	0.111155	0.16976	0.042246	0.037795	0.017287	0.018497	0.011712	0.000398	1055.826538
Max. Absolute Deviation-Successive [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Max. Absolute Deviation-Overall [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	14:00	92.209274	4.387126	1.091937	0.826547	1.073843	0.11139	0.168954	0.042686	0.038034	0.022947	0.016438	0.009722	0.002088	1055.854858
Max. Absolute Deviation [Mol%]			0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.22
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample FE5	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	14:07 - 14:12	92.204979	4.392692	1.09378	0.827606	1.074608	0.111267	0.168988	0.042393	0.037693	0.017117	0.018351	0.009619	0	1055.666504
Sample Bottle GC Analysis-2 [Mol%]			92.206299	4.390968	1.093729	0.826726	1.074304	0.111092	0.169768	0.042114	0.037513	0.017128	0.018415	0.011943	0	1055.763184
Sample Bottle GC Analysis-3 [Mol%]			92.201408	4.392983	1.094621	0.826366	1.07494	0.111313	0.17	0.042153	0.037544	0.01743	0.018763	0.012577	0	1055.858934
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	14:10	92.19706	4.388803	1.092462	0.826966	1.074276	0.111175	0.1687	0.042105	0.037713	0.027579	0.021504	0.00945	0.002209	1056.277466
Max. Absolute Deviation [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.61
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table D-2. Detailed results from MRF sampling tests, June 18, 2003: Controlled Rate Purge method.

Sample CR1	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	14:40 - 14:45	92.208361	4.391447	1.093147	0.827949	1.073077	0.110972	0.169605	0.04176	0.036933	0.017559	0.018768	0.009813	0.000622	1065.664062
Sample Bottle GC Analysis-2 [Mol%]			92.205276	4.389758	1.093181	0.82716	1.07285	0.111282	0.169885	0.042219	0.0377	0.018041	0.019153	0.01319	0.000294	1065.900269
Sample Bottle GC Analysis-3 [Mol%]			92.20636	4.390489	1.09448	0.827462	1.073032	0.111244	0.169885	0.042351	0.037662	0.017587	0.018678	0.010137	0.000434	1065.71167
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	14:40	92.197235	4.387389	1.092343	0.825324	1.073634	0.11115	0.168928	0.042393	0.037836	0.028404	0.021965	0.011176	0.002235	1066.436157
Max. Absolute Deviation [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.77
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample CR2	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	14:53 - 14:57	92.211464	4.388292	1.092862	0.827186	1.072769	0.111077	0.169737	0.042314	0.03787	0.016813	0.018347	0.010179	0.001087	1065.696289
Sample Bottle GC Analysis-2 [Mol%]			92.210236	4.386796	1.093131	0.826705	1.072639	0.111075	0.169842	0.042539	0.037686	0.01701	0.020421	0.010979	0.000931	1065.822998
Sample Bottle GC Analysis-3 [Mol%]			92.221909	4.377951	1.091938	0.827116	1.0766	0.111584	0.171276	0.042044	0.036803	0.014378	0.01816	0.009535	0.00071	1065.533691
Max. Absolute Deviation-Successive [Mol%]			0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Max. Absolute Deviation-Overall [Mol%]			0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	14:55	92.186249	4.38478	1.092304	0.82765	1.072865	0.11124	0.168874	0.042612	0.037899	0.031005	0.023455	0.018317	0.002747	1066.965576
Max. Absolute Deviation [Mol%]			0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	1.43
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample CR3	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	15:00 - 15:07	92.213585	4.38835	1.093276	0.826163	1.072528	0.111221	0.170056	0.041822	0.037381	0.017002	0.018594	0.01001	0	1065.624268
Sample Bottle GC Analysis-2 [Mol%]			92.216278	4.387124	1.09301	0.826114	1.072332	0.111008	0.169951	0.042187	0.037463	0.016682	0.018488	0.009359	0	1065.56958
Sample Bottle GC Analysis-3 [Mol%]			92.214378	4.387186	1.09341	0.826142	1.072683	0.111041	0.169741	0.042348	0.037627	0.016851	0.018595	0.009998	0	1065.621948
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	15:05	92.196091	4.382759	1.092165	0.827738	1.073049	0.111065	0.168903	0.042512	0.037969	0.030855	0.024045	0.010272	0.002591	1066.535278
Max. Absolute Deviation [Mol%]			0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.97
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample CR4	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	15:11 - 15:13	92.21106	4.389179	1.092915	0.826393	1.072685	0.111432	0.170196	0.042314	0.037504	0.017019	0.018668	0.009757	0.000487	1065.692261
Sample Bottle GC Analysis-2 [Mol%]			92.209569	4.388145	1.092538	0.826138	1.072667	0.111023	0.169273	0.042156	0.037464	0.015584	0.030514	0.013322	0.000603	1066.320435
Sample Bottle GC Analysis-3 [Mol%]			92.204262	4.387454	1.092454	0.827043	1.072129	0.111216	0.170046	0.042325	0.037492	0.012394	0.03006	0.012475	0.000661	1066.143433
Max. Absolute Deviation-Successive [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.63
Max. Absolute Deviation-Overall [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.63
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	15:10	92.204994	4.390719	1.091167	0.826147	1.072123	0.111075	0.168784	0.042349	0.037699	0.029875	0.02311	0.009603	0.002353	1066.387207
Max. Absolute Deviation [Mol%]			0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.89
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample CR5	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	15:15 - 15:19	92.194412	4.389174	1.093008	0.828875	1.072306	0.111128	0.169779	0.042518	0.037808	0.017478	0.028443	0.014629	0.00042	1066.361816
Sample Bottle GC Analysis-2 [Mol%]			92.208785	4.388082	1.093021	0.828917	1.072615	0.111294	0.170134	0.041986	0.037448	0.017723	0.018889	0.009698	0.000505	1065.657715
Sample Bottle GC Analysis-3 [Mol%]			92.208275	4.389711	1.092792	0.827886	1.072665	0.111266	0.169815	0.042339	0.037566	0.017728	0.019088	0.01059	0.000299	1065.739014
Max. Absolute Deviation-Successive [Mol%]			0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.70
Max. Absolute Deviation-Overall [Mol%]			0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.70
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	15:15	92.201523	4.382946	1.092048	0.826325	1.072182	0.111189	0.168718	0.042585	0.037907	0.029866	0.022829	0.009664	0.00222	1066.391113
Max. Absolute Deviation [Mol%]			0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.73
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table D-3. Detailed results from MRF sampling tests, June 18, 2003: Helium Pop method.

