TEST REPORT

EMISSION TEST PROGRAM
EPA ICR FOR DELAYED COKING UNITS
736 COKER UNIT

HOUSTON REFINING LP
12000 LAWNDALE
HOUSTON, TEXAS

PREPARED FOR:

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ARI Project No. H866-34
ARI Test Plan Project No. H866-32
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HRO Purchase Order No. 4401318097
Test Dates: July 18 through August 3, 2011

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STATEMENT OF CONFORMANCE AND TEST REPORT CERTIFICATION

I certify, to the best of my knowledge, that this test program was conducted in a manner conforming to the criteria set forth in ASTM D 7036-04: Standard Practice for Competence of Air Emission Testing Bodies, and that project management and supervision of all project related activities were performed by qualified individuals as defined by this practice.

I further certify that this test report and all attachments were prepared under my direction or supervision in accordance with the ARI Environmental, Inc. quality management system designed to ensure that qualified personnel gathered and evaluated the test information submitted. Based on my inquiry of the person or persons who performed the sampling and analysis relating to this performance test, the information submitted in this test report is, to the best of my knowledge and belief, true, accurate, and complete.

Greg D Burch

Greg Burch, QSTI
South Central Regional Manager, Source Testing Division
ARI Environmental, Inc.

SECTION ONE Introduction and Summary

ARI Environmental, Inc. (ARI) was retained by Houston Refining LP (HRO) to conduct an emission test program at their refinery located in Houston, Texas.

The testing was conducted on July 18 through August 3, 2011 on the 736 Delayed Coking Unit (DCU) in response to the USEPA Section 114 Information Collection Request (ICR) for Petroleum Refineries. The test program was conducted pursuant to the sampling and analytical procedures presented in the Test Plan (ARI Project No. H866-32) dated June 21, 2011.

The specific pollutants, test run duration and units of measure are presented in Table 1-1. The parameters and associated test methods are presented in Table 1-2.

Under the direct supervision of Mr. Greg Burch, ARI's test team consisted of Messrs. Zack McCain, Chris Hall, Jeff Knapp and Ron Mullins. Sample recovery and laboratory shipment activities were performed by Messrs. Richard Brank-Campbell and Ron White of ARI. Mr. Chris Towe of HRO provided coordination of the test program with refinery operations.

The results of the test program are presented in Section 4. The calculation summaries, field data, ARI reference method monitoring data, laboratory data, calibration data and test program qualifications are included in the appendices.

TABLE 1-1. POLLUTANTS, TEST RUN DURATION AND UNITS OF MEASURE

Group/Sub Group[1]	Pollutant	Test Run Duration (hours)[2]	Units of Measure
A1	Speciated Volatile Organic Hazardous Air Pollutants (HAP)	1	lb/hr, µg/dscm
A2	Speciated Semi-Volatile Organic HAP	4	lb/hr, µg/dscm
A1	Aldehydes	1	lb/hr, µg/dscm
A3	Total Hydrocarbons (THC)	1	lb/hr, ppmv db
A3	Methane, Ethane	1	lb/hr, ppmv db
A3	Carbon Monoxide (CO)	1	lb/hr, ppmv db
C1	Hydrogen Chloride (HCl), Chlorine (Cl_2), Hydrogen Fluoride (HF)	2	lb/hr, mg/dscm
C1	Hydrogen Cyanide (HCN)	1	lb/hr, µg/dscm
C2	Hydrogen Sulfide (H_2S), Carbonyl Sulfide (COS), and Carbon Disulfide (CS_2)	3	lb/hr, ppmv db
C2	Total Reduced Sulfur (TRS) Compounds	3	lb/hr, ppmv db
D2	Mercury (Hg)	3	lb/hr, µg/dscm
D1	Other Metals[3]	3	lb/hr, mg/dscm
D1	Particulate Matter (PM), PM under 2.5 microns ($PM_{2.5}$) (filterable)	2	lb/hr, gr/dscf
D1	$PM_{2.5}$ (condensable)	2	lb/hr, gr/dscf
D4	Nitrogen Oxides (NO_x)	2	lb/hr, ppmv db
D4	Sulfur Dioxide (SO_2)	2	lb/hr, ppmv db
A, B, C, D[4]	Flow Oxygen (O_2), Carbon Dioxide (CO_2) Moisture	Conducted simultaneously with the sampling in each group	acfm, scfm, dscfm % volume db % volume

Sampling was alternated between the two vents on DCU 736. Three runs were performed over each two day period during the daytime hours whenever possible. Three 3-inch ID sample ports were provided by the client so that three sample trains could be operated concurrently. Single point sampling was performed for all parameters/pollutants.

[1]Concurrent sampling was conducted for all pollutants in each subgroup.
[2]Three test runs were conducted for each pollutant. Due to the short duration of each vent cycle on the DCU, EPA allowed the sample volume collected during a vent cycle to constitute the required sample volume for that run. Therefore, the run times were based on the duration of each vent cycle and were as short as a few minutes or as long as one-hour in duration.
[3]Metals included antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), lead (Pb), manganese (Mn), nickel (Ni) and selenium (Se).
[4]Flows were measured in a fourth port that was a minimum of 2 inches ID per Method 1A.

TABLE 1-2. POLLUTANTS AND TEST METHODS

Group/Sub Group	Pollutant	Test Methods
A1	Speciated Volatile Organic HAP	USEPA Methods 18 and 308
A2	Speciated Semi-Volatile Organic HAP	SW-846 Method 0010 with SW-846 Method 8270C/D analytical finish
A1	Aldehydes	SW-846 Method 0011 with SW-846 Method 8315A
A3	THC	USEPA Method 25A
A3	Methane, Ethane	USEPA Method 18
A3	CO	USEPA Method 10
C1	HCl, Cl_2, HF	USEPA Method 26A
C1	HCN	USEPA Other Test Method (OTM) 29
C2	H_2S, COS, and CS_2	USEPA Method 15
C2	TRS Compounds	USEPA Method 16A
D2	Hg	ASTM D6784-02 (Ontario-Hydro Method)
D1	Other Metals	USEPA Method 29
D1	PM, Condensable PM	USEPA Methods 5/202
D4	SO_2, NO_x	USEPA Methods 6C and 7E

SECTION TWO Testing and Analytical Procedures

2.1 OVERVIEW

ARI conducted an emission test program on the two DCU 736 vents at HRO located in Houston, Texas. Testing was conducted in response to the USEPA Section 114 ICR for Petroleum Refineries. Three test runs were conducted at the two DCU 736 vents for all pollutants. The test run durations are shown in Table 1-1. The test methods are summarized in Table 1-2. The sample run time for each run was the duration of the vent cycle.

2.2 METHODOLOGY

Test methods followed the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, USEPA Methods 1-4, 5, 6C, 7E, 10, 18, 25A, 26A and 29; 40 CFR 51, Appendix M, USEPA Methods 202 and 205; 40 CFR 63, Appendix A, USEPA Method 308; USEPA OTM-29; SW-846 Methods 0010, 0011, 8270C/D and 8315A; ASTM D6784-02 (Ontario-Hydro Method); and the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods. All methods followed are those listed in Component 4 of the Petroleum Refinery Emissions Information Collection, Part VIII, Test Procedures, Methods and Reporting Requirements for the Information Collection Request for Petroleum Refineries.

2.2.1 Sampling Location (USEPA Method 1A)

The sampling point locations for the determination of gas velocity and volume flow rate were determined following the procedural requirements as detailed in USEPA Method 1A. Sampling was conducted at the two DCU 736 vents in the six sampling ports provided in each of the 8-inch diameter pipes. The sample ports were located a minimum of 4.5 diameters upstream and downstream from the nearest flow disturbances. See Figure 2-1.

2.2.2 Flue Gas Volumetric Flow Rate (USEPA Method 2)

Gas velocity and volumetric flow rate were determined following USEPA Method 2. Velocity head measurements were performed using a Type S pitot tube and Dwyer inclined 0 – 10-in. water manometer. Temperature measurements were conducted using a Chromel-Alumel thermocouple connected to a digital direct read-out potentiometer. Single point velocity measurement was performed based upon the duct size as well as safety considerations during the venting cycle.

2.2.3 Oxygen, Carbon Dioxide, Sulfur Dioxide, Nitrogen Oxides and Carbon Monoxide (USEPA Methods 3, 3A, 6C, 7E and 10)

O_2 and CO_2 concentrations were determined following USEPA Method 3A using an integrated bag system and analysis by Orsat or Method 3A procedures using ARI's Servomex, Inc. Model 1440C combination paramagnetic O_2 and non-dispersive infrared CO_2 analyzer. SO_2 sampling followed USEPA Method 6C procedures using ARI's Ametek (Bovar) Model 721-ATM non-dispersive ultraviolet SO_2 analyzer. NO_x sampling followed USEPA Method 7E procedures using ARI's California Analytical Instruments, Inc. Model 600-CLD chemiluminescent NO_x analyzer with low temperature NO_2 to NO conversion. CO sampling followed USEPA Method 10 procedures using ARI's Thermo Environmental Instruments, Inc. Model 48i gas filter correlation non-dispersive infrared CO analyzer.

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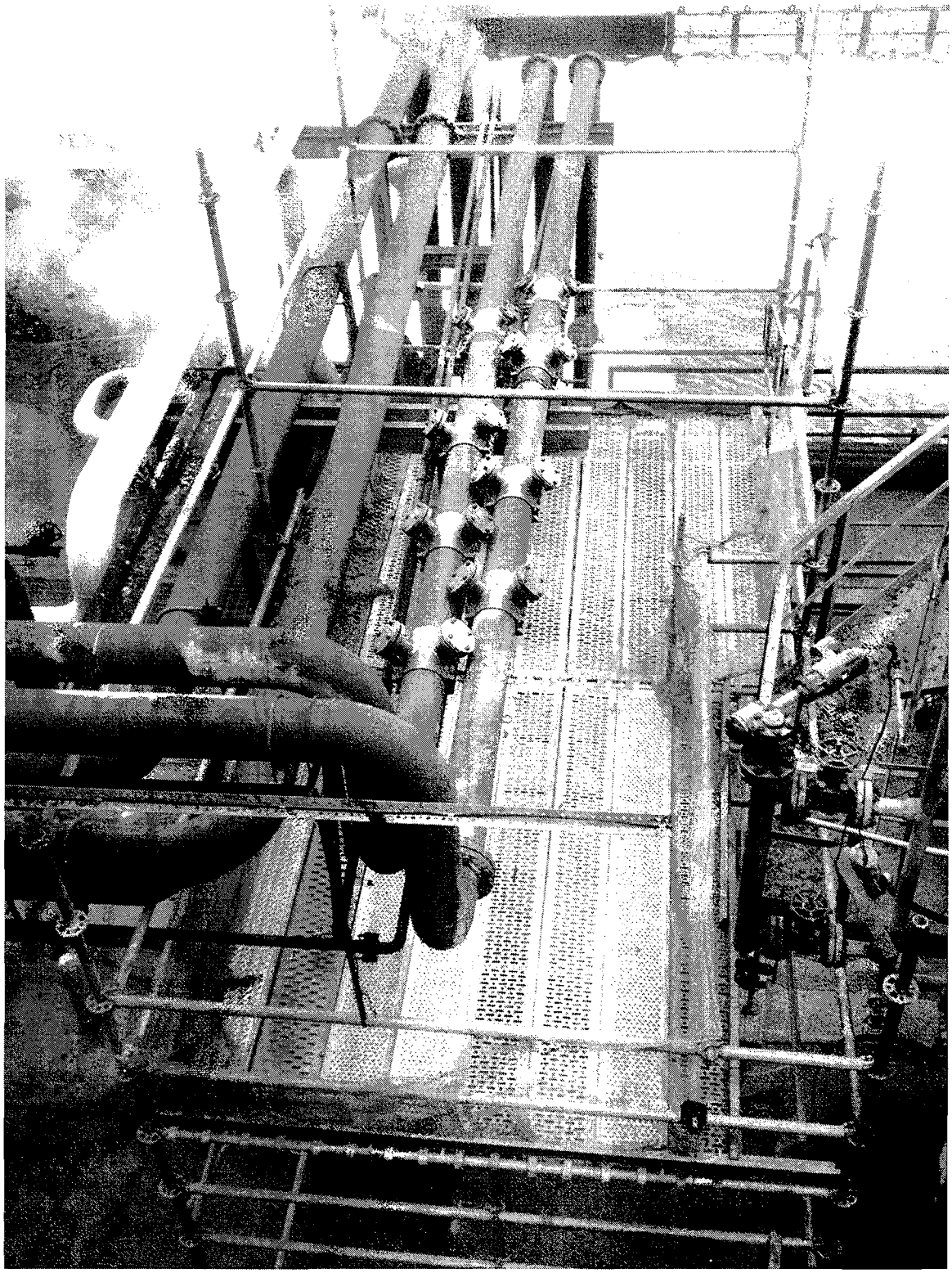
FIGURE 2-1. 736 COKER UNIT STACK SAMPLING LOCATION



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As shown in Figure 2-2, ARI's sampling system consisted of a heated probe with in-stack filter followed by a calibration tee assembly. The probe system was connected to a heated Teflon sampling line that transported the gas sample through an ice-cooled condenser and an electronic chiller to remove moisture. The dry sample gas was then transported to a manifold system by a Teflon lined sample pump and Teflon sample line. The manifold was connected with sample gas intake lines for ARI's O_2, CO_2, SO_2, NO_x and CO analyzers.

ARI's monitors were calibrated with applicable zero, mid-range and high-range gases as specified in the applicable USEPA methods. The calibration gases were generated from Protocol 1 calibration gases using an Environics Model 4040 Gas Dilution System. The gases met the calibration gas protocols as specified in USEPA Method 7E, Section 7.1.

Response time, calibration error and measurement system bias tests were performed prior to testing and a pre/post calibration drift test was conducted after each test repetition on each monitor. The average zero and calibration drift values obtained during each test run on the monitor were used to correct each monitor's raw data for instrument zero and drift for each respective test run.

The monitor data were collected at 15-second intervals and one-minute averages were calculated by ARI's data acquisition system consisting of an Omega OMB-DAQ-56 data acquisition module connected to a computer for digital data archiving and data reduction.

2.2.4 Flue Gas Moisture Content (USEPA Method 4)

The stack gas moisture content was determined following USEPA Method 4. Since the stack gas moisture content was near saturation during the venting period, the moisture content of the gas stream was calculated by both Method 4 and saturated vapor stream calculation techniques. The lower of the two moisture values was used in the emission rate calculations as required in Method 4. The following calculation was used to determine the stack moisture content at saturation:

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}}$$

where:

S.V.P. = Saturation vapor pressure at the stack temperature, in. Hg
P_{bar} = Barometric pressure, in. Hg
P_{static} = Absolute stack pressure, in. H_2O
13.6 = Conversion faction, in. Hg to in. H_2O

2.2.5 PM/$PM_{2.5}$ (Filterable Plus Condensable) (USEPA Methods 5 and 202)

Due to entrained droplets that exist in the DCU vents, sampling was conducted in accordance with USEPA Methods 5 and 202 using an Apex Instruments, Inc. particulate sampling train (see Figure 2-3). The front-half probe and filter assemblies were analyzed for filterable PM using USEPA Method 5, but modified with the filtering temperatures set at 320°F. The back-half impinger catch was analyzed for condensable particulate matter (CPM) in accordance with USEPA Method 202 procedures.

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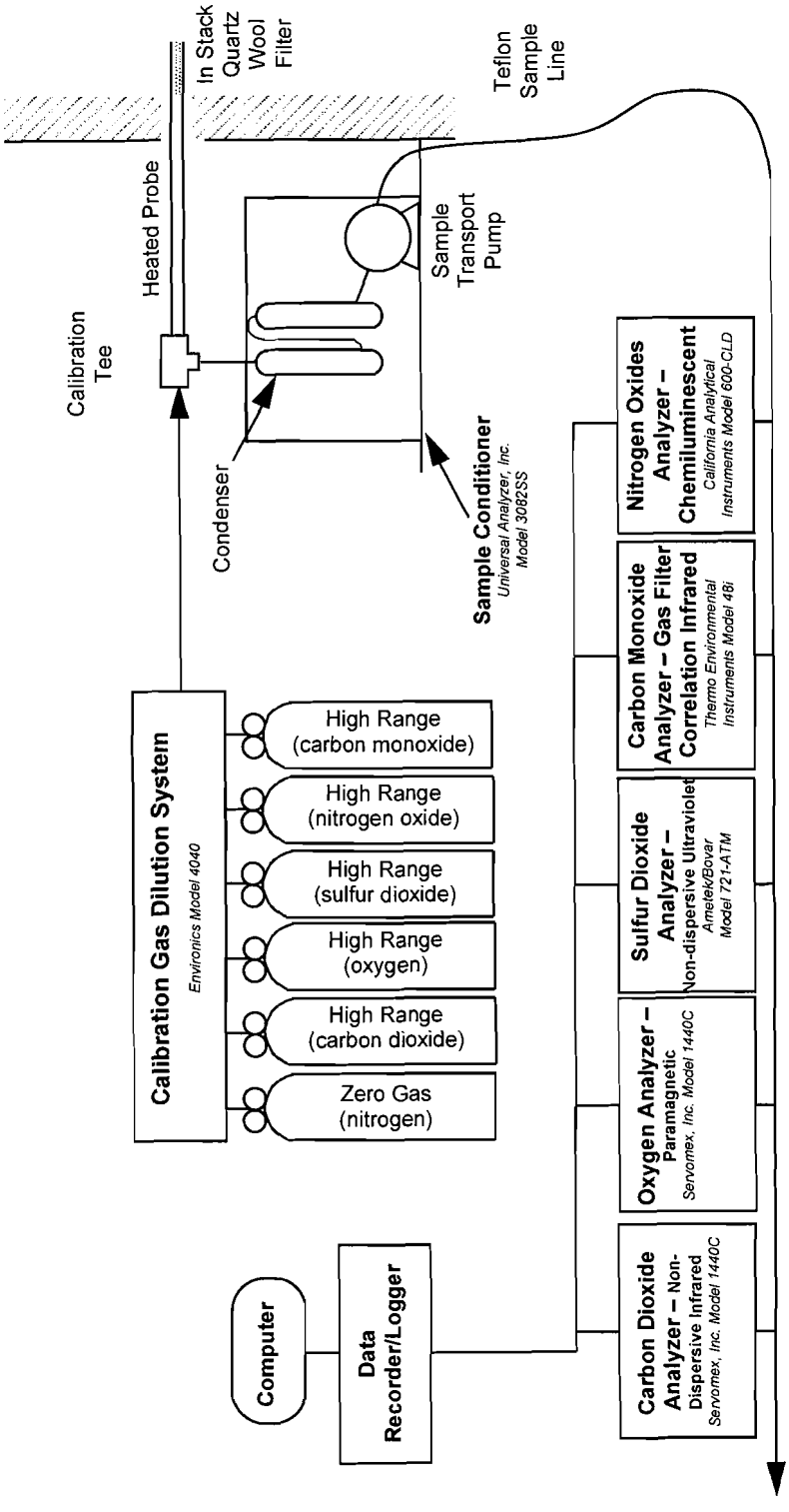

FIGURE 2-2. ARI REFERENCE METHOD CO_2, O_2, SO_2, NO_x AND CO SAMPLING SYSTEM

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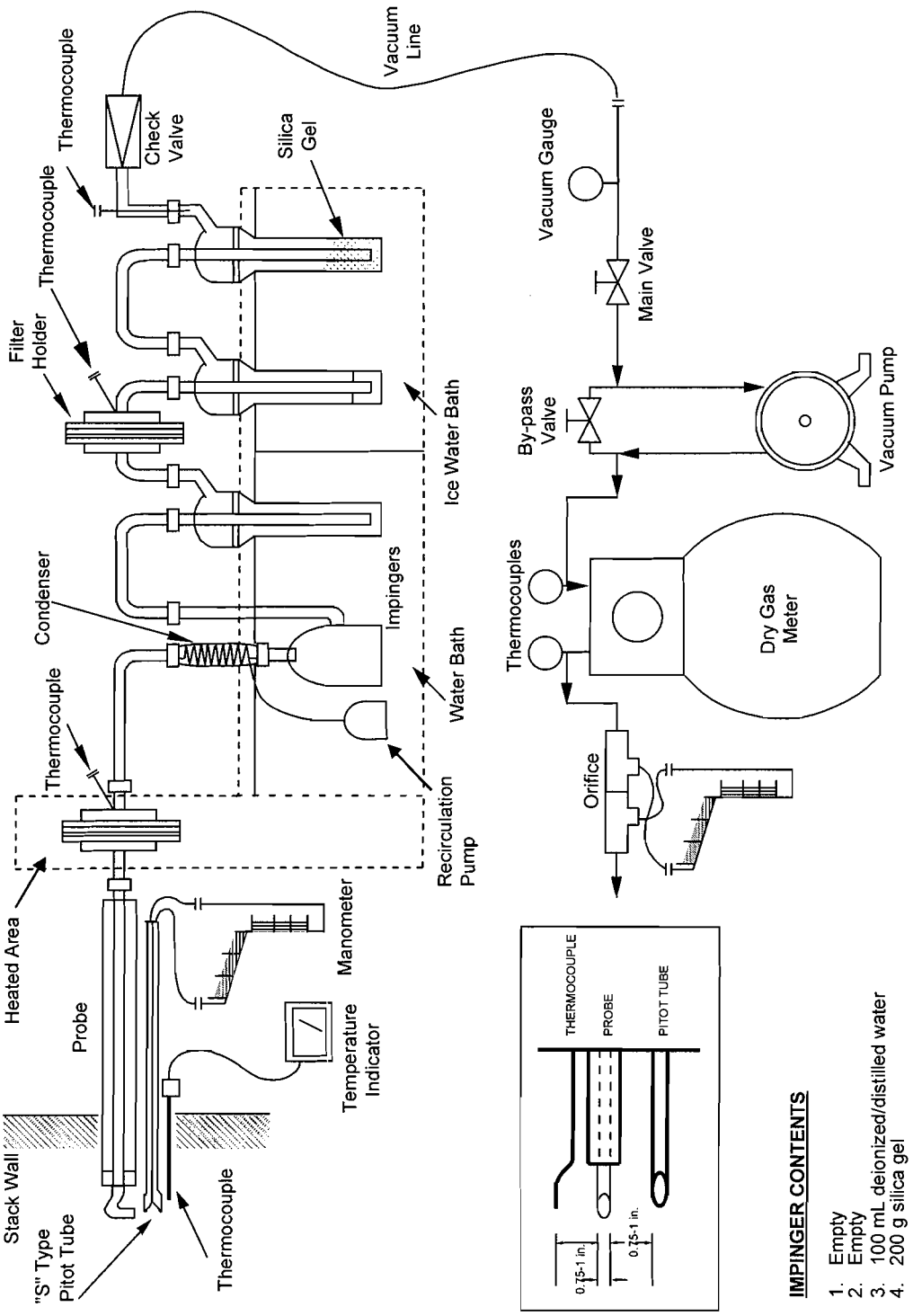

FIGURE 2-3. USEPA METHOD 5/202 PARTICULATE MATTER SAMPLING TRAIN

2.2.5.1 Sampling Apparatus

Assembled by ARI personnel, the sampling train consisted of the following:

Nozzle – Borosilicate glass.

Probe - Borosilicate glass with a heating system capable of maintaining a probe exit temperature of 320°F.

Pitot Tube - Type-S, attached to probe for monitoring stack gas velocity.

Heated Filter Holder - Borosilicate glass with a 4-in. Teflon frit filter support and a silicone rubber gasket. The holder design provided a positive seal against leakage from the outside or around the filter. The filter holder was heated to 320°F ±25°F during sampling. A thermocouple was placed in the back-half of the filter support in direct contact with the sample stream. A quartz fiber filter was used that meets the requirements of USEPA Method 5.

Ambient Filter Holder - Unheated borosilicate glass with a 4-in. Teflon frit filter support and a silicone rubber gasket. A thermocouple was placed in the back-half of the filter holder to measure sample gas temperature by direct contact with the sample stream. Temperature was maintained between 65 and 85°F. A Teflon filter disc was placed in the filter holder.

Draft Gauge - Inclined manometer with a readability of 0.01-in. H_2O in the 0- to 10-in. range.

Condenser – Glass, coil type with compatible fittings.

Impingers – Four (4) impingers connected in series with glass ball joints. The first impinger was of the Greenburg-Smith design, but with a shortened stem to act as a moisture knockout. The second, third and fourth impingers were of the Greenburg-Smith design, but modified by replacing the standard tip with a ½-in.-i.d. glass tube extending to within ½-in. of the bottom of the impinger flask. The second and third impingers were connected using the ambient filter holder.

Metering System - Apex Model 522. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with ±2 percent accuracy, and related equipment as required to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Mercury barometer capable of measuring atmospheric pressure to within ±0.1-in. Hg.

2.2.5.2 Sampling Procedures

The stack pressure, temperature, moisture and range of velocity head were measured according to procedures described in USEPA Methods 1 through 4. The first and second impingers were initially empty. The third impinger contained 100 mL of deionized/distilled water. The fourth impinger contained 200 to 300 g of silica gel.

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The impingers were placed in a container that has two compartments. The first two impingers were placed in the first compartment and the third and fourth impingers were placed in the second compartment. The first compartment contained water that was circulated through the condenser to reduce the sample gas to between 65 and 85°F at the exit of the ambient filter. The second compartment contained ice water to reduce the sample gas to ≤68°F upon exiting the last impinger. Both temperatures were recorded at each traverse point interval throughout each test run.

The sampling train was leak-checked at the sampling site by plugging the inlet to the nozzle and pulling a vacuum of 15-in. Hg. Leak rates of less than 0.02 ft^3/min at a vacuum of 15-in. Hg were considered acceptable. At the completion of each test run, the sampling train was again leak-checked by the same procedure, but at the highest vacuum attained during the test run. Both pre- and post-test leak checks of the pitot tube were made for each test run. Ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at less than 68°F.

During sampling, stack gas and sampling train data were recorded at specified intervals. Isokinetic sampling rates were based on the maximum volume capable of being pulled through the meter at approximately 98-100 percent of moisture and a vacuum of 15 inches of mercury.

2.2.5.3 Sample Recovery Procedures

After sampling was completed, a post-test nitrogen purge was conducted with the impingers still on ice at the meter ΔH@ for 60 minutes. Before the purge step began, the short stem of the first impinger was replaced with a long stem that was within ½-inch of the bottom of the impinger. If the stem did not extend below the water level in the impinger by 1 cm, then a measured amount of degassed, deionized, distilled water was added to adjust the level.

Method 5

The sample fractions were recovered as follows:

Container 1 - The heated filter was removed from the holder and placed in a Petri dish.

Container 2 - Loose particulate and acetone washings from all sample-exposed surfaces prior to the filter were placed in a glass bottle, sealed and labeled. Particulate was removed from the probe with the aid of a brush and acetone rinsing. The liquid level was marked after the container was sealed.

Container 3 - 150 mL of acetone was taken for blank analysis. The blank was obtained and treated in a similar manner as the contents of Container 2.

Method 202

The sample fractions were recovered as follows:

Container 4 - The contents from the first two impingers were placed into a glass container. The impingers (including the short stem), connecting glassware and front-half of the ambient filter were quantitatively rinsed twice with distilled/deionized water and the rinse was added to this container. The liquid level was marked after the container was sealed.

Container 5 - The first two impingers (including the short stem), connecting glassware and front-half of the ambient filter were then rinsed with acetone followed by two rinses with hexane and placed in a glass container. The liquid level was marked after the container was sealed.

Container 6 - The ambient filter was removed and placed in a Petri dish.

Containers 7 & 8 - 150 mL of distilled/deionized water and hexane were taken for blank analysis. The blanks were obtained and treated in a similar manner as the contents of Containers 1, 2 and 3.

The contents of the third impinger were weighed and the contents discarded. The contents of the fourth impinger (silica gel) were weighed to the nearest gram.

2.2.5.4 Analytical Procedures

Method 5

The analytical procedures followed those described in USEPA Method 5.

Container 1 - The filter and any loose particulate were transferred from the sample container to a tared glass weighing dish and desiccated for 24 hours in a desiccator containing anhydrous calcium sulfate or indicating silica gel. The filter was weighed to a constant weight and the results were reported to the nearest 0.1 mg.

Container 2 - The acetone washings were transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure. Then the contents were placed in a dessicator for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

Container 3 - The acetone blank was transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure. Then the contents were placed in a dessicator for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

Method 202

The analytical procedures followed those described in USEPA Method 202.

Container 4 - The liquid in this container was measured volumetrically and placed into a separatory funnel. Approximately 30 mL of hexane was added, mixed well and the lower organic phase drained off. This procedure was repeated twice, leaving a small amount of the organic/hexane phase in the separatory funnel each time to yield approximately 90 mL of organic extract. This organic extract was combined with Container 5. The aqueous fraction from Container 4 was transferred to a tared beaker and evaporated in an oven at 105°C to no less than 10 mL and allowed to air dry at ambient temperature. If a dried constant weight could not be achieved, the residue was redissolved in 100 mL of water and titrated with 0.1N NH_4OH to a pH of 7.0. The aqueous phase was evaporated in an oven at 105°C to approximately 10 mL, transferred to a pre-weighed tin, evaporated to dryness in a fume hood at ambient temperature and pressure, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg. The gain in mass represents the inorganic PM collected in the sampling train back-half.

Container 5 - The contents of this container were combined with the organic extract from Container 4, placed in a tared beaker and evaporated at ambient temperature and pressure in a fume hood to not less than 10 mL. The beaker contents were then transferred to a pre-weighed tin, evaporated to dryness at ambient temperature and pressure in a fume hood, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg. The gain in mass represents the organic PM collected in the sampling train back-half.

Container 6 – The ambient filter was folded in quarters and placed into a 50 mL extraction tube. Sufficient deionized/distilled water was used to cover the filter. The extraction tube was placed in a sonication bath and the water soluble material was extracted for a minimum of 2 minutes. The aqueous extract was combined with the contents of Container 4. This step was completed a total of three times. After completion of the aqueous extraction, the filter was covered with a sufficient amount of hexane. The extraction tube was placed in a sonication bath and the organic material was extracted for a minimum of 2 minutes. The organic extract was combined with the contents of Container 5. This step was completed a total of three times. The procedures for Container 6 were completed prior to any procedures for Containers 4 and 5.

Container 7 - The water blank was transferred to a tared beaker, evaporated to approximately 10 mL in an oven at 105°C, transferred to a pre-weighed tin, evaporated to dryness at ambient temperature and pressure in a fume hood, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

Container 8 - The hexane blank was transferred to a tared beaker, evaporated to approximately 10 mL at ambient temperature and pressure in a fume hood, transferred to a pre-weighed tin, evaporated to dryness at ambient temperature and pressure in a fume hood, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

The term "constant weight" means a difference of no more than 0.5 mg or 1 percent of the total weight less tare weight, whichever is greater between two consecutive readings, with no less than 6 hours of desiccation between weighings.

2.2.6 COS, CS_2 and H_2S (USEPA Method 15)

Determination of COS, CS_2 and H_2S were conducted in accordance with USEPA Method 15 using a gas chromatograph (GC) for separation of sulfur compounds and measurement by a flame photometric detector (FPD).

Modifications and improvements to USEPA Method 15 during the testing included the following:

1. No sample dilution was required (GC range ~500 ppm)

2. Protocol 1 calibration gases were used to calibrate the GC (no permeation tubes)

The gas sampling system consisted of a ¼-inch stainless steel probe connected to a Teflon sampling line. The exhaust gas was then conveyed through a series of Teflon impingers located on the sampling platform containing a citrate buffer solution to remove most of the SO_2 from the sample stream.

A Teflon lined sample pump transported the sample in ¼-inch ID Teflon tubing to the ARI mobile trailer. The sample was run to a manifold system at a flow rate of nominally 3-5 liters per minute from which a sample is introduced to the GC-FPD.

The GC-FPD system consisted of an SRI Model 9300B field GC containing a heated gas sampling valve, column oven and detector. A computer based integrator utilizing Peak Simple software was used for data acquisition and integration. Linear regressions of the square root of the area counts were used to calculate the calibration curves. A line loss test was conducted prior to the start of the test program.

The GC-FPD was calibrated with USEPA Protocol 1 gas standards. The gas standards were generated using an Environics Model 4040 Gas Dilution System. During each 180-minute test run, there will be at least 16 injections to the GC-FPD. Because venting period was shorter than 180 minutes, there were a fewer number of sample injections to the GC-FPD.

2.2.7 TRS (USEPA Method 16A)

The determination of TRS was conducted in accordance with USEPA Method 16A. This method extracted an integrated sample from the source and removed SO_2 using a citrate buffer scrubbing solution. TRS compounds were then oxidized in a combustion tube to SO_2 and collected as sulfate in the hydrogen peroxide (H_2O_2) impinger assembly. The sample collection assernbly was followed by a dry gas metering system. The mass of TRS as SO_2 collected was measured by the analytical procedures in USEPA Method 6 using a barium perchlorate-thorin titration. The major components of the sampling system depicted in Figure 2-4 are described below:

Probe – ¼-in borosilicate glass or Teflon tubing.

Particulate Filter – 50 millimeter (mm) Teflon filter holder containing a 1-2 µm porosity Teflon filter. The filter holder was heated to a sufficient temperature that prevented condensation of moisture (>250°F).

SO_2 Scrubber – Three 300 milliliter (mL) Teflon segmented impingers connected in series by thick walled Teflon tubing. The first two impingers contain 100 mL of citrate buffer and the third impinger is initially empty. The tips of the impinger stems that are below the solution level had an inner diameter no greater than ¼-in.

Combustion Tube – Quartz glass tube with a 12-in in length by 1-in expanded diameter combustion chamber with ¼-in connections on both ends.

Furnace – Capable of housing and heating the combustion tube to 1,472°F ±180°F.

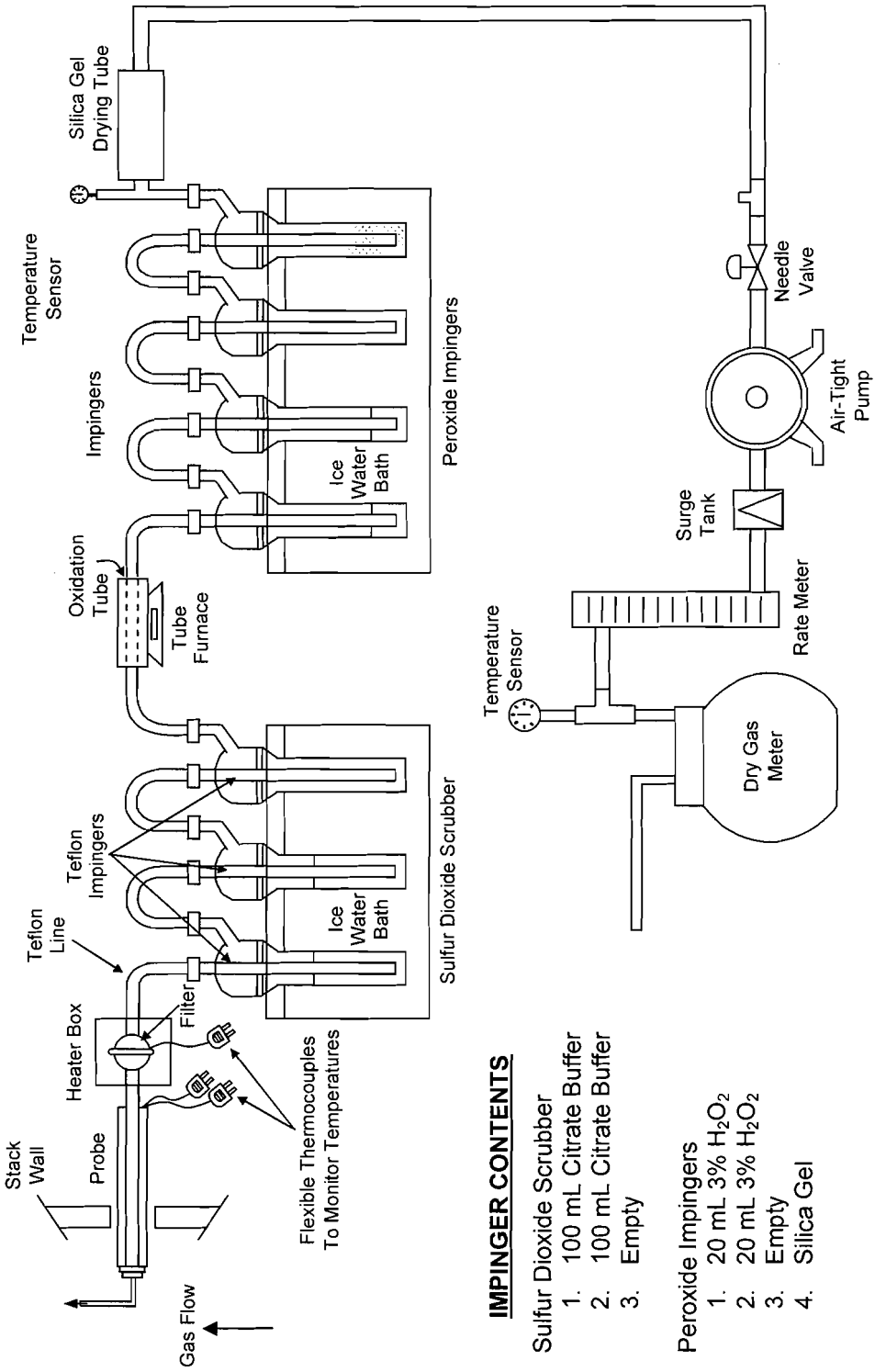

FIGURE 2-4. USEPA METHOD 16A SAMPLING TRAIN

Peroxide Impingers – Four (4) midget impingers connected in series. The first two impingers contained 20 mL of 3% H_2O_2, the third impinger is initially empty and the fourth contained silica gel.

Dry Gas Meter – Capable of measuring gas volume at a sample rate of 2 LPM at an accuracy of ±2%.

The sampling system was assembled with the probe connected to the heated filter followed by the citrate buffer SO_2 scrubber, then to the heater combustion tube followed by the H_2O_2 impingers and metering system. The appropriate volumes of solutions were placed in the SO_2 scrubber and H_2O_2 impingers. The citrate buffer was initially disconnected at the exit end and was conditioned by pulling stack gas through the system at 2 LPM for 10 minutes. After the initial conditioning period, the citrate buffer was reconnected to the entrance to the combustion tube and the sampling system was leak-checked. Following a successful leak-check, the system was ready to begin sampling stack gas at a rate of 2 LPM for the duration of the vent cycle.

After the sampling period was over, and the sampling system successfully passed a post-test leak check, the peroxide impingers were disconnected and recovered. The contents of the first three impingers were collected into a leak-free polyethylene jar and a subsequent rinse of the impingers and connecting glassware were also placed in the sample jar. The fluid level was marked and the jar was sealed and identified.

After completion of each test run, a system performance check was conducted to validate the test run and the sample train components and procedure. This involved sampling a known concentration of H_2S prior to cleaning the components upstream of the peroxide impingers and before recharging the citrate buffer solution. A 30-minute sample was collected at a rate of 2.5 LPM and the H_2O_2 impingers were recovered and analyzed in the same manner as the stack (source) samples.

Analysis of collected samples was conducted by ARI personnel while onsite by using the barium-thorin titration procedures described in USEPA Method 6.

2.2.8 Methane and Ethane (USEPA Method 18)

Methane and ethane were measured in conjunction with the THC (USEPA Method 25A) procedures. Tedlar bag samples were collected concurrently and analyzed by calibration procedures described in USEPA Method 18. One bag sample was collected in conjunction with each USEPA SW-846 Method 0010 semi-volatile sample run described in Subsection 2.2.17.

Specifically, the concentrations were measured by flame ionization detection with separation by gas chromatography (GC-FID). The GC-FID was calibrated by triplicate injections of cylinder gas standards to calculate a 4-point calibration curve.

Calibration gases were diluted from USEPA Protocol 1 high concentration standards. Dilution was performed using ARI's Environics Model 4040 Gas Dilution System. The dilution system was verified onsite before the start of testing following procedures described in USEPA Method 205.

2.2.9 Speciated Volatile Organic HAP (USEPA Method 18)

Volatile organic HAP sampling and analysis were conducted following the Method 18 Midget Impinger Method approved by USEPA and referenced on the Refinery ICR Website (FAQ Test-029) as an alternate method to determine the stack gas concentrations and emission rates of target volatile analytes listed in Table 1.3 of Cornponent 4 of the ICR. This method utilizes a midget impinger train with chilled ultrapure grade methanol as the volatiles collection media. Co-located sampling trains were performed as a duplicate determination of emissions. Therefore, the reported concentrations and mass emission rates were calculated as the average of the paired sampling trains.

The test consisted of three sampling runs and was conducted simultaneously with the semi-volatile organic HAP sampling. Each sampling run was conducted following USEPA Method 18 criteria for sorbent train sampling which requires that two co-located sampling trains be operated simultaneously. The co-located trains were spiked with both "labeled" and "native spikes" covering a specific list of recovery surrogates included in the refinery ICR Component 4 document. The labeled spikes were in the form of isotopologues that consisted of replacing the hydrogen atoms with deuterium (heavy hydrogen) isotope. The deuterated compounds can be differentiated from that of the naturally existing compounds by mass spectroscopy analytical detection and measurement. Respective recoveries for each deuterated compound can be calculated for each sample train without effect on the measurement of the flue gas native (naturally occurring) compounds. The purpose of this spiking was to determine the recovery efficiencies of each compound and to demonstrate the quality of the measurement data. The recovery surrogates that were spiked into the co-located trains included the following:

Labeled Spikes Plus the Corresponding Deuterium Count (added to each of the co-located trains):

1,3-Butadiene-d6	2,2,4-Trimethylpentane-d18
Pentane-d12	2-Nitropropane-d6
MTBE-d12	1,2-Dibromoethane-d4
n-Hexane-d14	Ethylbenzene-d10
Acrylonitrile-d3	Styrene-d8
Benzene-d6	Nitrobenzene-d5

Native Spikes (added to only one of the co-located trains):

Acrolein
Acetonitrile
Toluene
Trichloroethene
Methyl *iso*-Butyl Ketone

2.2.9.1 Sampling Apparatus

As shown in Figure 2-5, each of the two co-located sampling trains consisted of the following components:

Probe - Heated stainless steel probe with borosilicate glass liner.

Coil Condenser - Borosilicate glass condenser to cool the sample gas stream prior to entering the impinger train.

Impinger Train - Five borosilicate glass midget impingers with the first impinger acting as a moisture and condensable knockout and fitted with a shortened impinger tip. The second, third, and fourth impingers each contained an ultrapure grade (purge and trap grade) of methanol (10-20 mL each) with each impinger fitted with a tapered or fritted insert. The fifth impinger contained approximately 25 grams of silica gel to remove the final traces of moisture from the gas sample.

Meter Console - A VOST type meter console was used to control the sampling rate through the impinger train and monitor the temperature of the sampling train components. The meter console itself contained a dry gas meter to measure the volume of gas sampled. The gas meter has an accuracy of ± 1%.

2.2.9.2 Sampling Procedures

Sampling Train Glassware Preparation

The sampling train glassware was pre-cleaned, thoroughly rinsed with ultrapure grade methanol, baked in an oven at 100°C for two hours, cooled, sealed and stored separately from other reagents and other equipment to avoid contamination prior to assembly of the sampling train.

Recovery Surrogate Spiking of Impinger Train

The co-located sampling trains were assembled prior to charging the impingers with methanol. The co-located trains were both field spiked with the "labeled" spikes and one of the co-located trains was also spiked with the "native" spikes using the surrogate recovery standards prepared by the analytical laboratory. The contents of the prepared spikes were charged directly into impinger #2 of the sampling train which contained pre-chilled purge and trap grade methanol.

Sampling Train Operation

A leak check of the sampling train was performed before and after each sampling run at near 10 inches of mercury and was performed such that exposure of sampling train components to possible ambient air contaminants was avoided.

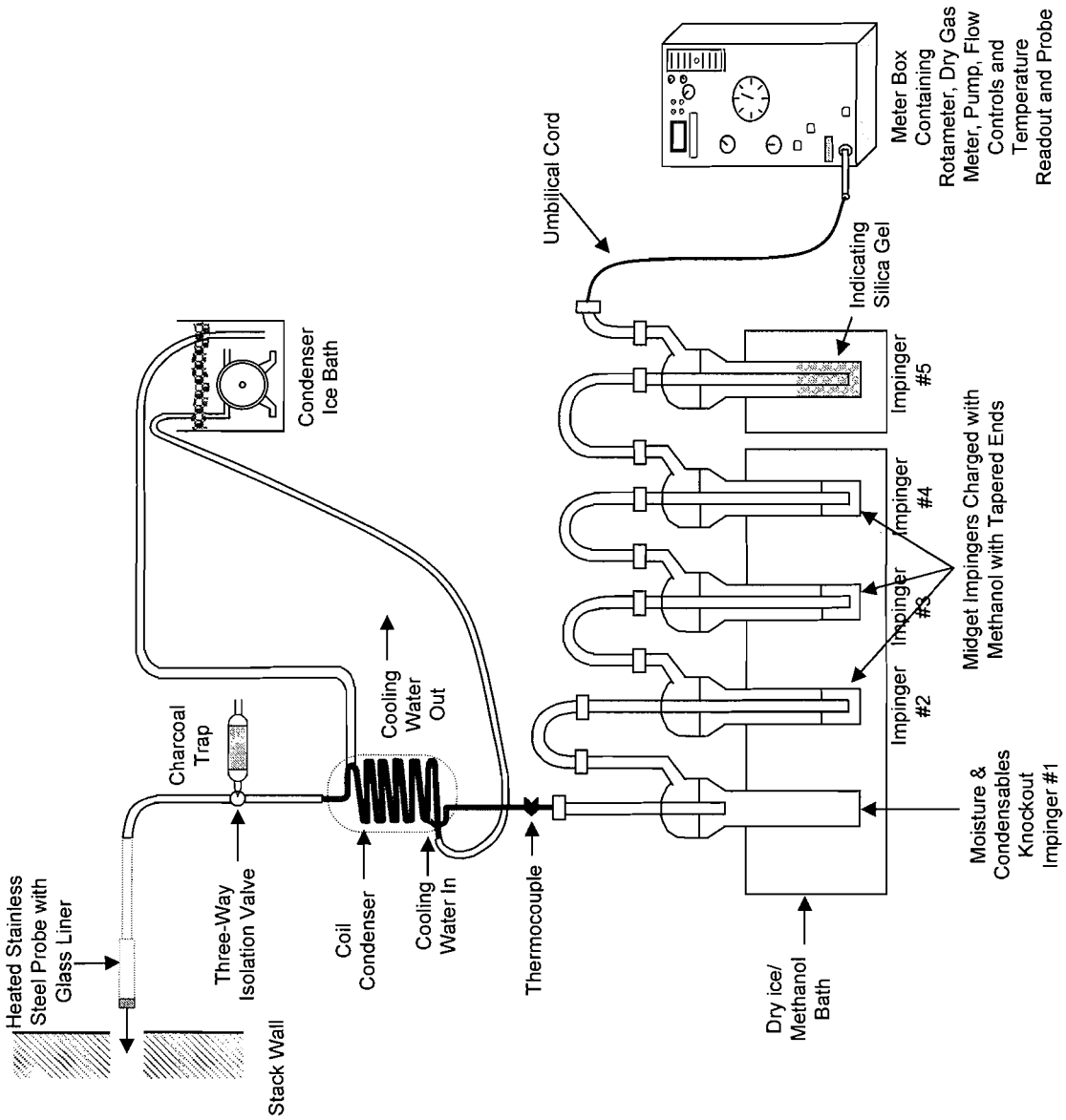

FIGURE 2-5. USEPA METHOD 18 MIDGET IMPINGER TRAIN

Following the leak check and prior to sampling, the sampling probe was heated to a temperature to prevent the condensation of organics and water vapor (280° to 302° F). The first four impingers of the sampling train were placed into a dry ice/methanol water bath and allowed to cool the impinger absorbing solutions prior to the start of sampling. Under these conditions, the target analytes of interest were efficiently trapped and dissolved in the methanol and stability of the samples was assured prior to analysis. Ice water circulated through the pre-impinger coil condenser to ensure that the first knockout impinger effectively collected sample gas condensate and low boiling organic components.

The probe was introduced into the stack and located either close to the centroid or greater than 3-feet from the inner wall of the stack cross-sectional plane. Sampling was conducted at a constant rate of 0.25 liters/minute during each sampling run to collect a nominal 20 L sample volume. Sampling train flow rate, temperature, and gas volume data were recorded at five-minute intervals throughout each sampling run. Following completion of the run, the sampling train was leak checked following the pretest leak check procedure.

2.2.9.3 Sample Recovery Procedures

Sample recovery from each of the co-located sampling trains was conducted as follows:

Container No. 1 - The contents of midget impingers #1 and #2 were combined, rinsed with a small quantity of methanol, and placed in a labeled 40 mL VOA vial. The probe, coil condenser and connecting glassware and tubing to the first impinger were rinsed with three small volumes of methanol and added to the Container No. 1 (VOA vial). The vial was labeled as Method 18 1st and 2nd Methanol Impinger Composite.

Container No. 2 - The contents of midget impinger #3 and rinse were placed in a separate 40 mL VOA vial and labeled as Method 18 3rd Methanol Impinger. This fraction was analyzed separately from the first fraction.

Container No. 3 - The contents of midget impinger #4 and rinse were placed in a separate 40 mL VOA vial and labeled as Method 18 4th Methanol Impinger. This fraction was analyzed separately from the other fractions.

Following sample recovery, ultrapure methanol was added to the sample vials to reduce the headspace and the vials were then placed in separate sealable poly bags and stored in coolers on dry ice prior to and during shipment of all samples to the analytical laboratory.

Blank Train and Trip Blanks (Quality Control Samples)

A train blank set of Method 18 samples and a methanol trip blank were collected one time during each source location.

During one of the sampling runs, a complete blank train was set up in the same manner as the sample trains. The methanol remained in the identical train for the same length of time as the duration of the sampling run. Beginning and end leak checks were performed and the probe was heated to temperature. The blank train samples were recovered in the same manner as those for the stack sampling runs.

Additionally, once for each test, a field spike was prepared for each of the two spiking standards (native and labeled spikes) by adding the contents of each spiking ampoule to a VOA vial containing 5 to 10 mL of purge and trap grade methanol. The ampoule was not rinsed. The vial was then filled with additional methanol to reduce headspace. These field spikes were QC samples to provide additional baseline data for the recovery study.

2.2.9.4 Analytical Procedures

Analysis of the collected stack run samples, one methanol trip blank sample, and the two spike QC samples for one source were performed by ALS Environmental Laboratories following SW-846 Methods 8260B employing purge and trap GC/MS procedures.

Sample volumes of the methanol sorbent for the purge and trap analysis procedure were adjusted in order to achieve a low end target analysis concentration in the stack gas stream of 0.1 ppmv.

2.2.10 Total Hydrocarbons (USEPA Method 25A)

THC sampling was conducted in accordance with USEPA Method 25A using a VIG Industries hydrocarbon analyzer equipped with a heated FID.

The sample delivery system consisted of a stainless steel probe, filter and calibration tee (on the end of the probe) connected to a heated 250°F Teflon sampling line. The sampling lines connected directly into the analyzers located in ARI's monitoring trailer. The THC analyzer is internally heated to keep the sample gas stream above its dew point (see Figure 2-6).

The analyzer was calibrated with applicable zero, low-range, mid-range and high-range gases as specified in USEPA Method 25A. The calibration gases were generated from Protocol 1 calibration standards using an Environics Model 4040 Gas Dilution System. The dilution system was verified on-site in strict accordance with USEPA Method 205. The gases met the calibration gas protocols specified in USEPA Method 7E, Section 7.1.

A calibration error test and measurement system bias test were performed prior to testing and a post calibration drift test was done on the monitor. The average zero and calibration drift values were used to correct the raw monitor data for each respective test run.

The monitor's data was collected at 15-second intervals by ARI's data acquisition system which consisted of an Omega OMB-DAQ-56 datalogger connected to a computer for digital data archiving and data reduction. DaqViewXL and Excel spreadsheet computer software were used for calculation of emission rates.

2.2.11 Hydrogen Chloride, Chlorine and Hydrogen Fluoride (USEPA Method 26A)

HCl, Cl_2 and HF sampling were conducted following USEPA Method 26A.

SECTION TWO Testing and Analytical Procedures

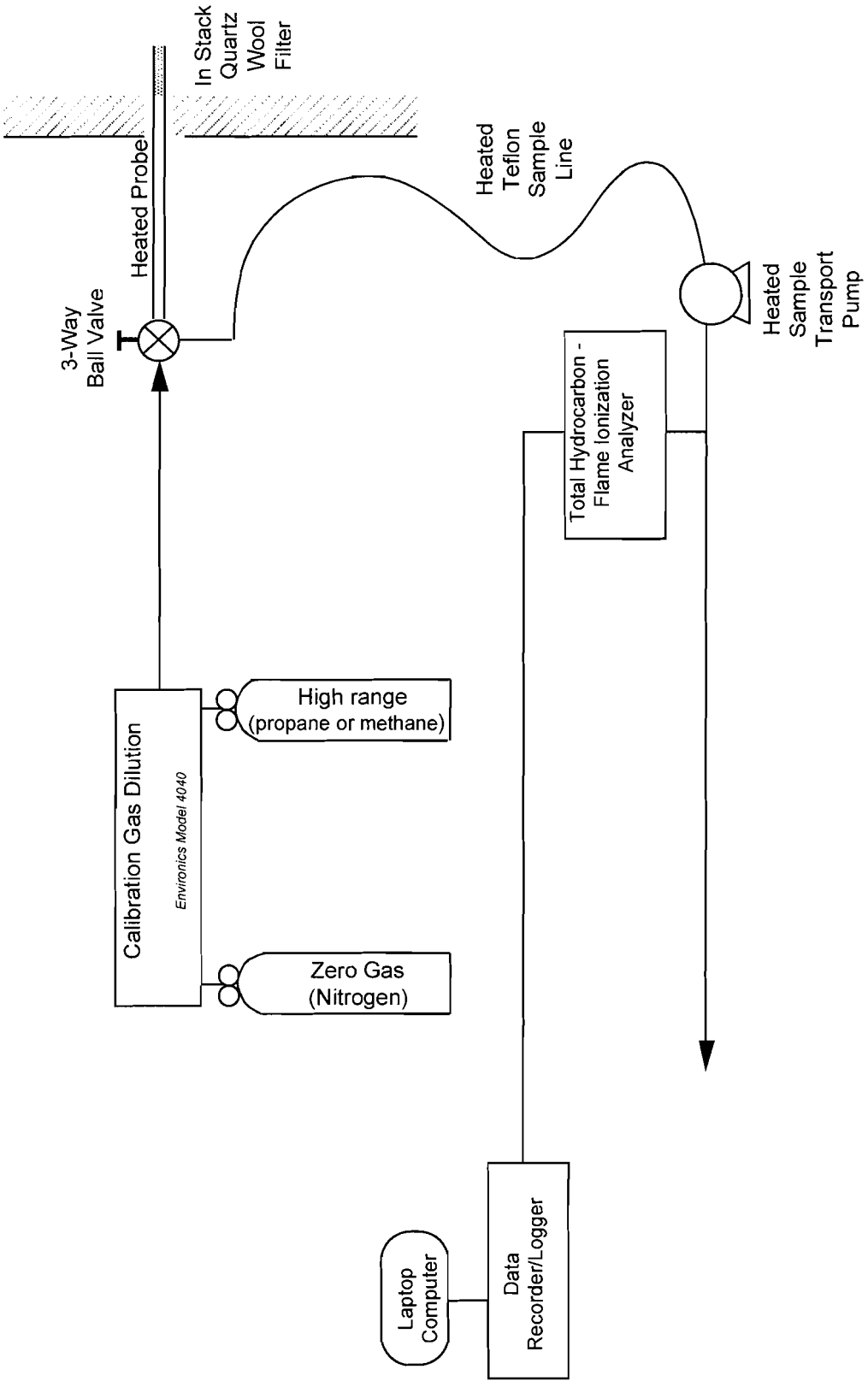

FIGURE 2-6. USEPA METHOD 25A - THC SAMPLING SYSTEM

Sample gas was withdrawn through a heated glass lined sample probe and heated Teflon filter followed by a series of chilled impingers. The front half of the sampling train consisted of a glass nozzle, heated glass lined probe and heated sample box containing a Teflon filter. The back half of the train consisted of five impingers. The first and second impingers (Greenburg-Smith) each contained 100 mL of 0.1N H_2SO_4, the third and fourth impingers contained 0.1N NaOH and the fifth impinger contained 200 grams of silica gel. See Figure 2-7.

At the conclusion of each test run, after the final leak check was performed, the following clean-up procedure was conducted:

1. The contents of impingers 1 and 2 were measured for volume and then placed in Container 1. The impingers were then rinsed with deionized distilled water and the contents placed in this container. The total volume was then measured and the liquid level marked on the outside of the bottle.

2. The contents of impingers 3 and 4 were measured for moisture and placed in Container 2. The impingers were then rinsed with deionized distilled water and the contents placed in this container. The total volume was then measured and the liquid level marked on the outside of the bottle.

3. The contents of impinger 5 were placed in Container 3 for subsequent weighing to the nearest gram.

4. A 200 mL reagent blank of the 0.1N H_2SO_4 was placed in Container 4.

At ARI's laboratory, analysis of the samples was performed in accordance with USEPA Method 26A using ion chromatography techniques.

2.2.12 Metals (USEPA Method 29)

Sampling and analysis for the following metals were performed in accordance with USEPA Method 29 using an Apex Instruments, Inc. sampling train (see Figure 2-8):

Antimony (Sb)	Cobalt (Co)
Arsenic (As)	Lead (Pb)
Beryllium (Be)	Manganese (Mn)
Cadmium (Cd)	Nickel (Ni)
Chromium (Cr)	Selenium (Se)

The samples were withdrawn from the exhaust stack and collected in a heated sample probe, heated filter (front-half catch) and a series of ice cooled impingers containing an acid/peroxide solution (back-half catch).

2.2.12.1 Sampling Apparatus

Assembled by ARI personnel, the sampling train consisted of the following:

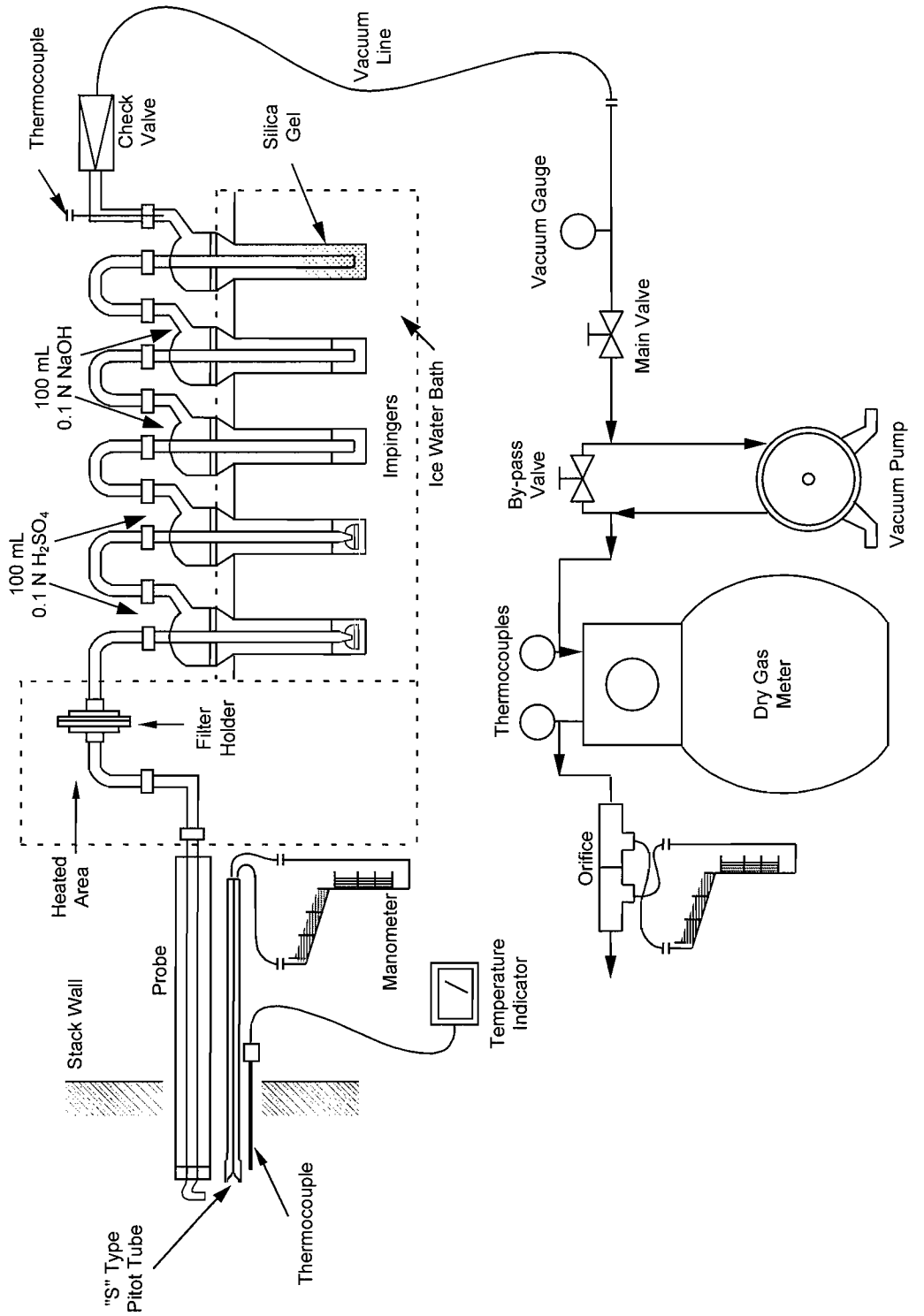

FIGURE 2-7. USEPA METHOD 26A SAMPLING TRAIN

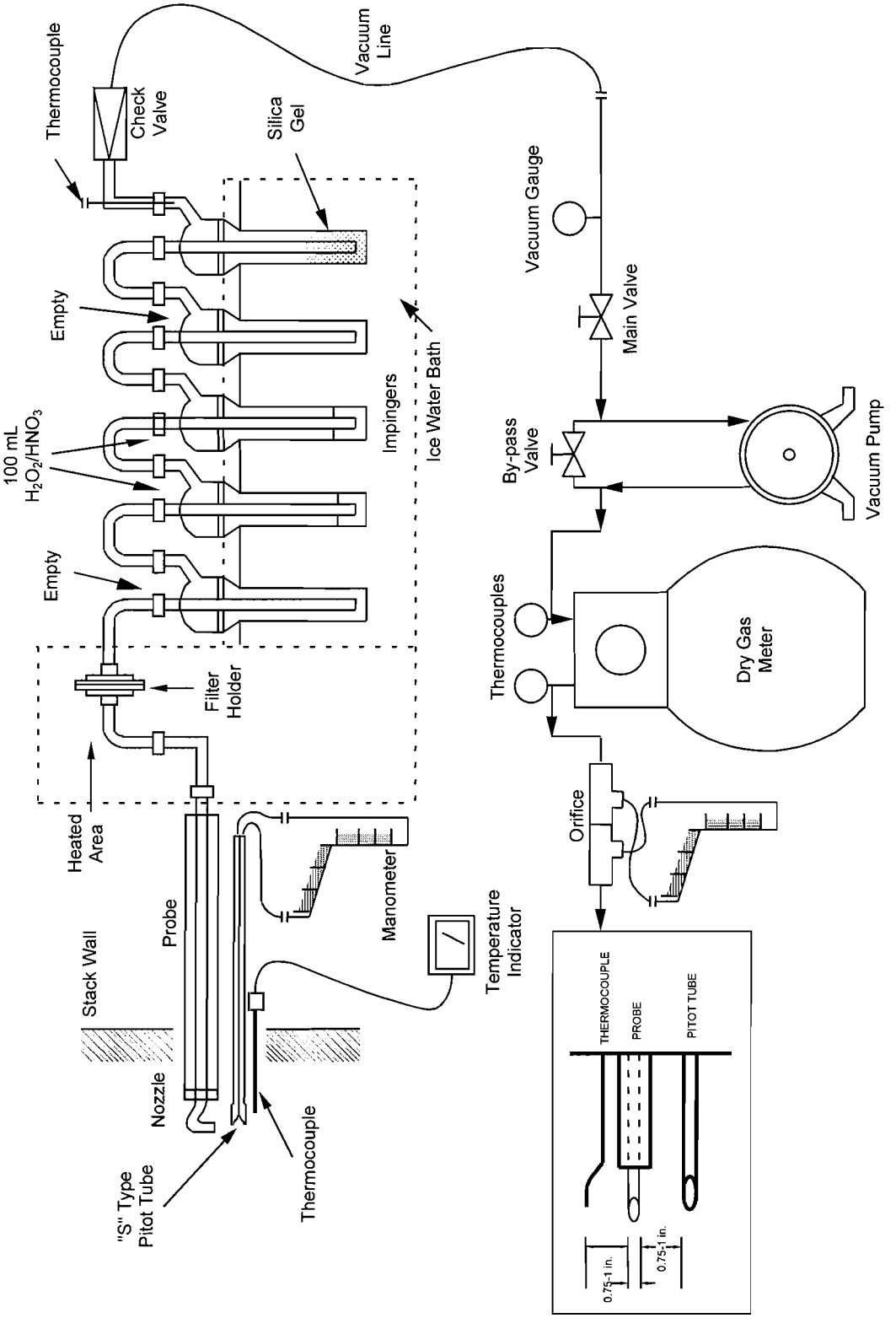

FIGURE 2-8. USEPA METHOD 29 SAMPLING TRAIN

Nozzle - Borosilicate glass with sharp, tapered leading edge.

Probe - Borosilicate glass with a heating system capable of maintaining a probe exit temperature of 248°F ±25°F.

Pitot Tube - Type-S, attached to probe for monitoring stack gas velocity.

Filter Media – A 4-in. quartz-fiber filter that met the requirements of Method 29.

Filter Holder - Borosilicate glass with a 4-in. Teflon frit filter support and a Viton O-ring gasket. The holder design provided a positive seal against leakage from the outside or around the filter. The filter holder was heated to 248°F ±25°F during sampling. A thermocouple was placed in the back-half of the filter holder for direct measurement of the sample stream temperature.

Draft Gauge - Inclined manometer with a readability of 0.01-in. H_2O in the 0- to 1-in. range and 0.1-in. H_2O in the 1-in. to 10-in. range.

Impingers – Five impingers connected in series with glass ball joints. The first impinger was empty with a shortened stem, the second and third impingers contained 100 mL of dilute nitric acid/hydrogen peroxide mixture, the fourth impinger was empty, and the fifth impinger contained approximately 200 grams of silica gel.

Metering System - Apex Model 522. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with ±2 percent accuracy, and related equipment as required to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Mercury barometer capable of measuring atmospheric pressure to within ±0.1-in. Hg.

2.2.12.2 Sampling Procedures

The stack pressure, temperature, moisture and range of velocity head were measured according to procedures described in USEPA Methods 1 through 4.

The sampling train was leak-checked at the sampling site by plugging the inlet to the nozzle and pulling a vacuum of 15-in. Hg. Leak rates of less than 0.02 ft^3/min at a vacuum of 15-in. Hg were recorded in all cases. At the completion of each test run, the sampling train was again leak-checked by the same procedure, but at the highest vacuum attained during the test run. Both pre- and post-test leak checks of the pitot tube were made for each test run. Ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at less than 68°F.

During sampling, stack gas and sampling train data were recorded at specified intervals. Isokinetic sampling rates were based on the maximum volume capable of being pulled through the meter at approximately 98-100 percent of moisture and a vacuum of 15 inches of mercury.

2.2.12.3 Sample Recovery Procedures

After sampling was completed and the final leak checks were performed, the sampling train was moved carefully from the test site to the recovery area.

The sample fractions were as follows:

Container 1 - The filter was removed from the filter holder and placed in a clean Petri dish and labeled.

Container 2 - A brush and acetone were used to clean the probe and other fittings as required. The washings from the inner surfaces of the nozzle and upstream portions of the filter holder were collected in a bottle and labeled.

Container 3 - A brush and 0.1 N nitric acid (HNO_3) were then used to rinse the probe and other fittings as required. The washings from the inner surfaces of the nozzle and upstream portions of the filter holder were collected in a bottle and labeled. The liquid level was marked after the container was sealed.

Container 4 - The contents of impingers 1, 2 and 3 were placed in a graduated cylinder to measure the total volume collected then rinsed with 0.1N HNO_3, then transferred to a bottle and labeled. The contents of impinger 4 were placed in a graduated cylinder to measure the total volume.

Container 5 - The contents of impinger 5 were transferred to a clean bottle and labeled. The weight of the silica gel was then determined. The difference between this final weight and the initial weight was the total moisture collected by the silica gel.

2.2.12.4 Analytical Procedures

Containers #1, #2, #3 and #4 and associated blanks were transported to the laboratory and analyzed for metals by ICAP in accordance with USEPA Method 29.

2.2.13 Gas Dilution System Verification (USEPA Method 205)

All applicable calibration gases were certified by USEPA Protocol 1 procedures. All diluted calibration standards were prepared using an Environics Model 4040 Gas Dilution System that was verified by a field evaluation prior to testing following the requirements of USEPA Method 205 (40 CFR 51, Appendix M).

ARI's Servomex Model 1440C O_2 analyzer was initially calibrated following USEPA Method 3A procedures. After the calibration procedure was complete, diluted low and mid-range standards and a mid-range EPA Protocol 1 standard were alternately introduced in triplicate and an average instrument response was calculated for each standard. No single response differed by more than $\pm$2% from the average response for each standard. The difference between the instrument average and the predicted concentration was less than $\pm$2% for each diluted standard. The difference between the certified gas concentration and the average instrument response for the mid-range EPA Protocol 1 standard was less than $\pm$2%.

2.2.14 Methanol Determination (USEPA Methods 308/18)

Methanol concentration and emission rate were determined following the basic principles of USEPA Method 308. Since the refinery ICR volatile organic HAP sampling requirements include surrogate spiking and recovery determination, the USEPA Method 308 test procedure included the addition of a co-located sampling train spiked with the target analyte (methanol) and operated simultaneously with the stack gas sampling train. This satisfies the ICR volatile organic HAP surrogate spiking and recovery requirement.

2.2.14.1 Sampling Apparatus

As shown in Figure 2-9, each of the co-located sampling trains consisted of the following components:

Probe - Heated stainless steel or borosilicate glass lined probe.

Teflon Tube - Connecting the probe to the absorbing solution/condensate impinger.

Impinger - Borosilicate glass impinger with tapered insert to collect moisture and condensable organics.

Sorbent Tube - Two section silica gel trap to collect non-condensable methanol fraction.

Pump - To transport gas sample through sampling train.

Needle Valve - To control gas sample flow rate through the sampling train.

Meter Console - A VOST type meter console was used to control the sampling rate through the impinger train and monitored the temperature of the sampling train components. The meter console itself contained a dry gas meter to measure the volume of gas sampled. The gas meter has an accuracy of ± 1%.

The unspiked sampling train included one midget impinger charged with 20 mL of ultrapure deionized water.

The spiked train included one midget impinger charged with 20 mL of laboratory prepared spiking solution for the recovery determination. The spiked train also included a two-section silica gel sorbent tube spiked with a known mass of ultra pure methanol into the first section for the recovery determination.

2.2.14.2 Sampling Procedures

Prior to the start of sampling, each of the sampling trains was leak checked at 10 inches of Hg. Acceptable leak rate is ≤ 2% of the average sampling rate. Following the leak check, the impinger was immersed in an ice water bath and the sample probe was positioned in the centroid of the stack. The sample probe was purged and sampling began with the sample rate adjusted to a selected flow rate in the range of 200 to 1000 mL/minute (dependent upon the methanol concentration in the stack and the detection limit required). Sample train flow rate and temperature data were recorded at five-minute intervals throughout the duration of the run.

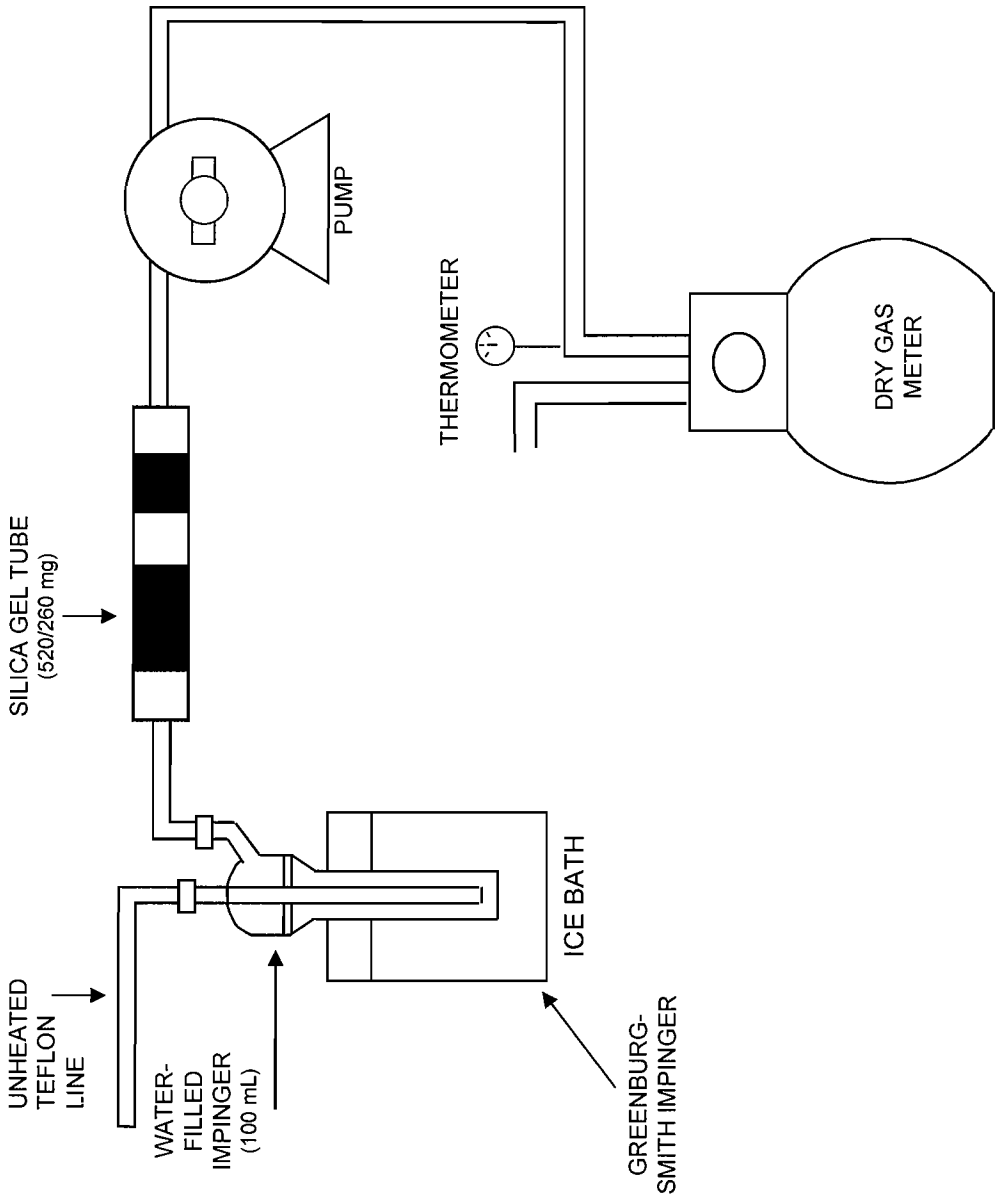

FIGURE 2-9. USEPA METHOD 308 SAMPLING TRAIN

Following completion of the run, a post test leak check was performed in the same manner as that conducted prior to the start of the run.

2.2.14.3 Sample Recovery Procedures

Sample recovery from each of the two co-located trains was conducted as follows:

Container #1 - The impinger absorbing solution and water rinse of the impinger and upstream sample tubing weres stored in a labeled and sealed 40 mL VOA vial and stored in a cooler with ice packs.

Silica Gel Sorbent Tube - The sorbent tube was capped, labeled, and stored in a cooler with cold packs.

Blanks - A methanol field blank and a sorbent tube blank were collected once for each source tested.

2.2.14.4 Analytical Procedures

At ARI's laboratory, the collected samples were analyzed using an SRI Model 8610 gas chromatograph equipped with a FID following USEPA Method 308 procedures to determine the methanol concentration.

Calibration of the gas chromatograph was performed using liquid standards prepared in the same impinger absorbing solution matrix as well as standards prepared in the sorbent tube desorbing solution. The samples were analyzed and target analyte recoveries were determined to meet the QA recovery requirements set forth in USEPA Method 18.

2.2.15 Mercury (ASTM D6784-02 – Ontario Hydro Method)

Total Hg was determined following the test procedures as detailed in ASTM Method D6784-02 (Ontario Hydro Method).

2.2.15.1 Sampling Apparatus

Assembled by ARI personnel, the sampling train consisted of the following (see Figure 2-10):

Nozzle - Borosilicate glass with sharp, tapered leading edge.

Probe - Borosilicate glass with a heating system capable of maintaining a probe exit temperature to within ±27°F of the flue gas temperature and no less than 248°F.

Pitot Tube - Type-S, attached to probe for monitoring stack gas velocity.

Filter Holder - Borosilicate glass with a 4-in. Teflon frit filter support and a Viton O-ring gasket. The holder design provided a positive seal against leakage from the outside or around the filter. The filter holder was heated to within ±27°F of the flue gas temperature and no less than 248°F during sampling. A thermocouple was placed in the back-half of the filter holder for direct measurement of the sample stream temperature.

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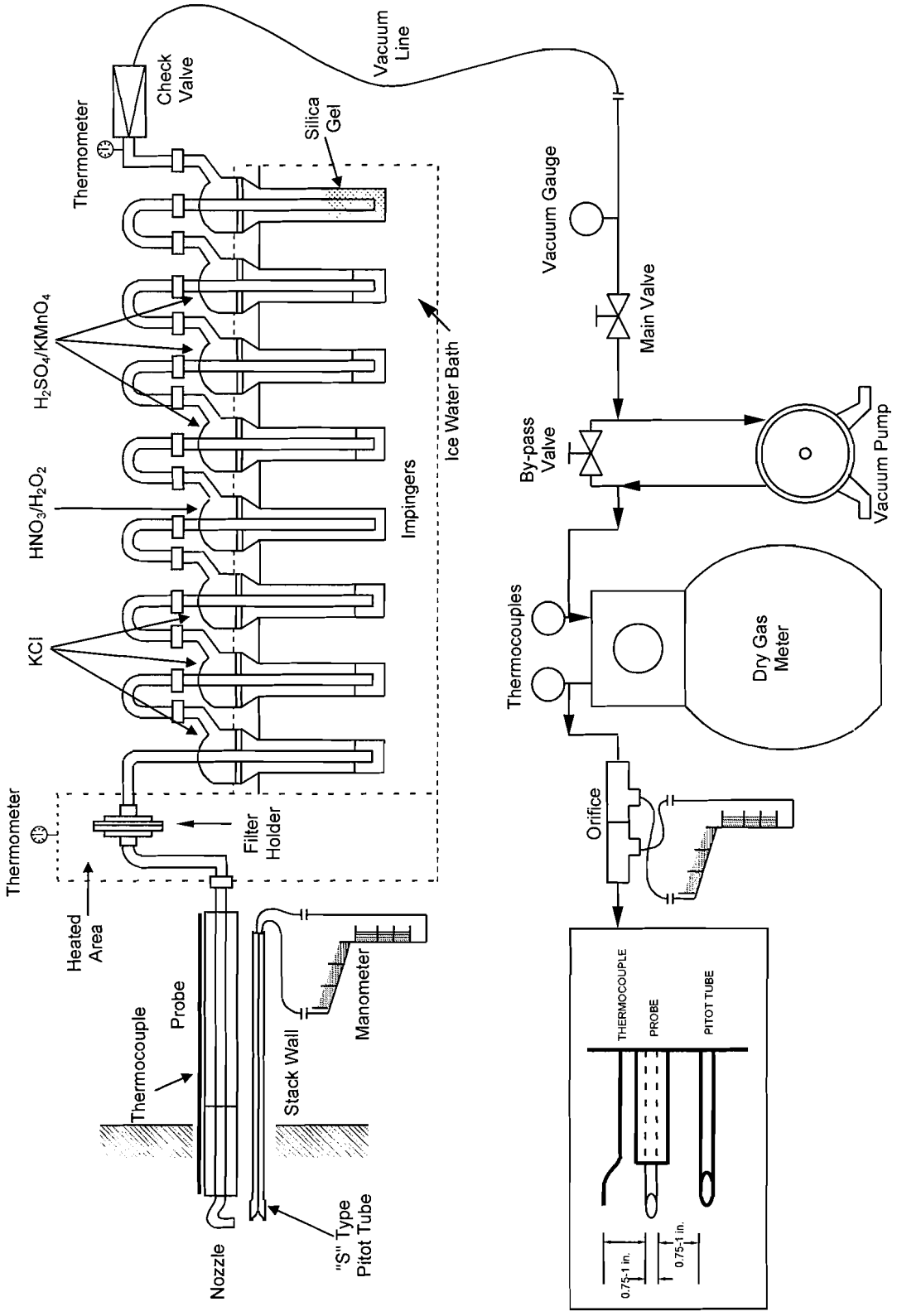


FIGURE 2-10. ASTM METHOD D6784-02 (ONTARIO HYDRO METHOD) MERCURY SAMPLING TRAIN

Draft Gauge - Inclined manometer with a readability of 0.01-in. H_2O in the 0- to 1-in. range and 0.1-in. H_2O in the 1-in. to 10-in. range.

Impingers – Eight impingers connected in series with glass ball joints. The first, second, fourth, fifth, sixth and eighth impingers were of the Greenburg-Smith design, but modified by replacing the standard tip with a ½-in.-i.d. glass tube extending to within ½-in. of the bottom of the impinger flask. The third and seventh impingers were of the Greenburg-Smith design with standard tips. The first, second and third impingers contained 100 mL of an aqueous 1 N potassium chloride (KCl) solution. The fourth impinger contained 100 mL of an aqueous solution of 5% HNO_3 and 10% hydrogen peroxide (H_2O_2). The fifth, sixth and seventh impingers each contained 100 mL of an aqueous solution of 4% potassium permanganate ($KMnO_4$) and 10% sulfuric acid (H_2SO_4). The last impinger contained 200 g of silica gel.

Metering System - Apex Model 522. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with ±2 percent accuracy, and related equipment as required to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Mercury barometer capable of measuring atmospheric pressure to within ±0.1-in. Hg.

2.2.15.2 Sampling Procedures

The stack pressure, temperature, moisture, and range of velocity head were measured according to procedures described in USEPA Methods 1 through 4.

Prior to final sampling train assembly, the weight of each impinger was recorded. The sampling train was leak-checked at the sampling site by plugging the inlet to the nozzle and pulling a vacuum of 15-in. Hg. Leak rates of less than 0.02 ft^3/min at a vacuum of 15-in. Hg were recorded in all cases. At the completion of each run, the sampling train was again leak-checked by the same procedure, but at the highest vacuum attained during the test run. Both pre- and post-test leak checks of the pitot tube were made for each test run. Ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at less than 68°F.

During sampling, stack gas and sampling train data were recorded at specified intervals. Isokinetic sampling rates were based on the maximum volume capable of being pulled through the meter at approximately 98-100 percent of moisture and a vacuum of 15 inches of mercury.

2.2.15.3 Sample Recovery Procedures

After sampling was completed and the final leak checks were performed, the filter and probe (front-half) were disconnected from the impinger train and moved carefully from the test site to the recovery area.

The sample fractions were recovered as follows:

Container 1 - The filter was removed and placed in a petri dish.

Container 2 - Loose particulate and 0.1 N HNO_3 washings from all sample-exposed surfaces prior to the filter were placed in a glass bottle, sealed, and labeled. Particulate was removed from the probe with the aid of a brush and 0.1 N HNO_3 rinsing. The liquid level was marked after the container was sealed.

Container 3 – Impingers 1, 2 and 3 were weighed to the nearest 0.5 g. The filter support, back half and connecting glassware were rinsed with 0.1 N HNO_3 and placed in a glass bottle. Small amounts of 5% $KMnO_4$ solution were added very slowly to each impinger and gently mixed until a purple color was obtained and remained for 15 minutes. The contents of each impinger were then added to Container 3. The impingers and connecting glassware were then rinsed with 10% HNO_3 and the rinses were added to Container 3. If the solution was clear, a small amount of 5% $KMnO_4$ solution was added until a pink or slightly purple color remained for 90 minutes. A final rinse of the impingers and glassware was conducted with 0.1 N HNO_3 and added to Container 3. The liquid level was marked after the container was sealed.

Container 4 – The contents of impinger 4 were placed in a glass bottle. The impinger and connecting glassware were rinsed a minimum of two times with 0.1 N HNO_3 and added to Container 4.

Container 5 – Impingers 5, 6 and 7 were weighed to the nearest 0.5 g. The contents of each impinger were placed in a glass bottle. The impingers and connecting glassware were rinsed a minimum of two times with 0.1 N HNO_3 and added to Container 5. A third rinse was conducted using 0.1 N HNO_3 and several drops of 10% hydroxylamine solution and added to Container 5. If the solution was clear, a small amount of $H_2SO_4/KMnO_4$ solution was added until a pink or slightly purple color was obtained. The solution was preserved by adding 1 mL of 5% dichromate solution to Container 5. A final rinse of the impingers and glassware was conducted with 0.1 N HNO_3 and added to Container 5. The liquid level was marked after the container was sealed.

Container 6 - The contents of the eighth impinger were weighed to the nearest gram and discarded.

Containers 7, 8, 9 & 10 – 50 mL each of 0.1 N HNO_3, 1 N KCl, 5% HNO_3/10% H_2O_2 and $H_2SO_4/KMnO_4$ were taken for blank analysis.

Container 11 - 100 mL of hydroxylamine solution was taken for blank analysis.

2.2.15.4 Analytical Procedures

The samples were transported to the laboratory and analyzed for Hg by cold-vapor atomic absorption (CVAAS) in accordance with ASTM Method D6784-02.

2.2.16 Hydrogen Cyanide (OTM-29, Revised March 2011)

Sampling was conducted in accordance with USEPA OTM-29 using an Apex Instruments, Inc. sampling console, glassware and impinger train. The back half impinger catch was analyzed in accordance with OTM-29 procedures for HCN by ion chromatography (IC).

2.2.16.1 Sampling Apparatus

Nozzle – Borosilicate glass with sharp, tapered leading edge.

Probe - Borosilicate glass with a heating system capable of maintaining a probe exit temperature of 248°F ± 25°F.

Pitot Tube - Type-S, or equivalent, attached to probe for monitoring stack gas velocity.

Filter Holder - Borosilicate glass with a Teflon filter support and a silicone rubber O-ring. The holder design provided a positive seal against leakage from the outside or around the filter. The filter holder was heated to 248°F ± 25°F during sampling.

Filter Media – 4-in. quartz fiber filter.

Draft Gauge - Inclined manometer with a readability of 0.01 in. H_2O in the 0- to 10-in. range.

Impingers – Five (5) impingers connected in series with glass ball joints. The first four impingers were of the Greenburg-Smith design with a standard tip. The fifth impinger was of the Greenburg-Smith design, but modified by replacing the standard tip with a ½-in.-i.d. glass tube extending to within ½ in. of the bottom of the impinger flask.

Metering System - Apex Model 522. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with ±2 percent accuracy, and related equipment as required to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within ±0.1 in. Hg.

2.2.16.2 Sampling Procedures

The stack pressure, temperature, moisture, and range of velocity head were measured according to procedures described in USEPA Methods 1 through 4. The first four impingers initially contained 100 mL of 6.0 N sodium hydroxide (NaOH). The fifth impinger contained 200 g of silica gel. The train was set up with the probe and filter holder as shown in Figure 2-11.

SECTION TWO Testing and Analytical Procedures

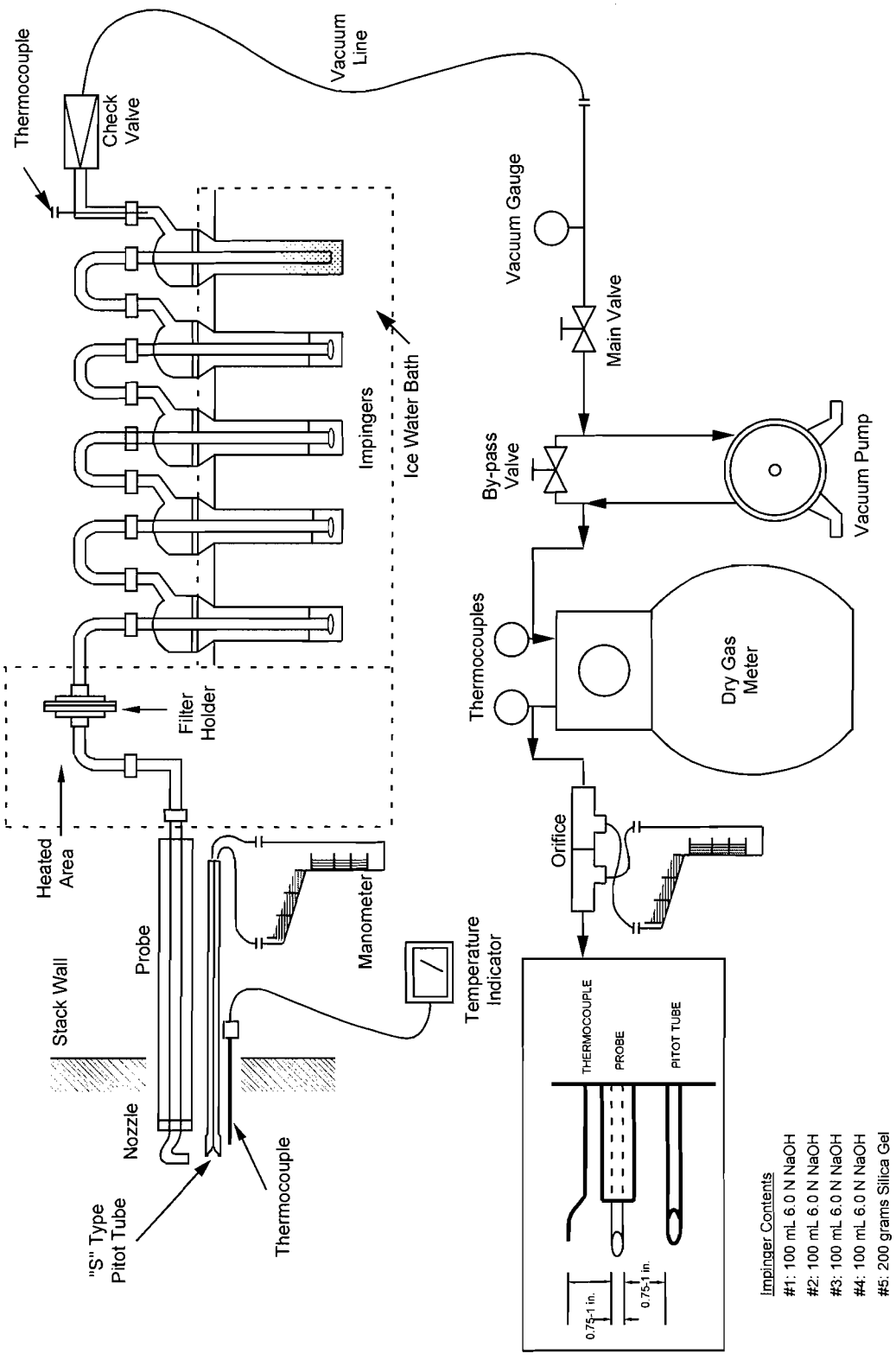


FIGURE 2-11. USEPA OTM-29 HYDROGEN CYANIDE SAMPLING TRAIN

The sampling train was leak-checked at the sampling site by plugging the inlet to the nozzle and pulling a vacuum of 15 in. Hg. Leak rates of less than 0.02 ft^3/min at a vacuum of 15 in. Hg were recorded in all cases. At the completion of each test run, the sampling train was again leak-checked by the same procedure, but at the highest vacuum attained during the test run.

Stack CO_2 was continuously recorded using procedures of USEPA Method 3A. In conjunction, a bag sample of the dry gas meter effluent was collected to determine the CO_2 content of the sample gas after being subjected to the impinger absorbents. The difference between the stack gas and final sample CO_2 concentrations were used to adjust the final sample volume.

Both pre- and post-test leak checks of the pitot tube were made for each test run. Ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at less than 68°F.

During sampling, stack gas impinger pH indicator and sampling train data were recorded at specified intervals. The pH in the impingers needs to be ≥12 and was monitored at 15-minute intervals. Isokinetic sampling rates were based on the maximum volume capable of being pulled through the meter at approximately 100 percent of moisture and a vacuum of 15 inches of mercury.

2.2.16.3 Sample Recovery Procedures

After sampling was completed, the sampling train was then moved carefully from the test site to the recovery area. The sample fractions were recovered as follows:

Container 1 – The pH was recorded for the first three impingers and the contents of impingers 1 through 3 were measured gravimetrically and placed in a glass bottle, sealed and labeled. A rinse of 0.1 N NaOH was performed on each of the first three impingers and placed in the same container.

Container 2 – After recording the pH and weighing, the contents of the fourth impinger were placed in a glass bottle along with the 0.1 N NaOH rinses. The contents of impinger 5 were weighed and then discarded.

Container 3 – 100 mL of 6.0 N NaOH was collected for blank analysis.

2.2.16.4 Analytical Procedures

The samples were analyzed by IC in accordance with USEPA OTM-29.

2.2.17 Speciated Semi-Volatile Organic HAP (SW-846 Method 0010)

Sampling in accordance with SW-846 Method 0010 was conducted for the following target analytes:

Acenaphthene	2-Chloronapthalele	Fluorene
Acenaphthylene	Chrysene	Indeno(1,2,3-cd)pyrene
Aniline	Dibenz[a,h]anthracene	Isophorone
Anthracene	Dibenzofuran	3-Methylcholanthrene
Benzidine	Dibenzo(a,e)pyrene	2-Methylnaphthalene
Benz[a]anthracene	3,3-Dimethoxybenzidine	Naphthalene
Benzo[b]fluoranthene	Dimethylaminobenzene	Perylene
Benzo[k]fluoranthene	7,12-Dimethylbenz(a)anthracene	Phenanthrene
Benzo[g,h,i]perylene	3,3-Dimethylbenzidine	Phenol
Benzo[a]pyrene	α, α -Dimethylphenethylamine	1,4-Phenylenediamine
Benzo[e]pyrene	2,4-Dimethylphenol	Pyrene
Biphenyl	Fluoranthene	o-Toluidine

The samples were withdrawn isokinetically from the stack location through a heated particulate filter followed by a condenser, a XAD-2 resin sorbent trap and a series of chilled impingers.

2.2.17.1 Sampling Apparatus

The sampling train was an Apex Instruments Modified Method 5 sampling train (see Figure 2-12). The major components are described below:

Nozzle - Borosilicate glass with sharp tapered leading edge.

Probe – Stainless steel with borosilicate glass liner and attached pitot tube and stack temperature thermocouple.

Apex Sample Box - Borosilicate glass filter holder, quartz fiber filter, a water jacketed sample chiller, a sorbent trap containing XAD-2 resin, five Greenburg-Smith impingers and the connecting glassware.

Apex Control Module – (per USEPA Method 5 specifications) pump, heat controllers and inclined-vertical oil gauge manometer.

The sample adsorbent traps and filters were cleaned and prepared by the laboratory following SW-846 Method 0010 procedures. ARI cleaned all sampling train glassware to pesticide analytical requirements using procedures outlined in Section 3A of the "Manual of Analytical Methods for the Analysis of Pesticide in Human and Environmental Samples".

The sample train was assembled as follows:

1. A glass nozzle was selected and attached to the probe.

2. A pre-weighed, pre-cleaned quartz fiber filter was placed in the filter holder and its number recorded on the data sheets.

3. The water jacket sample condenser and sorbent trap containing 50 grams of XAD-2 resin were placed in series after the filter holder.

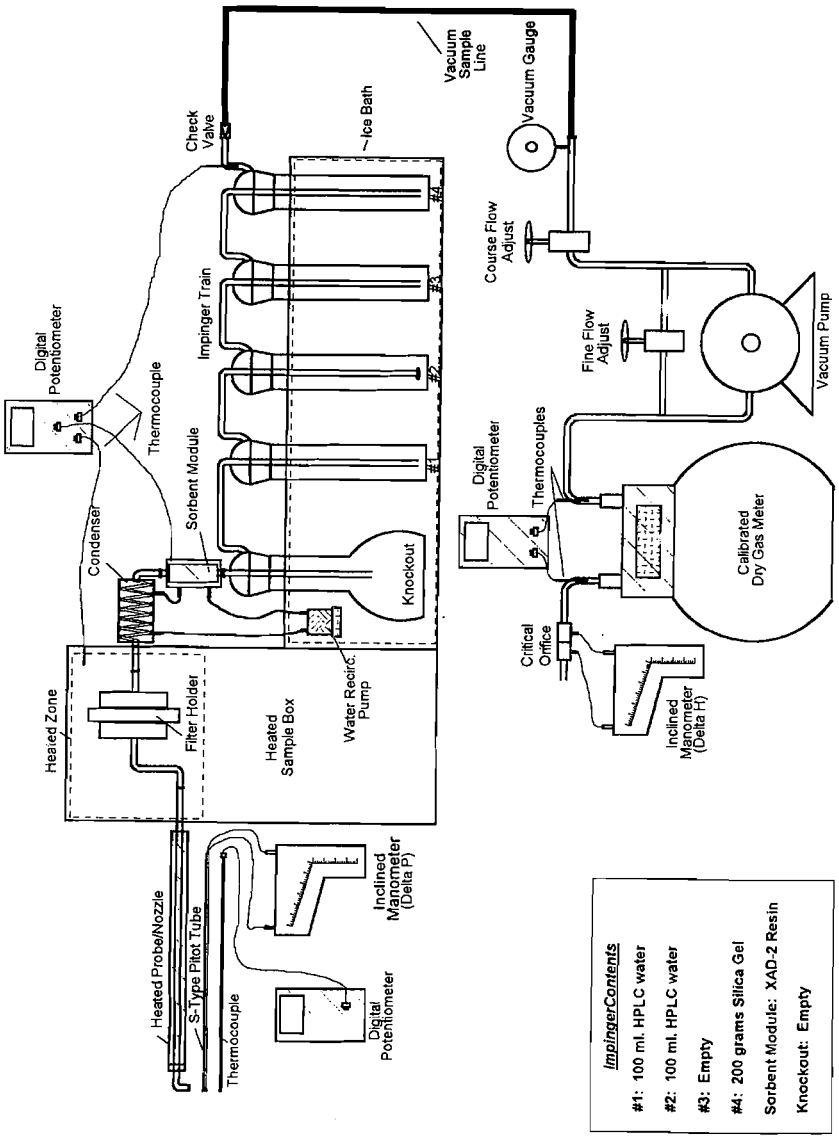


FIGURE 2-12. SW-846 METHOD 0010 SAMPLING TRAIN

4. The back half of the train consisted of five impingers. The first impinger was assembled empty. The second and third impingers contained 100 mL of HPLC grade water. The fourth impinger was assembled empty. The fifth impinger contained 200 grams of silica gel.

5. The sampling train was assembled on-site in ARI's monitoring trailer.

2.2.17.2 Sampling Procedures

The sampling train was leak checked prior to sampling using the following procedures:

1. The pump was started.

2. The course flow adjustment valve was opened.

3. Flow through the dry gas meter was checked.

4. The probe inlet was plugged.

5. The fine flow adjustment valve was adjusted so that the vacuum gauge read 15 in. Hg.

6. If the flow exceeded .02 ACFM, the pump was shut off and all connections were rechecked for tightness and the leak test procedure was repeated until acceptable results were obtained.

The pitot tube assembly was leak checked using the following procedures:

1. A positive (or negative) pressure of greater than 3 inches of water was created in the pitot line to be checked.

2. The line was plugged to hold the pressure, and the manometer was monitored to watch for any change in the reading.

3. If the reading changed, the system was rechecked for leaks and the leak check procedure was repeated until no leaks were present.

Crushed ice was added to the impinger compartment and the sample case was moved into position outside the first port to be sampled. When the filter holder assembly was properly heated, the nozzle was uncapped and the probe introduced into the stack to the first sampling point. The dry gas meter reading was recorded and sampling started. At each point, a pitot reading was made and the sampling rate adjusted using calculations based on preliminary temperature, pressure and estimated moisture. The sorbent trap was maintained below 68°F to insure XAD collection efficiency during testing. When sampling at the last point in the port was complete, the pump was turned off and the probe was carefully removed from that port.

A final leak test was performed on the sampling train, as previously described. The umbilical cord was disconnected, and the sample case and probe were then disassembled.

2.2.17.3 Sample Recovery Procedures

Upon completion of each test run and final leak check, the following sampling train clean-up procedure was performed:

Container 1 - The filter was removed from its holder and was placed and sealed in a glass Petri dish.

Container 2 - All loose particulate matter and rinse washings from all sample-exposed surfaces preceding the filter paper were placed in this container and sealed. The probe, nozzle and connecting heated Teflon line were scrubbed with a stiff Teflon brush and rinsed with a 1 to 1 (1:1) mixture of methanol and methylene chloride. The final level of liquid was marked on the bottle.

Container 3 - The contents of impingers 1, 2, 3 and 4 were measured for volume and then placed in Container 3. The total volume was measured to the closest ±1 mL and the liquid level was marked on the outside of the bottle.

Container 4 - The silica gel from impinger 5 was placed in Container 4.

Containers 5 & 6 - The sorbent traps were sealed with Teflon tape and glass end caps. The traps were refrigerated in ARI's monitoring trailer.

Blanks - During testing, a methanol/methylene chloride blank, DI water blank, XAD-2 resin blank and glass fiber filter blank were collected and placed into respective glass bottles with Teflon lined lids for analysis.

2.2.17.4 Analytical Procedures

After all chain of custody forms were completed, the samples were shipped to the laboratory for analysis in accordance with SW-846 Method 0010 and 8270C or D. The samples were stored in ice chests containing cold packs.

2.2.18 Aldehydes (SW-846 Method 0011)

Sampling for aldehydes (formaldehyde, acetaldehyde, propanal) was conducted in accordance with SW-846 Method 0011 using an Apex Instruments, Inc. sampling train as shown in Figure 2-13. The impinger catch was analyzed for aldehydes in accordance with SW-846 Method 8315A procedures.

2.2.18.1 Sampling Apparatus

The aldehydes sampling train met design specifications established by the USEPA. Assembled by ARI personnel, it consisted of the following:

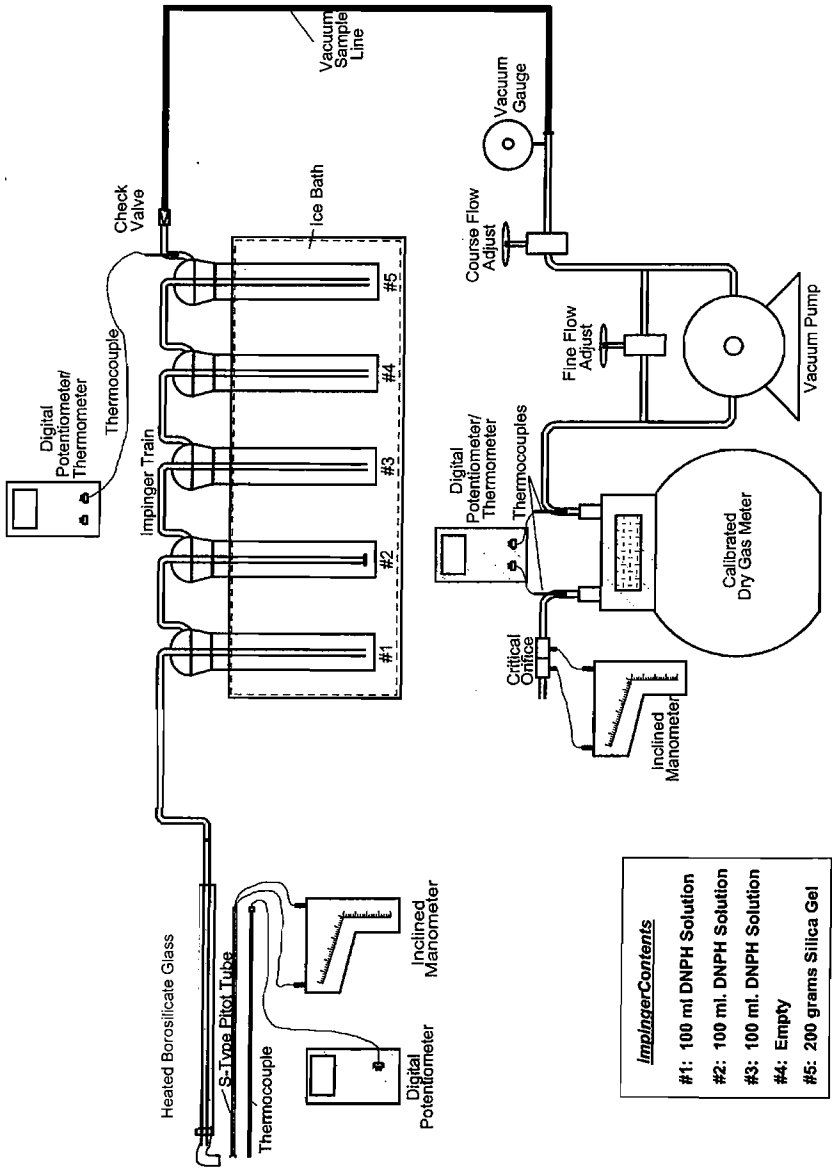


FIGURE 2-13. SW-846 METHOD 0011 SAMPLING TRAIN

Nozzle – Borosilicate glass with sharp, tapered, leading edge and accurately measured round opening.

Probe – Borosilicate glass with a heating system capable of maintaining a gas temperature of 248°F ± 25°F at the exit end during sampling.

Pitot Tube - A Type-S pitot tube that met all geometric standards; attached to the probe to monitor stack gas velocity.

Draft Gauge - A dual-inclined oil gauge manometer made by Dwyer with a readability of 0.01 in. H_2O in the 0- to 1-in. range and 0.1 in. H_2O in the 1- to 10-in. range.

Impingers - Five impingers connected in series with O-ring ball joints. The first, third, fourth and fifth impingers were of the Greenburg-Smith design, modified by replacing the tip with a 1/2-in.-i.d. glass tube extending to 1/2-in. from the bottom of the flask. The first three impingers contained a 2,4-dinitrophenylhydrazine (DNPH) solution.

Filter Holder - Borosilicate glass with a quartz fiber, 4-in. diameter, placed between the second and third impinger.

Metering System - Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with 2 percent accuracy, and related equipment to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Aneroid type to measure atmospheric pressure to ±0.1 in. Hg.

2.2.18.2 Sampling Procedures

Approximately 200 grams of silica gel were weighed and placed in a sealed impinger prior to each test run. 200 mL of DNPH was placed in the first impinger; the second and third impingers each contained 100 mL DNPH; the fourth impinger was empty, and the fifth impinger contained silica gel. The sampling train was leak-checked at the sampling site prior to each test run by plugging the inlet to the nozzle and pulling a 15-in. Hg vacuum; and at the conclusion of the test run, by plugging the inlet to the nozzle and pulling a vacuum equal to the highest vacuum reached during the test run.

The pitot tube and lines were leak-checked at the test site prior to and at the conclusion of each test run. The check was made by blowing into the impact opening of the pitot tube until 3 or more inches of water was recorded on the manometer and then capping the impact opening and holding it for 15 seconds to assure it was leak-free. The static pressure side of the pitot tube was leak-checked by the same procedure, except suction was used to obtain the 3-in. H_2O manometer reading. Crushed ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at 68°F or less.

During sampling, stack gas and sampling train data were recorded at each sampling point and whenever significant changes occurred in stack flow conditions. Isokinetic sampling rates were based on the maximum volume capable of being pulled through the meter at approximately 98-100 percent of moisture and a vacuum of 15 inches of mercury.

2.2.18.3 Sample Recovery Procedures

The sampling train was moved carefully from the test site to the cleanup area. The volume of DNPH from the first three impingers was measured, and sample fractions were recovered as follows:

Container 1 - Methylene chloride washings from all sample-exposed surfaces prior to the impinger train were placed in an amber glass container. Particulate was removed from the probe with the aid of a Teflon brush. The DNPH in the first three impinger sections of the sampling train was measured volumetrically and placed in the amber glass container. The impingers and connecting glassware were rinsed with methylene chloride and this rinse was added to the container for shipment to the laboratory. A final rinse of the impinger section was conducted using distilled H_2O and methylene chloride

Container 2 – Sample blank equal in volume to the sample runs.

Container 3 – The silica gel from the fifth impinger was weighed, and this value was recorded on the Sample Recovery and Integrity Sheet along with other pertinent data. The color of the indicating silica gel was observed to determine if there had been moisture breakthrough. The silica gel was weighed to the nearest 0.5 g.

2.2.18.4 Analytical Procedures

The analytical procedures followed those described in SW-846 Method 8315A.

SECTION THREE Process Description

Houston Refining operates the 736 Coker Unit at their Houston, Texas facility. Within the 736 Coker Unit are four coke drums which vent to atmosphere following operational process cycles of seven to eight hours. The venting process occurs after the drum has depressurized to approximately five psi and continues for a period of twenty-five to forty-five minutes until the drum is depressurized. Sampling was performed on the four coke drum vents through the two vent headers in the 736 Coker.

SECTION FOUR Test Results

The test results are presented in Table 4-1 through 4-15.

The calculation summaries, field data, analytical data, ARI reference method monitoring data, calibration data and test program qualifications are included in the appendices as detailed in the Table of Contents.

DISCUSSION

Volatile Organic HAPs

Data presented for the volatile organic HAPs (see Tables 4-3 and 4-5) should be qualified with the following observances:

Concentrations of acetone, methylene chloride and methanol appear as artifacts of cross-method contamination. Elevated levels of these compounds were found in the associated blanks, both field and reagent, and may not be considered characteristic of the Coker atmospheric emissions.

The laboratory reported inconsistencies with the recovery of nitrobenzene-d5 and subsequent quantification of native nitrobenzene. The purge and trap analysis suffered from run to run carry-over and there was no clear evidence of nitrobenzene in the samples. The detection limits for nitrobenzene were raised because of the uncertainty of low level data. Nitrobenzene data is also available from the SVOC data presented in Appendix C.

Due to the extremely elevated levels of reported concentrations and detection limits during the second run; the data is not considered representative of the coker emissions and is presented, but not included in the averaged results.

Semi-Volatile HAPs

The test results are based upon analytical data from the analysis of diluted sample extracts due to levels and interferences with dilutions of at least 1,000. The high dilutions resulted in the extraction standards potentially being well below quantifiable limits. As a result, field sampling and extraction standard recoveries could not be quantified. Additional extraction (internal) standard was added for quantification. As a result, laboratory values were not recovery corrected.

Methane

The methane concentration as measured during Run No. 3 on August 2, 2011, appears to be high in relation to the total hydrocarbon (THC) as measured during the same period. As a result, the three run average methane concentration and emission rate values are higher than the THC values. The problems encountered resulting in the variability between the test methods is due to the issues with the high concentrations of moisture and resultant low dry sample volumes.

SECTION FOUR Test Results

Aldehydes

The analytical results for the USEPA Method 0011 train indicated a rather high level of formaldehyde measured in the blank train. No immediate explanation can be given for this result. Since the measured concentrations and emission rates of formaldehyde from the Coker Unit were not corrected for the blank train contamination value, the reported formaldehyde emissions to atmosphere may be biased high.

Isokinetic Sampling Rates

It should be noted that at saturated gas stream moisture levels (97-99% by volume), maintaining isokinetic sampling rates between 90 and 110% for those parameters requiring isokinetic sampling, was virtually impossible. The extremely high volume of condensable water vapor, low dry gas flow rates through the metering system dry gas meter, the continuously variable exhaust gas flow rate from the Coker Unit during the venting cycle, and the short venting time periods were the primary causes for the difficulty in maintaining acceptable isokinetic sampling rates

During periods of the vent cycles when the temperature of the vent gas dropped below 210° F the moisture concentrations dropped accordingly with the saturation level, resulting in a low bias of the moisture concentrations and a high bias of the pollutant concentrations. At the typical vent temperature of 212 degrees when the vent stream is primarily steam (97 – 99+ % moisture), brief periods of lower temperature result in a significant drop in saturation content (during the vent cycles that this occurred the resultant average saturation content of the gas stream (approximately 78% saturation content at 200° F) resulted in a significant bias low of the moisture content and a corresponding high bias of the pollutant concentrations. Although the data from all runs are included in the averages, these runs should be considered as outliers due to the moisture bias.

While these issues are believed to be the result of errors in moisture correction for the extremely high moisture (approaching 100%) sample conditions, the data is reported as analyzed but should be interpreted with care.

SECTION FOUR Test Results

TABLE 4-1. DCU 736 SVOC CONCENTRATION TEST RESULTS SUMMARY

TEST RUN	:	0010-1	0010-2	0010-3	
TEST DATE	:	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	:	14:42 - 15:10	12:20 - 12:29	10:26 - 11:16	Average
CYCLE TIME (HRS)	:	0.467	0.150	0.833	
SVOC Sample Parameters					
Time, min		28	9	50	
Volume, dscm		0.018	0.036	0.069	
Volume, dscf		0.636	1.263	2.429	
Isokinetic rate, %		544.0	387.1	413.4	
Concentration - µg/dscm					
Acenaphthene		10,719	<461.4	10,425	<7,202
Acenaphthylene		<855.3	<111.9	<761.9	<576.3
Aniline		1927	<234.9	543.8	<901.9
Anthracene		46,152	2,964	33,440	27,519
Benzidine		<21,104	<1,063	<5,525	<9,231
Benzo[a]anthracene		3,832	<1,558	3,257	<2,882
Benzo[b]fluoranthene		<222.2	282.5	193.4	<232.7
Benzo[k]fluoranthene		<222.2	<111.9	<110.8	<148.3
Benzo[g,h,i]perylene		<222.2	469.8	280.6	<324.2
Benzo[a]pyrene		391.0	688.0	526.3	535.1
Benzo[e]pyrene		384.3	590.1	331.5	435.3
Biphenyl		15,051	668.4	14,190	9,970
2-Chloronapthalene		<222.2	<111.9	<58.16	<130.7
Chrysene		4,932	1,907	3,737	3,525
Dibenz[a,h]anthracene		<222.2	170.0	125.9	<172.7
Dibenzofuran		7,942	385.9	3,649	3,992
Dibenzo(a,e)pyrene		<222.2	<111.9	<58.16	<130.7
3,3'-Dimethoxybenzidine		<16,106	1,331	<4,216	<7,218
Dimethylaminobenzene		<1,111	<55.93	<290.8	<485.8
7,12-Dimethylbenz(a)anthracene		<222.2	<111.9	<58.16	<130.7
3,3'-Dimethylbenzidine		<16,106	<811.0	<4,216	<7,044
a,a-Dimethylphenethylamine		<6,665	<335.6	<1,745	<2,915
2,4-Dimethylphenol		9,053	757.9	2,908	4,239
Fluoranthene		11,941	1,152	4,900	5,998
Fluorene		37,044	1,560	32,568	23,724
Indeno(1,2,3-cd)pyrene		<222.2	127.0	93.92	<147.7
Isophorone		<1,250	<62.92	<327.1	<546.6
3-Methylcholanthrene		222.2	111.9	58.16	130.7
2-Methylnaphthalene		447,081	21,394	495,788	321,421
2-Methylphenol		3,654	514.6	1,074	1,748
3-Methylphenol & 4-Methylphenol		4,643	542.5	<1,062.8	<2,082.8
Naphthalene		238,258	13,284	177,379	142,973
Perylene		<222.2	<111.9	<58.16	<130.7
Phenanthrene		153,840	8,753	97,704	86,766
Phenol		<1,144	<489.4	<322.8	<652.1
1,4-Phenylenediamine		<9,997	<503.4	<2,617	<4,372
Pyrene		57,204	6,208	21,082	28,165
o-Toluidine		<2,777	<139.8	<442.0	<1,120

SECTION FOUR Test Results

TABLE 4-2. DCU 736 SVOC EMISSION RATE TEST RESULTS SUMMARY (LBS/HR)

TEST RUN	0010-1	0010-2	0010-3	
TEST DATE	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	14:42 - 15:10	12:20 - 12:29	10:26 - 11:16	Average
CYCLE TIME (HRS)	0.467	0.150	0.833	
Stack Gas Parameters				
Temperature, av. °F	213.0	213.0	212.4	212.8
Velocity, av. ft/sec	58.010	75.943	74.146	69.366
Volume flow, acfm	1,215	1,591	1,553	1,453
Volume flow, scfm	960	1,257	1,225	1,147
Volume flow, dscfm	8	66	21	32
Volume flow, scfh	57,578	75,421	73,524	68,841
Volume flow, dscfh	454	3,940	1,277	1,890
Moisture, av. % vol	99.21	94.78	98.26	97.42
CO_2, av. % vol, db	0.00	0.00	0.50	0.17
O_2, av. % vol, db	20.50	21.00	18.00	19.83
SVOC Sample Parameters				
Time, min	28	9	50	
Volume, dscm	0.018	0.036	0.069	
Volume, dscf	0.636	1.263	2.429	
Isokinetic rate, %	544.0	387.1	413.4	
Emission Rate - lb/hr x 10^{-3}				
Acenaphthene	0.3037	<0.1135	0.8314	<0.4162
Acenaphthylene	<0.0242	<0.0275	<0.0608	<0.0375
Aniline	0.0546	<0.0578	0.0434	<0.0519
Anthracene	1.3076	0.7292	2.6669	1.5679
Benzidine	<0.5980	<0.2614	<0.4406	<0.4333
Benzo[a]anthracene	0.1086	<0.3832	0.2597	<0.2505
Benzo[b]fluoranthene	<0.0063	0.0695	0.0154	<0.0304
Benzo[k]fluoranthene	<0.0063	<0.0275	<0.0088	<0.0142
Benzo[g,h,i]perylene	<0.0063	0.1156	0.0224	<0.0481
Benzo[a]pyrene	0.0111	0.1692	0.0420	0.0741
Benzo[e]pyrene	0.0109	0.1451	0.0264	0.0608
Biphenyl	0.4264	0.1644	1.1317	0.5742
2-Chloronapthalene	<0.0063	<0.0275	<0.0046	<0.0128
Chrysene	0.1397	0.4691	0.2980	0.3023
Dibenz[a,h]anthracene	<0.0063	0.0418	0.0100	<0.0194
Dibenzofuran	0.2250	0.0949	0.2910	0.2037
Dibenzo(a,e)pyrene	<0.0063	<0.0275	<0.0046	<0.0128
3,3'-Dimethoxybenzidine	0.4563	0.3274	<0.3363	<0.3733
Dimethylaminobenzene	<0.0315	<0.0138	<0.0232	<0.0228
7,12-Dimethylbenz(a)anthracene	<0.0063	<0.0275	<0.0046	<0.0128
3,3'-Dimethylbenzidine	<0.4563	<0.1995	<0.3363	<0.3307
a,a-Dimethylphenethylamine	<0.1888	<0.0825	<0.1391	<0.1368
2,4-Dimethylphenol	0.2565	0.1864	0.2319	0.2249
Fluoranthene	0.3383	0.2834	0.3908	0.3375
Fluorene	1.0496	0.3838	2.5973	1.3436
Indeno(1,2,3-cd)pyrene	<0.0063	0.0312	0.0075	<0.0150
Isophorone	<0.0354	<0.0155	<0.0261	<0.0257
3-Methylcholanthrene	0.0063	0.0275	0.0046	0.0128
2-Methylnaphthalene	12.6671	5.2623	39.5391	19.1562
2-Methylphenol	0.1035	0.1266	0.0857	0.1053
3-Methylphenol & 4-Methylphenol	0.1315	0.1334	<0.0848	<0.1166

TABLE 4-2 (CONTINUED). DCU 736 SVOC EMISSION RATE TEST RESULTS SUMMARY (LBS/HR)

TEST RUN	:	0010-1	0010-2	0010-3	
TEST DATE	:	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	:	14:42 - 15:10	12:20 - 12:29	10:26 - 11:16	Average
CYCLE TIME (HRS)	:	0.467	0.150	0.833	
Naphthalene		6.7505	3.2674	14.1460	8.0547
Perylene		<0.0063	<0.0275	<0.0046	<0.0128
Phenanthrene		4.3587	2.1531	7.7919	4.7679
Phenol		<0.0324	<0.1204	<0.0257	<0.0595
1,4-Phenylenediamine		<0.2832	<0.1238	<0.2087	<0.2053
Pyrene		1.6208	1.5271	1.6813	1.6097
o-Toluidine		<0.0787	<0.0344	<0.0352	<0.0494

TABLE 4-3. DCU 736 SVOC EMISSION RATE TEST RESULTS SUMMARY (LBS/CYCLE)

TEST RUN	0010-1	0010-2	0010-3	
TEST DATE	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	14:42 - 15:10	12:20 - 12:29	10:26 - 11:16	Average
CYCLE TIME (HRS)	0.467	0.150	0.833	
Stack Gas Parameters				
Temperature, av. °F	213.0	213.0	212.4	212.8
Velocity, av. ft/sec	58.010	75.943	74.146	69.366
Volume flow, acfm	1,215	1,591	1,553	1,453
Volume flow, scfm	960	1,257	1,225	1,147
Volume flow, dscfm	8	66	21	32
Volume flow, scfh	57,578	75,421	73,524	68,841
Volume flow, dscfh	454	3,940	1,277	1,890
Moisture, av. % vol	99.21	94.78	98.26	97.42
CO_2, av. % vol, db	0.00	0.00	0.50	0.17
O_2, av. % vol, db	20.50	21.00	18.00	19.83
SVOC Sample Parameters				
Time, min	28	9	50	
Volume, dscm	0.018	0.036	0.069	
Volume, dscf	0.636	1.263	2.429	
Isokinetic rate, %	544.0	387.1	413.4	
Emission Rate - lb/cycle x 10^{-3}				
Acenaphthene	0.1417	<0.0170	0.6928	<0.2839
Acenaphthylene	<0.0113	<0.0041	<0.0506	<0.0220
Aniline	0.0255	<0.0087	0.0361	<0.0234
Anthracene	0.6102	0.1094	2.2224	0.9807
Benzidine	<0.2790	<0.0392	<0.3672	<0.2285
Benzo[a]anthracene	0.0507	<0.0575	0.2164	<0.1082
Benzo[b]fluoranthene	<0.0029	0.0104	0.0129	<0.0087
Benzo[k]fluoranthene	<0.0029	<0.0041	<0.0074	<0.0048
Benzo[g,h,i]perylene	<0.0029	0.0173	0.0186	<0.0130
Benzo[a]pyrene	0.0052	0.0254	0.0350	0.0218
Benzo[e]pyrene	0.0051	0.0218	0.0220	0.0163
Biphenyl	0.1990	0.0247	0.9431	0.3889
2-Chloronapthalene	<0.0029	<0.0041	<0.0039	<0.0036
Chrysene	0.0652	0.0704	0.2483	0.1280
Dibenz[a,h]anthracene	<0.0029	0.0063	0.0084	<0.0059
Dibenzofuran	0.1050	0.0142	0.2425	0.1206
Dibenzo(a,e)pyrene	<0.0029	<0.0041	<0.0039	<0.0036
3,3'-Dimethoxybenzidine	0.2130	0.0491	<0.2802	<0.1808
Dimethylaminobenzene	<0.0147	<0.0021	<0.0193	<0.0120
7,12-Dimethylbenz(a)anthracene	<0.0029	<0.0041	<0.0039	<0.0036
3,3'-Dimethylbenzidine	<0.2130	<0.0299	<0.2802	<0.1744
a,a-Dimethylphenethylamine	<0.0881	<0.0124	<0.1160	<0.0722
2,4-Dimethylphenol	0.1197	0.0280	0.1933	0.1136
Fluoranthene	0.1579	0.0425	0.3256	0.1753
Fluorene	0.4898	0.0576	2.1644	0.9039
Indeno(1,2,3-cd)pyrene	<0.0029	0.0047	0.0062	<0.0046
Isophorone	<0.0165	<0.0023	<0.0217	<0.0135
3-Methylcholanthrene	0.0029	0.0041	0.0039	0.0036
2-Methylnaphthalene	5.9113	0.7893	32.9493	13.2167
2-Methylphenol	0.0483	0.0190	0.0714	0.0462
3-Methylphenol & 4-Methylphenol	0.0614	0.0200	<0.0706	<0.0507

TABLE 4-3 (CONTINUED). DCU 736 SVOC EMISSION RATE TEST RESULTS SUMMARY (LBS/CYCLE)

TEST RUN	:	0010-1	0010-2	0010-3	
TEST DATE	:	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	:	14:42 - 15:10	12:20 - 12:29	10:26 - 11:16	Average
CYCLE TIME (HRS)	:	0.467	0.150	0.833	
Naphthalene		3.1503	0.4901	11.7883	5.1429
Perylene		<0.0029	<0.0041	<0.0039	<0.0036
Phenanthrene		2.0341	0.3230	6.4932	2.9501
Phenol		<0.0151	<0.0181	<0.0215	<0.0182
1,4-Phenylenediamine		<0.1322	<0.0186	<0.1739	<0.1082
Pyrene		0.7564	0.2291	1.4011	0.7955
o-Toluidine		<0.0367	<0.0052	<0.0294	<0.0237

TABLE 4-4. 736 COKER UNIT VOLATILE ORGANIC HAP TEST RESULTS SUMMARY (LBS/HR)

TEST RUN	:	18-1	18-2*	18-3	
TEST DATE	:	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	:	14:42 - 15:08	12:20 - 12:29	10:26 -11:26	Average
CYCLE TIME	:	0.433	0.150	1.00	
Stack Gas Parameters					
Temperature, av. °F		213.0	213.0	212.4	212.8
Velocity, av. ft/sec		58.01	75.94	74.15	69.37
Volume flow, acfm		1,215	1,591	1,553	1,453
Volume flow, scfm		960	1,257	1,225	1,147
Volume flow, dscfm		8	66	21	32
Volume flow, scfh		57,578	75,421	73,524	68,841
Volume flow, dscfh		454	3,940	1,277	1,890
Moisture, av. % vol		99.21	94.78	98.26	97.42
CO_2, av. % vol, db		0.00	0.00	0.50	0.17
O_2, av. % vol, db		20.50	21.00	18.00	19.83

Run Numbers	18-1		18-2		18-3		Average	
Compound	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)
Acetone	**124,480**	**0.00353**	**22,815,882**	**5.61247**	**798,062**	**0.06363**	**461,271**	**0.03358**
Acetonitrile	< 10,712	< 0.00030	**39,574,932**	**9.73501**	< 13,306	< 0.00106	< 12009	< 0.00068
Acrolein	< 2,756	< 0.00008	< 48,062,770	< 11.82293	< 1,510	< 0.00012	< 2133	< 0.00010
Acrylonitrile	< 1,675	< 0.00005	< 92,499	< 0.02275	< 3,897	< 0.00031	< 2786	< 0.00018
Benzene	< 30,954	< 0.00088	< 99,210	< 0.02440	**401,550**	**0.03201**	< 216252	< 0.01645
1,3-Butadiene	< 1,675	< 0.00005	< 92,499	< 0.02275	< 4,088	< 0.00033	< 2882	< 0.00019
Carbon disulfide	< 1,675	< 0.00005	< 92,499	< 0.02275	< 4,189	< 0.00033	< 2932	< 0.00019
Chlorobenzene	< 1,675	< 0.00005	< 92,499	< 0.02275	< 3,897	< 0.00031	< 2786	< 0.00018
Cumene	< 1,675	< 0.00005	< 92,499	< 0.02275	< 7,159	< 0.00057	< 4417	< 0.00031
1,2-Dibromoethane	< 1,675	< 0.00005	< 92,499	< 0.02275	< 3,897	< 0.00031	< 2786	< 0.00018
Ethylbenzene	< 5,768	< 0.00016	< 92,499	< 0.02275	**125,217**	**0.00998**	< 65493	< 0.00507
Hexane	< 2,150	< 0.00006	< 92,499	< 0.02275	< 12,015	< 0.00096	< 7083	< 0.00051
Methyl isobutyl ketone	< 2,756	< 0.00008	< 25,886,898	< 6.36790	< 1,503	< 0.00012	< 2129	< 0.00010
Methyl t-butyl ether	< 1,675	< 0.00005	< 92,499	< 0.02275	< 3,897	< 0.00031	< 2786	< 0.00018
Methylene chloride	**21,344**	**0.00060**	**1,198,695**	**0.29487**	**20,324**	**0.00162**	**20,834**	**0.00111**
Nitrobenzene	< 8,377	< 0.00024	< 462,496	< 0.11377	< 42,969	< 0.00343	< 25673	< 0.00183
2-Nitropropane	< 24,313	< 0.00069	< 131,568	< 0.03236	< 85,984	< 0.00686	< 55149	< 0.00377
Pentane	< 5,789	< 0.00016	< 127,273	< 0.03131	< 51,220	< 0.00408	< 28504	< 0.00212
Styrene	< 1,675	< 0.00005	< 92,499	< 0.02275	< 7,657	< 0.00061	< 4666	< 0.00033
Tetrachloroethene	< 1,675	< 0.00005	< 92,499	< 0.02275	< 3,897	< 0.00031	< 2786	< 0.00018
Toluene	< 142,680	< 0.00404	**9,163,180**	**2.25405**	**558,887**	**0.04456**	< 350784	< 0.02430
Trichloroethene	< 2,756	< 0.00008	< 67,107	< 6.00023	< 2,295	< 0.00013	< 2525	< 0.00010
2,2,4 Trimethyl pentane	< 1,675	< 0.00005	< 92,499	< 0.02275	< 4,293	< 0.00034	< 2984	< 0.00019
Xylenes (m+p)	< 59,004	< 0.00167	< 265,626	< 0.06534	**1,165,947**	**0.09296**	< 612475	< 0.04732
Xylenes (o)	< 10,904	< 0.00031	< 97,297	< 0.02393	**222,520**	**0.01774**	< 116712	< 0.00903

*Run 2 not included in averages

SECTION FOUR

Test Results

TABLE 4-5. 736 COKER UNIT VOLATILE ORGANIC HAP TEST RESULTS SUMMARY (LBS/CYCLE)

TEST RUN	:	18-1	18-2*	18-3	
TEST DATE	:	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	:	14:42 - 15:08	12:20 - 12:29	10:26 -11:26	Average
CYCLE TIME	:	0.433	0.150	1.00	
Stack Gas Parameters					
Temperature, av. °F		213.0	213.0	212.4	212.8
Velocity, av. ft/sec		58.01	75.94	74.15	69.37
Volume flow, acfm		1,215	1,591	1,553	1,453
Volume flow, scfm		960	1,257	1,225	1,147
Volume flow, dscfm		8	66	21	32
Volume flow, scfh		57,578	75,421	73,524	68,841
Volume flow, dscfh		454	3,940	1,277	1,890
Moisture, av. % vol		99.21	94.78	98.26	97.42
CO_2, av. % vol, db		0.00	0.00	0.50	0.17
O_2, av. % vol, db		20.50	21.00	18.00	19.83

Run Numbers	18-1		18-2		18-3		Average	
Compound	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)
Acetone	**124,480**	**0.001529**	**22,815,882**	**0.841870**	**798,062**	**0.063628**	**461,271**	**0.03358**
Acetonitrile	< 10,712	< 0.000132	**39,574,932**	**1.460252**	< 13,306	< 0.001061	< 12009	< 0.00068
Acrolein	< 2,756	< 0.000034	< 48,062,770	< 1.773440	< 1,510	< 0.000120	< 2133	< 0.00010
Acrylonitrile	< 1,675	< 0.000021	< 92,499	< 0.003413	< 3,897	< 0.000311	< 2786	< 0.00018
Benzene	< 30,954	< 0.000380	< 99,210	< 0.003661	**401,550**	**0.032015**	< 216252	< 0.01645
1,3-Butadiene	< 1,675	< 0.000021	< 92,499	< 0.003413	< 4,088	< 0.000326	< 2882	< 0.00019
Carbon disulfide	< 1,675	< 0.000021	< 92,499	< 0.003413	< 4,189	< 0.000334	< 2932	< 0.00019
Chlorobenzene	< 1,675	< 0.000021	< 92,499	< 0.003413	< 3,897	< 0.000311	< 2786	< 0.00018
Cumene	< 1,675	< 0.000021	< 92,499	< 0.003413	< 7,159	< 0.000571	< 4417	< 0.00031
1,2-Dibromoethane	< 1,675	< 0.000021	< 92,499	< 0.003413	< 3,897	< 0.000311	< 2786	< 0.00018
Ethylbenzene	< 5,768	< 0.000071	< 92,499	< 0.003413	**125,217**	**0.009983**	< 65493	< 0.00507
Hexane	< 2,150	< 0.000026	< 92,499	< 0.003413	< 12,015	< 0.000958	< 7083	< 0.00051
Methyl isobutyl ketone	< 2,756	< 0.000034	< 25,886,898	< 0.955185	< 1,503	< 0.000120	< 2129	< 0.00010
Methyl t-butyl ether	< 1,675	< 0.000021	< 92,499	< 0.003413	< 3,897	< 0.000311	< 2786	< 0.00018
Methylene chloride	**21,344**	**0.000262**	**1,198,695**	**0.044230**	**20,324**	**0.001620**	**20,834**	**0.00111**
Nitrobenzene	< 8,377	< 0.000103	< 462,496	< 0.017065	< 42,969	< 0.003426	< 25673	< 0.00183
2-Nitropropane	< 24,313	< 0.000299	< 131,568	< 0.004855	< 85,984	< 0.006855	< 55149	< 0.00377
Pentane	< 5,789	< 0.000071	< 127,273	< 0.004696	< 51,220	< 0.004084	< 28504	< 0.00212
Styrene	< 1,675	< 0.000021	< 92,499	< 0.003413	< 7,657	< 0.000610	< 4666	< 0.00033
Tetrachloroethene	< 1,675	< 0.000021	< 92,499	< 0.003413	< 3,897	< 0.000311	< 2786	< 0.00018
Toluene	< 142,680	< 0.001753	**9,163,180**	**0.338107**	**558,887**	**0.044559**	< 350784	< 0.02430
Trichloroethene	< 2,756	< 0.000034	< 67,107	< 0.900035	< 2,295	< 0.000129	< 2525	< 0.00010
2,2,4 Trimethyl pentane	< 1,675	< 0.000021	< 92,499	< 0.003413	< 4,293	< 0.000342	< 2984	< 0.00019
Xylenes (m+p)	< 59,004	< 0.000725	< 265,626	< 0.009801	**1,165,947**	**0.092959**	< 612475	< 0.04732
Xylenes (o)	< 10,904	< 0.000134	< 97,297	< 0.003590	**222,520**	**0.017741**	< 116712	< 0.00903

*Run 2 not included in averages

TABLE 4-6. 736 COKER UNIT ALDEHYDES TEST RESULTS SUMMARY

TEST RUN	:	0011-1	0011-2	0011-3	
TEST DATE	:	7/19/2011	7/20/2011	7/21/2011	
TEST TIME	:	14:42 - 15:10	12:20 - 12:29	10:26 - 11:16	Average
CYCLE TIME (HRS)	:	0.467	0.150	0.833	
Stack Gas Parameters					
Temperature, av. °F		213	213.0	212.4	212.8
Velocity, av. ft/sec		58.05	77.07	74.09	69.74
Volume flow, acfm		1,216	1,614	1,552	1,461
Volume flow, scfm		960	1,275	1,225	1,153
Volume flow, dscfm		5	4	24	11
Volume flow, scfh		57,619	76,496	73,474	69,196
Volume flow, dscfh		319	261	1,452	677
Moisture, av. % vol		99.45	99.66	98.02	99.04
CO_2, av. % vol, db		0.00	0.00	0.50	0.17
O_2, av. % vol, db		20.50	21.00	18.00	19.83
Aldehydes Sample					
Time, min		28.0	9.0	50.0	
Volume, dscf		0.527	0.098	2.995	
Volume, dscm		0.015	0.003	0.085	
Isokinetic Ratio, %		641.3	452.2	448.5	
Formaldehyde[a]					
Concentration					
lb/dscf x 10^{-6}		124.8181	377.8952	17.8783	173.5305
µg/dscm		1,999,151.0	6,052,561.8	286,348.0	2,779,353.6
Emission rate					
lb/hr		0.0398	0.0986	0.0260	0.0548
lb/cycle		0.0186	0.0148	0.0216	0.0183
Acetaldehyde					
Concentration					
lb/dscf x 10^{-6}		160.3945	180.0385	42.5720	127.6683
µg/dscm		2,568,959.6	2,883,589.1	681,854.9	2,044,801.2
Emission rate					
lb/hr		0.0512	0.0470	0.0618	0.0533
lb/cycle		0.0239	0.0070	0.0515	0.0275
Propanal					
Concentration					
lb/dscf x 10^{-6}		30.9065	20.5177	5.4535	18.9592
µg/dscm		495,013.8	328,621.4	87,346.0	303,660.4
Emission rate					
lb/hr		0.0099	0.0054	0.0079	0.0077
lb/cycle		0.0046	0.0008	0.0066	0.0040

[a]Formaldehyde concentrations and emission rates were not corrected for blank train formaldehyde results. Therefore, measured formaldehyde concentrations and emission rates from the 736 Coker to atmosphere may be biased high. Acetaldehyde and propanal levels in the blank train were significantly lower and, therefore, the stated concentrations and emission rates are deemed representative.

SECTION FOUR Test Results

TABLE 4-7. 736 COKER UNIT METHANOL TEST RESULTS SUMMARY

TEST RUN	308-1	308-2	308-3	
TEST DATE	7/21/2011	7/21/2011	7/27/2011	
TEST TIME	10:26 – 11:16	18:15 - 19:34	13:37 - 14:45	Average
CYCLE TIME (HRS)	0.833	1.317	1.133	
Stack Gas Parameters				
Temperature, av. °F	212.4	212.4	212	212.3
Velocity, av. ft/sec	73.880	91.306	106.027	90.405
Volume flow, acfm	1,547	1,912	2,221	1,893
Volume flow, scfm	1,221	1,509	1,765	1,498
Volume flow, dscfm	36	18	32	28
Volume flow, scfh	73,260	90,540	105,875	89,892
Volume flow, dscfh	2,158	1,075	1,891	1,708
Moisture, av. % vol	98.81	98.81	98.21	98.61
CO_2, av. % vol, db	0.00	0.50	0.50	0.33
O_2, av. % vol, db	20.50	19.50	18.50	19.50
Spiked Train Parameters				
Time, min	25	65	68	
Volume, std liters	14.911	18.877	25.057	
Volume, dscf	0.527	0.667	0.885	
Unspiked Train Parameters				
Time, min	25	65	68	
Volume, std liters	7.087	13.084	40.063	
Volume, dscf	0.250	0.462	1.415	
Methanol Data				
Spike Recovered (R), percent	-525.419	-109.900	20.026	
Concentration				
ppbv db	-1,124[a]	-1,677[a]	94	94
mg/dscm	-1,497[a]	-2,234[a]	125	125
lb/dscf x 10^{-6}	-0.09349[a]	-0.13946[a]	0.00778	0.00778
Emission Rate				
lb/hr	-0.00020[a]	-0.00015[a]	0.000015	0.000015
lb/cycle	-0.00017	-0.00020	0.000017	0.000017

[a]Methanol concentration and emission rate results are negative due to cross method contamination of the spiked and unspiked methanol trains resulting in negative spike recovery (R) values. The average methanol concentration and emission rate is given as the Run No. 3 results only and may not be representative of the 736 Coker Unit methanol emissions to atmosphere.

SECTION FOUR Test Results

TABLE 4-8. 736 COKER UNIT HCl, Cl_2 AND HF TEST RESULTS SUMMARY

TEST RUN	26A-1	26A-3	26A-4	
TEST DATE	7/21/2011	7/27/2011	7/28/2011	
TEST TIME	18:15 - 19:34	13:37 - 14:45	15:18 - 16:11	Average
CYCLE TIME (HRS)	1.317	1.133	0.883	
Stack Gas Parameters				
Temperature, av. °F	212.2	212.0	213.3	212.5
Velocity, av. ft/sec	90.93	43.67	112.73	82.44
Volume flow, acfm	1,904	915	2,361	1,727
Volume flow, scfm	1,509	727	1,867	1,367
Volume flow, dscfm	29	13	48	30
Volume flow, scfh	90,514	43,606	111,996	82,030
Volume flow, dscfh	1,737	779	2,855	1,790
Moisture, av. % vol	98.08	98.21	97.45	97.92
CO_2, av. % vol, db	0.50	0.50	0.50	0.50
O_2, av. % vol, db	19.50	18.50	19.00	19.00
Sampling System Data				
Time, min	70.0	68.0	53.0	
Volume, dscf	2.641	11.195	3.662	
Volume, dscm	0.075	0.317	0.104	
Isokinetic Ratio, %	236.1	2,279.2	263.1	
Hydrogen Chloride (HCl)				
Concentration				
ppmv db	< 9.202	< 1.746	< 5.473	< 5.473
mg/dscm	< 13.9437	< 2.6462	< 8.2928	< 8.2942
lb/dscf x 10^{-6}	< 0.8706	< 0.1652	< 0.5178	< 0.5179
Emission rate				
lb/hr	< 0.00151	< 0.00013	< 0.00148	< 0.00104
lb/cycle	< 0.00199	< 0.00015	< 0.00131	< 0.00115
Chlorine (Cl_2)				
Concentration				
ppmv db	0.573	< 0.123	< 0.377	< 0.358
mg/dscm	1.6711	< 0.3596	< 1.0993	< 1.0433
lb/dscf x 10^{-6}	0.1043	< 0.0224	< 0.0686	< 0.0651
Emission rate				
lb/hr	0.00018	< 0.00002	< 0.00020	< 0.00013
lb/cycle	0.00024	< 0.00002	< 0.00017	< 0.00014
Hydrogen Fluoride (HF)				
Concentration				
ppmv db	< 2.105	< 0.428	< 1.345	< 1.293
mg/dscm	< 1.7513	< 0.3564	< 1.1186	< 1.0754
lb/dscf x 10^{-6}	< 0.1093	< 0.0223	< 0.0698	< 0.0671
Emission rate				
lb/hr	< 0.00019	< 0.00002	< 0.00020	< 0.00014
lb/cycle	< 0.00025	< 0.00002	< 0.00018	< 0.00015

SECTION FOUR Test Results

TABLE 4-9. 736 COKER UNIT MERCURY TEST RESULTS SUMMARY

TEST RUN	OH-1	OH-3	OH-4	
TEST DATE	7/21/2011	7/27/2011	7/28/2011	
TEST TIME	18:15 - 19:34	13:37 - 14:45	15:18 - 16:11	Average
CYCLE TIME (HRS)	1.317	1.133	0.883	
Stack Gas Parameters				
Temperature, °F	212.2	212.0	213.3	212.5
Velocity, av. ft/sec	91.132	106.027	112.854	103.338
Volumetric flow, acfm	1,909	2,221	2,364	2,164
Volumetric flow, scfm	1,512	1,765	1,869	1,715
Volumetric flow, dscfm	18	32	41	30
Volumetric flow, scfh	90,712	105,875	112,119	102,902
Volumetric flow, dscfh	1,077	1,891	2,441	1,803
Moisture, av. % vol	98.81	98.21	97.82	98.28
Carbon Dioxide, av. % vol	0.50	0.50	0.50	0.50
Oxygen, av. % vol	19.50	18.50	19.00	19.00
Metals Sample				
Time, min	64.0	68.0	53.0	
Volume, dscf	1.648	2.197	2.711	
Isokinetic Ratio, %	257.8	184.2	227.8	
Mercury Emissions				
Mercury-particle bound				
Mass, µg	< 0.0331	< 0.0974	< 0.0200	< 0.0502
Concentration				
µg/dscm	< 0.70917	< 1.56528	< 0.26048	< 0.84498
lb/dscf x 10^{-4}	< 0.04428	< 0.09773	< 0.01626	< 0.05276
Emission Rate				
lb/hr	< 0.00048	< 0.00185	< 0.00040	< 0.00091
lb/cycle	< 0.00063	< 0.00209	< 0.00035	< 0.00102
Mercury-oxidized				
Mass, µg	1.0900	< 0.0250	< 0.1550	< 0.4233
Concentration				
µg/dscm	23.35332	< 0.40177	< 2.01872	< 8.59127
lb/dscf x 10^{-4}	1.45808	< 0.02508	< 0.12604	< 0.53640
Emission Rate				
lb/hr	0.01570	< 0.00047	< 0.00308	< 0.00642
lb/cycle	0.02067	< 0.00054	< 0.00272	< 0.00798
Mercury-elemental				
Mass, µg	< 1.2660	< 1.0070	< 1.4730	< 1.2487
Concentration				
µg/dscm	< 27.12413	< 16.18316	< 19.18435	< 20.83055
lb/dscf x 10^{-4}	< 1.69351	< 1.01040	< 1.19779	< 1.30057
Emission Rate				
lb/hr	< 0.01824	< 0.01911	< 0.02924	< 0.02219
lb/cycle	< 1.69351	< 1.01040	< 1.19779	< 1.30057

TABLE 4-9 (CONTINUED). 736 COKER UNIT MERCURY TEST RESULTS SUMMARY

TEST RUN	OH-1	OH-3	OH-4	
TEST DATE	7/21/2011	7/27/2011	7/28/2011	
TEST TIME	18:15 - 19:34	13:37 - 14:45	15:18 - 16:11	Average
CYCLE TIME (HRS)	1.317	1.133	0.883	
Mercury-total				
Mass, µg	< 2.3891	< 1.1294	< 1.6480	< 1.7222
Concentration				
µg/dscm	< 51.18662	< 18.15021	< 21.46354	< 30.26679
lb/dscf x 10^{-4}	< 3.19587	< 1.13322	< 1.34009	< 1.88972
Emission Rate				
lb/hr	< 0.03441	< 0.02143	< 0.03271	< 0.02952
lb/cycle	< 0.04531	< 0.02429	< 0.02889	< 0.03283

SECTION FOUR Test Results

TABLE 4-10. 736 COKER UNIT HCN TEST RESULTS SUMMARY

TEST RUN	OTM 029-1	OTM 029-3	OTM 029-4	
TEST DATE	7/21/2011	7/27/2011	7/28/2011	
TEST TIME	18:25 - 19:30	13:37 -14:45	15:18 - 16:11	Average
CYCLE TIME (HRS)	1.083	1.133	0.883	
Stack Gas Parameters				
Temperature, av. °F	212.2	212.0	213.3	212.5
Velocity, av. ft/sec	91.1	105.5	112.8	103.2
Volume flow, acfm	1,909	2,211	2,363	2,161
Volume flow, scfm	1,512	1,761	1,868	1,714
Volume flow, dscfm	17	51	42	37
Volume flow, scfh	90,726	105,673	112,087	102,829
Volume flow, dscfh	1,026	3,038	2,549	2,204
Moisture, av. % vol	98.87	97.13	97.73	97.91
CO_2, av. % vol, db	0.50	0.50	0.50	0.50
O_2, av. % vol, db	19.50	18.50	19.00	19.00
Sampling Train Data				
Sample volume, dscf	1.754	6.226	3.570	3.850
Sample volume, dscm	0.050	0.176	0.101	0.109
% Isokinetic	389.0	327.0	287.0	334.3
Total Sample Time, min.	52.0	68.0	53.0	57.7
HCN collected, µg	112	3,446	1,007	1,521
Hydrogen Cyanide (HCN)				
Concentration				
lb/dscf x 10^{-6}	0.140	1.220	0.622	0.661
ppmv db	2.00	17.39	8.86	9.42
µg/dscm	2,248	19,542	9,956	10,582
Emission rate				
lb/hr	0.00014	0.00371	0.00158	0.00181
lb/cycle	0.00016	0.00420	0.00140	0.00192

SECTION FOUR Test Results

TABLE 4-11. 736 COKER UNIT PARTICULATE MATTER TEST RESULTS SUMMARY

TEST RUN	:	5-202-1	5-202-2	5-202-3	
TEST DATE	:	7/29/2011	8/1/2011	8/2/2011	
TEST TIME	:	07:52 - 09:07	12:42 - 13:01	16:11 - 16:16	Average
CYCLE TIME (HRS)	:	1.250	0.317	0.083	
Stack Gas Parameters					
Temperature, av. °F		212.6	262.8	212.0	229.1
Velocity, av. ft/sec		153.146	73.875	107.343	111.454
Volume flow, acfm		3,207	1,547	2,248	2,334
Volume flow, scfm		2,544	1,143	1,783	1,824
Volume flow, dscfm		32	25	482	180
Volume flow, dscfh		1,932	1,504	28,949	10,795
Moisture, av. % vol		98.73	97.81	72.95	89.83
CO_2, av. % vol, db		0.16	0.11	0.49	0.25
O_2, av. % vol, db		19.70	20.20	16.80	18.90
Sample Train Data					
Time, min		75.0	19.0	5.0	
Volume, dscf		2.207	1.461	1.274	
Volume, dscm		0.063	0.041	0.036	
Isokinetic Ratio, %		165.6	555.8	95.7	
Particulate Matter (PM)					
Filterable PM collected, mg		457.65	58.54	11.14	175.78
Concentration					
gr/dscf		3.19948	0.61823	0.13488	1.31753
lb/dscf x 10^{-6}		457.2163	88.3468	19.2751	188.2794
Emission rate					
lb/hr		0.8830	0.1328	0.5578	0.5246
lb/cycle		1.1038	0.0421	0.0465	0.3974
Condensable PM collected, mg		290.00	233.75	24.65	182.80
Concentration					
gr/dscf		2.02742	2.46858	0.29846	1.59815
lb/dscf x 10^{-6}		289.7252	352.7686	42.6510	228.3816
Emission rate					
lb/hr		0.5595	0.5304	1.2343	0.7747
lb/cycle		0.6994	0.1680	0.1029	0.3234
Total PM collected, mg		747.65	292.29	35.79	358.58
Concentration					
gr/dscf		5.22690	3.08681	0.43334	2.91568
lb/dscf x 10^{-6}		746.9415	441.1155	61.9261	416.6610
Emission rate					
lb/hr		1.4425	0.6633	1.7921	1.2993
lb/cycle		1.8032	0.2100	0.1493	0.7209

TABLE 4-12. 736 COKER UNIT METALS TEST RESULTS SUMMARY

TEST RUN :	29-1	29-2	29-3	
TEST DATE :	7/29/2011	8/1/2011	8/2/2011	
TEST TIME :	07:52 - 09:07	12:42 - 13:01	16:11 - 16:16	Average
CYCLE TIME (HRS):	1.250	0.317	0.083	
Stack Gas Parameters				
Temperature, av. °F	212.6	262.8	212.0	229.1
Velocity, av. ft/sec	128.642	73.592	114.633	105.622
Volume flow, acfm	2,694	1,541	2,401	2,212
Volume flow, scfm	2,137	1,138	1,905	1,727
Volume flow, dscfm	24	40	59	41
Volume flow, scfh	128,238	68,304	114,270	103,604
Volume flow, dscfh	1,417	2,383	3,545	2,448
Moisture, av. % vol	98.90	96.51	96.90	97.43
CO_2, av. % vol, db	0.16	0.11	0.49	0.25
O_2, av. % vol, db	19.70	20.20	16.80	18.90
Metals Sample				
Time, min	75.0	19.0	5.0	33.0
Volume, dscf	2.631	2.143	1.075	1.950
Volume, dscm	0.075	0.061	0.030	0.055
Isokinetic Ratio, %	269.2	514.7	659.0	481.0
Antimony (Sb)				
Concentration				
lb/dscf x 10^{-9}	< 0.25137	< 0.30859	< 0.61546	< 0.39180
mg/dscm	< 0.004027	< 0.004943	< 0.009859	< 0.006276
Emission rate				
lb/hr x 10^{-4}	< 0.00356	< 0.00735	< 0.02182	< 0.01091
lb/cycle x 10^{-4}	< 0.00445	< 0.00233	< 0.00182	< 0.00287
Arsenic (As)				
Concentration				
lb/dscf x 10^{-9}	< 1.00547	< 1.23434	< 2.46183	< 1.56721
mg/dscm	< 0.016106	< 0.019773	< 0.039435	< 0.025105
Emission rate				
lb/hr x 10^{-4}	< 0.01424	< 0.02941	< 0.08728	< 0.04364
lb/cycle x 10^{-4}	< 0.01780	< 0.00931	< 0.00727	< 0.01146
Beryllium (Be)				
Concentration				
lb/dscf x 10^{-9}	< 0.25137	< 0.30859	< 0.61546	< 0.39180
mg/dscm	< 0.004027	< 0.004943	< 0.009859	< 0.006276
Emission rate				
lb/hr x 10^{-4}	< 0.00356	< 0.00735	< 0.02182	< 0.01091
lb/cycle x 10^{-4}	< 0.00445	< 0.00233	< 0.00182	< 0.00287
Cadmium (Cd)				
Concentration				
lb/dscf x 10^{-9}	0.72645	0.40733	0.48826	0.54068
mg/dscm	0.011637	0.006525	0.007821	0.008661
Emission rate				
lb/hr x 10^{-4}	0.01029	0.00971	0.01731	0.01244
lb/cycle x 10^{-4}	0.01286	0.00307	0.00144	0.00579

TABLE 4-12 (CONTINUED). 736 COKER UNIT METALS TEST RESULTS SUMMARY

TEST RUN :	29-1	29-2	29-3	
TEST DATE :	7/29/2011	8/1/2011	8/2/2011	
TEST TIME :	07:52 - 09:07	12:42 - 13:01	16:11 - 16:16	Average
CYCLE TIME (HRS) :	1.250	0.317	0.083	
Chromium (Cr)				
Concentration				
lb/dscf x 10^{-9}	22.33652	1.18291	2.35925	8.62623
mg/dscm	0.357804	0.018949	0.037792	0.138182
Emission rate				
lb/hr x 10^{-4}	0.31641	0.02818	0.08364	0.14275
lb/cycle x 10^{-4}	0.39552	0.00893	0.00697	0.13714
Lead (Pb)				
Concentration				
lb/dscf x 10^{-9}	0.70048	0.56574	1.12834	0.79818
mg/dscm	0.011221	0.009062	0.018075	0.012786
Emission rate				
lb/hr x 10^{-4}	0.00992	0.01348	0.04000	0.02114
lb/cycle x 10^{-4}	0.01240	0.00427	0.00333	0.00667
Manganese (Mn)				
Concentration				
lb/dscf x 10^{-9}	10.36556	2.24239	18.42062	10.34285
mg/dscm	0.166044	0.035920	0.295076	0.165680
Emission rate				
lb/hr x 10^{-4}	0.14684	0.05343	0.65308	0.28445
lb/cycle x 10^{-4}	0.18354	0.01692	0.05442	0.08496
Nickel (Ni)				
Concentration				
lb/dscf x 10^{-9}	7.99265	6.24988	4.95648	6.39967
mg/dscm	0.128032	0.100116	0.079397	0.102515
Emission rate				
lb/hr x 10^{-4}	0.11322	0.14891	0.17573	0.14595
lb/cycle x 10^{-4}	0.14153	0.04716	0.01464	0.06778
Selenium (Se)				
Concentration				
lb/dscf x 10^{-9}	< 2.51368	< 3.08585	< 6.15457	< 3.91803
mg/dscm	< 0.040266	< 0.049432	< 0.098589	< 0.062762
Emission rate				
lb/hr x 10^{-4}	< 0.03561	< 0.07352	< 0.21820	< 0.10911
lb/cycle x 10^{-4}	< 0.04451	< 0.02328	< 0.01818	< 0.02866
Cobalt (Co)				
Concentration				
lb/dscf x 10^{-9}	2.18690	0.30859	2.09255	1.52935
mg/dscm	0.035031	0.004943	0.033520	0.024498
Emission rate				
lb/hr x 10^{-4}	0.03098	0.00735	0.07419	0.03751
lb/cycle x 10^{-4}	0.03872	0.00233	0.00618	0.01574

SECTION FOUR Test Results

TABLE 4-13. 736 COKER UNIT TRS TEST RESULTS SUMMARY

TEST RUN :	16A-1	16A-2	16A-3	
TEST DATE :	7/29/2011	8/1/2011	8/2/2011	
TEST TIME :	07:52 - 09:08	12:43 - 13:09	16:11 - 16:16	Average
CYCLE TIME (HRS) :	1.267	0.433	0.083	
Stack Gas Parameters				
Temperature, av. °F	212.6	262.8	212.0	229.1
Velocity, av. ft/sec	153.1	73.9	107.3	111.5
Volume flow, acfm	3,208	1,547	2,248	2,334
Volume flow, scfm	2,544	1,143	1,783	1,824
Volume flow, dscfm	32	25	482	180
Volume flow, scfh	152,666	68,566	107,003	109,412
Volume flow, dscfh	1,932	1,504	28,949	10,795
Moisture, av. % vol	98.73	97.81	72.95	89.83
CO_2, av. % vol, db	0.16	0.11	0.49	0.25
O_2, av. % vol, db	19.70	20.20	16.80	18.90
Total Reduced Sulfur (TRS) as SO_2				
Concentration				
ppmv db	1.60	<0.16	98.40	<33.39
lb/dscf x 10^{-6}	0.2660	<0.0266	16.3617	<5.5514
Emission rate				
lb/hr	0.00051	<0.000040	0.47365	<0.15807
lb/cycle	0.00065	<0.000017	0.03947	<0.01338

SECTION FOUR Test Results

TABLE 4-14. 736 COKER UNIT COS, CS_2 AND H_2S TEST RESULTS SUMMARY

TEST RUN	15-1	15-2	15-3	
TEST DATE	7/29/2011	8/1/2011	8/2/2011	
TEST TIME	07:52 - 09:08	12:43 - 13:09	16:11 - 16:16	Average
CYCLE TIME (HRS)	1.267	0.433	0.083	
Stack Gas Parameters				
Temperature, av. °F	212.6	262.8	212.0	229.1
Velocity, av. ft/sec	153.1	73.9	107.3	111.5
Volume flow, acfm	3,208	1,547	2,248	2,334
Volume flow, scfm	2,544	1,143	1,783	1,824
Volume flow, dscfm	32	25	482	180
Volume flow, scfh	152,666	68,566	107,003	109,412
Volume flow, dscfh	1,932	1,504	28,949	10,795
Moisture, av. % vol	98.73	97.81	72.95	89.83
CO_2, av. % vol, db	0.16	0.11	0.49	0.25
O_2, av. % vol, db	19.70	20.20	16.80	18.90
Carbonyl Sulfide				
Concentration				
ppmv db	< 82.2	< 82.2	< 50.6	< 71.7
lb/dscf x 10^{-6}	< 12.817	< 12.817	< 7.890	< 11.174
Emission rate				
lb/hr	< 0.0248	< 0.0193	< 0.2284	< 0.0908
lb/cycle	<0.0314	<0.0084	<0.0190	<0.0196
Carbon Disulfide				
Concentration				
ppmv db	< 40.1	< 40.1	< 32.0	< 37.4
lb/dscf x 10^{-6}	< 7.921	< 7.921	< 6.321	< 7.388
Emission rate				
lb/hr	< 0.0153	< 0.0119	< 0.1830	< 0.0701
lb/cycle	<0.0194	<0.0052	<0.0152	<0.0133
Hydrogen Sulfide				
Concentration				
ppmv db	425.0	< 91.7	82.9	< 199.9
lb/dscf x 10^{-6}	37.595	< 8.112	7.333	< 17.680
Emission rate				
lb/hr	0.073	< 0.012	0.212	< 0.099
lb/cycle	0.092	<0.0053	0.018	<0.0383

TABLE 4-15. 736 COKER UNIT SO_2, NO_X, CO, THC, CH_4 AND C_2H_6 TEST RESULTS SUMMARY

TEST RUN	:	1	2	3	
TEST DATE	:	7/29/2011	8/1/2011	8/2/2011	
TEST TIME	:	07:52 - 09:08	12:43 - 13:09	16:11 - 16:16	Average
CYCLE TIME (HRS)	:	1.267	0.433	0.083	
Stack Gas Parameters					
Temperature, av. °F		212.6	262.8	212.0	229.1
Velocity, av. ft/sec		153.15	73.87	107.34	111.45
Volume flow, acfm		3,207	1,547	2,248	2,334
Volume flow, scfh		152,666	68,566	107,003	109,412
Volume flow, dscfh		1,932	1,504	28,949	10,795
Moisture, av. % vol		98.73	97.81	72.95	89.83
CO_2, av. % vol, db		0.16	0.11	0.49	0.25
O_2, av. % vol, db		19.70	20.20	16.80	18.90
Sulfur Dioxide (SO_2)					
Concentration					
ppmv db		3.4	<1.8	<1.8	<2.3
lb/dscf x 10^{-6}		0.560	<0.299	<0.299	<0.386
Emission rate					
lb/hr		0.00108	<0.000450	<0.008656	<0.003396
lb/cycle		0.00138	<0.000195	<0.000721	<0.000765
Nitrogen Oxides (NO_x)					
Concentration					
ppmv db		<1.8	<1.8	<1.8	<1.8
lb/dscf x 10^{-6}		<0.215	<0.215	<0.215	<0.215
Emission rate					
lb/hr		<0.000415	<0.000323	<0.006222	<0.002320
lb/cycle		<0.000526	<0.000140	<0.000518	<0.000395
Carbon Monoxide (CO)					
Concentration					
ppmv db		<1.8	2.2	2.6	<2.2
lb/dscf x 10^{-6}		<0.131	0.159	0.188	<0.159
Emission rate					
lb/hr		<0.000253	0.000239	0.005454	<0.001982
lb/cycle		<0.000320	<0.000115	<0.000455	<0.000297
Total VOC (as Propane)					
Concentration					
ppmv db		58,961	16,843	11,205	29,003
lb/dscf x 10-6		6,748	1,928	1,282	3,319
Emission rate					
lb/hr		13.04	2.90	37.12	17.69
lb/cycle		16.51	1.26	3.09	6.95
Total Methane (CH_4)					
Concentration					
ppmv db		27,322	9,050	123,154	53,175
lb/dscf x 10-6		1,138	377	5,127	2,214
Emission rate					
lb/hr		2.20	0.57	148.43	50.40
lb/cycle		2.78	0.25	12.37	5.13

TABLE 4-15 (CONTINUED). 736 COKER UNIT SO_2, NO_X, CO THC, CH_4 AND C_2H_6 TEST RESULTS SUMMARY

TEST RUN	:	1	2	3	
TEST DATE	:	7/29/2011	8/1/2011	8/2/2011	
TEST TIME	:	07:52 - 09:08	12:43 - 13:09	16:11 - 16:16	Average
CYCLE TIME (HRS)	:	1.250	0.317	0.083	
Total Ethane (C_2H_6)					
Concentration					
ppmv db		2,168	862	9,853	4,294
lb/dscf x 10-6		169	67	769	335
Emission rate					
lb/hr		0.33	0.10	22.26	7.56
lb/cycle		0.41	0.04	1.86	0.77

APPENDIX A Calculation Summaries

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/29/2011
RUN NUMBER: 5-202-1

γ FACTOR:	0.999	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	2.266 **ft^3**
STATIC PRES:	2.65 **in.H_2O**	**METER TEMP:**	83.6 **°F**
STACK TEMP:	212.6 **°F**	**LIQUID COLL:**	3658.5 **milliliters**
SQ.RT ΔP:	1.9256 **in.H_2O**	**CO_2:**	0.16 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	19.70 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.207 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 172.206 \text{ scf}$$

V_{lc} = 3658.5 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9873$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9896$$

S.V.P. = 29.92 in. Hg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9873

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 5-202-1

SOURCE: 736 DCU
TEST DATE: 7/29/2011

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	2.65 **in.H_2O**	**CO_2:**	0.16 **% by volume**
STACK TEMP:	212.6 **°F**	**O_2:**	19.70 **% by volume**
SQ.RT ΔP:	1.9256 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.81	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.14	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.9256	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.6 °F + 460	=	672.6	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.24	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	153.146	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	3,207	**acfm**
Stack Area = 0.349 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	2,544 152,666	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	32 1,932	**dscfm** **dscfh**

ARI ENVIRONMENTAL, INC.
USEPA METHOD 5/202 - TOTAL PM CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/29/11
RUN NUMBER: 5-202-1
Cycle Time: 1.250 **hrs**

INPUT

V_m:	2.266	ft^3	Q_s:	32	dscfm
γ FACTOR:	0.9987		T_s:	212.6	°F
P_{bar}:	30.04	in.Hg	Runtime:	75	minutes
ΔH:	0.031	$in.H_2O$	V_s:	153.146	ft/sec
T_m:	83.6	°F	P_s:	30.24	in.Hg
V_{lc}:	3658.5	mL	Noz. diam:	0.188	inches
M_n total:	747.7	mg			
CO_2:	0.16	% by volume			
O_2:	19.70	% by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$ = 2.207 **dscf**

γ = 0.999

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$ = 172.206 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$ = 98.73 **%**

PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS

$$C_s = (0.01543)\left(\frac{M_n}{V_{mstd}}\right)$$ Total = 5.22690 **gr/dscf**

$$C_s' = (2.205 \times 10^{-6})\left(\frac{M_n}{V_{mstd}}\right)$$ C'$_s$ Total = 746.9415 **x 10^{-6} lbs/dscf**

EMISSION RATE

$$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$$ Total = 1.4425 **lbs/hr**
1.8032 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$ = 165.60 **% I**

A_n = 0.000193 ft^2 Runtime = 75 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 5 - FILTERABLE PARTICULATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/29/11
RUN NUMBER: 5-202-1
Cycle Time: 1.250 **hrs**

INPUT

V_m:	2.266	ft^3	Q_s:	32	dscfm
γ FACTOR:	0.9987		T_s:	212.6	°F
P_{bar}:	30.04	in.Hg	Runtime:	75	minutes
ΔH:	0.0307	$in.H_2O$	V_s:	153.146	ft/sec
T_m:	83.6	°F	P_s:	30.24	in.Hg
V_{lc}:	3658.5	mL	Noz. diam:	0.188	inches
M_n front:	457.65	mg			
CO_2:	0.16	% by volume			
O_2:	19.70	% by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 2.207 **dscf**

γ = 0.999

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

= 172.206 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

= 98.73 **%**

PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS

$$C_s = (0.01543)\left(\frac{M_n}{V_{mstd}}\right)$$

Total = 3.19948 **gr/dscf**

$$C_s' = (2.205 \times 10^{-6})\left(\frac{M_n}{V_{mstd}}\right)$$

C's Total = 457.2163 **x 10^{-6} lbs/dscf**

EMISSION RATE

$$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$$

= 0.8830 **lbs/hr**
1.1038 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 165.60 **% I**

A_n = 0.0001928 ft^2 Runtime = 75 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 202 - CONDENSIBLE PARTICULATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/29/11
RUN NUMBER: 5-202-1
Cycle Time: 1.250 **hrs**

INPUT

V_m:	2.266	ft^3	Q_s:	32	dscfm
γ FACTOR:	0.9987		T_s:	212.6	°F
P_{bar}:	30.04	in.Hg	Runtime:	75	minutes
ΔH:	0.03	$in.H_2O$	V_s:	153.146	ft/sec
T_m:	83.6	°F	P_s:	30.24	in.Hg
V_{lc}:	3658.5	mL	Noz. diam:	0.188	inches
N:	0.0000		m_{ib}:	0.00	mL
V_t:	0.00	mL	m_{ob}:	0.00	mL
m_r:	245.85	mg			
m_o:	44.15	mg			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 2.207 **dscf**

MASS OF AMMONIA CORRECTION

Equation #1 $m_c = 17.03 \times V_T \times N$ = 0.00 **mg**

MASS OF THE FIELD BLANK

Equation #2 $m_{fb} = m_{ib} + m_{ob}$ = 0.00 **mg**

MASS OF INORGANIC CONDENSIBLE PM

Equation #3 $m_i = m_r - m_c$ = 245.85 **mg**

TOTAL MASS OF CONDENSIBLE PM

Equation #4 $m_{cpm} = m_i + m_o - m_{fb}$ = 290.00 **mg**

TOTAL CONCENTRATION OF CONDENSIBLE PM - METRIC UNITS

Equation #5 $C_{cpm} = \frac{m_{cpm}}{V_{m(std)}}$ = 131.3946 **mg/dscf**

TOTAL CONCENTRATION OF CONDENSIBLE PM - ENGLISH UNITS

$C_s = (0.01543)(C_{cpm})$ Total = 2.02742 **gr/dscf**

$C_s' = (2.205 \times 10^{-6})(C_{cpm})$ C'$_s$ Total = 289.7252 **x 10^{-6} lbs/dscf**

EMISSION RATE

$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$ Total = 0.5595 **lbs/hr**
0.6994 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 165.60 **% I**

A_n = 0.000193 ft^2 Runtime = 75 minutes

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/1/2011
RUN NUMBER: 5-202-2

γ FACTOR:	1.005	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	1.563 **ft^3**
STATIC PRES:	2.85 **in.H_2O**	**METER TEMP:**	110.0 **°F**
STACK TEMP:	262.8 **°F**	**LIQUID COLL:**	1384.0 **milliliters**
SQ.RT ΔP:	0.8988 **in.H_2O**	**CO_2:**	0.11 **% by volume**
ΔH:	0.05 **in.H_2O**	**O_2:**	20.20 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.461 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 65.145 \text{ scf}$$

V_{lc} = 1384.0 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9781$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9891$$

S.V.P. = 29.92 in. Hg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9781

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY:	Houston Refining	**SOURCE:**	736 DCU
LOCATION:	Houston, TX	**TEST DATE:**	8/1/2011
RUN NUMBER:	5-202-2		

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	2.85 **in.H_2O**	**CO_2:**	0.11 **% by volume**
STACK TEMP:	262.75 **°F**	**O_2:**	20.20 **% by volume**
SQ.RT ΔP:	0.8988 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.83	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.24	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	0.8988	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 262.8 °F + 460	=	722.8	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.25	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	73.875	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,547	**acfm**
Stack Area = 0.349 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,143 68,566	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	25 1,504	**dscfm** **dscfh**

ARI ENVIRONMENTAL, INC.
USEPA METHOD 5/202 - TOTAL PM CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/1/11
RUN NUMBER: 5-202-2
Cycle Time: 0.317 **hrs**

INPUT

V_m:	1.563	ft^3	Q_s:	25	dscfm
γ FACTOR:	1.005		T_s:	262.8	°F
P_{bar}:	30.04	in.Hg	Runtime:	19	minutes
ΔH:	0.045	$in.H_2O$	V_s:	73.875	ft/sec
T_m:	110	°F	P_s:	30.25	in.Hg
V_{lc}:	1384	mL	Noz. diam:	0.188	inches
M_n total:	292.3	mg			
CO_2:	0.11	% by volume			
O_2:	20.20	% by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 1.461 **dscf**

γ = 1.005

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

= 65.145 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

= 97.81 **%**

PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS

$$C_s = (0.01543)\left(\frac{M_n}{V_{mstd}}\right)$$

Total = 3.08681 **gr/dscf**

$$C_s' = (2.205 \times 10^{-6})\left(\frac{M_n}{V_{mstd}}\right)$$

C's Total = 441.1155 **x 10^{-6} lbs/dscf**

EMISSION RATE

$$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$$

Total = 0.6633 **lbs/hr**
0.2100 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 555.82 **% I**

A_n = 0.000193 ft^2 Runtime = 19 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 5 - FILTERABLE PARTICULATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/1/11
RUN NUMBER: 5-202-2
Cycle Time: 0.317 **hrs**

INPUT

V_m:	1.563	ft^3	Q_s:	25	dscfm
γ FACTOR:	1.005		T_s:	262.8	°F
P_{bar}:	30.04	in.Hg	Runtime:	19	minutes
ΔH:	0.045	$in.H_2O$	V_s:	73.875	ft/sec
T_m:	110	°F	P_s:	30.25	in.Hg
V_{lc}:	1384	mL	Noz. diam:	0.188	inches
M_n front:	58.54	mg			
CO_2:	0.11	% by volume			
O_2:	20.20	% by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 1.461 **dscf**

γ = 1.005

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

= 65.145 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

= 97.81 **%**

PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS

$$C_s = (0.01543)\left(\frac{M_n}{V_{mstd}}\right)$$

Total = 0.61823 **gr/dscf**

$$C_s' = (2.205 \times 10^{-6})\left(\frac{M_n}{V_{mstd}}\right)$$

C's Total = 88.3468 **x 10^{-6} lbs/dscf**

EMISSION RATE

$$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$$

= 0.1328 **lbs/hr**
0.0421 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 555.82 **% I @ saturation**

A_n = 0.0001928 ft^2 Runtime = 19 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 202 - CONDENSIBLE PARTICULATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/1/11
RUN NUMBER: 5-202-2
Cycle Time: 0.317 **hrs**

INPUT

V_m:	1.563	ft^3	Q_s:	25	dscfm
γ FACTOR:	1.005		T_s:	262.8	°F
P_{bar}:	30.04	in.Hg	Runtime:	19	minutes
ΔH:	0.045	$in.H_2O$	V_s:	73.875	ft/sec
T_m:	110	°F	P_s:	30.25	in.Hg
V_{lc}:	1384	mL	Noz. diam:	0.188	inches
N:	0.0000		m_{ib}:	0.00	mL
V_t:	0.00	mL	m_{ob}:	0.00	mL
m_r:	45.40	mg			
m_o:	188.35	mg			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$ = 1.461 **dscf**

MASS OF AMMONIA CORRECTION

Equation #1 $m_c = 17.03 \times V_T \times N$ = 0.00 **mg**

MASS OF THE FIELD BLANK

Equation #2 $m_{fb} = m_{ib} + m_{ob}$ = 0.00 **mg**

MASS OF INORGANIC CONDENSIBLE PM

Equation #3 $m_i = m_r - m_c$ = 45.40 **mg**

TOTAL MASS OF CONDENSIBLE PM

Equation #4 $m_{cpm} = m_i + m_o - m_{fb}$ = 233.75 **mg**

TOTAL CONCENTRATION OF CONDENSIBLE PM - METRIC UNITS

Equation #5 $C_{cpm} = \frac{m_{cpm}}{V_{m(std)}}$ = 159.9858 **mg/dscf**

TOTAL CONCENTRATION OF CONDENSIBLE PM - ENGLISH UNITS

$C_s = (0.01543)(C_{cpm})$ Total = 2.46858 **gr/dscf**

$C_s' = (2.205 \times 10^{-6})(C_{cpm})$ C's Total = 352.7686 **x 10^{-} lbs/dscf**

EMISSION RATE

$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$ Total = 0.5304 **lbs/hr**
0.1680 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$ = 555.82 **% I**

A_n = 0.000193 ft^2 Runtime = 19 minutes

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/2/2011
RUN NUMBER: 5-202-3

γ FACTOR:	1.005	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.06 **in. Hg**	**METER VOLUME:**	1.360 **ft^3**
STATIC PRES:	2.00 **in.H_2O**	**METER TEMP:**	109.0 **°F**
STACK TEMP:	212.0 **°F**	**LIQUID COLL:**	73.0 **milliliters**
SQ.RT ΔP:	1.4491 **in.H_2O**	**CO_2:**	0.49 **% by volume**
ΔH:	0.04 **in.H_2O**	**O_2:**	16.80 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.274 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 3.436 \text{ scf}$$

V_{lc} = 73.0 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.7295$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9905$$

S.V.P. = 29.92 in. Hg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.7295

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 5-202-3

SOURCE: 736 DCU
TEST DATE: 8/2/2011

BAROMETRIC:	30.06 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	2 **in.H_2O**	**CO_2:**	0.49 **% by volume**
STACK TEMP:	212 **°F**	**O_2:**	16.80 **% by volume**
SQ.RT ΔP:	1.4491 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.75	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	20.91	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.4491	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
T_s = 212.0 °F + 460	=	672.0	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.21	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	107.343	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	2,248	**acfm**
Stack Area = 0.349 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,783 107,003	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	482 28,949	**dscfm** **dscfh**

ARI ENVIRONMENTAL, INC.
USEPA METHOD 5/202 - TOTAL PM CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/2/11
RUN NUMBER: 5-202-3
Cycle Time: 0.083 **hrs**

INPUT

V_m:	1.36	**ft^3**	**Q_s:**	482	**dscfm**
γ FACTOR:	1.005		**T_s:**	212	**°F**
P_{bar}:	30.06	**in.Hg**	**Runtime:**	5	**minutes**
ΔH:	0.04	**in.H_2O**	**V_s:**	107.343	**ft/sec**
T_m:	109	**°F**	**P_s:**	30.21	**in.Hg**
V_{lc}:	73.0	**mL**	**Noz. diam:**	0.188	**inches**
M_n total:	35.8	**mg**	**Regenerator Coke Burn (R_c):**	29,679	**lb/hr**
CO_2:	0.49	**% by volume**			
O_2:	16.80	**% by volume**			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 1.274 **dscf**

γ = 1.005

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

= 3.436 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

= 72.95 **%**

PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS

$$C_s = (0.01543)\left(\frac{M_n}{V_{mstd}}\right)$$

Total = 0.43334 **gr/dscf**

$$C_s' = (2.205 \times 10^{-6})\left(\frac{M_n}{V_{mstd}}\right)$$

C'$_s$ Total = 61.9261 **x 10^{-6} lbs/dscf**

EMISSION RATE

$$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$$

Total = 1.7921 **lbs/hr**
0.1493 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 95.70 **% I**

A_n = 0.000193 ft^2 Runtime = 5 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 5 - FILTERABLE PARTICULATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/2/11
RUN NUMBER: 5-202-3
Cycle Time: 0.083 **hrs**

INPUT

V_m:	1.36	ft^3	Q_s:	482	dscfm
γ FACTOR:	1.005		T_s:	212	°F
P_{bar}:	30.06	in.Hg	Runtime:	5	minutes
ΔH:	0.04	$in.H_2O$	V_s:	107.343	ft/sec
T_m:	109	°F	P_s:	30.21	in.Hg
V_{lc}:	73	mL	Noz. diam:	0.188	inches
M_n front:	11.14	mg			
CO_2:	0.49	% by volume			
O_2:	16.80	% by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 1.274 **dscf**

γ = 1.005

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

= 3.436 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

= 72.95 **%**

PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS

$$C_s = (0.01543)\left(\frac{M_n}{V_{mstd}}\right)$$

Total = 0.13488 **gr/dscf**

$$C_s' = (2.205 \times 10^{-6})\left(\frac{M_n}{V_{mstd}}\right)$$

C's Total = 19.2751 **x 10^{-6} lbs/dscf**

EMISSION RATE

$$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$$

= 0.5578 **lbs/hr**
0.0465 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 95.70 **% I**

A_n = 0.0001928 ft^2 Runtime = 5 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 202 - CONDENSIBLE PARTICULATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/2/11
RUN NUMBER: 5-202-3
Cycle Time: 0.083 **hrs**

INPUT					
V_m:	1.36	ft^3	Q_s:	482	**dscfm**
γ FACTOR:	1.005		T_s:	212.0	**°F**
P_{bar}:	30.06	**in.Hg**	Runtime:	5	**minutes**
ΔH:	0.04	**in.H_2O**	V_s:	107.343	**ft/sec**
T_m:	109	**°F**	P_s:	30.21	**in.Hg**
V_{lc}:	73	**mL**	Noz. diam:	0.188	**inches**
N:	0.0000		m_{ib}:	0.00	**mL**
V_t:	0.00	**mL**	m_{ob}:	0.00	**mL**
m_r:	12.75	**mg**			
m_o:	11.90	**mg**			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$ = 1.274 **dscf**

MASS OF AMMONIA CORRECTION

Equation #1 $m_c = 17.03 \times V_T \times N$ = 0.00 **mg**

MASS OF THE FIELD BLANK

Equation #2 $m_{fb} = m_{ib} + m_{ob}$ = 0.00 **mg**

MASS OF INORGANIC CONDENSIBLE PM

Equation #3 $m_i = m_r - m_c$ = 12.75 **mg**

TOTAL MASS OF CONDENSIBLE PM

Equation #4 $m_{cpm} = m_i + m_o - m_{fb}$ = 24.65 **mg**

TOTAL CONCENTRATION OF CONDENSIBLE PM - METRIC UNITS

Equation #5 $C_{cpm} = \frac{m_{cpm}}{V_{m(std)}}$ = 19.3428 **mg/dscf**

TOTAL CONCENTRATION OF CONDENSIBLE PM - ENGLISH UNITS

$C_s = (0.01543)(C_{cpm})$ Total = 0.29846 **gr/dscf**

$C_s' = (2.205 \times 10^{-6})(C_{cpm})$ C's Total = 42.6510 **x 10^{-6} lbs/dscf**

EMISSION RATE

$pmr = \left(\frac{C_s}{7000}\right)(Q_{std})(60)$ Total = 1.2343 **lbs/hr**
0.1029 **lbs/cycle**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$ = 95.70 **% I**

A_n = 0.000193 ft^2 Runtime = 5 minutes

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/19/2011
RUN NUMBER: 0011-1

γ FACTOR:	0.999	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	30.00 **in. Hg**	**METER VOLUME:**	0.537 **ft^3**
STATIC PRES:	1.67 **in.H_2O**	**METER TEMP:**	78.8 **°F**
STACK TEMP:	213.0 **°F**	**LIQUID COLL:**	2010.7 **milliliters**
SQ.RT ΔP:	0.7268 **in.H_2O**	**CO_2:**	0.00 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	20.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 0.527 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} \quad V_{wstd} = 0.04707 \times V_{lc} = 94.644 \text{ scf}$$

V_{lc} = 2010.7 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9945$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 1.0000$$

T = 373.6 °K
P = 765.1 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9945

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
RUN NUMBER: 0011-1

SOURCE: 736 DCU
TEST DATE: 7/19/2011

BAROMETRIC:	30.00 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.67 **in.H_2O**	**CO_2:**	0.00 **% by volume**
STACK TEMP:	213 **°F**	**O_2:**	20.50 **% by volume**
SQ.RT ΔP:	0.726784 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.82	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$	=	18.06	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	0.7268	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 213.0 °F + 460	=	673.0	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.12	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	58.050	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,215.80	**acfm**
Stack Area = 0.34907 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	960.31 57,619	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	5.32 319	**dscfm** **dscfh**

ALDEHYDES CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/19/2011
RUN NO: 0011-1

INPUT

V_m:	0.537 ft^3	Q_s:	319 **dscfh**
γ **FACTOR:**	0.999	T_s:	213.0 **°F**
P_{bar}:	30.00 **in. Hg**	Θ:	28.0 **minutes**
ΔH:	0.03	V_s:	58.050 **fps**
T_m:	78.8 **°F**	P_s:	30.12 **in. Hg**
Formaldehyde:	29,837 µg	V_{lc}:	2,010.7 **mL**
Acetaldehyde:	38,341 µg	$\%O_2$:	20.50 **%**
Propanal:	7,388 µg	Cycle TIme:	0.467 hrs

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 0.527 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 641.3 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 28 minutes

Total µg Formaldehyde in sample (M_n)	=	29,837 µg
Total µg Acetaldehyde in sample (M_n)	=	38341 µg
Total µg Propanal in sample (M_n)	=	7,388 µg

Concentration of Aldehydes

$$C_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} \text{ lb}/\mu g)(M_n)}{V_{mstd}}$$

		x 10^{-6} lb/dscf
	=	124.8181 **formaldehyde**
	=	160.3945 **acetaldehyde**
	=	30.9065 **propanal**
		µg/dscm
$C_{s(\mu g/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(V_{mstd})}$	=	1,999,151.0 **formaldehyde**
		2,568,959.6 **acetaldehyde**
		495,013.8 **propanal**

Aldehydes Mass Rate: $E = Q_s \times C_{s(lb/dscf)}$

		lb/hr
	=	0.0398 **formaldehyde**
	=	0.0512 **acetaldehyde**
		0.0099 **propanal**

Aldehydes Mass Rate: $E = Q_s \times C_{s(lb/dscf)}$

		lb/cycle
	=	0.0186 **formaldehyde**
	=	0.0239 **acetaldehyde**
		0.0046 **propanal**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/20/2011
RUN NUMBER: 0011-2

γ FACTOR:	0.999	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	0.101 **ft^3**
STATIC PRES:	1.10 **in.H_2O**	**METER TEMP:**	87.5 **°F**
STACK TEMP:	213.0 **°F**	**LIQUID COLL:**	606.3 **milliliters**
SQ.RT ΔP:	0.9643 **in.H_2O**	**CO_2:**	0.00 **% by volume**
ΔH:	0.02 **in.H_2O**	**O_2:**	21.00 **% by volume**

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}}$$

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 0.098 \textbf{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 28.539 \textbf{ scf}$$

V_{lc} = 606.3 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9966$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 1.0000$$

T = 373.6 °K
P = 765.1 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}}$$

B_{ws} = 0.9966

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
RUN NUMBER: 0011-2

SOURCE: 736 DCU
TEST DATE: 7/20/2011

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.10 **in.H_2O**	**CO_2:**	0.00 **% by volume**
STACK TEMP:	213 **°F**	**O_2:**	21.00 **% by volume**
SQ.RT ΔP:	0.964309 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.84 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$$ = 18.04 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 0.9643 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 213.0 °F + 460 = 673.0 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.12 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 77.073 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 1,614.22 **acfm**

Stack Area = 0.34907 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,274.93 **scfm, wb**
76,496 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 4.35 **dscfm**
261 **dscfh**

ALDEHYDES CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/20/2011
RUN NO: 0011-2

INPUT

V_m:	0.101	**ft^3**	**Q_s:**	261	**dscfh**
γ FACTOR:	0.999		**T_s:**	213.0	**°F**
P_{bar}:	30.04	**in. Hg**	**Θ:**	9.0	**minutes**
ΔH:	0.02		**V_s:**	77.073	**fps**
T_m:	87.5	**°F**	**P_s:**	30.12	**in. Hg**
Formaldehyde:	16,742	**µg**	**V_{lc}:**	606.3	**mL**
Acetaldehyde:	7,976	**µg**	**$\%O_2$:**	21.00	**%**
Propanal:	909	**µg**	Cycle TIme:	0.150	hrs

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 0.098 **dscf**

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 452.2 **% I**

A_n = 0.00019277 ft^2 Runtime (θ) = 9 minutes

Total µg Formaldehyde in sample (M_n) = 16,742 **µg**
Total µg Acetaldehyde in sample (M_n) = 7,976 **µg**
Total µg Propanal in sample (M_n) = 909 **µg**

Concentration of Aldehydes

$$C_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9}\ lb/\mu g)(M_n)}{V_{mstd}}$$

	x 10^{-6} lb/dscf
=	377.8952 **formaldehyde**
=	180.0385 **acetaldehyde**
=	20.5177 **propanal**

$$C_{s(\mu g/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(V_{mstd})}$$

	µg/dscm
	6,052,561.8 **formaldehyde**
=	2883589.1 **acetaldehyde**
	328621.4 **propanal**

Aldehydes Mass Rate:

$$E = Q_s \times C_{s(lb/dscf)}$$

	lb/hr
	0.0986 **formaldehyde**
=	0.0470 **acetaldehyde**
	0.0054 **propanal**

Aldehydes Mass Rate:

$$E = Q_s \times C_{s(lb/dscf)}$$

	lb/cycle
	0.0148 **formaldehyde**
=	0.0070 **acetaldehyde**
	0.0008 **propanal**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: 0011-3

γ FACTOR:	0.999	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	29.98 **in. Hg**	**METER VOLUME:**	3.106 **ft^3**
STATIC PRES:	1.20 **in.H_2O**	**METER TEMP:**	88.0 **°F**
STACK TEMP:	212.4 **°F**	**LIQUID COLL:**	3155.7 **milliliters**
SQ.RT ΔP:	0.9311 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.04 **in.H_2O**	**O_2:**	18.00 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.995 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 148.539 \text{ scf}$$

V_{lc} = 3155.7 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9802$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 0.9964$$

T = 373.2 °K
P = 763.7 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9802

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
RUN NUMBER: 0011-3

SOURCE: 736 DCU
TEST DATE: 7/21/2011

BAROMETRIC:	29.98 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.20 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212.4 **°F**	**O_2:**	18.00 **% by volume**
SQ.RT ΔP:	0.93113 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.80	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$	=	18.21	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	0.9311	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.4 °F + 460	=	672.4	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.07	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	74.092	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,551.77	**acfm**
Stack Area = 0.34907 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,224.56 73,474	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	24.20 1,452	**dscfm** **dscfh**

ALDEHYDES CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NO: 0011-3

INPUT

V_m:	3.106	**ft^3**	**Q_s:**	1,452	**dscfh**
γ FACTOR:	0.999		**T_s:**	212.4	**°F**
P_{bar}:	29.98	**in. Hg**	**Θ:**	50.0	**minutes**
ΔH:	0.04		**V_s:**	74.092	**fps**
T_m:	88.0	**°F**	**P_s:**	30.07	**in. Hg**
Formaldehyde:	24,288	**µg**	**V_{lc}:**	3,155.7	**mL**
Acetaldehyde:	57,836	**µg**	**$\%O_2$:**	18.00	**%**
Propanal:	7,409	**µg**	Cycle TIme:	0.833	hrs

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.995 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 448.5 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 50 minutes

Total µg Formaldehyde in sample (M_n)	=	24,288 **µg**
Total µg Acetaldehyde in sample (M_n)	=	57,836 **µg**
Total µg Propanal in sample (M_n)	=	7,409 **µg**

Concentration of Aldehydes

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} \text{ lb}/\mu g)(M_n)}{V_{mstd}}$$

		x 10^{-6} lb/dscf
	=	17.8783 **formaldehyde**
	=	42.5720 **acetaldehyde**
	=	5.4535 **propanal**
		µg/dscm
$C_{s(\mu g/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(V_{mstd})}$	=	286,348.0 **formaldehyde**
		681854.9 **acetaldehyde**
		87346.0 **propanal**

Aldehydes Mass Rate: $E = Q_s \times C'_{s(lb/dscf)}$

		lb/hr
=		0.0260 **formaldehyde**
=		0.0618 **acetaldehyde**
=		0.0079 **propanal**

Aldehydes Mass Rate: $E = Q_s \times C'_{s(lb/dscf)}$

		lb/cycle
=		0.0216 **formaldehyde**
=		0.0515 **acetaldehyde**
=		0.0066 **propanal**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: 26A-1

γ FACTOR:	0.997	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	30.00 **in. Hg**	**METER VOLUME:**	2.772 **ft^3**
STATIC PRES:	2.32 **in.H_2O**	**METER TEMP:**	94.0 **°F**
STACK TEMP:	212.2 **°F**	**LIQUID COLL:**	2867.1 **milliliters**
SQ.RT ΔP:	1.1448 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	19.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.641 \text{ dscf}$$

γ = 0.997

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 134.954 \text{ scf}$$

V_{lc} = 2867.1 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9808$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9881$$

T = 373.1 °K
P = 766.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9808

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 26A-1

SOURCE: 736 DCU
TEST DATE: 7/21/2011

BAROMETRIC:	30.00 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	2.32 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212.2 **°F**	**O_2:**	19.50 **% by volume**
SQ.RT ΔP:	1.1448 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.86	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$	=	18.21	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.1448	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.2 °F + 460	=	672.2	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.17	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	90.933	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,904.50	**acfm**
Stack Area = 0.35 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,508.56 90,514	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	28.96 1,737	**dscfm** **dscfh**

HYDROGEN CHLORIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NO: 26A-1
CYCLE TIME: 1.317 **hrs**

INPUT

V_m:	2.772 **ft³**	**Q_s:**	1,737 **dscfh**
γ FACTOR:	0.997	**T_s:**	212.2 **°F**
P_{bar}:	30.00 **in. Hg**	**Θ:**	79 **minutes**
ΔH:	0.03	**V_s:**	90.933 **fps**
T_m:	94.0 **°F**	**P_s:**	30.17 **in. Hg**
HCl in sample:	< 1,043 **µg**	**V_{lc}:**	2,867.1 **mL**
		%O_2:	19.50 **%**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 2.641 **dscf**

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 209.2 **% I**

A_n = 0.00019277 ft² Runtime (θ) = 79 minutes

Total µg HCl in sample (M_n) = < 1,043 **µg**

Concentration of HCl

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9}\ lb/\mu g)(M_n)}{V_{mstd}}$$

= < 0.8706 **x 10^{-6} lb/dscf**

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26\ ft^3/lb-mole}{36.45\ lb/lb-mole} \times 10^6$$

= < 9.202 **ppmv db**

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(1000\mu g/mg)(V_{mstd})}$$

= < 13.9437 **mg/dscm**

HCl Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)}$$

= < 0.00151 **lb/hr**
< 0.00199 **lb/cycle**

CHLORINE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NO: 26A-1
CYCLE TIME: 1.317 **hrs**

INPUT

V_m:	2.772 **ft³**	**Q_s:**	1,737 **dscfh**
γ FACTOR:	0.997	**T_s:**	212.2 **°F**
P_{bar}:	30.00 **in. Hg**	**Θ:**	79 **minutes**
ΔH:	0.03	**V_s:**	90.933 **fps**
T_m:	94.0 **°F**	**P_s:**	30.17 **in. Hg**
Cl_2 in sample:	< 125 **µg**	**V_{lc}:**	2,867.1 **mL**
		$\%O_2$:	19.50 **%**

Volume of Sample at Standard Conditions on a Dry Basis: — **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 2.641 **dscf**

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 209.2 **% I**

A_n = 0.00019277 ft² Runtime (θ) = 79 minutes

Total µg Cl_2 in sample (M_n) = 125 **µg**

Concentration of Cl_2

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9}\ lb/\mu g)(M_n)}{V_{mstd}}$$

= 0.1043 **x 10^{-6} lb/dscf**

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26\ ft^3/lb-mole}{70.096\ lb/lb-mole} \times 10^6$$

= 0.573 **ppmv db**

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(1000\ \mu g/mg)(V_{mstd})}$$

= 1.6711 **mg/dscm**

Cl_2 Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)}$$

= 0.00018 **lb/hr**
0.00024 **lb/cycle**

HYDROGEN FLUORIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NO: 26A-1
CYCLE TIME: 1.317 **hrs**

INPUT

V_m:	2.772 ft^3	Q_s:	1,737 **dscfh**
γ **FACTOR:**	0.997	T_s:	212.2 **°F**
P_{bar}:	30.00 **in. Hg**	Θ:	79 **minutes**
ΔH:	0.03	V_s:	90.933 **fps**
T_m:	94.0 **°F**	P_s:	30.17 **in. Hg**
HF in sample:	< 131 **µg**	V_{lc}:	2,867.1 **mL**
		$\%O_2$:	19.50 **%**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.641 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 209.2 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 79 minutes

Total µg HF in sample (M_n) = < 131 **µg**

Concentration of HF

$$C_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} \text{ lb}/\mu g)(M_n)}{V_{mstd}} = < 0.1093 \text{ x } 10^{-6} \text{ lb/dscf}$$

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26 \text{ ft}^3/\text{lb-mole}}{20.01 \text{ lb/lb-mole}} \times 10^6 = < 2.105 \text{ ppmv db}$$

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 \text{ ft}^3/\text{m}^3)}{(1000 \mu g/mg)(V_{mstd})} = < 1.7513 \text{ mg/dscm}$$

HF Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)} = < 0.00019 \text{ lb/hr}$$
$$< 0.00025 \text{ lb/cycle}$$

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NUMBER: 26A-3

γ FACTOR:	0.997	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	30.06 **in. Hg**	**METER VOLUME:**	12.016 **ft^3**
STATIC PRES:	2.71 **in.H_2O**	**METER TEMP:**	107.7 **°F**
STACK TEMP:	212.0 **°F**	**LIQUID COLL:**	3029.0 **milliliters**
SQ.RT ΔP:	0.5504 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.05 **in.H_2O**	**O_2:**	18.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 11.195 \text{ dscf}$$

γ = 0.997

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 142.575 \text{ scf}$$

V_{lc} = 3029.0 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9272$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9821$$

T = 373.0 °K
P = 768.6 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9821

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 26A-3

SOURCE: 736 DCU
TEST DATE: 7/27/2011

BAROMETRIC:	30.06 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	2.71 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212 **°F**	**O_2:**	18.50 **% by volume**
SQ.RT ΔP:	0.5504 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.82	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$	=	18.19	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	0.5504	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
T_s = 212.0 °F + 460	=	672.0	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.26	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	43.669	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	914.60	**acfm**
Stack Area = 0.35 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	726.77 43,606	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	12.98 779	**dscfm** **dscfh**

HYDROGEN CHLORIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NO: 26A-3
CYCLE TIME: 1.133 **hrs**

INPUT

V_m:	12.016	**ft^3**	**Q_s:**	779	**dscfh**
γ FACTOR:	0.997		**T_s:**	212.0	**°F**
P_{bar}:	30.06	**in. Hg**	**Θ:**	68	**minutes**
ΔH:	0.05		**V_s:**	43.669	**fps**
T_m:	107.7	**°F**	**P_s:**	30.26	**in. Hg**
HCl in sample:	< 839	**µg**	**V_{lc}:**	3,029.0	**mL**
			$\%O_2$:	18.50	**%**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 11.195 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} =$$

564.0 **% I**
2279.2 ***% I****

A_n = 0.00019277 ft^2 Runtime (θ) = 68 minutes

** based upon saturation*

Total µg HCl in sample (M_n) = < 839 **µg**

Concentration of HCl

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} \text{ lb}/\mu g)(M_n)}{V_{mstd}} = < 0.1652 \text{ x } 10^{-6} \text{ lb/dscf}$$

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26 \text{ ft}^3/\text{lb-mole}}{36.45 \text{ lb/lb-mole}} \times 10^6 = < 1.746 \text{ ppmv db}$$

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 \text{ ft}^3/\text{m}^3)}{(1000 \mu g/mg)(V_{mstd})} = < 2.6462 \text{ mg/dscm}$$

HCl Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)} = < 0.00013 \text{ lb/hr}$$
< 0.00015 **lb/cycle**

CHLORINE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NO: 26A-3
CYCLE TIME: 1.133 **hrs**

INPUT

V_m:	12.016	**ft^3**	**Q_s:**	779	**dscfh**
γ FACTOR:	0.997		**T_s:**	212.0	**°F**
P_{bar}:	30.06	**in. Hg**	**Θ:**	68	**minutes**
ΔH:	0.05		**V_s:**	43.669	**fps**
T_m:	107.7	**°F**	**P_s:**	30.26	**in. Hg**
Cl_2 in sample:	< 114	**µg**	**V_{lc}:**	3,029.0	**mL**
			$\%O_2$:	18.50	**%**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 11.195 **dscf**

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 564.0 **% I**
2279.2 ***% I****

A_n = 0.00019277 ft^2 Runtime (θ) = 68 minutes

** based upon saturation*

Total µg Cl_2 in sample (M_n) = < 114 µg

Concentration of Cl_2

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9}\ lb/\mu g)(M_n)}{V_{mstd}}$$

= < 0.0224 **x 10^{-6} lb/dscf**

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26\ ft^3/lb-mole}{70.096\ lb/lb-mole} \times 10^6$$

= < 0.123 **ppmv db**

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31\ ft^3/m^3)}{(1000\ \mu g/mg)(V_{mstd})}$$

= < 0.3596 **mg/dscm**

Cl_2 Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)}$$

= < 0.00002 **lb/hr**
< 0.00002 **lb/cycle**

HYDROGEN FLUORIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NO: 26A-3
CYCLE TIME: 1.133 **hrs**

INPUT

V_m:	12.016	ft^3	Q_s:	779	dscfh
γ FACTOR:	0.997		T_s:	212.0	°F
P_{bar}:	30.06	in. Hg	Θ:	68	minutes
ΔH:	0.05		V_s:	43.669	fps
T_m:	107.7	°F	P_s:	30.26	in. Hg
HF in sample:	< 113	µg	V_{lc}:	3,029.0	mL
			$\%O_2$:	18.50	%

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 11.195 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} =$$

564.0 **% I**
2279.2 ***% I****

A_n = 0.00019277 ft^2 Runtime (θ) = 68 minutes

** based upon saturation*

Total µg HF in sample (M_n) = < 113 µg

Concentration of HF

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} lb/\mu g)(M_n)}{V_{mstd}} = < 0.0223 \text{ x } 10^{-6} \text{ lb/dscf}$$

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26 ft^3/lb-mole}{20.01 lb/lb-mole} \times 10^6 = < 0.428 \text{ ppmv db}$$

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(1000 \mu g/mg)(V_{mstd})} = < 0.3564 \text{ mg/dscm}$$

HF Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)} = < 0.00002 \text{ lb/hr}$$
< 0.00002 **lb/cycle**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NUMBER: 26A-4

γ FACTOR:	0.997	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	29.98 **in. Hg**	**METER VOLUME:**	3.843 **ft^3**
STATIC PRES:	2.47 **in.H_2O**	**METER TEMP:**	93.7 **°F**
STACK TEMP:	213.3 **°F**	**LIQUID COLL:**	2974.1 **milliliters**
SQ.RT ΔP:	1.4205 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.07 **in.H_2O**	**O_2:**	19.00 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 3.662 \text{ dscf}$$

γ = 0.997

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 139.991 \text{ scf}$$

V_{lc} = 2974.1 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9745$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 1.0000$$

T = 373.7 °K
P = 766.1 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9745

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 26A-4

SOURCE: 736 DCU
TEST DATE: 7/28/2011

BAROMETRIC:	29.98 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	2.47 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	213.3 **°F**	**O_2:**	19.00 **% by volume**
SQ.RT ΔP:	1.4205 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.84 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$$ = 18.28 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 1.4205 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 213.3 °F + 460 = 673.3 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.16 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 112.729 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 2,361.00 **acfm**

Stack Area = 0.35 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,866.59 **scfm, wb**
111,996 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 47.58 **dscfm**
2,855 **dscfh**

HYDROGEN CHLORIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NO: 26A-4
CYCLE TIME: 0.883 **hrs**

INPUT

V_m:	3.843	ft^3	Q_s:	2,855	dscfh
γ FACTOR:	0.997		T_s:	213.3	°F
P_{bar}:	29.98	in. Hg	Θ:	53	minutes
ΔH:	0.07		V_s:	112.729	fps
T_m:	93.7	°F	P_s:	30.16	in. Hg
HCl in sample:	< 860	µg	V_{lc}:	2,974.1	mL
			$\%O_2$:	19.00	%

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 3.662 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 263.1 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 53 minutes

Total µg HCl in sample (M_n) = < 860 µg

Concentration of HCl

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} lb/\mu g)(M_n)}{V_{mstd}} = < 0.5178 \text{ x } 10^{-6} \text{ lb/dscf}$$

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26 ft^3/lb-mole}{36.45 lb/lb-mole} \times 10^6 = < 5.473 \text{ ppmv db}$$

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(1000 \mu g/mg)(V_{mstd})} = < 8.2928 \text{ mg/dscm}$$

HCl Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)} = < 0.00148 \text{ lb/hr}$$
$$< 0.00131 \text{ lb/cycle}$$

CHLORINE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NO: 26A-4
CYCLE TIME: 0.883 **hrs**

INPUT

V_m:	3.843	**ft^3**	**Q_s:**	2,855	**dscfh**
γ FACTOR:	0.997		**T_s:**	213.3	**°F**
P_{bar}:	29.98	**in. Hg**	**Θ:**	53	**minutes**
ΔH:	0.07		**V_s:**	112.729	**fps**
T_m:	93.7	**°F**	**P_s:**	30.16	**in. Hg**
Cl_2 in sample:	< 114	**µg**	**V_{lc}:**	2,974.1	**mL**
			$\%O_2$:	19.00	**%**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 3.662 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 263.1 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 53 minutes

Total µg Cl_2 in sample (M_n) = < 114 µg

Concentration of Cl_2

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} \text{ lb/µg})(M_n)}{V_{mstd}} = < 0.0686 \text{ x } 10^{-6} \text{ lb/dscf}$$

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26 \text{ ft}^3/\text{lb-mole}}{70.096 \text{ lb/lb-mole}} \times 10^6 = < 0.377 \text{ ppmv db}$$

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 \text{ ft}^3/\text{m}^3)}{(1000 \text{ µg/mg})(V_{mstd})} = < 1.0993 \text{ mg/dscm}$$

Cl_2 Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)} = < 0.00020 \text{ lb/hr}$$
< 0.00017 **lb/cycle**

HYDROGEN FLUORIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NO: 26A-4
CYCLE TIME: 0.883 **hrs**

INPUT

V_m:	3.843 **ft³**	Q_s:	2,855 **dscfh**
γ **FACTOR:**	0.997	T_s:	213.3 **°F**
P_{bar}:	29.98 **in. Hg**	Θ:	53 **minutes**
ΔH:	0.07	V_s:	112.729 **fps**
T_m:	93.7 **°F**	P_s:	30.16 **in. Hg**
HF in sample:	< 116 **µg**	V_{lc}:	2,974.1 **mL**
		$\%O_2$:	19.00 **%**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 3.662 **dscf**

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 263.1 **% I**

A_n = 0.00019277 ft^2 Runtime (θ) = 53 minutes

Total µg HF in sample (M_n) = < 116 **µg**

Concentration of HF

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9}\, lb/\mu g)(M_n)}{V_{mstd}}$$

= < 0.0698 **x 10^{-6} lb/ dscf**

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26\, ft^3/lb-mole}{20.01 lb/lb-mole} \times 10^6$$

= < 1.345 **ppmv db**

$$C_{s(mg/dscm)} = \frac{(M_n)(35.31 ft^3/m^3)}{(1000\, \mu g/mg)(V_{mstd})}$$

= < 1.1186 **mg/dscm**

HF Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)}$$

= < 0.00020 **lb/hr**
< 0.00018 **lb/cycle**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: OTM 029-1

γ FACTOR:	1.005	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.00 **in. Hg**	**METER VOLUME:**	1.836 **ft^3**
STATIC PRES:	2.32 **in.H_2O**	**METER TEMP:**	97.0 **°F**
STACK TEMP:	212.2 **°F**	**LIQUID COLL:**	3551.0 **milliliters**
SQ.RT ΔP:	1.1448 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	19.50 **% by volume**
		Meter Out CO_2:	0.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.754 \text{ dscf}$$

$$V_{actual} = \frac{(V_{mstd})(1 - \%CO_{2(dry)out})}{(1 - \%CO_{2(dry)in})} = 1.754 \text{ dscf}$$

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 167.146 \text{ scf}$$

V_{lc} = 3551.0 mL
Vlc = 3257.6 mL adjusted for saturation

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{actual}} = 0.9896$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9887$$

T = 373.1 °K
P = 766.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9887

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: OTM 029-1

SOURCE: 736 DCU
TEST DATE: 7/21/2011

BAROMETRIC: 30 **in. Hg**
STATIC PRES: 2.315385 **in.H_2O**
STACK TEMP: 212.1818 **°F**
SQ.RT ΔP: 1.144773 **in.H_2O**

STACK DIAM: 8.00 **inches**
CO_2: 0.50 **% by volume**
O_2: 19.50 **% by volume**

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.86	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.12	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.1448	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.2 °F + 460	=	672.2	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.17	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	91.150	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,909	**acfm**
Stack Area = 0.349 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,512.1 90,726	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	17.1 1,026	**dscfm** **dscfh**

ARI ENVIRONMENTAL, INC.
ISOKINETIC RATIO CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: OTM 029-1

INPUT

V_{mstd}:	1.754	**ft^3**	17	**dscfm**
γ FACTOR:	1.005		212.1818182	**°F**
P_{bar}:	30	**in.Hg**	52.0	**minutes**
ΔH:	0.03	**in.H_2O**	91.150	**ft/sec**
T_m:	97	**°F**	30.17	**in.Hg**
V_{lc}:	3551	**mL**	0.188	**inches**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{actual} = \frac{(V_{mstd})(1 - \%CO_{2(dry)out})}{(1 - \%CO_{2(dry)in})}$$

1.754 **dscf**

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

167.146 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

98.96 **%**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_{actual}}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} =$$

389.0 **% I**
357.2 **@ saturation**

A_n = 0.00019277 ft^2 Runtime = 52 minutes

HYDROGEN CYANIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NO: OTM 029-1

INPUT

V_{mstd}:	1.754 **ft³**	**Q_s:**	1,026 **dscfh**
γ FACTOR:	1.005	**T_s:**	212.2 **°F**
P_{bar}:	30.00 **in. Hg**	**Θ:**	52.0 **minutes**
ΔH:	0.03 **in. H_2O**	**V_s:**	91.150 **fps**
T_m:	97.0 **°F**	**P_s:**	30.17 **in. Hg**
HCN in sample:	112 **µg**	**V_{lc}:**	3,551.0 **mL**
Cycle Time:	1.083 **hrs**	**$\%O_2$:**	19.50 **%**

Volume of Sample at Standard Conditions on a Dry Basis: — **English Units (29.92 in. Hg, 68 °F)**

$$V_{actual} = \frac{(V_{mstd})(1-\%CO_{2(dry)out})}{(1-\%CO_{2(dry)in})} = 1.754 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_{actual}}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 389.0 \text{ \% I}$$

357.2 @ saturation

A_n = 0.00019277 ft² — Runtime (θ) = 52 minutes

Total µg HCN in sample (M_n) = 112 **µg**

Concentration of HCN

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9} lb/\mu g)(M_n)}{V_{actual}} = 0.1404 \text{ x } 10^{-6} \text{ lbs/dscf}$$

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26 ft^3/lb-mole}{27.03 lb/lb-mole} \times 10^6 = 2.00 \text{ ppmv db}$$

$$C_{s(\mu g/dscm)} = \frac{(M_{n,\mu g})(35.31)}{(V_{mstd,dscf})} = 2,248 \text{ µg/dscm}$$

HCN Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)} = 0.00014 \text{ lbs/hr}$$

0.00016 **lbs/cycle**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NUMBER: OTM 029-3

γ FACTOR:	0.999	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.06 **in. Hg**	**METER VOLUME:**	6.730 **ft^3**
STATIC PRES:	3.80 **in.H_2O**	**METER TEMP:**	112.8 **°F**
STACK TEMP:	212.0 **°F**	**LIQUID COLL:**	4469.1 **milliliters**
SQ.RT ΔP:	1.3364 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.07 **in.H_2O**	**O_2:**	18.50 **% by volume**
		Meter Out CO_2:	0.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = \quad 6.226 \quad \textbf{dscf}$$

$$V_{actual} = \frac{(V_{mstd})(1 - \%CO_{2(dry)out})}{(1 - \%CO_{2(dry)in})} = \quad 6.226 \quad \textbf{dscf}$$

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = \quad 210.361 \quad \textbf{scf}$$

V_{lc} = 4469.1 mL
6336.6

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{actual}} = \quad 0.9713$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = \quad 0.9796$$

T = 373.0 °K
P = 770.6 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9713

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY:	Houston Refining	**SOURCE:**	736 DCU
LOCATION:	Houston, TX	**TEST DATE:**	7/27/2011
RUN NUMBER:	OTM 029-3		

BAROMETRIC:	30.06 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	3.8 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212 **°F**	**O_2:**	18.50 **% by volume**
SQ.RT ΔP:	1.336367 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.82	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.31	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.3364	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
T_s = 212.0 °F + 460	=	672.0	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.34	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	105.547	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	2,211	**acfm**
Stack Area = 0.349 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,761.2 105,673	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	50.6 3,038	**dscfm** **dscfh**

ARI ENVIRONMENTAL, INC.
ISOKINETIC RATIO CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NUMBER: OTM 029-3

INPUT

V_{mstd}:	6.226	ft^3	51	dscfm
γ FACTOR:	0.9987		212	°F
P_{bar}:	30.06	in.Hg	68.0	minutes
ΔH:	0.07142857	$in.H_2O$	105.547	ft/sec
T_m:	112.785714	°F	30.34	in.Hg
V_{lc}:	4469.1	mL	0.188	inches

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{actual} = \frac{(V_{mstd})(1-\%CO_{2(dry)out})}{(1-\%CO_{2(dry)in})}$$

6.226 **dscf**

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

210.361 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

97.13 **%**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_{actual}}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} =$$

327.0 **% I**

A_n = 0.00019277 ft^2 Runtime = 68 minutes

HYDROGEN CYANIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NO: OTM 029-3

INPUT

V_{mstd}:	6.226	ft^3	Q_s:	3,038	dscfh
γ FACTOR:	0.999		T_s:	212.0	°F
P_{bar}:	30.06	in. Hg	Θ:	68.0	minutes
ΔH:	0.07	in. H_2O	V_s:	105.547	fps
T_m:	112.8	°F	P_s:	30.34	in. Hg
HCN in sample:	3,446	µg	V_{lc}:	4,469.1	mL
Cycle Time:	1.133	hrs	$\%O_2$:	18.50	%

Volume of Sample at Standard Conditions on a Dry Basis:

English Units (29.92 in. Hg, 68 °F)

$$V_{actual} = \frac{(V_{mstd})(1-\%CO_{2(dry)out})}{(1-\%CO_{2(dry)in})}$$

= 6.226 **dscf**

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 327.0 **% I**

A_n = 0.00019277 ft^2 Runtime (θ) = 68 minutes

Total µg HCN in sample (M_n) = 3,446 **µg**

Concentration of HCN

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9}\, lb/\mu g)(M_n)}{V_{actual}}$$

= 1.2204 **x 10^{-6} lbs/dscf**

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26\, ft^3/lb-mole}{27.03\, lb/lb-mole} \times 10^6$$

= 17.39 **ppmv db**

$$C_{s(\mu g/dscm)} = \frac{(M_{n,\mu g})(35.31)}{(V_{mstd,dscf})}$$

= 19,542 **µg/dscm**

HCN Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)}$$

= 0.00371 **lbs/hr**
0.00420 **lbs/cycle**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NUMBER: OTM 029-4

γ FACTOR:	0.999	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	29.98 **in. Hg**	**METER VOLUME:**	3.750 **ft^3**
STATIC PRES:	2.47 **in.H_2O**	**METER TEMP:**	95.0 **°F**
STACK TEMP:	213.3 **°F**	**LIQUID COLL:**	3259.3 **milliliters**
SQ.RT ΔP:	1.4205 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.04 **in.H_2O**	**O_2:**	19.00 **% by volume**
		Meter Out CO_2:	0.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = \quad 3.570 \quad \textbf{dscf}$$

$$V_{actual} = \frac{(V_{mstd})(1 - \%CO_{2(dry)out})}{(1 - \%CO_{2(dry)in})} = \quad 3.570 \quad \textbf{dscf}$$

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = \quad 153.415 \quad \textbf{scf}$$

V_{lc} = 3259.3 mL

#DIV/0!