Sample HP1	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	11:02 - 11:04	92.199527	4.396396	1.092616	0.834769	1.076049	0.111256	0.169909	0.042177	0.037521	0.016386	0.018675	0.010207	0.00029	1065.668232
Sample Bottle GC Analysis-2 [Mol%]			92.196899	4.39462	1.092704	0.832308	1.075523	0.111243	0.169528	0.042172	0.037631	0.017472	0.018691	0.011211	0	1065.753418
Sample Bottle GC Analysis-3 [Mol%]			92.19568	4.395656	1.092351	0.83191	1.075665	0.111449	0.169881	0.041993	0.037478	0.017726	0.018939	0.011094	0.000268	1065.804932
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	10:59	92.182167	4.397489	1.09312	0.824254	1.076563	0.111438	0.16902	0.042503	0.037879	0.030719	0.020589	0.01168	0.002581	1066.648193
Max. Absolute Deviation [Mol%]			0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.96
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP2	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	11:05 - 11:06	92.199799	4.394761	1.092317	0.832186	1.074546	0.111076	0.168481	0.04194	0.037176	0.017262	0.018211	0.010364	0.000636	1065.697144
Sample Bottle GC Analysis-2 [Mol%]			92.201111	4.395303	1.092538	0.830834	1.074892	0.11122	0.16952	0.041953	0.03705	0.016888	0.017938	0.010179	0.000473	1065.662354
Sample Bottle GC Analysis-3 [Mol%]			92.200296	4.394488	1.092702	0.831534	1.074829	0.110863	0.169278	0.041802	0.037079	0.017261	0.01825	0.011538	0	1065.699707
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	11:04	92.178398	4.399802	1.093604	0.824643	1.077471	0.11147	0.169205	0.042634	0.03771	0.02946	0.022907	0.010387	0.002313	1066.647583
Max. Absolute Deviation [Mol%]			0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.99
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP3	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	11:12 - 11:13	92.196969	4.397338	1.092167	0.831345	1.075406	0.111369	0.1698	0.042396	0.037651	0.017602	0.018768	0.009486	0.000765	1065.766625
Sample Bottle GC Analysis-2 [Mol%]			92.185158	4.386699	1.092762	0.829754	1.075752	0.111366	0.169806	0.042458	0.037729	0.014927	0.030505	0.012705	0.000478	1066.364868
Sample Bottle GC Analysis-3 [Mol%]			92.197789	4.397302	1.092379	0.82948	1.075551	0.111284	0.169805	0.041819	0.03751	0.017404	0.01916	0.010302	0.000239	1065.784668
Max. Absolute Deviation-Successive [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.60
Max. Absolute Deviation-Overall [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.60
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	11:09	92.180107	4.398138	1.092839	0.825659	1.077085	0.111499	0.169021	0.04263	0.037592	0.029795	0.02285	0.010521	0.002264	1066.633057
Max. Absolute Deviation [Mol%]			0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.87
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP4	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	11:15 - 11:16	92.197243	4.396825	1.093527	0.82793	1.07598	0.111335	0.168849	0.042014	0.037349	0.017109	0.01894	0.01126	0.000536	1065.842773
Sample Bottle GC Analysis-2 [Mol%]			92.200562	4.395389	1.092709	0.826536	1.075574	0.111144	0.168972	0.042237	0.03757	0.017678	0.018943	0.011488	0.000201	1065.872559
Sample Bottle GC Analysis-3 [Mol%]			92.203827	4.393878	1.092982	0.824994	1.075793	0.111374	0.169786	0.042137	0.037545	0.017346	0.018579	0.011047	0.00071	1065.853027
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Max. Absolute Deviation-Overall [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	11:14	92.178429	4.399913	1.093144	0.825565	1.076794	0.111421	0.169072	0.042531	0.037808	0.029846	0.022786	0.010317	0.002378	1066.638306
Max. Absolute Deviation [Mol%]			0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.80
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP5	Date	Sample Time	Methane	Ethane	CO2	Nitrogen	Propane	Isobutane	n-Butane	Isopentane	n-Pentane	Neopentane	n-Hexane	n-Heptane	n-Octane	Hv dry (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	6/18/2003	11:18 - 11:18	92.189812	4.396059	1.09314	0.832521	1.075613	0.111338	0.168605	0.042314	0.037498	0.017666	0.018921	0.015046	0.000286	1066.009005
Sample Bottle GC Analysis-2 [Mol%]			92.194466	4.396163	1.092268	0.832887	1.075686	0.11113	0.168764	0.042216	0.037521	0.017505	0.018481	0.011428	0.000489	1065.799927
Sample Bottle GC Analysis-3 [Mol%]			92.188797	4.396688	1.094035	0.83184	1.076761	0.111367	0.168944	0.042249	0.037603	0.017464	0.018869	0.011761	0.0007	1065.867451
Max. Absolute Deviation-Successive [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21
Max. Absolute Deviation-Overall [Mol%]			0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21
Repeatability Criteria [± Mol%]			0.52	0.10	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	6/18/2003	11:14	92.178429	4.399913	1.093144	0.825565	1.076794	0.111421	0.169072	0.042531	0.037808	0.029846	0.022786	0.010317	0.002378	1066.638306
Max. Absolute Deviation [Mol%]			0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.84
Reproducibility Criteria [± Mol%]			0.63	0.13	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table D-4. Detailed results from Powder Wash sampling tests, November 10, 2003: Controlled Rate Purge method.

Sample CR1	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2004	15:00 - 15:01	0.8941	84.3922	7.1106	4.0723	0.9592	1.1375	0.3925	0.2769	0.178	0.1145	0.0332	0	0.439	0	1199.1934	1179.6214
Sample Bottle GC Analysis-2 [Mol%]			0.915	84.3715	7.1083	4.0714	0.9605	1.1375	0.3929	0.2771	0.1781	0.1149	0.034	0	0.4388	0	1199.0634	1179.4935
Sample Bottle GC Analysis-3 [Mol%]			0.8889	84.3709	7.112	4.0798	0.9634	1.1405	0.3948	0.2786	0.1798	0.1176	0.0343	0	0.4394	0	1199.9216	1180.3974
Max. Absolute Deviation-Successive [Mol%]			0.03	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.84
Max. Absolute Deviation-Overall [Mol%]			0.03	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.84
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	15:04	0.8714	84.7088	7.0919	4.0171	0.9396	1.0965	0.3592	0.2461	0.1329	0.0782	0.0215	0	0.4368	0	1191.1378	1171.7004
Max. Absolute Deviation [Mol%]			0.04	0.34	0.02	0.05	0.02	0.04	0.04	0.03	0.05	0.04	0.01	0.00	0.00	0.00	8.78	8.64
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	NO	NO

Sample CR2	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2004	15:09 - 15:11																
Sample Bottle GC Analysis-2 [Mol%]																		
Sample Bottle GC Analysis-3 [Mol%]																		
Max. Absolute Deviation-Successive [Mol%]																		
Max. Absolute Deviation-Overall [Mol%]																		
Repeatability Criteria [± Mol%]																		
Repeatability Acceptable?																		
Process GC Analysis [Mol%]	11/10/2003	15:08	0.8779	84.7329	7.0826	4.0194	0.9329	1.0884	0.366	0.2446	0.1346	0.0784	0.0222	0	0.4301	0	1190.7341	1171.3035
Max. Absolute Deviation [Mol%]			0.68	84.73	7.08	4.02	0.93	1.09	0.36	0.24	0.13	0.08	0.02	0.00	0.43	0.00	1190.73	1171.30
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?																		