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{actual}} = \quad 0.9773$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = \quad 1.0000$$

T = 373.7 °K
P = 766.1 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9773

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: OTM 029-4

SOURCE: 736 DCU
TEST DATE: 7/28/2011

BAROMETRIC: 29.98 **in. Hg**
STATIC PRES: 2.472727 **in.H_2O**
STACK TEMP: 213.25 **°F**
SQ.RT ΔP: 1.420456 **in.H_2O**

STACK DIAM: 8.00 **inches**
CO_2: 0.50 **% by volume**
O_2: 19.00 **% by volume**

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.84	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.25	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.4205	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
T_s = 213.3 °F + 460	=	673.3	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.16	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	112.821	
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	2,363	**acfm**
Stack Area = 0.349 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,868.1 112,087	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	42.5 2,549	**dscfm** **dscfh**

ARI ENVIRONMENTAL, INC.
ISOKINETIC RATIO CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NUMBER: OTM 029-4

INPUT

V_{mstd}:	3.570	**ft^3**	42	**dscfm**
γ FACTOR:	0.9987		213.25	**°F**
P_{bar}:	29.98	**in.Hg**	53.0	**minutes**
ΔH:	0.04	**in.H_2O**	112.821	**ft/sec**
T_m:	95	**°F**	30.16	**in.Hg**
V_{lc}:	3259.3	**mL**	0.188	**inches**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS

$$V_{actual} = \frac{(V_{mstd})(1 - \%CO_{2(dry)out})}{(1 - \%CO_{2(dry)in})}$$

3.570 **dscf**

VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc}$$

153.415 **scf**

FRACTIONAL MOISTURE CONTENT OF STACK GAS

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$$

97.73 **%**

ISOKINETIC SAMPLING RATE

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_{actual}}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} =$$

287.0 **% I**

A_n = 0.00019277 ft^2 Runtime = 53 minutes

HYDROGEN CYANIDE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NO: OTM 029-4

INPUT

V_{mstd}:	3.570 **ft³**	**Q_s:**	2,549 **dscfh**
γ FACTOR:	0.999	**T_s:**	213.3 **°F**
P_{bar}:	29.98 **in. Hg**	**Θ:**	53.0 **minutes**
ΔH:	0.04 **in. H_2O**	**V_s:**	112.821 **fps**
T_m:	95.0 **°F**	**P_s:**	30.16 **in. Hg**
HCN in sample:	1,007 **µg**	**V_{lc}:**	3,259.3 **mL**
Cycle Time:	0.883 **hrs**	**$\%O_2$:**	19.00 **%**

Volume of Sample at Standard Conditions on a Dry Basis: — **English Units (29.92 in. Hg, 68 °F)**

$$V_{actual} = \frac{(V_{mstd})(1-\%CO_{2(dry)out})}{(1-\%CO_{2(dry)in})}$$

= 3.570 **dscf**

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)}$$

= 287.0 **% I**

A_n = 0.00019277 ft² Runtime (θ) = 53 minutes

Total µg HCN in sample (M_n) = 1,007 **µg**

Concentration of HCN

$$C'_{s(lb/dscf)} = \frac{(2.2046 \times 10^{-9}\, lb/\mu g)(M_n)}{V_{actual}}$$

= 0.6216 **x 10^{-6} lbs/dscf**

$$C_{s(ppmvdb)} = C'_{s(lb/dscf)} \times \frac{385.26\, ft^3/lb-mole}{27.03\, lb/lb-mole} \times 10^6$$

= 8.86

$$C_{s(\mu g/dscm)} = \frac{(M_{n,\mu g})(35.31)}{(V_{mstd,dscf})}$$

= 9,956 **µg/dscm**

HCN Mass Rate:

$$E = Q_s \times C'_{s(lb/dscf)}$$

= 0.00158 **lbs/hr**
0.00140 **lbs/cycle**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/29/2011
RUN NUMBER: 29-1

γ FACTOR:	1.005	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	2.697 **ft^3**
STATIC PRES:	2.65 **in.H_2O**	**METER TEMP:**	86.1 **°F**
STACK TEMP:	212.6 **°F**	**LIQUID COLL:**	5004.4 **milliliters**
SQ.RT ΔP:	1.6167 **in.H_2O**	**CO_2:**	0.16 **% by volume**
ΔH:	0.02 **in.H_2O**	**O_2:**	19.70 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.631 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 235.557 \text{ scf}$$

V_{lc} = 5004.4 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9890$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9950$$

8/2/2011 373.3 °K
P = 768.0 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9890

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 29-1

SOURCE: 736 DCU
TEST DATE: 7/29/2011

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	2.7 **in.H_2O**	**CO_2:**	0.16 **% by volume**
STACK TEMP:	212.6 **°F**	**O_2:**	19.70 **% by volume**
SQ.RT ΔP:	1.6167 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.81	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.12	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.6167	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.6 °F + 460	=	672.6	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.24	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	128.642	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	2,694	**acfm**
Stack Area = 0.3491 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard con 40757.00			
16:11 - 16:16 $Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	2,137.3 128,238	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	23.6 1,417	**dscfm** **dscfh**

METHOD 29 ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/29/2011
RUN NO: 29-1

INPUT

V_m:	2.697	**ft^3**	**Q_s:**	1,417	**dscfh**
γ FACTOR:	1.005		**T_s:**	212.6	**°F**
P_{bar}:	30.04	**in. Hg**	**Θ:**	75.0	**minutes**
ΔH:	0.02	**in. H_2O**	**V_s:**	128.642	**fps**
T_m:	86.1	**°F**	**P_s:**	30.24	**in. Hg**
			V_{lc}:	5,004.4	**mL**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.631 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 269.23 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 75 minutes

USEPA Method 29
Metals Emissions Calculation Summary

Client:	Houston Refining
Location:	Houston, TX
Source:	736 DCU
Date:	7/29/2011
Run #:	29-1

Test Data Input

Barometric pressure (P_{bar}):	30.04	**inches Hg**
Stack pressure (P_s):	30.24	**Inches Hg Abs.**
Test length (θ):	75.0	**minutes**
Sample nozzle diameter (D_n):	0.1880	**inches**
Sample nozzle area (A_n):	0.000193	**ft^3**
Stack temperature (T_s):	212.6	**°F**
Volume metered (V_{mstd}):	2.631	**dscf**
Stack gas velocity (V_s):	128.642	**ft/sec**
Stack gas volumetric flow (Q_{std}):	1.417	**dscfh**
Fractional Moisture content (B_{ws}):	0.9890	
Stack Oxygen Content (%O_2):	19.70	**%**
Cycle Time:	1.25	**hrs**

Metals Laboratory Analysis Weights (M_t)

Antimony (Sb):	< 0.30 µg	**Manganese (Mn):**	12.37 µg
Arsenic (As):	< 1.20 µg		
Beryllium (Be):	< 0.30 µg	**Nickel (Ni):**	9.54 µg
Cadmium (Cd):	0.87 µg	**Selenium (Se):**	< 3.00 µg
Chromium (Cr):	26.66 µg	**Cobalt (Co)**	2.61 µg
Lead (Pb):	0.84 µg		

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Metals concentration (µg/dscm):

$$C_s = \frac{M_t}{\left[\left(\frac{V_{mstd}}{35.315\,dscf/dscm}\right)\right]}$$

=	< 4.026601 µg/dscm	Antimony (Sb)	=	166.043612 µg/dscm	Manganese (Mn)
=	< 16.106405 µg/dscm	Arsenic (As)	=		
=	< 4.026601 µg/dscm	Beryllium (Be)	=	128.032497 µg/dscm	Nickel (Ni)
=	11.636878 µg/dscm	Cadmium (Cd)	=	< 40.266012 µg/dscm	Selenium (Se)
=	357.803784 µg/dscm	Chromium (Cr)	=	35.031431 µg/dscm	Cobalt (Co)
=	11.220795 µg/dscm	Lead (Pb)			

Metals concentration (x10^{-9} lb/dscf):

$$C'_s = \frac{\left(\frac{2.2046\times10^{-9}\,lb}{\mu g}\times M_t\right)}{V_{mstd}}$$

=	< 0.251368 x 10^{-9} lb/dscf	Antimony (Sb)	=	10.365560 x 10^{-9} lb/dscf	Manganese (Mn)
=	< 1.005470 x 10^{-9} lb/dscf	Arsenic (As)			
=	< 0.251368 x 10^{-9} lb/dscf	Beryllium (Be)	=	7.992650 x 10^{-9} lb/dscf	Nickel (Ni)
=	< 0.726452 x 10^{-9} lb/dscf	Cadmium (Cd)	=	< 2.513676 x 10^{-9} lb/dscf	Selenium (Se)
=	22.336521 x 10^{-9} lb/dscf	Chromium (Cr)	=	2.186898 x 10^{-9} lb/dscf	Cobalt (Co)
=	0.700478 x 10^{-9} lb/dscf	Lead (Pb)			

Metals emission rate (x10^{-4} lb/hr):

$$E_{m,lb/hr} = C'_s \times Q_{std}$$

=	< 0.003561 x10^{-4} lb/hr	Antimony (Sb)	=	0.146836 x10^{-4} lb/hr	Manganese (Mn)
=	< 0.014243 x10^{-4} lb/hr	Arsenic (As)			
=	< 0.003561 x10^{-4} lb/hr	Beryllium (Be)	=	0.113222 x10^{-4} lb/hr	Nickel (Ni)
=	0.010291 x10^{-4} lb/hr	Cadmium (Cd)	=	< 0.035608 x10^{-4} lb/hr	Selenium (Se)
=	0.316414 x10^{-4} lb/hr	Chromium (Cr)	=	0.030979 x10^{-4} lb/hr	Cobalt (Co)
=	0.009923 x10^{-4} lb/hr	Lead (Pb)			

Metals emission rate (x10^{-4} lb/cycle):

$$E_{m,lb/hr} = C'_s \times Q_{std}$$

=	< 0.004451 x10^{-4} lb/cycle	Antimony (Sb)	=	0.183545 x10^{-4} lb/cycle	Manganese (Mn)
=	< 0.017804 x10^{-4} lb/cycle	Arsenic (As)			
=	< 0.004451 x10^{-4} lb/cycle	Beryllium (Be)	=	0.141527 x10^{-4} lb/cycle	Nickel (Ni)
=	0.012863 x10^{-4} lb/cycle	Cadmium (Cd)	=	< 0.044510 x10^{-4} lb/cycle	Selenium (Se)
=	0.395517 x10^{-4} lb/cycle	Chromium (Cr)	=	0.038724 x10^{-4} lb/cycle	Cobalt (Co)
=	0.012403 x10^{-4} lb/cycle	Lead (Pb)			

Metals Laboratory Data Summary

Client: Houston Refining
Location: Houston, TX
Source: 736 DCU
Date: 7/29/2011
Run #: 29-1

Front Half Metal Calculation

Metal	Detection Limit (micrograms)	FH Sample (M_{fh}) (micrograms)	FH Blank (M_{fhb}) (micrograms)	*I Value* *A* Value (4 inch filter) (micrograms)	*II Values* 5 % of FH Sample (micrograms)	Lesser value (M_{fhb}) vs 5% (micrograms)	Greater Value *I vs II* (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)
Antimony	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.0000
Arsenic	**1**	1.0000	1.0000	**17.590**	0.050	0.050	17.590	1.000	0.0000
Beryllium	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.0000
Cadmium	**0.1**	0.1370	0.1220	**17.590**	0.007	0.007	17.590	0.122	0.0150
Chromium	**1**	1.4100	1.3500	**17.590**	0.071	0.071	17.590	1.350	0.0600
Lead	**0.5**	0.5140	0.5000	**17.590**	0.026	0.026	17.590	0.500	0.0140
Manganese	**0.5**	2.0400	1.9200	**17.590**	0.102	0.102	17.590	1.920	0.1200
Nickel	**0.2**	1.6400	1.5800	**17.590**	0.082	0.082	17.590	1.580	0.0600
Selenium	**2**	2.0000	2.0000	**17.590**	0.100	0.100	17.590	2.000	0.0000
Cobalt	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.0000

Back Half Metal Calculation

Metal	16:11 - 16:16 Detection Limit (micrograms)	BH Sample (M_{bh}) (micrograms)	BH Blank (M_{bhb}) (micrograms)	*I Value* (micrograms)	*II Values* 5 % of BH Sample (micrograms)	Lesser value (M_{bh}) vs 5% (micrograms)	Greater Value I vs II (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)
Antimony	**0.1**	0.1040	0.1000	**1.000**	0.005	0.005	1.000	0.100	0.0040
Arsenic	**0.2**	0.4150	0.2000	**1.000**	0.021	0.021	1.000	0.200	0.2150
Beryllium	**0.1**	0.1000	0.1000	**1.000**	0.005	0.005	1.000	0.100	0.0000
Cadmium	**0.05**	0.9020	0.0500	**1.000**	0.045	0.045	1.000	0.050	0.8520
Chromium	**0.15**	26.9000	0.3020	**1.000**	1.345	1.000	1.000	0.302	26.5980
Lead	**0.05**	0.9310	0.1090	**1.000**	0.047	0.047	1.000	0.109	0.8220
Manganese	**0.15**	12.5000	0.2490	**1.000**	0.625	0.625	1.000	0.249	12.2510
Nickel	**0.1**	10.4000	0.9210	**1.000**	0.520	0.520	1.000	0.921	9.4790
Selenium	**1**	1.2500	1.0000	**1.000**	0.063	0.063	1.000	1.000	0.2500
Cobalt	**0.1**	2.7100	0.1000	**1.000**	0.136	0.136	1.000	0.100	2.6100

Metal	FH Sample (M_{fh}) (micrograms)	FH Blank (M_{fhb}) (micrograms)	BH Sample (M_{bh}) (micrograms)	BH Blank (M_{bhb}) (micrograms)	Total Metal (M_t) (micrograms)	
Antimony	0.200	0.200	0.104	0.100	**0.300**	**BDL**
Arsenic	1.000	1.000	0.415	0.200	**1.200**	**BDL**
Beryllium	0.200	0.200	0.100	0.100	**0.300**	**BDL**
Cadmium	0.137	0.122	0.902	0.050	**0.867**	**ADL**
Chromium	1.410	1.350	26.900	0.302	**26.658**	**ADL**
Lead	0.514	0.500	0.931	0.109	**0.836**	**ADL**
Manganese	2.040	1.920	12.500	0.249	**12.371**	**ADL**
Nickel	1.640	1.580	10.400	0.921	**9.539**	**ADL**
Selenium	2.000	2.000	1.250	1.000	**3.000**	**BDL**
Cobalt	0.200	0.200	2.710	0.100	**2.610**	**ADL**

$$M_t = (M_{fh} - M_{fhb}) + (M_{bh} - M_{bhb})$$

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/1/2011
RUN NUMBER: 29-2

γ FACTOR:	0.999	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	2.300 **ft^3**
STATIC PRES:	2.85 **in.H_2O**	**METER TEMP:**	108.3 **°F**
STACK TEMP:	262.8 **°F**	**LIQUID COLL:**	1259.8 **milliliters**
SQ.RT ΔP:	0.8988 **in.H_2O**	**CO_2:**	0.11 **% by volume**
ΔH:	0.11 **in.H_2O**	**O_2:**	20.20 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.143 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 59.299 \text{ scf}$$

V_{lc} = 1259.8 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9651$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 1.0000$$

T = 401.2 °K
P = 768.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9651

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 29-2

SOURCE: 736 DCU
TEST DATE: 8/1/2011

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	2.9 **in.H_2O**	**CO_2:**	0.11 **% by volume**
STACK TEMP:	262.8 **°F**	**O_2:**	20.20 **% by volume**
SQ.RT ΔP:	0.8988 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.83 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 18.38 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 0.8988 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 262.8 °F + 460 = 722.8 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.25 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 73.592 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 1,541 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,138.4 **scfm, wb**
68,304 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 39.7 **dscfm**
2,383 **dscfh**

METHOD 29 ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/1/2011
RUN NO: 29-2

INPUT 8/2/2011

V_m:	2.300	**ft³**	Q_s:	2,383	**dscfh**
γ **FACTOR:**	0.999		T_s:	262.8	**°F**
P_{bar}:	30.04	**in. Hg**	Θ:	19.0	**minutes**
ΔH:	0.11	**in. H_2O**	V_s:	73.592	**fps**
T_m:	108.3	**°F**	P_s:	30.25	**in. Hg**
			V_{lc}:	1,259.8	**mL**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.143 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 514.69 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 19 minutes

USEPA Method 29
Metals Emissions Calculation Summary

Client:	Houston Refining
Location:	Houston, TX
Source:	736 DCU
Date:	8/1/2011
Run #:	29-2

Test Data Input

Barometric pressure (P_{bar}):	30.04	**inches Hg**
Stack pressure (P_s):	30.25	**Inches Hg Abs.**
Test length (θ):	19.0	**minutes**
Sample nozzle diameter (D_n):	0.1880	**inches**
Sample nozzle area (A_n):	0.000193	**ft^3**
Stack temperature (T_s):	262.8	**°F**
Volume metered (V_{mstd}):	2.143	**dscf**
Stack gas velocity (V_s):	73.592	**ft/sec**
Stack gas volumetric flow (Q_{std}):	2,383	**dscfh**
Fractional Moisture content (B_{ws}):	0.9651	
Stack Oxygen Content (%O_2):	20.20	**%**
Cycle Time:	0.317	**hrs**

Metals Laboratory Analysis Weights (M_t)

Antimony (Sb):	< 0.30 µg	**Manganese (Mn):**	2.18 υγ
Arsenic (As):	< 1.20 µg		
Beryllium (Be):	< 0.30 µg	**Nickel (Ni):**	6.08 µg
Cadmium (Cd):	0.40 µg	**Selenium (Se):**	< 3.00 µg
Chromium (Cr):	1.15 µg	**Cobalt (Co)**	0.30 µg
Lead (Pb):	0.55 µg		

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Metals concentration (µg/dscm):

$$C_s = \frac{M_t}{\left[\left(\frac{V_{mstd}}{35.315\,dscf/dscm}\right)\right]}$$

=	< 4.943162 µg/dscm	Antimony (Sb)	=	35.920310 µg/dscm	Manganese (Mn)
=	< 19.772648 µg/dscm	Arsenic (As)	=		
=	< 4.943162 µg/dscm	Beryllium (Be)	=	100.115507 µg/dscm	Nickel (Ni)
=	6.524974 µg/dscm	Cadmium (Cd)	=	< 49.431620 µg/dscm	Selenium (Se)
=	18.948788 µg/dscm	Chromium (Cr)	=	4.943162 µg/dscm	Cobalt (Co)
=	9.062464 µg/dscm	Lead (Pb)			

Metals concentration ($x10^{-9}$ lb/dscf):

$$C'_s = \frac{\left(\frac{2.2046 \times 10^{-9}\,lb}{\mu g} \times M_t\right)}{V_{mstd}}$$

=	< 0.308585 x 10^{-9} lb/dscf	Antimony (Sb)	=	2.242388	x 10^{-9} lb/dscf Manganese (Mn)
=	< 1.234342 x 10^{-9} lb/dscf	Arsenic (As)			
=	< 0.308585 x 10^{-9} lb/dscf	Beryllium (Be)	=	6.249884	x 10^{-9} lb/dscf Nickel (Ni)
=	0.407333 x 10^{-9} lb/dscf	Cadmium (Cd)	=	< 3.085854	x 10^{-9} lb/dscf Selenium (Se)
=	1.182911 x 10^{-9} lb/dscf	Chromium (Cr)	=	0.308585	x 10^{-9} lb/dscf Cobalt (Co)
=	0.565740 x 10^{-9} lb/dscf	Lead (Pb)			

Metals emission rate ($x10^{-4}$ lb/hr):

$$E_m = C'_s \times Q_{std}$$

=	< 0.007352 x10^{-4} lb/hr	Antimony (Sb)	=	0.053428 x10^{-4} lb/hr	Manganese (Mn)
=	< 0.029410 x10^{-4} lb/hr	Arsenic (As)			
=	< 0.007352 x10^{-4} lb/hr	Beryllium (Be)	=	0.148911 x10^{-4} lb/hr	Nickel (Ni)
=	0.009705 x10^{-4} lb/hr	Cadmium (Cd)	=	< 0.073524 x10^{-4} lb/hr	Selenium (Se)
=	0.028184 x10^{-4} lb/hr	Chromium (Cr)	=	0.007352 x10^{-4} lb/hr	Cobalt (Co)
=	0.013479 x10^{-4} lb/hr	Lead (Pb)			

Metals emission rate ($x10^{-4}$ lb/cycle):

$$E_{m,lb/hr} = C'_s \times Q_{std}$$

=	< 0.002328 x10^{-4} lb/cycle	Antimony (Sb)	=	0.016919 x10^{-4} lb/cycle	Manganese (Mn)
=	< 0.009313 x10^{-4} lb/cycle	Arsenic (As)			
=	< 0.002328 x10^{-4} lb/cycle	Beryllium (Be)	=	0.047155 x10^{-4} lb/cycle	Nickel (Ni)
=	0.003073 x10^{-4} lb/cycle	Cadmium (Cd)	=	< 0.023283 x10^{-4} lb/cycle	Selenium (Se)
=	0.008925 x10^{-4} lb/cycle	Chromium (Cr)	=	0.002328 x10^{-4} lb/cycle	Cobalt (Co)
=	0.004268 x10^{-4} lb/cycle	Lead (Pb)			

Metals Laboratory Data Summary

Client: Houston Refining
Location: Houston, TX
Source: 736 DCU
Date: 8/1/2011
Run #: 29-2

Front Half Metal Calculation

Metal	Detection Limit (micrograms)	FH Sample (M_{fh}) (micrograms)	FH Blank (M_{fhb}) (micrograms)	*I Value* *A* Value (4 inch filter) (micrograms)	*II Values* 5 % of FH Sample (micrograms)	Lesser value (M_{fhb}) vs 5% (micrograms)	Greater Value *I vs II* (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)
Antimony	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.000
Arsenic	**1**	1.0000	1.0000	**17.590**	0.050	0.050	17.590	1.000	0.000
Beryllium	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.000
Cadmium	**0.1**	0.1300	0.1000	**17.590**	0.007	0.007	17.590	0.100	0.030
Chromium	**1**	1.6200	1.7100	**17.590**	0.081	0.081	17.590	1.710	-0.090
Lead	**0.5**	0.5000	0.5000	**17.590**	0.025	0.025	17.590	0.500	0.000
Manganese	**0.5**	1.1000	0.6100	**17.590**	0.055	0.055	17.590	0.610	0.490
Nickel	**0.2**	4.5000	3.5600	**17.590**	0.225	0.225	17.590	3.560	0.940
Selenium	**2**	2.0000	2.0000	**17.590**	0.100	0.100	17.590	2.000	0.000
Cobalt	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.000

Back Half Metal Calculation

Metal	Detection Limit (micrograms)	BH Sample (M_{bh}) (micrograms)	BH Blank (M_{bhb}) (micrograms)	*I Value* (micrograms)	*II Values* 5 % of BH Sample (micrograms)	Lesser value (M_{bh}) vs 5% (micrograms)	Greater Value I vs II (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)
Antimony	**0.1**	0.1040	0.1000	**1.000**	0.005	0.005	1.000	0.100	0.004
Arsenic	**0.2**	0.2000	0.2000	**1.000**	0.010	0.010	1.000	0.200	0.000
Beryllium	**0.1**	0.1000	0.1000	**1.000**	0.005	0.005	1.000	0.100	0.000
Cadmium	**0.05**	0.4160	0.0500	**1.000**	0.021	0.021	1.000	0.050	0.366
Chromium	**0.15**	0.9920	0.5820	**1.000**	0.050	0.050	1.000	0.582	0.410
Lead	**0.05**	0.3950	0.0883	**1.000**	0.020	0.020	1.000	0.088	0.307
Manganese	**0.15**	1.8400	0.1500	**1.000**	0.092	0.092	1.000	0.150	1.690
Nickel	**0.1**	5.4500	0.3140	**1.000**	0.273	0.273	1.000	0.314	5.136
Selenium	**1**	1.0000	1.0000	**1.000**	0.050	0.050	1.000	1.000	0.000
Cobalt	**0.1**	0.3240	0.1000	**1.000**	0.016	0.016	1.000	0.100	0.224

Metal	FH Sample (M_{fh}) (micrograms)	FH Blank (M_{fhb}) (micrograms)	BH Sample (M_{bh}) (micrograms)	BH Blank (M_{bhb}) (micrograms)	Total Metal (M_t) (micrograms)	
Antimony	0.200	0.200	0.104	0.100	**0.300**	**BDL**
Arsenic	1.000	1.000	0.200	0.200	**1.200**	**BDL**
Beryllium	0.200	0.200	0.100	0.100	**0.300**	**BDL**
Cadmium	0.130	0.100	0.416	0.050	**0.396**	**ADL**
Chromium	1.620	1.710	0.992	0.582	**1.150**	**BDL**
Lead	0.500	0.500	0.395	0.088	**0.550**	**BDL**
Manganese	1.100	0.610	1.840	0.150	**2.180**	**ADL**
Nickel	4.500	3.560	5.450	0.314	**6.076**	**ADL**
Selenium	2.000	2.000	1.000	1.000	**3.000**	**BDL**
Cobalt	0.200	0.200	0.324	0.100	**0.300**	**BDL**

$$M_t = (M_{fh} - M_{fhb}) + (M_{bh} - M_{bhb})$$

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/2/2011
RUN NUMBER: 29-3

γ FACTOR:	0.999	**STACK DIAM:**	8.00 **inches**
BAROMETRIC:	30.06 **in. Hg**	**METER VOLUME:**	1.154 **ft^3**
STATIC PRES:	2.00 **in.H_2O**	**METER TEMP:**	109.0 **°F**
STACK TEMP:	212.0 **°F**	**LIQUID COLL:**	713.0 **milliliters**
SQ.RT ΔP:	1.4491 **in.H_2O**	**CO_2:**	0.49 **% by volume**
ΔH:	0.06 **in.H_2O**	**O_2:**	16.80 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.075 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 33.561 \text{ scf}$$

V_{lc} = 713.0 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9690$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9838$$

T = 373.0 °K
P = 767.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9690

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 29-3

SOURCE: 736 DCU
TEST DATE: 8/2/2011

BAROMETRIC:	30.06 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	2.0 **in.H_2O**	**CO_2:**	0.49 **% by volume**
STACK TEMP:	212.0 **°F**	**O_2:**	16.80 **% by volume**
SQ.RT ΔP:	1.4491 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.75 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 18.33 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 1.4491 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 212.0 °F + 460 = 672.0 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.21 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 114.633 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 2,401 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,904.5 **scfm, wb**
114,270 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 59.1 **dscfm**
3,545 **dscfh**

METHOD 29 ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 8/2/2011
RUN NO: 29-3

INPUT

V_m:	1.154	**ft³**	Q_s:	3,545	**dscfh**
γ **FACTOR:**	0.999		T_s:	212.0	**°F**
P_{bar}:	30.06	**in. Hg**	Θ:	5.0	**minutes**
ΔH:	0.06	**in. H_2O**	V_s:	114.633	**fps**
T_m:	109.0	**°F**	P_s:	30.21	**in. Hg**
			V_{lc}:	713.0	**mL**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.075 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 659.03 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 5 minutes

USEPA Method 29
Metals Emissions Calculation Summary

Client:	Houston Refining
Location:	Houston, TX
Source:	736 DCU
Date:	08/02/11
Run #:	29-3

Test Data Input

Barometric pressure (P_{bar}):	30.06 inches Hg
Stack pressure (P_s):	30.21 Inches Hg Abs.
Test length (θ):	5.0 minutes
Sample nozzle diameter (D_n):	0.1880 inches
Sample nozzle area (A_n):	0.000193 ft^3
Stack temperature (T_s):	212.0 °F
Volume metered (V_{mstd}):	1.075 dscf
Stack gas velocity (V_s):	114.633 ft/sec
Stack gas volumetric flow (Q_{std}):	3,545 dscfh
Fractional Moisture content (B_{ws}):	0.9690
Stack Oxygen Content (%O_2):	16.80 %
Cycle Time:	0.0833 hrs

Metals Laboratory Analysis Weights (M_t)

Antimony (Sb):	< 0.30 µg	**Manganese (Mn):**	8.98 υγ
Arsenic (As):	< 1.20 µg		
Beryllium (Be):	< 0.30 µg	**Nickel (Ni):**	2.42 µg
Cadmium (Cd):	0.24 µg	**Selenium (Se):**	< 3.00 µg
Chromium (Cr):	1.15 µg	**Cobalt (Co)**	1.02 µg
Lead (Pb):	0.55 µg		

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Metals concentration (µg/dscm):

$$C_s = \frac{M_t}{\left[\left(\frac{V_{mstd}}{35.315\,\text{dscf/dscm}}\right)\right]}$$

=	< 9.858863 µg/dscm	Antimony (Sb)	=	295.075768 µg/dscm	Manganese (Mn)
=	< 39.435452 µg/dscm	Arsenic (As)	=		
=	< 9.858863 µg/dscm	Beryllium (Be)	=	79.396709 µg/dscm	Nickel (Ni)
=	7.821365 µg/dscm	Cadmium (Cd)	=	< 98.588629 µg/dscm	Selenium (Se)
=	37.792308 µg/dscm	Chromium (Cr)	=	33.520134 µg/dscm	Cobalt (Co)
=	18.074582 µg/dscm	Lead (Pb)			

Metals concentration (x10^{-9} lb/dscf):

$$C'_s = \frac{\left(\frac{2.2046\times10^{-9}\,\text{lb}}{\mu\text{g}}\times M_t\right)}{V_{mstd}}$$

=	< 0.615457 x 10^{-9} lb/dscf	Antimony (Sb)	=	18.420616	x 10^{-9} lb/dscf Manganese (Mn)
=	< 2.461826 x 10^{-9} lb/dscf	Arsenic (As)			
=	< 0.615457 x 10^{-9} lb/dscf	Beryllium (Be)	=	4.956477	x 10^{-9} lb/dscf Nickel (Ni)
=	0.488262 x 10^{-9} lb/dscf	Cadmium (Cd)	=	< 6.154566	x 10^{-9} lb/dscf Selenium (Se)
=	2.359250 x 10^{-9} lb/dscf	Chromium (Cr)	=	2.092552	x 10^{-9} lb/dscf Cobalt (Co)
=	1.128337 x 10^{-9} lb/dscf	Lead (Pb)			

Metals emission rate (x10^{-4} lb/hr):

$$E_m = C'_s \times Q_{std}$$

=	< 0.021820 x10^{-4} lb/hr	Antimony (Sb)	=	0.653083 x10^{-4} lb/hr	Manganese (Mn)
=	< 0.087281 x10^{-4} lb/hr	Arsenic (As)			
=	< 0.021820 x10^{-4} lb/hr	Beryllium (Be)	=	0.175727 x10^{-4} lb/hr	Nickel (Ni)
=	0.017311 x10^{-4} lb/hr	Cadmium (Cd)	=	< 0.218204 x10^{-4} lb/hr	Selenium (Se)
=	0.083645 x10^{-4} lb/hr	Chromium (Cr)	=	0.074189 x10^{-4} lb/hr	Cobalt (Co)
=	0.040004 x10^{-4} lb/hr	Lead (Pb)			

Metals emission rate (x10^{-4} lb/cycle):

$$E_{m,lb/hr} = C'_s \times Q_{std}$$

=	< 0.001818 x10^{-4} lb/cycle	Antimony (Sb)	=	0.054424 x10^{-4} lb/cycle	Manganese (Mn)
=	< 0.007273 x10^{-4} lb/cycle	Arsenic (As)			
=	< 0.001818 x10^{-4} lb/cycle	Beryllium (Be)	=	0.014644 x10^{-4} lb/cycle	Nickel (Ni)
=	0.001443 x10^{-4} lb/cycle	Cadmium (Cd)	=	< 0.018184 x10^{-4} lb/cycle	Selenium (Se)
=	0.006970 x10^{-4} lb/cycle	Chromium (Cr)	=	0.006182 x10^{-4} lb/cycle	Cobalt (Co)
=	0.003334 x10^{-4} lb/cycle	Lead (Pb)			

Metals Laboratory Data Summary

Client: Houston Refining
Location: Houston, TX
Source: 736 DCU
Date: 8/2/2011
Run #: 29-3

Front Half Metal Calculation

Metal	Detection Limit (micrograms)	FH Sample (M_{fh}) (micrograms)	FH Blank (M_{fhb}) (micrograms)	*I Value* *A* Value (4 inch filter) (micrograms)	*II Values* 5 % of FH Sample (micrograms)	Lesser value (M_{fhb}) vs 5% (micrograms)	Greater Value *I vs II* (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)
Antimony	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.000
Arsenic	**1**	1.0000	1.0000	**17.590**	0.050	0.050	17.590	1.000	0.000
Beryllium	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.000
Cadmium	**0.1**	0.1000	0.1000	**17.590**	0.005	0.005	17.590	0.100	0.000
Chromium	**1**	1.4000	1.7100	**17.590**	0.070	0.070	17.590	1.710	-0.310
Lead	**0.5**	0.5000	0.5000	**17.590**	0.025	0.025	17.590	0.500	0.000
Manganese	**0.5**	9.5300	0.6100	**17.590**	0.477	0.477	17.590	0.610	8.920
Nickel	**0.2**	4.9200	3.5600	**17.590**	0.246	0.246	17.590	3.560	1.360
Selenium	**2**	2.0000	2.0000	**17.590**	0.100	0.100	17.590	2.000	0.000
Cobalt	**0.2**	0.2000	0.2000	**17.590**	0.010	0.010	17.590	0.200	0.000

Back Half Metal Calculation

Metal	Detection Limit (micrograms)	BH Sample (M_{bh}) (micrograms)	BH Blank (M_{bhb}) (micrograms)	*I Value* (micrograms)	*II Values* 5 % of BH Sample (micrograms)	Lesser value (M_{bh}) vs 5% (micrograms)	Greater Value I vs II (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)
Antimony	**0.1**	0.1000	0.1000	**1.000**	0.005	0.005	1.000	0.100	0.000
Arsenic	**0.2**	0.2000	0.2000	**1.000**	0.010	0.010	1.000	0.200	0.000
Beryllium	**0.1**	0.1000	0.1000	**1.000**	0.005	0.005	1.000	0.100	0.000
Cadmium	**0.05**	0.2880	0.0500	**1.000**	0.014	0.014	1.000	0.050	0.238
Chromium	**0.15**	0.8730	0.5820	**1.000**	0.044	0.044	1.000	0.582	0.291
Lead	**0.05**	0.3150	0.0883	**1.000**	0.016	0.016	1.000	0.088	0.227
Manganese	**0.15**	0.2090	0.1500	**1.000**	0.010	0.010	1.000	0.150	0.059
Nickel	**0.1**	1.3700	0.3140	**1.000**	0.069	0.069	1.000	0.314	1.056
Selenium	**1**	1.0000	1.0000	**1.000**	0.050	0.050	1.000	1.000	0.000
Cobalt	**0.1**	1.1200	0.1000	**1.000**	0.056	0.056	1.000	0.100	1.020

Metal	FH Sample (M_{fh}) (micrograms)	FH Blank (M_{fhb}) (micrograms)	BH Sample (M_{bh}) (micrograms)	BH Blank (M_{bhb}) (micrograms)	Total Metal (M_t) (micrograms)	
Antimony	0.200	0.200	0.100	0.100	**0.300**	**BDL**
Arsenic	1.000	1.000	0.200	0.200	**1.200**	**BDL**
Beryllium	0.200	0.200	0.100	0.100	**0.300**	**BDL**
Cadmium	0.100	0.100	0.288	0.050	**0.238**	**ADL**
Chromium	1.400	1.710	0.873	0.582	**1.150**	**BDL**
Lead	0.500	0.500	0.315	0.088	**0.550**	**BDL**
Manganese	9.530	0.610	0.209	0.150	**8.979**	**ADL**
Nickel	4.920	3.560	1.370	0.314	**2.416**	**ADL**
Selenium	2.000	2.000	1.000	1.000	**3.000**	**BDL**
Cobalt	0.200	0.200	1.120	0.100	**1.020**	**ADL**

$$M_t = (M_{fh} - M_{fhb}) + (M_{bh} - M_{bhb})$$

TRS EMISSION RATE DATA SHEET
USEPA METHOD 16A

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: GC-FPD
RUN NO: 16A-1
TEST DATE: 7/29/2011

INPUT

TRS as SO_2 AVERAGE READING (C):	1.60	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,932	dscfh
CYCLE TIME:	1.267	hrs

CALCULATIONS

TRS CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{64.06 lb/lb-mole}{385.26\times10^{6} ft^{3}/lb-mole}\right)$$

= 0.2660 x 10^{-6} lbs/dscf

TRS EMISSION RATE (AS SO_2):

STACK GAS VOLUMETRIC FLOW RATE = 1,932 dscfh

STACK TRS EMISSION RATE =

$$TRS_{pmr} = (C_{gas,lb/dscf})(Q_{std})$$

= 0.00051 lbs/hr
0.00065 lbs/cycle

USEPA METHOD 16A: TOTAL REDUCED SULFUR CALCULATION SHEET

Company: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Test Date: 7/29/2011
Run # : 16A-1

Raw Test Data:

16A-1		SRU-16A-1RS	
V_m:	5.474 ft^3	V_m:	2.579 ft^3
Y_d:	1.000 dimensionless	Y_d:	1.000 dimensionless
P_{bar}:	30.04 in.Hg	P_{bar}:	29.85 in.Hg
ΔH:	0.24 in.H_2O	ΔH:	0.10 in.H_2O
T_m:	98.3 °F	T_m:	103.0 °F
Q_s:	1,932 dscfh	$C_{RG\ (act)}$:	20.0 ppm

Laboratory Analysis of Hydrogen Peroxide (H_2O_2) for SO_2:

	16A-1	SRU-16A-1RS
Normality of $BaCl_2$ titrant:	0.00992 N	0.00992 N
Volume of Sample:	70 milliliters	80 milliliters
Volume of Sample Aliquot:	20 milliliters	20 milliliters
Volume of $BaCl_2$ titrant used:	0.78 milliliters	0.78 milliliters
Volume of Blank titrant used:	0.2 milliliters	0.2 milliliters

Calculations:

Volume of sample at standard conditions on dry basis:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

English Units (29.92 in. Hg, 68° F)

= 5.200 **dscf**
147.250 **liters**

Volume of recovery sample at standard conditions on dry basis:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 2.413 **dscf**
68.328 **liters**

Concentration of TRS as SO_2 in Sample

$$C_{TRS} = \frac{(12025)(N)(V_t - V_b)\left(\frac{V_{soln}}{V_a}\right)}{V_{mstd}}$$

= 1.630 **ppmv db TRS as SO_2**

Concentration of TRS as SO_2 in Recovery Sample

$$C_{RG(m)} = \frac{(12025)(N)(V_t - V_b)\left(\frac{V_{soln}}{V_a}\right)}{V_{mstd}}$$

= 4.016 **ppmv db TRS as SO_2**

Recovery Efficiency for the System Performance Check

$$R = \frac{C_{RG(m)}}{C_{RG(act)}} \times 100$$

= 20.08 %

TRS EMISSION RATE DATA SHEET
USEPA METHOD 16A

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: GC-FPD
RUN NO: 16A-2
TEST DATE: 8/1/2011

INPUT

TRS as SO_2 AVERAGE READING (C):	<0.16	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,504	dscfh
CYCLE TIME:	0.433	hrs

CALCULATIONS

TRS CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{64.06 lb/lb-mole}{385.26\times10^{6} ft^{3}/lb-mole}\right)$$

= <0.027 x 10^{-6} lbs/dscf

TRS EMISSION RATE (AS SO_2):

STACK GAS VOLUMETRIC FLOW RATE = 1,504 dscfh

STACK TRS EMISSION RATE =

$$TRS_{pmr} = (C_{gas,lb/dscf})(Q_{std})$$

= <0.000040 lbs/hr
<0.000017 lbs/cycle

USEPA METHOD 16A: TOTAL REDUCED SULFUR CALCULATION SHEET

Company: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Test Date: 8/1/2011
Run # : 16A-2

Raw Test Data:

16A-2		SRU-16A-2RS	
V_m:	1.441 ft^3	V_m:	3.394 ft^3
Y_d:	1.0000 dimensionless	Y_d:	1.0000 dimensionless
P_{bar}:	30.04 in.Hg	P_{bar}:	30.06 in.Hg
ΔH:	0.39 in.H_2O	ΔH:	0.13 in.H_2O
T_m:	100.8 °F	T_m:	99.2 °F
Q_s:	1.504 dscfh	$C_{RG\ (act)}$:	20.0 ppm

Laboratory Analysis of Hydrogen Peroxide (H_2O_2) for SO_2:

	16A-2	SRU-16A-2RS
Normality of $BaCl_2$ titrant:	0.00992 N	0.00992 N
Volume of Sample:	110 milliliters	100 milliliters
Volume of Sample Aliquot:	20 milliliters	20 milliliters
Volume of $BaCl_2$ titrant used:	0.20 milliliters	3.80 milliliters
Volume of Blank titrant used:	0.2 milliliters	0.2 milliliters

Calculations:

Volume of sample at standard conditions on dry basis:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

English Units (29.92 in. Hg, 68° F)

= 1.363 **dscf**
38.602 **liters**

Volume of recovery sample at standard conditions on dry basis:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 3.221 **dscf**
91.205 **liters**

Concentration of TRS as SO_2

$$C_{TRS} = \frac{(12025)(N)(V_t - V_b)\left(\frac{V_{soln}}{V_a}\right)}{V_{mstd}}$$

= 0.000 **ppmv db TRS as SO_2**

Concentration of TRS as SO_2 in Recovery Sample

$$C_{RG(m)} = \frac{(12025)(N)(V_t - V_b)\left(\frac{V_{soln}}{V_a}\right)}{V_{mstd}}$$

= 23.544 **ppmv db TRS as SO_2**

Recovery Efficiency for the System Performance Check

$$R = \frac{C_{RG(m)}}{C_{RG(act)}} \times 100$$

= 117.72 %

TRS EMISSION RATE DATA SHEET
USEPA METHOD 16A

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: GC-FPD
RUN NO: 16A-3
TEST DATE: 8/2/2011

INPUT

TRS as SO_2 AVERAGE READING (C):	98.40	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	28,949	dscfh
CYCLE TIME:	0.083	hrs

CALCULATIONS

TRS CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{64.06 lb/lb-mole}{385.26\times10^{6} ft^{3}/lb-mole}\right)$$

= 16.3617 x 10^{-6} lbs/dscf

TRS EMISSION RATE (AS SO_2):

STACK GAS VOLUMETRIC FLOW RATE = 28,949 dscfh

STACK TRS EMISSION RATE =

$$TRS_{pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= 0.4736 lbs/hr
<0.039471 lbs/cycle

USEPA METHOD 16A: TOTAL REDUCED SULFUR CALCULATION SHEET

Company: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Test Date: 8/2/2011
Run # : 16A-3

Raw Test Data:

	16A-3		SRU-16A-3RS
V_m:	0.155 ft^3	V_m:	3.308 ft^3
Y_d:	1.000 dimensionless	Y_d:	1.000 dimensionless
P_{bar}:	30.06 in.Hg	P_{bar}:	29.85 in.Hg
ΔH:	1.38 in.H_2O	ΔH:	0.10 in.H_2O
T_m:	95.6 °F	T_m:	99.7 °F
Q_s:	28,949 dscfh	$C_{RG\ (act)}$:	20.0 ppm

Laboratory Analysis of Hydrogen Peroxide (H_2O_2) for SO_2:

	16A-3	SRU-16A-3RS
Normality of $BaCl_2$ titrant:	0.00992 N	0.00992 N
Volume of Sample:	100 milliliters	100 milliliters
Volume of Sample Aliquot:	20 milliliters	20 milliliters
Volume of $BaCl_2$ titrant used:	0.88 milliliters	3.80 milliliters
Volume of Blank titrant used:	0.2 milliliters	0.2 milliliters

Calculations:

Volume of sample at standard conditions on dry basis:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

English Units (29.92 in. Hg, 68° F)

= 0.149 **dscf**
4.215 **liters**

Volume of recovery sample at standard conditions on dry basis:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right]$$

= 3.114 **dscf**
88.168 **liters**

Concentration of TRS as SO_2

$$C_{TRS} = \frac{(12025)(N)(V_t - V_b)\left(\frac{V_{soln}}{V_a}\right)}{V_{mstd}}$$

= 95.525 **ppmv db TRS as SO_2**

Concentration of TRS as SO_2 in Recovery Sample

$$C_{RG(m)} = \frac{(12025)(N)(V_t - V_b)\left(\frac{V_{soln}}{V_a}\right)}{V_{mstd}}$$

= 24.355 **ppmv db TRS as SO_2**

Recovery Efficiency for the System Performance Check

$$R = \frac{C_{RG(m)}}{C_{RG(act)}} \times 100$$

= 121.78 **%**

MONITOR DATA SUMMARY

COMPANY :	Houston Refining
SOURCE :	736 Coker
REPETITION :	1
TEST DATE :	7/29/2011
START TIME :	7:52
END TIME :	9:07

GAS ANALYZER O_2

SPAN VALUE :	22.70 %
AVERAGE CAL. BIAS (C_m):	11.219
AVERAGE ZERO BIAS (C_o):	0.013
CALIBRATION GAS:	EPA Protocol O_2
CALIBRATION % (C_{ma}):	11.00
% CORRECTED (C_{gas}):	**20.57**

GAS ANALYZER CO_2

SPAN VALUE :	19.60 %
AVERAGE CAL. BIAS (C_m):	9.74
AVERAGE ZERO BIAS (C_o):	-0.09
CALIBRATION GAS:	EPA Protocol CO_2
CALIBRATION % (C_{ma}):	9.50
% CORRECTED (C_{gas}):	**0.00**

GAS ANALYZER CO

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.58
AVERAGE ZERO BIAS (C_o):	0.61
CALIBRATION GAS:	EPA Protocol CO
CALIBRATION PPM (C_{ma}):	45.0
PPM CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER NO_x

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.2
AVERAGE ZERO BIAS (C_o):	0.5
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	45.0
ppm CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER VOCs

SPAN VALUE :	300000 ppm
AVERAGE CAL. BIAS (C_m):	95897
AVERAGE ZERO BIAS (C_o):	1654
CALIBRATION GAS:	EPA Protocol C_3H_8
CALIBRATION ppm (C_{ma}):	100000
ppm CORRECTED (C_{gas}):	**62023**

GAS ANALYZER SO_2

SPAN VALUE :	500 ppm
AVERAGE CAL. BIAS (C_m):	244.8
AVERAGE ZERO BIAS (C_o):	2.5
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	250.0
ppm CORRECTED (C_{gas}):	**3.4**

Example Calculation = $$C_{gas} = \left(\overline{C} - C_o\right) \frac{C_{ma}}{C_m - C_o}$$

CLOCK TIME	ELAPSED TIME	NO_x	SO_2	CO	C_3H_8	O_2	CO_2
7:52	0	-------	-------	-------	-------	-------	-------
7:53	1	0.3	9.1	0.8	64484	20.69	-0.08
7:54	2	0.5	8.9	0.9	64438	20.71	-0.09
7:55	3	3.4	8.8	3.9	64484	20.55	-0.09
7:56	4	0.4	9.0	15.8	64223	20.50	-0.08
7:57	5	0.3	9.0	3.4	62950	20.77	-0.09
7:58	6	0.3	9.1	0.7	62542	20.31	-0.09
7:59	7	0.3	9.2	0.9	62078	20.03	-0.09
8:00	8	0.3	9.0	2.3	61617	20.66	-0.08
8:01	9	0.4	8.7	1.6	61157	20.88	-0.08
8:02	10	0.3	8.5	1.4	61166	20.90	-0.08
8:03	11	0.3	8.6	1.5	61255	20.91	-0.08
8:04	12	0.3	8.4	0.7	60462	20.92	-0.08
8:05	13	0.3	8.0	0.5	59978	20.92	-0.09
8:06	14	0.3	7.7	1.6	59710	20.94	-0.09
8:07	15	0.3	7.5	1.7	59800	20.96	-0.09
8:08	16	0.3	7.2	1.4	59632	20.97	-0.09
8:09	17	0.3	6.8	1.3	59652	20.98	-0.09
8:10	18	0.3	6.6	1.4	59829	20.98	-0.09
8:11	19	0.3	6.5	1.4	60435	20.99	-0.08
8:12	20	0.3	6.2	1.6	59995	21.00	-0.08
8:13	21	0.3	6.0	1.6	60022	21.00	-0.08
8:14	22	0.3	5.6	1.5	60168	21.00	-0.08
8:15	23	0.3	5.4	1.5	60334	21.01	-0.08
8:16	24	0.3	5.1	1.4	60653	21.01	-0.08
8:17	25	0.3	5.1	1.4	60794	21.02	-0.09
8:18	26	0.3	4.9	1.2	60782	21.02	-0.09
8:19	27	0.3	4.9	1.3	60805	21.01	-0.09
8:20	28	0.3	5.0	1.3	60577	21.00	-0.09
8:21	29	0.3	4.9	1.3	61395	21.00	-0.09
8:22	30	0.3	4.9	1.2	61426	21.00	-0.09
8:23	31	0.3	4.9	0.8	59603	21.04	-0.08
8:24	32	0.3	4.9	1.3	61487	21.02	-0.08
8:25	33	0.3	4.9	1.1	61361	21.02	-0.08
8:26	34	0.3	4.7	1.0	61402	21.02	-0.08
8:27	35	0.3	4.8	1.0	60932	21.03	-0.08
8:28	36	0.3	4.9	1.0	60698	21.03	-0.09
8:29	37	0.3	4.9	1.1	60866	21.03	-0.09
8:30	38	0.3	5.1	1.0	61017	21.03	-0.09
8:31	39	0.3	4.9	1.1	60687	21.03	-0.09
8:32	40	0.3	5.2	1.1	60380	21.03	-0.09
8:33	41	0.3	5.0	1.0	59941	21.03	-0.08
8:34	42	0.3	5.2	1.0	59715	21.03	-0.08
8:35	43	0.3	5.4	0.9	59423	21.03	-0.08
8:36	44	0.3	5.2	0.8	59359	21.04	-0.08
8:37	45	0.3	5.4	0.5	59509	21.03	-0.08
8:38	46	0.3	5.2	0.4	59400	21.02	-0.09
8:39	47	0.3	5.3	0.6	59156	21.03	-0.09
8:40	48	0.3	5.2	0.5	59280	21.03	-0.09
8:41	49	0.3	5.2	0.5	58752	21.04	-0.09
8:42	50	0.3	5.0	0.5	59222	21.04	-0.09
8:43	51	0.3	5.1	0.5	59115	21.04	-0.09
8:44	52	0.3	4.8	0.3	58931	21.05	-0.08
8:45	53	0.3	5.0	0.4	59025	21.05	-0.08
8:46	54	0.3	4.9	0.3	58573	21.05	-0.08
8:47	55	0.2	4.8	0.4	58209	21.05	-0.08
8:48	56	0.3	4.8	0.5	58028	21.05	-0.08
8:49	57	0.2	4.6	0.4	58250	21.06	-0.08
8:50	58	0.3	4.4	0.9	58424	21.06	-0.09
8:51	59	0.3	4.6	1.0	58614	21.07	-0.08
8:52	60	0.3	4.4	0.9	58450	21.07	-0.09
8:53	61	0.3	4.6	0.8	58314	21.08	-0.08
8:54	62	0.3	4.5	0.9	58498	21.08	-0.08
8:55	63	0.3	4.6	0.9	61291	21.08	-0.08
8:56	64	0.3	4.5	0.9	64168	21.08	-0.08
8:57	65	0.3	4.5	1.0	62342	21.08	-0.08
8:58	66	0.3	4.5	1.0	60480	21.08	-0.08
8:59	67	0.3	4.4	0.9	59760	21.07	-0.08
9:00	68	0.3	4.5	0.9	59002	21.07	-0.08
9:01	69	0.3	4.5	0.9	58665	21.07	-0.09
9:02	70	0.3	4.5	0.8	57589	21.07	-0.09
9:03	71	0.3	4.6	0.9	56529	21.06	-0.09
9:04	72	0.3	4.7	1.0	56296	21.06	-0.09
9:05	73	0.3	4.5	1.0	56558	21.06	-0.08
9:06	74	0.3	4.7	0.9	56794	21.06	-0.08
9:07	75	0.3	4.8	0.9	56997	21.06	-0.08
	Uncorrected Average (C) =	**0.33**	**5.75**	**1.26**	**60105.8**	**20.971**	**-0.084**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
TEST DATE: 7/29/2011
RUN NUMBER: 1

γ FACTOR:	0.999	**STACK DIAM:**	8 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	2.266 **ft^3**
STATIC PRES:	2.65 **in.H_2O**	**METER TEMP:**	83.6 **°F**
STACK TEMP:	212.6 **°F**	**LIQUID COLL:**	3658.5 **milliliters**
SQ.RT ΔP:	1.9256 **in.H_2O**	**CO_2:**	0.16 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	19.70 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.207 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 172.206 \text{ scf}$$

V_{lc} = 3658.5 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9873$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 0.995$$

T = 373.3 °K
P = 768.0 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9873

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Ref ning
LOCATION: Houston, TX
RUN NUMBER: 1

SOURCE: 736 Coker
TEST DATE: 7/29/2011

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.00 **inches**
STATIC PRES:	2.653333 **in.H_2O**	**CO_2:**	0.16 **% by volume**
STACK TEMP:	212.6 °F	**O_2:**	19.70 **% by volume**
SQ.RT ΔP:	1.92561 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.81 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 18.14 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 1.9256 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 212.6 °F + 460 = 672.6 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.24 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 153.1457 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 3,207.5 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 2,544.4 **scfm, wb**
152,666 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 32.2 **dscfm**
1,932 **dscfh**

SO_2 CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 6C

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
MONITOR ID: Ametek Wesgtern Research Model 721
RUN NO: 1
TEST DATE: 7/29/2011

INPUT

SO_2 AVERAGE CHART READING (C):	5.75	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	2.5	ppmv
CAL GAS CONCENTRATION (C_{ma}):	250.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	244.8	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,932	dscfh
Cycle Time:	1.267	hrs

CALCULATIONS

STACK SO_2 AVERAGE CHART READING = 5.75 ppmv

STACK SO_2 CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

SO_2 CONC, ppmv (corrected) = $C_{gas,ppm} = (\overline{C} - C_o)\frac{C_{ma}}{C_m - C_o}$ = 3.39 ppmv db

SO_2 CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{64\,lb/lb-mole}{385.26\times10^6\,ft^3/lb-mole}\right) = 0.563 \times 10^{-6} \text{ lbs/dscf}$$

SO_2 EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,932 dscfh

STACK SO_2 EMISSION RATE =

$$SO_{2\,ppmr} = (C_{gas,lb/dscf})(Q_{std}) =$$ <0.00109 lbs/hr
<0.00138 lbs/cycle

NO_x CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 7E

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
MONITOR ID: California Analytical Instruments, Inc. Series 600
RUN NO: 1
TEST DATE: 7/29/2011

INPUT

NO_x AVERAGE CHART READING (C):	0.33	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	0.5	ppmv
CAL GAS CONCENTRATION (C_{ma}):	45.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	45.2	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,932	dscfh
Cycle Time:	1.267	hrs

CALCULATIONS

STACK NO_x AVERAGE CHART READING = 0.33 ppmv

STACK NO_x CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

NO_x CONC, ppmv (corrected) = $C_{gas,ppm} = (\overline{C} - C_o)\frac{C_{ma}}{C_m - C_o}$ = <1.80 ppmv db

NO_x CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{46 lb/lb-mole}{385.26 \times 10^6 ft^3/lb-mole}\right)$$ = <0.215 x 10^{-6} lbs/dscf

NO_x EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,932 dscfh

STACK NOx EMISSION RATE =

$$NO_{x_{pmr}} = (C_{gas,lb/dscf})(Q_{std})$$ = <0.00042 lbs/hr
<0.00053 lbs/cycle

CO CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 10

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
MONITOR ID: Thermo Environmental Model 48H
RUN NO: 1
TEST DATE: 7/29/2011

INPUT

CO AVERAGE CHART READING (C):	1.26	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	0.6	ppmv
CAL GAS CONCENTRATION (C_{ma}):	45.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	45.6	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,932	dscfh
Cycle Time:	1.267	hrs

CALCULATIONS

STACK CO AVERAGE CHART READING = 1.26 ppmv

STACK CO CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

CO CONC, ppmv (corrected) $C_{gas,ppm} = (\overline{C} - C_o)\frac{C_{ma}}{C_m - C_o}$ = <1.80 ppmv db

CO CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{28 lb/lb-mole}{385.26 \times 10^6 ft^3/lb-mole}\right)$$ = <0.131 x 10^{-6} lbs/dscf

CO EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,932 dscfh

STACK CO EMISSION RATE =

$CO_{pmr} = (C_{gas,lb/dscf})(Q_{std})$ = 0.000253 lbs/hr
= 0.00032 lbs/cycle

METHOD 25A TOTAL HYDROCARBON (THC) CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
RUN NUMBER: 1
TEST DATE: 7/29/2011

INPUT DATA

THC (as propane) average concentration:	60106	ppmv db
Propane/N_2 avg. Zero pre-test System Bias:	479	ppmv db
Propane/N_2 avg. Zero post-test System Bias:	2829	ppmv db
Propane/N_2 Cal. Gas Conc.:	100000.0	ppmv db
Propane/N_2 avg. Cal. pre-test System Bias:	97522.1	ppmv db
Propane/N_2 avg. Cal. post-test System Bias:	94271.4	ppmv db
Dilution Factor:	0.95	
Undiluted Moisture Fraction:	0.987	
Diluted Moisture Frafion:	0.0494	
Cycle Time :	1.267	hrs
Average THC (as propane) value (C) =	58960.8	ppmv db
THC as carbon, C_1 =	176882.4	ppmv db
Stack gas volumetric flow rate (Q_s) =	1,932	dscfh

CALCULATIONS

THC concentration in stack gas (lb/dscf)

$$C'_{gas(propane)} = \frac{(C_{gas(propane)})(44.09)}{(385.26 \times 10^6)} =$$ 6748 x 10^{-6} lb/dscf as propane

$$C'_{gas(carbon)} = \frac{(C_{gas(carbon)})(12.01)}{(385.26 \times 10^6)} =$$ 5514 x 10^{-6} lb/dscf as carbon

THC emission rate

$$E_{THC(propane)} = C'_{gas(propane)} \times Q_{std} =$$ 13.0357 lb/hr, 16.51 lb/cycle

$$E_{THC(carbon)} = C'_{gas(carbon)} \times Q_{std} =$$ 10.6526 lb/hr, 13.49 lb/cycle

METHOD 25A TOTAL HYDROCARBON (THC) CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
RUN NUMBER: 1
TEST DATE: 7/29/2011

INPUT DATA

Methane (CH_4) average concentration:	27322	ppmv db
Ethane (C_2H_6) average concentration:	2168	ppmv db
Cycle Time :	1.26666667	hrs
Stack gas volumetric flow rate (Q_s) =	1,932	dscfh

CALCULATIONS

THC concentration in stack gas (lb/dscf)

Methane $C'_{gas(methane)} = \frac{(C_{gas(Methane)})(16.04)}{(385.26 \times 10^6)} =$ 1138 x 10^{-6} lb/dscf as methane

Ethane $C'_{gas(ethane)} = \frac{(C_{gas(ethane)})(30.07)}{(385.26 \times 10^6)} =$ 169.21 x 10^{-6} lb/dscf as ethane

THC emission rate

$E_{THC(methane)} = C'_{gas(methane)} \times Q_{std} =$ 2.1976 lb/hr
2.7836 lb/cycle

$E_{HC(ethane)} = C'_{gas(ethane)} \times Q_{std} =$ 0.3269 lb/hr
0.4141 lb/cycle

MONITOR DATA SUMMARY

COMPANY :	Houston Refining
SOURCE :	736 Coker
REPETITION :	2
TEST DATE :	8/1/2011
START TIME :	12:42
END TIME :	13:09

GAS ANALYZER O_2

SPAN VALUE :	22.70 %
AVERAGE CAL. BIAS (C_m):	10.998
AVERAGE ZERO BIAS (C_o):	0.024
CALIBRATION GAS:	EPA Protocol O_2
CALIBRATION % (C_{ma}):	11.00
% CORRECTED (C_{gas}):	**20.26**

GAS ANALYZER CO_2

SPAN VALUE :	19.60 %
AVERAGE CAL. BIAS (C_m):	9.48
AVERAGE ZERO BIAS (C_o):	0.02
CALIBRATION GAS:	EPA Protocol CO_2
CALIBRATION % (C_{ma}):	9.50
% CORRECTED (C_{gas}):	**-0.12**

GAS ANALYZER CO

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	46.39
AVERAGE ZERO BIAS (C_o):	-0.28
CALIBRATION GAS:	EPA Protocol CO
CALIBRATION PPM (C_{ma}):	45.0
PPM CORRECTED (C_{gas}):	**<2.39**

GAS ANALYZER NO_x

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	46.2
AVERAGE ZERO BIAS (C_o):	0.3
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	45.0
ppm CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER VOCs

SPAN VALUE :	300000 ppm
AVERAGE CAL. BIAS (C_m):	43860
AVERAGE ZERO BIAS (C_o):	3363
CALIBRATION GAS:	EPA Protocol C_3H_8
CALIBRATION ppm (C_{ma}):	100000.0
ppm CORRECTED (C_{gas}):	**44273.3**

GAS ANALYZER SO_2

SPAN VALUE :	200 ppm
AVERAGE CAL. BIAS (C_m):	100.0
AVERAGE ZERO BIAS (C_o):	-1.9
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	100.0
ppm CORRECTED (C_{gas}):	**<1.8**

CLOCK TIME	ELAPSED TIME	NO_x	SO_2	CO	C_3H_8	O_2	CO_2
12:42	0	-------	-------	-------	-------	-------	-------
12:43	1	1.0	-1.7	1.2	60530	20.00	-0.11
12:44	2	1.0	-1.8	1.3	59187	20.00	-0.11
12:45	3	1.0	-1.9	1.4	57584	20.01	-0.10
12:46	4	1.0	-1.9	1.5	52802	20.02	-0.10
12:47	5	0.8	-2.1	5.8	61361	20.11	-0.10
12:48	6	0.3	-0.1	6.7	15329	20.21	-0.09
12:49	7	0.3	-1.8	2.2	12895	20.30	-0.10
12:50	8	0.3	-2.2	2.0	12607	20.30	-0.10
12:51	9	0.3	-2.1	2.2	12081	20.30	-0.10
12:52	10	0.3	-2.2	1.9	11376	20.31	-0.10
12:53	11	0.3	-2.4	1.7	10721	20.31	-0.11
12:54	12	0.3	-2.2	1.8	11156	20.31	-0.11
12:55	13	0.3	-2.2	1.7	11021	20.30	-0.11
12:56	14	0.3	-2.4	1.8	10481	20.31	-0.11
12:57	15	0.3	-2.4	1.6	9546	20.31	-0.10
12:58	16	0.3	-2.4	1.4	9258	20.31	-0.10
12:59	17	0.3	-2.5	1.4	8885	20.31	-0.10
13:00	18	0.3	-2.4	1.5	8567	20.31	-0.10
13:01	19	0.3	-2.6	1.5	8408	20.31	-0.10
	Uncorrected Average (C) =	**0.42**	**-2.09**	**2.19**	**21292.6**	**20.240**	**-0.102**

Example Calculation = $$C_{gas} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$$

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
TEST DATE: 8/1/2011
RUN NUMBER: 2

γ FACTOR:	1.005	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	1.563 **ft^3**
STATIC PRES:	2.85 **in.H_2O**	**METER TEMP:**	110.0 **°F**
STACK TEMP:	262.8 **°F**	**LIQUID COLL:**	1384.0 **milliliters**
SQ.RT ΔP:	0.8988 **in.H_2O**	**CO_2:**	0.11 **% by volume**
ΔH:	0.05 **in.H_2O**	**O_2:**	20.20 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.461 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 65.145 \text{ scf}$$

V_{lc} = 1384.0 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9781$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 1.000$$

T = 401.2 °K
P = 768.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9781

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 2

SOURCE: 736 Coker
TEST DATE: 8/1/2011

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	2.85 **in.H_2O**	**CO_2:**	0.11 **% by volume**
STACK TEMP:	262.75 **°F**	**O_2:**	20.20 **% by volume**
SQ.RT ΔP:	0.89877 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.83 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 18.24 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 0.8988 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 262.8 °F + 460 = 722.8 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.25 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 73.8746 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 1,547.2 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,142.77 **scfm, wb**
68,566 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 25.07 **dscfm**
1,504 **dscfh**

SO_2 CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 6C

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
MONITOR ID: Ametek Wesgtern Research Model 721
RUN NO: 2
TEST DATE: 8/1/2011

INPUT

SO_2 AVERAGE CHART READING (C):	-2.09	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	-1.85	ppmv
CAL GAS CONCENTRATION (C_{ma}):	100.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	100.0	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,504	dscfh
Cycle Time:	0.433	hrs

CALCULATIONS

STACK SO_2 AVERAGE CHART READING = (2.09) ppmv

STACK SO_2 CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

SO_2 CONC, ppmv (corrected) = $C_{gas,ppm} = (\overline{C} - C_o)\frac{C_{ma}}{C_m - C_o}$ = <1.80 ppmv db

SO_2 CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{64\,lb/lb-mole}{385.26\times10^6\,ft^3/lb-mole}\right)$$ = <0.299 x 10^{-6} lbs/dscf

SO_2 EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,504 dscfh

STACK NOx EMISSION RATE

$$SO_{2\,ppm} = (C_{gas,lb/dscf})(Q_{std})$$ = <0.00045 lbs/hr
= <0.00019 lbs/cycle

NO_x CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 7E

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
MONITOR ID: California Analytical Instruments, Inc. Series 600
RUN NO: 2
TEST DATE: 8/1/2011

INPUT

NO_x AVERAGE CHART READING (C):	0.42	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	0.32	ppmv
CAL GAS CONCENTRATION (C_{ma}):	45.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	46.2	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,504	dscfh
Cycle Time:	0.433	hrs

CALCULATIONS

STACK NO_x AVERAGE CHART READING = 0.42 ppmv

STACK NO_x CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

NO_x CONC, ppmv (corrected) = $C_{gas,ppm} = (\overline{C} - C_o)\frac{C_{ma}}{C_m - C_o}$ = <1.80 ppmv db

NO_x CONC.(lbs/dscf) =

$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{46\,lb/lb-mole}{385.26 \times 10^6\,ft^3/lb-mole}\right)$ = <0.215 x 10^{-6} lbs/dscf

NO_x EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,504 dscfh

STACK NOx EMISSION RATE =

$NO_{xpmr} = (C_{gas,lb/dscf})(Q_{std})$ = <0.00032 lbs/hr
= <0.00014 lbs/cycle

CO CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 10

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
MONITOR ID: Thermo Environmental Model 48H
RUN NO: 2
TEST DATE: 8/1/2011

INPUT

CO AVERAGE CHART READING (C):	2.19 ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	-0.3 ppmv
CAL GAS CONCENTRATION (C_{ma}):	45.0 ppmv
AVG CAL PRE/POST TEST READING (C_m):	45.6 ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,504 dscfh
Cycle Time:	0.433 hrs

CALCULATIONS

STACK CO AVERAGE CHART READING = 2.1928 ppmv

STACK CO CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

CO CONC, ppmv (corrected) = $C_{gas,ppm} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$ = 2.43 ppmv db

CO CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{28 lb/lb-mole}{385.26 \times 10^{6} ft^3/lb-mole}\right)$$ = 0.177 x 10^{-6} lbs/dscf

CO EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,504 dscfh

STACK CO EMISSION RATE =

$CO_{pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$ = 0.00027 lbs/hr
= 0.00012 lbs/cycle

METHOD 25A TOTAL HYDROCARBON (THC) CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
RUN NUMBER: 2
TEST DATE: 8/1/2011

INPUT DATA

THC (as propane) average concentration:	21293	ppmv db
Propane/N_2 avg. Zero pre-test System Bias:	856.65	ppmv db
Propane/N_2 avg. Zero post-test System Bias:	5870.00	ppmv db
Propane/N_2 Cal. Gas Conc.:	40000.0	ppmv db
Propane/N_2 avg. Cal. pre-test System Bias:	43480.0	ppmv db
Propane/N_2 avg. Cal. post-test System Bias:	44240.2	ppmv db
Dilution Factor:	0.95	
Undiluted Moisture Fraction:	0.978	
Diluted Moisture Frafion:	0.0489	
Cycle Time :	0.433	hrs
Average THC (as propane) value (C) =	16843.3	ppmv db
THC as carbon, C_1 =	50529.8	ppmv db
Stack gas volumetric flow rate (Q_s) =	1,504	dscfh

CALCULATIONS

THC concentration in stack gas (lb/dscf)

$$C'_{gas(propane)} = \frac{(C_{gas(propane)})(44.09)}{(385.26 \times 10^6)} =$$

1928 x 10^{-6} lb/dscf as propane

$$C'_{gas(carbon)} = \frac{(C_{gas(carbon)})(12.01)}{(385.26 \times 10^6)} =$$

1575 x 10^{-6} lb/dscf as carbon

THC emission rate

$$E_{THC\ (propane)} = C'_{gas(propane)} \times Q_{std} =$$

2.90 lb/hr
1.26 lb/cycle

$$E_{THC(carbon)} = C'_{gas(carbon)} \times Q_{std} =$$

2.37 lb/hr
1.03 lb/cycle

METHOD 25A TOTAL HYDROCARBON (THC) CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker
RUN NUMBER: 2
TEST DATE: 8/1/2011

INPUT DATA

Methane (CH_4) average concentration:	9050	ppmv db
Ethane (C_2H_6) average concentration:	862	ppmv db
Cycle Time :	0.433	hrs
Stack gas volumetric flow rate (Q_s) =	1,504	dscfh

CALCULATIONS

THC concentration in stack gas (lb dscf)

Methane $C'_{gas(methane)} = \frac{(C_{gas(Methane)})(16.04)}{(385.26 \times 10^6)} =$ 377 x 10^{-6} lb/dscf as methane

Ethane $C'_{gas(ethane)} = \frac{(C_{gas(ethane)})(30.07)}{(385.26 \times 10^6)} =$ 67.28 x 10^{-6} lb/dscf as ethane

THC emission rate

$E_{HC(methane)} = C'_{gas(methane)} \times Q_{std} =$ 0.5667 lb/hr, 0.2456 lb/cycle

$E_{THC(ethane)} = C'_{gas(ethane)} \times Q_{std} =$ 0.1012 lb/hr, 0.0439 lb/cycle

MONITOR DATA SUMMARY

COMPANY :	Houston Refining
SOURCE :	736 Coker
REPETITION :	3
TEST DATE :	8/2/2011
START TIME :	16:11
END TIME :	16:16

GAS ANALYZER O_2

SPAN VALUE :	22.70 %
AVERAGE CAL. BIAS (C_m):	9.970
AVERAGE ZERO BIAS (C_o):	0.007
CALIBRATION GAS:	EPA Protocol O_2
CALIBRATION % (C_{ma}):	10.00
% CORRECTED (C_{gas}):	**20.95**

GAS ANALYZER CO_2

SPAN VALUE :	19.60 %
AVERAGE CAL. BIAS (C_m):	8.56
AVERAGE ZERO BIAS (C_o):	-0.10
CALIBRATION GAS:	EPA Protocol CO_2
CALIBRATION % (C_{ma}):	8.63
% CORRECTED (C_{gas}):	**-0.01**

GAS ANALYZER CO

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.62
AVERAGE ZERO BIAS (C_o):	1.01
CALIBRATION GAS:	EPA Protocol CO
CALIBRATION PPM (C_{ma}):	45.0
PPM CORRECTED (C_{gas}):	**<2.59**

GAS ANALYZER NO_x

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.9
AVERAGE ZERO BIAS (C_o):	0.4
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	45.0
ppm CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER VOCs

SPAN VALUE :	300000 ppm
AVERAGE CAL. BIAS (C_m):	9879
AVERAGE ZERO BIAS (C_o):	-76
CALIBRATION GAS:	EPA Protocol C_3H_8
CALIBRATION ppm (C_{ma}):	10000.0
ppm CORRECTED (C_{gas}):	**11629.0**

GAS ANALYZER SO_2

SPAN VALUE :	200 ppm
AVERAGE CAL. BIAS (C_m):	98.0
AVERAGE ZERO BIAS (C_o):	-0.6
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	100.0
ppm CORRECTED (C_{gas}):	**<1.8**

CLOCK TIME	ELAPSED TIME	NO_x	SO_2	CO	C_3H_8	O_2	CO_2
16:11	0	-------	-------	-------	-------	-------	-------
16:12	1	0.7	-0.9	0.7	7338	20.75	-0.12
16:13	2	0.6	-1.0	0.7	9039	20.76	-0.12
16:14	3	0.3	-0.8	11.0	26818	20.83	-0.11
16:15	4	0.2	-0.8	3.8	8001	21.01	-0.12
16:16	5	0.2	-0.9	1.8	6309	21.04	-0.12
	Uncorrected Average (C) =	**0.41**	**-0.89**	**3.58**	**11501.0**	**20.878**	**-0.119**

Example Calculation = $$C_{gas} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$$

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 Coker
TEST DATE: 8/2/2011
RUN NUMBER: 3

γ FACTOR:	1.005	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	30.06 **in. Hg**	**METER VOLUME:**	1.360 **ft^3**
STATIC PRES:	2.00 **in.H_2O**	**METER TEMP:**	109.0 **°F**
STACK TEMP:	212.0 **°F**	**LIQUID COLL:**	73.0 **milliliters**
SQ.RT ΔP:	1.4491 **in.H_2O**	**CO_2:**	0.49 **% by volume**
ΔH:	0.04 **in.H_2O**	**O_2:**	16.80 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.274 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 3.436 \text{ scf}$$

V_{lc} = 73.0 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.7295$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 0.984$$

T = 373.0 °K
P = 767.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.7295

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining | **SOURCE:** 736 Coker
LOCATION: Houston, Texas | **TEST DATE:** 8/2/2011
RUN NUMBER: 3

BAROMETRIC:	30.06 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	2 **in.H_2O**	**CO_2:**	0.49 **% by volume**
STACK TEMP:	212 °F	**O_2:**	16.80 **% by volume**
SQ.RT ΔP:	1.449138 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.75 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 20.91 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 1.4491 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 212.0 °F + 460 = 672.0 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.21 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 107.3431 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 2,248.2 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,783.4 **scfm, wb**
107,003 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 482.5 **dscfm**
28,949 **dscfh**

SO_2 CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 6C

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 Coker
MONITOR ID: Ametek Wesgtern Research Model 721
RUN NO: 3
TEST DATE: 8/2/2011

INPUT

SO_2 AVERAGE CHART READING (C):	-0.89	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	-0.6	ppmv
CAL GAS CONCENTRATION (C_{ma}):	100.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	98.0	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	28,949	dscfh
Cycle Time:	0.0833	hrs

CALCULATIONS

STACK SO_2 AVERAGE CHART READING = (0.89) ppmv

STACK SO_2 CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

SO_2 CONC, ppmv (corrected) = $C_{gas,ppm} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$ = <1.80 ppmv db

SO_2 CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{64\,lb/lb-mole}{385.26\times10^6\,ft^3/lb-mole}\right) = <0.299 \times 10^{-6} \text{ lbs/dscf}$$

SO_2 EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 28,949 dscfh

STACK SO_2 EMISSION RATE =

$$SO_{2\,lbs/hr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right) = <0.00866 \text{ lbs/hr}$$
$$= <0.00072 \text{ lbs/cycle}$$

NO_x CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 7E

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 Coker
MONITOR ID: California Analytical Instruments, Inc. Series 600
RUN NO: 3
TEST DATE: 8/2/2011

INPUT

NO_x AVERAGE CHART READING (C):	0.41	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	0.4	ppmv
CAL GAS CONCENTRATION (C_{ma}):	45.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	45.9	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	28,949	dscfh
Cycle Time:	0.0833	hrs

CALCULATIONS

STACK NO_x AVERAGE CHART READING = 0.41 ppmv

STACK NO_x CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

NO_x CONC, ppmv (corrected) = $C_{gas,ppm} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$ = <1.80 ppmv db

NO_x CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{46\,lb/lb-mole}{385.26 \times 10^6\,ft^3/lb-mole}\right)$$ = <0.215 $\times 10^{-6}$ lbs/dscf

NO_x EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 28,949 dscfh

STACK NOx EMISSION RATE =

$$NO_{xpmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$ = <0.00622 lbs/hr
= <0.00052 lbs/cycle

CO CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 10

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 Coker
MONITOR ID: Thermo Environmental Model 48H
RUN NO: 3
TEST DATE: 8/2/2011

INPUT

CO AVERAGE CHART READING (C):	3.58	ppmv
AVG PRE/POST ZERO DRIFT READING (C_o):	1.0	ppmv
CAL GAS CONCENTRATION (C_{ma}):	45.0	ppmv
AVG CAL PRE/POST TEST READING (C_m):	45.6	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	28,949	dscfh
Cycle Time:	0.083	hrs

CALCULATIONS

STACK CO AVERAGE CHART READING = 3.58 ppmv

STACK CO CONC. CORRECTED FOR ZERO AND CALIBRATION DRIFT:

CO CONC, ppmv (corrected) = $C_{gas,ppm} = (\bar{C} - C_o)\frac{C_{ma}}{C_m - C_o}$ = 2.59 ppmv db

CO CONC.(lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{28 lb/lb-mole}{385.26 \times 10^{3} ft^3/lb-mole}\right)$$ = 0.188 x 10^{-6} lbs/dscf

CO EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 28,949 dscfh

STACK CO EMISSION RATE =

$C_{pmr} = (C_{gas,lb/dscf})(Q_{std})$ = 0.00545 lbs/hr
= 0.00045 lbs/cycle

METHOD 25A TOTAL HYDROCARBON (THC) CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 Coker
RUN NUMBER: 3
TEST DATE: 8/2/2011

INPUT DATA

THC (as propane) average concentration:	11501	ppmv db
Propane/N_2 avg. Zero pre-test System Bias:	-47.20	ppmv db
Propane/N_2 avg. Zero post-test System Bias:	-104.14	ppmv db
Propane/N_2 Cal. Gas Conc.:	10000.0	ppmv db
Propane/N_2 avg. Cal. pre-test System Bias:	9941.4	ppmv db
Propane/N_2 avg. Cal. post-test System Bias:	9817.4	ppmv db
Dilution Factor:	0.95	
Undiluted Moisture Fraction:	0.729	
Diluted Moisture Frat ion:	0.0365	
Cycle Time :	0.0833	
Averag THC (as propane) value (C) =	11204.8	ppmv wb

THC as carbon, C_1 = 33614.5 ppmv db

Stack gas volumetric flow rate (Q_s) = 28,949 dscfh

CALCULATIONS

THC concentration in stack gas (lb/dscf)

$$C'_{gas(propane)} = \frac{(C_{gas(propane)})(44.09)}{(385.26 \times 10^6)} =$$ 1282 x 10^{-6} lb/dscf as propane

$$C'_{gas(carbon)} = \frac{(C_{gas(carbon)})(12.01)}{(385.26 \times 10^6)} =$$ 1048 x 10^{-6} lb/dscf as carbon

THC emission rate

$$E_{THC\ (propane)} = C'_{gas(propane)} \times Q_{std} =$$ 37.12 lb/hr
3.09 lb/cycle

$$E_{THC(carbon)} = C'_{gas(carbon)} \times Q_{std} =$$ 30.33 lb/hr
2.53 lb/cycle

METHOD 25A TOTAL HYDROCARBON (THC) CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 Coker
RUN NUMBER: 3
TEST DATE: 8/2/2011

INPUT DATA

Methane (CH_4) average concentration:	123154 ppmv db
Ethane (C_2H_6) average concentration:	9853 ppmv db
Cycle Time :	0.0833 hrs
Stack gas volumetric flow rate (Q_s) =	28,949 dscfh

CALCULATIONS

THC concentration in stack gas (lb/dscf)

Methane $C'_{gas(methane)} = \frac{(C_{gas(Methane)})(16.04)}{(385.26 \times 10^6)} =$ 5127 x 10^{-6} lb/dscf as methane

Ethane $C'_{gas(ethane)} = \frac{(C_{gas(ethane)})(30.07)}{(385.26 \times 10^6)} =$ 769.04 x 10^{-6} lb/dscf as ethane

THC emission rate

$E_{THC(methane)} = C'_{gas(methane)} \times Q_{std} =$ 148.431 lb/hr
12.369 lb/cycle

$E_{THC(ethane)} = C'_{gas(ethane)} \times Q_{std} =$ 22.2625 lb/hr
1.855 lb/cycle

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: OH-1

γ FACTOR:	0.999	**STACK DIAM:**	8.000 **inches**
BAROMETRIC:	30.00 **in. Hg**	**METER VOLUME:**	1.738 **ft^3**
STATIC PRES:	2.32 **in.H_2O**	**METER TEMP:**	97.6 **°F**
STACK TEMP:	212.2 **°F**	**LIQUID COLL:**	4050.7 **milliliters**
SQ.RT ΔP:	1.1448 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	19.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.648 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 190.666 \text{ scf}$$

V_{lc} = 4050.7 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9914$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9881$$

T = 373.1 °K
P = 766.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9881

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
RUN NUMBER: OH-1

SOURCE: 736 DCU
TEST DATE: 7/21/2011

BAROMETRIC:	30 **in. Hg**	**STACK DIAM:**	8.000 **inches**
STATIC PRES:	2.32 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212.2 **°F**	**O_2:**	19.50 **% by volume**
SQ.RT ΔP:	1.1448 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.860	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.129	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.1448	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.2 °F + 460	=	672.2	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.17	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	91.132	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,909	**acfm**
Stack Area = 0.3491 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,511.9 90,712	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	17.9 1,077	**dscfm** **dscfh**

ONTARIO HYDRO ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NO: OH-1

INPUT

V_m:	1.738	ft^3	Q_s:	1,077	**dscfh**
γ **FACTOR:**	0.999		T_s:	212.2	**°F**
P_{bar}:	30.00	**in. Hg**	Θ:	64	**minutes**
ΔH:	0.03	**in. H_2O**	V_s:	91.132	**fps**
T_m:	97.6	**°F**	P_s:	30.17	**in. Hg**
			V_{lc}:	4,050.7	**mL**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.648 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 360.13 \text{ \% I}$$

257.82 % I* @saturation

A_n = 0.00019277 ft^2 Runtime (θ) = 64 minutes

Mercury Emissions Calculation Summary
Ontario Hydro (ASTM Method D6784-02)

Client:	Houston Refining
Location:	Houston, Texas
Source:	736 DCU
Date:	7/21/2011
Run #:	OH-1

Test Data Input		***Metals Laboratory Analysis Weights (Mt)***	
Barometric pressure (P_{bar}):	30.00 **inches Hg**	**Hg-FH (particle bound)**	< 0.033 **µg**
Stack pressure (P_s):	30.17 **Inches Hg Abs.**	**Hg-KCl (oxidized)**	1.0900 **µg**
Test length (θ):	64.0 **minutes**	**Hg-Acid/$KMnO_4$ (elemental)**	< 1.2660 **µg**
Sample nozzle diameter (D_n):	0.1880 **inches**	**Hg-Total**	< 2.3891 **µg**
Sample nozzle area (A_n):	0.000193 **ft^3**		
Stack temperature (T_s):	212.2 **°F**		
Volume metered (V_{mstd}):	1.648 **dscf**		
Stack gas velocity (V_s):	91.132 **ft/sec**		
Stack gas volumetric flow (Q_{std}):	1,077 **dscfh**		
Fractional Moisture content (B_{ws}):	0.9881 **%**		
Run Time	1.317 **hrs**		

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Mercury concentration (ug/dscm):

$$C_s = \frac{M_t}{\left[\left(\frac{V_{mstd}}{35.31 dscf/dscm}\right)\right]}$$

Hg-FH (particle bound)	=	**< 0.70917 µg/dscm**
Hg-KCl (oxidized)	=	**23.35332 µg/dscm**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 27.12413 µg/dscm**
Hg-Total	=	**< 51.18662 µg/dscm**

Mercury concentration (x10^{-9} lb/dscf):

$$C'_s = \frac{\left(\frac{2.2046 \times 10^{-9} lb}{\mu g} \times M_t\right)}{V_{mstd}}$$

Hg-FH (particle bound)	=	**< 0.04428 x 10^{-9} lb/dscf**
Hg-KCl (oxidized)	=	**1.45808 x 10^{-9} lb/dscf**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 1.69351 x 10^{-9} lb/dscf**
Hg-Total	=	**< 3.19587 x 10^{-9} lb/dscf**

Mercury emission rate (x10^{-4} lb/hr):

$$E_m = C'_s \times Q_{std}$$

Hg-FH (particle bound)	=	**< 0.00048 x 10^{-4} lb/hr**
Hg-KCl (oxidized)	=	**0.01570 x 10^{-4} lb/hr**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 0.01824 x 10^{-4} lb/hr**
Hg-Total	=	**< 0.03441 x 10^{-4} lb/hr**

Mercury emission rate (x10^{-4} lb/cycle):

$$E_m = C'_s \times Q_{std}$$

Hg-FH (particle bound)	=	**< 0.00063 x 10^{-4} lb/cycle**
Hg-KCl (oxidized)	=	**0.02067 x 10^{-4} lb/cycle**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 0.02401 x 10^{-4} lb/cycle**
Hg-Total	=	**< 0.04531 x 10^{-4} lb/cycle**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NUMBER: OH-3

γ FACTOR:	1.005	**STACK DIAM:**	8.000 **inches**
BAROMETRIC:	30.06 **in. Hg**	**METER VOLUME:**	2.362 **ft^3**
STATIC PRES:	2.71 **in.H_2O**	**METER TEMP:**	113.2 **°F**
STACK TEMP:	212.0 **°F**	**LIQUID COLL:**	4231.2 **milliliters**
SQ.RT ΔP:	1.3364 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.07 **in.H_2O**	**O_2:**	18.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.197 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 199.163 \text{ scf}$$

V_{lc} = 4231.2 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9891$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9821$$

T = 373.0 °K
P = 768.6 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9821

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
RUN NUMBER: OH-3

SOURCE: 736 DCU
TEST DATE: 7/27/2011

BAROMETRIC:	30.06 **in. Hg**	**STACK DIAM:**	8.000 **inches**
STATIC PRES:	2.71 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212.0 **°F**	**O_2:**	18.50 **% by volume**
SQ.RT ΔP:	1.3364 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.82	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.19	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	1.3364	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.0 °F + 460	=	672.0	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.26	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	106.027	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	2,221	**acfm**
Stack Area = 0.3491 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,764.6 105,875	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	31.5 1,891	**dscfm** **dscfh**

ONTARIO HYDRO ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NO: OH-3

INPUT

V_m:	2.362	ft^3	Q_s:	1,891	dscfh
γ FACTOR:	1.005		T_s:	212.0	°F
P_{bar}:	30.06	in. Hg	Θ:	68	minutes
ΔH:	0.07	in. H_2O	V_s:	106.027	fps
T_m:	113.2	°F	P_s:	30.26	in. Hg
			V_{lc}:	4,231.2	mL

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.197 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 304.06 \text{ \% I}$$

184.2 % I* @saturation

A_n = 0.00019277 ft^2 Runtime (θ) = 60 minutes

Mercury Emissions Calculation Summary
Ontario Hydro (ASTM Method D6784-02)

Client:	Houston Refining
Location:	Houston, Texas
Source:	736 DCU
Date:	7/27/2011
Run #:	OH-3

Test Data Input		***Metals Laboratory Analysis Weights (Mt)***	
Barometric pressure (P_{bar}):	30.06 **inches Hg**	**Hg-FH (particle bound)**	< 0.097 µg
Stack pressure (P_s):	30.26 **Inches Hg Abs.**	**Hg-KCl (oxidized)**	< 0.025 µg
Test length (θ):	68.0 **minutes**	**Hg-Acid/$KMnO_4$ (elemental)**	< 1.0070 µg
Sample nozzle diameter (D_n):	0.1880 **inches**	**Hg-Total**	< 1.1294 µg
Sample nozzle area (A_n):	0.000193 **ft^3**		
Stack temperature (T_s):	212.0 **°F**		
Volume metered (V_{mstd}):	2.197 **dscf**		
Stack gas velocity (V_s):	106.027 **ft/sec**		
Stack gas volumetric flow (Q_{std}):	1,891 **dscfh**		
Fractional Moisture content (B_{ws}):	0.9821 **%**		
Run Time	1.133 **hrs**		

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Mercury concentration (ug/dscm):

$$C_s = \frac{M_t}{\left[\left(\frac{V_{mstd}}{35.31 dscf / dscm}\right)\right]}$$

Hg-FH (particle bound)	=	**< 1.56528 µg/dscm**
Hg-KCl (oxidized)	=	**< 0.40177 µg/dscm**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 16.18316 µg/dscm**
Hg-Total	=	**< 18.15021 µg/dscm**

Mercury concentration (x10^{-9} lb/dscf):

$$C'_s = \frac{\left(\frac{2.2046 \times 10^{-9} lb}{\mu g} \times M_t\right)}{V_{mstd}}$$

Hg-FH (particle bound)	=	**< 0.09773 x 10^{-9} lb/dscf**
Hg-KCl (oxidized)	=	**< 0.02508 x 10^{-9} lb/dscf**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 1.01040 x 10^{-9} lb/dscf**
Hg-Total	=	**< 1.13322 x 10^{-9} lb/dscf**

Mercury emission rate (x10^{-4} lb/hr):

$$E_m = C'_s \times Q_{std}$$

Hg-FH (particle bound)	=	**< 0.00185 x 10^{-4} lb/hr**
Hg-KCl (oxidized)	=	**< 0.00047 x 10^{-4} lb/hr**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 0.01911 x 10^{-4} lb/hr**
Hg-Total	=	**< 0.02143 x 10^{-4} lb/hr**

Mercury emission rate (x10^{-4} lb/cycle):

$$E_m = C'_s \times Q_{std}$$

Hg-FH (particle bound)	=	**< 0.00209 x 10^{-4} lb/cycle**
Hg-KCl (oxidized)	=	**0.00054 x 10^{-4} lb/cycle**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 0.02166 x 10^{-4} lb/cycle**
Hg-Total	=	**< 0.02429 x 10^{-4} lb/cycle**

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NUMBER: OH-4

γ FACTOR:	1.005	**STACK DIAM:**	8.000 **inches**
BAROMETRIC:	29.98 **in. Hg**	**METER VOLUME:**	2.832 **ft^3**
STATIC PRES:	2.47 **in.H_2O**	**METER TEMP:**	95.5 **°F**
STACK TEMP:	213.3 **°F**	**LIQUID COLL:**	2588.2 **milliliters**
SQ.RT ΔP:	1.4205 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.04 **in.H_2O**	**O_2:**	19.00 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.711 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 121.827 \text{ scf}$$

V_{lc} = 2588.2 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9782$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 1.0000$$

T = 373.7 °K
P = 766.1 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9782

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
RUN NUMBER: OH-4

SOURCE: 736 DCU
TEST DATE: 7/28/2011

BAROMETRIC:	29.98 **in. Hg**	**STACK DIAM:**	8.000 **inches**
STATIC PRES:	2.47 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	213.3 **°F**	**O_2:**	19.00 **% by volume**
SQ.RT ΔP:	1.4205 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.84 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 18.24 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 1.4205 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 213.3 °F + 460 = 673.3 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.16 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 112.854 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 2,364 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,868.7 **scfm, wb**
112,119 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 40.7 **dscfm**
2,441 **dscfh**

ONTARIO HYDRO ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
TEST DATE: 7/28/2011
RUN NO: OH-4

INPUT

V_m:	2.832	ft^3	Q_s:	2,441	dscfh
γ FACTOR:	1.005		T_s:	213.3	°F
P_{bar}:	29.98	in. Hg	Θ:	53	minutes
ΔH:	0.04	in. H_2O	V_s:	112.854	fps
T_m:	95.5	°F	P_s:	30.16	in. Hg
			V_{lc}:	2,588.2	mL

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.711 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 227.84 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 60 minutes

Mercury Emissions Calculation Summary
Ontario Hydro (ASTM Method D6784-02)

Client:	Houston Refining
Location:	Houston, Texas
Source:	736 DCU
Date:	7/28/2011
Run #:	OH-4

Test Data Input		***Metals Laboratory Analysis Weights (Mt)***	
Barometric pressure (P_{bar}):	29.98 **inches Hg**	**Hg-FH (particle bound)**	< 0.020 µg
Stack pressure (P_s):	30.16 **Inches Hg Abs.**	**Hg-KCl (oxidized)**	< 0.155 µg
Test length (θ):	53.0 **minutes**	**Hg-Acid/$KMnO_4$ (elemental)**	< 1.4730 µg
Sample nozzle diameter (D_n):	0.1880 **inches**	**Hg-Total**	< 1.6480 µg
Sample nozzle area (A_n):	0.000193 **ft^3**		
Stack temperature (T_s):	213.3 **°F**		
Volume metered (V_{mstd}):	2.711 **dscf**		
Stack gas velocity (V_s):	112.854 **ft/sec**		
Stack gas volumetric flow (Q_{std}):	2,441 **dscfh**		
Fractional Moisture content (B_{ws}):	0.9782 **%**		
Run Time	0.883 **hrs**		

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Mercury concentration (ug/dscm):

$$C_s = \frac{M_t}{\left[\left(\frac{V_{mstd}}{35.31 dscf/dscm}\right)\right]}$$

Hg-FH (particle bound)	=	**< 0.26048 µg/dscm**
Hg-KCl (oxidized)	=	**< 2.01872 µg/dscm**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 19.18435 µg/dscm**
Hg-Total	=	**< 21.46354 µg/dscm**

Mercury concentration (x10^{-9} lb/dscf):

$$C'_s = \frac{\left(\frac{2.2046 \times 10^{-9} lb}{\mu g} \times M_t\right)}{V_{mstd}}$$

Hg-FH (particle bound)	=	**< 0.01626 x 10^{-9} lb/dscf**
Hg-KCl (oxidized)	=	**< 0.12604 x 10^{-9} lb/dscf**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 1.19779 x 10^{-9} lb/dscf**
Hg-Total	=	**< 1.34009 x 10^{-9} lb/dscf**

Mercury emission rate (x10^{-4} lb/hr):

$$E_m = C'_s \times Q_{std}$$

Hg-FH (particle bound)	=	**< 0.00040 x 10^{-4} lb/hr**
Hg-KCl (oxidized)	=	**< 0.00308 x 10^{-4} lb/hr**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 0.02924 x 10^{-4} lb/hr**
Hg-Total	=	**< 0.03271 x 10^{-4} lb/hr**

Mercury emission rate (x10^{-4} lb/cycle):

$$E_m = C'_s \times Q_{std}$$

Hg-FH (particle bound)	=	**< 0.00035 x 10^{-4} lb/cycle**
Hg-KCl (oxidized)	=	**0.00272 x 10^{-4} lb/cycle**
Hg-Acid/$KMnO_4$ (elemental)	=	**< 0.02582 x 10^{-4} lb/cycle**
Hg-Total	=	**< 0.02889 x 10^{-4} lb/cycle**

VOLATILE ORGANIC HAPS CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
SAMPLE: VolHAPs - Methanol Impingers
TEST DATE: 7/19/2011
RUN NO: 18-1

INPUT

Q_s : 454 **dscfh**
P_{bar} : 30.00 **in Hg**

	A Train:		*B Train:*
V_m **Unspiked:**	6.701 **liters**	V_m **Spiked:**	30.179 **liters**
V_m **Unspiked:**	0.237 **cubic ft**	V_m **Spiked:**	1.066 **cubic ft**
Y Sample :	0.975	**Y Sample :**	1.000
T_m **Sample:**	79.9 **°F**	T_m **Sample:**	79.4 **°F**
ΔH Sample:	1.00 **in. H_2O**	**ΔH Sample:**	1.73 **in. H_2O**

Volume of sample at standard conditions on dry basis — **English units (29.92 in. Hg 68° F)**

V_{mstd} Train A (V_s) = $(17.647)(V_m)(Y_d)(P_{bar}+\Delta H/13.6)/(T_m)$ = 0.227 **dscf**
V_{mstd} Train A ($V_{s\text{-liters}}$) = dscf x 28.32 = 6.423 **std liters**
V_{mstd} Train B (V_s) = $(17.647)(V_m)(Y_d)(P_{bar}+\Delta H/13.6)/(T_m)$ = 1.050 **dscf**
V_{mstd} Train B ($V_{u\text{-liters}}$) = dscf x 28.32 = 29.744 **std liters**

		A TRAIN					B TRAIN					AVERAGE	
Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)
Acetone	**58.08**	210.9690	1.3172E-05	87,371	210,969	0.00598	37.9904	2.3719E-06	15,733	37,990	0.00108	124,480	0.00353
Acetonitrile	41.05	< 10.7119	< 6.6879E-07	< 6277	< 10712	< 0.00030	< 105.4050	< 6.5808E-06	< 61762	< 105405	< 0.00299	< 10712	< 0.00030
Acrolein	56.06	< 2.7558	< 1.7206E-07	< 1182	< 2756	< 0.00008	< 34.8571	< 2.1763E-06	< 14956	< 34857	< 0.00099	< 2756	< 0.00008
Acrylonitrile	53.06	< 2.7558	< 1.7206E-07	< 1249	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 270	< 595	< 0.00002	< 1675	< 0.00005
Benzene	78.11	< 58.8222	< 3.6725E-06	< 18114	< 58822	< 0.00167	< 3.0863	< 1.9269E-07	< 950	< 3086	< 0.00009	< 30954	< 0.00088
1,3-Butadiene	54.09	< 2.7558	< 1.7206E-07	< 1225	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 265	< 595	< 0.00002	< 1675	< 0.00005
Carbon disulfide	76.14	< 2.7558	< 1.7206E-07	< 871	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 188	< 595	< 0.00002	< 1675	< 0.00005
Chlorobenzene	112.56	< 2.7558	< 1.7206E-07	< 589	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 127	< 595	< 0.00002	< 1675	< 0.00005
Cumene	120.19	< 2.7558	< 1.7206E-07	< 552	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 119	< 595	< 0.00002	< 1675	< 0.00005
1,2-Dibromoethane	187.86	< 2.7558	< 1.7206E-07	< 353	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 76	< 595	< 0.00002	< 1675	< 0.00005
Ethylbenzene	106.17	< 10.4005	< 6.4935E-07	< 2356	< 10401	< 0.00029	< 1.1364	< 7.0947E-08	< 257	< 1136	< 0.00003	< 5768	< 0.00016
Hexane	86.18	< 3.7056	< 2.3135E-07	< 1034	< 3706	< 0.00011	< 0.5951	< 3.7153E-08	< 166	< 595	< 0.00002	< 2150	< 0.00006
Methyl isobutyl ketone	100.16	< 2.7558	< 1.7206E-07	< 662	< 2756	< 0.00008	< 129.4465	< 8.0818E-06	< 31086	< 129447	< 0.00367	< 2756	< 0.00008
Methyl t-butyl ether	88.15	< 2.7558	< 1.7206E-07	< 752	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 162	< 595	< 0.00002	< 1675	< 0.00005
Methylene chloride	**84.93**	34.7204	2.1677E-06	9,833	34,720	0.00098	7.9679	4.9747E-07	2,257	7,968	0.00023	21,344	0.00060
Nitrobenzene	123.06	< 13.7792	< 8.6029E-07	< 2693	< 13779	< 0.00039	< 2.9754	< 1.8576E-07	< 582	< 2975	< 0.00008	< 8377	< 0.00024
2-Nitropropane	89.09	< 47.4563	< 2.9629E-06	< 12813	< 47456	< 0.00135	< 1.1700	< 7.3046E-08	< 316	< 1170	< 0.00003	< 24313	< 0.00069
Pentane	72.15	< 10.8676	< 6.7851E-07	< 3623	< 10868	< 0.00031	< 0.7094	< 4.4289E-08	< 236	< 709	< 0.00002	< 5789	< 0.00016
Styrene	104.15	< 2.7558	< 1.7206E-07	< 636	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 137	< 595	< 0.00002	< 1675	< 0.00005
Tetrachloroethene	165.83	< 2.7558	< 1.7206E-07	< 400	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 86	< 595	< 0.00002	< 1675	< 0.00005
Toluene	92.14	< 142.6804	< 8.9081E-06	< 37247	< 142680	< 0.00404	< 83.8748	< 5.2366E-06	< 21896	< 83875	< 0.00238	< 142680	< 0.00404
Trichloroethene	131.39	< 2.7558	< 1.7206E-07	< 505	< 2756	< 0.00008	< 162.2091	< 1.0127E-05	< 29695	< 162209	< 0.00460	< 2756	< 0.00008
2,2,4 Trimethyl pentane	114.23	< 2.7558	< 1.7206E-07	< 580	< 2756	< 0.00008	< 0.5951	< 3.7153E-08	< 125	< 595	< 0.00002	< 1675	< 0.00005
Xylenes (m+p)	106.16	< 108.3649	< 6.7656E-06	< 24553	< 108365	< 0.00307	< 9.6422	< 6.0200E-07	< 2185	< 9642	< 0.00027	< 59004	< 0.00167
Xylenes (o)	106.16	< 19.8980	< 1.2423E-06	< 4508	< 19898	< 0.00056	< 1.9096	< 1.1922E-07	< 433	< 1910	< 0.00005	< 10904	< 0.00031

VOLATILE ORGANIC HAPS CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
SAMPLE: VolHAPs - Methanol Impingers
TEST DATE: 7/19/2011
RUN NO: 18-1

INPUT

Q_s :	454 dscfh		
P_{bar} :	30.00 in Hg		
Cycle Time:	0.433 hrs		
	A Train:		*B Train:*
V_m Unspiked:	6.701 liters	V_m Spiked:	30.179 liters
V_m Unspiked:	0.237 cubic ft	V_m Spiked:	1.066 cubic ft
Y Sample :	0.975	Y Sample :	1.000
T_m Sample:	79.9 °F	T_m Sample:	79.4 °F
ΔH Sample:	1.00 in. H_2O	ΔH Sample:	1.73 in. H_2O

Volume of sample at standard conditions on dry basis		English units (29.92 in. Hg 68° F)
V_{mstd} Train A (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.227 dscf
V_{mstd} Train A ($V_{s\text{-liters}}$) = dscf x 28.32	=	6.423 std liters
V_{mstd} Train B (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	1.050 dscf
V_{mstd} Train B ($V_{u\text{-liters}}$) = dscf x 28.32	=	29.744 std liters

		A TRAIN					B TRAIN					AVERAGE	
Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)
Acetone	58.08	210.9690	1.3172E-05	87,371	210,969	0.002591	37.9904	2.3719E-06	15,733	37,990	0.000467	124,480	0.001529
Acetonitrile	41.05	< 10.7119	< 6.6879E-07	< 6277	< 10712	< 0.000132	< 105.4050	< 6.5808E-06	< 61762	< 105405	< 0.001295	< 10712	< 0.000132
Acrolein	56.06	< 2.7558	< 1.7206E-07	< 1182	< 2756	< 0.000034	< 34.8571	< 2.1763E-06	< 14956	< 34857	< 0.000428	< 2756	< 0.000034
Acrylonitrile	53.06	< 2.7558	< 1.7206E-07	< 1249	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 270	< 595	< 0.000007	< 1675	< 0.000021
Benzene	78.11	< 58.8222	< 3.6725E-06	< 18114	< 58822	< 0.000723	< 3.0863	< 1.9269E-07	< 950	< 3086	< 0.000038	< 30954	< 0.000380
1,3-Butadiene	54.09	< 2.7558	< 1.7206E-07	< 1225	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 265	< 595	< 0.000007	< 1675	< 0.000021
Carbon disulfide	76.14	< 2.7558	< 1.7206E-07	< 871	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 188	< 595	< 0.000007	< 1675	< 0.000021
Chlorobenzene	112.56	< 2.7558	< 1.7206E-07	< 589	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 127	< 595	< 0.000007	< 1675	< 0.000021
Cumene	120.19	< 2.7558	< 1.7206E-07	< 552	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 119	< 595	< 0.000007	< 1675	< 0.000021
1,2-Dibromoethane	187.86	< 2.7558	< 1.7206E-07	< 353	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 76	< 595	< 0.000007	< 1675	< 0.000021
Ethylbenzene	106.17	< 10.4005	< 6.4935E-07	< 2356	< 10401	< 0.000128	< 1.1364	< 7.0947E-08	< 257	< 1136	< 0.000014	< 5768	< 0.000071
Hexane	86.18	< 3.7056	< 2.3135E-07	< 1034	< 3706	< 0.000046	< 0.5951	< 3.7153E-08	< 166	< 595	< 0.000007	< 2150	< 0.000026
Methyl isobutyl ketone	100.16	< 2.7558	< 1.7206E-07	< 662	< 2756	< 0.000034	< 129.4465	< 8.0818E-06	< 31086	< 129447	< 0.001590	< 2756	< 0.000034
Methyl t-butyl ether	88.15	< 2.7558	< 1.7206E-07	< 752	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 162	< 595	< 0.000007	< 1675	< 0.000021
Methylene chloride	84.93	34.7204	2.1677E-06	9,833	34,720	0.000426	7.9679	4.9747E-07	2,257	7,968	0.000098	21,344	0.000262
Nitrobenzene	123.06	< 13.7792	< 8.6029E-07	< 2693	< 13779	< 0.000169	< 2.9754	< 1.8576E-07	< 582	< 2975	< 0.000037	< 8377	< 0.000103
2-Nitropropane	89.09	< 47.4563	< 2.9629E-06	< 12813	< 47456	< 0.000583	< 1.1700	< 7.3046E-08	< 316	< 1170	< 0.000014	< 24313	< 0.000299
Pentane	72.15	< 10.8676	< 6.7851E-07	< 3623	< 10868	< 0.000133	< 0.7094	< 4.4289E-08	< 236	< 709	< 0.000009	< 5789	< 0.000071
Styrene	104.15	< 2.7558	< 1.7206E-07	< 636	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 137	< 595	< 0.000007	< 1675	< 0.000021
Tetrachloroethene	165.83	< 2.7558	< 1.7206E-07	< 400	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 86	< 595	< 0.000007	< 1675	< 0.000021
Toluene	92.14	< 142.6804	< 8.9081E-06	< 37247	< 142680	< 0.001753	< 83.8748	< 5.2366E-06	< 21896	< 83875	< 0.001030	< 142680	< 0.001753
Trichloroethene	131.39	< 2.7558	< 1.7206E-07	< 505	< 2756	< 0.000034	< 162.2091	< 1.0127E-05	< 29695	< 162209	< 0.001992	< 2756	< 0.000034
2,2,4 Trimethyl pentane	114.23	< 2.7558	< 1.7206E-07	< 580	< 2756	< 0.000034	< 0.5951	< 3.7153E-08	< 125	< 595	< 0.000007	< 1675	< 0.000021
Xylenes (m+p)	106.16	< 108.3649	< 6.7656E-06	< 24553	< 108365	< 0.001331	< 9.6422	< 6.0200E-07	< 2185	< 9642	< 0.000118	< 59004	< 0.000725
Xylenes (o)	106.16	< 19.8980	< 1.2423E-06	< 4508	< 19898	< 0.000244	< 1.9096	< 1.1922E-07	< 433	< 1910	< 0.000023	< 10904	< 0.000134

Volatile Organic HAPs Laboratory Data Summary

Client: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Date: 7/19/2011
Run No: 18-1

Compound	Molecular Weight	Sample Train A Analysis (M_u) (micrograms)	% Recovery	Sample Train B Analysis (M_u) (micrograms)	% Recovery
Acetone	58.08	1,355.0		1130	
Acetonitrile	41.05	< 68.8	84	< 3135.2	49
Acrolein	56.06	< 17.7		< 1036.8	
Acrylonitrile	53.06	< 17.7	84	< 17.7	49
Benzene	78.11	< 377.8	76	< 91.8	59
1,3-Butadiene	54.09	< 17.7	78	< 17.7	135
Carbon disulfide	76.14	< 17.7		< 17.7	
Chlorobenzene	112.56	< 17.7		< 17.7	
Cumene	120.19	< 17.7		< 17.7	
1,2-Dibromoethane	187.86	< 17.7	118	< 17.7	56
Ethylbenzene	106.17	< 66.8	87	< 33.8	67
Hexane	86.18	< 23.8	60	< 17.7	69
Methyl isobutyl ketone	100.16	< 17.7		< 3850.3	136
Methyl t-butyl ether	88.15	< 17.7	80	< 17.7	54
Methylene chloride	84.93	223.0		237.0	
Nitrobenzene	123.06	< 88.5	71	< 88.5	50
2-Nitropropane	89.09	< 304.8	80	< 34.8	50
Pentane	72.15	< 70	57	< 21	63
Styrene	104.15	< 17.7	75	< 17.7	52
Tetrachloroethene	165.83	< 17.7		< 17.7	
Toluene	92.14	< 916.4		< 2494.8	
Trichloroethene	131.39	< 17.7		< 4825	89
2,2,4 Trimethyl pentane	114.23	< 17.7	63	< 17.7	73
Xylenes (m+p)	106.16	< 696.0		< 286.8	
Xylenes (o)	106.16	< 127.8		< 56.8	

VOLATILE ORGANIC HAPS CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
SAMPLE: VolHAPs - Methanol Impingers
TEST DATE: 7/20/2011
RUN NO: 18-2

INPUT

Q_s :	3,940 **dscfh**		
P_{bar} :	30.04 **in Hg**		
	A Train:		***B Train:***
V_m **Unspiked:**	0.174 **liters**	V_m **Spiked:**	0.151 **liters**
V_m **Unspiked:**	0.006 **cubic ft**	V_m **Spiked:**	0.005 **cubic ft**
Y Sample :	0.975	**Y Sample :**	1.000
T_m **Sample:**	90.0 **°F**	T_m **Sample:**	90.0 **°F**
ΔH Sample:	1.00 **in.** H_2O	**ΔH Sample:**	1.00 **in.** H_2O

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Train A (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.006	**dscf**
V_{mstd} Train A ($V_{s\text{-liters}}$) = dscf x 28.32	=	0.164	**std liters**
V_{mstd} Train B (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.005	**dscf**
V_{mstd} Train B ($V_{u\text{-liters}}$) = dscf x 28.32	=	0.146	**std liters**

		A TRAIN					B TRAIN					AVERAGE	
Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)
Acetone	58.08	10,291.8006	6.4256E-04	4,262,250	10,291,801	2.53167	35,339.9643	2.2064E-03	14,635,704	35,339,964	8.69326	22,815,882	5.61247
Acetonitrile	41.05	39,574.9321	2.4708E-03	23,188,953	39,574,932	9.73501	< 120.6329	< 7.5316E-06	< 70685	< 120633	< 0.02967	< 39574932	< 9.73501
Acrolein	56.06	< 48062.7698	< 3.0007E-03	< 20621955	< 48062770	< 11.82293	< 117.8913	< 7.3604E-06	< 50583	< 117891	< 0.02900	< 48062770	< 11.82293
Acrylonitrile	53.06	< 67.1072	< 4.1898E-06	< 30421	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 53443	< 117891	< 0.02900	< 92499	< 0.02275
Benzene	78.11	< 80.5286	< 5.0277E-06	< 24798	< 80529	< 0.01981	< 117.8913	< 7.3604E-06	< 36304	< 117891	< 0.02900	< 99210	< 0.02440
1,3-Butadiene	54.09	< 67.1072	< 4.1898E-06	< 29842	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 52425	< 117891	< 0.02900	< 92499	< 0.02275
Carbon disulfide	76.14	< 67.1072	< 4.1898E-06	< 21200	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 37243	< 117891	< 0.02900	< 92499	< 0.02275
Chlorobenzene	112.56	< 67.1072	< 4.1898E-06	< 14340	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 25193	< 117891	< 0.02900	< 92499	< 0.02275
Cumene	120.19	< 67.1072	< 4.1898E-06	< 13430	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 23593	< 117891	< 0.02900	< 92499	< 0.02275
1,2-Dibromoethane	187.86	< 67.1072	< 4.1898E-06	< 8592	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 15095	< 117891	< 0.02900	< 92499	< 0.02275
Ethylbenzene	106.17	< 67.1072	< 4.1898E-06	< 15203	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 26709	< 117891	< 0.02900	< 92499	< 0.02275
Hexane	86.18	< 67.1072	< 4.1898E-06	< 18730	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 32904	< 117891	< 0.02900	< 92499	< 0.02275
Methyl isobutyl ketone	100.16	< 25886.8983	< 1.6162E-03	< 6216699	< 25886898	< 6.36790	< 117.8913	< 7.3604E-06	< 28311	< 117891	< 0.02900	< 25886898	< 6.36790
Methyl t-butyl ether	88.15	< 67.1072	< 4.1898E-06	< 18311	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 32169	< 117891	< 0.02900	< 92499	< 0.02275
Methylene chloride	84.93	1,122.5200	7.0083E-05	317,912	1,122,520	0.27613	1,274.8707	7.9595E-05	361,060	1,274,871	0.31360	1,198,695	0.29487
Nitrobenzene	123.06	< 335.5359	< 2.0949E-05	< 65584	< 335536	< 0.08254	< 589.4563	< 3.6802E-05	< 115215	< 589456	< 0.14500	< 462496	< 0.11377
2-Nitropropane	89.09	< 67.1072	< 4.1898E-06	< 18118	< 67107	< 0.01651	< 196.0285	< 1.2239E-05	< 52925	< 196029	< 0.04822	< 131568	< 0.03236
Pentane	72.15	< 136.6546	< 8.5319E-06	< 45558	< 136655	< 0.03362	< 117.8913	< 7.3604E-06	< 39302	< 117891	< 0.02900	< 127273	< 0.03131
Styrene	104.15	< 67.1072	< 4.1898E-06	< 15498	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 27227	< 117891	< 0.02900	< 92499	< 0.02275
Tetrachloroethene	165.83	< 67.1072	< 4.1898E-06	< 9734	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 17100	< 117891	< 0.02900	< 92499	< 0.02275
Toluene	92.14	9,163.1799	5.7209E-04	2,392,060	9,163,180	2.25405	315.2906	1.9685E-05	82,307	315,291	0.07756	9,163,180	2.25405
Trichloroethene	131.39	< 24392.2385	< 1.5229E-03	< 4465432	< 24392238	< 6.00023	< 117.8913	< 7.3604E-06	< 21582	< 117891	< 0.02900	< 67107	< 6.00023
2,2,4 Trimethyl pentane	114.23	< 67.1072	< 4.1898E-06	< 14131	< 67107	< 0.01651	< 117.8913	< 7.3604E-06	< 24824	< 117891	< 0.02900	< 92499	< 0.02275
Xylenes (m+p)	106.16	< 99.4406	< 6.2085E-06	< 22531	< 99441	< 0.02446	431.8110	2.6960E-05	97,838	431,811	0.10622	< 265626	< 0.06534
Xylenes (o)	106.16	< 67.1072	< 4.1898E-06	< 15205	< 67107	< 0.01651	< 127.4871	< 7.9595E-06	< 28885	< 127487	< 0.03136	< 97297	< 0.02393

VOLATILE ORGANIC HAPS CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
SAMPLE: VolHAPs - Methanol Impingers
TEST DATE: 7/20/2011
RUN NO: 18-2

INPUT

Q_s :	3,940 **dscfh**		
P_{bar} :	30.04 **in Hg**		
Cycle Time:	0.150 **hrs**		
	A Train:		***B Train:***
V_m **Unspiked:**	0.174 **liters**	V_m **Spiked:**	0.151 **liters**
V_m **Unspiked:**	0.006 **cubic ft**	V_m **Spiked:**	0.005 **cubic ft**
Y Sample :	0.975	**Y Sample :**	1.000
T_m **Sample:**	90.0 **°F**	T_m **Sample:**	90.0 **°F**
ΔH Sample:	1.00 **in. H_2O**	**ΔH Sample:**	1.00 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Train A (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.006	**dscf**
V_{mstd} Train A ($V_{s\text{-liters}}$) = dscf x 28.32	=	0.164	**std liters**
V_{mstd} Train B (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.005	**dscf**
V_{mstd} Train B ($V_{u\text{-liters}}$) = dscf x 28.32	=	0.146	**std liters**

		A TRAIN					B TRAIN					AVERAGE	
Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)
Acetone	58.08	10,291.8006	6.4256E-04	4,262,250	10,291,801	0.379751	35,339.9643	2.2064E-03	14,635,704	35,339,964	1.303989	22,815,882	0.841870
Acetonitrile	41.05	39,574.9321	2.4708E-03	23,188,953	39,574,932	1.460252	< 120.6329	< 7.5316E-06	< 70685	< 120633	< 0.004451	< 39574932	< 1.460252
Acrolein	56.06	< 48062.7698	< 3.0007E-03	< 20621955	< 48062770	< 1.773440	< 117.8913	< 7.3604E-06	< 50583	< 117891	< 0.004350	< 48062770	< 1.773440
Acrylonitrile	53.06	< 67.1072	< 4.1898E-06	< 30421	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 53443	< 117891	< 0.004350	< 92499	< 0.003413
Benzene	78.11	< 80.5286	< 5.0277E-06	< 24798	< 80529	< 0.002971	< 117.8913	< 7.3604E-06	< 36304	< 117891	< 0.004350	< 99210	< 0.003661
1,3-Butadiene	54.09	< 67.1072	< 4.1898E-06	< 29842	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 52425	< 117891	< 0.004350	< 92499	< 0.003413
Carbon disulfide	76.14	< 67.1072	< 4.1898E-06	< 21200	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 37243	< 117891	< 0.004350	< 92499	< 0.003413
Chlorobenzene	112.56	< 67.1072	< 4.1898E-06	< 14340	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 25193	< 117891	< 0.004350	< 92499	< 0.003413
Cumene	120.19	< 67.1072	< 4.1898E-06	< 13430	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 23593	< 117891	< 0.004350	< 92499	< 0.003413
1,2-Dibromoethane	187.86	< 67.1072	< 4.1898E-06	< 8592	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 15095	< 117891	< 0.004350	< 92499	< 0.003413
Ethylbenzene	106.17	< 67.1072	< 4.1898E-06	< 15203	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 26709	< 117891	< 0.004350	< 92499	< 0.003413
Hexane	86.18	< 67.1072	< 4.1898E-06	< 18730	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 32904	< 117891	< 0.004350	< 92499	< 0.003413
Methyl isobutyl ketone	100.16	< 25886.8983	< 1.6162E-03	< 6216699	< 25886898	< 0.955185	< 117.8913	< 7.3604E-06	< 28311	< 117891	< 0.004350	< 25886898	< 0.955185
Methyl t-butyl ether	88.15	< 67.1072	< 4.1898E-06	< 18311	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 32169	< 117891	< 0.004350	< 92499	< 0.003413
Methylene chloride	84.93	1,122.5200	7.0083E-05	317,912	1,122,520	0.041419	1,274.8707	7.9595E-05	361,060	1,274,871	0.047041	1,198,695	0.044230
Nitrobenzene	123.06	< 335.5359	< 2.0949E-05	< 65584	< 335536	< 0.012381	< 589.4563	< 3.6802E-05	< 115215	< 589456	< 0.021750	< 462496	< 0.017065
2-Nitropropane	89.09	< 67.1072	< 4.1898E-06	< 18118	< 67107	< 0.002476	< 196.0285	< 1.2239E-05	< 52925	< 196029	< 0.007233	< 131568	< 0.004855
Pentane	72.15	< 136.6546	< 8.5319E-06	< 45558	< 136655	< 0.005042	< 117.8913	< 7.3604E-06	< 39302	< 117891	< 0.004350	< 127273	< 0.004696
Styrene	104.15	< 67.1072	< 4.1898E-06	< 15498	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 27227	< 117891	< 0.004350	< 92499	< 0.003413
Tetrachloroethene	165.83	< 67.1072	< 4.1898E-06	< 9734	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 17100	< 117891	< 0.004350	< 92499	< 0.003413
Toluene	92.14	9,163.1799	5.7209E-04	2,392,060	9,163,180	0.338107	315.2906	1.9685E-05	82,307	315,291	0.011634	9,163,180	0.338107
Trichloroethene	131.39	< 24392.2385	< 1.5229E-03	< 4465432	< 24392238	< 0.900035	< 117.8913	< 7.3604E-06	< 21582	< 117891	< 0.004350	< 67107	< 0.900035
2,2,4 Trimethyl pentane	114.23	< 67.1072	< 4.1898E-06	< 14131	< 67107	< 0.002476	< 117.8913	< 7.3604E-06	< 24824	< 117891	< 0.004350	< 92499	< 0.003413
Xylenes (m+p)	106.16	< 99.4406	< 6.2085E-06	< 22531	< 99441	< 0.003669	431.8110	2.6960E-05	97,838	431,811	0.015933	< 265626	< 0.009801
Xylenes (o)	106.16	< 67.1072	< 4.1898E-06	< 15205	< 67107	< 0.002476	< 127.4871	< 7.9595E-06	< 28885	< 127487	< 0.004704	< 97297	< 0.003590

Volatile Organic HAPs Laboratory Data Summary

Client: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Date: 7/20/2011
Run No: 18-2

Compound	Molecular Weight	Sample Train A Analysis (M_u) (micrograms)	% Recovery	Sample Train B Analysis (M_u) (micrograms)	% Recovery
Acetone	58.08	1,687.0		5156	
Acetonitrile	41.05	6487.0		< 17.6	
Acrolein	56.06	< 7878.3		< 17.2	
Acrylonitrile	53.06	< 11.0	106	< 17.2	90
Benzene	78.11	< 13.2	108	< 17.2	89
1,3-Butadiene	54.09	< 11.0	183	< 17.2	160
Carbon disulfide	76.14	< 11.0		< 17.2	
Chlorobenzene	112.56	< 11.0		< 17.2	
Cumene	120.19	< 11.0		< 17.2	
1,2-Dibromoethane	187.86	< 11.0	104	< 17.2	99
Ethylbenzene	106.17	< 11.0	110	< 17.2	101
Hexane	86.18	< 11.0	97	< 17.2	87
Methyl isobutyl ketone	100.16	< 4243.3		< 17.2	
Methyl t-butyl ether	88.15	< 11.0	106	< 17.2	88
Methylene chloride	84.93	184.0		186.0	
Nitrobenzene	123.06	< 55.0	79	< 86.0	74
2-Nitropropane	89.09	< 11.0	103	< 28.6	86
Pentane	72.15	< 22	94	< 17.2	81
Styrene	104.15	< 11.0	107	< 17.2	99
Tetrachloroethene	165.83	< 11.0		< 17.2	
Toluene	92.14	1502		46	
Trichloroethene	131.39	< 3998.3		< 17.2	
2,2,4 Trimethyl pentane	114.23	< 11.0	100	< 17.2	90
Xylenes (m+p)	106.16	< 16.3		63.0	
Xylenes (o)	106.16	< 11.0		< 18.6	

VOLATILE ORGANIC HAPS CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
SAMPLE: VolHAPs - Methanol Impingers
TEST DATE: 7/21/2011
RUN NO: 18-3

INPUT

Q_s :	1,277 **dscfh**
P_{bar} :	29.98 **in Hg**

	A Train:		*B Train:*
V_m **Unspiked:**	15.151 **liters**	V_m **Spiked:**	5.09 **liters**
V_m **Unspiked:**	0.535 **cubic ft**	V_m **Spiked:**	0.180 **cubic ft**
Y Sample :	1.000	**Y Sample :**	0.975
T_m **Sample:**	89.8 **°F**	T_m **Sample:**	90.5 **°F**
ΔH Sample:	1.69 **in. H_2O**	**ΔH Sample:**	1.31 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**
V_{mstd} Train A (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.517 **dscf**
V_{mstd} Train A ($V_{s\text{-liters}}$) = dscf x 28.32	=	14.640 **std liters**
V_{mstd} Train B (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.169 **dscf**
V_{mstd} Train B ($V_{u\text{-liters}}$) = dscf x 28.32	=	4.785 **std liters**

		A TRAIN					B TRAIN					AVERAGE	
Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)	VOC Concentration (µg/dscm)	VOC Emission (lb/hr)
Acetone	58.08	41.1891	2.5716E-06	17,058	41,189	0.00328	1,554.9350	9.7081E-05	643,961	1,554,935	0.12397	798,062	0.06363
Acetonitrile	41.05	< 13.3062	< 8.3076E-07	< 7797	< 13306	< 0.00106	1,515.0166	9.4588E-05	887,725	1,515,017	0.12079	< 13306	< 0.00106
Acrolein	56.06	< 1.5096	< 9.4249E-08	< 648	< 1510	< 0.00012	< 136.4748	< 8.5206E-06	< 58556	< 136475	< 0.01088	< 1510	< 0.00012
Acrylonitrile	53.06	< 1.5028	< 9.3823E-08	< 681	< 1503	< 0.00012	< 6.2908	< 3.9276E-07	< 2852	< 6291	< 0.00050	< 3897	< 0.00031
Benzene	78.11	224.3881	1.4009E-05	69,098	224,388	0.01789	578.7117	3.6131E-05	178,209	578,712	0.04614	401,550	0.03201
1,3-Butadiene	54.09	< 1.8853	< 1.1770E-07	< 838	< 1885	< 0.00015	< 6.2908	< 3.9276E-07	< 2797	< 6291	< 0.00050	< 4088	< 0.00033
Carbon disulfide	76.14	< 1.5028	< 9.3823E-08	< 475	< 1503	< 0.00012	< 6.8760	< 4.2929E-07	< 2172	< 6876	< 0.00055	< 4189	< 0.00033
Chlorobenzene	112.56	< 1.5028	< 9.3823E-08	< 321	< 1503	< 0.00012	< 6.2908	< 3.9276E-07	< 1344	< 6291	< 0.00050	< 3897	< 0.00031
Cumene	120.19	< 3.0328	< 1.8935E-07	< 607	< 3033	< 0.00024	< 11.2858	< 7.0462E-07	< 2259	< 11286	< 0.00090	< 7159	< 0.00057
1,2-Dibromoethane	187.86	< 1.5028	< 9.3823E-08	< 192	< 1503	< 0.00012	< 6.2908	< 3.9276E-07	< 805	< 6291	< 0.00050	< 3897	< 0.00031
Ethylbenzene	106.17	60.2467	3.7614E-06	13,649	60,247	0.00480	190.1869	1.1874E-05	43,088	190,187	0.01516	125,217	0.00998
Hexane	86.18	9.3580	5.8426E-07	2,612	9,358	0.00075	< 14.6716	< 9.1600E-07	< 4095	< 14672	< 0.00117	< 12015	< 0.00096
Methyl isobutyl ketone	100.16	< 1.5028	< 9.3823E-08	< 361	< 1503	< 0.00012	< 1293.0622	< 8.0731E-05	< 310527	< 1293062	< 0.10309	1,503	< 0.00012
Methyl t-butyl ether	88.15	< 1.5028	< 9.3823E-08	< 410	< 1503	< 0.00012	< 6.2908	< 3.9276E-07	< 1717	< 6291	< 0.00050	< 3897	< 0.00031
Methylene chloride	84.93	8.8799	5.5441E-07	2,515	8,880	0.00071	31.7675	1.9834E-06	8,997	31,767	0.00253	20,324	0.00162
Nitrobenzene	123.06	< 29.5086	< 1.8423E-06	< 5768	< 29509	< 0.00235	< 56.4291	< 3.5231E-06	< 11030	< 56429	< 0.00450	< 42969	< 0.00343
2-Nitropropane	89.09	< 40.3011	< 2.5162E-06	< 10881	< 40301	< 0.00321	< 131.6679	< 8.2205E-06	< 35549	< 131668	< 0.01050	< 85984	< 0.00686
Pentane	72.15	67.0774	4.1879E-06	22,362	67,077	0.00535	< 35.3622	< 2.2078E-06	< 11789	< 35362	< 0.00282	< 51220	< 0.00408
Styrene	104.15	< 3.4427	< 2.1494E-07	< 795	< 3443	< 0.00027	11.8710	7.4115E-07	2,742	11,871	0.00095	< 7657	< 0.00061
Tetrachloroethene	165.83	< 1.5028	< 9.3823E-08	< 218	< 1503	< 0.00012	< 6.2908	< 3.9276E-07	< 912	< 6291	< 0.00050	< 3897	< 0.00031
Toluene	92.14	558.8870	3.4893E-05	145,898	558,887	0.04456	1,819.3157	1.1359E-04	474,935	1,819,316	0.14505	558,887	0.04456
Trichloroethene	131.39	< 1.6120	< 1.0065E-07	< 295	< 1612	< 0.00013	1,091.1714	6.8126E-05	199,758	1,091,171	0.08700	< 2295	< 0.00013
2,2,4 Trimethyl pentane	114.23	< 2.2951	< 1.4329E-07	< 483	< 2295	< 0.00018	< 6.2908	< 3.9276E-07	< 1325	< 6291	< 0.00050	< 4293	< 0.00034
Xylenes (m+p)	106.16	575.4856	3.5930E-05	130,391	575,486	0.04588	1,756.4077	1.0966E-04	397,959	1,756,408	0.14003	1,165,946.6	0.09296
Xylenes (o)	106.16	97.2690	6.0729E-06	22,039	97,269	0.00776	347.7704	2.1713E-05	78,796	347,770	0.02773	222,519.7	0.01774

VOLATILE ORGANIC HAPS CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
SAMPLE: VolHAPs - Methanol Impingers
TEST DATE: 7/21/2011
RUN NO: 18-3

INPUT

Q_s :	1,277 **dscfh**		
P_{bar} :	29.98 **in Hg**		
Cycle Time:	1.000 **hrs**		
	A Train:		***B Train:***
V_m **Unspiked:**	15.151 **liters**	V_m **Spiked:**	5.09 **liters**
V_m **Unspiked:**	0.535 **cubic ft**	V_m **Spiked:**	0.180 **cubic ft**
Y Sample :	1.000	**Y Sample :**	0.975
T_m **Sample:**	89.8 **°F**	T_m **Sample:**	90.5 **°F**
ΔH Sample:	1.69 **in. H_2O**	**ΔH Sample:**	1.31 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Train A (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.517	**dscf**
V_{mstd} Train A ($V_{s\text{-liters}}$) = dscf x 28.32	=	14.640	**std liters**
V_{mstd} Train B (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.169	**dscf**
V_{mstd} Train B ($V_{u\text{-liters}}$) = dscf x 28.32	=	4.785	**std liters**

		A TRAIN					B TRAIN					AVERAGE	
Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	Mass/volume (M_v) (µg/liter)	VOC Concentration (lb/dscf)	VOC Concentration (ppb db)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)	VOC Concentration (µg/dscm)	VOC Emission (lb/cycle)
Acetone	58.08	41.1891	2.5716E-06	17,058	41,189	0.003284	1,554.9350	9.7081E-05	643,961	1,554,935	0.123972	798,062	0.063628
Acetonitrile	41.05	< 13.3062	< 8.3076E-07	< 7797	< 13306	< 0.001061	1,515.0166	9.4588E-05	887,725	1,515,017	0.120789	< 13306	< 0.001061
Acrolein	56.06	< 1.5096	< 9.4249E-08	< 648	< 1510	< 0.000120	< 136.4748	< 8.5206E-06	< 58556	< 136475	< 0.010881	< 1510	< 0.000120
Acrylonitrile	53.06	< 1.5028	< 9.3823E-08	< 681	< 1503	< 0.000120	< 6.2908	< 3.9276E-07	< 2852	< 6291	< 0.000502	< 3897	< 0.000311
Benzene	78.11	224.3881	1.4009E-05	69,098	224,388	0.017890	578.7117	3.6131E-05	178,209	578,712	0.046140	401,550	0.032015
1,3-Butadiene	54.09	< 1.8853	< 1.1770E-07	< 838	< 1885	< 0.000150	< 6.2908	< 3.9276E-07	< 2797	< 6291	< 0.000502	< 4088	< 0.000326
Carbon disulfide	76.14	< 1.5028	< 9.3823E-08	< 475	< 1503	< 0.000120	< 6.8760	< 4.2929E-07	< 2172	< 6876	< 0.000548	< 4189	< 0.000334
Chlorobenzene	112.56	< 1.5028	< 9.3823E-08	< 321	< 1503	< 0.000120	< 6.2908	< 3.9276E-07	< 1344	< 6291	< 0.000502	< 3897	< 0.000311
Cumene	120.19	< 3.0328	< 1.8935E-07	< 607	< 3033	< 0.000242	< 11.2858	< 7.0462E-07	< 2259	< 11286	< 0.000900	< 7159	< 0.000571
1,2-Dibromoethane	187.86	< 1.5028	< 9.3823E-08	< 192	< 1503	< 0.000120	< 6.2908	< 3.9276E-07	< 805	< 6291	< 0.000502	< 3897	< 0.000311
Ethylbenzene	106.17	60.2467	3.7614E-06	13,649	60,247	0.004803	190.1869	1.1874E-05	43,088	190,187	0.015163	125,217	0.009983
Hexane	86.18	9.3580	5.8426E-07	2,612	9,358	0.000746	< 14.6716	< 9.1600E-07	< 4095	< 14672	< 0.001170	< 12015	< 0.000958
Methyl isobutyl ketone	100.16	< 1.5028	< 9.3823E-08	< 361	< 1503	< 0.000120	< 1293.0622	< 8.0731E-05	< 310527	< 1293062	< 0.103093	1,503	< 0.000120
Methyl t-butyl ether	88.15	< 1.5028	< 9.3823E-08	< 410	< 1503	< 0.000120	< 6.2908	< 3.9276E-07	< 1717	< 6291	< 0.000502	< 3897	< 0.000311
Methylene chloride	84.93	8.8799	5.5441E-07	2,515	8,880	0.000708	31.7675	1.9834E-06	8,997	31,767	0.002533	20,324	0.001620
Nitrobenzene	123.06	< 29.5086	< 1.8423E-06	< 5768	< 29509	< 0.002353	< 56.4291	< 3.5231E-06	< 11030	< 56429	< 0.004499	< 42969	< 0.003426
2-Nitropropane	89.09	< 40.3011	< 2.5162E-06	< 10881	< 40301	< 0.003213	< 131.6679	< 8.2205E-06	< 35549	< 131668	< 0.010498	< 85984	< 0.006855
Pentane	72.15	67.0774	4.1879E-06	22,362	67,077	0.005348	< 35.3622	< 2.2078E-06	< 11789	< 35362	< 0.002819	< 51220	< 0.004084
Styrene	104.15	< 3.4427	< 2.1494E-07	< 795	< 3443	< 0.000274	11.8710	7.4115E-07	2,742	11,871	0.000946	< 7657	< 0.000610
Tetrachloroethene	165.83	< 1.5028	< 9.3823E-08	< 218	< 1503	< 0.000120	< 6.2908	< 3.9276E-07	< 912	< 6291	< 0.000502	< 3897	< 0.000311
Toluene	92.14	558.8870	3.4893E-05	145,898	558,887	0.044559	1,819.3157	1.1359E-04	474,935	1,819,316	0.145050	558,887	0.044559
Trichloroethene	131.39	< 1.6120	< 1.0065E-07	< 295	< 1612	< 0.000129	1,091.1714	6.8126E-05	199,758	1,091,171	0.086997	< 2295	< 0.000129
2,2,4 Trimethyl pentane	114.23	< 2.2951	< 1.4329E-07	< 483	< 2295	< 0.000183	< 6.2908	< 3.9276E-07	< 1325	< 6291	< 0.000502	< 4293	< 0.000342
Xylenes (m+p)	106.16	575.4856	3.5930E-05	130,391	575,486	0.045882	1,756.4077	1.0966E-04	397,959	1,756,408	0.140035	1,165,946.6	0.092959
Xylenes (o)	106.16	97.2690	6.0729E-06	22,039	97,269	0.007755	347.7704	2.1713E-05	78,796	347,770	0.027727	222,519.7	0.017741

Volatile Organic HAPs Laboratory Data Summary

Client: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Date: 7/21/2011
Run No: 18-3

Compound	Molecular Weight	Sample Train A Analysis (M_u) (micrograms)	% Recovery	Sample Train B Analysis (M_u) (micrograms)	% Recovery
Acetone	58.08	603.0		7440	
Acetonitrile	41.05	< 194.8		7249	
Acrolein	56.06	< 22.1		< 653.0	
Acrylonitrile	53.06	< 22.0	50	< 30.1	77
Benzene	78.11	3285	63	2769	81
1,3-Butadiene	54.09	< 27.6		< 30.1	
Carbon disulfide	76.14	< 22.0		< 32.9	
Chlorobenzene	112.56	< 22.0		< 30.1	
Cumene	120.19	< 44.4		54.0	
1,2-Dibromoethane	187.86	< 22.0	116	< 30.1	132
Ethylbenzene	106.17	882	61	910	92
Hexane	86.18	137	53	< 70.2	19
Methyl isobutyl ketone	100.16	< 22.0		< 6187.0	
Methyl t-butyl ether	88.15	< 22.0	61	< 30.1	93
Methylene chloride	84.93	130.0		152.0	
Nitrobenzene	123.06	< 432.0	160	< 270.0	192
2-Nitropropane	89.09	< 590.0	63	< 630.0	90
Pentane	72.15	982	29	< 169	4
Styrene	104.15	< 50.4	47	56.8	80
Tetrachloroethene	165.83	< 22.0		< 30.1	
Toluene	92.14	8182		8705	
Trichloroethene	131.39	< 23.6		5221.0	
2,2,4 Trimethyl pentane	114.23	< 33.6	54	< 30.1	37
Xylenes (m+p)	106.16	8425		8404	
Xylenes (o)	106.16	1424		1664	

CARBONYL SULFIDE EMISSION RATE CALCULATION SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-1
TEST DATE: 7/29/2011

INPUT

COS CONCENTRATION (C):	< 82.2 ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,932 dscfh
CYCLE TIME:	1.267 hrs

CALCULATIONS

STACK COS AVERAGE CHART READING = < 82.2 ppmv

COS CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{60.07 lb/lb-mole}{385.26\times10^{-6} ft^3/lb-mole}\right)$$

= < 12.817 x 10^{-6} lbs/dscf

COS EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,932 dscfh

STACK COS EMISSION RATE =

$$COS_{pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= < 0.0248 lbs/hr
= < 0.031 lb/cycle

HYDROGEN SULFIDE EMISSION RATE CALCULATION SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-1
TEST DATE: 7/29/2011

INPUT

H_2S CONCENTRATION (C):	425.0	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,932	dscfh
CYCLE TIME:	1.267	hrs

CALCULATIONS

STACK H_2S AVERAGE CHART READING = 425.0 ppmv

H_2S CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{34.08 lb / lb-mole}{385.26 \times 10^{-6} ft^3 / lb-mole}\right)$$

= 37.595 x 10^{-6} lbs/dscf

H_2S EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,932 dscfh

STACK H_2S EMISSION RATE =

$$H_2S_{pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= 0.0726 lbs/hr
= 0.0920 lb/cycle

CARBON DISULFIDE EMISSION RATE CALCULATION SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736.DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-1
TEST DATE: 7/29/2011

INPUT

CS_2 CONCENTRATION (C):	<40.1 ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,932 dscfh
CYCLE TIME:	1.267 hrs

CALCULATIONS

STACK CS_2 AVERAGE CHART READING = < 40.1 ppmv

CS_2 CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{76.1 lb/lb-mole}{385.26 \times 10^{-6} ft^3/lb-mole}\right)$$

= < 7.921 x 10^{-6} lbs/dscf

CS_2 EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,932 dscfh

STACK CS_2 EMISSION RATE =

$$CS_{2pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= < 0.0153 lbs/hr
= < 0.0194 lb/cycle

CARBONYL SULFIDE EMISSION RATE CALCULATION SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-2
TEST DATE: 8/1/2011

INPUT

COS CONCENTRATION (C):	< 82.2	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,504	dscfh
CYCLE TIME:	0.433	hrs

CALCULATIONS

STACK COS AVERAGE CHART READING = < 82.2 ppmv

COS CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{60.07 lb/lb-mole}{385.26\times10^{-6} ft^3/lb-mole}\right)$$

= < 12.817 x 10^{-6} lbs/dscf

COS EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,504 dscfh

STACK COS EMISSION RATE =

$$COS_{pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= < 0.0193 lbs/hr
= < 0.0084 lb/cycle

HYDROGEN SULFIDE CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-2
TEST DATE: 8/1/2011

INPUT

H_2S CONCENTRATION (C):	<91.7 ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,504 dscfh
CYCLE TIME:	0.433 hrs

CALCULATIONS

STACK H_2S AVERAGE CHART READING = < 91.7 ppmv

H_2S CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{34.08 lb/lb-mole}{385.26 \times 10^{-6} ft^3/lb-mole}\right)$$

= <8.112 x 10^{-6} lbs/dscf

H_2S EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,504 dscfh

STACK H_2S EMISSION RATE =

$$H_2S_{pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= < 0.0122 lbs/hr
= < 0.0053 lb/cycle

CARBON DISULFIDE EMISSION RATE CALCULATION SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-2
TEST DATE: 8/1/2011

INPUT

CS_2 CONCENTRATION (C):	<40.1 ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	1,504 dscfh
CYCLE TIME:	0.433 hrs

CALCULATIONS

STACK CS_2 AVERAGE CHART READING = < 40.1 ppmv

CS_2 CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{76.1 lb/lb-mole}{385.26 \times 10^{-6} ft^3/lb-mole}\right)$$

= < 7.921 x 10^{-6} lbs/dscf

CS_2 EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 1,504 dscfh

STACK CS_2 EMISSION RATE =

$$CS_{2pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= < 0.0119 lbs/hr
= < 0.0052 lb/cycle

CARBONYL SULFIDE EMISSION RATE CALCULATION SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-3
TEST DATE: 8/2/2011

INPUT

COS CONCENTRATION (C):	<50.6	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	28,949	dscfh
CYCLE TIME:	0.083	hrs

CALCULATIONS

STACK COS AVERAGE CHART READING = < 50.6 ppmv

COS CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = (C_{gas,ppm})\left(\frac{60.07 lb/lb-mole}{385.26 \times 10^{-6} ft^3/lb-mole}\right)$$

= <7.890 x 10^{-6} lbs/dscf

COS EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 28,949 dscfh

STACK COS EMISSION RATE =

$$COS_{pmr} = (C_{gas,lb/dscf})(Q_{std})$$

= < 0.2284 lbs/hr
= < 0.0190 lb/cycle

HYDROGEN SULFIDE CALIBRATION CORRECTION DATA SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-3
TEST DATE: 8/2/2011

INPUT

H_2S CONCENTRATION (C):	82.9	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	28,949	dscfh
CYCLE TIME:	0.083	hrs

CALCULATIONS

STACK H_2S AVERAGE CHART READING = 82.9 ppmv

H_2S CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{34.08 lb/lb-mole}{385.26 \times 10^{-6} ft^3/lb-mole}\right)$$

= 7.333 x 10^{-6} lbs/dscf

H_2S EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 28,949 dscfh

STACK H_2S EMISSION RATE =

$$H_2S_{pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= < 0.212 lbs/hr
= < 0.018 lb/cycle

CARBON DISULFIDE EMISSION RATE CALCULATION SHEET
USEPA METHOD 15

COMPANY: Houston Refining
LOCATION: Houston, Texas
SOURCE: 736 DCU
MONITOR ID: SRI-9300B: GC-FPD
RUN NO: 15-3
TEST DATE: 8/2/2011

INPUT

CS_2 CONCENTRATION (C):	<32.0	ppmv
STACK GAS VOLUMETRIC FLOW RATE (Q_{std}):	28,949	dscfh
CYCLE TIME:	0.083	hrs

CALCULATIONS

STACK CS_2 AVERAGE CHART READING = < 32.0 ppmv

CS_2 CONCENTRATION (lbs/dscf) =

$$C_{gas,lb/dscf} = \left(C_{gas,ppm}\right)\left(\frac{76.1 lb / lb-mole}{385.26 \times 10^{-6} ft^3 / lb-mole}\right)$$

= < 6.321 x 10^{-6} lbs/dscf

CS_2 EMISSION RATE:

STACK GAS VOLUMETRIC FLOW RATE = 28,949 dscfh

STACK CS_2 EMISSION RATE =

$$CS_{2pmr} = \left(C_{gas,lb/dscf}\right)\left(Q_{std}\right)$$

= < 0.1830 lbs/hr
= < 0.0152 lb/cycle

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/19/2011
RUN NUMBER: 0010-1

γ FACTOR:	1.005	**STACK DIAM:**	8.000 **inches**
BAROMETRIC:	30.00 **in. Hg**	**METER VOLUME:**	0.655 **ft^3**
STATIC PRES:	1.667 **in.H_2O**	**METER TEMP:**	88.2 **°F**
STACK TEMP:	213.0 **°F**	**LIQUID COLL:**	1700.3 **milliliters**
SQ.RT ΔP:	0.7268 **in.H_2O**	**CO_2:**	0.00 **% by volume**
ΔH:	0.02 **in.H_2O**	**O_2:**	20.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 0.636 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 80.033 \text{ scf}$$

V_{lc} = 1700.3 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9921$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 1.0000$$

T = 373.6 °K
P = 765.1 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9921

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 0010-1

SOURCE: 736 DCU
TEST DATE: 7/19/2011

BAROMETRIC:	30 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.67 **in.H_2O**	**CO_2:**	0.00 **% by volume**
STACK TEMP:	213 **°F**	**O_2:**	20.50 **% by volume**
SQ.RT ΔP:	0.7268 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.820	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	18.085	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	0.7268	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
T_s = 213.0 °F + 460	=	673.0	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.12	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	58.010	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,215	**acfm**
Stack Area = 0.3491 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	959.6 57,578	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	7.6 454	**dscfm** **dscfh**

METHOD 0010 ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/19/2011
RUN NO: 0010-1

INPUT

V_m:	0.655	ft^3	Q_s:	454	dscfh
γ FACTOR:	1.005		T_s:	213.0	°F
P_{bar}:	30.00	in. Hg	Θ:	28	minutes
ΔH:	0.02	in. H_2O	V_s:	58.010	fps
T_m:	88.2	°F	P_s:	30.12	in. Hg
			V_{lc}:	1,700.3	mL

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 0.636 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 543.98 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 28 minutes

SVOC CALCULATION SUMMARY

COMPANY :	Houston Refining
LOCATION :	Houston, TX
SOURCE :	736 DCU
TEST DATE :	7/19/2011
TEST RUN NO. :	0010-1
CYCLE TIME:	0.467 **hrs**
SAMPLE VOLUME :	0.636 **dscf**
SAMPLE VOLUME :	0.018 **dscm**
GAS FLOW RATE :	454 **dscfh**
STACK O_2 CONTENT :	20.50 **%**

VOST COMPOUND	TOTAL SAMPLE MASS (nanogram)	MOLECULAR WEIGHT	STACK GAS CONCENTRATION (lb/dscf x 10^{-9})	STACK GAS CONCENTRATION (µg/dscm)	STACK GAS CONCENTRATION (ppb db)	EMISSION RATE (lb/hr x 10^{-3})	EMISSION RATE (lb/cycle x 10^{-3})
Acenaphthene	193,000	154.21	669.2	10,719	1,672	0.3037	0.1417
Acenaphthylene	<15,400	152.19	<53.40	<855.3	<135.2	<0.02423	<0.01131
Aniline	34,700	93.13	120.3	1,927	497.8	0.05460	0.02548
Anthracene	831,000	178.23	2.882	46,152	6,229	1.308	0.610
Benzidine	<380,000	184.24	<1,317.7	<21,104	<2,755.3	<0.59795	<0.27904
Benzo[a]anthracene	69,000	228.29	239.3	3,832	403.8	0.1086	0.0507
Benzo[b]fluoranthene	<4,000	252.31	<13.87	<222.2	<21.18	<0.006294	<0.002937
Benzo[k]fluoranthene	<4,000	252.31	<13.87	<222.2	<21.18	<0.006294	<0.002937
Benzo[g,h,i]perylene	<4,000	276.33	<13.87	<222.2	<19.34	<0.006294	<0.002937
Benzo[a]pyrene	7,040	252.31	24.41	391.0	37.27	0.01108	0.00517
Benzo[e]pyrene	6,920	252.31	24.00	384.3	36.64	0.01089	0.00508
Biphenyl	271,000	154.21	939.7	15,051	2,348	0.4264	0.1990
2-Chloronapthalene	<4,000	162.62	<13.87	<222.2	<32.86	<0.006294	<0.002937
Chrysene	88,800	228.28	307.9	4,932	519.7	0.1397	0.0652
Dibenz[a,h]anthracene	<4,000	278.35	<13.87	<222.2	<19.20	<0.006294	<0.002937
Dibenzofuran	143,000	168.19	495.86	7,941.9	1,135.8	0.22502	0.10501
Dibenzo(a,e)pyrene	<4,000	302.37	<13.87	<222.2	<17.67	<0.006294	<0.002937
3,3'-Dimethoxybenzidine	<290,000	244.29	<1,006	<16,106	<1,586	<0.4563	<0.2130
Dimethylaminobenzene	<20,000	225.29	<69.35	<1,111	<118.6	<0.03147	<0.01469
7,12-Dimethylbenz(a)anthracene	<4,000	256.34	<13.87	<222.2	<20.85	<0.006294	<0.002937
3,3'-Dimethylbenzidine	<290,000	212.29	<1,006	<16,106	<1,825	<0.4563	<0.2130
a,a-Dimethylphenethylamine	<120,000	149.23	<416.1	<6,665	<1,074	<0.1888	<0.0881
2,4-Dimethylphenol	163,000	122.17	565.2	9,053	1,782	0.2565	0.1197
Fluoranthene	215,000	202.26	745.5	11,941	1,420	0.3383	0.1579
Fluorene	667,000	166.22	2.313	37,044	5,361	1.050	0.490
Indeno(1,2,3-cd)pyrene	<4,000	276.33	<13.87	<222.2	<19.34	<0.006294	<0.002937
Isophorone	<22,500	138.21	<78.02	<1,250	<217.5	<0.03540	<0.01652
3-Methylcholanthrene	<4,000	268.35	<13.87	<222.2	<19.91	<0.006294	<0.002937
2-Methylnaphthalene	8,050,000	142.20	27,914	447,081	75,626	12.67	5.91
2-Methylphenol	65,800	108.14	228.2	3,654	812.9	0.1035	0.0483
3-Methylphenol & 4-Methylphenol	83,600	108.14	289.9	4,643	1,033	0.1315	0.0614
Naphthalene	4,290,000	128.17	14,876	238,258	44,714	6.751	3.150
Perylene	<4,000	252.31	<13.87	<222.2	<21.18	<0.006294	<0.002937
Phenanthrene	2,770,000	178.23	9.605	153,840	20,762	4.359	2.034
Phenol	<20,600	94.11	<71.43	<1,144	<292.4	<0.03242	<0.01513
1,4-Phenylenediamine	<180,000	108.10	<624.2	<9,997	<2,224	<0.2832	<0.1322
Pyrene	1,030,000	202.25	3.572	57,204	6,803	1.621	0.756
o-Toluidine	<50,000	107.17	<173.38	<2,777	<623.3	<0.07868	<0.03672

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/20/2011
RUN NUMBER: 0010-2

γ FACTOR:	1.005	**STACK DIAM:**	8.000 **inches**
BAROMETRIC:	30.04 **in. Hg**	**METER VOLUME:**	1.301 **ft^3**
STATIC PRES:	1.350 **in.H_2O**	**METER TEMP:**	89.0 **°F**
STACK TEMP:	213.0 **°F**	**LIQUID COLL:**	486.7 **milliliters**
SQ.RT ΔP:	0.9643 **in.H_2O**	**CO_2:**	0.00 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	21.00 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.263 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 22.909 \text{ scf}$$

V_{lc} = 486.7 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9478$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 1.0000$$

T = 373.6 °K
P = 765.5 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9478

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 0010-2

SOURCE: 736 DCU
TEST DATE: 7/20/2011

BAROMETRIC:	30.04 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.35 **in.H_2O**	**CO_2:**	0.00 **% by volume**
STACK TEMP:	213 **°F**	**O_2:**	21.00 **% by volume**
SQ.RT ΔP:	0.9643 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.84 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 18.57 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 0.9643 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 213.0 °F + 460 = 673.0 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.14 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 75.943 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 1,591 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,257.0 **scfm, wb**
75,421 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 65.7 **dscfm**
3,940 **dscfh**

METHOD 0010 ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/20/2011
RUN NO: 0010-2

INPUT

V_m:	1.301	**ft³**	Q_s:	3,940	**dscfh**
γ **FACTOR:**	1.005		T_s:	213.0	**°F**
P_{bar}:	30.04	**in. Hg**	Θ:	9	**minutes**
ΔH:	0.03	**in. H_2O**	V_s:	75.943	**fps**
T_m:	89.0	**°F**	P_s:	30.14	**in. Hg**
			V_{lc}:	486.7	**mL**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.263 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 387.12 \text{ \% I}$$

A_n = 0.00019277 ft^2 Runtime (θ) = 9 minutes

SVOC CALCULATION SUMMARY

COMPANY :	Houston Refining
LOCATION :	Houston, TX
SOURCE :	736 DCU
TEST DATE :	7/20/2011
TEST RUN NO. :	0010-2
CYCLE TIME:	0.150 **hrs**
SAMPLE VOLUME :	1.263 **dscf**
SAMPLE VOLUME :	0.036 **dscm**
GAS FLOW RATE :	3,940 **dscfh**
STACK O_2 CONTENT :	21.00 **%**

VOST COMPOUND	TOTAL SAMPLE MASS (nanogram)	MOLECULAR WEIGHT	STACK GAS CONCENTRATION (lb/dscf x 10^{-6})	STACK GAS CONCENTRATION (µg/dscm)	STACK GAS CONCENTRATION (ppb db)	EMISSION RATE (lb/hr x 10^{-3})	EMISSION RATE (lb/cycle x 10^{-3})
Acenaphthene	<16,500	154.21	<28.81	<461.4	<71.97	<0.1135	<0.0170
Acenaphthylene	<4,000	152.19	<6.984	<111.9	<17.68	<0.02752	<0.00413
Aniline	<8,400	93.13	<14.67	<234.9	<60.67	<0.05778	<0.00867
Anthracene	106,000	178.23	185.1	2,964	400.1	0.7292	0.1094
Benzidine	<38,000	184.24	<66.35	<1,063	<138.7	<0.2614	<0.0392
Benzo[a]anthracene	<55,700	228.29	<97.25	<1,558	<164.1	<0.3832	<0.0575
Benzo[b]fluoranthene	10,100	252.31	17.64	282.5	26.93	0.06948	0.01042
Benzo[k]fluoranthene	<4,000	252.31	<6.984	<111.9	<10.66	<0.02752	<0.00413
Benzo[g,h,i]perylene	16,800	276.33	29.33	469.8	40.90	0.1156	0.0173
Benzo[a]pyrene	24,600	252.31	42.95	688.0	65.59	0.1692	0.0254
Benzo[e]pyrene	21,100	252.31	36.84	590.1	56.25	0.1451	0.0218
Biphenyl	23,900	154.21	41.73	668.4	104.3	0.1644	0.0247
2-Chloronapthalene	<4,000	162.62	<6.98	<111.9	<16.55	<0.02752	<0.00413
Chrysene	68,200	228.28	119.1	1,907	201.0	0.4691	0.0704
Dibenz[a,h]anthracene	6,080	278.35	10.62	170.0	14.69	0.04182	0.00627
Dibenzofuran	13,800	168.19	24.10	385.9	55.19	0.09493	0.01424
Dibenzo(a,e)pyrene	<4,000	302.37	<6.984	<111.9	<8.90	<0.02752	<0.00413
3,3'-Dimethoxybenzidine	47,600	244.29	83.11	1,331	131.1	0.3274	0.0491
Dimethylaminobenzene	<2,000	225.29	<3.492	<55.93	<5.97	<0.01376	<0.00206
7,12-Dimethylbenz(a)anthracene	<4,000	256.34	<6.984	<111.9	<10.50	<0.02752	<0.00413
3,3'-Dimethylbenzidine	<29,000	212.29	<50.64	<811.0	<91.89	<0.1995	<0.0299
a,a-Dimethylphenethylamine	<12,000	149.23	<21.0	<336	<54.09	<0.0825	<0.0124
2,4-Dimethylphenol	27,100	122.17	47.32	757.9	149.2	0.1864	0.0280
Fluoranthene	41,200	202.26	71.94	1,152	137.0	0.2834	0.0425
Fluorene	55,800	166.22	97.43	1,560	225.8	0.3838	0.0576
Indeno(1,2,3-cd)pyrene	4,540	276.33	7.927	127.0	11.05	0.03123	0.00468
Isophorone	<2,250	138.21	<3.93	<62.9	<11.0	<0.0155	<0.0023
3-Methylcholanthrene	<4,000	268.35	<6.984	<111.9	<10.03	<0.02752	<0.00413
2-Methylnaphthalene	765,000	142.20	1,336	21,394	3,619	5.262	0.789
2-Methylphenol	18,400	108.14	32.13	514.6	114.5	0.1266	0.0190
3-Methylphenol & 4-Methylphenol	19,400	108.14	33.87	542.5	120.7	0.1334	0.0200
Naphthalene	475,000	128.17	829.4	13,284	2,493	3.267	0.490
Perylene	<4,000	252.31	<6.984	<111.9	<10.66	<0.02752	<0.00413
Phenanthrene	313,000	178.23	546.5	8,753	1,181	2.153	0.323
Phenol	<17,500	94.11	<30.56	<489.4	<125.1	<0.1204	<0.0181
1,4-Phenylenediamine	<18,000	108.10	<31.43	<503.4	<112.0	<0.1238	<0.0186
Pyrene	222,000	202.25	387.6	6,208	738.4	1.527	0.229
o-Toluidine	<5,000	107.17	<8.730	<139.8	<31.38	<0.03439	<0.00516

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: 0010-3

γ FACTOR:	1.005	**STACK DIAM:**	8.000 **inches**
BAROMETRIC:	29.98 **in. Hg**	**METER VOLUME:**	2.500 **ft^3**
STATIC PRES:	1.180 **in.H_2O**	**METER TEMP:**	87.4 **°F**
STACK TEMP:	212.4 **°F**	**LIQUID COLL:**	2918.3 **milliliters**
SQ.RT ΔP:	0.9311 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.05 **in.H_2O**	**O_2:**	18.00 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.429 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 137.364 \text{ scf}$$

V_{lc} = 2918.3 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9826$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.9965$$

T = 373.2 °K
P = 763.7 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9826

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 0010-3

SOURCE: 736 DCU
TEST DATE: 7/21/2011

BAROMETRIC:	29.98 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.18 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212.4 **°F**	**O_2:**	18.00 **% by volume**
SQ.RT ΔP:	0.9311 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.80 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18B_{ws}$$ = 18.19 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 0.9311 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 212.4 °F + 460 = 672.4 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.07 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 74.146 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 1,553 **acfm**

Stack Area = 0.3491 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,225.4 **scfm, wb**
73,524 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 21.3 **dscfm**
1,277 **dscfh**

METHOD 0010 ISOKINETIC CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NO: 0010-3

INPUT

V_m:	2.500	**ft³**	Q_s:	1,277	**dscfh**
γ **FACTOR:**	1.005		T_s:	212.4	**°F**
P_{bar}:	29.98	**in. Hg**	Θ:	50	**minutes**
ΔH:	0.05	**in. H_2O**	V_s:	74.146	**fps**
T_m:	87.4	**°F**	P_s:	30.07	**in. Hg**
			V_{lc}:	2,918.3	**mL**

Volume of Sample at Standard Conditions on a Dry Basis: **English Units (29.92 in. Hg, 68 °F)**

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.429 \text{ dscf}$$

Isokinetic Sampling Rate

$$\%ISO = \frac{(100)(T_s)\left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m}\right)(\gamma)\left(P_{bar} + \left(\frac{\Delta H}{13.6}\right)\right)\right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 413.40 \text{ \% I}$$

A_n = 0.00019277 ft² Runtime (θ) = 50 minutes

SVOC CALCULATION SUMMARY

COMPANY :	Houston Refining
LOCATION :	Houston, TX
SOURCE :	736 DCU
TEST DATE :	7/21/2011
TEST RUN NO. :	0010-3
CYCLE TIME:	0.833 **hrs**
SAMPLE VOLUME :	2.429 **dscf**
SAMPLE VOLUME :	0.069 **dscm**
GAS FLOW RATE :	1,277 **dscfh**
STACK O_2 CONTENT :	18.00 **%**

VOST COMPOUND	TOTAL SAMPLE MASS (nanogram)	MOLECULAR WEIGHT	STACK GAS CONCENTRATION (lb/dscf x 10^{-6})	STACK GAS CONCENTRATION (µg/dscm)	STACK GAS CONCENTRATION (ppb db)	EMISSION RATE (lb/hr x 10^{-3})	EMISSION RATE (lb/cycle x 10^{-3})
Acenaphthene	717,000	154.21	650.9	10,425	1,626.05	0.8314	0.6928
Acenaphthylene	<52,400	152.19	<47.57	<761.9	<120.4	<0.06076	<0.05063
Aniline	37,400	93.13	33.95	543.8	140.4	0.04337	0.03614
Anthracene	2,300,000	178.23	2.088	33,440	4,513	2.667	2.222
Benzidine	<380,000	184.24	<344.95	<5,524.9	<721.32	<0.44061	<0.36718
Benzo[a]anthracene	224,000	228.29	203.3	3,257	343.2	0.2597	0.2164
Benzo[b]fluoranthene	13,300	252.31	12.07	193.4	18.44	0.01542	0.01285
Benzo[k]fluoranthene	<7,620	252.31	<6.917	<110.8	<10.56	<0.008835	<0.007363
Benzo[g,h,i]perylene	19,300	276.33	17.52	280.6	24.43	0.02238	0.01865
Benzo[a]pyrene	36,200	252.31	32.86	526.3	50.18	0.04197	0.03498
Benzo[e]pyrene	22,800	252.31	20.70	331.5	31.60	0.02644	0.02203
Biphenyl	976,000	154.21	886.0	14,190	2,213	1.132	0.943
2-Chloronapthalene	<4,000	162.62	<3.631	<58.16	<8,602	<0.004638	<0.003865
Chrysene	257,000	228.28	233.3	3,737	393.7	0.2980	0.2483
Dibenz[a,h]anthracene	8,660	278.35	7.861	125.9	10.88	0.01004	0.00837
Dibenzofuran	251,000	168.19	227.8	3,649	521.9	0.2910	0.2425
Dibenzo(a,e)pyrene	<4,000	302.37	<3.631	<58.16	<4.626	<0.004638	<0.003865
3,3'-Dimethoxybenzidine	<290,000	244.29	<263.3	<4,216	<415.2	<0.3363	<0.2802
Dimethylaminobenzene	<20,000	225.29	<18.16	<290.8	<31.05	<0.02319	<0.01933
7,12-Dimethylbenz(a)anthracene	<4,000	256.34	<3.631	<58.16	<5.457	<0.004638	<0.003865
3,3'-Dimethylbenzidine	<290,000	212.29	<263.3	<4,216	<477.7	<0.3363	<0.2802
a,a-Dimethylphenethylamine	<120,000	149.23	<108.9	<1,745	<281.2	<0.1391	<0.1160
2,4-Dimethylphenol	200,000	122.17	181.6	2,908	572.5	0.2319	0.1933
Fluoranthene	337,000	202.26	305.9	4,900	582.7	0.3908	0.3256
Fluorene	2,240,000	166.22	2.033	32,568	4,713	2.597	2.164
Indeno(1,2,3-cd)pyrene	6,460	276.33	5.864	93.92	8.176	0.007490	0.006242
Isophorone	<22,500	138.21	<20.42	<327.1	<56.93	<0.02609	<0.02174
3-Methylcholanthrene	<4,000	268.35	<3.631	<58.16	<5.213	<0.004638	<0.003865
2-Methylnaphthalene	34,100,000	142.20	30,955	495,788	83,865	39.54	32.95
2-Methylphenol	73,900	108.14	67.08	1,074	239.0	0.08569	0.07141
3-Methylphenol & 4-Methylphenol	<73,100	108.14	<66.36	<1,063	<236.4	<0.08476	<0.07063
Naphthalene	12,200,000	128.17	11,075	177,379	33,289	14.15	11.79
Perylene	<4,000	252.31	<3.631	<58.16	<5.544	<0.004638	<0.003865
Phenanthrene	6,720,000	178.23	6.100	97,704	13,186	7.792	6.493
Phenol	<22,200	94.11	<20.15	<322.8	<82.50	<0.02574	<0.02145
1,4-Phenylenediamine	<180,000	108.10	<163.4	<2,617	<582.3	<0.2087	<0.1739
Pyrene	1,450,000	202.25	1,316	21,082	2,507	1.681	1.401
o-Toluidine	<30,400	107.17	<27.60	<442.0	<99.20	<0.03525	<0.02937

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: 0010-3 (308-1)

γ FACTOR:	1.005	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	29.98 **in. Hg**	**METER VOLUME:**	2.500 **ft^3**
STATIC PRES:	1.18 **in.H_2O**	**METER TEMP:**	87.4 **°F**
STACK TEMP:	212.4 **°F**	**LIQUID COLL:**	1700.3 **milliliters**
SQ.RT ΔP:	0.9311 **in.H_2O**	**CO_2:**	0.00 **% by volume**
ΔH:	0.05 **in.H_2O**	**O_2:**	20.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.429 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} V_{wstd} = 0.04707 \times V_{lc} = 80.033 \text{ scf}$$

V_{lc} = 1700.3 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9705$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 0.9965$$

T = 373.2 °K
P = 763.7 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9705

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: 0010-3 (308-1)

SOURCE: 736 DCU
TEST DATE: 7/21/2011

BAROMETRIC:	29.98 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.18 **in.H_2O**	**CO_2:**	0.00 **% by volume**
STACK TEMP:	212.4 **°F**	**O_2:**	20.50 **% by volume**
SQ.RT ΔP:	0.9311 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.82	**lb/lb-mole**
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$	=	18.32	**lb/lb-mole**
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O			
$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$	=	0.9311	**in. H_2O**
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s =$ 212.4 °F + 460	=	672.4	**°R**
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	30.07	**in.Hg**
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(\text{avg}\sqrt{\Delta P})\sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	73.880	**ft/sec**
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	1,547.35	**acfm**
Stack Area = 0.34907 ft^2			
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	1,221.01 73,260	**scfm, wb** **scfh, wb**
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	35.96 2,158	**dscfm** **dscfh**

METHANOL CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
SAMPLE: Methanol
TEST DATE: 7/21/2011
RUN NO: 308-1
CYCLE TIME: 0.833 **hrs**

INPUT

Q_s : 2,158 **dscfh**
P_{bar} : 29.98 **in Hg**

Spiked Train:			*Unspiked Train:*	
V_m **Spiked:**	15.434	**liters**	V_m **Unspiked:**	7.7 **liters**
V_m **Spiked:**	0.545	**cubic ft**	V_m **Unspiked:**	0.272 **cubic ft**
Y Spiked :	1.000		**Y Sample :**	0.951
T_m **Spiked:**	88	**°F**	T_m **Sample:**	88 **°F**
ΔH Spiked:	0.30	**in. H_2O**	**ΔH Sample:**	1.00 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Spiked (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.527	**dscf**
V_{mstd} Spiked ($V_{s\text{-liters}}$) = dscf x 28.32	=	14.911	**std liters**
V_{mstd} Unspiked (V_u) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.250	**dscf**
V_{mstd} Unspiked ($V_{u\text{-liters}}$) = dscf x 28.32	=	7.087	**std liters**

Recovery Calculations

$M_v = (M_s/V_{s\text{-liters}}) - (M_u/V_{u\text{-liters}})$

$R = (M_v * V_{s\text{-liters}}) / S$

Stack gas volume flow rate

Q_s = dscfh

Stack VOC emission rate

$Q_s \times C_s$

VOC Concentration

$C_s = 2.2046 \times 10^{-9}$ lb/µg x M_u / V_u

Reported $C_s = C_s / R$

ppb = $C_s * (385.26 \times 10^9 / MW)$

Reported ppb = ppb/R

Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	Fraction of Spike Recovered R (fractional)	VOC Concentration (lb/dscf)	Reported VOC Concentration (lb/dscf)	VOC Concentration (ppb)	Reported VOC Concentration (ppb)	Reported VOC Concentration (µg/dscm)	Reported VOC Emission (lb/hr)	Reported VOC Emission (lb/cycle)
Methanol	32.04	-620.2	-525.4	4.9123E-05	-9.3494E-08	590,677	-1,124	-1,497	-0.00020	-0.00017

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/21/2011
RUN NUMBER: OH-1 (308-2)

γ FACTOR:	0.999	**STACK DIAM:**	0.8 **inches**
BAROMETRIC:	30.00 **in. Hg**	**METER VOLUME:**	1.738 **ft^3**
STATIC PRES:	2.32 **in.H_2O**	**METER TEMP:**	97.6 **°F**
STACK TEMP:	212.2 **°F**	**LIQUID COLL:**	4050.7 **milliliters**
SQ.RT ΔP:	1.1448 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.03 **in.H_2O**	**O_2:**	19.50 **% by volume**

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}}$$

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 1.648 \text{ dscf}$$

γ = 0.999

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 190.666 \text{ scf}$$

V_{lc} = 4050.7 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9914$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 0.9881$$

T = 373.1 °K
P = 766.3 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

$$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}}$$

B_{ws} = 0.9881

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: OH-1 (308-2)

SOURCE: 736 DCU
TEST DATE: 7/21/2011

BAROMETRIC:	29.98 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	1.18 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212.4 **°F**	**O_2:**	19.50 **% by volume**
SQ.RT ΔP:	1.1448 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.86 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$$ = 18.13 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 1.1448 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 212.4 °F + 460 = 672.4 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.07 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 91.306 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 1,912.31 **acfm**

Stack Area = 0.34907 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,509.00 **scfm, wb**
90,540 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 17.91 **dscfm**
1,075 **dscfh**

METHANOL CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
SAMPLE: Methanol
TEST DATE: 7/21/2011
RUN NO: 308-2
CYCLE TIME: 1.317 **hrs**

INPUT

Q_s : 1,075 **dscfh**
P_{bar} : 30.00 **in Hg**

Spiked Train:		*Unspiked Train:*	
V_m **Spiked:**	19.991 **liters**	V_m **Unspiked:**	13.593 **liters**
V_m **Spiked:**	0.706 **cubic ft**	V_m **Unspiked:**	0.480 **cubic ft**
Y Spiked :	0.975	**Y Sample :**	1.000
T_m **Spiked:**	87.6 **°F**	T_m **Sample:**	91.77 **°F**
ΔH Spiked:	0.73 **in. H_2O**	**ΔH Sample:**	1.31 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Spiked (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.667	**dscf**
V_{mstd} Spiked ($V_{s\text{-liters}}$) = dscf x 28.32	=	18.877	**std liters**
V_{mstd} Unspiked (V_u) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.462	**dscf**
V_{mstd} Unspiked ($V_{u\text{-liters}}$) = dscf x 28.32	=	13.084	**std liters**

Recovery Calculations
$M_v = (M_s/V_{s\text{-liters}}) - (M_u/V_{u\text{-liters}})$
$R = (M_v * V_{s\text{-liters}}) / S$

Stack gas volume flow rate
Q_s = dscfh

Stack VOC emission rate
$Q_s \times C_s$

VOC Concentration
$C_s = 2.2046 \times 10^{-9}$ lb/µg x M_u / V_u
Reported $C_s = C_s / R$
ppb = C_s * (385.26×10^9 / MW)
Reported ppb = ppb/R

Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	Fraction of Spike Recovered R (fractional)	VOC Concentration (lb/dscf)	Reported VOC Concentration (lb/dscf)	VOC Concentration (ppb)	Reported VOC Concentration (ppb)	Reported VOC Concentration (µg/dscm)	Reported VOC Emission (lb/hr)	Reported VOC Emission (lb/cycle)
Methanol	32.04	-102.46	-109.90	1.5327E-05	-1.3946E-07	184,297	-1,677	-2,234	-0.00015	-0.00020

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
TEST DATE: 7/27/2011
RUN NUMBER: OH-2 (308-3)

γ FACTOR:	1.005	**STACK DIAM:**	8.0 **inches**
BAROMETRIC:	30.06 **in. Hg**	**METER VOLUME:**	2.352 **ft^3**
STATIC PRES:	2.71 **in.H_2O**	**METER TEMP:**	113.2 **°F**
STACK TEMP:	212.0 **°F**	**LIQUID COLL:**	4231.2 **milliliters**
SQ.RT ΔP:	1.3364 **in.H_2O**	**CO_2:**	0.50 **% by volume**
ΔH:	0.07 **in.H_2O**	**O_2:**	18.50 **% by volume**

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE
@ STANDARD CONDITIONS, DRY BASIS

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 2.188 \text{ dscf}$$

γ = 1.005

VOLUME OF WATER IN SAMPLE
@ STANDARD CONDITIONS

$$V_{wstd} = 0.04707 \times V_{lc} = 199.163 \text{ scf}$$

V_{lc} = 4231.2 mL

FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED

$$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.9891$$

FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION

$$MF = \frac{\left(10^{\left[8.361 - \left(\frac{1893.5}{T - 27.65}\right)\right]}\right) - 0.5}{P} = 0.9821$$

T = 373.0 °K
P = 768.6 mmHg

FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS

B_{ws} = 0.9821

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
RUN NUMBER: OH-2 (308-3)

SOURCE: 736 DCU
TEST DATE: 7/27/2011

BAROMETRIC:	30.06 **in. Hg**	**STACK DIAM:**	8.0 **inches**
STATIC PRES:	2.71 **in.H_2O**	**CO_2:**	0.50 **% by volume**
STACK TEMP:	212.0 **°F**	**O_2:**	18.50 **% by volume**
SQ.RT ΔP:	1.3364 **in.H_2O**		

DRY MOLECULAR WEIGHT OF STACK GAS

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$ = 28.82 **lb/lb-mole**

MOLECULAR WEIGHT OF STACK GAS, wet basis

$$M_s = M_d(1 - B_{ws}) + 18(B_{ws})$$ = 18.19 **lb/lb-mole**

PITOT TUBE COEFFICIENT

C_p (from calibration curve or geometric specifications) = 0.84

AVERAGE VELOCITY HEAD OF STACK GAS, in. H_2O

$$\overline{\sqrt{\Delta P}} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p}$$ = 1.3364 **in. H_2O**

AVERAGE ABSOLUTE STACK GAS TEMPERATURE

T_s = 212.0 °F + 460 = 672.0 **°R**

ABSOLUTE STACK GAS PRESSURE

$$P_s = P_{bar} + \frac{P_{static}}{13.6}$$ = 30.26 **in.Hg**

STACK GAS VELOCITY

$$V_s = (85.49)(C_p)\left(\text{avg}\sqrt{\Delta P}\right)\sqrt{\frac{T_s}{(P_s)(M_s)}}$$ = 106.027 **ft/sec**

STACK GAS VOLUMETRIC FLOW RATE, actual

$$Q_s = 60 \times V_s \times A_s$$ = 2,220.63 **acfm**

Stack Area = 0.34907 ft^2

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis

$$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$$ = 1,764.59 **scfm, wb**
105,875 **scfh, wb**

STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis

$$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$$ = 31.52 **dscfm**
1,891 **dscfh**

METHANOL CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
SAMPLE: Methanol
TEST DATE: 7/27/2011
RUN NO: 308-3
CYCLE TIME: 1.133 **hrs**

INPUT

Q_s : 1,891 **dscfh**
P_{bar} : 30.06 **in Hg**

	Spiked Train:		*Unspiked Train:*	
V_m Spiked:	27.244	**liters**	V_m Unspiked:	42.382 **liters**
V_m Spiked:	0.962	**cubic ft**	V_m Unspiked:	1.497 **cubic ft**
Y Spiked :	0.975		Y Sample :	1.000
T_m Spiked:	102.6	**°F**	T_m Sample:	102.9 **°F**
ΔH Spiked:	0.18	**in. H_2O**	ΔH Sample:	1.26 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Spiked (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.885	**dscf**
V_{mstd} Spiked ($V_{s\text{-liters}}$) = dscf x 28.32	=	25.057	**std liters**
V_{mstd} Unspiked (V_u) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	1.415	**dscf**
V_{mstd} Unspiked ($V_{u\text{-liters}}$) = dscf x 28.32	=	40.063	**std liters**

Recovery Calculations

$M_v = (M_s/V_{s\text{-liters}}) - (M_u/V_{u\text{-liters}})$
$R = (M_v * V_{s\text{-liters}}) / S$

VOC Concentration

$C_s = 2.2046 \times 10^{-9}$ lb/µg x M_u / V_u
Reported $C_s = C_s / R$
$ppb = C_s * (385.26 \times 10^9 / MW)$
Reported ppb = ppb/R

Stack gas volume flow rate

Q_s = dscfh

Stack VOC emission rate

$Q_s \times C_s$

Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	Fraction of Spike Recovered R (fractional)	VOC Concentration (lb/dscf)	Reported VOC Concentration (lb/dscf)	VOC Concentration (ppb)	Reported VOC Concentration (ppb)	Reported VOC Concentration (µg/dscm)	Reported VOC Emission (lb/hr)	Reported VOC Emission (lb/cycle)
Methanol	32.04	14.1	20.03	1.5584E-07	7.7819E-09	1,874	94	124.6	0.00001	0.00002

USEPA Method 18 Field Data Summary

Company: Houston Refining
Location: Houston, TX
Source: 736 DCU
Sample: Methanol

Test Date: 7/21/2011
Run # : 308-1
Test Length (min): 24.62
Test Time: 10:26 - 10:55
P_{bar} : 29.98 **in Hg**
Qs : 2,158 **dscfh**

Spiked Train:			*Sample Train:*		
V_m Spiked:	15.434	**liters**	**V_m Sample:**	7.700	**liters**
V_m Spiked:	0.545	**cubic ft**	**V_m Sample:**	0.272	**cubic ft**
Y Spiked :	1.000		**Y Sample :**	0.951	
T_m Spiked:	88.0	**°F**	**T_m Sample:**	88.0	**°F**
ΔH Spiked:	0.30	**in. H_2O**	**ΔH Sample:**	1.00	**in. H_2O**

Test Date: 7/21/2011
Run # : 308-2
Test Length (min): 64.72
Test Time: 18:15 - 19:19
P_{bar} : 30.00 **in Hg**
Qs : 1,075 **dscfh**

Spiked Train:			*Sample Train:*		
V_m Spiked:	19.991	**liters**	**V_m Sample:**	13.593	**liters**
V_m Spiked:	0.706	**cubic ft**	**V_m Sample:**	0.480	**cubic ft**
Y Spiked :	0.975		**Y Sample :**	1.000	
T_m Spiked:	87.6	**°F**	**T_m Sample:**	91.8	**°F**
ΔH Spiked:	0.73	**in. H_2O**	**ΔH Sample:**	1.31	**in. H_2O**

Test Date: 7/27/2011
Run # : 308-3
Test Length (min): 68
Test Time: 13:37 - 14:45
P_{bar} : 30.06 **in Hg**
Qs : 1,891 **dscfh**

Spiked Train:			*Sample Train:*		
V_m Spiked:	27.244	**liters**	**V_m Sample:**	42.382	**liters**
V_m Spiked:	0.962	**cubic ft**	**V_m Sample:**	1.497	**cubic ft**
Y Spiked :	0.975		**Y Sample :**	1.000	
T_m Spiked:	102.6	**°F**	**T_m Sample:**	102.9	**°F**
ΔH Spiked:	0.18	**in. H_2O**	**ΔH Sample:**	1.26	**in. H_2O**

SUMMARY OF METHANOL TEST RESULTS

COMPANY	Houston Refining			
LOCATION	Houston, TX			
SOURCE	736 DCU			
RUN NO	308-1	308-2	308-3	
TEST TIME	10:26 - 10:55	18:15 - 19:19	13:37 - 14:45	Average
TEST DATE	7/21/2011	7/21/2011	7/27/2011	
CYCLE TIME (HRS)	0.833	1.317	1.133	
Stack Gas Parameters				
Temperature, av. °F	212.4	212.4	212	212.3
Velocity, av. ft/sec	73.880	91.306	106.027	90.405
Volume flow, acfm	1,547	1,912	2,221	1,893
Volume flow, scfm	1,221	1,509	1,765	1,498
Volume flow, dscfm	36	18	32	28
Volume flow, scfh	73,260	90,540	105,875	89,892
Volume flow, dscfh	2,158	1,075	1,891	1,708
Moisture, av. % vol	98.81	98.81	98.21	98.61
CO_2, av. % vol, db	0.00	0.50	0.50	0.33
O_2, av. % vol, db	20.50	19.50	18.50	19.50
Spiked Train Parameters				
Time, min	25	65	68	
Volume, std liters	14.911	18.877	25.057	
Volume, dscf	0.527	0.667	0.885	
Unspiked Train Parameters				
Time, min	25	65	68	
Volume, std liters	7.087	13.084	40.063	
Volume, dscf	0.250	0.462	1.415	
Methanol Data				
Spike Recovered (R), fractional	-525.419	-109.900	20.026	
Concentration				
ppbv db	-1,124	-1,677	94	-903
mg/dscm	-1,497	-2,234	125	-1,202
lb/dscf x 10^{-6}	-0.09349	-0.13946	0.00778	-0.07506
Emission Rate				
lb/hr	-0.00020	-0.00015	0.00001	-0.00011
lb/cycle	-0.00017	-0.00020	0.00002	-0.00012

APPENDIX B

Field Data

HIGH PRESSURE SOURCE TRAVERSE POINT LOCATIONS FOR PACKING GLAND EQUIPPED PROBE SYSTEMS

Facility Houston Refining
Date 7-18-11
Sampling Location 736 Coker AB Drum
Port Distance Downstream From Disturbance (B) 36" (in.)
Port Distance Upstream From Disturbance (A) 120" (in.)
Inside of Far Wall to
Outside of Packing Gland (Distance C) 16" (in.)
Inside of Near Wall to
Outside of Packing Gland (Distance D) See note 8" (in.)
Stack ID (E) = (Distance C- Distance D) 8" (in.)
Probe Length (F) (From U-clip to Nozzle) _____ (in.)
Probe Length (G) (From U-clip to Outside
of Packing Gland in Order to Close Port) _____ (in.)

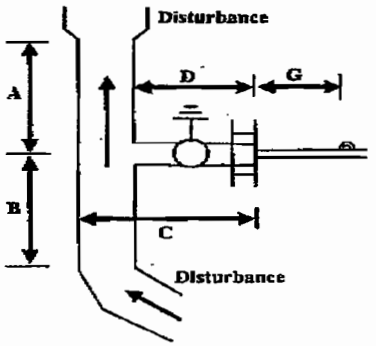
Note: Sketch Stack/Ports/Control Device on Back of Form

Equivalent Diameters Downstream From Disturbance (B) =
[Distance B / Stack ID]

Equivalent Diameters Upstream From Disturbance (A) =
[Distance A / Stack ID]

Equivalent Diameter For a Square or Rectangular Stack =
[(2 x L x W) / (L + W)]

Port #4 = 2" Diameter
Port Diameter 3" (in.) Refractory Thickness _____ (in.)
Number of Ports 4 Traverse Points / Port 1



1	2	3	4	5	6
Port Traverse Point Number	Fractional % of Stack I.D. (frac. %) (Tables)	Traverse Point Location in Stack (Column 2 x E) (inches)	Port Length (D) (inches)	Traverse Point Location from Outside of Port (Sum of Columns 3 and 4 in inches)	Probe Length from C Clip to Packing Gland (F – Col. 5) (inches)
1	50	4	8	12	
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

For Stacks / Ducts ≤ 24 inches ID – No traverse point shall be located less than 0.5 inches from stack wall

For Stacks / Ducts > 24 inches ID – No traverse point shall be located less than 1.0 inches from stack wall

QA/QC Check:
Completeness _____ Legibility _____ Accuracy _____ Specifications _____

Method 1 Calculator Signature/Date Richard Cyrulli

Field Supervisor Signature/Date _____

Note: D = (Port + Packing gland length) + (Wall thickness) + (Refractory thickness)

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

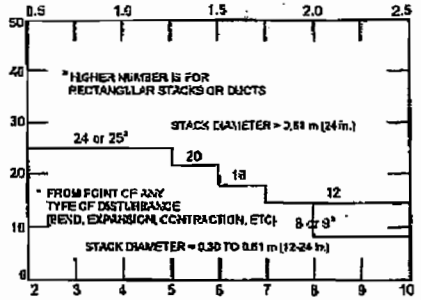
Pts	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.5	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	36.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS
CEMS*

Pts	2	3	4	5	6	7	8	9
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8
4			87.5	70.0	58.3	50.0	43.8	38.9
5				90.0	75.0	64.3	56.3	50.0
6					91.7	78.6	68.8	61.1
7						92.9	81.3	72.2
8							93.8	83.3
9								94.4

*3 point CEMS RATA traverse point locations (valid for rectangular and round stacks)

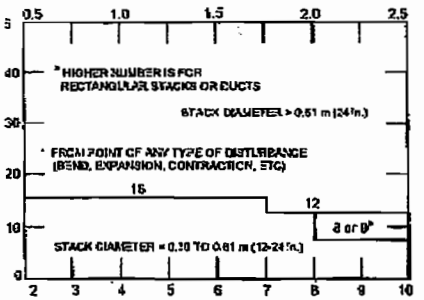
DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE* (DISTANCE A)



DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE* (DISTANCE B)

MINIMUM NUMBER OF TRAVERSE POINTS
ISOKINETIC TESTING

DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE* (DISTANCE A)



DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE* (DISTANCE B)

MINIMUM NUMBER OF TRAVERSE POINTS
FOR VELOCITY (NON-ISOKINETIC) TRAVERSES

Form FDF 4002.00

B-1

HIGH PRESSURE SOURCE TRAVERSE POINT LOCATIONS FOR PACKING GLAND EQUIPPED PROBE SYSTEMS

Facility Houston Refining
Date 7-18-11
Sampling Location 736 Coker CO Drum
Port Distance Downstream From Disturbance (B) 48" (in.)
Port Distance Upstream From Disturbance (A) 110" (in.)
Inside of Far Wall to Outside of Packing Gland (Distance C) 16" (in.)
Inside of Near Wall to Outside of Packing Gland (Distance D) See note 8" (in.)
Stack ID (E) = (Distance C- Distance D) 8" (in.)
Probe Length (F) (From U-clip to Nozzle) _____ (in.)
Probe Length (G) (From U-clip to Outside of Packing Gland in Order to Close Port) _____ (in.)

Note: Sketch Stack/Ports/Control Device on Back of Form

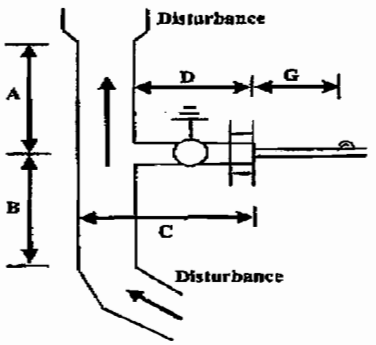
Equivalent Diameters Downstream From Disturbance (B) = [Distance B / Stack ID]

Equivalent Diameters Upstream From Disturbance (A) = [Distance A / Stack ID]

Equivalent Diameter For a Square or Rectangular Stack = [(2 x L x W) / (L + W)]

Port # 4 = 2" Diameter

Port Diameter 3" (in.) Refractory Thickness _____ (in.)
Number of Ports 4 Traverse Points / Port 1



1	2	3	4	5	6
Port Traverse Point Number	Fractional % of Stack I.D. (frac. %) (Tables)	Traverse Point Location in Stack (Column 2 x E) (inches)	Port Length (D) (inches)	Traverse Point Location from Outside of Port (Sum of Columns 3 and 4 in inches)	Probe Length from C-Clip to Packing Gland (F – Col. 5) (inches)
1	50	4	8	12	
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

For Stacks / Ducts ≤ 24 inches ID – No traverse point shall be located less than 0.5 inches from stack wall

For Stacks / Ducts > 24 inches ID – No traverse point shall be located less than 1.0 inches from stack wall

QA/QC Check:
Completeness _____ Legibility _____ Accuracy _____ Specifications _____

Method 1 Calculator Signature/Date Richard Cipolla

Field Supervisor Signature/Date _____

Note: D = (Port + Packing gland length) + (Wall thickness) + (Refractory thickness)

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

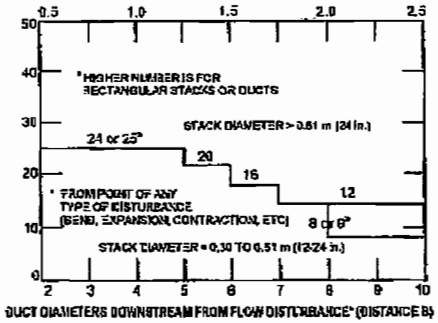
Pts	4	5	8	10	12
1	3.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	96.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS CEMS*

Pts	2	3	4	5	6	7	8	9
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8
4			87.5	70.0	58.3	50.0	43.8	38.9
5				90.0	75.0	64.3	56.2	50.0
6					91.7	78.6	68.8	61.1
7						92.9	81.3	72.2
8							93.8	83.3
9								94.4

*3 point CEMS RATA traverse point locations valid for rectangular and round stacks

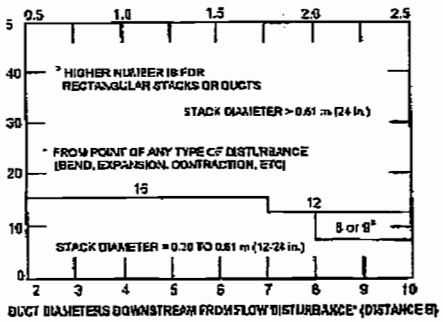
DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE* (DISTANCE A)



DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE* (DISTANCE B)

MINIMUM NUMBER OF TRAVERSE POINTS (ISOKINETIC TESTING)

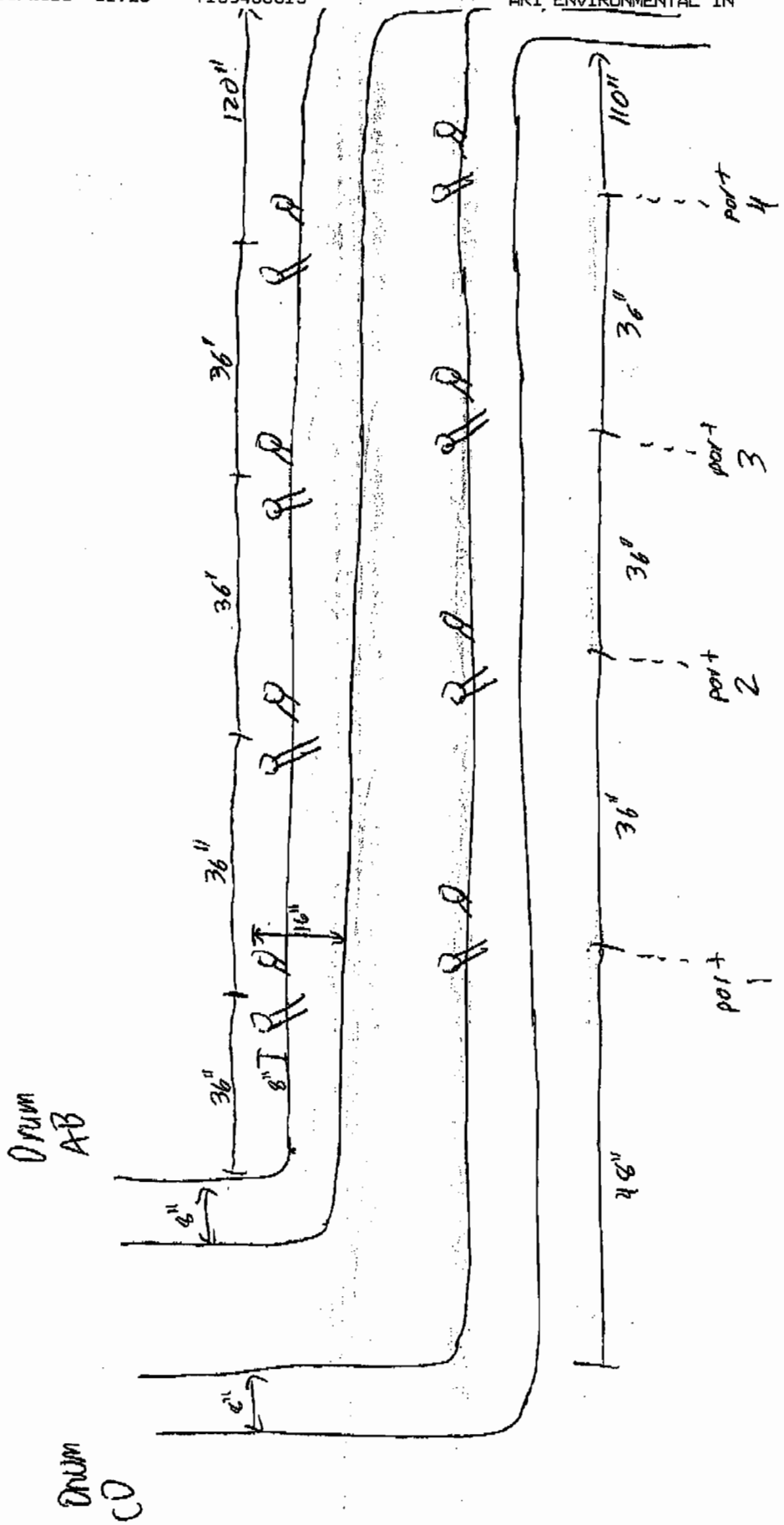
DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE* (DISTANCE A)



DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE* (DISTANCE B)

MINIMUM NUMBER OF TRAVERSE POINTS FOR VELOCITY (NON-ISOKINETIC) TRAVERSES

Form FDF 4002.00


Drum AB
Drum C
120"
36"
36"
36"
8"
16"
6"
6"
110"
36"
36"
36"
46"
port 1
port 2
port 3
port 4
port 1-3 Diameter = 3" → heated glass probe
port 4 Diameter = 2" → pitot and CEMs probe

FIELD DATA

29

PLANT	Houston Refining	AMBIENT TEMPERATURE	83	PROBE HEATER SETTING	260		
DATE	7/29/11	BAROMETRIC PRESSURE	30.04	HEATER BOX SETTING	260		
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	100	METER $H_{@}$	1.87		
OPERATOR	SK	PROBE LENGTH, in.	31	C_p FACTOR	0.84		
STACK NO.	DCU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	1.005		
RUN NO.	29-1	STACK DIAMETER, in.	8	PITOT/THERM #	P93		
SAMPLE BOX NO.	-	MINUTES PER POINT	5				
METER BOX NO.	3840/9	NUMBER OF POINTS	-				
START TIME	0752	NUMBER OF PORTS	1				

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= B=

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg.
0752	1	0	+2.2	213	~~0.07~~	1.4	0.02		885.283	86		261	258	257	64	15.0
0757	1	5	+2.4	213	1.9		0.02		885.87	86		257	261	260	62	15.0
0802	1	10	+2.8	213	2.2		0.02		886.02	86		259	262	259	62	15.0
0807	1	15	+3.4	213	3.0		0.02		886.22	86		258	260	260	61	15.0
0812	1	20	+3.0	212	2.8		0.02		886.41	86		257	259	261	61	15.0
0817	1	25	+3.0	213	3.4		0.02		886.58	86		256	260	258	62	15.0
0822	1	30	+3.2	213	3.6		0.02		886.77	86		258	261	259	62	15.0
0827	1	35	+3.5	213	3.7		0.02		886.91	86		259	260	258	63	15.0
0832	1	40	+3.3	213	4.0		0.02		887.05	86		260	258	256	62	15.0
0837	1	45	+3.0	213	2.9		0.02		887.18	86		263	256	254	63	15.0
0842	1	50	+3.0	214	1.5		0.02		887.29	86		262	254	253	62	15.0
0847		55	+2.0	212	1.9		0.02		887.40	86		261	253	257	62	15.0
0852		60	+2.0	211	2.2		0.02		887.51	86		260	256	259	63	15.0
0857		65	+2.0	211	2.5		0.02		887.63	87		261	258	261	64	15.0
0902		70	+2.0	212	3.0		0.02		887.79	87		260	259	253	63	15.0
0907		75							887.98							
AVERAGE			2.65	212.6		1.6167	0.02		2.697	86.1						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL	COLLECTED (specify ml or g)				

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-28-11
Location:	Houston, TX	Test Date:	7-29-11
Source:	736 Coker	Date Recovered:	7-29-11
Run No.:	~~5~~ 29-1	USEPA Method:	29
		Corresponding Filter No:	~~N/A~~ H44941
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	Empty	581.8	998.0	416.2	
2	5% HNO_3/10% H_2O_2	778.0	992.0	214.0	
3	5% HNO_3/10% H_2O_2	~~778.0~~ 674.6	854.5	179.9	
4	Empty	610.6	611.6	1.0	
5	Silica Gel	940.9	945.9	5.0	
6					

Total diff. 5004.4

FIELD DATA
M29

PLANT	Houston Refining	AMBIENT TEMPERATURE	98	PROBE HEATER SETTING	260
DATE	8/1/11	BAROMETRIC PRESSURE	30.04	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	9	METER $H_@$	1.755
OPERATOR	JS	PROBE LENGTH, in.	31	C_p FACTOR	0.84
STACK NO.	DCU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	0.9987
RUN NO.	25-2	STACK DIAMETER, in.	8	PITOT/THERM #	P93
SAMPLE BOX NO.	—	MINUTES PER POINT	5		
METER BOX NO.	1104027	NUMBER OF POINTS	—		
START TIME	1242	NUMBER OF PORTS	—		

WEIGHT OF PARTICULATE, mg	
Filter No.	
Sample	
Final wt	
Tare wt	
Wt. gain	
TOTAL	mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) 'F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) 'F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) 'F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. 'F	LAST IMPINGER OUTLET TEMP. 'F	PUMP VACUUM in. Hg
1242	1	0					0.15		359.451	108		260	258	257	61	15.0
1247	1	5					0.12		360.21	108		260	258	260	62	15.0
1252	1	10					0.10		360.70	108		262	257	259	61	15.0
1257	1	15					0.08		361.07	109		259	256	260	62	15.0
1301	END	20 @ 4							361.743							
AVERAGE							.1125		2.292	108.3						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
IAL					
JID COLLECTED					
AL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-30-11
Location:	Houston, TX	Test Date:	8-1-11
Source:	736 Cokes	Date Recovered:	8-1-11
Run No.:	29-2	USEPA Method:	29
		Corresponding Filter No:	~~N/A~~ H44943
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol (g)/mL	Final wt/vol (g)/mL	Difference wt/vol (g)/mL	Sample Container No.
1	Empty	611.1	612.7	1.6	
2	5% HNO_3/10% H_2O_2	706.2	706.6	Ø	
3	5% HNO_3/10% H_2O_2	715.2	715.8	0.6	
4	Empty	609.8	610.1	0.3	
5	Silica Gel	942.2	943.5	1.3	
6					

Total diff
1259.8g

B-88

FIELD DATA

M29

PLANT	Houston	AMBIENT TEMPERATURE	98	PROBE HEATER SETTING	260		
DATE	8/2/11	BAROMETRIC PRESSURE	30.06	HEATER BOX SETTING	260		
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	9	METER $H_@$	1.255		
OPERATOR	SK	PROBE LENGTH, in.	3'	C_p FACTOR	0.84		
STACK NO	DC	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	0.9987		
RUN NO.	29-3	STACK DIAMETER, in	8	PITOT/THERM #	M3		
SAMPLE BOX NO		MINUTES PER POINT	5				
METER BOX NO	1109027	NUMBER OF POINTS	1				
START TIME	1611	NUMBER OF PORTS	1				

WEIGHT OF PARTICULATE, mg	
Filter No.	
Sample	
Final wt.	
Tare wt.	
Wt. gain	
TOTAL	mg

A= B=

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1611	1	0					0.06		363.114	109		263	260	259	64	15.0
1616		5							364.268							
AVERAGE							0.06		1.154	109						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ARI ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	8-1-11
Location:	~~736 Coker~~ Houston, TX	Test Date:	8-2-11
Source:	736 Coker	Date Recovered:	8-2-11
Run No.:	29-3	USEPA Method:	29
		Corresponding Filter No:	H44945
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	Empty	618.4	619.7	1.3	
2	5% HNO_3/10% H_2O_2	712.9	713.8	0.9	
3	5% HNO_3/10% H_2O_2	737.9	738.5	0.6	
4	Empty	609.3	609.9	0.6	
5	Silica Gel	898.6	903.5	4.9	
6					

Total diff.
= 56.4g

B-10

FIELD DATA

0011

PLANT	Houston Refining	AMBIENT TEMPERATURE	78	PROBE HEATER SETTING	260		
DATE	7/19/11	BAROMETRIC PRESSURE	30.00	HEATER BOX SETTING	260		
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	9070	METER $H_@$	1.735		
OPERATOR	JK	PROBE LENGTH, in.	31	C_p FACTOR	0.89		
STACK NO.	DCU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	0.9587		
RUN NO.	0011-1	STACK DIAMETER, in.	8	PITOT/THERM #	05		
SAMPLE BOX NO.	-	MINUTES PER POINT	5				
METER BOX NO.	1104027	NUMBER OF POINTS	—				
START TIME	1442	NUMBER OF PORTS	1				

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A=____ B=____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) 'F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) 'F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) 'F	SAMPLE BOX TEMP. °F	Probe ~~COND.~~ EXIT TEMP °F	Flex SORBENT MODULE TEMP. 'F	LAST IMPINGER OUTLET TEMP. 'F	PUMP VACUUM in. Hg
1442		0	+1.4	213	0.40		~~0.03~~		332.840	78		258	260	255	64	15
1447		5	1.6	213	0.49		.03		332.976	79		259	257	256	60	15
1452		10	2.0	213	0.42		.03		333.02	79		260	259	258	59	15
1457		15	1.8	213	0.63		.03		333.68	79		261	260	257	59	15
1502		20	1.6	213	0.72		.03		333.20	79		259	258	259	59	15
1507		25	1.6	213	0.60		.03		333.780	79		258	257	258	58	15
1510		28		~~213~~	~~0.54~~		~~.03~~		333.377	~~79~~		260	261	257	57	15
AVERAGE			1.67	213		0.77	.03		0,537	78,9		256.4				15

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.008	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@> 3"H_2O
POST:	✓	@> 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Lyondell (Houston Refining)	Date Set-up:	7-18-2011
Location:	Houston, TX	Test Date:	7-19-2011
Source:	736 Colar Unit	Date Recovered:	7-20-2011
Run No.:	~~0011-2~~ 0011-1	USEPA Method:	0011
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	200ml DNPH	785.5	963.3	177.8	
2	100ml DNPH	646.3	1103.2	456.9	
3	100ml DNPH	688.4	1176.8	488.4	
4	Empty	582.9	742.3	159.4	
5	Silica Gel	867.1	874.2	7.1	
6					
	KO	409.4	1130.5	721.1	

2010.7

FIELD DATA

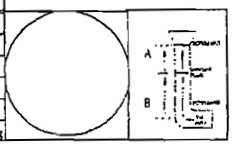
0011

PLANT	Houston Refining	AMBIENT TEMPERATURE	90	PROBE HEATER SETTING	260
DATE	7/20/11	BAROMETRIC PRESSURE	30.04	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	20	METER H_a	1.755
OPERATOR	JK	PROBE LENGTH, in.	3'	C_p FACTOR	0.84
STACK NO.	DOC	NOZZLE DIAMETER, in.	0.180	Y_d FACTOR	0.9987
RUN NO.	0011-2	STACK DIAMETER, in	8	PITOT/THERM #	RG3
SAMPLE BOX NO.		MINUTES PER POINT	5		
METER BOX NO	17047027	NUMBER OF POINTS	8		
START TIME	1220	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg	
Filter No.	
Sample	
Final wt.	
Tare wt.	
Wt. gain	
TOTAL	mg

A= B=

CROSS SECTION



CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	PROBE/COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1220	1	0	1.1	213	0.91		0.02		334.817	87		261	260	251	64	15.0
1225		5		213	0.95		0.02		334.653	88		263	259	254	63	15.0
1229		9							334.718							
AVERAGE			1.1	213	0.9643		0.02		0.101	87.5						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.006	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

Company:	Lyondell (Houston Refining)	**Date Set-up:**	7-19-2011
Location:	Houston, TX	**Test Date:**	7-20-2011
Source:	736 Coker Unit	**Date Recovered:**	7-20-2011
Run No.:	0011-2	**USEPA Method:**	0011
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	200ml DNPH	821.2	872.9	51.7	
2	100ml DNPH	672.9	867.3	194.4	
3	100ml DNPH	704.5	675.7	-28.8	
4	Empty	565.5	565.9	0.4	
5	Silica Gel	872.9	879.9	7.0	
6					
	KO	406.1	787.7	381.6g	

✓ total 606.3 g

B-14

FIELD DATA

0011

PLANT	Houston Refining	AMBIENT TEMPERATURE	89	PROBE HEATER SETTING	260
DATE	7/21/11	BAROMETRIC PRESSURE	29.68	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	100	METER H_a	1.785
OPERATOR	SL	PROBE LENGTH, in.	31	C_p FACTOR	0.84
STACK NO.	DCU	NOZZLE DIAMETER, in.	0.180	Y_d FACTOR	1.785 0.9987
RUN NO.	0011-3	STACK DIAMETER, in	8	PITOT/THERM #	PS 5
SAMPLE BOX NO.		MINUTES PER POINT	5		
METER BOX NO	1104027	NUMBER OF POINTS	1		
START TIME	1026	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg	
Filter No.	
Sample	
Final wt.	
Tare wt.	
Wt. gain	
TOTAL	mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	~~Probe~~ COND. EXIT TEMP °F	Flex SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1026	1	0	+1.2	212	0.77		0.04		330.037	87	N/A	261	258	259	62	15.0
1031	1	5	+1.2	212	0.72		0.04		331.25	87		260	259	258	61	15.0
1036	1	10	+1.2	212	0.90		0.04		331.52	87		262	260	259	60	15.0
1041	1	15	+1.3	212	0.98		0.04		331.87	87		261	262	259	60	15.0
1046	1	20	+1.3	212	1.0		0.04		332.21	88		258	263	259	59	15.0
1051	1	25	+1.3	212	1.0		0.04		332.51	88		259	262	260	59	15.0
1056	1	30	+1.2	213	0.75		0.04		332.62	88		260	264	261	60	15.0
1101	1	35	+1.0	213	0.63		0.04		332.74	89		257	261	259	59	15.0
1106	1	40	+0.80	213	0.88		0.04		332.70	89		258	260	257	59	15.0
1111	1	45	+1.5	213	1.1		0.04		332.88	90		259	257	255	61	15.0
1116		50							333.143							
AVERAGE			1.2	212.4		.9311	0.04		3,106	88						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g)				SILICA GEL WEIGHT
	#1	#2	#3	#4	g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL	COLLECTED (specify ml or g)				

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-20-2011
Location:	Houston, TX	Test Date:	7-21-2011
Source:	736 Coker Unit	Date Recovered:	7-21-2011
Run No.:	0011-3	USEPA Method:	0011
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	200 ml DNPH	825.9	960.9	135.0	
2	100 ml DNPH	672.8	898.8	226.0	
3	100 ml DNPH	698.5	974.0	275.5	
4	Empty	584.3	894.5	310.2	
5	Silica Gel	888.4	897.7	9.3	
6					
	KO	384.7	~~955.2~~ 949.1	564.4	

2 additional impinges at total = 1635.3g

3155.7g

B-15

FIELD DATA

26A

PLANT	Houston Refining	AMBIENT TEMPERATURE	95	PROBE HEATER SETTING	250		
DATE	7-26-11	BAROMETRIC PRESSURE	30.00	HEATER BOX SETTING	250		
LOCATION	Houston TX	ASSUMED MOISTURE, %	9	METER $H_@$	1.85		
OPERATOR	CB	PROBE LENGTH, in	36"	C_p FACTOR	0.84		
STACK NO	Z36- Orm O	NOZZLE DIAMETER, in	B 0.180	Y_d FACTOR	0.997		
RUN NO	26A-1	STACK DIAMETER, in.	0.182 B	PITOT/THERM #	(14)		
SAMPLE BOX NO	26A	MINUTES PER POINT	5				
METER BOX NO	40928	NUMBER OF POINTS	—				
START TIME	1815	NUMBER OF PORTS	1				

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	PROBE EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1815	1	0		212			0.03		663.918	95		275	266		64	0
1820	2	5		210			0.03		664.277	95		275	260		62	22"
1825	3	10	24	212			0.03		664.405	95		275	260		61	22"
1830	4	15		212			0.03		664.621	94		275	263		60	22"
1835	5	20		212			0.03		664.815	94		275	263		60	22"
1850	6	25	3.6	212			Stop 1835-1850		665.101	94		275	263		61	22"
1851		30		213			Empty Impgs		665.230	94		275	263		61	22"
1860		35		213			0.03		665.334	94		275	263		61	22"
1905		40		212			0.03		665.392	93		276	261		60	22"
1915							1850 Stop 1905 Empty Impgs		665.472							
1820		45		217			0.03		665.620	93		276	261		60	22"
1830							Empty Impgs		665.712	93		277	261		60	22"
1834		—		—				—	666.8 33							
									0.099 m³							
AVERAGE				212.2			0.03		2.772	94.0						

Probe cont. 44.594 / 64

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FI					
IN L					
L D COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-21-2011
Location:	Houston, TX	Test Date:	7-22-2011
Source:	736 Coker Unit	Date Recovered:	7-22-2011
Run No.:	26A-1	USEPA Method:	26A
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.	Final pH
1	0.1N H_2SO_4	627.4	802.9	175.5		3
2	0.1N H_2SO_4	707.8	806.9	99.1		4
3	0.1N H_2SO_4	672.7	1048.4	375.7		6
4	0.1N NaOH	716.7	703.7	-13.0		9
5	0.1N NaOH	697.4	637.9	-59.5		10
6	Silica Gel	903.2	908.1	4.9		

KO's 1018 + 834 + 100.2 + 332.2 = 2284.4

✓

Total diff. 2867.1 g

FIELD DATA

26A

PLANT	Houston Refining	AMBIENT TEMPERATURE	98	PROBE HEATER SETTING	260
DATE	7-27-11	BAROMETRIC PRESSURE	30.06	HEATER BOX SETTING	260
LOCATION	Houston TX	ASSUMED MOISTURE, %	10	METER $H_@$	1.85
OPERATOR	GD	PROBE LENGTH, in.	3'	C_p FACTOR	0.84
STACK NO.	FK Flare	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	0.997
RUN NO.	26A-2	STACK DIAMETER, in.	8	PITOT/THERM #	P93
SAMPLE BOX NO.		MINUTES PER POINT	5		
METER BOX NO.	40828	NUMBER OF POINTS	12		
START TIME	1337	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= B=

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) °F	SAMPLE BOX TEMP. °F	Filter ~~COND.~~ EXIT TEMP °F	Flex ~~SORBENT~~ MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1337	1	0					0.05		658.338	110	107	255	257	260	60	15.0
1342	1	5					0.05		~~660.00~~	111	108	258	260	261	62	15.0
1347	1	10					0.05	→	666.65	110	107	259	261	264	63	15.0
1352	1	15					0.05		666.90	109	106	260	258	257	62	15.0
1357	1	20					0.05		667.01	109	104	262	259	259	61	15.0
1402	1	25					0.05		668.52	109	104	261	260	262	59	15.0
1407	1	30					0.05		669.08	107	105	263	264	261	61	15.0
1412	1	35					0.05		669.12	107	106	259	263	260	62	15.0
1417	1	40					0.05		669.22	108	106	261	264	262	64	15.0
1422	1	45					0.05		664.31	109	106	260	264	260	65	15.0
1427	1	50					0.05		669.47	110	106	261	262	261	63	15.0
1432	1	55					0.05		669.57	110	106	258	263	260	63	15.0
1437	1	60					0.05		669.64	111	107	259	264	258	62	15.0
1442		65					0.05		669.82	111	107	257	264	260	62	15.0
1445		68							670.35	–	–	–	–	–	–	–
AVERAGE							0.05		12.016		107.7					

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	**Date Set-up:**	7-26-2011
Location:	Houston, TX	**Test Date:**	7-27-11
Source:	736 Coker Unit	**Date Recovered:**	7-27-11
Run No.:	2 (Unit) 26A-3	**USEPA Method:**	26A
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.	pH
1	0.1N H_2SO_4	612.2	614.0	1.8		3
2	0.1N H_2SO_4	724.7	727.2	2.5		3
3	0.1N H_2SO_4	731.2	804.0	72.8		4
4	0.1N NaOH	722.2	691.9	-30.3		10
5	0.1N NaOH	702.5	673.8	-28.7		10
6	Silica Gel	920.9	926.2	5.3		
7						
8						

KO's
1035.8
928.3
+ 1041.5
3005.6

Total diff
3029.0 a

B-20

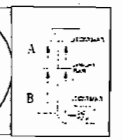
FIELD DATA

PLANT	Lyondell	AMBIENT TEMPERATURE	90	PROBE HEATER SETTING	250
DATE	7/28/11	BAROMETRIC PRESSURE	29.98	HEATER BOX SETTING	250
LOCATION	Houston TX	ASSUMED MOISTURE, %	N/A 2.00	METER $H_@$	1.85
OPERATOR	ZM	PROBE LENGTH, in.		C_p FACTOR	0.811
STACK NO.	736	NOZZLE DIAMETER, in.	N/A 0.188	Y_d FACTOR	0.997
RUN NO.	3 (7) 26A-3	STACK DIAMETER, in.	8	PITOT/THERM #	P93
SAMPLE BOX NO.	N/A	MINUTES PER POINT	N/A 5		
METER BOX NO.	4082	NUMBER OF POINTS	1		
START TIME	1518	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= B=

CROSS SECTION



CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (V_m) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	Probe SAMPLE BOX TEMP. °F	Filter COND. EXIT TEMP °F	Flex SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1518		0					0.12	0.2	670.735	95	94	258	258	265	57	13
1523		5					0.10		671.31	93	94	258	257	264	58	13
1528		10					0.10		671.59	93	94	257	257	264	59	13
1533		15					0.07		671.81	95	94	258	260	263	59	10
1538		20					0.07		672.04	95	94	260	259	264	60	11
1543		25					0.06		672.23	94	93	259	260	263	60	13
1548		30					0.06		672.48	94	93	258	260	262	61	13
1553		35					0.05		672.78	93	92	257	259	262	62	13
1558		40					0.05		673.13	94	92	255	258	263	62	13
1603		45					0.05		673.48	94	92	255	257	261	62	15
1608		50					0.05		673.90	94	92	256	258	262	60	15
1611		53.00					0.05		674.578	94	92	256	258	262	60	15
AVERAGE							0.07		3.843	93.7						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-27-2011
Location:	Houston, TX	Test Date:	7-28-11
Source:	736 Coker Unit	Date Recovered:	7-29-11
Run No.:	3 / 26A-4 (Hg1)	USEPA Method:	26A
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.	pH
1	0.1N H_2SO_4	634.8	635.5	0.7		3
2	0.1N H_2SO_4	722.0	722.2	0.2		3
KO's 3	0.1N H_2SO_4	676.1	676.1	0.0		3
997.9 4	0.1N NaOH	697.8	698.1	0.3		9-10
1033.7 5	0.1N NaOH	649.0	649.3	0.3		9-10
+ 937.6 6	Silica Gel	923.6	927.0	3.4		
2969.2						

Total diff
2974.1 g

B-21

FIELD DATA

OTM 029

PLANT	Houston Refining	AMBIENT TEMPERATURE	89	PROBE HEATER SETTING	260
DATE	7/21/14	BAROMETRIC PRESSURE	30.00	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	9	METER $H_@$	1.87
OPERATOR	SK	PROBE LENGTH, in	3'	C_p FACTOR	0.84
STACK NO	DCU	NOZZLE DIAMETER, in	0.180	Y_d FACTOR	1.005
RUN NO	OTM-029-1	STACK DIAMETER, in.	8	PITOT/THERM #	R3
SAMPLE BOX NO	—	MINUTES PER POINT	5		
METER BOX NO	5040.19	NUMBER OF POINTS	—		
START TIME	1815	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	PROBE/COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1815	0	0	+2.4	212			0.03		864.575	97		261	258	256	64	15.0
1820	1	5	+2.3	213			0.03		864.882	97		262	261	257	63	15.0
1825	1	10	+2.2	212			0.03		865.04	97		261	260	262	63	15.0
1830	1	15	+2.2	212			0.03		865.22	97		263	262	260	62	15.0
1835		20	+2.2	212			0.03		865.321	97		261	266	261	61	15.0
1851		25	+3.6	212			0.03		865.580	97		260	261	262	61	15.0
1856/1859		30	+1.6	212			0.03		865.73	97		261	260	261	61	15.0
1904		35	+1.4	212			0.03		865.81	97		262	260	260	60	15.0
1906/1915		37	+1.0	212			0.03		865.951	97		262	261	258	61	15.0
1920		42	+3.4	212			0.03		866.11	97		262	260	258	60	15.0
1925		47	+3.2	212			0.03		866.24	97		263	259	257	59	15.0
1930		52					0.03		866.411							
AVERAGE			2.35	212			0.03		1.836	97						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FI					
IF L					
L D COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1	2011	0.5	19.5
TRIAL 2	2020	0.5	19.5
TRIAL 3	2034	0.5	19.5
Average		0.5	19.5

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	—	@ > 3"H_2O
POST:	—	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-21-2011
Location:	Houston, TX	Test Date:	7-22-11
Source:	736 Coker Unit	Date Recovered:	7-22-11
Run No.:	OTM-29-1	USEPA Method:	OTM-29
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial (wt)/vol g/mL	Final (wt)/vol g/mL	Difference (wt)/vol g/mL	Sample Container No.	
1	6N NaOH	706.9	1127.6	420.7		pH>13
2	6N NaOH	645.4	1112.1	466.7		pH>13
3	6N NaOH	712.1	607.0	-105.1		pH>13
4	6N NaOH	713.1	596.2	-116.3		pH>13
5	Silica Gel	892.2	896.8	4.6		
6						

KO's
641.1
872.2
546
+ 771.1
2880.4

Total diff
3551.0 g

B-23

FIELD DATA

0:M029

PLANT	Houston Refining	AMBIENT TEMPERATURE	98	PROBE HEATER SETTING	260	A=	B=
DATE	7/27/11	BAROMETRIC PRESSURE	30.06	HEATER BOX SETTING	260		
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	9	METER $H_@$	1.755		
OPERATOR	TK	PROBE LENGTH, in	3'	C_p FACTOR	~~0.84~~ 0.84		
STACK NO	DCU	NOZZLE DIAMETER, in	0.188	Y_d FACTOR	0.9987		
RUN NO	UM-029-2	STACK DIAMETER, in.	8	PITOT/THERM #	PS3		
SAMPLE BOX NO		MINUTES PER POINT	5				
METER BOX NO	11094027	NUMBER OF POINTS	12				
START TIME	1337	NUMBER OF PORTS	1				

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP / °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1337	1	0					0.08		345.468	111		260	258	260	62	15.0
1342	1	5					0.08		346.56	112		259	259	259	61	15.0
1347	1	10					0.08		347.16	113		258	259	261	61	15.0
1352	1	15					0.08		347.70	113		259	260	262	60	15.0
1357	1	20					0.08		348.43	113		260	261	261	60	15.0
1402	1	25					0.08		348.71	113		259	260	260	60	15.0
1407	1	30					0.08		349.10	113		260	255	257	59	15.0
1412	1	35					0.07		349.51	113		258	257	258	58	15.0
1417	1	40					0.07		349.73	113		257	258	257	59	15.0
1422	1	45					0.06		350.25	113		256	254	259	60	15.0
1427	1	50					0.06		350.50	113		257	260	261	61	15.0
1432	1	55					0.06		351.02	113		256	261	260	60	15.0
1437	1	60					0.06		351.35	113		256	260	261	61	15.0
1442	1	65					0.06		351.71	113		257	261	260	61	15.0
1445		7068							352.198							
									✓	✓						
AVERAGE							0.07		6730	112.8						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FI					
IN L					
L) COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1	1530	0.5	18.5
TRIAL 2	1537	0.5	18.5
TRIAL 3	1543	0.5	18.5
Average		0.5	18.5

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-26-2011
Location:	Houston, TX	Test Date:	7-27-2011
Source:	736 Coker Unit	Date Recovered:	7-27-2011
Run No.: 2	OTM29-3	USEPA Method:	OTM-29
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.	pH
1	6N NaOH	713.5	819.9	106.4		10
2	6N NaOH	708.4	708.8	0.4		12
3	6N NaOH	683.4	683.4	0		>12
4	6N NaOH	646.1	646.2	-0.1		>12
5	Silica Gel	938.9	942.5	3.6		
6						

KO's
184
1006.8
1069.3
1052.7
+ 1046
4358.8

Total diff
4469.1 g

B-25

B-26

FIELD DATA

STM 029

PLANT	Houston Refining	AMBIENT TEMPERATURE	29,4850	PROBE HEATER SETTING	360
DATE	7/28/11	BAROMETRIC PRESSURE	29.88	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	3.00	METER $H_{@}$	1.755
OPERATOR	SIC	PROBE LENGTH, in.	3.188	C_p FACTOR	0.84
STACK NO	DUC OTM	NOZZLE DIAMETER, in.	8	Y_d FACTOR	1.2552 0.9987
RUN NO.	3(7)-0729-3	STACK DIAMETER, in.		PITOT/THERM #	P93
SAMPLE BOX NO.		MINUTES PER POINT	5		
METER BOX NO.	1104027	NUMBER OF POINTS	7		
START TIME	1518	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= B=

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1518	09	0					0.15		350.393	95		263	263	259	62	15.0
1523	1	5					0.05		351.75	95		263	262	260	62	15.0
1528	1	10					0.05		352.94	95		264	263	261	61	15.0
1533	1	15					0.04		353.03	95		263	260	260	61	15.0
1538	1	20					0.04		353.13	95		261	259	258	60	15.0
1543	1	25					0.04		353.19	95		260	260	259	60	15.0
1548	1	30					0.04		353.25	95		257	258	257	61	15.0
1553	1	35					0.02		353.29	95		256	257	256	61	15.0
1558	1	40					0.02		353.35	95		257	256	254	61	15.0
1603	1	45					0.02		353.44	95		256	257	260	62	15.0
1608	1	50					0.02		353.41	95		257	259	262	63	15.0
1611		53							354.143							
AVERAGE							0.04		3.75	95						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
VAL					
ITIAL					
QUID COLLECTED					
OTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1	1659	0.5	19.0
TRIAL 2	1708	0.5	19.0
TRIAL 3	1715	0.5	19.0
Average		0.5	19.0

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@>3"H_2O
POST:	✓	@>3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-27-2011
Location:	Houston, TX	Test Date:	7-28-2011
Source:	736 Coker Unit	Date Recovered:	7-29-2011
Run No.: 3	OTM29-4	USEPA Method:	OTM-29
		Corresponding Filter No:	N/A
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.	pH
1	6N NaOH	711.7	715.6	3.9		>12
2	6N NaOH	651.3	651.4	0.1		>12
3	6N NaOH	720.5	720.2	-0.3		>12
4	6N NaOH	716.9	716.9	0		>12
5	Silica Gel	877.5	880.1	2.6		
6						

KO's
1006.4
990.7
1013.2
+242.7
3253.0

Total diff
3259.3g

FIELD DATA

ONTARIO HYDRO

B-28

PLANT	Houston Refining	AMBIENT TEMPERATURE	89	PROBE HEATER SETTING	260
DATE	7/21/11	BAROMETRIC PRESSURE	30.00	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	99	METER $H_@$	1.755
OPERATOR	SK	PROBE LENGTH, in.	31	C_p FACTOR	0.84
STACK NO	OCU	NOZZLE DIAMETER, in	0.188	Y_d FACTOR	.9887
RUN NO	OH-1	STACK DIAMETER, in	3	PITOT/THERM #	PG3
SAMPLE BOX NO	—	MINUTES PER POINT	5		
METER BOX NO	1104822	NUMBER OF POINTS	7		
START TIME	1816	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	Probe ~~COND.~~ EXIT TEMP °F	Flex ~~SORBENT~~ MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1815	1	10	+2.4	213	0.68		0.03		335.178	97		261	258	257	62	15.0
1820		5	+2.3	213	1.40		0.03		335.27	97		260	257	259	61	15.0
1825	1	10	+2.2	213	1.0		0.03		335.39	97		261	259	260	61	15.0
1830	1	15	+2.2	212	1.1		0.03		335.42	97		260	258	257	60	15.0
1835	1	20	+2.2	212	1.1		0.03		335.51	97		260	258	256	59	15.0
1840	1	25	+3.6	212	1.2		0.03		335.62	98		261	259	257	60	15.0
1845/1850	1	30	+1.6	212	1.0		0.03		335.70	98		261	258	259	60	15.0
1855		35	+1.4	212	0.78		0.03		336.014	98		262	259	260	59	15.0
1900		40	+1.4	212	0.67		0.03		336.11	98		263	260	260	60	15.0
1906		45	+1.9	212	2.2		0.03		336.19	98		263	261	259	60	15.0
1906/1915		~~46~~ Lk	—	—	PRAIN		—	—	336.23	—	—	—	—	—	—	
1920		51	+3.6	212	2.7		0.03		336.42	98		263	261	258	62	15.0
1925		56	+2.8	212	2.4		0.03		336.51	98		261	262	257	60	15.0
1930		61	+2.7	212	1.7		0.03		336.72	98		262	260	259	66	
1935		64 ✓							336.916							
AVERAGE			+2.315	212.2		1.1148	0.03		1.738	97.6					<68	15

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FI					
IN L					
LI) COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	**Date Set-up:**	7-21-2011
Location:	Houston, TX	**Test Date:**	7-22-11
Source:	736 Coker Unit	**Date Recovered:**	7-22-11
Run No.:	OH-1	**USEPA Method:**	ASTM D6784-02
		Corresponding Filter No:	H44840
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	KCl	725.9	1151.0	425.1	
2	KCl	699.6	1068.6	369	
3	KCl	682.2	647.8	-34.4	
4	5% HNO_3/10% H_2O_2	709.9	656.2	-53.7	
5	4% $KMnO_4$/10% H_2SO_4	723.8	701.6	22.2	
6	4% $KMnO_4$/10% H_2SO_4	715.3	666.8	-48.5	
7	4% $KMnO_4$/10% H_2SO_4	720.6	648.6	-72	
8	Silica Gel	901.4	905.7	4.3	
			partial total	612	

KO's
994.9
660
102.2
786.1
+ 895.5
3438.7

Total diff
4050.7 ~~4115.5~~

FIELD DATA

ONTARIO Hydro

330

PLANT	Lambton Refinery	AMBIENT TEMPERATURE	98	PROBE HEATER SETTING	260
DATE	1/27/93	BAROMETRIC PRESSURE	30.06	HEATER BOX SETTING	260
LOCATION	Sarnia, ON	ASSUMED MOISTURE, %	10.0	METER $H_{@}$	1.87
OPERATOR	SJC	PROBE LENGTH, in	3	C_p FACTOR	0.84
STACK NO	DCU	NOZZLE DIAMETER, in	0.188	Y_d FACTOR	1.005
RUN NO	OH-2 (3)	STACK DIAMETER, in.	8	PITOT/THERM #	PS3
SAMPLE BOX NO		MINUTES PER POINT	5		
METER BOX NO	304014	NUMBER OF POINTS	1		
START TIME	1337	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg	
Filter No.	
Sample	
Final wt	
Tare wt	
Wt. gain	
TOTAL	mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1337	1	0	+2.4	212	1.8		0.08		878.135	112	NA	257	256	262	61	15.0
1342	1	5	+2.4	212	1.9		0.08		878.320	112		258	257	261	61	15.0
1347	1	10	+2.4	212	2.2		0.08		878.511	112		260	257	262	61	15.0
1352	1	15	+2.8	212	2.3		0.08		878.80	112		261	258	260	62	15.0
1357	1	20	+2.6	212	1.9		0.08		879.10	113		259	257	259	61	15.0
1402	1	25	+2.6	212	1.8		0.08		879.20	113		260	259	260	61	15.0
1407	1	30	+2.6	212	1.7		0.07		879.25	113		259	260	258	60	15.0
1412	1	35	+2.7	212	1.6		0.06		879.56	114		260	258	257	59	15.0
1417		40	+2.6	212	1.5		0.06		879.60	114		259	260	256	58	15.0
1422		45	+2.5	212	1.5		0.06		879.67	114		258	257	254	60	15.0
1427		50	+2.2	212	1.4		0.06		879.79	114		258	256	257	61	15.0
1432		55	+2.2	212	1.3		0.06		879.97	114		257	256	258	61	15.0
1437		60	+2.2	212	1.9		0.06		880.14	114		256	257	260	62	15.0
1442		65	+3.8	212	2.4		0.06		880.37	114		258	258	261	63	15.0
1445		68	+2.7	212	2.2	—	—	—	880.497	—	—	—	—	—	—	—
AVERAGE			2.714	212		1.3364	0.0693		2.362	113.2					2.68	15

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FR					
IN					
LI / COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ARI ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-26-2011
Location:	Houston, TX	Test Date:	7-27-2011
Source:	736 Coker Unit	Date Recovered:	7-27-2011
Run No.:	OH-3	USEPA Method:	ASTM D6784-02
		Corresponding Filter No:	H44707
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	KCl	673.0	702.1	29.1	
2	KCl	711.1	712.8	1.7	
3	KCl	704.3	705.7	1.4	
4	5% HNO_3 / 10% H_2O_2	629.7	630.2	0.7	
5	4% $KMnO_4$ / 10% H_2SO_4	729.5	730.3	0.8	
6	4% $KMnO_4$ / 10% H_2SO_4	747.3	748.3	1.0	
7	4% $KMnO_4$ / 10% H_2SO_4	727.5	728.5	1.0	
8	Silica Gel	896.1	903.1	7.0	
				42.7	

KO's
1033.6
1032
1056.9
+ 1044
4188.5

✓
Total diff
4231.2 g

B-32

FIELD DATA
ONTARIO Hydro

PLANT	Houston Refining	AMBIENT TEMPERATURE	90	PROBE HEATER SETTING	260
DATE	7/28/11	BAROMETRIC PRESSURE	29.98	HEATER BOX SETTING	260
LOCATION	Pasadena TX	ASSUMED MOISTURE, %	100	METER $H_@$	1.87
OPERATOR	JK	PROBE LENGTH, in.	31	C_p FACTOR	0.84
STACK NO.	DCU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	1.005
RUN NO.	3(7) OH-3 (4)	STACK DIAMETER, in.	8	PITOT/THERM #	P73
SAMPLE BOX NO		MINUTES PER POINT	5		
METER BOX NO.	5640/9	NUMBER OF POINTS	7		
START TIME	1518	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= B=

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1518	1	0	+2.1	216	2.0		0.08		881.004	90		261	258	257	62	15.0
1523	1	5	+2.4	213	2.3		0.04		881.752	96		258	262	259	61	15.0
1528	1	10	+2.8	213	+2.7		0.04		882.21	96		259	261	260	60	15.0
1533		15	+2.3	213	2.0		0.03		882.48	96		260	258	261	60	15.0
1538		20	+4.0	213	3.3		0.03		882.701	96		261	259	260	59	15.0
1543		25	+2.9	213	2.2		0.03		882.93	96		260	260	257	60	15.0
1548		30	+2.4	213	1.8		0.03		883.06	96		261	257	258	62	15.0
1553		35	+2.2	213	1.4		0.03		883.16	96		260	257	256	61	15.0
1558		40	+2.2	213	1.8		0.03		883.23	96		261	258	256	62	15.0
1603		45	+2.6	213	2.3		0.03		883.34	96		260	257	255	63	15.0
1608		50	+1.3	213	0.91		0.03		883.54	96		260	257	256	62	15.0
1611		53	-	-	-	-	-	-	883.836	-	-	-	-	-	-	
AVERAGE			2.47	213.3		1.4205	0.04		2.832	95.5					62	15

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
NAL					
ITIAL					
QUID COLLECTED					
OTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	**Date Set-up:**	7-27-2011
Location:	Houston, TX	**Test Date:**	7-28-2011
Source:	736 Coker Unit	**Date Recovered:**	7-29-2011
Run No.:	OH-4	**USEPA Method:**	ASTM D6784-02
		Corresponding Filter No:	H44840
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	KCl	672.6	672.8	0.2	
2	KCl	708.0	707.8	-0.2	
3	KCl	710.9	710.5	-0.4	
4	5% HNO_3/10% H_2O_2	636.8	636.6	-0.2	
5	4% $KMnO_4$/10% H_2SO_4	725.9	725.6	-0.3	
6	4% $KMnO_4$/10% H_2SO_4	734.6	734.5	-0.1	
7	4% $KMnO_4$/10% H_2SO_4	750.9	~~734.5~~ 751.1	0.2	
8	Silica Gel	921.6	924.9	3.3	

KO's
675.0
.996
+914
2585.7

Total diff
2588.29

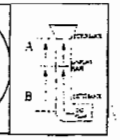
FIELD DATA
0010

PLANT	Hooston Refining	AMBIENT TEMPERATURE	78	PROBE HEATER SETTING	260
DATE	7/19/11	BAROMETRIC PRESSURE	30.00	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	10	METER $H_@$	1.87
OPERATOR	TK	PROBE LENGTH, in.	3'	C_p FACTOR	0.84
STACK NO	DUC	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	1.005
RUN NO.	0010-1	STACK DIAMETER, in.	8	PITOT/THERM #	DP3
SAMPLE BOX NO.	—	MINUTES PER POINT	5		
METER BOX NO.	5040/9	NUMBER OF POINTS	1		
START TIME	1442	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= ____ B= ____

CROSS SECTION



CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) °F	SAMPLE BOX TEMP. °F	~~PROBE~~ COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1442	1	0	+1.4	213	0.40		0.010	~~0.08~~	856.153	89		261	260	55	62	15.0
1447	1	5	1.6	213	0.44		0.020	0.02	856.383	89		260	264	54	60	15.0
1452	1	10	2.0	213	0.52		0.020		856.49	88		262	263	55	60	15.0
1457	1	15	1.8	213	0.63		0.02		856.560	88		261	260	56	59	15.0
1502	1	20	1.6	213	0.72		0.02		856.66	88		261	258	57	58	15.0
1507	1	25	1.0	213	0.60		0.02		856.76	88		260	259	57	59	15.0
1510	1	28		~~213~~	~~0.54~~		~~0.02~~		856.802	~~88~~		~~260~~	~~258~~	~~57~~	~~59~~	~~15.0~~
									~~856.912~~							
AVERAGE			+1.67	213		0.7268			0.655	88.2						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
IAL					
TIAL					
UID COLLECTED					
TAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.005	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	V	@ > 3"H_2O
POST:	V	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Lyondell (Houston Refining)	Date Set-up:	7-18-2011
Location:	Houston, TX	Test Date:	7-19-2011
Source:	736 Coker Unit	Date Recovered:	7-19-2011
Run No.:	0010-1	USEPA Method:	0010
		Corresponding Filter No:	H44793
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	KO	369.3	1056.4	687.1	
2	HPLC Water	~~605.3~~ 705.2	1167.1	461.9	
3	HPLC Water	~~581.8~~ 680.9	1166.5	485.6	
4	Empty	610.5	670.6	60.1	
5	Silica Gel	895.2	900.8	5.6	
6					
	~~KO~~	~~406.4~~	~~1089.6~~		

B-35

1700.3

ARI ENVIRONMENTAL INC.

FIELD DATA

0010

PLANT	Houston Refining	AMBIENT TEMPERATURE	90	PROBE HEATER SETTING	260
DATE	7/20/11	BAROMETRIC PRESSURE	30.04	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	9.0	METER $H_@$	1.87
OPERATOR	SK	PROBE LENGTH, in.	3'	C_p FACTOR	0.84
STACK NO	DHU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	1.005
RUN NO.	0010-2	STACK DIAMETER, in	8	PITOT/THERM #	PT3
SAMPLE BOX NO		MINUTES PER POINT	5		
METER BOX NO	5040/9	NUMBER OF POINTS	1		
START TIME	1220	NUMBER OF PORTS	1		

A= ____ B= ____

WEIGHT OF PARTICULATE, mg.	
Filter No.	
Sample	
Final wt.	
Tare wt.	
Wt. gain	
TOTAL	mg

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	PROBE/COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
									857.057							
1220	1	0	11.1	213	0.91		0.03		857.057	89		258	259	54	62	15.0
1225	1	5	11.6	213	0.95		0.03		857.247	89		254	260	55	61	15.0
1229	1	10							857.358							
		15														
		20														
AVERAGE				213			0.03		1.301							

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Lyondell (Houston Refn.)	Date Set-up:	7-18-2011
Location:	Houston, TX	Test Date:	7-20-2011
Source:	736 Coker Unit	Date Recovered:	7-20-2011
Run No.:	0010-2	USEPA Method:	0010
		Corresponding Filter No:	~~0010 H44794~~ H44795
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol (g)/mL	Final wt/vol (g)/mL	Difference wt/vol (g)/mL	Sample Container No.
1	KO	355.5	786.0	430.5	
2	Water	714.7	761.3	46.6	
3	Water	717.9	720.9	3.0	
4	Empty	616.9	618.1	1.2	
5	Silica Gel	919.7	925.1	5.4	
6					

✓ total 486.7g

ARI ENVIRONMENTAL INC.

FIELD DATA

0010

PLANT	~~Houston~~ Refinery	AMBIENT TEMPERATURE	89	PROBE HEATER SETTING	260	WEIGHT OF PARTICULATE, mg	
DATE	7/21/11	BAROMETRIC PRESSURE	29.98	HEATER BOX SETTING	260	Filter No.	
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	10.0	METER $H_@$	1.87	Sample	
OPERATOR	JK	PROBE LENGTH, in.	3'	C_p FACTOR	0.84	Final wt.	
STACK NO	ROV	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	1.005	Tare wt.	
RUN NO.	0010-3	STACK DIAMETER, in	8	PITOT/THERM #	PS3	Wt. gain	
SAMPLE BOX NO.		MINUTES PER POINT	5			TOTAL	mg
METER BOX NO	504019	NUMBER OF POINTS	—				
START TIME	1026	NUMBER OF PORTS	1				

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	~~Sample~~ Box Temp. °F	~~Cond.~~ Probe Exit Temp °F	Sorbent Module Temp. °F	Last Impinger Outlet Temp. °F	Pump Vacuum in. Hg
1026	1	0	+1.2	212	0.67		0.05		861.408	85		~~257~~ 257	259	56	62	15.0
1031	1	5	+1.2	212	0.72		0.05		861.85	85		~~256~~ 256	260	~~55~~ 55	61	15.0
1036	1	10	+1.2	212	0.90		0.05		862.15	86		257	262	55	61	15.0
1041	1	15	+1.3	212	0.98		0.05		862.49	86		257	261	54	60	15.0
1046	1	20	+1.3	212	1.0		0.05		862.81	87		256	260	55	59	15.0
1051	1	25	+1.3	212	1.0		0.05		863.02	88		259	263	56	60	15.0
1056	1	30	+1.2	213	0.75		0.05		363.29	89		258	262	56	60	15.0
1101	1	35	+1.0	213	0.63		0.05		363.41	89		259	260	55	61	15.0
1106	1	40	+0.80	213	0.88		0.04		363.51	89		260	261	56	60	15.0
1111	1	45	+1.3	213	+1.1		0.04		363.66	90		257	263	56	60	15.0
1116		50							863.908							
AVERAGE			1.18	212.4		0.9311	0.048		2,500	87.4						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	**Date Set-up:**	~~7~~ 7-20-11
Location:	Houston, TX	**Test Date:**	7-21-11
Source:	736 Coker Unit	**Date Recovered:**	7-21-11
Run No.:	0010-3	**USEPA Method:**	0010
		Corresponding Filter No:	~~H44795~~ H44839
		Filter Container No:	N/A

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	KO	370.1	975.0	604.9	
2	water	713.1	946.4	233.3	
3	water	687.3	625.1	-62.2	
4	Empty	613.9	759.3	145.4	
5	Silica Gel	964.2	973.8	9.6	
6					

1 additional impingers
wt total = ~~1635~~ 1987.3 g

✓ total 2918.3 g

D-40

FIELD DATA

5/202

PLANT	Houston Refining	AMBIENT TEMPERATURE	83	PROBE HEATER SETTING	260
DATE	7/29/11	BAROMETRIC PRESSURE	30.04	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	100	METER $H_@$	1.755
OPERATOR	JR	PROBE LENGTH, in.	31	C_p FACTOR	0.84
STACK NO	DCU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	0.9987
RUN NO.	D-202-1	STACK DIAMETER, in.	8	PITOT/THERM #	PM3
SAMPLE BOX NO.	-	MINUTES PER POINT	5		
METER BOX NO.	1104027	NUMBER OF POINTS	-		
START TIME	0752	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_{in}) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm_{out}) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
0752	1	0					0.04		355.745	83		264	261	262	63	15
0757	1	5					0.03		356.18	83		254	256	261	63	15
0802	1	10					0.03		356.26	83		257	258	260	62	15
0807	1	15					0.03		356.34	83		259	260	257	61	15
0812	1	20					0.03		356.42	83		257	262	256	61	15
0817	1	25					0.03		356.51	83		258	260	259	62	15
0822	1	30					0.03		356.57	83		259	261	260	62	15
0827	1	35					0.03		356.68	84		260	262	263	63	15
0832	1	40					0.03		356.73	84		261	259	260	62	15
0837	1	45					0.03		356.80	84		257	260	258	63	15
0842	1	50					0.03		356.83	84		258	262	259	63	15
0847	1	55					0.03		356.89	84		260	263	260	62	15
0852	1	60					0.03		356.96	84		259	261	261	61	15
0857	1	65					0.03		357.02	84		260	260	258	61	15
0902		70					0.03		357.07	85		259	258	259	62	15
0907		75							358.011							
AVERAGE							0.031		2.266	83.6						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average		0.16	19.7

By HIB

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	V	@ > 3"H_2O
POST:	V	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-28-11
Location:	Houston, TX	Test Date:	7-29-11
Source:	736 Coker	Date Recovered:	7-29-11
Run No.:	5B-1	USEPA Method:	Method 5B / 202
		Corresponding Filter No:	43016
		Filter Container No:	775.3 mg

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	Knockout	377.4	380.5	3.1	
2	Empty	596.2	598.2	2.0	
3	water	712.8	715.5	2.7	
4	Silica Gel	892.7	899.5	6.8	
5					
6					

KO's
1001.8
1021.0
1019.4
+ 601.7
3643.9

Total diff.
3658.5 g

B-42

FIELD DATA

5/B02

PLANT	Houston Ref.	AMBIENT TEMPERATURE	98	PROBE HEATER SETTING	260		
DATE	8/17/11	BAROMETRIC PRESSURE	30.04	HEATER BOX SETTING	260		
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	99	METER $H_@$	1.87		
OPERATOR	JK	PROBE LENGTH, in.	31	C_p FACTOR	~~0.84~~ 0.84		
STACK NO.	DCU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	~~0.84~~ 1.805		
RUN NO.	5-202-2	STACK DIAMETER, in.	8	PITOT/THERM #	P93		
SAMPLE BOX NO.	—	MINUTES PER POINT	5				
METER BOX NO.	504019	NUMBER OF POINTS	—				
START TIME	1242	NUMBER OF PORTS	1				

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= ____ B= ____

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	~~Probe~~ EXIT TEMP °F	~~Flex~~ MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1242	1	0	+2.6	253	0.78		0.05		888.578	110		260	257	260	64	15.0
1247	1	5	+2.4	263	0.85		0.05		889.14	110		258	259	262	62	15.0
1252	1	10	+2.6	269	0.64		0.05		889.35	110		257	260	258	61	15.0
1257	1	15	+3.8	266	0.98		0.03		889.50	110		256	257	257	60	15.0
1302	301								890.141							
1307	END															
1312																
1317																
AVERAGE			2.85	262.75		0.8978	0.045		1.563	110						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
IAL					
TIAL					
QUID COLLECTED					
TAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average		0.11	20.2

By MB

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@ > 3"H_2O
POST:	✓	@ > 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	7-30-11
Location:	Houston, TX	Test Date:	8-1-11
Source:	736 Coker	Date Recovered:	8-1-11
Run No.:	5B-2	USEPA Method:	5B/202
		Corresponding Filter No:	43049
		Filter Container No:	784.1 mg

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	Empty	~~618.3~~ 496.8	498.0	1.2	
2	Empty	597.2	597.6	0.4	
3	Water	707.7	708.4	0.7	
4	Silica Gel	911.8	914.5	2.7	
5					
6					

KO's
1001.4
+ 377.6
1379

✓
Total diff.
1384.0 g

FIELD DATA

5/202

B44

PLANT	Houston Refining	AMBIENT TEMPERATURE	98	PROBE HEATER SETTING	260
DATE	8/2/11	BAROMETRIC PRESSURE	30.06	HEATER BOX SETTING	260
LOCATION	Pasadena, TX	ASSUMED MOISTURE, %	99	METER $H_@$	1.87
OPERATOR	JC	PROBE LENGTH, in.	3'	C_p FACTOR	0.84
STACK NO.	DCU	NOZZLE DIAMETER, in.	0.188	Y_d FACTOR	1.005
RUN NO.	5-202-3	STACK DIAMETER, in.	8	PITOT/THERM #	093
SAMPLE BOX NO.	~	MINUTES PER POINT	5		
METER BOX NO.	504019	NUMBER OF POINTS	1		
START TIME	1611	NUMBER OF PORTS	1		

WEIGHT OF PARTICULATE, mg		
Filter No.		
Sample		
Final wt		
Tare wt		
Wt. gain		
TOTAL		mg

A= B=

CROSS SECTION

CLOCK TIME	TRAVERSE POINT NUMBER	SAMPLING TIME (Θ) min.	STATIC PRESSURE (in. H_2O)	STACK TEMP (T_S) °F	VELOCITY HEAD (ΔP_S)	VELOCITY HEAD ($\sqrt{\Delta P_S}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O DESIRED	GAS SAMPLE VOLUME (Vm) ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP. °F	COND. EXIT TEMP °F	SORBENT MODULE TEMP. °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM in. Hg
1611	1	0	2.0	212	2.1		0.04		891.214			264	261	257	64	15.0
1616	END	5							892.574							
1621		10														
AVERAGE			2.0	212			0.04		1.36	109						

VOLUME OR WEIGHT OF LIQUID WATER COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g) #1	#2	#3	#4	SILICA GEL WEIGHT g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL COLLECTED (specify ml or g)					

ORSAT DATA	TIME	CO_2	O_2
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average		0.49	12.8

B44B

LEAK CHECK		
SYSTEM PRE:	0.000	CFM@15"Hg
POST:	0.000	CFM@15"Hg
PITOT PRE:	✓	@> 3"H_2O
POST:	✓	@> 3"H_2O

IMPINGER RECOVERY DATA SHEET

ENVIRONMENTAL INC.

Company:	Houston Refining	Date Set-up:	8-1-11
Location:	Houston, TX	Test Date:	8-2-11
Source:	736 Coker	Date Recovered:	8-2-11
Run No.:	5B-3	USEPA Method:	5B/202
		Corresponding Filter No:	43050
		Filter Container No:	778.7 mg

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	Empty	552.5	555.6	3.1	
2	Empty	596.3	597.4	1.1	
3	Water	690.6	690.6	0	
4	SilicaGel	880.3	884.2	3.9	
5					
6					

HCO's 64.9

Total diff. 73.0g

METHANOL CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
SAMPLE: Methanol
TEST DATE: 7/21/2011
RUN NO: 308-1

INPUT

Q_s :	2,158 **dscfh**
P_{bar} :	29.98 **in Hg**

	Spiked Train:		***Unspiked Train:***
V_m **Spiked:**	15.434 **liters**	V_m **Unspiked:**	7.7 **liters**
V_m **Spiked:**	0.545 **cubic ft**	V_m **Unspiked:**	0.272 **cubic ft**
Y Spiked :	1.000	**Y Sample :**	0.951
T_m **Spiked:**	88 °F	T_m **Sample:**	88 °F
ΔH Spiked:	0.30 **in.** H_2O	**ΔH Sample:**	1.00 **in.** H_2O

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Spiked (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.527	**dscf**
V_{mstd} Spiked ($V_{s\text{-liters}}$) = dscf x 28.32	=	14.911	**std liters**
V_{mstd} Unspiked (V_u) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.250	**dscf**
V_{mstd} Unspiked ($V_{u\text{-liters}}$) = dscf x 28.32	=	7.087	**std liters**

Recovery Calculations
$M_v = (M_s/V_{s\text{-liters}}) - (M_u/V_{u\text{-liters}})$
$R = (M_v * V_{s\text{-liters}}) / S$

VOC Concentration
$C_s = 2.2046 \times 10^{-9}$ lb/µg x M_u / V_u
Reported $C_s = C_s / R$
ppb = $C_s * (385.26 \times 10^9 / MW)$
Reported ppb = ppb/R

Stack gas volume flow rate
Q_s = dscfh

Stack VOC emission rate
$Q_s \times C_s$

Compound	Molecular Weight	Mass/volume (M_u) (µg/liter)	Fraction of Spike Recovered R (fractional)	VOC Concentration (lb/dscf)	Reported VOC Concentration (lb/dscf)	VOC Concentration (ppb)	Reported VOC Concentration (ppb)	Reported VOC Concentration (µg/dscm)	Reported VOC Emission (lb/hr)
Methanol	32.04	-620.2	-525.4	4.9123E-05	-9.3494E-08	590,677	-1,124	-1,497	-0.00020

METHANOL CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
SAMPLE: Methanol
TEST DATE: 7/21/2011
RUN NO: 308-2

INPUT

Q_s :	1,075 **dscfh**
P_{bar} :	30.00 **In Hg**

Spiked Train:		***Unspiked Train:***	
V_m **Spiked:**	19.991 **liters**	V_m **Unspiked:**	13.593 **liters**
V_m **Spiked:**	0.706 **cubic ft**	V_m **Unspiked:**	0.480 **cubic ft**
Y Spiked :	0.975	**Y Sample :**	1.000
T_m **Spiked:**	87.6 **°F**	T_m **Sample:**	91.77 **°F**
ΔH Spiked:	0.73 **in. H_2O**	**ΔH Sample:**	1.31 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Spiked (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.667	**dscf**
V_{mstd} Spiked ($V_{s\text{-liters}}$) = dscf x 28.32	=	18.877	**std liters**
V_{mstd} Unspiked (V_u) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.462	**dscf**
V_{mstd} Unspiked ($V_{u\text{-liters}}$) = dscf x 28.32	=	13.084	**std liters**

Recovery Calculations
$M_v = (M_s/V_{s\text{-liters}}) - (M_u/V_{u\text{-liters}})$
$R = (M_v * V_{s\text{-liters}}) / S$

VOC Concentration
$C_s = 2.2046 \times 10^{-9}$ lb/µg x M_u / V_u
Reported $C_s = C_s / R$
ppb = C_s * (385.26×10^9 / MW)
Reported ppb = ppb/R

Stack gas volume flow rate
Q_s = dscfh

Stack VOC emission rate
$Q_s \times C_s$

Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	Fraction of Spike Recovered R (fractional)	VOC Concentration (lb/dscf)	Reported VOC Concentration (lb/dscf)	VOC Concentration (ppb)	Reported VOC Concentration (ppb)	Reported VOC Concentration (µg/dscm)	Reported VOC Emission (lb/hr)
Methanol	32.04	-102.46	-109.90	1.5327E-05	-1.3946E-07	184,297	-1,677	-2,234	-0.00015

METHANOL CALCULATION SUMMARY

COMPANY: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 DCU
SAMPLE: Methanol
TEST DATE: 7/27/2011
RUN NO: 308-3

INPUT

Q_s :	1,891 **dscfh**
P_{bar} :	30.06 **in Hg**

	Spiked Train:		***Unspiked Train:***	
V_m **Spiked:**	27.244	**liters**	V_m **Unspiked:**	42.382 **liters**
V_m **Spiked:**	0.962	**cubic ft**	V_m **Unspiked:**	1.497 **cubic ft**
Y Spiked :	0.975		**Y Sample :**	1.000
T_m **Spiked:**	102.6	**°F**	T_m **Sample:**	102.9 **°F**
ΔH Spiked:	0.18	**in. H_2O**	**ΔH Sample:**	1.26 **in. H_2O**

Volume of sample at standard conditions on dry basis		**English units (29.92 in. Hg 68° F)**	
V_{mstd} Spiked (V_s) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	0.885	**dscf**
V_{mstd} Spiked ($V_{s\text{-liters}}$) = dscf x 28.32	=	25.057	**std liters**
V_{mstd} Unspiked (V_u) = (17.647)(V_m)(Y_d)(P_{bar}+ΔH/13.6)/(T_m)	=	1.415	**dscf**
V_{mstd} Unspiked ($V_{u\text{-liters}}$) = dscf x 28.32	=	40.063	**std liters**

Recovery Calculations
$M_v = (M_s/V_{s\text{-liters}}) - (M_u/V_{u\text{-liters}})$
$R = (M_v * V_{s\text{-liters}}) / S$

VOC Concentration
$C_s = 2.2046 \times 10^{-9}$ lb/µg x M_u / V_u
Reported $C_s = C_s / R$
ppb = $C_s * (385.26 \times 10^9 / MW)$
Reported ppb = ppb/R

Stack gas volume flow rate
Q_s = dscfh

Stack VOC emission rate
$Q_s \times C_s$

Compound	Molecular Weight	Mass/volume (M_v) (µg/liter)	Fraction of Spike Recovered R (fractional)	VOC Concentration (lb/dscf)	Reported VOC Concentration (lb/dscf)	VOC Concentration (ppb)	Reported VOC Concentration (ppb)	Reported VOC Concentration (µg/dscm)	Reported VOC Emission (lb/hr)
Methanol	32.04	14.1	20.03	1.5584E-07	7.7819E-09	1,874	94	124.6	0.00001

USEPA Method 18 Field Data Summary

Company: Houston Refining
Location: Houston, TX
Source: 736 DCU
Sample: Methanol

Test Date: 7/21/2011
Run # : 308-1
Test Length (min): 24.62
Test Time: 10:26 - 10:55:37
P_{bar} : 29.98 **in Hg**
Qs : 2,158 **dscfh**

Spiked Train:			*Sample Train:*	
V_m Spiked:	15.434 **liters**	**V_m Sample:**	7.700 **liters**	
V_m Spiked:	0.545 **cubic ft**	**V_m Sample:**	0.272 **cubic ft**	
Y Spiked :	1.000	**Y Sample :**	0.951	
T_m Spiked:	88.0 **°F**	**T_m Sample:**	88.0 **°F**	
ΔH Spiked:	0.30 **in. H_2O**	**ΔH Sample:**	1.00 **in. H_2O**	

Test Date: 7/21/2011
Run # : 308-2
Test Length (min): 64.72
Test Time: 18:15 - 19:19:43
P_{bar} : 30.00 **in Hg**
Qs : 1,075 **dscfh**

Spiked Train:			*Sample Train:*	
V_m Spiked:	19.991 **liters**	**V_m Sample:**	13.593 **liters**	
V_m Spiked:	0.706 **cubic ft**	**V_m Sample:**	0.480 **cubic ft**	
Y Spiked :	0.975	**Y Sample :**	1.000	
T_m Spiked:	87.6 **°F**	**T_m Sample:**	91.8 **°F**	
ΔH Spiked:	0.73 **in. H_2O**	**ΔH Sample:**	1.31 **in. H_2O**	

Test Date: 7/27/2011
Run # : 308-3
Test Length (min): 68
Test Time: 13:37 - 14:45
P_{bar} : 30.06 **in Hg**
Qs : 1,891 **dscfh**

Spiked Train:			*Sample Train:*	
V_m Spiked:	27.244 **liters**	**V_m Sample:**	42.382 **liters**	
V_m Spiked:	0.962 **cubic ft**	**V_m Sample:**	1.497 **cubic ft**	
Y Spiked :	0.975	**Y Sample :**	1.000	
T_m Spiked:	102.6 **°F**	**T_m Sample:**	102.9 **°F**	
ΔH Spiked:	0.18 **in. H_2O**	**ΔH Sample:**	1.26 **in. H_2O**	

Methanol Laboratory Data Summary

Client: Houston Refining
Location: Houston, TX
Source: 736 DCU
Date: 7/21/2011
Run No: 308-1

Compound	Molecular Weight	Spiked Value (S) (micrograms)	Spiked Train Analysis (M_s) (micrograms)	Unspiked Train Analysis (M_u) (micrograms)
Methanol	32.04	17.6	2,485.0	5,576.0

Client: Houston Refining
Location: Houston, TX
Source: 736 DCU
Date: 7/21/2011
Run No: 308-2

Compound	Molecular Weight	Spiked Value (S) (micrograms)	Spiked Train Analysis (M_s) (micrograms)	Unspiked Train Analysis (M_u) (micrograms)
Methanol	32.04	17.6	2,700.0	3,212.0

Client: Houston Refining
Location: Houston, TX
Source: 736 DCU
Date: 7/27/2011
Run No: 308-3

Compound	Molecular Weight	Spiked Value (S) (micrograms)	Spiked Train Analysis (M_s) (micrograms)	Unspiked Train Analysis (M_u) (micrograms)
Methanol	32.04	17.6	415.0	< 100

ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	LyondeII	**Meter No.:**	100196	**Ambient Temperature:**	78
Date:	7/19/11	**Y Factor:**	0.975	**Barometric Pressure:**	30.00
Location:	~~2M 736 Coker~~ Houston TX	**Trap Contents:**		**Stack Diameter:**	8
Source:	736 Coker	**USEPA Method:**	M18	**Pre-Test Leak Check:**	0.000
Run No.:	1-M18 A	**Compound Analysis:**		**Post-Test Leak Check:**	0.001
Operators:	ZM, DC	**Spike in Trap (Y/(N)):**	NO		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1442	0	1.0	4	1.0	0.000	78
1447	5	1.0	4	0.1	5.392	79
1452	10	1.0	4	0.4	5.403	79
1457	15	1.0	4	0.3	5.891	79
1502	20	1.0	4	0.5	6.085	80
1507	25	1.0	10	0.1	6.699	82
1508	~~26~~ 25.50	1.0	5	0.1	6.701	82
					✓	✓
		1.0 ✓			6.701	79.9

ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	Lyondell	**Meter No.:**	1105003	**Ambient Temperature:**	78
Date:	7/19/11	**Y Factor:**	1.000	**Barometric Pressure:**	30.00
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	8
Source:	736 Coker	**USEPA Method:**	M18	**Pre-Test Leak Check:**	0.001
Run No.:	1- M18 B	**Compound Analysis:**		**Post-Test Leak Check:**	0.000
Operators:	ZM, DC	**Spike In Trap (Y/N):**	Yes		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1442	0	2.1	1	1	0.000	78
1447	5	2.1	1	1	7.81	78
1452	10	2.1	1	1	14.37	79
1457	15	1.5	1	1	20.07	79
1502	20	1.1	2	1	24.99	80
1507	25	1.2	4	1	29.98	81
1508	26.50	0	15	0	30.179	81
		1.73			30.179	79.4

ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	Lyondell	**Meter No.:**	100198	**Ambient Temperature:**	90
Date:	7/20/11	**Y Factor:**	0.975	**Barometric Pressure:**	30.09
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	
Source:	736 Cokor	**USEPA Method:**	18	**Pre-Test Leak Check:**	0.001
Run No.:	2-18A	**Compound Analysis:**		**Post-Test Leak Check:**	0.001
Operators:	SM	**Spike in Trap (Y/N):**	NO		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (In. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1220	0	1.0	1	1	0.000	90
1225	5	1.0	1	1	0.000	90
~~1229~~ ~~1230~~	2~~0~~ 9.25	1.0	1	1	0.174	90
		1.0			0.174	90.0

ARI ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	LyondellBasell	**Meter No.:**	1105003	**Ambient Temperature:**	90
Date:	7/20/11	**Y Factor:**	1.000	**Barometric Pressure:**	30.04
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	8
Source:	736 Coker	**USEPA Method:**	18	**Pre-Test Leak Check:**	0.00
Run No.:	2-18B	**Compound Analysis:**		**Post-Test Leak Check:**	0.00
Operators:	ZM	**Spike in Trap (Y/N):**	Yes		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (In. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1220	0	1.0	1	1	0.000	90
1225	2nd 5	1.0	1	1	0.00	90
1227	9:25	1.0	1	1	0.151	90
		✓			✓	✓
		1.0			0.151	90

ARI ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	Lyondell	**Meter No.:**	1105803	**Ambient Temperature:**	89
Date:	7/21/11	**Y Factor:**	1.000	**Barometric Pressure:**	29.98
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	8
Source:	736	**USEPA Method:**	M18	**Pre-Test Leak Check:**	0.001
Run No.:	3-M18A	**Compound Analysis:**		**Post-Test Leak Check:**	0.000
Operators:	ZM	**Spike in Trap (Y/N):**	NO		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1026	0	2	11	1	0.000	88
1031	5	2	11	1	7.01	88
1036	10	4	1	1	12.14	89
1041	15	3	14	1	14.20	89
1046	20	1	29	1	14.47	90
1051	25	1	28	1	1457	90
1056	30	1	28	1	14.66	90
1101	35	1	28	1	14.78	90
1106	40	1	28	1	14.85	90
1111	45	1	28	1	14.93	90
1116	50	1	28	1	14.99	91
1121	55	1	28	1	15.07	91
1126	60	1	28	1	15.151	91
		✓			✓	
		1.69			15.151	

ARI ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	Lyondell	**Meter No.:**	100196	**Ambient Temperature:**	89
Date:	7/21/11	**Y Factor:**	0.975	**Barometric Pressure:**	29.98
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	8
Source:	736	**USEPA Method:**	M18	**Pre-Test Leak Check:**	0.000
Run No.:	3 - M18B	**Compound Analysis:**		**Post-Test Leak Check:**	0.000
Operators:	ZM	**Spike in Trap (Y/N):**	Yes		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (In. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
10:26	0	4	1	1	0.000	89
10:31	5	2	1	1	2.51	90
1036	10	1	1	1	2.51	90
1041	15	1	1	1	3.73	90
1046	20	1	1	1	4.05	90
1051	25	1	1	1	4.74	90
1056	30	1	1	1	5.09	90
1101	35	1	1	1	5.09	90
1106	40	1	1	1	5.09	91
1111	45	1	1	1	5.09	91
1116	50	1	1	1	5.09	91
1121	55	1	1	1	5.09	92
1126	60	1	1	1	5.09	92
		✓			✓	✓
		1.31			5.09	90.5

ARI ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	LYONDELL	**Meter No.:**	8003708	**Ambient Temperature:**	89
Date:	7/21/11	**Y Factor:**	0.951	**Barometric Pressure:**	29.78
Location:	HOUSTON TX	**Trap Contents:**		**Stack Diameter:**	
Source:	736 Coker	**USEPA Method:**	308	**Pre-Test Leak Check:**	0.001
Run No.:	RUN-1A 308-1A	**Compound Analysis:**		**Post-Test Leak Check:**	0.001
Operators:	ZM	**Spike in Trap (Y/N):**	NO		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (In. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1026	0	1.0	1	1	179.7	88
1031	5	1.0	1	1	182.7	88
1036	10	1.0	1	1	185.3	88
1041	15	1.0	1	1	187.3	88
1046	20	1.0	1	1	189.4	88
	24.37	1.0	1	1	187.4	88
		✓			✓	✓
		1.0 in H_2O			770	88

ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	Lyondell	**Meter No.:**	1105002	**Ambient Temperature:**	89
Date:	7/21/11	**Y Factor:**	1.0	**Barometric Pressure:**	29.98
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	
Source:	DC	**USEPA Method:**	308	**Pre-Test Leak Check:**	0.002
Run No.:	1B 308-1B	**Compound Analysis:**		**Post-Test Leak Check:**	0.001
Operators:	ZM	**Spike in Trap (Y/N):**	Yes		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (~~in. H_2O~~) mmHg	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1026	0	10.0	1	1	0.000	88
1031	5	10.0	6	1	4.7	88
1036	10	11.0	1	1	9.47	88
1041	15	8.0	1	1	12.06	88
1046	20	8.0	7	1	14.18	88
	24.37	8.0	7	1	15.434	
					15.434	88

0.30 in H_2O

ARI ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	Lyondell	**Meter No.:**	1105003	**Ambient Temperature:**	89
Date:	7/21/11	**Y Factor:**	1.0	**Barometric Pressure:**	30.40
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	
Source:	736	**USEPA Method:**	308	**Pre-Test Leak Check:**	0.000
Run No.:	4 308-29	**Compound Analysis:**		**Post-Test Leak Check:**	0.000
Operators:	ZM	**Spike in Trap (Y/N):**	NO		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1815	0	5	3	0.9	0.000	92
1820	5	1	1	0.4	5.15	92
1825	10	1	1	0.6	6.07	93
1830	15	1	1	0.7	7.18	93
1835	20	1	1	0.5	8.10	92
1840	25	1	1	0.4	8.89	92
1845	30	1	1	0.4	9.97	92
1850	35	1	1	0.2	10.85	92
1855	40	1	1	0.2	11.86	91
1900	45	1	1	0.1	12.55	91
1905	50	1	1	0.1	13.11	91
1910	55	1	1	0.1	13.59	91
1919	55.28	1	1	0.1	13.593	91
		✓			✓	✓
		1.31 "Hg			13.593	91.77

ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	Lyondell	**Meter No.:**	100196	**Ambient Temperature:**	89
Date:	7/21/11	**Y Factor:**	0.975	**Barometric Pressure:**	30.00
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	
Source:	736	**USEPA Method:**	308	**Pre-Test Leak Check:**	0.000
Run No.:	4 308-2B	**Compound Analysis:**		**Post-Test Leak Check:**	0.000
Operators:	ZM	**Spike in Trap (Y/N):**	Yes		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
~~1806~~ 1815	0	7	3	0.6	0.000	90
1820	5	15	1	1	5.11	90
1825	10	15	1	0.7	7.43	90
1830	15	20	1	0.5	9.82	89
1835	20	16	1	0.5	12.02	89
1840	25	16	1	0.6	14.05	88
1845	30	20	1	0.3	14.43	88
1850	35	14	1	0.3	14.69	87
1855	40	5	1	0.3	15.01	87
1900	45	9	1	0.2	15.67	86
1905	50	29	1	0.2	18.04	86
1910	55	9	1	0.1	18.92	86
1915	60	19	1	0.1	19.46	86
1916	64.43	18	1	0.1	19.991	85
		18.64 ✓			19.991 ✓	87.6 ✓

0.23 in H_2O

ARI ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	LYONDell	**Meter No.:**	1105002	**Ambient Temperature:**	98
Date:	7/27/11	**Y Factor:**	1.0	**Barometric Pressure:**	30.06
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	
Source:	736	**USEPA Method:**	308	**Pre-Test Leak Check:**	0.001
Run No.:	6 (3) 308-3A	**Compound Analysis:**		**Post-Test Leak Check:**	0.001
Operators:	ZM	**Spike In Trap (Y/N):**	NO		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. ~~H_2O~~ mmHg)	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1337	0	50	2	0.75	0.000	108
1342	5	50	2	0.50	3.70	105
1347	10	35	2	0.40	9.52	104
1352	15	40	2	0.35	12.52	104
1357	20	30	1	0.30	15.34	104
1402	25	30	1	0.30	18.11	102
1407	30	30	1	0.25	21.55	102
1412	35	30	1	0.30	24.77	102
1417	40	28	1	0.40	28.12	102
1422	45	30	1	0.40	30.95	102
1427	50	30	1	0.45	33.74	102
1432	55	30	1	0.40	35.88	102
1437	60	22	1	0.40	38.75	102
1442	65	22	1	0.35	40.93	102
1445	68.02	22	1	0.45	42.382	102
		✓			✓	✓
		1.26 in H_2O			42.382	1029

ENVIRONMENTAL INC.

FIELD DATA SHEET

Plant:	LyondellI	**Meter No.:**	1105503	**Ambient Temperature:**	98
Date:	7/27/11	**Y Factor:**	1.0	**Barometric Pressure:**	30.06
Location:	Houston TX	**Trap Contents:**		**Stack Diameter:**	
Source:	736 Coker	**USEPA Method:**	308	**Pre-Test Leak Check:**	0.000
Run No.:	6 (3) 308-3B	**Compound Analysis:**		**Post-Test Leak Check:**	0.000
Operators:	ZM	**Spike in Trap (Y/N):**	Yes		
Comments:					

Clock Time	Sampling Time (min)	Meter Pressure (in. H_2O)	Sample Vacuum (in. Hg)	Gas Sample Rate (liters/min)	Gas Sample Volume (Vm liters)	Gas Meter Temperature (°F)
1331	0	5	1	0.75	0.000	105
1342	5	5	1	0.50	3.51	104
1347	10	4	1	0.35	7.81	103
1352	15	5	1	0.40	10.57	103
1357	20	5	1	0.35	13.11	103
1402	25	5	1	0.30	15.90	103
1407	30	5	1	0.30	16.69	102
1412	35	5	1	0.30	18.51	102
1417	~~30~~ 40	5	1	0.30	20.07	102
1422	~~30~~ 45	4	1	0.25	21.07	102
1427	~~30~~ 50	4	1	0.25	21.86	102
1432	55	4	1	0.25	23.44	102
1437	60	5	1	0.25	24.89	102.
1442	65	5	1	0.25	26.20	102
1445	68.02	5	1	0.25	27.244	102
						102.6
		4.67				

0.18 in H_2O

APPENDIX C

Analytical Data

ANALYTICAL REPORT

Project Name:	Lyondell Basell (Houston Refining)
Project Number:	Houston Refining-ICR H09487
Sample Location:	Houston, TX
Sample Date:	7-29-11, 8-1-11, 8-2-11
Analysis Date:	8-4-11, 8-10-11 to 8-12-11
Analytical Method:	M-18, and ASTM 1945/1946 Fixed Gases

Prepared For:

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ARI Environmental, Inc. Texas NELAP ID: T104704428-10-2

PROJECT NARRATIVE

This report contains the results of analyses performed on samples received under the project name referenced on the cover page and identified with the ARI Project Number: Houston Refining-ICR H09487

All analytical results reported under this report number apply only to the samples as received and properly identified in the signed chain-of-custody. The original chain of custody documentation is included with this report.

The samples were received in good condition and were logged in on 8/3/11. The samples were analyzed at the ARI Environmental, Inc. laboratory located in Pasadena, TX between 8/4/11 and 8/12/11.

Unless otherwise noted in this project narrative, all test results reported in this analytical report meet all requirements of the NELAC standards and all requirements set forth in the applicable USEPA reference methods.

This report will be filed for a minimum of five years after which it may be destroyed without further notice, unless otherwise arranged by the sponsoring client. The samples received and described in this report will be filed for 60 days after which they may be properly disposed without further notice, unless otherwise arranged by the sponsoring client.

Sample Receipt Quality Assurance:

Unless otherwise noted, all sample receipt criteria listed on the ARI Sample Receipt Checklist were met.

Analytical Quality Assurance:

Unless otherwise noted, all sample analyses met the procedural requirements and QA/QC criteria contained in the test method(s), associated analytical standard operating procedure(s), and, where applicable, the project test plan.

Data Interpretation and Comments:

Unless otherwise noted, there were no deviations from the test methods and no non-standard conditions that may affect the quality of the test results.

Method 18 requires the determined concentrations be corrected for bias from matrix interferences and moisture.

The lower percent recovery was used in all determinations of bias for recovery. No results were corrected downward where the recovery study had greater than 100% recovery.

The correction for moisture was done with the highest percent moisture determined on all analysis days assuming saturated conditions in the bag.

Therefore the M-18 results are the most conservative estimates of the bias corrections was used for all sample runs.

Signature: Jim Presley, Senior Chemist — Date: 8-12-11

Signature: Ron White, Laboratory Manager — Date: 8-12-2011

SAMPLE ID AND METHOD SUMMARY

Sample Description	Label No.	Lab ID No.	Test Method
Bag 1 Run 7	H41156	H0811017	M-18 C1 to C6 Hydrocarbons
Bag 1 Run 7	H41156	H0811017	ASTM 1945/1946 Mol Wt
Bag 2 Run 8	H41154	H0811018	M-18 C1 to C6 Hydrocarbons
Bag 2 Run 8	H41154	H0811018	ASTM 1945/1946 Mol Wt
Bag 3 Run 9	H41155	H0811019	M-18 C1 to C6 Hydrocarbons
Bag 3 Run 9	H41155	H0811019	ASTM 1945/1946 Mol Wt

Notes:
- The analytical results of the samples listed above are presented on the following pages.

Notes:
- All calculations are performed before rounding to avoid round-off errors in final results.
- Results noted as "ND" were not detected below the stated limit.
- This report shall not be reproduced, except in full, without the expressed written approval of ARI Environmental, Inc.

DATA FLAGGING CRITERIA

X Quality control deficiency observed and flagged as noted.

B A target analyte or common lab contaminant was identified in the blank which may indicate field or lab contamination.

D The sample(s) required dilution due to analyte detection over the highest calibration point. Test results are from a diluted sample.

E The results are reported as estimated since the data exceeds the upper calibration limit.

J Analyte was identified, but below the limit of quantitation (LOQ).

U Analyte was not detected (below the limit of detection)..

T Sample(s) analyzed outside of maximum recommended holding time.

Client: Houston Refining
Location: Pasadena, TX
Source: 736 Coker
Sample Dates: 7/29/11, 8/1/11, 8/2/11

M-18 Bias Corrected Analysis Summary

Lab No	Sample No	Description	Methane ppmv	Ethane ppmv	Ethylene ppmv	Propane ppmv	Propylene ppmv	Isobutane ppmv	n-Butane ppmv	t-2-Butene ppmv	1-Butene ppmv	Isobutylene ppmv	c-2-Butene ppmv	Isopentane ppmv	n-Pentane ppmv	1,3-Butadiene ppmv	n-Hexane ppmv
H0811017	H41156	Bag 1 Run 7	27,322	2,168	269	281	64.6	23.7	32.8	16.6	11.6	14.1	18.4	36.1	39.3	7.6	81.6
H0811018	H41154	Bag 2 Run 8	9,050	862	96.7	79.8	17.1	5.3	8.9	4.2	2.0	2.5	3.1	5.7	5.4	1.1	12.5
H0811019	H41155	Bag 3 Run 9	123,154	9,853	1,389	912	344	63.1	95.1	46.3	55.3	13.0	37.4	25.7	24.3	133	44.8

Lab No	Sample No	Description	Total C1 to C6 Hydrocarbons ppmv
H0811017	H41156	Bag 1 Run 7	30,386
H0811018	H41154	Bag 2 Run 8	10,156
H0811019	H41155	Bag 3 Run 9	136,190

Client	Lyondell (Houston Refining)
Location	Pasadena, TX
Source	736 Coker
Sample Dates	7/29/11, 8/1/11, 8/2/11

ACCREDITED IN ACCORDANCE WITH

ARI ENVIRONMENTAL INC.

ASTM 1945/1946 Composition Summary & Molecular Wt.

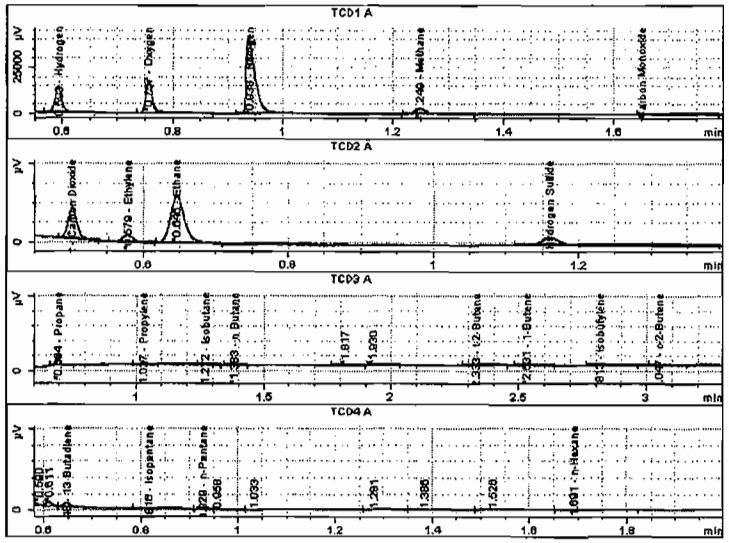
Lab No	H0811017	H0811018	H0811019
Sample No	H41156	H41154	H41155
Description	Bag 1 Run 7	Bag 2 Run 8	Bag 3 Run 9
Component	Mol %	Mol %	Mol %
Hydrogen	1.7	0.22	6.4
Oxygen	19.7	20.2	16.8
Nitrogen	73.7	75.7	63.1
Methane	2.5	0.63	9.8
Carbon Monoxide	<0.050	<0.050	<0.050
Carbon Dioxide	0.16	0.11	0.49
Ethylene	0.031	<0.010	0.14
Ethane	0.25	0.071	1.0
Acetylene	<0.010	<0.010	<0.010
Hydrogen Sulfide	0.066	<0.010	0.11
Propane	0.037	0.011	0.10
Propylene	0.012	<0.010	0.040
Isobutane	<0.010	<0.010	<0.010
n-Butane	0.012	0.013	0.019
c-2-Butene	0.010	<0.010	<0.010
1-Butene	0.015	0.012	0.016
Isobutylene	0.012	<0.010	<0.010
t-2-Butene	<0.010	<0.010	<0.010
1,3-Butadiene	<0.010	<0.010	<0.010
Isopentane	0.019	<0.010	0.012
n-Pentane	<0.010	0.028	<0.010
n-Hexane	<0.010	<0.010	<0.010
Mol wt	27.61	27.89	25.43

Micro GC Summary Runs from 8/4/11

	Mol Wt	2.02	32.00	28.01	16.04	28.01	44.01	28.05	30.07	26.04	34.08	44.10	42.08	58.12	58.12	56.11	56.11	56.11	56.11	54.09	72.15	72.15	86.17
Method	Time	Hydrogen	Oxygen	Nitrogen	Methane	Carbon Monoxide	Carbon Dioxide	Ethylene	Ethane	Acetylene	Hydrogen Sulfide	Propane	Propylene	Isobutane	n-Butane	c-2-Butene	1-Butene	Isobutylene	t-2-Butene	1,3-Butadiene	Isopentane	n-Pentane	n-Hexane
	10:20 AM	0.00	0.55	84.21	0.96	0.00	0.06	0.97	0.97	0.00	0.00	0.97	0.97	0.96	0.96	0.97	0.95	0.95	0.96	0.97	0.96	0.96	0.95
1.0 end	10:26 AM	0.00	0.56	84.42	0.95	0.00	0.06	0.97	0.96	0.00	0.00	0.97	0.97	0.96	0.96	0.97	0.96	0.95	0.96	0.97	0.96	0.96	0.95
	10:31 AM	0.00	0.54	84.22	0.97	0.00	0.06	0.97	0.96	0.00	0.00	0.97	0.97	0.96	0.96	0.98	0.95	0.96	0.96	0.97	0.97	0.97	0.96
	12:14 PM	0.00	0.00	98.69	0.10	0.00	0.05	0.098	0.095	0.00	0.00	0.10	0.10	0.12	0.094	0.11	0.11	0.10	0.11	0.10	0.10	0.10	0.11
0.10 STD	12:19 PM	0.00	0.00	98.76	0.11	0.00	0.05	0.099	0.095	0.00	0.00	0.10	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.11
	12:24 PM	0.00	0.00	98.80	0.10	0.00	0.05	0.098	0.096	0.00	0.00	0.10	0.10	0.11	0.11	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.11
											Samples on Micro GC													
Bag 1 Run 7	4:27 PM	1.74	19.72	73.86	2.55	0.00	0.16	0.030	0.25	0.00	0.059	0.037	0.014	0.000	0.013	0.014	0.020	0.015	0.011	0.00	0.017	0.000	0.000
Bag 1 Run 7	4:33 PM	1.73	19.63	73.55	2.52	0.00	0.16	0.030	0.24	0.00	0.068	0.039	0.012	0.000	0.012	0.006	0.013	0.010	0.000	0.00	0.020	0.000	0.000
Bag 1 Run 7	4:38 PM	1.73	19.63	73.57	2.51	0.00	0.17	0.032	0.25	0.00	0.072	0.037	0.010	0.000	0.011	0.011	0.011	0.010	0.000	0.00	0.019	0.000	0.000
	Ave =	**1.73**	**19.66**	**73.66**	**2.53**	**0.00**	**0.16**	**0.03**	**0.25**	**0.00**	**0.07**	**0.04**	**0.01**	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**
Bag 2 Run 8	4:44 PM	0.22	20.18	75.65	0.63	0.00	0.11	0.000	0.070	0.00	0.00	0.012	0.009	0.00	0.014	0.000	0.020	0.000	0.010	0.00	0.027	0.038	0.000
Bag 2 Run 8	4:49 PM	0.22	20.18	75.67	0.63	0.00	0.11	0.000	0.071	0.00	0.00	0.011	0.010	0.00	0.014	0.000	0.015	0.000	0.000	0.00	0.000	0.000	0.000
Bag 2 Run 8	4:54 PM	0.22	20.19	75.77	0.64	0.00	0.11	0.000	0.070	0.00	0.00	0.012	0.008	0.00	0.011	0.000	0.000	0.000	0.014	0.00	0.000	0.045	0.000
	Ave =	**0.22**	**20.18**	**75.70**	**0.63**	**0.00**	**0.11**	**0.00**	**0.07**	**0.00**	**0.00**	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**0.01**	**0.03**	**0.00**
Bag 3 Run 9	5:00 PM	6.39	16.74	63.02	9.78	0.00	0.49	0.14	1.00	0.00	0.11	0.099	0.041	0.011	0.021	0.00	0.016	0.000	0.014	0.00	0.011	0.009	0.000
Bag 3 Run 9	5:05 PM	6.40	16.76	63.04	9.87	0.00	0.49	0.14	1.01	0.00	0.11	0.10	0.039	0.000	0.016	0.00	0.018	0.000	0.000	0.00	0.013	0.010	0.000
Bag 3 Run 9	5:10 PM	6.40	16.78	63.12	9.81	0.00	0.49	0.14	1.01	0.00	0.11	0.10	0.041	0.013	0.021	0.00	0.016	0.000	0.000	0.00	0.011	0.009	0.000
	Ave =	**6.40**	**16.76**	**63.06**	**9.82**	**0.00**	**0.49**	**0.14**	**1.01**	**0.00**	**0.11**	**0.10**	**0.04**	**0.01**	**0.02**	**0.00**	**0.02**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	**0.00**
	27.61	0.03	6.29	20.63	0.41	0.00	0.07	0.01	0.07	0.00	0.02	0.02	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00
	27.89	0.00	6.46	21.20	0.10	0.00	0.05	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.02	0.00
	25.43	0.13	5.36	17.66	1.58	0.00	0.22	0.04	0.30	0.00	0.04	0.04	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 7 (7-29-11) H41156 H0811017 Rep 1
Sample note:	
Submission time:	Thursday, August 04, 2011 4:27:06 PM
Operator:	
Injection date:	Thursday, August 04, 2011 4:27:59 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.593	MM m	11048.24973	0.00016	1.73714	Hydrogen
1	0.757	MM m	14281.08946	0.00138	19.71917	Oxygen
1	0.938	MM m	45132.20361	0.00164	73.85717	Nitrogen
1	1.249	MM m	3736.29806	0.00068	2.54883	Methane
1	1.650	MM m	2.05467	0.00000	0.00000	Carbon Monoxide
2	0.502	MM m	673.13603	0.00024	0.16441	Carbon Dioxide
2	0.579	MM m	177.63533	0.00017	0.02995	Ethylene
2	0.646	MM m	1581.09560	0.00016	0.24642	Ethane
2	1.161	MM m	351.08260	0.00017	0.05922	Hydrogen Sulfide
3	0.694	MM m	124.53084	0.00030	0.03702	Propane
3	1.027	MM m	43.66832	0.00031	0.01358	Propylene
3	1.272	MM m	32.16788	0.00026	0.00827	Isobutane
3	1.383	MM m	50.74608	0.00025	0.01261	n Butane
3	2.333	MM m	44.06861	0.00026	0.01143	t-2-Butene
3	2.531	MM m	76.25984	0.00026	0.01973	1-Butene
3	2.813	MM m	56.90455	0.00026	0.01472	Isobutylene
3	3.047	MM m	52.45505	0.00026	0.01358	c-2-Butene
4	0.648	FM m	366.05447	0.00002	0.00778	13 Butadiene
4	0.816	VV	879.85702	0.00002	0.01667	Isopentane
4	0.929	VV	230.21126	0.00002	0.00431	n-Pentane
4	1.691	VP	57.70204	0.00002	0.00104	n-Hexane

Total amount = 98.52305

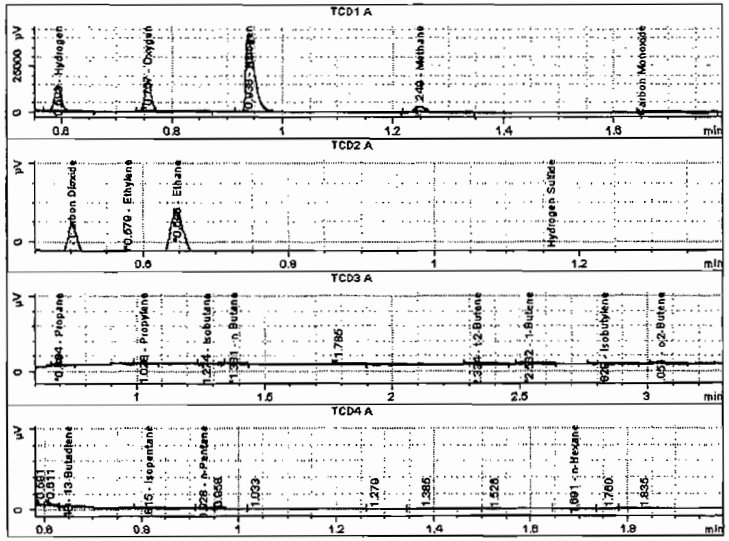
Report summary:
WARNING: Negative amount(s) converted to zero.

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 7 (7-29-11) H41156 H0811017 Rep 2
Sample note:	
Submission time:	Thursday, August 04, 2011 4:27:07 PM
Operator:	
Injection date:	Thursday, August 04, 2011 4:33:14 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.593	MM m	11026.08839	0.00016	1.73373	Hydrogen
1	0.757	MM m	14214.98281	0.00138	19.62647	Oxygen
1	0.938	MM m	44945.45270	0.00164	73.54747	Nitrogen
1	1.249	MM m	3697.69094	0.00068	2.52249	Methane
1	1.650	MM m	9.89879	0.00000	0.00000	Carbon Monoxide
2	0.502	MM m	673.04562	0.00024	0.16440	Carbon Dioxide
2	0.579	MM m	177.90641	0.00017	0.03000	Ethylene
2	0.646	MM m	1569.13778	0.00016	0.24456	Ethane
2	1.161	MM m	404.94188	0.00017	0.06831	Hydrogen Sulfide
3	0.694	MM m	129.68416	0.00030	0.03855	Propane
3	1.028	MM m	38.89160	0.00031	0.01209	Propylene
3	1.274	MM m	23.96893	0.00026	0.00616	Isobutane
3	1.381	MM m	49.06965	0.00025	0.01219	n Butane
3	2.334	MM m	28.34187	0.00026	0.00735	t-2-Butene
3	2.532	MM m	49.37783	0.00026	0.01277	1-Butene
3	2.829	MM m	37.28090	0.00026	0.00964	Isobutylene
3	3.051	MM m	24.72762	0.00026	0.00640	c-2-Butene
4	0.648	FM m	215.81747	0.00002	0.00459	13 Butadiene
4	0.815	VV	1047.54175	0.00002	0.01985	Isopentane
4	0.928	VV	263.59621	0.00002	0.00494	n-Pentane
4	1.691	VV	120.13559	0.00002	0.00216	n-Hexane

Total amount = 98.07412

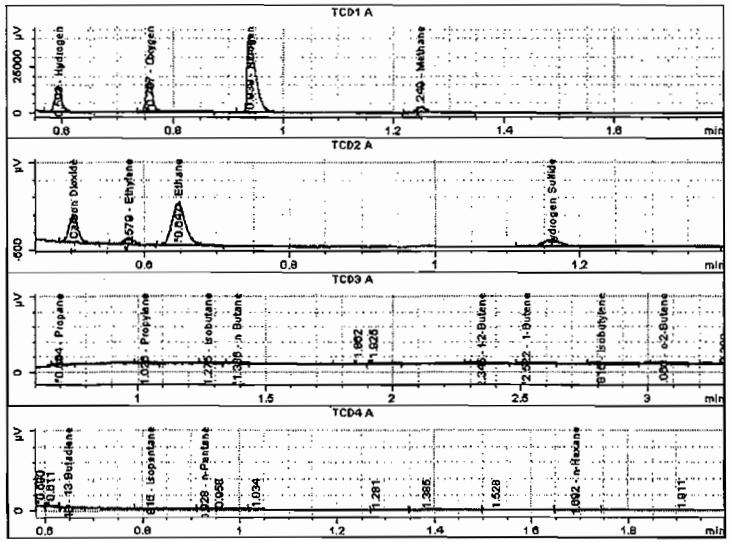
Report summary:
WARNING: Negative amount(s) converted to zero.

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 7 (7-29-11) H41156 H0811017 Rep 3
Sample note:	
Submission time:	Thursday, August 04, 2011 4:27:08 PM
Operator:	
Injection date:	Thursday, August 04, 2011 4:38:24 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.593	MM m	11025.58678	0.00016	1.73365	Hydrogen
1	0.757	MM m	14220.97006	0.00138	19.63487	Oxygen
1	0.939	MM m	44956.80387	0.00164	73.56630	Nitrogen
1	1.249	MM m	3678.28764	0.00068	2.50925	Methane
2	0.503	MM m	678.58150	0.00024	0.16531	Carbon Dioxide
2	0.579	MM m	188.29288	0.00017	0.03175	Ethylene
2	0.647	MM m	1584.08420	0.00016	0.24689	Ethane
2	1.161	MM m	424.25924	0.00017	0.07157	Hydrogen Sulfide
3	0.694	MM m	123.78903	0.00030	0.03680	Propane
3	1.026	MM m	31.14933	0.00031	0.00969	Propylene
3	1.275	MM m	34.49145	0.00026	0.00886	Isobutane
3	1.386	MM m	45.64374	0.00025	0.01134	n Butane
3	2.345	MM m	19.92913	0.00026	0.00517	t-2-Butene
3	2.522	MM m	43.67355	0.00026	0.01130	1-Butene
3	2.815	MM m	39.63660	0.00026	0.01025	Isobutylene
3	3.060	MM m	40.93107	0.00026	0.01059	c-2-Butene
4	0.648	FM m	148.11896	0.00002	0.00315	13 Butadiene
4	0.816	VV	1009.31655	0.00002	0.01913	Isopentane
4	0.928	VV	255.28058	0.00002	0.00478	n-Pentane
4	1.692	VV	100.94553	0.00002	0.00181	n-Hexane

Total amount = 98.09245

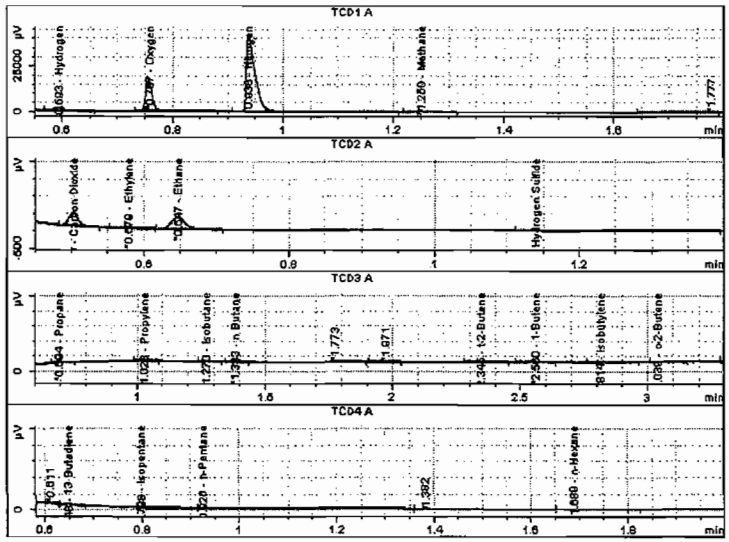
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 8 (7-29-11) H41154 H0811018 Rep 1
Sample note:	
Submission time:	Thursday, August 04, 2011 4:43:17 PM
Operator:	
Injection date:	Thursday, August 04, 2011 4:44:25 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.593	MM m	1202.19333	0.00018	0.22233	Hydrogen
1	0.757	MM m	14612.92468	0.00138	20.18451	Oxygen
1	0.938	MM m	46213.90314	0.00164	75.65103	Nitrogen
1	1.250	MM m	927.66414	0.00068	0.63283	Methane
2	0.503	MM m	328.78287	0.00033	0.10754	Carbon Dioxide
2	0.579	MM m	51.40631	0.00017	0.00867	Ethylene
2	0.647	MM m	452.25772	0.00016	0.07049	Ethane
2	1.140	MM m	10.22624	0.00017	0.00173	Hydrogen Sulfide
3	0.694	MM m	39.61501	0.00030	0.01178	Propane
3	1.028	MM m	29.41359	0.00031	0.00915	Propylene
3	1.270	MM m	23.42292	0.00026	0.00602	Isobutane
3	1.383	MM m	54.40140	0.00025	0.01351	n Butane
3	2.345	MM m	39.10045	0.00026	0.01014	t-2-Butene
3	2.560	MM m	75.81018	0.00026	0.01961	1-Butene
3	2.814	MM m	15.97742	0.00026	0.00413	Isobutylene
3	3.039	MM m	19.16396	0.00026	0.00496	c-2-Butene
4	0.648	FM m	22.48386	0.00002	0.00048	13 Butadiene
4	0.798	VV	1402.45944	0.00002	0.02658	Isopentane
4	0.926	VV	2023.77806	0.00002	0.03791	n-Pentane
4	1.689	VB	62.69170	0.00002	0.00113	n-Hexane

Total amount = 97.02451

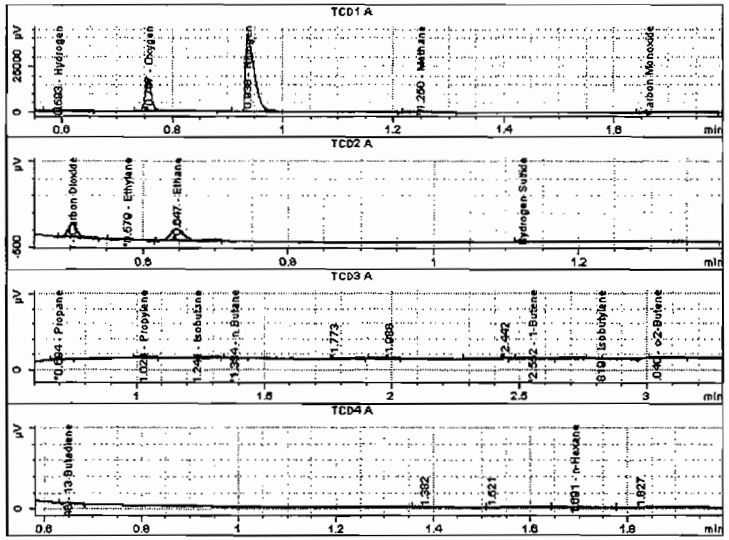
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 8 (7-29-11) H41154 H0811018 Rep 2
Sample note:	
Submission time:	Thursday, August 04, 2011 4:43:18 PM
Operator:	
Injection date:	Thursday, August 04, 2011 4:49:38 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.593	MM m	1198.51024	0.00019	0.22177	Hydrogen
1	0.757	MM m	14606.32562	0.00138	20.17525	Oxygen
1	0.938	MM m	46223.19067	0.00164	75.66643	Nitrogen
1	1.250	MM m	923.56750	0.00068	0.63004	Methane
1	1.664	MM m	7.37322	0.00000	0.00000	Carbon Monoxide
2	0.503	MM m	330.14088	0.00033	0.10776	Carbon Dioxide
2	0.579	MM m	44.76735	0.00017	0.00755	Ethylene
2	0.647	MM m	456.80933	0.00016	0.07120	Ethane
2	1.123	MM m	17.45736	0.00017	0.00294	Hydrogen Sulfide
3	0.694	MM m	36.43868	0.00030	0.01083	Propane
3	1.026	MM m	31.21708	0.00031	0.00971	Propylene
3	1.241	MM m	18.38599	0.00026	0.00472	Isobutane
3	1.384	MM m	56.27607	0.00025	0.01398	n Butane
3	2.552	MM m	57.94130	0.00026	0.01499	1-Butene
3	2.819	MM m	25.83092	0.00026	0.00668	Isobutylene
3	3.040	MM m	27.29293	0.00026	0.00706	c-2-Butene
4	0.648	FM m	10.68365	0.00002	0.00023	13 Butadiene
4	1.691	BV	30.46356	0.00002	0.00055	n-Hexane

Total amount = 96.95170

Report summary:
WARNING: Negative amount(s) converted to zero.

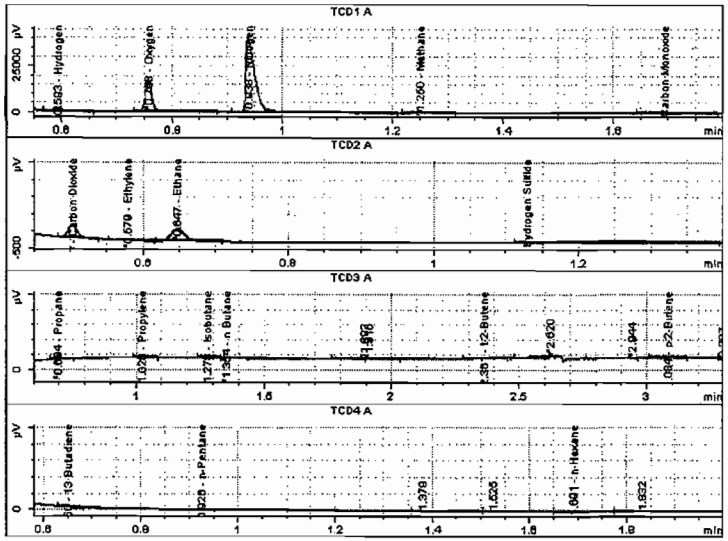
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 8 (7-29-11) H41154 H0811018 Rep 3
Sample note:	
Submission time:	Thursday, August 04, 2011 4:43:19 PM
Operator:	
Injection date:	Thursday, August 04, 2011 4:54:52 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.593	MM m	1201.19843	0.00018	0.22218	Hydrogen
1	0.758	MM m	14619.87841	0.00138	20.19426	Oxygen
1	0.938	MM m	46284.25754	0.00164	75.76770	Nitrogen
1	1.250	MM m	931.88890	0.00068	0.63572	Methane
1	1.693	MM m	4.30408	0.00000	0.00000	Carbon Monoxide
2	0.503	MM m	325.64769	0.00033	0.10702	Carbon Dioxide
2	0.579	MM m	49.76540	0.00017	0.00839	Ethylene
2	0.647	MM m	450.46721	0.00016	0.07021	Ethane
2	1.128	MM m	23.04735	0.00017	0.00389	Hydrogen Sulfide
3	0.694	MM m	39.64042	0.00030	0.01178	Propane
3	1.026	MM m	24.63234	0.00031	0.00766	Propylene
3	1.278	MM m	14.88804	0.00026	0.00383	Isobutane
3	1.354	MM m	44.01308	0.00025	0.01093	n Butane
3	2.361	MM m	55.81029	0.00026	0.01447	t-2-Butene
3	3.084	MM m	32.34313	0.00026	0.00837	c-2-Butene
4	0.650	FM m	2.90653	0.00002	0.00006	13 Butadiene
4	0.926	VV	2397.55468	0.00002	0.04491	n-Pentane
4	1.691	BV	155.22964	0.00002	0.00279	n-Hexane

Total amount = 97.11417

Report summary:
WARNING: Negative amount(s) converted to zero.

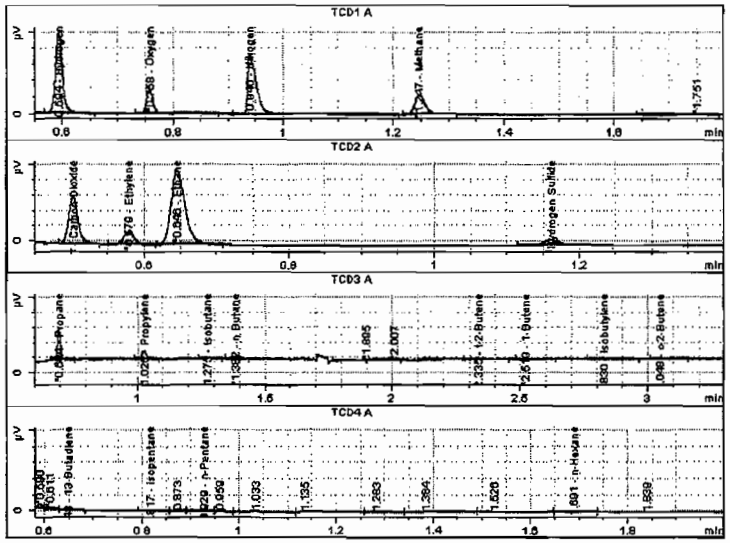
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 9 (7-29-11) H41155 H0811019 Rep 1
Sample note:	
Submission time:	Thursday, August 04, 2011 4:58:17 PM
Operator:	
Injection date:	Thursday, August 04, 2011 5:00:07 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.594	MM m	41315.62754	0.00015	6.39374	Hydrogen
1	0.758	MM m	12156.62003	0.00138	16.74002	Oxygen
1	0.940	MM m	38596.29078	0.00163	63.01822	Nitrogen
1	1.247	MM m	14337.60496	0.00068	9.78082	Methane
2	0.503	MM m	2643.07500	0.00019	0.48977	Carbon Dioxide
2	0.579	MM m	819.67213	0.00017	0.13822	Ethylene
2	0.646	MM m	6441.92963	0.00016	1.00401	Ethane
2	1.161	MM m	653.72595	0.00017	0.11027	Hydrogen Sulfide
3	0.694	MM m	333.29803	0.00030	0.09908	Propane
3	1.026	MM m	130.59873	0.00031	0.04061	Propylene
3	1.275	MM m	42.62085	0.00026	0.01095	Isobutane
3	1.382	MM m	82.84486	0.00025	0.02058	n Butane
3	2.335	MM m	55.24084	0.00026	0.01433	t-2-Butene
3	2.519	MM m	63.05507	0.00026	0.01631	1-Butene
3	2.830	MM m	26.76497	0.00026	0.00692	Isobutylene
3	3.048	MM m	34.12094	0.00026	0.00883	c-2-Butene
4	0.648	FM m	95.04248	0.00002	0.00202	13 Butadiene
4	0.817	VV	598.77878	0.00002	0.01135	Isopentane
4	0.929	VV	465.08725	0.00002	0.00871	n-Pentane
4	1.691	VP	109.45128	0.00002	0.00197	n-Hexane

Total amount = 97.91672

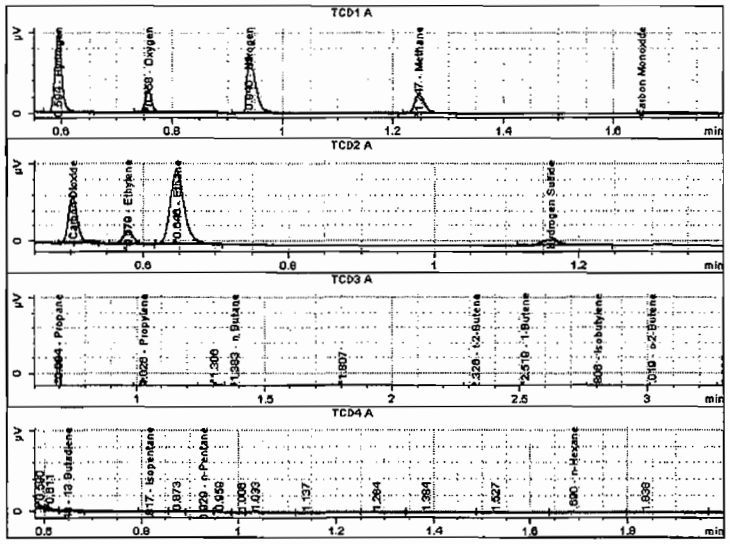
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 9 (7-29-11) H41155 H0811019 Rep 2
Sample note:	
Submission time:	Thursday, August 04, 2011 4:58:18 PM
Operator:	
Injection date:	Thursday, August 04, 2011 5:05:21 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.594	MM m	41378.71828	0.00015	6.40345	Hydrogen
1	0.758	MM m	12172.87639	0.00138	16.76281	Oxygen
1	0.940	MM m	38609.49641	0.00163	63.04012	Nitrogen
1	1.247	MM m	14462.12699	0.00068	9.86577	Methane
1	1.650	MM m	4.86319	0.00000	0.00000	Carbon Monoxide
2	0.503	MM m	2651.31383	0.00019	0.49113	Carbon Dioxide
2	0.579	MM m	822.72737	0.00017	0.13873	Ethylene
2	0.646	MM m	6462.30424	0.00016	1.00718	Ethane
2	1.161	MM m	641.06567	0.00017	0.10814	Hydrogen Sulfide
3	0.694	MM m	344.75314	0.00030	0.10248	Propane
3	1.026	MM m	126.76806	0.00031	0.03942	Propylene
3	1.383	MM m	65.24822	0.00025	0.01621	n Butane
3	2.326	MM m	19.51164	0.00026	0.00506	t-2-Butene
3	2.519	MM m	68.02049	0.00026	0.01760	1-Butene
3	2.806	MM m	17.70530	0.00026	0.00458	Isobutylene
3	3.019	MM m	11.08408	0.00026	0.00287	c-2-Butene
4	0.648	FM m	97.15950	0.00002	0.00207	13 Butadiene
4	0.817	VV	670.66609	0.00002	0.01271	Isopentane
4	0.929	VV	543.06438	0.00002	0.01017	n-Pentane
4	1.690	VV	219.78666	0.00002	0.00395	n-Hexane

Total amount = 98.03443

Report summary:
WARNING: Negative amount(s) converted to zero.

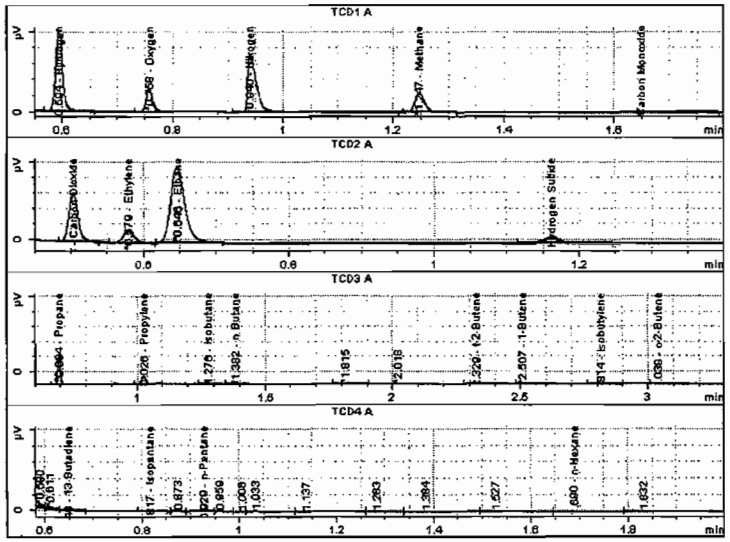
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Houston Refining Coker Run 9 (7-29-11) H41155 H0811019 Rep 3
Sample note:	
Submission time:	Thursday, August 04, 2011 4:58:19 PM
Operator:	
Injection date:	Thursday, August 04, 2011 5:10:34 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.594	MM m	41342.00186	0.00015	6.39780	Hydrogen
1	0.758	MM m	12186.16697	0.00138	16.78145	Oxygen
1	0.940	MM m	38655.14753	0.00163	63.11582	Nitrogen
1	1.247	MM m	14376.78892	0.00068	9.80755	Methane
1	1.650	MM m	3.24819	0.00000	0.00000	Carbon Monoxide
2	0.503	MM m	2651.13218	0.00019	0.49110	Carbon Dioxide
2	0.579	MM m	822.11734	0.00017	0.13863	Ethylene
2	0.646	MM m	6473.28161	0.00016	1.00889	Ethane
2	1.161	MM m	638.76982	0.00017	0.10775	Hydrogen Sulfide
3	0.694	MM m	337.57871	0.00030	0.10035	Propane
3	1.026	MM m	131.62036	0.00031	0.04093	Propylene
3	1.276	MM m	51.50583	0.00026	0.01323	Isobutane
3	1.382	MM m	84.23301	0.00025	0.02092	n Butane
3	2.329	MM m	33.64277	0.00026	0.00872	t-2-Butene
3	2.507	MM m	60.16993	0.00026	0.01556	1-Butene
3	2.814	MM m	23.55985	0.00026	0.00610	Isobutylene
3	3.039	MM m	45.44904	0.00026	0.01176	c-2-Butene
4	0.648	FM m	90.87686	0.00002	0.00193	13 Butadiene
4	0.817	VV	574.33739	0.00002	0.01088	Isopentane
4	0.929	VV	454.19646	0.00002	0.00851	n-Pentane
4	1.690	VV	186.34602	0.00002	0.00335	n-Hexane

Total amount = 98.09125

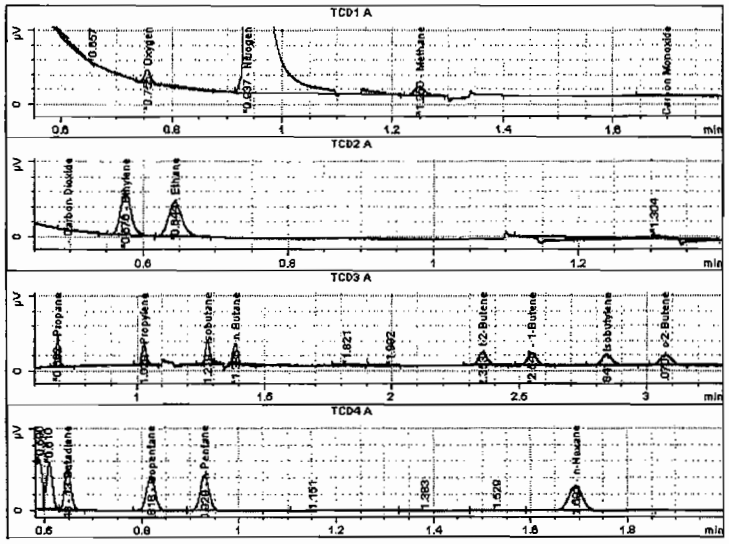
Report summary:
WARNING: Negative amount(s) converted to zero.

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1000 ppm Hydrocarbons Std (Air Liquide, CC67464) Rep 1
Sample note:	
Submission time:	Monday, August 08, 2011 12:08:08 PM
Operator:	
Injection date:	Monday, August 08, 2011 12:14:17 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.755	MM m	163.66830	0.00000	0.00000	Oxygen
1	0.937	MM m	60106.47014	0.00164	98.69003	Nitrogen
1	1.250	MM m	152.09388	0.00068	0.10376	Methane
1	1.698	MM m	9.73436	0.00000	0.00000	Carbon Monoxide
2	0.497	MM m	1.75112	0.03057	0.05353	Carbon Dioxide
2	0.576	MM m	578.93118	0.00017	0.09762	Ethylene
2	0.644	MM m	609.37502	0.00016	0.09497	Ethane
3	0.692	MM m	346.32710	0.00030	0.10295	Propane
3	1.029	MM m	336.98496	0.00031	0.10479	Propylene
3	1.279	MM m	475.06388	0.00026	0.12207	Isobutane
3	1.386	MM m	378.16989	0.00025	0.09394	n Butane
3	2.353	MM m	412.69027	0.00026	0.10702	t-2-Butene
3	2.547	MM m	410.76445	0.00026	0.10625	1-Butene
3	2.841	MM m	402.08220	0.00026	0.10402	Isobutylene
3	3.070	MM m	421.32298	0.00026	0.10904	c-2-Butene
4	0.648	FM m	4729.12605	0.00002	0.10052	13 Butadiene
4	0.818	VV	5465.13415	0.00002	0.10357	Isopentane
4	0.929	VB	5477.17701	0.00002	0.10259	n-Pentane
4	1.693	VB	6017.64137	0.00002	0.10808	n-Hexane

Total amount = 100.30476

Report summary:
WARNING: Negative amount(s) converted to zero.

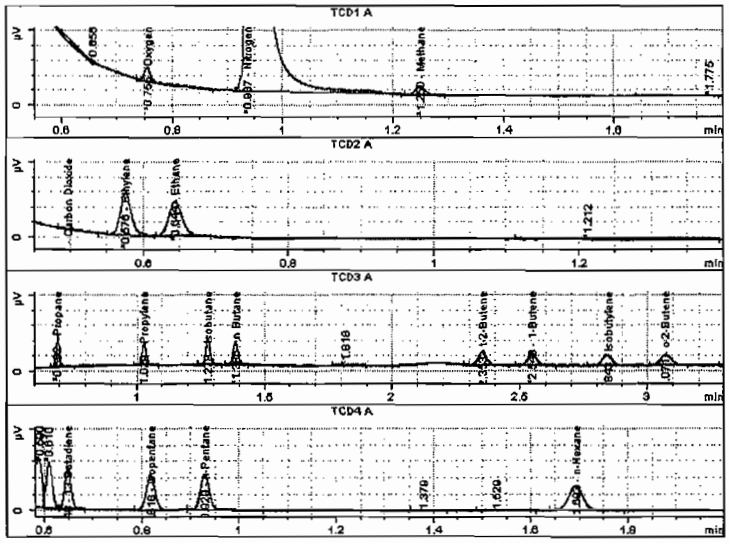
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1000 ppm Hydrocarbons Std (Air Liquide, CC67464) Rep 2
Sample note:	
Submission time:	Monday, August 08, 2011 12:08:09 PM
Operator:	
Injection date:	Monday, August 08, 2011 12:19:27 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.755	MM m	160.30093	0.00000	0.00000	Oxygen
1	0.937	MM m	60146.79345	0.00164	98.75691	Nitrogen
1	1.250	MM m	154.29934	0.00068	0.10526	Methane
2	0.497	MM m	2.15825	0.02483	0.05360	Carbon Dioxide
2	0.576	MM m	585.16145	0.00017	0.09867	Ethylene
2	0.644	MM m	609.63210	0.00016	0.09501	Ethane
3	0.692	MM m	348.31814	0.00030	0.10354	Propane
3	1.029	MM m	333.78183	0.00031	0.10379	Propylene
3	1.278	MM m	414.75353	0.00026	0.10657	Isobutane
3	1.386	MM m	442.47253	0.00025	0.10992	n Butane
3	2.353	MM m	385.17688	0.00026	0.09989	t-2-Butene
3	2.546	MM m	432.57935	0.00026	0.11190	1-Butene
3	2.843	MM m	400.26417	0.00026	0.10355	Isobutylene
3	3.071	MM m	407.65141	0.00026	0.10550	c-2-Butene
4	0.648	FM m	4725.90342	0.00002	0.10045	13 Butadiene
4	0.818	VV	5490.93980	0.00002	0.10406	Isopentane
4	0.929	VB	5499.42796	0.00002	0.10300	n-Pentane
4	1.693	BB	5930.18184	0.00002	0.10651	n-Hexane

Total amount = 100.36813

Report summary:
WARNING: Negative amount(s) converted to zero.

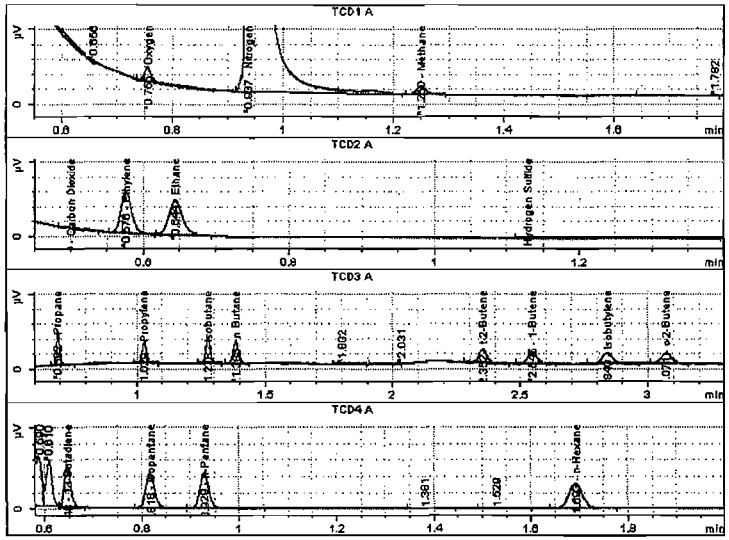
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1000 ppm Hydrocarbons Std (Air Liquide, CC67464) Rep 3
Sample note:	
Submission time:	Monday, August 08, 2011 12:08:15 PM
Operator:	
Injection date:	Monday, August 08, 2011 12:24:36 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.755	MM m	167.40973	0.00000	0.00000	Oxygen
1	0.937	MM m	60174.51743	0.00164	98.80288	Nitrogen
1	1.250	MM m	146.70840	0.00068	0.10008	Methane
2	0.500	MM m	2.17457	0.02465	0.05360	Carbon Dioxide
2	0.576	MM m	580.53430	0.00017	0.09789	Ethylene
2	0.644	MM m	615.76490	0.00016	0.09597	Ethane
2	1.130	MM m	36.97361	0.00017	0.00624	Hydrogen Sulfide
3	0.692	MM m	337.25895	0.00030	0.10026	Propane
3	1.029	MM m	330.47611	0.00031	0.10276	Propylene
3	1.278	MM m	403.92803	0.00026	0.10379	Isobutane
3	1.386	MM m	446.39406	0.00025	0.11089	n Butane
3	2.352	MM m	386.61228	0.00026	0.10026	t-2-Butene
3	2.545	MM m	414.77210	0.00026	0.10729	1-Butene
3	2.840	MM m	383.45441	0.00026	0.09920	Isobutylene
3	3.071	MM m	400.78417	0.00026	0.10372	c-2-Butene
4	0.648	FM m	4721.45750	0.00002	0.10035	13 Butadiene
4	0.818	VV	5499.45011	0.00002	0.10422	Isopentane
4	0.929	VB	5492.16126	0.00002	0.10287	n-Pentane
4	1.693	BB	5916.94410	0.00002	0.10627	n-Hexane

Total amount = 100.39856

Report summary:
WARNING: Negative amount(s) converted to zero.

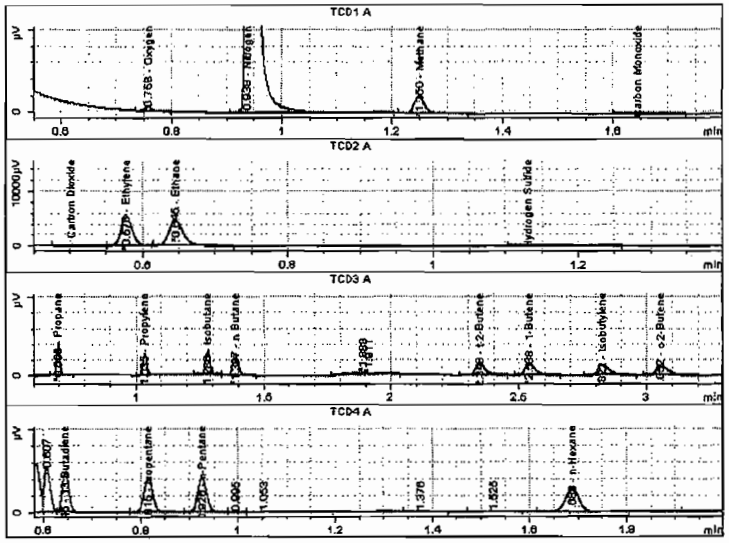
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std C (Air Liquide, 40403X) Rep 1
Sample note:	
Submission time:	Thursday, August 04, 2011 11:19:49 AM
Operator:	
Injection date:	Thursday, August 04, 2011 11:41:33 AM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.758	MM m	258.40990	0.00021	0.05509	Oxygen
1	0.938	MM m	50833.99375	0.00164	83.31285	Nitrogen
1	1.250	MM m	1423.31295	0.00068	0.97095	Methane
1	1.645	MM m	52.54981	0.00006	0.00313	Carbon Monoxide
2	0.502	MM m	91.46117	0.00075	0.06834	Carbon Dioxide
2	0.578	MM m	5943.76230	0.00017	1.00227	Ethylene
2	0.645	MM m	6263.09811	0.00016	0.97614	Ethane
2	1.130	MM m	100.86071	0.00017	0.01701	Hydrogen Sulfide
3	0.696	MM m	3342.32406	0.00030	0.99357	Propane
3	1.035	MM m	3210.04396	0.00031	0.99817	Propylene
3	1.280	MM m	3818.25922	0.00026	0.98111	Isobutane
3	1.387	MM m	3954.09815	0.00025	0.98225	n Butane
3	2.343	MM m	3936.10653	0.00026	1.02076	t-2-Butene
3	2.538	MM m	3795.23837	0.00026	0.98173	1-Butene
3	2.822	MM m	3778.66307	0.00026	0.97756	Isobutylene
3	3.052	MM m	3823.62623	0.00026	0.98956	c-2-Butene
4	0.645	VV	46582.18222	0.00002	0.99010	13 Butadiene
4	0.815	VV	52080.66389	0.00002	0.98701	Isopentane
4	0.926	VV	52779.29254	0.00002	0.98855	n-Pentane
4	1.688	PB	55347.18285	0.00002	0.99408	n-Hexane

Total amount = 98.29023

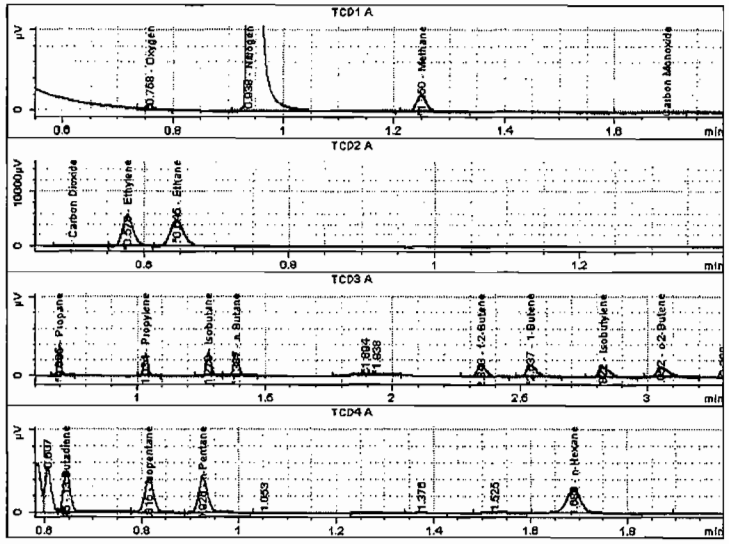
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std C (Air Liquide, 40403X) Rep 2
Sample note:	
Submission time:	Thursday, August 04, 2011 11:19:50 AM
Operator:	
Injection date:	Thursday, August 04, 2011 11:46:43 AM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.758	MM m	272.06884	0.00027	0.07424	Oxygen
1	0.938	MM m	51205.90354	0.00164	83.92961	Nitrogen
1	1.250	MM m	1421.98360	0.00068	0.97005	Methane
1	1.696	MM m	43.78720	0.00000	0.00000	Carbon Monoxide
2	0.502	MM m	85.91989	0.00078	0.06743	Carbon Dioxide
2	0.578	MM m	5853.41161	0.00017	0.98703	Ethylene
2	0.645	MM m	6278.29145	0.00016	0.97850	Ethane
3	0.695	MM m	3344.68837	0.00030	0.99427	Propane
3	1.034	MM m	3198.70438	0.00031	0.99465	Propylene
3	1.279	MM m	3824.34530	0.00026	0.98268	Isobutane
3	1.387	MM m	3960.42984	0.00025	0.98382	n Butane
3	2.343	MM m	3791.39324	0.00026	0.98323	t-2-Butene
3	2.537	MM m	3801.42427	0.00026	0.98333	1-Butene
3	2.822	MM m	3765.94392	0.00026	0.97427	Isobutylene
3	3.052	MM m	3837.55397	0.00026	0.99316	c-2-Butene
4	0.645	VV	46788.87876	0.00002	0.99450	13 Butadiene
4	0.815	VV	52186.20837	0.00002	0.98901	Isopentane
4	0.926	VB	52896.48983	0.00002	0.99074	n-Pentane
4	1.689	BB	55628.14396	0.00002	0.99913	n-Hexane

Total amount = 98.86965

Report summary:
WARNING: Negative amount(s) converted to zero.

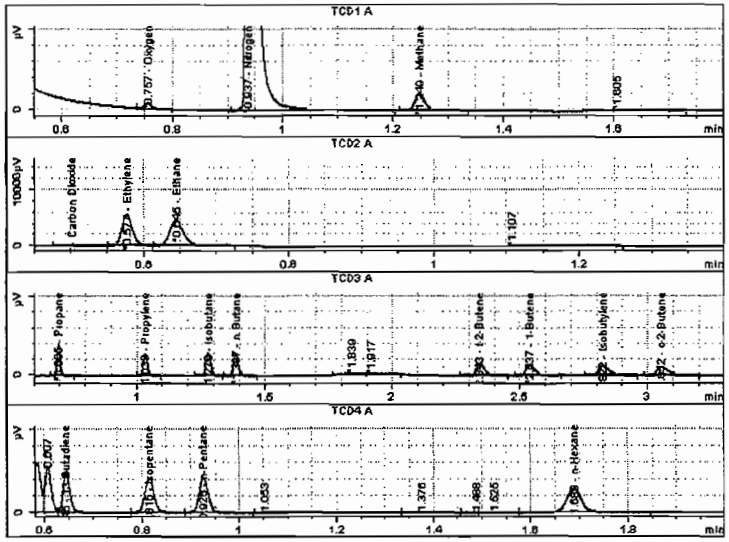
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std C (Air Liquide, 40403X) Rep 3
Sample note:	
Submission time:	Thursday, August 04, 2011 11:19:51 AM
Operator:	
Injection date:	Thursday, August 04, 2011 11:51:56 AM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.757	MM m	288.47390	0.00034	0.09724	Oxygen
1	0.937	MM m	50954.64229	0.00164	83.51293	Nitrogen
1	1.249	MM m	1438.57997	0.00068	0.98137	Methane
2	0.502	MM m	88.65361	0.00077	0.06788	Carbon Dioxide
2	0.577	MM m	5842.40550	0.00017	0.98518	Ethylene
2	0.645	MM m	6260.77500	0.00016	0.97577	Ethane
3	0.695	MM m	3348.41225	0.00030	0.99538	Propane
3	1.033	MM m	3202.57425	0.00031	0.99585	Propylene
3	1.279	MM m	3821.63462	0.00026	0.98198	Isobutane
3	1.387	MM m	3967.68780	0.00025	0.98562	n Butane
3	2.343	MM m	3818.90702	0.00026	0.99037	t-2-Butene
3	2.537	MM m	3818.19772	0.00026	0.98767	1-Butene
3	2.822	MM m	3787.52919	0.00026	0.97985	Isobutylene
3	3.052	MM m	3850.47057	0.00026	0.99650	c-2-Butene
4	0.645	VV	47045.43055	0.00002	0.99995	13 Butadiene
4	0.815	VV	52402.14036	0.00002	0.99310	Isopentane
4	0.926	VB	53198.75792	0.00002	0.99641	n-Pentane
4	1.689	VB	55799.70305	0.00002	1.00221	n-Hexane

Total amount = 98.52527

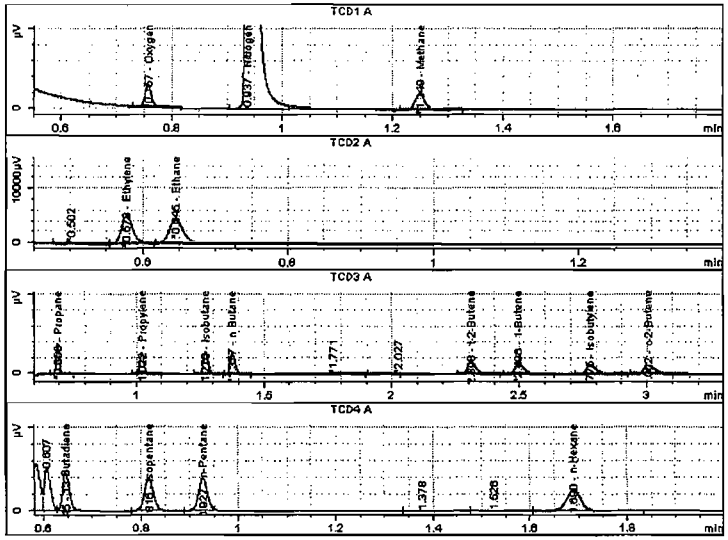
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std D (Air Liquide, 40403X) Rep 1
Sample note:	
Submission time:	Thursday, August 04, 2011 5:37:10 PM
Operator:	
Injection date:	Thursday, August 04, 2011 5:38:04 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Friday, August 05, 2011 8:11:27 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.757	MM m	1088.41945	0.00112	1.21901	Oxygen
1	0.937	MM m	50200.22959	0.00164	82.26183	Nitrogen
1	1.249	MM m	1314.58677	0.00068	0.89678	Methane
2	0.578	MM m	5473.39654	0.00017	0.92295	Ethylene
2	0.645	MM m	5908.35088	0.00016	0.92085	Ethane
3	0.693	MM m	3191.98056	0.00030	0.94888	Propane
3	1.022	MM m	3043.64890	0.00031	0.94643	Propylene
3	1.270	MM m	3670.67571	0.00026	0.94319	Isobutane
3	1.377	MM m	3757.98572	0.00025	0.93353	n Butane
3	2.308	MM m	3608.86340	0.00026	0.93589	t-2-Butene
3	2.496	MM m	3624.86386	0.00026	0.93766	1-Butene
3	2.775	MM m	3591.55248	0.00026	0.92915	Isobutylene
3	3.002	MM m	3628.01990	0.00026	0.93893	c-2-Butene
4	0.645	VV	45207.96091	0.00002	0.96089	13 Butadiene
4	0.816	VV	49527.21054	0.00002	0.93862	Isopentane
4	0.927	VV	50123.87141	0.00002	0.93881	n-Pentane
4	1.690	VB	50418.72202	0.00002	0.90556	n-Hexane

Total amount = 97.47899

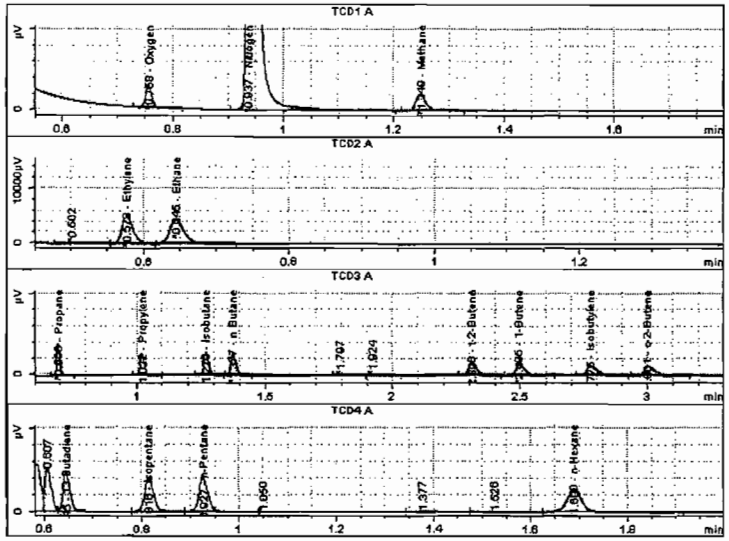
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std D (Air Liquide, 40403X) Rep 2
Sample note:	
Submission time:	Thursday, August 04, 2011 5:37:11 PM
Operator:	
Injection date:	Thursday, August 04, 2011 5:43:20 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Friday, August 05, 2011 8:11:27 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.758	MM m	1084.34920	0.00112	1.21331	Oxygen
1	0.937	MM m	50098.01741	0.00164	82.09233	Nitrogen
1	1.249	MM m	1320.53295	0.00068	0.90084	Methane
2	0.578	MM m	5484.30848	0.00017	0.92479	Ethylene
2	0.645	MM m	5896.00249	0.00016	0.91892	Ethane
3	0.693	MM m	3196.46781	0.00030	0.95021	Propane
3	1.022	MM m	3060.75962	0.00031	0.95175	Propylene
3	1.270	MM m	3694.16872	0.00026	0.94923	Isobutane
3	1.377	MM m	3787.09085	0.00025	0.94076	n Butane
3	2.308	MM m	3649.28039	0.00026	0.94638	t-2-Butene
3	2.495	MM m	3660.62028	0.00026	0.94691	1-Butene
3	2.775	MM m	3599.05856	0.00026	0.93109	Isobutylene
3	3.001	MM m	3655.85072	0.00026	0.94614	c-2-Butene
4	0.645	VV	45916.74644	0.00002	0.97596	13 Butadiene
4	0.816	VV	50421.22927	0.00002	0.95556	Isopentane
4	0.927	VV	50907.28825	0.00002	0.95349	n-Pentane
4	1.690	VB	52188.66665	0.00002	0.93735	n-Hexane

Total amount = 97.43501

Report summary:
Warning(s): Calibrated compound(s) not found

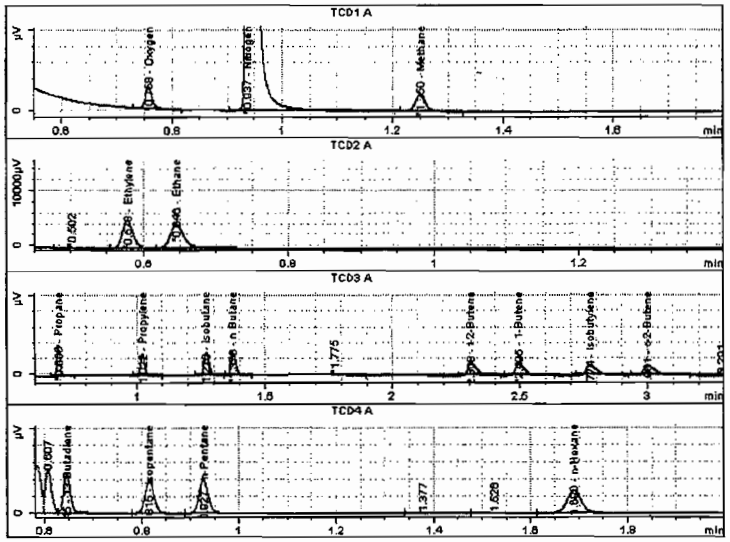
Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

C-26

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std D (Air Liquide, 40403X) Rep 3
Sample note:	
Submission time:	Thursday, August 04, 2011 5:37:12 PM
Operator:	
Injection date:	Thursday, August 04, 2011 5:48:29 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Friday, August 05, 2011 8:11:27 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.758	MM m	1088.57705	0.00112	1.21923	Oxygen
1	0.937	MM m	50167.79261	0.00164	82.20804	Nitrogen
1	1.250	MM m	1312.11450	0.00068	0.89510	Methane
2	0.578	MM m	5477.78478	0.00017	0.92369	Ethylene
2	0.646	MM m	5893.62342	0.00016	0.91855	Ethane
3	0.693	MM m	3201.65384	0.00030	0.95175	Propane
3	1.022	MM m	3065.39756	0.00031	0.95319	Propylene
3	1.270	MM m	3706.08986	0.00026	0.95229	Isobutane
3	1.376	MM m	3800.09192	0.00025	0.94399	n Butane
3	2.308	MM m	3673.70088	0.00026	0.95271	t-2-Butene
3	2.495	MM m	3646.12775	0.00026	0.94316	1-Butene
3	2.774	MM m	3620.96686	0.00026	0.93676	Isobutylene
3	3.001	MM m	3675.48915	0.00026	0.95122	c-2-Butene
4	0.645	VV	45980.46840	0.00002	0.97731	13 Butadiene
4	0.815	VV	50562.49225	0.00002	0.95824	Isopentane
4	0.927	VV	51770.93998	0.00002	0.96966	n-Pentane
4	1.690	VB	52692.05057	0.00002	0.94639	n-Hexane

Total amount = 97.60130

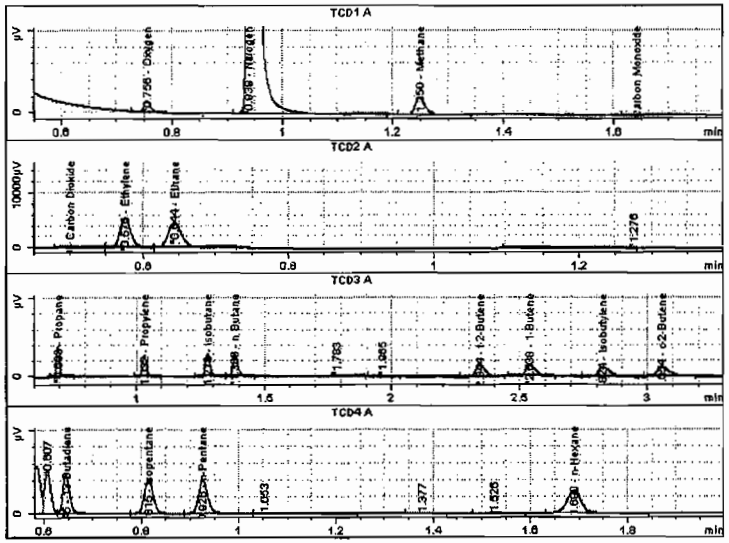
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std A (Air Liquide, 40403X) Rep 1
Sample note:	
Submission time:	Monday, August 08, 2011 10:14:45 AM
Operator:	
Injection date:	Monday, August 08, 2011 10:20:53 AM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.756	MM m	609.10341	0.00090	0.54687	Oxygen
1	0.939	MM m	51373.75315	0.00164	84.20797	Nitrogen
1	1.250	MM m	1414.29018	0.00068	0.96480	Methane
1	1.642	MM m	48.31058	0.00000	0.00000	Carbon Monoxide
2	0.500	MM m	63.51115	0.00100	0.06373	Carbon Dioxide
2	0.576	MM m	5780.76955	0.00017	0.97478	Ethylene
2	0.644	MM m	6205.74571	0.00016	0.96720	Ethane
3	0.693	MM m	3258.16738	0.00030	0.96855	Propane
3	1.032	MM m	3112.77042	0.00031	0.96793	Propylene
3	1.278	MM m	3747.71655	0.00026	0.96299	Isobutane
3	1.386	MM m	3845.86231	0.00025	0.95536	n Butane
3	2.344	MM m	3701.24904	0.00026	0.95985	t-2-Butene
3	2.538	MM m	3672.26905	0.00026	0.94993	1-Butene
3	2.824	MM m	3684.15863	0.00026	0.95311	Isobutylene
3	3.054	MM m	3745.04999	0.00026	0.96922	c-2-Butene
4	0.645	VV	45423.52973	0.00002	0.96548	13 Butadiene
4	0.815	VV	50679.73748	0.00002	0.96046	Isopentane
4	0.926	VB	51259.25960	0.00002	0.96008	n-Pentane
4	1.690	BB	53011.83422	0.00002	0.95214	n-Hexane

Total amount = 99.25043

Report summary:
WARNING: Negative amount(s) converted to zero.

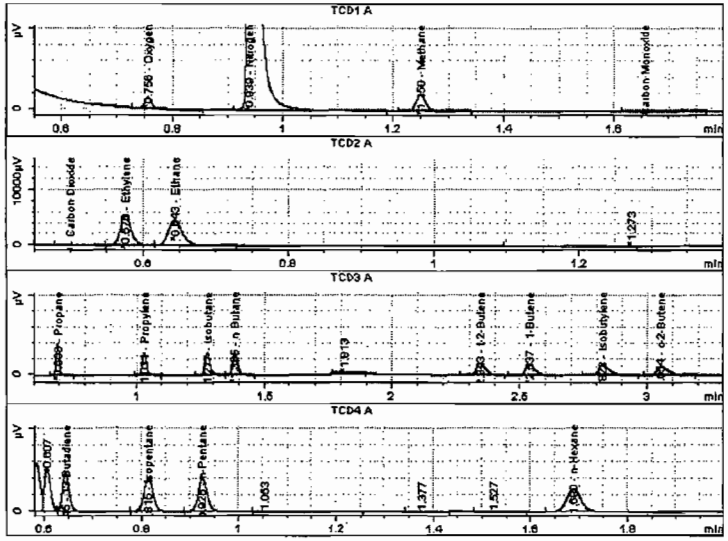
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std A (Air Liquide, 40403X) Rep 2
Sample note:	
Submission time:	Monday, August 08, 2011 10:14:46 AM
Operator:	
Injection date:	Monday, August 08, 2011 10:26:09 AM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.756	MM m	621.01291	0.00091	0.56357	Oxygen
1	0.939	MM m	51500.93356	0.00164	84.41888	Nitrogen
1	1.250	MM m	1399.51594	0.00068	0.95472	Methane
1	1.658	MM m	51.39140	0.00002	0.00104	Carbon Monoxide
2	0.500	MM m	63.07270	0.00101	0.06366	Carbon Dioxide
2	0.576	MM m	5763.91091	0.00017	0.97194	Ethylene
2	0.643	MM m	6184.00633	0.00016	0.96381	Ethane
3	0.693	MM m	3258.79517	0.00030	0.96874	Propane
3	1.031	MM m	3112.00991	0.00031	0.96769	Propylene
3	1.277	MM m	3753.54191	0.00026	0.96448	Isobutane
3	1.385	MM m	3846.75772	0.00025	0.95558	n Butane
3	2.343	MM m	3710.51934	0.00026	0.96226	t-2-Butene
3	2.537	MM m	3697.24638	0.00026	0.95639	1-Butene
3	2.823	MM m	3688.34933	0.00026	0.95419	Isobutylene
3	3.054	MM m	3767.29374	0.00026	0.97498	c-2-Butene
4	0.645	VV	45491.46067	0.00002	0.96692	13 Butadiene
4	0.815	VV	50738.95023	0.00002	0.96158	Isopentane
4	0.926	VB	51312.37751	0.00002	0.96107	n-Pentane
4	1.690	PB	52933.00169	0.00002	0.95072	n-Hexane

Total amount = 99.48221

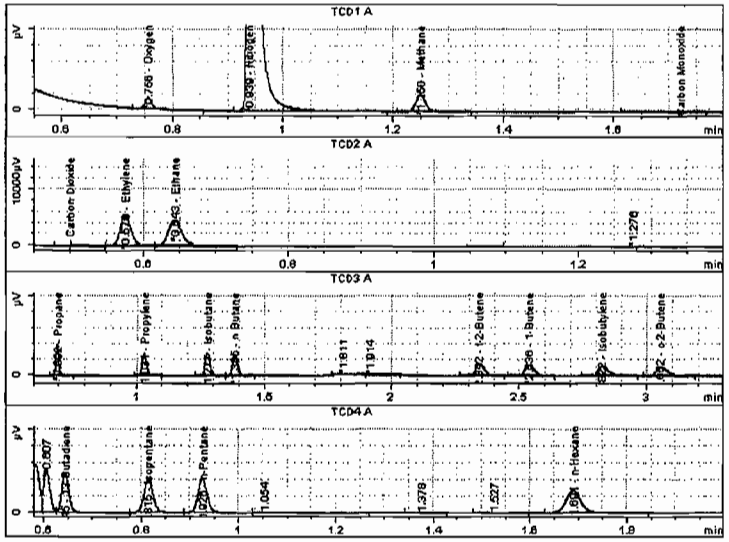
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: 1.0% Hydrocarbons Std A (Air Liquide, 40403X) Rep 3
Sample note:	
Submission time:	Monday, August 08, 2011 10:14:48 AM
Operator:	
Injection date:	Monday, August 08, 2011 10:31:23 AM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.756	MM m	607.53084	0.00090	0.54466	Oxygen
1	0.939	MM m	51379.37344	0.00164	84.21729	Nitrogen
1	1.250	MM m	1421.95616	0.00068	0.97003	Methane
1	1.722	MM m	40.51652	0.00000	0.00000	Carbon Monoxide
2	0.500	MM m	58.73941	0.00107	0.06294	Carbon Dioxide
2	0.576	MM m	5749.64723	0.00017	0.96954	Ethylene
2	0.643	MM m	6171.62561	0.00016	0.96188	Ethane
3	0.692	MM m	3256.46864	0.00030	0.96805	Propane
3	1.031	MM m	3112.15050	0.00031	0.96773	Propylene
3	1.277	MM m	3754.13568	0.00026	0.96464	Isobutane
3	1.385	MM m	3852.35419	0.00025	0.95697	n Butane
3	2.342	MM m	3704.32723	0.00026	0.96065	t-2-Butene
3	2.536	MM m	3690.95348	0.00026	0.95476	1-Butene
3	2.822	MM m	3702.77336	0.00026	0.95793	Isobutylene
3	3.052	MM m	3776.42686	0.00026	0.97734	c-2-Butene
4	0.645	VV	45644.77622	0.00002	0.97018	13 Butadiene
4	0.815	VV	50927.24025	0.00002	0.96515	Isopentane
4	0.926	VB	51561.45509	0.00002	0.96574	n-Pentane
4	1.691	PB	53487.61123	0.00002	0.96068	n-Hexane

Total amount = 99.29615

Report summary:
WARNING: Negative amount(s) converted to zero.

Warning(s): Calibrated compound(s) not found

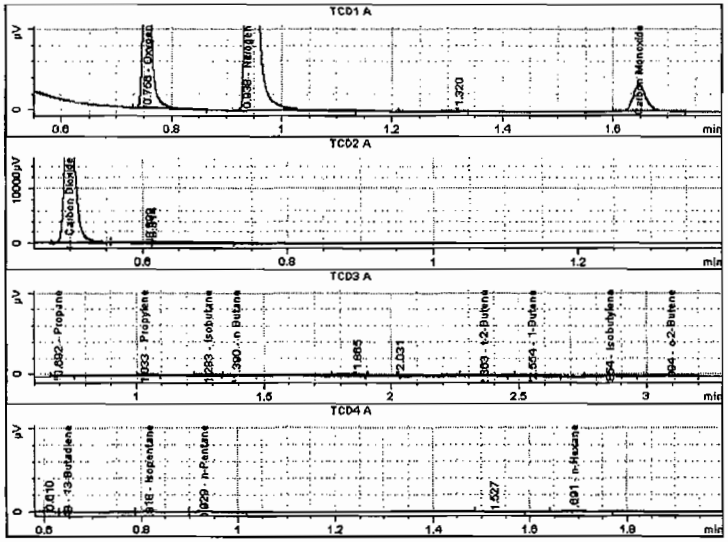
Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

C-30

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: ASTM Std (Air Liquide, AAL067795) Rep 1
Sample note:	
Submission time:	Thursday, August 04, 2011 12:14:18 PM
Operator:	
Injection date:	Thursday, August 04, 2011 12:20:24 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.756	MM m	14425.04866	0.00138	19.92105	Oxygen
1	0.938	MM m	42635.66150	0.00164	69.71699	Nitrogen
1	1.647	MM m	2830.54147	0.00177	5.01460	Carbon Monoxide
2	0.499	MM m	29661.40383	0.00017	4.95212	Carbon Dioxide
3	0.692	MM m	16.91581	0.00030	0.00503	Propane
3	1.033	MM m	13.09896	0.00031	0.00407	Propylene
3	1.283	MM m	13.16789	0.00026	0.00338	Isobutane
3	1.390	MM m	42.74160	0.00025	0.01062	n Butane
3	2.363	MM m	83.41691	0.00026	0.02163	t-2-Butene
3	2.554	MM m	22.02608	0.00026	0.00570	1-Butene
3	2.854	MM m	36.47072	0.00026	0.00944	Isobutylene
3	3.094	MM m	49.49159	0.00026	0.01281	c-2-Butene
4	0.648	VV	953.28007	0.00002	0.02026	13 Butadiene
4	0.818	VV	734.65838	0.00002	0.01392	Isopentane
4	0.929	VB	916.10430	0.00002	0.01716	n-Pentane
4	1.691	BB	2085.62965	0.00002	0.03746	n-Hexane

Total amount = 99.76623

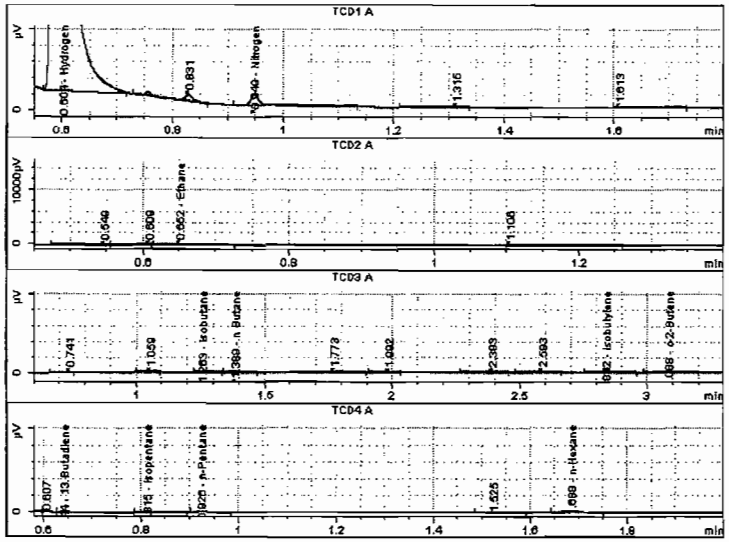
Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Agilent Cerity QA/QC Report

Sample name:	*Reprocessed: Hydrogen Std (Air Liquide, 117LAP0695C) Rep 1
Sample note:	
Submission time:	Thursday, August 04, 2011 12:27:01 PM
Operator:	
Injection date:	Thursday, August 04, 2011 12:33:06 PM
GC Description:	MicroGC - SN: US10648003
Signal description:	TCD1 A; TCD2 A; TCD3 A; TCD4 A
Method:	Flare Analysis II
Method last saved:	Wednesday, July 13, 2011 11:33:15 AM



ESTD Report

Calibration last saved:	Wednesday, July 13, 2011 11:28:48 AM
Multiplier:	1.0000
Dilution:	1.0000
Sample amount:	0.0000 mole%
Sample type:	Sample
Sampling source:	Inlet

Signal	Retention Time [min]	Type	Area [µV*s]	Amt/Area	Amount [mole%]	Name
1	0.604	MM m	649551.02438	0.00015	99.97003	Hydrogen
1	0.949	MM m	622.99101	0.00007	0.04447	Nitrogen
2	0.652	MM m	129.74915	0.00016	0.02022	Ethane
3	1.263	MM m	6.51145	0.00026	0.00167	Isobutane
3	1.389	MM m	33.88583	0.00025	0.00842	n Butane
3	2.842	MM m	39.76114	0.00026	0.01029	Isobutylene
3	3.088	MM m	42.43029	0.00026	0.01098	c-2-Butene
4	0.644	VV	284.29446	0.00002	0.00604	13 Butadiene
4	0.815	VB	153.51193	0.00002	0.00291	Isopentane
4	0.926	BB	180.98221	0.00002	0.00339	n-Pentane
4	1.688	BP	524.75034	0.00002	0.00942	n-Hexane

Total amount = 100.08785

Report summary:
Warning(s): Calibrated compound(s) not found

Warning(s): Sample amount is zero. Absolute amounts calculated

Instrument run log:

Analysis Summary

Lab No	Sample No	Description	Methane ppmv	Ethane ppmv	Ethylene ppmv	Propane ppmv	Propylene ppmv	Isobutane ppmv	n-Butane ppmv	t-2-Butene ppmv	1-Butene ppmv	Isobutylene ppmv	c-2-Butene ppmv	Isopentane ppmv	n-Pentane ppmv	1,3-Butadiene ppmv	n-Hexane ppmv
H0811017	H41156	Bag 1 Run 7	20,251.3	2,115.3	262.8	273.8	63.0	23.1	32.0	16.2	11.3	13.7	18.0	35.2	38.4	7.4	79.6
H0811018	H41154	Bag 2 Run 8	6,707.6	840.9	94.4	77.9	16.7	5.2	8.7	4.1	2.0	2.4	3.1	5.6	5.3	1.0	12.2
H0811019	H41155	Bag 3 Run 9	91,282.3	9,614.7	1,354.9	889.9	336.1	61.5	92.8	45.2	54.0	12.7	36.5	25.1	23.8	130.2	43.7
			% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec
H0811017	H41156	Bag 1 Run 7 Spike	76.0	110.1	114.5	108.3	113.1	113.9	113.7	116.6	119.5	120.3	114.9	113.6	111.7	115.8	102.8
		Bias Correction Factor =	0.760	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Moisture Correction Factor = 0.9758

M-18 Bias Corrrected Analysis Summary

Lab No	Sample No	Description	Methane ppmv	Ethane ppmv	Ethylene ppmv	Propane ppmv	Propylene ppmv	Isobutane ppmv	n-Butane ppmv	t-2-Butene ppmv	1-Butene ppmv	Isobutylene ppmv	c-2-Butene ppmv	Isopentane ppmv	n-Pentane ppmv	1,3-Butadiene ppmv	n-Hexane ppmv
H0811017	H41156	Bag 1 Run 7	27,322	2,168	269	281	64.6	23.7	32.8	16.6	11.6	14.1	18.4	36.1	39.3	7.6	81.6
H0811018	H41154	Bag 2 Run 8	9,050	862	96.7	79.8	17.1	5.3	8.9	4.2	2.0	2.5	3.1	5.7	5.4	1.1	12.5
H0811019	H41155	Bag 3 Run 9	123,154	9,853	1,389	912	344	63.1	95.1	46.3	55.3	13.0	37.4	25.7	24.3	133	44.8

Lab No	Sample No	Description	Total C1 to C6 Hydrocarbons ppmv
H0811017	H41156	Bag 1 Run 7	30,386
H0811018	H41154	Bag 2 Run 8	10,156
H0811019	H41155	Bag 3 Run 9	136,190

USEPA Method 4
Relative Humidity and Moisture Calculation
Using Wet Bulb/Dry Bulb Measurements

Client: Lyondell (Houston Refining)
Location: Pasadena, TX
Source: 736 Coker
Analysis Date: 8/11/2011
Sample No.: All Samples

Data Input:

Barometric pressure (P_{bar}):	29.91	inches Hg
Dry bulb (t_d) or ambient (T_{amb}) temperature:	71.4	°F
Wet bulb temperature (t_w)	71.4	°F
Static Pressure (S_p):	0.0	inches H_2O

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Absolute Pressure:

= **29.91 inches Hg**

= **759.74 mm Hg**

Saturated vapor pressure of t_d:

S_{vp} = **0.7643 inches Hg**

Actual vapor pressure:

= **0.7643 inches Hg**

Fractional moisture content:

= **0.0256 B_{wo}**

Moisture content:

2.56 %

Fractional moisture content of gas at saturated conditions:

= **294.9 °Kelvin**

where:
A= 8.361
B=1893.5
C=27.65

= **0.0242 B_{wos}**

Percent moisture at saturated conditions:

= **2.42 %**

Percent relative humidity:

= **100.00 %**

Percent moisture used for emissions calculations:

For Bag Calculations not Stacks = **2.42 %**

Percent moisture used for emissions calculations:

= **0.0242 fractional**

= **0.9758 correction**

USEPA Method 4
Relative Humidity and Moisture Calculation
Using Wet Bulb/Dry Bulb Measurements

Client:	**Lyondell (Houston Refining)**
Location:	**Pasadena, TX**
Source:	**736 Coker**
Analysis Date:	**8/10/2011**
Sample No.:	**All Samples**

Data Input:

Barometric pressure (P_{bar}):	29.88	inches Hg
Dry bulb (t_d) or ambient (T_{amb}) temperature:	69.7	°F
Wet bulb temperature (t_w)	69.7	°F
Static Pressure (S_t):	0.0	inches H_2O

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Absolute Pressure:

= **29.88 inches Hg**

= **758.98 mm Hg**

Saturated vapor pressure of t_d:

S_{vp} = **0.7140 inches Hg**

Actual vapor pressure:

= **0.7140 inches Hg**

Fractional moisture content:

= **0.0239 B_{wo}**

Moisture content:

2.39 %

Fractional moisture content of gas at saturated conditions:

= **293.9 °Kelvin**

where:
A= 8.361
B=1893.5
C=27.65

= **0.0228 B_{wos}**

Percent moisture at saturated conditions:

= **2.28 %**

Percent relative humidity:

= **100.00 %**

Percent moisture used for emissions calculations:

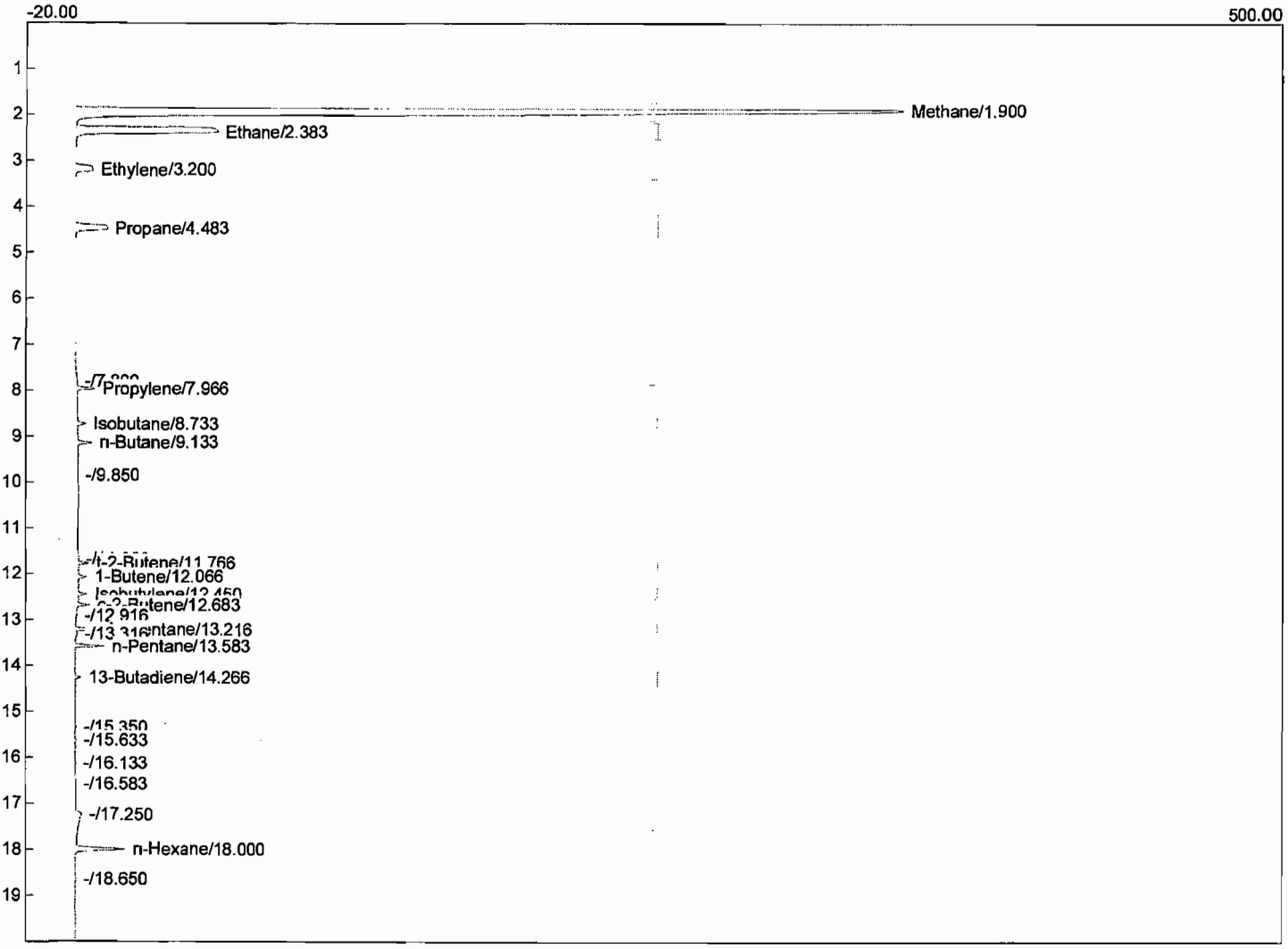
For Bag Calculations not Stacks = **2.28 %**

Percent moisture used for emissions calculations:

= **0.0228 fractional**

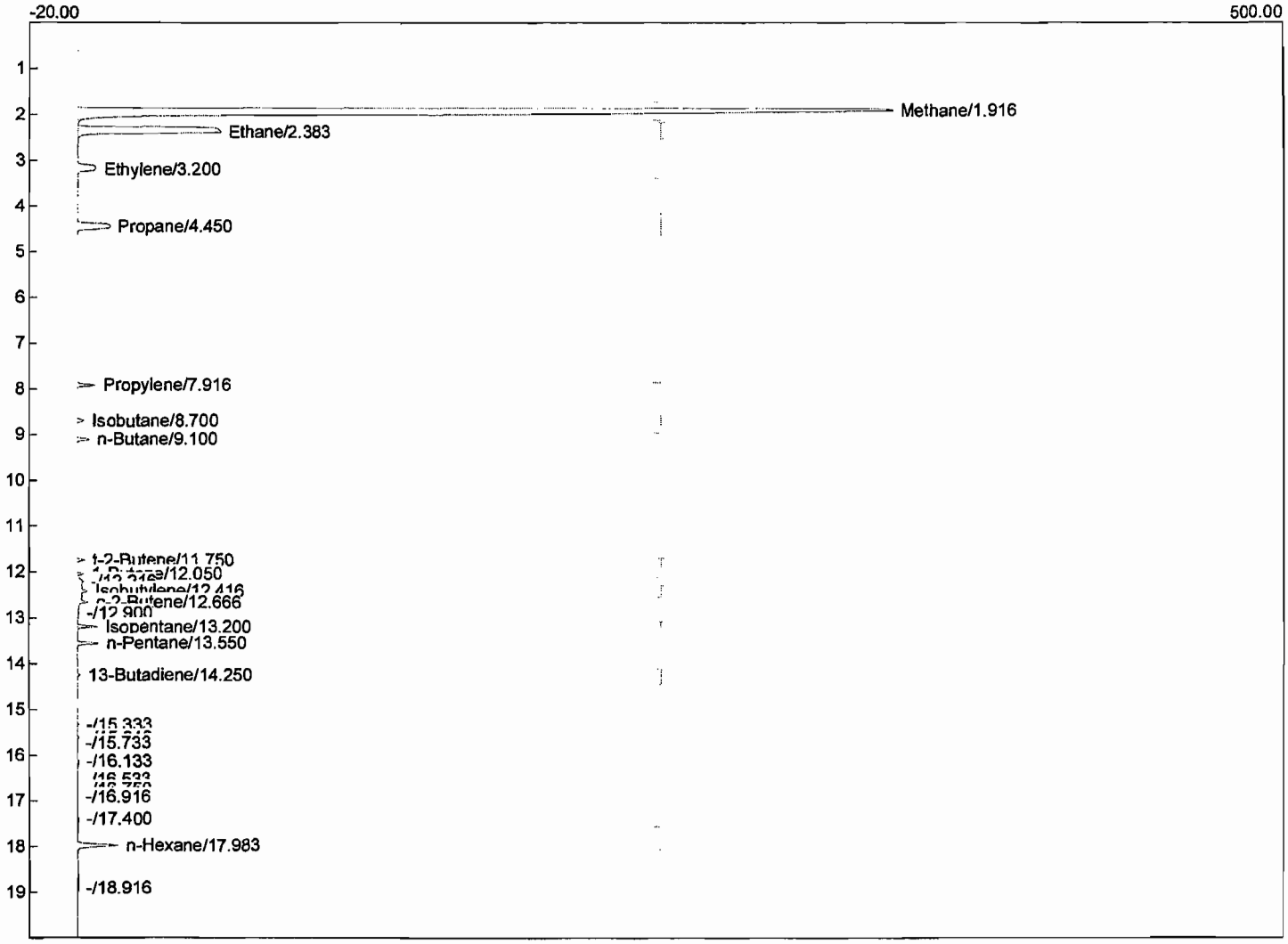
= **0.9772 correction**

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41156
Analysis date: 08/10/2011 16:08:53
Method: M-18
Lab ID: H0811017
Description: 1:30 Dil
Data file: DC811-15.CHR ()
Sample: DCU Bag 1 Run 7



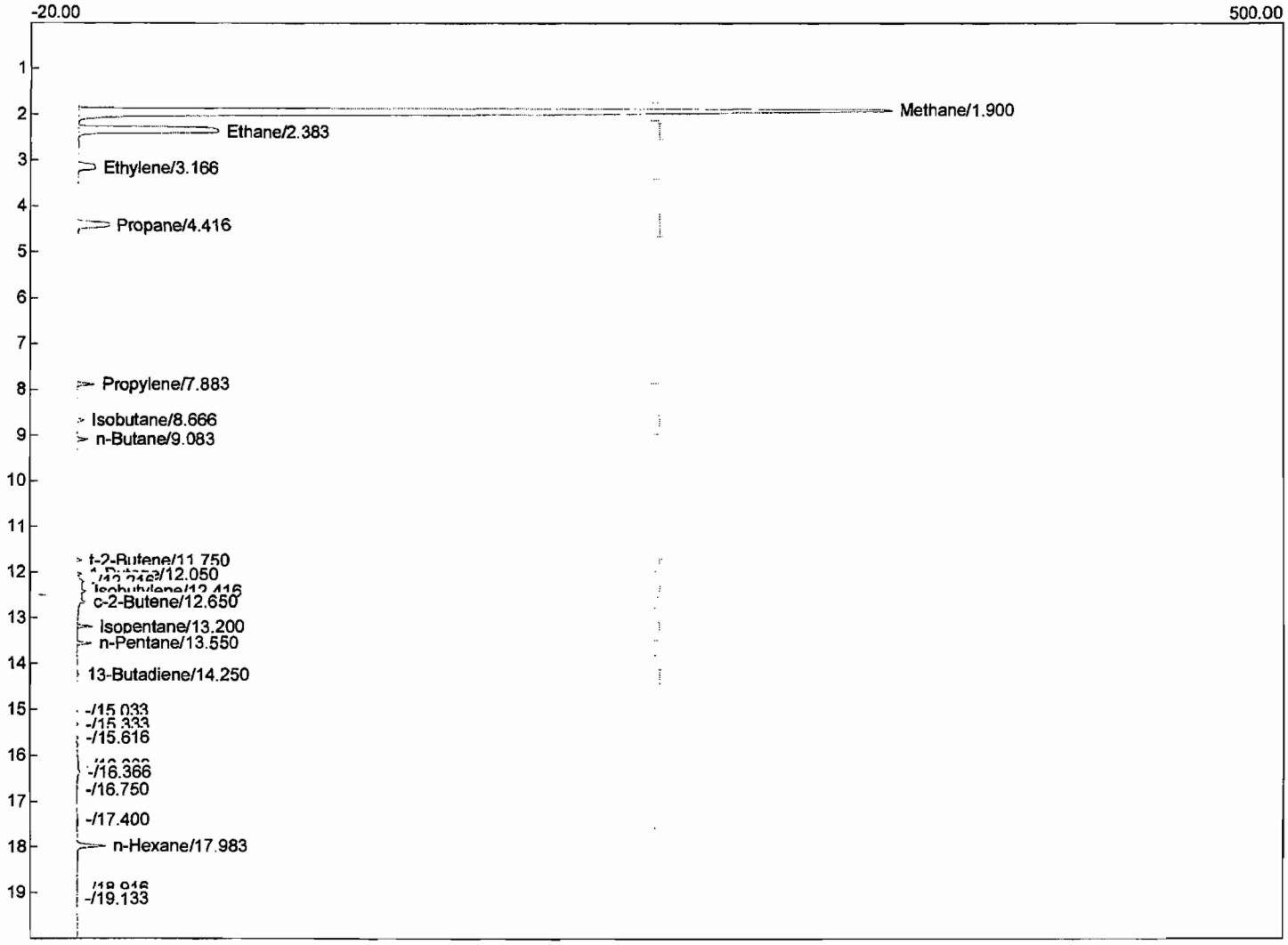
Component	Area
Methane	2742.6
Ethane	532.1
Ethylene	64.6
Propane	106.2
Propylene	23.1
Isobutane	12.2
n-Butane	19.0
t-2-Butene	10.9
1-Butene	8.6
Isobutylene	8.4
c-2-Butene	13.3
Isopentane	27.6
n-Pentane	32.8
13-Butadiene	6.0
n-Hexane	76.3
	3683.6

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41156
Analysis date: 08/10/2011 16:33:53
Method: M-18
Lab ID: H0811017
Description: 1:30 Dil
Data file: DC811-16.CHR ()
Sample: DCU Bag 1 Run 7



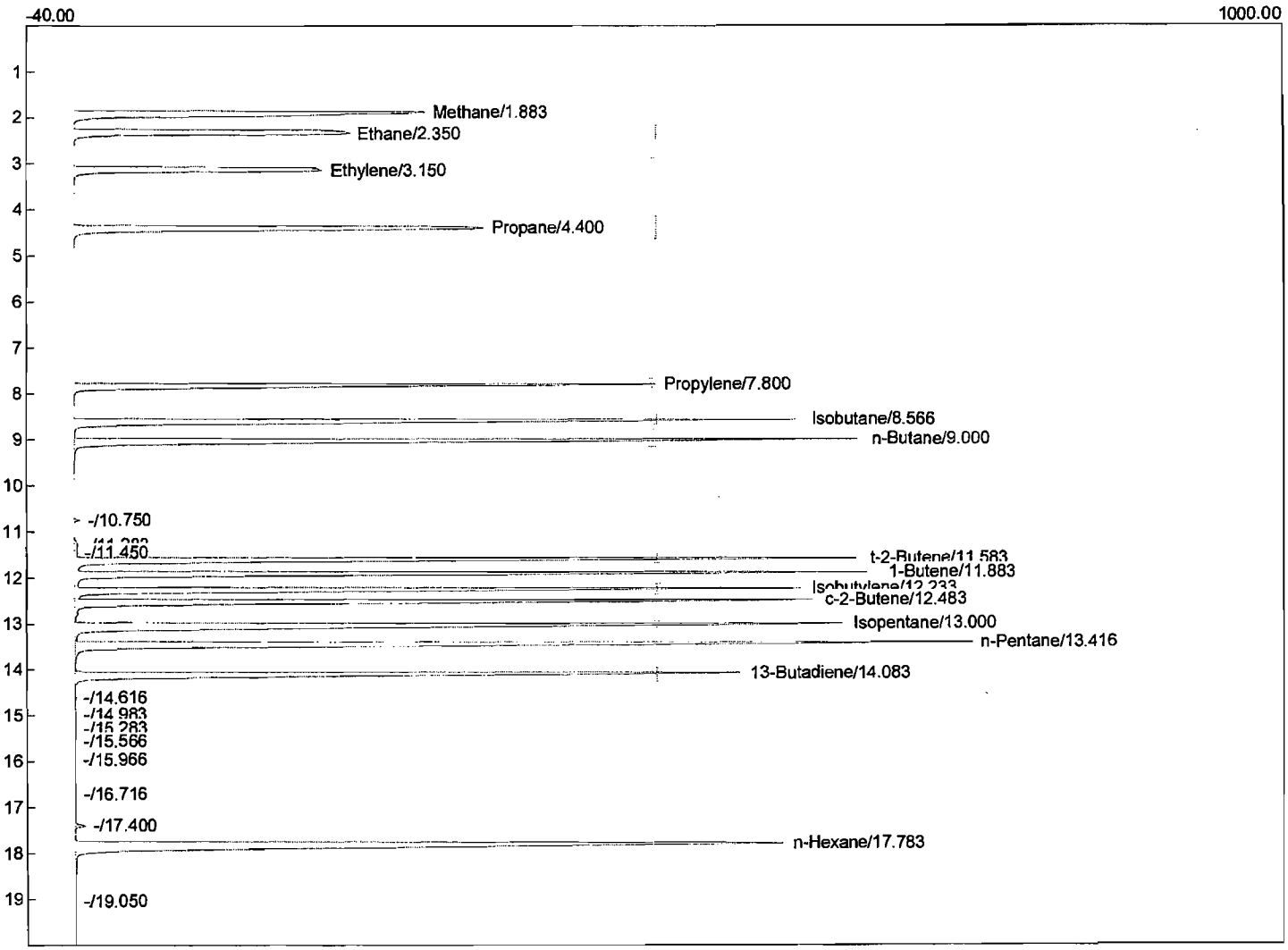
Component	Area
Methane	2692.6
Ethane	518.8
Ethylene	62.4
Propane	103.5
Propylene	22.8
Isobutane	10.0
n-Butane	15.4
t-2-Butene	7.2
1-Butene	4.4
Isobutylene	5.8
c-2-Butene	8.6
Isopentane	21.5
n-Pentane	23.6
13-Butadiene	2.6
n-Hexane	64.9
	3564.1

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41156
Analysis date: 08/10/2011 16:58:53
Method: M-18
Lab ID: H0811017
Description: 1:30 Dil
Data file: DC811-17.CHR ()
Sample: DCU Bag 1 Run 7



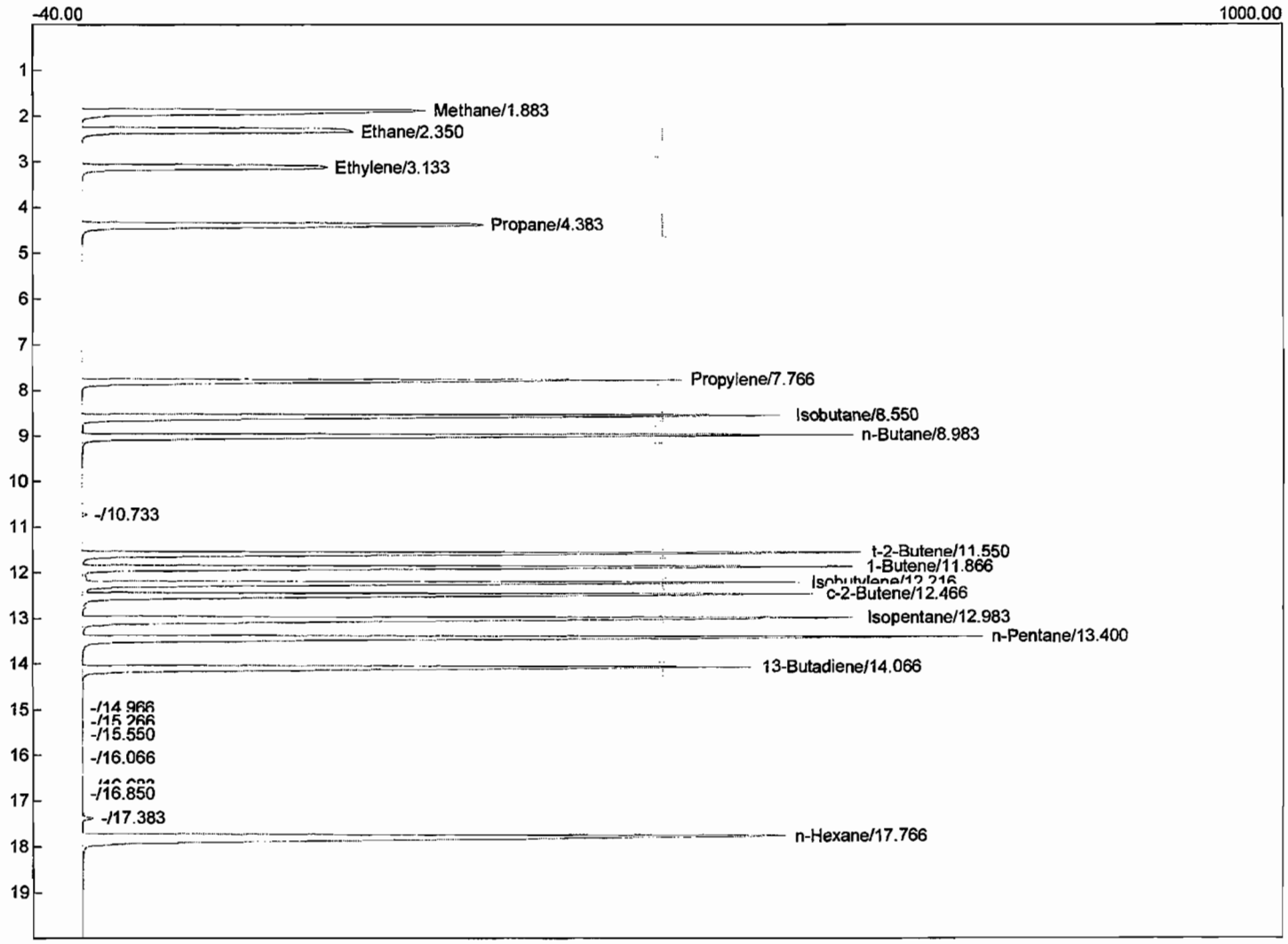
Component	Area
Methane	2695.3
Ethane	517.3
Ethylene	61.9
Propane	103.3
Propylene	21.6
Isobutane	11.6
n-Butane	14.4
t-2-Butene	5.6
1-Butene	3.2
Isobutylene	4.5
c-2-Butene	5.0
Isopentane	16.5
n-Pentane	16.8
13-Butadiene	2.0
n-Hexane	48.2
	3527.0

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41156
Analysis date: 08/11/2011 10:29:29
Method: M-18
Lab ID: H0811017
Description: 1:60 Dil
Data file: DC811-27.CHR ()
Sample: DCU Bag 1 Run 7 Spike
Comments: 9800 ml N2, 2000 ml of 1000 STD, 200 ml Sample,



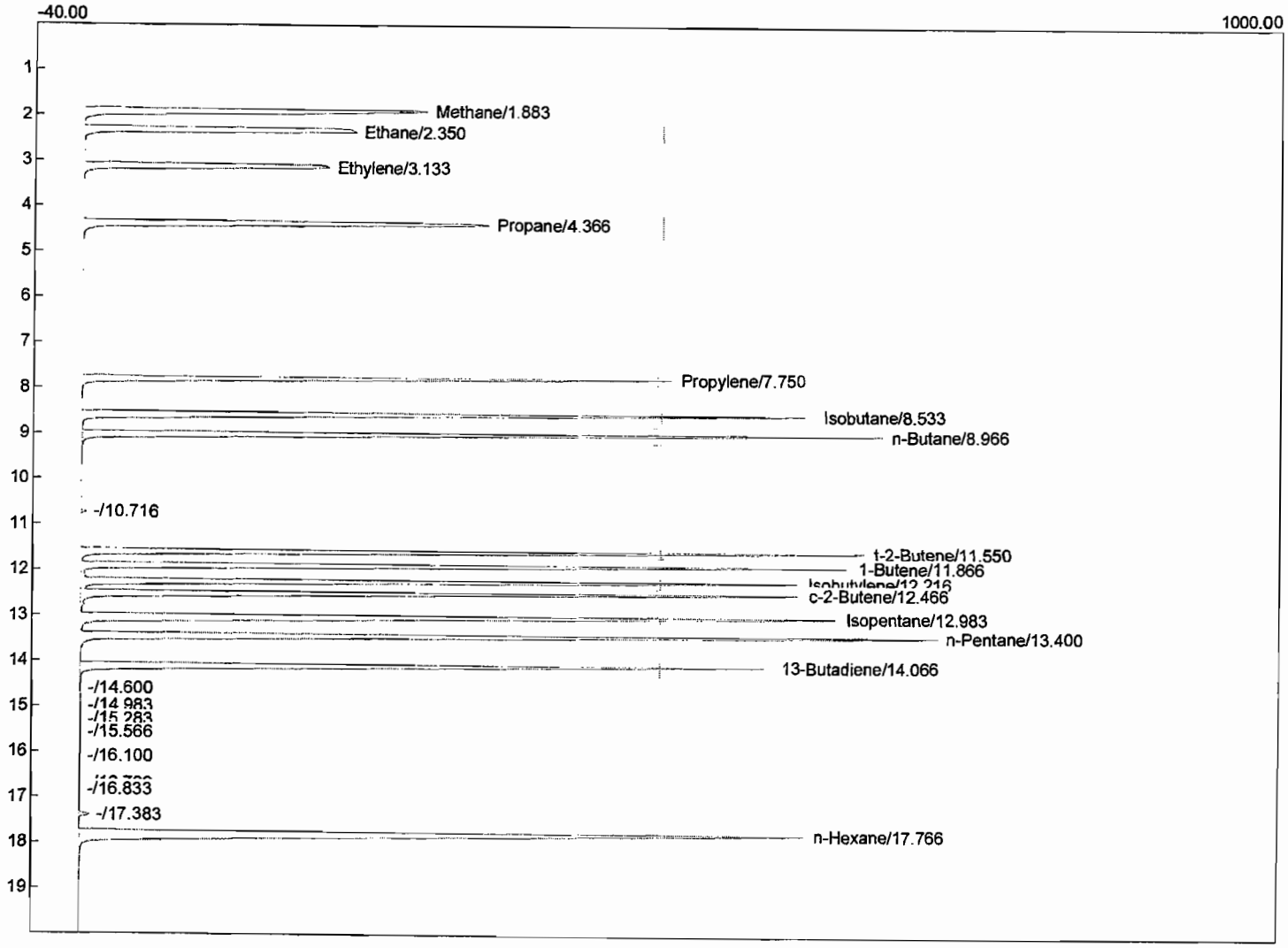
Component	Area
Methane	1894.5
Ethane	1639.5
Ethylene	1422.8
Propane	2127.1
Propylene	2080.9
Isobutane	2771.8
n-Butane	2882.3
t-2-Butene	2912.6
1-Butene	2874.0
Isobutylene	2722.7
c-2-Butene	2886.9
Isopentane	3534.5
n-Pentane	3577.9
13-Butadiene	2770.5
n-Hexane	4084.2
	40181.9