Sample CR3	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2004	15:15 - 15:18	0.8844	84.5588	7.0981	4.0397	0.9429	1.1092	0.3772	0.2627	0.1641	0.1023	0.0381	0	0.4325	0	1195.4947	1175.9846
Sample Bottle GC Analysis-2 [Mol%]			0.9088	84.5266	7.0962	4.0384	0.9469	1.1106	0.3781	0.2637	0.1653	0.1047	0.0296	0	0.4331	0	1195.6415	1176.1289
Sample Bottle GC Analysis-3 [Mol%]			0.9386	84.4964	7.0936	4.0378	0.947	1.1103	0.3782	0.2638	0.1666	0.1056	0.0304	0	0.4328	0	1196.3871	1176.8788
Max. Absolute Deviation-Successive [Mol%]			0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25
Max. Absolute Deviation-Overall [Mol%]			0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	15:17	0.8774	84.6252	7.1622	3.9892	0.947	1.095	0.3583	0.2432	0.1351	0.0761	0.0186	0	0.4747	0	1190.5899	1171.1717
Max. Absolute Deviation [Mol%]			0.06	0.13	0.07	0.05	0.00	0.02	0.02	0.02	0.03	0.03	0.01	0.00	0.04	0.00	5.04	4.96
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	NO

Sample CR4	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2004	15:22 - 15:25	0.8888	84.5327	7.1392	4.0619	0.9407	1.0974	0.3676	0.2536	0.1524	0.0914	0.0238	0	0.4505	0	1193.8647	1174.3818
Sample Bottle GC Analysis-2 [Mol%]			0.8889	84.5267	7.1402	4.0608	0.9427	1.0975	0.3678	0.2538	0.1526	0.0923	0.0242	0	0.4505	0	1193.9844	1174.4996
Sample Bottle GC Analysis-3 [Mol%]			0.889	84.5255	7.1388	4.0635	0.9431	1.098	0.368	0.2538	0.1527	0.0923	0.0245	0	0.4508	0	1194.0571	1174.571
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.19
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	15:22	0.894	84.9187	7.0804	3.8158	0.9354	1.0862	0.3544	0.2418	0.1337	0.0752	0.019	0	0.4354	0	1186.9911	1167.6233
Max. Absolute Deviation [Mol%]			0.01	0.39	0.05	0.25	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.00	0.02	0.00	7.07	6.95
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Sample CR5	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2004	15:29 - 15:31	0.8941	84.4935	7.1144	4.0814	0.9614	1.1113	0.3707	0.2533	0.1449	0.0858	0.0213	0	0.4579	0	1194.1936	1174.7052
Sample Bottle GC Analysis-2 [Mol%]			0.8939	84.4998	7.1159	4.0932	0.9619	1.1099	0.3707	0.2535	0.146	0.0859	0.0225	0	0.458	0	1194.3291	1174.8374
Sample Bottle GC Analysis-3 [Mol%]			0.8945	84.4706	7.1169	4.0847	0.9644	1.1125	0.3715	0.2545	0.1481	0.0864	0.026	0	0.458	0	1194.8291	1175.33
Max. Absolute Deviation-Successive [Mol%]			0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.49
Max. Absolute Deviation-Overall [Mol%]			0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.62
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	15:31	0.8784	84.8262	7.1025	3.9607	0.9042	1.0899	0.3486	0.237	0.1326	0.0751	0.0173	0	0.4355	0	1188.2162	1168.8278
Max. Absolute Deviation [Mol%]			0.02	0.36	0.02	0.14	0.04	0.04	0.02	0.02	0.02	0.01	0.01	0.00	0.02	0.00	6.61	6.50
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Table D-5. Detailed results from Powder Wash sampling tests, November 10, 2003: Helium Pop method.

Sample HP1	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	15:54 - 15:55	0.959	84.6484	7.0669	4.0194	0.9328	1.0747	0.3557	0.2415	0.1402	0.0824	0.0209	0	0.4581	0	1169.4113	1170.0032
Sample Bottle GC Analysis-2 [Mol%]			0.9682	84.6324	7.069	4.0211	0.9345	1.0753	0.3563	0.2417	0.1405	0.0823	0.0205	0	0.4582	0	1169.4208	1170.0125
Sample Bottle GC Analysis-3 [Mol%]			0.9722	84.6267	7.0656	4.0224	0.9342	1.0749	0.3565	0.2416	0.1402	0.0825	0.0248	0	0.4584	0	1169.5854	1170.1744
Max. Absolute Deviation-Successive [Mol%]			0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16
Max. Absolute Deviation-Overall [Mol%]			0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.17
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	15:57	0.9018	84.8819	7.033	3.9884	0.9204	1.0597	0.3443	0.2323	0.1256	0.0691	0.019	0	0.4245	0	1167.0873	1167.7178
Max. Absolute Deviation [Mol%]			0.07	0.26	0.04	0.03	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.03	0.00	2.50	2.46
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP2	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	15:58 - 15:59	1.0057	84.5459	7.0682	4.0327	0.9413	1.0865	0.3624	0.2464	0.1435	0.0845	0.0229	0	0.461	0	1190.2386	1170.8167
Sample Bottle GC Analysis-2 [Mol%]			1.0225	84.519	7.0697	4.0362	0.9443	1.0865	0.3632	0.2469	0.1433	0.0861	0.0216	0	0.4607	0	1190.262	1170.8398
Sample Bottle GC Analysis-3 [Mol%]			1.0318	84.5169	7.0677	4.0338	0.9423	1.0846	0.3627	0.2463	0.1437	0.086	0.0229	0	0.4613	0	1190.0668	1170.6478
Max. Absolute Deviation-Successive [Mol%]			0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.19
Max. Absolute Deviation-Overall [Mol%]			0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.19
Repeatability Criteria [± Mol%]			0.10	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	15:57	0.9018	84.8819	7.033	3.9884	0.9204	1.0597	0.3443	0.2323	0.1256	0.0691	0.019	0	0.4245	0	1167.0873	1167.7178
Max. Absolute Deviation [Mol%]			0.13	0.36	0.04	0.05	0.02	0.03	0.02	0.01	0.02	0.02	0.00	0.00	0.04	0.00	3.17	3.12
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Sample HP3	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:02 - 16:03	0.9106	84.6483	7.0759	4.0227	0.9399	1.0835	0.3605	0.2444	0.1427	0.0844	0.0248	0	0.4633	0	1190.9367	1171.5049
Sample Bottle GC Analysis-2 [Mol%]			0.9118	84.6396	7.0802	4.0288	0.9411	1.0813	0.3604	0.2442	0.1429	0.0846	0.0219	0	0.4633	0	1190.9057	1171.4725
Sample Bottle GC Analysis-3 [Mol%]			0.913	84.6396	7.0798	4.0274	0.9411	1.0809	0.3603	0.2442	0.1429	0.0851	0.0225	0	0.4632	0	1190.9127	1171.4793
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	16:01	0.8965	84.8736	7.0427	3.9997	0.9181	1.0574	0.3437	0.2321	0.1266	0.0693	0.0156	0	0.4248	0	1167.1226	1167.7524
Max. Absolute Deviation [Mol%]			0.02	0.23	0.04	0.03	0.02	0.03	0.02	0.01	0.02	0.02	0.01	0.00	0.04	0.00	3.82	3.75
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Sample HP4	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:06 - 16:07																
Sample Bottle GC Analysis-2 [Mol%]																		
Sample Bottle GC Analysis-3 [Mol%]																		
Max. Absolute Deviation-Successive [Mol%]																		
Max. Absolute Deviation-Overall [Mol%]																		
Repeatability Criteria [± Mol%]																		
Repeatability Acceptable?																		
Process GC Analysis [Mol%]	11/10/2003	16:06	0.8924	84.8756	7.0449	3.9885	0.9167	1.0548	0.3431	0.232	0.1275	0.0701	0.0197	0	0.4247	0	1167.3406	1167.9668
Max. Absolute Deviation [Mol%]			0.89	84.88	7.04	4.00	0.92	1.05	0.34	0.23	0.13	0.07	0.02	0.00	0.42	0.00	1167.34	1167.97
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?																		