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41156
Analysis date: 08/11/2011 10:54:29
Method: M-18
Lab ID: H0811017
Description: 1:60 Dil
Data file: DC811-28.CHR ()
Sample: DCU Bag 1 Run 7 Spike
Comments: 9800 ml N2, 2000 ml of 1000 STD, 200 ml Sample,



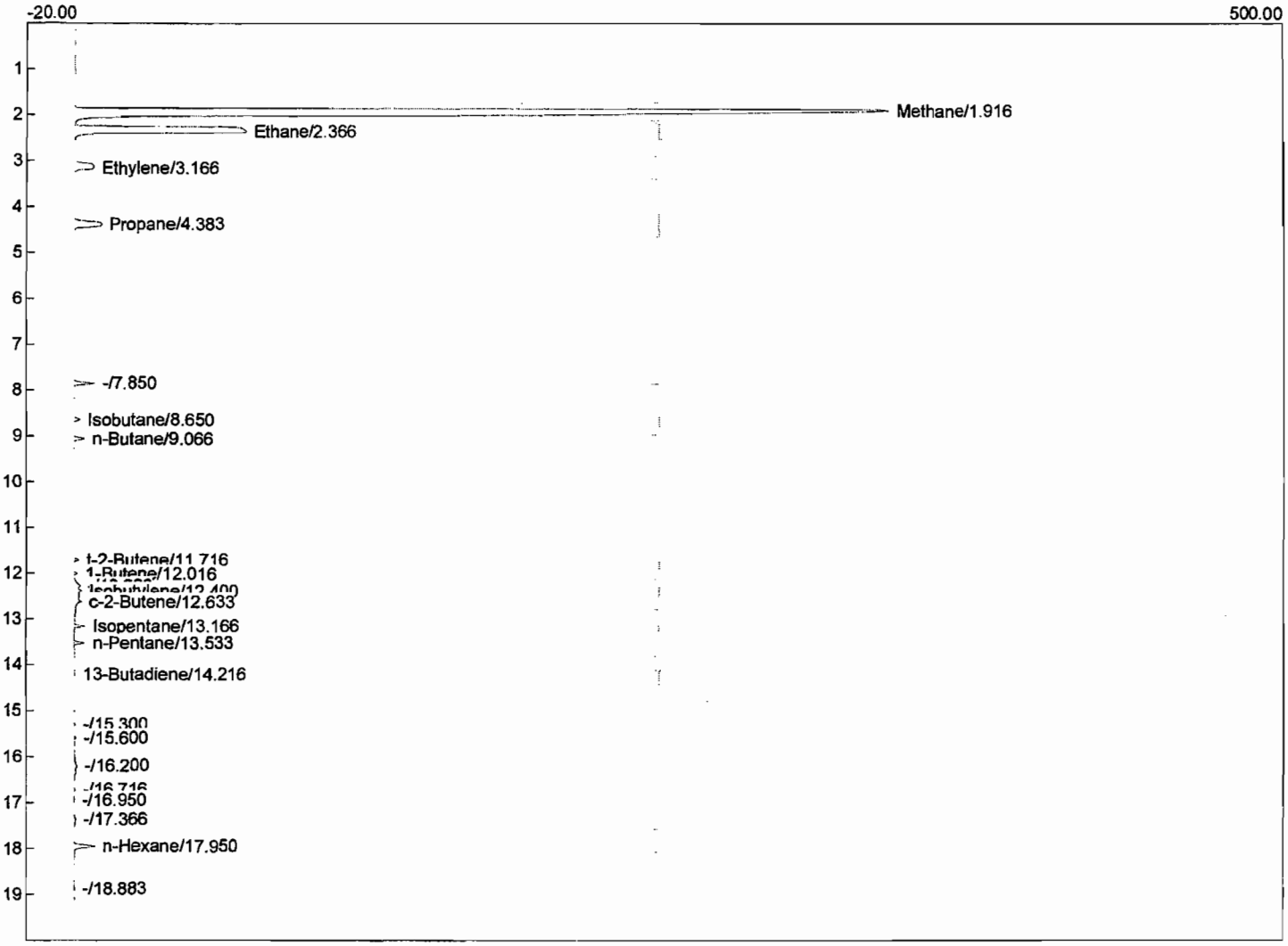
Component	Area
Methane	1850.9
Ethane	1614.4
Ethylene	1397.7
Propane	2111.9
Propylene	2004.9
Isobutane	2801.7
n-Butane	2931.5
t-2-Butene	2808.9
1-Butene	2852.2
Isobutylene	2745.7
c-2-Butene	2855.1
Isopentane	3533.9
n-Pentane	3548.1
13-Butadiene	2764.1
n-Hexane	4115.1
	39935.9

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41156
Analysis date: 08/11/2011 11:19:29
Method: M-18
Lab ID: H0811017
Description: 1:60 Dil
Data file: DC811-29.CHR ()
Sample: DCU Bag 1 Run 7 Spike
Comments: 9800 ml N2, 2000 ml of 1000 STD, 200 ml Sample,



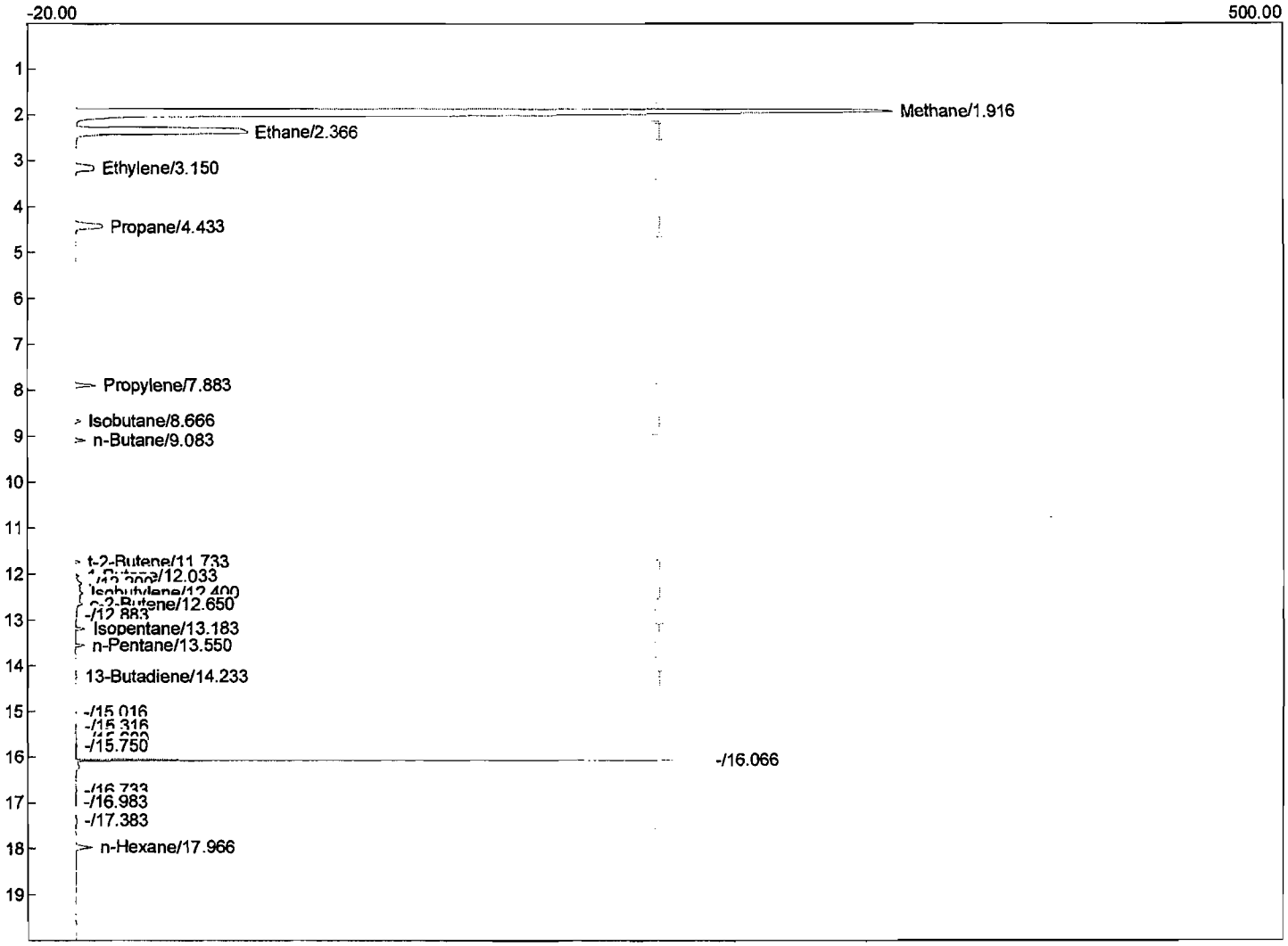
Component	Area
Methane	1844.6
Ethane	1611.3
Ethylene	1390.2
Propane	2107.2
Propylene	2002.2
Isobutane	2769.2
n-Butane	2868.8
t-2-Butene	2807.9
1-Butene	2843.8
Isobutylene	2740.8
c-2-Butene	2873.0
Isopentane	3534.9
n-Pentane	3563.7
13-Butadiene	2714.0
n-Hexane	4123.1
	39795.0

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41154
Analysis date: 08/10/2011 17:22:23
Method: M-18
Lab ID: H0811018
Description: 1:10 Dil
Data file: DC811-18.CHR ()
Sample: DCU Bag 2 Run 8



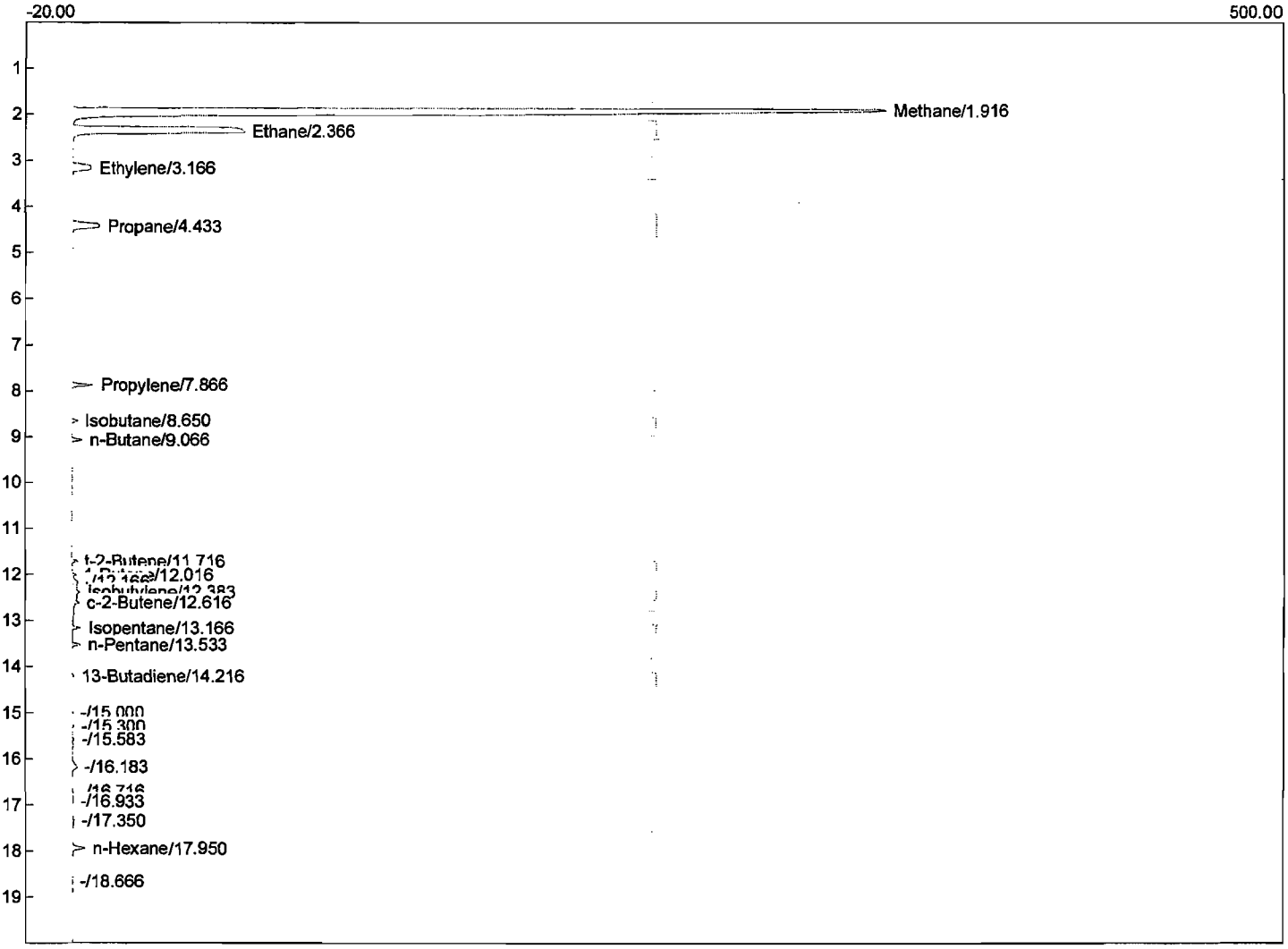
Component	Area
Methane	2699.8
Ethane	625.7
Ethylene	68.1
Propane	89.8
Propylene	0.0
Isobutane	7.6
n-Butane	13.3
t-2-Butene	5.5
1-Butene	3.2
Isobutylene	3.0
c-2-Butene	3.8
Isopentane	11.4
n-Pentane	11.2
13-Butadiene	1.0
n-Hexane	34.6
	3578.2

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41154
Analysis date: 08/10/2011 17:47:23
Method: M-18
Lab ID: H0811018
Description: 1:10 Dil
Data file: DC811-19.CHR ()
Sample: DCU Bag 2 Run 8



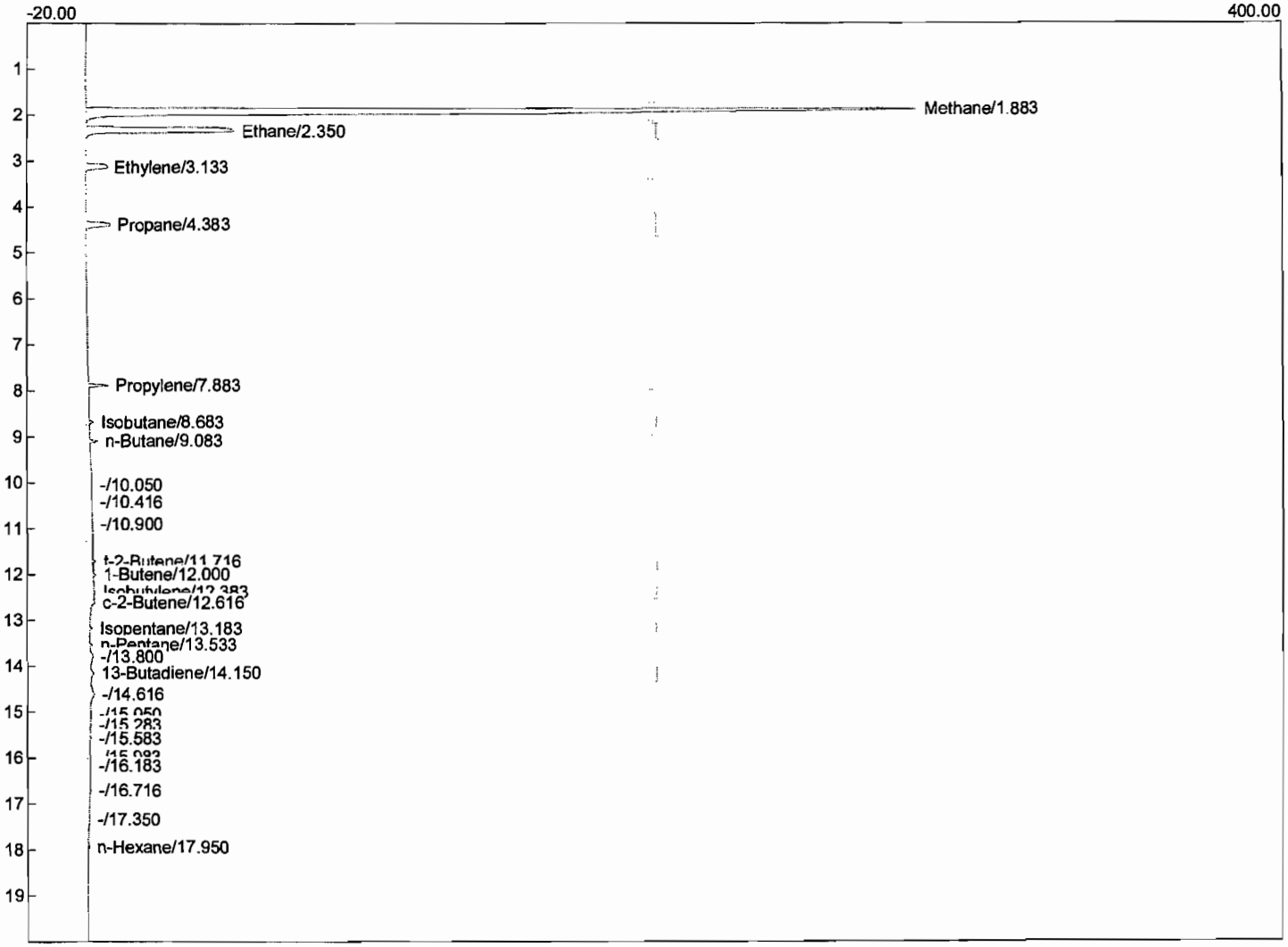
Component	Area
Methane	2700.3
Ethane	622.9
Ethylene	67.9
Propane	88.8
Propylene	26.7
Isobutane	7.6
n-Butane	12.9
t-2-Butene	6.1
1-Butene	2.8
Isobutylene	3.2
c-2-Butene	4.0
Isopentane	10.5
n-Pentane	9.7
13-Butadiene	1.6
n-Hexane	29.2
	3594.3

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41154
Analysis date: 08/10/2011 18:12:23
Method: M-18
Lab ID: H0811018
Description: 1:10 Dil
Data file: DC811-20.CHR ()
Sample: DCU Bag 2 Run 8



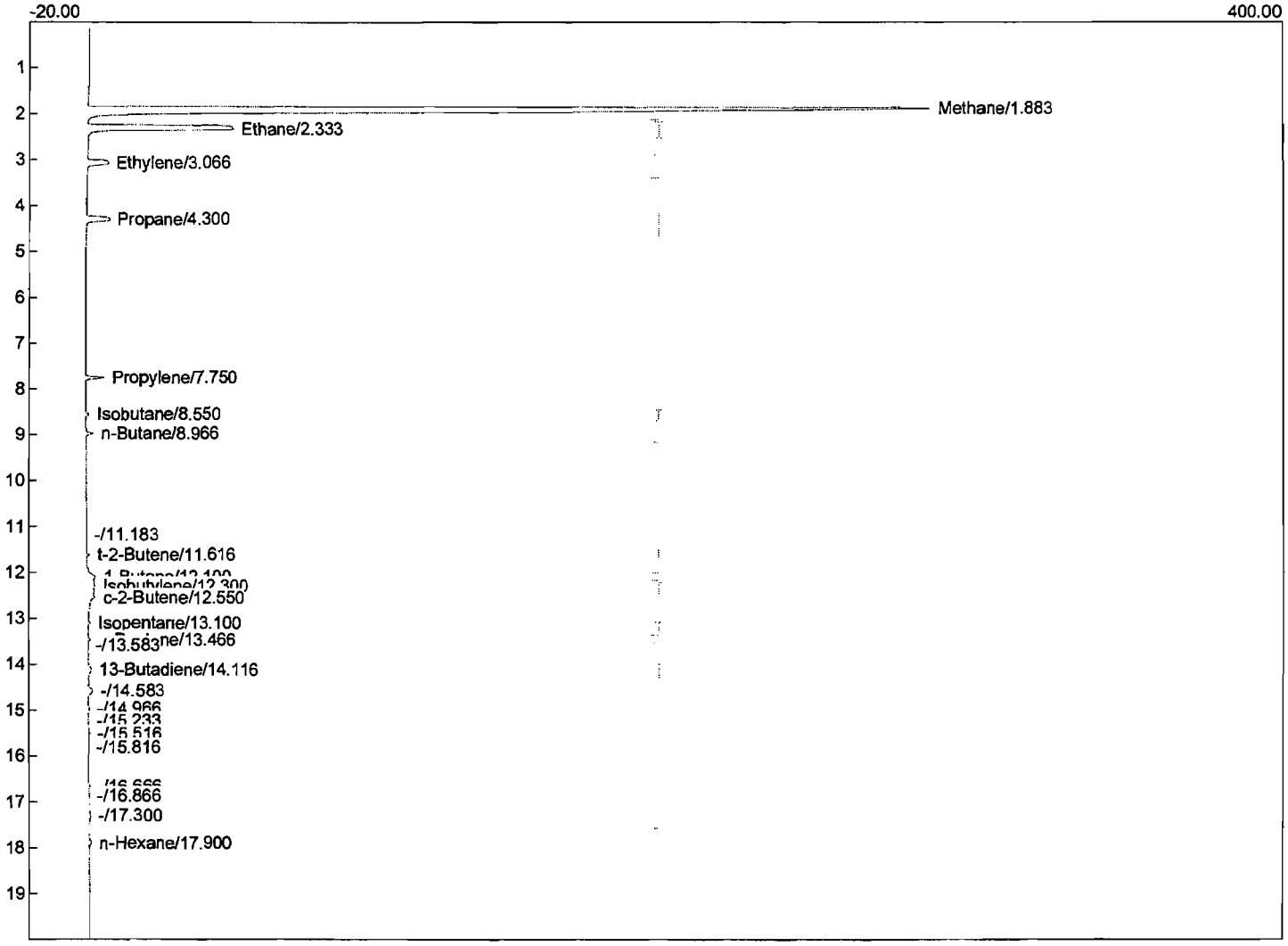
Component	Area
Methane	2678.8
Ethane	621.7
Ethylene	67.6
Propane	88.4
Propylene	27.0
Isobutane	7.4
n-Butane	13.4
t-2-Butene	6.2
1-Butene	2.4
Isobutylene	3.6
c-2-Butene	6.0
Isopentane	9.1
n-Pentane	9.2
13-Butadiene	1.8
n-Hexane	23.1
	3565.6

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41155
Analysis date: 08/11/2011 09:01:03
Method: M-18
Lab ID: H0811019
Description: 1:200 Dil
Data file: DC811-24.CHR ()
Sample: DCU Bag 3 Run 9



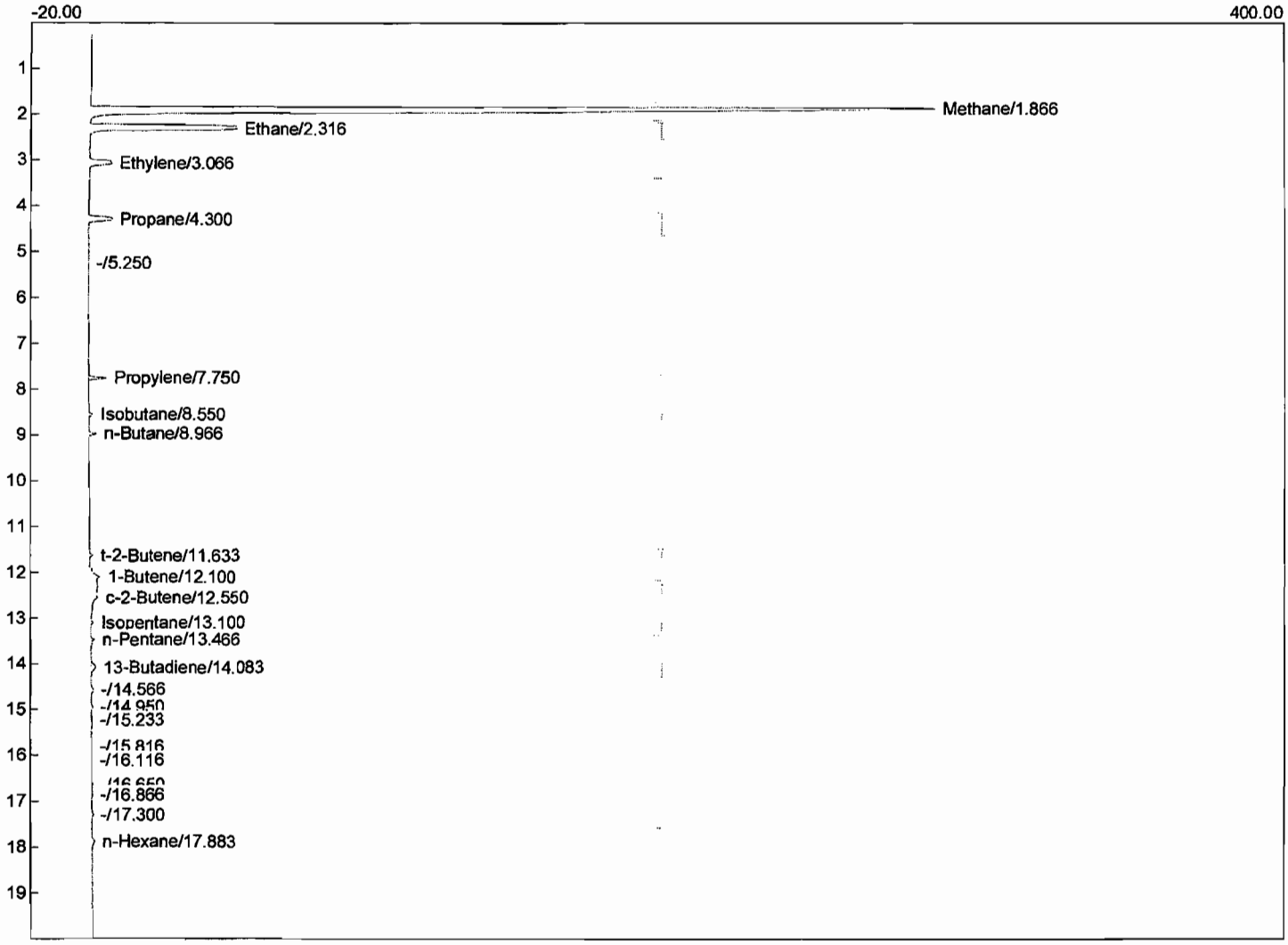
Component	Area
Methane	1818.3
Ethane	361.3
Ethylene	49.6
Propane	51.3
Propylene	17.9
Isobutane	5.1
n-Butane	7.0
t-2-Butene	3.6
1-Butene	1.8
Isobutylene	1.4
c-2-Butene	3.0
Isopentane	2.2
n-Pentane	2.0
13-Butadiene	6.6
n-Hexane	2.8
	2333.7

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41155
Analysis date: 08/11/2011 09:26:03
Method: M-18
Lab ID: H0811019
Description: 1:200 Dil
Data file: DC811-25.CHR ()
Sample: DCU Bag 3 Run 9



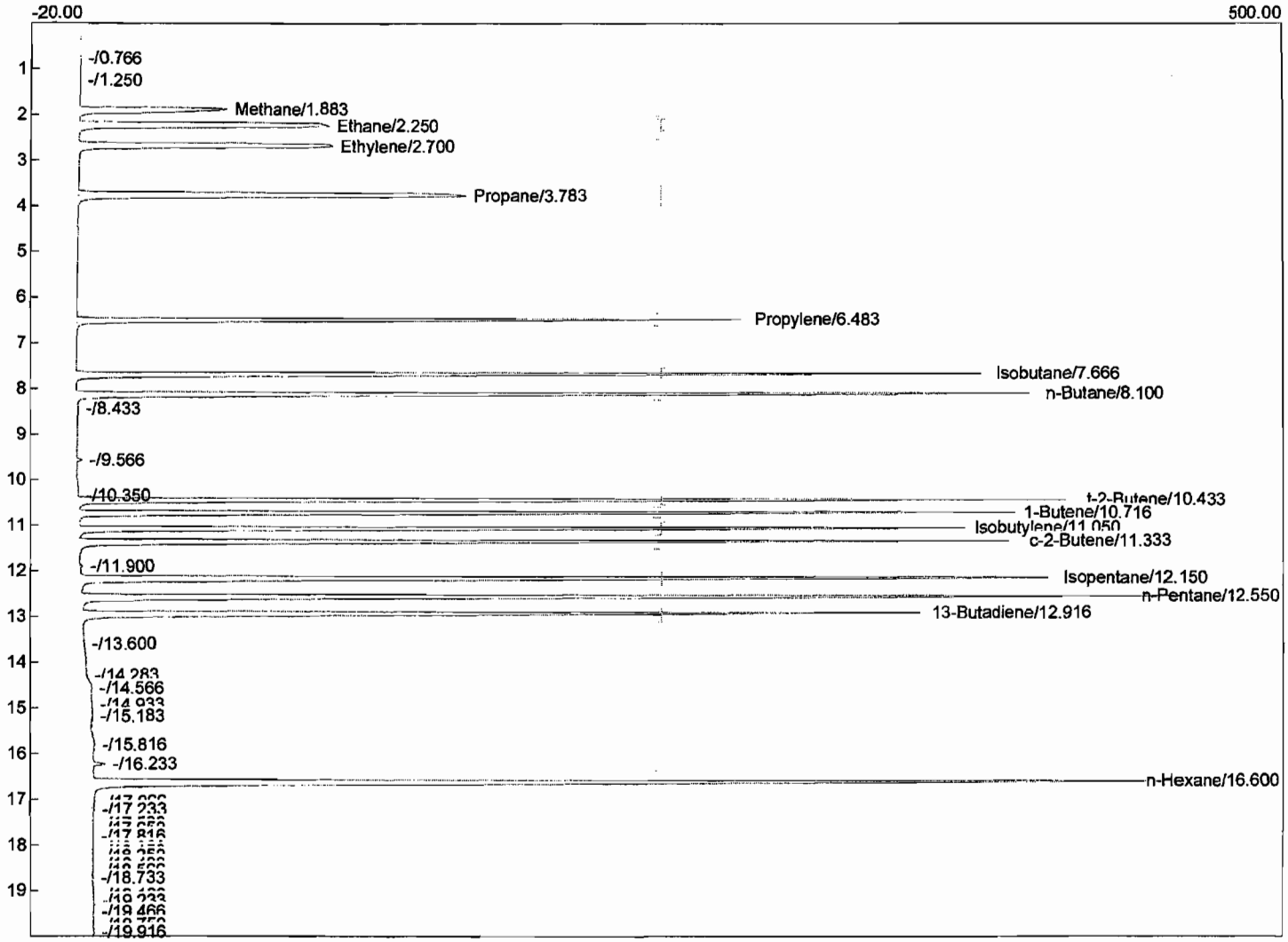
Component	Area
Methane	1833.7
Ethane	353.6
Ethylene	48.1
Propane	51.1
Propylene	18.3
Isobutane	4.1
n-Butane	7.2
t-2-Butene	2.7
1-Butene	5.4
Isobutylene	1.2
c-2-Butene	2.6
Isopentane	2.3
n-Pentane	2.2
13-Butadiene	9.2
n-Hexane	5.9
	2347.5

Lab name: ARI Environmental
Client: Houston Refining
Client ID: H41155
Analysis date: 08/11/2011 09:51:03
Method: M-18
Lab ID: H0811019
Description: 1:200 Dil
Data file: DC811-26.CHR ()
Sample: DCU Bag 3 Run 9



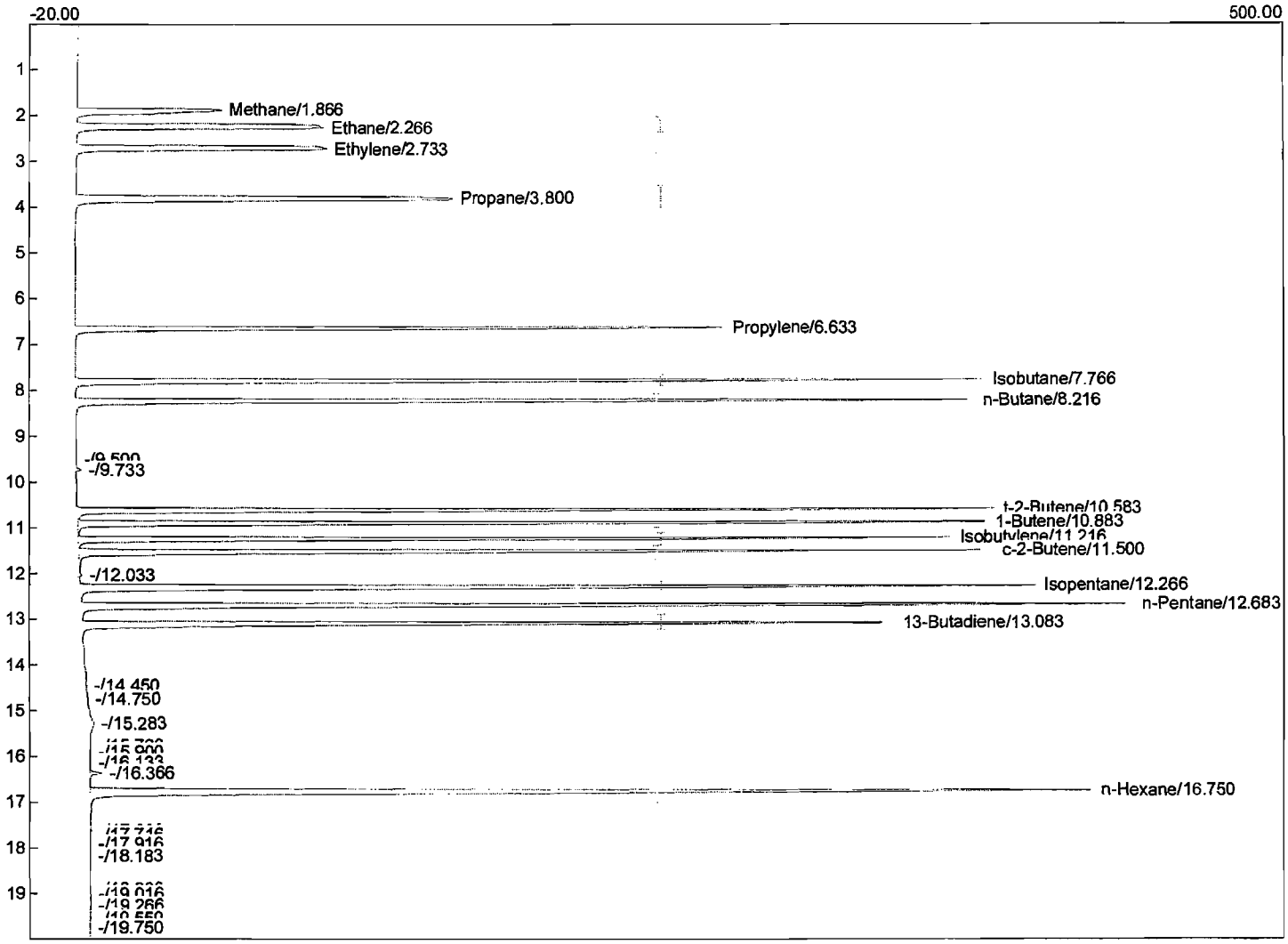
Component	Area
Methane	1845.2
Ethane	354.3
Ethylene	48.4
Propane	50.2
Propylene	17.8
Isobutane	4.3
n-Butane	7.0
t-2-Butene	3.6
1-Butene	4.4
Isobutylene	0.0
c-2-Butene	2.6
Isopentane	2.5
n-Pentane	2.6
13-Butadiene	12.0
n-Hexane	6.9
	2361.8

Lab name: ARI Environmental
Analysis date: 08/12/2011 11:39:32
Method: M-18
Data file: DC811-39.CHR ()
Sample: 100 ppmv LCS



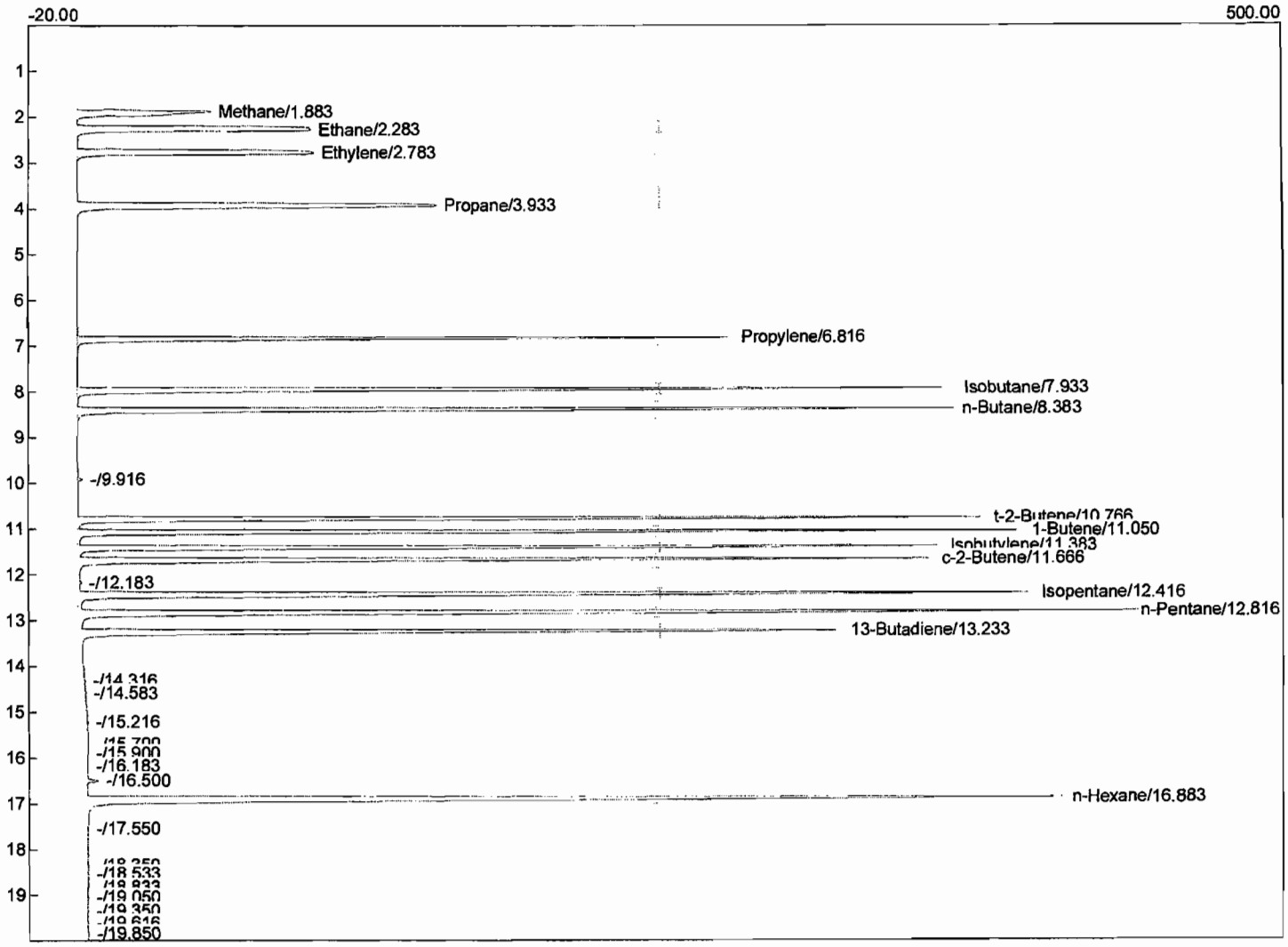
Component	Area
Methane	392.6
Ethane	745.5
Ethylene	732.5
Propane	1103.2
Propylene	1046.0
Isobutane	1420.3
n-Butane	1508.4
t-2-Butene	1484.3
1-Butene	1483.8
Isobutylene	1397.6
c-2-Butene	1507.9
Isopentane	1882.7
n-Pentane	1895.1
13-Butadiene	1460.9
n-Hexane	2212.5
	20273.1

Lab name: ARI Environmental
Analysis date: 08/12/2011 12:04:32
Method: M-18
Data file: DC811-40.CHR ()
Sample: 100 ppmv LCS



Component	Area
Methane	380.1
Ethane	720.2
Ethylene	705.7
Propane	1071.8
Propylene	1030.3
Isobutane	1423.4
n-Butane	1482.3
t-2-Butene	1447.7
1-Butene	1459.1
Isobutylene	1362.6
c-2-Butene	1471.8
Isopentane	1835.7
n-Pentane	1847.1
13-Butadiene	1424.1
n-Hexane	2113.4
	19775.2

Lab name: ARI Environmental
Analysis date: 08/12/2011 12:29:32
Method: M-18
Data file: DC811-41.CHR ()
Sample: 100 ppmv LCS



Component	Area
Methane	357.0
Ethane	691.4
Ethylene	673.8
Propane	1030.3
Propylene	996.6
Isobutane	1379.6
n-Butane	1444.4
t-2-Butene	1399.6
1-Butene	1408.5
Isobutylene	1319.5
c-2-Butene	1409.8
Isopentane	1760.8
n-Pentane	1788.0
13-Butadiene	1357.6
n-Hexane	2054.0
	19070.7

Standards Calculated as Sample Results

File	Date	Time	Description	DF	Methane ppmv	Ethane ppmv	Ethylene ppmv	Propane ppmv	Propylene ppmv	Isobutane ppmv	n-Butane ppmv	t-2-Butene ppmv	1-Butene ppmv	Isobutylene ppmv	c-2-Butene ppmv	Isopentane ppmv	n-Pentane ppmv	1,3-Butadiene ppmv	n-Hexane ppmv
DC811-03.CHR	8/10/11	9:50 AM	1.0 ppmv STD	1.00	1.00	0.93	0.90	1.0	0.98	0.94	0.97	0.90	0.90	0.88	0.91	0.93	0.93	0.90	1.06
DC811-04.CHR	8/10/11	10:15 AM	1.0 ppmv STD	1.00	1.0	0.93	0.95	1.0	0.92	0.91	0.93	0.91	0.85	0.92	0.94	0.91	0.97	0.96	1.14
DC811-05.CHR	8/10/11	10:40 AM	1.0 ppmv STD	1.00	1.1	1.0	0.99	1.1	0.96	1.0	0.93	0.92	0.84	0.85	0.90	0.90	0.97	0.93	1.08
				Ave =	1.0	0.95	0.95	1.0	0.96	0.95	0.94	0.91	0.86	0.88	0.92	0.92	0.96	0.93	1.1
DC811-07.CHR	8/10/11	11:54 AM	100.0 ppmv STD	1.00	89.6	94.1	95.1	90.4	94.1	94.8	94.1	95.8	99.3	98.3	95.3	95.0	93.1	94.2	85.6
DC811-08.CHR	8/10/11	12:19 PM	100.0 ppmv STD	1.00	92.8	98.5	99.1	95.5	98.5	100.9	99.5	102.1	102.0	102.3	97.9	100.5	98.3	99.7	91.3
DC811-09.CHR	8/10/11	12:44 PM	100.0 ppmv STD	1.00	93.4	99.3	99.8	95.7	101.4	99.9	100.3	102.8	103.9	106.2	103.2	101.7	99.5	99.6	93.3
				Ave =	91.9	97.3	98.0	93.9	98.0	98.5	98.0	100.2	101.8	102.3	98.8	99.1	97.0	97.8	90.1
DC811-12.CHR	8/10/11	1:57 PM	1000 ppmv STD	1.00	1,043	1,084	1,083	1,023	1,078	1,070	1,089	1,082	1,130	1,087	1,112	1,102	1,074	1,120	1,017
DC811-13.CHR	8/10/11	2:22 PM	1000 ppmv STD	1.00	1,023	1,077	1,074	1,008	1,062	1,055	1,067	1,093	1,122	1,106	1,096	1,095	1,080	1,084	995
DC811-14.CHR	8/10/11	2:47 PM	1000 ppmv STD	1.00	1,012	1,060	1,066	1,004	1,052	1,075	1,082	1,080	1,105	1,092	1,082	1,081	1,054	1,079	995
				Ave =	1026	1074	1074	1012	1064	1067	1079	1085	1119	1095	1097	1092	1069	1094	1002
DC811-39.CHR	8/12/11	11:39 AM	LCS Sample	1.0	392.6	745.5	732.5	1,103.2	1,046.0	1,420.3	1,508.4	1,484.3	1,483.8	1,397.6	1,507.9	1,882.7	1,895.1	1,460.9	2,212.5
DC811-40.CHR	8/12/11	12:04 PM	LCS Sample	1.0	380.1	720.2	705.7	1,071.8	1,030.3	1,423.4	1,482.3	1,447.7	1,459.1	1,362.6	1,471.8	1,835.7	1,847.1	1,424.1	2,113.4
DC811-41.CHR	8/12/11	12:29 PM	LCS Sample	1.0	357.0	691.4	673.8	1,030.3	996.6	1,379.6	1,444.4	1,399.6	1,408.5	1,319.5	1,409.8	1,760.8	1,788.0	1,357.6	2,054.0

Sample Results

DC811-15.CHR	8/10/11	4:08 PM	Bag 1 Run 7	30.0	20,494	2,153	270	279	64.7	25.0	37.4	22.4	18.0	18.5	26.7	44.5	51.6	12.6	96.2
DC811-16.CHR	8/10/11	4:33 PM	Bag 1 Run 7	30.0	20,120	2,099	260	272	63.9	20.5	30.3	14.8	9.2	12.8	17.2	34.7	37.1	5.5	81.8
DC811-17.CHR	8/10/11	4:58 PM	Bag 1 Run 7	30.0	20,140	2,093	258	271	60.5	23.8	28.4	11.5	6.7	9.9	10.0	26.6	26.4	4.2	60.8
				Ave =	20,251	2,115	263	274	63.0	23.1	32.0	16.2	11.3	13.7	18.0	35.2	38.4	7.4	79.6
DC811-18.CHR	8/10/11	5:22 PM	Bag 2 Run 8	10.0	6,725	844	94.7	78.6	0.0	5.2	8.7	3.8	2.2	2.2	2.5	6.1	5.9	0.7	14.5
DC811-19.CHR	8/10/11	5:47 PM	Bag 2 Run 8	10.0	6,726	840	94.5	77.7	24.9	5.2	8.5	4.2	2.0	2.3	2.7	5.6	5.1	1.1	12.3
DC811-20.CHR	8/10/11	6:12 PM	Bag 2 Run 8	10.0	6,672	839	94.0	77.3	25.2	5.1	8.8	4.2	1.7	2.6	4.0	4.9	4.8	1.3	9.7
				Ave =	6,708	841	94.4	77.9	16.7	5.2	8.7	4.1	2.0	2.4	3.1	5.6	5.3	1.0	12.2
DC811-21.CHR	8/10/11	6:39 PM	Bag 3 Run 9	100.0															
DC811-22.CHR	8/10/11	7:04 PM	Bag 3 Run 9	100.0	Off Scale														
DC811-23.CHR	8/10/11	7:29 PM	Bag 3 Run 9	100.0															
DC811-24.CHR	8/11/11	9:01 AM	Bag 3 Run 9	200.0	90,580	9,747	1,380	897	334	69.7	91.9	49.3	25.1	20.5	40.1	23.6	21.0	92.8	23.5
DC811-25.CHR	8/11/11	9:26 AM	Bag 3 Run 9	200.0	91,347	9,539	1,338	894	342	56.1	94.5	37.0	75.4	17.6	34.7	24.7	23.1	129	49.6
DC811-26.CHR	8/11/11	9:51 AM	Bag 3 Run 9	200.0	91,920	9,558	1,347	878	332	58.8	91.9	49.3	61.4	0.0	34.7	26.9	27.3	169	58.0
				Ave =	91,282	9,615	1,355	890	336.1	61.5	92.8	45.2	54.0	12.7	36.5	25.1	23.8	130	43.7
DC811-27.CHR	8/11/11	10:29 AM	Bag 1 Run 7 Spike	60.0	28,313	13,269	11,876	11,164	11,658	11,372	11,354	11,959	12,036	11,979	11,573	11,394	11,250	11,680	10,301
DC811-28.CHR	8/11/11	10:54 AM	Bag 1 Run 7 Spike	60.0	27,681	13,066	11,666	11,084	11,232	11,494	11,548	11,533	11,945	12,081	11,446	11,392	11,157	11,654	10,379
DC811-29.CHR	8/11/11	11:19 AM	Bag 1 Run 7 Spike	60.0	27,567	13,041	11,604	11,060	11,217	11,361	11,301	11,529	11,910	12,059	11,517	11,395	11,206	11,442	10,399
				Ave =	27,847	13,125	11,715	11,103	11,369	11,409	11,401	11,674	11,964	12,040	11,512	11,394	11,204	11,592	10,360
				% Rec =	76.0	110.1	114.5	108.3	113.1	113.9	113.7	116.6	119.5	120.3	114.9	113.8	111.7	115.8	102.8
			Spike Details		200 ml Sample + 2000 ml of 1000 ppmv STD+9800 ml Nitrogen from Cylinder No: CC67464									Spiked on 8/4/11 @ 5:30 pm					
DC811-31.CHR	8/11/11	1:14 PM	100.0 End STD	1.0	90.1	91.9	92.7	88.9	90.7	92.8	92.5	98.1	98.3	97.2	95.6	94.6	95.3	95.5	86.0
DC811-32.CHR	8/11/11	1:39 PM	100.0 End STD	1.0	92.7	97.9	99.1	94.6	99.5	99.9	99.9	101.0	103.2	104.7	100.2	99.9	97.9	100.0	91.5
DC811-33.CHR	8/11/11	2:04 PM	100.0 End STD	1.0	92.6	94.9	95.9	89.2	95.4	95.9	95.8	99.0	99.0	103.4	99.1	97.8	95.4	96.5	88.3
				Ave =	91.8	94.9	95.9	90.9	95.2	96.2	96.1	99.3	100.1	101.8	98.3	97.4	96.2	97.4	88.6
DC811-39.CHR	8/12/11	11:39 AM	LCS Sample	1.0	97.8	100.6	101.9	96.5	97.7	97.1	99.0	101.6	103.6	102.5	100.7	101.2	99.3	102.7	93.0
DC811-40.CHR	8/12/11	12:04 PM	LCS Sample	1.0	94.7	97.1	98.2	93.8	96.2	97.3	97.3	99.1	101.8	99.9	98.3	98.6	96.8	100.1	88.8
DC811-41.CHR	8/12/11	12:29 PM	LCS Sample	1.0	88.9	93.3	93.7	90.1	93.1	94.3	94.8	95.8	98.3	96.8	94.2	94.6	93.7	95.4	86.3
				Ave =	93.8	97.0	97.9	93.5	95.6	96.3	97.1	98.8	101.2	99.7	97.8	98.1	96.6	99.4	89.4

LCS was from Cylinder No: ALM068014

HREF-C1TOC6-WORKBOOK-028T-REV1				RF =	4.015	7.414	7.188	11.432	10.710	14.625	15.231	14.613	14.327	13.637	14.967	18.613	19.082	14.231	23.789
Peak Areas																			
File	Date	Time	Description	DF	Methane Area	Ethane Area	Ethylene Area	Propane Area	Propylene Area	Isobutane Area	n-Butane Area	t-2-Butene Area	1-Butene Area	Isobutylene Area	c-2-Butene Area	Isopentane Area	n-Pentane Area	1,3-Butadiene Area	n-Hexane Area
DC811-03.CHR	8/10/11	9:50 AM	1.0 ppmv STD	1.00	4.0	6.9	6.5	11.8	10.5	13.7	14.7	13.2	12.9	12.0	13.6	17.4	17.8	12.8	25.3
DC811-04.CHR	8/10/11	10:15 AM	1.0 ppmv STD	1.00	4.2	6.9	6.8	11.6	9.9	13.3	14.1	13.3	12.2	12.5	14.1	17.0	18.6	13.6	27.2
DC811-05.CHR	8/10/11	10:40 AM	1.0 ppmv STD	1.00	4.3	7.4	7.1	12.6	10.3	14.6	14.2	13.5	12.0	11.6	13.4	16.8	18.6	13.2	25.8
DC811-07.CHR	8/10/11	11:54 AM	100.0 ppmv STD	1.00	359.7	697.5	683.5	1,033.0	1,008.2	1,386.5	1,433.0	1,400.0	1,423.1	1,340.1	1,426.2	1,767.4	1,776.8	1,340.6	2,037.2
DC811-08.CHR	8/10/11	12:19 PM	100.0 ppmv STD	1.00	372.7	730.6	712.2	1,092.1	1,055.3	1,475.0	1,514.9	1,491.6	1,461.7	1,395.0	1,465.0	1,871.4	1,876.1	1,418.4	2,172.1
DC811-09.CHR	8/10/11	12:44 PM	100.0 ppmv STD	1.00	375.0	736.1	717.2	1,094.0	1,086.3	1,460.7	1,527.9	1,502.7	1,488.9	1,448.5	1,544.4	1,893.2	1,899.2	1,417.9	2,219.3
DC811-12.CHR	8/10/11	1:57 PM	1000 ppmv STD	1.00	4,186.4	8,035.7	7,785.3	11,692.1	11,550.1	15,653.0	16,592.5	15,813.6	16,195.1	14,823.7	16,639.4	20,506.9	20,488.9	15,942.9	24,185.2
DC811-13.CHR	8/10/11	2:22 PM	1000 ppmv STD	1.00	4,109.0	7,984.2	7,719.5	11,524.9	11,378.0	15,427.3	16,254.9	15,973.3	16,074.8	15,076.2	16,408.3	20,376.7	20,607.9	15,421.2	23,671.1
DC811-14.CHR	8/10/11	2:47 PM	1000 ppmv STD	1.00	4,064.5	7,861.0	7,662.6	11,479.1	11,264.4	15,719.4	16,473.3	15,787.3	15,831.7	14,896.6	16,198.4	20,112.0	20,117.1	15,349.7	23,659.4
			Initial Ave Peak Area =		369.1	721.4	704.3	1,073.0	1,049.9	1,440.7	1,491.9	1,464.8	1,457.9	1,394.5	1,478.5	1,844.0	1,850.7	1,392.3	2,142.9
			End Ave Peak Area =		368.6	703.7	689.6	1,039.0	1,019.9	1,406.6	1,463.2	1,451.6	1,434.8	1,387.8	1,471.4	1,813.8	1,835.5	1,385.6	2,107.8
			% Difference =		0.1	2.5	2.1	3.2	2.9	2.4	1.9	0.9	1.6	0.5	0.5	1.7	0.8	0.5	1.6
			All Calibration STDs were from Cylinder No: CC67464																
DC811-15.CHR	8/10/11	4:08 PM	Bag 1 Run 7	30.0	2,742.6	532.1	64.6	106.2	23.1	12.2	19.0	10.9	8.6	8.4	13.3	27.6	32.8	6.0	76.3
DC811-16.CHR	8/10/11	4:33 PM	Bag 1 Run 7	30.0	2,692.8	518.8	62.4	103.5	22.8	10.0	15.4	7.2	4.4	5.8	8.6	21.5	23.6	2.6	64.9
DC811-17.CHR	8/10/11	4:58 PM	Bag 1 Run 7	30.0	2,695.3	517.3	61.9	103.3	21.6	11.6	14.4	5.6	3.2	4.5	5.0	16.5	16.8	2.0	48.2
DC811-18.CHR	8/10/11	5:22 PM	Bag 2 Run 8	10.0	2,699.8	625.7	68.1	89.8	0.0	7.6	13.3	5.5	3.2	3.0	3.8	11.4	11.2	1.0	34.6
DC811-19.CHR	8/10/11	5:47 PM	Bag 2 Run 8	10.0	2,700.3	622.9	67.9	88.8	26.7	7.6	12.9	8.1	2.8	3.2	4.0	10.5	9.7	1.6	29.2
DC811-20.CHR	8/10/11	6:12 PM	Bag 2 Run 8	10.0	2,678.6	621.7	67.6	88.4	27.0	7.4	13.4	6.2	2.4	3.6	6.0	9.1	9.2	1.8	23.1
DC811-21.CHR	8/10/11	6:39 PM	Bag 3 Run 9	100.0															
DC811-22.CHR	8/10/11	7:04 PM	Bag 3 Run 9	100.0	Off Scale														
DC811-23.CHR	8/10/11	7:29 PM	Bag 3 Run 9	100.0															
DC811-24.CHR	8/11/11	9:01 AM	Bag 3 Run 9	200.0	1,818.3	361.3	49.6	51.3	17.9	5.1	7.0	3.6	1.8	1.4	3.0	2.2	2.0	6.6	2.8
DC811-25.CHR	8/11/11	9:26 AM	Bag 3 Run 9	200.0	1,833.7	353.6	48.1	51.1	18.3	4.1	7.2	2.7	5.4	1.2	2.6	2.3	2.2	9.2	5.9
DC811-26.CHR	8/11/11	9:51 AM	Bag 3 Run 9	200.0	1,845.2	354.3	48.4	50.2	17.8	4.3	7.0	3.6	4.4	0.0	2.6	2.5	2.6	12.0	6.9
DC811-27.CHR	8/11/11	10:29 AM	Bag 1 Run 7 Spike	60.0	1,894.5	1,639.5	1,422.8	2,127.1	2,080.9	2,771.8	2,882.3	2,912.6	2,874.0	2,722.7	2,886.9	3,534.5	3,577.9	2,770.5	4,084.2
DC811-28.CHR	8/11/11	10:54 AM	Bag 1 Run 7 Spike	60.0	1,850.9	1,614.4	1,397.7	2,111.9	2,004.9	2,801.7	2,931.5	2,808.9	2,852.2	2,745.7	2,855.1	3,533.9	3,548.1	2,764.1	4,115.1
DC811-29.CHR	8/11/11	11:19 AM	Bag 1 Run 7 Spike	60.0	1,844.8	1,611.3	1,390.2	2,107.2	2,002.2	2,769.2	2,868.8	2,807.9	2,843.8	2,740.8	2,873.0	3,534.9	3,563.7	2,714.0	4,123.1
DC811-31.CHR	8/11/11	1:14 PM	100.0 End STD	1.0	361.9	681.5	666.7	1,016.8	971.6	1,357.3	1,408.8	1,433.0	1,408.1	1,326.1	1,430.4	1,761.0	1,818.3	1,359.3	2,046.8
DC811-32.CHR	8/11/11	1:39 PM	100.0 End STD	1.0	372.2	725.6	712.6	1,081.0	1,066.1	1,460.3	1,521.4	1,475.9	1,478.1	1,427.5	1,500.3	1,859.2	1,868.2	1,423.8	2,176.4
DC811-33.CHR	8/11/11	2:04 PM	100.0 End STD	1.0	371.7	703.9	689.4	1,019.2	1,022.1	1,402.1	1,459.3	1,446.0	1,418.2	1,409.7	1,483.5	1,821.1	1,820.1	1,373.7	2,100.3

Initial Calibration - 8/10/11

Initial Cal Page 1

Compound Name	Area (1)	Area (2)	Area (3)	Area (ave)	Area (1) % Dev	Area (2) % Dev	Area (3) % Dev
Methane	4.0	4.2	4.3	4.2	4.0	0.8	3.2
Ethane	6.9	6.9	7.4	7.1	2.4	2.4	4.7
Ethylene	6.5	6.8	7.1	6.8	4.4	0.0	4.4
Propane	11.8	11.6	12.6	12.0	1.7	3.3	5.0
Propylene	10.5	9.9	10.3	10.2	2.6	3.3	0.7
Isobutane	13.7	13.3	14.6	13.9	1.2	4.1	5.3
n-Butane	14.7	14.1	14.2	14.3	2.6	1.6	0.9
t-2-Butene	13.2	13.3	13.5	13.3	1.0	0.2	1.3
1-Butene	12.9	12.2	12.0	12.4	4.3	1.3	3.0
Isobutylene	12.0	12.5	11.6	12.0	0.3	3.9	3.6
c-2-Butene	13.6	14.1	13.4	13.7	0.7	2.9	2.2
Isopentane	17.4	17.0	16.8	17.1	2.0	0.4	1.6
n-Pentane	17.8	18.6	18.6	18.3	2.9	1.5	1.5
1,3-Butadiene	12.8	13.6	13.2	13.2	3.0	3.0	0.0
n-Hexane	25.3	27.2	25.8	26.1	3.1	4.2	1.1

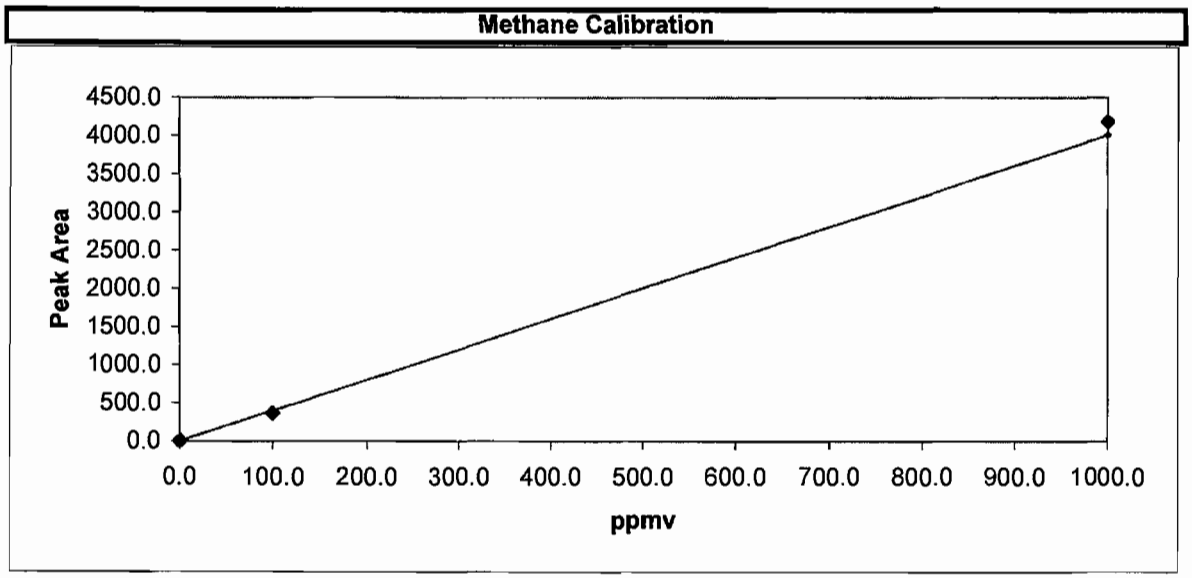
ppmv = 1.0

Compound Name	Area (1)	Area (2)	Area (3)	Area (ave)	Area (1) % Dev	Area (2) % Dev	Area (3) % Dev
Methane	359.7	372.7	375.0	369.1	2.6	1.0	1.6
Ethane	697.5	730.6	736.1	721.4	3.3	1.3	2.0
Ethylene	683.5	712.2	717.2	704.3	3.0	1.1	1.8
Propane	1,033.0	1,092.1	1,094.0	1,073.0	3.7	1.8	2.0
Propylene	1,008.2	1,055.3	1,086.3	1,049.9	4.0	0.5	3.5
Isobutane	1,386.5	1,475.0	1,460.7	1,440.7	3.8	2.4	1.4
n-Butane	1,433.0	1,514.9	1,527.9	1,491.9	4.0	1.5	2.4
t-2-Butene	1,400.0	1,491.6	1,502.7	1,464.8	4.4	1.8	2.6
1-Butene	1,423.1	1,461.7	1,488.9	1,457.9	2.4	0.3	2.1
Isobutylene	1,340.1	1,395.0	1,448.5	1,394.5	3.9	0.0	3.9
c-2-Butene	1,426.2	1,465.0	1,544.4	1,478.5	3.5	0.9	4.5
Isopentane	1,767.4	1,871.4	1,893.2	1,844.0	4.2	1.5	2.7
n-Pentane	1,776.8	1,876.1	1,899.2	1,850.7	4.0	1.4	2.6
1,3-Butadiene	1,340.6	1,418.4	1,417.9	1,392.3	3.7	1.9	1.8
n-Hexane	2,037.2	2,172.1	2,219.3	2,142.9	4.9	1.4	3.6

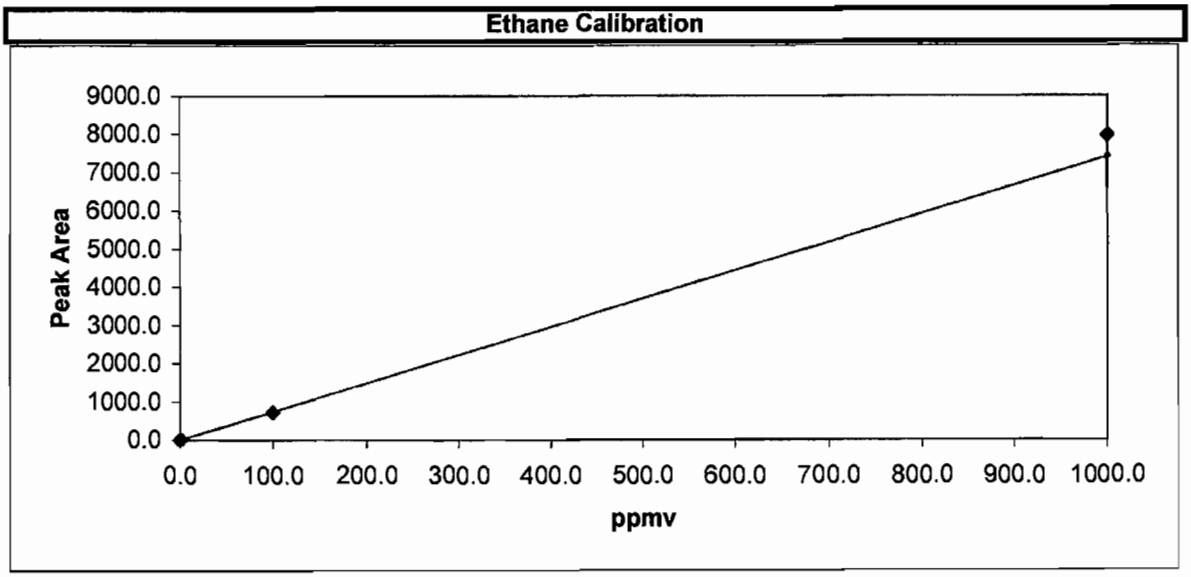
ppmv = 100.0

Compound Name	Area (1)	Area (2)	Area (3)	Area (ave)	Area (1) % Dev	Area (2) % Dev	Area (3) % Dev
Methane	4,186.4	4,109.0	4,064.5	4,120.0	1.6	0.3	1.3
Ethane	8,035.7	7,984.2	7,861.0	7,960.3	0.9	0.3	1.2
Ethylene	7,785.3	7,719.5	7,662.6	7,722.5	0.8	0.0	0.8
Propane	11,692.1	11,524.9	11,479.1	11,565.4	1.1	0.3	0.7
Propylene	11,550.1	11,378.0	11,264.4	11,397.5	1.3	0.2	1.2
Isobutane	15,653.0	15,427.3	15,719.4	15,599.9	0.3	1.1	0.8
n-Butane	16,592.5	16,254.9	16,473.3	16,440.2	0.9	1.1	0.2
t-2-Butene	15,813.6	15,973.3	15,787.3	15,858.1	0.3	0.7	0.4
1-Butene	16,195.1	16,074.8	15,831.7	16,033.9	1.0	0.3	1.3
Isobutylene	14,823.7	15,076.2	14,896.6	14,932.2	0.7	1.0	0.2
c-2-Butene	16,639.4	16,408.3	16,198.4	16,415.4	1.4	0.0	1.3
Isopentane	20,506.9	20,376.7	20,112.0	20,331.9	0.9	0.2	1.1
n-Pentane	20,488.9	20,607.9	20,117.1	20,404.6	0.4	1.0	1.4
1,3-Butadiene	15,942.9	15,421.2	15,349.7	15,571.3	2.4	1.0	1.4
n-Hexane	24,185.2	23,671.1	23,659.4	23,838.6	1.5	0.7	0.8

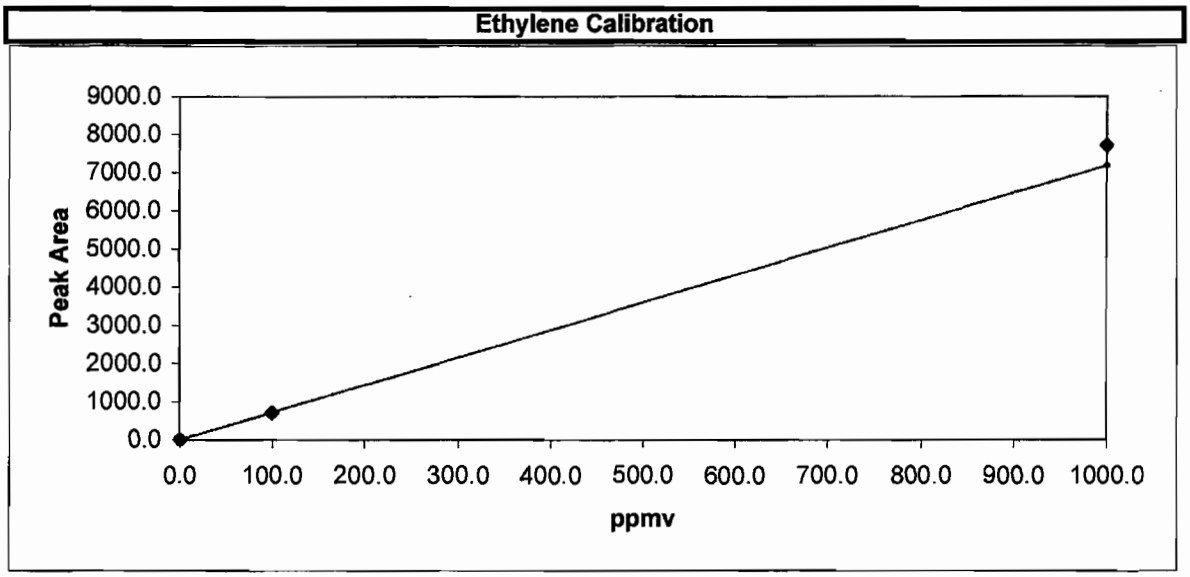
ppmv = 1,000.0



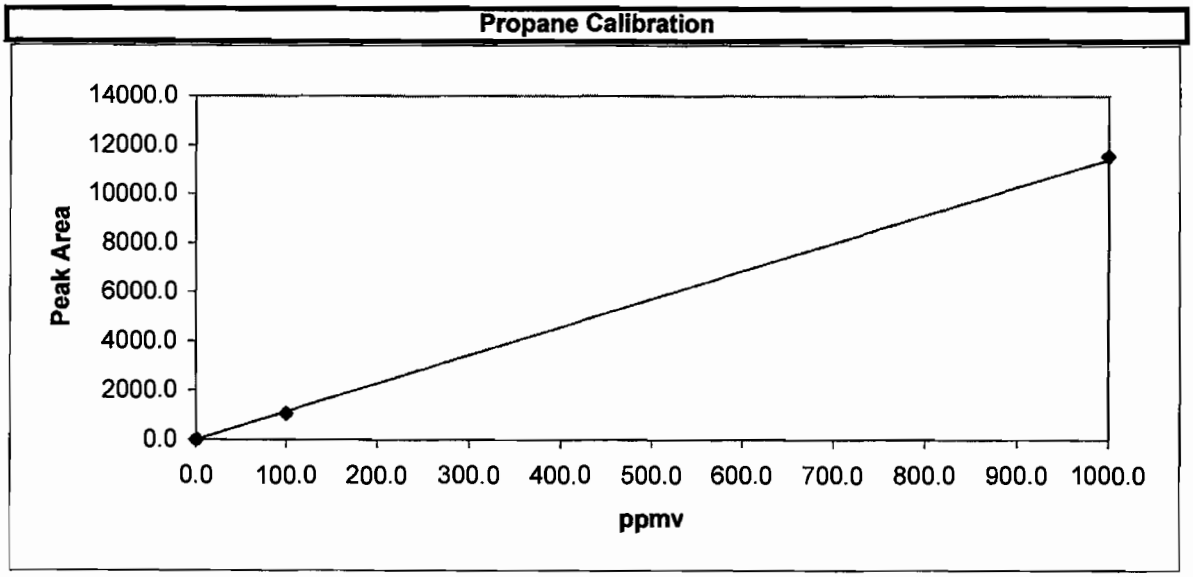
ppmv	area	RF	Corr
0.0	0.0	4.015	0.9999
1.0	4.2		
100.0	369.1		
1000.0	4,186.4		



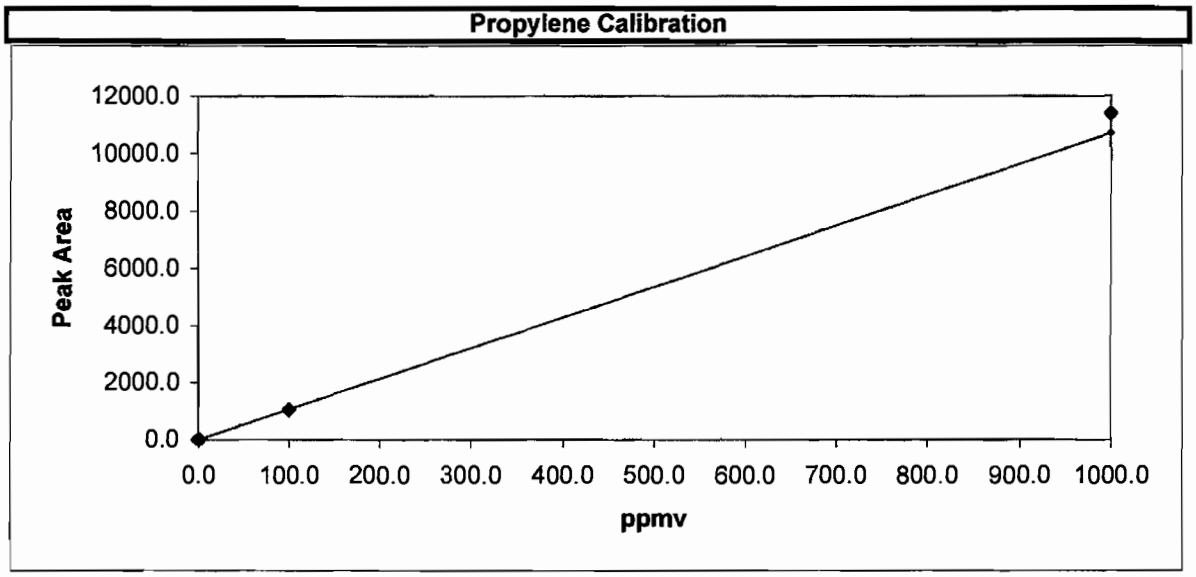
ppmv	area	RF	Corr
0.0	0.0	7.414	1.0000
1.0	7.1		
100.0	721.4		
1000.0	7,960.3		



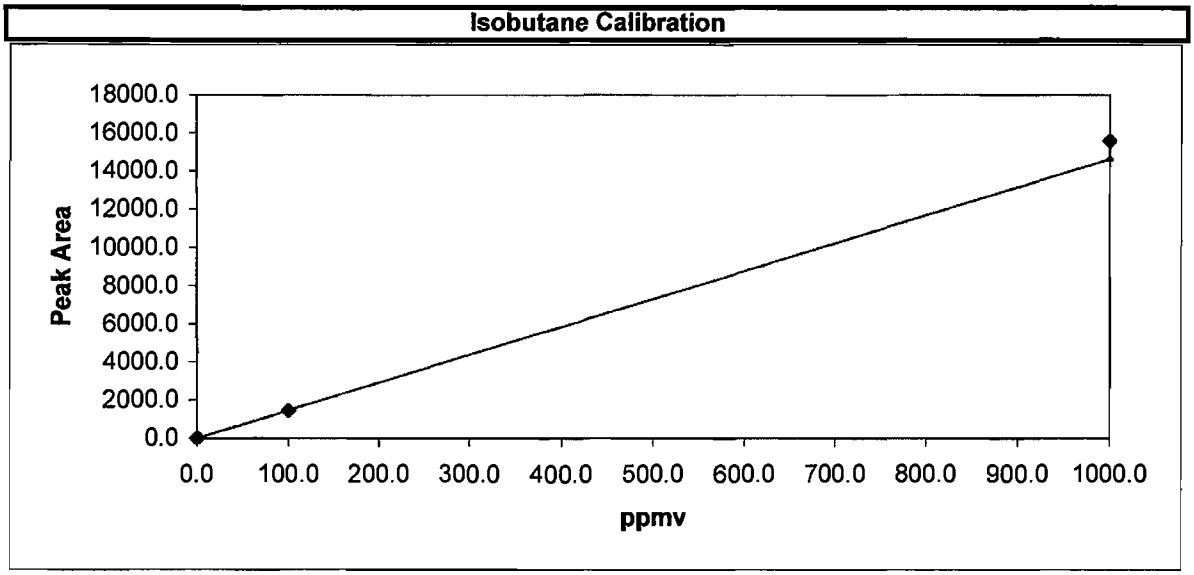
ppmv	area	RF	Corr
0.0	0.0	7.188	1.0000
1.0	6.8		
100.0	704.3		
1000.0	7,722.5		



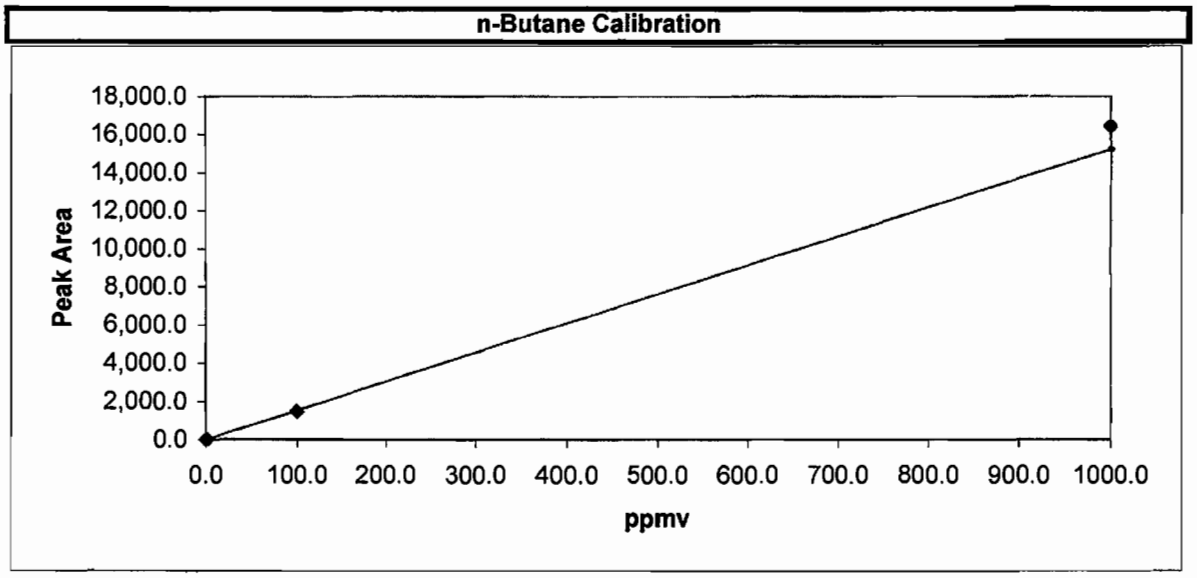
ppmv	area	RF	Corr
0.0	0.0	11.432	1.0000
1.0	12.0		
100.0	1,073.0		
1000.0	11,565.4		



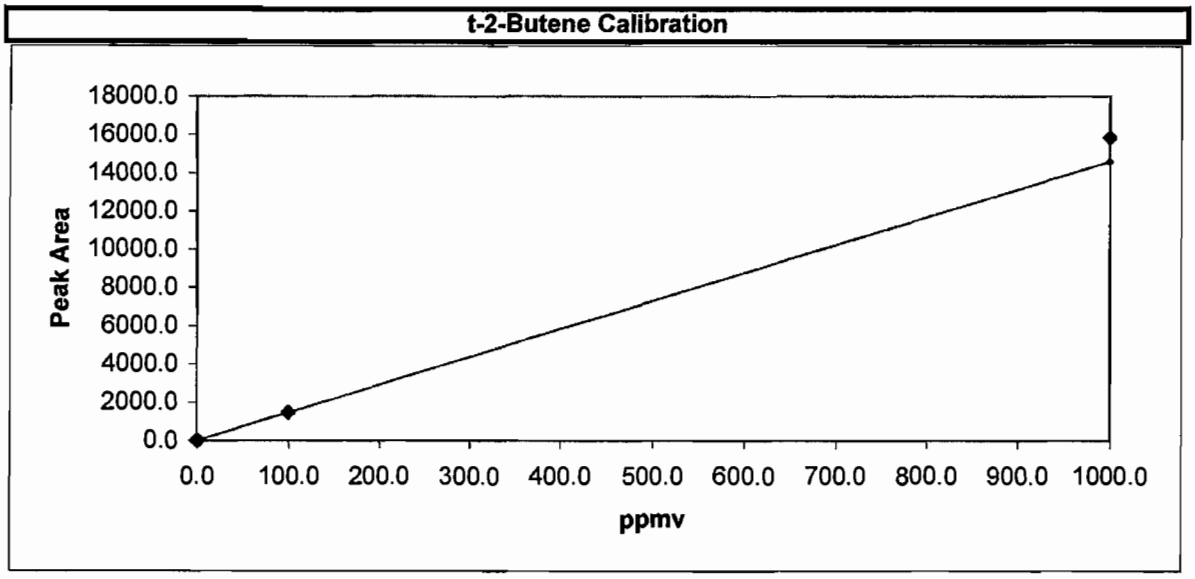
ppmv	area	RF	Corr
0.0	0.0	10.710	1.0000
1.0	10.2		
100.0	1,049.9		
1000.0	11,397.5		



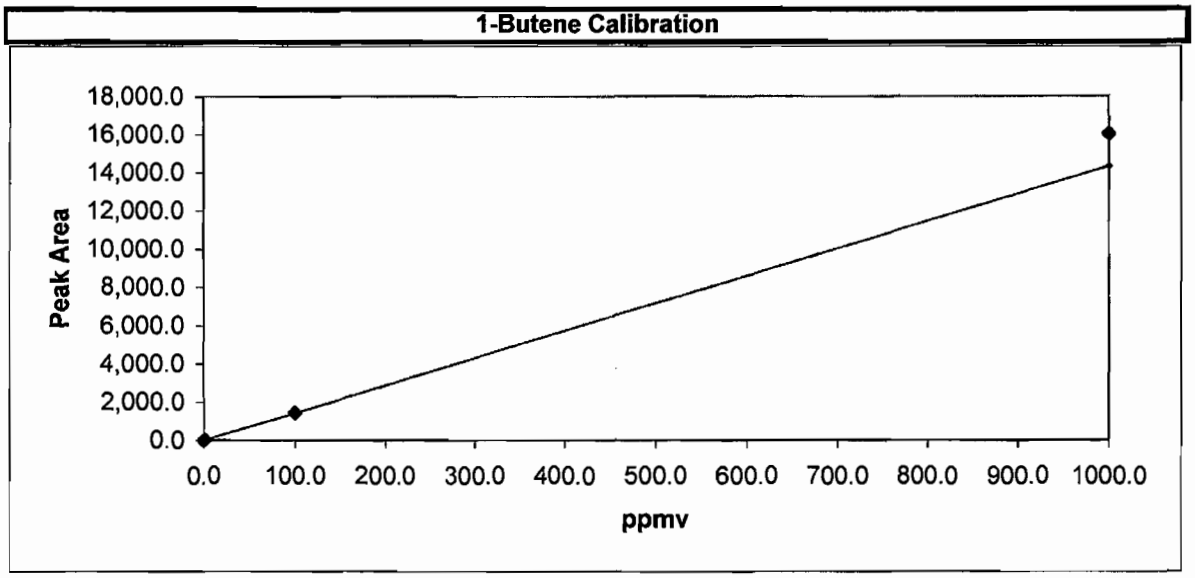
ppmv	area	RF	Corr
0.0	0.0	14.625	1.0000
1.0	13.9		
100.0	1,440.7		
1000.0	15,599.9		



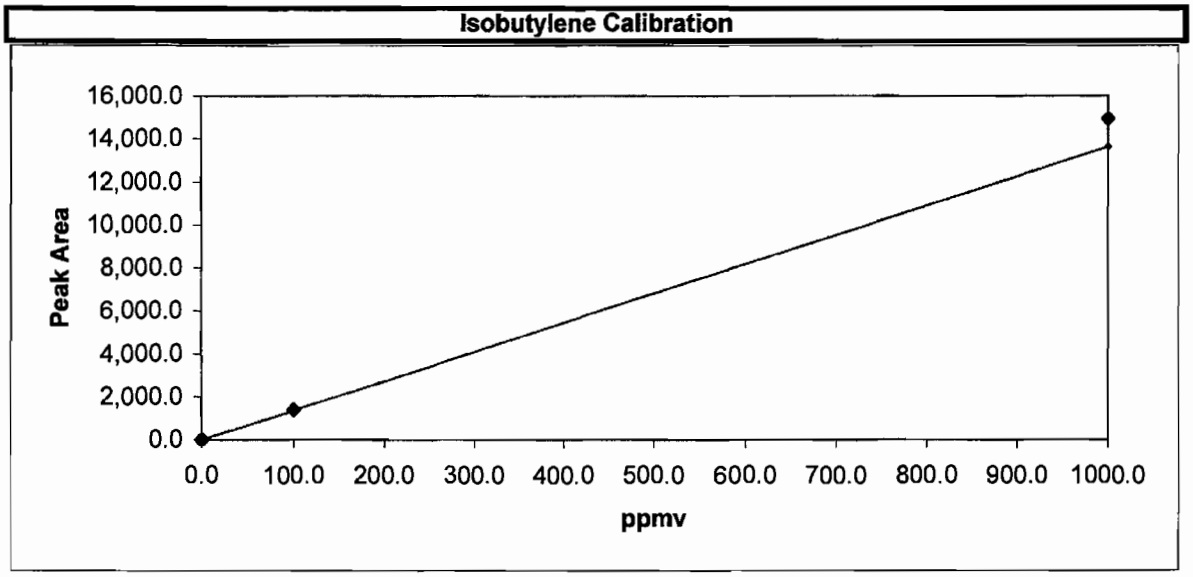
ppmv	area	RF	Corr
0.0	0.0	15.231	1.0000
1.0	14.3		
100.0	1,491.9		
1000.0	16,440.2		



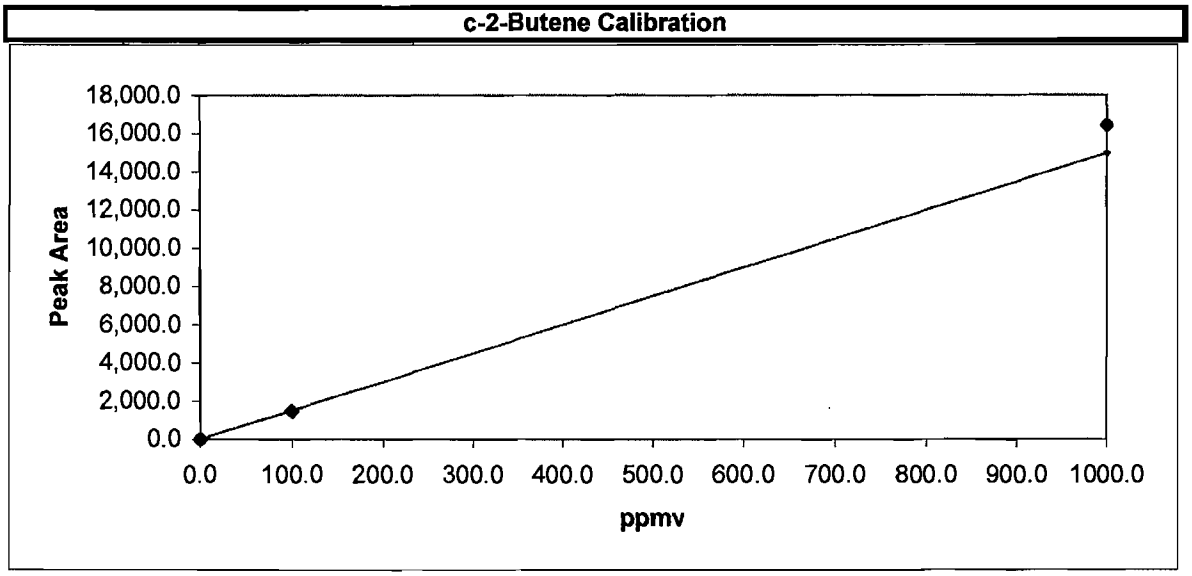
ppmv	area	RF	Corr
0.0	0.0	14.613	1.0000
1.0	13.3		
100.0	1,464.8		
1000.0	15,858.1		



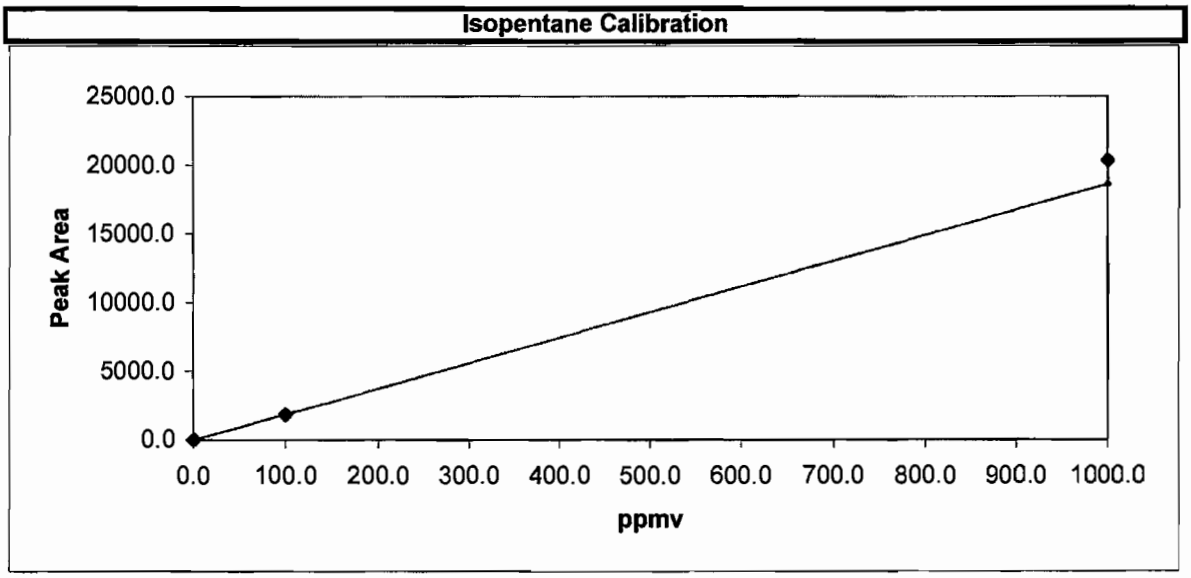
ppmv	area	RF	Corr
0.0	0.0	14.327	1.0000
1.0	12.4		
100.0	1,457.9		
1000.0	16,033.9		



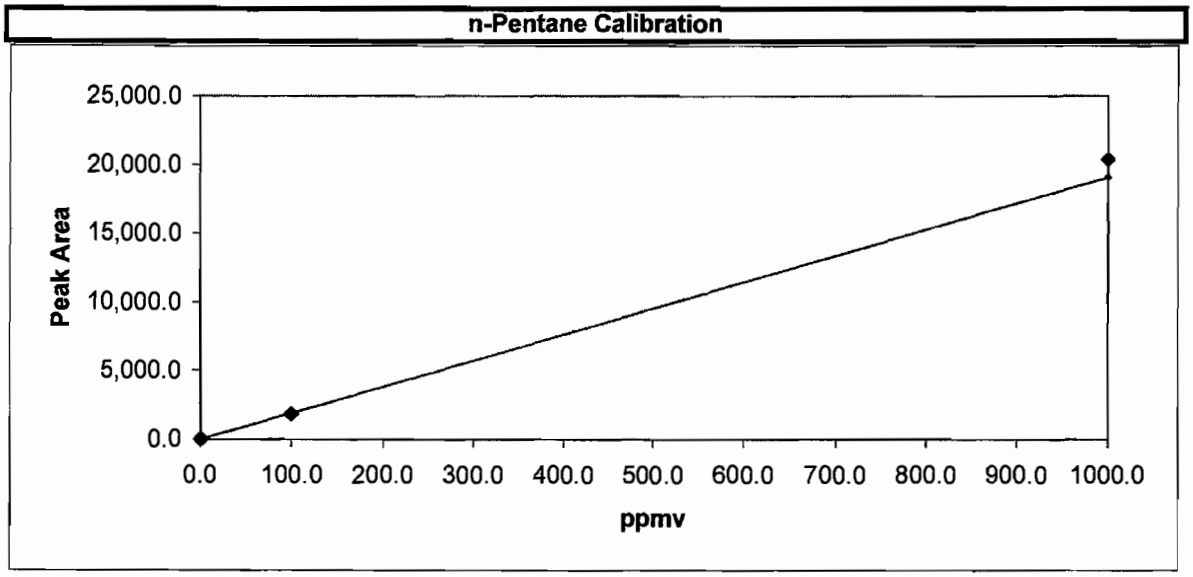
ppmv	area	RF	Corr
0.0	0.0	13.637	1.0000
1.0	12.0		
100.0	1,394.5		
1000.0	14,932.2		



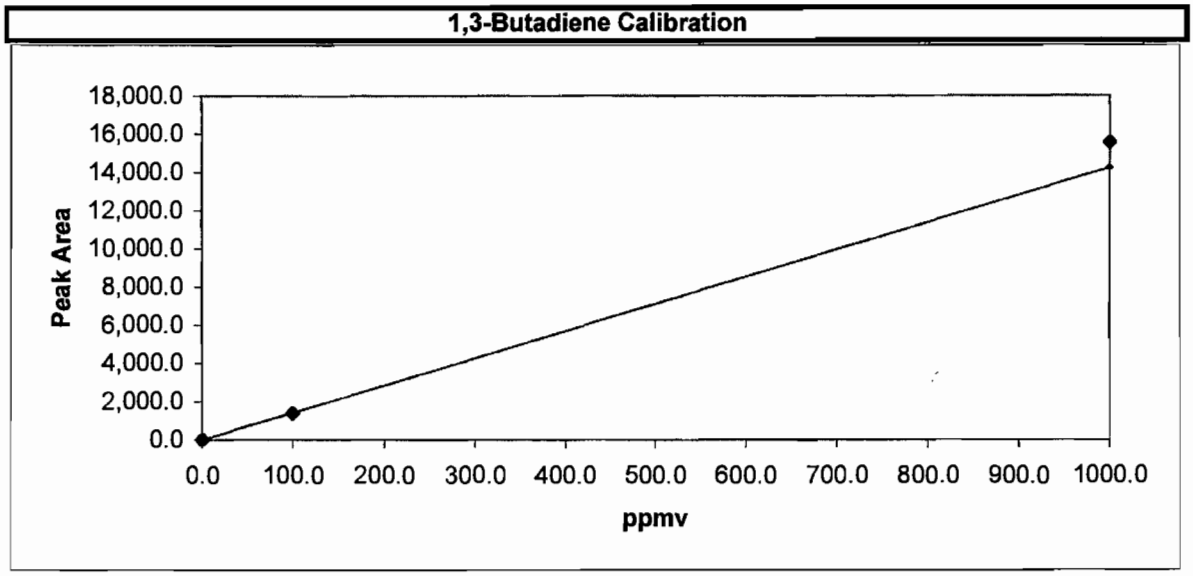
ppmv	area	RF	Corr
0.0	0.0	14.967	1.0000
1.0	13.7		
100.0	1,478.5		
1000.0	16,415.4		



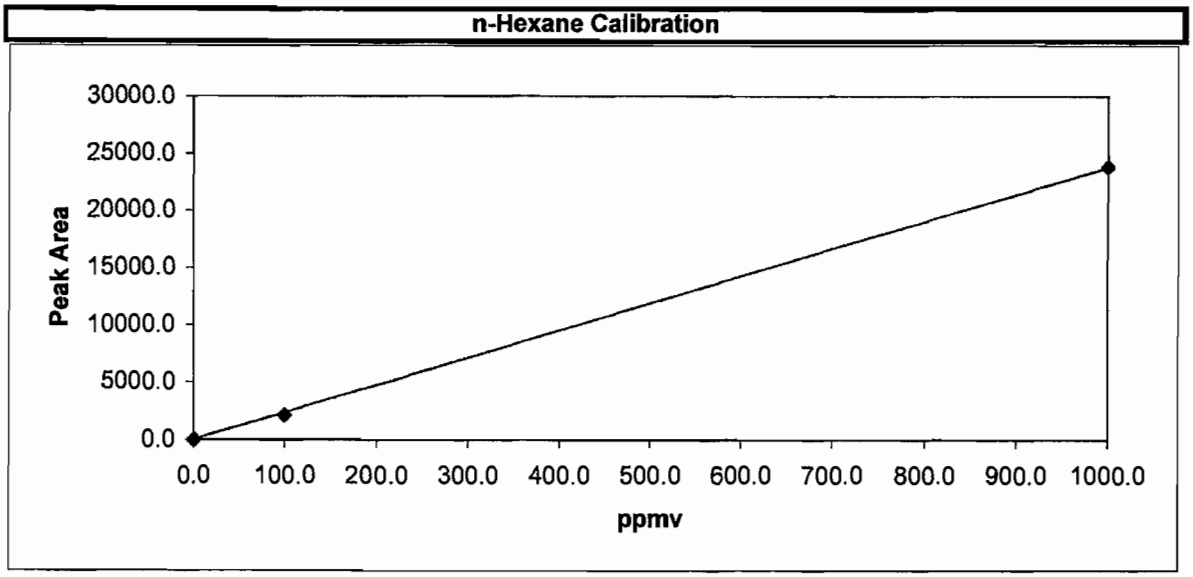
ppmv	area	RF	Corr
0.0	0.0	18.613	1.0000
1.0	17.1		
100.0	1,844.0		
1000.0	20,331.9		



ppmv	area	RF	Corr
0.0	0.0	19.082	1.0000
1.0	18.3		
100.0	1,850.7		
1000.0	20,404.6		

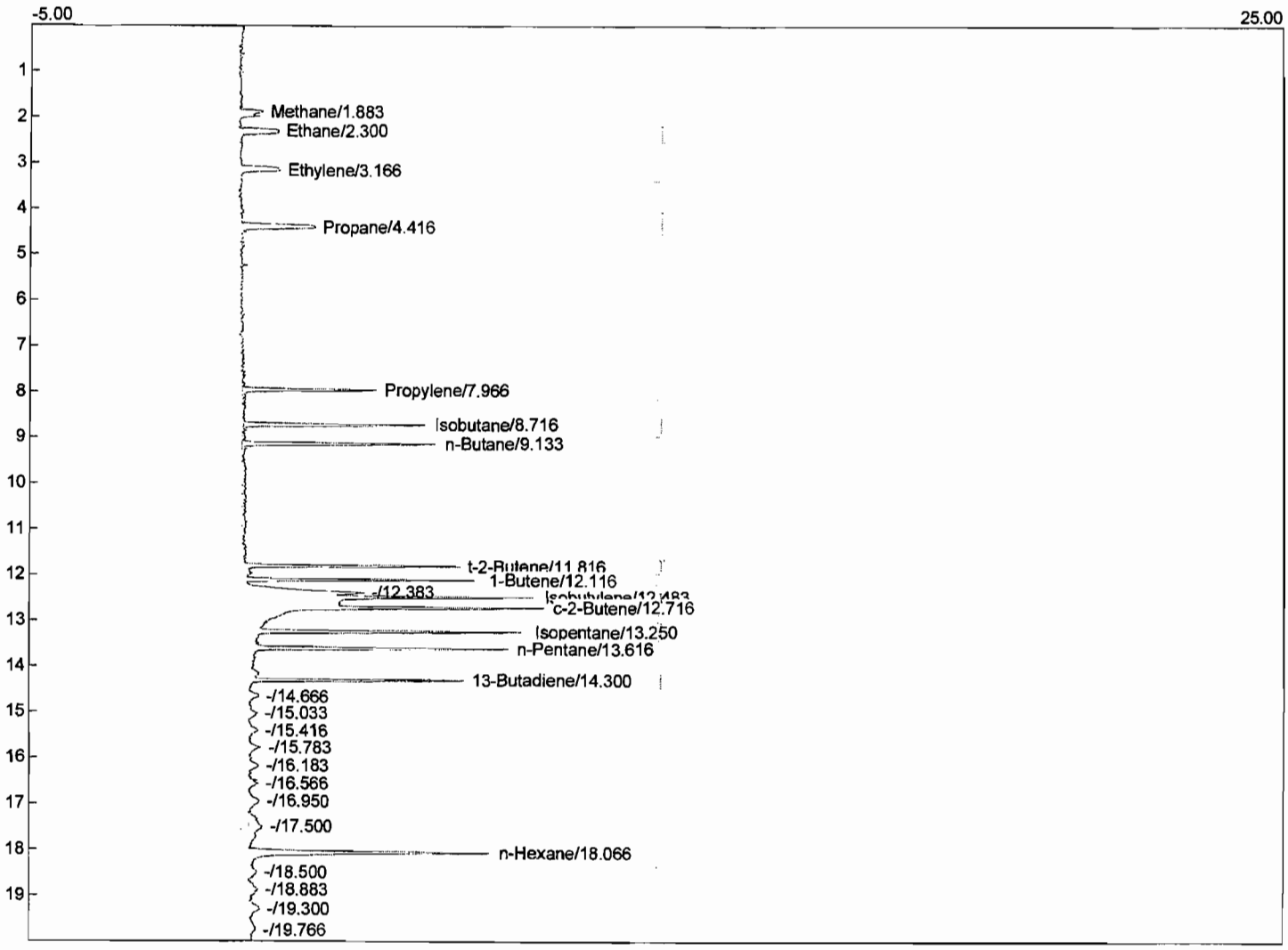


ppmv	area	RF	Corr
0.0	0.0	14.231	0.9999
1.0	13.2		
100.0	1,392.3		
1000.0	15,571.3		



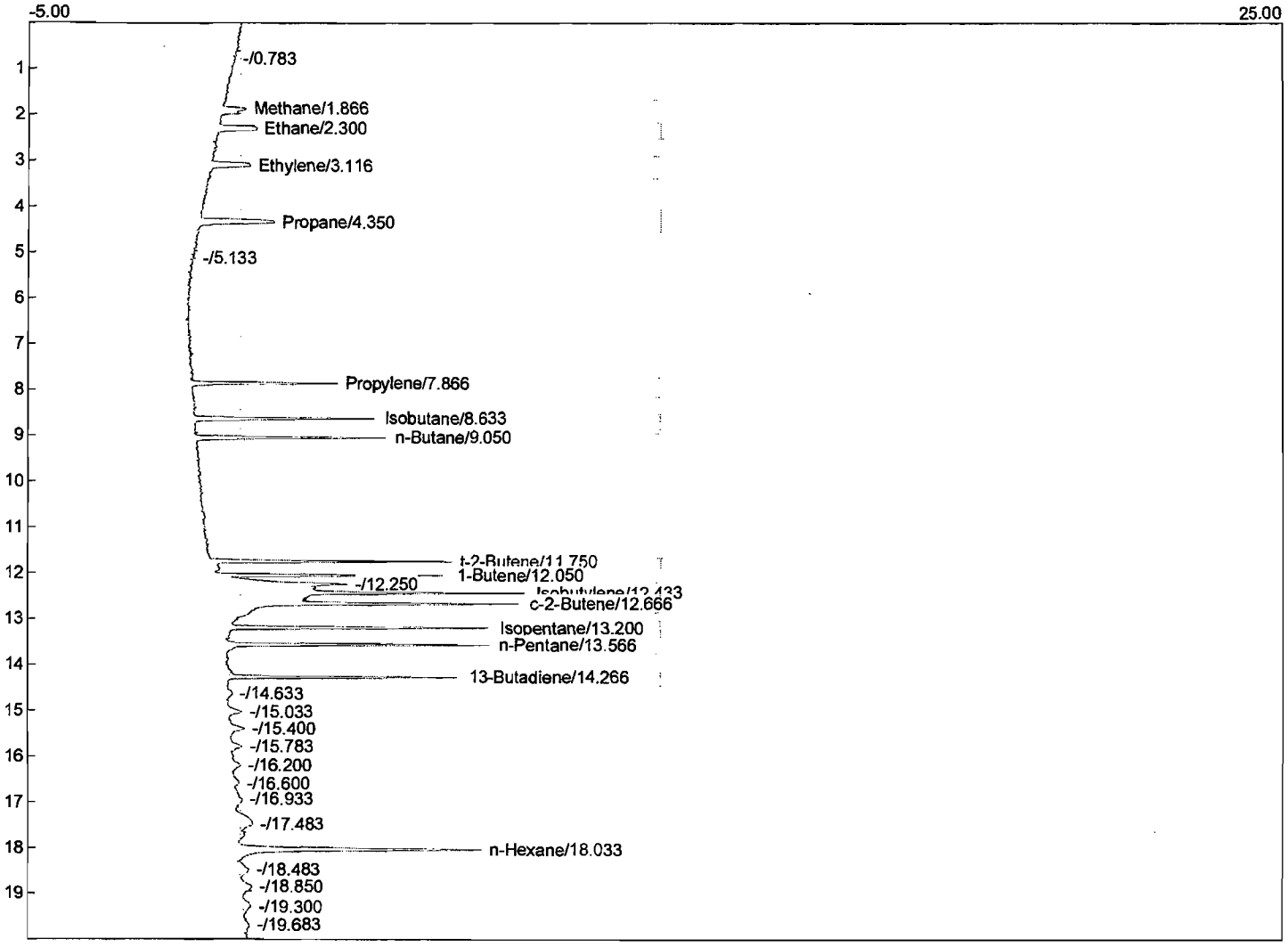
ppmv	area	RF	Corr
0.0	0.0	23.789	0.9999
1.0	26.1		
100.0	2,142.9		
1000.0	23,838.6		

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 09:50:44
Method: M-18
Data file: DC811-03.CHR ()
Sample: 1.0 STD



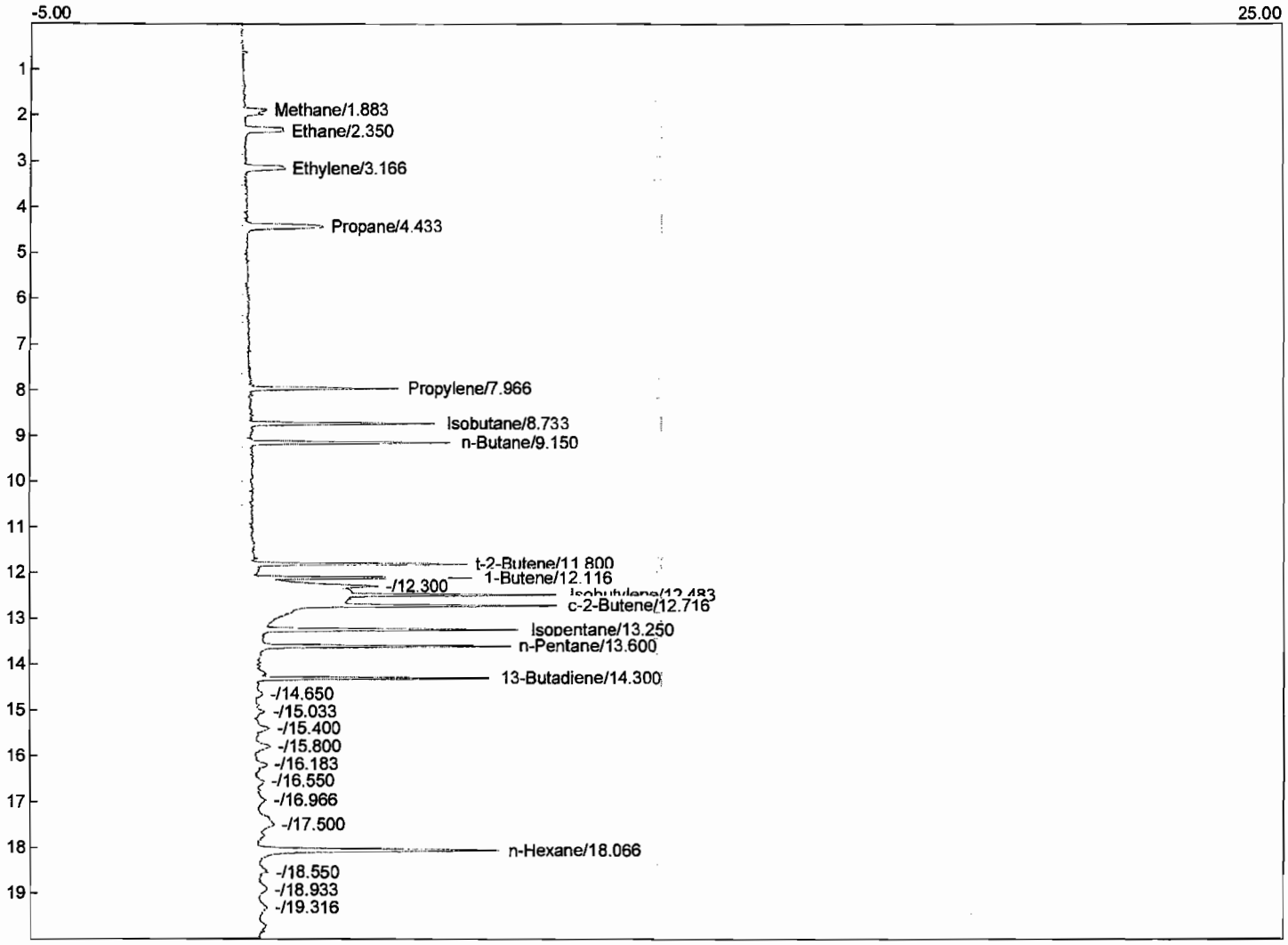
Component	Area
Methane	4.0
Ethane	6.9
Ethylene	6.5
Propane	11.8
Propylene	10.5
Isobutane	13.7
n-Butane	14.7
t-2-Butene	13.2
1-Butene	12.9
Isobutylene	12.0
c-2-Butene	13.6
Isopentane	17.4
n-Pentane	17.8
13-Butadiene	12.8
n-Hexane	25.3
	193.1

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 10:15:44
Method: M-18
Data file: DC811-04.CHR ()
Sample: 1.0 STD



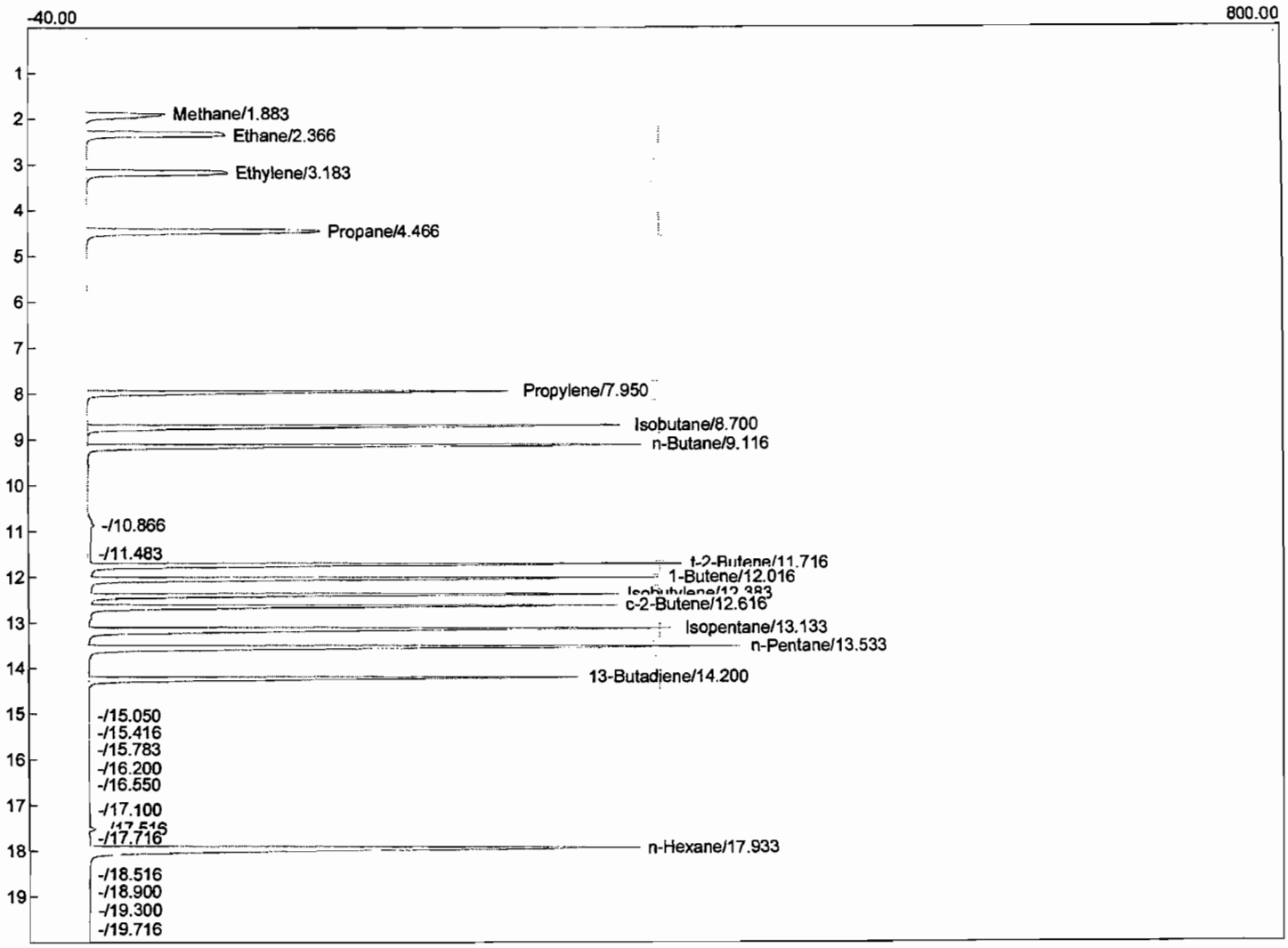
Component	Area
Methane	4.2
Ethane	6.9
Ethylene	6.8
Propane	11.6
Propylene	9.9
Isobutane	13.3
n-Butane	14.1
t-2-Butene	13.3
1-Butene	12.2
Isobutylene	12.5
c-2-Butene	14.1
Isopentane	17.0
n-Pentane	18.6
13-Butadiene	13.6
n-Hexane	27.2
	195.3

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 10:40:44
Method: M-18
Data file: DC811-05.CHR ()
Sample: 1.0 STD



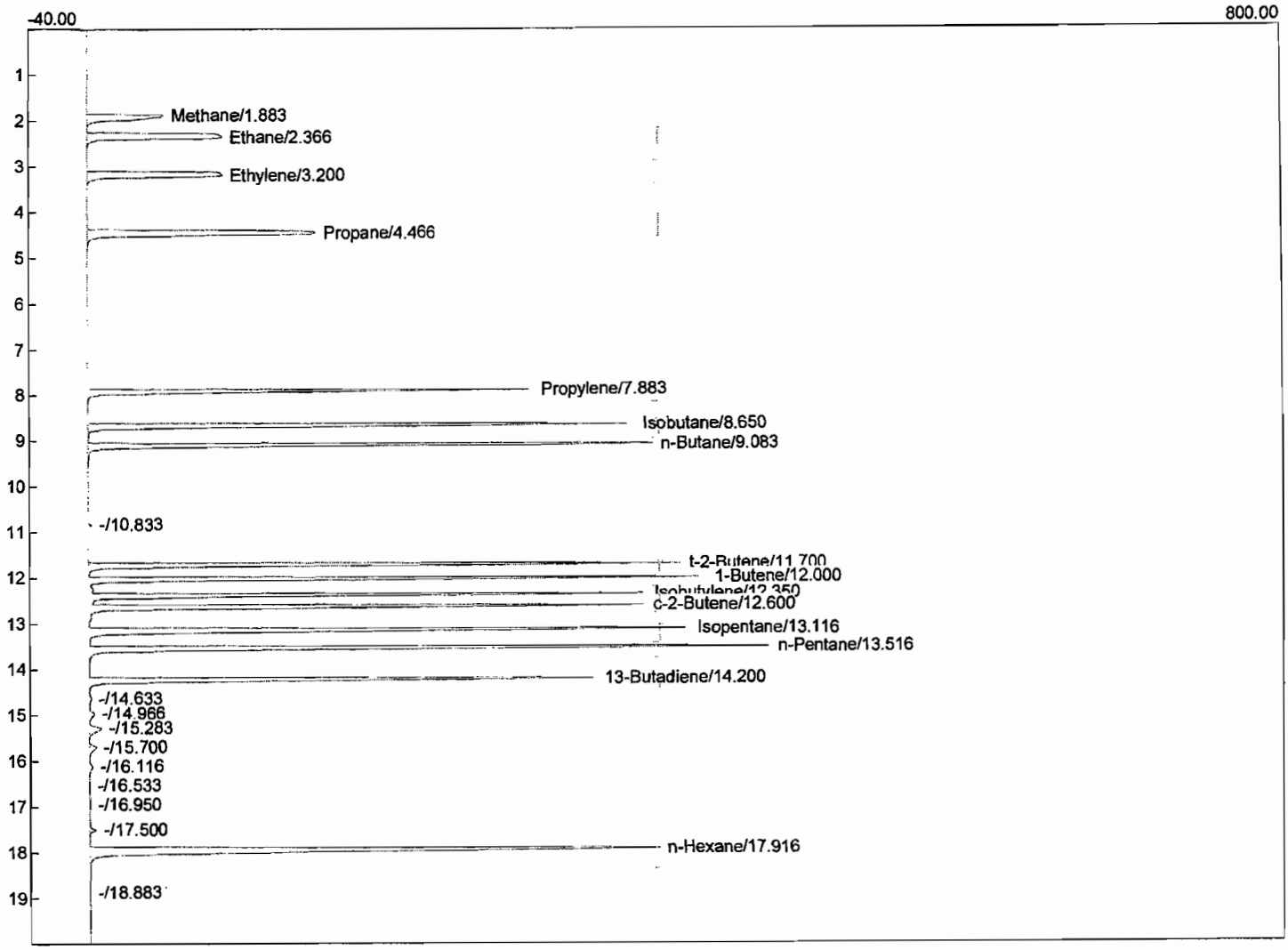
Component	Area
Methane	4.3
Ethane	7.4
Ethylene	7.1
Propane	12.6
Propylene	10.3
Isobutane	14.6
n-Butane	14.2
t-2-Butene	13.5
1-Butene	12.0
Isobutylene	11.6
c-2-Butene	13.4
Isopentane	16.8
n-Pentane	18.6
13-Butadiene	13.2
n-Hexane	25.8
	195.2

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 11:54:37
Method: M-18
Data file: DC811-07.CHR ()
Sample: 100.0 STD



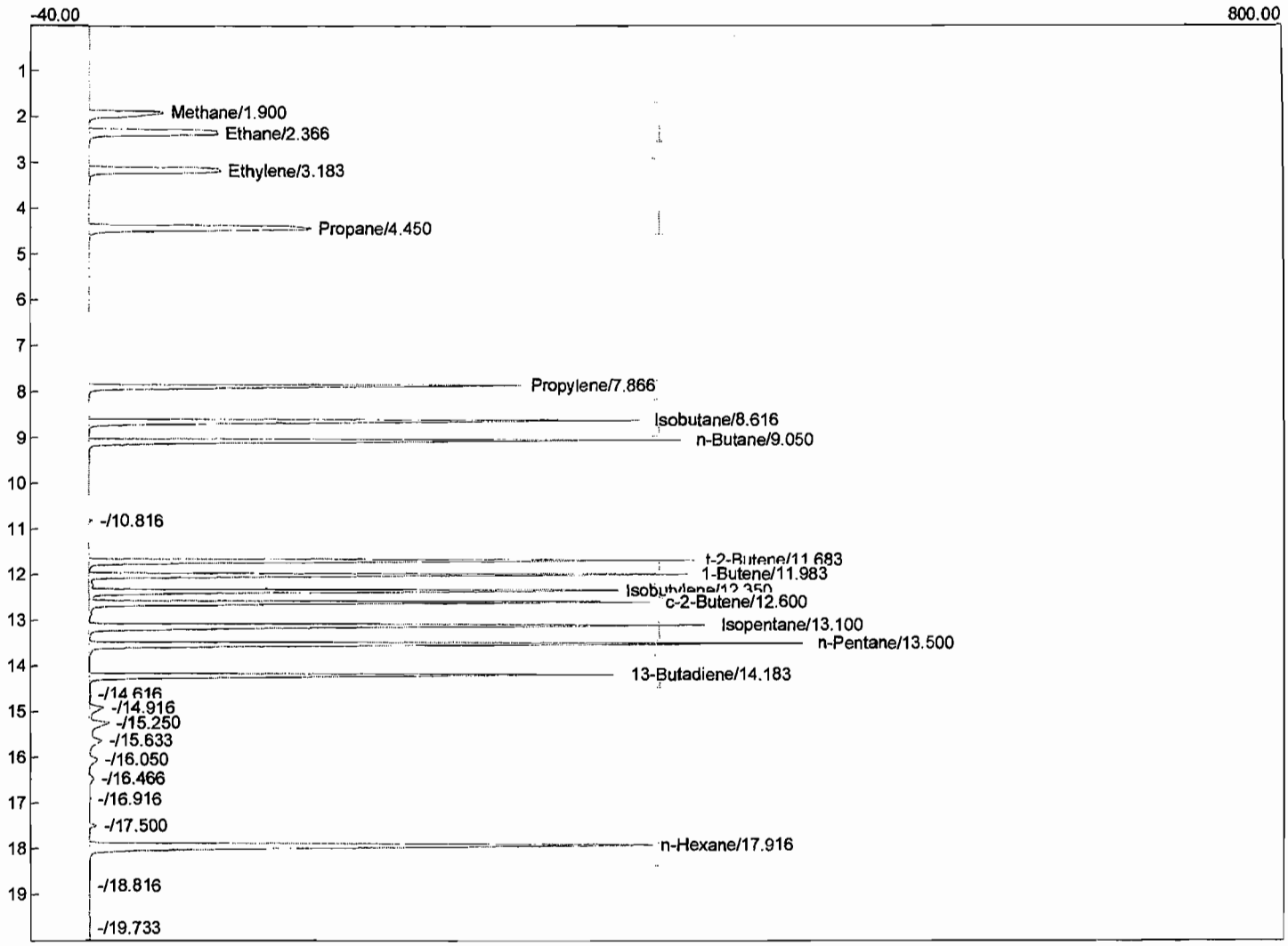
Component	Area
Methane	359.7
Ethane	697.5
Ethylene	683.5
Propane	1033.0
Propylene	1008.2
Isobutane	1386.5
n-Butane	1433.0
t-2-Butene	1400.0
1-Butene	1423.1
Isobutylene	1340.1
c-2-Butene	1426.2
Isopentane	1767.4
n-Pentane	1776.8
13-Butadiene	1340.6
n-Hexane	2037.2
	19112.9

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 12:19:37
Method: M-18
Data file: DC811-08.CHR ()
Sample: 100.0 STD



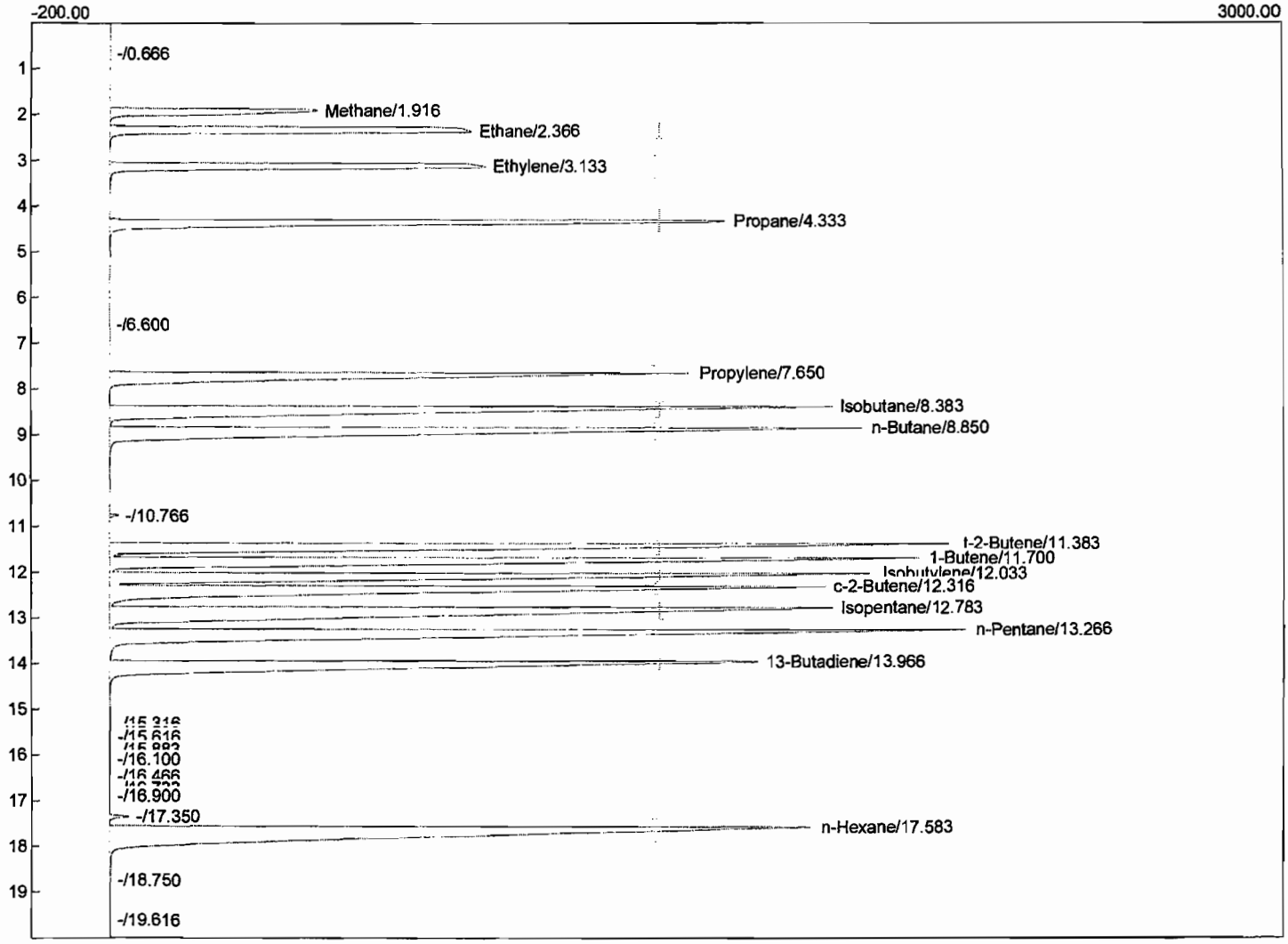
Component	Area
Methane	372.7
Ethane	730.6
Ethylene	712.2
Propane	1092.1
Propylene	1055.3
Isobutane	1475.0
n-Butane	1514.9
t-2-Butene	1491.6
1-Butene	1461.7
Isobutylene	1395.0
c-2-Butene	1465.0
Isopentane	1871.4
n-Pentane	1876.1
13-Butadiene	1418.4
n-Hexane	2172.1
	20104.0

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 12:44:37
Method: M-18
Data file: DC811-09.CHR ()
Sample: 100.0 STD



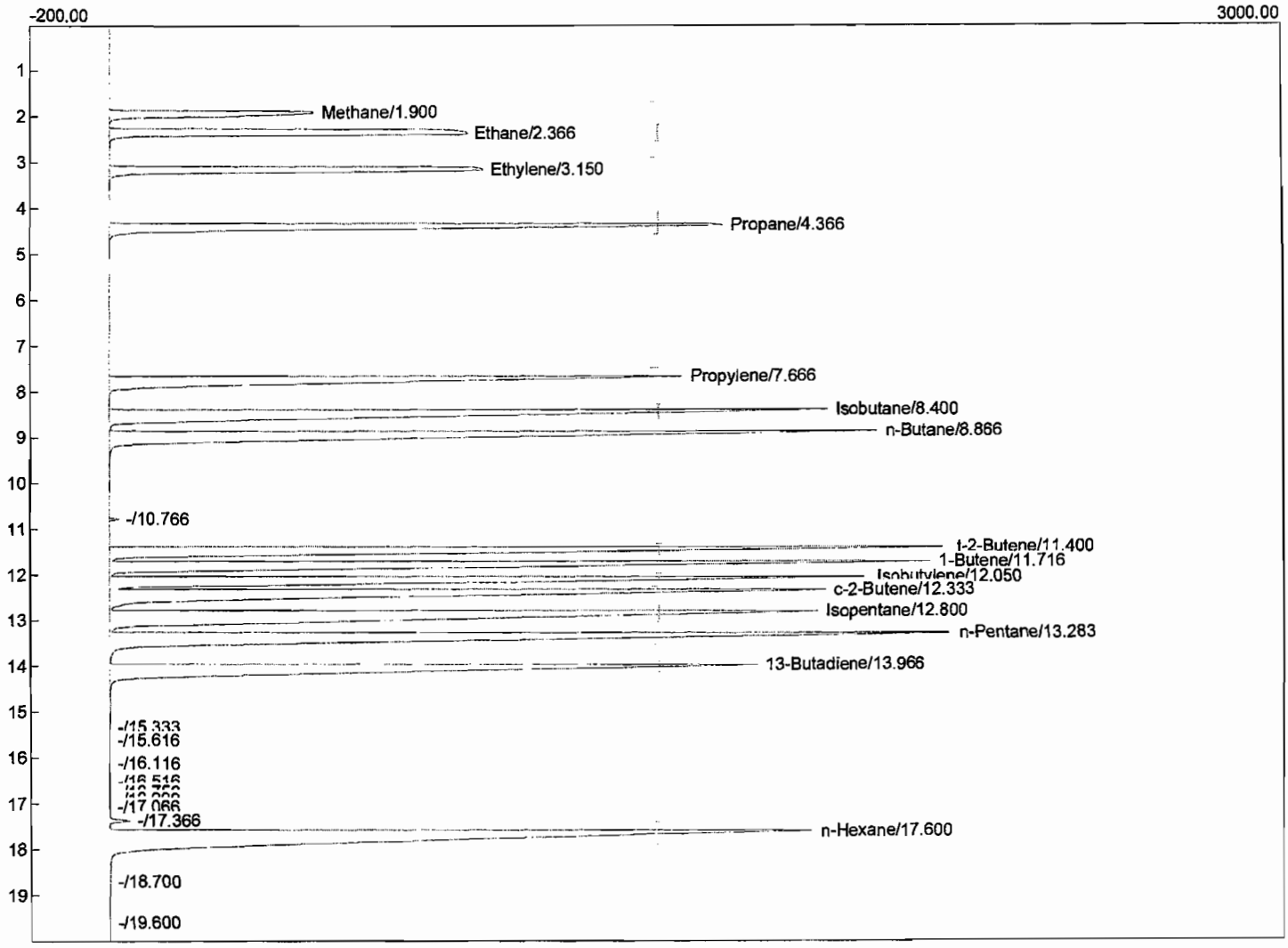
Component	Area
Methane	375.0
Ethane	736.1
Ethylene	717.2
Propane	1094.0
Propylene	1086.3
Isobutane	1460.7
n-Butane	1527.9
t-2-Butene	1502.7
1-Butene	1488.9
Isobutylene	1448.5
c-2-Butene	1544.4
Isopentane	1893.2
n-Pentane	1899.2
13-Butadiene	1417.9
n-Hexane	2219.3
	20411.3

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 13:57:49
Method: M-18
Data file: DC811-12.CHR ()
Sample: 1000.0 STD



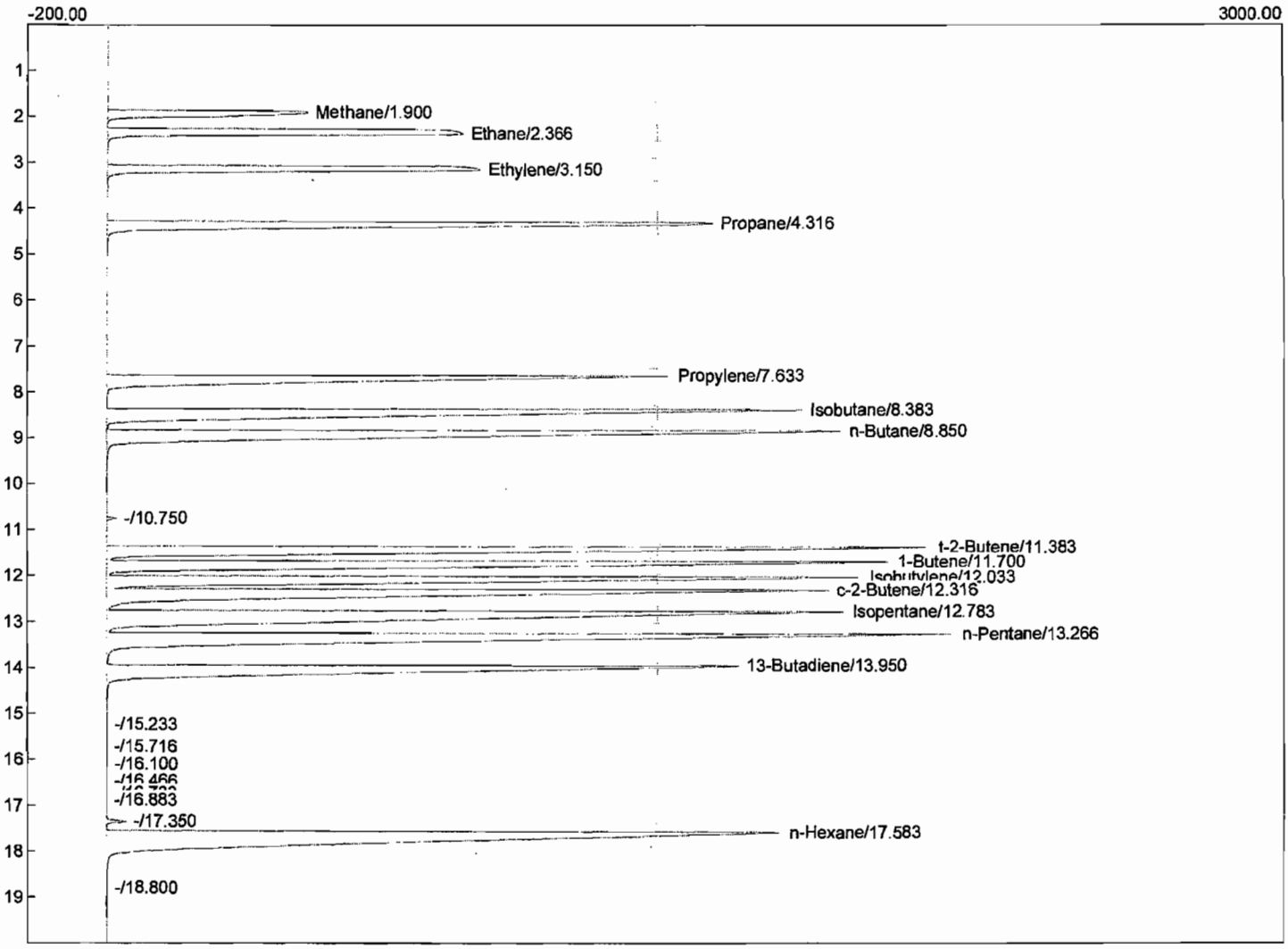
Component	Area
Methane	4186.4
Ethane	8035.7
Ethylene	7785.3
Propane	11692.1
Propylene	11550.1
Isobutane	15653.0
n-Butane	16592.5
t-2-Butene	15813.6
1-Butene	16195.1
Isobutylene	14823.7
c-2-Butene	16639.4
Isopentane	20506.9
n-Pentane	20488.9
13-Butadiene	15942.9
n-Hexane	24185.2
	220090.8

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 14:22:49
Method: M-18
Data file: DC811-13.CHR ()
Sample: 1000.0 STD



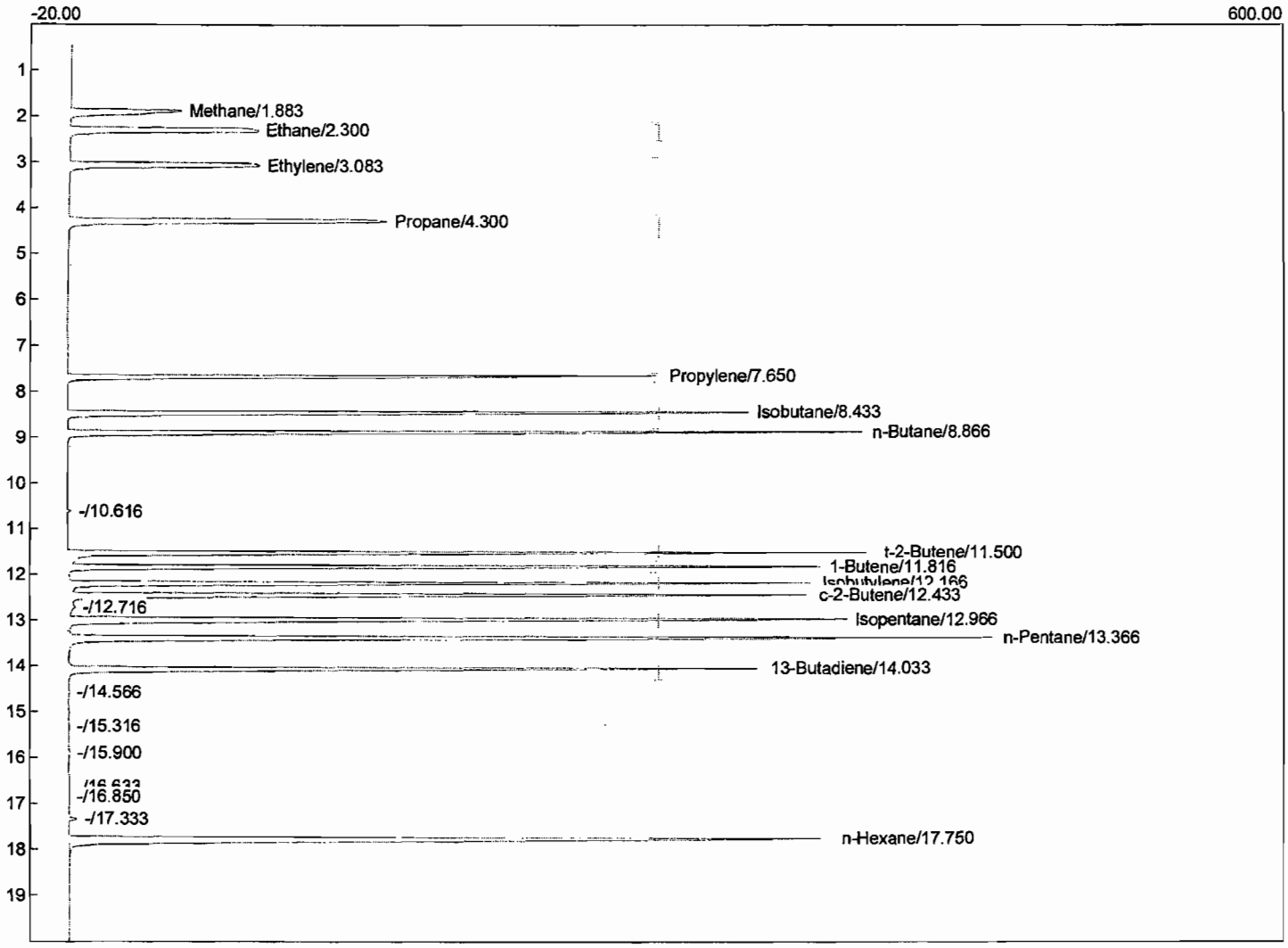
Component	Area
Methane	4109.0
Ethane	7984.2
Ethylene	7719.5
Propane	11524.9
Propylene	11378.0
Isobutane	15427.3
n-Butane	16254.9
t-2-Butene	15973.3
1-Butene	16074.8
Isobutylene	15076.2
c-2-Butene	16408.3
Isopentane	20376.7
n-Pentane	20607.9
13-Butadiene	15421.2
n-Hexane	23671.1
	218007.2

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/10/2011 14:47:50
Method: M-18
Data file: DC811-14.CHR ()
Sample: 1000.0 STD



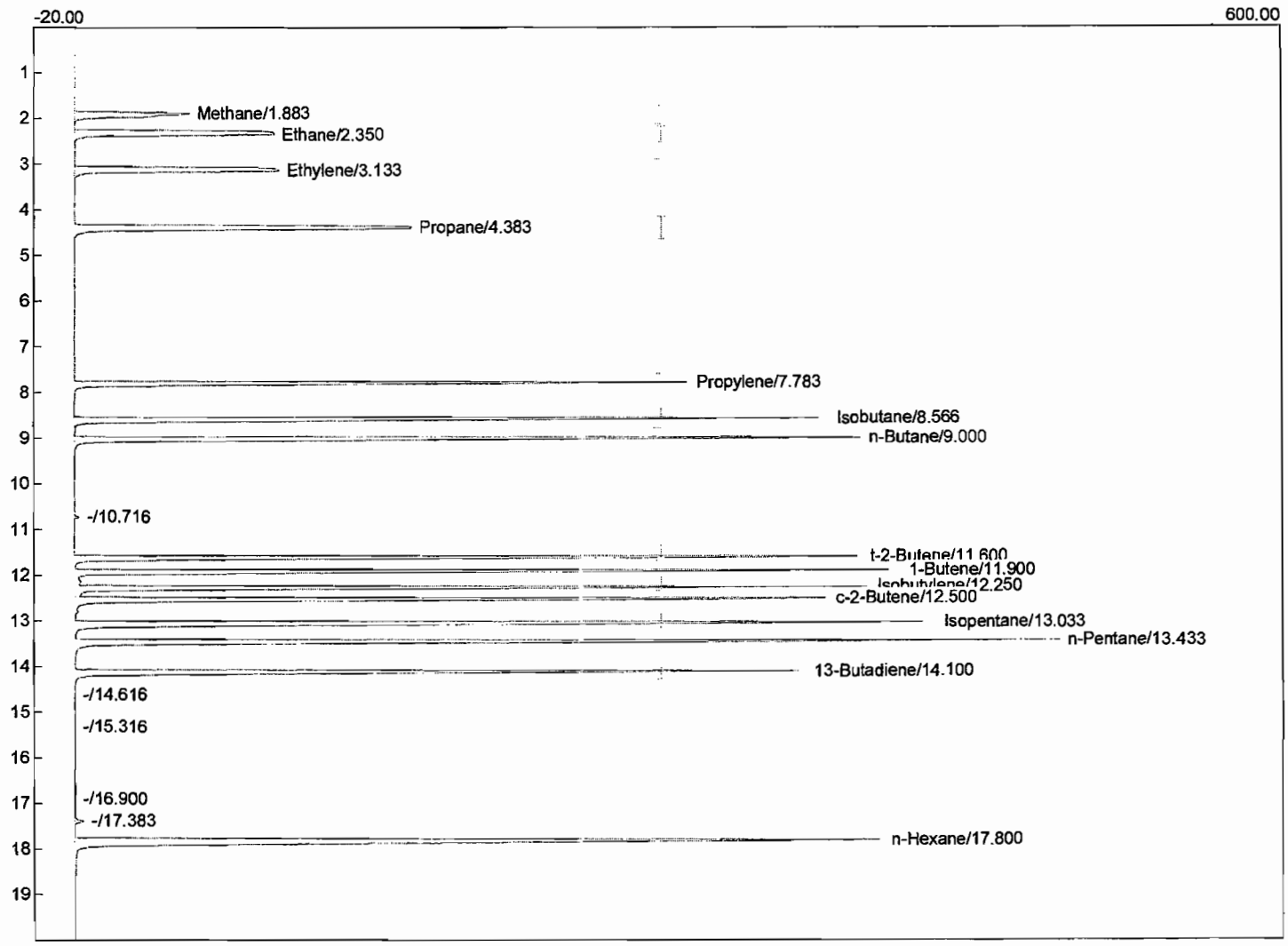
Component	Area
Methane	4064.5
Ethane	7861.0
Ethylene	7662.6
Propane	11479.1
Propylene	11264.4
Isobutane	15719.4
n-Butane	16473.3
t-2-Butene	15787.3
1-Butene	15831.7
Isobutylene	14896.6
c-2-Butene	16198.4
Isopentane	20112.0
n-Pentane	20117.1
13-Butadiene	15349.7
n-Hexane	23659.4
	216476.4

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/11/2011 13:14:27
Method: M-18
Data file: DC811-31.CHR ()
Sample: 100 End STD
Comments:



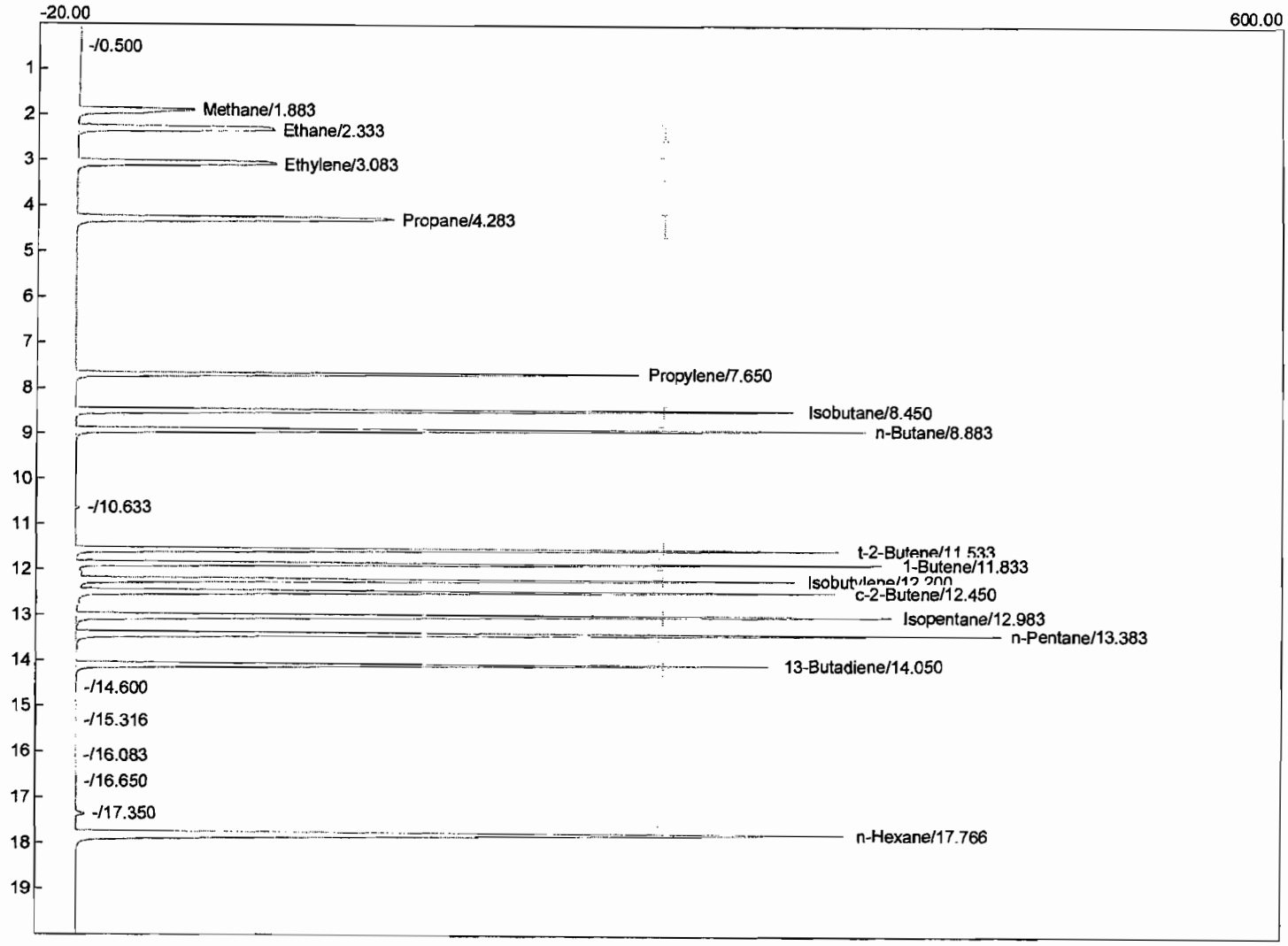
Component	Area
Methane	361.9
Ethane	681.5
Ethylene	666.7
Propane	1016.8
Propylene	971.6
Isobutane	1357.3
n-Butane	1408.8
t-2-Butene	1433.0
1-Butene	1408.1
Isobutylene	1326.1
c-2-Butene	1430.4
Isopentane	1761.0
n-Pentane	1818.3
13-Butadiene	1359.3
n-Hexane	2046.8
	19047.7

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/11/2011 13:39:27
Method: M-18
Data file: DC811-32.CHR ()
Sample: 100 End STD
Comments:



Component	Area
Methane	372.2
Ethane	725.6
Ethylene	712.6
Propane	1081.0
Propylene	1066.1
Isobutane	1460.3
n-Butane	1521.4
t-2-Butene	1475.9
1-Butene	1478.1
Isobutylene	1427.5
c-2-Butene	1500.3
Isopentane	1859.2
n-Pentane	1868.2
13-Butadiene	1423.8
n-Hexane	2176.4
	20148.6

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/11/2011 14:04:27
Method: M-18
Data file: DC811-33.CHR ()
Sample: 100 End STD
Comments:



Component	Area
Methane	371.7
Ethane	703.9
Ethylene	689.4
Propane	1019.2
Propylene	1022.1
Isobutane	1402.1
n-Butane	1459.3
t-2-Butene	1446.0
1-Butene	1418.2
Isobutylene	1409.7
c-2-Butene	1483.5
Isopentane	1821.1
n-Pentane	1820.1
13-Butadiene	1373.7
n-Hexane	2100.3
	19540.4

C-80

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

ARI ENVIRONMENTAL, INC.

Chain of Custody Record H09487

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY		
Lab Project No.	Client Name: Houston Refining	Location: PASADENA, TX
ARI Project Manager: GREG BURCH		ARI Sampler Initials
Analysis Location (Wauconda or Pasadena): PASADENA		
Engineering or Compliance Test Samples		

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request: Method 18 Methane/Ethane	Analysis Request: Fixed Gases	Analysis Request: THC	Analysis Request:	Comments
H41156	7/29/11	BAG 1 RUN 7	1	BAG		✓	✓	✓		H0811017
H41154	8/1/11	BAG 2 RUN 8	1	BAG		✓	✓	✓		H0811018
H41155	8/2/11	BAG 3 RUN 9	1	BAG		✓	✓	✓		H0811019

Preservation Code

1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions / Comments

Requested Analysis Completion Date:

Report Level: Tier I: Engineering | Tier II: Compliance | Tier III: QAPP

Route Results Through:

	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By
	(1) Date / Time: 8/3/11 1200	(2) Date / Time	(3) Date / Time
	(1) Company: ARI	(2) Company	(3) Company
	(1) Received By:	(2) Received By	(3) Received By
	(1) Date / Time: 8-3-11 12:10	(2) Date / Time	(3) Date / Time
	(1) Company: ARI	(2) Company	(3) Company

SHIPMENT: HAND CARRY / FEDX / UPS

Custody Seal Applied: Yes No

Form LF0001

Houston Refining Bags

Project No_____

Lab No:	Sample No:	Description	Sample Date	Project Mgr	No Cont	Tests
H0811017	H41156	Bag 1 Run 7	7/29/2011	GB	1	M-18 Methane & Ethane, GC/FID C1 to C6, Mol Wt
H0811018	H41154	Bag 2 Run 8	8/1/2011	GB	1	M-18 Methane & Ethane, GC/FID C1 to C6, Mol Wt
H0811019	H41155	Bag 3 Run 9	8/2/2011	GB	1	M-18 Methane & Ethane, GC/FID C1 to C6, Mol Wt

951 Old Rand Road, Unit 106
Wauconda, Illinois 60084

1710 Preston Road, Unit C
Pasadena, Texas 77503

SAMPLE RECEIPT CHECKLIST

Client Name: Houston Refining

Site Location: Pasadena, TX

ARI Project Manager: GB

Sample Collection Date(s): 7-29-11 to 8-2-11

Chain-of-Custody Number(s): H09487

Chain-of-Custody Form(s):

Custody release signatures, dates, and times present	(Yes)	No
Preservation code noted	(Yes)	No
Project information clearly identified	(Yes)	No
Sample information clearly identified	(Yes)	No
Analysis request clearly identified	(Yes)	No
Report tier level noted	(Yes)	No

Sample Containers:

Custody seal(s) applied and intact	Yes	(No)	NA
Quantity of samples match number on COC	(Yes)	No	
Container label ID numbers and descriptions match COC	(Yes)	No	
All containers received in good condition	(Yes)	No	
Liquid levels marked and no indications of leakage	Yes	(No)	NA
All container labels are legible	(Yes)	No	
All sample IDs are unique	(Yes)	No	
Samples received in correct type of container	(Yes)	No	
Samples received within the required holding time	(Yes)	No	
Samples received under the required preservation code	(Yes)	No	

Non-Conformances and/or Corrective Actions Applied:

Samples Received by: Jim Presley (Printed Name) _____ (Signature)

Date and Time Received: 8-3-11 12:10

Form LF0002

ANALYTICAL SUMMARY

CLIENT: Houston Refinery
LOCATION: Houston, TX
SAMPLE DATES: 7/19/11 - 7/21/11
ANALYSIS: Formaldehyde
METHOD: USEPA 8315A

Analyst: J. Ruggaber
Date of Completion: 8/15/2011
Template Control ID: SW846-M0011-Aldehydes-Template-65T-Rev1

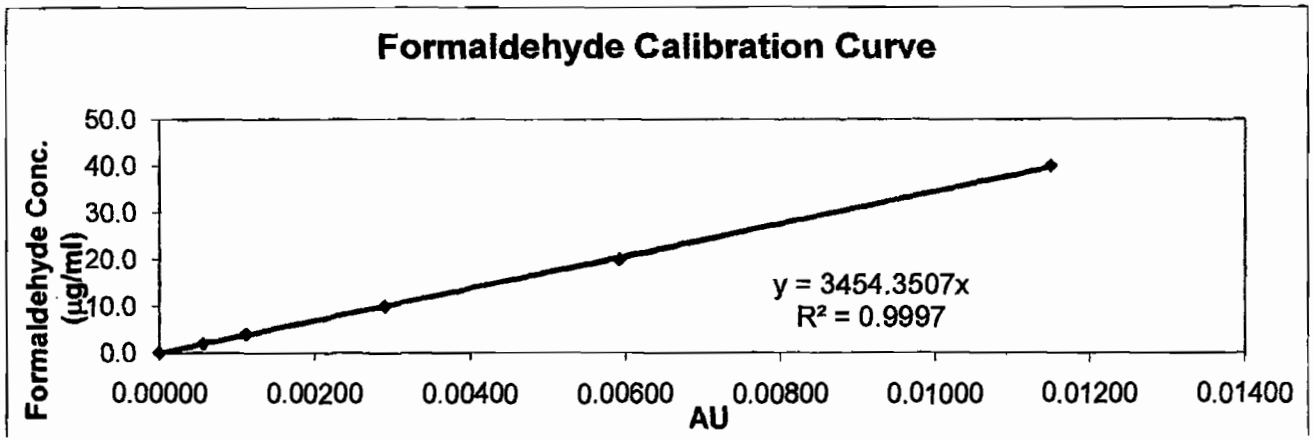
Std. (µg/ml)	Cal (AU*min)	RF	Cal Conc	% Dif
2.0	0.00057	0.00029	2.0	-0.87
4.0	0.00112	0.00028	3.9	-2.61
10.0	0.00290	0.00029	10.1	0.87
20.0	0.00592	0.00030	20.6	2.96
40.0	0.01150	0.00029	39.9	-0.07
	mean RF -->	**0.00029**		

CCVs

Conc. (µg/ml)	Area (AU*min)	Cal Conc.	% Dif
19.98	0.00585	20.21	1.1
19.98	0.00557	19.24	-3.7
19.98	0.00612	21.14	5.8

Sample Concentration Calculations

ID	Analysis 1 (AU*min)	Analysis 2 (AU*min)	Average (AU*min)	Concentration (µg/ml)	Deviation (%)	Dilution Factor	Aliquot volume(ml)	Aliquot Mass (µg)	Sample Mass (µg)
FCU-0011-1	0.00700	0.00682	0.00691	23.87	-1.30	10	25	5967.4	29837.0
FCU-0011-2	0.00780	0.00771	0.00776	26.79	-0.58	5	25	3348.6	16742.8
FCU-0011-3	0.00369	0.00381	0.00375	12.95	1.60	15	25	4857.7	24288.4
Field Spike Standard	0.00549	0.00566	0.00558	19.26	1.52	50	25	24072.5	60181.3
DNPH blank	0.00224	0.00246	0.00235	8.12	4.68	1	25	202.9	507.4
Impinger Content blank	0.00663	0.00670	0.00667	23.02	0.53	5	25	2877.9	7194.8
Field HPLC water blank	<0.00006	<0.00006	0.00006	<0.21	0.00	1	25	<5.2	<13.0
Lab acetonitrile blank	<0.00006	<0.00006	0.00006	<0.21	0.00	1	25	<5.2	<13.0



ANALYTICAL SUMMARY

CLIENT: Houston Refinery
LOCATION: Houston, TX
SAMPLE DATES: 7/19/11 - 7/21/11
ANALYSIS: Acetalehyde
METHOD: USEPA 8315A

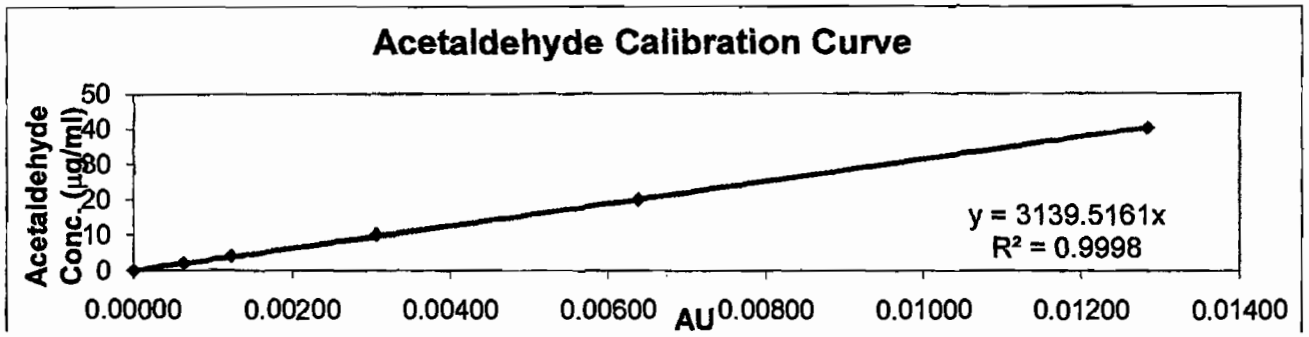
Analyst: J. Ruggaber
Date of Completion: 8/15/2011
Template Control ID: SW846-M0011-Aldehydes-Template-65T-Rev1

Std. (µg/ml)	Cal (AU*min)	RF	Cal Conc	% Dif
2.0	0.00063	0.00031	2.0	-1.87
4.0	0.00123	0.00031	3.8	-4.21
10.0	0.00305	0.00030	9.5	-4.98
20.1	0.00638	0.00032	20.0	-0.62
40.2	0.01284	0.00032	41.1	2.39
	mean RF -->	**0.00031**		

CCVs			
Conc. (µg/ml)	Area (AU*min)	Cal. Conc.	% Dif
20.08	0.00598	18.77	-6.5
20.08	0.00627	19.68	-2.0
20.08	0.00657	20.63	2.7

Sample Concentration Calculations

ID	Analysis 1 (AU*min)	Analysis 2 (AU*min)	Average (AU*min)	Concentration (µg/ml)	Deviation (%)	Dilution Factor	Sample volume(ml)	Aliquot Mass (µg)	Sample Mass (µg)
FCU-0011-1	0.00954	0.01000	0.00977	30.67	2.35	10	25	7668.3	38341.3
FCU-0011-2	0.00393	0.00420	0.00407	12.76	3.32	5	25	1595.3	7976.3
FCU-0011-3	0.00975	0.00990	0.00983	30.85	0.76	15	25	11567.2	57835.8
Field Spike Standard	0.00049	0.00046	0.00048	1.49	-3.16	1	25	37.3	93.2
DNPH blank	0.00025	0.00025	0.00025	0.78	0.00	1	25	19.6	49.1
Impinger Content blank	0.00188	0.00200	0.00194	6.09	3.09	1	25	152.3	380.7
Field HPLC water blank	<0.00006	<0.00006	<0.00006	<0.19	0.00	1	25	<4.7	<11.8
Lab acetonitrile blank	<0.00006	<0.00006	<0.00006	<0.19	0.00	1	25	<4.7	<11.8



ANALYTICAL SUMMARY

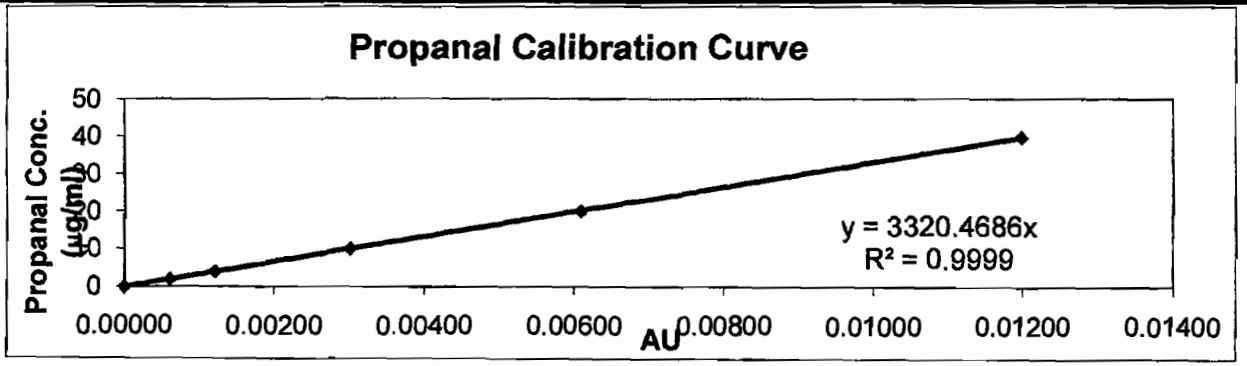
CLIENT: Houston Refinery
LOCATION: Houston, TX
SAMPLE DATES: 7/19/11 - 7/21/11
ANALYSIS: Propanal
METHOD: USEPA 8315A

Analyst: J. Ruggaber
Date of Completion: 8/15/2011
Template Control ID: SW846-M0011-Aldehydes-Template-65T-Rev1

Std. (µg/ml)	Cal (AU*min)	RF	Cal Conc	% Dif	CCVs Conc. (µg/ml)	Area (AU*min)	Cal. Conc.	% Dif
2.0	0.00061	0.00031	2.0	1.84	19.96	0.00592	19.66	-1.5
4.0	0.00121	0.00030	4.0	1.00	19.96	0.00599	19.89	-0.4
10.0	0.00301	0.00030	10.0	0.50	19.96	0.00626	20.79	4.1
20.0	0.00609	0.00031	20.3	1.67				
39.9	0.01198	0.00030	39.5	-0.99				
	mean RF -->	**0.00030**						

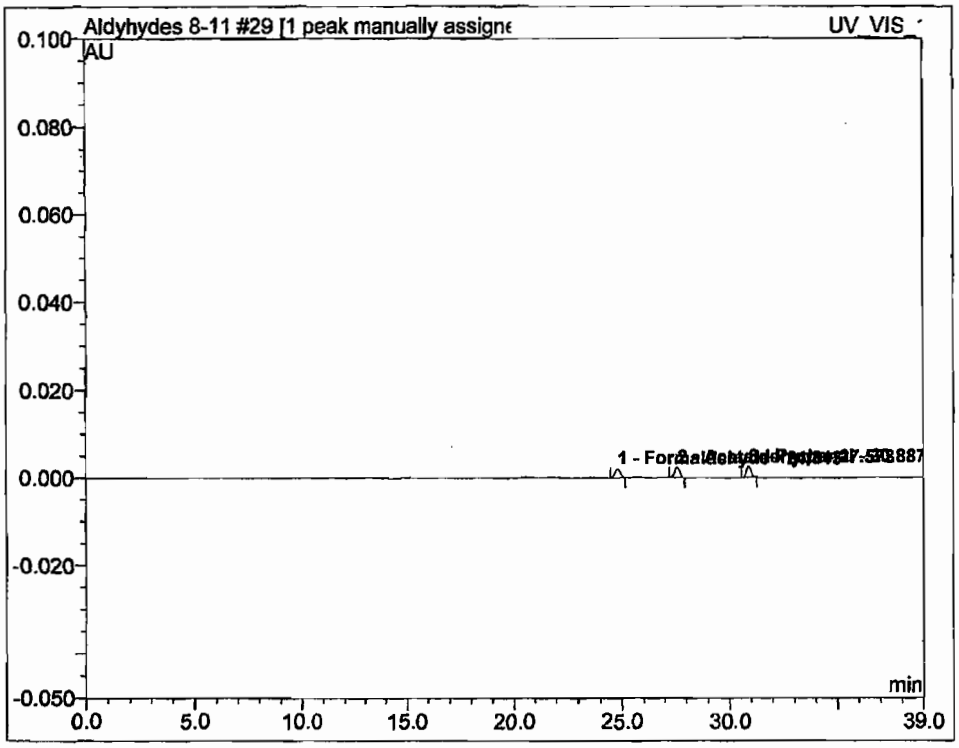
Sample Concentration Calculations

ID	Analysis 1 (AU*min)	Analysis 2 (AU*min)	Average (AU*min)	Concentration (µg/ml)	Deviation (%)	Dilution	Sample volume(ml)	Aliquot Mass (µg)	Sample Mass (µg)
FCU-0011-1	0.00186	0.00170	0.00178	5.91	-4.49	10	25	1477.6	7388.0
FCU-0011-2	0.00216	0.00222	0.00219	7.27	1.37	1	25	181.8	909.0
FCU-0011-3	0.00115	0.00123	0.00119	3.95	3.36	15	25	1481.8	7408.8
Field Spike Standard	0.00011	0.00011	0.00011	0.37	0.00	1	25	9.1	22.8
DNPH blank	<0.00006	<0.00006	<0.00006	0.20	0.00	1	25	<5.0	<12.5
Impinger Content blank	0.00041	0.00040	0.00041	1.34	-1.23	1	25	33.6	84.0
Field HPLC water blank	<0.00006	<0.00006	<0.00006	0.20	0.00	1	25	<5.0	<12.5
Lab acetonitrile blank	<0.00006	<0.00006	<0.00006	0.20	0.00	1	25	<5.0	<12.5



29 2 ppm aldehyde std 8-8-11

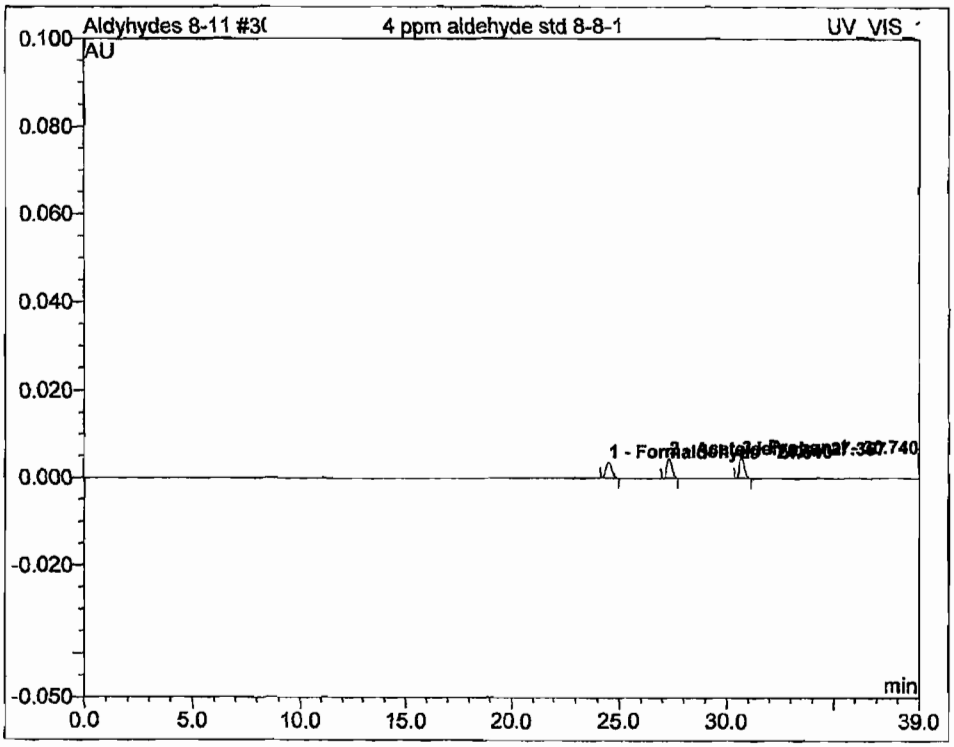
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**standard**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/9/2011 19:26**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
1	24.81	Formaldehyde	0.0020	0.00057
2	27.57	Acetaldehyde	0.0023	0.00063
3	30.89	Propanal	0.0024	0.00061
Total:			0.007	0.371

30 4 ppm aldehyde std 8-8-11

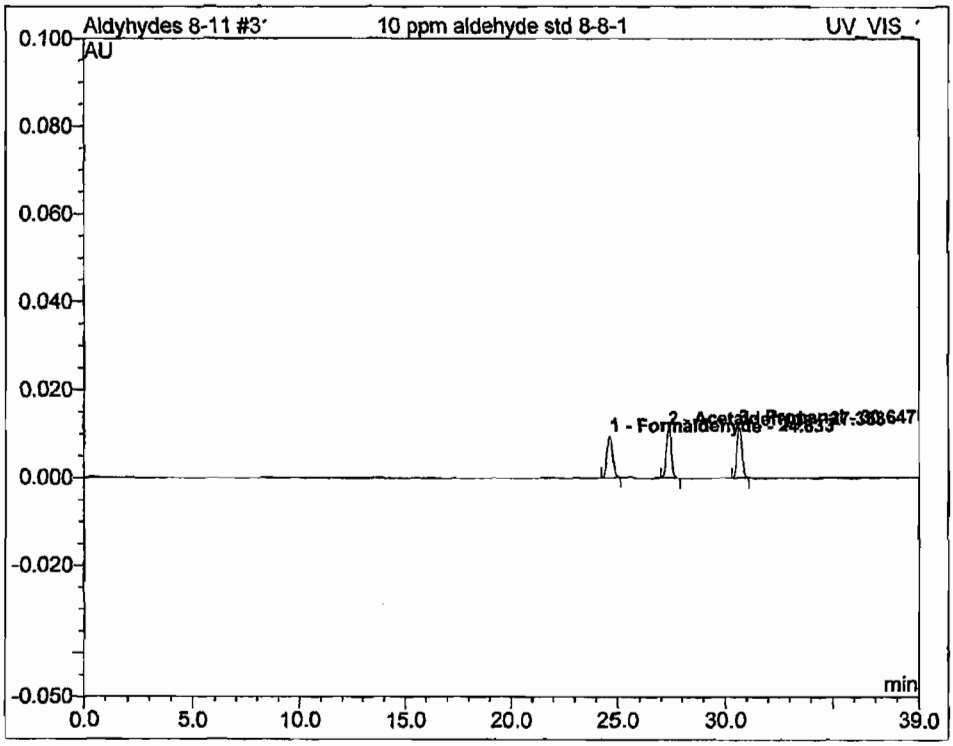
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	1			**UV_VIS_1**
Sample Type:	**standard**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/9/2011 20:10**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
1	24.54	Formaldehyde	0.0036	0.00112
2	27.37	Acetaldehyde	0.0043	0.00123
3	30.74	Propanal	0.0046	0.00121
Total:			0.013	0.715

31 10 ppm aldehyde std 8-8-11

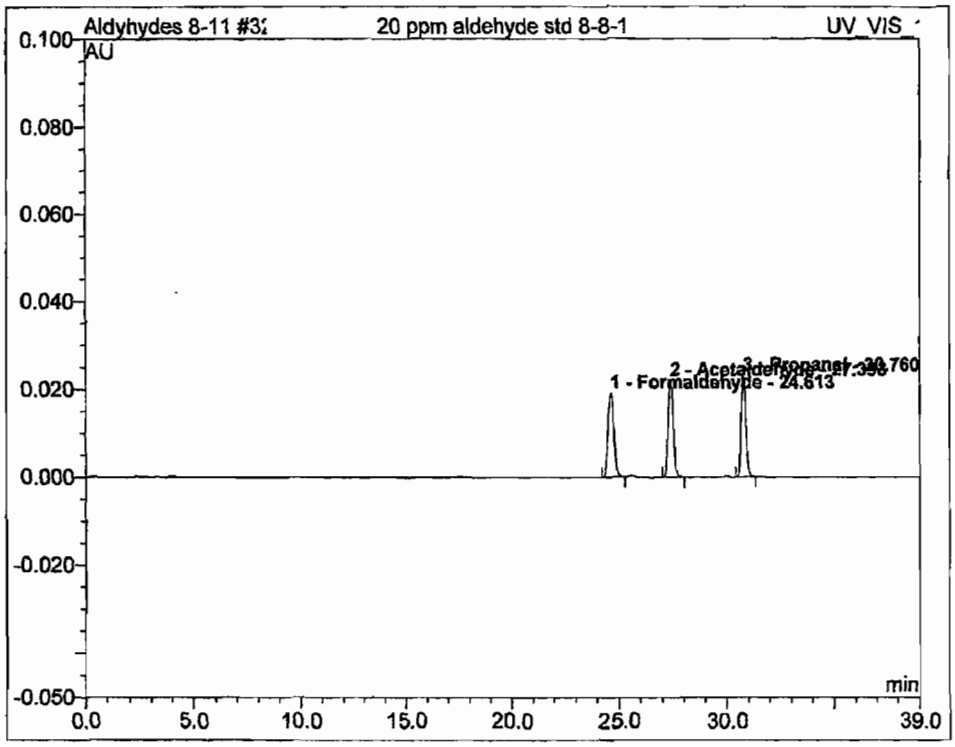
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**standard**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/9/2011 20:54**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
1	24.63	Formaldehyde	0.0094	0.00290
2	27.35	Acetaldehyde	0.0111	0.00305
3	30.65	Propanal	0.0114	0.00301
Total:			0.032	1.801

32 20 ppm aldehyde std 8-8-11

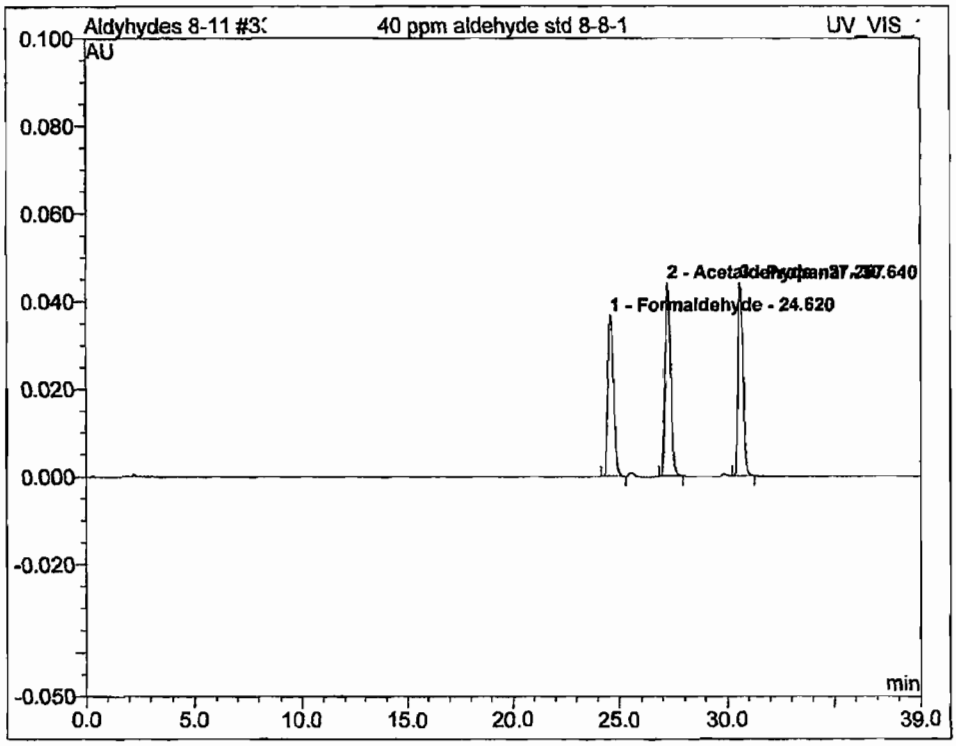
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**standard**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/9/2011 21:39**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
1	24.61	Formaldehyde	0.0191	0.00592
2	27.39	Acetaldehyde	0.0221	0.00638
3	30.76	Propanal	0.0231	0.00609
Total:			0.064	3.692

33 40 ppm aldehyde std 8-8-11

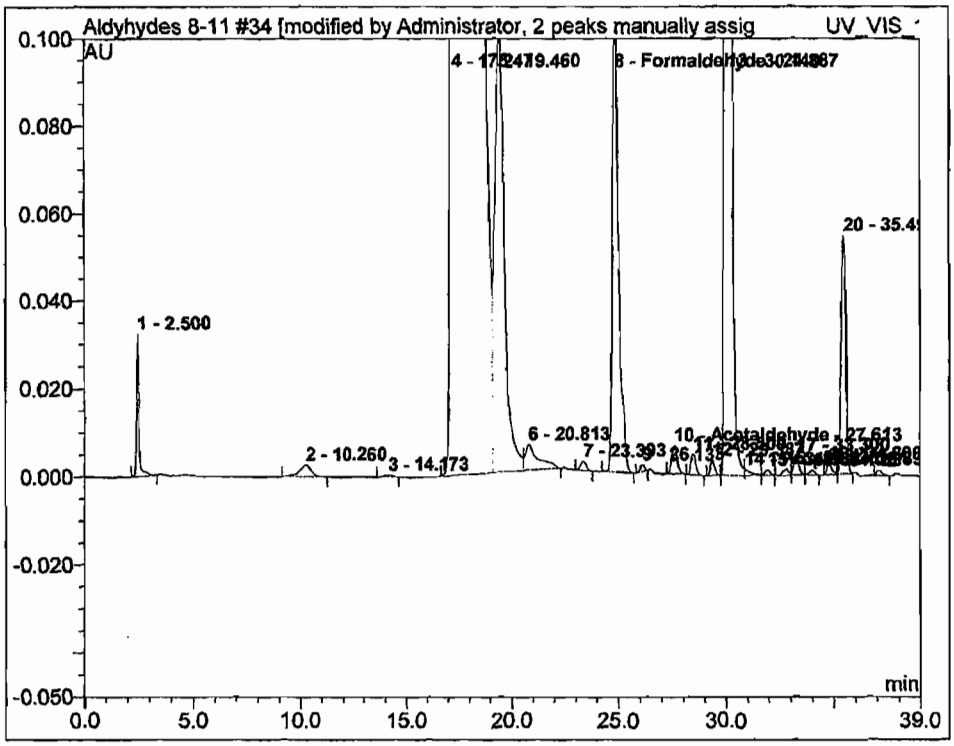
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**standard**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/9/2011 22:23**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
1	24.62	Formaldehyde	0.0366	0.01150
2	27.27	Acetaldehyde	0.0441	0.01284
3	30.64	Propanal	0.0440	0.01198
Total:			0.125	7.287

34 FCU 0011-Blank

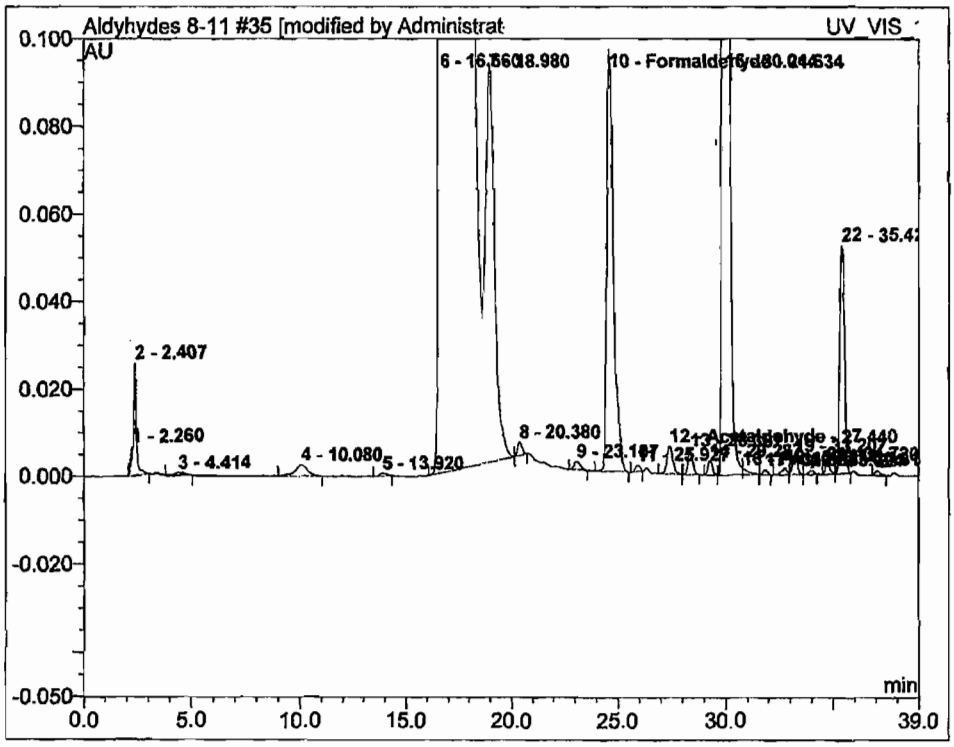
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/9/2011 23:07**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
8	24.89	Formaldehyde	0.1032	0.03439
10	27.61	Acetaldehyde	0.0064	0.00188
14	30.89	Propanal	0.0014	0.00041
Total:			0.111	7.828

35 FCU 0011-Blank

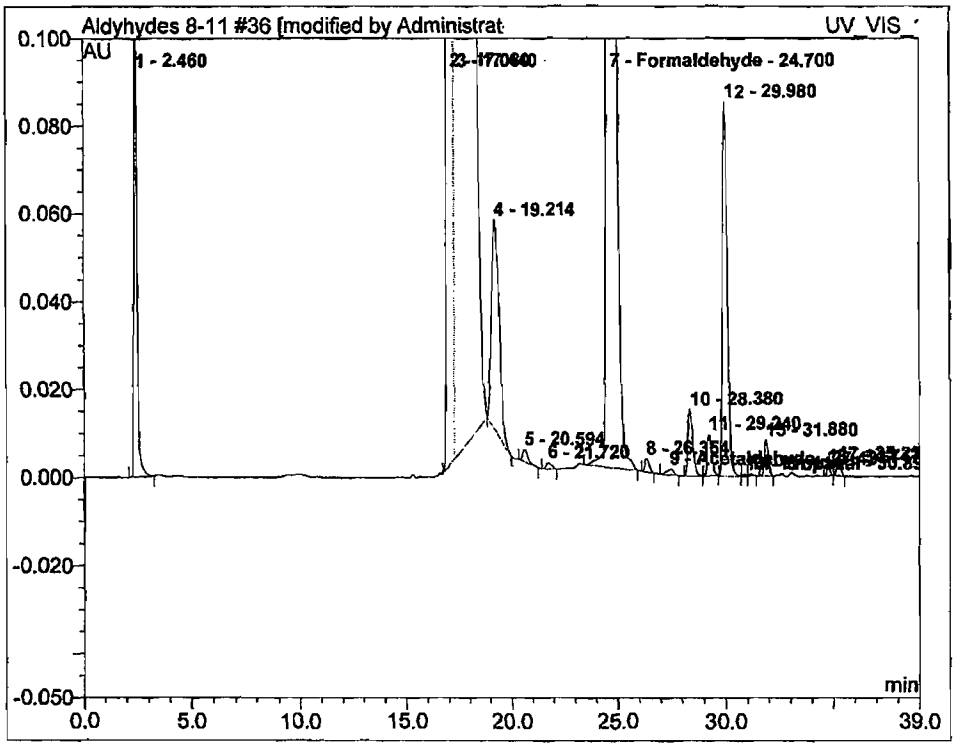
Client	Houston Refin.	Unknown 13	Aldehyde C 35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/9/2011 23:51**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
10	24.63	Formaldehyde	0.0964	0.03424
12	27.44	Acetaldehyde	0.0063	0.00200
16	30.81	Propanal	0.0013	0.00040
Total:			0.104	7.815

36 FCU 0011-Field spike

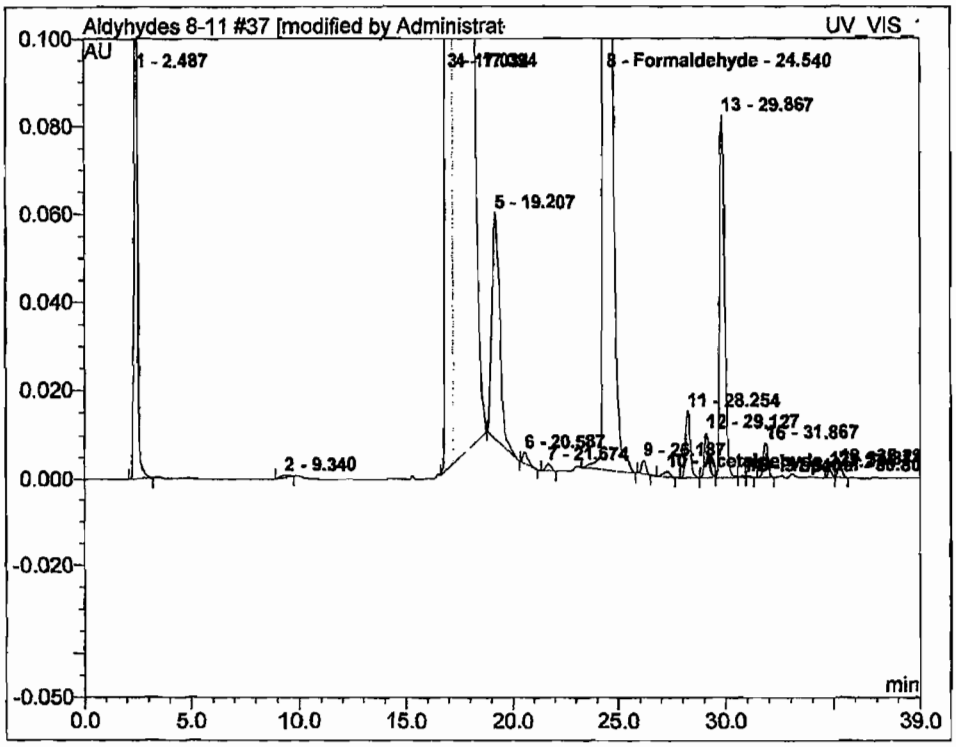
Client	Houston Refin.	Unknown 13	Aldehyde C 35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 0:35**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
7	24.70	Formaldehyde	0.9325	0.29025
9	27.43	Acetaldehyde	0.0013	0.00049
13	30.89	Propanal	0.0005	0.00011
Total:			0.934	62.494

37 FCU 0011-Field spike

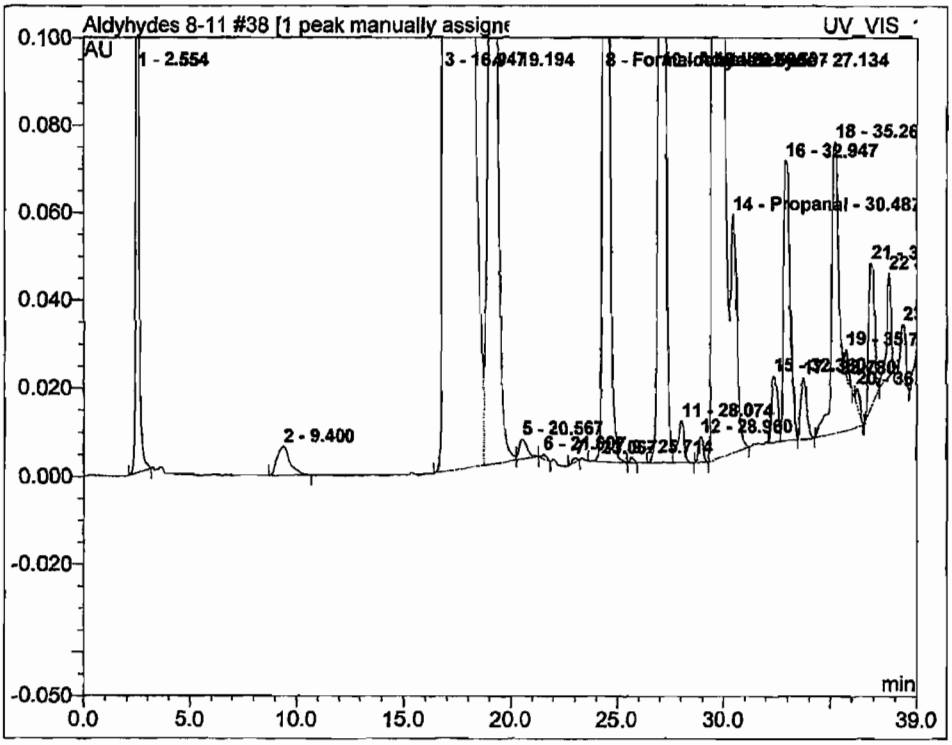
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 1:19**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
8	24.54	Formaldehyde	0.9460	0.29083
10	27.27	Acetaldehyde	0.0013	0.00046
14	30.81	Propanal	0.0005	0.00011
Total:			0.948	62.613

38 FCU 0011-1

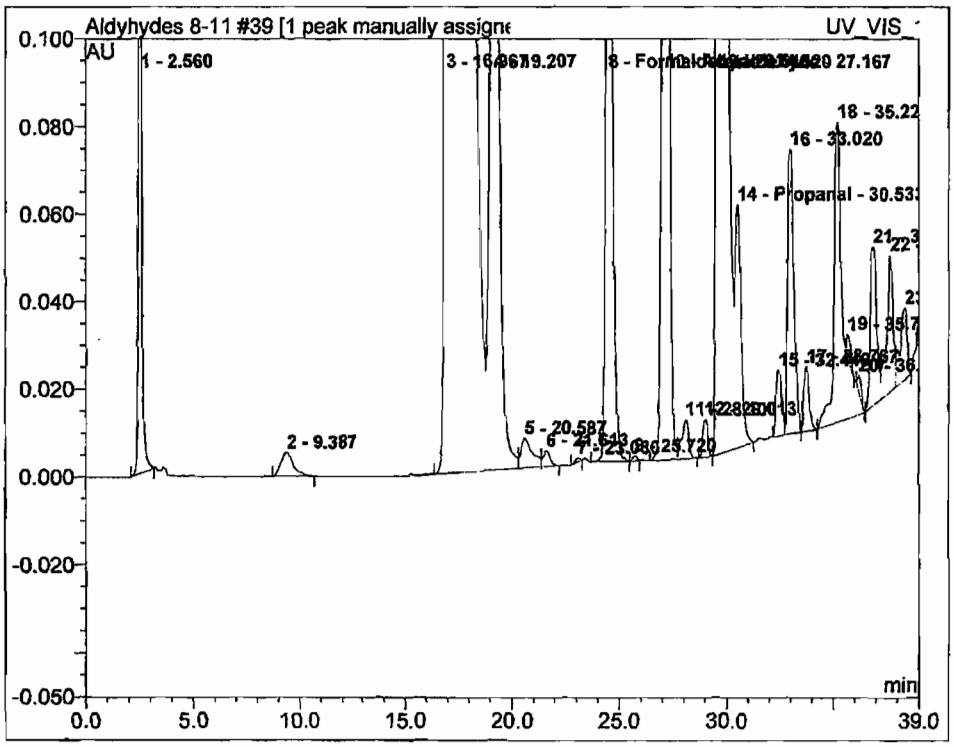
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**unknown**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/10/2011 2:03**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
8	24.51	Formaldehyde	0.2175	0.07001
10	27.13	Acetaldehyde	0.3207	0.10058
14	30.49	Propanal	0.0543	0.01868
Total:			0.593	37.784

39 FCU 0011-1

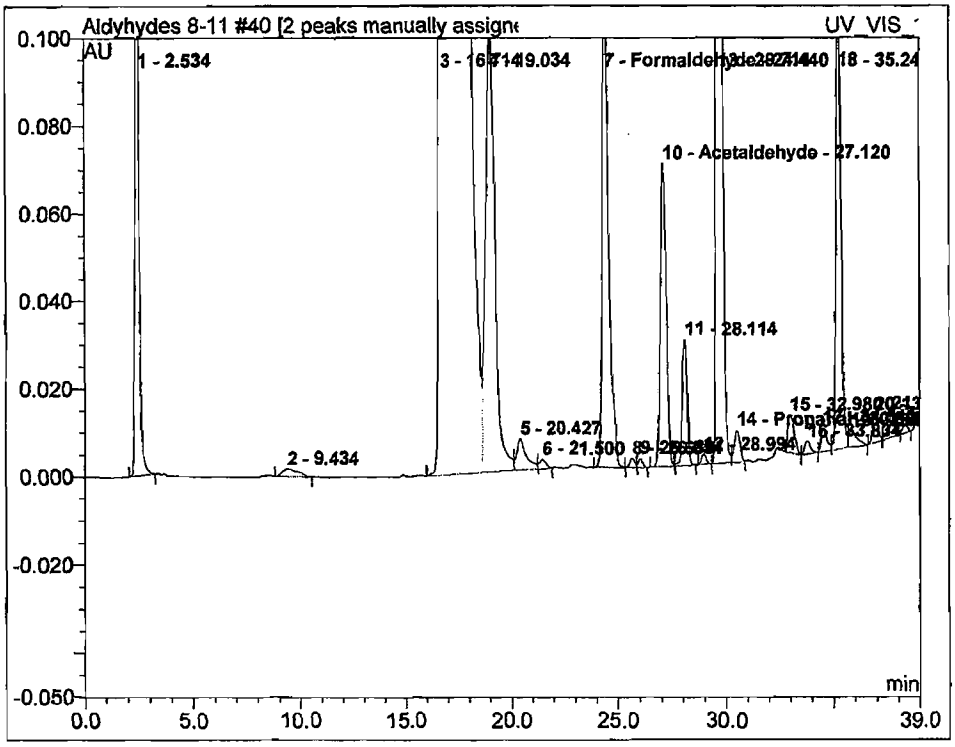
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	1		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 2:47**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
8	24.52	Formaldehyde	0.2164	0.06958
10	27.17	Acetaldehyde	0.3210	0.10195
14	30.53	Propanal	0.0556	0.01913
Total:			0.593	38.038

40 FCU 0011-2

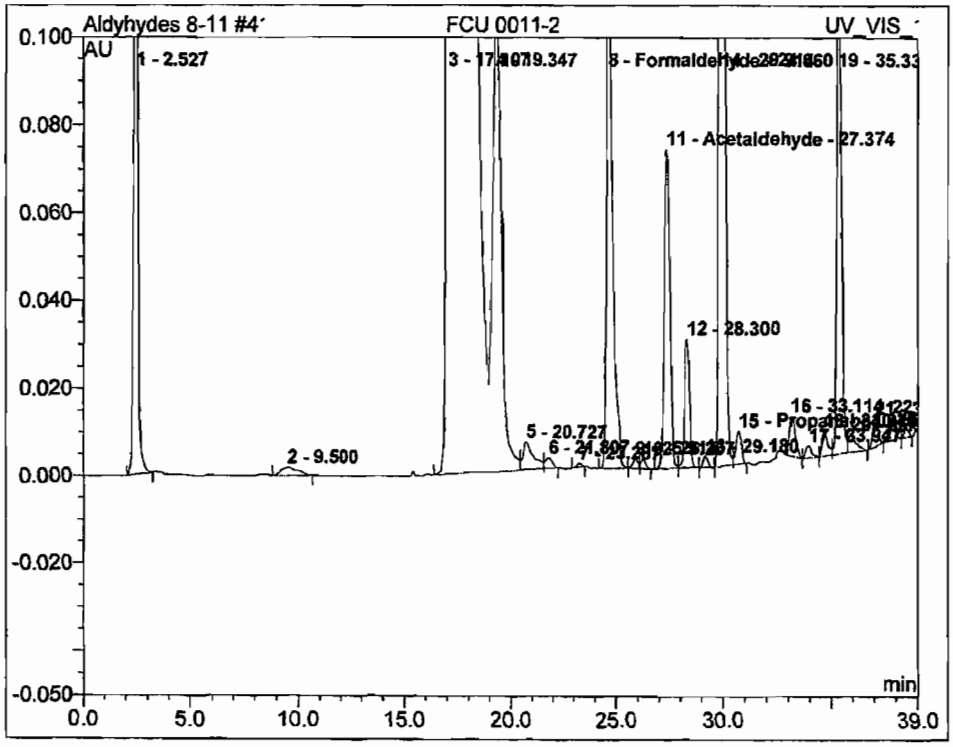
Client	Houston Refin.	Unknown 13	Aldehyde C 35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 3:31**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
7	24.44	Formaldehyde	0.1113	0.03808
10	27.12	Acetaldehyde	0.0692	0.02121
14	30.53	Propanal	0.0072	0.00216
Total:			0.188	12.624