Sample HP5	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:10 - 16:11	0.9456	84.7939	7.0261	3.9794	0.9172	1.0571	0.3557	0.2403	0.1418	0.0857	0.0222	0	0.434	0	1168.4007	1169.0094
Sample Bottle GC Analysis-2 [Mol%]			0.9664	84.7638	7.0238	3.9763	0.9196	1.0584	0.3575	0.2412	0.1421	0.0877	0.0284	0.0009	0.4339	0	1168.7327	1169.3959
Sample Bottle GC Analysis-3 [Mol%]			0.9907	84.7433	7.0215	3.978	0.9187	1.0586	0.3571	0.2416	0.1431	0.089	0.024	0	0.4344	0	1168.2808	1168.8916
Max. Absolute Deviation-Successive [Mol%]			0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.45	0.44
Max. Absolute Deviation-Overall [Mol%]			0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.45	0.44
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	16:10	0.8903	84.9446	7.0602	3.9617	0.911	1.0471	0.3386	0.2288	0.1249	0.0697	0.0181	0	0.425	0	1166.9443	1166.594
Max. Absolute Deviation [Mol%]			0.10	0.20	0.03	0.03	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.00	0.01	0.00	2.79	2.74
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table D-6. Detailed results from Powder Wash sampling tests, November 10, 2003: High-Pressure Helium Displacement method.

Sample EF1	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:30 - 16:33	0.8944	84.7343	7.0323	3.953	0.9063	1.0719	0.3755	0.2693	0.166	0.11	0.0392	0.0013	0.4366	0	1193.2324	1173.7603
Sample Bottle GC Analysis-2 [Mol%]			0.8943	84.7428	7.0345	3.953	0.9053	1.0707	0.375	0.2688	0.1673	0.1103	0.0311	0	0.4369	0	1192.7186	1173.295
Sample Bottle GC Analysis-3 [Mol%]			0.8945	84.7266	7.0374	3.9591	0.9069	1.0727	0.3758	0.2694	0.1683	0.1107	0.0317	0	0.4369	0	1193.0447	1173.5757
Max. Absolute Deviation-Successive [Mol%]			0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.51	0.51
Max. Absolute Deviation-Overall [Mol%]			0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.51	0.51
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	16:34	0.865	84.8667	7.0933	3.9992	0.9063	1.026	0.3233	0.2159	0.1175	0.065	0.0182	0	0.4636	0	1184.73	1165.4001
Max. Absolute Deviation [Mol%]			0.01	0.16	0.06	0.05	0.02	0.05	0.05	0.04	0.05	0.05	0.02	0.00	0.03	0.00	8.50	8.36
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO

Sample EF2	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:37 - 16:39	0.8685	84.7175	7.0803	3.9762	0.9274	1.0732	0.3694	0.2542	0.1596	0.1047	0.029	0	0.44	0	1192.792	1173.3272
Sample Bottle GC Analysis-2 [Mol%]			0.8682	84.7052	7.0807	3.979	0.9272	1.0732	0.3692	0.2543	0.1601	0.1047	0.0368	0.0011	0.4403	0	1193.3315	1173.8577
Sample Bottle GC Analysis-3 [Mol%]			0.8687	84.7033	7.0836	3.9833	0.9276	1.0738	0.3697	0.2544	0.1601	0.1061	0.0259	0	0.4401	0	1193.0551	1173.5858
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.54	0.53
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.54	0.53
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	16:38	0.8898	84.9675	7.0577	3.9768	0.9034	1.0245	0.323	0.2147	0.1158	0.0644	0.018	0	0.4443	0	1184.0135	1164.6955
Max. Absolute Deviation [Mol%]			0.02	0.26	0.03	0.01	0.02	0.05	0.05	0.04	0.04	0.04	0.02	0.00	0.00	0.00	9.32	9.16
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	NO	YES	NO	NO	YES	YES	YES	YES	NO	NO

Sample EF3	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:44 - 16:46	0.8615	84.3986	7.1377	4.073	0.9693	1.1223	0.3973	0.2714	0.1597	0.1039	0.0291	0	0.4768	0	1197.7978	1178.2492
Sample Bottle GC Analysis-2 [Mol%]			0.8614	84.3904	7.1384	4.0742	0.971	1.1246	0.3981	0.272	0.1604	0.1037	0.0291	0	0.4767	0	1198.0021	1178.45
Sample Bottle GC Analysis-3 [Mol%]			0.8613	84.3862	7.1368	4.0763	0.9711	1.1245	0.3984	0.2723	0.1605	0.1046	0.0292	0	0.4768	0	1198.1057	1178.5519
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.30
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	16:43	0.891	85.0036	7.0409	3.9674	0.8996	1.0244	0.3246	0.2161	0.1161	0.0646	0.0178	0	0.434	0	1183.8436	1164.5283
Max. Absolute Deviation [Mol%]			0.03	0.62	0.10	0.11	0.07	0.10	0.07	0.06	0.04	0.04	0.01	0.00	0.04	0.00	14.26	14.02
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	NO	YES	NO	NO	NO	NO	YES	YES	NO	YES	NO	NO

Sample EF4	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:50 - 16:52	0.8636	84.4207	7.0725	4.0437	0.9639	1.1274	0.4215	0.298	0.1965	0.1171	0.0397	0	0.4454	0	1200.7421	1181.1441
Sample Bottle GC Analysis-2 [Mol%]			0.8635	84.4062	7.0725	4.0463	0.9645	1.1281	0.422	0.2986	0.1972	0.1181	0.0369	0.0011	0.445	0	1201.3726	1181.7641
Sample Bottle GC Analysis-3 [Mol%]			0.8653	84.3909	7.0774	4.0525	0.9665	1.1308	0.4237	0.2996	0.1985	0.1191	0.0304	0	0.4453	0	1201.3547	1181.7464
Max. Absolute Deviation-Successive [Mol%]			0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.63	0.62
Max. Absolute Deviation-Overall [Mol%]			0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.63	0.62
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	16:52	0.879	85.0436	7.0685	3.9073	0.8963	1.0203	0.3264	0.2174	0.117	0.0655	0.0191	0	0.4396	0	1183.2745	1163.9689
Max. Absolute Deviation [Mol%]			0.02	0.65	0.01	0.15	0.07	0.11	0.10	0.08	0.08	0.05	0.02	0.00	0.01	0.00	18.10	17.80
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	NO	YES	NO	NO	YES	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO

Sample EF5	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	16:57 - 16:59	0.8646	84.5968	7.0529	3.9881	0.9482	1.1022	0.4012	0.2814	0.177	0.1151	0.031	0	0.4315	0	1197.2096	1177.6707
Sample Bottle GC Analysis-2 [Mol%]			0.8646	84.5921	7.055	4.0003	0.9493	1.1022	0.4011	0.2815	0.1772	0.1154	0.0312	0	0.4311	0	1197.2976	1177.7573
Sample Bottle GC Analysis-3 [Mol%]			0.8643	84.5841	7.0555	4.0017	0.949	1.103	0.4017	0.2819	0.1789	0.1165	0.0318	0	0.4316	0	1197.5322	1177.9879
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.23
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.32
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	16:58	0.8756	84.9519	7.0994	3.9617	0.898	1.0183	0.325	0.2159	0.1153	0.0647	0.0151	0	0.4591	0	1183.7709	1164.4571
Max. Absolute Deviation [Mol%]			0.01	0.37	0.05	0.04	0.05	0.08	0.08	0.07	0.06	0.05	0.02	0.00	0.03	0.00	13.76	13.53
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	NO	YES	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO

Table D-7. Detailed results from Powder Wash sampling tests, November 10, 2003: Pitot and Bypass method.

Sample PP1	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	17:31 - 17:32	1.802	84.9715	6.5186	3.5043	0.8943	1.0264	0.3619	0.2609	0.1455	0.0977	0.0153	0	0.4117	0	1168.3057	1149.2527
Sample Bottle GC Analysis-2 [Mol%]			5.683	81.6073	6.2219	3.3658	0.8671	0.9973	0.352	0.2457	0.1448	0.088	0.0183	0	0.4088	0	1122.3956	1104.0797
Sample Bottle GC Analysis-3 [Mol%]																		
Max. Absolute Deviation-Successive [Mol%]			5.68	81.61	6.22	3.37	0.87	1.00	0.35	0.25	0.14	0.09	0.02	0.00	0.41	0.00	1122.36	1104.08
Max. Absolute Deviation-Overall [Mol%]			5.68	84.97	6.52	3.50	0.89	1.03	0.36	0.25	0.15	0.10	0.02	0.00	0.41	0.00	1168.31	1149.25
Repeatability Criteria [± Mol%]			0.10	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO	NO
Process GC Analysis [Mol%]	11/10/2003	17:38	0.8963	84.9848	7.0286	3.9658	0.9041	1.0313	0.3443	0.2311	0.1193	0.0606	0.0123	0	0.4316	0	1184.5002	1165.174
Max. Absolute Deviation [Mol%]			4.79	84.98	7.03	3.96	0.90	1.03	0.34	0.23	0.12	0.06	0.01	0.00	0.43	0.00	1184.50	1165.17
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO	NO

Sample PP2	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	17:39 - 17:41	0.8572	84.8614	7.0217	3.9074	0.9188	1.0634	0.3795	0.2646	0.166	0.1035	0.0285	0	0.4279	0	1191.8862	1172.4463
Sample Bottle GC Analysis-2 [Mol%]			0.8568	84.8613	7.0211	3.9023	0.9196	1.0639	0.3801	0.2651	0.1665	0.1044	0.0311	0	0.4279	0	1192.074	1172.6212
Sample Bottle GC Analysis-3 [Mol%]			0.857	84.8578	7.021	3.905	0.9198	1.0641	0.3802	0.2651	0.1666	0.107	0.0281	0	0.4283	0	1192.0856	1172.6325
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.17
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.19
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	17:41	0.8739	84.9586	7.0635	3.9684	0.9049	1.0279	0.3423	0.2301	0.1191	0.0608	0.0119	0	0.4487	0	1184.6845	1165.3651
Max. Absolute Deviation [Mol%]			0.02	0.10	0.04	0.06	0.01	0.04	0.04	0.04	0.06	0.05	0.02	0.00	0.02	0.00	7.39	7.27
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES	YES	NO	NO

Sample PP3	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	17:47 - 17:49	0.8997	85.1878	6.8665	3.7651	0.8984	1.0322	0.3708	0.2569	0.1562	0.1039	0.0305	0	0.4426	0	1185.4633	1166.1213
Sample Bottle GC Analysis-2 [Mol%]			0.9085	85.2072	6.857	3.7564	0.89	1.0238	0.3678	0.2556	0.1602	0.1011	0.027	0	0.4434	0	1185.2027	1165.8651
Sample Bottle GC Analysis-3 [Mol%]			0.9017	85.2184	6.8712	3.7601	0.8816	1.014	0.3644	0.2531	0.1599	0.1004	0.0314	0	0.4436	0	1184.8726	1165.5406
Max. Absolute Deviation-Successive [Mol%]			0.00	0.02	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.33	0.32
Max. Absolute Deviation-Overall [Mol%]			0.00	0.03	0.00	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.59	0.58
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	17:50	0.8686	84.9607	7.0732	3.9175	0.9109	1.0341	0.3452	0.2311	0.1209	0.0627	0.0122	0	0.4449	0	1184.825	1165.4934
Max. Absolute Deviation [Mol%]			0.04	0.24	0.21	0.16	0.03	0.02	0.03	0.03	0.04	0.04	0.02	0.00	0.00	0.00	0.64	0.63
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	NO	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES

Sample PP4	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	17:55 - 17:56	0.8544	84.9579	7.042	3.9046	0.8927	1.0299	0.362	0.2496	0.1537	0.0961	0.0317	0	0.4255	0	1189.0774	1169.6747
Sample Bottle GC Analysis-2 [Mol%]			0.8545	84.9441	7.0493	3.9158	0.8908	1.026	0.3609	0.249	0.1542	0.0967	0.0321	0.0009	0.4257	0	1189.2432	1169.8378
Sample Bottle GC Analysis-3 [Mol%]			0.8551	85.0417	7.0726	3.9312	0.8471	0.9754	0.3433	0.2369	0.1469	0.0917	0.0309	0	0.4272	0	1185.9632	1166.6127
Max. Absolute Deviation-Successive [Mol%]			0.00	0.10	0.02	0.02	0.04	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	3.26	3.23
Max. Absolute Deviation-Overall [Mol%]			0.00	0.10	0.03	0.03	0.05	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	3.26	3.23
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
Process GC Analysis [Mol%]	11/10/2003	17:55	0.8603	85.0213	7.0387	3.9176	0.91	1.0395	0.3508	0.235	0.1228	0.0631	0.0131	0	0.4278	0	1185.3275	1165.9874
Max. Absolute Deviation [Mol%]			0.01	0.08	0.03	0.01	0.06	0.06	0.01	0.01	0.03	0.03	0.02	0.00	0.00	0.00	3.92	3.85
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Sample PP5	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	11/10/2003	18:02 - 18:03	0.9034	85.2614	6.8268	3.7458	0.9012	1.0315	0.3609	0.2485	0.1557	0.1017	0.0303	0	0.4328	0	1184.8462	1165.5146
Sample Bottle GC Analysis-2 [Mol%]			0.9019	85.2597	6.828	3.7492	0.9027	1.0342	0.3627	0.25	0.1529	0.1047	0.0227	0	0.4335	0	1184.7194	1165.3898
Sample Bottle GC Analysis-3 [Mol%]			0.9047	85.2162	6.8333	3.7605	0.9056	1.0389	0.3663	0.2525	0.1566	0.108	0.0236	0	0.4348	0	1185.5684	1166.2247
Max. Absolute Deviation-Successive [Mol%]			0.00	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.85	0.83
Max. Absolute Deviation-Overall [Mol%]			0.00	0.05	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.85	0.83
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	11/10/2003	18:04	0.8827	84.976	7.0153	3.9042	0.9112	1.0446	0.3613	0.2454	0.1314	0.0673	0.0141	0	0.4466	0	1186.8753	1166.5261
Max. Absolute Deviation [Mol%]			0.02	0.29	0.19	0.16	0.01	0.01	0.01	0.01	0.02	0.04	0.02	0.00	0.01	0.00	1.16	1.14
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	NO	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES

Table D-8. Detailed results from Powder Wash sampling tests, December 19, 2003: Fill-and-Empty method.

Sample FE1	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	13:57 - 14:03	0.7513	83.9975	7.2188	4.2871	1.0213	1.1721	0.4483	0.3121	0.2041	0.1097	0.036	0.0007	0.441	0	1210.6705	1190.9059
Sample Bottle GC Analysis-2 [Mol%]			0.7513	83.9954	7.2185	4.2861	1.022	1.1724	0.4486	0.3124	0.2044	0.1099	0.0364	0.0015	0.4411	0	1210.7835	1191.0169
Sample Bottle GC Analysis-3 [Mol%]			0.7514	83.993	7.2181	4.2879	1.0225	1.1731	0.449	0.3126	0.2047	0.1101	0.0363	0.0003	0.441	0	1210.7966	1191.0288
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.12
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	14:02	0.7557	83.9691	7.1917	4.3322	1.0294	1.1826	0.4664	0.3193	0.1996	0.0941	0.0258	0	0.4341	0	1210.8973	1191.1287
Max. Absolute Deviation [Mol%]			0.00	0.03	0.03	0.05	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00	0.01	0.00	0.23	0.22
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.13	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample FE2	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	14:10 - 14:15	0.7872	84.0245	7.2797	4.3586	1.0025	1.1304	0.4017	0.2726	0.1739	0.0987	0.0351	0.0021	0.433	0	1206.3388	1186.6466
Sample Bottle GC Analysis-2 [Mol%]			0.7868	84.0248	7.2805	4.3599	1.0025	1.1306	0.4017	0.2725	0.1736	0.0982	0.0348	0.001	0.4331	0	1206.2522	1186.5615
Sample Bottle GC Analysis-3 [Mol%]			0.7867	84.0259	7.2796	4.367	1.0027	1.1307	0.4018	0.2727	0.1738	0.0985	0.0354	0.002	0.4332	0	1206.331	1186.6391
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	14:13	0.7738	84.0674	7.2166	4.2998	1.0108	1.1478	0.4224	0.2917	0.19	0.1018	0.0315	0.0005	0.4459	0	1207.2201	1187.5133
Max. Absolute Deviation [Mol%]			0.01	0.04	0.06	0.06	0.01	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.00	0.97	0.95
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.13	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample FE3	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	14:21 - 14:25	0.7778	83.9304	7.2675	4.4334	1.011	1.1436	0.4092	0.2778	0.1826	0.1079	0.0391	0.0006	0.4291	0	1209.2752	1189.534
Sample Bottle GC Analysis-2 [Mol%]			0.7776	83.9205	7.2668	4.4336	1.0107	1.1433	0.409	0.2776	0.1824	0.1079	0.0391	0.002	0.4294	0	1209.3245	1189.5824
Sample Bottle GC Analysis-3 [Mol%]			0.7774	83.9222	7.2684	4.4329	1.0108	1.1429	0.4089	0.2776	0.1824	0.1078	0.039	0.0004	0.4293	0	1209.2112	1189.471
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	14:24	0.7749	84.0865	7.264	4.3595	0.998	1.1238	0.394	0.266	0.1693	0.0961	0.0328	0.0017	0.4334	0	1205.2252	1185.5517
Max. Absolute Deviation [Mol%]			0.00	0.17	0.00	0.07	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	4.10	4.03
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO

Sample FE4	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	14:31 - 14:36	0.7475	83.99	7.2667	4.4426	1.0018	1.1252	0.3996	0.2689	0.1761	0.1085	0.043	0.0018	0.4283	0	1208.5965	1188.8665
Sample Bottle GC Analysis-2 [Mol%]			0.748	83.9873	7.2702	4.4443	1.0007	1.124	0.3992	0.2686	0.1758	0.1082	0.043	0.0021	0.4286	0	1208.9608	1188.8314
Sample Bottle GC Analysis-3 [Mol%]			0.7474	83.9871	7.2696	4.4428	1.0015	1.125	0.3998	0.269	0.1761	0.1085	0.043	0.0019	0.4283	0	1208.6267	1188.8963
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.06
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.06
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	14:35	0.7772	84.0451	7.2526	4.3918	1.0018	1.1246	0.3976	0.2687	0.1755	0.1021	0.0348	0.0003	0.4279	0	1206.4897	1186.795
Max. Absolute Deviation [Mol%]			0.03	0.06	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	2.14	2.10
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.13	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample FE5	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	14:43 - 14:48	0.7524	83.9104	7.2854	4.5104	1.0016	1.1204	0.3967	0.2682	0.1742	0.1064	0.0427	0.0027	0.4265	0	1209.452	1189.7077
Sample Bottle GC Analysis-2 [Mol%]			0.752	83.9019	7.2899	4.5137	1.002	1.1212	0.399	0.2682	0.1742	0.1062	0.0424	0.0027	0.4266	0	1209.5515	1189.8055
Sample Bottle GC Analysis-3 [Mol%]			0.7523	83.9029	7.2897	4.5132	1.0026	1.1221	0.3991	0.2683	0.174	0.1059	0.0418	0.0016	0.4265	0	1209.4603	1189.7158
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	14:46	0.7509	84.0409	7.2443	4.4594	0.9942	1.1124	0.3938	0.2643	0.1708	0.102	0.0378	0.0016	0.4276	0	1207.0844	1187.3797
Max. Absolute Deviation [Mol%]			0.00	0.14	0.05	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.47	2.43
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table D-9. Detailed results from Powder Wash sampling tests, December 19, 2003: Helium Pop method.

Sample HP1	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	15:12 - 15:15	0.8212	83.971	7.1874	4.4689	1.0043	1.1489	0.3905	0.2601	0.1694	0.1028	0.0411	0.0026	0.4318	0	1207.0873	1187.3827
Sample Bottle GC Analysis-2 [Mol%]			0.8202	83.9736	7.1877	4.4682	1.0039	1.1482	0.3904	0.2601	0.1696	0.1029	0.0413	0.0025	0.4315	0	1207.0808	1187.3763
Sample Bottle GC Analysis-3 [Mol%]			0.8197	83.9711	7.1867	4.4699	1.0041	1.148	0.3903	0.26	0.1693	0.1026	0.0413	0.003	0.432	0	1207.1137	1187.4087
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	15:16	0.7632	84.0296	7.2116	4.4645	1.0031	1.139	0.3863	0.2579	0.1674	0.1021	0.0406	0.0014	0.4333	0	1207.1272	1187.4219
Max. Absolute Deviation [Mol%]			0.06	0.06	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.13	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP2	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	15:18 - 15:19	0.909	83.9023	7.1578	4.4659	1.0037	1.1522	0.3936	0.2618	0.1725	0.1058	0.0427	0.003	0.4297	0	1206.5116	1186.8168
Sample Bottle GC Analysis-2 [Mol%]			0.9088	83.9014	7.1586	4.4656	1.0037	1.1522	0.3936	0.2618	0.1726	0.106	0.0431	0.0028	0.4298	0	1206.5363	1186.8411
Sample Bottle GC Analysis-3 [Mol%]			0.9088	83.8981	7.1586	4.4675	1.0042	1.1523	0.3936	0.2619	0.1727	0.1061	0.0431	0.0033	0.4298	0	1206.6208	1186.9242
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	15:21	0.7818	84.0413	7.1817	4.4617	1.0008	1.1441	0.3876	0.2582	0.1682	0.1015	0.0394	0.0021	0.4316	0	1206.7762	1187.0768
Max. Absolute Deviation [Mol%]			0.13	0.14	0.02	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.26
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.13	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP3	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	15:23 - 15:25	0.7676	84.0376	7.1643	4.4675	1.0027	1.1522	0.3954	0.262	0.1726	0.1042	0.0406	0.0021	0.4313	0	1207.808	1188.0913
Sample Bottle GC Analysis-2 [Mol%]			0.7675	84.0336	7.1648	4.4712	1.0021	1.1514	0.3953	0.2619	0.1726	0.1046	0.0411	0.0025	0.4315	0	1207.904	1188.1856
Sample Bottle GC Analysis-3 [Mol%]			0.7672	84.0299	7.1633	4.4704	1.0041	1.1533	0.396	0.2624	0.1729	0.1049	0.0414	0.0028	0.4314	0	1208.0689	1188.3478
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.26
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	15:27	0.7641	84.0851	7.1617	4.4613	0.9983	1.1438	0.3884	0.2578	0.1679	0.1011	0.0394	0.0017	0.4304	0	1206.6497	1186.9524
Max. Absolute Deviation [Mol%]			0.00	0.06	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	1.42	1.40
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP4	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	15:30 - 15:32	0.7513	84.174	7.0681	4.3969	1.0026	1.1729	0.4028	0.2652	0.1726	0.1036	0.04	0.0009	0.4291	0	1207.2967	1187.5895
Sample Bottle GC Analysis-2 [Mol%]			0.7513	84.1551	7.0722	4.4014	1.0048	1.1755	0.4043	0.2662	0.1737	0.1045	0.0406	0.0016	0.4288	0	1207.7429	1188.0272
Sample Bottle GC Analysis-3 [Mol%]			0.7541	84.1397	7.077	4.4045	1.0052	1.1764	0.4049	0.2668	0.1744	0.1049	0.0413	0.002	0.4288	0	1207.9712	1188.2517
Max. Absolute Deviation-Successive [Mol%]			0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.44
Max. Absolute Deviation-Overall [Mol%]			0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.66
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	15:32	0.7608	84.0851	7.1594	4.4555	0.9981	1.1453	0.3925	0.2599	0.1704	0.1012	0.038	0.002	0.4318	0	1206.8774	1187.1762
Max. Absolute Deviation [Mol%]			0.01	0.09	0.09	0.06	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	1.09	1.08
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample HP5	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	15:37 - 15:38	0.8751	84.009	7.146	4.4473	0.9932	1.1396	0.3923	0.2557	0.1648	0.0996	0.0402	0.003	0.4382	0	1204.8445	1185.1776
Sample Bottle GC Analysis-2 [Mol%]			0.8755	83.9994	7.1491	4.4503	0.9941	1.1367	0.3926	0.2559	0.1649	0.0996	0.0404	0.0033	0.4382	0	1205.0036	1185.334
Sample Bottle GC Analysis-3 [Mol%]			0.8749	84.0037	7.1498	4.4518	0.9927	1.1362	0.3922	0.2555	0.1645	0.0991	0.0394	0.003	0.4382	0	1204.8381	1185.1713
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.16
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.16
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	15:38	0.752	84.094	7.1545	4.4586	0.9958	1.1415	0.3938	0.2597	0.1705	0.1028	0.0395	0.002	0.4353	0	1206.9924	1187.2893
Max. Absolute Deviation [Mol%]			0.12	0.09	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	2.15	2.12
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table D-10. Detailed results from Powder Wash sampling tests, December 19, 2003: Pitot and Bypass method.