41 FCU 0011-2

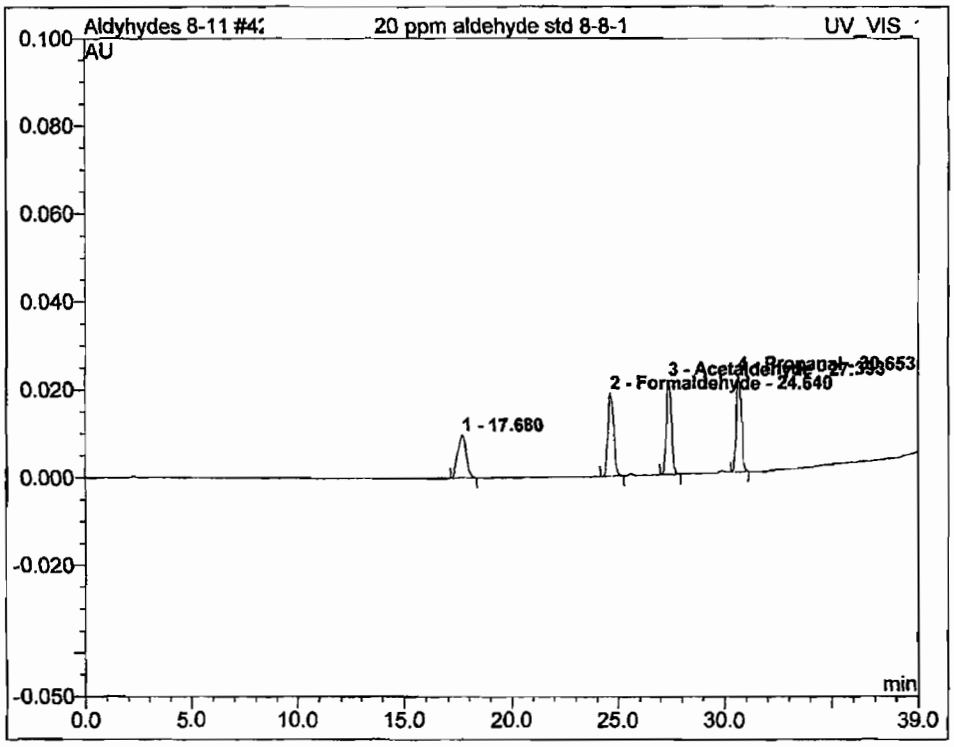
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 4:16**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
8	24.66	Formaldehyde	0.1181	0.03913
11	27.37	Acetaldehyde	0.0728	0.02177
15	30.71	Propanal	0.0076	0.00222
Total:			0.198	12.967

42 20 ppm aldehyde std 8-8-11

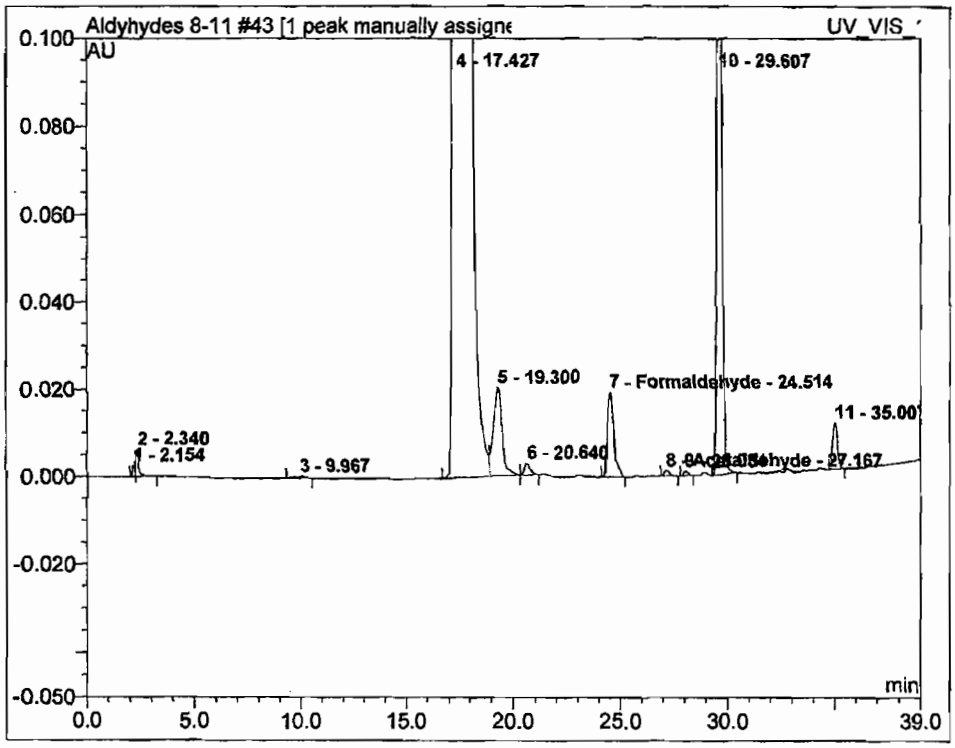
Client	Houston Refin.	Unknown 13	Aldehyde C 35
Vial Number:	1		**UV_VIS_1**
Sample Type:	**standard**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 9:01**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
2	24.64	Formaldehyde	0.0188	0.00585
3	27.39	Acetaldehyde	0.0215	0.00598
4	30.65	Propanal	0.0222	0.00592
Total:			0.063	3.568

43 FCU 0011-Blank 5X

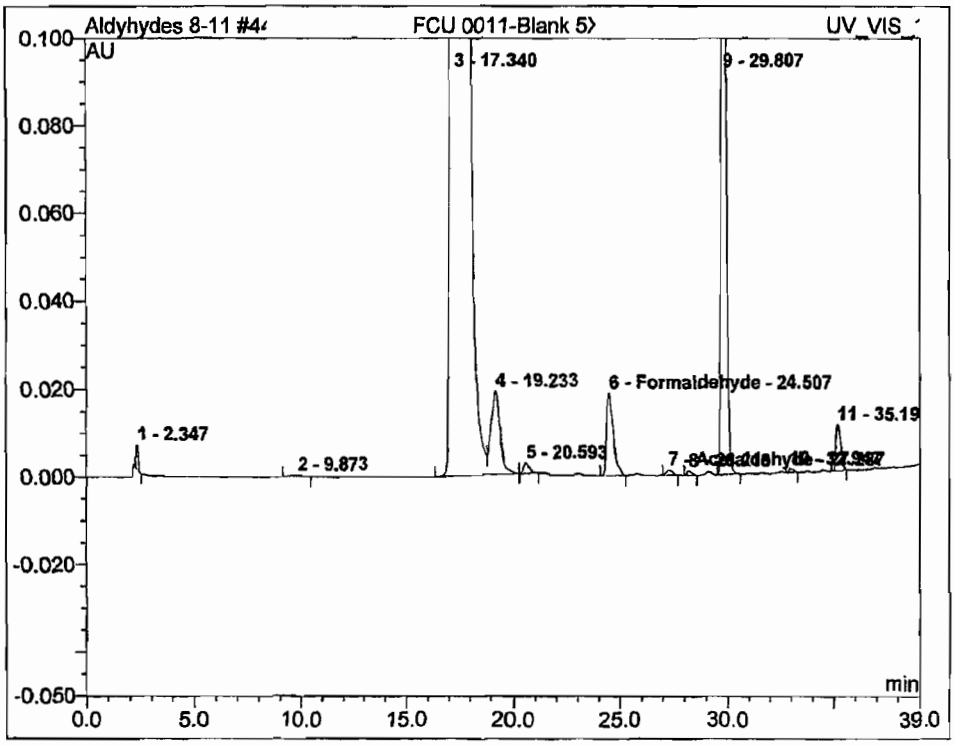
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 9:55**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
7	24.51	Formaldehyde	0.0193	0.00663
8	27.17	Acetaldehyde	0.0012	0.00036
Total:			0.021	1.492

44 FCU 0011-Blank 5X

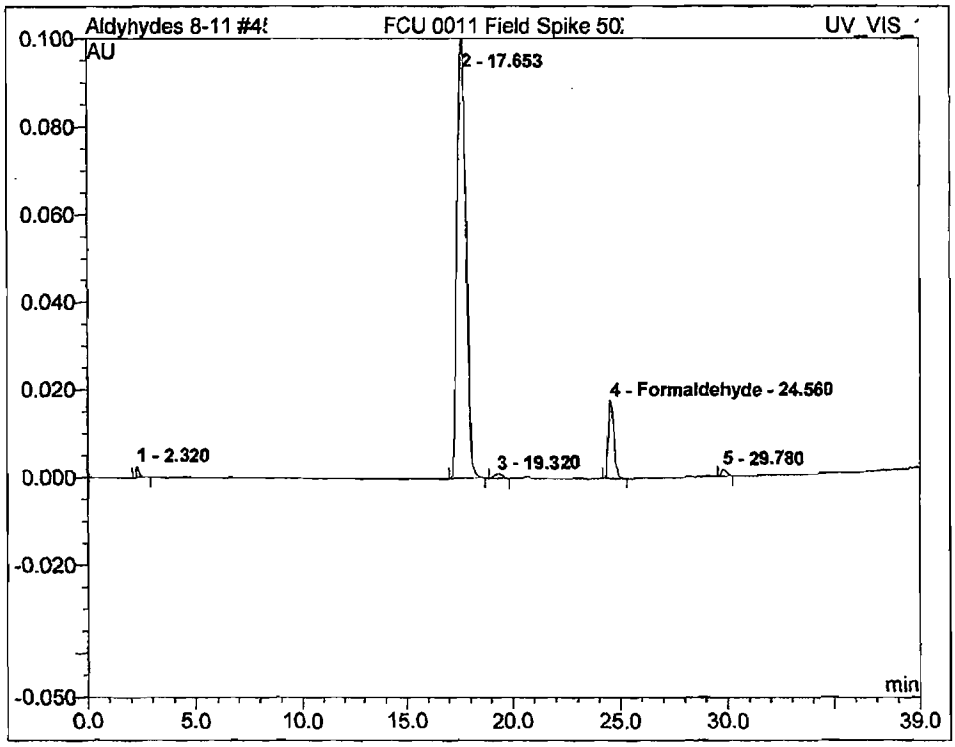
Client	Houston Refin.	Unknown 13	Aldehyde C35	
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**unknown**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/10/2011 10:39**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
6	24.51	Formaldehyde	0.0188	0.00670
7	27.29	Acetaldehyde	0.0012	0.00035
Total:			0.020	1.508

45 FCU 0011 Field Spike 50X

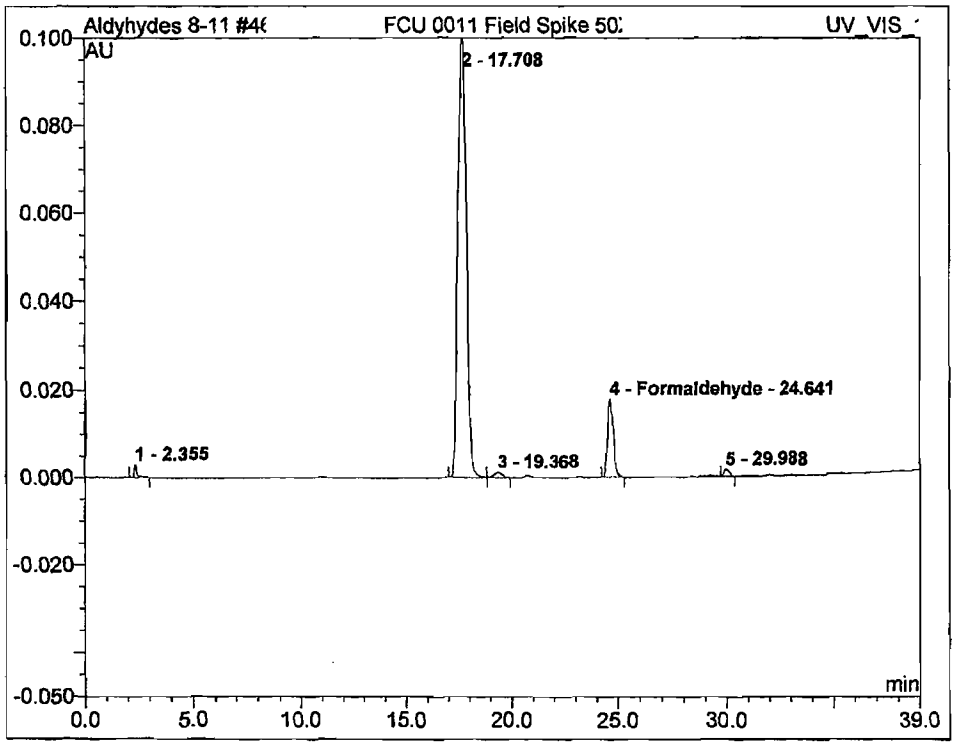
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 11:23**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
4	24.56	Formaldehyde	0.0177	0.00549
Total:			0.018	1.180

46 FCU 0011 Field Spike 50X

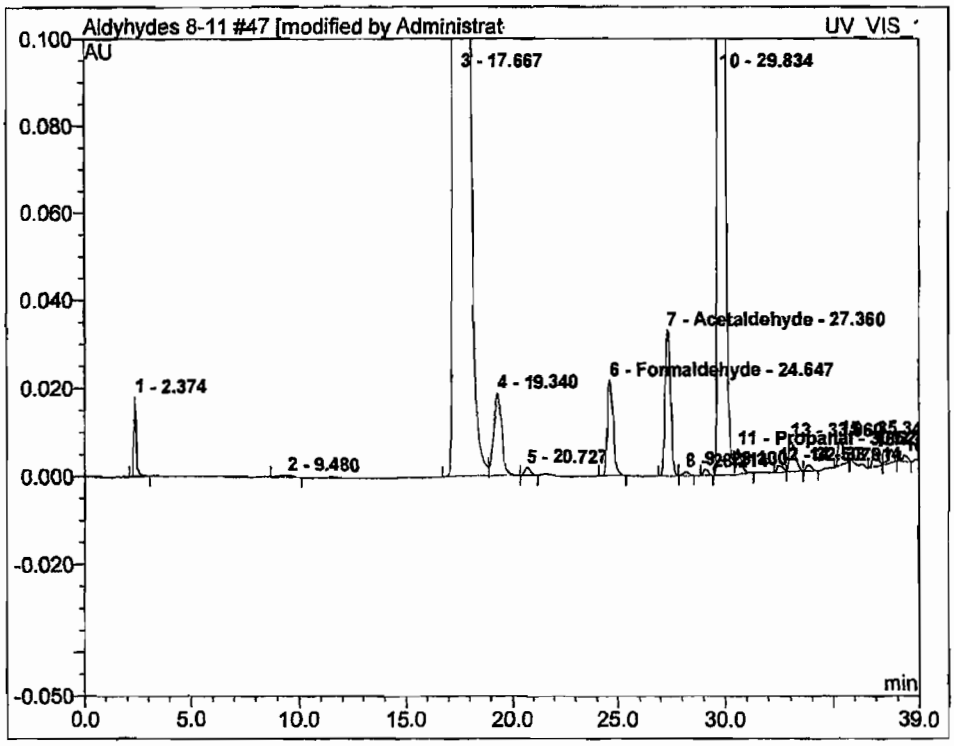
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 12:07**		**1.0000**
Run Time (min):	**38.99**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
4	24.64	Formaldehyde	0.0179	0.00566
Total:			0.018	1.217

47 FCU 0011-1 10X

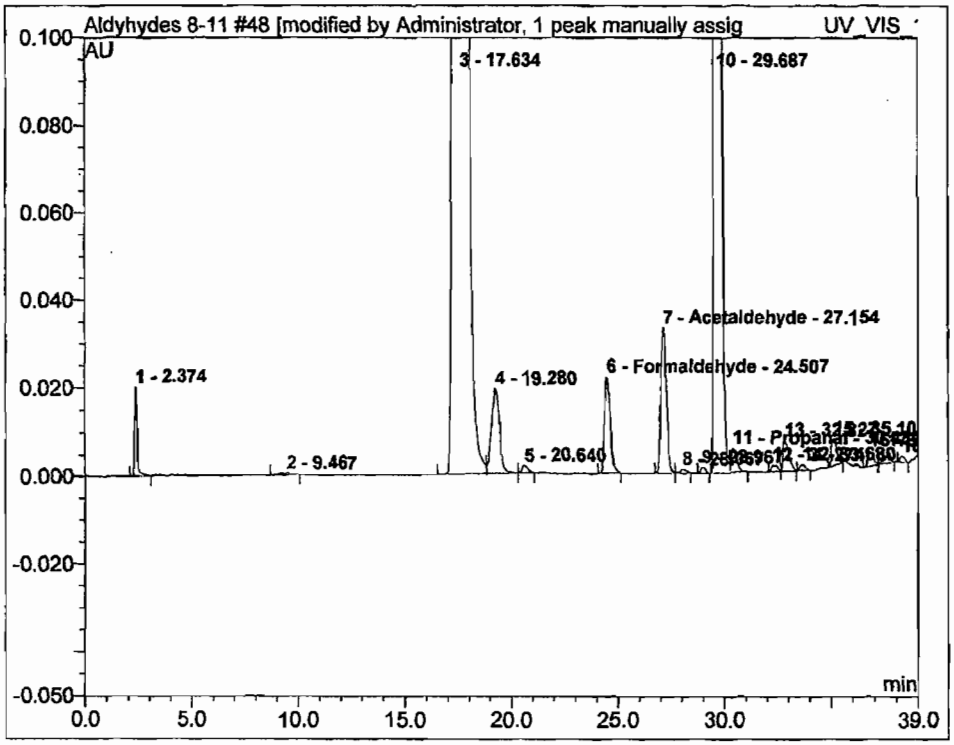
Client	Houston Refin.	Unknown 13	Aldehyde C 35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 12:51**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
6	24.65	Formaldehyde	0.0217	0.00700
7	27.36	Acetaldehyde	0.0331	0.00954
11	30.63	Propanal	0.0057	0.00186
Total:			0.061	3.679

48 FCU 0011-1 10X

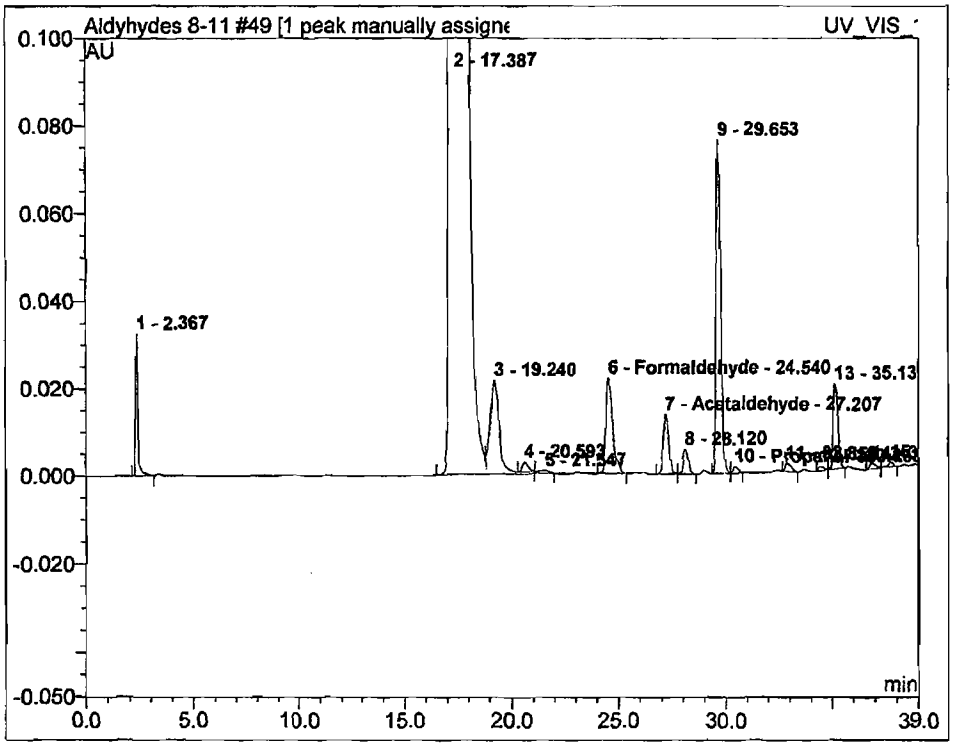
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**unknown**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/10/2011 13:35**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
6	24.51	Formaldehyde	0.0218	0.00682
7	27.15	Acetaldehyde	0.0330	0.01000
11	30.43	Propanal	0.0056	0.00170
Total:			0.060	3.695

49 FCU 0011-2 5X

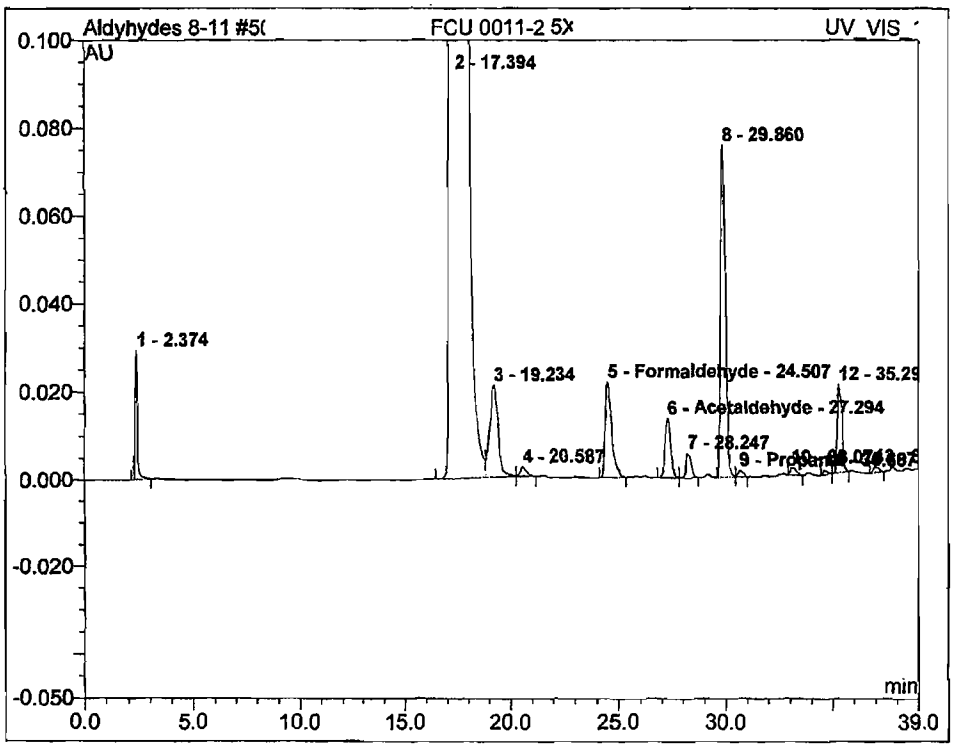
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**unknown**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/10/2011 14:19**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
6	24.54	Formaldehyde	0.0219	0.00780
7	27.21	Acetaldehyde	0.0137	0.00393
10	30.43	Propanal	0.0015	0.00044
Total:			0.037	2.506

50 FCU 0011-2 5X

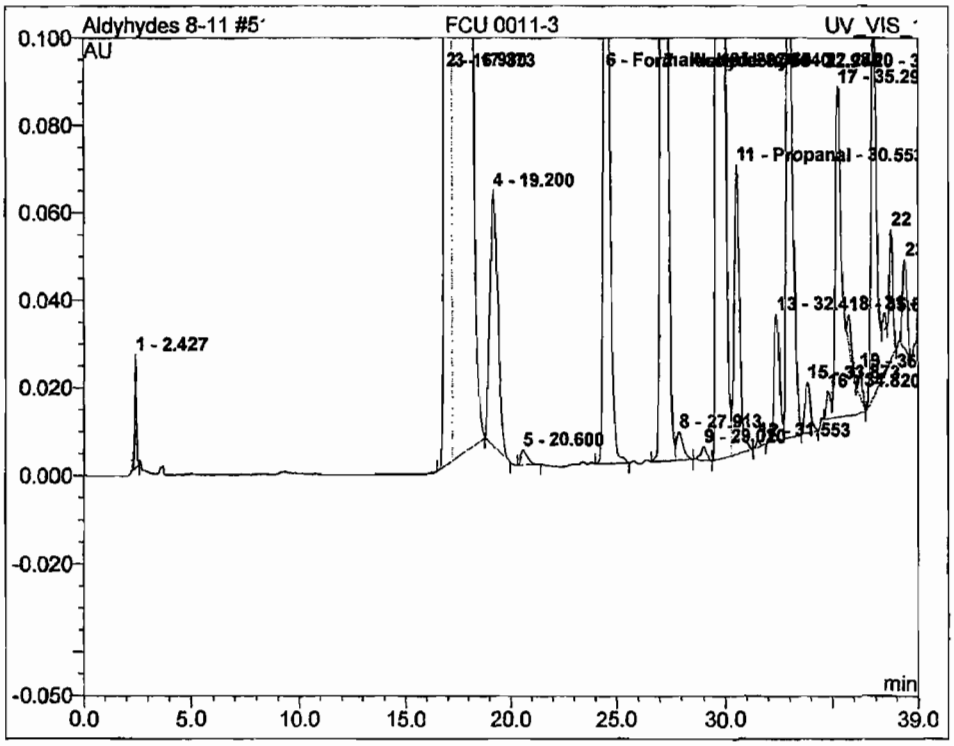
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 15:04**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
5	24.51	Formaldehyde	0.0217	0.00771
6	27.29	Acetaldehyde	0.0135	0.00420
9	30.67	Propanal	0.0015	0.00042
Total:			0.037	2.535

51 FCU 0011-3

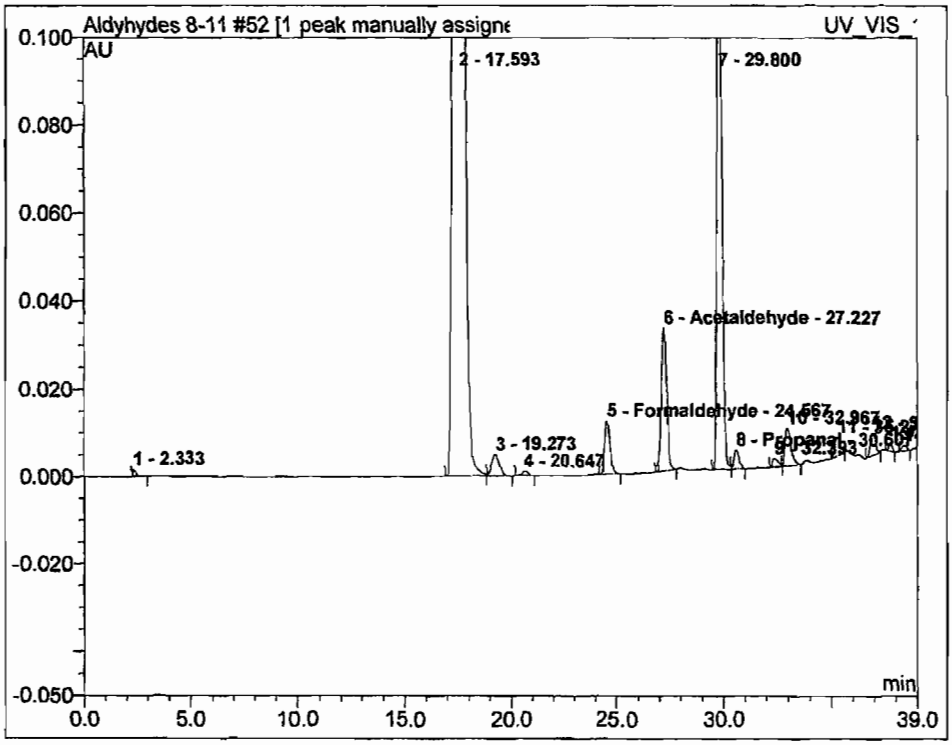
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 15:52**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
6	24.54	Formaldehyde	0.1801	0.05585
7	27.24	Acetaldehyde	0.4786	0.13453
11	30.55	Propanal	0.0660	0.01915
Total:			0.725	41.252

52 FCU 0011-3 15X

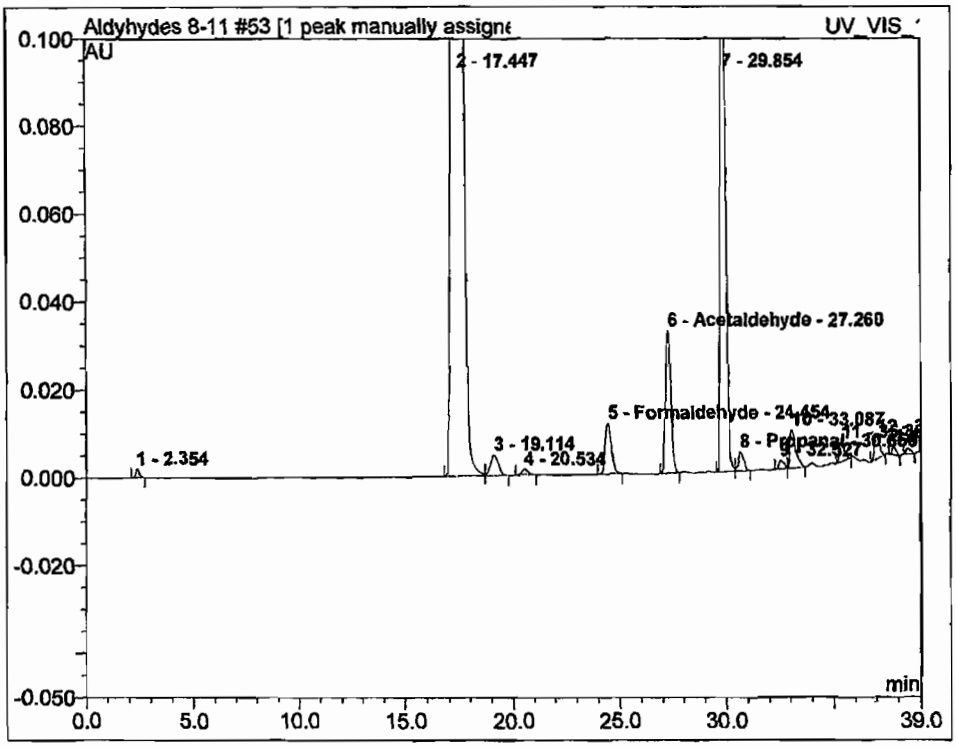
Client	Houston Refin.	Unknown 13	Aldehyde C 35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 16:55**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
5	24.57	Formaldehyde	0.0122	0.00369
6	27.23	Acetaldehyde	0.0326	0.00975
8	30.61	Propanal	0.0042	0.00115
Total:			0.049	2.865

53 FCU 0011-3 15X

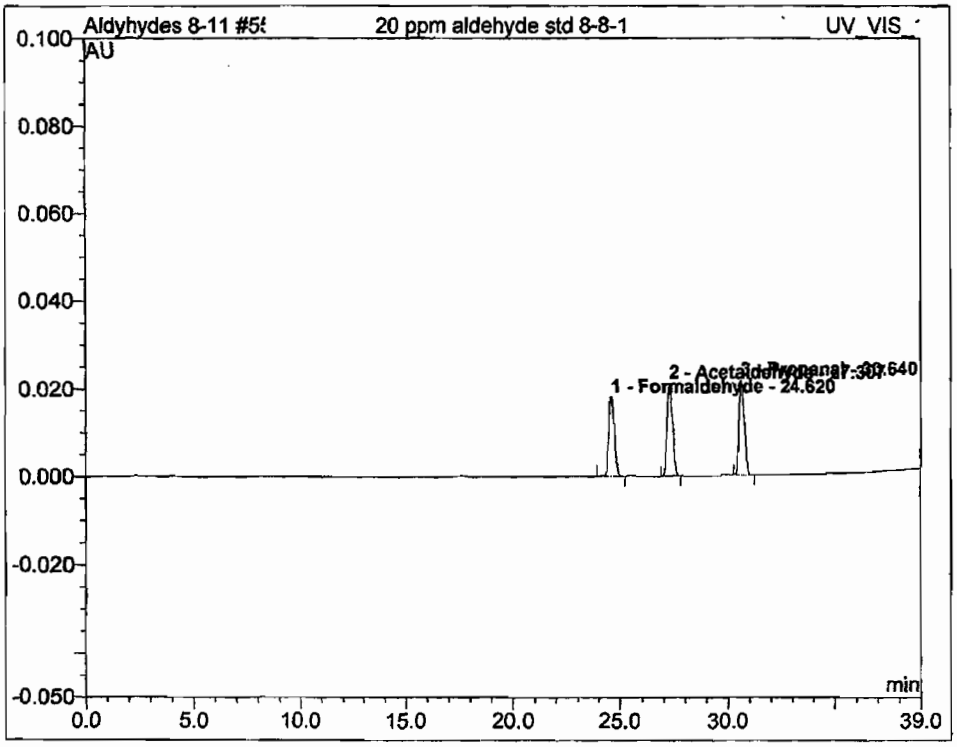
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 17:39**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
5	24.45	Formaldehyde	0.0117	0.00381
6	27.26	Acetaldehyde	0.0325	0.00990
8	30.66	Propanal	0.0044	0.00123
Total:			0.048	2.935

55 20 ppm aldehyde std 8-8-11

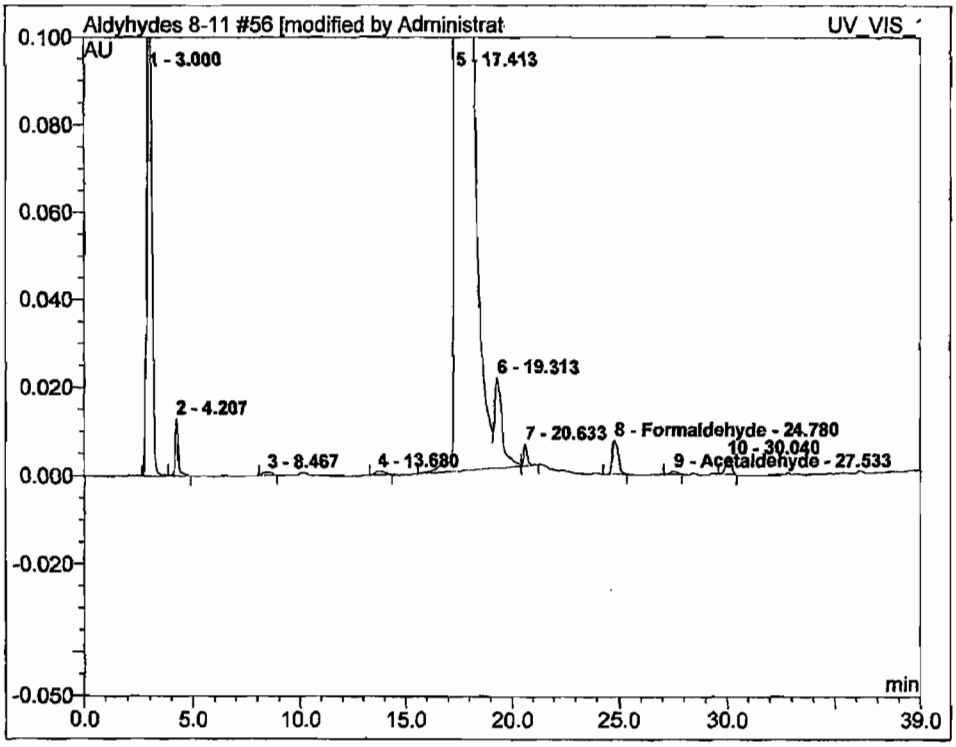
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**standard**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 19:08**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
1	24.62	Formaldehyde	0.0183	0.00557
2	27.31	Acetaldehyde	0.0212	0.00627
3	30.64	Propanal	0.0217	0.00599
Total:			0.061	3.574

56 DNPH blank

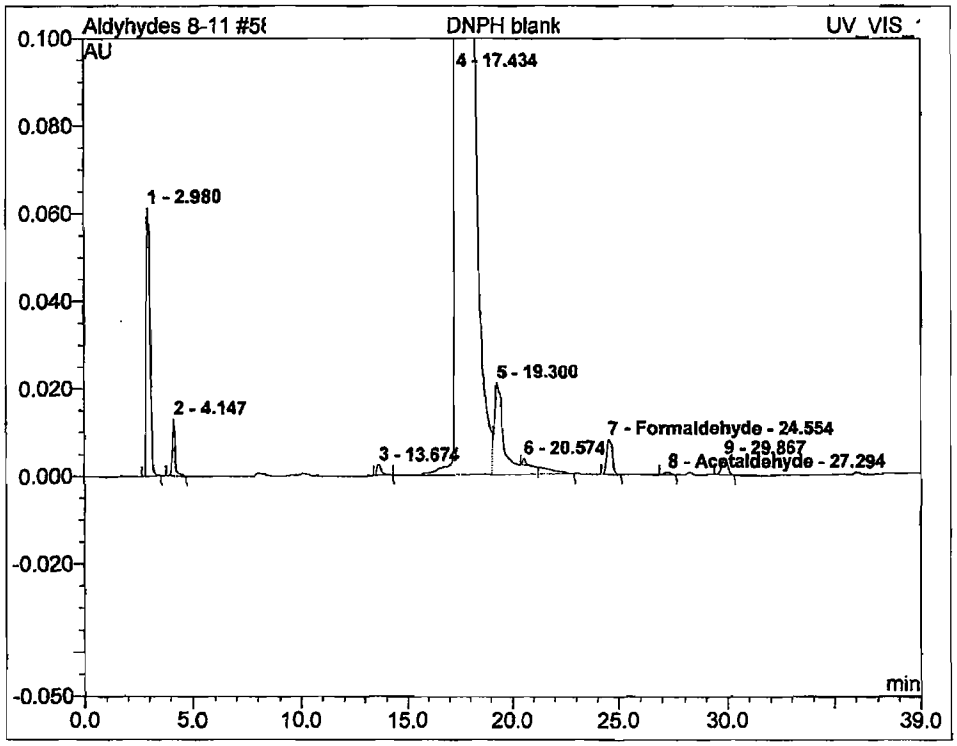
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 19:52**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
8	24.78	Formaldehyde	0.0075	0.00224
9	27.53	Acetaldehyde	0.0007	0.00025
Total:			0.008	0.532

58 DNPH blank

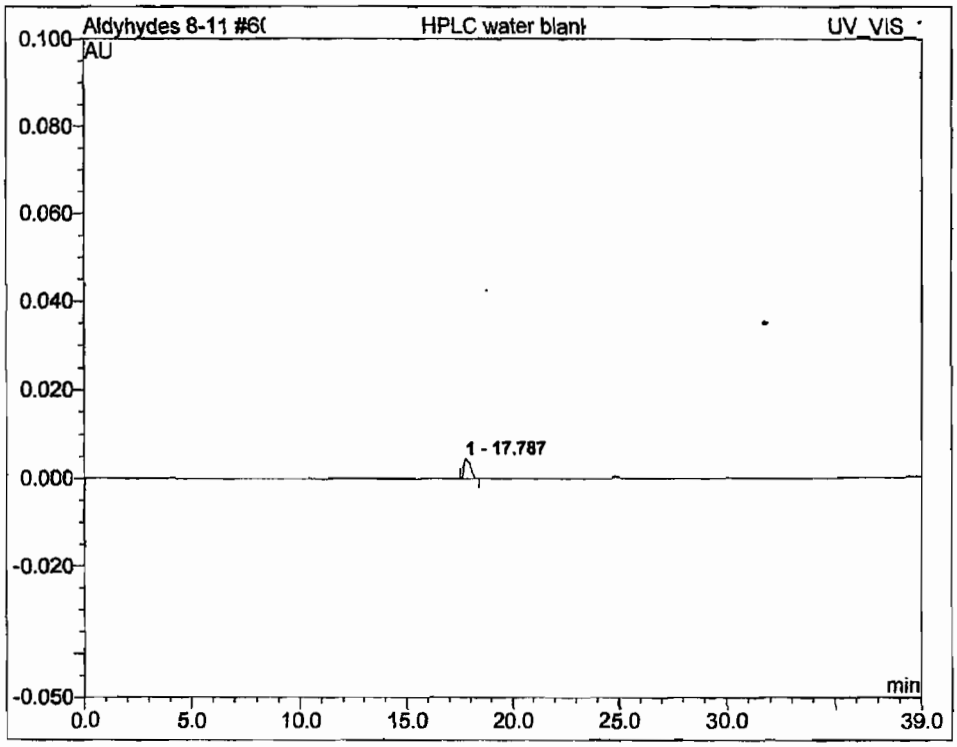
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 21:20**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
7	24.55	Formaldehyde	0.0081	0.00246
8	27.29	Acetaldehyde	0.0007	0.00025
Total:			0.009	0.576

60 HPLC water blank

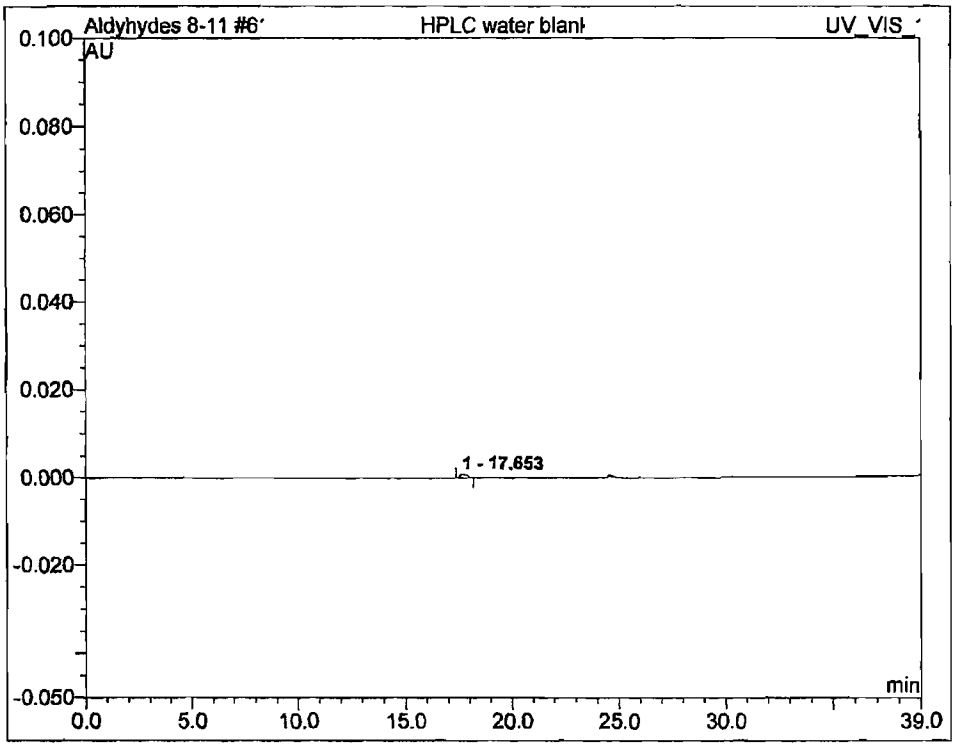
Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**unknown**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/10/2011 22:48**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
Total:			0.000	0.000

61 HPLC water blank

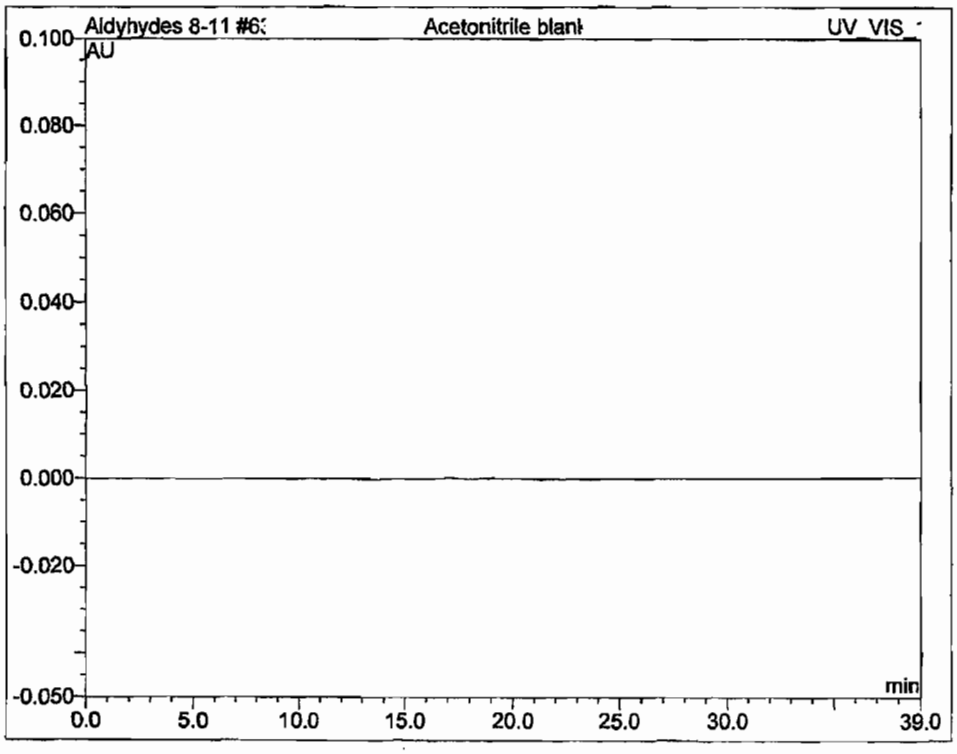
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/10/2011 23:32**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
Total:			0.000	0.000

63 Acetonitrile blank

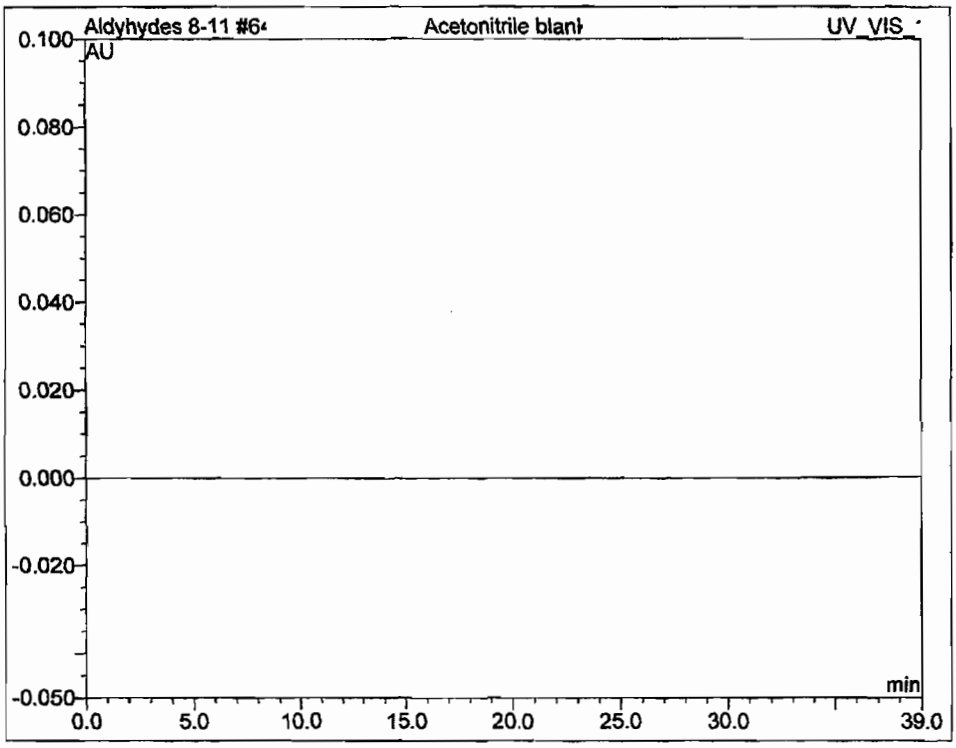
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/11/2011 1:01**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
Total:			0.000	0.000

64 Acetonitrile blank

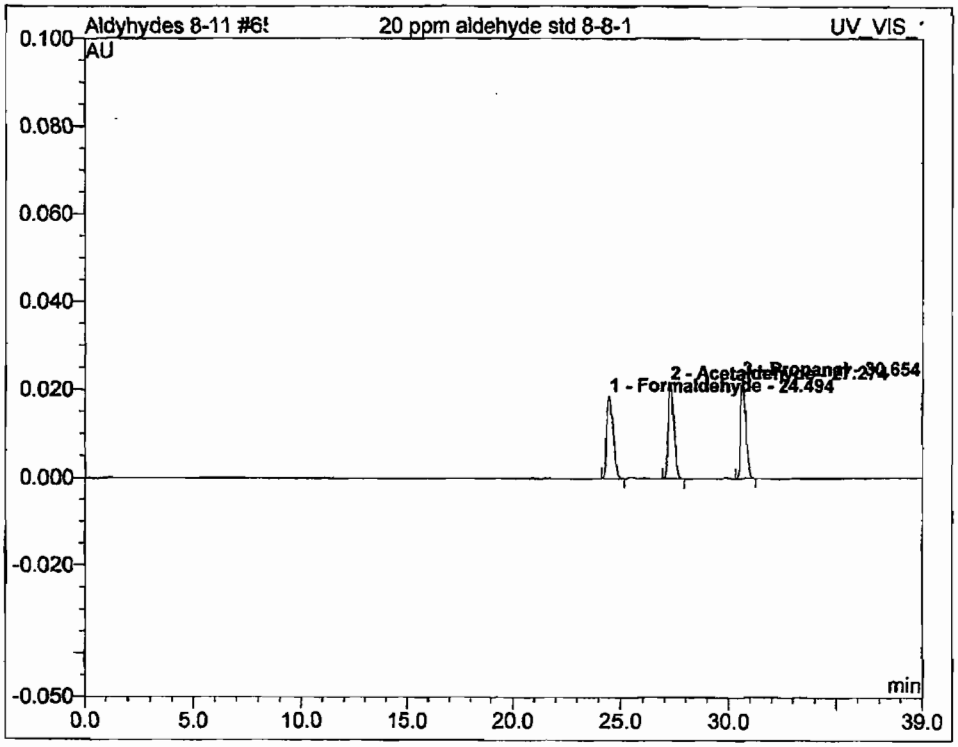
Client	Houston Refin.	Unknown 13	Aldehyde C35
Vial Number:	**1**		**UV_VIS_1**
Sample Type:	**unknown**		**n.a.**
Control Program:	**ALDEHYDES 7-11**		**n.a.**
Quantif. Method:	**Aldedehydes**		**1.0000**
Recording Time:	**8/11/2011 1:45**		**1.0000**
Run Time (min):	**39.00**		**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
Total:			0.000	0.000

65 20 ppm aldehyde std 8-8-11

Client	Houston Refin.	Unknown	13	Aldehyde C35
Vial Number:	**1**			**UV_VIS_1**
Sample Type:	**standard**			**n.a.**
Control Program:	**ALDEHYDES 7-11**			**n.a.**
Quantif. Method:	**Aldedehydes**			**1.0000**
Recording Time:	**8/11/2011 2:29**			**1.0000**
Run Time (min):	**39.00**			**1.0000**



No.	Ret.Time min	Peak Name	Height AU	Area AU*min
1	24.49	Formaldehyde	0.0186	0.00612
2	27.27	Acetaldehyde	0.0215	0.00657
3	30.65	Propanal	0.0223	0.00626
Total:			0.062	3.805

8315A TASK SCHEDULE

Client: Houston Refining

Location: Houston, TX

Project Manager: G. Burch

Date Sampled: 7/19/11 – 7/21/11

Lab Project #: 08-327

Spreadsheet Template ID: SW846-M0011-Aldehydes-Template-65T-Rev1

Analyst: J. Ruggaber

Eluent

Acetonitrile manufacturer and lot Acros HPLC grade, lot B00L3595

DI Water

Calibration Standard Identification

1) 2 ppm aldehyde std, 8/8/11

2) 4 ppm aldehyde std, 8/8/11

3) 10 ppm aldehyde std, 8/8/11

4) 20 ppm aldehyde std, 8/8/11

5) 40 ppm aldehyde std, 8/8/11

Equipment: ICS 2500 with Acclaim 120 C18 column, 4.6x250 mm

DATE	TASK
8/8/11	Transfer each sample to a separatory flask, and drain out the methylene chloride portion. Extract the aqueous portion twice more with 20 mL of methylene chloride. Transfer all of the methylene chloride to a 250 mL (or larger, if needed) volumetric flask and dilute to volume with methylene chloride.
8/8/11 – 8/9/11	Remove a 100 mL aliquot, and use a condenser and hot water bath to condense the sample to ~10 mL. Add ~10 mL of acetonitrile, and condense again. Transfer to an appropriate size volumetric flask (10 or 25 mL), and dilute to volume with acetonitrile. Store samples in sealed vials under refrigeration.
8/9/11	Equilibrate the instrument until a stable baseline is achieved.
8/9/11	Inject each standard solution once. Plot the standard injection areas against calibration standard concentrations to determine a calibration curve.
8/9/11 – 8/11/11	Inject each sample solution in duplicate. Check that the area count for each duplicate injection is within 5% of the mean.
8/9/11 – 8/1/11	If necessary, dilute sample solutions if the peak areas are greater than the highest standard and re-inject in duplicate.
8/9/11 – 8/11/11	Inject a midpoint standard once after every 10 sample injections. Check that the midpoint standard is within 15% of the value generated by the initial calibration curve.
8/11/11	Inject a midpoint standard solution once at the end of the run. Check that the midpoint standard is within 15% of the value generated by the initial calibration curve.
8/15/11	Determine the concentration for each component in each sample using the calibration curve.
8/15/11	Prepare report
	Report QA review
	Report distribution

736 Coker Unit

ARI ENVIRONMENTAL, INC.

Chain of Custody Record H08041

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY	Client Name	Location
08-327	Houston Refining	Houston, TX
Lab Project No.	Client Name	Location
Greg Burch		RW
ARI Project Manager		ARI Sampler Initials

Analysis Location (Wauconda or Pasadena)

Engineering or Compliance Test Samples

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request: Method 0011 (SW-846 Method 8315A)				Comments
H44809	7-19-11	Probe Rinse	1	✓	1	✓				Run # 0011-1
H44810	7-19-11	Knockout Recovery	1	✓	1	✓				Run # 0011-1
H44811	7-19-11	Impinger #1 + #2	1	✓	1	✓				Run # 0011-1
H44812	7-19-11	Impinger #3 + #4	1	✓	1	✓				Run # 0011-1
H44827	7-20-11	Probe Rinse	1	✓	1	✓				Run # 0011-2
H44828	7-20-11	Knockout Recovery	1	✓	1	✓				Run # 0011-2
H44829	7-20-11	Impingers contents	1	✓	1	✓				Run # 0011-2
H44844	7-21-11	Probe Rinse	1	✓	1	✓				Run # 0011-3
H44845	7-21-11	Knockout Recovery	1	✓	1	✓				Run # 0011-3
H44846	7-21-11	Impingers contents (composite)	4	✓	1	✓				Run # 0011-3
H44847	7-21-11	Impinger contents blank	1	✓	1	✓				Run # 0011-Blank
H44848	7-21-11	DNPH blank	1	✓	1	✓				solvent blank
H44849	7-21-11	Methylene Chloride blank	1	✓	1	✓				solvent blank
H44850	7-21-11	HPLC Water blank	1	✓	1	✓				solvent blank
H44851	7-21-11	Field Spike Standard	1	✓	1	✓				Field Standard

Preservation Code

1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions / Comments	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By	SHIPMENT:
	Ron White			HAND CARRY
	(1) Date / Time 8-3-11 @0500	(2) Date / Time	(3) Date / Time	FEDX
	(1) Company ARI	(2) Company	(3) Company	UPS
Requested Analysis Completion Date:	(1) Received By	(2) Received By	(3) Received By	Custody Seal Applied
Report Level: Tier I: Engineering Tier II: Compliance Tier III: QAPP	(1) Date / Time 8/5/11 17:00	(2) Date / Time	(3) Date / Time	Yes No
Route Results Through:	(1) Company ARI	(2) Company	(3) Company	

Form LF0001

C-121

ANALYTICAL SUMMARY

CLIENT: Houston Refining — page 1 of 2
LOCATION: Houston, TX — Analyst: J. Ruggaber
SAMPLE DATES: 7/22/11, 7/27/11, 7/29/11 — Date of Completion: 8/19/2011
ANALYSIS: Hydrochloric Acid — Template Control ID: USEPA-M26-HCl-Template-052T-REV1
METHOD: USEPA Method 26

Calibration Curve Calculation

Std. (µg/ml)	Pre Cal (µS*min)	Post Cal (µS*min)	Average (µS*min)	Deviation (%)
0.0	0.00	0.00	0.00	0.00
1.0	0.130	0.128	0.129	0.77
2.0	0.260	0.266	0.263	-1.12
5.0	0.660	0.674	0.667	-1.00
10.1	1.360	1.384	1.372	-0.86

	Conc. Ug/ml	Peak Area	RF	Cal Conc	% Dif
	1.0	0.129	0.128	1.0	-2.70
	2.0	0.263	0.131	2.0	-1.10
	5.0	0.667	0.133	5.1	0.46
	10.1	1.372	0.136	10.4	3.34
		mean RF--->	0.1320		
Second. Std.	5.0	0.6687		4.94	-1.26

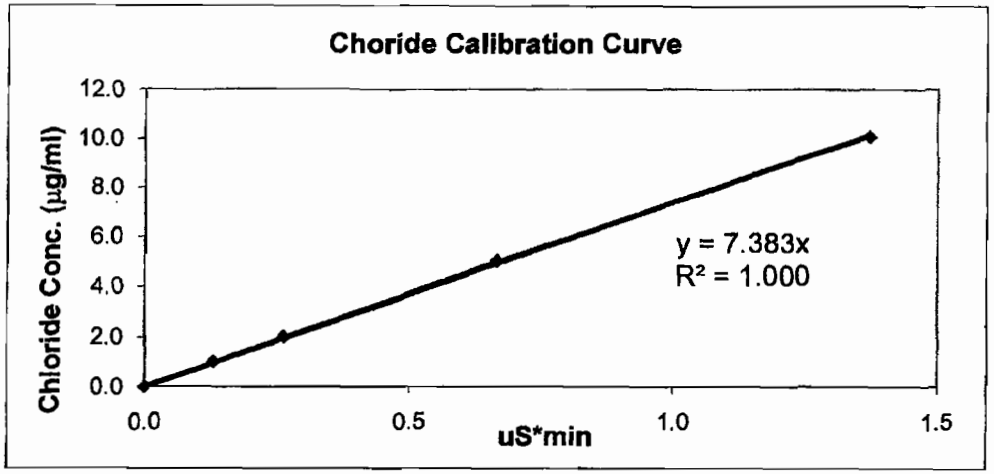
CCVs	Peak Area	Cal. Conc.	% Diff
5.0	0.662	4.890	-2.8
5.0	0.611	4.508	-10.4
5.0	0.675	4.986	-0.9
5.0	0.665	4.906	-2.5

Sample Concentration Calculations

ID	Analysis 1 (area counts)	Analysis 2 (area counts)	Average (area counts)	Deviation (%)	Diluted Conc. (µg/ml)	Dilution Factor	Sample volume(ml)	Total Mass HCl (µg)
26-1 H2SO4	0.040	0.040	0.040	-0.13	0.29	1	1000	300
26-3 H2SO4	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<117
26-4 H2SO4	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<117
Knockout-26-1	<0.031	<0.031	<0.031	0.00	<0.23	1	3190	<743
Knockout-26-3	<0.031	<0.031	<0.031	0.00	<0.23	1	3100	<722
Knockout-26-4	<0.031	<0.031	<0.031	0.00	<0.23	1	3190	<743
26-Blank	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<117
0.1 N H2SO4 Blank	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<117
Lab DI Water Blank	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<117

ID	Analysis 1 (area counts)	Analysis 2 (area counts)	Average (area counts)	Deviation (%)	Actual Conc. (µg/ml)	Spike Conc. (µg/ml)	R (%)	Pass/Fail
26-1 spike	0.059	0.058	0.058	0.86	0.43	0.14	97	Pass
26-3 spike	0.121	0.129	0.125	-3.04	0.92	0.93	99	Pass

CLIENT:	Houston Refining	Analyst:	J. Ruggaber
LOCATION:	Houston, TX	Date of Completion:	8/19/2011
SAMPLE DATES:	7/22/11, 7/27/11, 7/29/11	Template Control ID:	USEPA-M26-HCl-Template-052T-REV1
ANALYSIS:	Hydrochloric Acid		
METHOD:	USEPA Method 26		



ANALYTICAL SUMMARY

CLIENT: Houston Refining
LOCATION: Houston, TX
SAMPLE DATES: 7/22/11, 7/27/11, 7/29/11
ANALYSIS: Hydrofluoric Acid
METHOD: USEPA Method 26

Analyst: J. Ruggaber
Date of Completion: 8/19/2011
Template Control ID: USEPA-M26-HCl-Template-052T-REV1

Calibration Curve Calculation

Std. (µg/ml)	Pre Cal (µS*min)	Post Cal (µS*min)	Average (µS*min)	Deviation (%)		Conc. Ug/ml	Peak Area	RF	Cal Conc	% Dif
0.0	0.00	0.00	0.00	0.00		1.0	0.146	0.146	0.9	-9.10
1.0	0.152	0.141	0.146	3.62		2.0	0.316	0.157	2.0	-2.02
2.0	0.317	0.314	0.316	0.44		5.0	0.834	0.166	5.2	3.52
5.0	0.841	0.826	0.834	0.91		10.0	1.733	0.173	10.8	7.60
10.0	1.741	1.724	1.733	0.49			**mean RF--->**	0.1604		
					Second. Std.	5.0	0.8358	N/A	4.89	-2.79

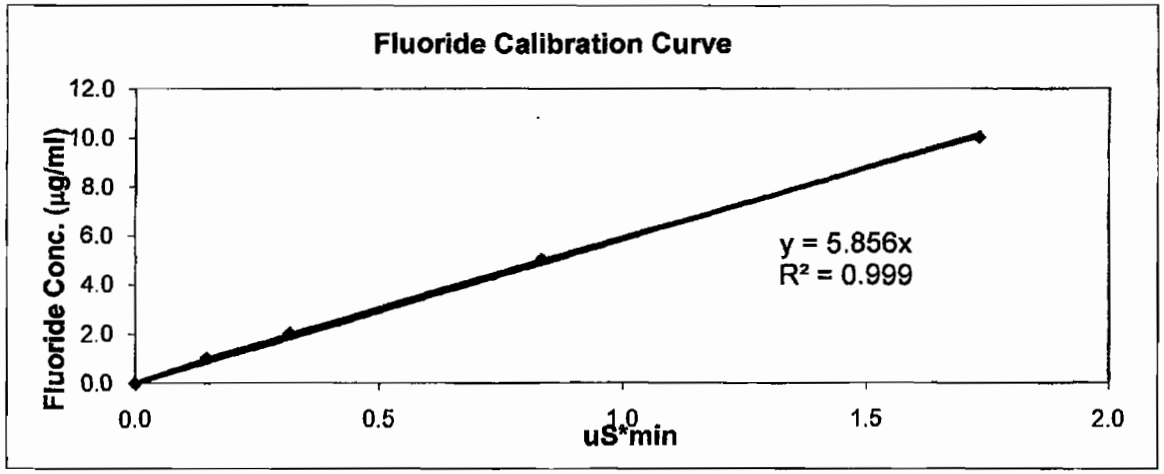
CCVs	Peak Area	Cal. Conc.	% Diff
5.0	0.828	4.821	-4.0
5.0	0.750	4.399	-12.4
5.0	0.832	4.880	-2.8
5.0	0.839	4.924	-1.9

Sample Concentration Calculations

ID	Analysis 1 (area counts)	Analysis 2 (area counts)	Average (area counts)	Deviation (%)	Diluted Conc. (µg/ml)	Dilution Factor	Sample volume(ml)	Total Mass HF(µg)
26-1 H2SO4	<0.005	<0.005	<0.005	0.00	<0.03	1	1000	<31
26-3 H2SO4	<0.005	<0.005	<0.005	0.00	<0.03	1	500	<16
26-4 H2SO4	<0.005	<0.005	<0.005	0.00	<0.03	1	500	<16
Knockout-26-1	<0.005	<0.005	<0.005	0.00	<0.03	1	3190	<100
Knockout-26-3	<0.005	<0.005	<0.005	0.00	<0.03	1	3100	<97
Knockout-26-4	<0.005	<0.005	<0.005	0.00	<0.03	1	3190	<100
26-Blank	<0.005	<0.005	<0.005	0.00	<0.03	1	500	<16
0.1 N H2SO4 Blank	<0.005	<0.005	<0.005	0.00	<0.03	1	500	<16
Lab DI Water Blank	<0.005	<0.005	<0.005	0.00	<0.03	1	500	<16

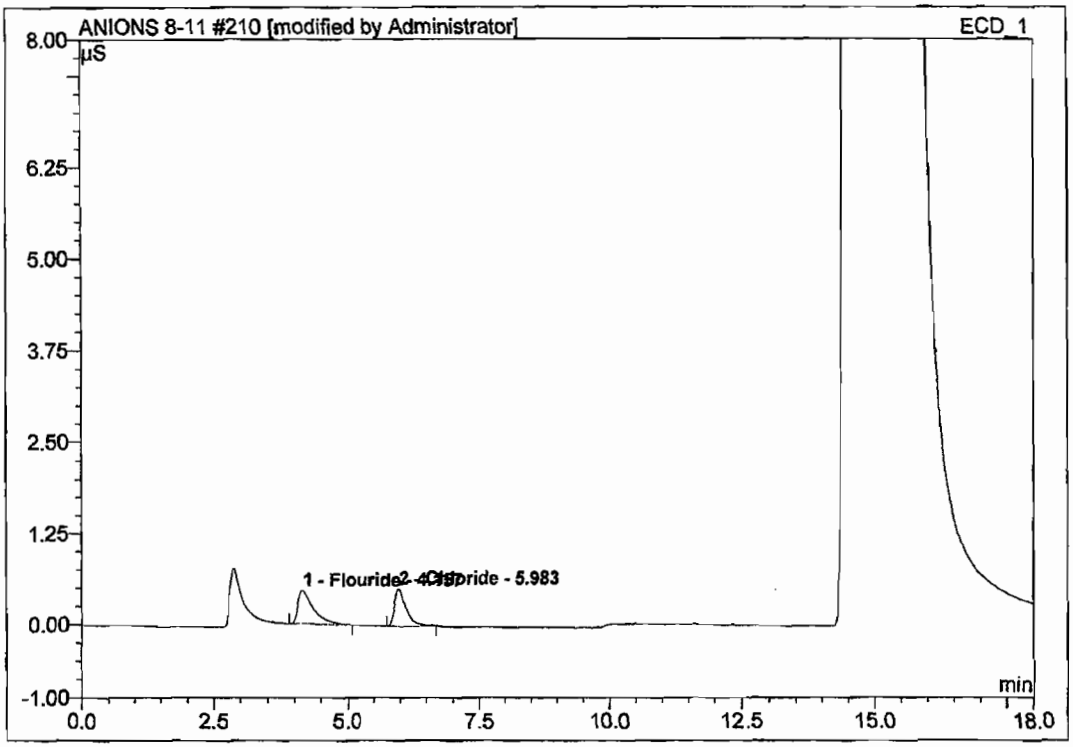
ID	Analysis 1 (area counts)	Analysis 2 (area counts)	Average (area counts)	Deviation (%)	Actual Conc. (µg/ml)	Spike Conc. (µg/ml)	R (%)	Pass/Fail
FCU-26-1 spike	0.019	0.018	0.018	2.21	0.11	0.12	88	Pass
FCU-26-3 spike	0.113	0.119	0.116	-2.58	0.68	0.80	85	Pass

CLIENT:	Houston Refining	Analyst:	J. Ruggaber
LOCATION:	Houston, TX	Date of Completion:	8/19/2011
SAMPLE DATES:	7/22/11, 7/27/11, 7/29/11	Template Control ID:	USEPA-M26-HCl-Template-052T-REV1
ANALYSIS:	Hydrofluoric Acid		
METHOD:	USEPA Method 26		



210 1.0 ppm F, Cl std 8-10-11-pre

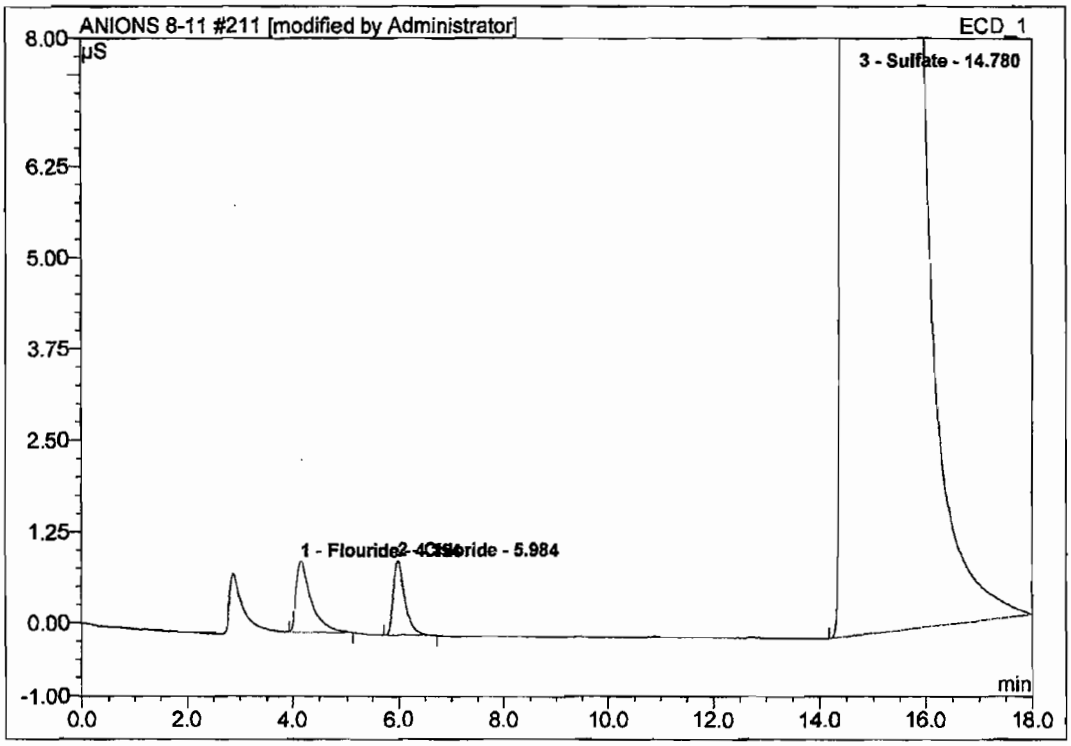
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 14:13**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.16	Flouride	0.451	0.1517
2	5.98	Chloride	0.504	0.1302
Total:			0.955	0.282

211 2.0 ppm F, Cl std 8-10-11-pre

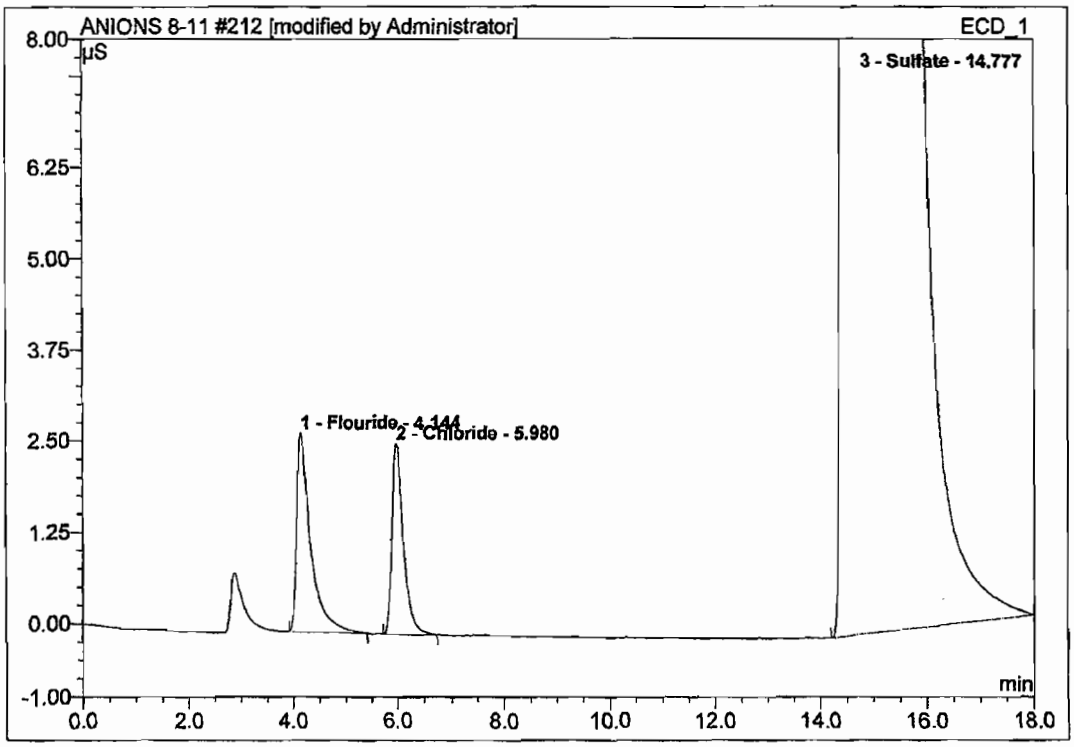
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 14:32**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.15	Flouride	0.971	0.3170
2	5.98	Chloride	1.021	0.2597
3	14.78	Sulfate	414.305	285.0071
Total:			416.297	285.584

212 5.0 ppm F, Cl std 8-10-11-pre

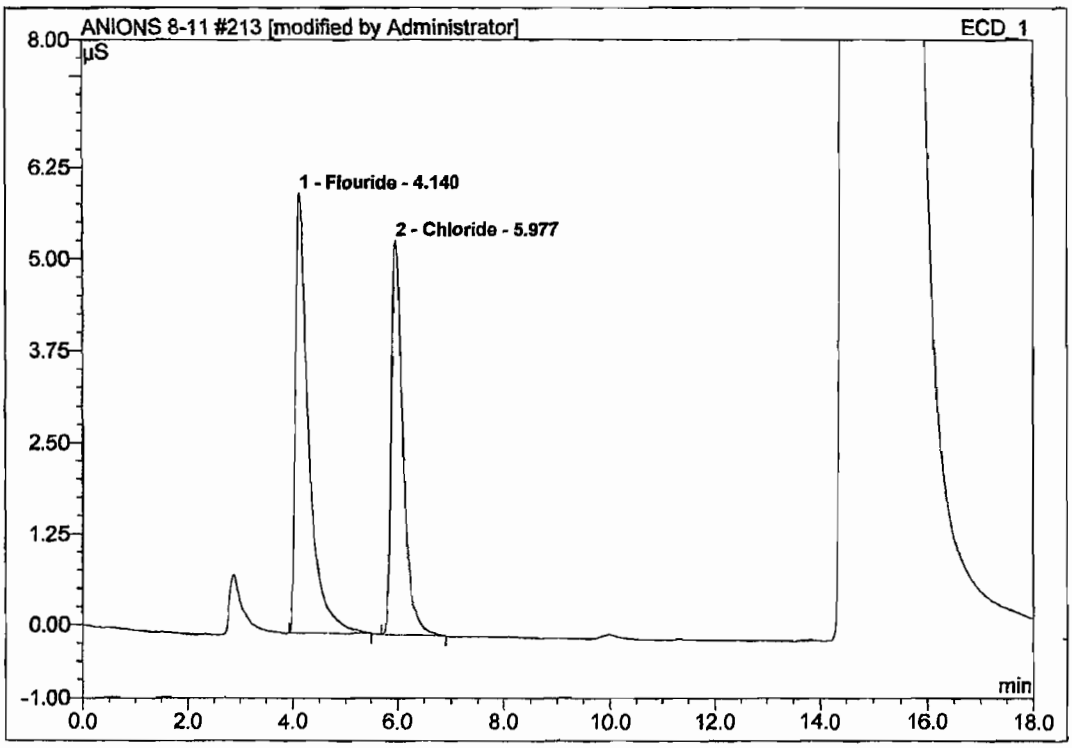
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 14:51**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.14	Flouride	2.710	0.8411
2	5.98	Chloride	2.598	0.6603
3	14.78	Sulfate	409.654	281.9218
Total:			414.962	283.423

213 10.0 ppm F, Cl std 8-10-11-pre

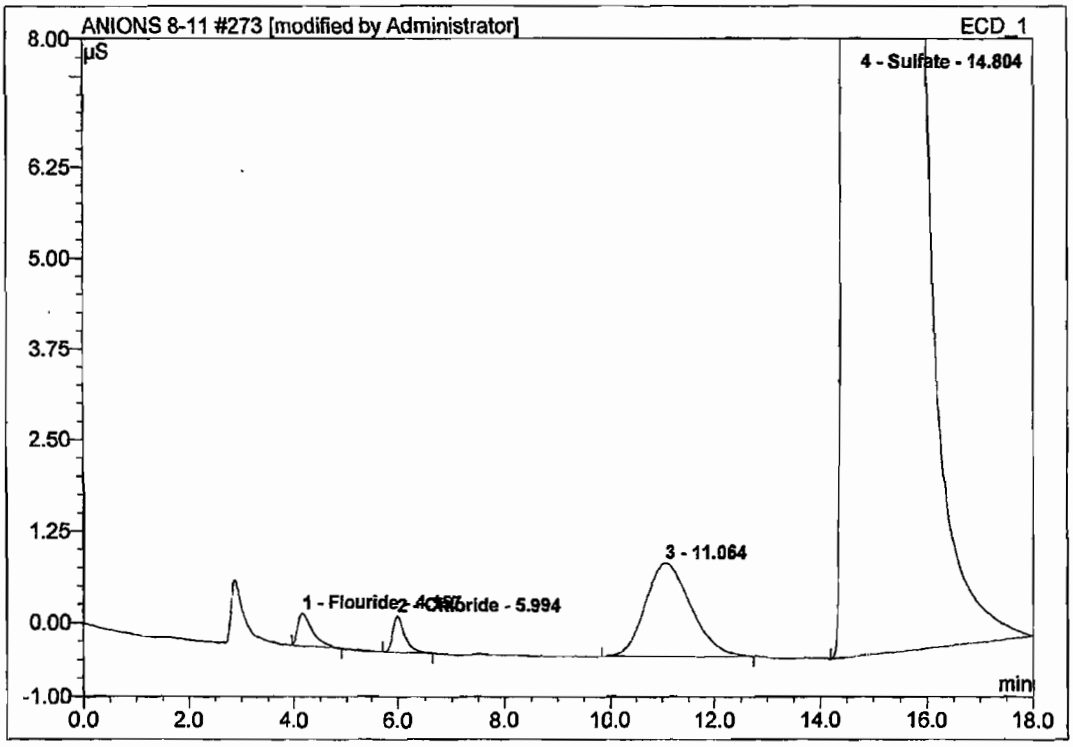
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 15:10**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.14	Flouride	6.015	1.7414
2	5.98	Chloride	5.387	1.3603
Total:			11.402	3.102

273 1.0 ppm F, Cl std 8-10-11

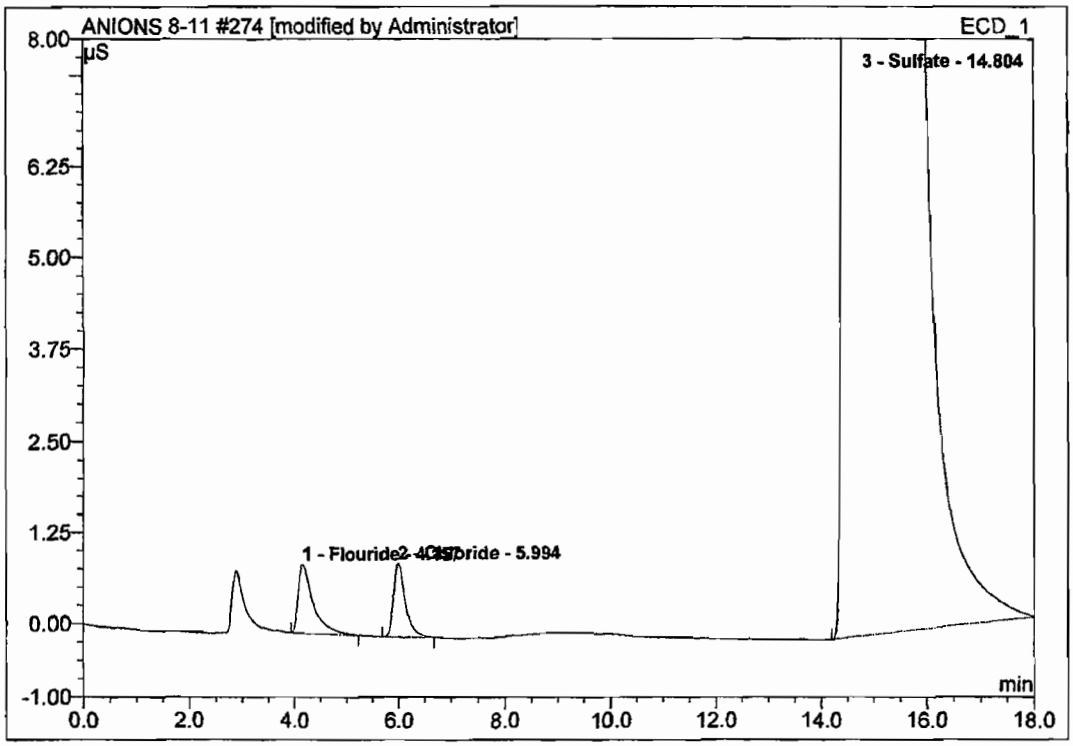
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 13:26**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.16	Flouride	0.441	0.1411
2	5.99	Chloride	0.489	0.1282
4	14.80	Sulfate	410.960	285.0769
Total:			411.890	285.346

274 2.0 ppm F, Cl std 8-10-11

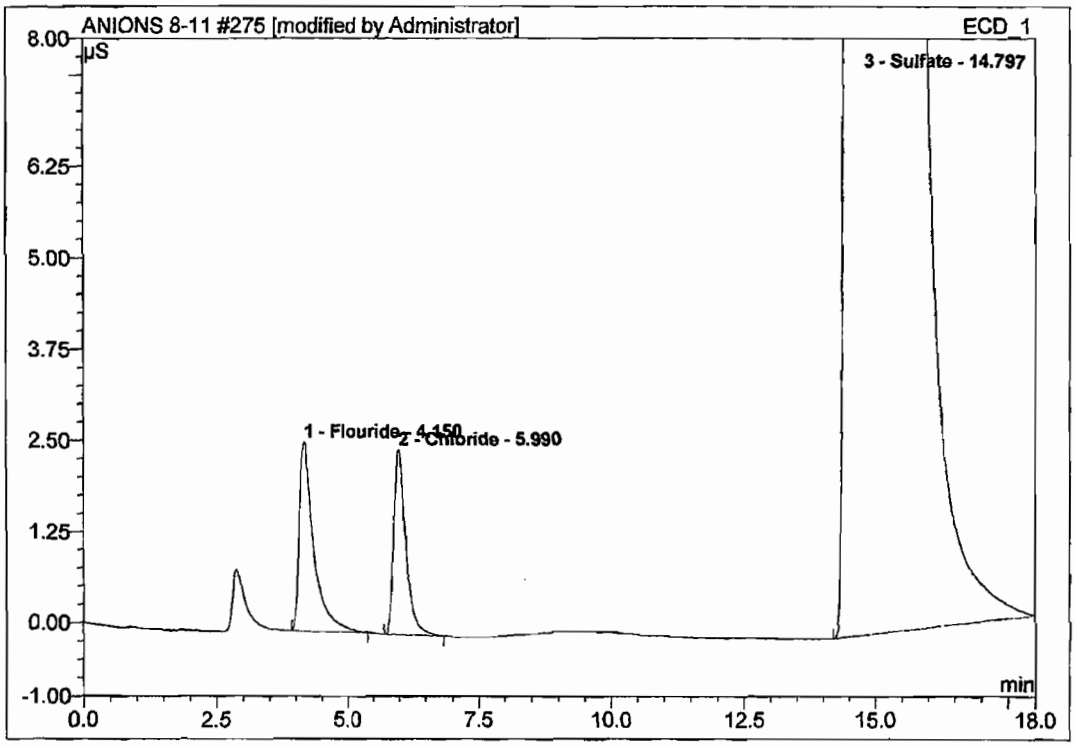
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 13:45**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.16	Flouride	0.938	0.3142
2	5.99	Chloride	1.003	0.2656
3	14.80	Sulfate	410.576	284.8520
Total:			412.518	285.432

275 5.0 ppm F, Cl std 8-10-11

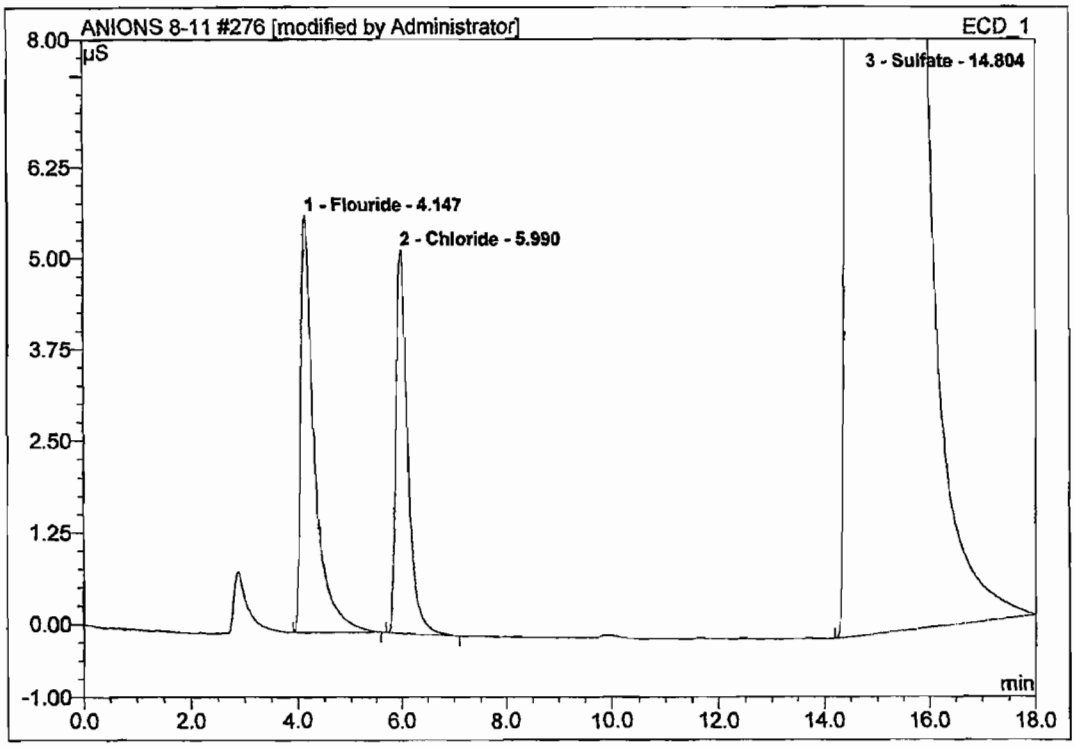
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 14:04**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.15	Flouride	2.593	0.8260
2	5.99	Chloride	2.536	0.6737
3	14.80	Sulfate	408.720	283.6770
Total:			413.849	285.177

276 10.0 ppm F, Cl std 8-10-11

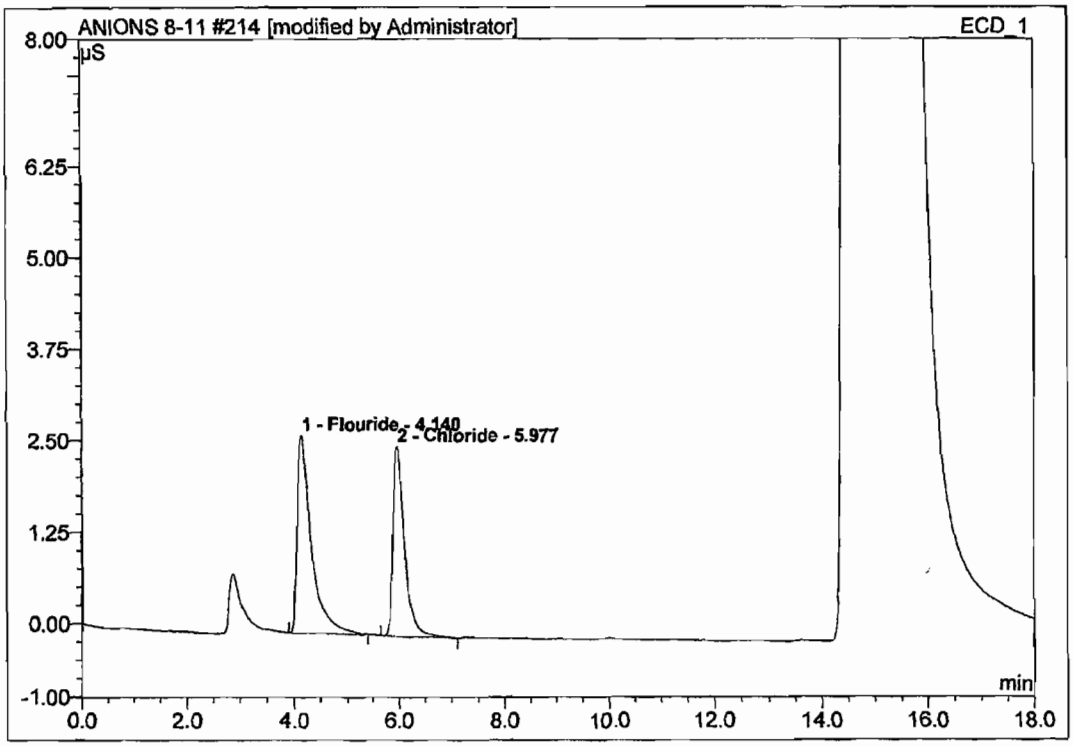
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 14:23**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.15	Flouride	5.694	1.7243
2	5.99	Chloride	5.236	1.3840
3	14.80	Sulfate	405.059	281.1443
Total:			415.989	284.253

214 5 ppm F, Cl second std 8-10-11

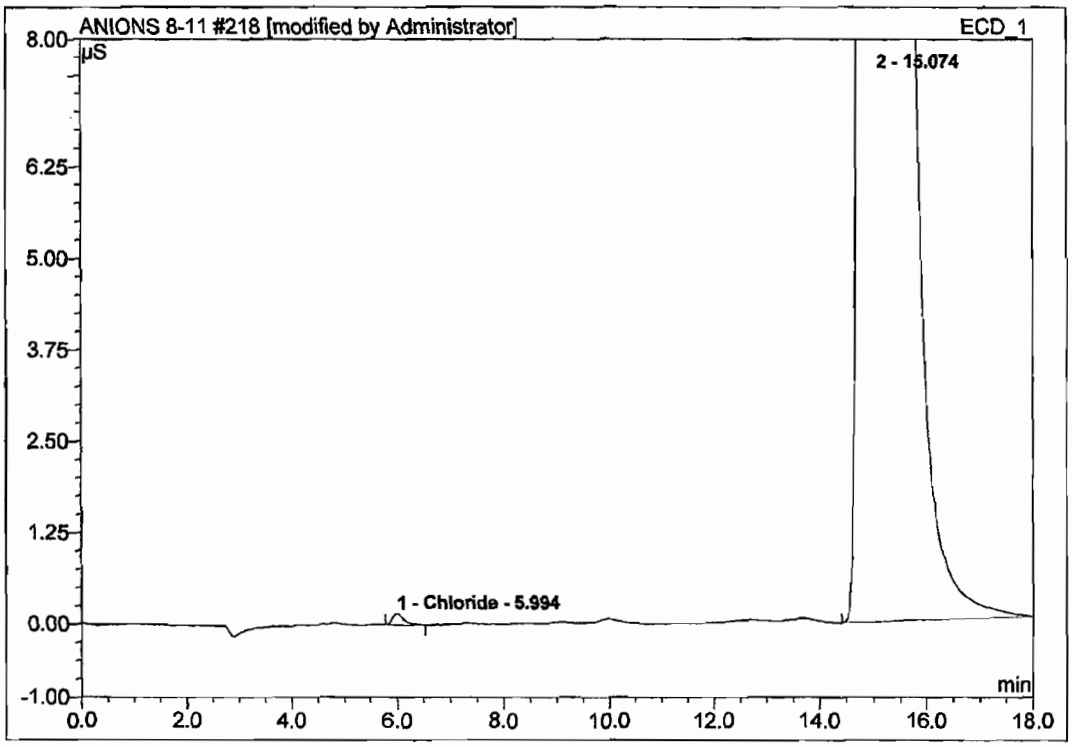
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 15:30**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.14	Flouride	2.699	0.8358
2	5.98	Chloride	2.592	0.6687
Total:			5.292	1.504

218 26-1 H2SO4

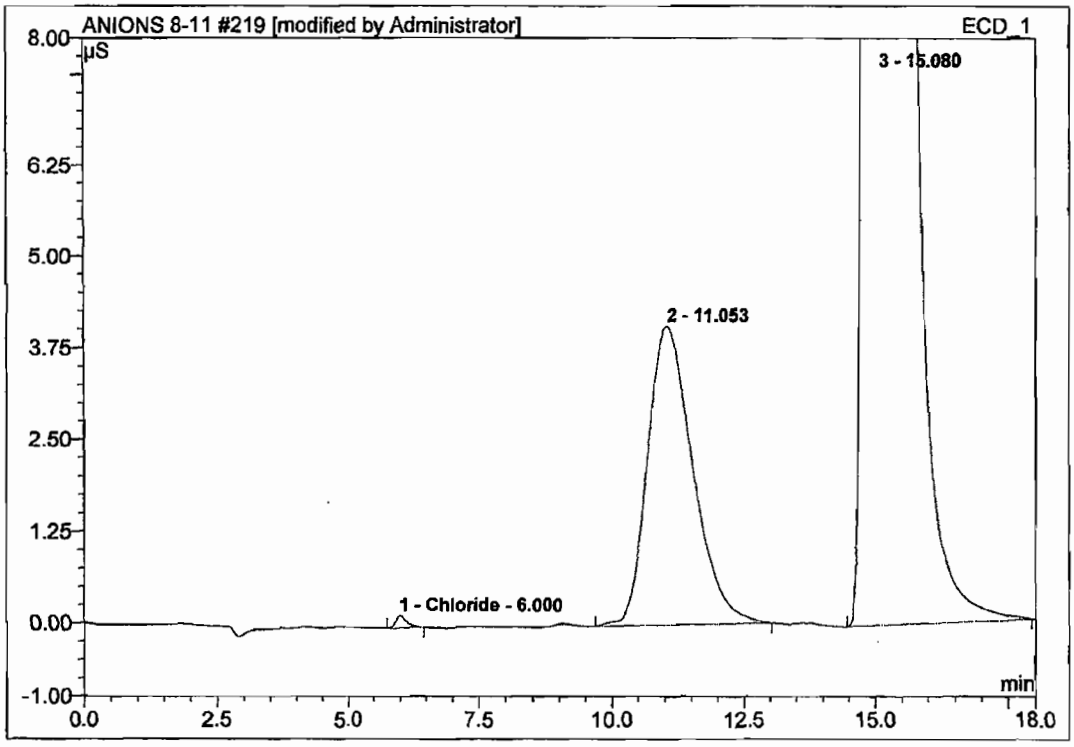
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 17:15**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	0.156	0.0395
Total:			0.156	0.040

219 26-1 H2SO4

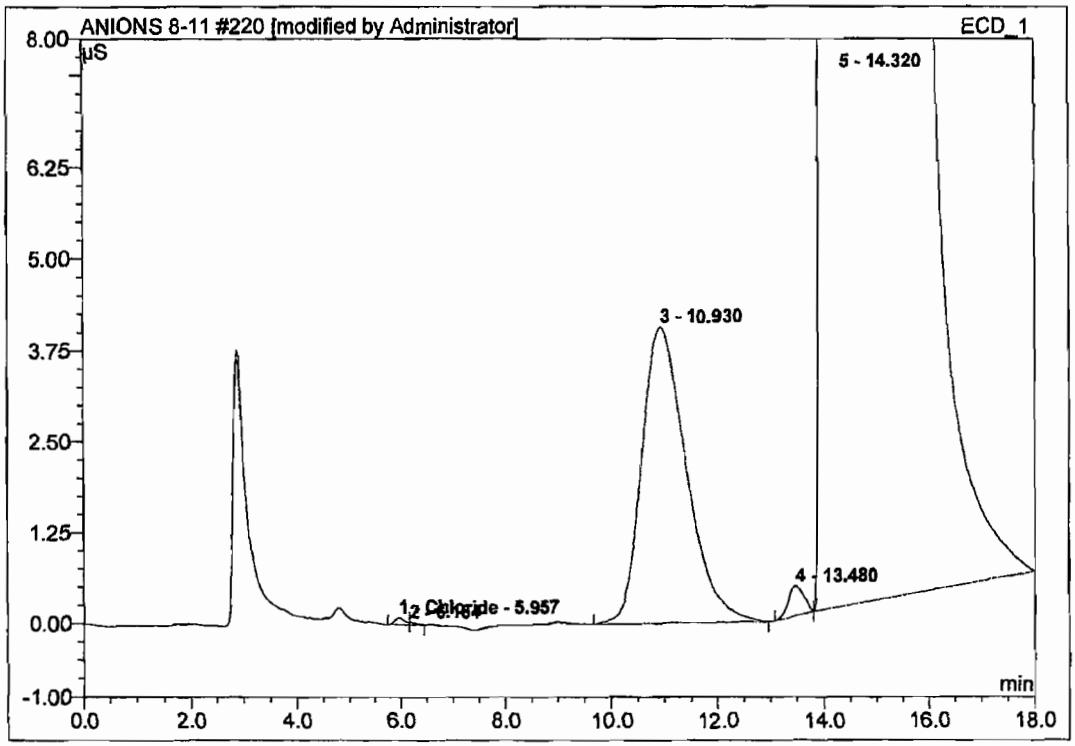
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 17:34**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.166	0.0396
Total:			0.166	0.040

220 26-3 H2SO4

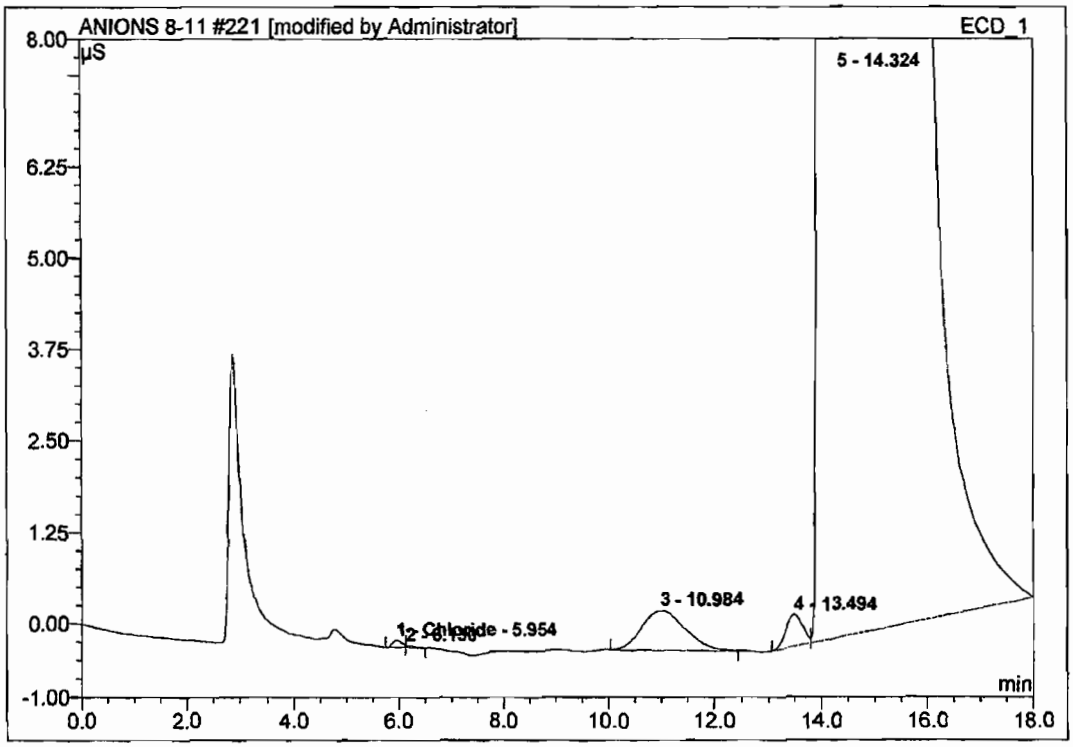
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 17:53**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.96	Chloride	0.089	0.0194
Total:			0.089	0.019

221 26-3 H2SO4

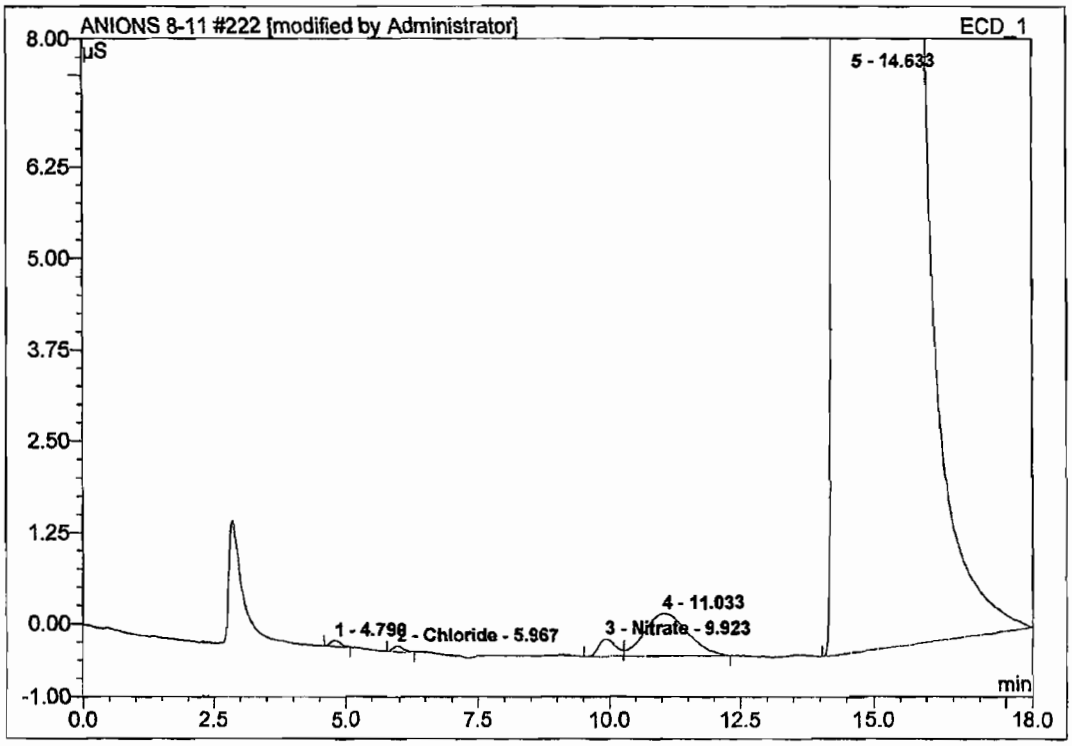
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 18:12**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.95	Chloride	0.091	0.0187
Total:			0.091	0.019

222 26-4 H2SO4

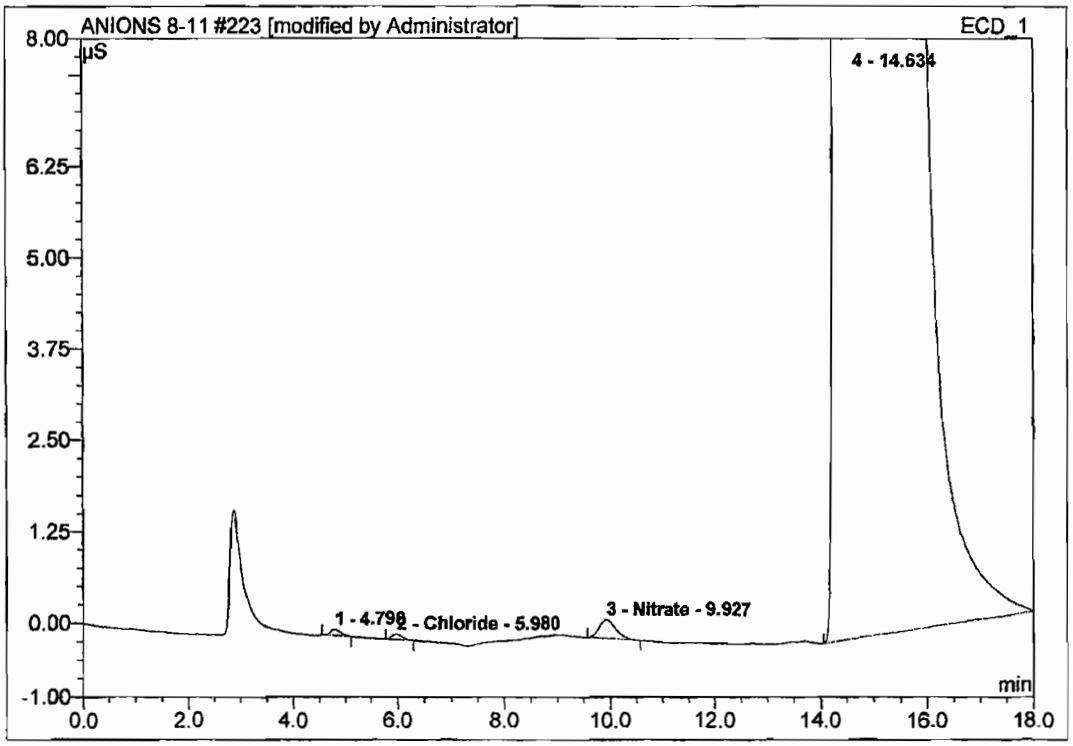
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 18:31**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
2	5.97	Chloride	0.076	0.0171
3	9.92	Nitrate	0.243	0.0895
Total:			0.320	0.107

223 26-4 H2SO4

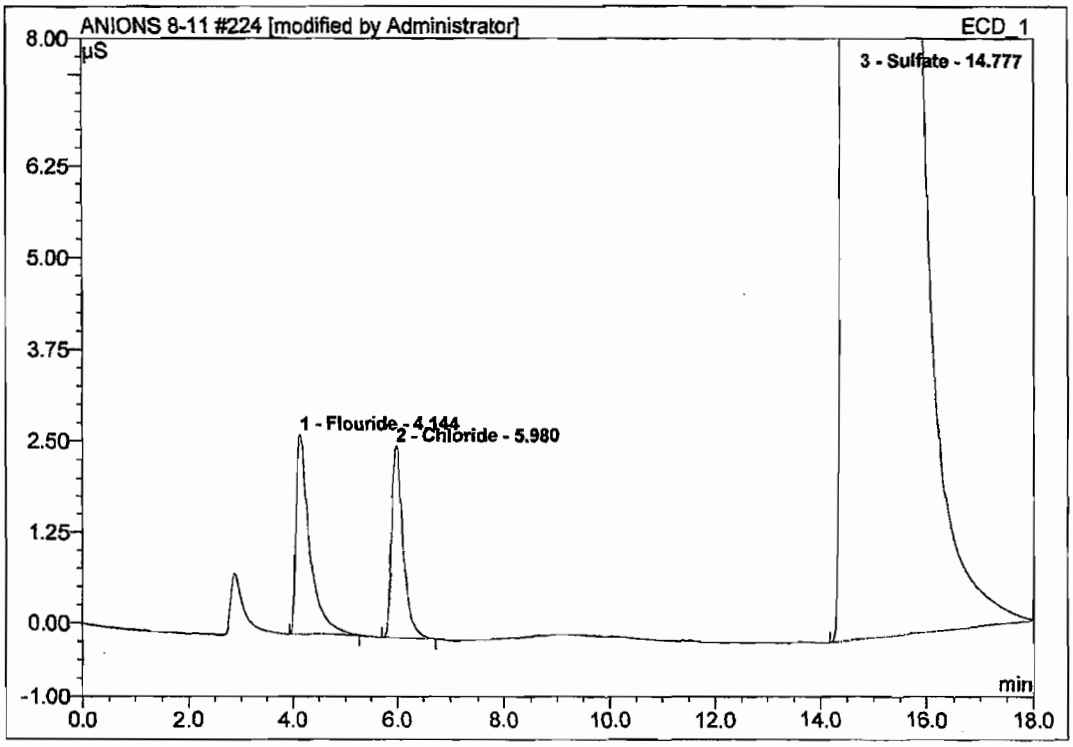
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 18:50**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
2	5.98	Chloride	0.073	0.0163
3	9.93	Nitrate	0.243	0.0880
Total:			0.316	0.104

224 5.0 ppm F, Cl std 8-10-11

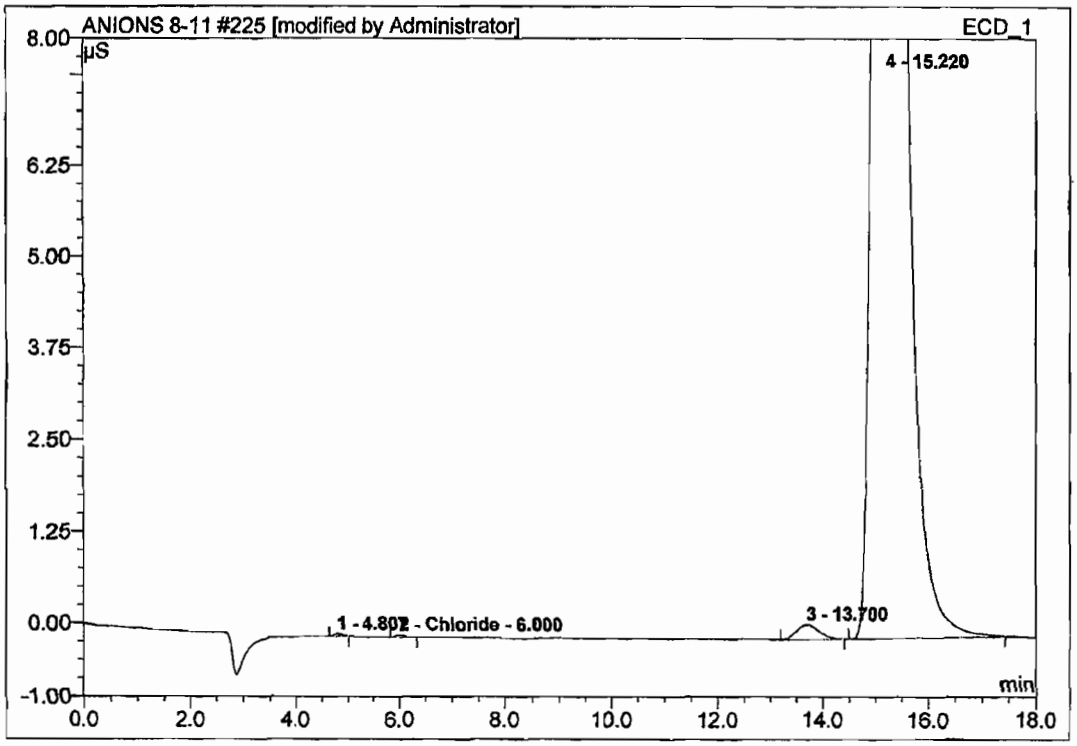
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 19:09**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.14	Flouride	2.735	0.8279
2	5.98	Chloride	2.626	0.6623
3	14.78	Sulfate	410.460	280.3672
Total:			415.821	281.857

225 26-1 knockout

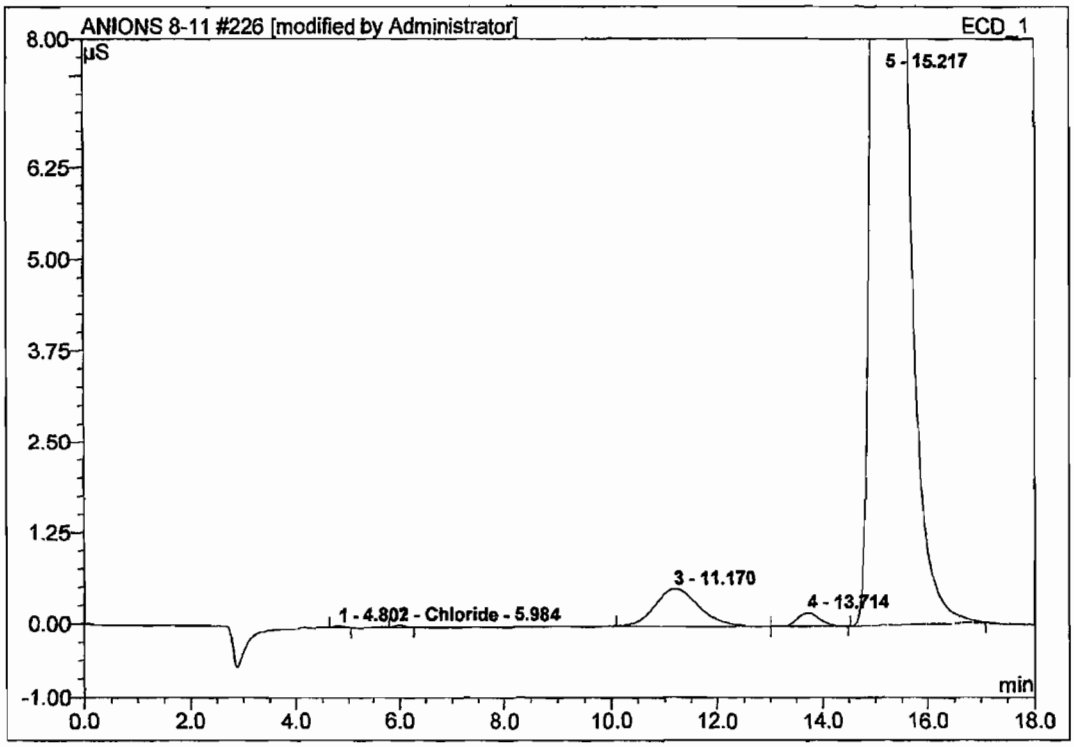
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 19:28**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
2	6.00	Chloride	0.028	0.0062
Total:			0.028	0.006

226 26-1 knockout

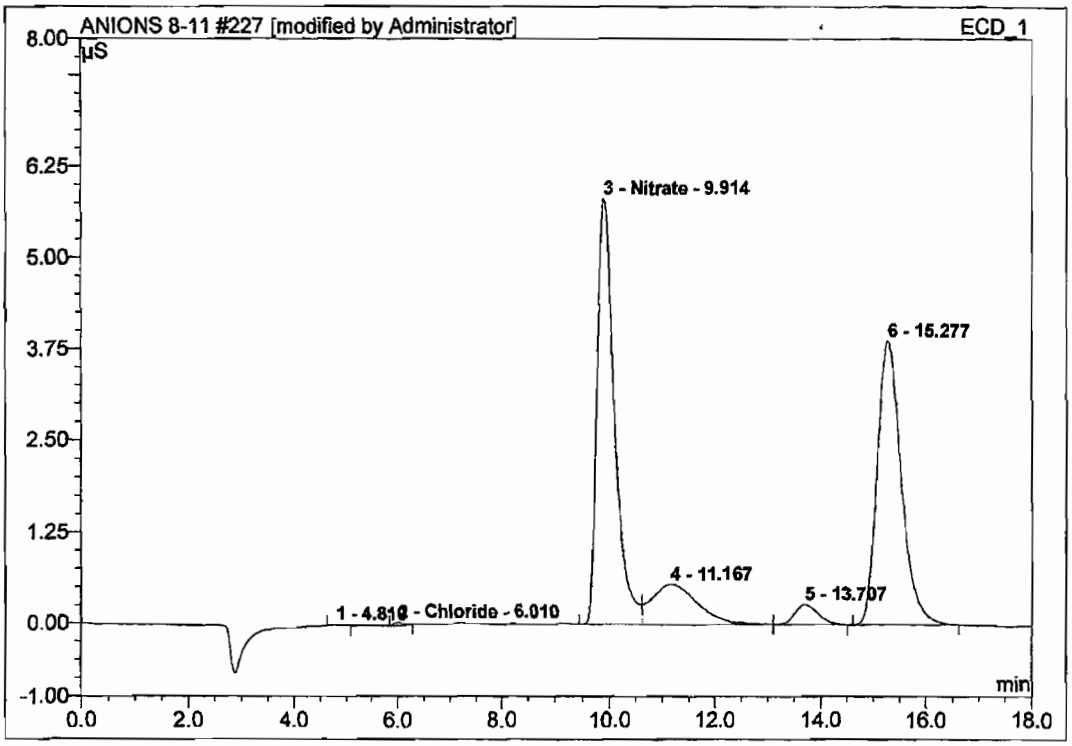
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 19:48**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
2	5.98	Chloride	0.031	0.0073
Total:			0.031	0.007

227 26-3 knockout

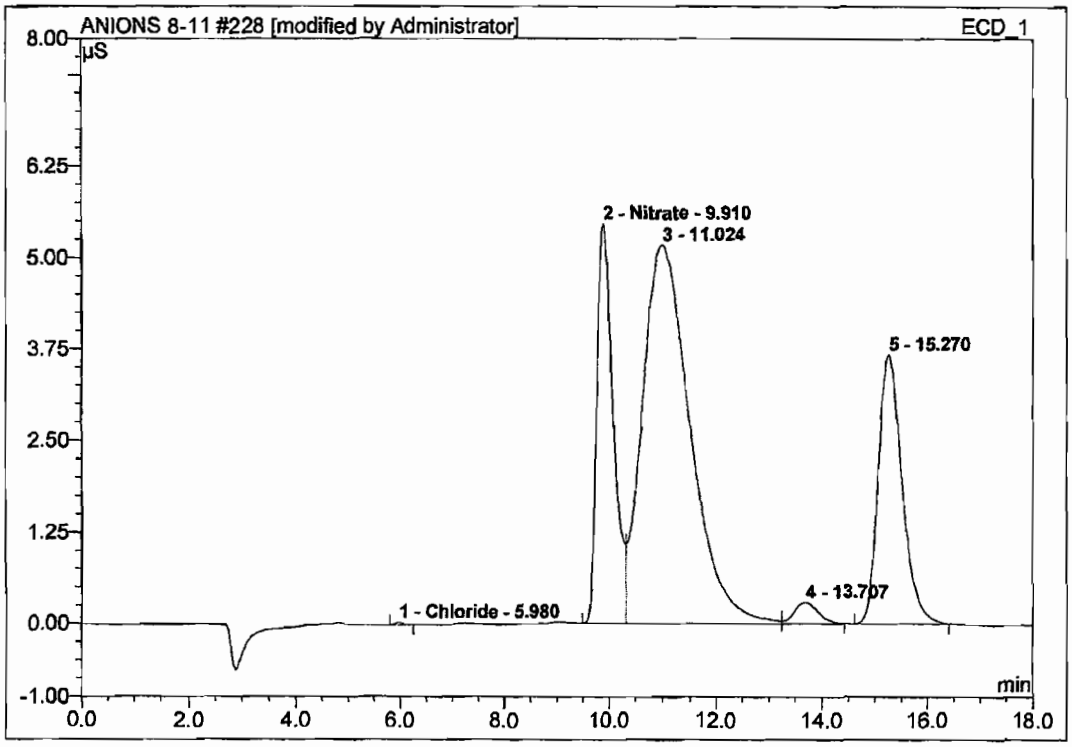
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 20:07**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
2	6.01	Chloride	0.042	0.0087
3	9.91	Nitrate	5.819	2.1822
Total:			5.861	2.191

228 26-3 knockout

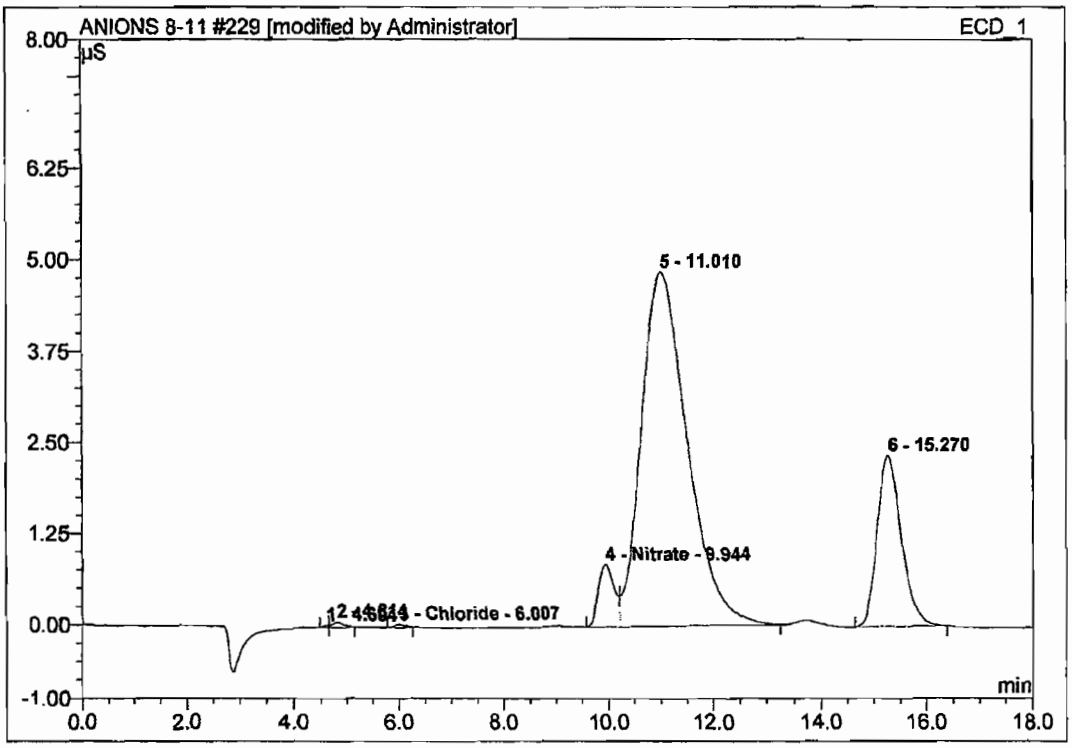
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 20:26**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.98	Chloride	0.036	0.0067
2	9.91	Nitrate	5.459	1.9852
Total:			5.495	1.992

229 26-4 knockout

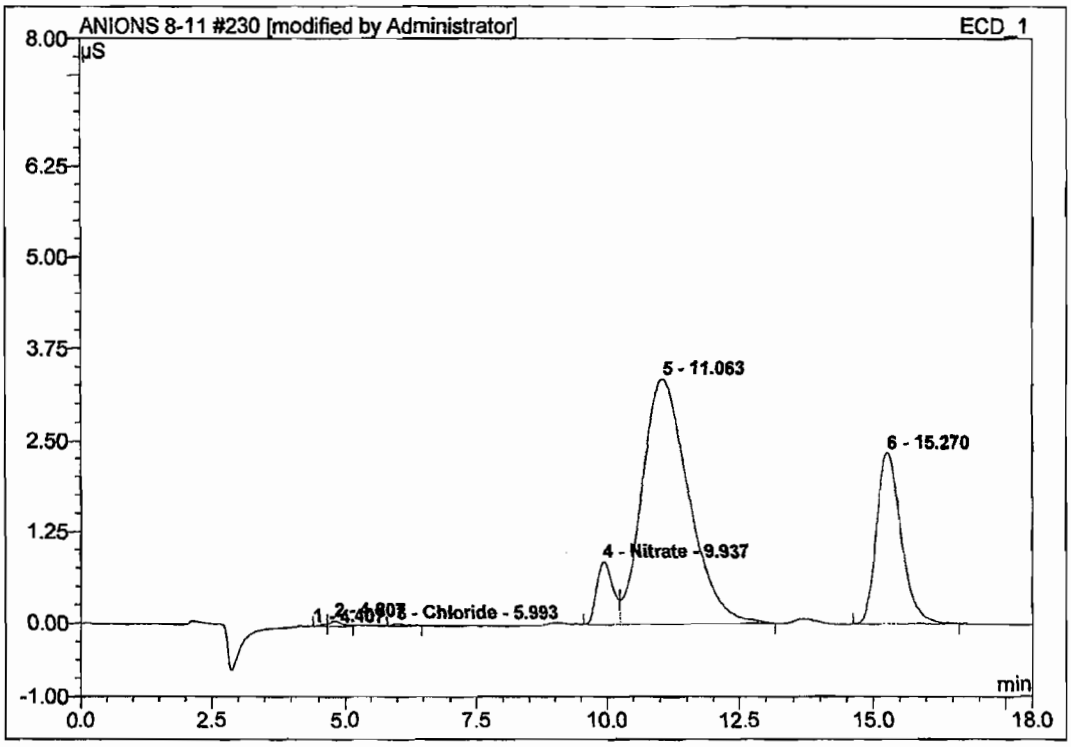
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 20:45**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
3	6.01	Chloride	0.038	0.0095
4	9.94	Nitrate	0.845	0.2969
Total:			0.884	0.306

230 26-4 knockout

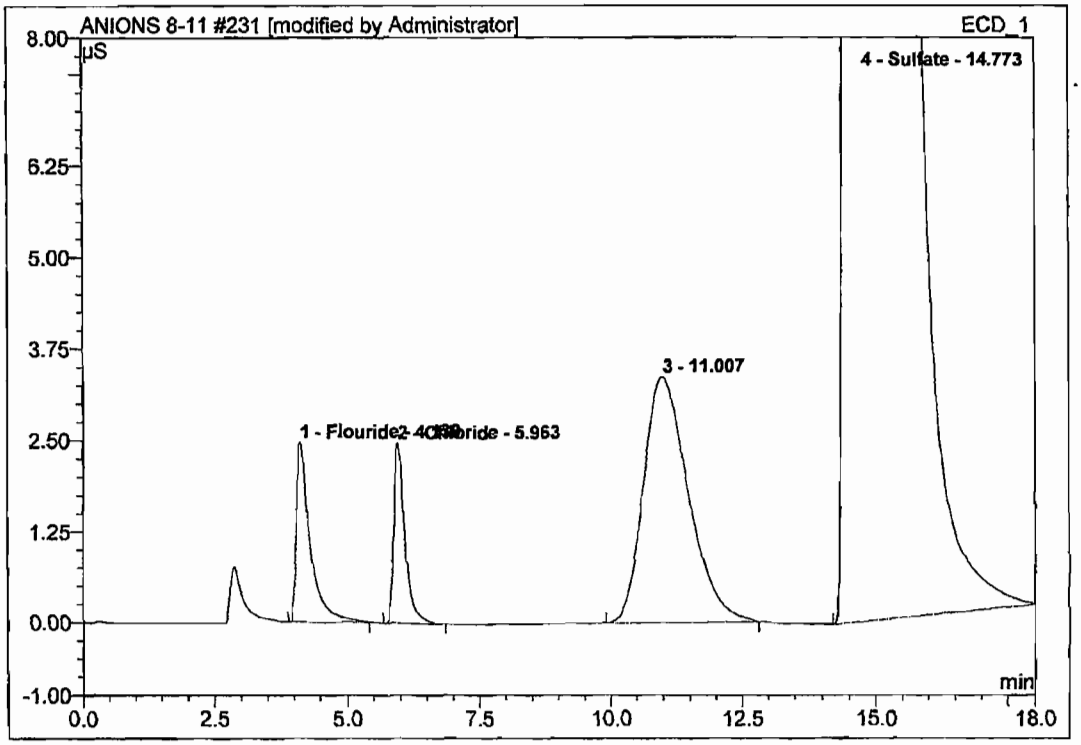
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 21:04**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
3	5.99	Chloride	0.037	0.0097
4	9.94	Nitrate	0.852	0.3077
Total:			0.889	0.317

231 5.0 ppm F, Cl std 8-10-11

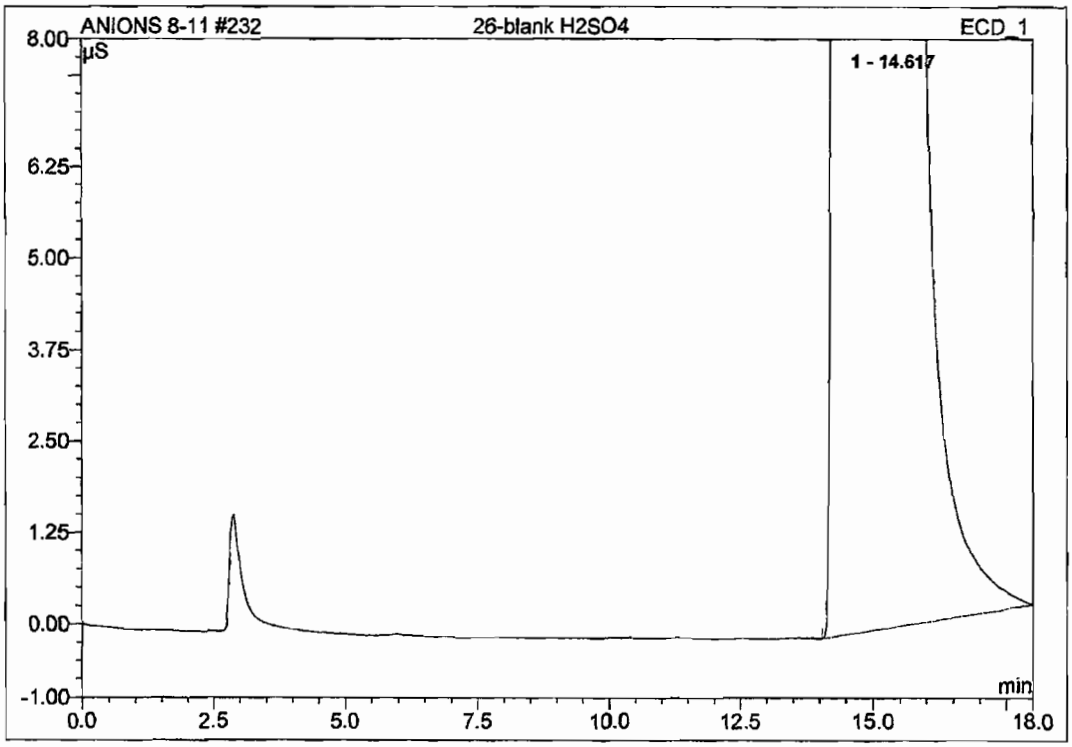
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 21:23**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.13	Flouride	2.462	0.7495
2	5.96	Chloride	2.466	0.6106
4	14.77	Sulfate	382.054	253.8669
Total:			386.981	255.227

232 26-blank H2SO4

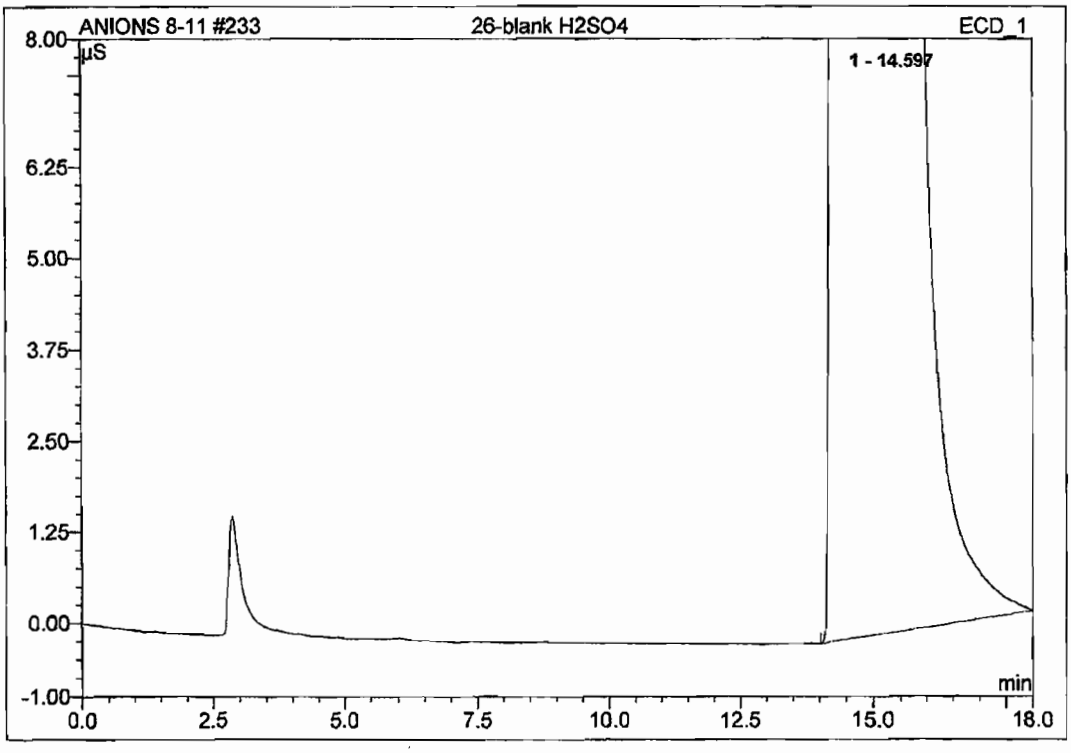
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 21:42**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
Total:			0.000	0.000

233 26-blank H2SO4

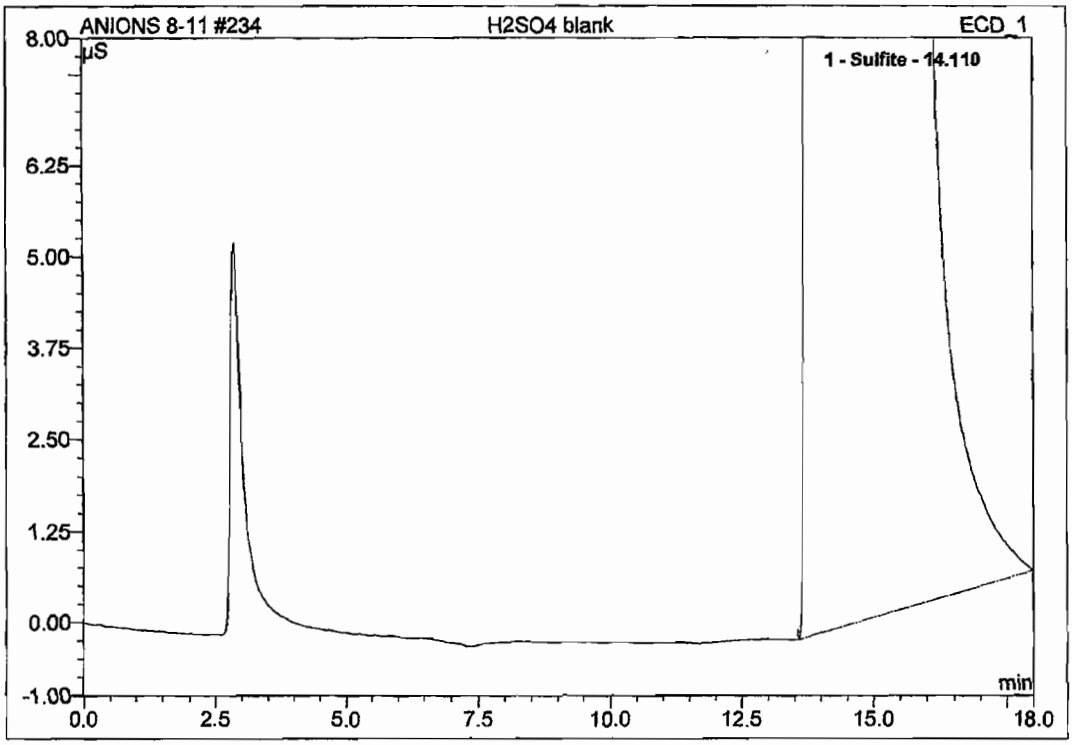
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 22:01**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
Total:			0.000	0.000

234 H2SO4 blank

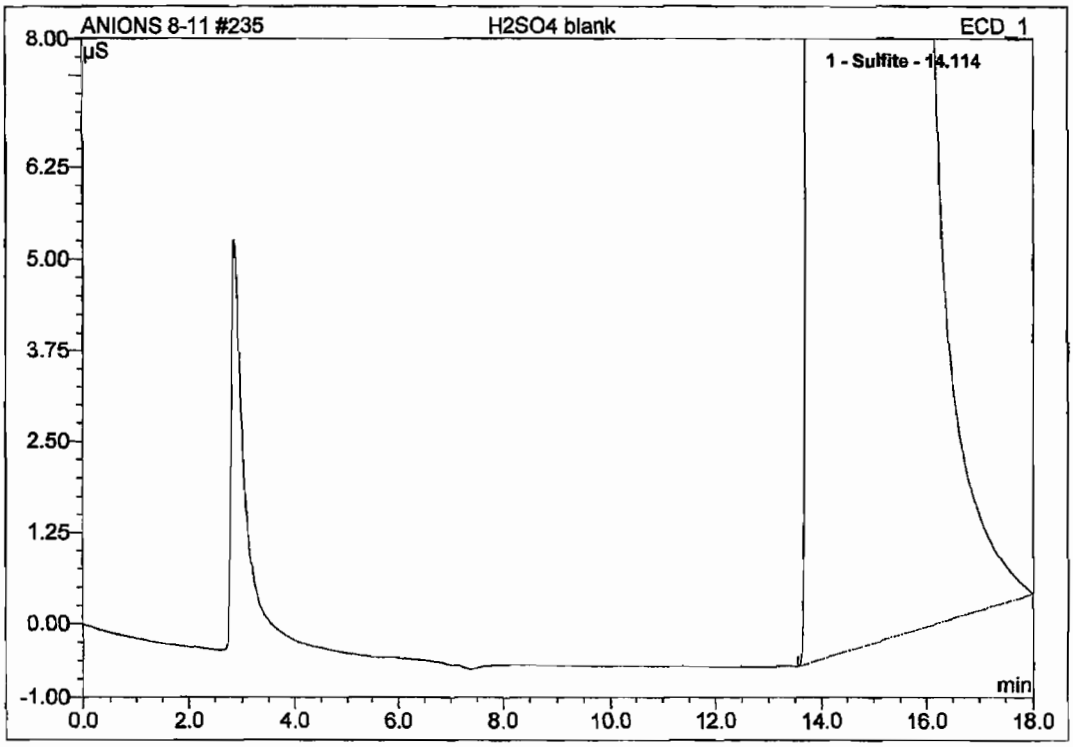
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 22:20**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	14.11	Sulfite	994.226	996.6164
Total:			994.226	996.616

235 H2SO4 blank

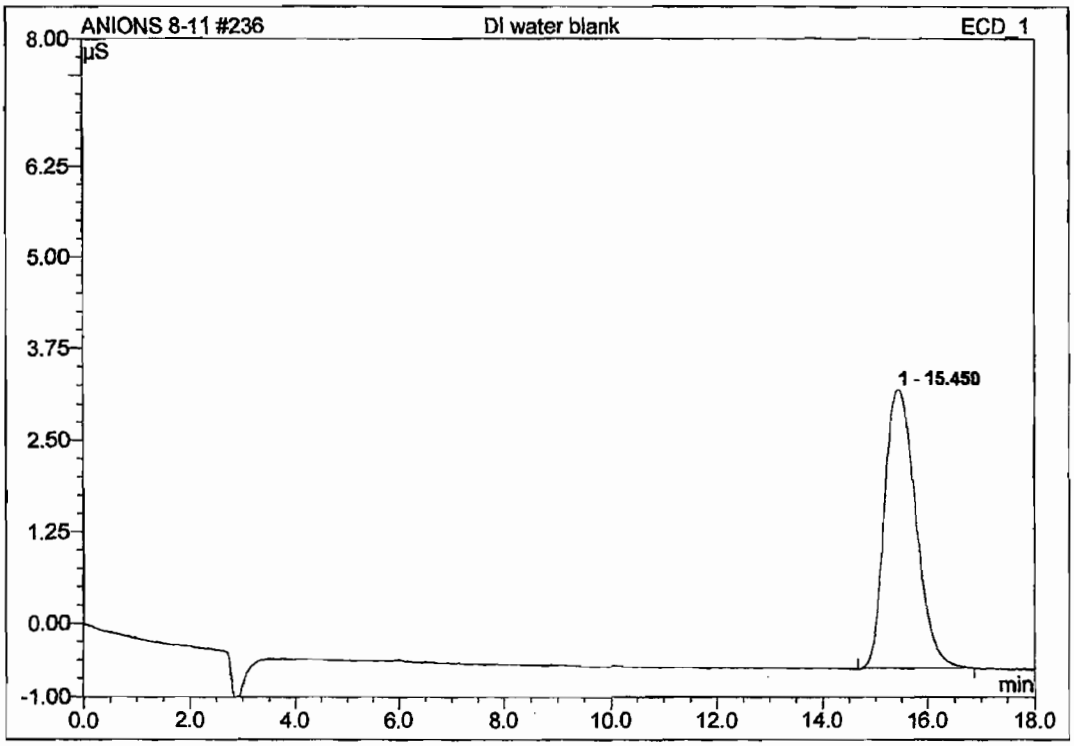
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 22:39**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	14.11	Sulfite	1007.164	#########
Total:			1007.164	1019.394

236 DI water blank

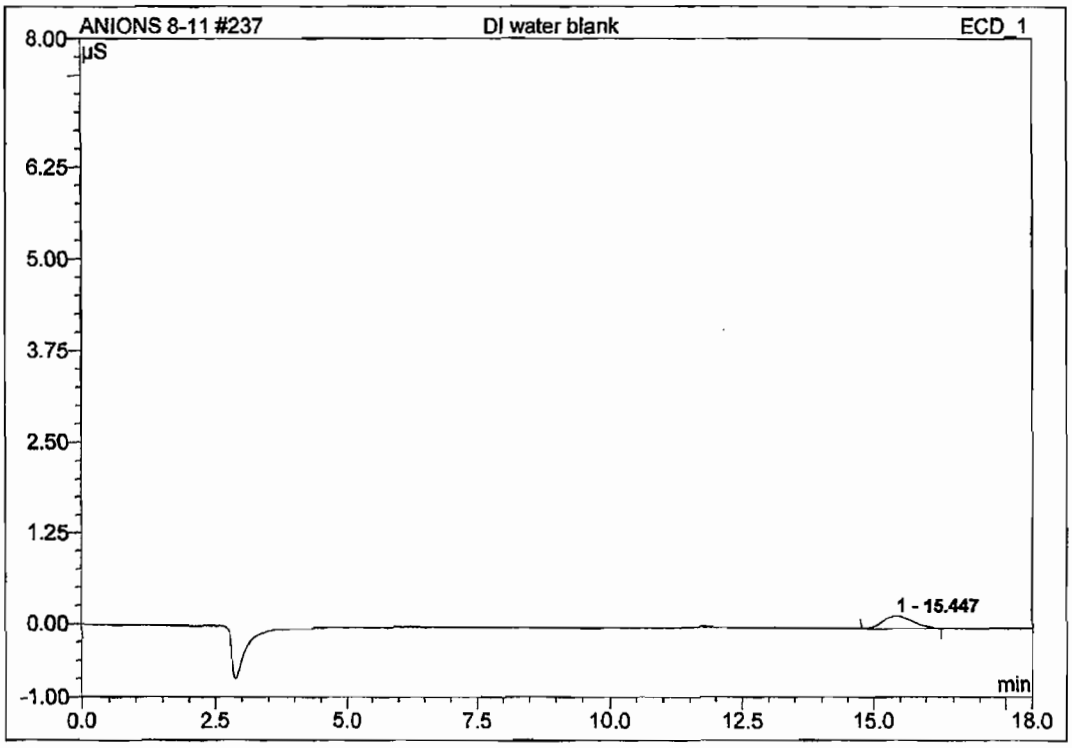
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 22:59**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
Total:			0.000	0.000

237 DI water blank

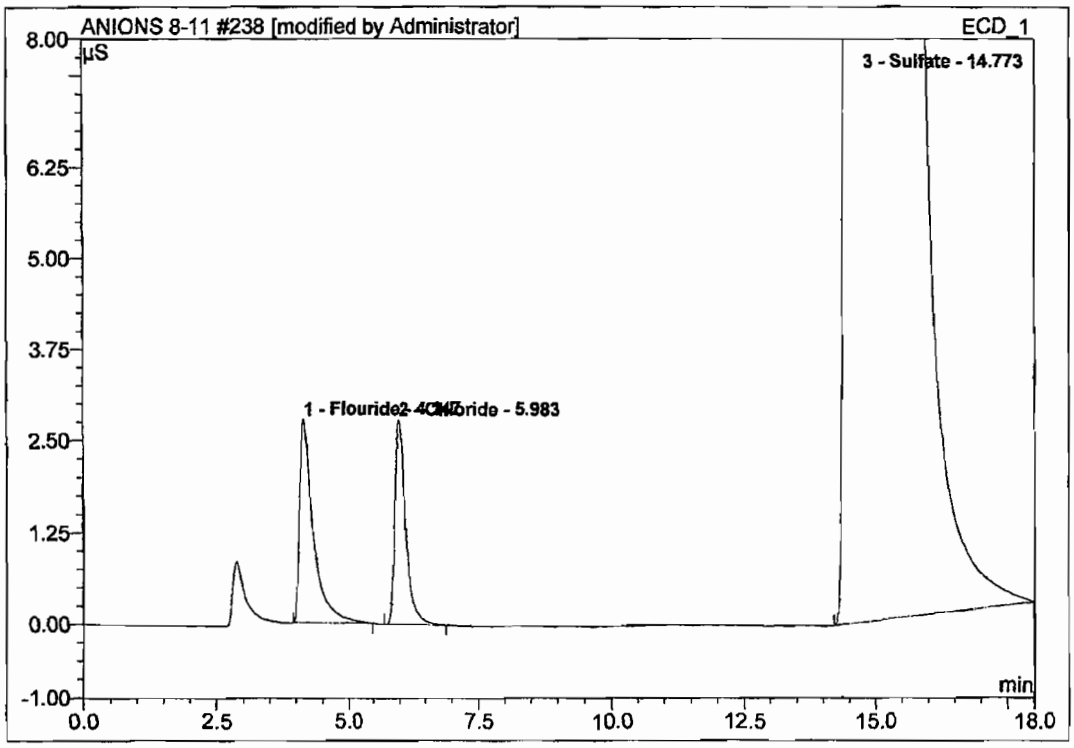
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 23:18**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
Total:			0.000	0.000

238 5.0 ppm F, Cl std 8-10-11

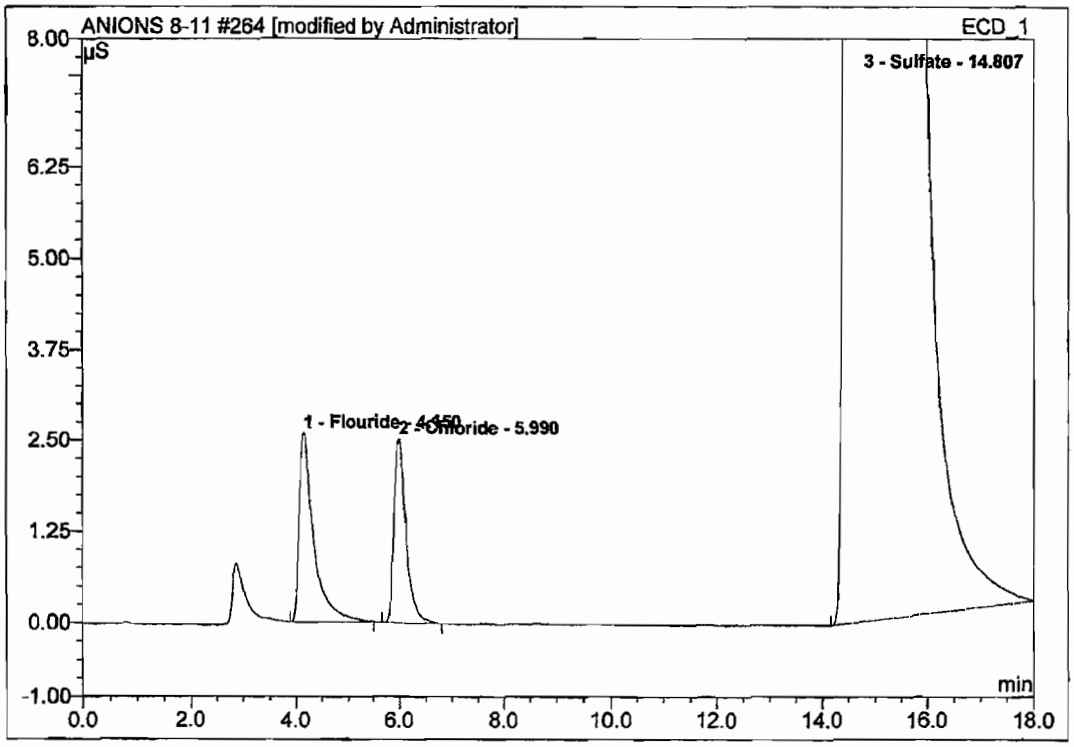
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 23:37**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.15	Flouride	2.764	0.8315
2	5.98	Chloride	2.776	0.6754
3	14.77	Sulfate	417.590	283.6498
Total:			423.130	285.157

264 5.0 ppm F, Cl std 8-10-11

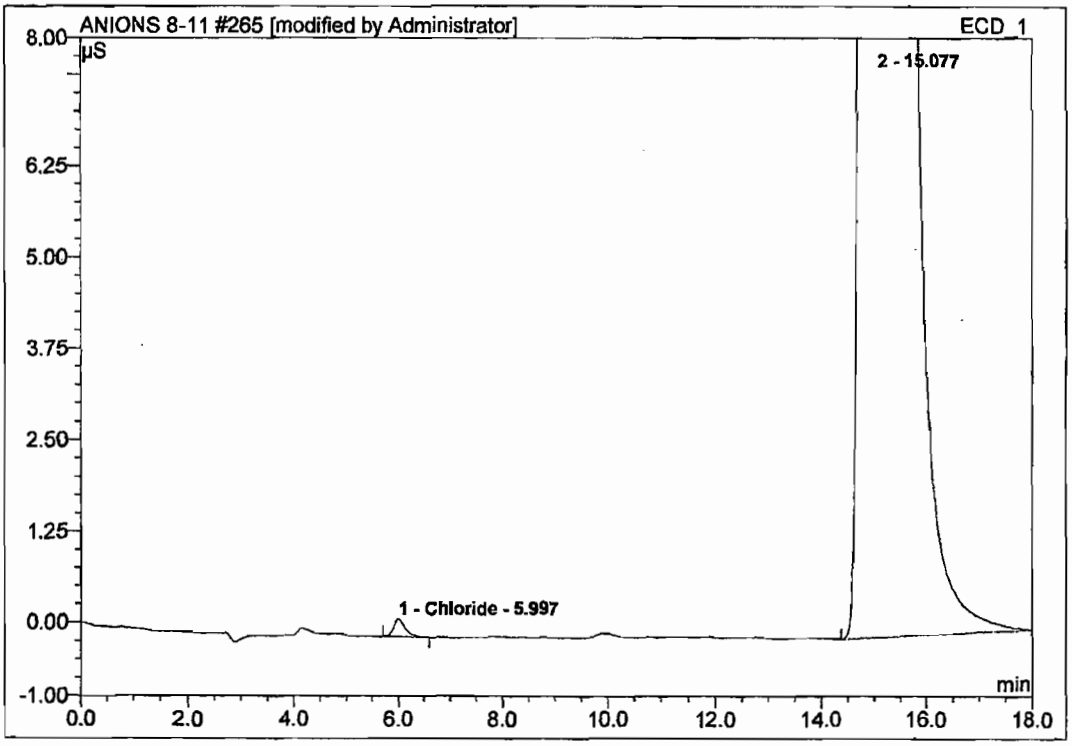
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 10:32**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.15	Flouride	2.592	0.8389
2	5.99	Chloride	2.520	0.6645
3	14.81	Sulfate	404.148	281.6500
Total:			409.259	283.153

265 26-1 H2SO4 Cl spike

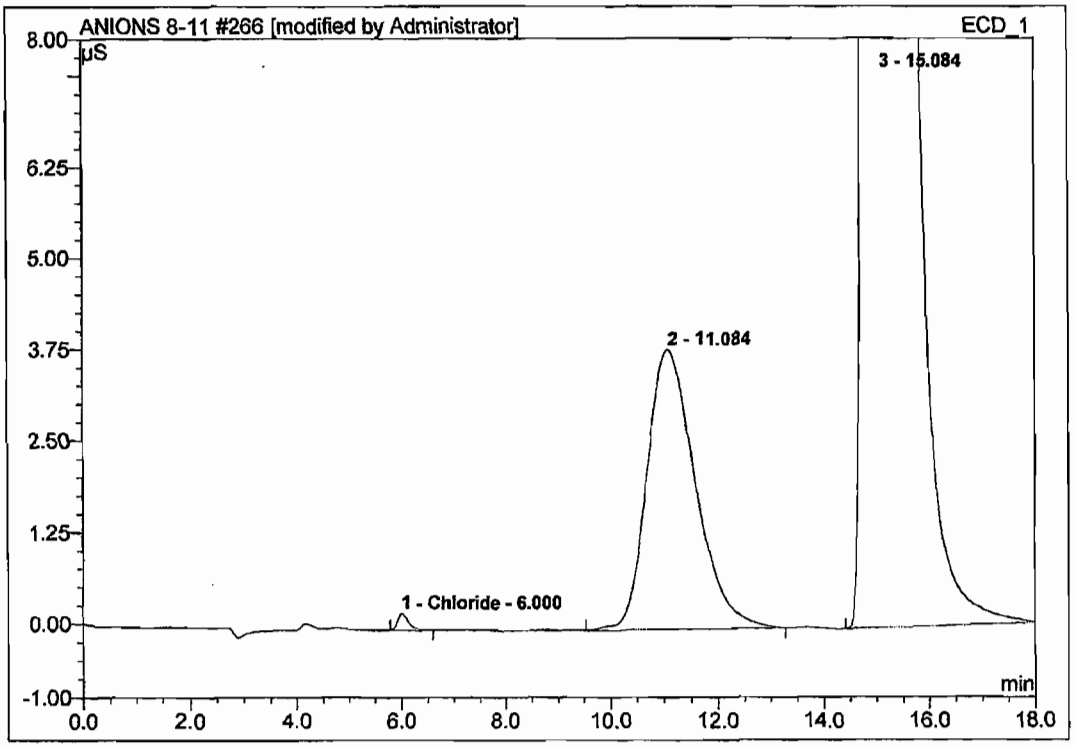
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 10:51**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.234	0.0588
Total:			0.234	0.059

266 26-1 H2SO4 Cl spike

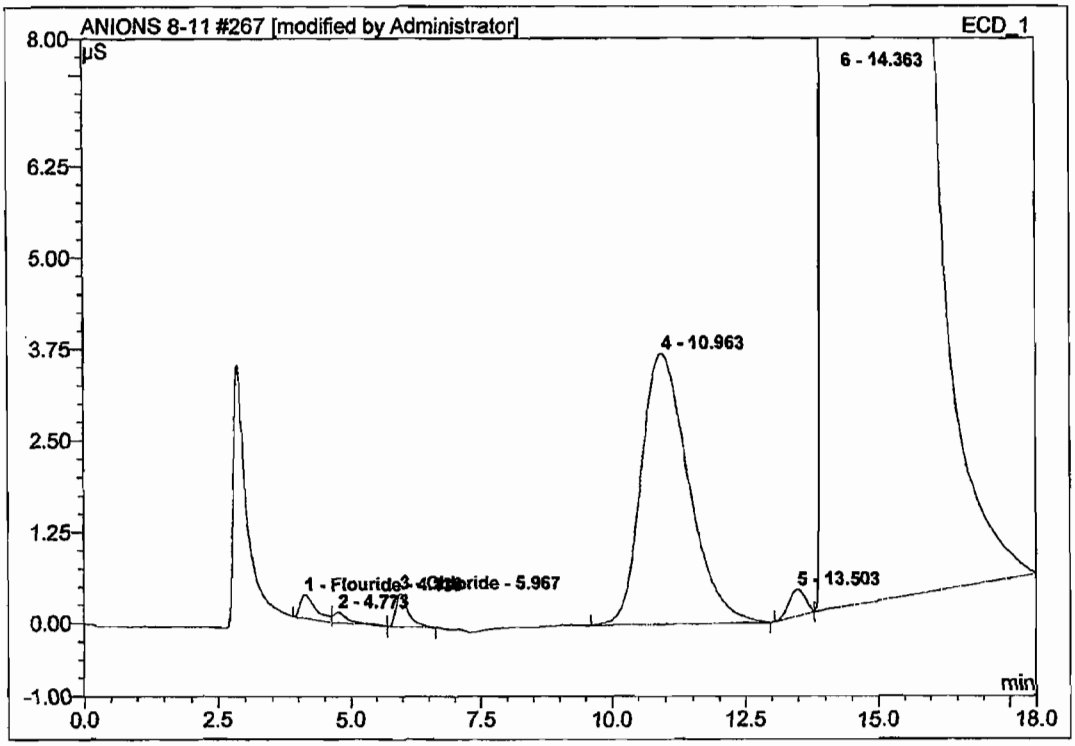
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 11:10**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.226	0.0578
Total:			0.226	0.058

267 26-3 H2SO4 F, Cl spike

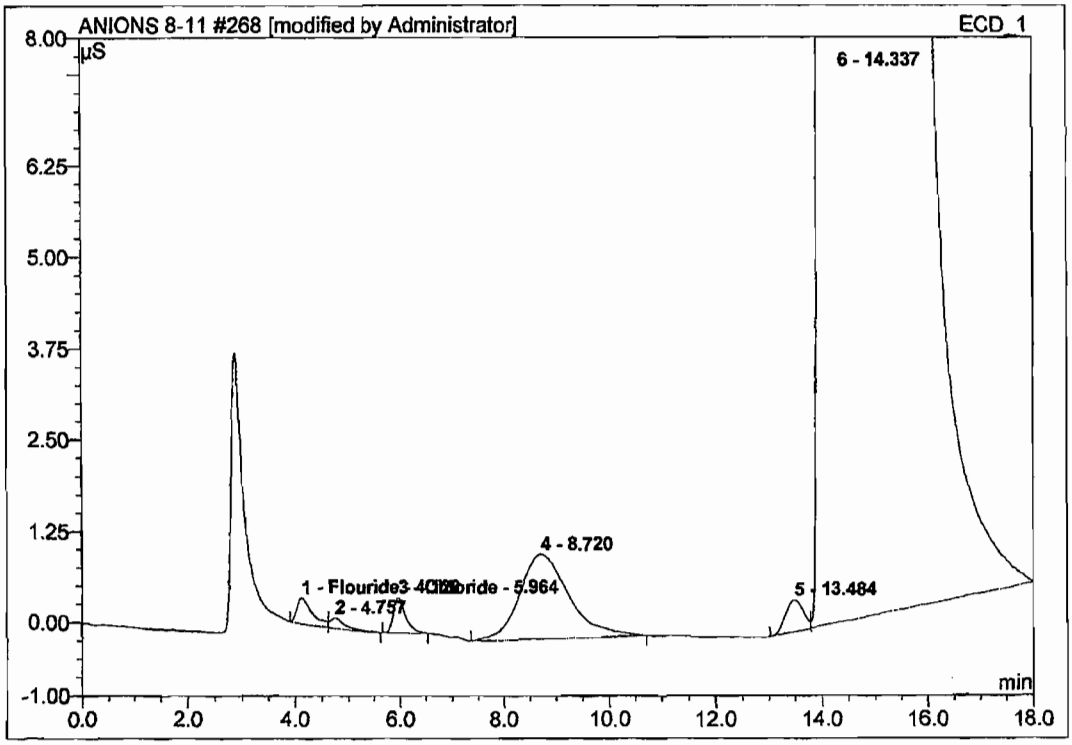
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 11:29**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.13	Flouride	0.320	0.1132
3	5.97	Chloride	0.450	0.1214
Total:			0.770	0.235

268 26-3 H2SO4 F, Cl spike

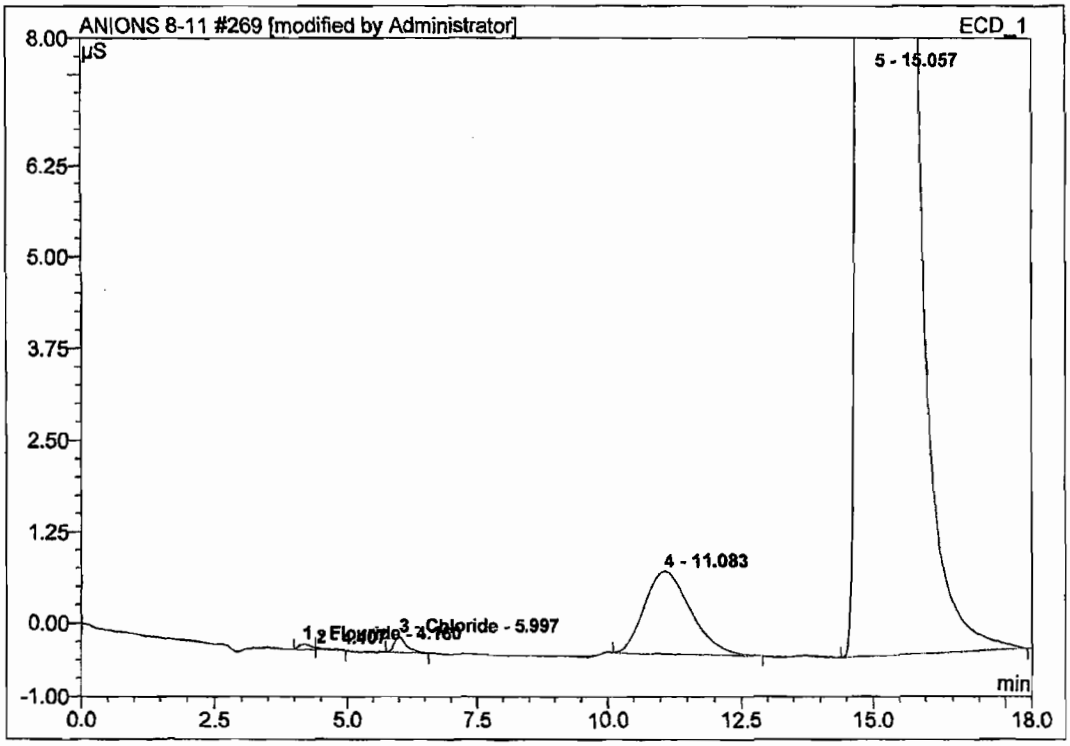
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 11:50**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.12	Flouride	0.349	0.1192
3	5.96	Chloride	0.480	0.1290
Total:			0.829	0.248

269 26-1 H2SO4 F spike

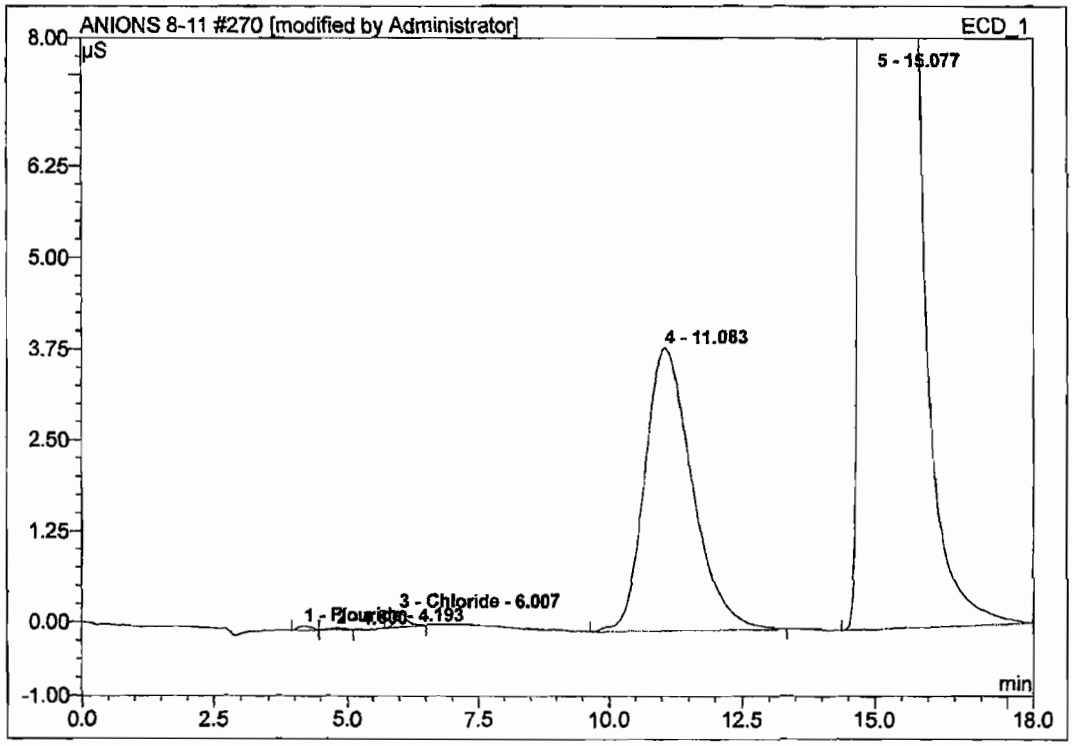
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 12:09**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.16	Flouride	0.073	0.0185
3	6.00	Chloride	0.219	0.0584
Total:			0.292	0.077

270 26-1 H2SO4 F spike

Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 12:28**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	4.19	Flouride	0.061	0.0177
3	6.01	Chloride	0.212	0.0565
Total:			0.273	0.074

USEPA METHOD 26 TASK SCHEDULE

Client: Houston Refining

Location: Houston, TX

Project Manager: G. Burch

Date Sampled: 7/22/11, 7/27/11, 7/29/11

Lab Project #: 08-3327

Spreadsheet Template ID: USEPA-M26-HCl-Template-052T-REV1

Analyst: J. Ruggaber

Eluent

Sodium Carbonate (Na_2CO_3) manufacturer and lot: Fisher, lot 095351

Batch Number	Amount weighed/2L	Date/Time Prepared
1	1.6962 g	8/16/11, 10:10
2	1.6963 g	8/17/11, 14:45
3	g	

Sodium Bicarbonate ($NaHCO_3$) manufacturer and lot: Fisher, lot 103353

Batch Number	Amount weighed/2L	Date/Time Prepared
1	0.1676 g	8/16/11, 10:10
2	0. 1682 g	8/17/11, 14:45
3	g	

Standard Identification

1) 1.0 ppm F, Cl, 8/10/11 (prepared in 0.04 N H2SO4)

2) 2.0 ppm F, Cl, 8/10/11 (prepared in 0.04 N H2SO4)

3) 5.0 ppm F, Cl, 8/10/11 (prepared in 0.04 N H2SO4)

4) 10.0 ppm F, Cl, 8/10/11 (prepared in 0.04 N H2SO4, used as spiking solution)

5) 1.0 ppm Cl, 8/10/11 (prepared in 0.04 N NaOH)

6) 2.0 ppm Cl, 8/10/11 (prepared in 0.04 N NaOH)

7) 5.0 ppm Cl, 8/10/11 (prepared in 0.04 N NaOH)

8) 10.0 ppm Cl, 8/10/11 (prepared in 0.04 N NaOH, used as spiking solution)

Secondary standard solutions:
5.0 ppm F, Cl 8/10/11 check (prepared in 0.04 N H2SO4)
5.0 ppm Cl 8/10/11 check (prepared in 0.04 N NaOH)

DATE	EQUIPMENT	TASK
8/16/11	-	Pour each sample into a 100 mL (or larger) volumetric flask. Dilute to volume with water.
8/16/11	ICS 1000 Anions	Equilibrate the instrument until a stable baseline is achieved.
8/16/11	ICS 1000 Anions	Inject each standard solution once. Plot the standard injection areas against calibration standard concentrations to determine an initial calibration curve.
8/16/11	ICS 1000 Anions	Inject secondary standard once. Check that the secondary standard is within 15% of the value generated by the initial calibration curve.
8/16/11 – 8/17/11	ICS 1000 Anions	Inject each sample solution in duplicate. Check that the area count for each anion in each duplicate injection is within 5% of the mean.
N/A	N/A	If necessary, dilute sample solutions if the peak areas are greater than the highest standard and re-inject in duplicate.
8/16/11 – 8/17/11	ICS 1000 Anions	Inject the midpoint standard once after every 20 sample injections.

8/17/11	ICS 1000 Anions	Inject each standard solution once at the end of the run.
8/18/11	-	For each anion, plot the average of the standard injections against calibration standard concentrations to determine a final calibration curve.
8/18/11 – 8/19/11	-	Determine the concentrations of each anion in each sample using the calibration curve.
8/19/11	-	Prepare report
		Report QA review
		Report distribution

C-166

736 Coker Unit

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

ARI ENVIRONMENTAL, INC.

Chain of Custody Record H08429

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY	Houston Refining	Houston, TX
Lab Project No. 08-327	Client Name	Location RW
ARI Project Manager Greg Burch		ARI Sampler Initials
Analysis Location (Wauconda or Pasadena)		
Engineering or Compliance Test Samples		

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request: Mt Method 26A	Comments
H44865	7-22-11	Impingers #1+2 (0.1 N H_2SO_4)	1	✓	1	✓	Run #26A-1
H44866	7-22-11	Impingers #3 (0.1 N H_2SO_4)	1	✓	1	✓	Run #26A-1
H44867	7-22-11	Impingers #4+5 (0.1N NaOH)	1	✓	1	✓	Run #26A-1
H44868	7-22-11	Knockout Recovery	4	✓	1	✓	Run #26A-1
H44738	7-27-11	Impingers #1, 2, 3 (0.1N H_2SO_4)	1	✓	1	✓	Run #26A-3
H44739	7-27-11	Impingers #4, 5 (0.1N NaOH)	1	✓	1	✓	Run #26A-3
H44740	7-27-11	Knockout contents	3	✓	1	✓	Run #26A-3
44749 ~~H44748~~ RW	7-29-11	Impingers #1, 2, 3 (0.1 N H_2SO_4)	1	✓	1	✓	Run #26A-4
44750 ~~H44749~~ RW	7-29-11	Impingers #4, 5 (0.1 N NaOH)	1	✓	1	✓	Run #26A-4
44748 ~~H44750~~ RW	7-29-11	Knockout contents	3	✓	1	✓	Run #26A-4
H44743	7-27-11	Impingers #1, 2, 3 (0.1N H_2SO_4)	1	✓	1	✓	Run # 26A-Blank
H44744	7-27-11	Impingers #4, 5 (0.1N NaOH)	1	✓	1	✓	Run # 26A-Blank
H44745	7-27-11	HPLC Water	1	✓	1	✓	Blank
H44746	7-27-11	0.1 N H_2SO_4 Solution	1	✓	1	✓	Blank
H44747	7-27-11	0.1 N NaOH Solution	1	✓	1	✓	Blank

Preservation Code
1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions / Comments

Requested Analysis Completion Date:

Report Level: Tier I: Engineering Tier II: Compliance Tier III: QAPP

Route Results Through:

	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By
	Ron White		
	(1) Date / Time 8-3-11 @ 0500	(2) Date / Time	(3) Date / Time
	(1) Company ARI	(2) Company	(3) Company
	(1) Received By	(2) Received By	(3) Received By
	(1) Date / Time 8/5/11 17:00	(2) Date / Time	(3) Date / Time
	(1) Company ARI	(2) Company	(3) Company

SHIPMENT: HAND CARRY FEDX UPS

Custody Seal Applied Yes No

Form LF0001

ANALYTICAL SUMMARY

CLIENT: Houston Refining — page 1 of 2
LOCATION: Houston, TX — Analyst: J. Ruggaber
SAMPLE DATES: 7/22/11, 7/27/11, 7/29/11 — Date of Completion: 8/19/2011
ANALYSIS: Chlorine — Template Control ID: USEPA-M26-HCl-Template-052T-REV1
METHOD: USEPA Method 26

Calibration Curve Calculation

Std. (µg/ml)	Pre Cal (µS*min)	Post Cal (µS*min)	Average (µS*min)	Deviation (%)		Conc. Ug/mL	Peak Area	RF	Cal Conc	% Dif
0.0	0.00	0.00	0.00	0.00		1.0	0.128	0.127	1.0	-4.23
1.0	0.131	0.125	0.128	2.19		2.0	0.265	0.132	2.0	-0.54
2.0	0.261	0.270	0.265	-1.75		5.0	0.678	0.135	5.1	1.54
5.0	0.678	0.677	0.678	0.06		10.1	1.378	0.137	10.4	3.24
10.1	1.375	1.381	1.378	-0.21			**mean RF---**	0.1327		
					Second. Std.	5.0	0.6669	N/A	4.89	-2.14

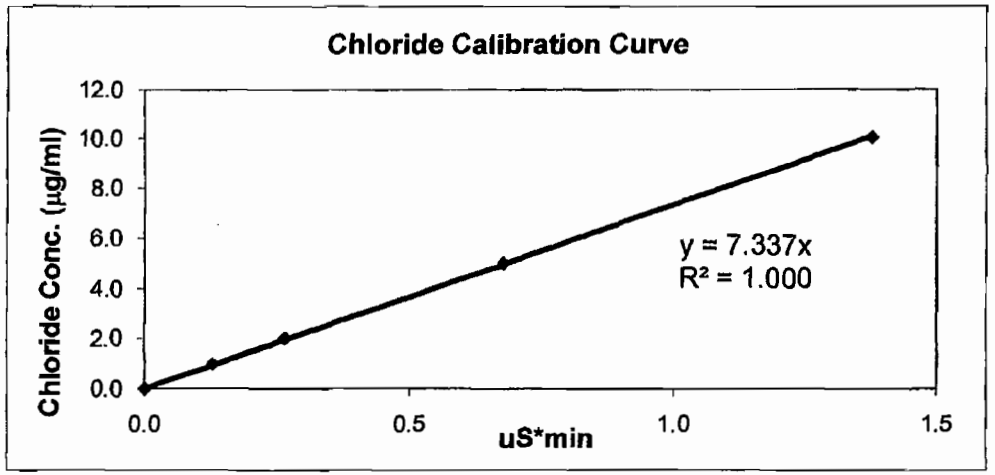
CCVs	Peak Area	Cal. Conc.	% Diff
5.0	0.652	4.795	-4.7
5.0	0.682	5.011	-0.4
5.0	0.656	4.822	-4.1

Sample Concentration Calculations

ID	Analysis 1 (area counts)	Analysis 2 (area counts)	Average (area counts)	Deviation (%)	Diluted Conc. (µg/ml)	Dilution Factor	Sample volume(ml)	Total Mass Cl_2 (µg)
26-1 NaOH	0.034	0.034	0.034	0.29	0.25	1	500	125
26-3 NaOH	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<114
26-4 NaOH	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<114
26-Blank	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<114
0.1 N NaOH Blank	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<114
Lab DI Water Blank	<0.031	<0.031	<0.031	0.00	<0.23	1	500	<114

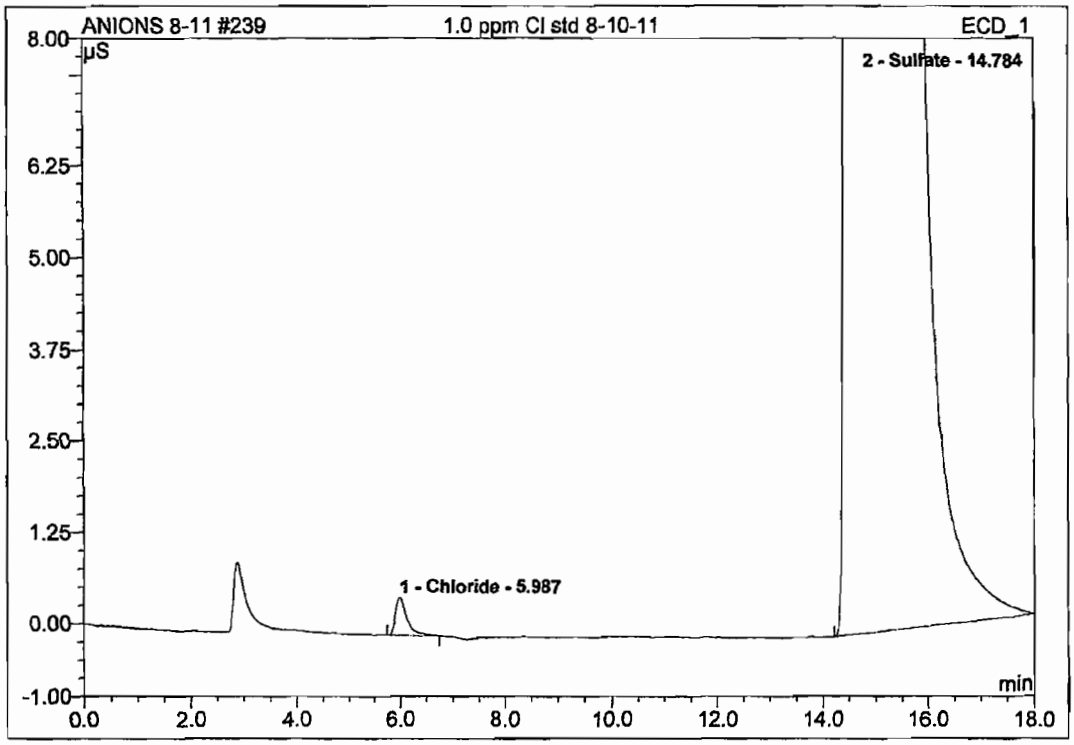
ID	Analysis 1 (area counts)	Analysis 2 (area counts)	Average (area counts)	Deviation (%)	Actual Conc. (µg/ml)	Spike Conc. (µg/ml)	R (%)	Pass/Fail
26-1 spike	0.052	0.053	0.053	-0.57	0.39	0.14	95	Pass
26-3 spike	0.136	0.139	0.137	-0.98	1.01	0.94	108	Pass

CLIENT:	Houston Refining		page 2 of 2
LOCATION:	Houston, TX	Analyst:	J. Ruggaber
SAMPLE DATES:	7/22/11, 7/27/11, 7/29/11	Date of Completion:	8/19/2011
ANALYSIS:	Chlorine	Template Control ID:	USEPA-M26-HCl-Template-052T-REV1
METHOD:	USEPA Method 26		



239 1.0 ppm Cl std 8-10-11

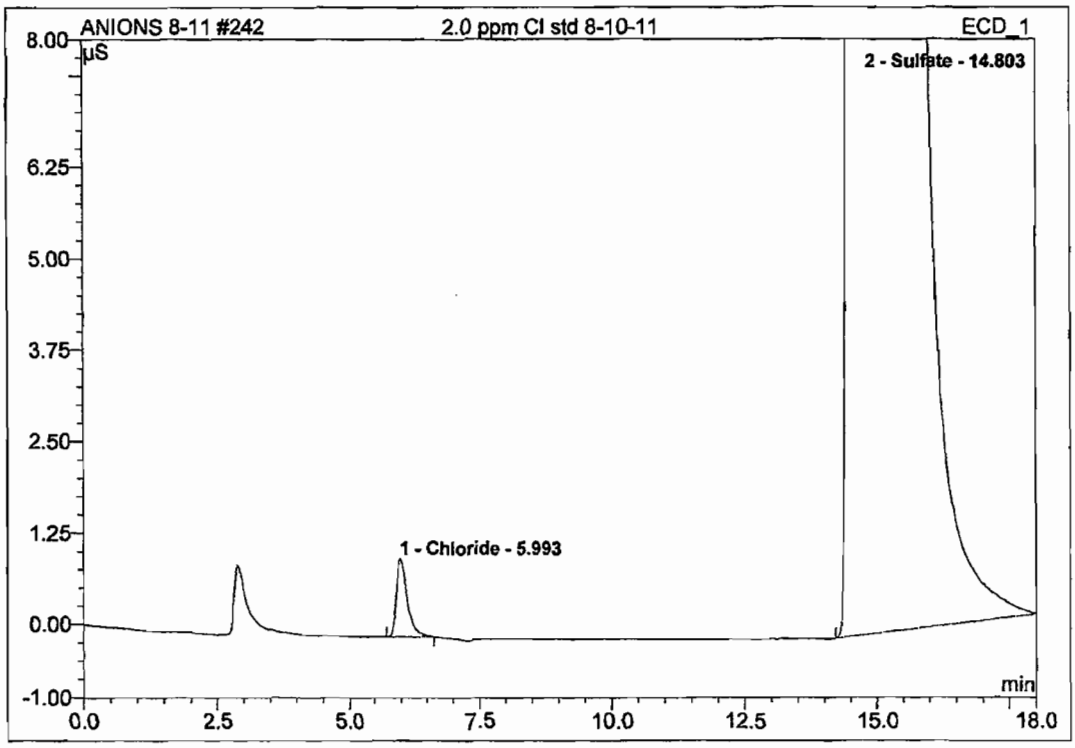
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/16/2011 23:56**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	0.515	0.1306
2	14.78	Sulfate	413.100	279.2734
Total:			413.615	279.404

242 2.0 ppm Cl std 8-10-11

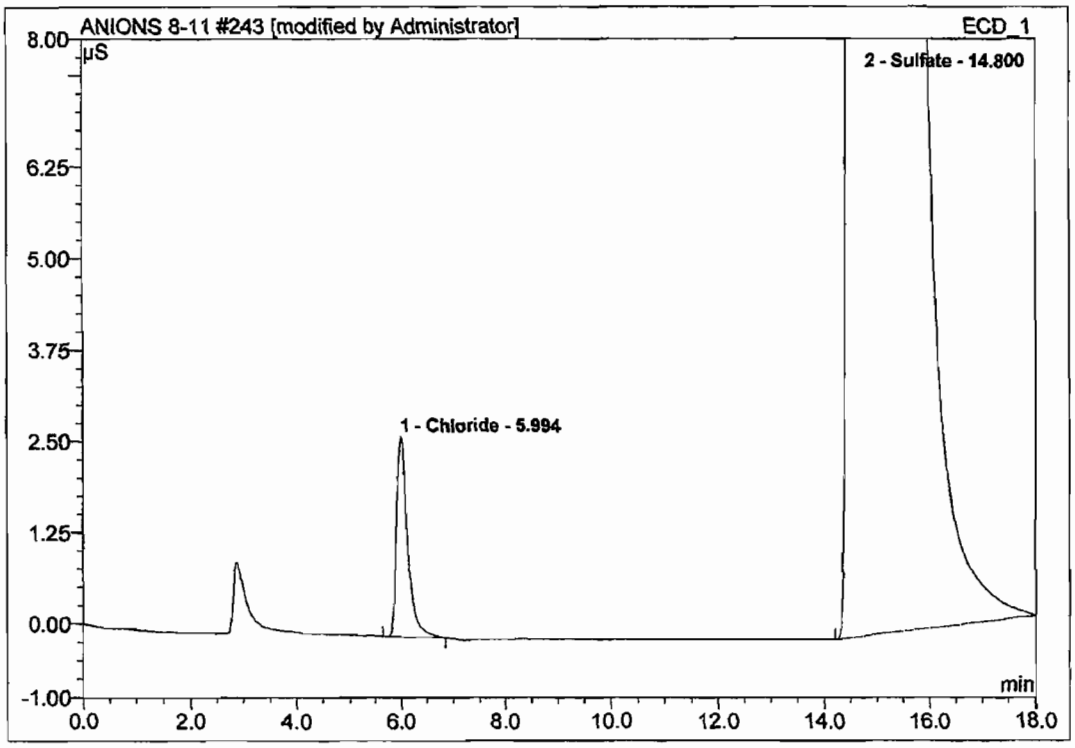
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 0:53**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	1.062	0.2608
2	14.80	Sulfate	415.779	283.6026
Total:			416.840	283.863

243 5.0 ppm Cl std 8-10-11

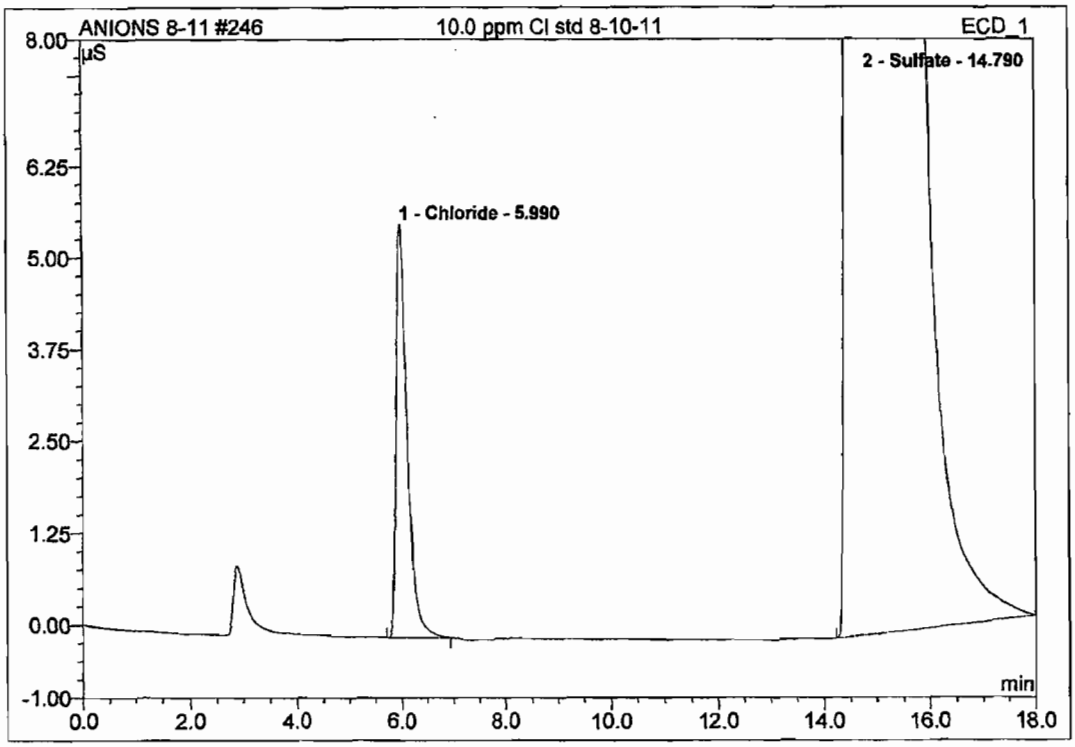
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 1:12**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	2.747	0.6779
2	14.80	Sulfate	419.270	285.8139
Total:			422.016	286.492

246 10.0 ppm Cl std 8-10-11

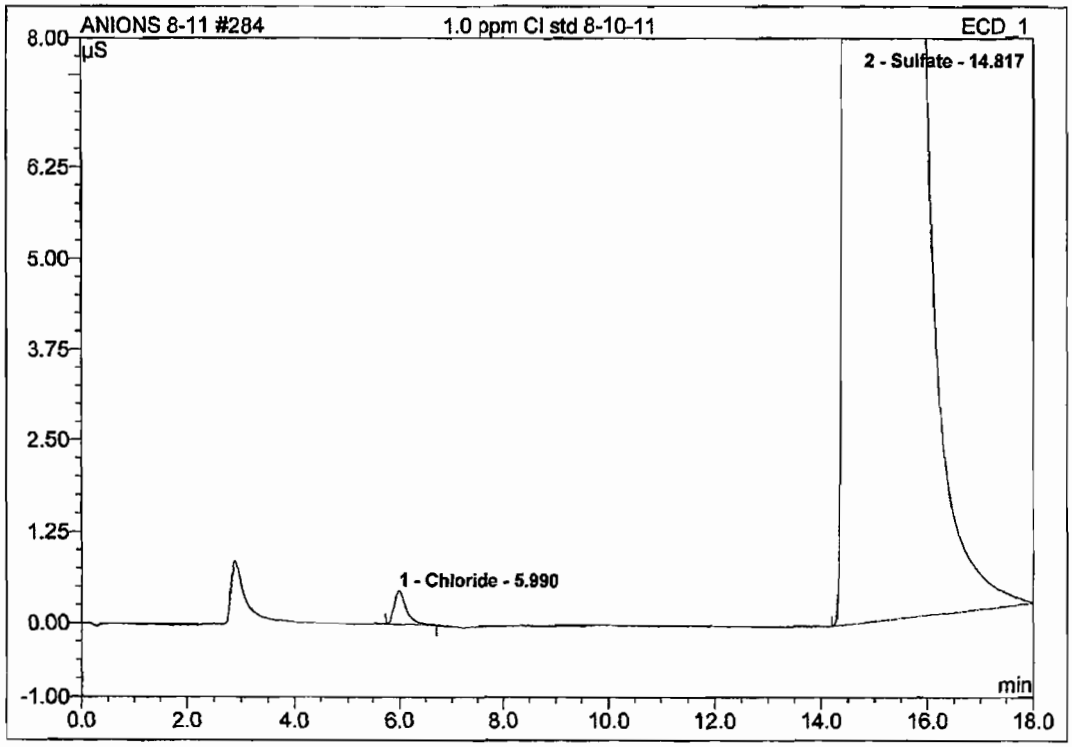
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 2:10**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	5.638	1.3748
2	14.79	Sulfate	414.107	279.8355
Total:			419.745	281.210

284 1.0 ppm Cl std 8-10-11

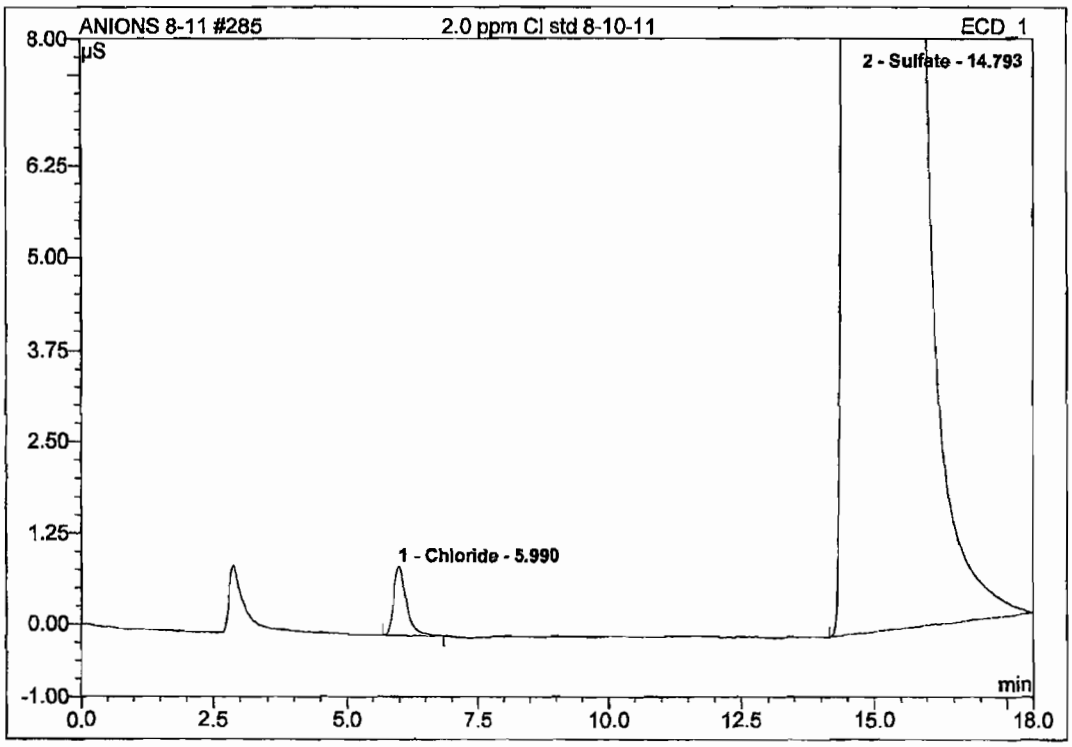
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 19:03**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	0.456	0.1250
2	14.82	Sulfate	385.261	265.3702
Total:			385.717	265.495

285 2.0 ppm Cl std 8-10-11

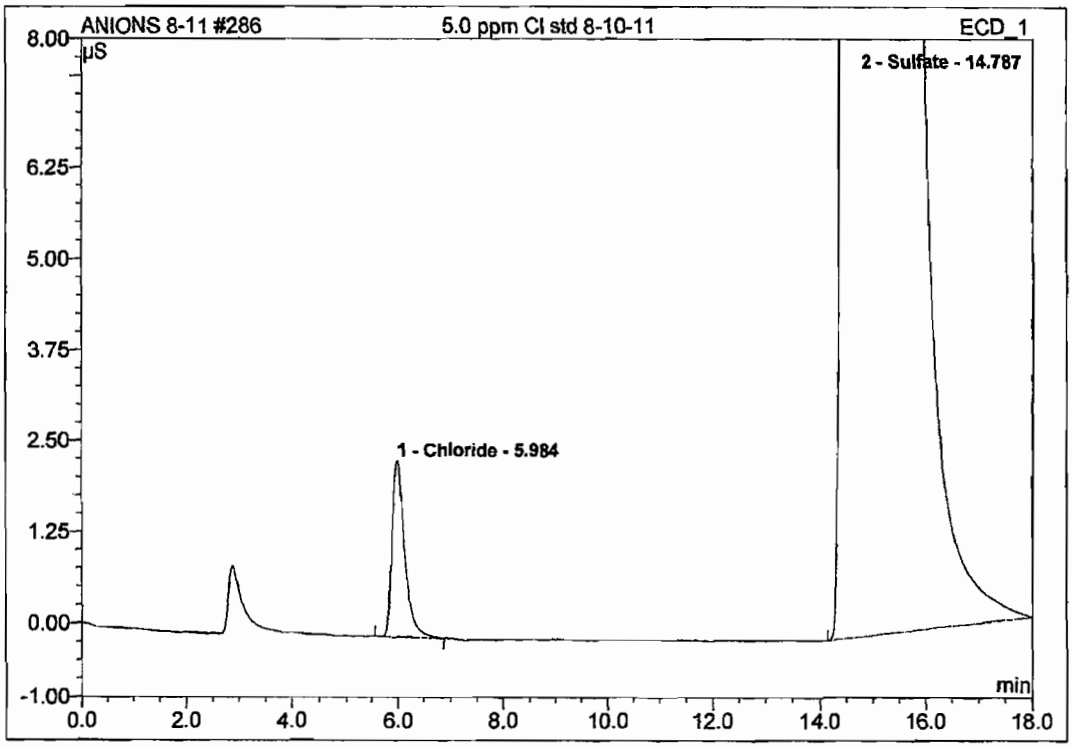
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 19:22**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	0.947	0.2701
2	14.79	Sulfate	406.744	286.2153
Total:			407.691	286.485

286 5.0 ppm Cl std 8-10-11

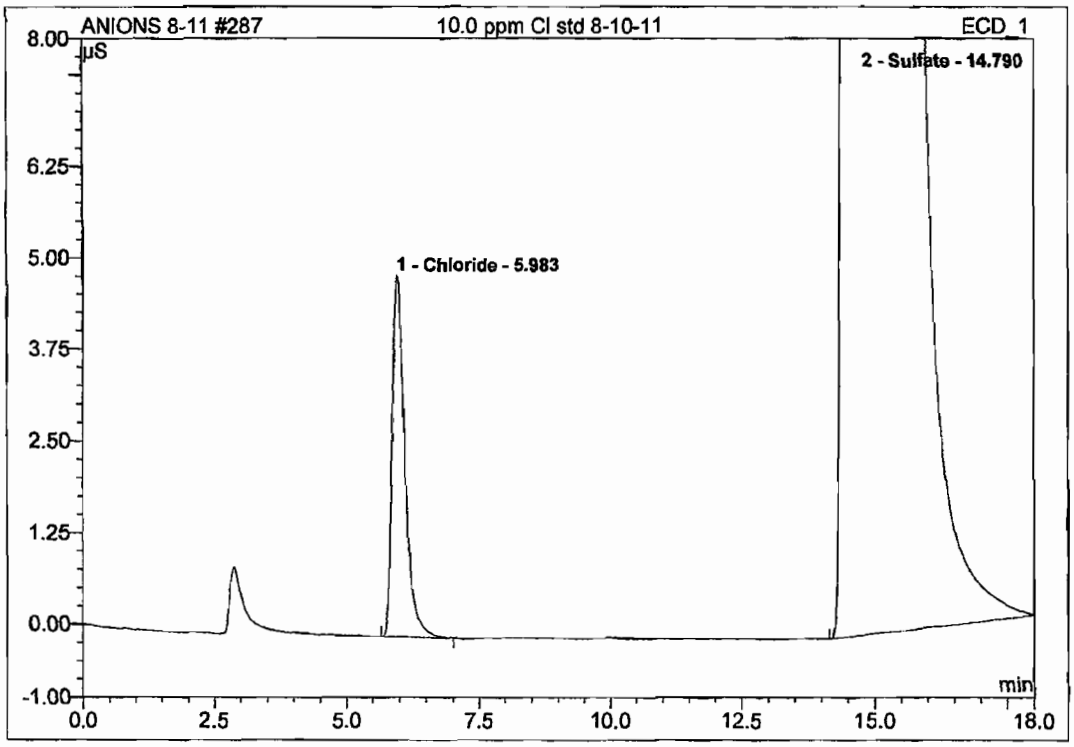
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 19:41**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.98	Chloride	2.407	0.6771
2	14.79	Sulfate	402.210	283.3213
Total:			404.617	283.998

287 10.0 ppm Cl std 8-10-11

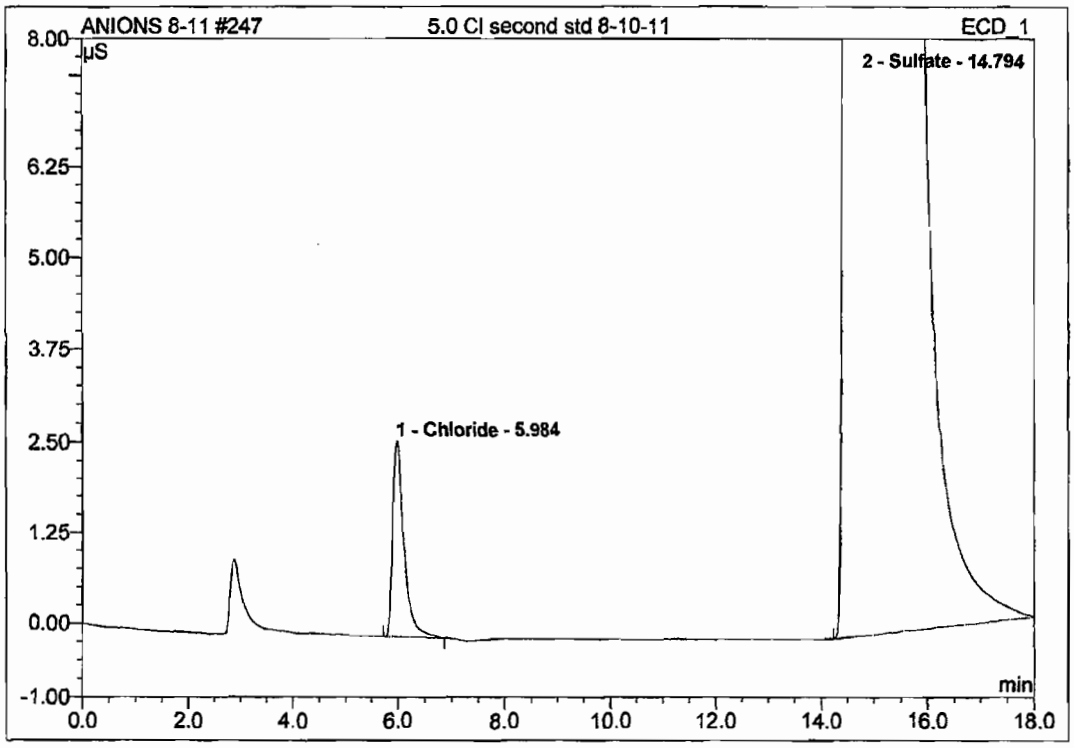
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 20:00**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.98	Chloride	4.930	1.3806
2	14.79	Sulfate	403.380	283.4387
Total:			408.310	284.819

247 5.0 Cl second std 8-10-11

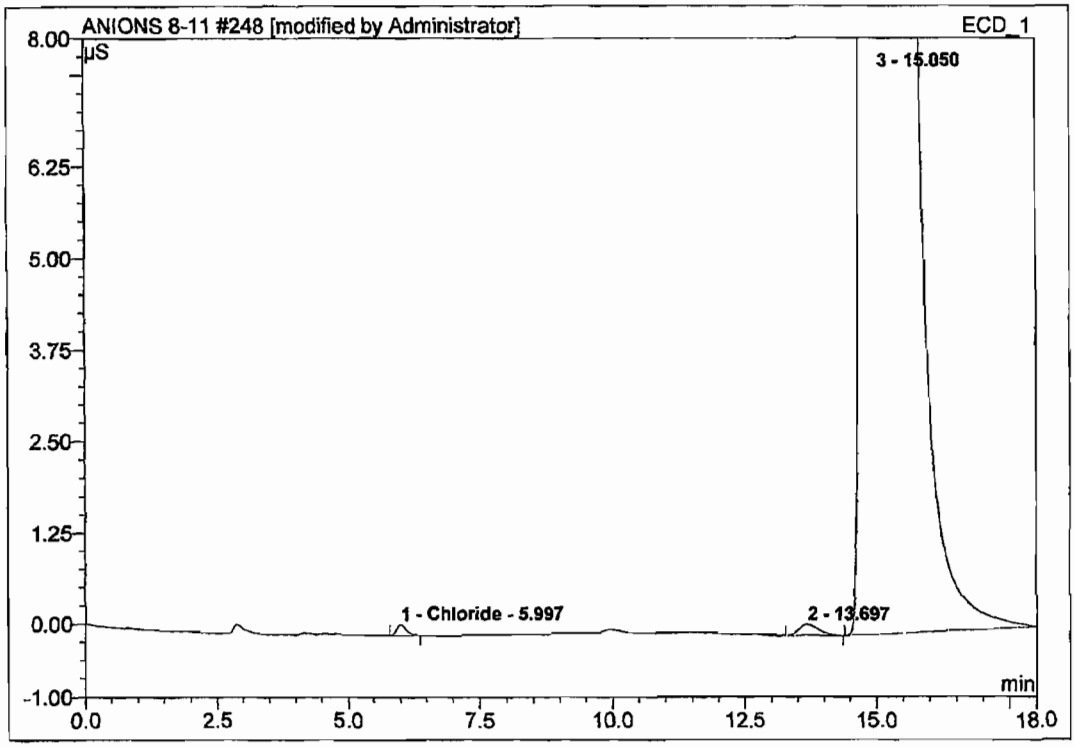
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 2:29**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.98	Chloride	2.697	0.6669
2	14.79	Sulfate	408.145	274.3209
Total:			410.841	274.988

248 26-1 NaOH

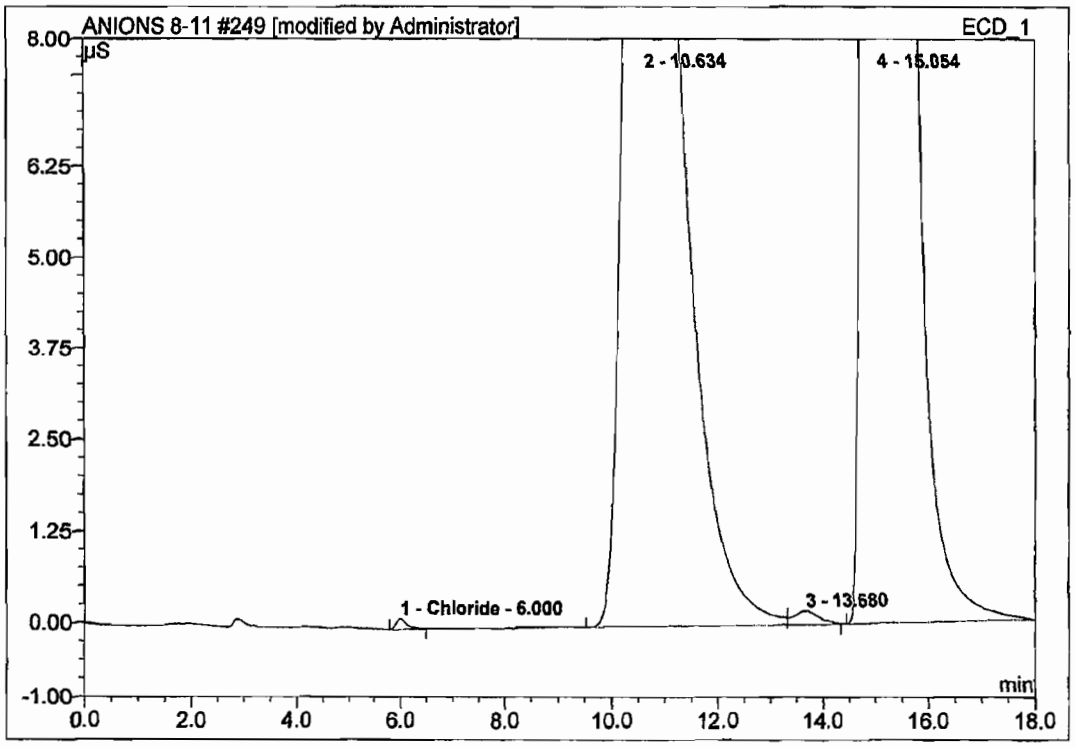
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 2:48**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.149	0.0341
Total:			0.149	0.034

249 26-1 NaOH

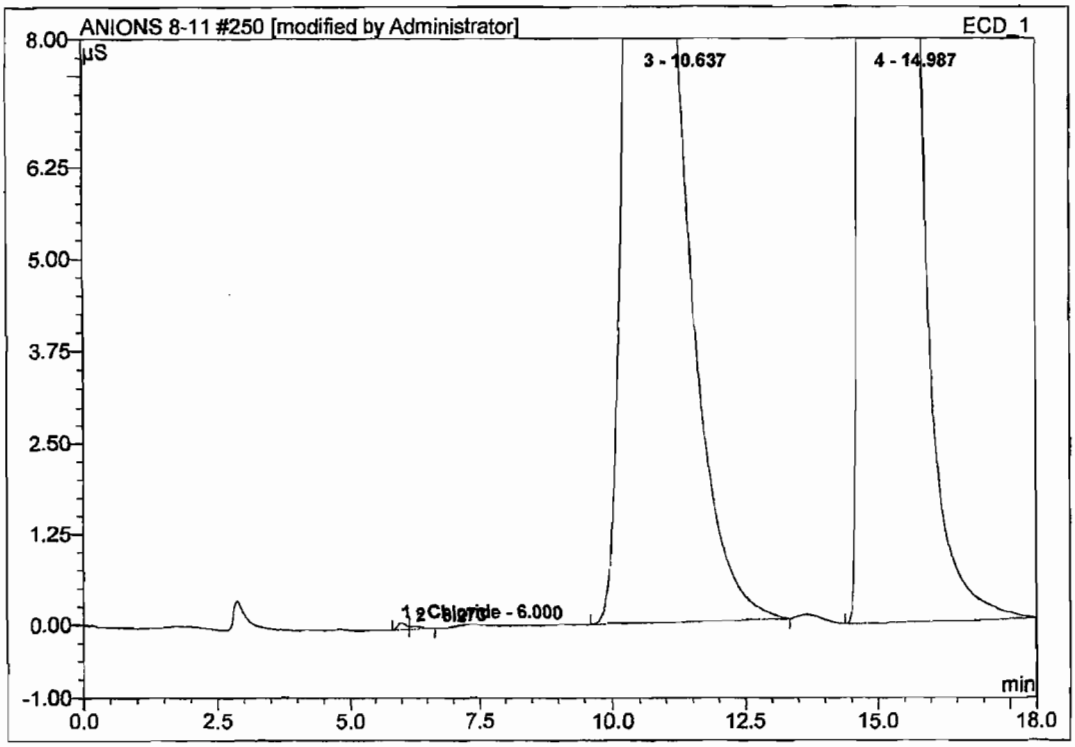
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 3:07**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.139	0.0339
Total:			0.139	0.034

250 26-3 NaOH

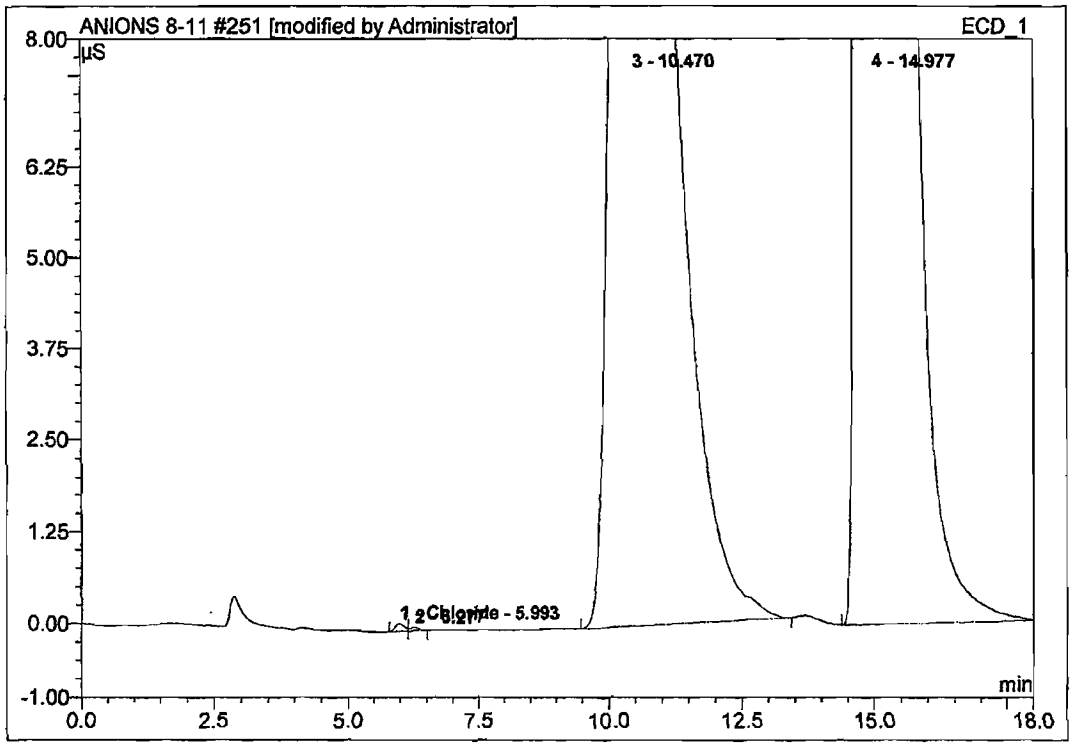
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 3:26**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.094	0.0185
Total:			0.094	0.019

251 26-3 NaOH

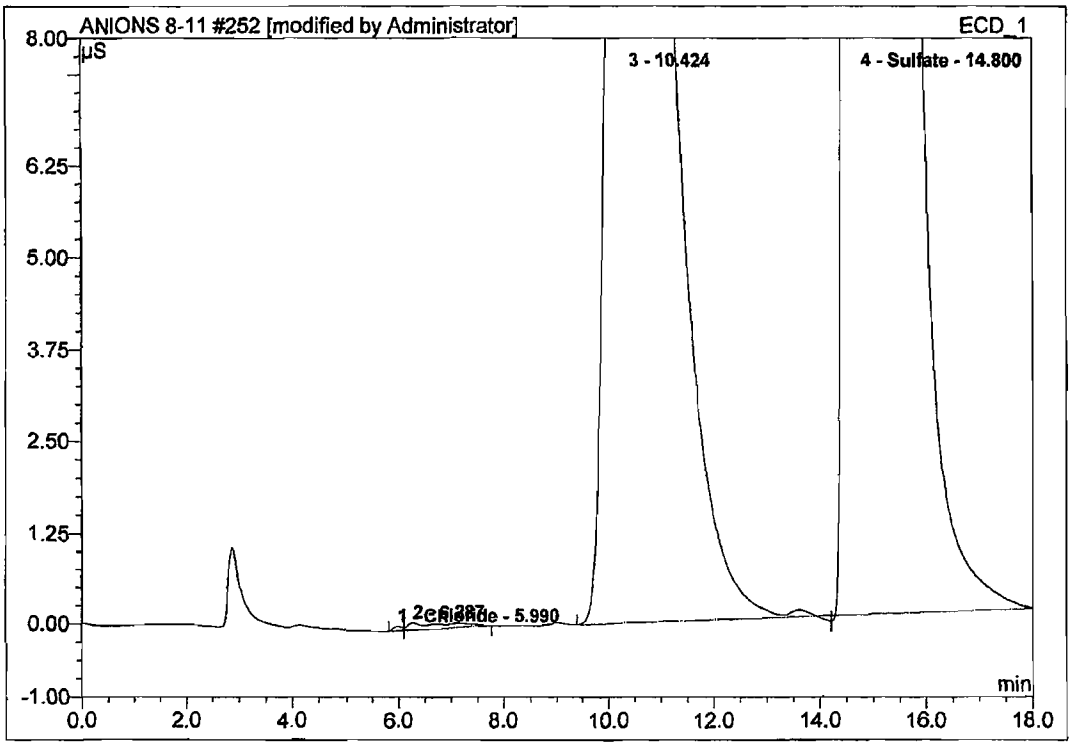
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 3:45**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	0.104	0.0207
Total:			0.104	0.021

252 26-4 NaOH

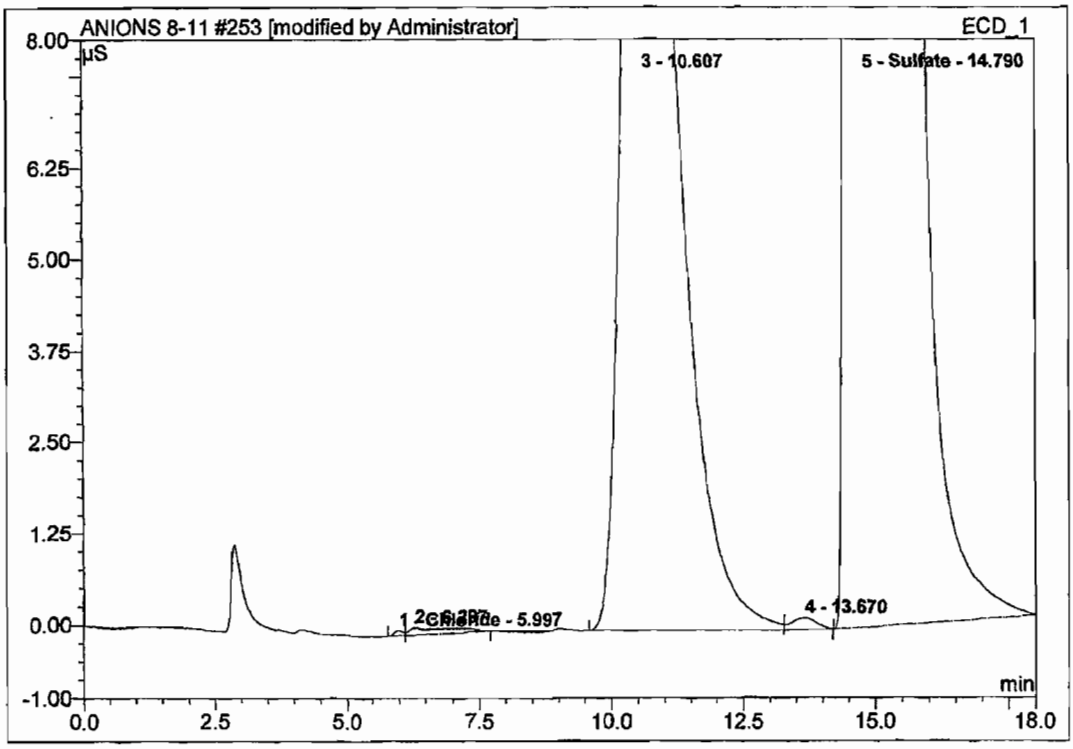
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 4:04**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	0.052	0.0096
4	14.80	Sulfate	395.615	265.9816
Total:			395.667	265.991

253 26-4 NaOH

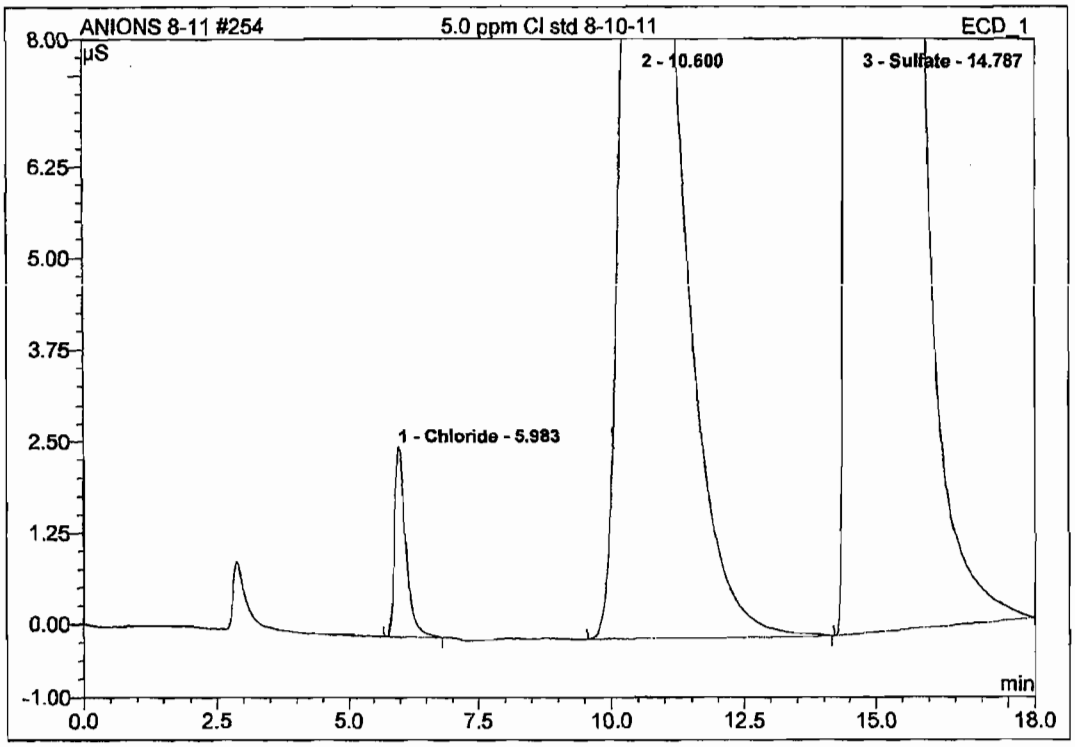
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 4:23**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.072	0.0136
5	14.79	Sulfate	406.344	274.4352
Total:			406.416	274.449

254 5.0 ppm Cl std 8-10-11

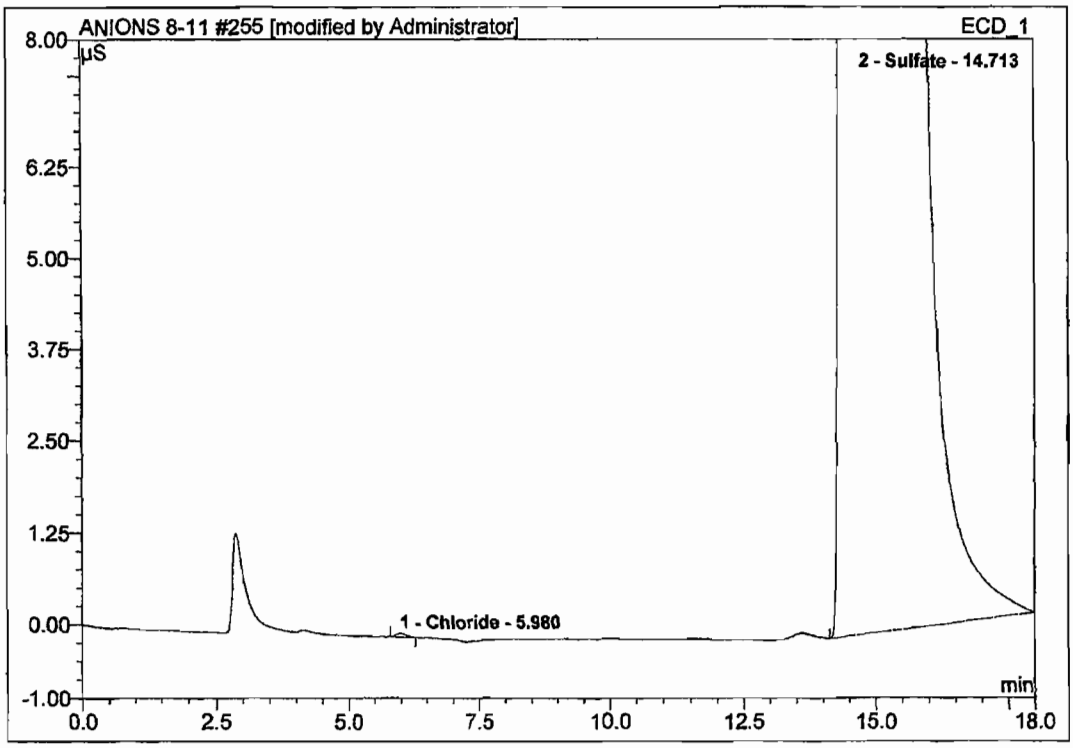
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 4:42**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.98	Chloride	2.601	0.6523
3	14.79	Sulfate	403.914	274.6587
Total:			406.515	275.311

255 26-blank NaOH

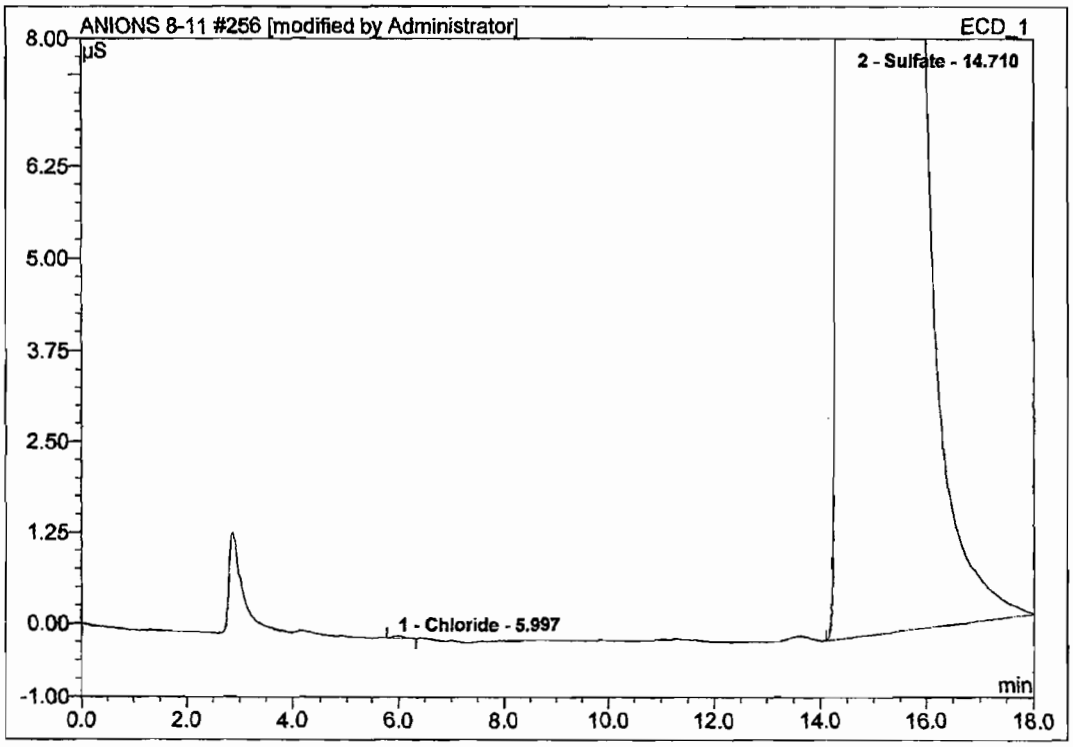
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 5:01**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.98	Chloride	0.048	0.0103
2	14.71	Sulfate	473.993	344.5605
Total:			474.042	344.571

256 26-blank NaOH

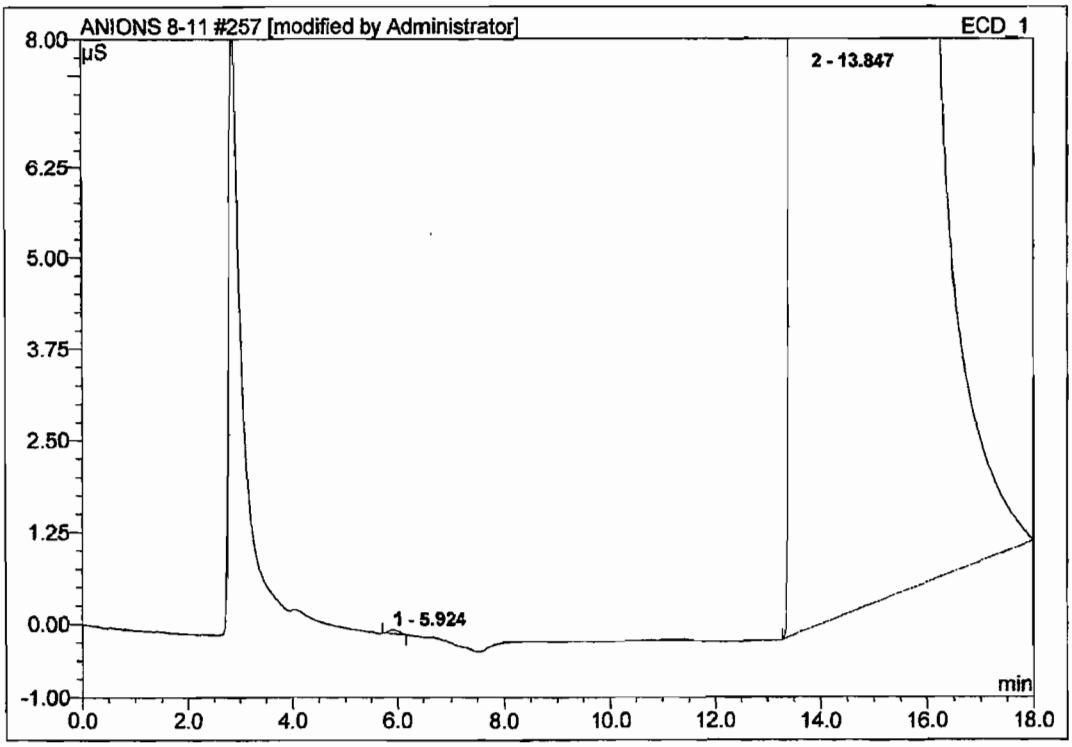
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 5:21**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.037	0.0090
2	14.71	Sulfate	475.321	348.9128
Total:			475.358	348.922

257 NaOH blank

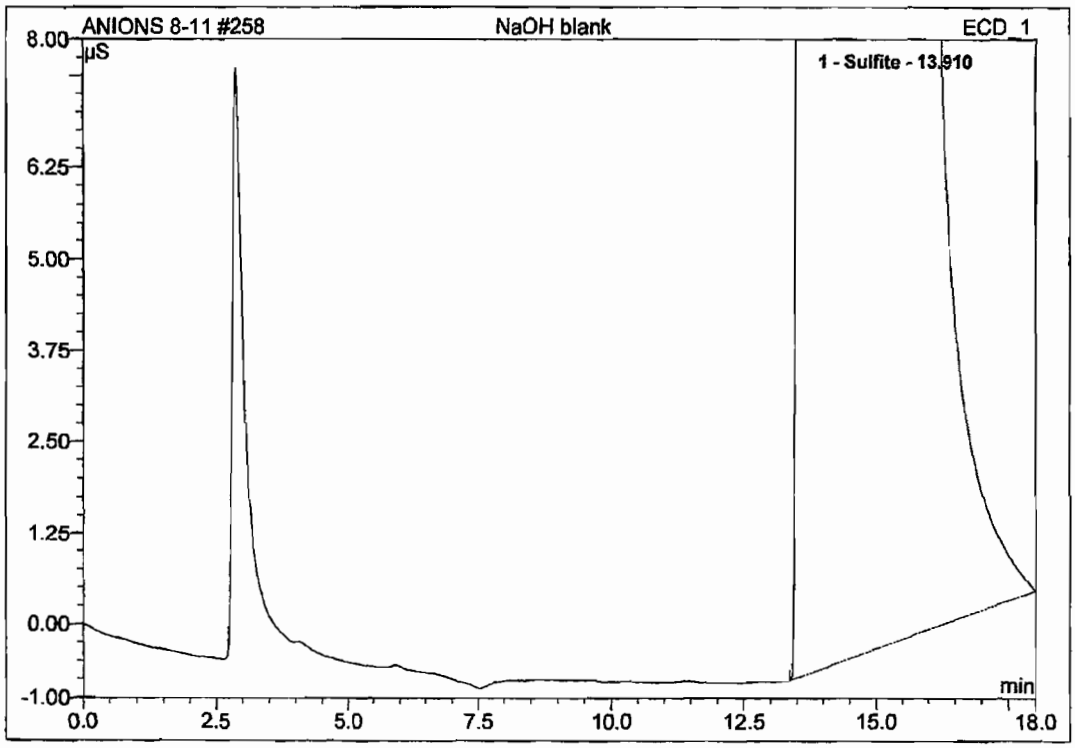
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 5:40**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
Total:			0.000	0.000

258 NaOH blank

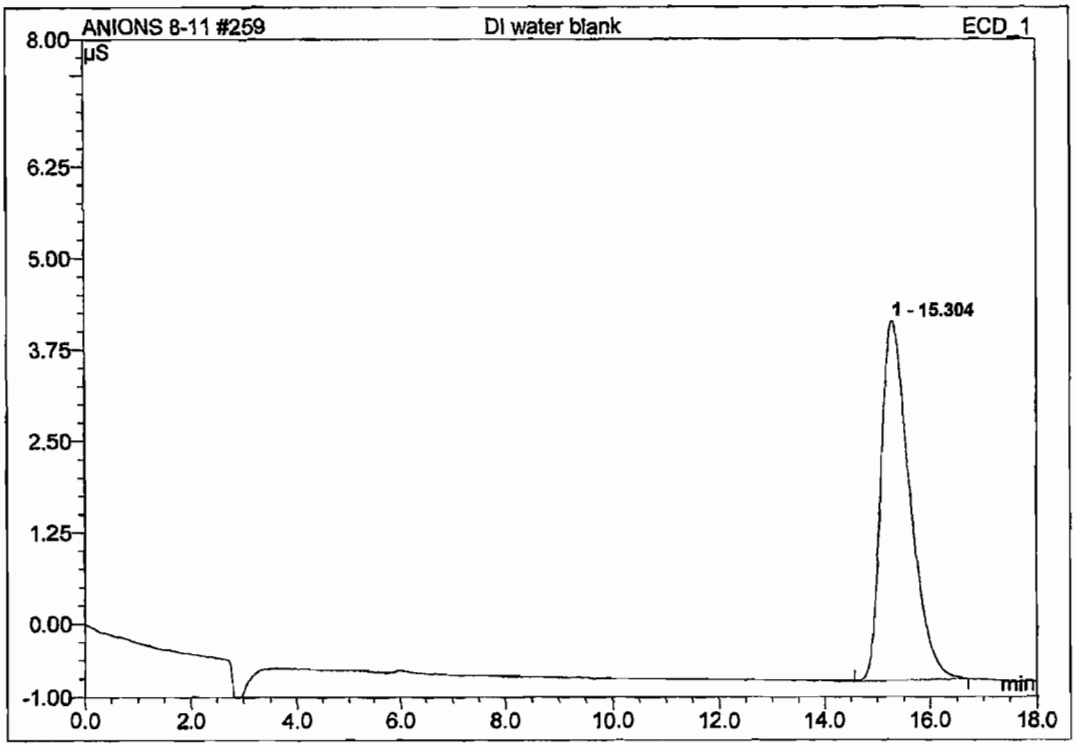
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 5:59**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	13.91	Sulfite	1192.393	#########
Total:			1192.393	1349.708

259 DI water blank

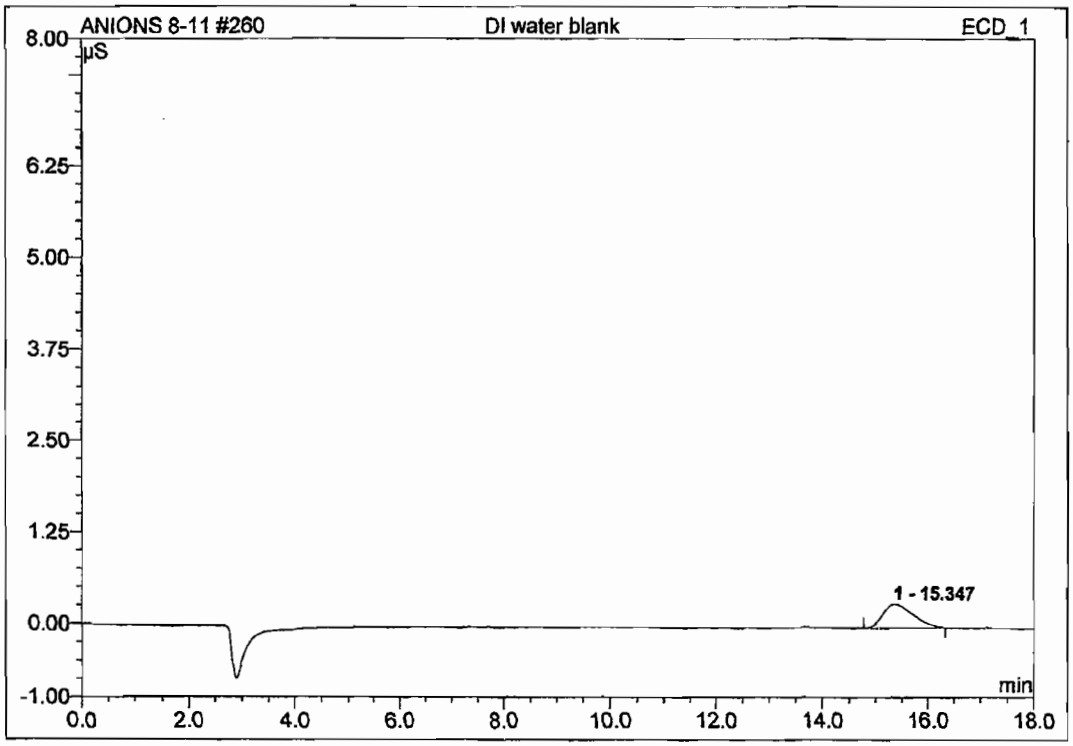
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 6:18**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
Total:			0.000	0.000

260 DI water blank

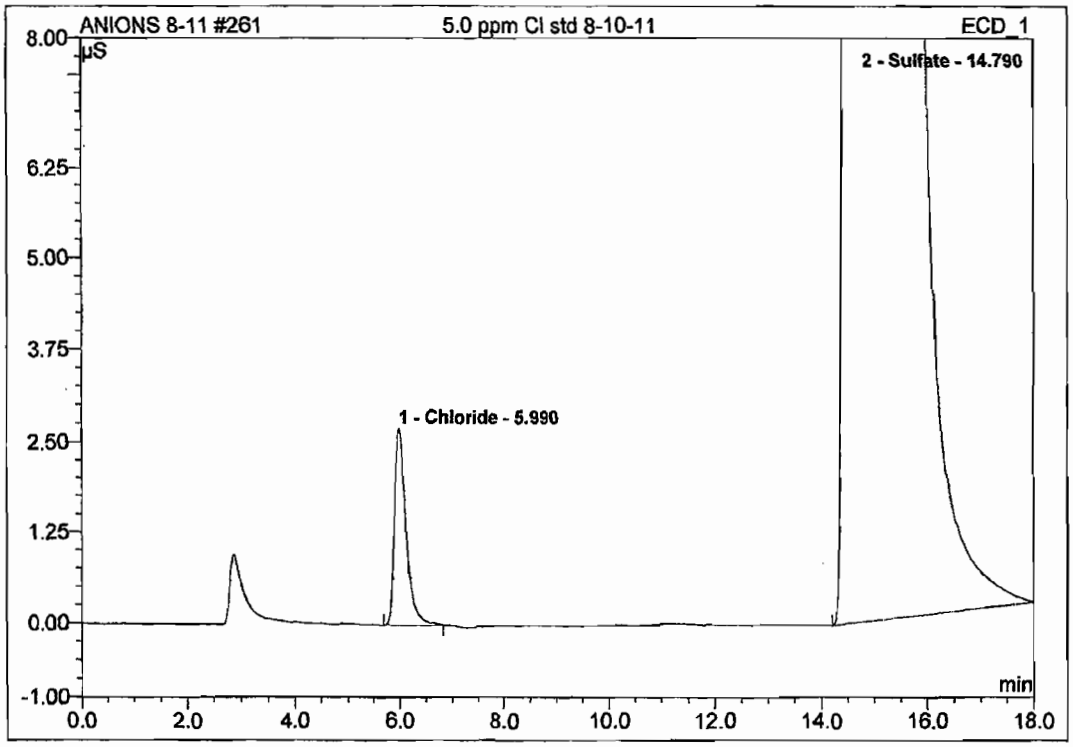
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 6:37**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
Total:			0.000	0.000

261 5.0 ppm Cl std 8-10-11

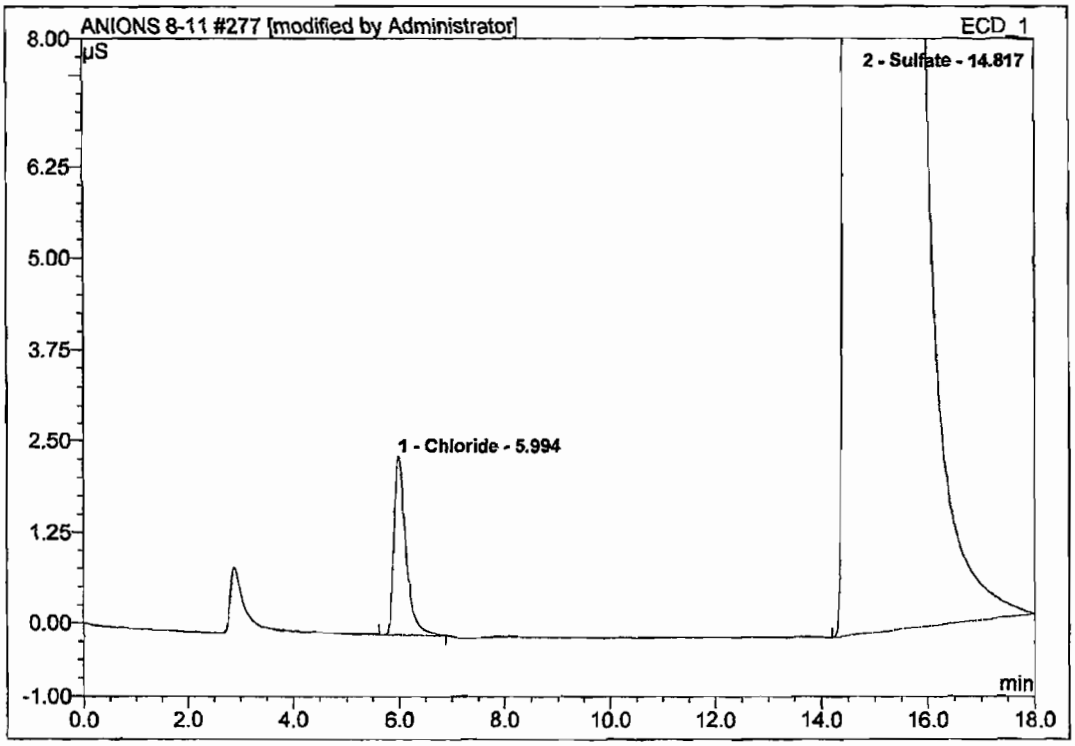
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 6:56**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	2.705	0.6817
2	14.79	Sulfate	415.949	285.4980
Total:			418.654	286.180

277 5.0 ppm Cl std 8-10-11

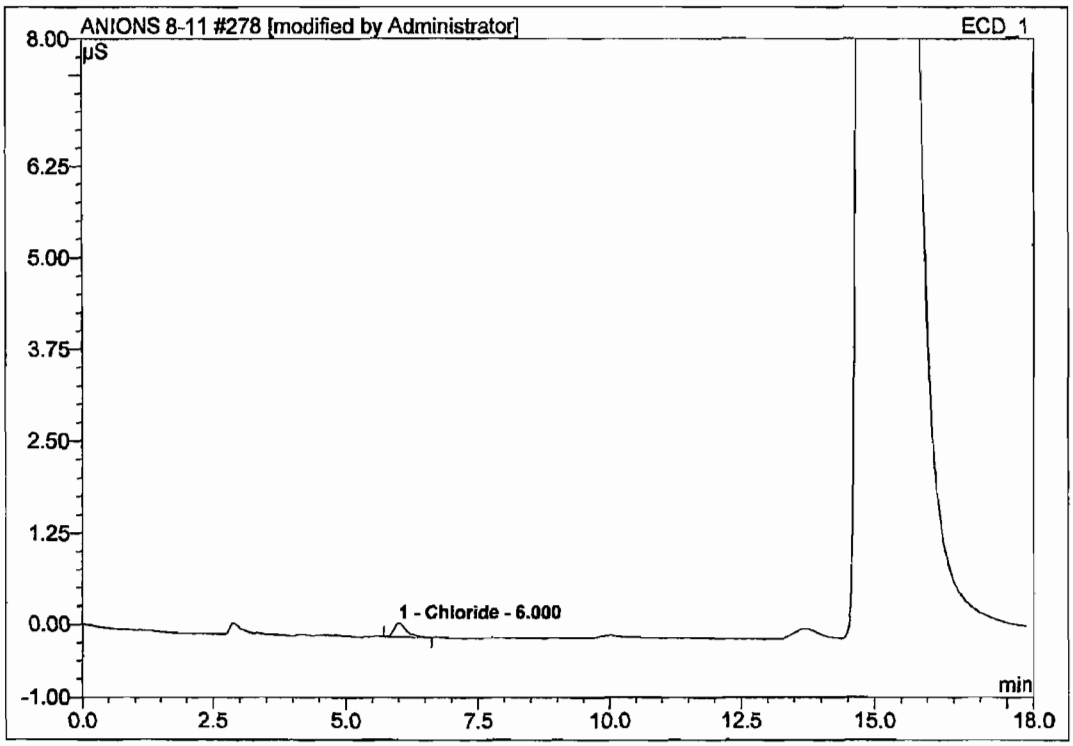
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 14:42**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	5.99	Chloride	2.445	0.6560
2	14.82	Sulfate	397.312	274.2843
Total:			399.757	274.940

278 26-1 NaOH Cl spike

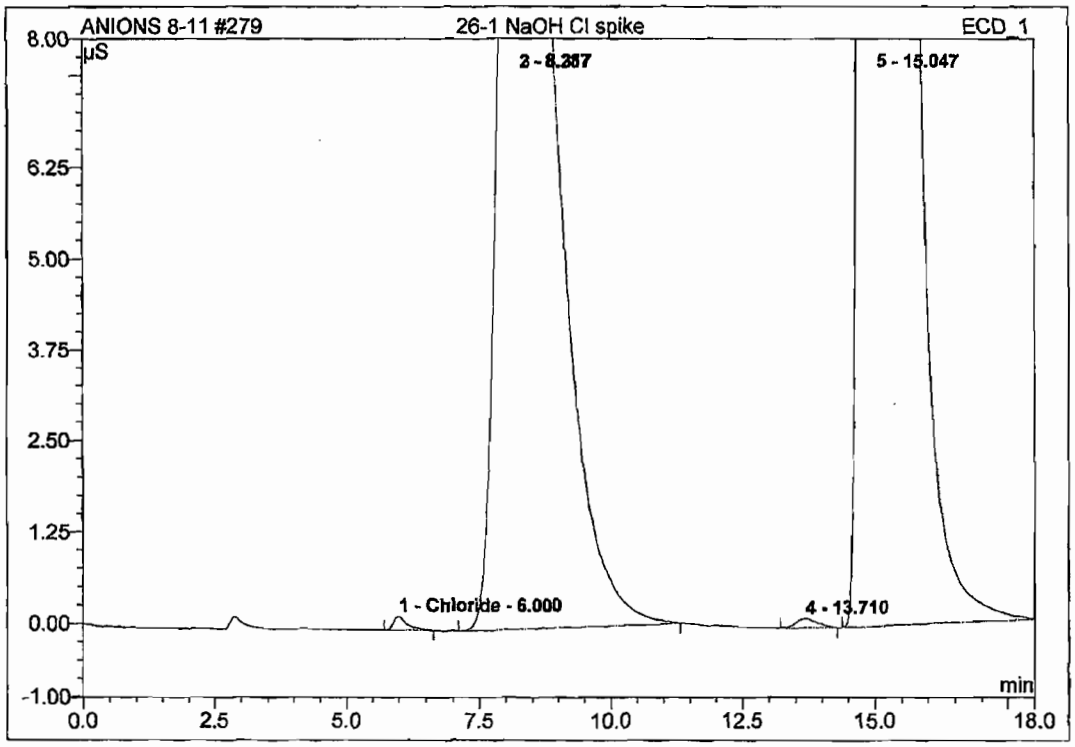
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 15:01**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.189	0.0522
Total:			0.189	0.052

279 26-1 NaOH Cl spike

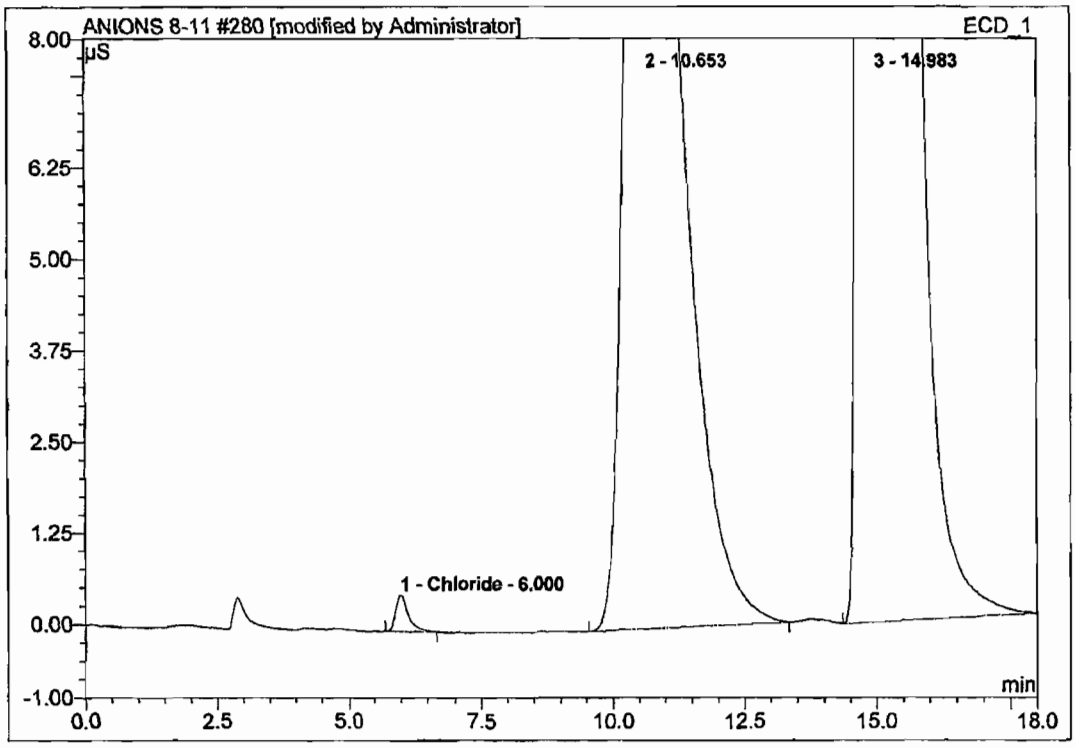
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 15:23**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.188	0.0528
Total:			0.188	0.053

280 26-3 NaOH Cl spike

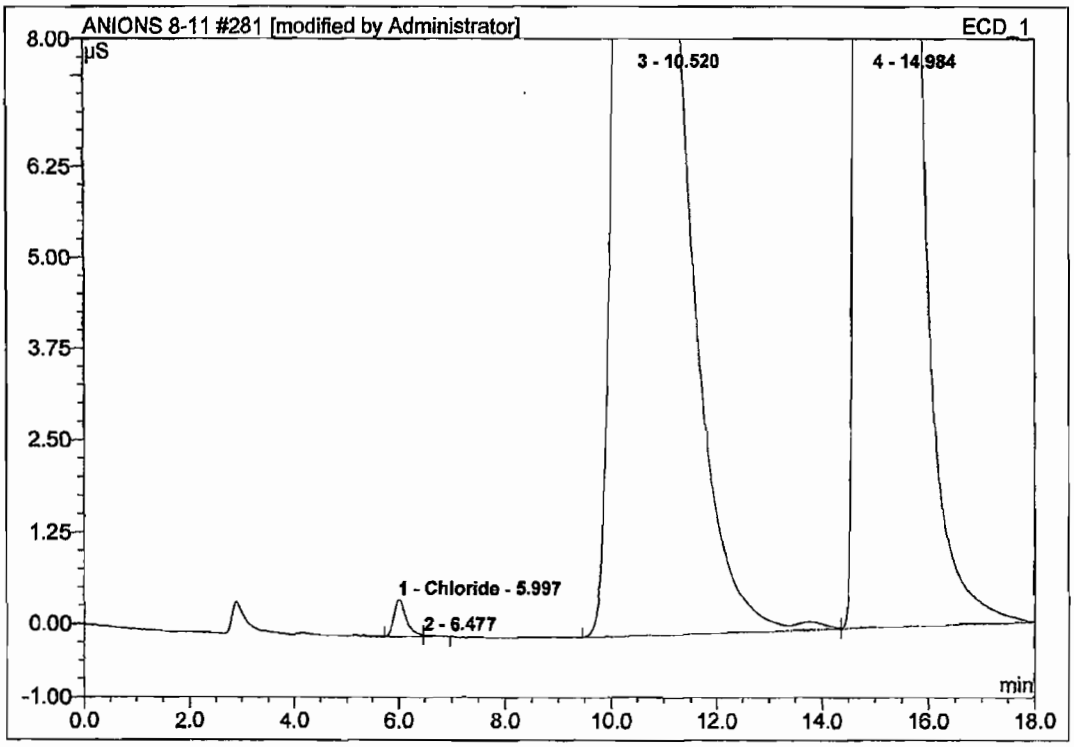
Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 15:42**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.496	0.1360
Total:			0.496	0.136

281 26-3 NaOH Cl spike

Client	**Houston Refining**	*Injection Volume:*	**35.0**
Vial Number:	**1**	*Channel:*	**ECD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**Anions 1000**	*Bandwidth:*	**n.a.**
Quantif. Method:	**ICS_1000_Anions**	*Dilution Factor:*	**1.0000**
Recording Time:	**8/17/2011 16:01**	*Sample Weight:*	**1.0000**
Run Time (min):	**12.00**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min
1	6.00	Chloride	0.510	0.1387
Total:			0.510	0.139

ANALYTICAL SUMMARY

CLIENT: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker Unit
SAMPLE DATE: 7/29/11, 8/1/11, 8/2/11
ANALYSIS: Particulates
METHOD: USEPA Method 202

Analyst: J. Ruggaber
Date of Completion: 8/23/2011
Template Control ID: USEPA-NEW202-Partic-Template-060T-REV1

Identification		Solvent Mass (g)	Tare	WT1	WT2	WT 1 - WT 2 (mg)	% difference	Particulate (mg)	Blank Corrected Particulate (mg)	Total M5 Particulate (mg)
Run 5B-1	FILTER	-	775.3	910.3	910.7	-0.40	N/A	135.20	-	457.65
	PW	70.7	97532.5	97855.4	97855.0	0.40	N/A	322.70	322.45	
Run 5B-2	FILTER	-	784.1	806.4	806.4	0.00	N/A	22.30	-	58.54
	PW	60.3	109179.8	109216.1	109216.4	-0.30	N/A	36.45	36.24	
Run 5B-3	FILTER	-	778.7	782.3	782.8	-0.50	N/A	3.85	-	11.14
	PW	58.5	118456.5	118464.1	118463.9	0.20	N/A	7.50	7.29	
Filter Blank	FILTER	-	778.7	783.2	783.6	-0.40	N/A	4.70	-	-
Acetone Blank	PW	85.5	110443.2	110443.6	110443.4	0.20	N/A	0.30	-	-

Identification		Tare	WT1	WT2	WT 1 - WT 2 (mg)	% difference	Condensate (mg)
Run 5B-1	Organic	114656.5	114700.6	114700.7	-0.10	N/A	44.15
Run 5B-2	Organic	99245.9	99434.1	99434.4	-0.30	N/A	188.35
Run 5B-3	Organic	109914.3	109928.0	109928.4	-0.40	N/A	13.90
Field Blank	Organic	116544.1	116544.1	116543.8	0.30	N/A	<0.10
Acetone Blank	Organic	110443.2	110443.6	110443.4	0.20	N/A	0.30
Hexane Blank	Organic	120465.0	120465.1	120465.0	0.10	N/A	0.05

Identification		Tare	WT1	WT2	WT 1 - WT 2 (mg)	% difference	Condensate (mg)
Run 5B-1	Inorganic	114981.0	115227.8	115227.6	0.20	N/A	246.70
Run 5B-2	Inorganic	121290.2	121336.2	121336.7	-0.50	N/A	46.25
Run 5B-3	Inorganic	111424.7	111437.3	111437.6	-0.30	N/A	12.75
Field Blank	Inorganic	118321.4	118322.4	118322.1	0.30	N/A	0.85
DI Water Blank	Inorganic	124213.3	124213.6	124213.4	0.20	N/A	0.20

Identification		Volume (mL)	Tare	WT1	WT2	WT 1 - WT 2 (mg)	Condensate (mg)	Target Weight (mg)	Recovery (%)	Pass/Fail
LCS	QC	100	114660.7	114768.8	114769.1	-0.30	108.25	107.20	101.0	PASS

CLIENT: Houston Refining
LOCATION: Houston, TX
SOURCE: 736 Coker Unit
SAMPLE DATE: 7/29/11, 8/1/11, 8/2/11
ANALYSIS: Particulates
METHOD: USEPA Method 202

Analyst: J. Ruggaber
Date of Completion: 8/23/2011
Template Control ID: USEPA-NEW202-Partic-Template-060T-REV1

Total Condensable Particulate Matter (TCPM)

Identification		Org. CPM (mg)	Inorg. CPM (mg)	Total CPM (mg)	Corrected CPM (mg)
Run 5B-1	TCPM	44.15	246.70	290.85	290.00
Run 5B-2	TCPM	188.35	46.25	234.60	233.75
Run 5B-3	TCPM	13.90	12.75	26.65	25.80
Field Blank	TCPM	<0.10	0.85	0.85	-

USEPA METHOD 5 TASK SCHEDULE

Client: Houston Refining

Location: Houston, TX

Project Manager: G. Burch

Date Sampled: 7/29/11, 8/1/11, 8/2/11

Lab Project #: 08-327

Spreadsheet Template ID: USEPA-NEW202-Partic-Template-060T-REV1

Analyst: J. Ruggaber

DATE	TIME	EQUIPMENT	TASK
8/10/11	16:00	Desiccator #2	Place labeled beakers in dessicator (store 24 hrs)
8/16/11	13:20	Desiccator #2	Place filters in dessicator (store min. 24 hours)
8/12/11	10:15	Ohaus Adventurer SL balance	Weigh conditioned beakers and record tares
8/12/11-8/16/11	-	-	Dry down probe washes in tared beakers
8/16/11	13:20	Desiccator #2	Place beakers in dessicator (store min. 24 hours)
8/19/11	9:05	Ohaus Adventurer SL balance	Beaker weighing #1
8/19/11	15:19	Ohaus Adventurer SL balance	Beaker weighing #2 (min. 6 hrs after weighing #1)
N/A	N/A	N/A	Beaker weighing #3 (min. 6 hrs after weighing #2)
N/A	N/A	N/A	Beaker weighing #4 (min. 6 hrs after weighing #3)
8/19/11	9:05	Ohaus Adventurer SL balance	Filter weighing #1 (min. 24 hrs in dessicator)
8/19/11	15:19	Ohaus Adventurer SL balance	Filter weighing #2 (min. 6 hrs after weighing #1)
N/A	N/A	N/A	Filter weighing #3 (min. 6 hrs after weighing #2)
N/A	N/A	N/A	Filter weighing #4 (min. 6 hrs after weighing #3)
8/23/11	-	-	Prepare report
			Report QA review
			Report distribution

LCS Solution used: Sodium Chloride Solution: 0.1072 g/L NaCl in DI water, 8/12/11

USEPA METHOD 202 TASK SCHEDULE

Client: Houston Refining

Location: Houston, TX

Project Manager: G. Burch

Date Sampled: 7/29/11, 8/1/11, 8/2/11

Lab Project #: 08-327

Spreadsheet Template ID: USEPA-NEW202-Partic-Template-060T-REV1

Analyst: J. Ruggaber

Reagent Information
Hexane Lot #106898, Fisher

Phenolphthalein Solution (if needed): N/A

0.1 N Ammonium Hydroxide Lot # (if needed): N/A

Sodium Chloride Solution: 0.1072 g/L NaCl in DI water, 8/12/11

DATE	TIME	EQUIPMENT	TASK
8/10/11	16:00	Desiccator # 2	Label beakers for hexane rinse, imp samples, and LCS sample. Place beakers in dessicator (store 24 hrs).
8/12/11	10:15	Ohaus Adventurer SL balance	Weigh conditioned beakers and record tares.
8/12/11	-	-	Sonicate filter in water for at least two minutes. Add the water to the imp contents. Repeat 2 more times.
8/12/11	-	-	Sonicate filter in hexane for at least two minutes. Add the hexane to the hexane sample contents. Repeat 2 more times.
8/12/11	-	-	Extract the imp contents with 30 mL of hexane 3 times. Collect all hexane extractions in the labeled and tared hexane beaker. Add the hexane sample to the hexane extractions.
8/12/11	-	-	Drain the water phase into the labeled and tared beaker.
8/12/11–8/16/11	-	-	Evaporate hexane beakers to dryness in a fume hood.
8/12/11	-	-	Transfer 200 mL of the sodium chloride solution into the tared LCS beaker.
8/12/11–8/16/11	-	Oven #1	Place the water phase beakers and LCS sample in an oven or hot plate and evaporate to not less than 10 mL. Allow to evaporate to dryness in a fume hood at room temperature.

8/16/11 (5B-1 aqueous only: 8/19/11)	13:20 (5B-1 aqueous only:16:55)	Desiccator #2	Place beakers in dessicator (store min. 24 hours)
8/19/11	9:05	Ohaus Adventurer SL Balance	Hexane beaker weighing #1
8/19/11	15:19	Ohaus Adventurer SL Balance	Hexane beaker weighing #2 (min. 6 hrs after weighing #1)
N/A	N/A	N/A	Hexane beaker weighing #3 (min. 6 hrs after weighing #2)
N/A	N/A	N/A	Hexane beaker weighing #4 (min. 6 hrs after weighing #3)
8/19/11 (5B-1 only: 8/22/11)	9:05 (5B-1 only: 9:08)	Ohaus Adventurer SL Balance	Water Phase and LCS beaker weighing #1
8/19/11 (5B-1 only: 8/22/11)	15:19 (5B-1 only: 16:30)	Ohaus Adventurer SL Balance	Water Phase and LCS beaker weighing #2 (min. 6 hrs after weighing #1)
N/A	N/A	N/A	Water Phase and LCS beaker weighing #3 (min. 6 hrs after weighing #2)
N/A	N/A	N/A	Water Phase and LCS beaker weighing #4 (min. 6 hrs after weighing #3)
If Water Phase Beakers achieve constant weight, skip this section			
N/A	N/A	N/A	Redissolve the residue from water phases in 100 mL of DI water. Add approximately 5 drops of phenolphthalein.
N/A	N/A	N/A	Titrate with 0.1 N ammonium hydroxide. Record the amount of ammonium hydroxide used.
N/A	N/A	N/A	Return the water phase beakers to the oven or hot plate and evaporate to not less than 10 mL. Allow to evaporate to dryness in a fume hood at room temperature.
N/A	N/A	N/A	Place beakers in dessicator (store min. 24 hours)
N/A	N/A	N/A	Water Phase beaker weighing #1
N/A	N/A	N/A	Water Phase beaker weighing #2 (min. 6 hrs after weighing #1)
N/A	N/A	N/A	Water Phase beaker weighing #3 (min. 6 hrs after weighing #2)
N/A	N/A	N/A	Water Phase beaker weighing #4 (min. 6 hrs after weighing #3)
End Section			
8/23/11	-	-	Prepare report
			Report QA review
			Report distribution

C-202

736 Coker Unit

ARI ENVIRONMENTAL, INC.

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

Chain of Custody Record H08436

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY	Client Name	Location
08-327	Houston Refining	Houston, TX
Lab Project No.		
Greg Burch		RW
ARI Project Manager		ARI Sampler Initials

Analysis Location (Wauconda or Pasadena)

Engineering or Compliance Test Samples

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request: Method 5B	Analysis Request: Method 202	Analysis Request	Analysis Request	Comments
H44946	7-29-11	Organics Probe Rinse	1	✓	1	✓				Run # 5B-1
H44947	7-29-11	Aqueous Impinger Rinse	4	✓	1		✓			Run # 5B-1
H44948	7-29-11	Organics Impinger Rinse	1	✓	1		✓			Run # 5B-1
H44952	8-1-11	Organics Probe Rinse	1	✓	1	✓				Run # 5B-2
H44953	8-1-11	Aqueous Impinger Rinse	2	✓	1		✓			Run # 5B-2
H44954	8-1-11	Organics Impinger Rinse	1	✓	1		✓			Run # 5B-2
H44960	8-2-11	Organics Probe Rinse	1	✓	1	✓				Run # 5B-3
H44961	8-2-11	Aqueous Impinger Rinse	1	✓	1		✓			Run # 5B-3
H44962	8-2-11	Organics Impinger Rinse	1	✓	1		✓			Run # 5B-3
H44967	8-2-11	Field Blank	1	✓	1		✓			Run # 5B-Blank
H44968	8-2-11	Water (Blank)	1	✓	1		✓			Blank
H44969	8-2-11	Acetone (Blank)	1	✓	1	✓	✓			Blank
H44970	8-2-11	Hexanes (Blank)	1	✓	1	✓	✓			Blank

Preservation Code

1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions / Comments

Requested Analysis Completion Date:

Report Level: Tier I: Engineering Tier II: Compliance Tier III: QAPP

Route Results Through:

	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By
	Ron White		
	(1) Date / Time: 8-3-11 @ 0500	(2) Date / Time	(3) Date / Time
	(1) Company: ARI	(2) Company	(3) Company
	(1) Received By: Ron T Vogt	(2) Received By	(3) Received By
	(1) Date / Time: 8/5/11 17:00	(2) Date / Time	(3) Date / Time
	(1) Company: ARI	(2) Company	(3) Company

SHIPMENT: HAND CARRY FEDX UPS

Custody Seal Applied Yes No

Form LF0001

736 Coker Unit

ARI ENVIRONMENTAL, INC.

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

Chain of Custody Record H08434

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY	Client Name	Location
68-327	Houston Refining	Houston, TX
Lab Project No.		
Greg Burch		RW
ARI Project Manager		ARI Sampler Initials

Analysis Location (Wauconda or Pasadena)

Engineering or Compliance Test Samples

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request: Method 5B	Analysis Request: Method 202	Analysis Request	Analysis Request	Comments
H43016	7-29-11	Filter	1	Petri	1	✓				Run # 5B-1
H43049	8-1-11	Filter	1	Petri	1	✓				Run # 5B-2
43050	8-2-11	Filter	1	Petri	1	✓				Run # 5B-3
H43019	8-2-11	Filter	1	Petri	1	✓				Run # 5B-Blank
H44766	7-29-11	CPM Filter	1	Petri	1		✓			Run # 5B-1
H44767	8-1-11	CPM Filter	1	Petri	1		✓			Run # 5B-2
H44944	8-2-11	CPM Filter	1	Petri	1		✓			Run # 5B-3
H44779	8-2-11	CPM Filter	1	Petri	1		✓			Run # 5B-Blank

Preservation Code

1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions / Comments	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By	SHIPMENT:
	Ron White			HAND CARRY
	(1) Date / Time 8-3-11 @ 0500	(2) Date / Time	(3) Date / Time	FEDX
	(1) Company ARI	(2) Company	(3) Company	UPS
Requested Analysis Completion Date:	(1) Received By	(2) Received By	(3) Received By	Custody Seal Applied Yes No
Report Level: Tier I: Engineering Tier II: Compliance Tier III: QAPP	(1) Date / Time 8/5/11 17:00	(2) Date / Time	(3) Date / Time	
Route Results Through:	(1) Company ARI	(2) Company	(3) Company	

Form LF0001

C-203

DAT Report®

Data Analysis Technologies, Inc.
7715 Corporate Blvd.
Plain City, OH 43064
800-733-8644

Sample Analysis Certificate

Client:	ARI Environmental, Inc.	Date:	8/31/2011
Address:	951 Old Rand Road, Unit 106	DAT Project ID:	0811013
	Wauconda, IL 60084	Date Received:	8/8/2011
		Date Analyzed:	8/18/2011

Attn:	Dan Fitzgerald
Client Project:	Houston Refining-OTM-29
Analysis:	OTM-29

The following samples were received on 8/8/2011:

DAT Sample ID	Client Sample ID	Date Sampled	Matrix
0811013-01	H44872 Knockout Contents Run #OTM29-1	7/22/2011	Liquid
0811013-02	H44873 Impingers #1,2,3 Run #OTM29-1	7/22/2011	Liquid
0811013-03	H44874 Impingers #4 Run #OTM29-1	7/22/2011	Liquid
0811013-04	H44727 Knockout Contents Run #OTM29-3	7/27/2011	Liquid
0811013-05	H44728 Impingers #1,2,3 Run #OTM29-3	7/27/2011	Liquid
0811013-06	H44729 Impingers #4 Run #OTM29-3	7/27/2011	Liquid
0811013-07	H44760 Knockout Contents Run #OTM29-4	7/29/2011	Liquid
0811013-08	H44764 Impingers #1,2,3 Run #OTM29-4	7/29/2011	Liquid
0811013-09	H44765 Impingers #4 Run #OTM29-4	7/29/2011	Liquid
0811013-10	H44734 Impingers #1,2,3 Run #OTM29-Blank	7/27/2011	Liquid
0811013-11	H44735 Impingers #4 Run #OTM29-Blank	7/27/2011	Liquid
0811013-12	H44736 Field Spike Blank	7/27/2011	Liquid

0811013-13 H44737 6N NaOH Solution Blank 7/27/2011 Liquid

Results: See attached summary.

QC: Met the criteria for the method. See attached summary.

Reviewed and approved for release by: _____ Date: 8/31/2011

Ronald K. Mitchum, Ph.D.
President, DAT

Data Analysis Technologies, Inc.
7715 Corporate Blvd.
Plain City, OH 43064

Data Summary Table

Client:	**ARI Environmental**
Client Project:	**Houston Refining**
Analysis:	**Cyanide by OTM-29**
DAT Project:	**0811013**
Extraction Date:	**7/27,28,29/2011**
Analysis Date:	**8/18/11**

Client ID	DAT ID		*MDL* *ug*	Total Cyanide Conc., ug	Q
Reagent Blank NaOH	**0811013-**	**13**	*0.485*	**ND**	
Field Blank Imp. 1-3	**0811013-**	**10**	*2.200*	**ND**	
Field Blank Imp. 4	**0811013-**	**11**	*0.730*	**ND**	
Knockout Contents Run#OTM29-1	**0811013-**	**1**	*10.250*	**ND**	**D**
Impingers 1-3 Run#OTM29-1	**0811013-**	**2**	*6.400*	**ND**	
Impingers 4 Run#OTM29-1	**0811013-**	**3**	*3.200*	**95**	
Knockout Contents Run#OTM29-3	**0811013-**	**4**	*21.900*	**3180**	
Impingers 1-3 Run#OTM29-3	**0811013-**	**5**	*265.000*	**ND**	**D**
Impingers 4 Run#OTM29-3	**0811013-**	**6**	*0.680*	**ND**	
Knockout Contents Run#OTM29-4	**0811013-**	**7**	*16.150*	**791**	
Impingers 1-3 Run#OTM29-4	**0811013-**	**8**	*215.000*	**ND**	**D**
Impingers 4 Run#OTM29-4	**0811013-**	**9**	*0.720*	**ND**	
Field Spike	**0811013-**	**12**	*34.000*	**2196**	**D**

D= Value from a dilution

Data Analysis Technologies, Inc.
7715 Corporate Blvd.
Plain City, OH 43064

QC Summary Table

Client: **ARI Environmental**
Client Project: Houston Refining
Analysis: Cyanide by OTM-29
DAT Project: 0811013
Extraction Date: 7/27,28,29/2011
Analysis Date: 8/18/11
Spike Amt. Added, ug: 0.2

Client ID:	DAT ID:	Cyanide, ug/mL	Cyanide, ug	*MDL ug/mL*	% Rec	% RPD	Q
Cal Check Standard	ICV 0.2 ug/mL ()		0.21		105		
Instr Blank	NaOH Blank ()			*0.001*			
Sample	0811013-6		0				
Sample Duplicate	0811013-6 Dup		0			0	
Cal Check Standard	CCV 0.2 ug/mL ()		0.18		90		
Instr Blank	NaOH Blank ()			*0.001*			
Cal Check Standard	CCV 0.2 ug/mL ()		0.20		99		
Instr Blank	NaOH Blank ()			*0.001*			
Matrix Spike	0811013-7 MS	0.393	1269		74		
Matrix Spike Duplicate	0811013-7 MSD	0.421	1360		88	7	
Field Spike 1	0811013-12	16.150	2196		110		
Lab Spike	LS	0.183	0.183		92		
Lab Spike Duplicate	LSD	0.182	0.182		91	1	
Cal Check Standard	CCV 0.2 ug/mL ()		0.19		95		
Instr Blank	NaOH Blank ()		ND	*0.001*			

ND = Not detected at the reporting limit shown.

DOCUMENTATION

736 . Coker Unit

ARI ENVIRONMENTAL, INC.

Chain of Custody Record H08430

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY	Houston Refining	Houston, TX
Lab Project No.	Client Name	Location
Greg Burch		RW
ARI Project Manager		ARI Sampler Initials

Analysis Location (Wauconda or Pasadena)

Engineering or Compliance Test Samples

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request: OTM-29 (HCN)				Comments
H44872	7-22-11	Knockout contents	3	✓	1	✓				Run # OTM29-1
H44873	7-22-11	Impingers #1, 2, 3	2	✓	1	✓				Run # OTM29-1
H44874	7-22-11	Impinger #4	1	✓	1	✓				Run # OTM29-1
H44727	7-27-11	Knockout contents	5	✓	1	✓				Run # OTM29-3
H44728	7-27-11	Impingers #1, 2, 3	1	✓	1	✓				Run # OTM29-3
H44729	7-27-11	Impinger #4	1	✓	1	✓				Run # OTM29-3
H44760	7-29-11	Knockout contents	4	✓	1	✓				Run # OTM29-4
H44764	7-29-11	Impingers #1, 2, 3	1	✓	1	✓				Run # OTM29-4
H44765	7-29-11	Impinger #4	1	✓	1	✓				Run # OTM29-4
H44734	7-27-11	Impingers #1, 2, 3	1	✓	1	✓				Run # OTM29-Blank
H44735	7-27-11	Impinger #4	1	✓	1	✓				Run # OTM29-Blank
H44736	7-27-11	Field Spike (2ml 1000 ppm CN into 100 ml 6N NaOH recovered)	1	✓	1	✓				Blank
H44737	7-27-11	6N NaOH Solution	1	✓	1	✓				Blank

Preservation Code: 1 = Ambient Temp. 2 = 4°C (Ice Packs) 3 = Dry Ice 4 = Other (Noted)

Special Instructions / Comments	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By	SHIPMENT:
	Ken White			
	(1) Date / Time: 8-3-11 @ 0500	(2) Date / Time: 8/8/11 1535	(3) Date / Time	HAND CARRY
	(1) Company: ARI	(2) Company: ARI	(3) Company	FEDX
				UPS
Requested Analysis Completion Date:	(1) Received By	(2) Received By	(3) Received By	Custody Seal Applied
Report Level: Tier I: Engineering Tier II: Compliance Tier III: QAPP	(1) Date / Time: 8-3-11 @ 0900	(2) Date / Time	(3) Date / Time: 8-8-11 1540	Yes No
Route Results Through:	(1) Company: ARI	(2) Company	(3) Company	

Form LF0001

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 0811013

Date Received:	8/8/2011	**Carrier:**	Hand Delivered
Client Name:	ARI Environmental	**Analysis:**	OTM-29
Tracking number:	NA	**Package Temp:**	25.7°C (AMB-Room)
Custody Seals ?:	No	**COC:** ☑	check if COC from client

Sample Information

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
H44872 Knockout Contents Run #OTM29-1	0811013-01 AB&C	7/22/2011	Liquid	1liter Plastic WM Bottle	
H44873 Impingers #1,2,3 Run #OTM29-1	0811013-02 A&B	7/22/2011	Liquid	1liter & 500ml Plastic WM Btle	
H44874 Impingers #4 Run #OTM29-1	0811013-03	7/22/2011	Liquid	1liter Plastic WM Bottle	
H44727 Knockout Contents Run #OTM29-3	0811013-04 ABCD&E	7/27/2011	Liquid	1liter & 500ml Plastic WM Btle	
H44728 Impingers #1,2,3 Run #OTM29-3	0811013-05	7/27/2011	Liquid	500ml Plastic WM Bottle	
H44729 Impingers #4 Run #OTM29-3	0811013-06	7/27/2011	Liquid	125ml Plastic WM Bottle	
H44760 Knockout Contents Run #OTM29-4	0811013-07 ABC&D	7/29/2011	Liquid	1liter & 500ml Plastic WM Btle	

LQ

Laboratory Receiving Initials

0811013

8/8/2011 4:17:26 PM

DAT SAMPLE RECEIVING

7715 Corporate Blvd. Plain City,OH 43064.

Project Number: 0811013

Client ID:	Laboratory ID	Date	Matrix:	Container:	Comment:
H44764 Impingers #1,2,3 Run #OTM29-4	0811013-08	7/29/2011	Liquid	500ml Plastic WM Bottle	
H44765 Impingers #4 Run #OTM29-4	0811013-09	7/29/2011	Liquid	125ml Plastic WM Bottle	
H44734 Impingers #1,2,3 Run #OTM29-Blank	0811013-10	7/27/2011	Liquid	500ml Plastic WM Bottle	
H44735 Impingers #4 Run #OTM29-Blank	0811013-11	7/27/2011	Liquid	125ml Plastic WM Bottle	
H44736 Field Spike Blank	0811013-12	7/27/2011	Liquid	125ml Plastic WM Bottle	
H44737 6N NaOH Solution Blank	0811013-13	7/27/2011	Liquid	125ml Plastic WM Bottle	

LQ

Laboratory Receiving Initials

0811013

8/8/2011 4:17:26 PM

C-212

DAT Labs Inc.
Sample Receipt Report

Client/Number: ARI Environmental (10119)
Custodian Initial: LL Date: 8-8-11
Secondary Review: Initials: Date:

The client has been contacted.
_____ Yes _____ No

Upon receipt of samples, check if any of the following discrepancies have been noted.

	Discrepancy Type	*Specify applicable client ID or "all"*
	COC and samples do not match	
	No unique sample identifications	
	Samples received outside of the required temp criteria. **Receipt Temp:** 25.1 C	
	No preservation type was noted **Correction Factor:** +0.6 C	
	No date of collection stated **Corrected Temp:** 25.7 C	(Amb. Room)
X	No time of collection stated	
	The sample collector was not named	
	Sample containers were not appropriate	
	Sample labels were destroyed or unreadable	
	Samples were received outside of holding time	
	There was not enough sample to perform the requested analysis.	
	Samples showed sign of damage or contamination.	
	Aqueous samples for volatile analysis: Headspace? Y N	If Yes, list sample ID(s) in details:

Details: _____

Sample pH for nonvolatile aqueous samples and presence or absence of headspace (Y or N) for VOA aqueous samples shall be recorded at time of sample log-in.
Under no circumstances shall VOA vials be opened at time of sample receipt.

Other Discrepancies:

Sample ID	**Discrepancy**

Container Return
Yes / (No)
Price:
Size:
Return Spl wt:

☑ ***Upon receipt, the samples met all of DAT's acceptance criteria.*** ***DAT Project #*** 081013

ALS Environmental

5420 Mainway Drive, Unit 5, Burlington ON, L7L 6A4
Phone: 905-331-3111, FAX: 905-331-4567

SCC Accredited Lab ID# 1003-15/779 Ont DW License #: 2285
NELAC Primary Accreditation, NJ DEP ID# CANA003: Secondary Accreditation, TX Cert# T104704433-08-TX

Certificate of Analysis

ALS Project Contact:	Ron McLeod	**Client Name:**	ARI Environmental Inc.
ALS Project ID:	ARI100	**Client Address:**	1710 Preston Road
ALS WO#:	L1042736		Unit C
Date of Report	24-Aug-11		Pasadena, TX, 77503
Date of Sample Receipt	8-Aug-11	**Client Contact:**	Dan Fitzgerald
		Client Project ID:	736 Coker Unit

COMMENTS:
Metals analysed via ICP-MS Method USEPA 6020A (MC 23-Aug-2011)
Sample Preparation via USEPA Method 29 (MB 23-Aug-2011)

Front Half HF Fraction 1A

There was a positive concentration of antimony detected in the laboratory control blank.
The recoveries of beryllium ans selenium were marginally above method control limits for the LCS and LCSD.
However these elements have not been detected in the samples.

Back Half (HNO3 / H2O2) Fraction 2A

The recoveries are above method control limits for the LCSD. However, MS and MSD recoveries are all well within limits.

No negative impact to overall data quality is expected.

LCB = Laboratory Control Blank
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOR = Limit of Reporting

Certified by: _____
Steve Kennedy
Laboratory Manager

ALS Environmental

Sample Analysis Summary Report

Sample Name		RUN# 29-1 H44768/H44769/H44770/H44941	RUN# 29-2 H44775/H44776/H44777/H44943	RUN# 29-3 H44957/H44958/H44959/H44945	BLANK H44963/H44964/H44965/H44966
ALS Sample ID		L1042736-1	L1042736-2	L1042736-3	L1042736-4
Matrix		STACK	STACK	STACK	STACK
Analysis Type		Sample	Sample	Sample	Sample
Sampling Date		29-Jul-11	1-Aug-11	2-Aug-11	2-Aug-11
Date of Receipt		8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11
Multi-Metals via ICP-MS	**LOR**				
	ug	**ug**	**ug**	**ug**	**ug**
Front Half HF Fraction 1A					
Antimony	0.2	<	<	<	<
Arsenic	1	<	<	<	<
Beryllium	0.2	<	<	<	<
Cadmium	0.1	0.137	0.130	<	<
Chromium	1	1.41	1.62	1.40	1.71
Cobalt	0.2	<	<	<	<
Lead	0.5	0.514	<	<	<
Manganese	0.5	2.04	1.10	9.53	0.610
Nickel	0.2	1.64	4.50	4.92	3.56
Selenium	2	<	<	<	<
Back Half (HNO3 / H2O2) Fraction 2A					
Antimony	0.1	0.104	<	<	<
Arsenic	0.2	0.415	<	<	<
Beryllium	0.1	<	<	<	<
Cadmium	0.05	0.902	0.416	0.288	<
Chromium	0.15	26.9	0.992	0.873	0.582
Cobalt	0.1	2.71	0.324	1.12	<
Lead	0.05	0.931	0.395	0.315	0.0883
Manganese	0.15	12.3	1.84	0.209	<
Nickel	0.1	10.4	5.45	1.37	0.314
Selenium	1	1.25	<	<	<

ALS Environmental

Sample QC Summary Report

Sample Name		LCB	LCS	LCS	LCSD	LCSD
ALS Sample ID		LCB	LCS	LCS	LCSD	LCSD
Matrix		STACK	STACK	STACK	STACK	STACK
Analysis Type		Blank	LCS	LCS	LCS	LCS
Sampling Date		n/a	n/a	n/a	n/a	n/a
Date of Receipt		n/a	n/a	n/a	n/a	n/a
Multi-Metals via ICP-MS	**LOR ug**	**ug**	**ug**	**% Rec**	**ug**	**% Rec**
Front Half HF Fraction 1A						
Antimony	0.2	2.05	14.2	101	13.1	92
Arsenic	1	<	71.0	118	67.4	112
Beryllium	0.2	<	68.8	115	66.5	111
Cadmium	0.1	<	33.9	113	32.5	108
Chromium	1	<	65.7	109	62.6	104
Cobalt	0.2	<	65.4	109	63.0	105
Lead	0.5	<	68.6	114	65.1	109
Manganese	0.5	<	63.6	106	60.4	101
Nickel	0.2	<	65.7	109	61.3	102
Selenium	2	<	72.0	119	69.2	115
Back Half (HNO3 / H2O2) Fraction 2A						
Antimony	0.1	<	6.24	103	6.60	109
Arsenic	0.2	<	33.5	112	35.2	117
Beryllium	0.1	<	33.6	112	35.4	118
Cadmium	0.05	<	16.1	107	17.0	113
Chromium	0.15	<	32.7	109	35.6	118
Cobalt	0.1	<	33.3	111	35.8	119
Lead	0.05	0.0807	32.6	108	34.5	115
Manganese	0.15	<	32.1	108	33.6	113
Nickel	0.1	<	33.7	112	35.6	118
Selenium	1	<	35.1	117	36.2	120

ALS Environmental

Sample QC Summary Report

Sample Name		RUN# 29-1 H44768/H44769/H44770/H44941	RUN# 29-1 H44768/H44769/H44770/H44941	RUN# 29-1 H44768/H44769/H44770/H44941	RUN# 29-1 H44768/H44769/H44770/H44941	RUN# 29-1 H44768/H44769/H44770/H44941	RUN# 29-1 H44768/H44769/H44770/H44941
ALS Sample ID		L1042736-1	L1042736-1	MS	MS	MSD	MSD
Matrix		STACK	STACK	STACK	STACK	STACK	STACK
Analysis Type		Sample	Duplicate	Matrix Spike	Matrix Spike	Matrix Spike Dup	Matrix Spike Dup
Sampling Date		29-Jul-11	29-Jul-11	29-Jul-11	29-Jul-11	29-Jul-11	29-Jul-11
Date of Receipt		8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11
Multi-Metals via ICP-MS	**LOR**						
	ug	**ug**	**ug**	**ug**	**% Rec**	**ug**	**% Rec**
Front Half HF Fraction 1A							
Antimony	0.2	<	<	24.7	102	25.8	107
Arsenic	1	<	<	126	105	132	110
Beryllium	0.2	<	<	124	104	129	108
Cadmium	0.1	0.137	<	62.8	104	64.9	108
Chromium	1	1.41	1.24	128	105	133	110
Cobalt	0.2	<	<	124	103	125	105
Lead	0.5	0.514	<	126	105	128	107
Manganese	0.5	2.04	1.64	125	102	138	114
Nickel	0.2	1.64	1.62	124	102	127	105
Selenium	2	<	<	124	104	133	112
Back Half (HNO3 / H2O2) Fraction 2A							
Antimony	0.1	0.104	0.112	11.6	96	11.8	98
Arsenic	0.2	0.415	0.420	62.2	103	62.8	104
Beryllium	0.1	<	<	59.3	99	59.7	100
Cadmium	0.05	0.902	0.923	30.3	98	31.1	101
Chromium	0.15	26.9	27.5	91.0	107	93.0	110
Cobalt	0.1	2.71	2.79	65.8	105	66.8	107
Lead	0.05	0.931	0.944	66.0	108	67.2	110
Manganese	0.15	12.3	12.5	73.8	102	75.1	105
Nickel	0.1	10.4	10.5	73.6	105	75.8	109
Selenium	1	1.25	1.23	62.7	102	64.5	105

ALS Environmental
5420 Mainway Drive, Unit 5, Burlington ON, L7L 6A4
Phone: 905-331-3111, FAX: 905-331-4567

SCC Accredited Lab ID# 1003-15/779 Ont DW License #: 2285
NELAC Primary Accreditation, NJ DEP ID# CANA003: Secondary Accreditation, TX Cert# T104704433-08-TX

Certificate of Analysis

ALS Project Contact:	Steve Kennedy	**Client Name:**	ARI Environmental Inc.
ALS Project ID:	ARI100	**Client Address:**	1710 Preston Rd. Unit C
ALS WO#:	L1043067		Pasadena, TX. 77503
Date of Report	26-Aug-11		
Date of Sample Receipt	8-Aug-11	**Client Contact:**	D. Fitzgerald
		Client Project ID:	736 COKER UNIT

COMMENTS:

Mercury Analysis via CVAA Method USEPA 7470A (MC1 26/08/11)
Sample Preparation via ASTM D6784-02 (MC1 26/08/11)

The impinger 1-3 protions were composited with the corresponding knockout contents for the following samples:

OH-1 H44855/856/857/858/859/860
OH-2 H44706/707/708/709/710/711
OH-4 H44840/753/754/755/756/757

LCB = Laboratory Control Blank
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOR = Limit of Reporting

Certified by: _____
Steve Kennedy
Laboratory Manager

ALS Environmental

Sample Analysis Summary Report

Sample Name		OH-1 H44855/H44856/H44857/H44858/H44859/H44860	OH-3 H44706/H44707/H44708/H44709/H44710/H44711	OH-BLANK H4471S/H44716/H44717	OH-4 H44840/H44753/H44754/H44755/H44756/H44757	BLANK H44718/H44719/H44720/H44721/H44722/H44723/H44724/H44725/H44726
ALS Sample ID		L1043067-1	L1043067-2	L1043067-3	L1043067-4	L1043067-5
Matrix		STACK	STACK	STACK	STACK	STACK
Analysis Type		Sample	Sample	Sample	Sample	Sample
Sampling Date		22-Jul-11	27-Jul-11	27-Jul-11	29-Jul-11	27-Jul-11
Date of Receipt		8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11
Mercury via FIMS CVAA	**LOR**					
	ug	**ug**	**ug**	**ug**	**ug**	**ug**
Analytical Fraction 1B	0.015	0.0159	0.0924	N/A	<	<
Analytical Fraction 0.1 HNO3	0.005	0.0172	<	N/A	<	<
Analytical Fraction IMP 1-3 KCl	0.025	1.09	<0.235	<	<0.155	<
Analytical Fraction IMP 4 5% HNO3/ 10% H2O2	0.031	<	<	0.100	<	0.0650
Analytical Fraction IMP 5-7 KMnO4	0.025	0.365	0.105	0.0500	0.442	0.0156
Analytical Fraction 10% HYDROXYLAMINE BLANK	0.0625	N/A	N/A	N/A	N/A	<
Analytical Fraction 10% HNO3 BLANK	0.0067	N/A	N/A	N/A	N/A	<

ALS Environmental

Sample QC Summary Report

Sample Name		LCB	LCS	LCS	LCSD	LCSD
ALS Sample ID		LCB	LCS	LCS	LCSD	LCSD
Matrix		STACK	STACK	STACK	STACK	STACK
Analysis Type		Blank	LCS	LCS	LCS	LCS
Sampling Date		n/a	n/a	n/a	n/a	n/a
Date of Receipt		n/a	n/a	n/a	n/a	n/a
Mercury via FIMS CVAA	**LOR**					
	ug	**ug**	**ug**	**% Rec**	**ug**	**% Rec**
Analytical Fraction 1B	0.02	<	0.294	101	0.307	106
Analytical Fraction 0.1 HNO3	0.005	<	0.0916	93	0.0905	92
Analytical Fraction IMP 1-3 KCl	0.03	<	0.456	92	0.476	96
Analytical Fraction IMP 4 5% HNO3/ 10% H2O2	0.03	<	0.099	98	0.101	100
Analytical Fraction IMP 5-7 KMnO4	0.03	<	0.499	100	0.501	100

ALS Environmental

Sample QC Summary Report

Sample Name		OH-1 H44855/H44856/H44857/H44858/H44859/H44860	OH-1 H44855/H44856/H44857/H44858/H44859/H44860	OH-1 H44855/H44856/H44857/H44858/H44859/H44860	OH-1 H44855/H44856/H44857/H44858/H44859/H44860	OH-1 H44855/H44856/H44857/H44858/H44859/H44860	OH-1 H44855/H44856/H44857/H44858/H44859/H44860
ALS Sample ID		L1043067-1	L1043067-1	MS	MS	MSD	MSD
Matrix		STACK	STACK	STACK	STACK	STACK	STACK
Analysis Type		Sample	Duplicate	Matrix Spike	Matrix Spike	Matrix Spike Dup	Matrix Spike Dup
Sampling Date		22-Jul-11	22-Jul-11	22-Jul-11	22-Jul-11	22-Jul-11	22-Jul-11
Date of Receipt		8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11
Mercury via FIMS CVAA	**LOR**						
	ug	**ug**	**ug**	**ug**	**% Rec**	**ug**	**% Rec**
Analytical Fraction 1B	0.015	0.0159	0.0192	0.327	104	0.315	100
Analytical Fraction 0.1 HNO3	0.005	0.0172	0.0180	0.0981	81	0.113	96
Analytical Fraction IMP 1-3 KCl	0.025	1.09	0.872	5.59	92	5.53	91
Analytical Fraction IMP 4 5% HNO3/ 10% H2O2	0.031	<	<	0.618	99	0.609	97
Analytical Fraction IMP 5-7 KMnO4	0.025	0.365	0.396	0.842	95	0.913	110

ALS Environmental
5420 Mainway Drive, Unit 5, Burlington ON, L7L 6A4
Phone: 905-331-3111, FAX: 905-331-4567

SCC (ISO 17025:2005) Accreditation Lab ID: 1003-15/779 Ont DW License #: 2285
NELAC Primary Accreditation, NJ DEP ID# CANA003: Secondary Accreditation, TX Cert# T104704433-08-TX

Certificate of Analysis

ALS Project Contact:	Ron McLeod	**Client Name:**	ARI Environmental Inc.
ALS Project ID:	ARI100	**Client Address:**	1710 Preston Rd. Unit C
ALS WO#:	L1041493		Pasadena,TX 77503
Date of Report	29-Aug-11		USA
Date of Sample Receipt	8-Aug-11	**Client Contact:**	Dan Fitzgerald
		Client Project ID:	736 Coker Unit

COMMENTS: **SVOC via SW846 Method 3542/8270D**

The recovery of pentachlorophenol does not meet method control limits for the laboratory control sample.
A bias to low recoveries on non-acidied resin media is common for acidic compounds and is most commonly observed for the more acidic components such as PCP. Note that field 'run' samples do not often show this bias since these samples are usually acidied by the source stack gases.

Method Summary:
The 0010 train samples were extracted by SW846 Method 3542. For each train, the front half solids and the XAD2 sorbent were extracted together in a single soxhlet. The extraction standards for 8270D and PAH analyses were spiked into the solids/sorbent media just prior to extraction. The condensates were extracted by B/N/A liquid/liquid extraction technique using separatory funnels and dichloromethane as the extracting solvent. The extract from the soxhlet and the condensates for each train were combined for each train and reduced to a 5mL final volume. A 1/2 portion was removed and concentrated to 1mL for analysis of PAHs via isotope dilution and selected ion monitoring GC/LRMS analysis. A portion of the remaining extract was removed for analysis of semi-volatile organics via SW846 method 8270D.

Certified by: _____
Steve Kennedy
Laboratory Manager

ALS Environmental
5420 Mainway Drive, Unit 5, Burlington ON, L7L 6A4
Phone: 905-331-3111, FAX: 905-331-4567

SCC (ISO 17025:2005) Accreditation Lab ID: 1003-15/779 Ont DW License #: 2285
NELAC Primary Accreditation, NJ DEP ID# CANA003: Secondary Accreditation, TX Cert# T104704433-08-TX

Certificate of Analysis

ALS Project Contact:	Ron McLeod	**Client Name:**	Ari Environmental, Inc.
ALS Project ID:	ARI100	**Client Address:**	1710 Preston Rd Unit C
ALS WO#:	L1041493		Pasadena, Tx
Date of Report	29-Aug-11		77503
Date of Sample Receipt	8-Aug-11	**Client Contact:**	D. Fitzgerald
		Client Project ID:	736 Coker Unit

COMMENTS: **PAH by CARB method 429 (LR option)-isotope dilution**

The recovery of acenaphthylene does not meet method control limits for the laboratory control sample. The sample is spiked with high levels of acenaphthene for the 8270 analysis, and the standard likely contains trace levels of native acenaphthylene.

The results for the run samples have been reported from the anlaysis of diluted sample extracts due to levels and interferences, with dilutions of at least 1000. As a result, field sampling and extraction standard recoveries could not be quantified. Additional extraction (internal) standard was added for quantification after dilution. As a result, concentrations have not been recovery-corrected.

Certified by: _____
Steve Kennedy
Laboratory Manager

ALS Environmental

Sample Analysis Summary Report

Sample Name	Method Blank		RUN# 0010-BLANK H44836/H44837/H44838/H44842/H44843		RUN# 0010-1 H44804/H44805/H44806/H44807/H44793		RUN# 0010-2 H44823/H44824/H44825/H44826/H44795		RUN# 0010-3 H44830/H44831/H44832/H44833/H44839		LCS	Control Limits
ALS Sample ID	WG1327430-1		L1041493-4		L1041493-1		L1041493-2		L1041493-3		WG1327430-2	
Sample Size	1		1		1		1		1		1	
Sample units	sample		sample		sample		sample		sample		n/a	
Moisture Content	n/a		n/a		n/a		n/a		n/a		n/a	
Matrix	QC		Stack		Stack		Stack		Stack		QC	
Sampling Date	n/a		21-Jul-11		19-Jul-11		20-Jul-11		21-Jul-11		n/a	
Extraction Date	10-Aug-11		10-Aug-11		10-Aug-11		10-Aug-11		10-Aug-11		n/a	
Target Analytes	**ng/sample**		**ng/sample**		**ng/sample**		**ng/sample**		**ng/sample**		**% Recovery**	
Naphthalene	241		323		4290000		475000		12200000		129	50-150
2-Methylnaphthalene	<4	U	131		8050000		765000		34100000		NS	
Acenaphthylene	<4	U	<4	U	<15400	R	<4000	U	<52400	R	263	50-150
Acenaphthene	<4	U	5.54		193000		<16500	R	717000		114	50-150
Fluorene	<4	U	13.7		667000		55800		2240000		114	50-150
Phenanthrene	<4	U	25.4		2770000		313000		6720000		109	50-150
Anthracene	<4	U	7.22		831000		106000		2300000		110	50-150
Fluoranthene	<4	U	<4	U	215000		41200		337000		116	50-150
Pyrene	<6.82	R	<12.4	R	1030000		222000		1450000		103	50-150
Benzo(a)anthracene	<4	U	<4	U	69000		<55700	R	224000		99	50-150
Chrysene/Triphenylene	<4	U	<4	U	88800		68200		257000		98	50-150
Benzo(b)flouranthene	<4	U	<4	U	<4000	U	10100		13300		102	50-150
Benzo(k)fluoranthene	<4	U	5.9		<4000	U	<4000	U	<7620	R	108	50-150
Benzo(e)pyrene	<4	U	<18.6	R	6920		21100		22800		NS	
Benzo(a)pyrene	<4	U	<4	U	7040		24600		36200		86	50-150
Perylene	<13	R	6.62		<4000	U	<4000	U	<4000	U	NS	
Indeno(1,2,3-cd)pyrene	<4	U	<4	U	<4000	U	4540		6460		102	50-150
Dibenzo(a,h/a,c)anthracene	<4	U	<4	U	<4000	U	6080		8660		100	50-150
Benzo(g,h,i)perylene	<4	U	<4	U	<4000	U	16800		19300		105	50-150
Additional Analytes												
2-Chloronaphthalene	<4	U	<4	U	<4000	U	<4000	U	<4000	U	NS	
Biphenyl	199		<199	R	271000		23900		976000		NS	
7,12-Dimethylbenzo(a)anthracene	<4	U	<4	U	<4000	U	<4000	U	<4000	U	NS	
3-Methylcholanthrene	<4	U	<4	U	<4000	U	<4000	U	<4000	U	NS	
Dibenzo(a,e)pyrene	<4	U	<4	U	<4000	U	<4000	U	<4000	U	NS	
Field Sampling Standards	**% Rec**		**% Rec**		**% Rec**		**% Rec**		**% Rec**		**% Rec**	
d10-Fluorene	NS		100		NQ		NQ		NQ		NQ	
d14-Terphenyl	NS		112		NQ		NQ		NQ		NQ	
Extraction Standards	**% Rec**		**% Rec**		**% Rec**		**% Rec**		**% Rec**		**% Rec**	
d8-Naphthalene	81		80		NQ		NQ		NQ		76	50-150
d10-2-Methylnaphthalene	84		84		NQ		NQ		NQ		76	50-150
d8-Acenaphthylene	91		101		NQ		NQ		NQ		83	50-150
d10-Phenanthrene	85		75		NQ		NQ		NQ		65	50-150
d10-Anthracene	79		80		NQ		NQ		NQ		62	50-150
d10-Fluoranthene	85		87		NQ		NQ		NQ		74	50-150
d12-Benzo(a)anthracene	124		139		NQ		NQ		NQ		125	50-150
d12-Chrysene	83		91		NQ		NQ		NQ		85	50-150
d12-Benzo(b)fluoranthene	98		102		NQ		NQ		NQ		93	50-150
d12-Benzo(k)fluoranthene	81		86		NQ		NQ		NQ		85	50-150
d12-Benzo(a)pyrene	128		138		NQ		NQ		NQ		128	50-150
d12-Perylene	83		109		NQ		NQ		NQ		94	50-150
d12-Indeno(1,2,3,c-d)pyrene	100		121		NQ		NQ		NQ		118	50-150
d14-Dibenz(a,h)anthracene	90		100		NQ		NQ		NQ		104	50-150
d12-Benzo(ghi)perylene	83		90		NQ		NQ		NQ		89	50-150

U Indicates that this compound was not detected above the LOD.
NS Indicates that this compound was not spiked
NQ Indicates that this compound was not quantifiable due to high dilution

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Sample Analysis Summary Report

Sample Name	Method Blank		RUN# 0010-BLANK H44836/H44837/H44838/H44842/H44843		RUN# 0010-1 H44804/H44805/H44806/H44807/H44793		RUN# 0010-2 H44823/H44824/H44825/H44826/H44795		RUN# 0010-3 H44830/H44831/H44832/H44833/H44839		Control Limits
ALS Sample ID	WG1327430-1		L1041493-4		L1041493-1		L1041493-2		L1041493-3		
Sample Size	1		1		1		1		1		
Sample units	sample		sample		sample		sample		sample		
Moisture Content	n/a		n/a		n/a		n/a		n/a		
Matrix	QC		Stack		Stack		Stack		Stack		
Sampling Date	n/a		21-Jul-11		19-Jul-11		20-Jul-11		21-Jul-11		
Extraction Date	10-Aug-11		10-Aug-11		10-Aug-11		10-Aug-11		10-Aug-11		
Target Analytes	**ug/sample**		**ug/sample**		**ug/sample**		**ug/sample**		**ug/sample**		
Aniline	<1.85	U	<1.85	U	34.7		<8.4	R	37.4		
Phenol	<1.95	U	<1.95	U	<20.6	R	<17.5	R	<22.2	R	
2-Methylphenol	<2.1	U	<2.1	U	65.8	M	18.4	M	73.9	M	
4-Methylphenol&3-Methylphenol	<5.65	U	<5.65	U	83.6	M	19.4	M	<73.1	R	
o-Toluidine	<5.0	U	<5.0	U	<50	U	<5.0	U	<30.4	R	
Isophorone	<2.25	U	<2.25	U	<22.5	U	<2.25	U	<22.5	U	
2,4-Dimethylphenol	<2.6	U	<2.6	U	163		27.1		200		
Dibenzofuran	<2.3	U	<2.3	U	143	M	13.8	M	251	M	
a,a-Dimethylphenethylamine	<12	U	<12	U	<120	U	<12	U	<120	U	
1,4-Phenylenediamine	<18	U	<18	U	<180	U	<18	U	<180	U	
Benzidine	<38	U	<38	U	<380	U	<38	U	<380	U	
Dimethylaminobenzene	<2.0	U	<2.0	U	<20	U	<2.0	U	<20	U	
3,3'-Dimethylbenzidine	<29	U	<29	U	<290	U	<29	U	<290	U	
3,3'-Dimethoxybenzidine	<29	U	<29	U	<290	U	47.6		<290	U	
Extraction Standards	**% Rec**		**% Rec**		**% Rec**		**% Rec**		**% Rec**		
2-Fluorophenol	66		68		69	M	72	M	55	M	25-121
d5-Phenol	69		69		55	M	65		52	M	24-113
d5-Nitrobenzene	87		84		93		69		69		23-120
2-Fluorobiphenyl	93		89		90		97		50		30-115
2,4,6-Tribromophenol	45		48		77		84		64		19-122

U Indicates that this compound was not detected above the LOD.
M Indicates that a peak has been manually integrated.
R Indicates that the ion abundance ratio does not meet method control limits.Value represents estimated maximum.

ALS Environmental

ICR Petroleum Sector LCS Data for 0010/3542/8270D on 8270D LCS Performance Compounds

Sample Name	Laboratory Control Sample (LCS) #1	Target Solids Recovery Acceptance Limits
ALS Sample ID	WG1327430-2	
Sample Size	1	
ALS WO#	**L1041493**	
Extraction Date	10-Aug-11	
Target Analytes	**% Recovery**	**% Recovery**
Phenol	91	26-90
2-Chlorophenol	72	25-102
1,4-Dichlorobenzene	76	n/a
N-Nitrosodi-n-propylamine	84	41-126
1,2,4-Trichlorobenzene	77	n/a
4-Chloro-3-methylphenol	75	26-103
2,4-Dinitrotoluene	84	28-89
4-Nitrophenol	71	11-114
Acenaphthene	69	31-137
Pentachlorophenol	3*	17-109
Pyrene	71	35-142
Extraction Standards	**% Rec**	**% Rec**
2-Fluorophenol	59	25-121
d5-Phenol	61	24-113
d5-Nitrobenzene	87	23-120
2-Fluorobiphenyl	91	30-115
2,4,6-Tribromophenol	57	19-122

* A bias to low recoveries on non-acidied resin media is common for acidic compounds and is most commonly observed for the more acidic components such as PCP. Note that field 'run' samples do not often show this bias since these samples are usually acidied by the source stack gases.

ALS Environmental
5420 Mainway Drive, Unit 5, Burlington ON, L7L 6A4
Phone: 905-331-3111, FAX: 905-331-4567

SCC Accredited Lab ID# 1003-15/779 Ont DW License #: 2285
NELAC Primary Accreditation, NJ DEP ID# CANA003: Secondary Accreditation, TX Cert# T104704433-08-TX

Certificate of Analysis

ALS Project Contact: Ron McLeod
ALS Project ID: ARI100
ALS WO#: L1020406
Date of Report 26-Aug-11
Date of Sample Receipt 8-Aug-11

Client Name: ARI Environmental, INC.
Client Address: 1710 Preston Road, Unit C
Pasadena TX 77503

Client Contact: Dan Fitzgerald
Client Project ID: 736 Coker Unit, Houston Refinery

COMMENTS: **VOCs via modified method 18 - Chilled Methanol Impingers - GC/MS Selected Ion Monitoring**

Unless indicated otherwise, limits of reporting have been defined by the level equivalent to the low instrument calibration point and sensitivity standard.

Nitrobenzene quantification suffered from instrument related run-to-run carry-over. Reporting limits for nitrobenzene has been raised to account for uncertainty from this run-to-run carry-over. Alternative nitrobenzene data is available from the 0010 train.

Data are not blank corrected. Data are not corrected for field spike recoveries.

The Run 2A vs 2B samples were evidently reversed with respect to native spiking and the train identified in the Chain-of-Custody. The re-assignment of the trains is based upon the presence or absence of the native spiked analytes as observed in the analysis of the samples.

Field blank recovery responses were used to calibrate the deuterated and native spike recoveries.

Where there are nil recoveries for butadiene-d6 and pentane-d12 on the composite data, the corresponding native target is reported as not available (n/a).

Summary of the Method:
The sampling train consisted of 4 midget impingers. The 1st impinger was a moisture knock-out. The 2nd, 3rd and 4th impinger contained approximately 15mL each of methanol. Impingers 1 and 2 were recovered combined. Impingers 3 and 4 were each recovered separately. The methanolic impinger solutions were diluted 100-fold into water and analyzed by purge and trap GC/MS (i.e via SW846 5030B/8260B) using selected ion monitoring technique.

Certified by:

Ron McLeod, Ph.D.
General Manager and Technical Director

ALS Environmental

COMPOSITE SPIKE RECOVERY DATA

Sample Name	H44798/H44799/H4480 0 RUN# 18-1-A			H44817/H44818/H4481 9 RUN# 18-2-A			H41167/H41166/H4116 5 RUN# 18-3-A			H41141/H4112/1H4114 3 BLANK RUN A			H44801/H44802/H4480 3 RUN# 18-1-B			H44820/H44821/H4482 2 RUN# 18-2-B			H41168/H41169/H4117 0 RUN# 18-3-B			H41140/H41144/H4114 5 BLANK RUN B		
ALS Sample ID	L1041539-1/2/3			L1041539-7/8/9			L1041539-13/14/15			L1041539-19/20/21			L1041539-4/5/6			L1041539-10/11/12			L1041539-16/17/18			L1041539-22/23/24		
Matrix	Impinger			Impinger			Impinger			Impinger			Impinger			Impinger			Impinger			Impinger		
Sampling Date	19-Jul-11			20-Jul-11			20-Jul-11			20-Jul-11			19-Jul-11			20-Jul-11			20-Jul-11			20-Jul-11		
Date of Receipt	8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11		
VOC via Modified Method 18																								
	% Rec	Qualifier	Data Source	% Rec	Qualifier	Data Source	% Rec	Qualifier	Data Source	% Rec	Qualifier	Data Source	% Rec	Qualifier	Data Source	% Rec	Qualifier	Data Source	% Rec	Qualifier	Data Source	% Rec	Qualifier	Data Source
Labelled Analyte Recoveries																								
1,3-Butadiene-d6	93		UI1-4	191		UI1-4	0		UI1-4	227		UI1-4	135		UI1-4	165		UI1-4	0		UI1-4	100		UI1-4
Pentane-d12	65		UI1-4	97		UI1-4	30		UI1-4	99		UI1-4	63		UI1-4	83		UI1-4	6		UI1-4	100		UI1-4
acrylonitrile-d3	89		UI1-4	106		UI1-4	51		UI1-4	136		UI1-4	49		UI1-4	91		UI1-4	105		UI1-4	100		UI1-4
MTBE-d12	85		UI1-4	107		UI1-4	61		UI1-4	117		UI1-4	55		UI1-4	88		UI1-4	125		UI1-4	100		UI1-4
n-Hexane-d14	66		UI1-4	98		UI1-4	53		UI1-4	97		UI1-4	69		UI1-4	88		UI1-4	32		UI1-4	100		UI1-4
2,2,4-Trimethylpentane-d18	69		UI1-4	101		UI1-4	54		UI1-4	94		UI1-4	73		UI1-4	90		UI1-4	59		UI1-4	100		UI1-4
Benzene-d6	82		UI1-4	108		UI1-4	63		UI1-4	109		UI1-4	59		UI1-4	90		UI1-4	116		UI1-4	100		UI1-4
2-Nitropropane-d6	84		UI1-4	103		UI1-4	64		UI1-4	131		UI1-4	50		UI1-4	86		UI1-4	120		UI1-4	100		UI1-4
1.2-Dibromoethane-d4	123		UI1-4	105		UI1-4	116		UI1-4	131		UI1-4	56		UI1-4	99		UI1-4	182		UI1-4	100		UI1-4
Ethylbenzene-d10	92		UI1-4	110		UI1-4	61		UI1-4	117		UI1-4	67		UI1-4	101		UI1-4	126		UI1-4	100		UI1-4
Styrene-d8	80		UI1-4	108		UI1-4	47		UI1-4	123		UI1-4	52		UI1-4	99		UI1-4	108		UI1-4	100		UI1-4
Nitrobenzene-d5	77		UI1-4	84		UI1-4	161		UI1-4	151		UI1-4	51		UI1-4	78		UI1-4	227		UI1-4	105		UI1-4
Native Analyte Recoveries - Corrected**																								
Acrolein	-			106		SI1-4	-			-			15		SI1-4	-			10			100		SI1-4
Acetonitrile	-			107		SI1-4	-			-			50		SI1-4	-			133			100		SI1-4
Trichloroethene	-			98		SI1-4	-			-			145		SI1-4	-			183			100		SI1-4
Methyl iso-Butyl Ketone	-			101		SI1-4	-			-			96		SI1-4	-			176			100		SI1-4
Toluene	-			105		SI1-4	-			-			118		SI1-4	-			44*			100		SI1-4

INT = Interference
* Estimated level. Native spiking level too low for accurate recovery determination
** Corrected for levels in the unspiked trains

UI# = Impinger Number from the Unspiked Train
SI# = Impinger Number from the Spiked Train

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ALS Environmental

COMPOSITE TARGET ANALYTE DATA

Sample Name	H44798/H44799/H44800 RUN# 18-1-A			H44820/H44821/H44822 RUN# 18-2-B			H41167/H41166/H41165 RUN# 18-3-A			H44801/H44802/H44803 RUN# 18-1-B			H44817/H44818/H44819 RUN# 18-2-A			H41168/H41169/H41170 RUN# 18-3-B			H41141/H41112/1H41143 BLANK RUN A			H44956 BLANK PURGE + TRAP METHANOL		
ALS Sample ID	L1041539-1/2/3			L1041539-10/11/12			L1041539-13/14/15			L1041539-4/5/6			L1041539-7/8/9			L1041539-16/17/18			L1041539-19/20/21			L1041539-25		
Matrix	Impinger			Impinger			Impinger			Impinger			Impinger			Impinger			Impinger			Impinger		
Sampling Date	19-Jul-11			20-Jul-11			20-Jul-11			20-Jul-11			19-Jul-11			20-Jul-11			20-Jul-11			20-Jul-11		
Date of Receipt	8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11			8-Aug-11		
VOC via Modified Method 18	ug	Qualifier	Data Source	ug	Qualifier	Data Source	ug	Qualifier	Data Source	ug	Qualifier	Data Source	ug	Qualifier	Data Source	ug	Qualifier	Data Source	ug	Qualifier	Data Source	ug	Qualifier	Data Source
Target VOCs																								
1,3-Butadiene	<18	BDL	UI1-4	<17	BDL	UI1-4	n/a			-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Pentane	64.8	DDL	UI1-4	<17	BDL	UI1-4	982	ADL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Acrolein	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	1032	ADL	UI1-4	7874	ADL	UI1-4	603	ADL	UI1-4	<9	BDL	UI1-4	<17.2	BDL	UI1-2
Acetone	1356	ADL, B	UI1-4	5156	ADL, B	UI1-4	603	ADL, B	UI1-4	-			-			-			470	ADL, B	UI1-4	140	ADL, B	UI1-2
Acetonitrile	<70	BDL, INT	UI1-4	<17	BDL	UI1-4	<190	BDL, INT	UI1-4	3129	ADL	UI1-4	6487	ADL	UI1-4	7249	ADL	UI1-4	<13	BDL, INT	UI1-4	<22	BDL, INT	UI1-2
Carbon Disulfide	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Methylene Chloride	223	ADL, B	UI1-4	185	ADL, B	UI1-4	130	ADL, B	UI1-4	-			-			-			651	ADL, B	UI1-4	70	ADL, B	UI1-2
Acrylonitrile	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Methyl t-Butyl Ether (MTBE)	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Hexane	19.0	DDL	UI1-4	<17	BDL	UI1-4	137	ADL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
2,2,4-Trimethylpentane	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Benzene	373	DDL	UI1-4	<17	BDL	UI1-4	3285	ADL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Trichloroethene	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	4820	ADL	UI1-4	3994	ADL	UI1-4	5221	ADL	UI1-4	<9	BDL	UI1-4	<17.2	BDL	UI1-2
2-Nitropropane	<300	BDL, INT	UI1-4	<30	BDL, INT	UI1-4	<500	BDL, INT	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Methyl Iso-Butyl Ketone	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	3848	ADL	UI1-4	4227	ADL	UI1-4	6186	ADL	UI1-4	<9	BDL	UI1-4	<17.2	BDL	UI1-2
Toluene	914	DDL	UI1-4	46	DDL	UI1-4	8183	ADL	UI1-4	2490	ADL	UI1-4	1502	ADL	UI1-4	8705	ADL	UI1-4	<9	BDL	UI1-4	<17.2	BDL	UI1-2
Tetrachloroethene	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
1,2-Dibromoethane	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Chlorobenzene	<18	BDL	UI1-4	<17	BDL	UI1-4	<22	BDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Ethylbenzene	62.3	DDL	UI1-4	<17	BDL	UI1-4	882	ADL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
m&p-Xylenes	695	DDL	UI1-4	64	DDL	UI1-4	8424	ADL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
o-Xylene	123	DDL	UI1-4	10	DDL	UI1-4	1425	ADL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Styrene	<18	BDL	UI1-4	<17	BDL	UI1-4	48	DDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Cumene (Isopropylbenzene)	<18	BDL	UI1-4	<17	BDL	UI1-4	42	DDL	UI1-4	-			-			-			<9	BDL	UI1-4	<17.2	BDL	UI1-2
Nitrobenzene	<89	BDL	UI1-4	<86	BDL	UI1-4	<400	BDL	UI1-4	-			-			-			<46	BDL	UI1-4	<86	BDL	UI1-2

ADL = Below Detection Limit
BDL = Below Detection Limit
DLL = Composite data where at least one data point (but not all data points) is above the detection limit
INT = Interference; Detection Limit Raised
UI# = Impinger Number from the Unspiked Train
SI# = Impinger Number from the Spiked Train
B = Observed in the Field Blank at similar levels to the field run samples

ALS Environmental

Instrument Run Date: 12-Aug-11 — **ANALYTICAL DATA FROM INDIVIDUAL GC/MS INSTRUMENT RUNS**

Client Container ID:	Laboratory Method Blank	H44798 RUN# 18-1-A IMPINGER #1 + #2 (COMPOSITE)	H44799 RUN# 18-1-A IMPINGER #3	H44801 RUN# 18-1-B IMPINGER #1 + #2 (COMPOSITE)	H44802 RUN# 18-1-B IMPINGER #3	H44803 RUN# 18-1-B IMPINGER #4	H44817 RUN# 18-2-A IMPINGER #1 + #2 (COMPOSITE)	H44818 RUN# 18-2-A IMPINGER #3
ALS Sample ID	mblk	L1041539-1;ext1	L1041539-2;ext1	L1041539-4;ext1	L1041539-5;ext1	L1041539-6;ext1	L1041539-7;ext1	L1041539-8;ext1
Instrument File #	5301053.D	5401054.D	5501055.D	5701057.D	5801058.D	5901059.D	6001060.D	6101061.D
Sample Volume (mL)	24	129	24	129	24	24	43	24
Dilution Factor	1	1	1	1	1	1	1	1
VOC via Modified Method 18								
	ug	ug	ug	ug	ug	ug	ug	ug
1,3-Butadiene	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Pentane	<2.4	65	<2.4	16.3	<2.4	<2.4	<4.3	<2.4
Acrolein	<2.4	<12.9	<2.4	1032	<2.4	<2.4	7850	24
Acetone	3.7	897	277	731	251	148	318	626
Acetonitrile	<2.4	<64*	<2.4	3129	<3.8*	<2.4	6461	21
Carbon Disulfide	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Methylene Chloride	<2.4	129	55	167	25	45	72	45
Acrylonitrile	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Methyl t-Butyl Ether (MTBE)	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Hexane	<2.4	19.0	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
2,2,4-Trimethylpentane	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Benzene	<2.4	373	<2.4	87	<2.4	<2.4	<4.3	<2.4
Trichloroethene	<2.4	<12.9	<2.4	4820	<2.4	<2.4	3980	14
2-Nitropropane	<2.4	<300*	<2.4	<30*	<2.4	<2.4	<4.3	<2.4
Methyl iso-Butyl Ketone	<2.4	<12.9	<2.4	3844	3.9	<2.4	4227	<12*
Toluene	<2.4	911	3	2490	<2.4	<2.4	1481	10
Tetrachloroethene	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
1,2-Dibromoethane	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Chlorobenzene	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Ethylbenzene	<2.4	62	<2.4	29	<2.4	<2.4	<4.3	<2.4
m&p-Xylenes	<2.4	690	5	282	<2.4	<2.4	<4.3	5
o-Xylene	<2.4	123	<2.4	52	<2.4	<2.4	<4.3	<2.4
Styrene	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Cumene (Isopropylbenzene)	<2.4	<12.9	<2.4	<12.9	<2.4	<2.4	<4.3	<2.4
Nitrobenzene	<12	<64.5	<12	<64.5	<12	<12	<21.5	<12
Labelled Analyte Recoveries	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec
1,3-Butadiene-d6	0	78	15	135	0	0	183	8
Pentane-d12	0	57	7	63	0	0	94	3
acrylonitrile-d3	0	84	5	49	0	0	106	0
MTBE-d12	0	80	5	54	0	0	106	0
n-Hexane-d14	0	60	6	69	0	0	97	1
2,2,4-Trimethylpentane-d18	0	63	5	73	0	0	100	1
Benzene-d6	0	76	5	59	0	0	108	0
2-Nitropropane-d6	0	80	4	50	0	0	103	0
1.2-Dibromoethane-d4	0	118	5	56	0	0	104	0
Ethylbenzene-d10	0	87	5	67	0	0	110	0
Styrene-d8	0	75	4	52	0	0	107	0
Nitrobenzene-d5	0	71	4	50	1	0	79	3
Native Analyte Recoveries-Uncorrec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec
Acrolein	-	-	-	15	-	-	116	-
Acetonitrile	-	1	-	50	-	-	104	-
Trichloroethene	-	-	-	145	-	-	119	-
Methyl iso-Butyl Ketone	-	-	-	96	-	-	106	-
Toluene	-	68	-	186	-	-	111	-
P&T Surrogate Recoveries	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec	% Rec
1,2,-Dichloroethane-d4	104	90	98	78	107	100	73	100
Toluene-d8	103	88	96	109	99	102	68	100
4-Fluorobenzene	118	108	120	138	123	126	117	120

*Detection limit raised due to chemical interference
** Uncorrected for the levels in the unspiked trains
*** Likely carry-over from prior sample.

ALS Environmental

Instrument Run Date: 12-Aug-11

ANALYTICAL DATA FROM INDIVIDUAL GC/MS INSTRUMENT RUNS

Client Container ID:	H44819 RUN# 18-2-A IMPINGER #4	H44820 RUN# 18-2-B IMPINGER #1 + #2 (COMPOSITE)	H44821 RUN# 18-2-B IMPINGER #3	H44822 RUN# 18-2-B IMPINGER #4	H41167 RUN# 18-3-A IMPINGER #1 + #2 (COMPOSITE)	H41166 RUN# 18-3-A IMPINGER #3	H41165 RUN# 18-3-A IMPINGER #4	H41168 RUN# 18-3-B IMPINGER #1 + #2 (COMPOSITE)
ALS Sample ID	L1041539-9;ext1	L1041539-10;ext1	L1041539-11;ext1	L1041539-12;ext1	L1041539-13;ext1	L1041539-14;ext1	L1041539-15;ext1	L1041539-16;ext1
Instrument File #	6201062.D	6301063.D	6401064.D	6501065.D	6801068.D	6901069.D	7001070.D	7101071.D
Sample Volume (mL)	43	86	43	43	172	24	24	172
Dilution Factor	1	1	1	1	1	1	1	1
VOC via Modified Method 18								
	ug	**ug**	**ug**	**ug**	**ug**	**ug**	**ug**	**ug**
1,3-Butadiene	<4.3	<8.6	<4.3	<4.3	<17.2	<8*	<2.4	<17.2
Pentane	15.7	<8.6	<4.3	<4.3	165	750	67	<17.2
Acrolein	<4.3	<8.6	<4.3	<4.3	<17.2	<2.5*	<2.4	127
Acetone	743	3252	689	1215	426	122	55	816
Acetonitrile	5	<8.6	<4.7*	<4.3	<190*	<2.4	<2.4	1907
Carbon Disulfide	<4.3	<8.6	<4.3	<4.3	<17.2	<2.4	<2.4	20
Methylene Chloride	67	91	49	46	91	24	15	57
Acrylonitrile	<4.3	<8.6	<4.3	<4.3	<17.2	<2.4	<2.4	<17.2
Methyl t-Butyl Ether (MTBE)	<4.3	<8.6	<4.3	<4.3	<17.2	<2.4	<2.4	<17.2
Hexane	<4.3	<8.6	<4.3	<4.3	34	95	8	<17.2
2,2,4-Trimethylpentane	<4.3	<8.6	<4.3	<4.3	<17.2	<14*	<2.4	<17.2
Benzene	6.5	<8.6	<4.3	<4.3	2277	939	69	963
Trichloroethene	<4.3	<8.6	<4.3	<4.3	<17.2	4	<2.4	571
2-Nitropropane	<4.3	<20*	<4.3	<4.3	<500*	<40*	<50*	<30*
Methyl Iso-Butyl Ketone	<4.3	<8.6	<4.3	<4.3	<17.2	<2.4	<2.4	1652
Toluene	11	28	13	5	6631	1264	287	3677
Tetrachloroethene	<4.3	<8.6	<4.3	<4.3	<17.2	<2.4	<2.4	<17.2
1,2-Dibromoethane	<4.3	<8.6	<4.3	<4.3	<17.2	<2.4	<2.4	<17.2
Chlorobenzene	<4.3	<8.6	<4.3	<4.3	<17.2	<2.4	<2.4	<17.2
Ethylbenzene	<4.3	<8.6	<4.3	<4.3	696	157	29	332
m&p-Xylenes	7	53	6	4	6930	1231	264	3534
o-Xylene	<4.3	10	<4.3	<4.3	1230	160	34	699
Styrene	<4.3	<8.6	<4.3	<4.3	43	5	<2.4	24
Cumene (Isopropylbenzene)	<4.3	<8.6	<4.3	<4.3	36	6	<2.4	19
Nitrobenzene	<21.5	<43	<21.5	<21.5	<400*	<20*	<12	<150*
Labelled Analyte Recoveries	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
1,3-Butadiene-d6	0	160	5	0	0	0	0	0
Pentane-d12	0	81	2	0	3	21	5	0
acrylonitrile-d3	0	90	0	0	49	1	0	23
MTBE-d12	0	88	0	0	53	6	2	27
n-Hexane-d14	0	87	1	0	11	34	8	1
2,2,4-Trimethylpentane-d18	0	90	0	0	20	28	6	3
Benzene-d6	0	89	0	0	37	23	3	12
2-Nitropropane-d6	0	86	0	0	63	0	0	29
1.2-Dibromoethane-d4	0	99	0	0	91	21	4	36
Ethylbenzene-d10	0	101	0	0	49	10	2	22
Styrene-d8	0	99	0	0	42	4	1	25
Nitrobenzene-d5	1	74	3	1	159	1	0	57
Native Analyte Recoveries-Uncorrec	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
Acrolein	-	-	-	-	5	-	-	2
Acetonitrile	-	-	-	-	3	-	-	31
Trichloroethene	-	-	-	-	-	-	-	17
Methyl Iso-Butyl Ketone	-	-	-	-	-	-	-	41
Toluene	-	2	-	-	496	95	22	275
P&T Surrogate Recoveries	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
1,2,-Dichloroethane-d4	102	82	105	105	97	84	92	93
Toluene-d8	100	79	99	99	96	108	99	101
4-Fluorobenzene	127	111	120	120	102	116	115	106

*Detection limit raised due to chemical interference
** Uncorrected for the levels in the unspiked trains
*** Likely carry-over from prior sample.

ALS Environmental

Instrument Run Date: 12-Aug-11

ANALYTICAL DATA FROM INDIVIDUAL GC/MS INSTRUMENT RUNS

Client Container ID:	**H41169 RUN# 18-3-B IMPINGER #3**	**H41142 BLANK RUN A IMPINGER #3**	**H41143 BLANK RUN A IMPINGER #4**	**H41140 BLANK RUN B IMPINGER #1,2**	**H41144 BLANK RUN B IMPINGER #3**	**H41145 BLANK RUN B IMPINGER #4**	**H44956 BLANK PURGE + TRAP METHANOL**
ALS Sample ID	L1041539-17;ext1	L1041539-20;ext1	L1041539-21;ext1	L1041539-22;ext1	L1041539-23;ext1	L1041539-24;ext1	L1041539-25;ext1
Instrument File #	7201072.D	7501075.D	7601076.D	7701077.D	7801078.D	7901079.D	8001080.D
Sample Volume (mL)	86	24	24	43	24	24	172
Dilution Factor	1	1	1	1	1	1	1
VOC via Modified Method 18							
	ug	**ug**	**ug**	**ug**	**ug**	**ug**	**ug**
1,3-Butadiene	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Pentane	113	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Acrolein	476	<2.4	<2.4	6770	5.5***	<2.4	<17.2
Acetone	4388	141	126	226	123	153	140
Acetonitrile	4039	<3.4*	<2.4	6210	11.1***	<2.9*	<22*
Carbon Disulfide	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Methylene Chloride	62	217	197	293	184	215	70
Acrylonitrile	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Methyl t-Butyl Ether (MTBE)	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Hexane	38	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
2,2,4-Trimethylpentane	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Benzene	1429	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Trichloroethene	3548	<2.4	<2.4	3331	<2.4	<2.4	<17.2
2-Nitropropane	<400*	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Methyl iso-Butyl Ketone	3468	<2.4	<2.4	3990	8.0***	<2.4	<17.2
Toluene	3558	<2.4	<2.4	1336	<2.4	<2.4	<17.2
Tetrachloroethene	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
1,2-Dibromoethane	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Chlorobenzene	<8.6	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Ethylbenzene	480	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
m&p-Xylenes	3832	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
o-Xylene	792	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Styrene	27	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Cumene (Isopropylbenzene)	29	<2.4	<2.4	<4.3	<2.4	<2.4	<17.2
Nitrobenzene	<60*	<12	<12	<21.5	<12	<12	<86
Labelled Analyte Recoveries	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
1,3-Butadiene-d6	0	0	0	100	0	0	0
Pentane-d12	4	0	0	100	0	0	0
acrylonitrile-d3	54	0	0	100	0	0	0
MTBE-d12	66	0	0	100	0	0	0
n-Hexane-d14	18	0	0	100	0	0	0
2,2,4-Trimethylpentane-d18	34	0	0	100	0	0	0
Benzene-d6	69	0	0	100	0	0	0
2-Nitropropane-d6	61	0	0	100	0	0	0
1.2-Dibromoethane-d4	96	0	0	100	0	0	0
Ethylbenzene-d10	70	0	0	100	0	0	0
Styrene-d8	55	0	0	100	0	0	0
Nitrobenzene-d5	135	1	0	100	4	1	3
Native Analyte Recoveries-Uncorrec	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
Acrolein	7	-	-	100	-	-	-
Acetonitrile	65	-	-	100	-	-	-
Trichloroethene	107	-	-	100	-	-	-
Methyl iso-Butyl Ketone	87	-	-	100	-	-	-
Toluene	266	-	-	100	-	-	-
P&T Surrogate Recoveries	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
1,2,-Dichloroethane-d4	89	93	92	75	93	97	95
Toluene-d8	92	100	100	72	101	100	101
4-Fluorobenzene	109	121	123	115	122	127	126

*Detection limit raised due to chemical interference
** Uncorrected for the levels in the unspiked trains
*** Likely carry-over from prior sample.

ALS Environmental

Instrument Run Date: 16-Aug-11 — **ANALYTICAL DATA FROM INDIVIDUAL GC/MS INSTRUMENT RUNS**

Client Container ID:	**Laboratory Method Blank**	**H44800 RUN# 18-1-A IMPINGER #4**	**H41170 RUN# 18-3-B IMPINGER #4**	**H41141 BLANK RUN A IMPINGER #1,2**
ALS Sample ID	mBlk	L1041539-3;RepExt1	L1041539-18;RepExt1	L1041539-19;RepExt1
Instrument File #	0301003.D	0401004.D	0501005.D	0601006.D
Sample Volume (mL)	24	24	43	43
Dilution Factor	1	1	1	1
VOC via Modified Method 18				
	ug	**ug**	**ug**	**ug**
1,3-Butadiene	<2.4	<2.4	<4.3	<4.3
Pentane	<2.4	<2.4	39	<4.3
Acrolein	<2.4	<2.4	<50*	<4.3
Acetone	<2.4	181	2236	203
Acetonitrile	<2.4	<2.4	1303	<6.9*
Carbon Disulfide	<2.4	<2.4	<4.3	<4.3
Methylene Chloride	<2.4	39	33	237.2
Acrylonitrile	<2.4	<2.4	<4.3	<4.3
Methyl t-Butyl Ether (MTBE)	<2.4	<2.4	<4.3	<4.3
Hexane	<2.4	<2.4	15	<4.3
2,2,4-Trimethylpentane	<2.4	<2.4	<4.3	<4.3
Benzene	<2.4	<2.4	377	<4.3
Trichloroethene	<2.4	<2.4	1102	<4.3
2-Nitropropane	<2.4	<2.4	<200*	<4.3
Methyl iso-Butyl Ketone	<2.4	<2.4	1067	<4.3
Toluene	<2.4	<2.4	1470	<4.3
Tetrachloroethene	<2.4	<2.4	<4.3	<4.3
1,2-Dibromoethane	<2.4	<2.4	<4.3	<4.3
Chlorobenzene	<2.4	<2.4	<4.3	<4.3
Ethylbenzene	<2.4	<2.4	98	<4.3
m&p-Xylenes	<2.4	<2.4	1038	<4.3
o-Xylene	<2.4	<2.4	173	<4.3
Styrene	<2.4	<2.4	5.8	<4.3
Cumene (Isopropylbenzene)	<2.4	<2.4	6.0	<4.3
Nitrobenzene	<12	<12	<60*	<21.5
Labelled Analyte Recoveries	**% Rec**	**% Rec**	**% Rec**	**% Rec**
1,3-Butadiene-d6	0	0	0	227
Pentane-d12	0	1	2	99
acrylonitrile-d3	0	1	28	136
MTBE-d12	0	1	32	117
n-Hexane-d14	0	1	13	97
2,2,4-Trimethylpentane-d18	0	1	22	94
Benzene-d6	0	1	35	109
2-Nitropropane-d6	0	0	31	131
1.2-Dibromoethane-d4	0	1	51	131
Ethylbenzene-d10	0	1	34	117
Styrene-d8	0	1	29	123
Nitrobenzene-d5	0	1	35	150
Native Analyte Recoveries-Uncorrec	**% Rec**	**% Rec**	**% Rec**	**% Rec**
Acrolein	-	-	1	-
Acetonitrile	-	-	38	-
Trichloroethene	-	-	59	-
Methyl iso-Butyl Ketone	-	-	48	-
Toluene	-	-	197	-
P&T Surrogate Recoveries	**% Rec**	**% Rec**	**% Rec**	**% Rec**
1,2,-Dichloroethane-d4	105	103	88	80
Toluene-d8	101	98	94	74
4-Fluorobenzene	117	130	99	113

*Detection limit raised due to chemical interference
** Uncorrected for the levels in the unspiked trains
*** Likely carry-over from prior sample.

ALS Environmental

Analyte Quantitation References

VOC via Modified Method 18 Target VOCs	Corresponding Purge & Trap Internal Standard[2.]	Corresponding Field Spike[1.]
1,3-Butadiene	Fluorobenzene	1,3-Butadiene-d6
Pentane	Fluorobenzene	Pentane-d12
Acrolein	Fluorobenzene	Benzene-d6
Acetone	Fluorobenzene	Acrylonitrile-d3
Acetonitrile	Fluorobenzene	Acrylonitrile-d3
Carbon Disulfide	Fluorobenzene	Benzene-d6
Methylene Chloride	Fluorobenzene	Benzene-d6
Acrylonitrile	Fluorobenzene	Acrylonitrile-d3
Methyl t-Butyl Ether (MTBE)	Fluorobenzene	MTBE-d12
Hexane	Fluorobenzene	n-Hexane-d14
2,2,4-Trimethylpentane	Chlorobenzene-d5	2,2,4-Trimethylpentane-d18
Benzene	Chlorobenzene-d5	Benzene-d6
Trichloroethene	Chlorobenzene-d5	Benzene-d6
2-Nitropropane	Chlorobenzene-d5	2-Nitropropane-d6
Methyl iso-Butyl Ketone	Chlorobenzene-d5	Ethylbenzene-d10
Toluene	Chlorobenzene-d5	Ethylbenzene-d10
Tetrachloroethene	Chlorobenzene-d5	Ethylbenzene-d10
1,2-Dibromoethane	Chlorobenzene-d5	1.2-Dibromoethane-d4
Chlorobenzene	Chlorobenzene-d5	Ethylbenzene-d10
Ethylbenzene	1,4-Dichlorobenzene-d4	Ethylbenzene-d10
m&p-Xylenes	1,4-Dichlorobenzene-d4	Ethylbenzene-d10
o-Xylene	1,4-Dichlorobenzene-d4	Ethylbenzene-d10
Styrene	1,4-Dichlorobenzene-d4	Styrene-d8
Cumene (Isopropylbenzene)	1,4-Dichlorobenzene-d4	Ethylbenzene-d10
Nitrobenzene	1,4-Dichlorobenzene-d4	Nitrobenzene-d5
Labelled Field Standards[1.]		
1,3-Butadiene-d6	Fluorobenzene	-
Pentane-d12	Fluorobenzene	-
Acrylonitrile-d3	Fluorobenzene	-
MTBE-d12	Fluorobenzene	-
n-Hexane-d14	Fluorobenzene	-
2,2,4-Trimethylpentane-d18	Chlorobenzene-d5	-
Benzene-d6	Chlorobenzene-d5	-
2-Nitropropane-d6	Chlorobenzene-d5	-
1.2-Dibromoethane-d4	Chlorobenzene-d5	-
Ethylbenzene-d10	1,4-Dichlorobenzene-d4	-
Styrene-d8	1,4-Dichlorobenzene-d4	-
Nitrobenzene-d5	1,4-Dichlorobenzene-d4	-
Purge & Trap Surrogate Standards[2.]		
1,2,-Dichloroethane-d4	Chlorobenzene-d5	-
Toluene-d8	Chlorobenzene-d5	-
4-Fluorobenzene	1,4-Dichlorobenzene-d4	-

All target analyte and surrogate data are reported corrected for the corresponding P&T internal standard responses.
Target analyte data including the native spike recoveries are reported uncorrected for corresponding labelled field spike recoveries.

[1.] Spiked into impinger 2 just prior to sampling in the field.
[2.] Spiked into the purge water just prior to instrumental analysis.

Company: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Test Date: 7/29/2011
Run # : 16A-1

Laboratory Analysis of Hydrogen Peroxide (H_2O_2) for SO_2:

Standardization of Barium Chloride	
H_2SO_4 used:	25.00 ml
BaCl used:	25.20 ml
Normality of $BaCl_2$ titrant:	0.00992 N
Volume of Blank titrant used:	0.2 milliliters

Titration of Sample	16A-1
Volume of Sample:	70 milliliters
Volume of Sample Aliquot:	20 milliliters

1st titration
Volume of $BaCl_2$ titrant used: 0.75 milliliters

2nd titration
Volume of $BaCl_2$ titrant used: 0.8 milliliters

Company: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Test Date: 8/1/2011
Run # : 16A-2

Laboratory Analysis of Hydrogen Peroxide (H_2O_2) for SO_2:

Standardization of Barium Chloride	
H_2SO_4 used:	25.00 ml
BaCl used:	25.20 ml
Normality of $BaCl_2$ titrant:	0.00992 N
Volume of Blank titrant used:	0.2 milliliters

Titration of Sample	16A-2
Volume of Sample:	110 milliliters
Volume of Sample Aliquot:	20 milliliters
1st titration	
Volume of $BaCl_2$ titrant used:	0.2 milliliters
2nd titration	
Volume of $BaCl_2$ titrant used:	0.2 milliliters

Company: Houston Refining
Location: Houston, Texas
Source: 736 DCU
Test Date: 8/2/2011
Run # : 16A-3

Laboratory Analysis of Hydrogen Peroxide (H_2O_2) for SO_2:

Standardization of Barium Chloride	
H_2SO_4 used:	25.00 ml
BaCl used:	25.20 ml
Normality of $BaCl_2$ titrant:	0.00992 N
Volume of Blank titrant used:	0.2 milliliters

Titration of Sample	16A-3
Volume of Sample:	100 milliliters
Volume of Sample Aliquot:	20 milliliters
1st titration	
Volume of $BaCl_2$ titrant used:	0.9 milliliters
2nd titration	
Volume of $BaCl_2$ titrant used:	0.85 milliliters

Client Lyondell (Houston Refining)
Location Pasadena, TX

Method 15 Summary

Run Number	Date	Number of Injections	Hydrogen Sulfide ppmv	Carbonyl Sulfide ppmv	Carbon Disulfide ppmv
Run 1	7/29/11	7	425	<82.2	<40.1
Run 2	8/1/11	3	<91.7	<82.2	<40.1
Run 3	8/2/11	1	82.9	<50.6	<32.0

Method 16A Summary

Run Number	Date	L of Gas	Sulfur Dioxide ppmv	Notes
Run 1	7/29/11	155	1.6	Bad Connection @ Reaction Tube
Run 2	8/1/11	40.8	<0.16	None Detected
Run 3	8/2/11	4.4	98.4	118.7% of Method 15 Result

Client	**Lyondell (Houston Refining)**
Location	**Houston, TX**
Source	**736 Coker**
Sample Dates	**7/29/11 to 8/2/11**

M16 A Titrations

Sample ID	Aliquot Volume(ml)	Sample Volume(ml)	Titrant(ml)	$SO_{2(ul)}$	DGM (L)	SO_2 ppmv	SO_2(ave) ppmv	Det Limit ppmv
Field Blank Run A	20.0	80.0	0.20	0.0	NA	NA	NA	NA
Field Blank Run B	20.0	80.0	0.20	0.0	NA	NA	NA	NA
Run 1 A	20.0	70.0	0.75	230.1	155	1.5	**1.6**	**0.027**
Run 1 B	20.0	70.0	0.80	251.1	155	1.6		
Run 2 A	20.0	110.0	0.20	0.0	40.8	0.0	**ND**	**0.16**
Run 2 B	20.0	110.0	0.20	0.0	40.8	0.0		
Run 3 A	20.0	100.0	0.90	418.4	4.1	102.1	**98.4**	**1.5**
Run 3 B	20.0	100.0	0.85	388.5	4.1	94.8		

$0.01\ N\ H_2SO_4$	Volume(H_2SO_4)	Titrant(ml)	Normality
Rep 1	25.00	25.20	0.00992
Rep 2	25.00	25.10	0.00996
		Ave =	0.00994

Temp F(deg)	68.0
Pressure (atm)	29.92
Molar Volume(L)	24.05

SO_2 Mol Wt	Equiv SO_2 (wt)	SO_2 Conv
64.066	32,033	12,026.5

Sample ID	Date	H2S Analysis ppmv	COS Analysis ppmv	CS2 Analysis ppmv
Run 1	7/29/2011	401	ND	ND
Run 2	8/1/2011	ND	ND	ND
Run 3	8/2/2011	78.1	ND	ND

ND = Not Detected

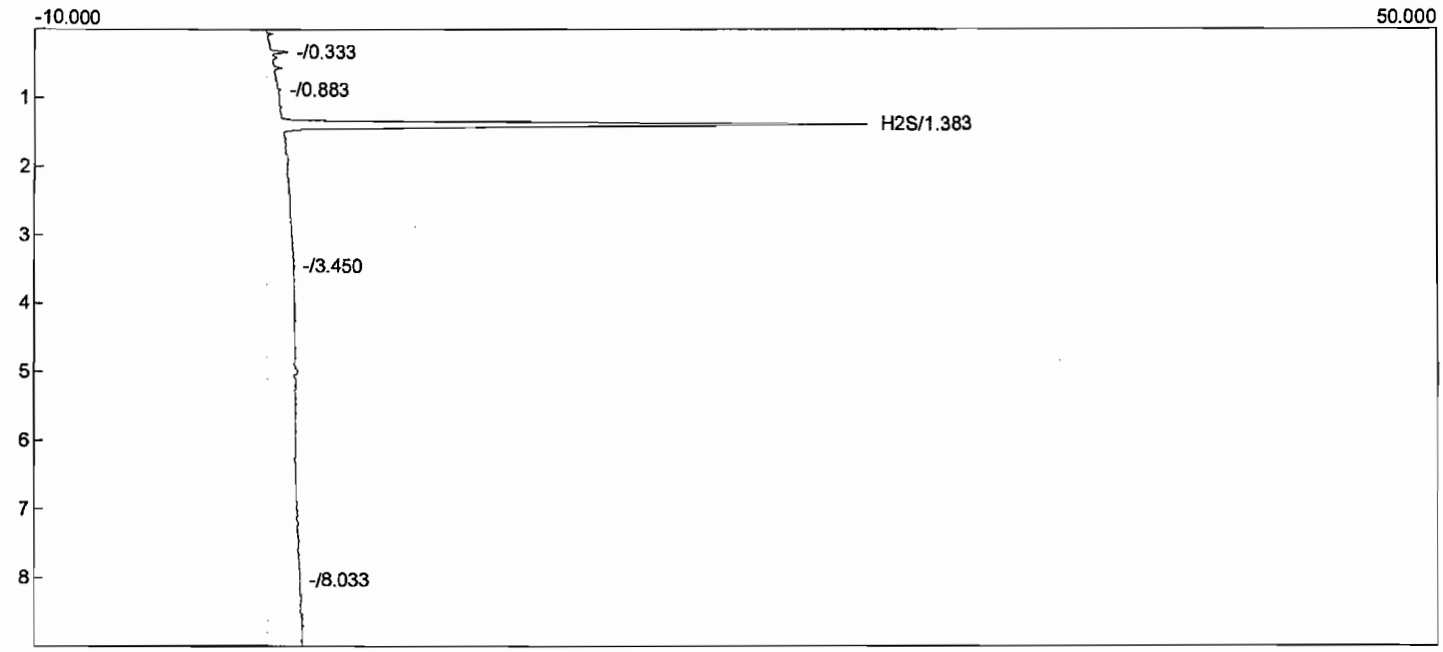
Sample ID	Date	H2S Analysis ppmv	COS Analysis ppmv	CS2 Analysis ppmv
Run 1	7/29/2011	401	82.2	39.2
Run 2	8/1/2011	86.4	82.2	39.2
Run 3	8/2/2011	78.1	50.6	31.3
	% Line Loss =	5.7	Tracer	2.2
	Correction Factor =	0.9426	1.0000	0.9776

Sample ID	Date	H2S Bias Corrected ppmv	COS Bias Corrected ppmv	CS2 Bias Corrected ppmv
Run 1	7/29/2011	425	82.2	40.1
Run 2	8/1/2011	91.7	82.2	40.1
Run 3	8/2/2011	82.9	50.6	32.0

Sample Results Run 1

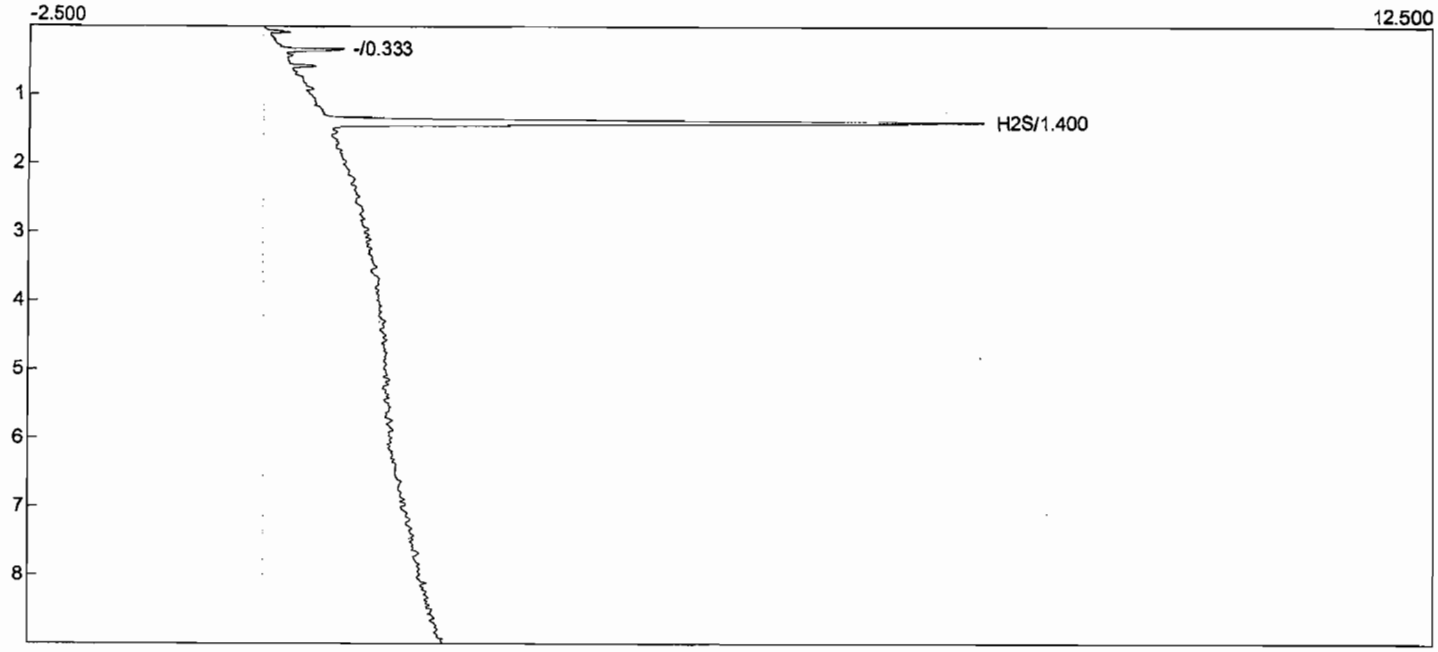
File	Date	Time	Description	H2S Area	COS Area	CS2 Area	H2S ppmv	COS ppmv	CS2 ppmv	Dil factor
Lyondell (7-29-11)-02.CHR	7/29/2011	7:56 AM	Run 1	97.9	0.00	0.00	784	<82.2	<39.2	42.33
Lyondell (7-29-11)-03.CHR	7/29/2011	8:07 AM	Run 1	29.8	0.00	0.00	442	<82.2	<39.2	42.33
Lyondell (7-29-11)-04.CHR	7/29/2011	8:18 AM	Run 1	23.4	0.00	0.00	394	<82.2	<39.2	42.33
Lyondell (7-29-11)-05.CHR	7/29/2011	8:29 AM	Run 1	17.4	0.00	0.00	341	<82.2	<39.2	42.33
Lyondell (7-29-11)-06.CHR	7/29/2011	8:40 AM	Run 1(Not Used in Ave)	0.0	0.00	0.00	<86.5	<82.2	<39.2	42.33
Lyondell (7-29-11)-07.CHR	7/29/2011	8:51 AM	Run 1	6.5	0.00	0.00	213	<82.2	<39.2	42.33
Lyondell (7-29-11)-08.CHR	7/29/2011	9:02 AM	Run 1	7.9	0.00	0.00	234	<82.2	<39.2	42.33
		8:40 AM	Believed to be a bad injection				**Ave = 401**	**<82.2**	**<39.2**	

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 07:56:13
Data file: Lyondell (7-29-11)-02.CHR ()
Sample: Run 1
Operator: JP



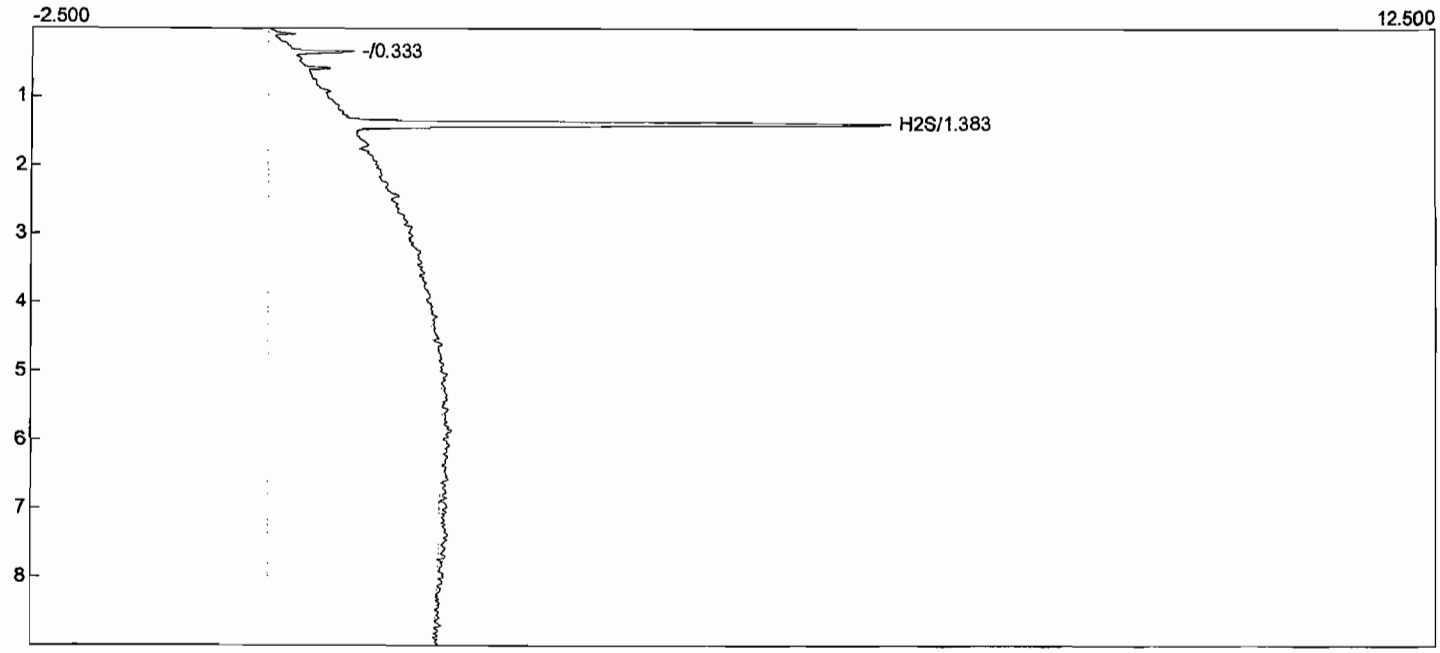
Component	Area
H2S	97.9
COS	0.0
CS2	0.0
	97.9

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 08:07:13
Data file: Lyondell (7-29-11)-03.CHR ()
Sample: Run 1
Operator: JP



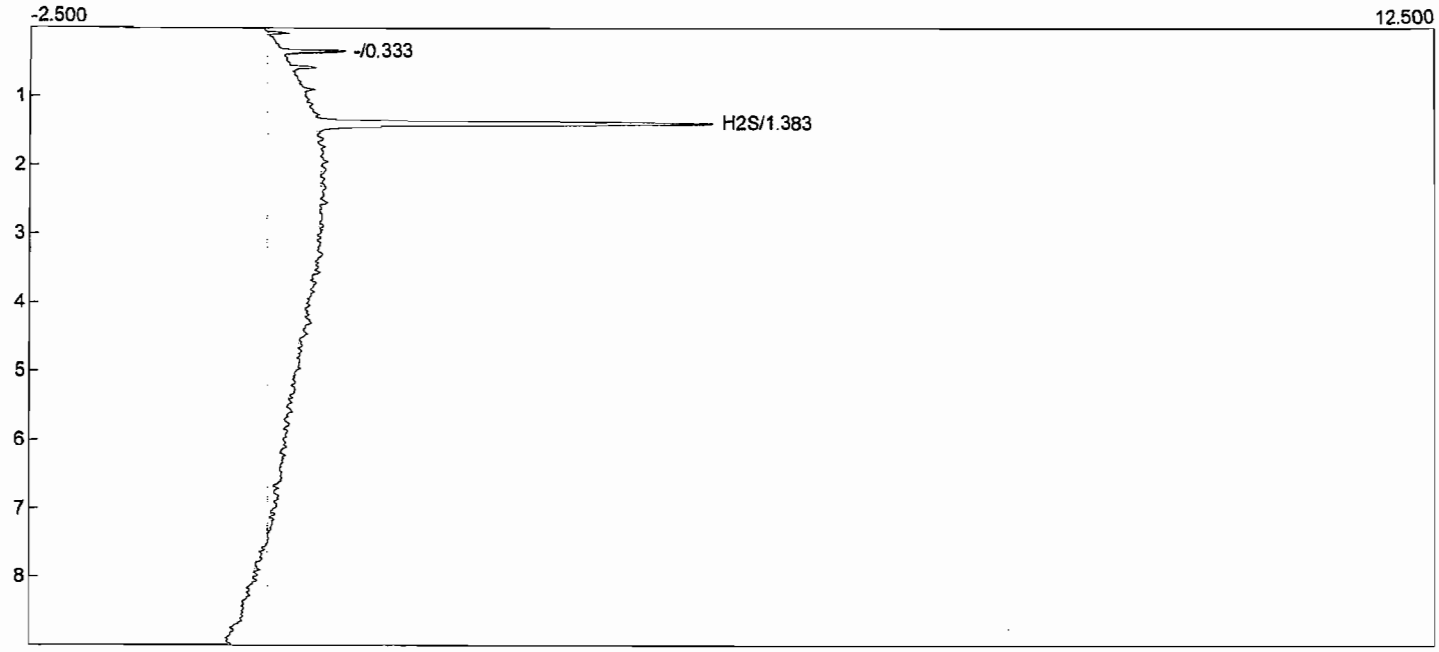
Component	Area
H2S	29.8
COS	0.0
CS2	0.0
	29.8

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 08:18:13
Data file: Lyondell (7-29-11)-04.CHR ()
Sample: Run 1
Operator: JP



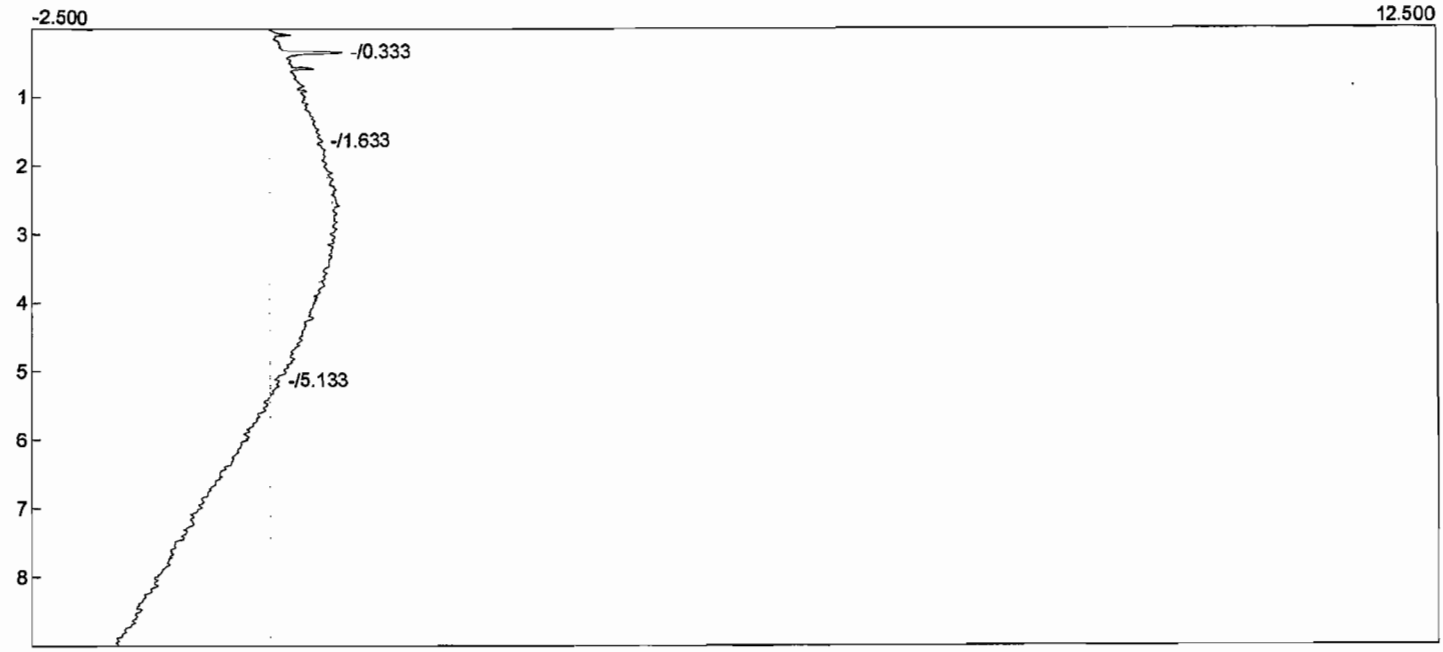
Component	Area
H2S	23.4
COS	0.0
CS2	0.0
	23.4

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 08:29:13
Data file: Lyondell (7-29-11)-05.CHR ()
Sample: Run 1
Operator: JP



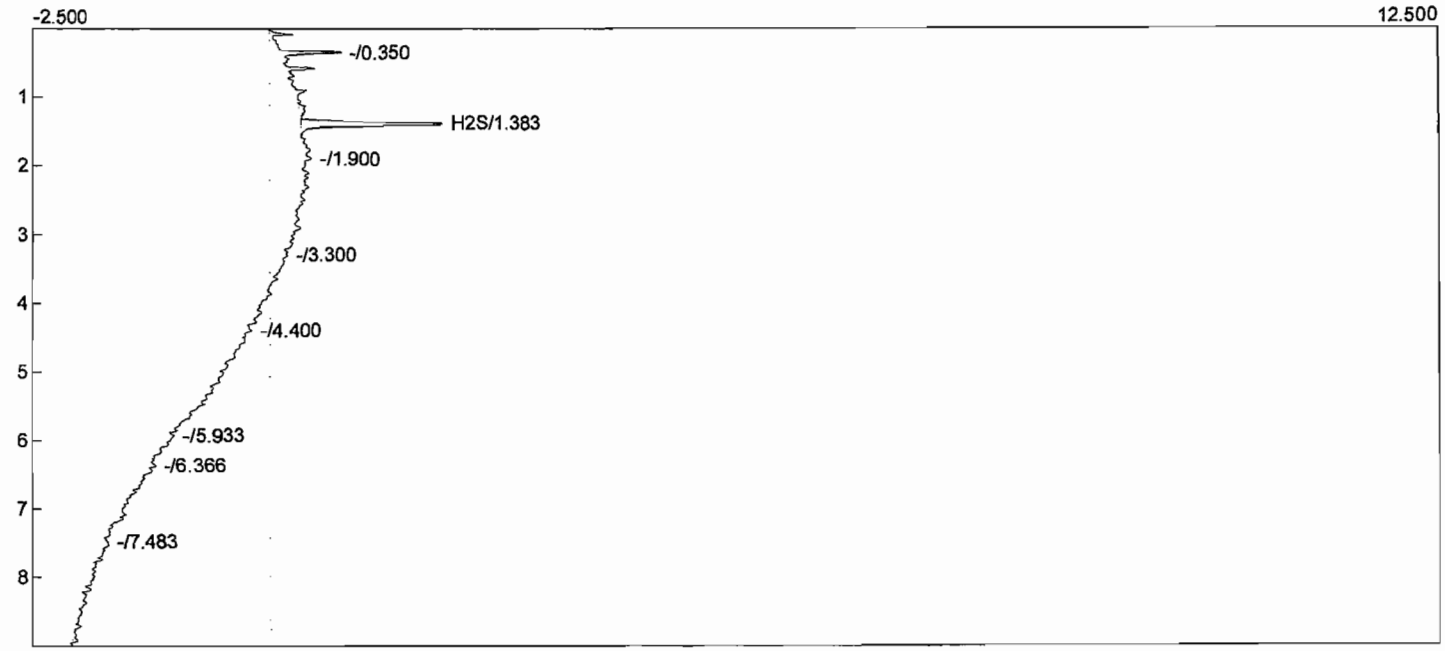
Component	Area
H2S	17.4
COS	0.0
CS2	0.0
	17.4

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 08:40:13
Data file: Lyondell (7-29-11)-06.CHR ()
Sample: Run 1
Operator: JP



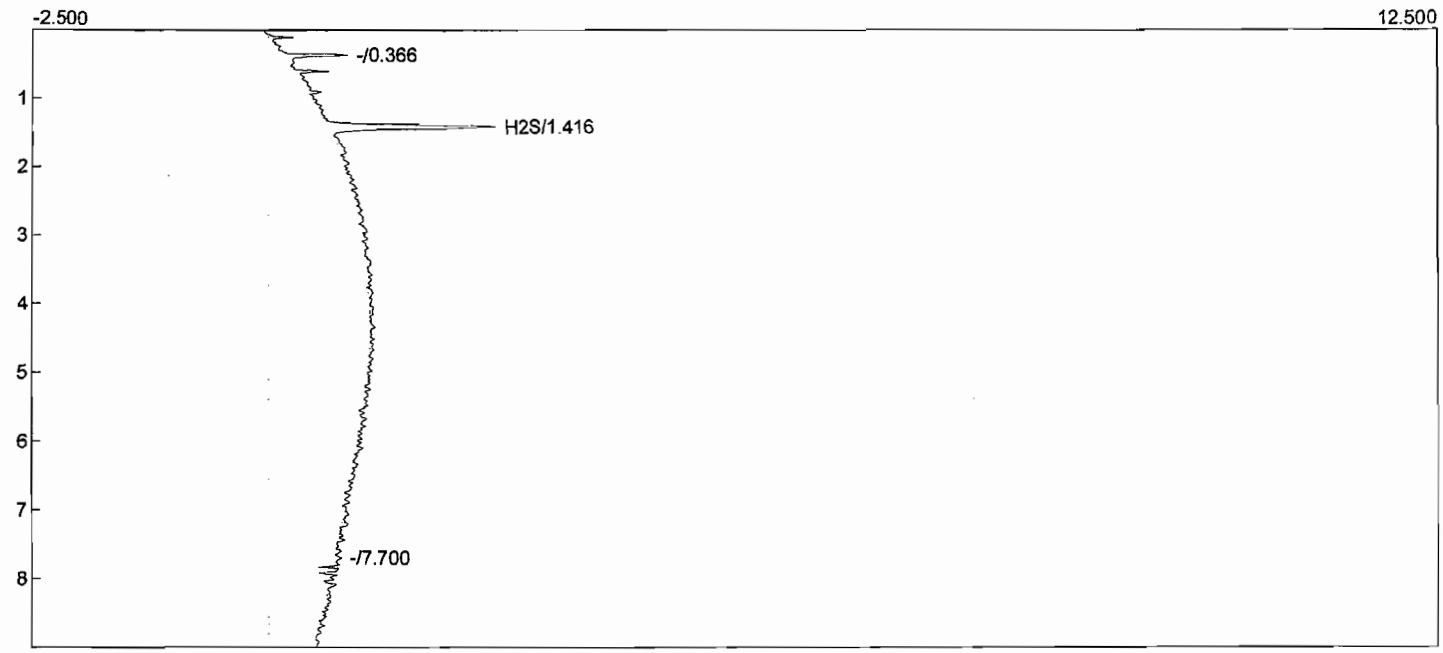
Component	Area
H2S	0.0
COS	0.0
CS2	0.0
	0.0

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 08:51:13
Data file: Lyondell (7-29-11)-07.CHR ()
Sample: Run 1
Operator: JP



Component	Area
H2S	6.5
COS	0.0
CS2	0.0
	6.5

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 09:02:13
Data file: Lyondell (7-29-11)-08.CHR ()
Sample: Run 1
Operator: JP

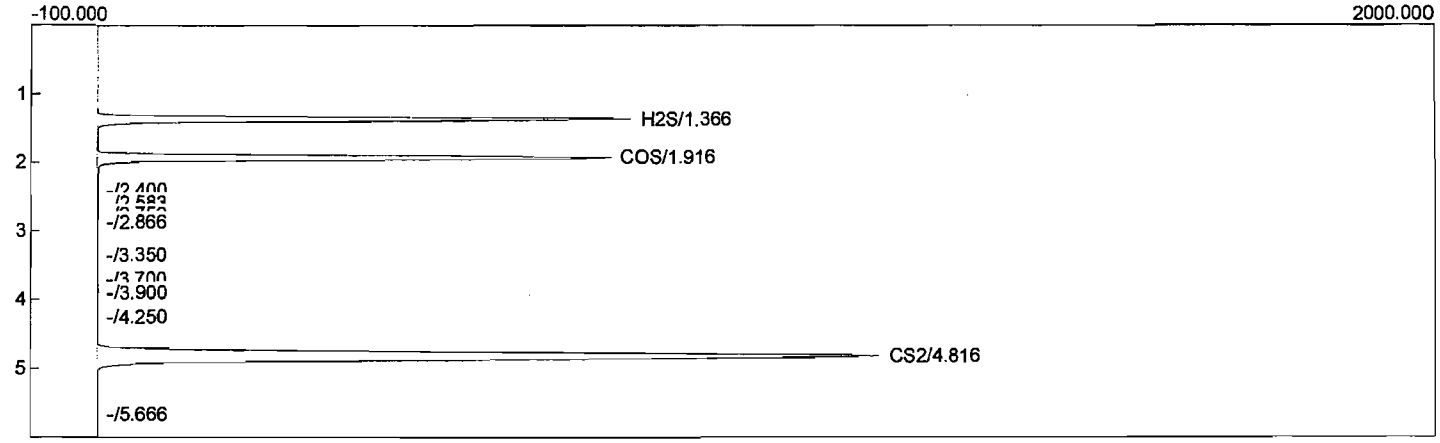


Component	Area
H2S	7.9
COS	0.0
CS2	0.0
	7.9

Sample Results Run 2

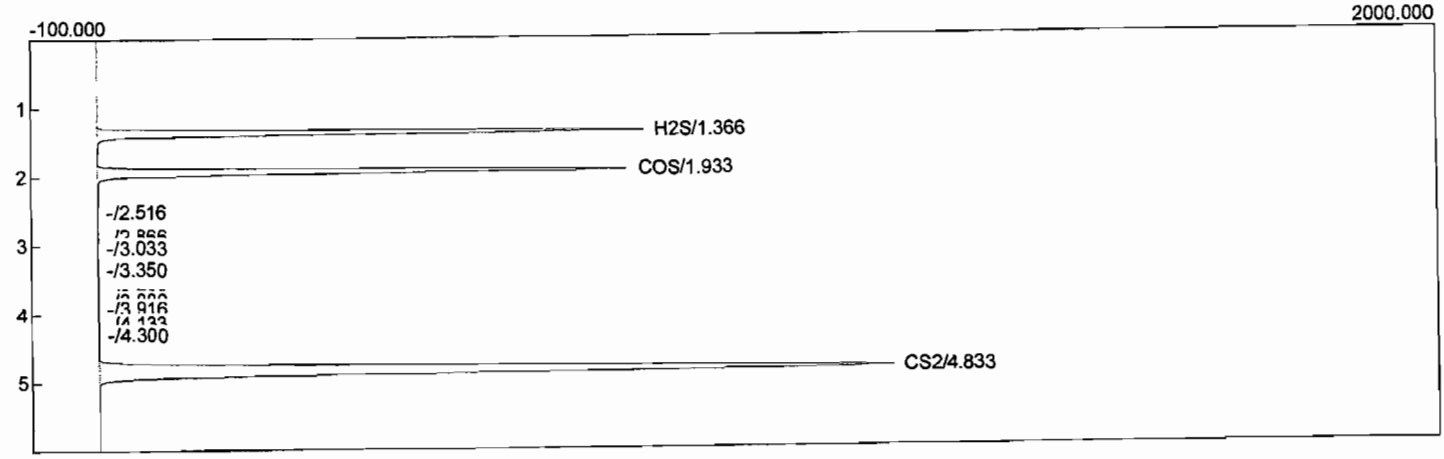
File	Date	Time	Description	H2S Area	COS Area	CS2 Area	H2S log10(Area)	COS log10(Area)	CS2 log10(Area)	Dil factor
Lyondell (8-1-11)-06.CHR	8/1/11	10:49 AM	100 STD	3,157.00	3,400.5	8,365.3	98.5	114.4	100.5	1.00
Lyondell (8-1-11)-07.CHR	8/1/11	10:57 AM	100 STD	3,239.00	3,442.1	8,500.5	99.7	115.1	101.3	1.00
Lyondell (8-1-11)-08.CHR	8/1/11	11:04 AM	100 STD	3,322.10	3,496.8	8,757.9	101.0	116.0	102.9	1.00
Lyondell (8-1-11)-09.CHR	8/1/2011	12:46 PM	Run 2	0.0	0.0	0.0	0.0	0.0	0.0	42.33
Lyondell (8-1-11)-10.CHR	8/1/2011	12:53 PM	Run 2	0.0	0.0	0.0	0.0	0.0	0.0	42.33
Lyondell (8-1-11)-11.CHR	8/1/2011	1:01 PM	Run 2	0.0	0.0	0.0	0.0	0.0	0.0	42.33
						Ave =	<86.4	<82.2	<39.2	

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 10:49:53
Method: 15
Data file: Lyondell (8-1-11)-06.CHR ()
Sample: 100 ppmv pre
Operator: JP



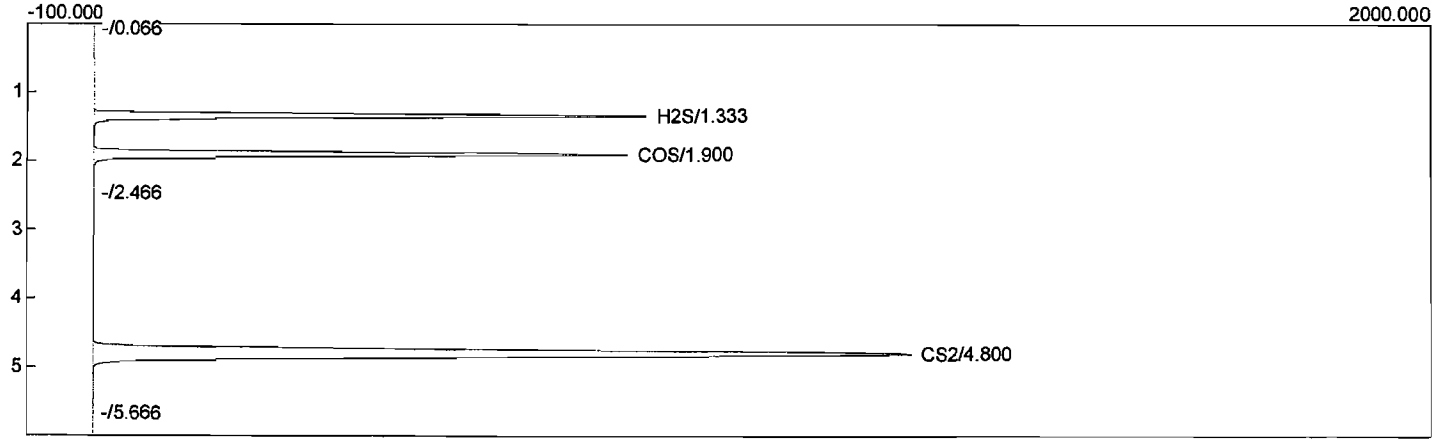
Component	Area
H2S	3157.0
COS	3400.5
CS2	8365.3
	14922.9

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 10:57:41
Method: 15
Data file: Lyondell (8-1-11)-07.CHR ()
Sample: 100 ppmv pre
Operator: JP



Component	Area
H2S	3239.0
COS	3442.1
CS2	8500.5
	15181.6

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 11:04:56
Method: 15
Data file: Lyondell (8-1-11)-08.CHR ()
Sample: 100 ppmv pre
Operator: JP

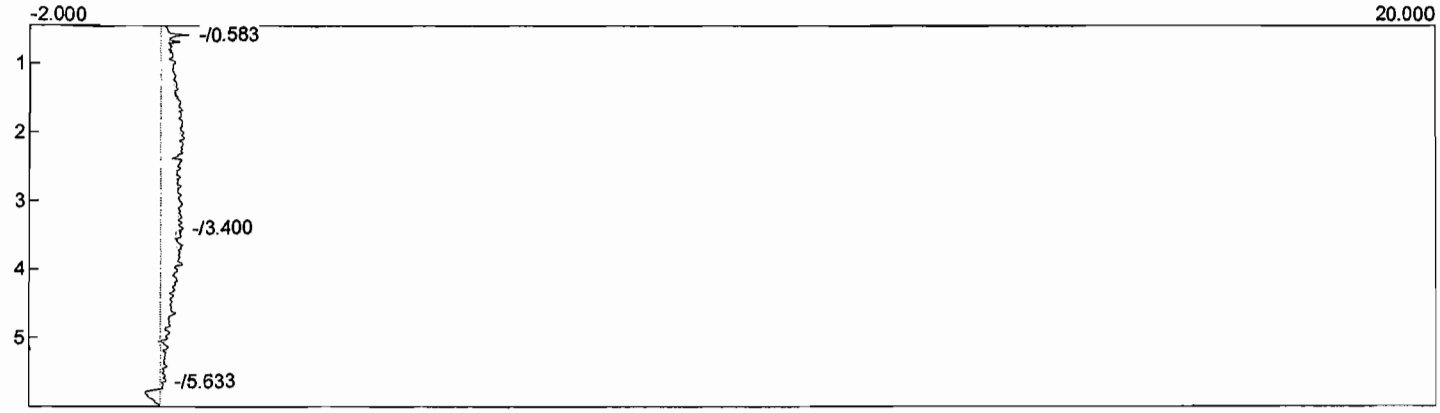


Component	Area
H2S	3322.1
COS	3496.8
CS2	8757.9
	15576.9

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 12:46:43
Method: 15
Data file: Lyondell (8-1-11)-09.CHR ()
Sample: Run 2
Operator: JP

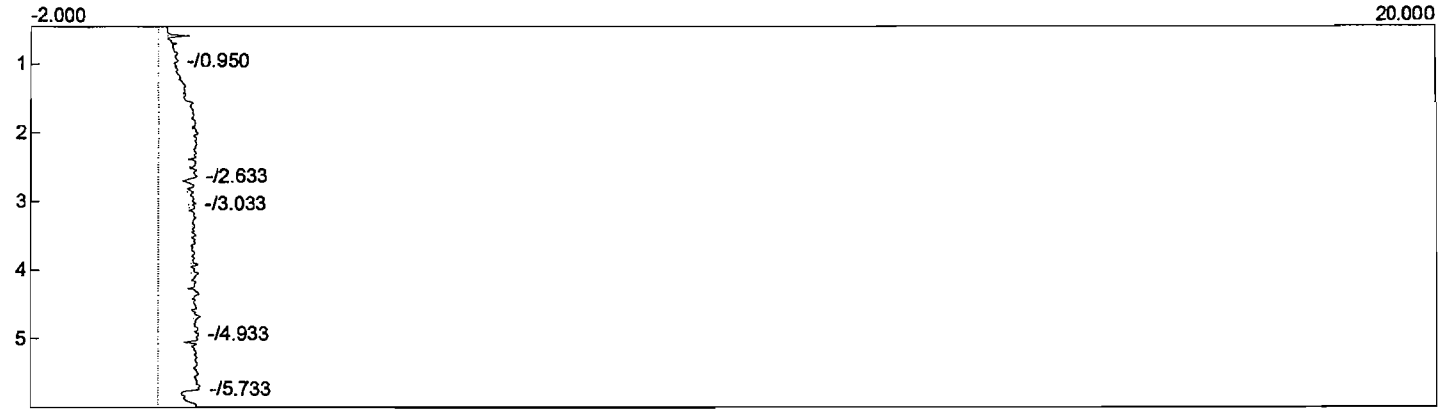
Component	Area
H2S	0.0
COS	0.0
CS2	0.0
	0.0

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 12:53:58
Method: 15
Data file: Lyondell (8-1-11)-10.CHR ()
Sample: Run 2
Operator: JP



Component	Area
H2S	0.0
COS	0.0
CS2	0.0
	0.0

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 13:01:13
Method: 15
Data file: Lyondell (8-1-11)-11.CHR ()
Sample: Run 2
Operator: JP



Component	Area
H2S	0.0
COS	0.0
CS2	0.0
	0.0

QA/QC Line Loss & Dilution Orafice Calibration

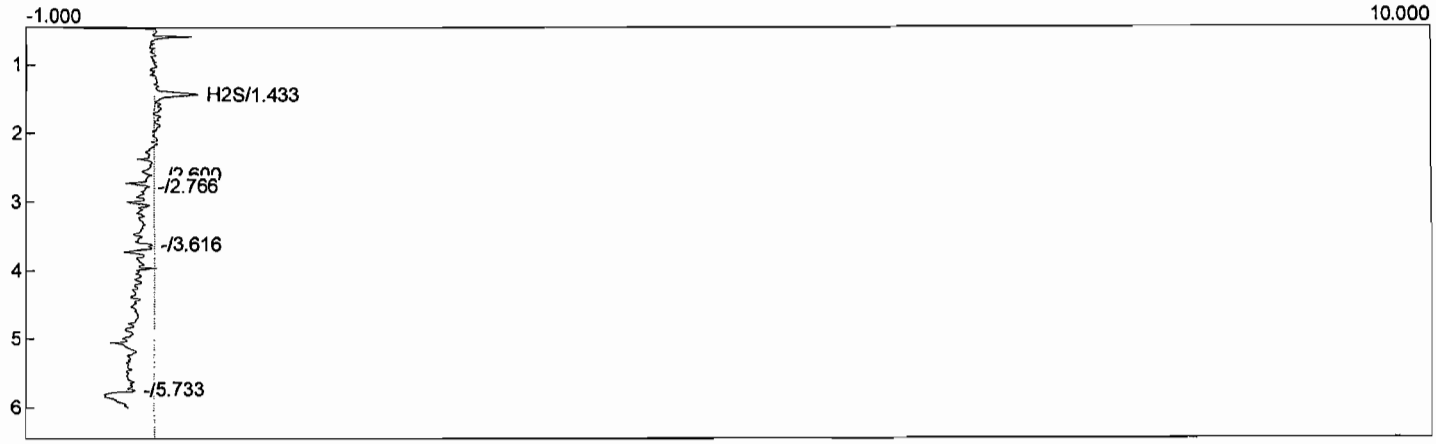
Note: Dilution System was modified after the check COS being used as a tracer gas

Lyondell (8-2-11)-28.CHR	8/2/2011	3:06 PM	Line Loss & Dilution Orafice Cal Run	53.1	78.6	186.1	10.9	11.6	11.5	1.00
Lyondell (8-2-11)-29.CHR	8/2/2011	3:13 PM	Line Loss & Dilution Orafice Cal Run	54.9	81.5	187.5	11.1	11.8	11.6	1.00
Lyondell (8-2-11)-30.CHR	8/2/2011	3:20 PM	Line Loss & Dilution Orafice Cal Run	58.0	83.0	188.2	11.4	12.0	11.6	1.00
							Ave = 11.1	11.8	11.5	
							Dilution Ratio = **42.33**			
Lyondell (8-2-11)-28.CHR	8/2/2011	3:06 PM	Line Loss & Dilution Orafice Cal Run	53.1	78.6	186.1	461.8	492.1	487.2	42.33
Lyondell (8-2-11)-29.CHR	8/2/2011	3:13 PM	Line Loss & Dilution Orafice Cal Run	54.9	81.5	187.5	469.5	501.5	489.1	42.33
Lyondell (8-2-11)-30.CHR	8/2/2011	3:20 PM	Line Loss & Dilution Orafice Cal Run	58.0	83.0	188.2	482.6	506.3	490.1	42.33
			500.0 ppmv STD Injected for Orifice Cal & Line Loss				**Ave =** 471.3	500.0	488.8	
							% Recovery = 94.3	Tracer	97.8	

Sample Results

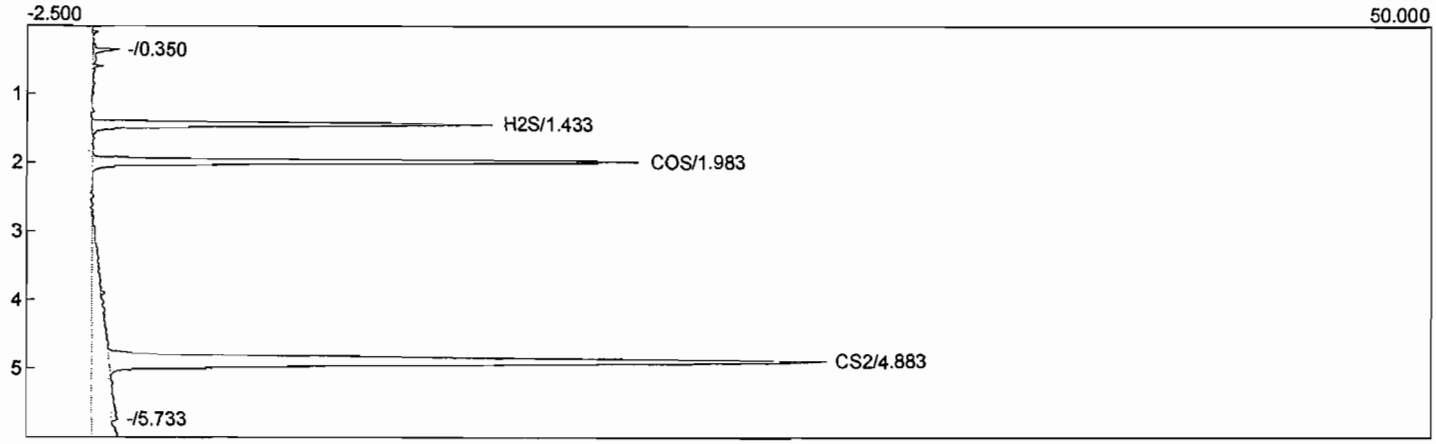
File	Date	Time	Description	H2S Area	COS Area	CS2 Area	H2S ppmv	COS ppmv	CS2 ppmv	Dil factor
Lyondell (8-2-11)-31.CHR	8/2/11	4:15 PM	Run 3	1.5	0.0	0.0	78.1	0.0	0.0	42.33

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 16:15:46
Method: 15
Data file: Lyondell (8-2-11)-31.CHR ()
Sample: Run 3
Operator: JP



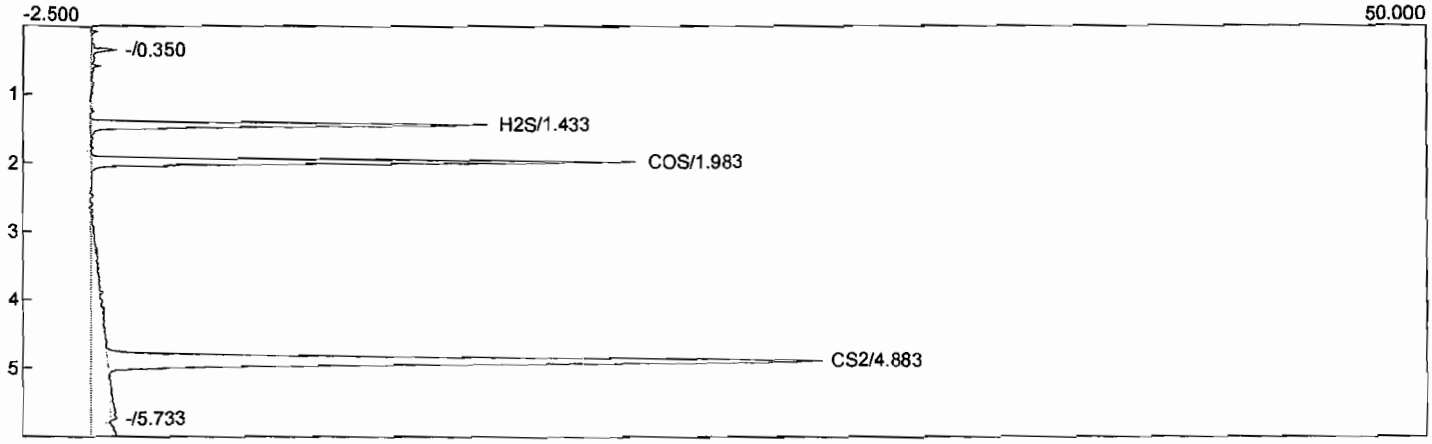
Component	Area
H2S	1.5
COS	0.0
CS2	0.0
	1.5

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 15:06:24
Method: 15
Description: COS used as Tracer
Data file: Lyondell (8-2-11)-28.CHR ()
Sample: 500 ppmv Line Loss
Operator: JP



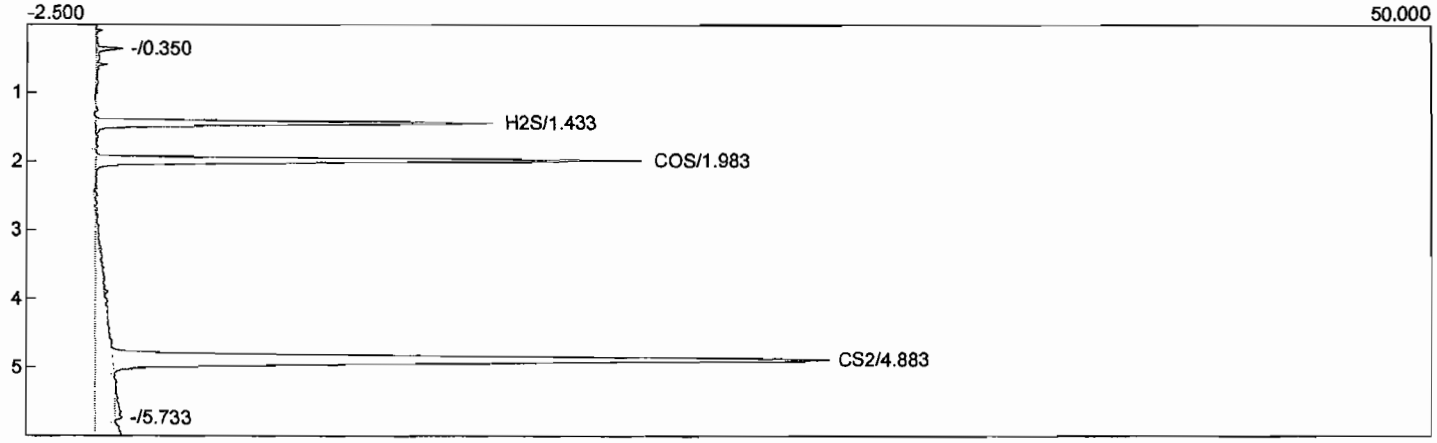
Component	Area
H2S	53.1
COS	78.6
CS2	186.1
	317.8

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 15:13:25
Method: 15
Description: COS used as Tracer
Data file: Lyondell (8-2-11)-29.CHR ()
Sample: 500 ppmv Line Loss
Operator: JP



Component	Area
H2S	54.9
COS	81.5
CS2	187.5
	323.9

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 15:20:06
Method: 15
Description: COS used as Tracer
Data file: Lyondell (8-2-11)-30.CHR ()
Sample: 500 ppmv Line Loss
Operator: JP



Component	Area
H2S	58.0
COS	83.0
CS2	188.2
	329.2

C-260

Calibration Details &

File	Date	Time	Description	H2S Area	COS Area	CS2 Area	H2S ppmv	COS ppmv	CS2 ppmv
Lyondell (7-27-11)-26.CHR	7/28/2011	5:38 PM	5.0 STD	6.1	6.5	26.0	5.0	5.0	5.0
Lyondell (7-27-11)-27.CHR	7/28/2011	5:49 PM	5.0 STD	6.5	6.6	25.8	5.0	5.0	5.0
Lyondell (7-27-11)-28.CHR	7/28/2011	6:00 PM	5.0 STD	6.5	6.6	25.1	5.0	5.0	5.0
			Ave =	6.4	6.6	25.6			
Lyondell (7-27-11)-22.CHR	7/28/2011	4:50 PM	100.0 STD	3,402.6	2,627.8	8,629.7	100.0	100.0	100.0
Lyondell (7-27-11)-23.CHR	7/28/2011	5:01 PM	100.0 STD	3,512.3	2,723.9	8,633.5	100.0	100.0	100.0
Lyondell (7-27-11)-24.CHR	7/28/2011	5:12 PM	100.0 STD	3,469.0	2,664.4	8,570.4	100.0	100.0	100.0
			Ave =	3,461.3	2,672.0	8,611.2			
Lyondell (7-27-11)-30.CHR	7/28/2011	6:24 PM	200.0 STD	12,986.1	10,072.7	30,517.7	200.0	200.0	200.0
Lyondell (7-27-11)-31.CHR	7/28/2011	6:35 PM	200.0 STD	13,196.6	10,197.7	30,616.8	200.0	200.0	200.0
Lyondell (7-27-11)-32.CHR	7/28/2011	6:46 PM	200.0 STD	13,085.1	10,109.1	30,557.2	200.0	200.0	200.0
			Ave =	13,089.3	10,126.5	30,563.9			

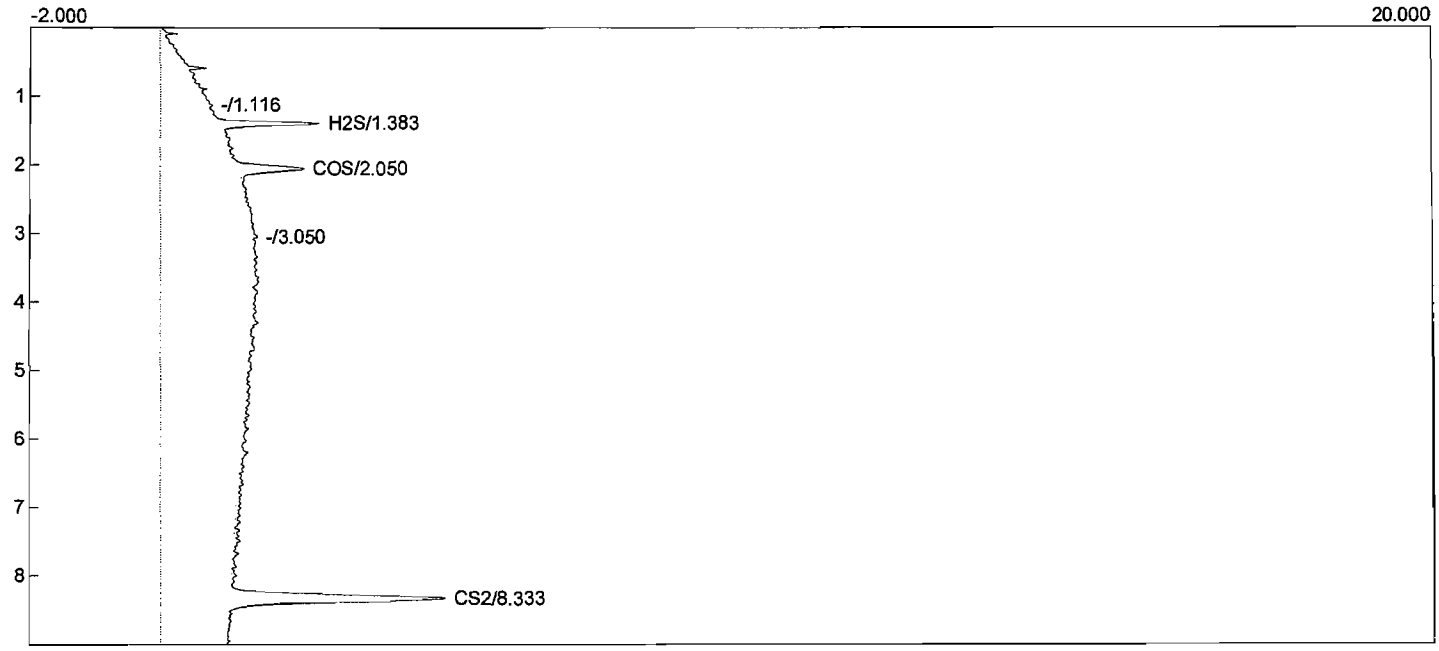
HREF-TRSBAGS-WORKBOOK-032T-REV1

Slope =	**2.078**	**1.995**	**1.927**
Intercept =	**-0.644**	**-0.575**	**0.065**

Standards Calculated as Samples

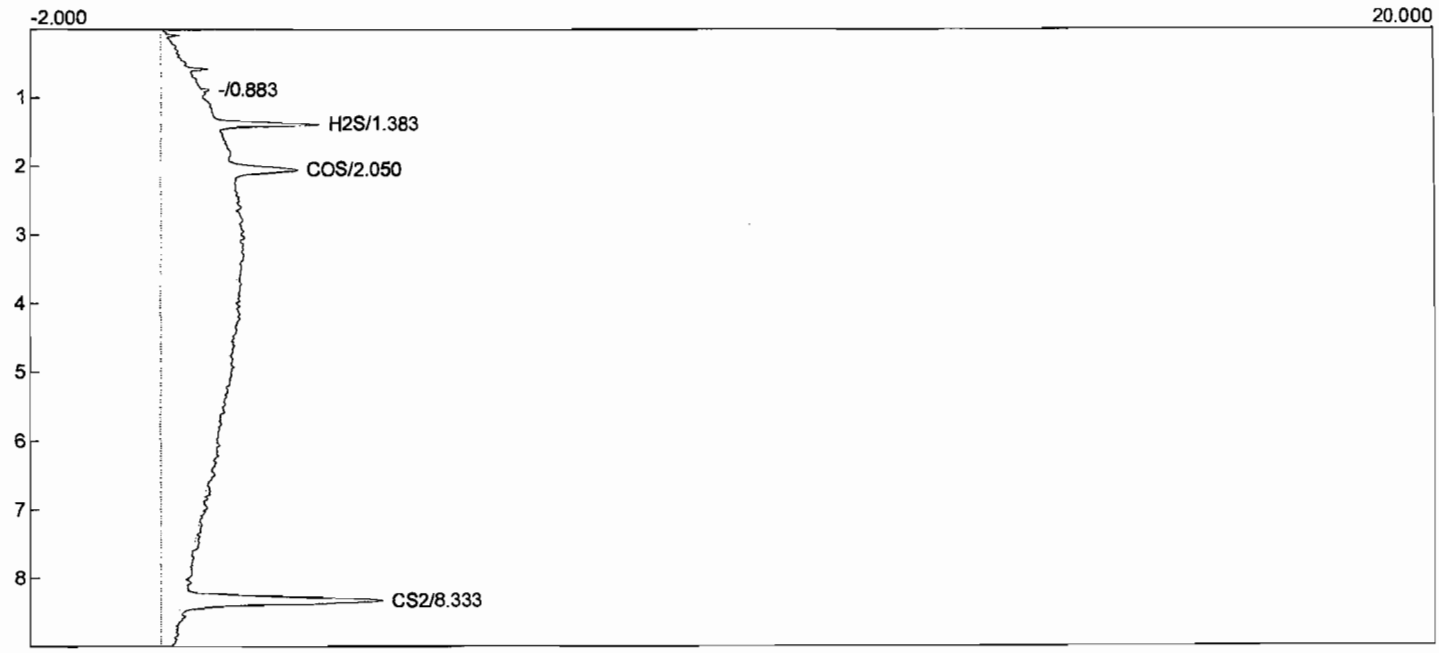
File	Date	Time	Description	H2S Area	COS Area	CS2 Area		H2S ppmv	COS ppmv	CS2 ppmv
Lyondell (7-27-11)-26.CHR	7/28/11	5:38:31 PM	5.0 STD	6.1	6.5	26.0		4.9	5.0	5.0
Lyondell (7-27-11)-27.CHR	7/28/11	5:49:31 PM	5.0 STD	6.5	6.6	25.8		5.0	5.0	5.0
Lyondell (7-27-11)-28.CHR	7/28/11	6:00:31 PM	5.0 STD	6.5	6.6	25.1		5.0	5.0	4.9
				6.4	6.6	25.6	**Ave =**	5.0	5.0	5.0
Lyondell (7-27-11)-22.CHR	7/28/11	4:50:56 PM	100.0 STD	3,402.6	2,627.8	8,629.7		102.1	100.6	102.1
Lyondell (7-27-11)-23.CHR	7/28/11	5:01:56 PM	100.0 STD	3,512.3	2,723.9	8,633.5		103.7	102.4	102.1
Lyondell (7-27-11)-24.CHR	7/28/11	5:12:56 PM	100.0 STD	3,469.0	2,664.4	8,570.4		103.1	101.3	101.7
				3,461.3	2,672.0	8,611.2	**Ave =**	103.0	101.4	102.0
Lyondell (7-27-11)-30.CHR	7/28/11	6:24:11 PM	200.0 STD	12,986.1	10,072.7	30,517.7		194.6	197.2	196.7
Lyondell (7-27-11)-31.CHR	7/28/11	6:35:11 PM	200.0 STD	13,196.6	10,197.7	30,616.8		196.1	198.4	197.0
Lyondell (7-27-11)-32.CHR	7/28/11	6:46:12 PM	200.0 STD	13,085.1	10,109.1	30,557.2		195.3	197.6	196.8
				13,089.3	10,126.5	30,563.9	**Ave =**	195.3	197.8	196.8

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 17:38:31
Data file: Lyondell (7-27-11)-26.CHR ()
Sample: 5.0 ppmv STD
Operator: JP



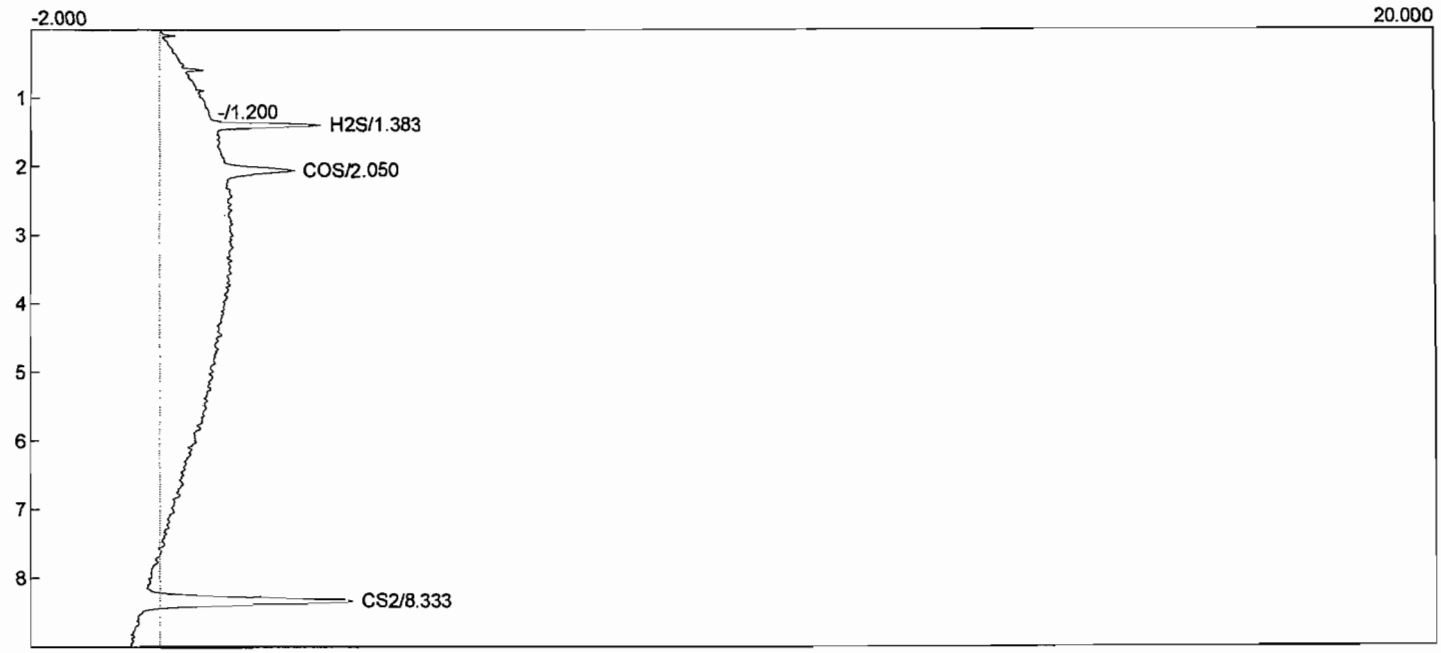
Component	Area
H2S	6.1
COS	6.5
CS2	26.0
	38.6

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 17:49:31
Data file: Lyondell (7-27-11)-27.CHR ()
Sample: 5.0 ppmv STD
Operator: JP



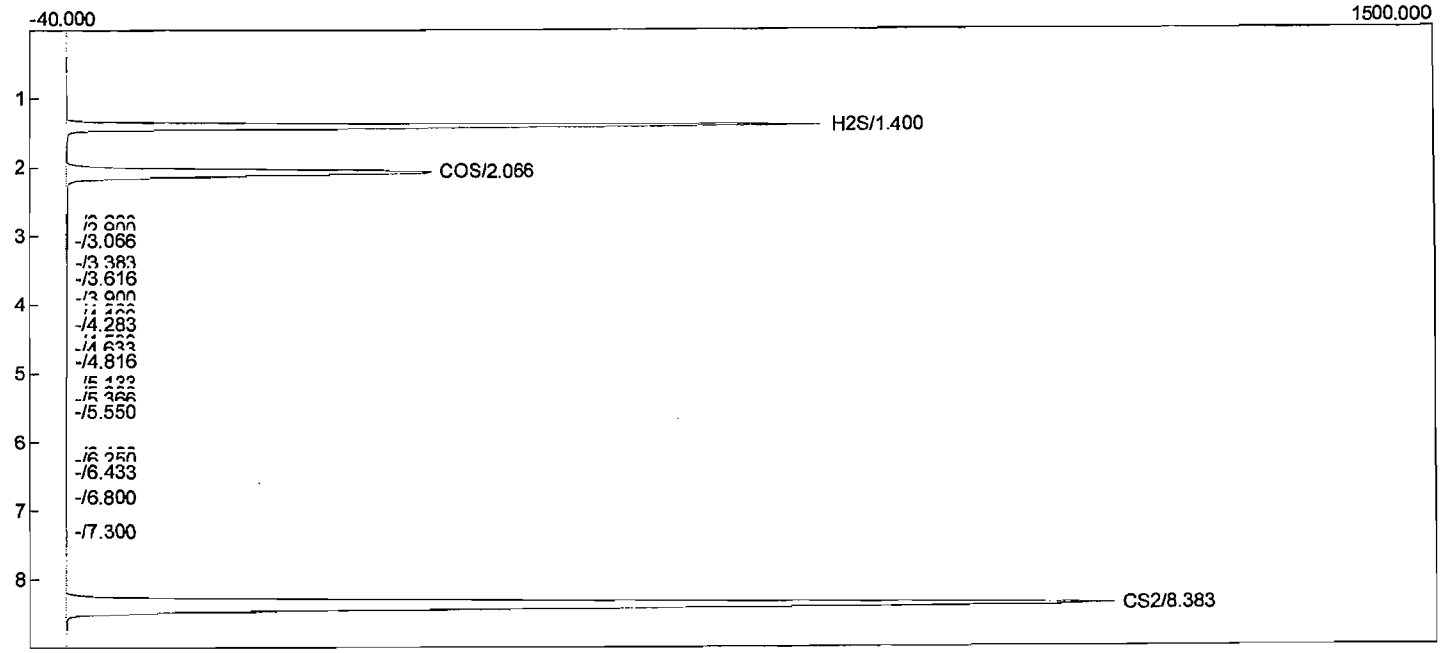
Component	Area
H2S	6.5
COS	6.6
CS2	25.8
	38.8

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 18:00:31
Data file: Lyondell (7-27-11)-28.CHR ()
Sample: 5.0 ppmv STD
Operator: JP



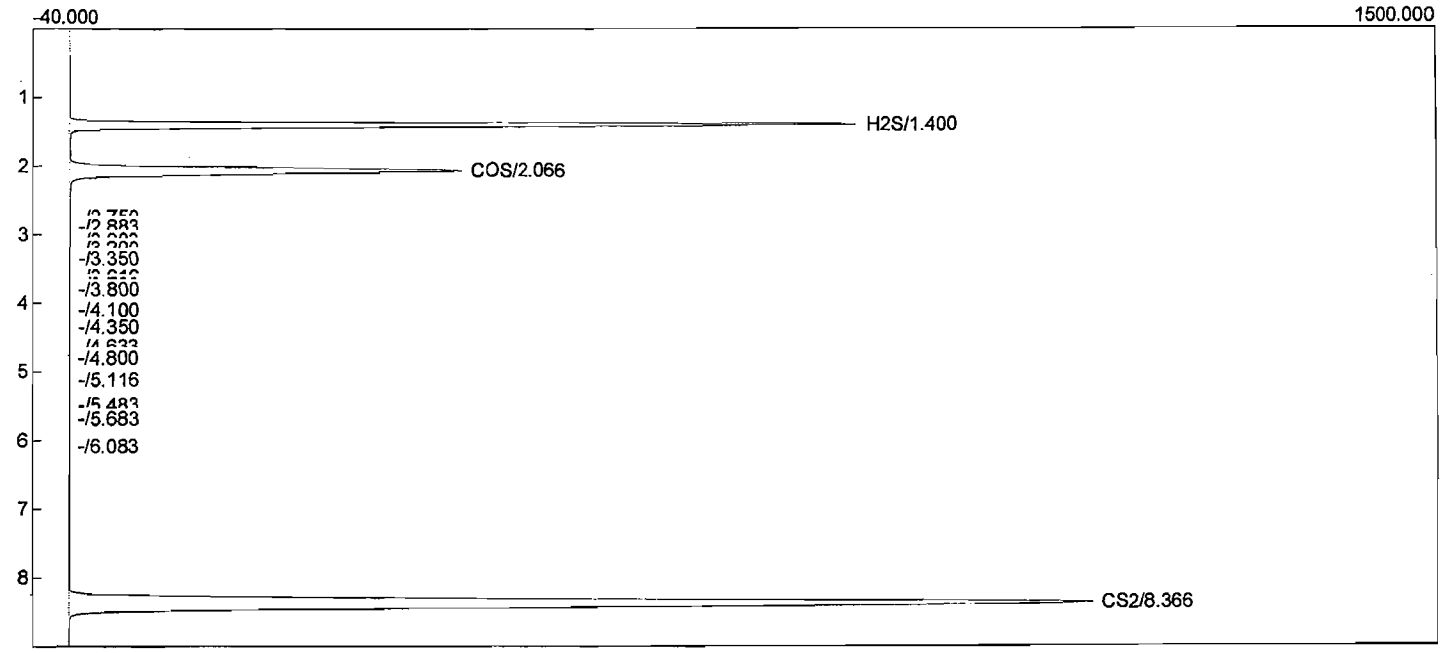
Component	Area
H2S	6.5
COS	6.6
CS2	25.1
	38.2

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 16:50:56
Data file: Lyondell (7-27-11)-22.CHR ()
Sample: 100 ppmv STD
Operator: JP



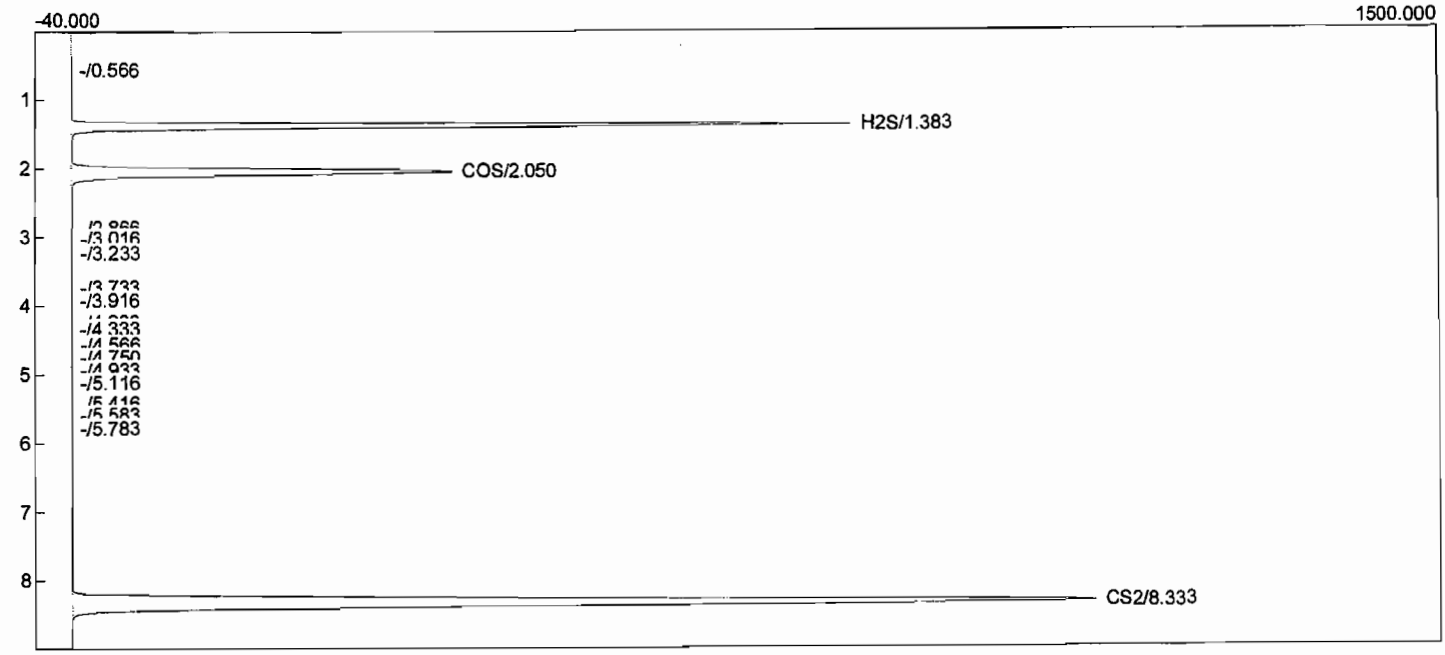
Component	Area
H2S	3402.6
COS	2627.8
CS2	8629.7
	14660.2

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 17:01:56
Data file: Lyondell (7-27-11)-23.CHR ()
Sample: 100 ppmv STD
Operator: JP



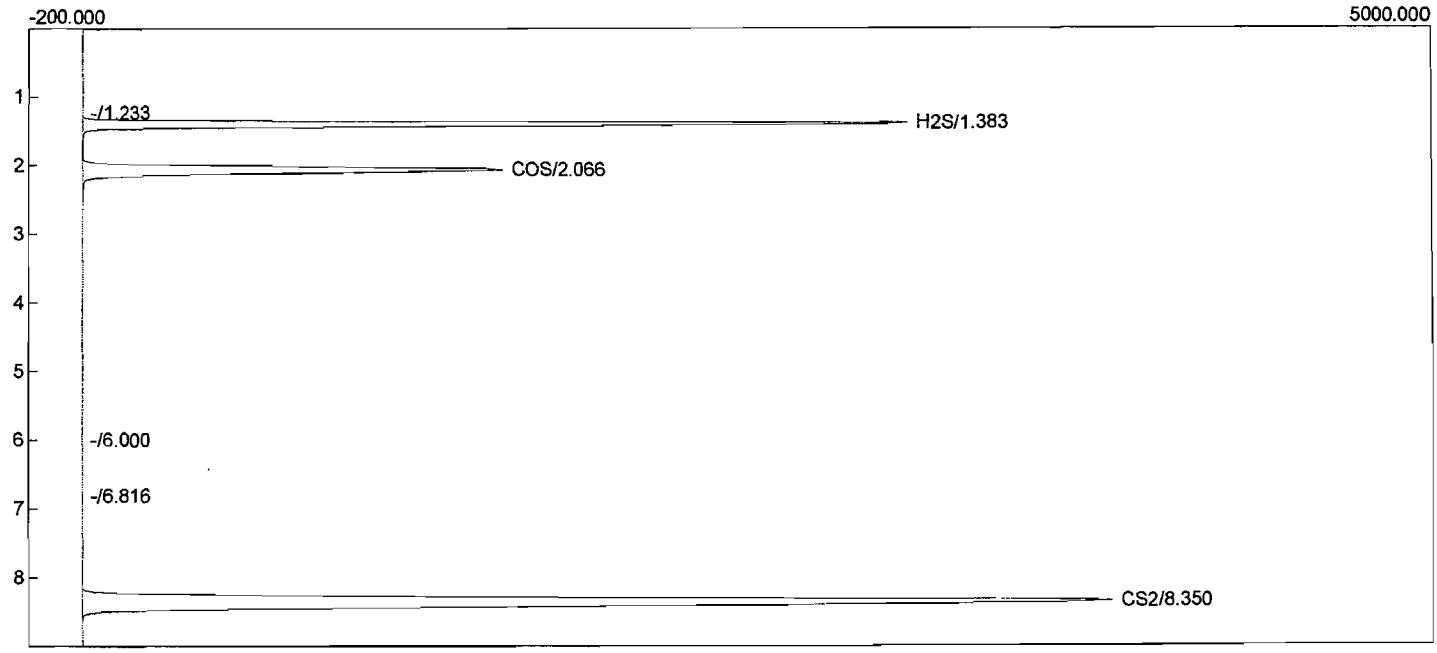
Component	Area
H2S	3512.3
COS	2723.9
CS2	8633.5
	14869.7

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 17:12:56
Data file: Lyondell (7-27-11)-24.CHR ()
Sample: 100 ppmv STD
Operator: JP



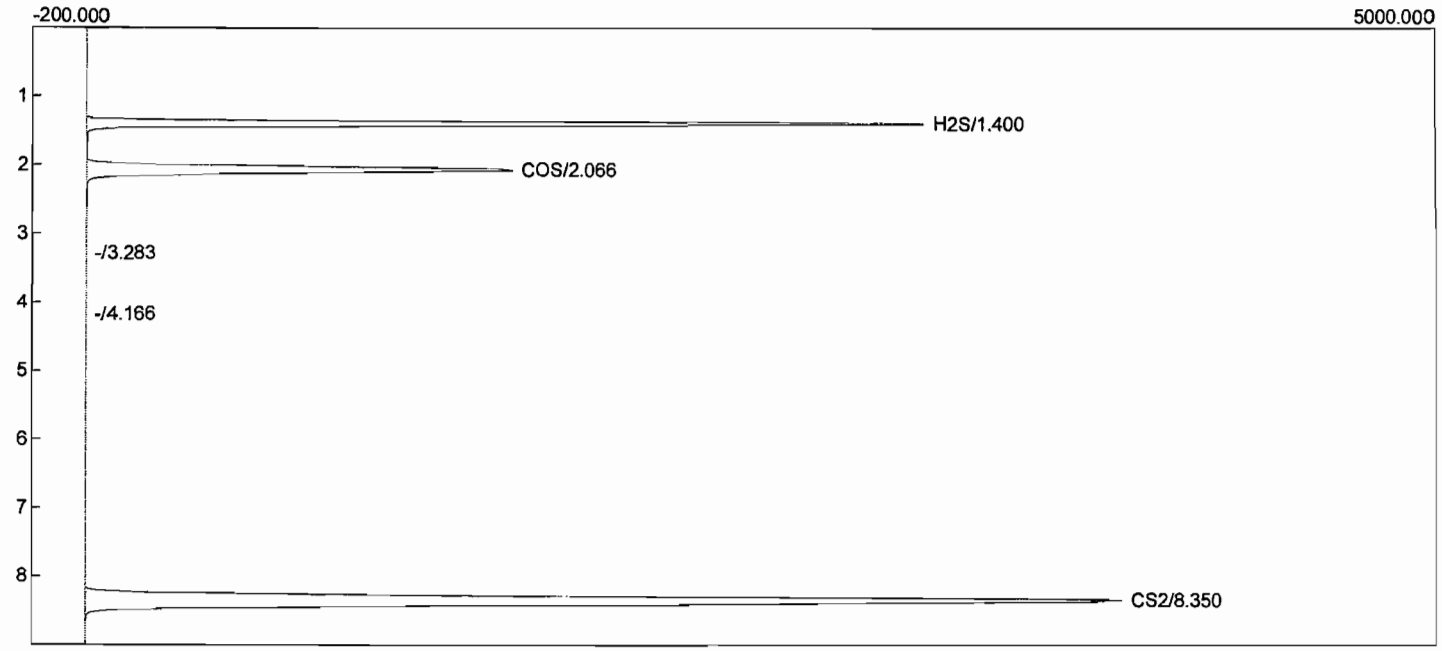
Component	Area
H2S	3469.0
COS	2664.4
CS2	8570.4
	14703.7

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 18:24:11
Data file: Lyondell (7-27-11)-30.CHR ()
Sample: 200.0 ppmv STD
Operator: JP



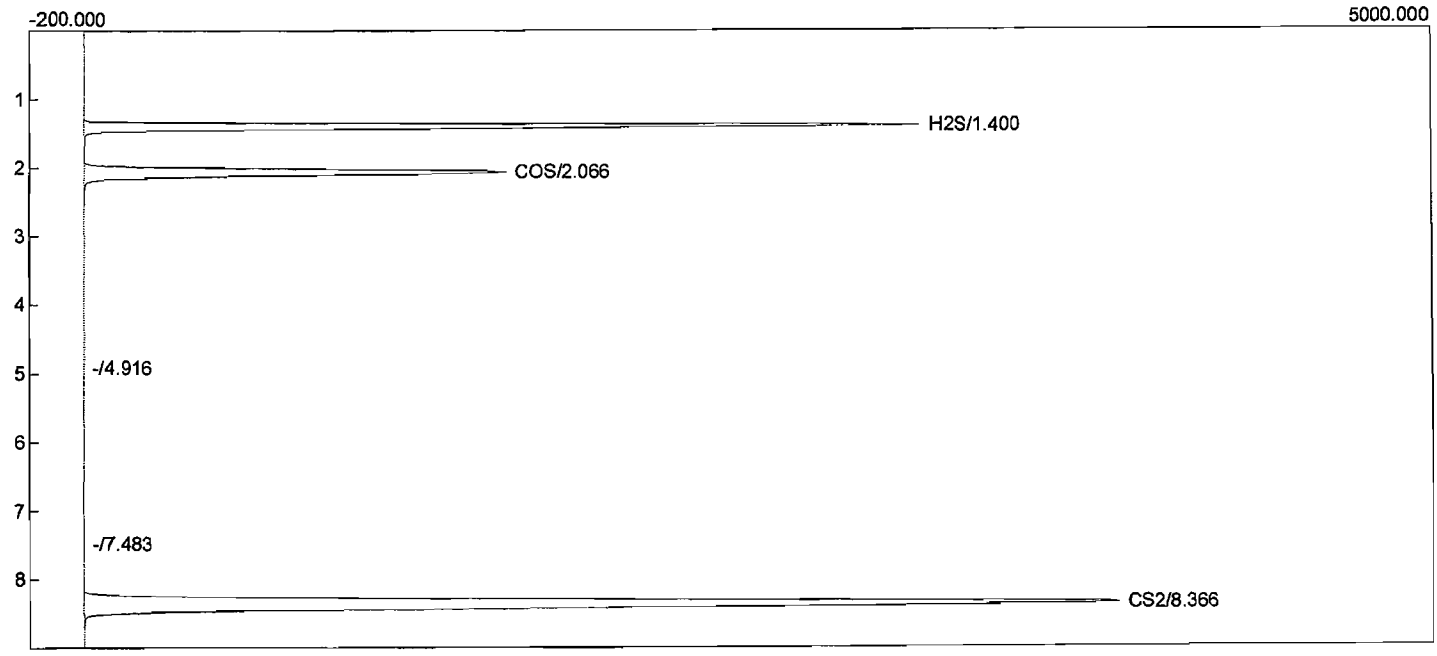
Component	Area
H2S	12986.1
COS	10072.7
CS2	30517.7
	53576.5

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 18:35:11
Data file: Lyondell (7-27-11)-31.CHR ()
Sample: 200.0 ppmv STD
Operator: JP

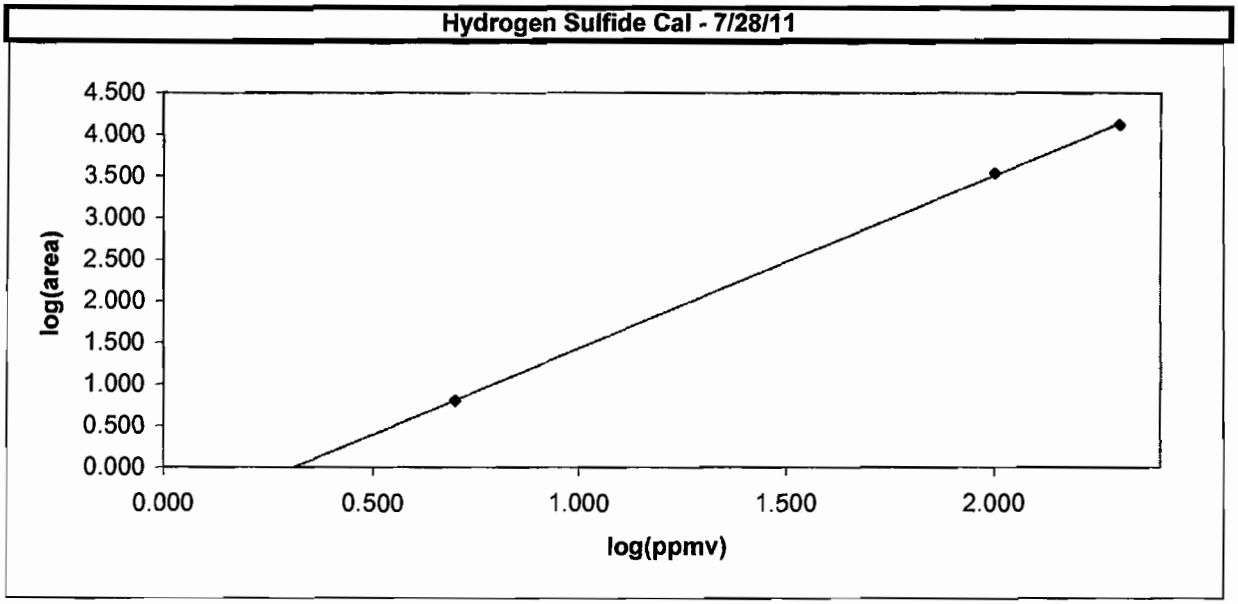


Component	Area
H2S	13196.6
COS	10197.7
CS2	30616.8
	54011.1

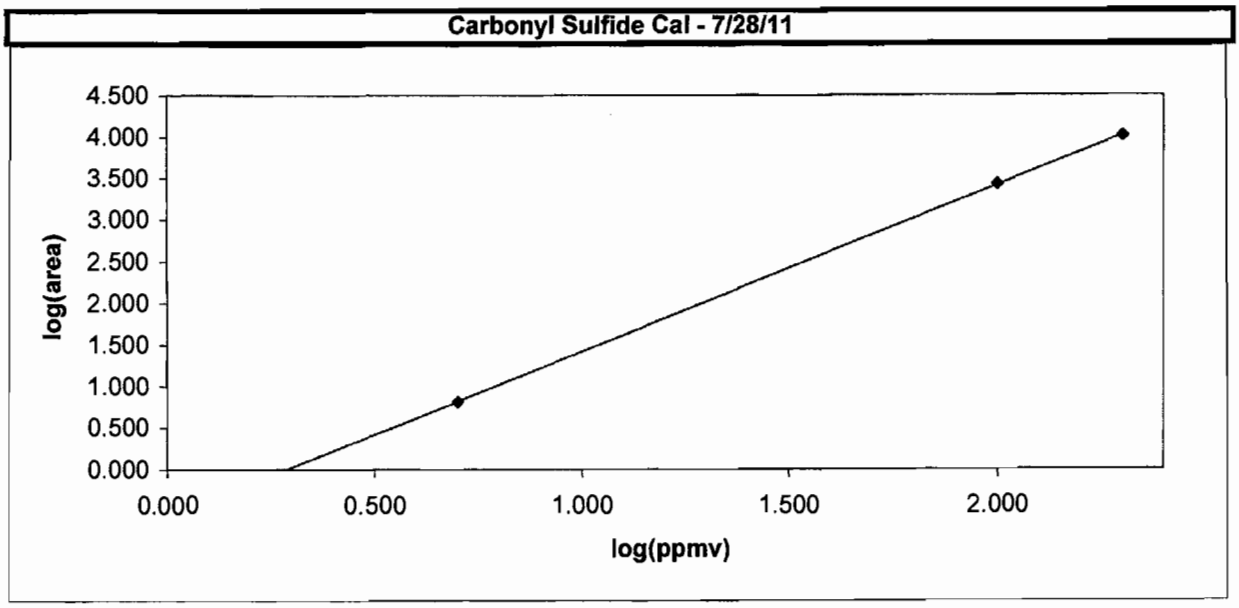
Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/28/2011 18:46:12
Data file: Lyondell (7-27-11)-32.CHR ()
Sample: 200.0 ppmv STD
Operator: JP



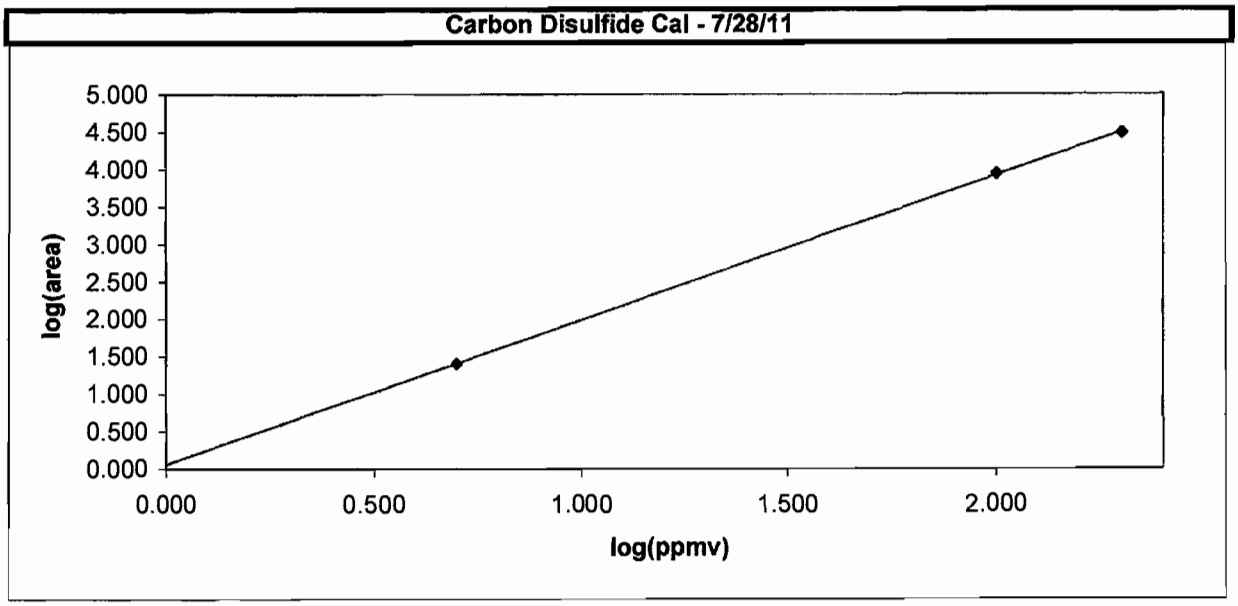
Component	Area
H2S	13085.1
COS	10109.1
CS2	30557.2
	53751.4



ppmv	area	log(ppmv)	log(area)	Slope	Intercept	Corr
0.0				2.078	-0.644	1.000
5.0	6.37	0.699	0.804			
100.0	3,461.3	2.000	3.539			
200.0	13,089.3	2.301	4.117			



ppmv	area	log(ppmv)	log(area)	Slope	Intercept	Corr
0.0	0.0			1.995	-0.575	1.000
5.0	6.6	0.699	0.817			
100.0	2,672.0	2.000	3.427			
200.0	10,126.50	2.301	4.005			



ppmv	area	log(ppmv)	log(area)	Slope	Intercept	Corr
0.0	0.0			1.927	0.065	1.000
5.0	25.63	0.699	1.409			
100.0	8,611.2	2.000	3.935			
200.0	30,563.9	2.301	4.485			

End Checks

Lyondell (7-29-11)-15.CHR	7/29/2011	5:28 PM	100 STD	3,389.20	2,638.10	9,075.60	101.9	100.8	104.8	1.00
Lyondell (7-29-11)-16.CHR	7/29/2011	5:39 PM	100 STD	3,616.8	2,796.30	9,169.20	105.2	103.7	105.4	1.00
Lyondell (7-29-11)-17.CHR	7/29/2011	5:50 PM	100 STD	3,675.5	2,822.90	9,206.60	106.0	104.2	105.6	1.00
Lyondell (7-29-11)-18.CHR	7/29/2011	6:08 PM	5.0 STD	6.5	6.7	28.6	5.0	5.0	5.3	1.00
Lyondell (7-29-11)-19.CHR	7/29/2011	6:19 PM	5.0 STD	6.7	6.5	26.5	5.1	5.0	5.1	1.00
Lyondell (7-29-11)-20.CHR	7/29/2011	6:30 PM	5.0 STD	6.7	6.8	24.9	5.1	5.1	4.9	1.00
Lyondell (7-29-11)-22.CHR	7/29/2011	7:06 PM	200.0 STD	12,262.70	9,500.00	30,379.60	189.3	191.5	196.2	1.00
Lyondell (7-29-11)-23.CHR	7/29/2011	7:25 PM	200.0 STD	12,542.50	9,714.00	31,218.90	191.3	193.7	199.0	1.00
Lyondell (7-29-11)-24.CHR	7/29/2011	7:36 PM	200.0 STD	13,343.80	10,336.40	31,620.00	197.1	199.8	200.3	1.00

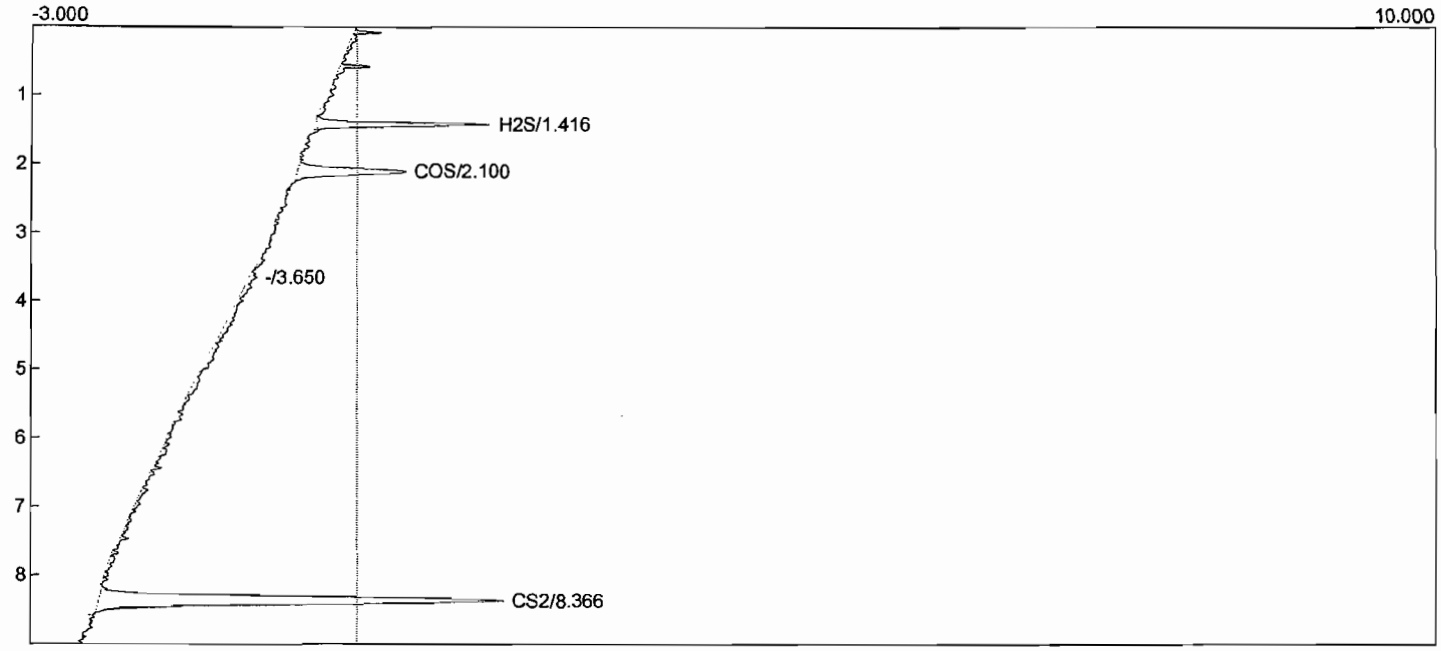
Initial Calibration

ppmv	log10(ppmv)	H2S Area	COS Area	CS2 Area	H2S log10(Area)	COS log10(Area)	CS2 log10(Area)
5.0	0.6990	6.37	6.57	25.63	0.8039	0.8173	1.4088
100.0	2.0000	3,461.30	2,672.03	8,611.20	3.5392	3.4268	3.9351
200.0	2.3010	13,089.27	10,126.50	30,563.90	4.1169	4.0055	4.4852
				Initial Cal Slope =	**2.0783**	**1.9947**	**1.9267**

End Calibration

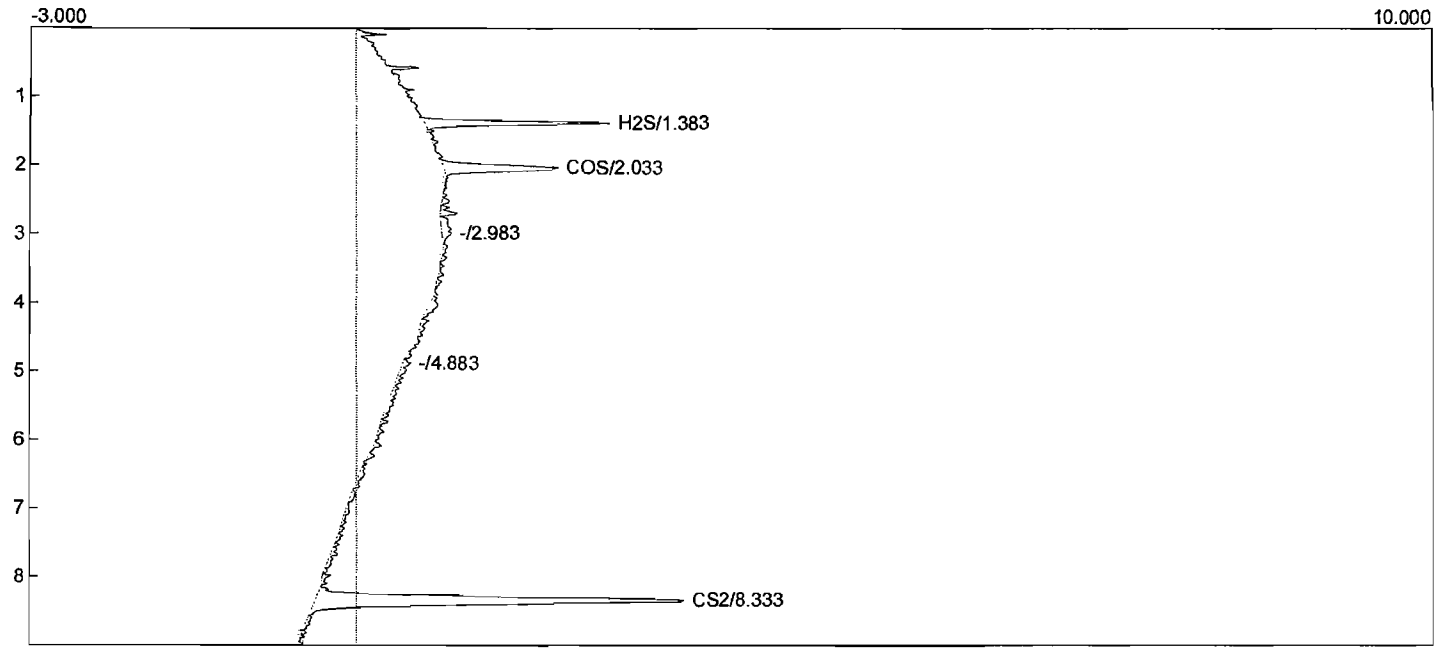
ppmv	log10(ppmv)	H2S Area	COS Area	CS2 Area	H2S log10(Area)	COS log10(Area)	CS2 log10(Area)
5.0	0.6990	6.63	6.67	26.67	0.8217	0.8239	1.4260
100.0	2.0000	3,560.50	2,752.43	9,150.47	3.5515	3.4397	3.9614
200.0	2.3010	12,716.33	9,850.13	31,072.83	4.1044	3.9934	4.4924
				Final Cal Slope =	**2.0637**	**1.9880**	**1.9244**
				Pre & Post Slope Ave =	**2.0710**	**1.9914**	**1.9256**
				SDEV =	0.0103	0.0047	0.0016
				% Difference =	**0.50**	**0.24**	**0.083**

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 18:08:50
Data file: Lyondell (7-29-11)-18.CHR ()
Sample: 5.0 STD
Operator: JP



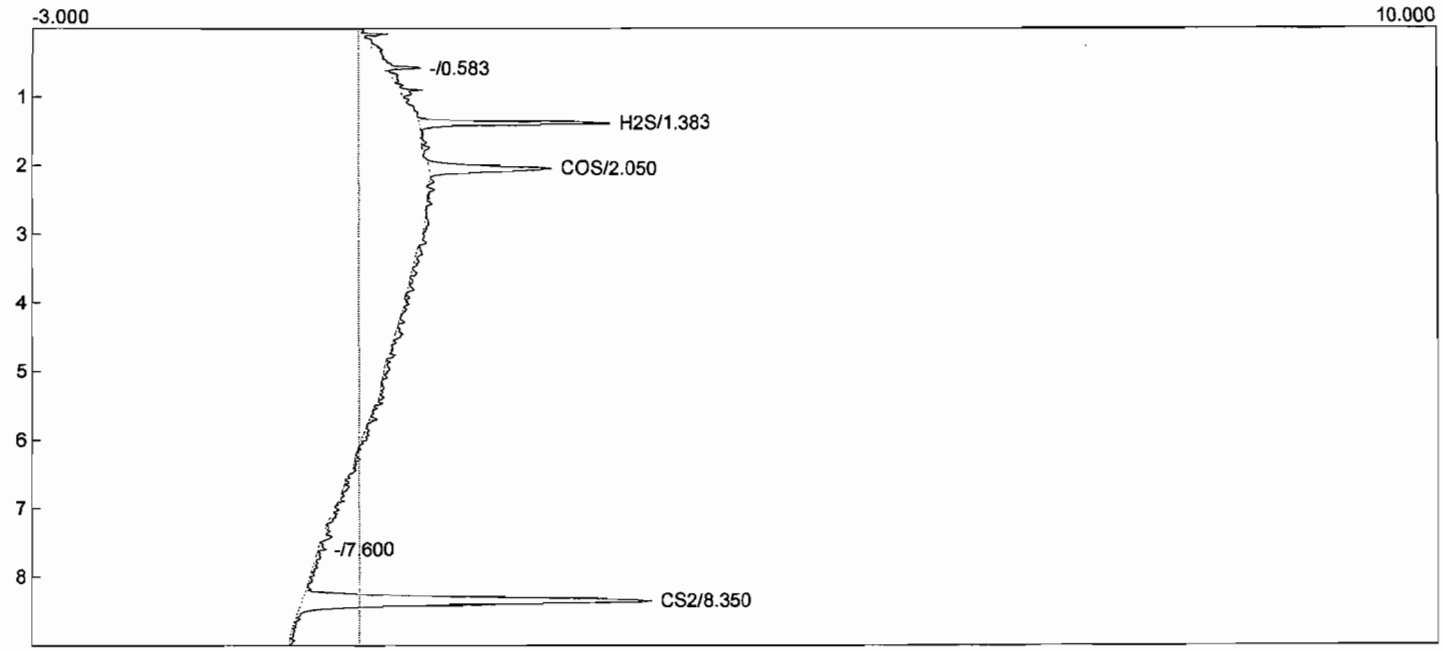
Component	Area
H2S	6.5
COS	6.7
CS2	28.6
	41.7

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 18:19:50
Data file: Lyondell (7-29-11)-19.CHR ()
Sample: 5.0 STD
Operator: JP



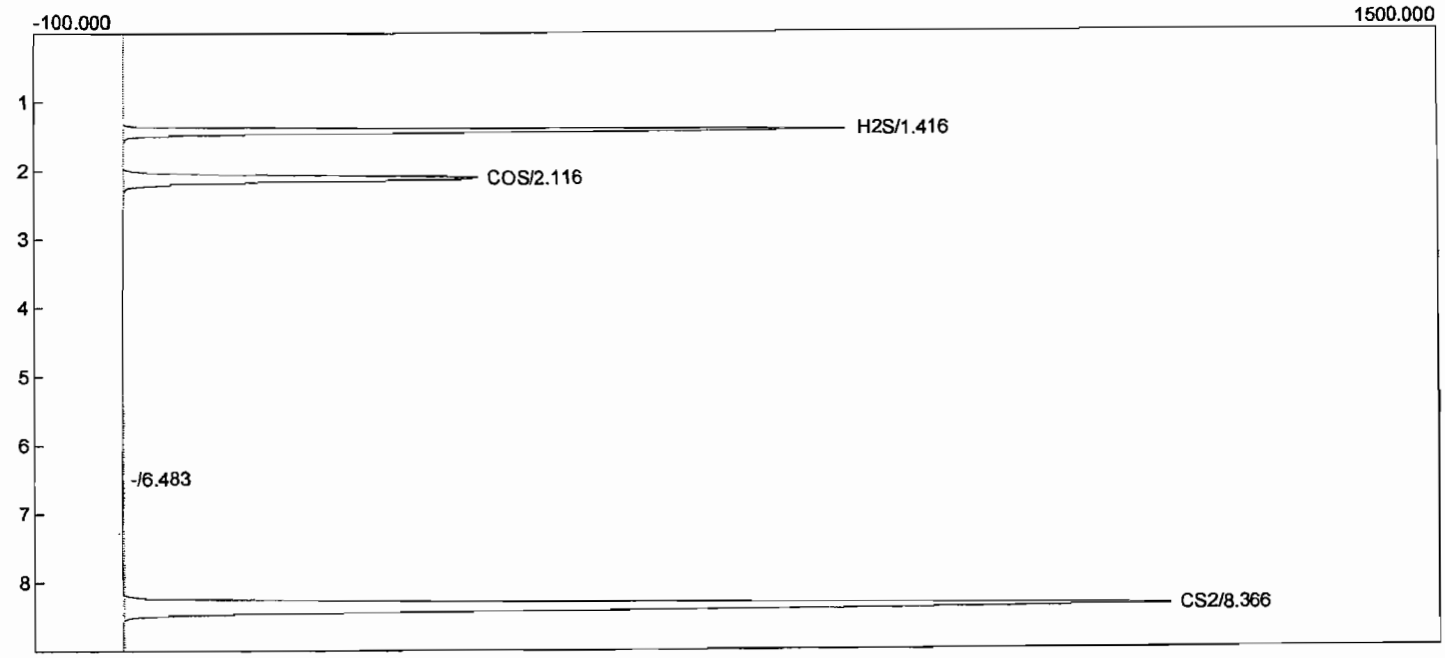
Component	Area
H2S	6.7
COS	6.5
CS2	26.5
	39.7

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 18:30:50
Data file: Lyondell (7-29-11)-20.CHR ()
Sample: 5.0 STD
Operator: JP



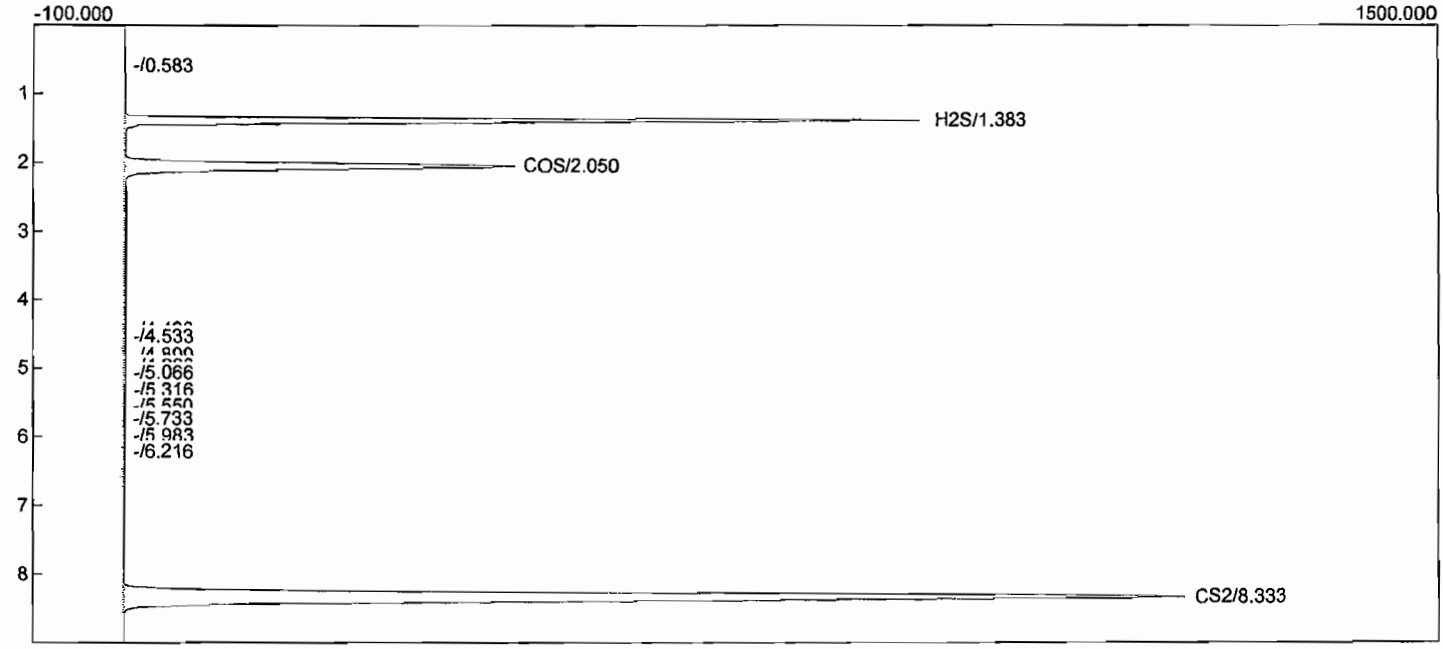
Component	Area
H2S	6.7
COS	6.8
CS2	24.9
	38.4

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 17:28:12
Data file: Lyondell (7-29-11)-15.CHR ()
Sample: 100.0 STD
Operator: JP



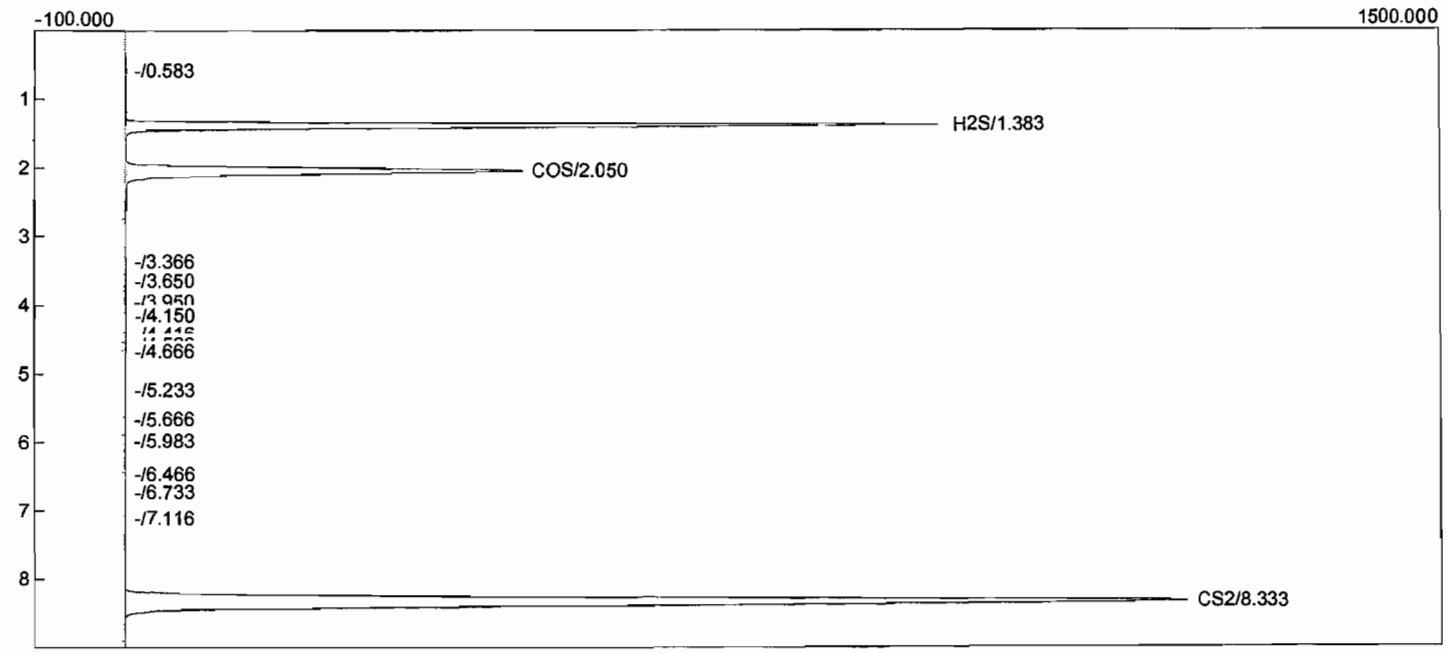
Component	Area
H2S	3389.2
COS	2638.1
CS2	9075.6
	15103.0

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 17:39:12
Data file: Lyondell (7-29-11)-16.CHR ()
Sample: 100.0 STD
Operator: JP



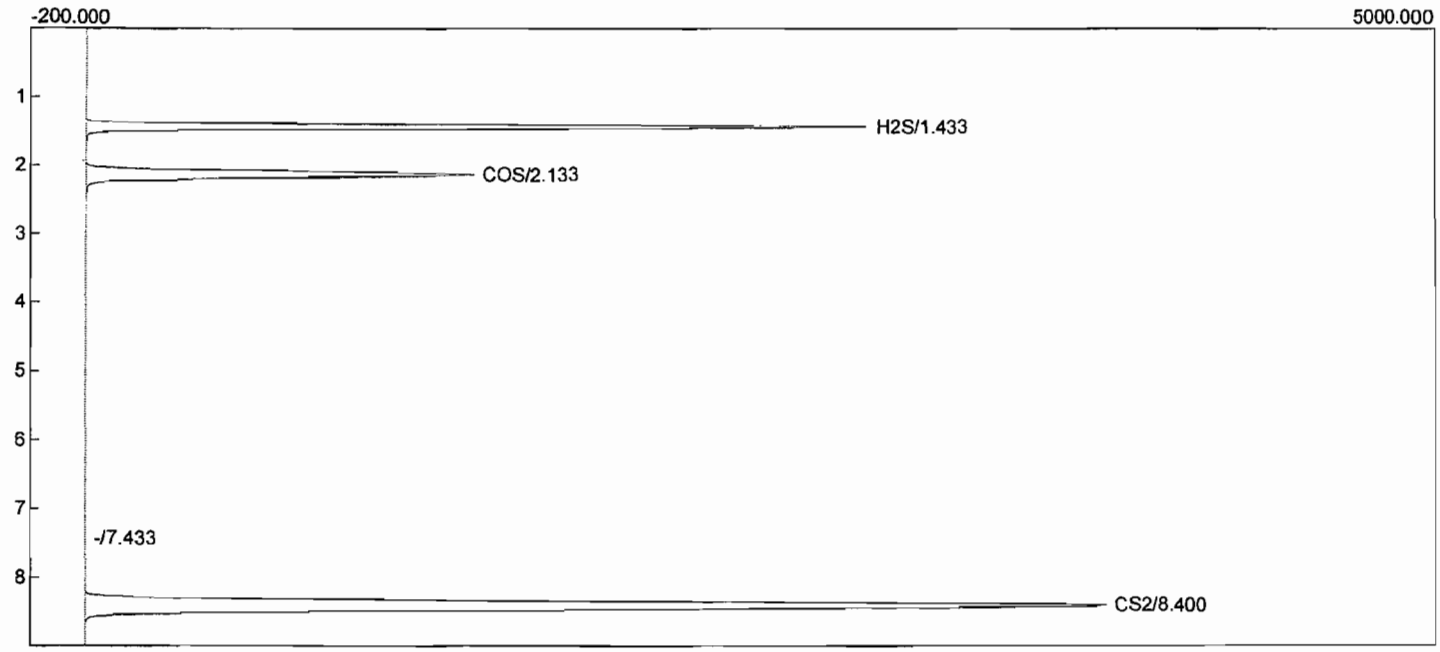
Component	Area
H2S	3616.8
COS	2796.3
CS2	9169.2
	15582.2

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 17:50:12
Data file: Lyondell (7-29-11)-17.CHR ()
Sample: 100.0 STD
Operator: JP



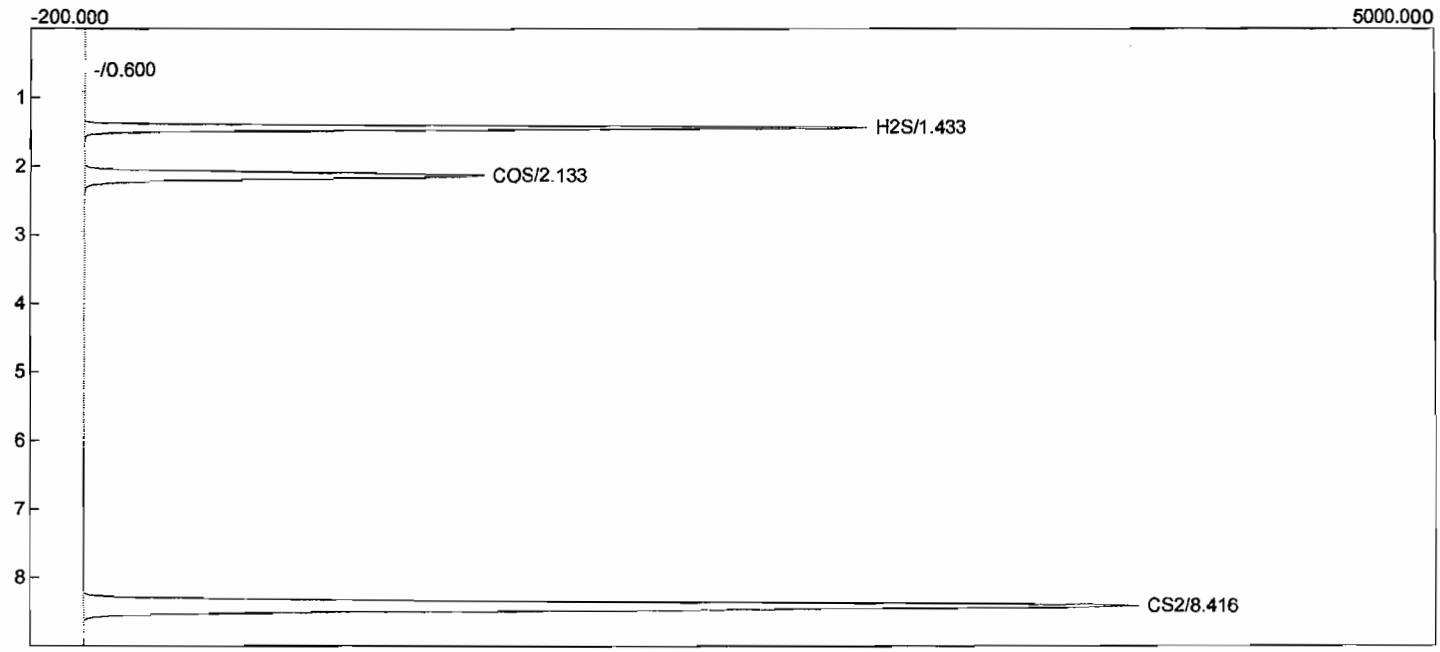
Component	Area
H2S	3675.5
COS	2822.9
CS2	9206.6
	15705.0

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 19:06:33
Data file: Lyondell (7-29-11)-22.CHR ()
Sample: 200.0 STD
Operator: JP



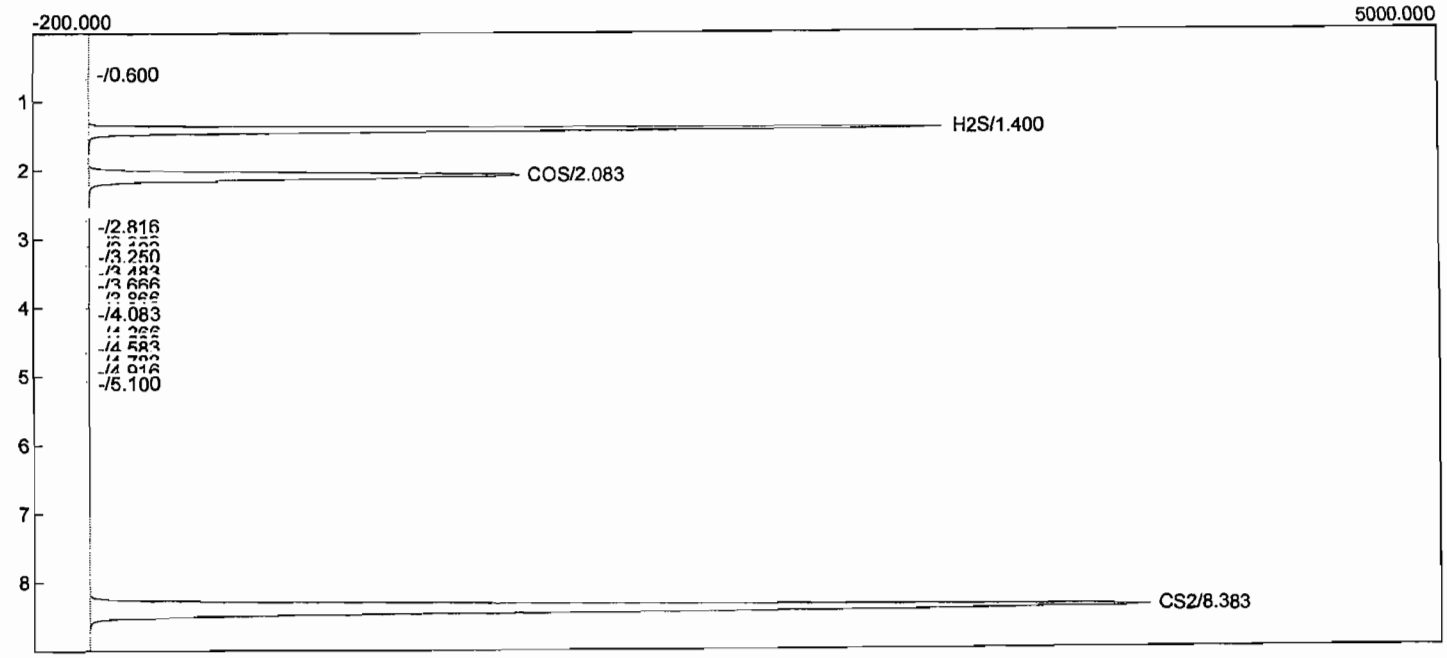
Component	Area
H2S	12262.7
COS	9500.0
CS2	30379.6
	52142.4

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 19:25:40
Data file: Lyondell (7-29-11)-23.CHR ()
Sample: 200.0 STD
Operator: JP



Component	Area
H2S	12542.5
COS	9714.0
CS2	31218.9
	53475.3

Lab name: ARI Environmental Inc
Client: Lyondell
Analysis date: 07/29/2011 19:36:40
Data file: Lyondell (7-29-11)-24.CHR ()
Sample: 200.0 STD
Operator: JP



Component	Area
H2S	13343.8
COS	10336.4
CS2	31620.0
	55300.2

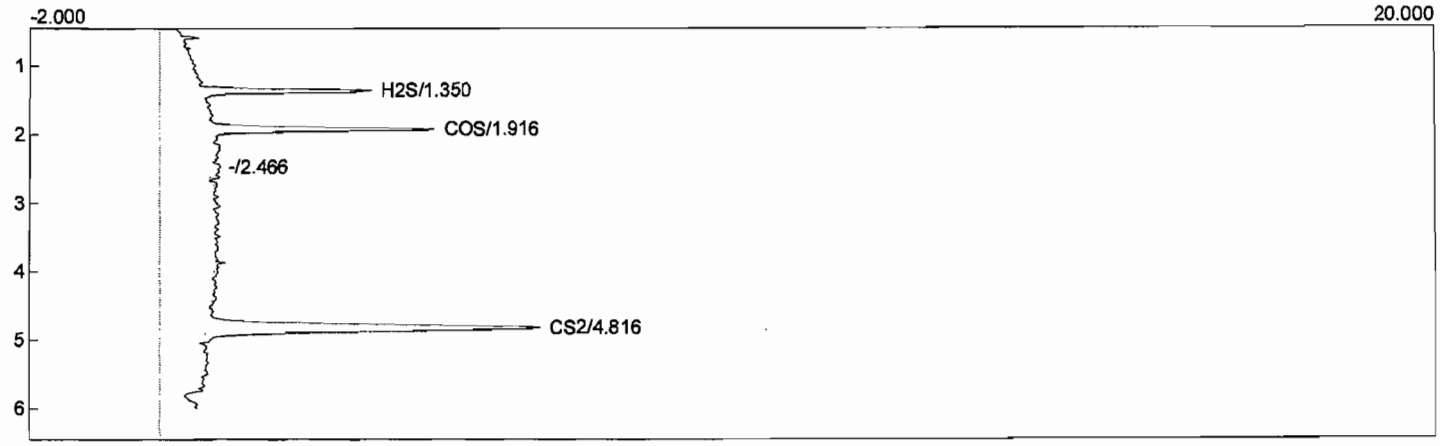
Calibration Details &

File	Date	Time	Description	H2S Area	COS Area	CS2 Area	H2S ppmv	COS ppmv	CS2 ppmv
Lyondell (8-1-11)-16.CHR	8/1/11	2:25 PM	5.0 STD	10.9	16.1	38.8	5.0	5.0	5.0
Lyondell (8-1-11)-17.CHR	8/1/11	2:32 PM	5.0 STD	11.1	15.3	37.7	5.0	5.0	5.0
Lyondell (8-1-11)-19.CHR	8/1/11	2:47 PM	5.0 STD	10.8	14.8	35.5	5.0	5.0	5.0
			Ave =	10.9	15.4	37.3			
Lyondell (8-1-11)-20.CHR	8/1/11	2:55 PM	100.0 STD	4,949.6	5,248.5	12,804.0	100.0	100.0	100.0
Lyondell (8-1-11)-22.CHR	8/1/11	3:09 PM	100.0 STD	4,779.0	5,049.9	12,287.0	100.0	100.0	100.0
Lyondell (8-1-11)-23.CHR	8/1/11	3:16 PM	100.0 STD	4,985.3	5,234.9	12,764.0	100.0	100.0	100.0
			Ave =	4,904.6	5,177.8	12,618.3			
Lyondell (8-1-11)-25.CHR	8/1/11	3:35 PM	200.0 STD	16,880.8	17,350.5	39,202.0	200.0	200.0	200.0
Lyondell (8-1-11)-26.CHR	8/1/11	3:43 PM	200.0 STD	17,109.7	17,718.3	39,558.6	200.0	200.0	200.0
Lyondell (8-1-11)-27.CHR	8/1/11	3:50 PM	200.0 STD	17,244.1	17,781.8	39,769.3	200.0	200.0	200.0
			Ave =	17,078.2	17,616.9	39,510.0			
HREF-TRSBAGS-WORKBOOK-032T-REV1									
			Slope =	**2.007**	**1.919**	**1.905**			
			Intercept =	**-0.358**	**-0.149**	**0.249**			

Standards Calculated as Samples

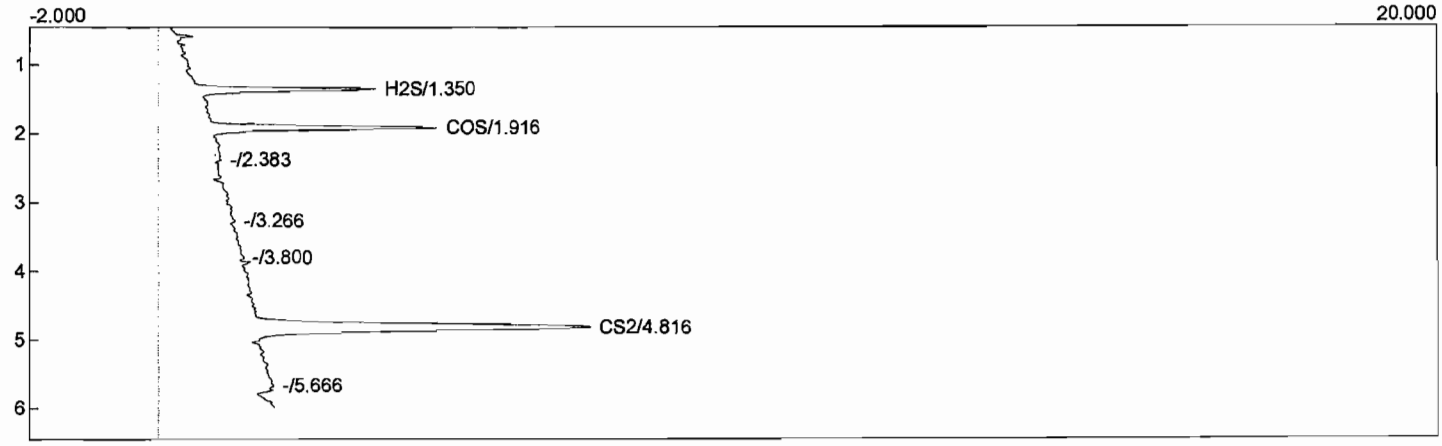
File	Date	Time	Description	H2S Area	COS Area	CS2 Area		H2S ppmv	COS ppmv	CS2 ppmv
Lyondell (8-1-11)-16.CHR	8/1/11	2:25 PM	5.0 STD	10.9	16.1	38.8		5.0	5.1	5.1
Lyondell (8-1-11)-17.CHR	8/1/11	2:32 PM	5.0 STD	11.1	15.3	37.7		5.0	5.0	5.0
Lyondell (8-1-11)-19.CHR	8/1/11	2:47 PM	5.0 STD	10.8	14.8	35.5		4.9	4.9	4.8
				10.9	15.4	37.3	Ave =	5.0	5.0	5.0
Lyondell (8-1-11)-20.CHR	8/1/11	2:55 PM	100.0 STD	4,949.6	5,248.5	12,804.0		104.5	103.8	106.1
Lyondell (8-1-11)-22.CHR	8/1/11	3:09 PM	100.0 STD	4,779.0	5,049.9	12,287.0		102.7	101.7	103.9
Lyondell (8-1-11)-23.CHR	8/1/11	3:16 PM	100.0 STD	4,985.3	5,234.9	12,764.0		104.9	103.7	106.0
				4,904.6	5,177.8	12,618.3	Ave =	104.0	103.1	105.3
Lyondell (8-1-11)-25.CHR	8/1/11	3:35 PM	200.0 STD	16,880.8	17,350.5	39,202.0		192.6	193.6	191.0
Lyondell (8-1-11)-26.CHR	8/1/11	3:43 PM	200.0 STD	17,109.7	17,718.3	39,558.6		193.9	195.7	191.9
Lyondell (8-1-11)-27.CHR	8/1/11	3:50 PM	200.0 STD	17,244.1	17,781.8	39,769.3		194.6	196.1	192.4
				17,078.2	17,616.9	39,510.0	Ave =	193.7	195.1	191.8

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 14:25:40
Method: 15
Data file: Lyondell (8-1-11)-16.CHR ()
Sample: 5.0 STD
Operator: JP



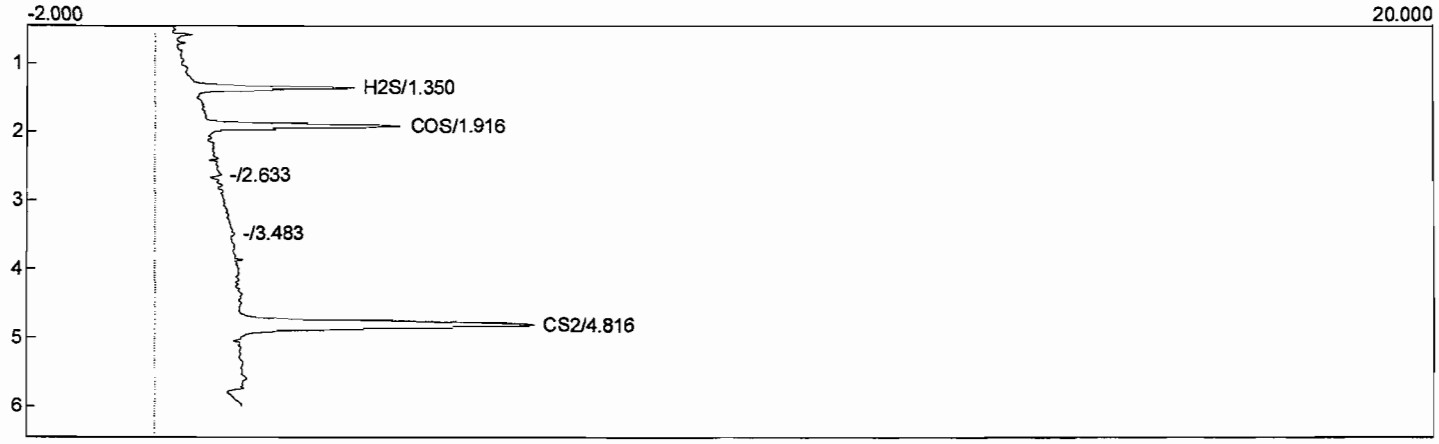
Component	Area
H2S	10.9
COS	16.1
CS2	38.8
	65.8

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 14:32:55
Method: 15
Data file: Lyondell (8-1-11)-17.CHR ()
Sample: 5.0 STD
Operator: JP



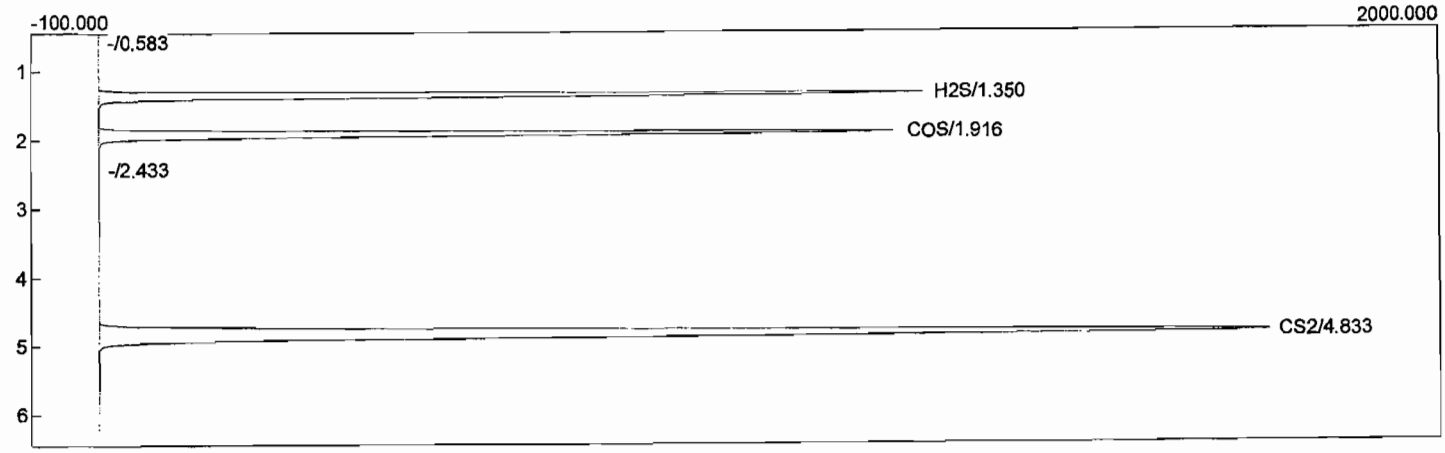
Component	Area
H2S	11.1
COS	15.3
CS2	37.7
	64.0

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 14:47:26
Method: 15
Data file: Lyondell (8-1-11)-19.CHR ()
Sample: 5.0 STD
Operator: JP



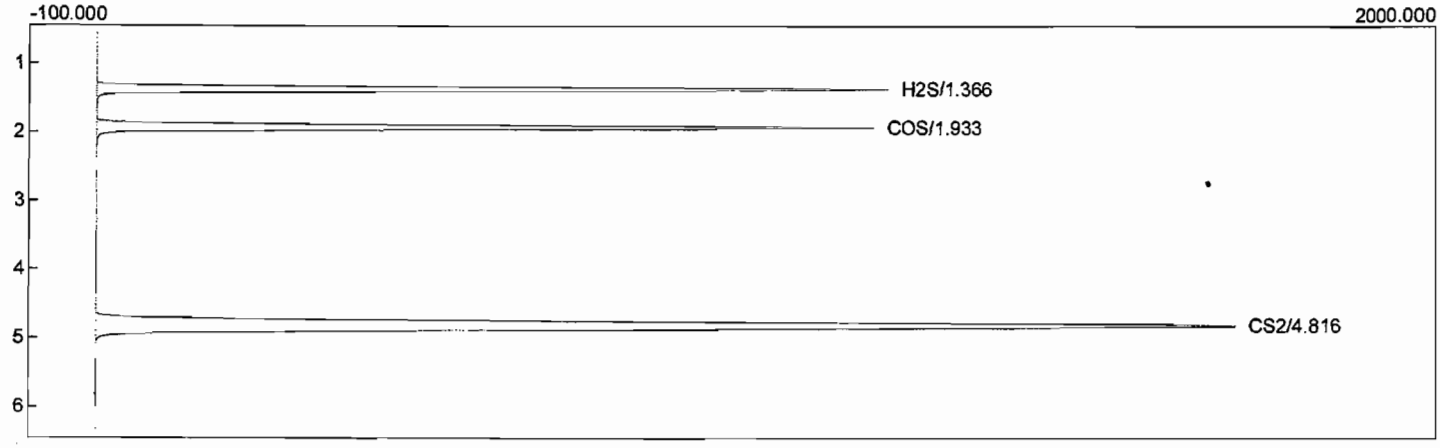
Component	Area
H2S	10.8
COS	14.8
CS2	35.5
	61.1

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 14:55:06
Method: 15
Data file: Lyondell (8-1-11)-20.CHR ()
Sample: 100.0 STD
Operator: JP



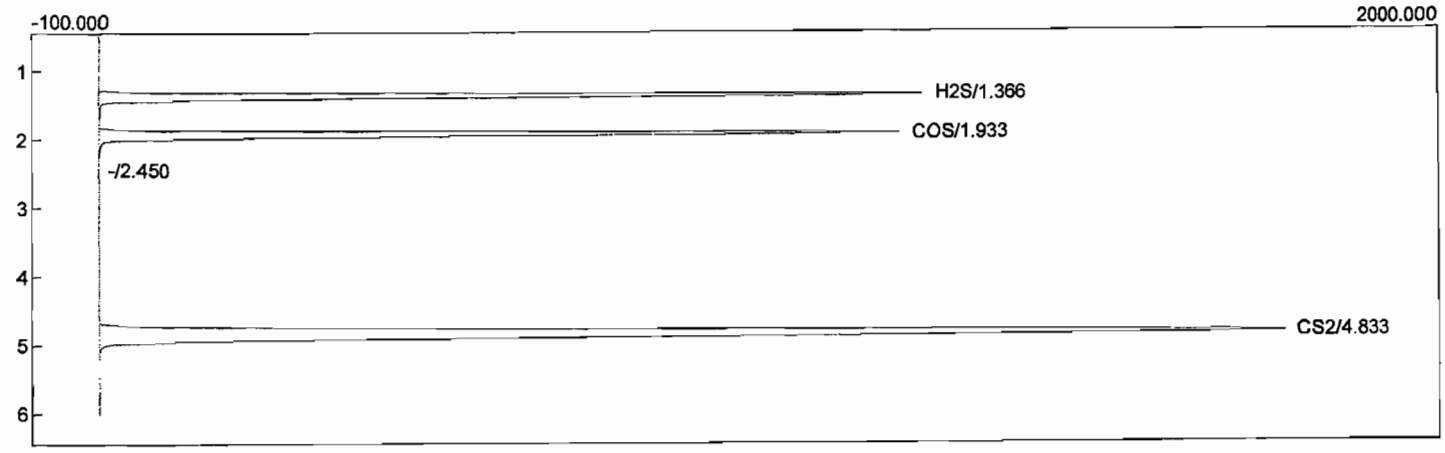
Component	Area
H2S	4949.6
COS	5248.5
CS2	12804.0
	23002.1

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 15:09:36
Method: 15
Data file: Lyondell (8-1-11)-22.CHR ()
Sample: 100.0 STD
Operator: JP



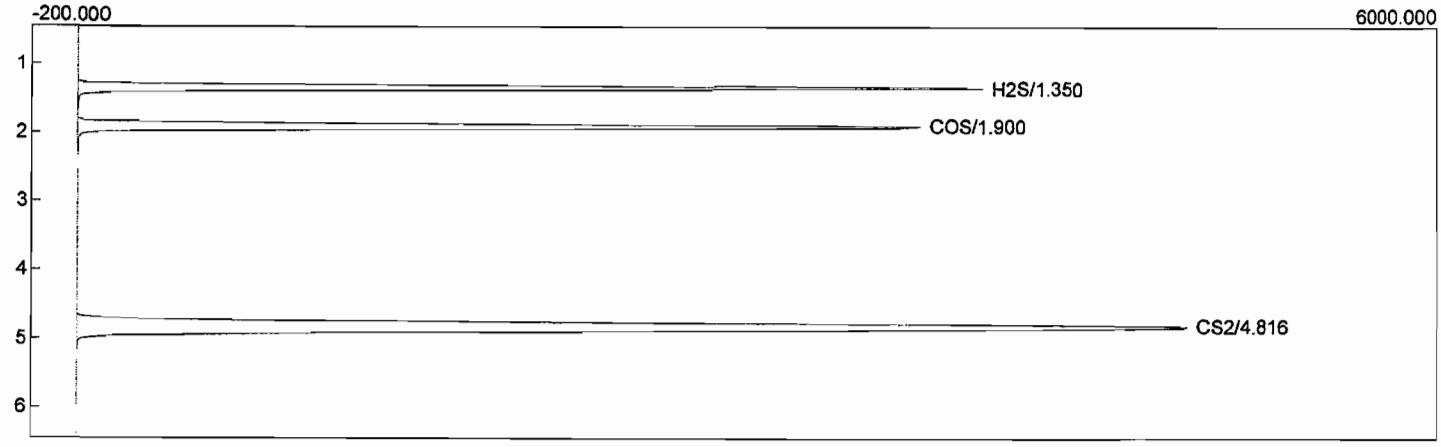
Component	Area
H2S	4779.0
COS	5049.9
CS2	12287.0
	22116.0

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 15:16:51
Method: 15
Data file: Lyondell (8-1-11)-23.CHR ()
Sample: 100.0 STD
Operator: JP



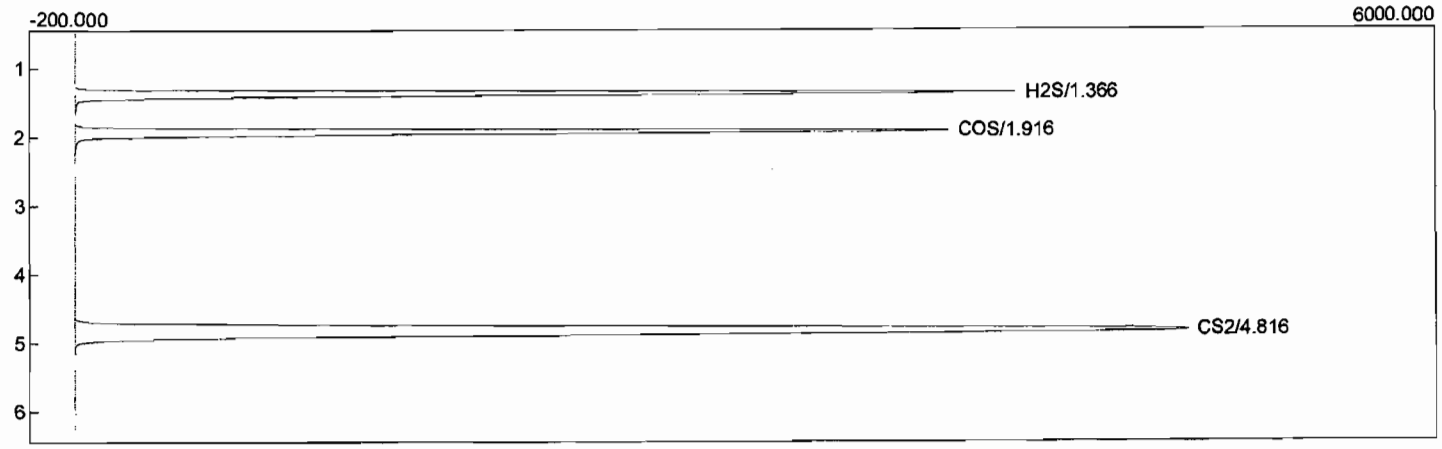
Component	Area
H2S	4985.3
COS	5234.9
CS2	12764.0
	22984.3

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 15:35:47
Method: 15
Data file: Lyondell (8-1-11)-25.CHR ()
Sample: 200.0 STD
Operator: JP



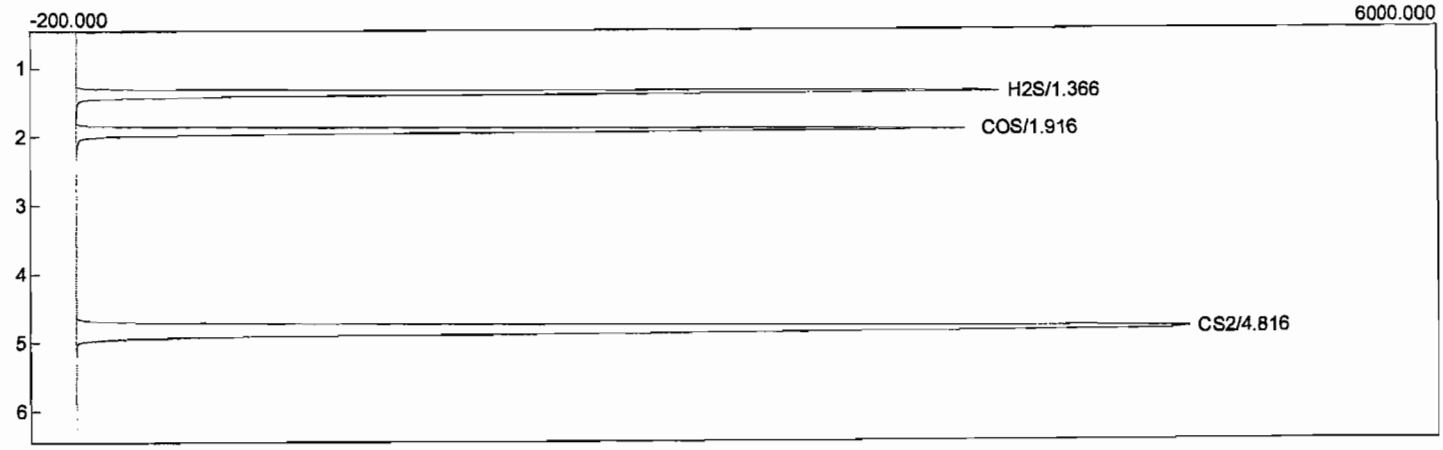
Component	Area
H2S	16880.8
COS	17350.5
CS2	39202.0
	73433.3

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 15:43:02
Method: 15
Data file: Lyondell (8-1-11)-26.CHR ()
Sample: 200.0 STD
Operator: JP



Component	Area
H2S	17109.7
COS	17718.3
CS2	39558.6
	74386.6

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/1/11
Analysis date: 08/01/2011 15:50:17
Method: 15
Data file: Lyondell (8-1-11)-27.CHR ()
Sample: 200.0 STD
Operator: JP



Component	Area
H2S	17244.1
COS	17781.8
CS2	39769.3
	74795.2

End Checks

Lyondell (8-2-11)-37.CHR	8/2/11	5:37 PM	5.0 STD	9.5	12.6	40.2	4.9	5.0	5.5	1
Lyondell (8-2-11)-38.CHR	8/2/11	5:44 PM	5.0 STD	9.6	13.1	38.9	4.9	5.1	5.4	1
Lyondell (8-2-11)-42.CHR	8/2/11	6:12 PM	5.0 STD	9.5	12.5	36.8	4.9	4.9	5.3	1
				Ave = 9.5	12.7	38.6	**Ave = 4.9**	**5.0**	**5.4**	
Lyondell (8-2-11)-33.CHR	8/2/11	5:02 PM	100.0 STD	4,897.2	5,366.3	12,596.4	106.9	108.1	108.4	1
Lyondell (8-2-11)-34.CHR	8/2/11	5:09 PM	100.0 STD	4,871.9	5,263.7	12,375.0	106.6	107.1	107.4	1
Lyondell (8-2-11)-35.CHR	8/2/11	5:16 PM	100.0 STD	4,939.7	5,267.0	12,461.7	107.4	107.1	107.8	1
							Ave = 107.0	**107.4**	**107.9**	
Lyondell (8-2-11)-47.CHR	8/2/11	7:13 PM	200.0 STD	15,855.4	17,275.4	35,061.8	190.8	196.5	184.1	1
Lyondell (8-2-11)-49.CHR	8/2/11	7:26 PM	200.0 STD	15,961.2	17,299.2	35,144.0	191.4	196.6	184.4	1
Lyondell (8-2-11)-50.CHR	8/2/11	7:32 PM	200.0 STD	15,967.1	17,385.9	35,554.0	191.5	197.1	185.5	1
							Ave = 191.2	**196.7**	**184.7**	

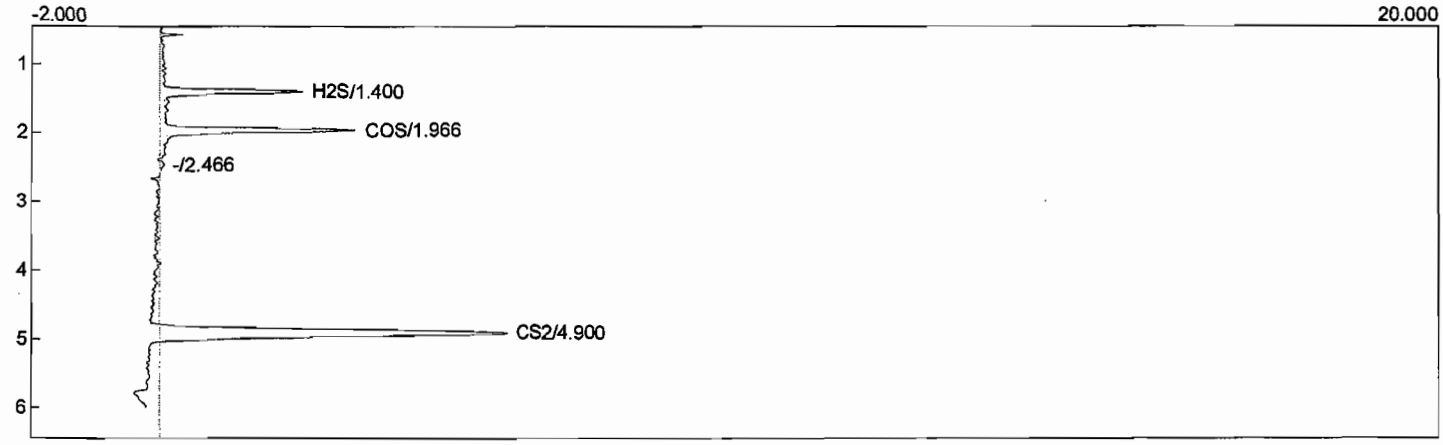
Initial Calibration

ppmv	log10(ppmv)	H2S Area	COS Area	CS2 Area	H2S log10(Area)	COS log10(Area)	CS2 log10(Area)
5.0	4:46 PM	10.93	15.40	37.33	1.0388	1.1875	1.5721
100.0	12:00 AM	4,904.63	5,177.77	12,618.33	3.6906	3.7141	4.1010
200.0	7:13 AM	17,078.20	17,616.87	39,509.97	4.2324	4.2459	4.5967
				Initial Cal Slope =	**2.0069**	**1.9189**	**1.9046**

End Calibration

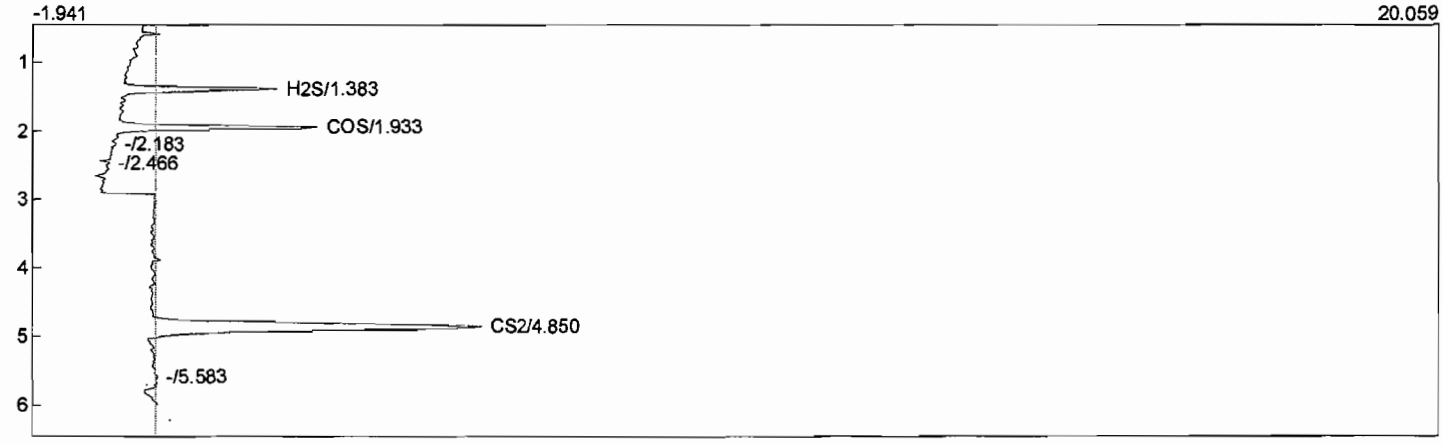
ppmv	log10(ppmv)	H2S Area	COS Area	CS2 Area	H2S log10(Area)	COS log10(Area)	CS2 log10(Area)
5.0	4:46 PM	9.53	12.73	38.63	0.9792	1.1049	1.5870
100.0	12:00 AM	4,902.93	5,299.00	12,477.70	3.6905	3.7242	4.0961
200.0	7:13 AM	15,927.90	17,320.17	35,253.27	4.2022	4.2386	4.5472
				Final Cal Slope =	**2.0333**	**1.9731**	**1.8719**
				Pre & Post Slope Ave =	**2.0201**	**1.9460**	**1.8883**
				SDEV =	0.0187	0.0383	0.0231
				% Difference =	**0.93**	**2.0**	**1.2**

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 17:37:49
Method: 15
Data file: Lyondell (8-2-11)-37.CHR ()
Sample: 5.0 STD
Operator: JP



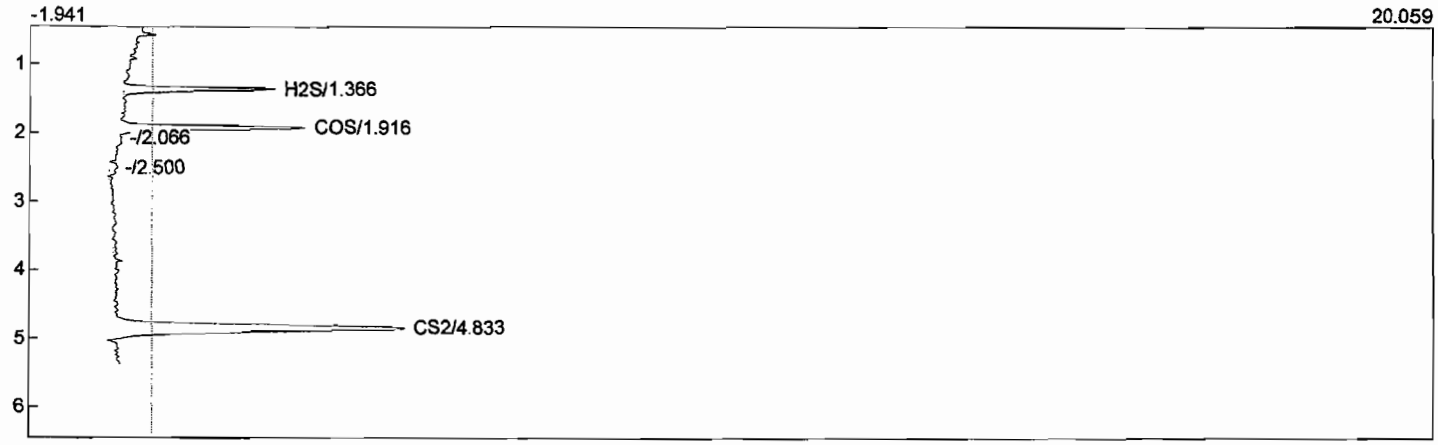
Component	Area
H2S	9.5
COS	12.6
CS2	40.2
	62.3

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 17:44:49
Method: 15
Data file: Lyondell (8-2-11)-38.CHR ()
Sample: 5.0 STD
Operator: JP



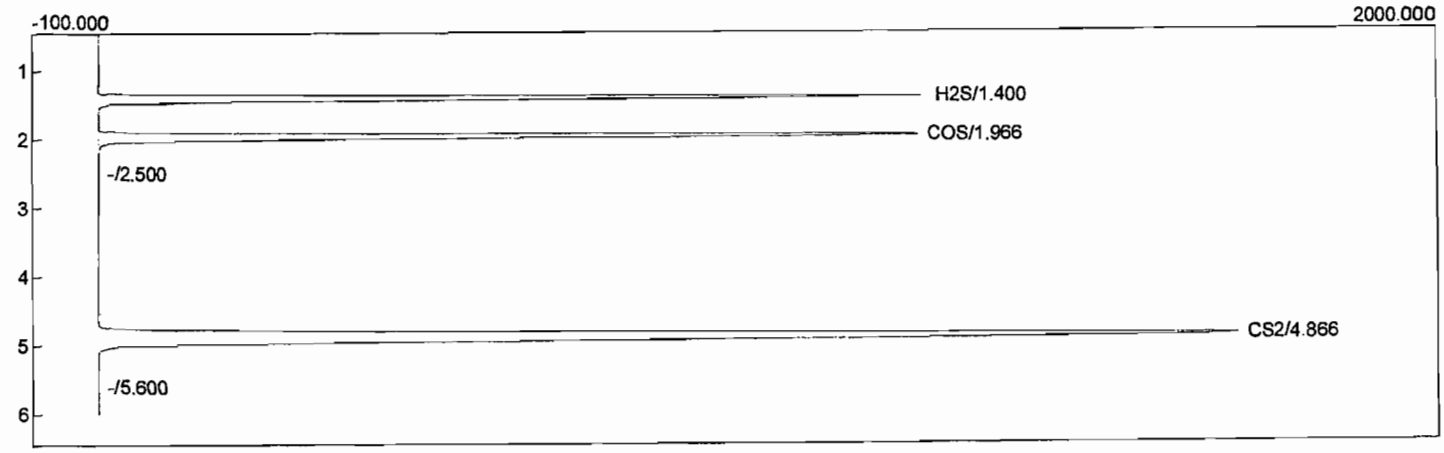
Component	Area
H2S	9.6
COS	13.1
CS2	38.9
	61.6

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 18:12:49
Method: 15
Data file: Lyondell (8-2-11)-42.CHR ()
Sample: 5.0 STD
Operator: JP



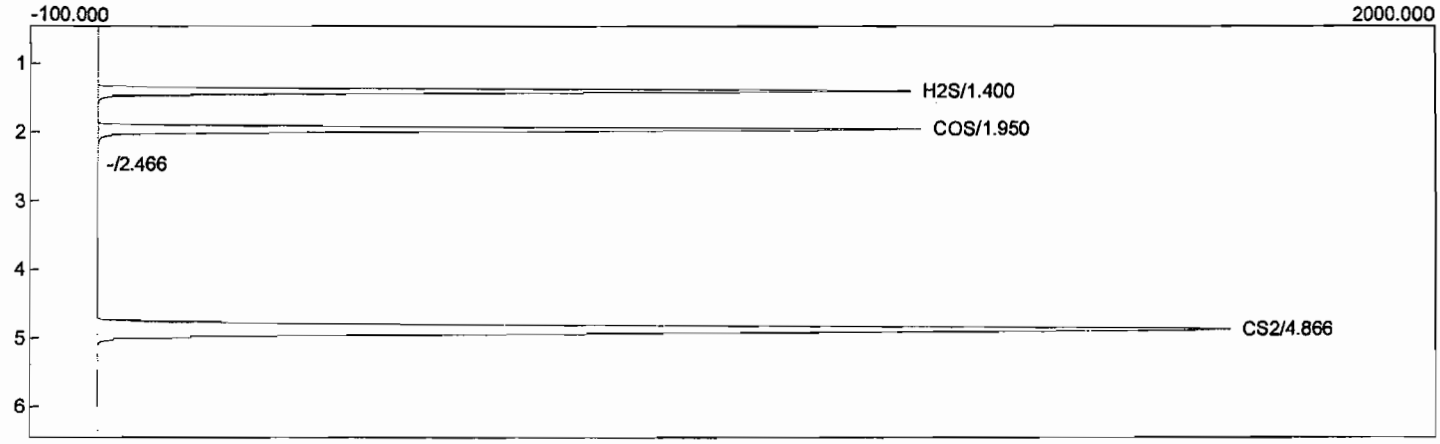
Component	Area
H2S	9.5
COS	12.5
CS2	36.8
	58.8

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 17:02:47
Method: 15
Data file: Lyondell (8-2-11)-33.CHR ()
Sample: 100 STD
Operator: JP



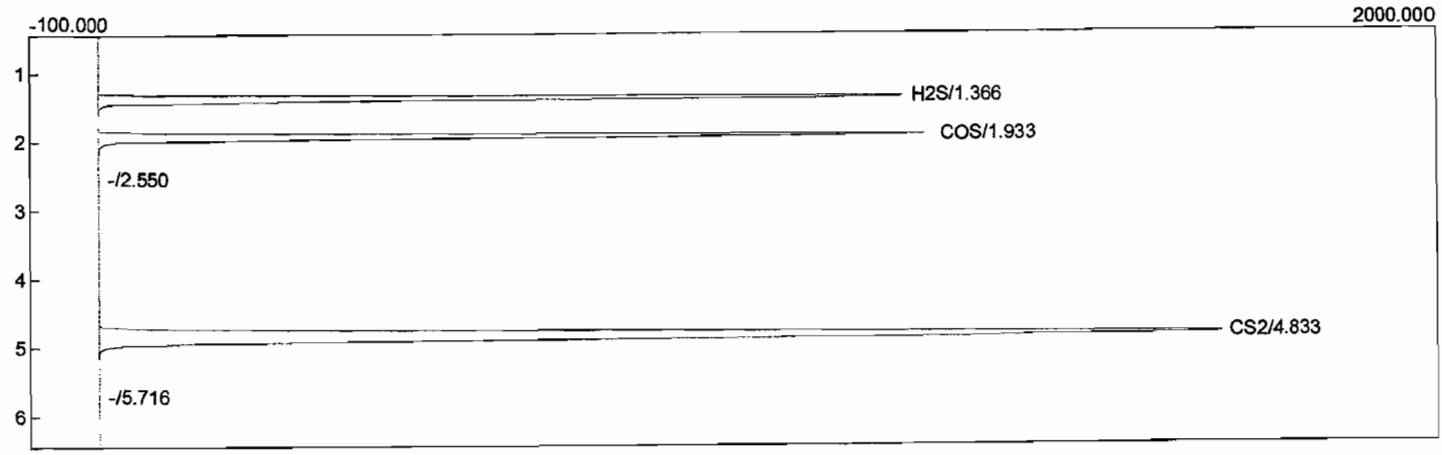
Component	Area
H2S	4897.2
COS	5366.3
CS2	12596.4
	22860.0

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 17:09:47
Method: 15
Data file: Lyondell (8-2-11)-34.CHR ()
Sample: 100 STD
Operator: JP



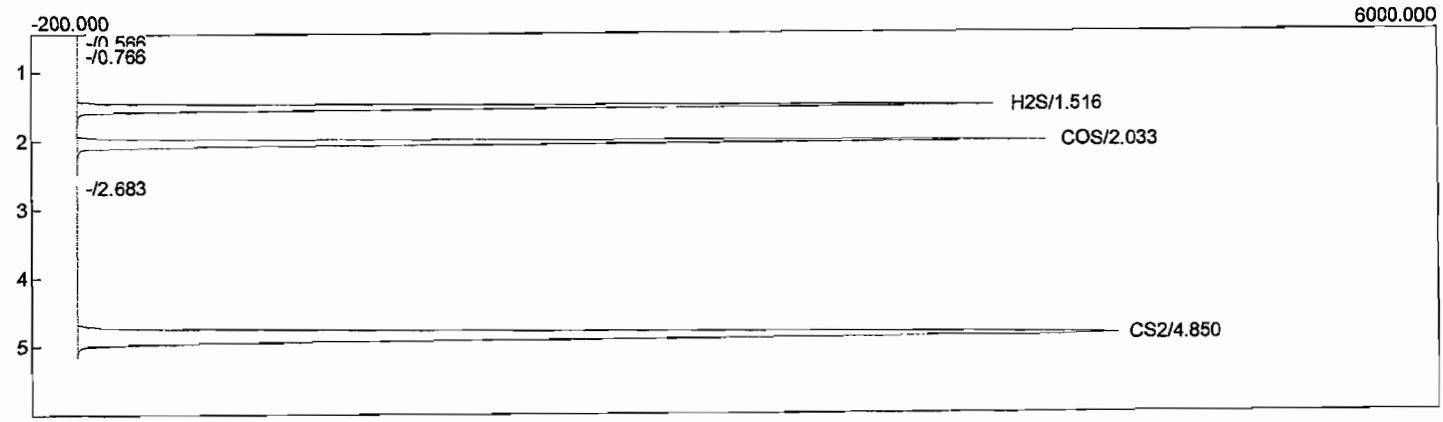
Component	Area
H2S	4871.9
COS	5263.7
CS2	12375.0
	22510.6

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 17:16:47
Method: 15
Data file: Lyondell (8-2-11)-35.CHR ()
Sample: 100 STD
Operator: JP



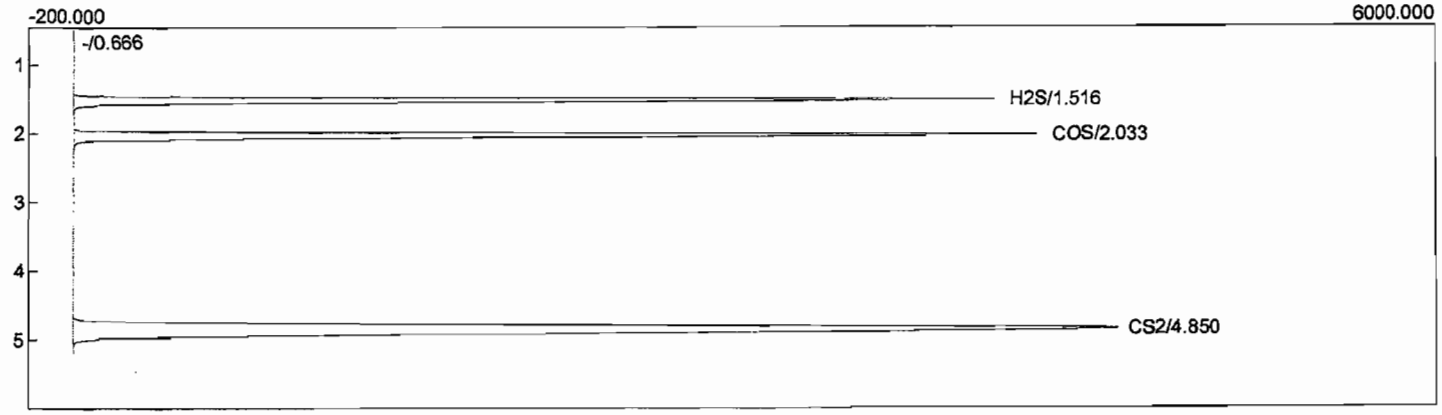
Component	Area
H2S	4939.7
COS	5267.0
CS2	12461.7
	22668.3

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 19:13:02
Method: 15
Data file: Lyondell (8-2-11)-47.CHR ()
Sample: 200.0 STD
Operator: JP



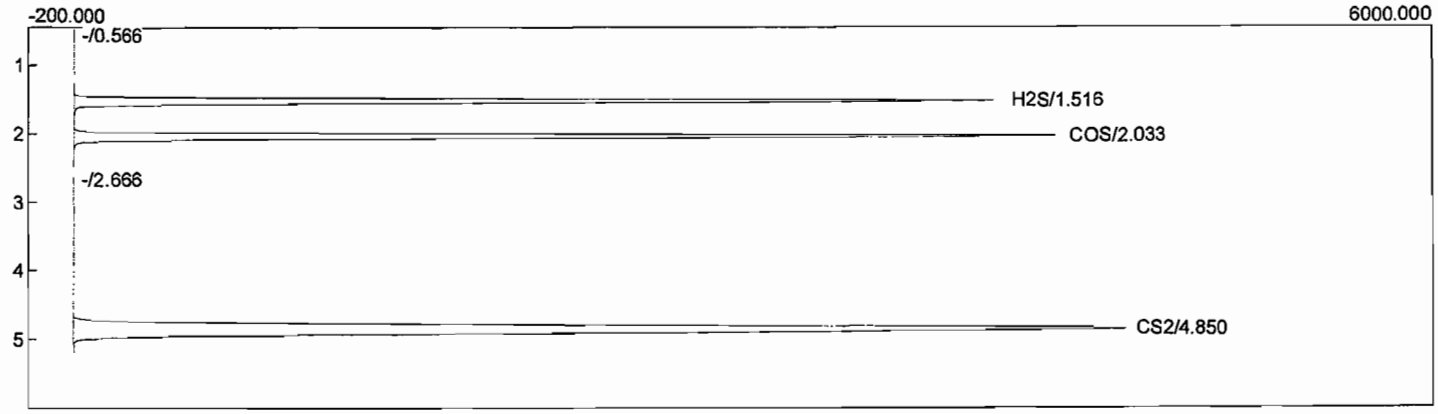
Component	Area
H2S	15855.4
COS	17275.4
CS2	35061.8
	68192.5

Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 19:26:07
Method: 15
Data file: Lyondell (8-2-11)-49.CHR ()
Sample: 200.0 STD
Operator: JP

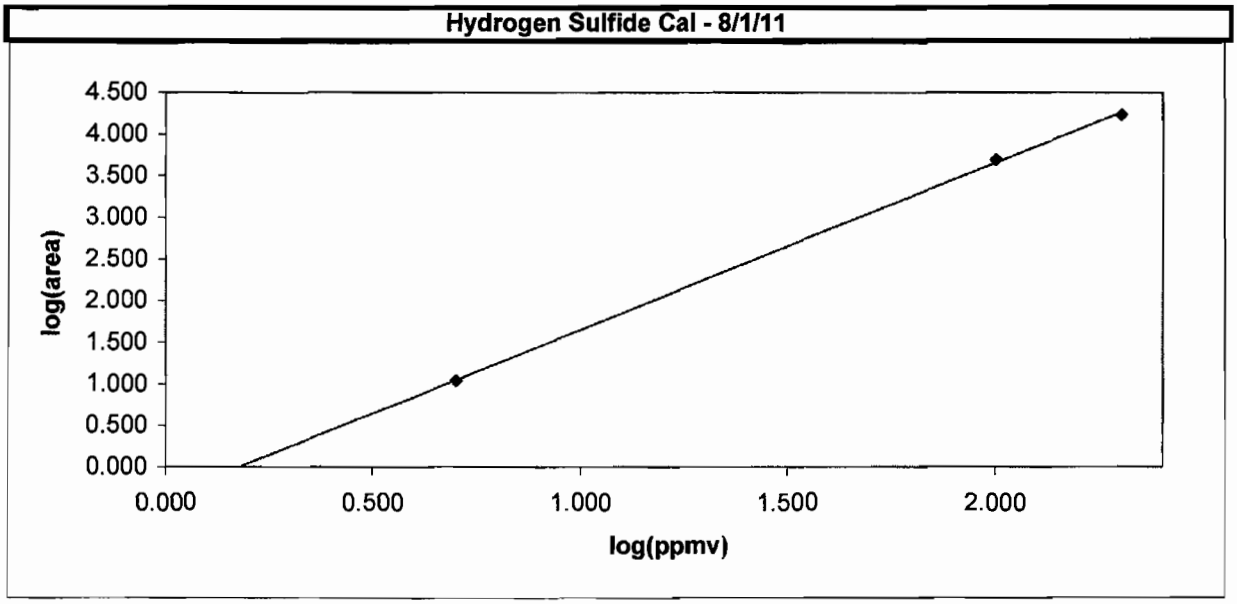


Component	Area
H2S	15961.2
COS	17299.2
CS2	35144.0
	68404.4

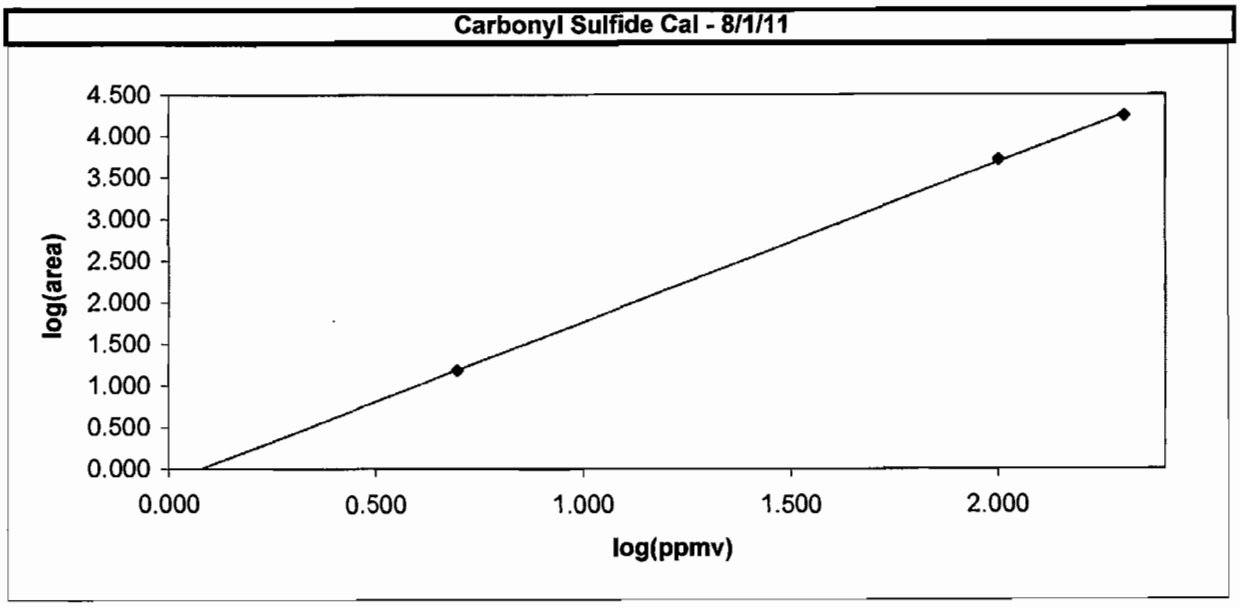
Lab name: ARI Environmental Inc
Client: Lyondell
Client ID: Coker 136
Collected: 8/2/11
Analysis date: 08/02/2011 19:32:30
Method: 15
Data file: Lyondell (8-2-11)-50.CHR ()
Sample: 200.0 STD
Operator: JP



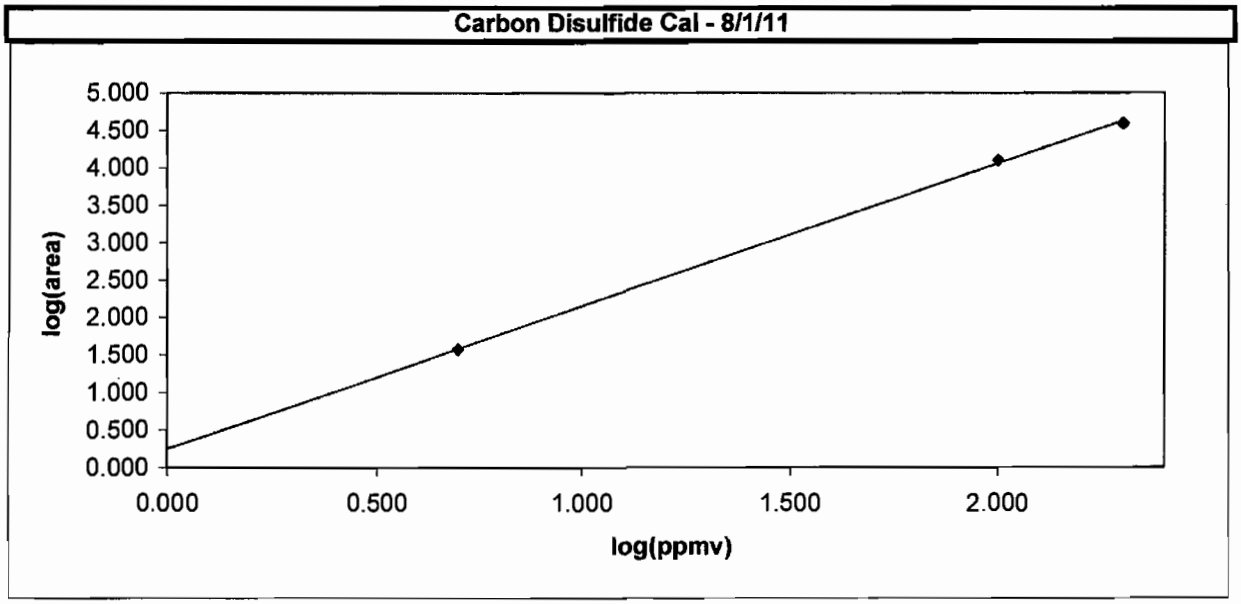
Component	Area
H2S	15967.1
COS	17385.9
CS2	35554.0
	68907.1



ppmv	area	log(ppmv)	log(area)	Slope	Intercept	Corr
0.0				2.007	-0.358	1.000
5.0	10.93	0.699	1.039			
100.0	4,904.6	2.000	3.691			
200.0	17,078.2	2.301	4.232			



ppmv	area	log(ppmv)	log(area)	Slope	Intercept	Corr
0.0	0.0			1.919	-0.149	1.000
5.0	15.4	0.699	1.188			
100.0	5,177.8	2.000	3.714			
200.0	17,616.87	2.301	4.246			



ppmv	area	log(ppmv)	log(area)	Slope	Intercept	Corr
0.0	0.0			1.905	0.249	1.000
5.0	37.33	0.699	1.572			
100.0	12,618.3	2.000	4.101			
200.0	39,510.0	2.301	4.597			

C-308

Houston Refining, Houston TX, 736 Coker Unit, Methanol, Method 18 - 7/19 - 7/28/11

Calibration Curve Calculation

Std. (µg/ml)	Pre Cal 1 (area counts)	Pre Cal 2 (area counts)	Pre Cal 3 (area counts)	Average (area counts)	Post Cal 1 (area counts)	Post Cal 2 (area counts)	Post Cal 3 (area counts)	Average (area counts)	Pre-Post Average (area counts)	Pre-Post Deviation (%)
2.0	7.59	7.38	7.77	7.58						
5.0	15.80	15.51	15.42	15.57						
10.0	31.88	32.53	31.77	32.06						
24.9	72.87	73.82	70.80	72.50	71.74	72.81	68.26	70.94	71.72	-1.1
49.8	140.18	139.82	141.34	140.45						
99.7	272.23	277.24	277.26	275.58						
199.3	538.02	557.69	558.91	551.54						

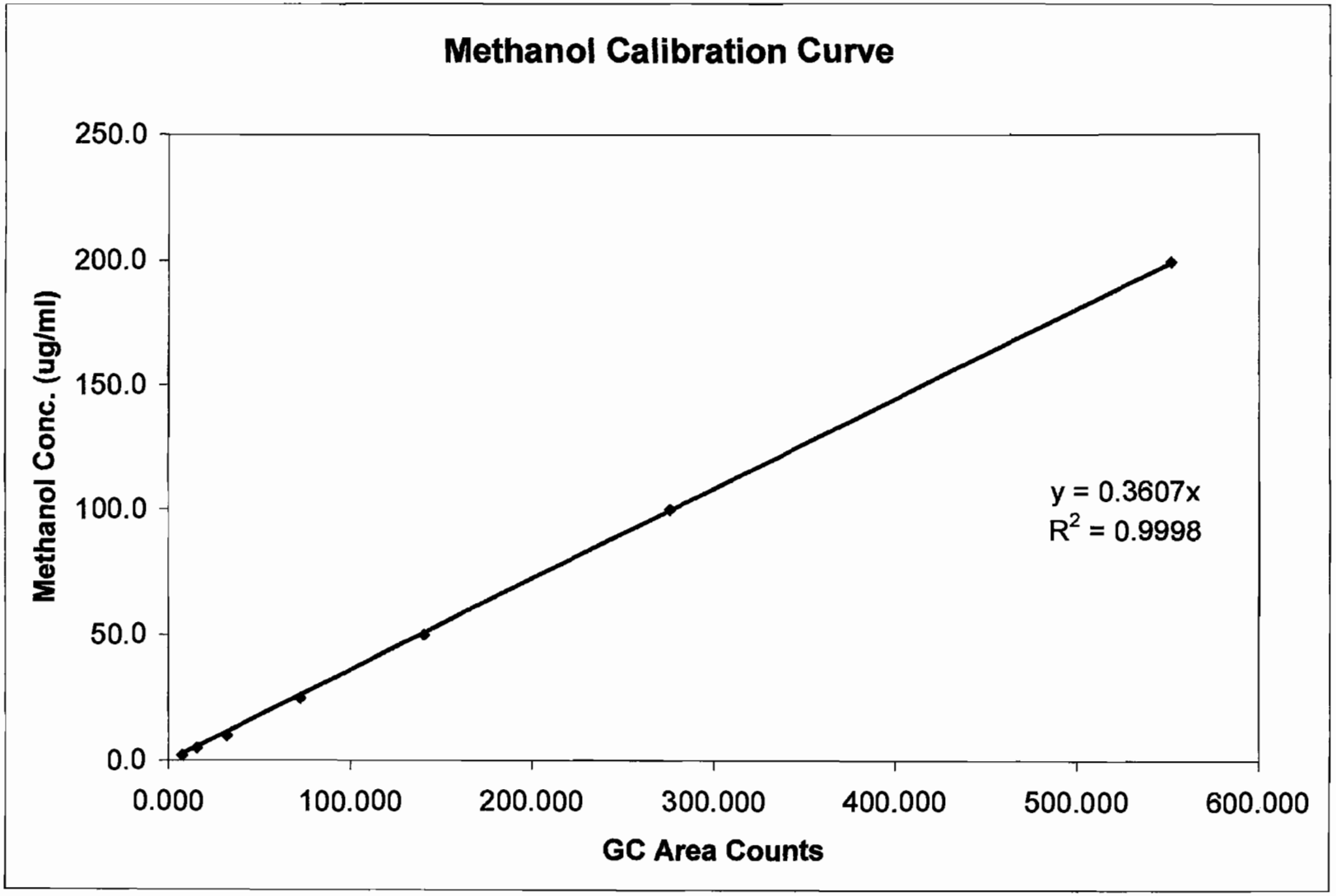
Sample Concentration Calculations

Location Description	Analysis 1 (area counts)	Analysis 2 (area counts)	Analysis 3 (area counts)	Average (area counts)	concentration (µg/ml)	Volume (mls)	Dilution Factor	Mass (µg)
308-1-A Imp Unspiked	284.75	291.37	296.56	290.89	104.93	50	1	5,246
308-1-A Tube Unspiked	230.06	226.09	230.43	228.86	82.55	4	1	330
308-1-B Imp Spiked	123.14	121.42	122.46	122.34	44.13	50	1	2,206
308-1-B Tube Spiked	195.07	193.86	191.32	193.41	69.76	4	1	279
308-2-A Imp Unspiked	9.01	8.65	8.33	8.66	3.12	1000	1	3,124
308-2-A Tube Unspiked	61.81	59.93	61.81	61.18	22.07	4	1	88
308-2-B Imp Spiked	7.92	6.56	7.13	7.21	2.60	1000	1	2,599
308-2-B Tube Spiked	73.26	66.28	70.71	70.08	25.28	4	1	101
308-3-A Imp Unspiked	<0.50	<0.50	<0.50	<0.50	<0.18	500	1	<90
308-3-A Tube Unspiked	7.04	6.96	6.60	6.87	2.48	4	1	10
308-3-B Imp Spiked	5.60	5.69	5.19	5.49	1.98	200	1	396
308-3-B Tube Spiked	13.74	13.03	13.55	13.44	4.85	4	1	19
Blank 308-A Imps unspiked	<0.50	<0.50	<0.50	<0.50	<0.18	50	1	<9
Blank 308-B Imps spiked	17.60	17.73	17.56	17.63	6.36	50	1	318
Reagent Water Blank unspiked	<0.50	<0.50	<0.50	<0.50	<0.18	-	-	-
Reagent Water Blank spiked	41.37	40.93	38.95	40.42	14.58	-	-	-
Lab DI Water Blank	<0.50	<0.50	<0.50	<0.50	<0.18	-	-	-
3% n-propanol Blank	<0.50	<0.50	<0.50	<0.50	<0.18	-	-	-
Blank 308-A Tube unspiked	2.77	3.17	3.09	3.01	1.09	4	1	4.3
Blank 308-B Tube spiked	3.43	3.19	3.32	3.31	1.19	4	1	4.8

Template Control ID: USEPA-M18-SORBENT-TEMPLATE-64T-REV1

Analyst: E. Vogt
Date: 8/19/11

Spike Amount (µg/ml): Imps: 15.8
Spike Amount (µg): Tubes: 1.8


Methanol Calibration Curve
Methanol Conc. (ug/ml)
250.0
200.0
150.0
100.0
50.0
0.0
0.000
100.000
200.000
300.000
400.000
500.000
600.000
GC Area Counts
y = 0.3607x
R2 = 0.9998

Houston Refining, Houston TX, 736 Coker Unit, Methanol, Method 18 - 7/19 - 7/28/11

QA/QC Checks

Standard Replicate Deviation Check, should be less than 5% deviation from average

	Std. (µg/ml)	Pre Cal 1 (area counts)	Pre Cal 2 (area counts)	Pre Cal 3 (area counts)	Average (area counts)	Post Cal 1 (area counts)	Post Cal 2 (area counts)	Post Cal 3 (area counts)	Post Cal Average (area counts)	Pre-Post Average (area counts)
	2.0	7.59	7.38	7.77	7.58					
% Dev. from Average		**-0.15**	**2.63**	**-2.49**						
	5.0	15.80	15.51	15.42	15.57					
% Dev. from Average		**-1.42**	**0.42**	**1.00**						
	10.0	31.88	32.53	31.77	32.06					
% Dev. from Average		**0.57**	**-1.48**	**0.91**						
	24.9	72.87	73.82	70.80	72.50	71.74	72.81	68.26	70.94	71.72
% Dev. from Average		**-0.52**	**-1.83**	**2.34**		**-1.14**	**-2.64**	**3.78**		
	49.8	140.18	139.82	141.34	140.45					
% Dev. from Average		**0.19**	**0.45**	**-0.63**						
	99.7	272.23	277.24	277.26	275.58					
% Dev. from Average		**1.21**	**-0.60**	**-0.61**						
	199.3	538.02	557.69	558.91	551.54					
% Dev. from Average		**2.45**	**-1.12**	**-1.34**						

Sample Description	Analysis (area counts)	concentration (µg/ml)	Certified (µg/ml)	% Difference	Acceptable (<25%)
Secondary 10ppm Std.	33.90	12.23	9.97	22.7	Yes

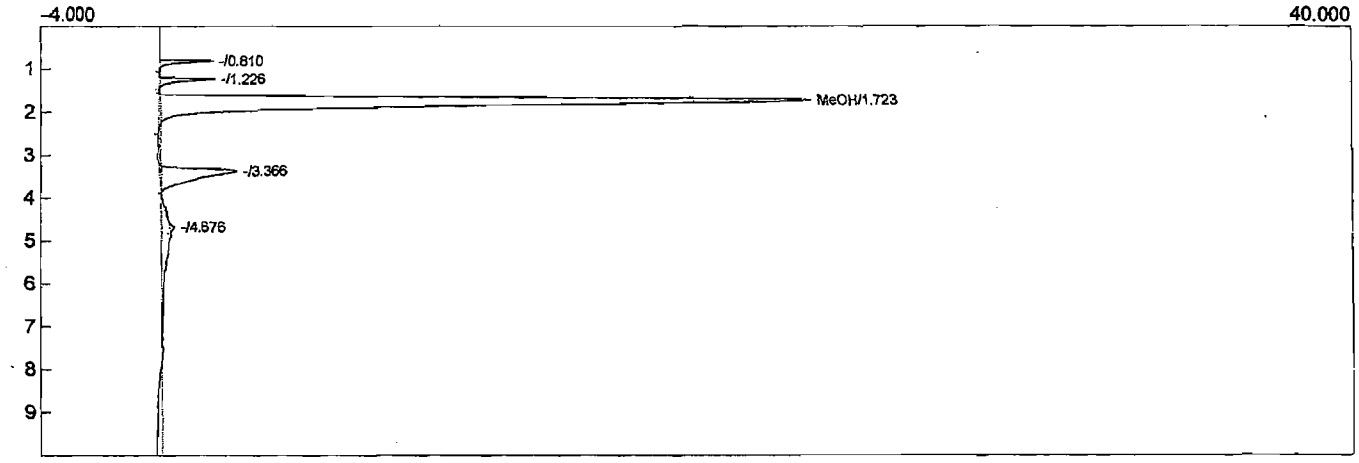
Sample Description	Analysis (area counts)	Pre Cal Average	% Difference	Acceptable (<10%)
25 ppm Check Std. #520	70.80	72.50	-2.3	Yes
25 ppm Check Std #539	67.95	72.50	-6.3	Yes
25 ppm Check Std #556	67.70	72.50	-6.6	Yes

Analyst: E. Vogt
Date: 8/19/11

Individual Standard Deviations from Calibration Curve (not required by Method 18)

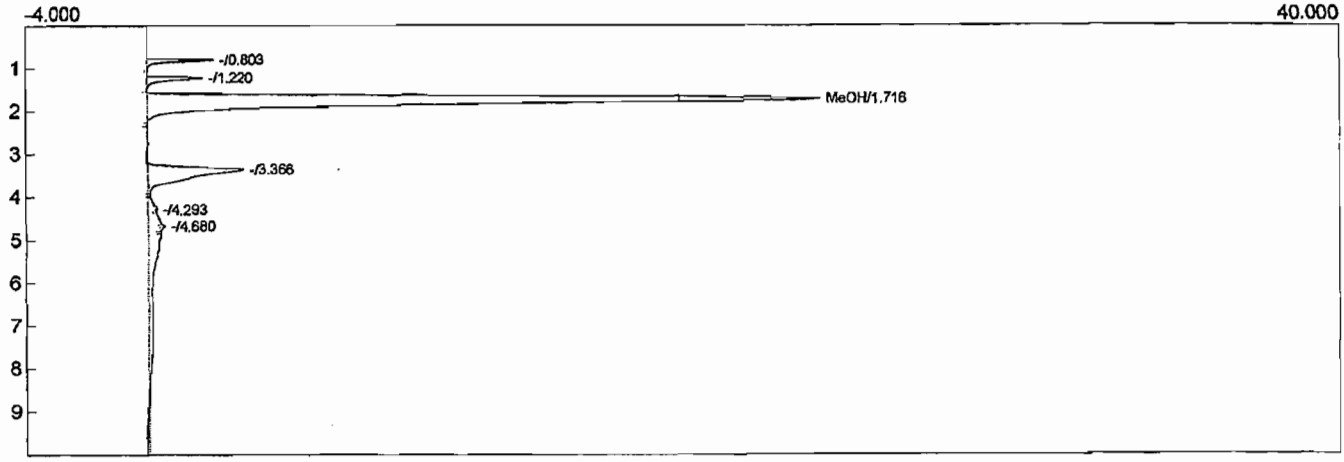
Conc. Ug/m	Peak Area	RF	%dev	
2.0	7.580	3.8028	24.3	
5.0	15.575	3.1255	2.2	
10.0	32.059	3.2169	5.2	
24.9	72.499	2.9099	-4.9	
49.8	140.447	2.8202	-7.8	
99.7	275.576	2.7652	-9.6	
199.3	551.540	2.7671	-9.5	**mean RF-----** 3.0582

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 18:10:41
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR523.chr ()
Sample: 736 Coker 308-1 Imps No Spike
Operator: E. Vogt



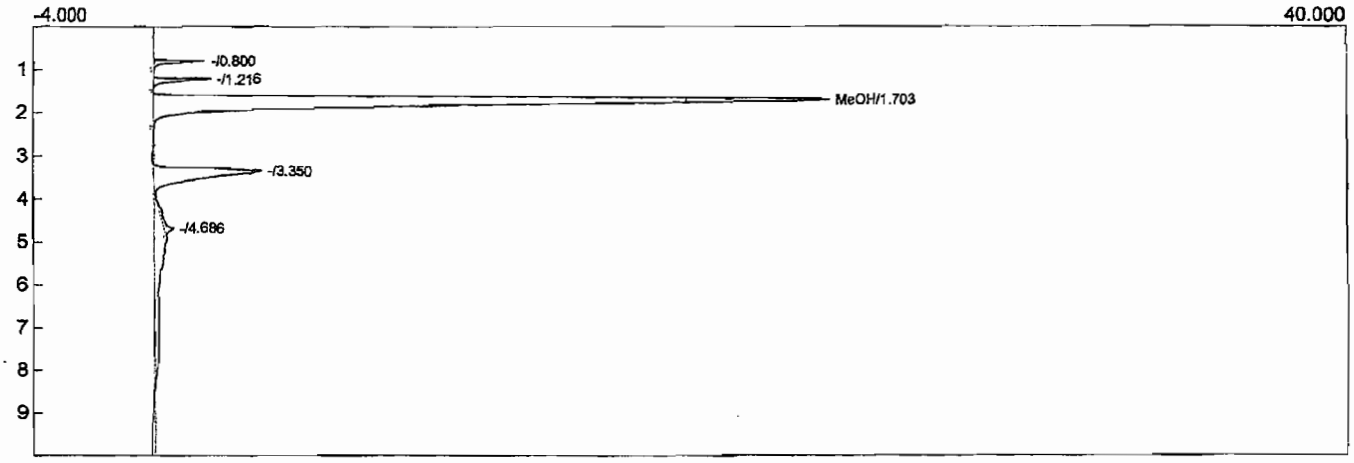
Component	Retention	Area
MeOH	1.723	284.7476
		284.7476

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 17:53:15
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR522.chr ()
Sample: 736 Coker 308-1 Imps No Spike
Operator: E. Vogt



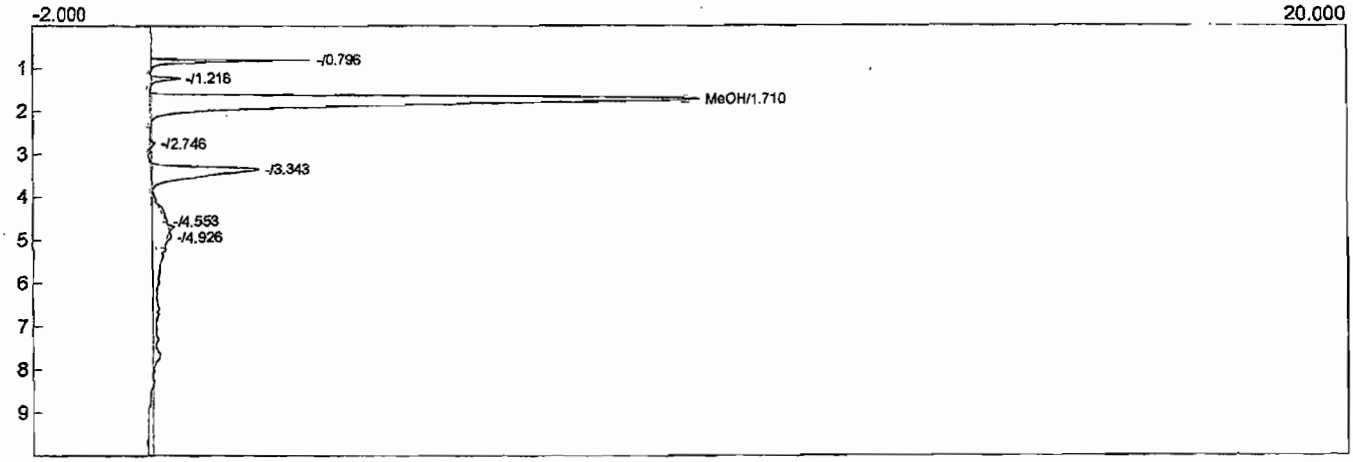
Component	Retention	Area
MeOH	1.716	291.3745
		291.3745

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 17:35:26
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR521.chr ()
Sample: 736 Coker 308-1 Imps No Spike
Operator: E. Vogt



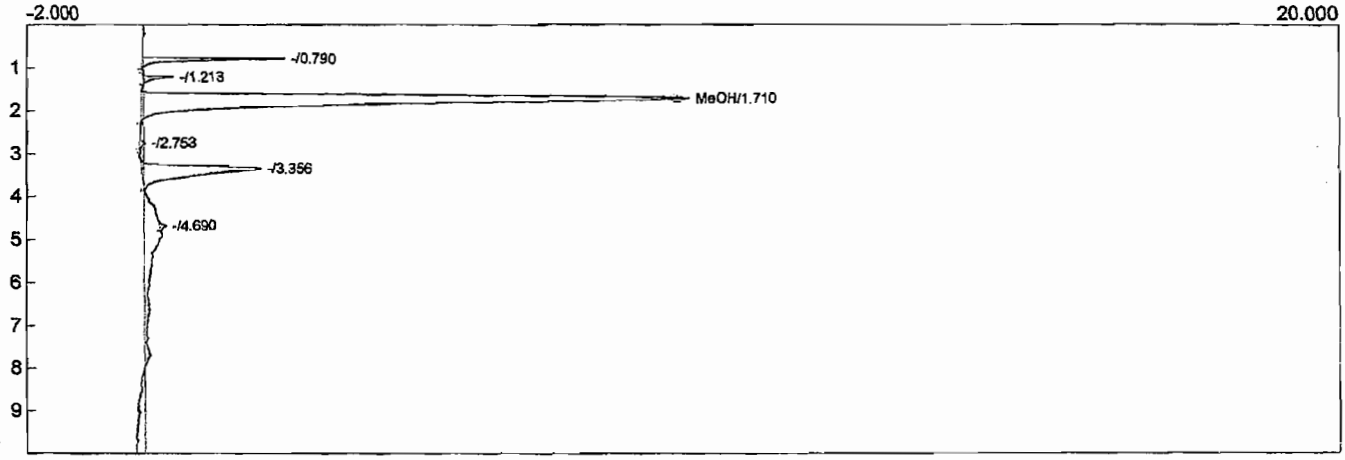
Component	Retention	Area
MeOH	1.703	296.5583
		296.5583

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 19:02:42
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR526.chr ()
Sample: 736 Coker 308-1 Imps Spiked
Operator: E. Vogt



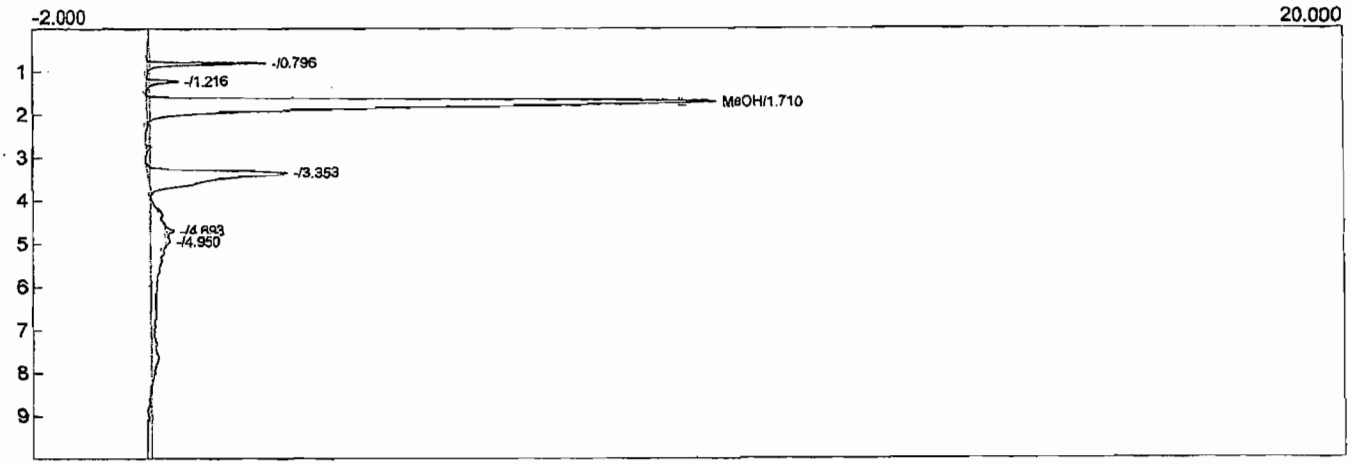
Component	Retention	Area
MeOH	1.710	123.1364
		123.1364

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 18:45:19
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR525.chr ()
Sample: 736 Coker 308-1 Imps Spiked
Operator: E. Vogt



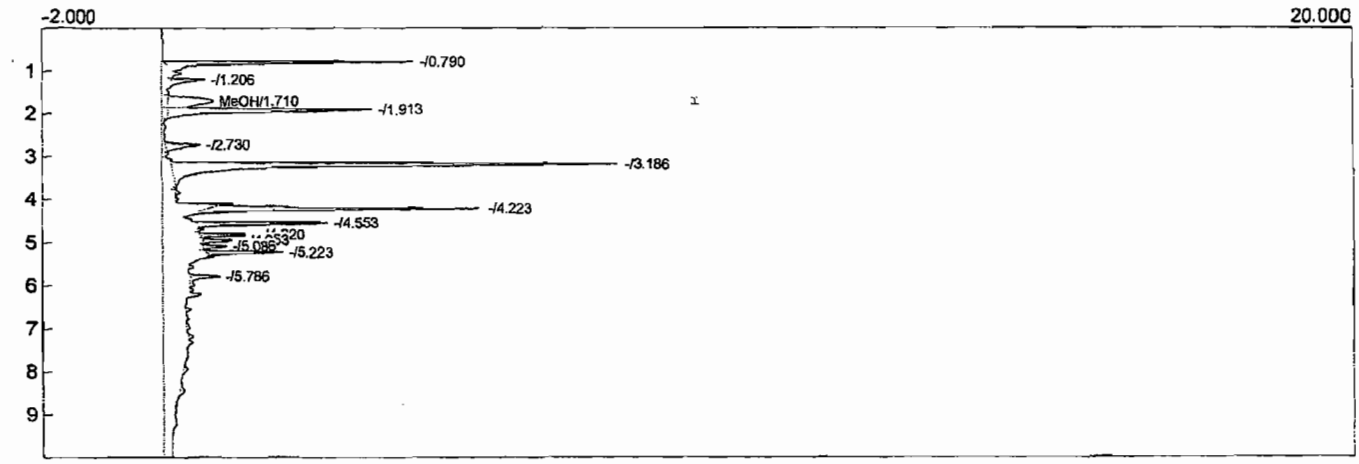
Component	Retention	Area
MeOH	1.710	121.4246
		121.4246

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 18:28:00
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR524.chr ()
Sample: 736 Coker 308-1 Imps Spiked
Operator: E. Vogt



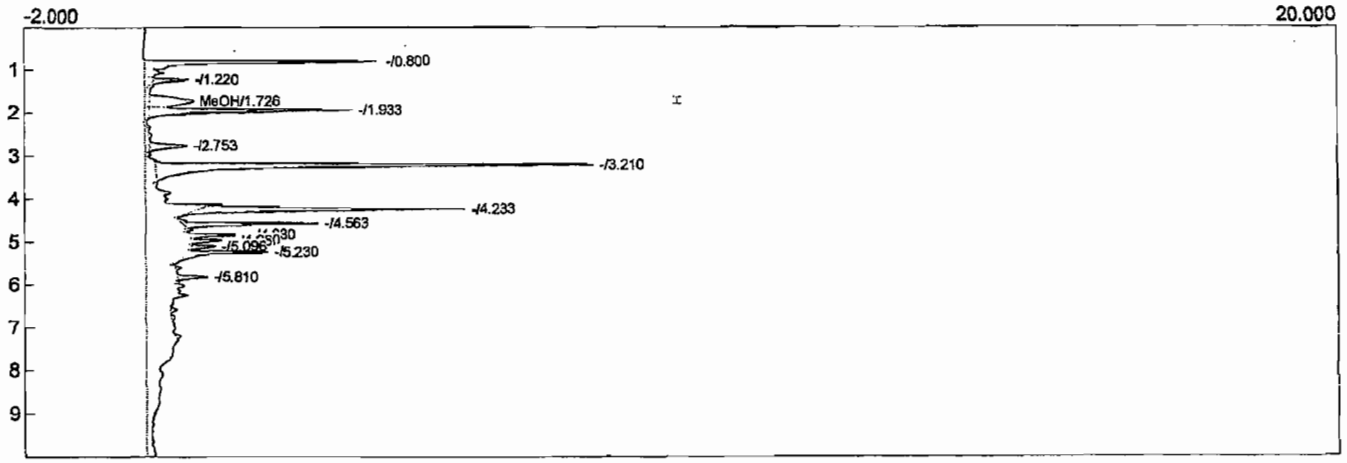
Component	Retention	Area
MeOH	1.710	122.4644
		122.4644

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 16:08:06
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR558.CHR ()
Sample: 736 Coker 308-2 Imps no spike
Operator: E. Vogt



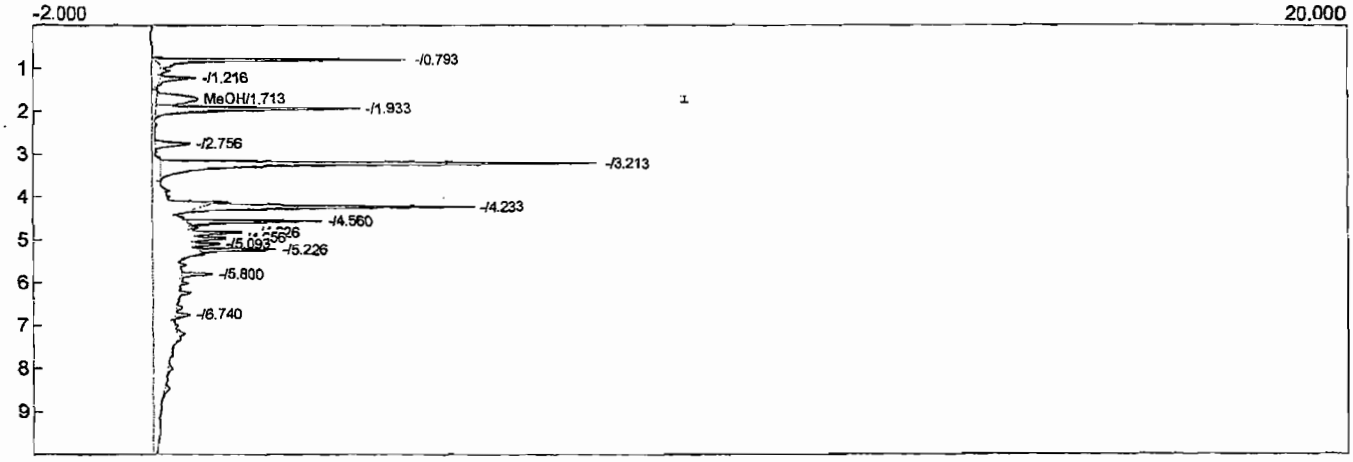
Component	Retention	Area
MeOH	1.710	9.0070
		9.0070

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 16:25:29
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR559.CHR ()
Sample: 736 Coker 308-2 Imps no spike
Operator: E. Vogt



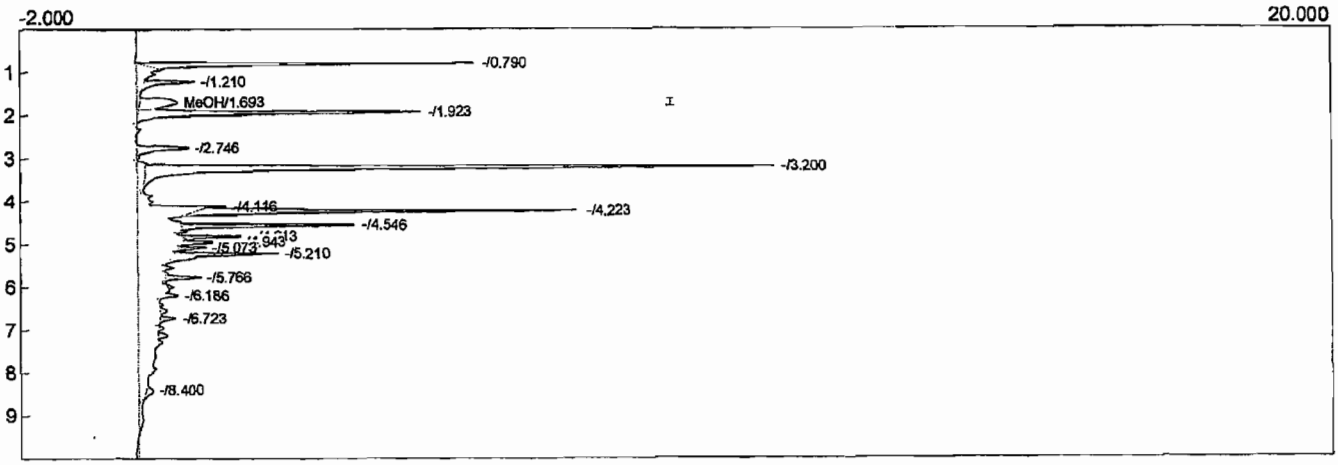
Component	Retention	Area
MeOH	1.726	8.6504
		8.6504

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 16:42:38
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR560.CHR ()
Sample: 736 Coker 308-2 Imps no spike
Operator: E. Vogt



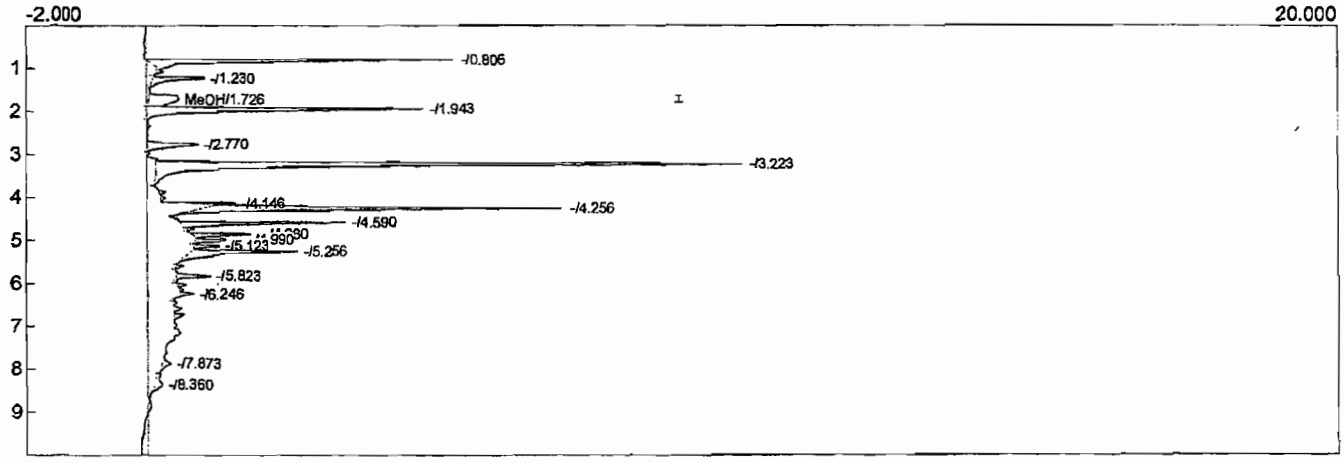
Component	Retention	Area
MeOH	1.713	8.3264
		8.3264

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 17:34:53
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR563.chr ()
Sample: 736 Coker 308-2 Imps spiked
Operator: E. Vogt



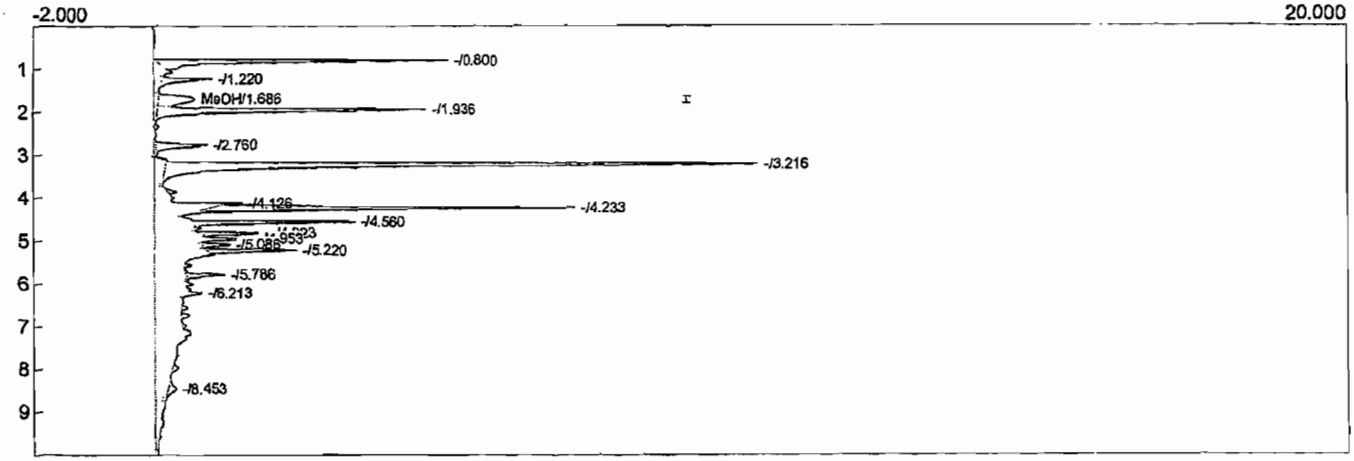
Component	Retention	Area
MeOH	1.693	7.9242
		7.9242

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 17:17:43
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR562.chr ()
Sample: 736 Coker 308-2 Imps spiked
Operator: E. Vogt



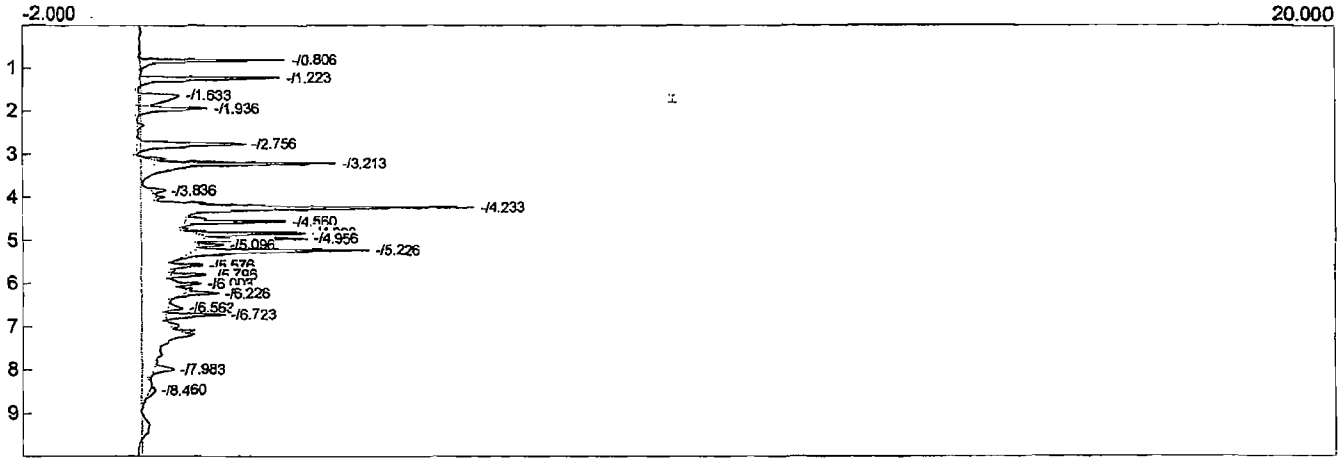
Component	Retention	Area
MeOH	1.726	6.5628
		6.5628

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 17:00:00
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR561.chr ()
Sample: 736 Coker 308-2 lmps spiked
Operator: E. Vogt



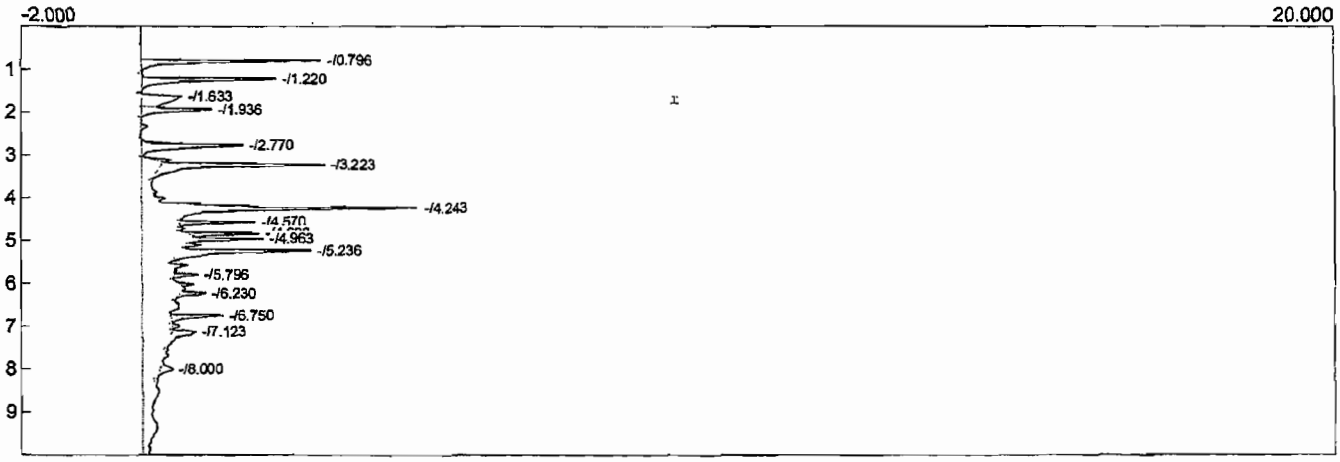
Component	Retention	Area
MeOH	1.686	7.1318
		7.1318

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 18:27:09
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR566.chr ()
Sample: 736 Coker 308-3 Imps no spike
Operator: E. Vogt



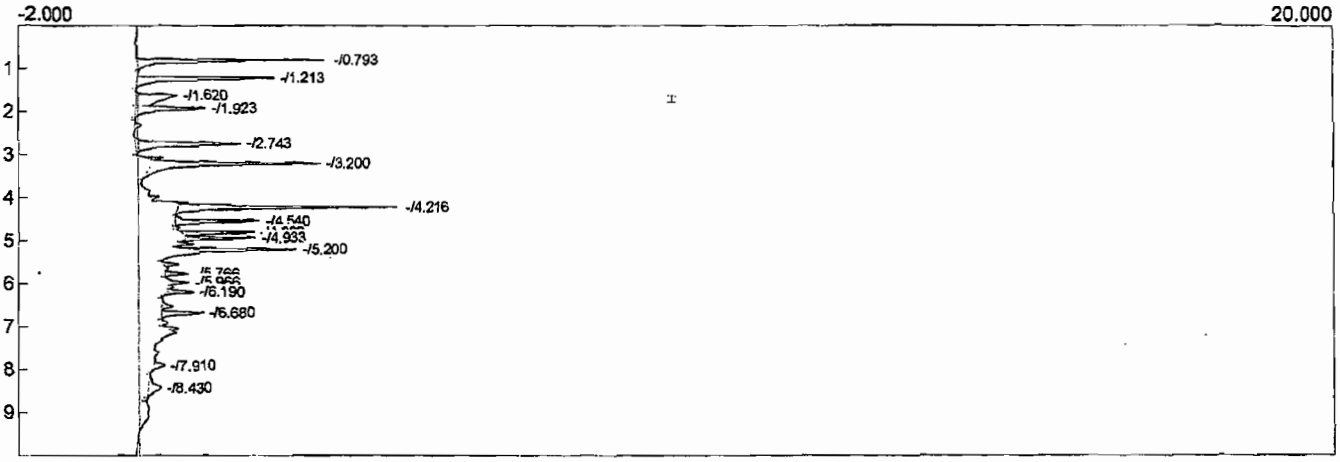
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 18:09:48
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR565.chr ()
Sample: 736 Coker 308-3 Imps no spike
Operator: E. Vogt



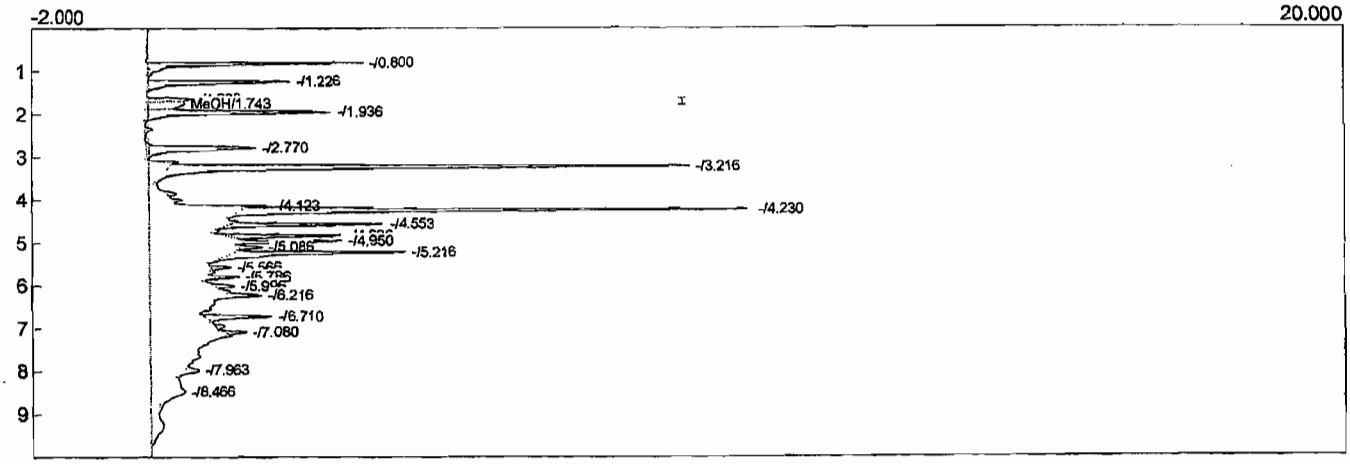
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 17:52:09
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR564.chr ()
Sample: 736 Coker 308-3 Imps no spike
Operator: E. Vogt



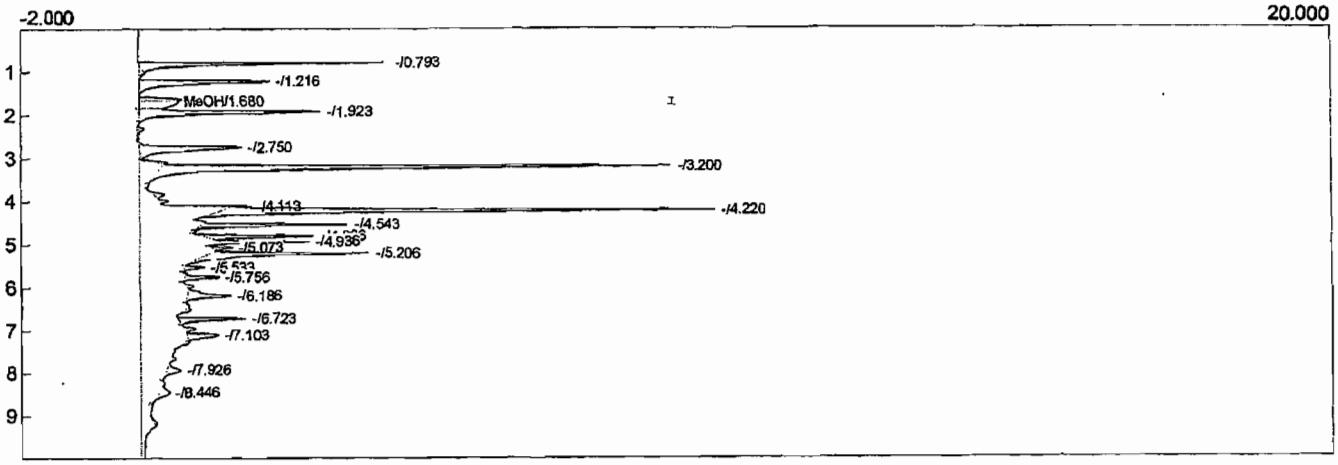
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 19:02:02
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR568.CHR ()
Sample: 736 Coker 308-3 Imps spiked
Operator: E. Vogt



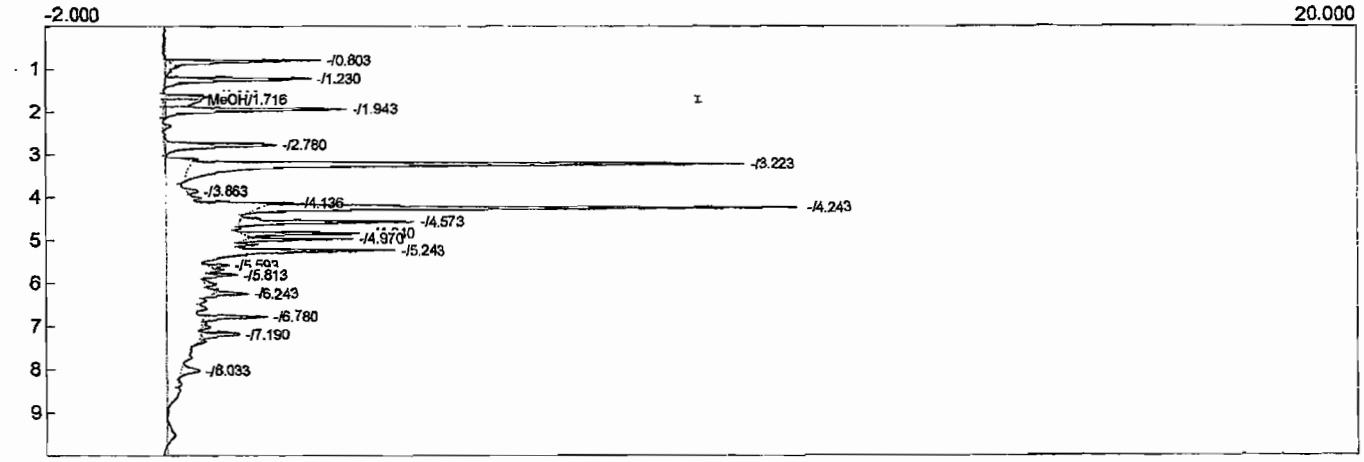
Component	Retention	Area
MeOH	1.743	5.5987
		5.5987

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 18:44:11
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR567.CHR ()
Sample: 736 Coker 308-3 Imps spiked
Operator: E. Vogt



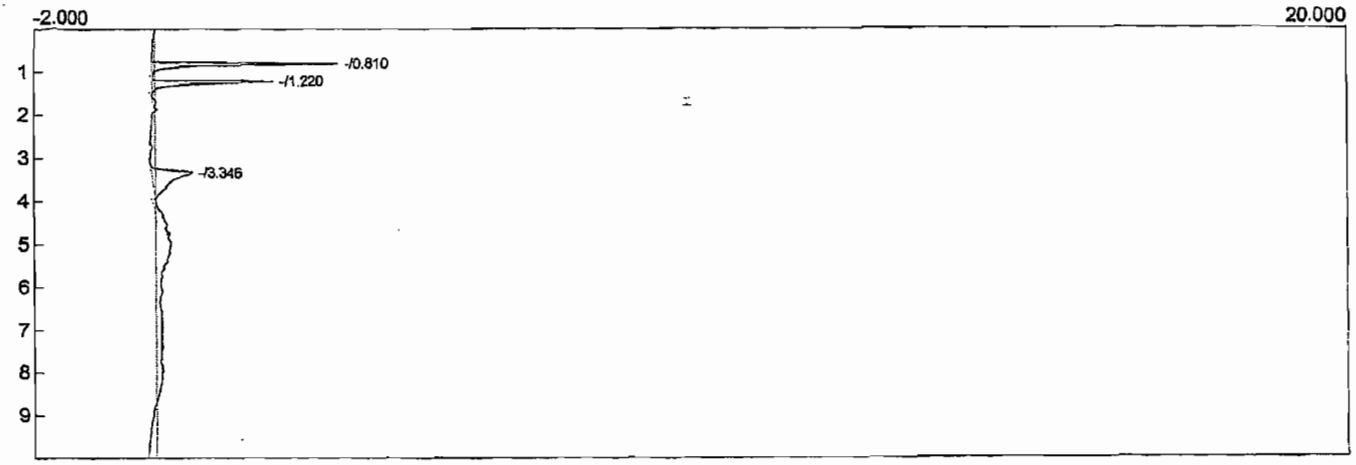
Component	Retention	Area
MeOH	1.680	5.6908
		5.6908

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 21:59:11
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR536.chr ()
Sample: 736 Coker 308-3 Imps Spiked
Operator: E. Vogt



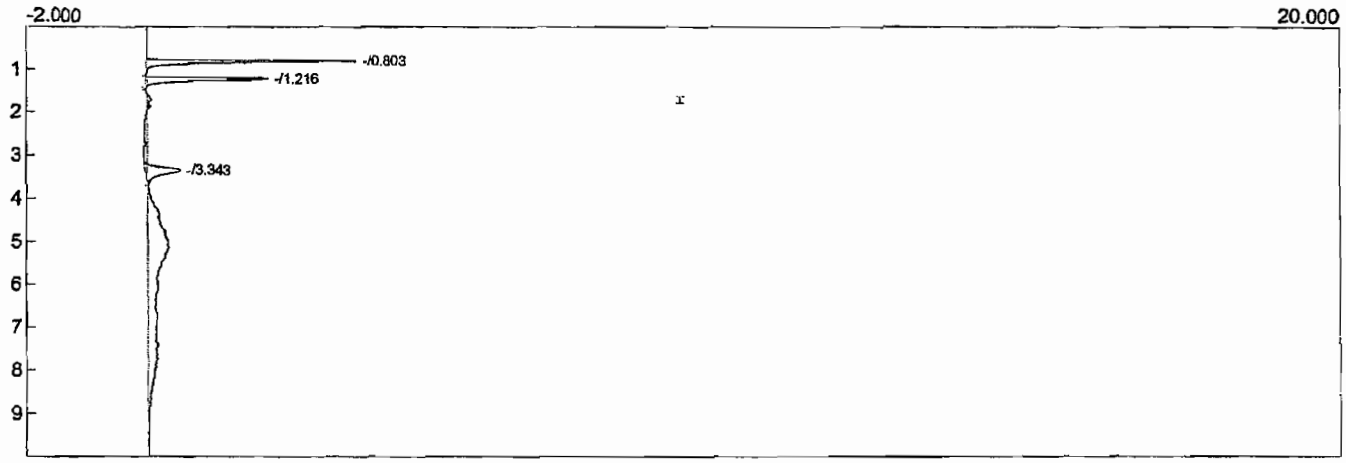
Component	Retention	Area
MeOH	1.716	5.1930
		5.1930

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 14:09:28
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR553.chr ()
Sample: 736 Coker Field Blank Water no spike
Operator: E. Vogt



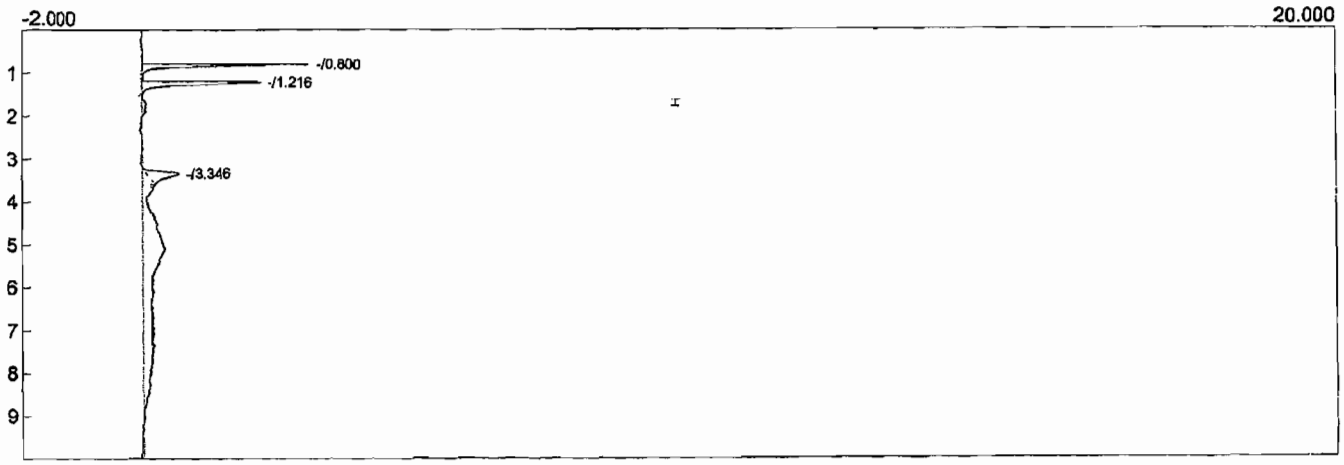
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 14:27:05
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR554.CHR ()
Sample: 736 Coker Field Blank Water no spike
Operator: E. Vogt



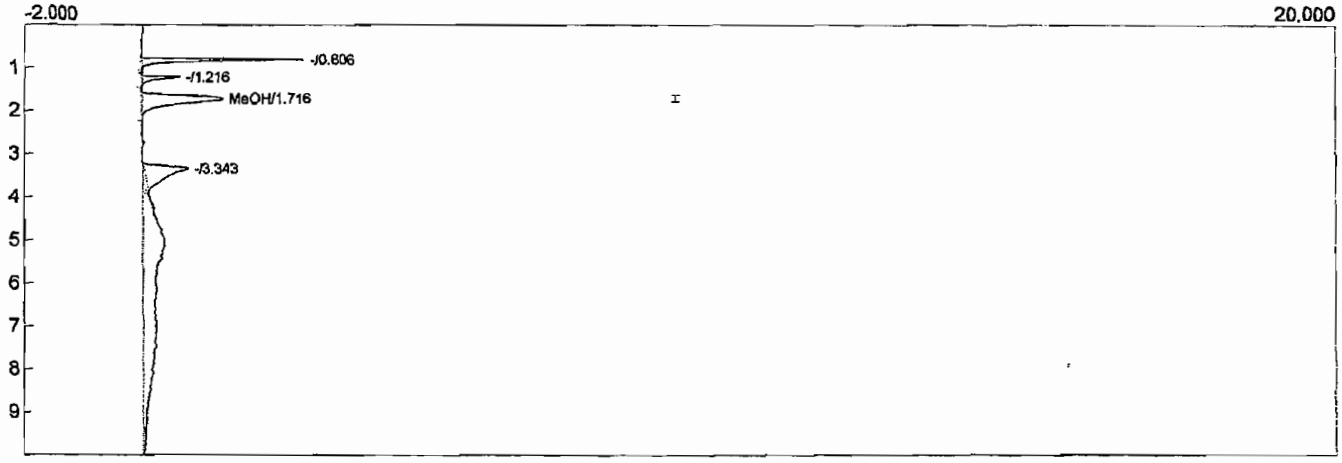
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 14:44:46
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR555.CHR ()
Sample: 736 Coker Field Blank Water no spike
Operator: E. Vogt



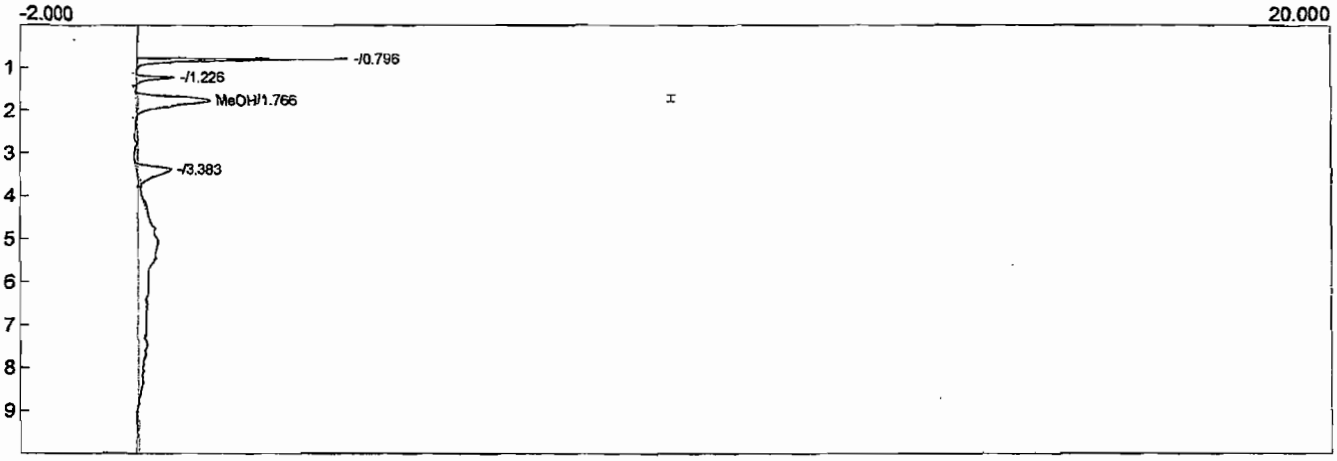
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 13:31:53
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR551.CHR ()
Sample: 736 Coker Field Blank Water spiked
Operator: E. Vogt



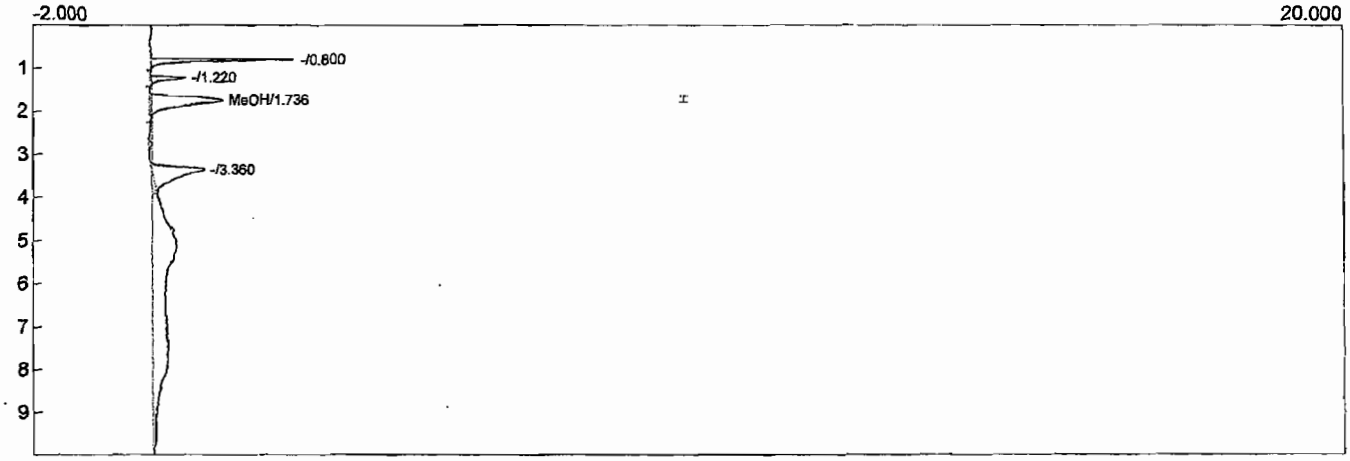
Component	Retention	Area
MeOH	1.716	17.5987
		17.5987

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 13:49:35
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR552.CHR ()
Sample: 736 Coker Field Blank Water spiked
Operator: E. Vogt



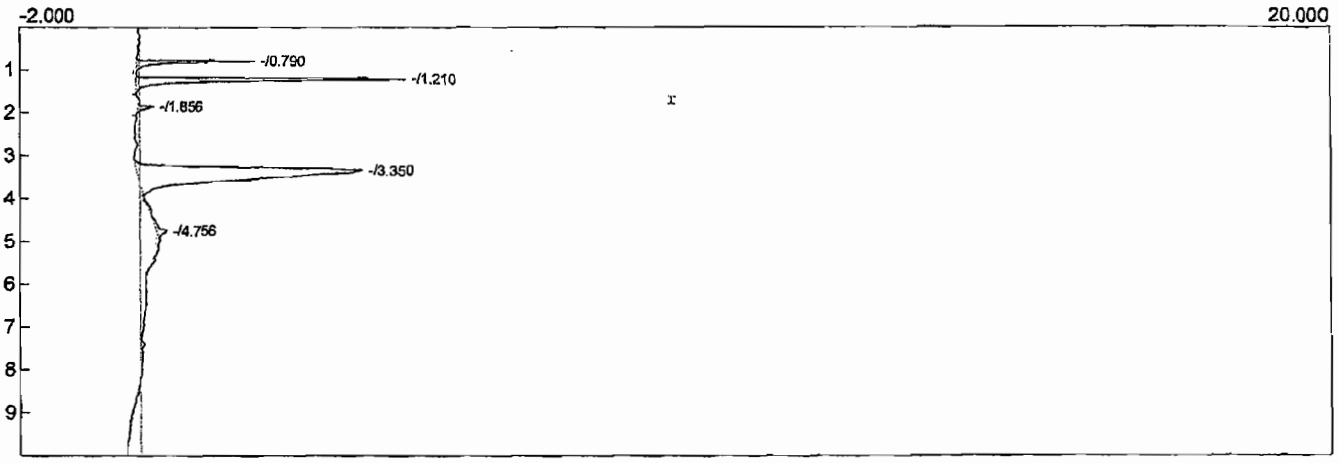
Component	Retention	Area
MeOH	1.766	17.7303
		17.7303

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 13:14:42
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR550.chr ()
Sample: 736 Coker Field Blank Water spiked
Operator: E. Vogt



Component	Retention	Area
MeOH	1.736	17.5554
		17.5554

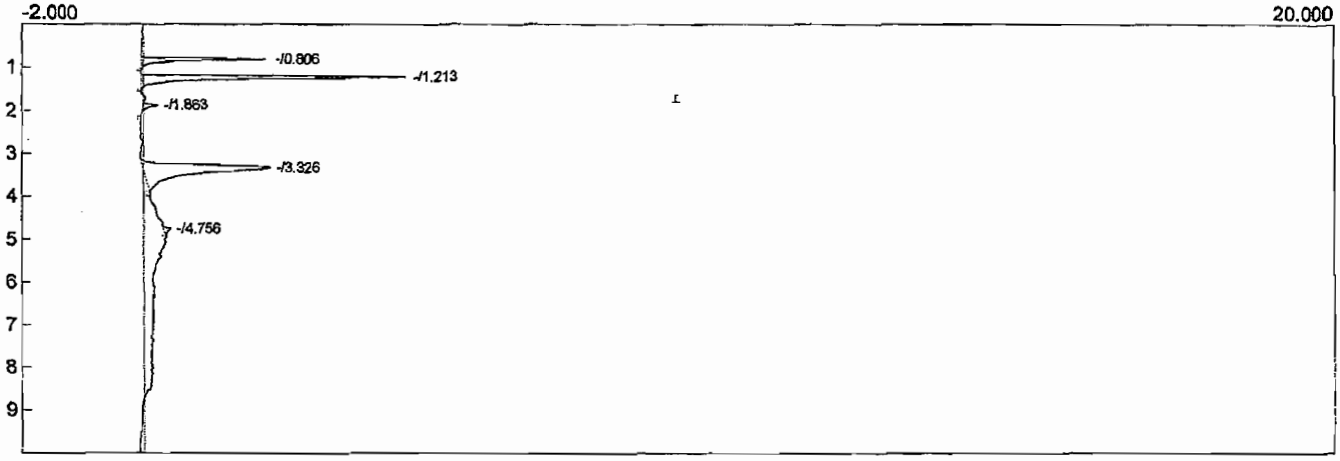
Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 11:15:39
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR544.chr ()
Sample: 736 Coker Reagent Blank Water no spike
Operator: E. Vogt



Component	Retention	Area

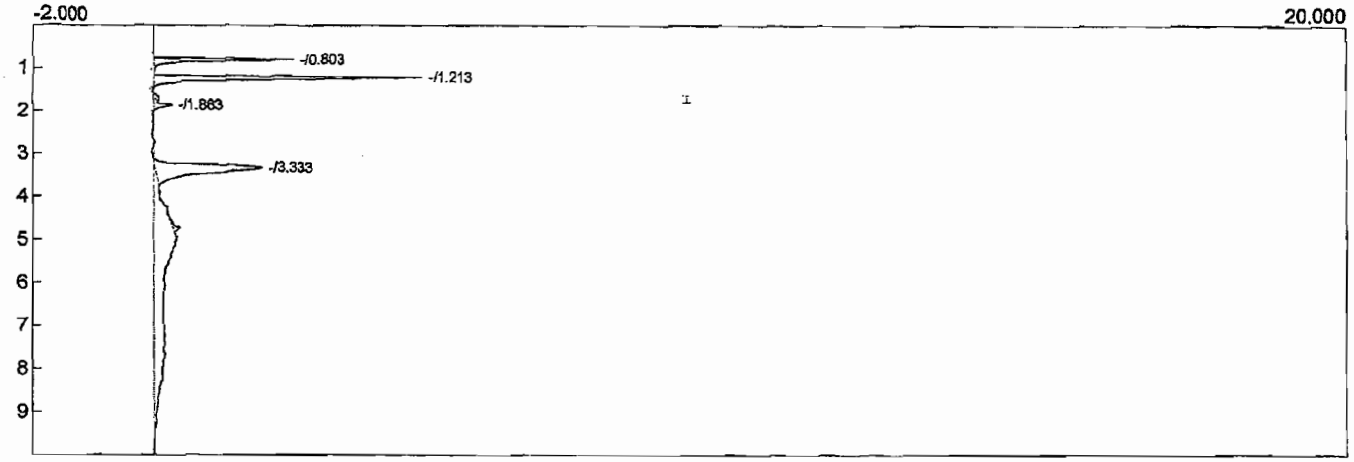
0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 11:32:43
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR545.chr ()
Sample: 736 Coker Reagent Blank Water no spike
Operator: E. Vogt



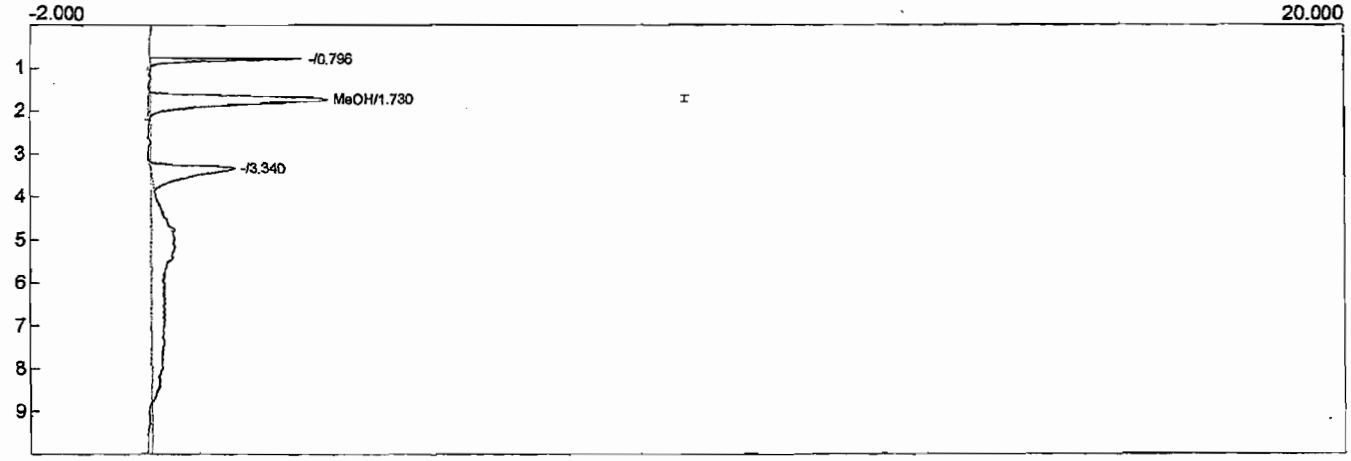
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 11:49:34
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR546.chr ()
Sample: 736 Coker Reagent Blank Water no spike
Operator: E. Vogt



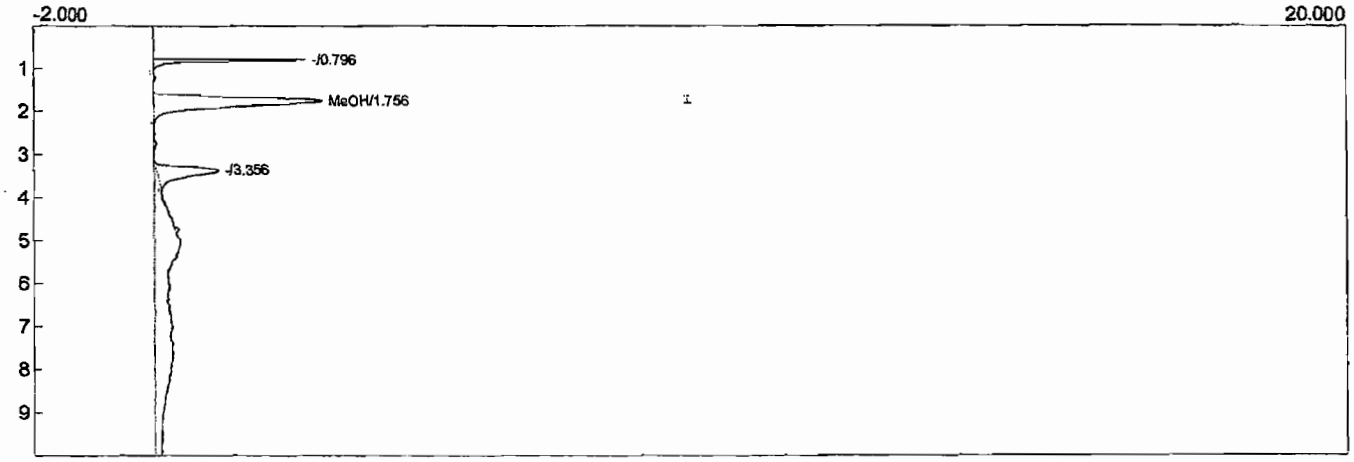
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 12:16:41
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR547.CHR ()
Sample: 736 Coker Reagent Blank Water spiked
Operator: E. Vogt



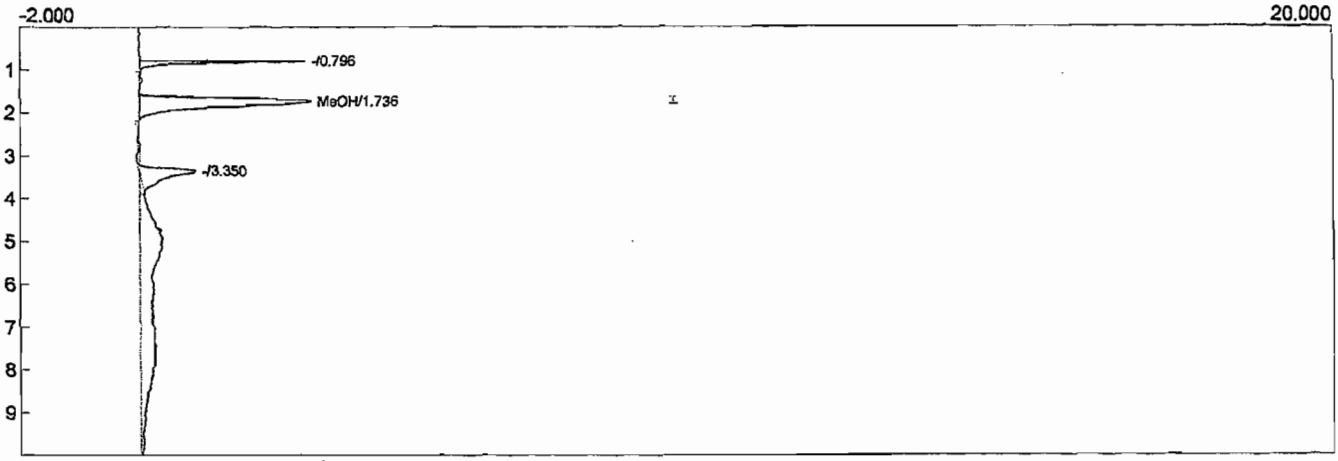
Component	Retention	Area
MeOH	1.730	41.3708
		41.3708

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 12:33:38
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR548.CHR ()
Sample: 736 Coker Reagent Blank Water spiked
Operator: E. Vogt



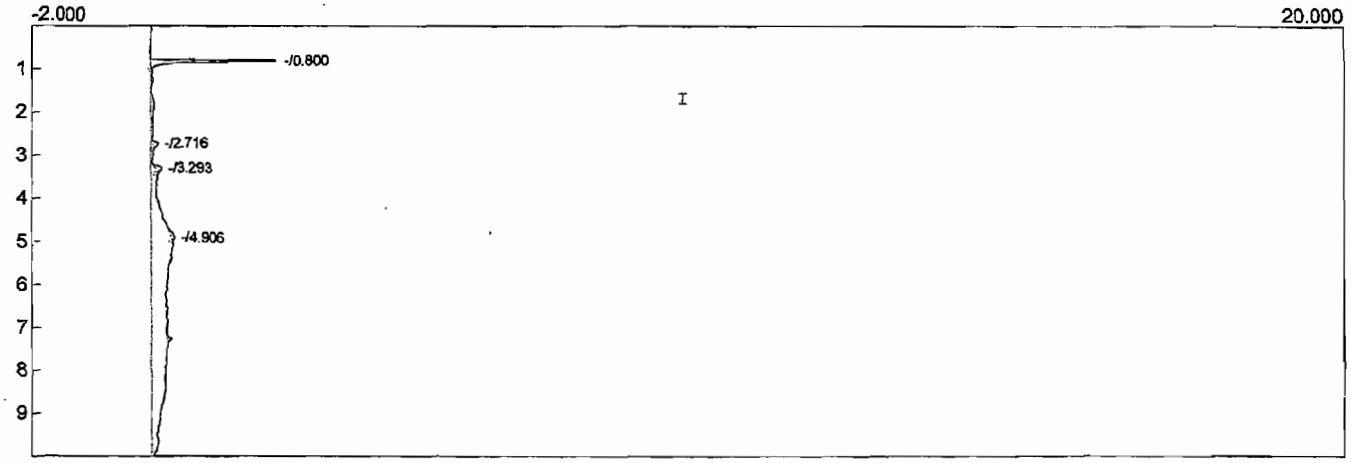
Component	Retention	Area
MeOH	1.756	40.9328
		40.9328

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 12:51:05
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR549.CHR ()
Sample: 736 Coker Reagent Blank Water spiked
Operator: E. Vogt



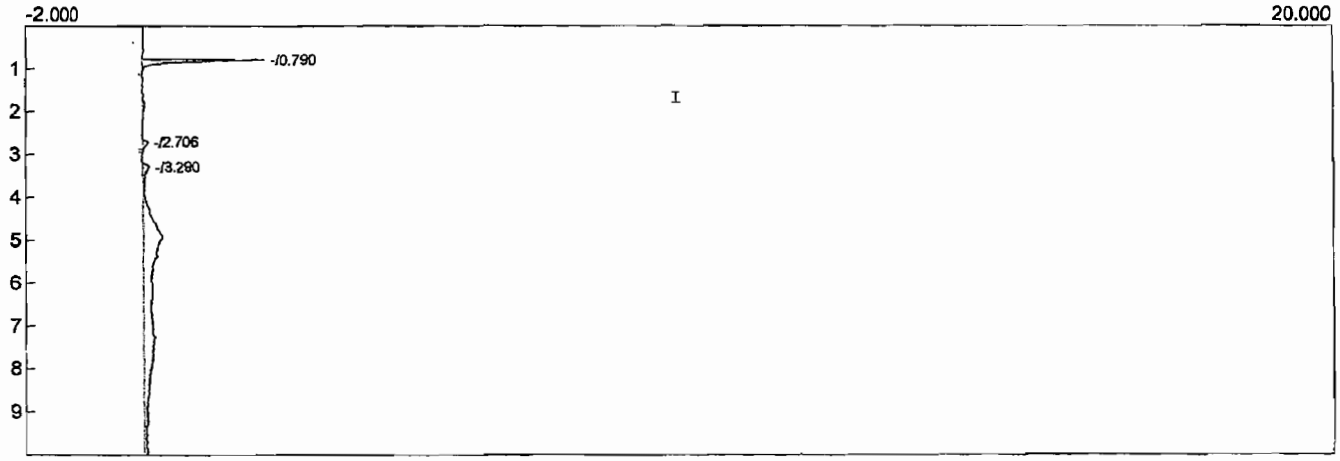
Component	Retention	Area
MeOH	1.736	38.9526
		38.9526

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 16:57:33
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR487.chr ()
Sample: DI Water Blank
Operator: E. Vogt



Component	Retention	Area
		0.0000

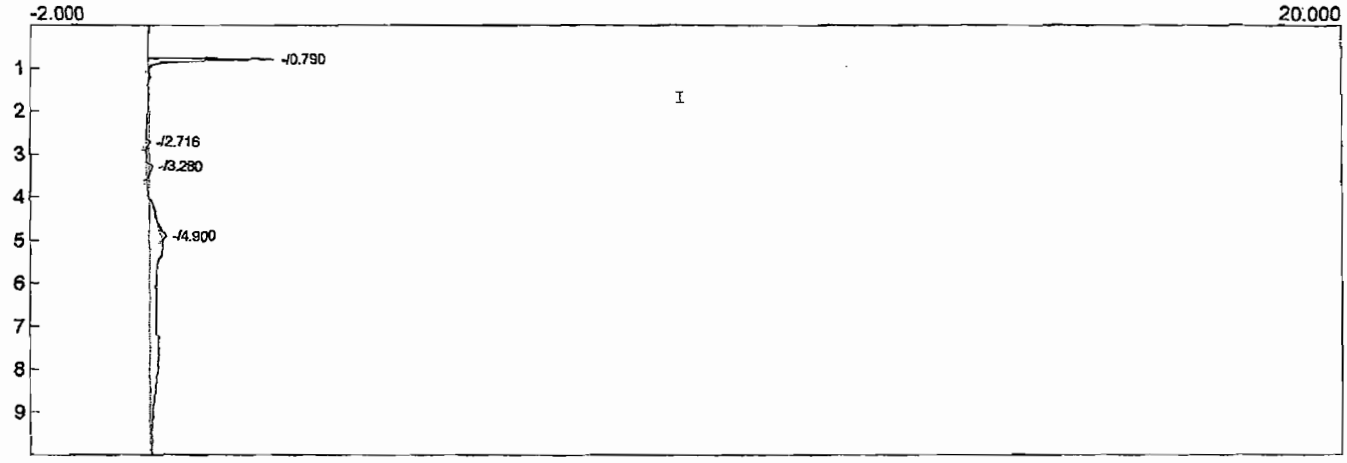
Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 17:14:47
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR488.chr ()
Sample: DI Water Blank
Operator: E. Vogt



Component	Retention	Area

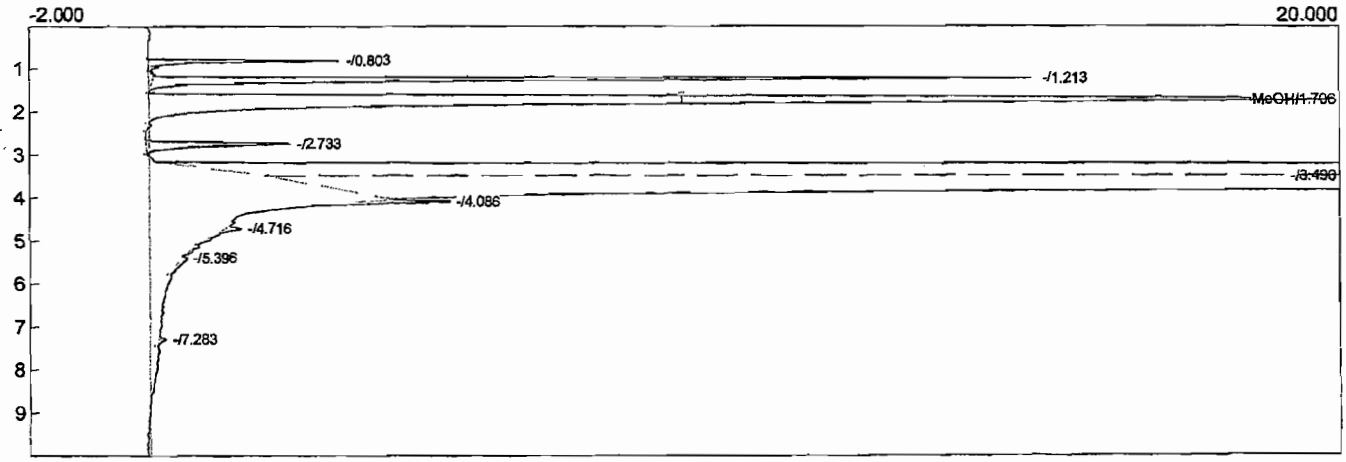
0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 17:31:32
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR489.CHR ()
Sample: DI Water Blank
Operator: E. Vogt



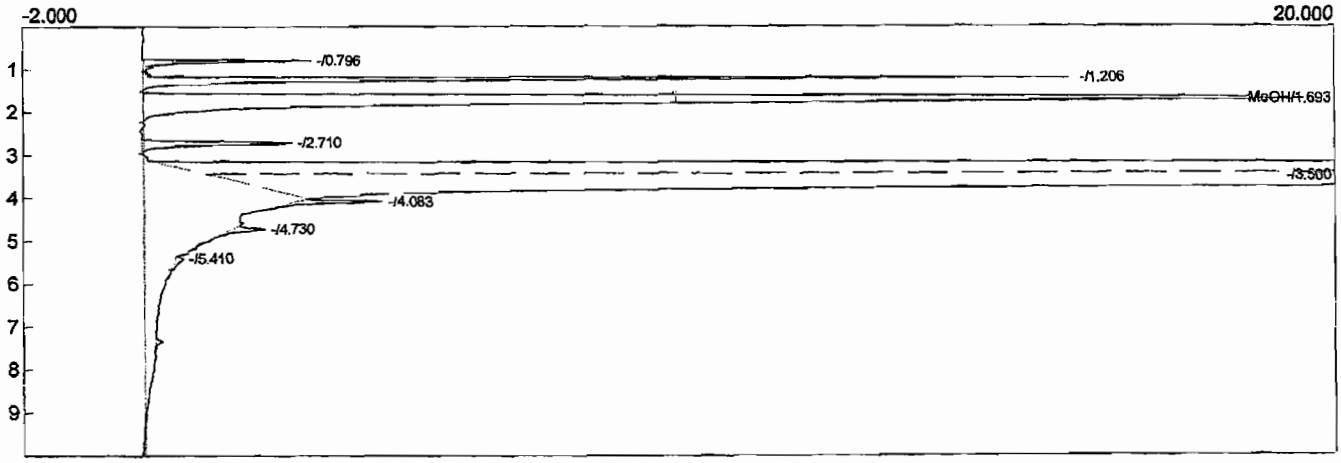
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 10:47:33
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR499.CHR ()
Sample: 736 Coker 308-1 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



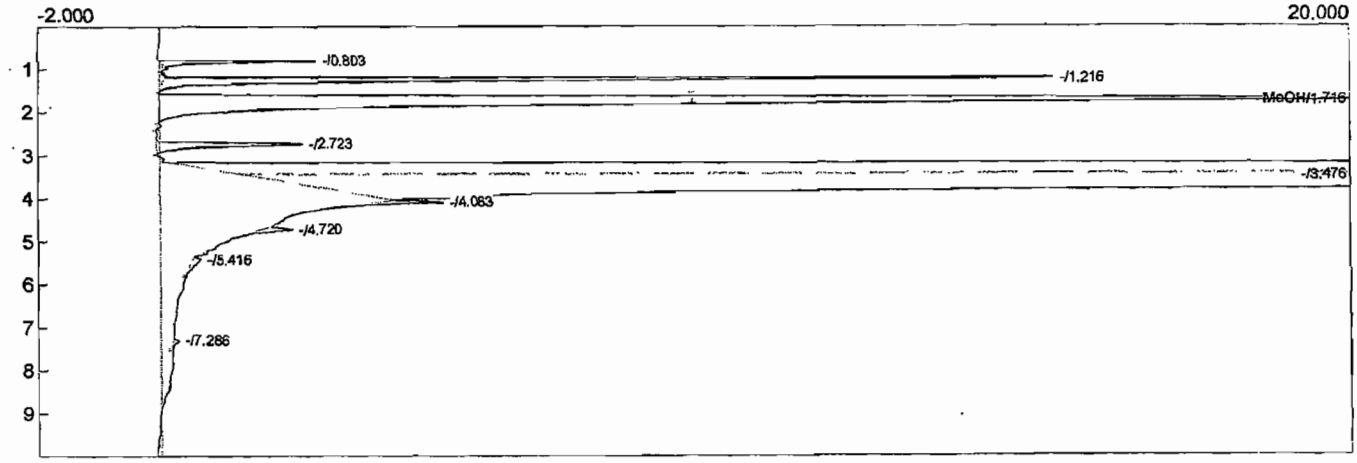
Component	Retention	Area
MeOH	1.706	230.0603
		230.0603

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 11:20:48
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR501.CHR ()
Sample: 736 Coker 308-1 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



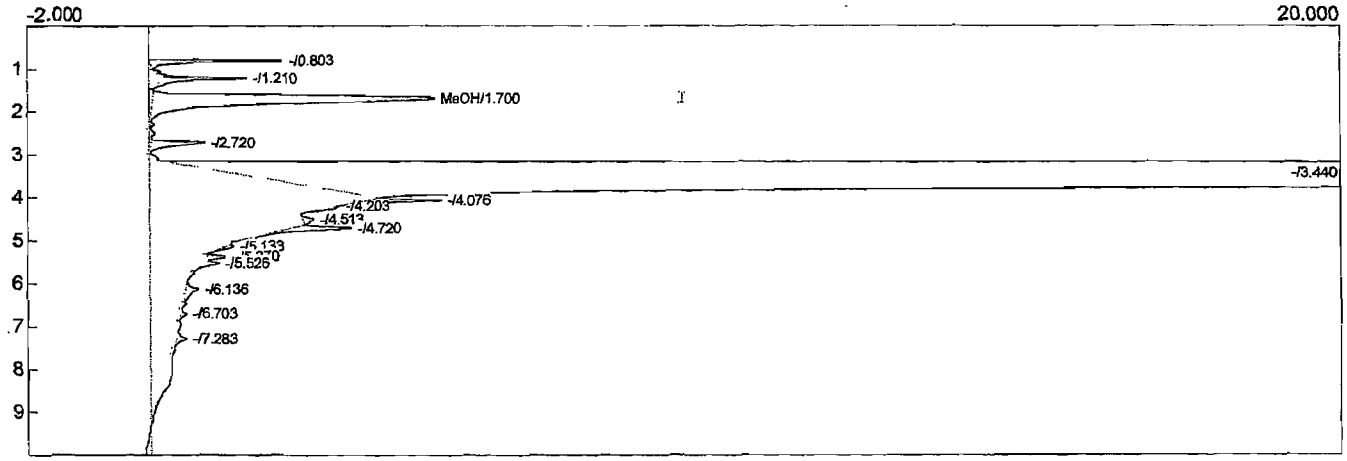
Component	Retention	Area
MeOH	1.693	226.0935
		226.0935

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 11:04:10
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR500.chr ()
Sample: 736 Coker 308-1 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



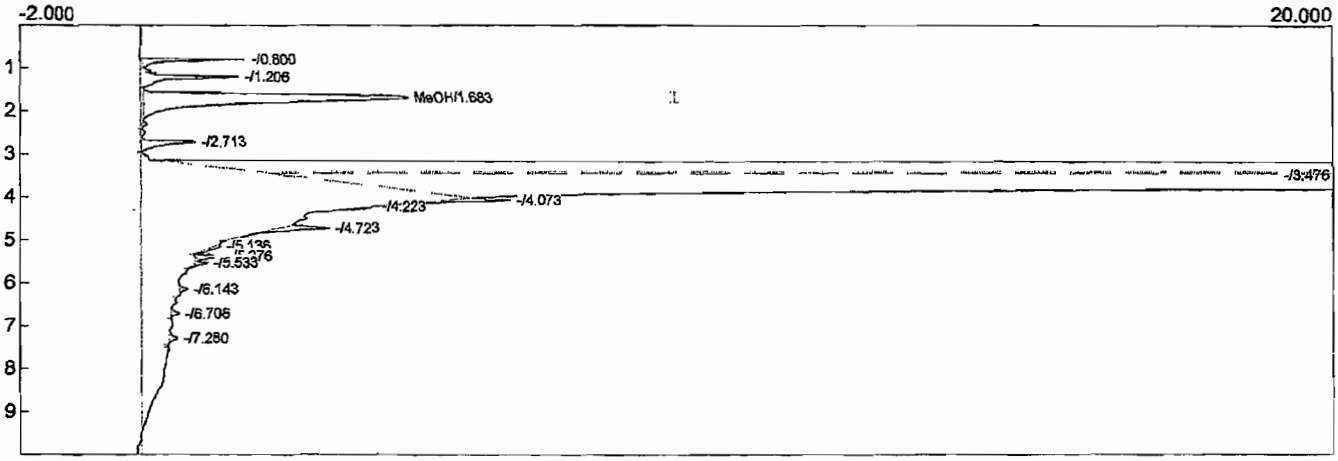
Component	Retention	Area
MeOH	1.716	230.4301
		230.4301

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 11:37:34
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR502.chr ()
Sample: 736 Coker 308-2 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



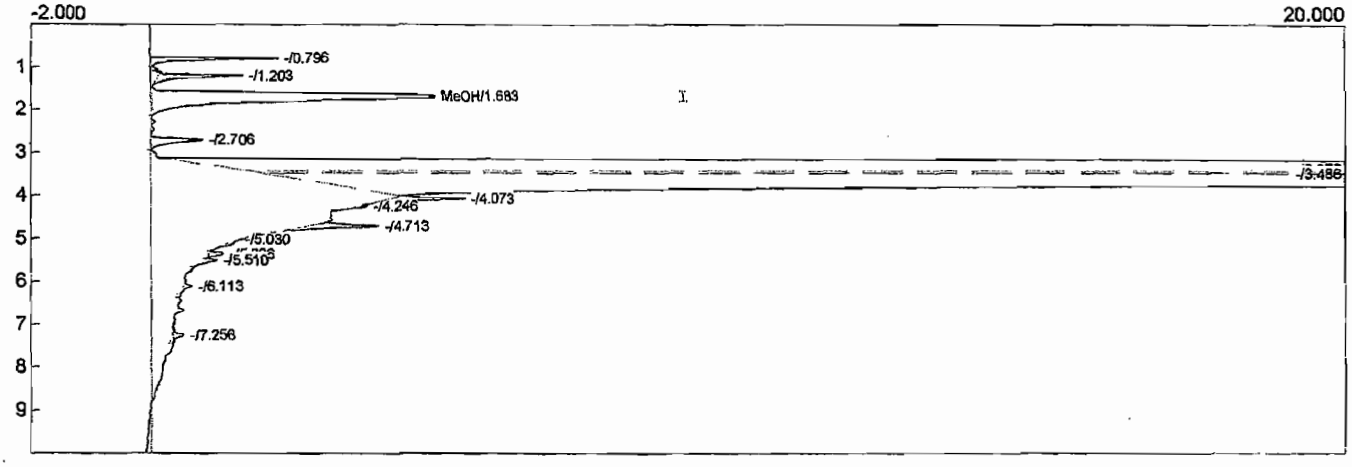
Component	Retention	Area
MeOH	1.700	61.8136
		61.8136

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 11:54:28
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR503.chr ()
Sample: 736 Coker 308-2 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



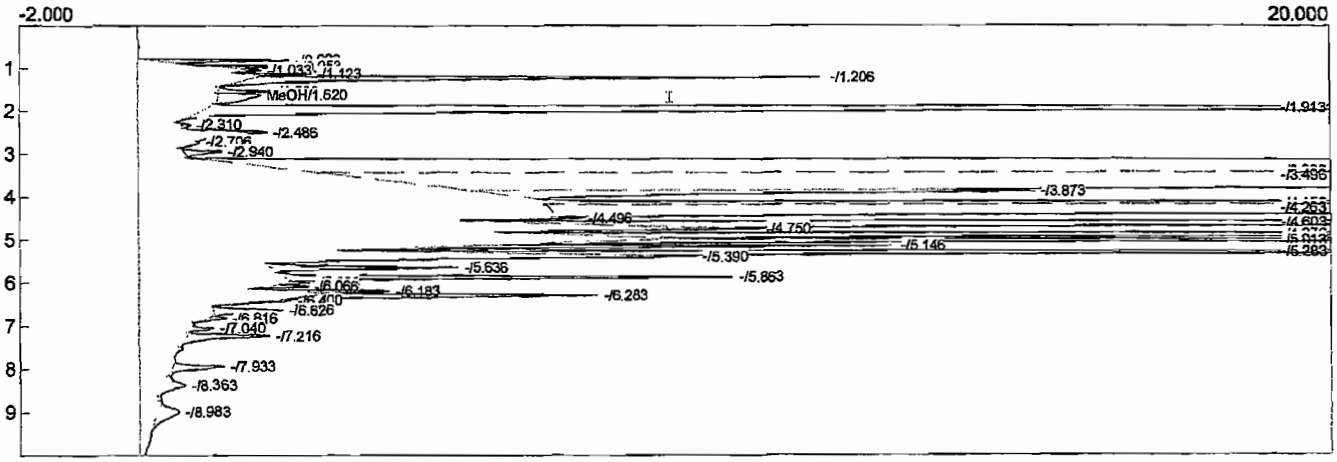
Component	Retention	Area
MeOH	1.683	59.9256
		59.9256

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 12:11:13
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR504.chr ()
Sample: 736 Coker 308-2 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



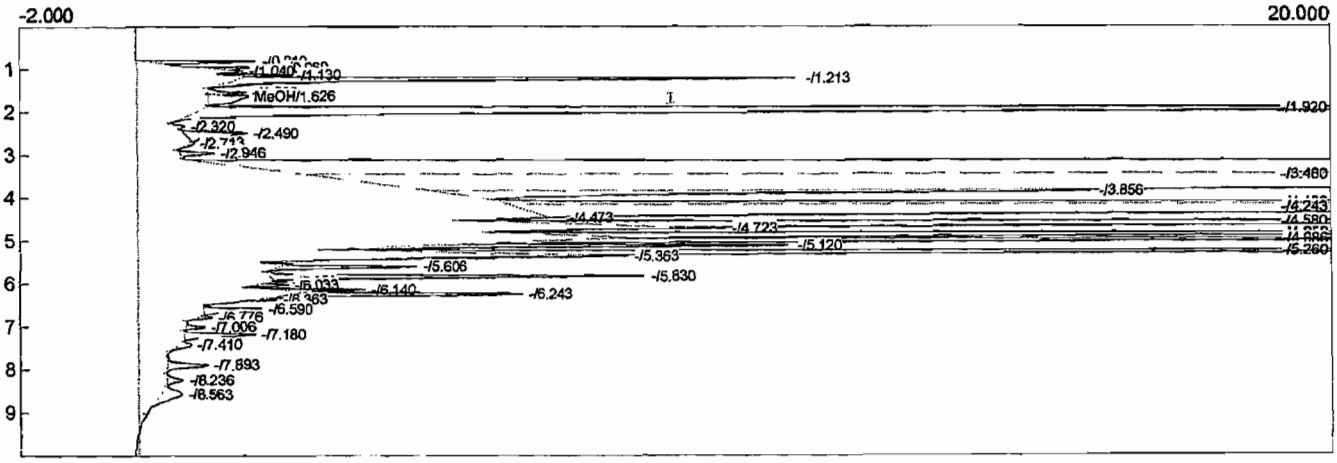
Component	Retention	Area
MeOH	1.683	61.8058
		61.8058

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 12:29:12
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR505.CHR ()
Sample: 736 Coker 308-3 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



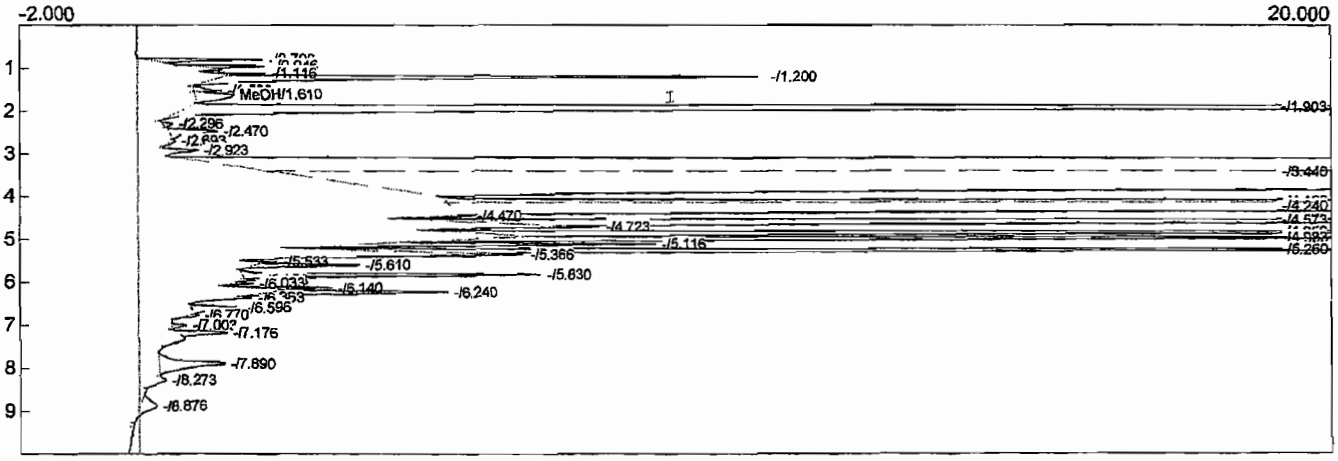
Component	Retention	Area
MeOH	1.620	7.0379
		7.0379

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 12:46:20
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR506.CHR ()
Sample: 736 Coker 308-3 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



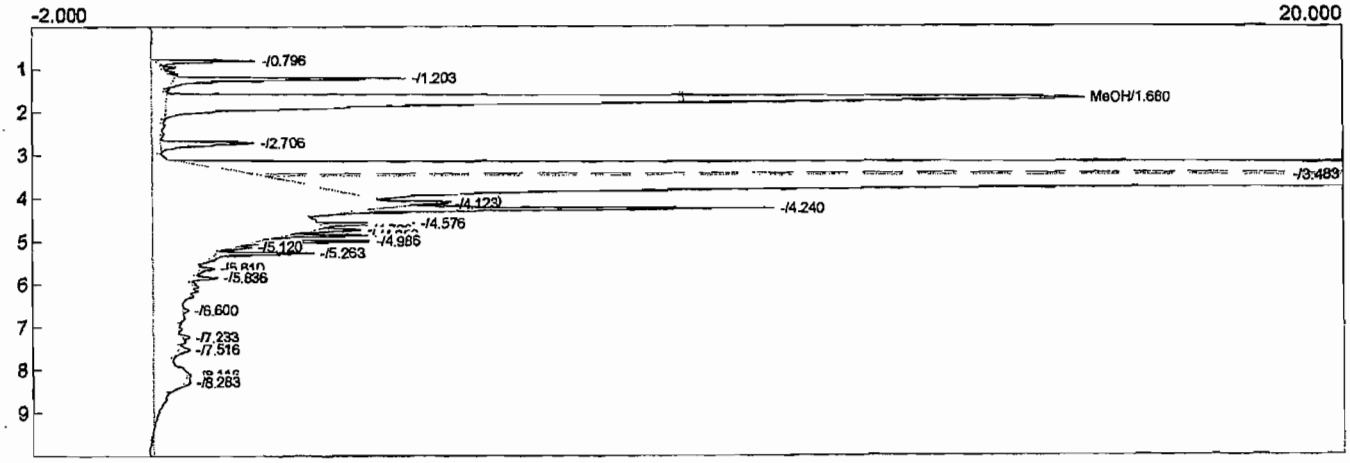
Component	Retention	Area
MeOH	1.626	6.9614
		6.9614

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 13:03:23
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR507.CHR ()
Sample: 736 Coker 308-3 Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



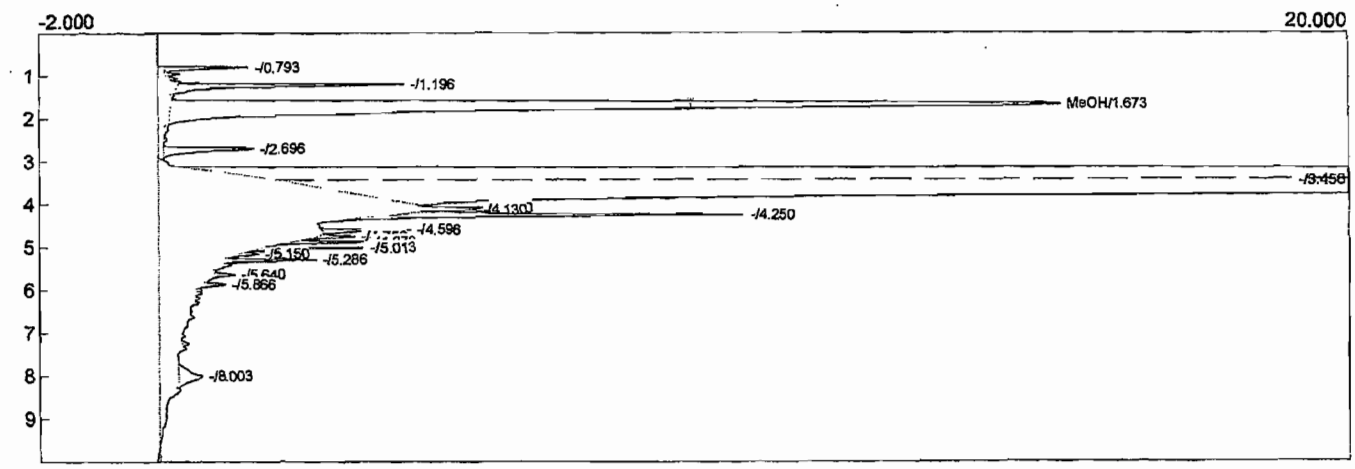
Component	Retention	Area
MeOH	1.610	6.5990
		6.5990

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 13:20:08
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR508.CHR ()
Sample: 736 Coker 308-1 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



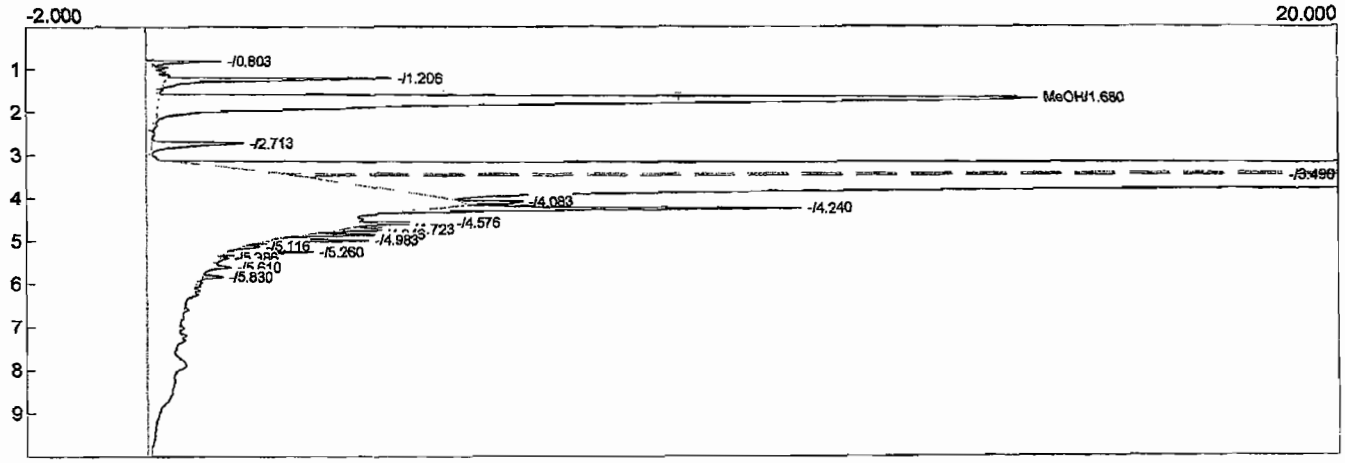
Component	Retention	Area
MeOH	1.680	195.0668
		195.0668

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 13:43:34
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR509.CHR ()
Sample: 736 Coker 308-1 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



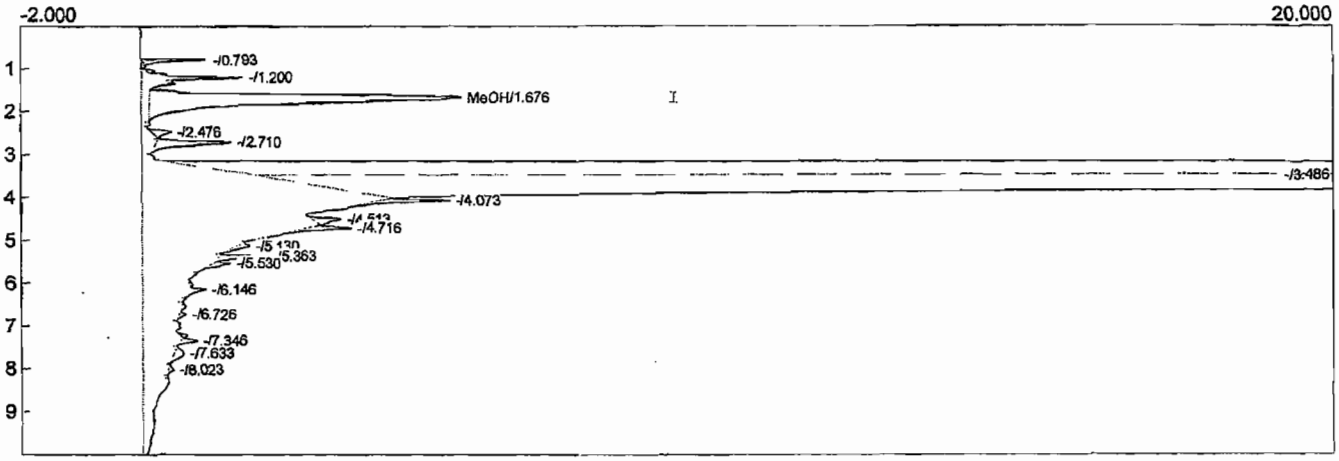
Component	Retention	Area
MeOH	1.673	193.8556
		193.8556

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 14:00:13
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR510.CHR ()
Sample: 736 Coker 308-1 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



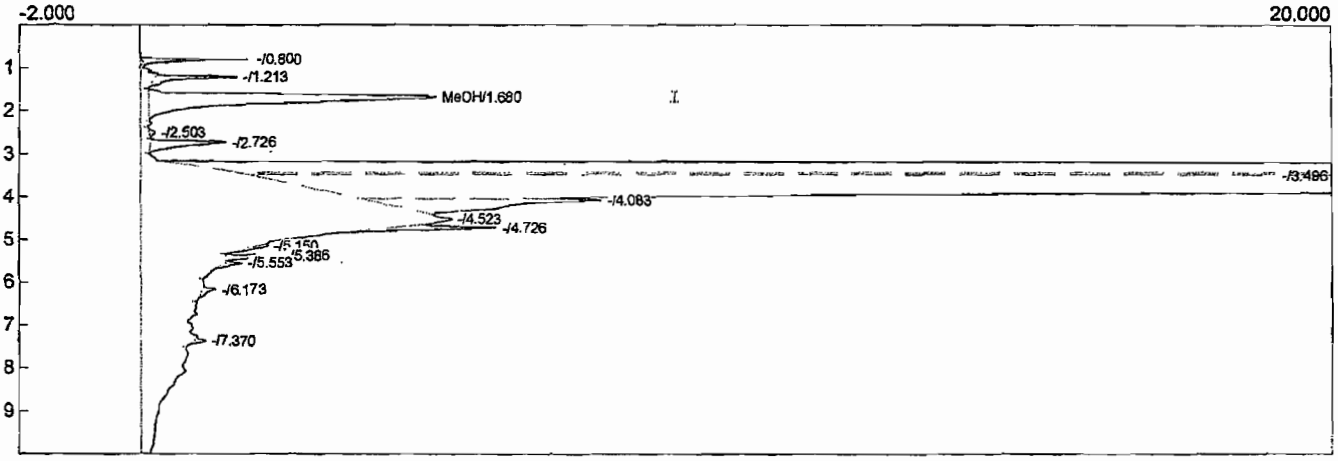
Component	Retention	Area
MeOH	1.680	191.3154
		191.3154

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 14:28:55
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR511.CHR ()
Sample: 736 Coker 308-2 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



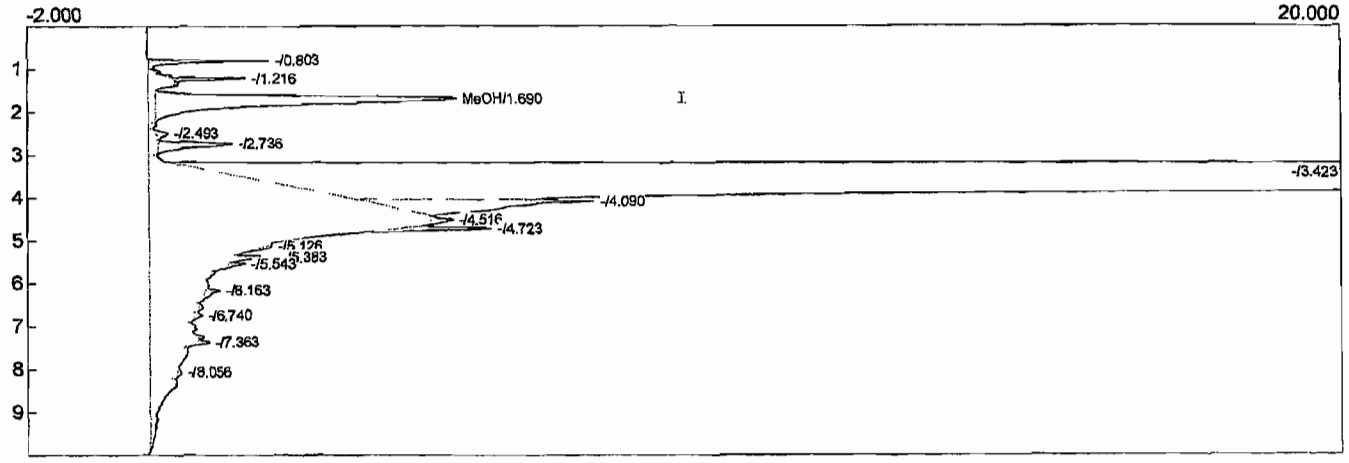
Component	Retention	Area
MeOH	1.676	73.2568
		73.2568

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 14:45:16
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR512.CHR ()
Sample: 736 Coker 308-2 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



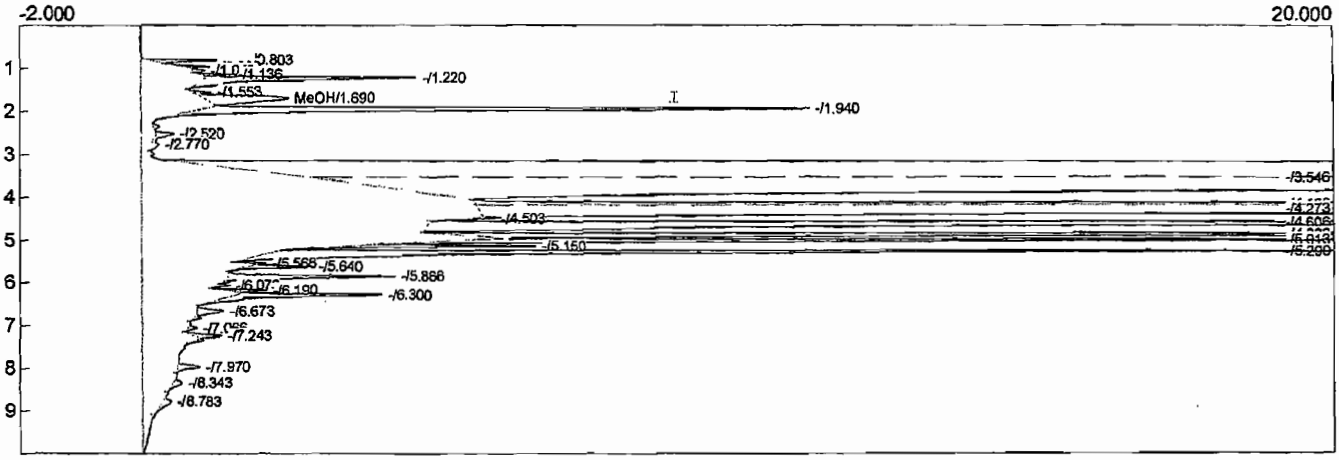
Component	Retention	Area
MeOH	1.680	66.2792
		66.2792

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 15:02:40
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR513.CHR ()
Sample: 736 Coker 308-2 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



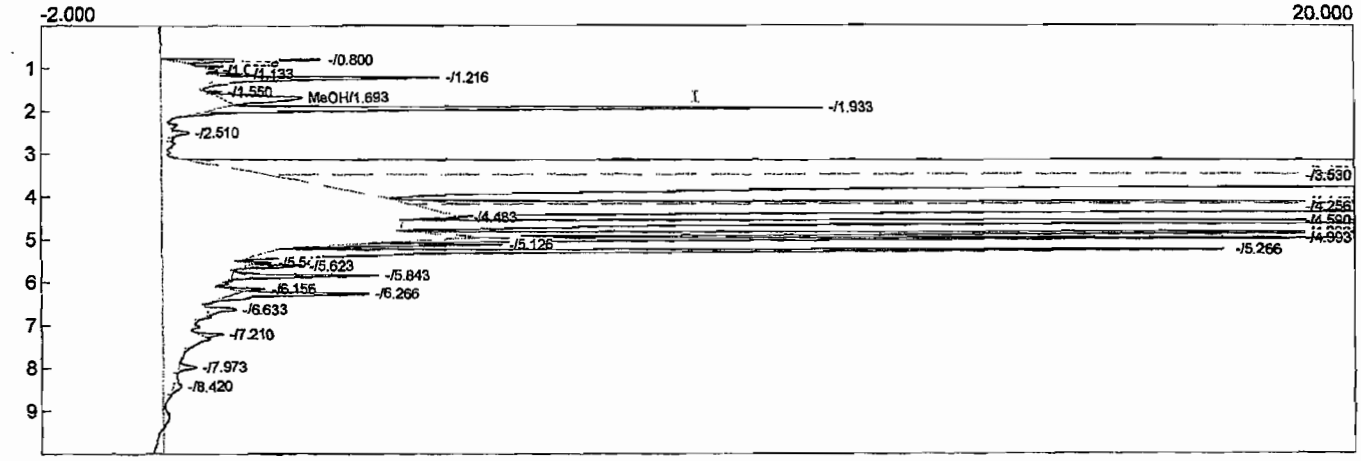
Component	Retention	Area
MeOH	1.690	70.7127
		70.7127

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 15:23:08
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR514.CHR ()
Sample: 736 Coker 308-3 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



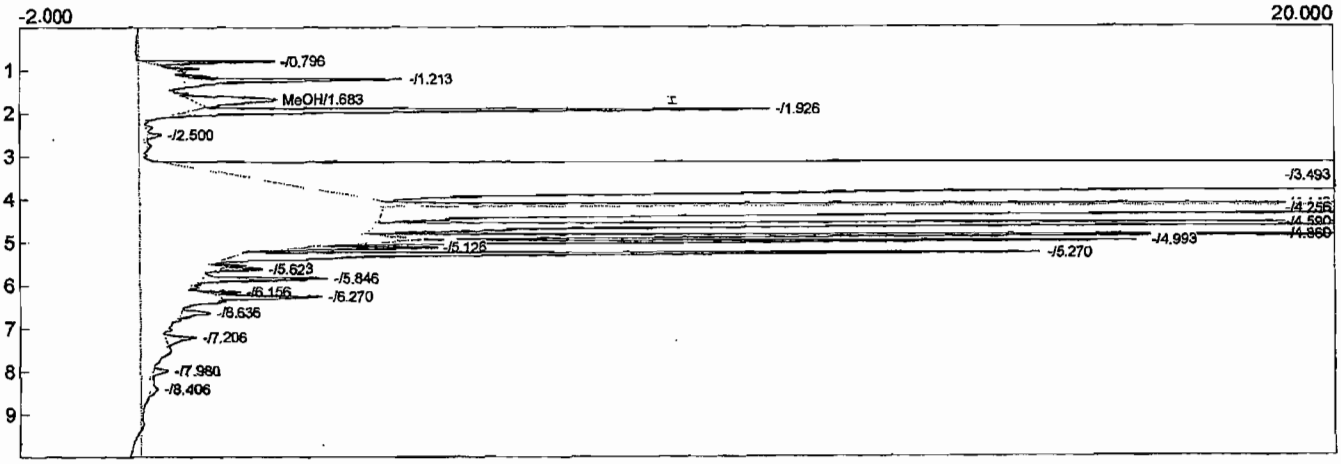
Component	Retention	Area
MeOH	1.690	13.7371
		13.7371

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 15:41:04
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR515.CHR ()
Sample: 736 Coker 308-3 Tube Spiked
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



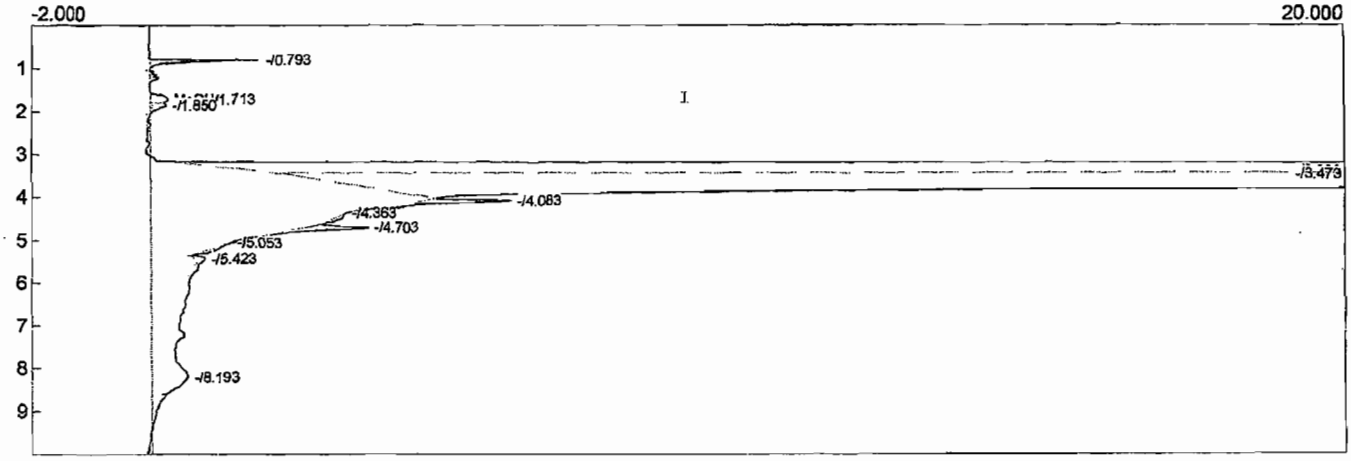
Component	Retention	Area
MeOH	1.693	13.0320
		13.0320

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 15:58:41
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR516.chr ()
Sample: 736 Coker 308-3 Tube Spiked
Operator: E. Vogt



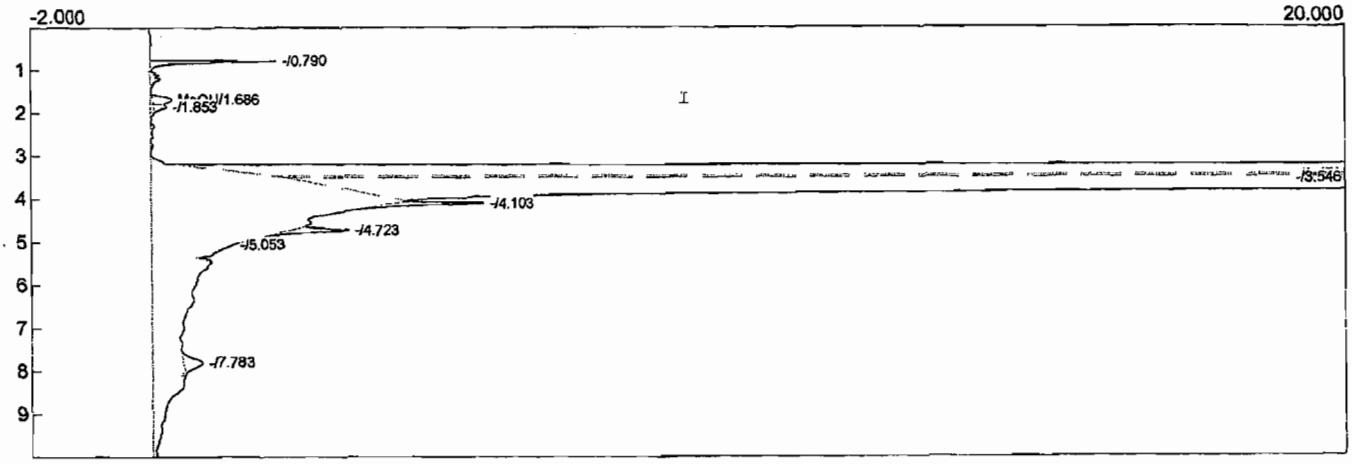
Component	Retention	Area
MeOH	1.683	13.5476
		13.5476

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 16:23:43
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR517.CHR ()
Sample: 736 Coker Blank Tube No Spike
Operator: E. Vogt
Comments: 4 ml 3% n-propanol tube extraction volume



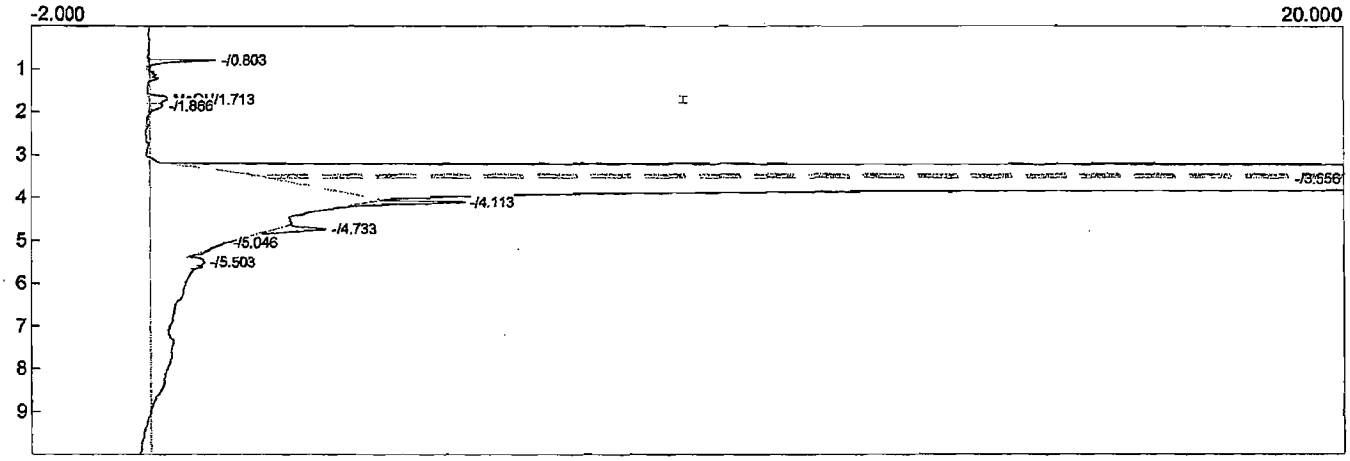
Component	Retention	Area
MeOH	1.713	2.7742
		2.7742

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 16:41:21
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR518.CHR ()
Sample: 736 Coker Blank Tube No Spike
Operator: E. Vgt
Comments: 4 ml 3% n-propanol tube extraction volume



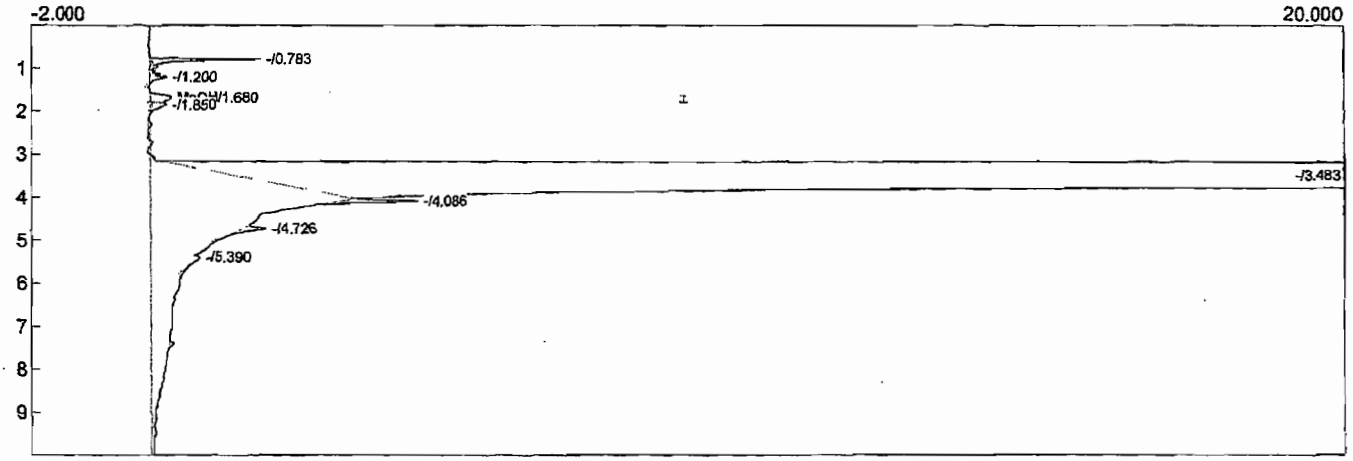
Component	Retention	Area
MeOH	1.686	3.1717
		3.1717

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 17:00:09
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR519.CHR ()
Sample: 736 Coker Blank Tube No Spike
Operator: E. Vogt



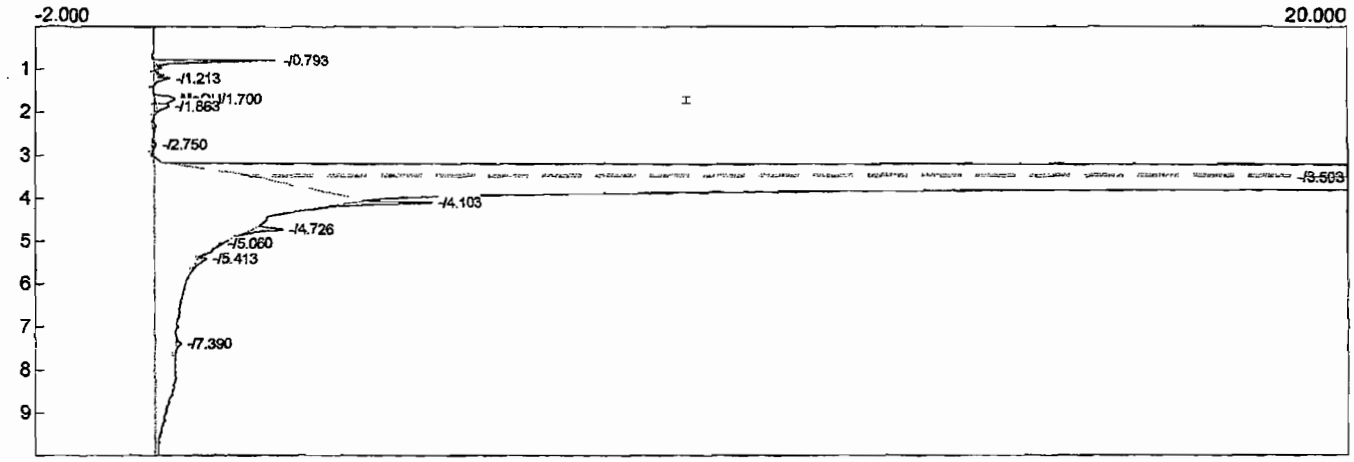
Component	Retention	Area
MeOH	1.713	3.0886
		3.0886

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 10:12:33
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR541.chr ()
Sample: 736 Coker Blank Tube Spiked
Operator: E. Vogt



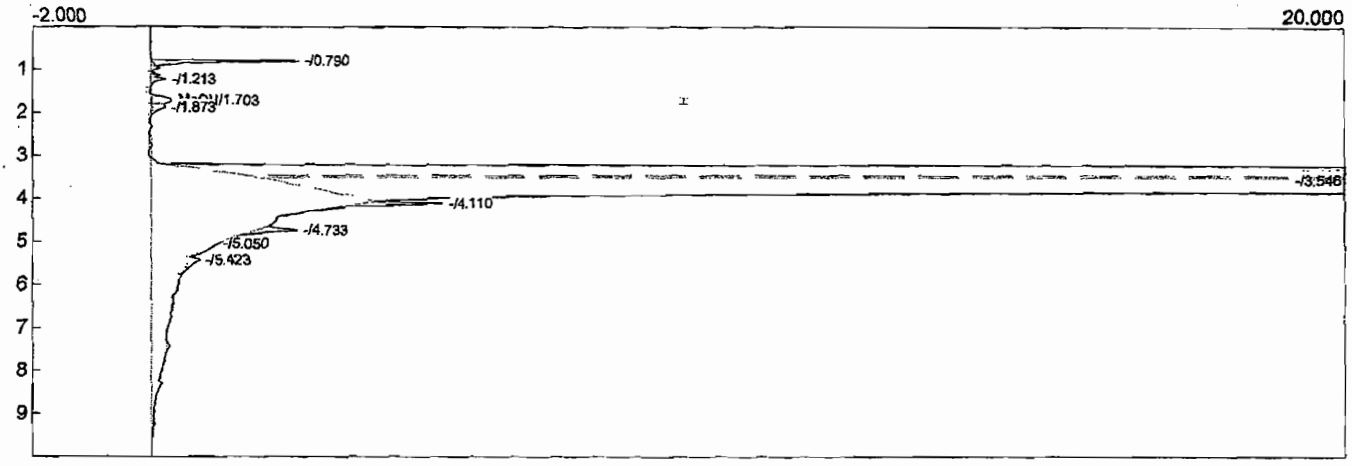
Component	Retention	Area
MeOH	1.680	3.4288
		3.4288

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 10:29:35
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR542.CHR ()
Sample: 736 Coker Blank Tube Spiked
Operator: E. Vogt



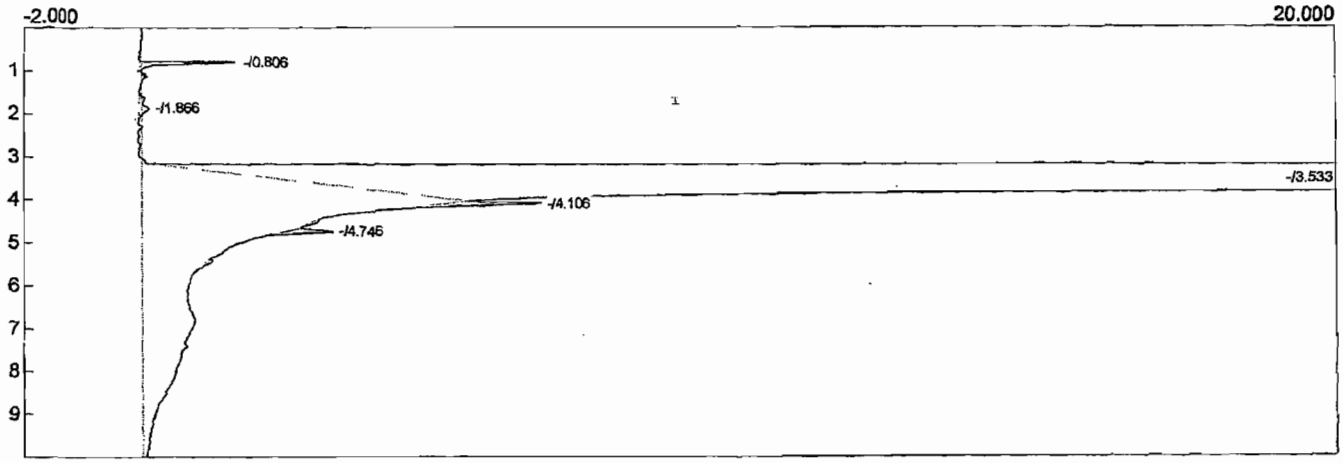
Component	Retention	Area
MeOH	1.700	3.1928
		3.1928

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 10:47:33
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR543.CHR ()
Sample: 736 Coker Blank Tube Spiked
Operator: E. Vogt



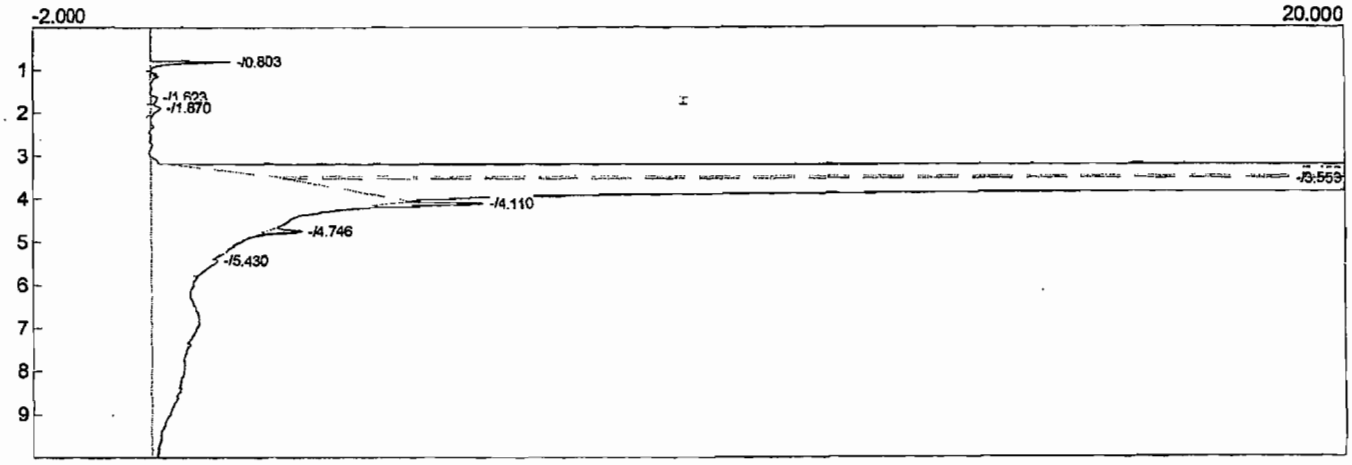
Component	Retention	Area
MeOH	1.703	3.3174
		3.3174

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/19/2011 13:02:03
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR576.CHR ()
Sample: 3% n-propanol blank
Operator: E. Vogt



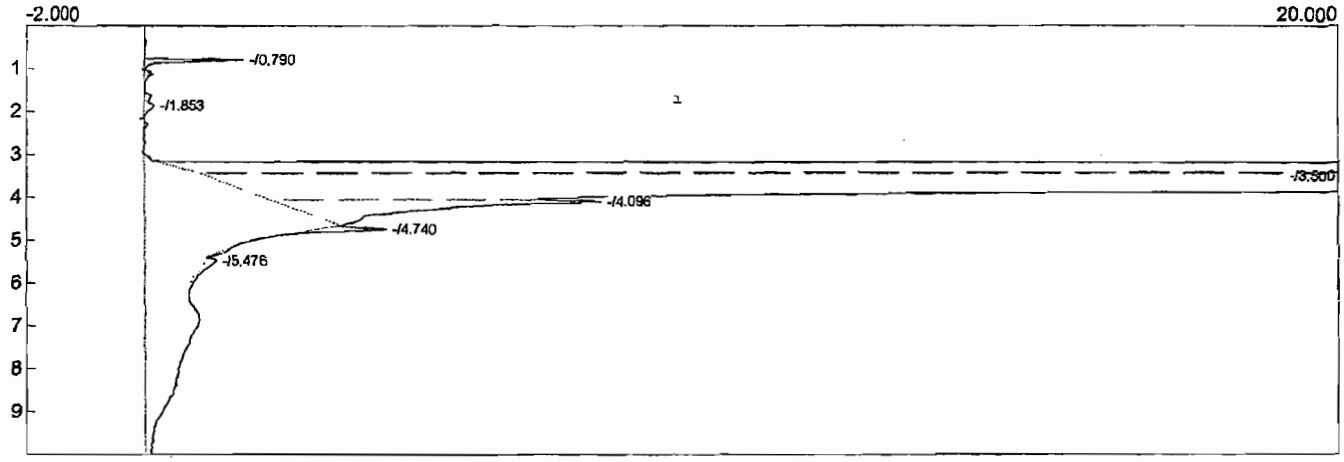
Component	Retention	Area
		0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/19/2011 13:18:56
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR577.CHR ()
Sample: 3% n-propanol blank
Operator: E. Vogt



Component	Retention	Area
		0.0000

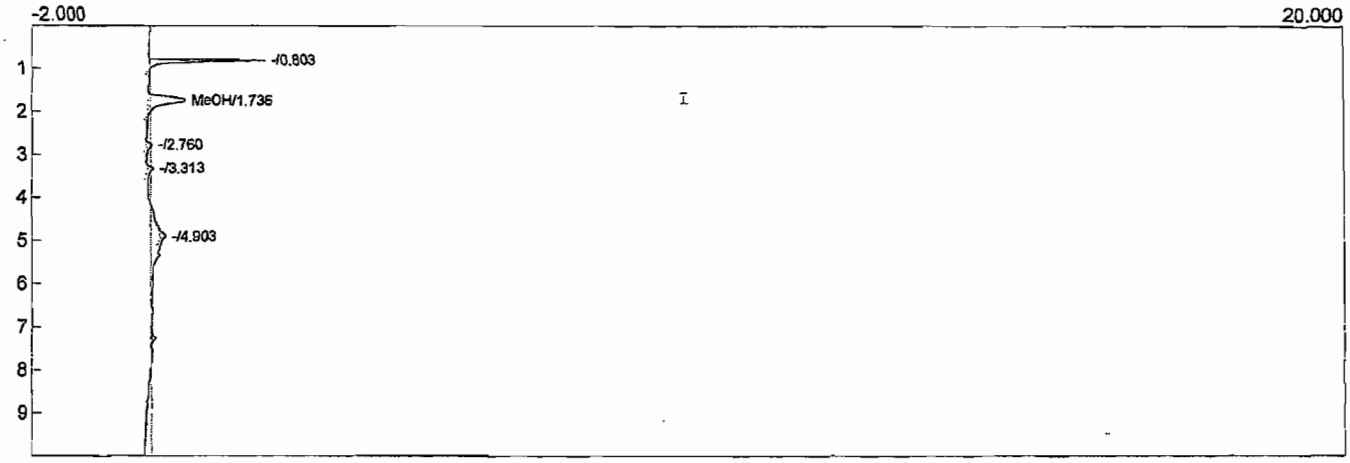
Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/19/2011 13:37:04
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR578.CHR ()
Sample: 3% n-propanol blank
Operator: E. Vogt



Component	Retention	Area

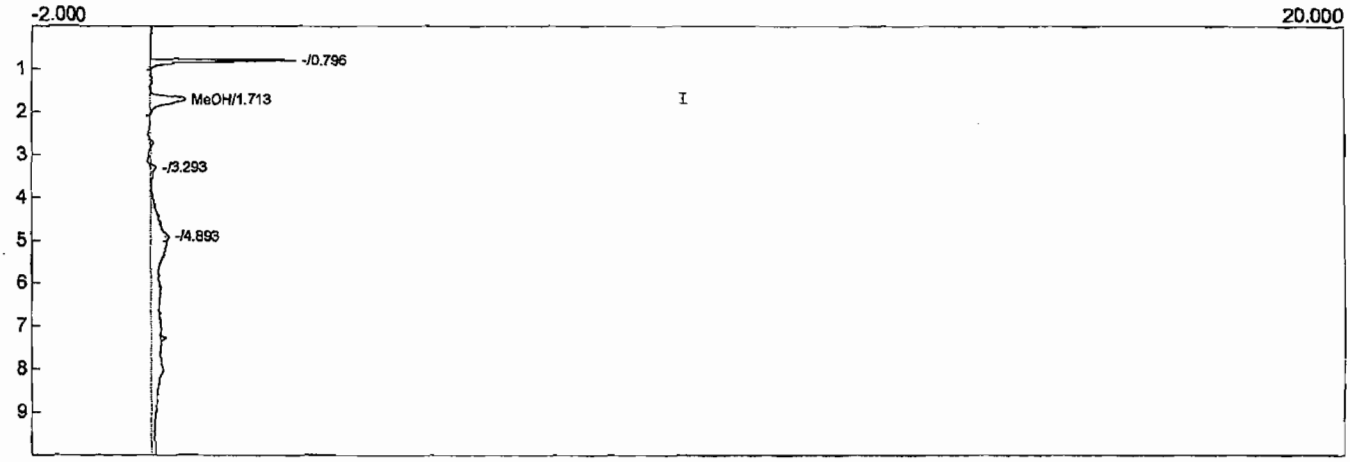
0.0000

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 18:05:55
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR491.chr ()
Sample: 2.0 ppm MeOH std. - pre
Operator: E. Vogt



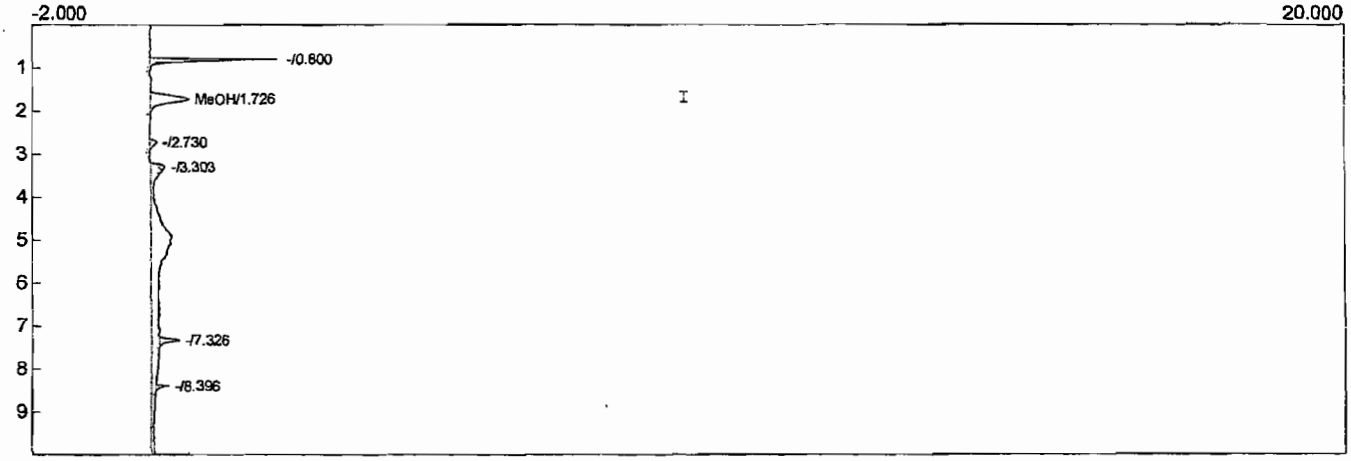
Component	Retention	Area
MeOH	1.736	7.5910
		7.5910

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 09:16:19
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR494.CHR ()
Sample: 2.0 ppm MeOH Std. - pre
Operator: E. Vogt



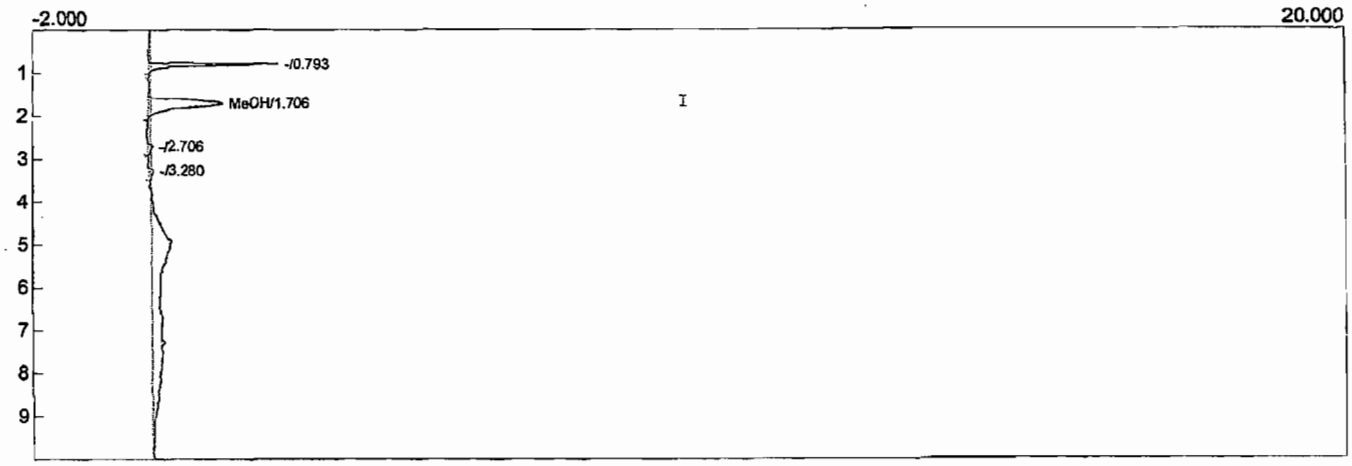
Component	Retention	Area
MeOH	1.713	7.3801
		7.3801

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 08:59:38
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR493.chr ()
Sample: 2.0 ppm MeOH Std. - pre
Operator: E. Vogt



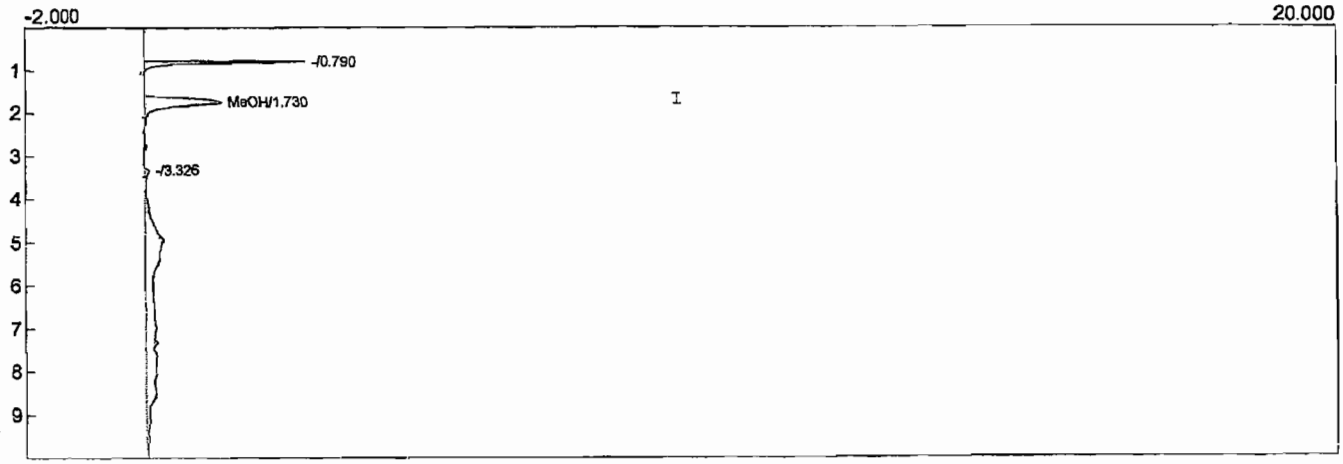
Component	Retention	Area
MeOH	1.726	7.7681
		7.7681

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 09:36:26
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR495.chr ()
Sample: 5.0 ppm MeOH Std. - pre
Operator: E. Vogt



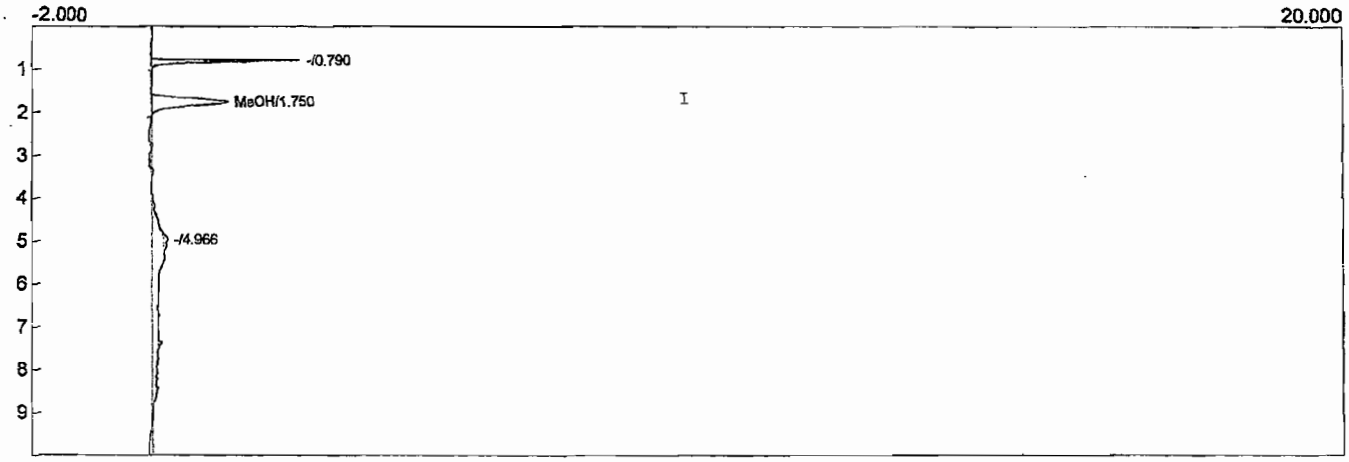
Component	Retention	Area
MeOH	1.706	15.7963
		15.7963

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 10:11:10
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR497.CHR ()
Sample: 5.0 ppm MeOH Std. - pre
Operator: E. Vogt



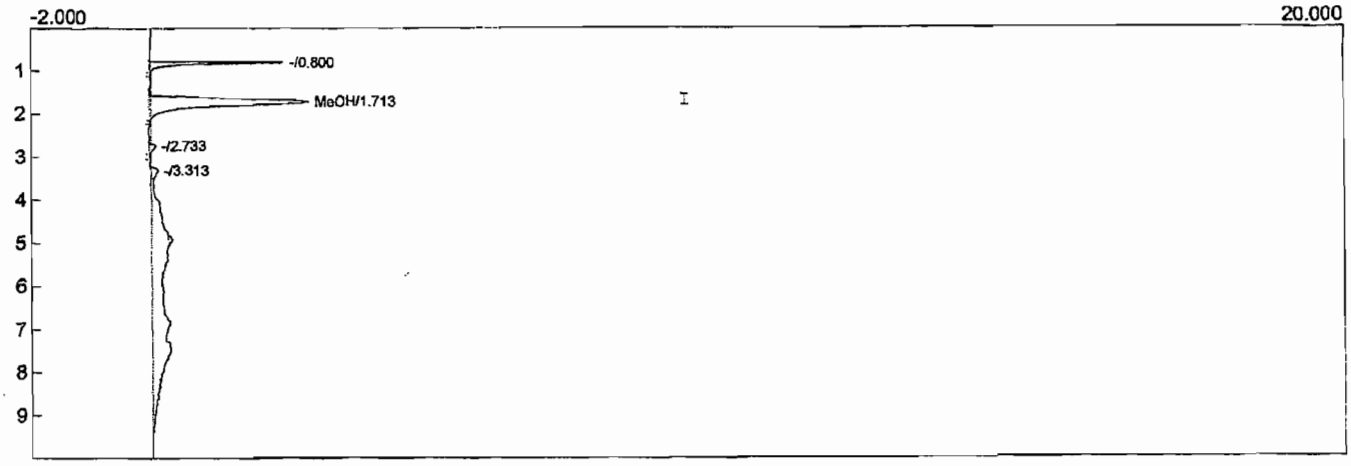
Component	Retention	Area
MeOH	1.730	15.5089
		15.5089

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 10:29:00
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR498.CHR ()
Sample: 5.0 ppm MeOH Std. - pre
Operator: E. Vogt



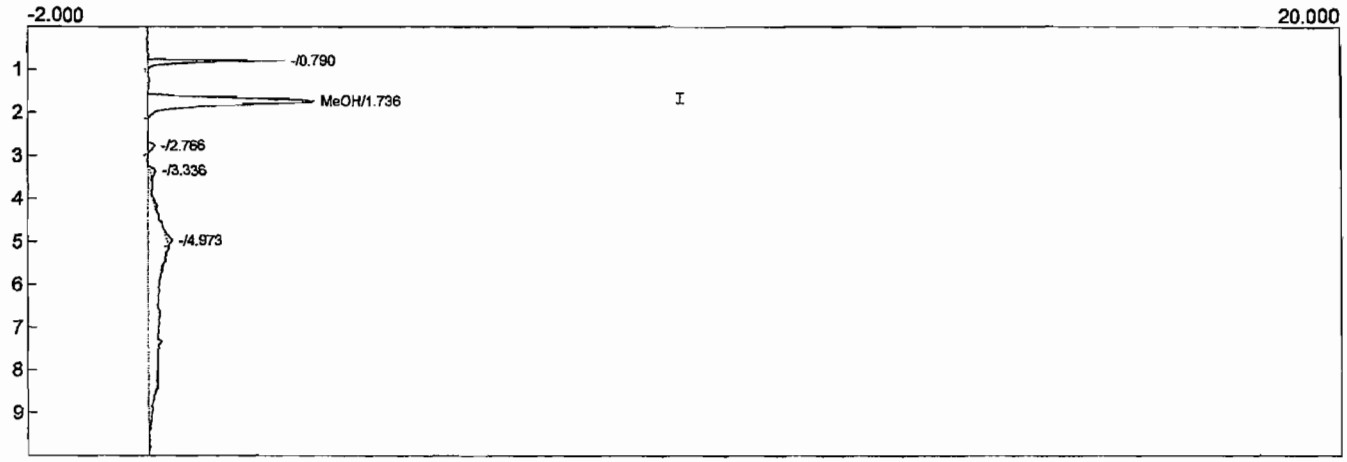
Component	Retention	Area
MeOH	1.750	15.4186
		15.4186

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 12:24:27
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR472.CHR ()
Sample: 10 ppm MeOH Std. - pre
Operator: E. Vogt



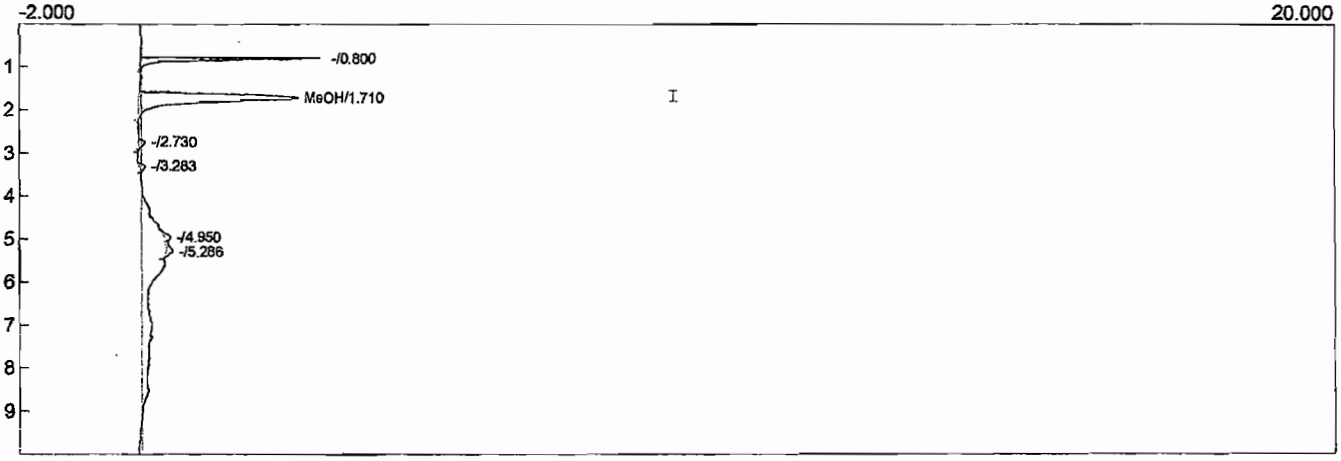
Component	Retention	Area
MeOH	1.713	31.8774
		31.8774

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 12:41:38
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR473.CHR ()
Sample: 10 ppm MeOH Std. - pre
Operator: E. Vogt



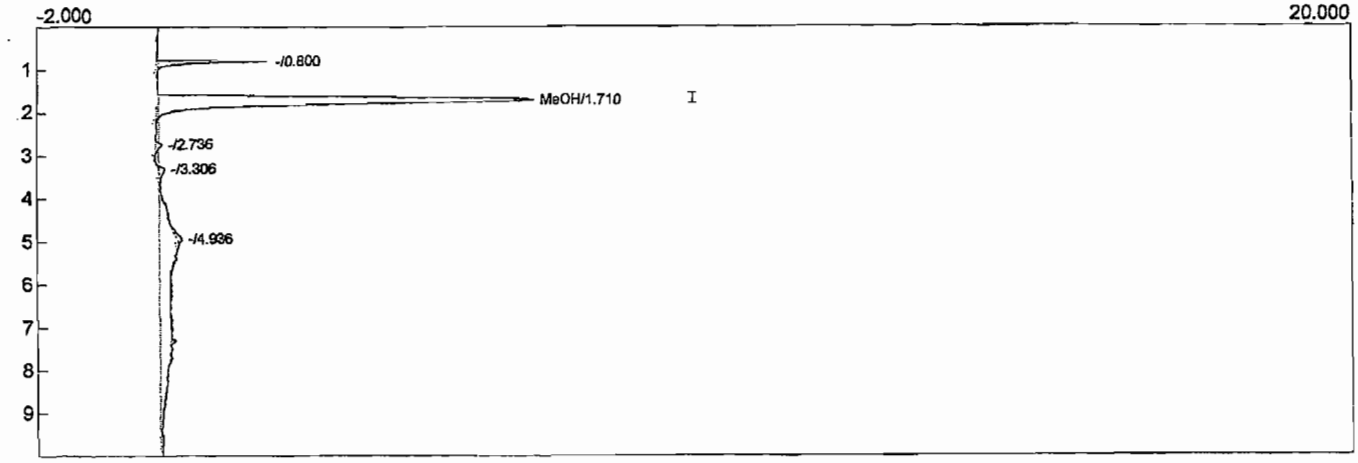
Component	Retention	Area
MeOH	1.736	32.5326
		32.5326

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 12:58:08
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR474.CHR ()
Sample: 10 ppm MeOH Std. - pre
Operator: E. Vogt



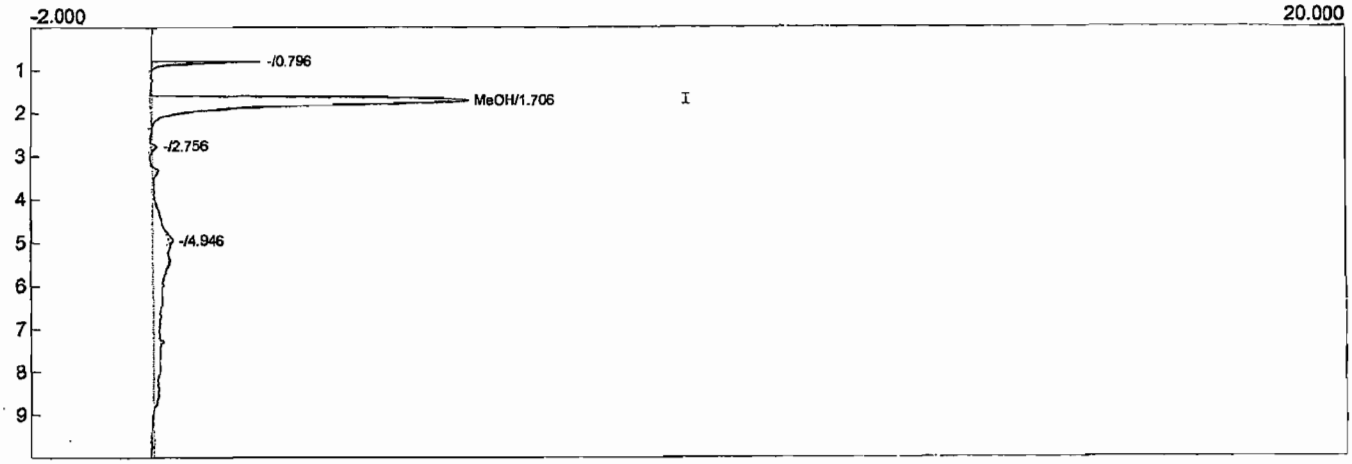
Component	Retention	Area
MeOH	1.710	31.7682
		31.7682

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 13:14:35
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR475.CHR ()
Sample: 25 ppm MeOH Std. - pre
Operator: E. Vogt



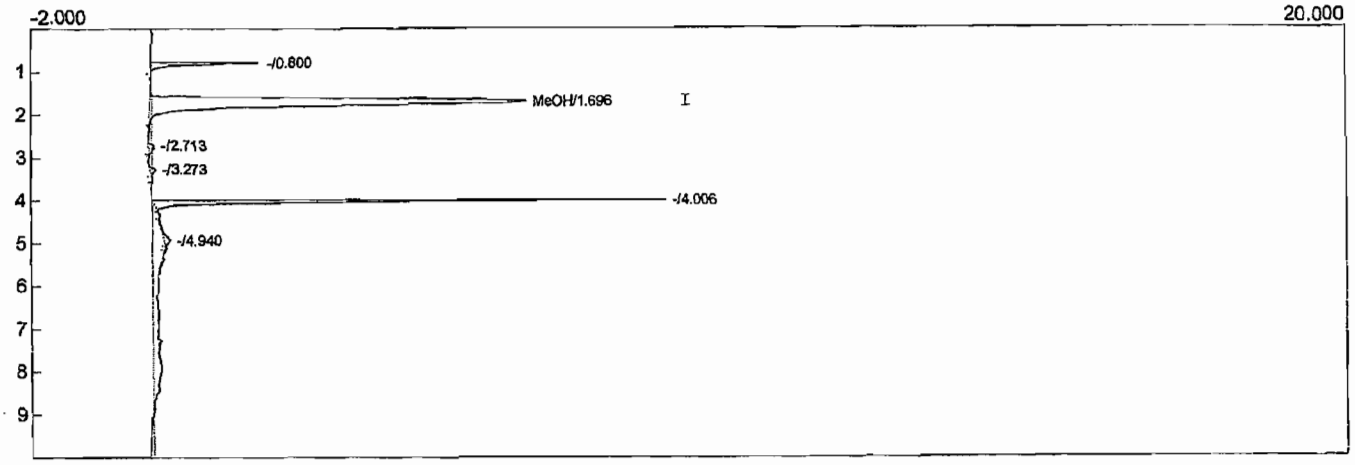
Component	Retention	Area
MeOH	1.710	72.8743
		72.8743

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 13:31:39
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR476.CHR ()
Sample: 25 ppm MeOH Std. - pre
Operator: E. Vogt



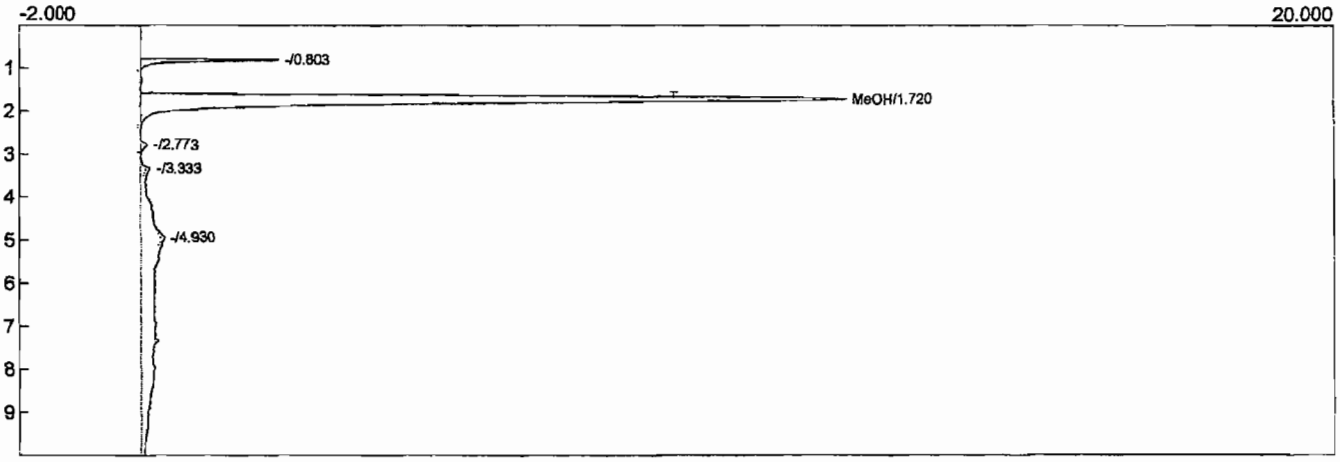
Component	Retention	Area
MeOH	1.706	73.8230
		73.8230

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 13:48:24
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR477.CHR ()
Sample: 25 ppm MeOH Std. - pre
Operator: E. Vogt



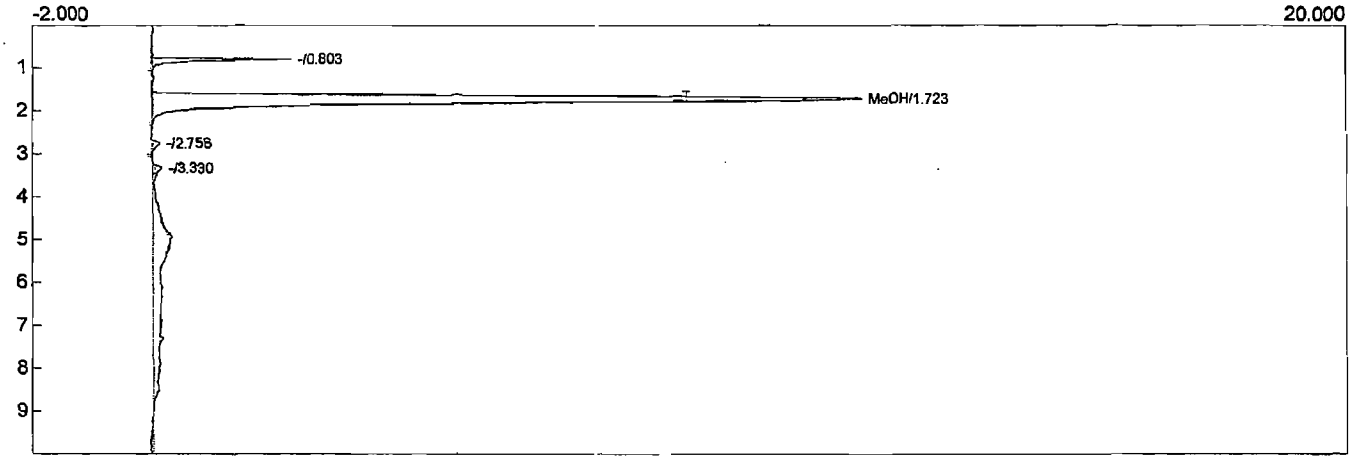
Component	Retention	Area
MeOH	1.696	70.8010
		70.8010

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 14:05:22
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR478.CHR ()
Sample: 50 ppm MeOH Std. - pre
Operator: E. Vogt



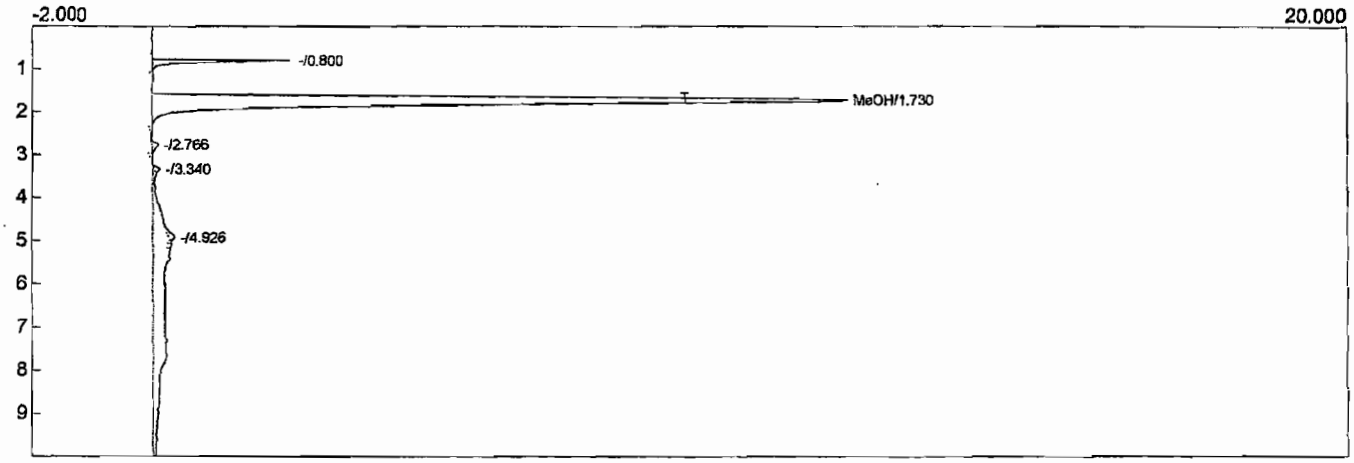
Component	Retention	Area
MeOH	1.720	140.1828
		140.1828

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 14:22:41
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR479.CHR ()
Sample: 50 ppm MeOH Std. - pre
Operator: E. Vogt



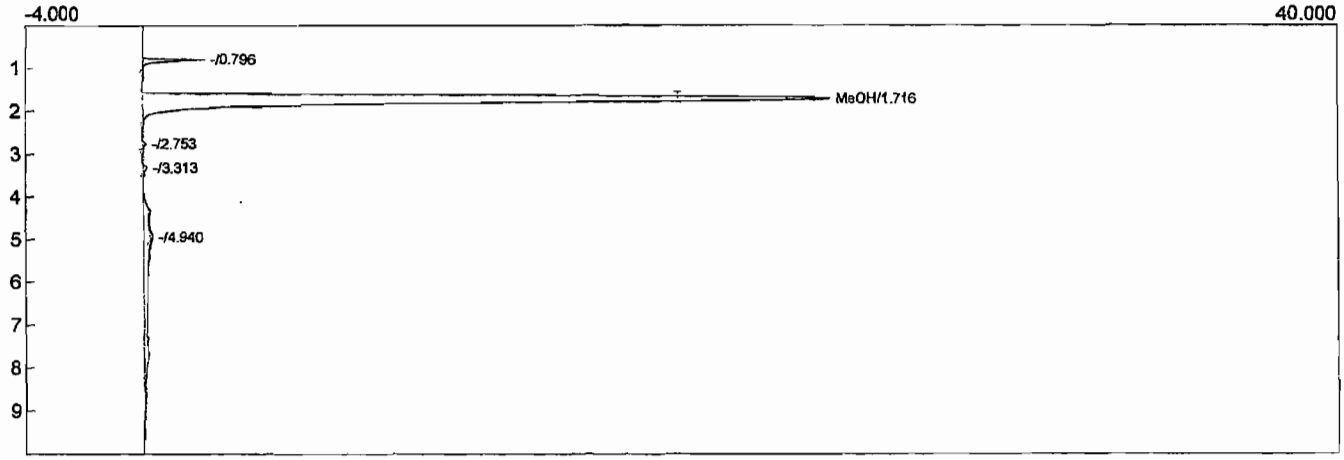
Component	Retention	Area
MeOH	1.723	139.8216
		139.8216

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 14:39:40
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR480.CHR ()
Sample: 50 ppm MeOH Std. - pre
Operator: E. Vogt



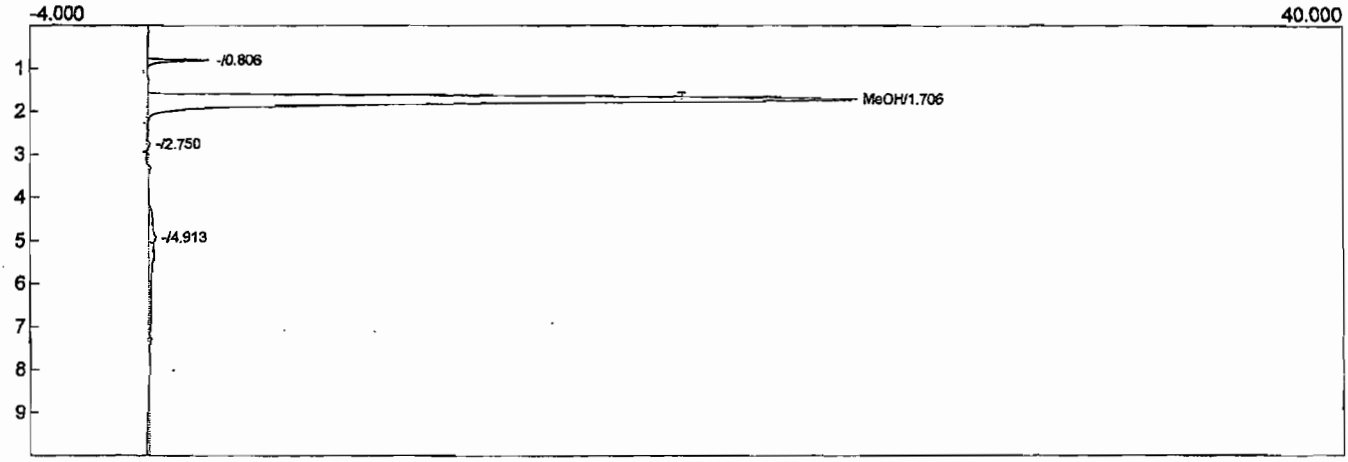
Component	Retention	Area
MeOH	1.730	141.3366
		141.3366

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 14:57:03
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR481.CHR ()
Sample: 100 ppm MeOH Std. - pre
Operator: E. Vogt



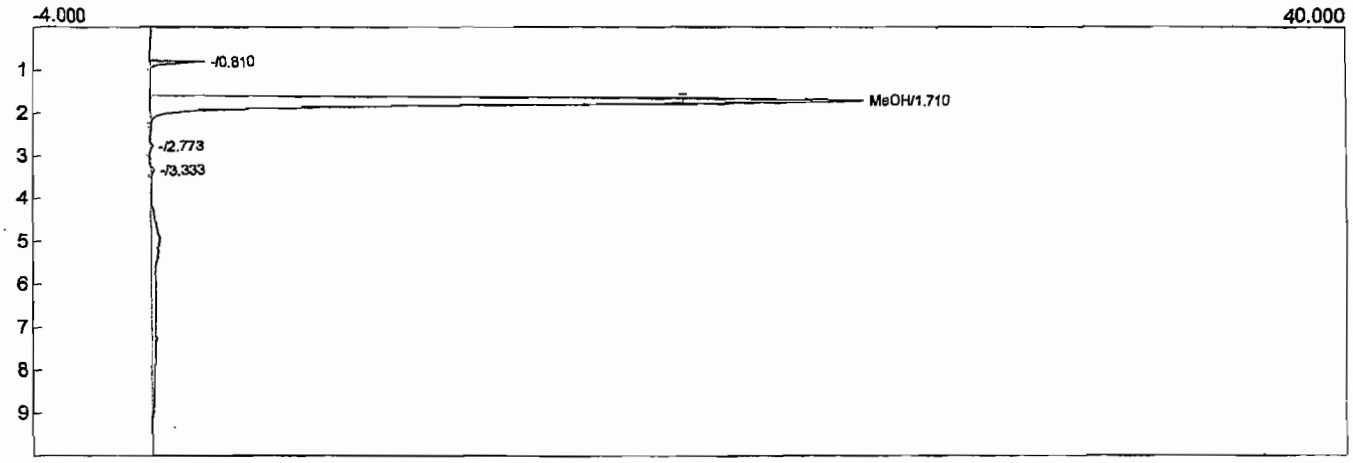
Component	Retention	Area
MeOH	1.716	272.2312
		272.2312

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 15:14:16
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR482.CHR ()
Sample: 100 ppm MeOH Std. - pre
Operator: E. Vogt



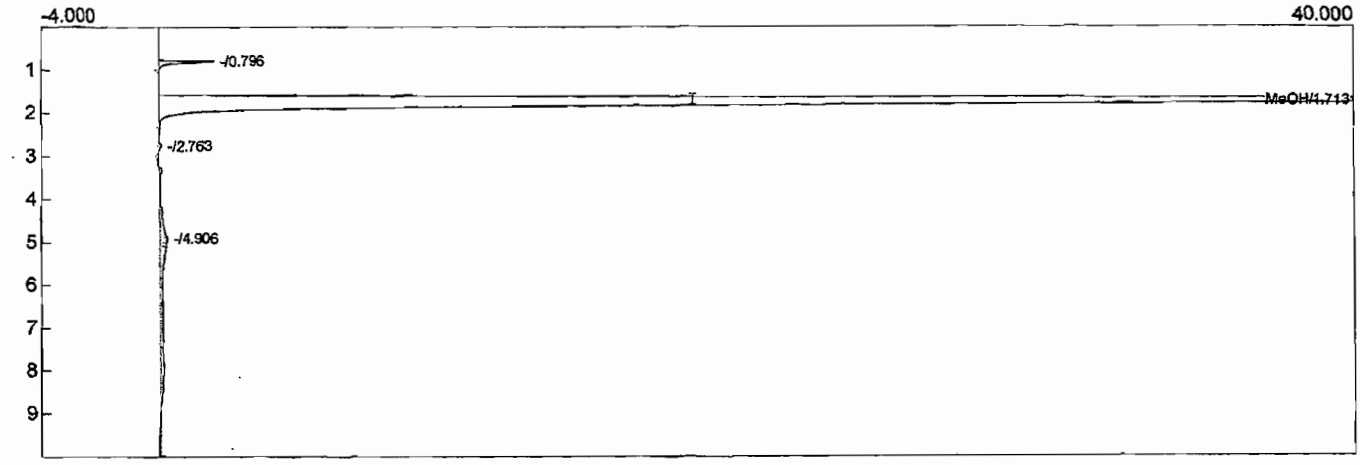
Component	Retention	Area
MeOH	1.706	277.2366
		277.2366

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 15:31:24
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR483.CHR ()
Sample: 100 ppm MeOH Std. - pre
Operator: E. Vogt



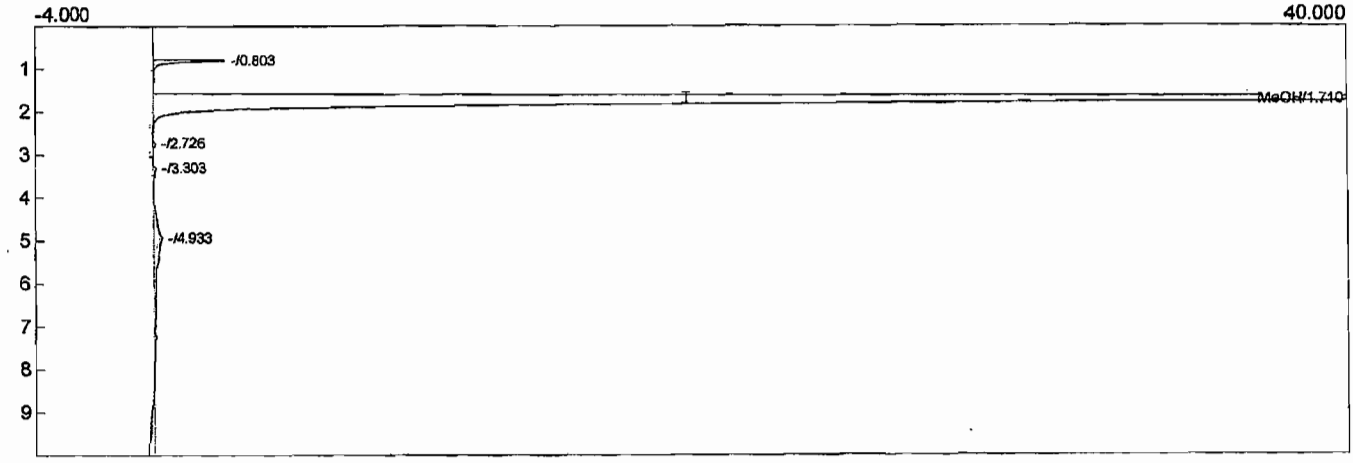
Component	Retention	Area
MeOH	1.710	277.2595
		277.2595

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 15:48:48
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR484.CHR ()
Sample: 200 ppm MeOH Std. - pre
Operator: E. Vogt



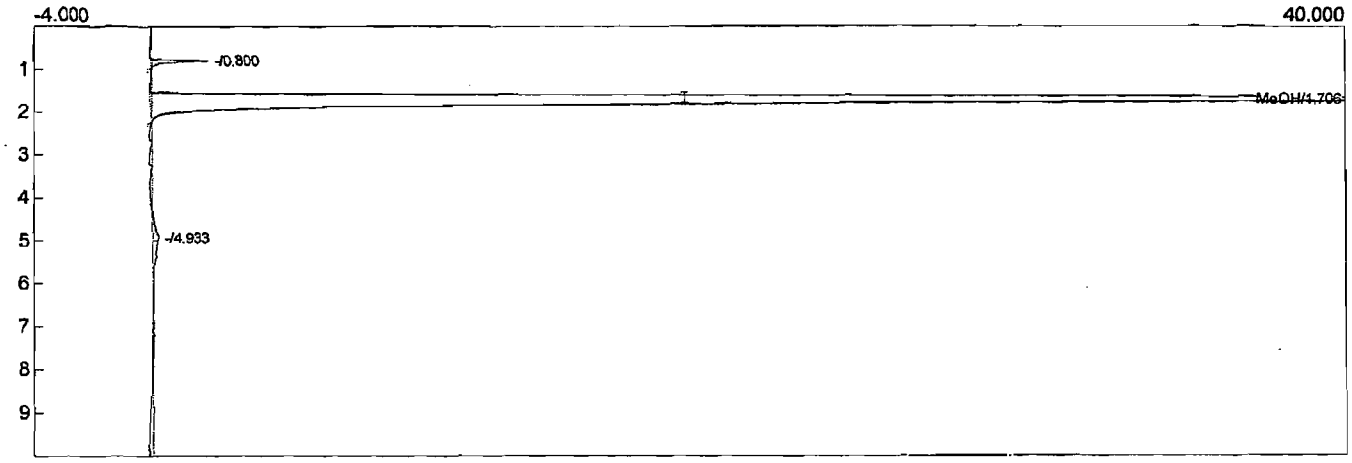
Component	Retention	Area
MeOH	1.713	538.0157
		538.0157

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 16:06:11
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR485.CHR ()
Sample: 200 ppm MeOH Std. - pre
Operator: E. Vogt



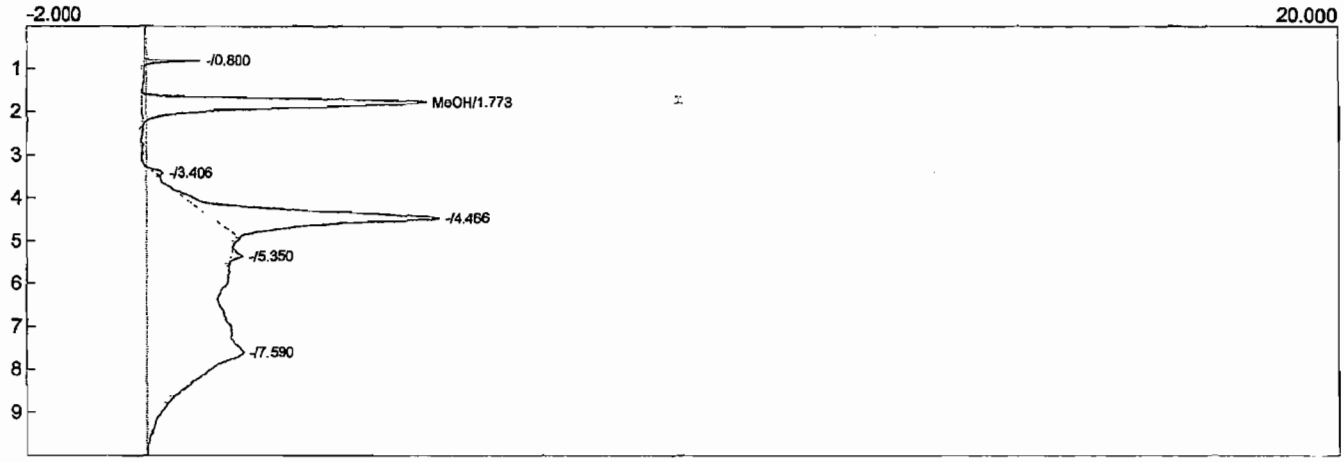
Component	Retention	Area
MeOH	1.710	557.6907
		557.6907

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/15/2011 16:23:07
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR486.CHR ()
Sample: 200 ppm MeOH Std. - pre
Operator: E. Vogt



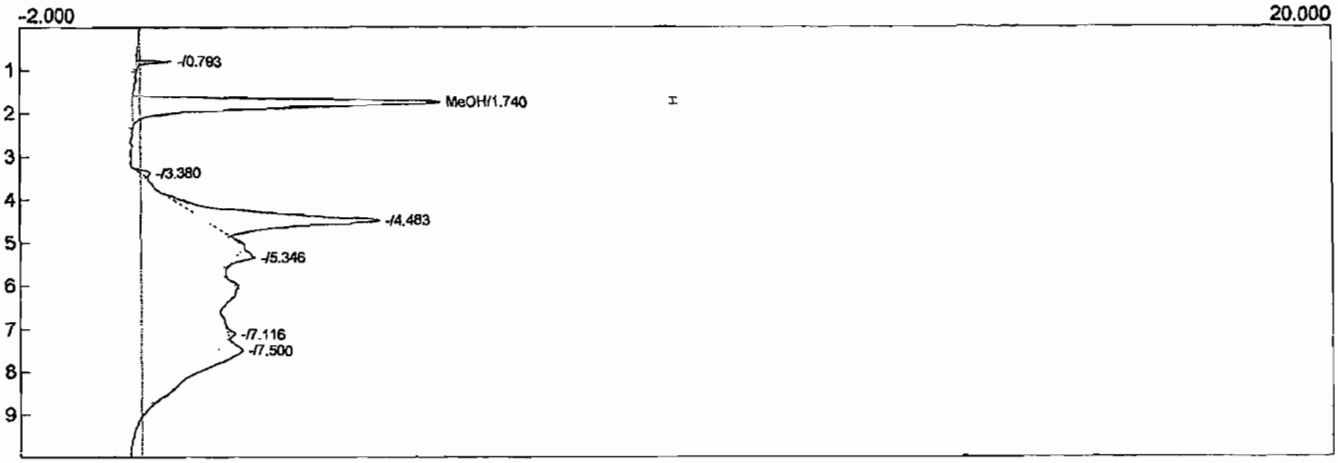
Component	Retention	Area
MeOH	1.706	558.9126
		558.9126

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 20:12:00
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR572.CHR ()
Sample: 25 ppm MeOH std. - post
Operator: E. Vogt



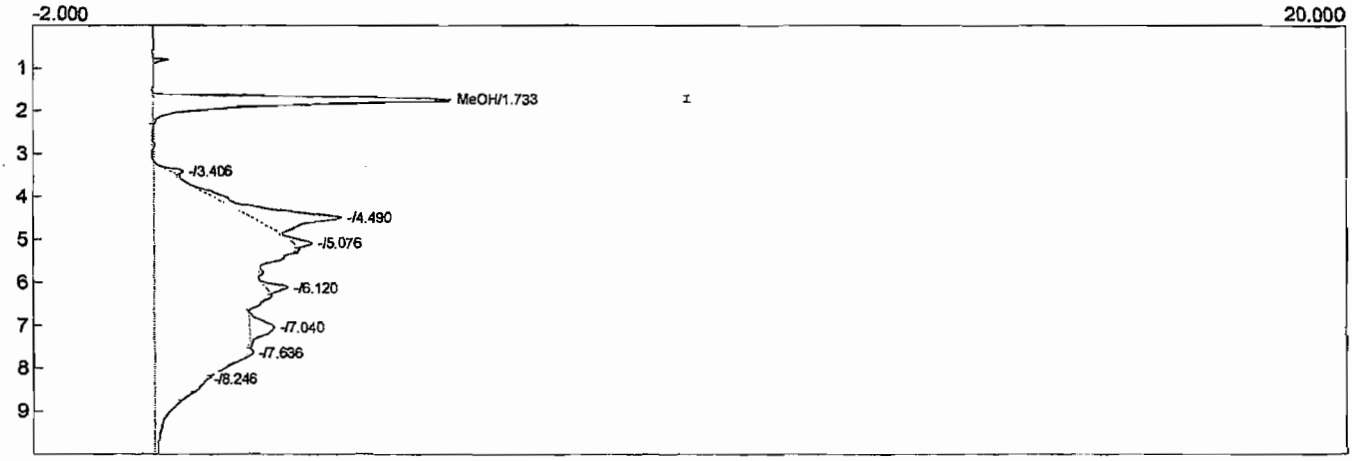
Component	Retention	Area
MeOH	1.773	71.7404
		71.7404

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 19:54:18
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR571.CHR ()
Sample: 25 ppm MeOH Std.- post
Operator: E. Vogt



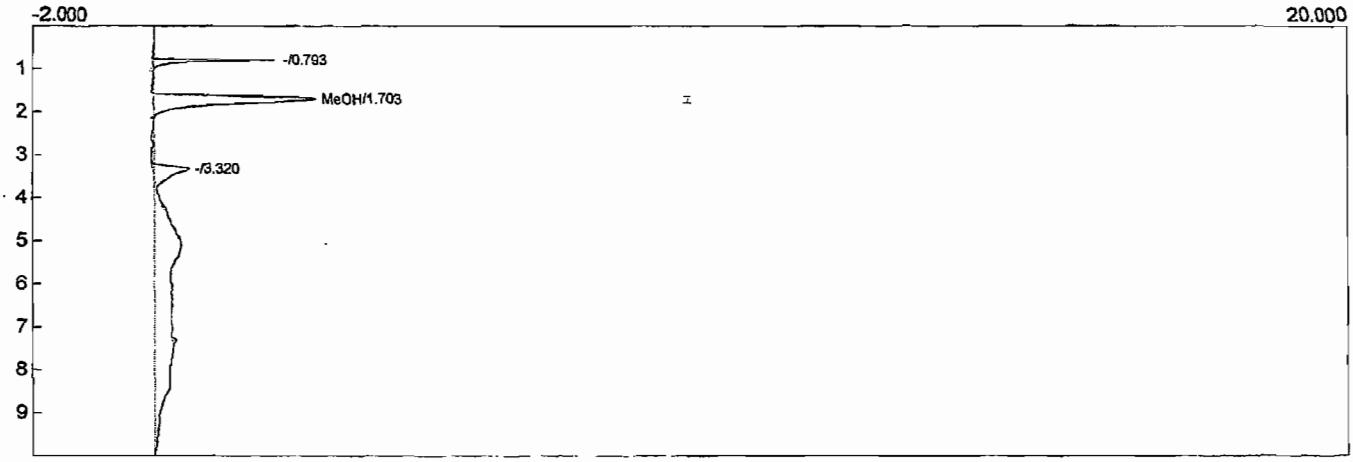
Component	Retention	Area
MeOH	1.740	72.8088
		72.8088

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 19:37:00
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR570.chr ()
Sample: 25 ppm MeOH std. - post
Operator: E. Vogt



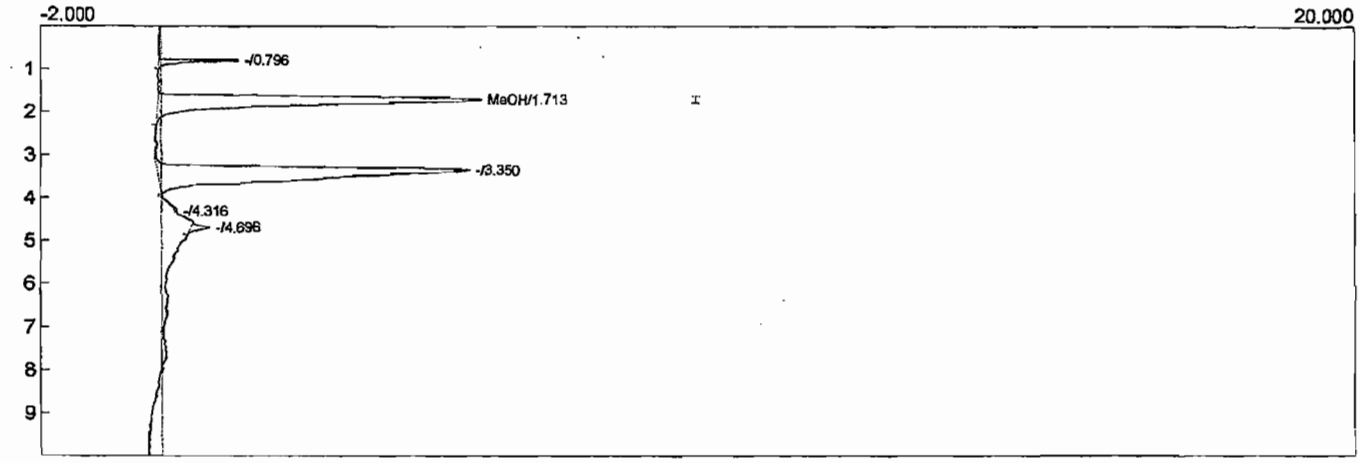
Component	Retention	Area
MeOH	1.733	68.2558
		68.2558

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 15:38:13
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR557.CHR ()
Sample: 10 ppm MeOH secondary std.
Operator: E. Vogt



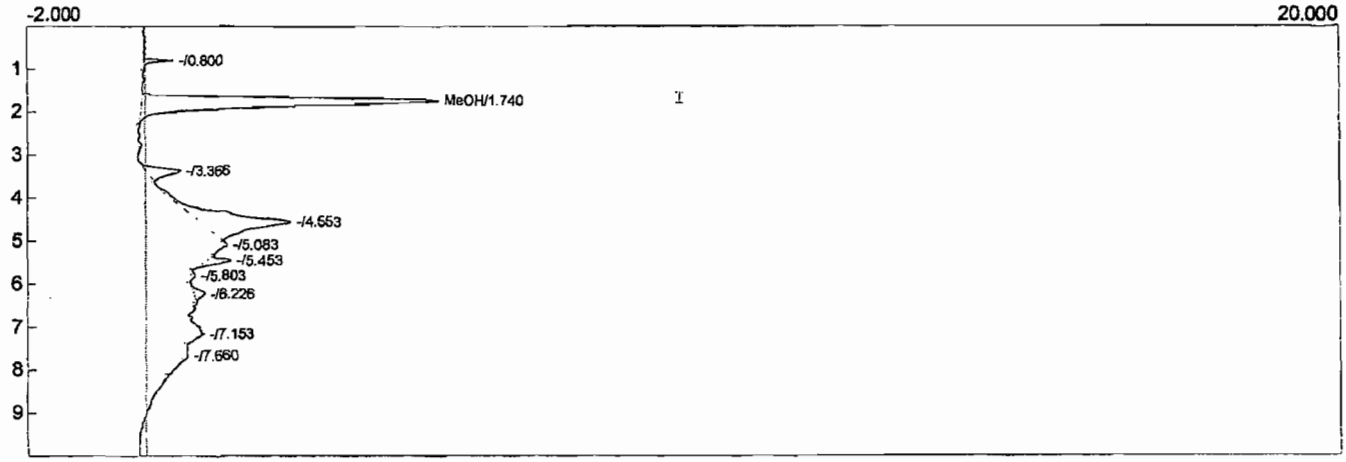
Component	Retention	Area
MeOH	1.703	33.8986
		33.8986

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 17:18:12
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR520.chr ()
Sample: 25 ppm MeOH std. - Check
Operator: E. Vogt



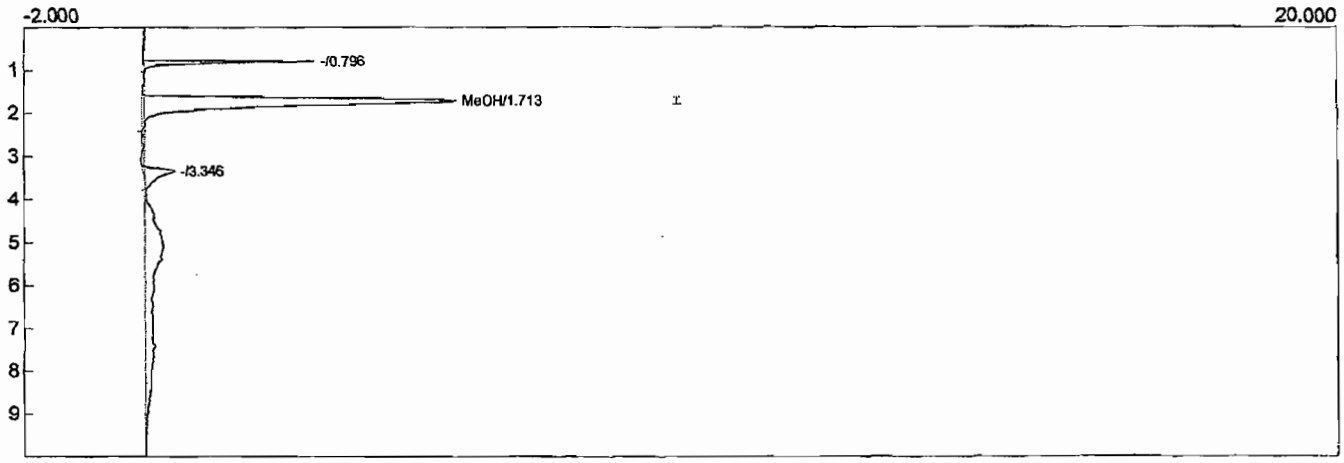
Component	Retention	Area
MeOH	1.713	70.7982
		70.7982

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/16/2011 22:50:42
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR539.CHR ()
Sample: 25 ppm MeOH std. - Check
Operator: E. Vogt



Component	Retention	Area
MeOH	1.740	67.9504
		67.9504

Lab name: ARI Environmental
Client: Houston Refining
Analysis date: 08/17/2011 15:03:08
Method: Syringe Injection
Description: GC FID
Carrier: HELIUM
Data file: MEOH ICR556.CHR ()
Sample: 25 ppm MeOH std. - check
Operator: E. Vogt



Component	Retention	Area
MeOH	1.713	67.7029
		67.7029

USEPA METHOD 18 TASK SCHEDULE

Client: Houston Refining

Location: Houston, TX

Project Manager: Greg Burch

Date Sampled: 7/19 – 7/28/11

Lab Project #: 08-327

Spreadsheet Template ID: USEPA-M18-SORBANT-TEMPLATE-64T-REV1

Analyst: E. Vogt

Reagents

Hydrogen Gas Manufacturer and Lot: Air Liquide Cylinder # K011471

Helium Gas Manufacturer and Lot: Air Liquide Cylinder # K014782

Air Manufacturer and Lot: K026516

Nitrogen Manufacturer and Lot: N/A

Standard Identification

1) 996.6 µg/ml MeOH Stock Standard made from Fisher Purge & Trap Grade Lot #064748 (8/15/11)

2) 2.0 µg/ml MeOH

3) 5.0 µg/ml MeOH

4) 10.0 µg/ml MeOH

5) 24.9 µg/ml MeOH

6) 49.8 µg/ml MeOH

7) 99.7 µg/ml MeOH

8) 199.3 µg/ml MeOH

9)_____

Secondary standard: 996.6 µg/ml MeOH Stock Standard made from Fisher Purge & Trap Grade Lot #104737, then diluted to 24.9 µg/ml

DATE	EQUIPMENT	TASK
8/15/11	SRI GC #3	Equilibrate the instrument until a stable baseline is achieved.
8/15/11	SRI GC #3	Inject each compound to be analyzed once. Establish the retention time windows for each compound. Adjust GC conditions if needed to ensure separation.
8/15/11 – 8/16/11	SRI GC #3	Inject each standard in triplicate. Ensure that each standard agrees within 5% of the mean of the three injections. Plot the standard injection areas against calibration standard concentrations to determine an initial calibration curve.
8/16/11- 8/17/11	SRI GC #3	Inject each sample in triplicate.
N/A	-	If necessary, dilute samples if the peak areas are greater than the highest standard and re-inject in triplicate.
8/16/11 – 8/17/11	SRI GC #3	Inject the midpoint standard and a blank once after every 20 sample injections. Check that the midpoint standard is within 10% of the value generated by the initial calibration curve.
8/17/11	SRI GC #3	Inject secondary standard at the end of the run.
8/19/11		For each analyte, plot the average of the standard injections against calibration standard concentrations to determine a final calibration curve.
8/19/11		Determine the concentrations of each analyte in each sample using the calibration curve.
8/19/11		Prepare report
		Report QA review
		Report distribution

736 Coker Unit

ARI ENVIRONMENTAL, INC.

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

Chain of Custody Record H08042

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY		
08-327	Houston Refining	Houston, TX
Lab Project No.	Client Name	Location
Greg Burch		RW
ARI Project Manager		ARI Sampler Initials

Analysis Location (Wauconda or Pasadena)

Engineering or Compliance Test Samples

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb) (VOA vials)	Preservation Code	Analysis Request: Method 308 Speciated volatile HAP for MeOH determination	Analysis Request: * Not spiked	Analysis Request: Spiked Solutions	Analysis Request:	Comments
H44813	7-19-11	Impinger contents *		✓	2	✓	✓			Run # 308-1-A *
H44814	7-19-11	Sorbent tube *	1	✓	2	✓	✓			Run # 308-1-A *
H44815	7-19-11	Impinger contents		✓	2	✓		✓		Run # 308-1-B
H44816	7-19-11	sorbent tube (spiked)	1	✓	2	✓		✓		Run # 308-1-B
H41150	7-21-11	Impinger contents (composite)	16	✓	2	✓	✓			Run # 308-2-A *
H41163	7-21-11	sorbent tube	1	✓	2	✓	✓			Run # 308-2-A *
H41151	7-21-11	Impinger contents (composite)	23	✓	2	✓		✓		Run # 308-2-B
H41164	7-21-11	sorbent tube (spiked)	1	✓	2	✓		✓		Run # 308-2-B
H41181	7-28-11	Impinger contents (composite)	10	✓	2	✓	✓			Run # 308-3-A *
H41178	7-28-11	sorbent tube	1	✓	2	✓	✓			Run # 308-3-A *
H41179	7-28-11	Impinger contents (composite)	4	✓	2	✓		✓		Run # 308-3-B
H41177	7-28-11	sorbent tube (spiked)	1	✓	2	✓		✓		Run # 308-3-B

Preservation Code

1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions / Comments	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By	SHIPMENT:
	Ron White			
	(1) Date / Time 8-3-11 @ 0500	(2) Date / Time	(3) Date / Time	HAND CARRY
	(1) Company ARI	(2) Company	(3) Company	FEDX
				UPS
Requested Analysis Completion Date:	(1) Received By Ron Ung	(2) Received By	(3) Received By	Custody Seal Applied
Report Level: Tier I: Engineering Tier II: Compliance Tier III: QAPP	(1) Date / Time 8/5/11 17:00	(2) Date / Time	(3) Date / Time	Yes No
Route Results Through:	(1) Company ARI	(2) Company	(3) Company	

C-401

Form LF0001

C-402

736 Coker Unit

ARI ENVIRONMENTAL, INC.

951 N. Old Rand Rd, Unit 106
Wauconda, Illinois 60084

Chain of Custody Record H08045

1710 Preston Rd., Unit C
Pasadena, Texas 77503

LAB USE ONLY		
08-327	Houston Refining	Houston, TX
Lab Project No.	Client Name	Location
Greg Burda		Blue
ARI Project Manager		ARI Sampler Initials

Analysis Location (Wauconda or Pasadena)

Engineering or Compliance Test Samples

Sample No.	Date Collected	Sample ID	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Method 308 specific volatile HAP for MeOH determination	* Not Spiked	Spiked Solution		Comments
H41182	7-28-11	Impinger contents	1	✓	2	✓	✓			Blank Run 308-A*
H41148	7-28-11	sorbent tube	1	✓	2	✓	✓			Blank Run 308-A*
H41183	7-28-11	Impinger contents	1	✓	2	✓		✓		Blank Run 308-B
H41147	7-28-11	sorbent tube (spiked)	1	✓	2	✓		✓		Blank Run 308-B
H41152	7-21-11	Water Reagent Blank	1	✓	2	✓	✓			HPLC water Blank
H41153	7-21-11	Spike solution Reagent Blank	1	✓	2	✓		✓		spiked Blank

Preservation Code

1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions / Comments	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By	SHIPMENT:
	(1) Date / Time 8-3-11 @ 0500	(2) Date / Time	(3) Date / Time	HAND CARRY
	(1) Company ARI	(2) Company	(3) Company	FEDX
Requested Analysis Completion Date:	(1) Received By	(2) Received By	(3) Received By	UPS
Report Level: Tier I: Engineering Tier II: Compliance Tier III: QAPP	(1) Date / Time 8/5/11 17:00	(2) Date / Time	(3) Date / Time	Custody Seal Applied
Route Results Through:	(1) Company ARI	(2) Company	(3) Company	Yes No

Form LF0001

APPENDIX D ARI Reference Method Monitoring Data

MONITOR DATA SUMMARY

COMPANY :	Houston Refining
SOURCE :	736 Coker
REPETITION :	7
TEST DATE :	7/29/2011
START TIME :	7:52
END TIME :	9:07

GAS ANALYZER O_2

SPAN VALUE :	22.70 %
AVERAGE CAL. BIAS (C_m):	11.219
AVERAGE ZERO BIAS (C_o):	0.013
CALIBRATION GAS:	EPA Protocol O_2
CALIBRATION % (C_{ma}):	11.00
% CORRECTED (C_{gas}):	**20.57**

GAS ANALYZER CO_2

SPAN VALUE :	19.60 %
AVERAGE CAL. BIAS (C_m):	9.74
AVERAGE ZERO BIAS (C_o):	-0.09
CALIBRATION GAS:	EPA Protocol CO_2
CALIBRATION % (C_{ma}):	9.50
% CORRECTED (C_{gas}):	**0.00**

GAS ANALYZER CO

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.58
AVERAGE ZERO BIAS (C_o):	0.61
CALIBRATION GAS:	EPA Protocol CO
CALIBRATION PPM (C_{ma}):	45.0
PPM CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER NO_x

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.2
AVERAGE ZERO BIAS (C_o):	0.5
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	45.0
ppm CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER VOCs

SPAN VALUE :	300000 ppm
AVERAGE CAL. BIAS (C_m):	95897
AVERAGE ZERO BIAS (C_o):	1654
CALIBRATION GAS:	EPA Protocol C_3H_8
CALIBRATION ppm (C_{ma}):	100000
ppm CORRECTED (C_{gas}):	**62023**

GAS ANALYZER SO_2

SPAN VALUE :	500 ppm
AVERAGE CAL. BIAS (C_m):	244.8
AVERAGE ZERO BIAS (C_o):	2.5
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	250.0
ppm CORRECTED (C_{gas}):	**3.4**

Example Calculation = $$C_{gas} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$$

CLOCK TIME	ELAPSED TIME	NO_x	SO_2	CO	C_3H_8	O_2	CO_2
7:52	0	-------	-------	-------	-------	-------	-------
7:53	1	0.3	9.1	0.8	64484	20.69	-0.08
7:54	2	0.5	8.9	0.9	64438	20.71	-0.09
7:55	3	3.4	8.8	3.9	64484	20.55	-0.09
7:56	4	0.4	9.0	15.8	64223	20.50	-0.08
7:57	5	0.3	9.0	3.4	62950	20.77	-0.09
7:58	6	0.3	9.1	0.7	62542	20.31	-0.09
7:59	7	0.3	9.2	0.9	62078	20.03	-0.09
8:00	8	0.3	9.0	2.3	61617	20.66	-0.08
8:01	9	0.4	8.7	1.6	61157	20.88	-0.08
8:02	10	0.3	8.5	1.4	61166	20.90	-0.08
8:03	11	0.3	8.6	1.5	61255	20.91	-0.08
8:04	12	0.3	8.4	0.7	60462	20.92	-0.08
8:05	13	0.3	8.0	0.5	59978	20.92	-0.09
8:06	14	0.3	7.7	1.6	59710	20.94	-0.09
8:07	15	0.3	7.5	1.7	59800	20.96	-0.09
8:08	16	0.3	7.2	1.4	59632	20.97	-0.09
8:09	17	0.3	6.8	1.3	59652	20.98	-0.09
8:10	18	0.3	6.6	1.4	59829	20.98	-0.09
8:11	19	0.3	6.5	1.4	60435	20.99	-0.08
8:12	20	0.3	6.2	1.6	59995	21.00	-0.08
8:13	21	0.3	6.0	1.6	60022	21.00	-0.08
8:14	22	0.3	5.6	1.5	60168	21.00	-0.08
8:15	23	0.3	5.4	1.5	60334	21.01	-0.08
8:16	24	0.3	5.1	1.4	60653	21.01	-0.08
8:17	25	0.3	5.1	1.4	60794	21.02	-0.09
8:18	26	0.3	4.9	1.2	60782	21.02	-0.09
8:19	27	0.3	4.9	1.3	60805	21.01	-0.09
8:20	28	0.3	5.0	1.3	60577	21.00	-0.09
8:21	29	0.3	4.9	1.3	61395	21.00	-0.09
8:22	30	0.3	4.9	1.2	61426	21.00	-0.09
8:23	31	0.3	4.9	0.8	59603	21.04	-0.08
8:24	32	0.3	4.9	1.3	61487	21.02	-0.08
8:25	33	0.3	4.9	1.1	61361	21.02	-0.08
8:26	34	0.3	4.7	1.0	61402	21.02	-0.08
8:27	35	0.3	4.8	1.0	60932	21.03	-0.08
8:28	36	0.3	4.9	1.0	60698	21.03	-0.09
8:29	37	0.3	4.9	1.1	60866	21.03	-0.09
8:30	38	0.3	5.1	1.0	61017	21.03	-0.09
8:31	39	0.3	4.9	1.1	60687	21.03	-0.09
8:32	40	0.3	5.2	1.1	60380	21.03	-0.09
8:33	41	0.3	5.0	1.0	59941	21.03	-0.08
8:34	42	0.3	5.2	1.0	59715	21.03	-0.08
8:35	43	0.3	5.4	0.9	59423	21.03	-0.08
8:36	44	0.3	5.2	0.8	59359	21.04	-0.08
8:37	45	0.3	5.4	0.5	59509	21.03	-0.08
8:38	46	0.3	5.2	0.4	59400	21.02	-0.09
8:39	47	0.3	5.3	0.6	59156	21.03	-0.09
8:40	48	0.3	5.2	0.5	59280	21.03	-0.09
8:41	49	0.3	5.2	0.5	58752	21.04	-0.09
8:42	50	0.3	5.0	0.5	59222	21.04	-0.09
8:43	51	0.3	5.1	0.5	59115	21.04	-0.09
8:44	52	0.3	4.8	0.3	58931	21.05	-0.08
8:45	53	0.3	5.0	0.4	59025	21.05	-0.08
8:46	54	0.3	4.9	0.3	58573	21.05	-0.08
8:47	55	0.2	4.8	0.4	58209	21.05	-0.08
8:48	56	0.3	4.8	0.5	58028	21.05	-0.08
8:49	57	0.2	4.6	0.4	58250	21.06	-0.08
8:50	58	0.3	4.4	0.9	58424	21.06	-0.09
8:51	59	0.3	4.6	1.0	58614	21.07	-0.08
8:52	60	0.3	4.4	0.9	58450	21.07	-0.09
8:53	61	0.3	4.6	0.8	58314	21.08	-0.08
8:54	62	0.3	4.5	0.9	58498	21.08	-0.08
8:55	63	0.3	4.6	0.9	61291	21.08	-0.08
8:56	64	0.3	4.5	0.9	64168	21.08	-0.08
8:57	65	0.3	4.5	1.0	62342	21.08	-0.08
8:58	66	0.3	4.5	1.0	60480	21.08	-0.08
8:59	67	0.3	4.4	0.9	59760	21.07	-0.08
9:00	68	0.3	4.5	0.9	59002	21.07	-0.08
9:01	69	0.3	4.5	0.9	58665	21.07	-0.09
9:02	70	0.3	4.5	0.8	57589	21.07	-0.09
9:03	71	0.3	4.6	0.9	56529	21.06	-0.09
9:04	72	0.3	4.7	1.0	56296	21.06	-0.09
9:05	73	0.3	4.5	1.0	56558	21.06	-0.08
9:06	74	0.3	4.7	0.9	56794	21.06	-0.08
9:07	75	0.3	4.8	0.9	56997	21.06	-0.08
	Uncorrected Average (C) =	**0.33**	**5.75**	**1.26**	**60105.8**	**20.971**	**-0.084**

MONITOR DATA SUMMARY

COMPANY :	Houston Refining
SOURCE :	736 Coker
REPETITION :	8
TEST DATE :	8/1/2011
START TIME :	12:42
END TIME :	13:09

GAS ANALYZER O_2

SPAN VALUE :	22.70 %
AVERAGE CAL. BIAS (C_m):	10.998
AVERAGE ZERO BIAS (C_o):	0.024
CALIBRATION GAS:	EPA Protocol O_2
CALIBRATION % (C_{ma}):	11.00
% CORRECTED (C_{gas}):	**20.26**

GAS ANALYZER CO_2

SPAN VALUE :	19.60 %
AVERAGE CAL. BIAS (C_m):	9.48
AVERAGE ZERO BIAS (C_o):	0.02
CALIBRATION GAS:	EPA Protocol CO_2
CALIBRATION % (C_{ma}):	9.50
% CORRECTED (C_{gas}):	**-0.12**

GAS ANALYZER CO

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	46.39
AVERAGE ZERO BIAS (C_o):	-0.28
CALIBRATION GAS:	EPA Protocol CO
CALIBRATION PPM (C_{ma}):	45.0
PPM CORRECTED (C_{gas}):	**<2.39**

GAS ANALYZER NO_x

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	46.2
AVERAGE ZERO BIAS (C_o):	0.3
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	45.0
ppm CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER VOCs

SPAN VALUE :	300000 ppm
AVERAGE CAL. BIAS (C_m):	43860
AVERAGE ZERO BIAS (C_o):	3363
CALIBRATION GAS:	EPA Protocol C_3H_8
CALIBRATION ppm (C_{ma}):	100000.0
ppm CORRECTED (C_{gas}):	**44273.3**

GAS ANALYZER SO_2

SPAN VALUE :	200 ppm
AVERAGE CAL. BIAS (C_m):	100.0
AVERAGE ZERO BIAS (C_o):	-1.9
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	100.0
ppm CORRECTED (C_{gas}):	**<1.8**

CLOCK TIME	ELAPSED TIME	NO_x	SO_2	CO	C_3H_8	O_2	CO_2
12:42	0	-------	-------	-------	-------	-------	-------
12:43	1	1.0	-1.7	1.2	60530	20.00	-0.11
12:44	2	1.0	-1.8	1.3	59187	20.00	-0.11
12:45	3	1.0	-1.9	1.4	57584	20.01	-0.10
12:46	4	1.0	-1.9	1.5	52802	20.02	-0.10
12:47	5	0.8	-2.1	5.8	61361	20.11	-0.10
12:48	6	0.3	-0.1	6.7	15329	20.21	-0.09
12:49	7	0.3	-1.8	2.2	12895	20.30	-0.10
12:50	8	0.3	-2.2	2.0	12607	20.30	-0.10
12:51	9	0.3	-2.1	2.2	12081	20.30	-0.10
12:52	10	0.3	-2.2	1.9	11376	20.31	-0.10
12:53	11	0.3	-2.4	1.7	10721	20.31	-0.11
12:54	12	0.3	-2.2	1.8	11156	20.31	-0.11
12:55	13	0.3	-2.2	1.7	11021	20.30	-0.11
12:56	14	0.3	-2.4	1.8	10481	20.31	-0.11
12:57	15	0.3	-2.4	1.6	9546	20.31	-0.10
12:58	16	0.3	-2.4	1.4	9258	20.31	-0.10
12:59	17	0.3	-2.5	1.4	8885	20.31	-0.10
13:00	18	0.3	-2.4	1.5	8567	20.31	-0.10
13:01	19	0.3	-2.6	1.5	8408	20.31	-0.10
	Uncorrected Average (C) =	**0.42**	**-2.09**	**2.19**	**21292.6**	**20.240**	**-0.102**

Example Calculation = $$C_{gas} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$$

MONITOR DATA SUMMARY

COMPANY :	Houston Refining
SOURCE :	736 Coker
REPETITION :	9
TEST DATE :	8/2/2011
START TIME :	16:11
END TIME :	16:16

GAS ANALYZER O_2

SPAN VALUE :	22.70 %
AVERAGE CAL. BIAS (C_m):	9.970
AVERAGE ZERO BIAS (C_o):	0.007
CALIBRATION GAS:	EPA Protocol O_2
CALIBRATION % (C_{ma}):	10.00
% CORRECTED (C_{gas}):	**20.95**

GAS ANALYZER CO_2

SPAN VALUE :	19.60 %
AVERAGE CAL. BIAS (C_m):	8.56
AVERAGE ZERO BIAS (C_o):	-0.10
CALIBRATION GAS:	EPA Protocol CO_2
CALIBRATION % (C_{ma}):	8.63
% CORRECTED (C_{gas}):	**-0.01**

GAS ANALYZER CO

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.62
AVERAGE ZERO BIAS (C_o):	1.01
CALIBRATION GAS:	EPA Protocol CO
CALIBRATION PPM (C_{ma}):	45.0
PPM CORRECTED (C_{gas}):	**<2.59**

GAS ANALYZER NO_x

SPAN VALUE :	90 ppm
AVERAGE CAL. BIAS (C_m):	45.9
AVERAGE ZERO BIAS (C_o):	0.4
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	45.0
ppm CORRECTED (C_{gas}):	**<1.80**

GAS ANALYZER VOCs

SPAN VALUE :	300000 ppm
AVERAGE CAL. BIAS (C_m):	9879
AVERAGE ZERO BIAS (C_o):	-76
CALIBRATION GAS:	EPA Protocol C_3H_8
CALIBRATION ppm (C_{ma}):	10000.0
ppm CORRECTED (C_{gas}):	**11629.0**

GAS ANALYZER SO_2

SPAN VALUE :	200 ppm
AVERAGE CAL. BIAS (C_m):	98.0
AVERAGE ZERO BIAS (C_o):	-0.6
CALIBRATION GAS:	EPA Protocol NO
CALIBRATION ppm (C_{ma}):	100.0
ppm CORRECTED (C_{gas}):	**<1.8**

CLOCK TIME	ELAPSED TIME	NO_x	SO_2	CO	C_3H_8	O_2	CO_2
16:11	0	-------	-------	-------	-------	-------	-------
16:12	1	0.7	-0.9	0.7	7338	20.75	-0.12
16:13	2	0.6	-1.0	0.7	9039	20.76	-0.12
16:14	3	0.3	-0.8	11.0	26818	20.83	-0.11
16:15	4	0.2	-0.8	3.8	8001	21.01	-0.12
16:16	5	0.2	-0.9	1.8	6309	21.04	-0.12
	Uncorrected Average (C) =	**0.41**	**-0.89**	**3.58**	**11501.0**	**20.878**	**-0.119**

Example Calculation =

$$C_{gas} = \left(\overline{C} - C_o\right)\frac{C_{ma}}{C_m - C_o}$$

Houston Refining: Houston, Texas
736 Coker
ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
7/29/11 5:36:45	1.96	1.28	0.0	0.26	10.6	479	
7/29/11 5:37:00	0.25	0.06	0.0	0.25	3.0	478	
7/29/11 5:37:15	0.06	-0.05	0.0	0.26	1.0	477	
7/29/11 5:37:30	0.05	-0.07	0.0	0.25	0.5	478	
7/29/11 5:37:45	0.05	-0.07	0.0	0.25	1.0	478	
7/29/11 5:38:00	0.04	-0.07	0.0	0.25	1.3	479	Calibration Error
7/29/11 5:38:15	**0.04**	**-0.07**	**0.0**	**0.26**	**1.0**	**478**	**O_2 CE Zero = 0.04**
7/29/11 5:38:30	**0.04**	**-0.08**	**0.0**	**0.27**	**0.6**	**479**	**CO_2 CE Zero = -0.08**
7/29/11 5:38:45	**0.04**	**-0.08**	**0.0**	**0.25**	**0.9**	**478**	**SO_2 CE Zero = 0.0**
7/29/11 5:39:00	**0.03**	**-0.08**	**0.0**	**0.25**	**1.2**	**480**	**NO_x CE Zero = 0.3**
7/29/11 5:39:15	0.03	-0.08	0.0	0.28	1.2	478	CO CE Zero = 0.9
7/29/11 5:39:30	0.12	0.18	0.0	0.28	17.6	479	
7/29/11 5:39:45	4.96	5.69	0.0	0.26	68.6	479	
7/29/11 5:40:00	11.60	10.51	0.0	0.25	97.7	479	
7/29/11 5:40:15	15.55	13.35	0.0	0.28	100.0	479	
7/29/11 5:40:30	17.18	14.65	0.0	0.27	100.0	479	
7/29/11 5:40:45	17.47	14.84	0.0	0.27	100.0	479	
7/29/11 5:41:00	17.49	14.86	0.0	0.25	100.0	478	
7/29/11 5:41:15	17.50	14.90	0.0	0.28	100.0	479	
7/29/11 5:41:30	17.49	14.95	0.0	0.25	100.0	478	
7/29/11 5:41:45	17.48	14.98	0.0	0.27	100.0	480	
7/29/11 5:42:00	17.48	15.00	0.0	0.26	100.0	479	
7/29/11 5:42:15	17.48	15.01	0.0	0.26	100.0	480	
7/29/11 5:42:30	17.48	15.01	0.0	0.27	100.0	481	
7/29/11 5:42:45	17.47	15.01	0.0	0.26	100.0	480	
7/29/11 5:43:00	17.47	15.01	0.0	0.26	100.0	480	
7/29/11 5:43:15	17.46	15.01	0.0	0.25	100.0	479	
7/29/11 5:43:30	17.46	15.01	0.0	0.28	100.0	480	
7/29/11 5:43:45	17.46	15.01	0.0	0.28	100.0	479	
7/29/11 5:44:00	17.48	15.02	0.0	0.25	100.0	480	
7/29/11 5:44:15	17.82	15.02	0.0	0.28	100.0	480	
7/29/11 5:44:30	17.98	15.02	0.0	0.28	100.0	479	
7/29/11 5:44:45	17.98	15.02	0.0	0.25	100.0	478	
7/29/11 5:45:00	17.98	14.98	0.0	0.27	100.0	480	
7/29/11 5:45:15	17.98	14.97	0.0	0.36	100.0	480	
7/29/11 5:45:30	18.33	12.59	0.0	0.37	95.1	479	
7/29/11 5:45:45	19.48	7.77	0.0	0.42	70.0	479	
7/29/11 5:46:00	20.24	5.01	0.0	0.43	47.8	479	
7/29/11 5:46:15	20.59	3.73	0.0	0.32	41.0	480	
7/29/11 5:46:30	20.33	5.27	0.0	0.26	72.4	480	
7/29/11 5:46:45	19.14	14.53	0.0	0.26	100.0	481	
7/29/11 5:47:00	23.05	17.73	0.0	0.29	100.0	480	
7/29/11 5:47:15	22.74	18.92	0.0	0.29	100.0	480	
7/29/11 5:47:30	22.67	19.05	0.0	0.25	100.0	480	
7/29/11 5:47:45	22.66	19.05	0.0	0.25	100.0	479	
7/29/11 5:48:00	22.65	19.05	0.0	0.25	100.0	480	
7/29/11 5:48:15	22.64	19.06	0.0	0.26	100.0	479	
7/29/11 5:48:30	22.63	19.07	-19.0	0.27	100.0	479	
7/29/11 5:48:45	22.63	19.07	-23.4	0.26	100.0	480	
7/29/11 5:49:00	22.62	19.06	-22.8	0.26	100.0	479	
7/29/11 5:49:15	22.62	19.30	-22.8	0.25	100.0	479	Calibration Error
7/29/11 5:49:30	**22.62**	**19.49**	-22.8	0.26	100.0	480	**O_2 CE Span = 22.63**
7/29/11 5:49:45	**22.63**	**19.50**	-22.8	0.25	100.0	479	**CO_2 CE Span = 19.50**
7/29/11 5:50:00	**22.64**	**19.50**	-22.8	0.26	100.0	481	
7/29/11 5:50:15	**22.63**	**19.50**	-22.8	0.27	100.0	481	
7/29/11 5:50:30	22.63	19.50	-22.8	0.26	100.0	480	
7/29/11 5:50:45	22.63	19.50	-22.8	0.26	100.0	481	
7/29/11 5:51:00	22.63	19.50	-22.8	0.26	100.0	481	
7/29/11 5:51:15	17.87	15.13	-22.8	0.26	100.0	481	
7/29/11 5:51:30	14.51	11.61	-22.8	0.27	97.2	482	
7/29/11 5:51:45	10.39	8.72	-22.8	0.26	84.6	479	
7/29/11 5:52:00	8.86	7.72	-22.8	0.26	77.9	481	
7/29/11 5:52:15	8.70	7.63	-22.8	0.27	75.7	482	
7/29/11 5:52:30	8.67	7.61	-22.8	0.27	75.4	481	
7/29/11 5:52:45	8.66	7.60	-22.8	0.26	76.0	481	
7/29/11 5:53:00	8.65	7.60	-22.8	0.26	76.3	481	
7/29/11 5:53:15	8.66	7.61	-22.8	0.26	73.0	482	
7/29/11 5:53:30	8.16	6.73	-22.8	0.25	51.1	480	
7/29/11 5:53:45	4.22	2.99	-22.8	0.25	22.0	481	
7/29/11 5:54:00	0.94	0.54	-22.8	0.25	6.7	482	
7/29/11 5:54:15	0.11	0.00	-22.8	0.25	1.5	481	
7/29/11 5:54:30	0.05	-0.04	-22.8	0.25	0.5	481	
7/29/11 5:54:45	0.04	-0.05	-22.8	0.28	6.5	482	
7/29/11 5:55:00	2.83	3.75	-22.8	0.26	50.2	481	
7/29/11 5:55:15	10.16	9.69	-22.8	0.25	96.1	480	
7/29/11 5:55:30	15.14	13.18	-22.8	0.26	100.0	481	
7/29/11 5:55:45	17.53	15.08	-22.8	0.28	100.0	482	
7/29/11 5:56:00	18.10	15.50	-22.8	0.27	100.0	482	
7/29/11 5:56:15	18.13	15.52	-22.8	0.28	100.0	480	
7/29/11 5:56:30	18.23	14.03	-22.8	0.42	93.5	479	
7/29/11 5:56:45	19.54	7.53	-22.8	0.41	57.7	480	
7/29/11 5:57:00	20.66	3.07	-22.8	0.27	48.0	480	
7/29/11 5:57:15	19.98	7.54	-22.8	0.27	85.6	480	
7/29/11 5:57:30	18.91	12.29	-22.8	0.25	100.0	480	
7/29/11 5:57:45	18.31	14.91	-22.8	0.26	100.0	481	

Houston Refining: Houston, Texas
736 Coker
ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
7/29/11 5:58:00	18.10	15.54	-22.8	0.26	100.0	480	
7/29/11 5:58:15	18.07	15.59	-22.8	0.25	100.0	481	
7/29/11 5:58:30	18.05	15.59	-22.8	0.26	100.0	482	
7/29/11 5:58:45	18.05	15.59	-22.8	0.27	100.0	482	
7/29/11 5:59:00	17.69	14.90	-22.8	0.25	100.0	481	
7/29/11 5:59:15	13.83	11.16	-22.8	0.25	97.2	481	
7/29/11 5:59:30	10.04	8.52	-22.8	0.26	84.9	481	
7/29/11 5:59:45	10.85	9.77	-22.8	0.26	77.5	481	
7/29/11 6:00:00	10.73	9.70	-22.8	0.26	76.5	482	
7/29/11 6:00:15	10.71	9.68	-22.8	0.25	76.9	481	
7/29/11 6:00:30	10.70	9.68	-22.8	0.26	77.2	483	
7/29/11 6:00:45	10.69	9.67	-22.8	0.27	76.7	482	
7/29/11 6:01:00	10.76	9.66	-22.8	0.26	76.2	482	Calibration Error
7/29/11 6:01:15	**10.82**	**9.66**	-22.8	0.28	76.6	480	O_2 CE Mid = 10.81
7/29/11 6:01:30	**10.81**	**9.66**	-22.8	0.25	77.2	481	CO_2 CE Mid = 9.65
7/29/11 6:01:45	**10.81**	**9.65**	-17.1	0.26	76.9	481	
7/29/11 6:02:00	**10.81**	**9.65**	-0.1	0.26	76.3	481	
7/29/11 6:02:15	10.81	9.64	-0.1	0.26	76.1	483	
7/29/11 6:02:30	10.83	9.61	-0.1	7.88	65.3	482	
7/29/11 6:02:45	9.94	5.01	0.1	61.48	38.2	483	
7/29/11 6:03:00	5.82	1.62	0.1	83.73	13.9	483	
7/29/11 6:03:15	1.16	0.21	0.2	91.91	2.9	482	
7/29/11 6:03:30	0.15	-0.02	0.2	93.37	1.5	483	
7/29/11 6:03:45	0.06	-0.04	0.1	94.03	1.4	481	
7/29/11 6:04:00	0.05	-0.05	0.1	94.05	0.8	483	
7/29/11 6:04:15	0.04	-0.05	0.1	94.06	0.7	481	
7/29/11 6:04:30	0.04	-0.06	0.2	94.05	1.0	482	
7/29/11 6:04:45	0.04	-0.06	0.2	94.15	1.4	482	
7/29/11 6:05:00	0.04	-0.06	0.0	94.24	1.0	482	
7/29/11 6:05:15	0.03	-0.06	0.1	94.36	0.4	482	
7/29/11 6:05:30	0.03	-0.06	0.3	94.38	0.9	481	
7/29/11 6:05:45	0.03	-0.06	0.3	94.43	1.2	481	
7/29/11 6:06:00	0.03	-0.06	0.0	94.55	1.0	481	
7/29/11 6:06:15	0.03	-0.06	0.1	94.65	0.5	481	
7/29/11 6:06:30	0.03	-0.07	0.2	94.66	0.7	481	
7/29/11 6:06:45	0.03	-0.07	0.2	94.62	1.3	482	
7/29/11 6:07:00	0.02	-0.07	0.2	94.50	1.2	481	
7/29/11 6:07:15	0.02	-0.07	0.2	94.38	0.5	481	
7/29/11 6:07:30	0.02	-0.07	0.3	94.35	0.6	482	
7/29/11 6:07:45	0.02	-0.07	0.2	94.44	1.2	483	
7/29/11 6:08:00	0.02	-0.07	0.3	94.60	1.1	483	
7/29/11 6:08:15	0.02	-0.07	0.2	94.79	0.5	480	
7/29/11 6:08:30	0.02	-0.07	0.1	94.96	0.5	482	
7/29/11 6:08:45	0.02	-0.07	0.0	92.59	1.2	482	Calibration Error
7/29/11 6:09:00	0.02	-0.07	0.0	**90.42**	1.1	481	NO_x CE Span = 90.7
7/29/11 6:09:15	0.02	-0.07	-0.2	**90.67**	0.5	483	
7/29/11 6:09:30	0.02	-0.07	0.0	**90.82**	0.4	481	
7/29/11 6:09:45	0.01	-0.07	0.0	**90.95**	0.9	482	
7/29/11 6:10:00	0.02	-0.07	0.0	84.36	1.2	483	
7/29/11 6:10:15	0.01	-0.07	0.0	47.96	0.8	483	
7/29/11 6:10:30	0.01	-0.08	-0.2	46.38	0.6	481	
7/29/11 6:10:45	0.01	-0.08	0.1	46.20	0.9	483	
7/29/11 6:11:00	0.01	-0.08	0.0	46.04	1.2	482	Calibration Error
7/29/11 6:11:15	0.01	-0.08	0.0	**45.89**	0.8	480	NO_x CE Mid = 45.7
7/29/11 6:11:30	0.01	-0.08	-0.1	**45.74**	0.4	483	
7/29/11 6:11:45	0.01	-0.08	0.1	**45.68**	0.6	482	
7/29/11 6:12:00	0.01	-0.08	0.2	**45.59**	1.3	482	
7/29/11 6:12:15	0.01	-0.08	0.1	45.51	1.1	482	
7/29/11 6:12:30	0.01	-0.08	0.1	44.79	0.5	481	
7/29/11 6:12:45	1.21	-0.07	0.2	35.60	0.9	482	
7/29/11 6:13:00	10.92	0.00	0.0	72.16	4.7	480	
7/29/11 6:13:15	17.66	0.60	-0.1	25.76	22.7	483	
7/29/11 6:13:30	13.12	4.48	0.1	4.53	56.1	482	
7/29/11 6:13:45	9.95	7.39	0.0	2.23	76.2	481	
7/29/11 6:14:00	9.86	8.35	0.0	1.70	85.9	482	
7/29/11 6:14:15	10.13	8.67	0.2	1.57	89.6	481	
7/29/11 6:14:30	10.35	8.83	0.1	1.45	90.5	481	
7/29/11 6:14:45	10.42	8.87	0.1	1.37	90.6	482	
7/29/11 6:15:00	10.44	8.87	0.2	1.31	91.3	482	
7/29/11 6:15:15	10.45	8.88	-0.1	1.26	91.7	480	
7/29/11 6:15:30	10.46	8.89	0.0	1.21	91.3	482	Calibration Error
7/29/11 6:15:45	10.46	8.90	0.0	1.17	**90.0**	482	CO CE Span = 89.9
7/29/11 6:16:00	10.46	8.93	0.3	1.14	**89.7**	482	
7/29/11 6:16:15	10.46	8.95	0.1	1.12	**90.1**	483	
7/29/11 6:16:30	10.46	8.97	0.1	1.08	**89.8**	482	
7/29/11 6:16:45	10.46	8.98	0.2	1.07	89.1	482	
7/29/11 6:17:00	10.46	8.98	0.2	1.04	89.6	481	
7/29/11 6:17:15	10.46	8.99	0.2	1.01	90.1	482	
7/29/11 6:17:30	10.46	8.99	0.2	1.00	90.0	483	
7/29/11 6:17:45	10.46	8.99	0.3	0.88	86.8	484	
7/29/11 6:18:00	10.02	8.35	0.2	0.91	69.2	483	
7/29/11 6:18:15	7.16	5.73	0.3	0.91	55.4	483	
7/29/11 6:18:30	5.46	4.58	0.2	0.91	47.0	483	Calibration Error
7/29/11 6:18:45	5.27	4.48	0.0	0.91	**45.5**	481	CO CE Mid = 45.5
7/29/11 6:19:00	5.26	4.47	0.2	0.90	**45.0**	482	

Houston Refining: Houston, Texas
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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
7/29/11 6:19:15	5.25	4.47	0.2	0.88	**45.5**	481		
7/29/11 6:19:30	5.25	4.47	0.3	0.88	**46.0**	483		
7/29/11 6:19:45	5.25	4.47	0.3	0.88	45.6	482		
7/29/11 6:20:00	5.26	4.47	0.1	0.85	45.3	484		
7/29/11 6:20:15	5.26	4.47	0.1	0.87	45.6	481		
7/29/11 6:20:30	5.25	4.47	0.4	0.86	45.9	481		
7/29/11 6:20:45	5.26	4.46	0.4	0.99	45.8	480		
7/29/11 6:21:00	5.26	4.46	0.3	1.30	40.6	481		
7/29/11 6:21:15	7.13	3.68	0.3	1.30	27.6	483		
7/29/11 6:21:30	15.86	1.30	0.1	6.37	10.5	482		
7/29/11 6:21:45	20.13	0.45	0.4	19.81	5.8	482		
7/29/11 6:49:15	-0.02	-0.09	479.6	0.61	1.1	480		
7/29/11 6:49:30	-0.02	-0.09	499.6	0.61	0.9	479		
7/29/11 6:49:45	-0.02	-0.09	501.3	0.61	0.4	479	Calibration Error	
7/29/11 6:50:00	-0.02	-0.09	**502.1**	0.61	0.4	479	SO_2 CE Span =	502.4
7/29/11 6:50:15	-0.02	-0.09	**502.5**	0.61	0.9	478		
7/29/11 6:50:30	-0.02	-0.09	**502.4**	0.61	0.9	479		
7/29/11 6:50:45	-0.02	-0.09	**502.7**	0.61	0.2	480		
7/29/11 6:51:00	-0.02	-0.09	502.9	0.61	0.4	480		
7/29/11 6:51:15	-0.02	-0.09	475.6	0.56	0.9	479		
7/29/11 6:51:30	-0.02	-0.09	295.2	0.53	1.0	478		
7/29/11 6:51:45	-0.02	-0.09	238.6	0.58	0.4	479		
7/29/11 6:52:00	-0.02	-0.09	233.0	0.60	0.2	481		
7/29/11 6:52:15	-0.02	-0.09	232.6	0.59	0.8	479		
7/29/11 6:52:30	-0.02	-0.09	232.6	0.60	1.0	479		
7/29/11 6:52:45	-0.02	-0.09	232.7	0.58	0.7	479		
7/29/11 6:53:00	-0.02	-0.09	232.8	0.60	0.3	480		
7/29/11 6:53:15	-0.02	-0.09	237.8	0.59	0.6	479	Calibration Error	
7/29/11 6:53:30	-0.02	-0.09	**253.2**	0.59	1.0	479	SO_2 CE Mid =	253.6
7/29/11 6:53:45	-0.02	-0.09	**253.3**	0.57	0.8	480		
7/29/11 6:54:00	-0.02	-0.09	**253.8**	0.57	0.3	479		
7/29/11 6:54:15	-0.02	-0.09	**254.0**	0.58	0.5	479		
7/29/11 6:54:30	-0.02	-0.09	253.9	0.58	0.9	479	Introduce Mid NO_x	
7/29/11 6:54:45	-0.02	-0.09	189.0	1.62	1.2	478		
7/29/11 6:55:00	-0.02	-0.08	40.2	3.33	1.7	479		
7/29/11 6:55:15	-0.02	-0.05	7.2	8.12	1.8	480		
7/29/11 6:55:30	-0.02	-0.08	3.2	14.66	1.5	478		
7/29/11 6:55:45	-0.02	-0.09	2.6	26.04	1.3	479		
7/29/11 6:56:00	-0.02	-0.09	2.2	33.23	0.8	481		
7/29/11 6:56:15	-0.02	-0.09	2.6	43.21	0.5	480		
7/29/11 6:56:30	-0.02	-0.09	2.7	44.27	1.0	479	System Bias	
7/29/11 6:56:45	**-0.02**	**-0.09**	**2.7**	**45.33**	**1.4**	480	O_2 Bias 1 Zero =	-0.02
7/29/11 6:57:00	**-0.02**	**-0.09**	**2.9**	**45.39**	**1.0**	479	CO_2 Bias 1 Zero =	-0.09
7/29/11 6:57:15	**-0.02**	**-0.09**	**3.7**	**45.17**	**0.3**	480	SO_2 Bias 1 Zero =	3.3
7/29/11 6:57:30	**-0.02**	**-0.09**	**3.9**	**44.22**	**0.6**	479	NO_x Bias 1 Mid =	45.0
7/29/11 6:57:45	-0.02	-0.09	4.1	45.57	1.1	479	CO Bias 1 Zero =	0.8
7/29/11 6:58:00	-0.02	-0.09	8.9	30.17	1.1	480	Introduce Mid SO_2	
7/29/11 6:58:15	-0.02	-0.09	17.2	27.16	0.4	479		
7/29/11 6:58:30	-0.02	-0.09	54.4	7.09	0.5	480		
7/29/11 6:58:45	-0.02	-0.09	180.9	2.56	1.0	478		
7/29/11 6:59:00	-0.02	-0.09	240.7	2.13	1.1	480	System Bias	
7/29/11 6:59:15	-0.02	-0.09	**244.6**	0.25	0.7	493	SO_2 Bias 1 Mid =	245.2
7/29/11 6:59:30	-0.02	-0.09	**245.8**	0.28	0.6	480		
7/29/11 6:59:45	-0.02	-0.09	**243.6**	0.29	0.9	479		
7/29/11 7:00:00	-0.02	-0.09	**246.8**	0.27	1.2	480		
7/29/11 7:00:15	-0.02	-0.09	246.6	0.25	0.8	478	Introduce Mid CO	
7/29/11 7:00:30	-0.02	-0.09	243.7	0.28	1.1	478		
7/29/11 7:00:45	0.00	-0.09	212.5	0.31	14.9	479		
7/29/11 7:01:00	0.10	-0.09	210.9	0.33	34.4	479		
7/29/11 7:01:15	3.63	0.04	186.2	0.34	44.6	480	System Bias	
7/29/11 7:01:30	6.04	1.59	11.7	0.33	**44.3**	479	CO Bias 1 Mid =	45.0
7/29/11 7:01:45	5.31	3.62	12.4	0.32	**44.9**	480		
7/29/11 7:02:00	5.27	4.29	13.4	0.33	**45.3**	479		
7/29/11 7:02:15	5.28	4.08	14.2	0.32	**45.4**	479		
7/29/11 7:02:30	5.32	7.73	15.1	0.32	48.9	478		
7/29/11 7:02:45	7.41	7.73	16.3	0.31	79.4	478		
7/29/11 7:03:00	11.80	9.73	17.1	0.32	80.0	478		
7/29/11 7:03:15	11.43	9.73	17.9	0.29	80.4	478		
7/29/11 7:03:30	11.40	9.73	19.2	0.27	79.8	479		
7/29/11 7:03:45	11.39	9.73	19.1	0.29	79.3	479		
7/29/11 7:04:00	11.39	9.73	18.8	0.28	79.8	479		
7/29/11 7:04:15	11.39	9.73	18.8	0.28	80.3	480		
7/29/11 7:04:30	11.32	9.73	18.7	0.28	80.1	478	System Bias	
7/29/11 7:04:45	**11.22**	**9.73**	**18.5**	**0.29**	**80.3**	**479**	O_2 Bias 1 Mid =	11.22
7/29/11 7:05:00	**11.22**	**9.73**	**18.1**	**0.27**	**80.2**	**479**	CO_2 Bias 1 Mid =	9.73
7/29/11 7:05:15	**11.22**	**9.73**	**17.8**	**0.27**	**79.5**	**478**	NO_x Bias 1 Zero =	0.3
7/29/11 7:05:30	**11.22**	**9.73**	**17.5**	**0.27**	**79.6**	**479**		
7/29/11 7:05:45	11.22	9.73	17.4	0.28	80.3	478		
7/29/11 7:06:00	10.19	6.09	17.0	0.27	80.4	478		
7/29/11 7:06:15	4.02	3.09	16.4	0.28	79.6	479		
7/29/11 7:06:30	0.52	0.29	16.3	0.26	79.5	477		
7/29/11 7:06:45	-0.02	0.09	16.3	0.28	1.1	479		
7/29/11 7:07:00	-0.02	-0.09	16.2	0.26	0.5	479		
7/29/11 7:07:15	-0.02	-0.09	16.1	0.25	0.7	479		
7/29/11 7:07:30	-0.02	-0.09	15.8	0.25	1.1	479		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
7/29/11 7:07:45	-0.02	-0.09	15.7	0.25	1.1	478		
7/29/11 7:08:00	-0.02	-0.09	15.4	0.27	0.7	478		
7/29/11 7:08:15	-0.02	-0.09	15.3	0.26	0.5	479		
7/29/11 7:08:30	-0.02	-0.09	15.2	0.25	1.1	479		
7/29/11 7:08:45	-0.02	-0.09	15.0	0.25	1.2	479		
7/29/11 7:09:00	-0.02	-0.09	15.0	0.28	0.5	478		
7/29/11 7:09:15	-0.02	-0.09	14.9	0.25	0.3	479		
7/29/11 7:09:30	-0.02	-0.09	14.6	0.25	0.8	479		
7/29/11 7:09:45	-0.02	-0.09	14.6	0.26	1.0	479		
7/29/11 7:10:00	-0.02	-0.09	14.7	0.26	0.8	479		
7/29/11 7:10:15	-0.02	-0.09	14.3	0.26	0.3	479		
7/29/11 7:10:30	-0.02	-0.09	14.1	0.28	0.8	479		
7/29/11 7:10:45	-0.02	-0.09	13.9	0.26	1.2	478		
7/29/11 7:11:00	-0.02	-0.09	14.0	0.29	1.0	479		
7/29/11 7:11:15	-0.02	-0.09	13.9	0.25	0.3	478		
7/29/11 7:11:30	-0.02	-0.09	14.0	0.26	0.7	479		
7/29/11 7:11:45	-0.02	-0.09	13.8	0.27	1.1	479		
7/29/11 7:12:00	-0.02	-0.09	13.6	0.25	1.1	479		
7/29/11 7:12:15	-0.02	-0.09	13.6	0.26	0.4	479		
7/29/11 7:12:30	-0.02	-0.10	13.5	0.26	0.4	480		
7/29/11 7:12:45	-0.02	-0.10	13.4	0.26	1.0	479		
7/29/11 7:13:00	-0.02	-0.10	13.1	0.25	1.2	479		
7/29/11 7:13:15	-0.02	-0.10	13.2	0.25	0.7	479		
7/29/11 7:13:30	-0.02	-0.10	13.1	0.25	0.5	33920		
7/29/11 7:13:45	-0.02	-0.10	13.1	0.26	0.9	9194		
7/29/11 7:14:00	-0.02	-0.10	13.1	0.25	1.2	4075		
7/29/11 7:14:15	-0.02	-0.10	12.9	0.25	0.8	2881		
7/29/11 7:14:30	-0.02	-0.10	12.8	0.25	0.4	10455		
7/29/11 7:14:45	-0.02	-0.10	12.5	0.25	0.8	6268		
7/29/11 7:15:00	-0.02	-0.10	12.4	0.27	1.2	9554		
7/29/11 7:15:15	-0.02	-0.09	12.3	0.25	0.9	12816		
7/29/11 7:15:30	-0.02	-0.09	12.3	0.25	0.2	15655		
7/29/11 7:15:45	-0.02	-0.09	12.1	0.25	0.5	17839		
7/29/11 7:16:00	-0.02	-0.09	12.1	0.25	0.9	20309		
7/29/11 7:16:15	-0.02	-0.09	12.0	0.27	1.0	22416		
7/29/11 7:16:30	-0.02	-0.09	12.0	0.26	0.3	24322		
7/29/11 7:16:45	-0.02	-0.09	12.1	0.27	0.2	26360		
7/29/11 7:17:00	-0.02	-0.09	12.1	0.29	0.8	28669		
7/29/11 7:17:15	-0.02	-0.09	12.1	0.30	1.2	30761		
7/29/11 7:17:30	-0.02	-0.09	11.9	0.30	0.8	33208		
7/29/11 7:17:45	-0.02	-0.09	11.7	0.29	0.4	35524		
7/29/11 7:18:00	-0.02	-0.09	11.7	0.26	0.7	37907		
7/29/11 7:18:15	-0.02	-0.09	12.0	0.26	1.0	40237		
7/29/11 7:18:30	-0.02	-0.09	11.9	0.27	0.8	42349		
7/29/11 7:18:45	-0.02	-0.09	12.1	0.28	0.2	43244		
7/29/11 7:19:00	-0.02	-0.09	11.8	0.28	0.6	41045		
7/29/11 7:19:15	0.01	-0.09	11.6	0.28	1.1	37750		
7/29/11 7:19:30	3.21	-0.09	11.6	0.26	1.0	34503		
7/29/11 7:19:45	9.92	-0.09	11.6	0.26	0.5	31384		
7/29/11 7:20:00	16.86	-0.09	11.3	0.25	0.4	29369		
7/29/11 7:20:15	20.64	-0.09	11.3	0.25	0.8	27968		
7/29/11 7:20:30	20.64	-0.09	11.6	0.25	1.1	26684		
7/29/11 7:20:45	20.64	-0.09	11.5	0.28	0.7	25769		
7/29/11 7:21:00	20.64	-0.09	11.3	0.27	0.3	25096		
7/29/11 7:21:15	20.64	-0.09	11.4	0.27	0.7	23848		
7/29/11 7:21:30	20.64	-0.09	11.4	0.25	1.3	21546		
7/29/11 7:21:45	20.64	-0.09	11.1	0.26	1.0	18647		
7/29/11 7:22:00	20.64	-0.09	11.0	0.26	0.3	14333		
7/29/11 7:22:15	20.64	-0.09	11.1	0.29	0.5	483	Calibration Error	
7/29/11 7:22:30	20.64	-0.09	11.1	0.28	1.0	**479**	C_3H_8 CE Zero =	479
7/29/11 7:22:45	20.64	-0.09	10.9	0.26	1.1	**479**		
7/29/11 7:23:00	20.64	-0.10	10.6	0.25	0.4	**479**		
7/29/11 7:23:15	20.64	-0.10	10.7	0.26	0.3	**478**		
7/29/11 7:23:30	20.64	-0.10	10.6	0.28	1.0	480073		
7/29/11 7:23:45	20.64	-0.10	10.6	0.27	1.2	925454		
7/29/11 7:24:00	20.64	-0.10	10.5	0.28	0.6	526540		
7/29/11 7:24:15	20.64	-0.10	10.5	0.28	0.2	288461		
7/29/11 7:24:30	20.64	-0.10	10.5	0.27	0.7	281610		
7/29/11 7:24:45	20.64	-0.10	10.2	0.26	1.0	301072		
7/29/11 7:25:00	20.64	-0.10	9.9	0.26	0.6	298033		
7/29/11 7:25:15	20.64	-0.10	9.8	0.26	0.3	271028		
7/29/11 7:25:30	20.64	-0.10	10.1	0.28	0.8	233111		
7/29/11 7:25:45	20.64	-0.09	10.3	0.25	1.1	198793		
7/29/11 7:26:00	20.64	-0.09	10.2	0.28	1.0	173469		
7/29/11 7:26:15	20.65	-0.09	10.2	0.30	0.5	153945		
7/29/11 7:26:30	20.64	-0.09	10.1	0.26	0.7	139683		
7/29/11 7:26:45	20.65	-0.09	9.9	0.28	1.0	127308		
7/29/11 7:27:00	20.65	-0.09	9.8	0.26	0.9	218893		
7/29/11 7:27:15	20.65	-0.09	9.9	0.26	0.2	290357		
7/29/11 7:27:30	20.64	-0.09	9.9	0.25	0.3	312343		
7/29/11 7:27:45	20.65	-0.09	9.7	0.28	0.7	292156		
7/29/11 7:28:00	20.64	-0.09	9.7	0.27	1.1	268648		
7/29/11 7:28:15	20.65	-0.09	9.6	0.28	0.7	247471		
7/29/11 7:28:30	20.65	-0.09	9.6	0.26	0.1	230280		
7/29/11 7:28:45	20.65	-0.09	9.7	0.26	0.5	217690		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
7/29/11 7:29:00	20.65	-0.09	9.8	0.27	1.2	287519		
7/29/11 7:29:15	20.65	-0.09	9.6	0.27	0.8	305773		
7/29/11 7:29:30	20.64	-0.09	9.6	0.26	0.2	305745		
7/29/11 7:29:45	20.65	-0.09	9.7	0.26	0.6	322244		
7/29/11 7:30:00	20.65	-0.09	9.6	0.26	1.2	311718		
7/29/11 7:30:15	20.65	-0.09	9.4	0.27	0.9	318393		
7/29/11 7:30:30	20.65	-0.09	9.3	0.30	0.3	320817	Calibration Error	
7/29/11 7:30:45	20.65	-0.09	9.4	0.28	0.5	**303497**	C_3H_8 CE Span =	300921
7/29/11 7:31:00	20.65	-0.09	9.4	0.28	1.1	**301674**		
7/29/11 7:31:15	20.65	-0.09	9.3	0.29	1.2	**298532**		
7/29/11 7:31:30	20.65	-0.09	9.4	0.29	0.4	**299980**		
7/29/11 7:31:45	20.65	-0.09	9.4	0.31	0.3	297912		
7/29/11 7:32:00	20.65	-0.09	9.2	0.35	0.9	271082		
7/29/11 7:32:15	20.65	-0.09	9.4	0.29	1.1	257172		
7/29/11 7:32:30	20.65	-0.09	9.4	0.31	0.6	243515		
7/29/11 7:32:45	20.65	-0.09	9.4	0.29	0.2	229605		
7/29/11 7:33:00	20.64	-0.09	9.4	0.30	0.6	215917		
7/29/11 7:33:15	20.65	-0.09	9.3	0.29	1.0	202506		
7/29/11 7:33:30	20.65	-0.09	9.2	0.31	0.9	189498		
7/29/11 7:33:45	20.65	-0.09	9.2	0.30	0.3	177273		
7/29/11 7:34:00	20.65	-0.09	9.1	0.29	0.5	165320	Calibration Error	
7/29/11 7:34:15	20.65	-0.09	9.1	0.28	0.9	**153735**	C_3H_8 CE Mid =	151524
7/29/11 7:34:30	20.65	-0.09	9.2	0.28	1.0	**152960**		
7/29/11 7:34:45	20.65	-0.09	9.1	0.28	0.4	**149496**		
7/29/11 7:35:00	20.66	-0.09	8.2	0.32	0.2	**149906**		
7/29/11 7:35:15	20.66	-0.09	6.6	0.29	0.6	132156		
7/29/11 7:35:30	20.67	-0.09	4.8	0.32	0.9	121730		
7/29/11 7:35:45	20.67	-0.09	3.8	0.30	0.4	111943		
7/29/11 7:36:00	20.67	-0.09	2.9	0.31	0.0	103153	Calibration Error	
7/29/11 7:36:15	20.67	-0.09	2.5	0.30	0.4	**94705**	C_3H_8 CE Low =	97522
7/29/11 7:36:30	20.67	-0.09	2.3	0.29	1.0	**97173**		
7/29/11 7:36:45	20.67	-0.09	2.2	0.29	0.7	**98235**		
7/29/11 7:37:00	20.67	-0.09	2.1	0.28	0.0	**99975**		
7/29/11 7:37:15	20.66	-0.09	2.0	0.28	0.4	97434		
7/29/11 7:37:30	20.66	-0.09	2.1	0.29	0.8	83921		
7/29/11 7:37:45	20.66	-0.09	2.0	0.32	0.8	85024		
7/29/11 7:38:00	20.66	-0.09	1.7	0.30	0.1	85935		
7/29/11 7:38:15	20.66	-0.09	1.8	0.28	0.2	79501		
7/29/11 7:38:30	20.65	-0.09	1.9	0.28	0.8	73962		
7/29/11 7:38:45	20.65	-0.09	2.0	0.29	0.8	68629		
7/29/11 7:39:00	20.66	-0.09	2.0	0.28	0.2	64159		
7/29/11 7:39:15	20.66	-0.09	2.4	0.28	0.1	59963		
7/29/11 7:39:30	20.66	-0.09	2.6	0.28	0.7	56347		
7/29/11 7:39:45	20.66	-0.09	2.9	0.29	1.0	53326		
7/29/11 7:40:00	20.65	-0.09	3.3	0.28	0.4	50159		
7/29/11 7:40:15	20.66	-0.09	3.9	0.28	0.0	47432		
7/29/11 7:40:30	20.66	-0.09	4.0	0.28	0.5	45063		
7/29/11 7:40:45	20.66	-0.09	4.3	0.28	1.0	42887		
7/29/11 7:41:00	20.66	-0.09	4.2	0.29	0.7	40994		
7/29/11 7:41:15	20.66	-0.09	4.2	0.28	0.1	39429		
7/29/11 7:41:30	20.66	-0.09	4.4	0.28	0.2	38053		
7/29/11 7:41:45	20.66	-0.09	4.4	0.28	0.6	36647		
7/29/11 7:42:00	20.66	-0.09	4.7	0.28	0.6	34939		
7/29/11 7:42:15	20.66	-0.09	4.7	0.28	0.1	34189		
7/29/11 7:42:30	20.66	-0.09	4.7	0.28	0.2	33846		
7/29/11 7:42:45	20.66	-0.09	4.8	0.28	0.7	33824		
7/29/11 7:43:00	20.66	-0.09	4.8	0.28	0.8	33285		
7/29/11 7:43:15	20.66	-0.09	4.9	0.28	0.2	33624		
7/29/11 7:43:30	20.65	-0.09	5.0	0.28	0.0	33880		
7/29/11 7:43:45	20.66	-0.09	5.0	0.29	0.6	34311		
7/29/11 7:44:00	20.66	-0.09	5.9	0.28	0.8	35496		
7/29/11 7:44:15	20.66	-0.09	7.4	0.26	0.4	36988		
7/29/11 7:44:30	20.66	-0.09	8.1	0.26	0.0	38837		
7/29/11 7:44:45	20.66	-0.09	8.4	0.25	0.5	40785		
7/29/11 7:45:00	20.66	-0.09	8.4	0.26	1.0	43229		
7/29/11 7:45:15	20.66	-0.09	8.6	0.26	0.7	45575		
7/29/11 7:45:30	20.66	-0.09	8.9	0.25	-0.1	47688		
7/29/11 7:45:45	20.66	-0.09	8.9	0.26	0.3	49450		
7/29/11 7:46:00	20.66	-0.09	8.8	0.26	0.9	51961		
7/29/11 7:46:15	20.66	-0.09	8.7	0.28	0.8	53795		
7/29/11 7:46:30	20.65	-0.09	8.6	0.27	0.0	54803		
7/29/11 7:46:45	20.65	-0.09	8.9	0.29	0.1	56459		
7/29/11 7:47:00	20.65	-0.09	9.2	0.35	0.8	57618		
7/29/11 7:47:15	20.76	-0.05	9.2	0.44	0.9	58764		
7/29/11 7:47:30	20.97	0.00	9.0	0.34	0.1	59464		
7/29/11 7:47:45	21.02	0.00	8.8	0.26	0.1	59974		
7/29/11 7:48:00	20.83	-0.06	8.8	0.26	0.8	60875		
7/29/11 7:48:15	20.69	-0.09	8.8	0.26	1.2	61540		
7/29/11 7:48:30	20.66	-0.09	8.7	0.26	0.7	61677		
7/29/11 7:48:45	20.66	-0.09	8.6	0.28	0.2	62675		
7/29/11 7:49:00	20.66	-0.09	8.9	0.26	0.5	62716		
7/29/11 7:49:15	20.65	-0.09	8.9	0.26	0.9	63324		
7/29/11 7:49:30	20.66	-0.09	8.9	0.25	0.6	63452		
7/29/11 7:49:45	20.66	-0.09	9.2	0.26	0.0	63751		
7/29/11 7:50:00	20.66	-0.09	9.1	0.26	0.3	64202		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
7/29/11 7:50:15	20.66	-0.09	9.0	0.25	0.8	64445	
7/29/11 7:50:30	20.66	-0.09	9.2	0.25	0.8	64374	
7/29/11 7:50:45	20.67	-0.08	9.1	0.26	0.1	64500	
7/29/11 7:51:00	20.67	-0.08	9.1	0.26	0.1	64460	
7/29/11 7:51:15	20.67	-0.08	9.2	0.28	0.5	64474	
7/29/11 7:51:30	20.68	-0.08	9.1	0.28	0.8	64308	
7/29/11 7:51:45	20.68	-0.08	9.1	0.28	0.4	64371	Begin Venting Drum A
7/29/11 7:52:00	**20.68**	**-0.08**	**9.1**	**0.30**	**0.2**	**64530**	
7/29/11 7:52:15	**20.69**	**-0.08**	**9.2**	**0.30**	**0.7**	**64506**	
7/29/11 7:52:30	**20.69**	**-0.08**	**9.2**	**0.28**	**1.4**	**64432**	
7/29/11 7:52:45	**20.70**	**-0.08**	**9.1**	**0.29**	**1.0**	**64468**	
7/29/11 7:53:00	**20.71**	**-0.09**	**9.0**	**0.31**	**0.4**	**64389**	
7/29/11 7:53:15	**20.71**	**-0.08**	**9.0**	**0.31**	**0.8**	**64490**	
7/29/11 7:53:30	**20.72**	**-0.08**	**8.9**	**0.32**	**1.3**	**64293**	
7/29/11 7:53:45	**20.72**	**-0.09**	**8.7**	**1.02**	**1.3**	**64580**	
7/29/11 7:54:00	**20.73**	**-0.09**	**8.7**	**5.06**	**0.8**	**64632**	
7/29/11 7:54:15	**20.67**	**-0.09**	**8.6**	**5.47**	**0.8**	**64153**	
7/29/11 7:54:30	**20.45**	**-0.09**	**8.7**	**2.51**	**2.5**	**63777**	
7/29/11 7:54:45	**20.34**	**-0.09**	**9.2**	**0.63**	**11.6**	**65373**	
7/29/11 7:55:00	**20.27**	**-0.07**	**9.2**	**0.40**	**24.7**	**65458**	
7/29/11 7:55:15	**20.39**	**-0.07**	**9.0**	**0.34**	**20.7**	**64883**	
7/29/11 7:55:30	**20.62**	**-0.08**	**8.9**	**0.34**	**10.5**	**63500**	
7/29/11 7:55:45	**20.71**	**-0.08**	**8.8**	**0.34**	**7.2**	**63049**	
7/29/11 7:56:00	**20.74**	**-0.09**	**9.1**	**0.34**	**4.5**	**62818**	
7/29/11 7:56:15	**20.77**	**-0.09**	**8.9**	**0.34**	**3.3**	**63132**	
7/29/11 7:56:30	**20.78**	**-0.09**	**9.0**	**0.34**	**3.1**	**63105**	
7/29/11 7:56:45	**20.77**	**-0.09**	**9.0**	**0.34**	**2.7**	**62744**	
7/29/11 7:57:00	**20.58**	**-0.09**	**8.8**	**0.34**	**1.1**	**62641**	
7/29/11 7:57:15	**20.34**	**-0.09**	**9.2**	**0.34**	**0.3**	**62762**	
7/29/11 7:57:30	**20.20**	**-0.09**	**9.2**	**0.34**	**0.5**	**62213**	
7/29/11 7:57:45	**20.13**	**-0.09**	**9.2**	**0.34**	**1.0**	**62551**	
7/29/11 7:58:00	**20.07**	**-0.09**	**9.1**	**0.34**	**0.8**	**62416**	
7/29/11 7:58:15	**20.03**	**-0.09**	**9.1**	**0.34**	**0.3**	**62380**	
7/29/11 7:58:30	**20.00**	**-0.09**	**9.2**	**0.34**	**0.6**	**61840**	
7/29/11 7:58:45	**20.00**	**-0.09**	**9.3**	**0.34**	**1.9**	**61674**	
7/29/11 7:59:00	**20.23**	**-0.08**	**8.9**	**0.34**	**3.2**	**62164**	
7/29/11 7:59:15	**20.70**	**-0.08**	**9.0**	**0.34**	**2.2**	**61636**	
7/29/11 7:59:30	**20.85**	**-0.08**	**8.9**	**0.34**	**1.8**	**61278**	
7/29/11 7:59:45	**20.87**	**-0.08**	**9.0**	**0.34**	**2.0**	**61389**	
7/29/11 8:00:00	**20.88**	**-0.08**	**8.7**	**0.34**	**1.8**	**61431**	
7/29/11 8:00:15	**20.88**	**-0.08**	**8.7**	**0.37**	**1.2**	**61006**	
7/29/11 8:00:30	**20.89**	**-0.08**	**8.9**	**0.35**	**1.5**	**61166**	
7/29/11 8:00:45	**20.89**	**-0.08**	**8.5**	**0.34**	**1.9**	**61026**	
7/29/11 8:01:00	**20.89**	**-0.08**	**8.6**	**0.34**	**1.9**	**61415**	
7/29/11 8:01:15	**20.90**	**-0.08**	**8.5**	**0.32**	**1.1**	**61269**	
7/29/11 8:01:30	**20.90**	**-0.08**	**8.5**	**0.34**	**1.0**	**61122**	
7/29/11 8:01:45	**20.91**	**-0.08**	**8.6**	**0.32**	**1.7**	**60857**	
7/29/11 8:02:00	**20.91**	**-0.08**	**8.7**	**0.31**	**1.9**	**61217**	
7/29/11 8:02:15	**20.91**	**-0.08**	**8.6**	**0.31**	**1.2**	**61151**	
7/29/11 8:02:30	**20.92**	**-0.08**	**8.6**	**0.31**	**1.1**	**61411**	
7/29/11 8:02:45	**20.92**	**-0.08**	**8.6**	**0.26**	**1.7**	**61241**	
7/29/11 8:03:00	**20.92**	**-0.08**	**8.5**	**0.26**	**1.6**	**60958**	
7/29/11 8:03:15	**20.92**	**-0.08**	**8.4**	**0.27**	**0.8**	**60932**	
7/29/11 8:03:30	**20.92**	**-0.08**	**8.3**	**0.28**	**0.1**	**59969**	
7/29/11 8:03:45	**20.92**	**-0.08**	**8.4**	**0.26**	**0.5**	**59987**	
7/29/11 8:04:00	**20.92**	**-0.09**	**8.2**	**0.26**	**1.0**	**60479**	
7/29/11 8:04:15	**20.92**	**-0.09**	**8.0**	**0.30**	**0.5**	**59652**	
7/29/11 8:04:30	**20.92**	**-0.09**	**7.9**	**0.30**	**0.0**	**59896**	
7/29/11 8:04:45	**20.93**	**-0.09**	**7.6**	**0.32**	**0.7**	**59887**	
7/29/11 8:05:00	**20.93**	**-0.09**	**7.7**	**0.33**	**1.7**	**59541**	
7/29/11 8:05:15	**20.94**	**-0.08**	**7.8**	**0.32**	**1.8**	**60168**	
7/29/11 8:05:30	**20.95**	**-0.08**	**7.8**	**0.30**	**1.3**	**59647**	
7/29/11 8:05:45	**20.95**	**-0.09**	**7.5**	**0.28**	**1.8**	**59484**	
7/29/11 8:06:00	**20.95**	**-0.09**	**7.2**	**0.28**	**2.1**	**59634**	
7/29/11 8:06:15	**20.96**	**-0.09**	**7.6**	**0.30**	**1.9**	**59914**	
7/29/11 8:06:30	**20.97**	**-0.09**	**7.6**	**0.29**	**1.3**	**59897**	
7/29/11 8:06:45	**20.97**	**-0.09**	**7.6**	**0.28**	**1.5**	**59756**	
7/29/11 8:07:00	**20.97**	**-0.09**	**7.4**	**0.29**	**1.8**	**59513**	
7/29/11 8:07:15	**20.97**	**-0.09**	**7.3**	**0.28**	**1.7**	**59227**	
7/29/11 8:07:30	**20.98**	**-0.09**	**7.2**	**0.28**	**1.0**	**59413**	
7/29/11 8:07:45	**20.98**	**-0.09**	**7.1**	**0.28**	**0.9**	**60375**	
7/29/11 8:08:00	**20.98**	**-0.09**	**6.8**	**0.29**	**1.7**	**60045**	
7/29/11 8:08:15	**20.98**	**-0.09**	**6.8**	**0.29**	**1.7**	**59430**	
7/29/11 8:08:30	**20.98**	**-0.09**	**6.8**	**0.28**	**0.9**	**59585**	
7/29/11 8:08:45	**20.98**	**-0.09**	**6.7**	**0.29**	**1.0**	**59549**	
7/29/11 8:09:00	**20.98**	**-0.09**	**6.4**	**0.29**	**1.7**	**59377**	
7/29/11 8:09:15	**20.99**	**-0.09**	**6.8**	**0.28**	**1.7**	**59552**	
7/29/11 8:09:30	**20.98**	**-0.09**	**6.9**	**0.30**	**1.0**	**60457**	
7/29/11 8:09:45	**20.99**	**-0.09**	**6.4**	**0.28**	**1.2**	**59932**	
7/29/11 8:10:00	**20.99**	**-0.08**	**6.7**	**0.30**	**1.5**	**60033**	
7/29/11 8:10:15	**20.99**	**-0.08**	**6.5**	**0.28**	**1.7**	**60464**	
7/29/11 8:10:30	**20.99**	**-0.08**	**6.3**	**0.28**	**1.3**	**60947**	
7/29/11 8:10:45	**20.99**	**-0.08**	**6.4**	**0.28**	**1.1**	**60294**	
7/29/11 8:11:00	**20.99**	**-0.08**	**6.3**	**0.28**	**1.6**	**59720**	
7/29/11 8:11:15	**20.99**	**-0.08**	**6.2**	**0.29**	**2.2**	**60446**	

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
7/29/11 8:11:30	21.00	-0.08	6.0	0.28	1.4	59834	
7/29/11 8:11:45	21.00	-0.08	6.3	0.30	1.1	59981	
7/29/11 8:12:00	20.99	-0.08	6.1	0.30	1.6	60318	
7/29/11 8:12:15	21.00	-0.08	5.9	0.28	2.0	59611	
7/29/11 8:12:30	21.00	-0.08	6.0	0.28	1.6	60245	
7/29/11 8:12:45	21.00	-0.08	6.0	0.29	1.0	59914	
7/29/11 8:13:00	21.00	-0.08	5.9	0.28	1.3	60051	
7/29/11 8:13:15	21.00	-0.08	5.6	0.28	1.8	60927	
7/29/11 8:13:30	21.00	-0.08	5.5	0.28	1.7	59695	
7/29/11 8:13:45	21.00	-0.08	5.5	0.28	1.1	59999	
7/29/11 8:14:00	21.00	-0.08	5.5	0.28	1.3	59921	
7/29/11 8:14:15	21.01	-0.08	5.5	0.28	1.7	59970	
7/29/11 8:14:30	21.01	-0.08	5.2	0.28	1.7	60757	
7/29/11 8:14:45	21.01	-0.08	5.3	0.28	1.2	60688	
7/29/11 8:15:00	21.01	-0.08	5.2	0.28	1.2	60767	
7/29/11 8:15:15	21.01	-0.08	5.0	0.28	1.5	60824	
7/29/11 8:15:30	21.01	-0.08	5.0	0.29	1.6	60523	
7/29/11 8:15:45	21.01	-0.08	5.1	0.28	1.2	60499	
7/29/11 8:16:00	21.01	-0.08	5.2	0.28	1.0	60759	
7/29/11 8:16:15	21.01	-0.09	5.1	0.30	1.6	60597	
7/29/11 8:16:30	21.01	-0.09	4.9	0.28	1.8	60959	
7/29/11 8:16:45	21.02	-0.09	5.0	0.28	1.2	60860	
7/29/11 8:17:00	21.02	-0.09	5.0	0.28	0.8	61386	
7/29/11 8:17:15	21.02	-0.09	4.9	0.28	1.3	60513	
7/29/11 8:17:30	21.02	-0.09	4.8	0.28	1.6	60751	
7/29/11 8:17:45	21.02	-0.09	4.9	0.28	1.3	60477	
7/29/11 8:18:00	21.01	-0.09	5.0	0.28	0.7	60654	
7/29/11 8:18:15	21.00	-0.09	4.9	0.28	1.3	60919	
7/29/11 8:18:30	21.00	-0.09	4.8	0.28	1.6	60843	
7/29/11 8:18:45	21.00	-0.09	5.0	0.28	1.5	60805	
7/29/11 8:19:00	21.00	-0.09	5.1	0.28	0.9	60317	
7/29/11 8:19:15	21.00	-0.09	4.9	0.31	1.1	60763	
7/29/11 8:19:30	21.00	-0.09	4.9	0.28	1.6	60336	
7/29/11 8:19:45	21.00	-0.09	4.9	0.28	1.7	60891	
7/29/11 8:20:00	21.00	-0.09	4.9	0.28	1.0	61034	
7/29/11 8:20:15	21.00	-0.09	4.8	0.28	1.0	61436	
7/29/11 8:20:30	21.00	-0.09	4.9	0.28	1.6	61712	
7/29/11 8:20:45	21.00	-0.09	4.9	0.28	1.7	61396	
7/29/11 8:21:00	21.00	-0.09	5.0	0.28	1.1	61520	
7/29/11 8:21:15	21.00	-0.09	4.8	0.28	0.8	61363	
7/29/11 8:21:30	21.00	-0.09	4.9	0.28	1.4	61149	
7/29/11 8:21:45	21.01	-0.08	5.0	0.28	1.6	61672	
7/29/11 8:22:00	21.01	-0.08	4.8	0.28	1.3	61121	
7/29/11 8:22:15	21.01	-0.08	4.8	0.27	0.7	61004	
7/29/11 8:22:30	21.01	-0.08	4.9	0.27	1.1	61243	
7/29/11 8:22:45	21.01	-0.08	4.8	0.28	1.7	61341	
7/29/11 8:23:00	21.02	-0.08	4.9	0.28	1.4	61498	
7/29/11 8:23:15	21.02	-0.08	4.9	0.29	0.8	61254	
7/29/11 8:23:30	21.02	-0.08	4.9	0.28	1.2	61325	
7/29/11 8:23:45	21.02	-0.08	5.0	0.28	1.8	61873	
7/29/11 8:24:00	21.02	-0.08	5.0	0.28	1.4	61590	
7/29/11 8:24:15	21.02	-0.08	4.9	0.28	0.8	61238	
7/29/11 8:24:30	21.02	-0.08	5.0	0.28	0.9	61116	
7/29/11 8:24:45	21.02	-0.08	4.6	0.28	1.3	61499	
7/29/11 8:25:00	21.02	-0.08	4.7	0.28	1.4	61377	
7/29/11 8:25:15	21.02	-0.08	4.6	0.28	0.8	61457	
7/29/11 8:25:30	21.02	-0.08	4.6	0.28	0.8	61477	
7/29/11 8:25:45	21.03	-0.08	4.7	0.28	1.2	61297	
7/29/11 8:26:00	21.03	-0.08	5.0	0.28	1.5	61107	
7/29/11 8:26:15	21.03	-0.08	4.9	0.28	0.9	60691	
7/29/11 8:26:30	21.03	-0.08	4.7	0.31	0.6	61049	
7/29/11 8:26:45	21.03	-0.08	4.7	0.28	1.1	60880	
7/29/11 8:27:00	21.03	-0.08	4.7	0.28	1.4	60351	
7/29/11 8:27:15	21.03	-0.09	4.9	0.28	1.1	60431	
7/29/11 8:27:30	21.02	-0.09	5.1	0.29	0.5	60789	
7/29/11 8:27:45	21.02	-0.09	4.9	0.28	1.0	61222	
7/29/11 8:28:00	21.02	-0.09	4.8	0.28	1.6	61242	
7/29/11 8:28:15	21.03	-0.09	5.0	0.28	1.2	60720	
7/29/11 8:28:30	21.02	-0.09	5.0	0.28	0.5	60937	
7/29/11 8:28:45	21.03	-0.09	5.0	0.30	1.0	60565	
7/29/11 8:29:00	21.03	-0.09	5.0	0.28	1.3	61114	
7/29/11 8:29:15	21.03	-0.09	4.9	0.28	1.2	61298	
7/29/11 8:29:30	21.03	-0.09	5.2	0.29	0.7	60728	
7/29/11 8:29:45	21.03	-0.09	5.2	0.29	1.0	60928	
7/29/11 8:30:00	21.03	-0.09	5.0	0.28	1.4	60490	
7/29/11 8:30:15	21.03	-0.09	4.8	0.31	1.4	61029	
7/29/11 8:30:30	21.03	-0.09	4.9	0.28	0.8	60745	
7/29/11 8:30:45	21.03	-0.09	5.0	0.28	0.7	60485	
7/29/11 8:31:00	21.03	-0.09	5.2	0.28	1.3	60528	
7/29/11 8:31:15	21.03	-0.09	5.3	0.28	1.6	60170	
7/29/11 8:31:30	21.03	-0.08	5.1	0.28	1.0	60477	
7/29/11 8:31:45	21.03	-0.08	5.1	0.28	0.7	60346	
7/29/11 8:32:00	21.03	-0.08	5.1	0.28	1.0	60449	
7/29/11 8:32:15	21.04	-0.08	4.9	0.28	1.4	60262	
7/29/11 8:32:30	21.03	-0.08	5.2	0.30	0.9	59559	

Houston Refining: Houston, Texas
736 Coker
ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
7/29/11 8:32:45	21.03	-0.08	5.0	0.28	0.5	59491	
7/29/11 8:33:00	21.03	-0.08	5.1	0.28	1.0	59517	
7/29/11 8:33:15	21.03	-0.08	5.1	0.26	1.4	59588	
7/29/11 8:33:30	21.03	-0.08	5.2	0.27	1.1	59794	
7/29/11 8:33:45	21.03	-0.08	5.5	0.28	0.5	59961	
7/29/11 8:34:00	21.03	-0.08	5.5	0