Sample PP1	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	16:01 - 16:04	0.7818	84.1754	7.173	4.3486	0.9862	1.1214	0.4	0.2608	0.17	0.102	0.0398	0.0023	0.4408	0	1204.5869	1184.9242
Sample Bottle GC Analysis-2 [Mol%]			0.7816	84.1722	7.173	4.3496	0.9861	1.1213	0.4001	0.2609	0.17	0.1023	0.0399	0.0024	0.4407	0	1204.6624	1184.9984
Sample Bottle GC Analysis-3 [Mol%]			0.7812	84.1721	7.1728	4.349	0.9864	1.1216	0.4002	0.2611	0.1701	0.1023	0.0399	0.0024	0.4409	0	1204.6818	1185.0176
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	16:05	0.7298	84.1841	7.1903	4.3455	0.9907	1.1363	0.4033	0.2649	0.1743	0.1041	0.0384	0.0019	0.4374	0	1206.0743	1186.3866
Max. Absolute Deviation [Mol%]			0.05	0.01	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49	1.46
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample PP2	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	16:11 - 16:14	0.8003	84.2559	7.1537	4.2983	0.9784	1.1096	0.3951	0.259	0.1691	0.1019	0.0399	0.0024	0.4404	0	1202.749	1183.1171
Sample Bottle GC Analysis-2 [Mol%]			0.8	84.2454	7.1539	4.3016	0.9796	1.1074	0.3964	0.2597	0.1699	0.1026	0.0406	0.0027	0.4403	0	1203.0467	1183.4098
Sample Bottle GC Analysis-3 [Mol%]			0.7998	84.2308	7.1572	4.3043	0.9814	1.1096	0.3976	0.2608	0.1709	0.1035	0.0411	0.0027	0.4403	0	1203.3874	1183.7449
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.34
Max. Absolute Deviation-Overall [Mol%]			0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.63
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	16:10	0.7804	84.2213	7.1584	4.3333	0.9826	1.1166	0.3961	0.2594	0.1691	0.1017	0.039	0.0022	0.4399	0	1203.8474	1184.1971
Max. Absolute Deviation [Mol%]			0.02	0.03	0.00	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	1.08
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample PP3	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	16:22 - 16:24	0.7534	84.3322	7.1539	4.2651	0.9803	1.1034	0.3985	0.261	0.1725	0.1047	0.0412	0.0026	0.4412	0	1203.0563	1183.4193
Sample Bottle GC Analysis-2 [Mol%]			0.7549	84.3259	7.1567	4.2662	0.9805	1.1039	0.3984	0.261	0.1726	0.1048	0.0412	0.0026	0.4413	0	1203.0997	1183.4619
Sample Bottle GC Analysis-3 [Mol%]			0.7529	84.3286	7.157	4.2652	0.9806	1.1041	0.3987	0.2611	0.1724	0.1045	0.0409	0.0027	0.4414	0	1203.0939	1183.4562
Max. Absolute Deviation-Successive [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
Max. Absolute Deviation-Overall [Mol%]			0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	16:21	0.79	84.3453	7.1369	4.2732	0.9725	1.0957	0.3878	0.2546	0.1645	0.0966	0.0377	0.0023	0.4369	0	1201.2078	1181.6017
Max. Absolute Deviation [Mol%]			0.04	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	1.89	1.86
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample PP4	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	16:31 - 16:33	0.758	84.4003	7.1577	4.2153	0.9767	1.0913	0.3897	0.257	0.1687	0.102	0.04	0.0027	0.4406	0	1201.3649	1181.7962
Sample Bottle GC Analysis-2 [Mol%]			0.7579	84.3962	7.1609	4.2163	0.9768	1.0913	0.3898	0.2572	0.1687	0.1021	0.04	0.0022	0.4406	0	1201.3913	1181.7822
Sample Bottle GC Analysis-3 [Mol%]			0.7579	84.3959	7.1602	4.2181	0.9765	1.0914	0.3896	0.257	0.1687	0.1019	0.0399	0.0021	0.4408	0	1201.3742	1181.7653
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	16:32	0.7502	84.4199	7.1477	4.2257	0.9727	1.0926	0.3883	0.2563	0.1669	0.0993	0.0376	0.0023	0.4405	0	1201.0583	1181.4547
Max. Absolute Deviation [Mol%]			0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Sample PP5	Date	Sample Time	nitrogen	methane	ethane	propane	iso-butane	n-butane	i-pentane	n-pentane	hexanes	heptanes	octanes	nonanes	CO2	H2S	Hv dry (Btu/scf)	Hv sat (Btu/scf)
Sample Bottle GC Analysis-1 [Mol%]	12/19/2003	16:41 - 16:43	0.7351	84.5245	7.1417	4.1737	0.9729	1.0805	0.3833	0.2529	0.1647	0.0958	0.0356	0.0008	0.4374	0	1199.4834	1179.9061
Sample Bottle GC Analysis-2 [Mol%]			0.735	84.5233	7.1413	4.172	0.9731	1.0807	0.3834	0.2532	0.165	0.0974	0.0367	0.0016	0.4373	0	1199.6214	1180.0418
Sample Bottle GC Analysis-3 [Mol%]			0.7349	84.5215	7.1436	4.1742	0.9728	1.0807	0.3834	0.2531	0.1647	0.0969	0.0359	0.0009	0.4374	0	1199.5434	1179.9651
Max. Absolute Deviation-Successive [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14
Max. Absolute Deviation-Overall [Mol%]			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14
Repeatability Criteria [± Mol%]			0.02	0.52	0.18	0.10	0.02	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.00	1.00
Repeatability Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Process GC Analysis [Mol%]	12/19/2003	16:43	0.7576	84.5025	7.1518	4.1762	0.9678	1.0775	0.38	0.251	0.1622	0.0962	0.0368	0.0023	0.4381	0	1199.0512	1179.4812
Max. Absolute Deviation [Mol%]			0.02	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.56
Reproducibility Criteria [± Mol%]			0.04	0.63	0.26	0.13	0.04	0.13	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	3.00	3.00
Reproducibility Acceptable?			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES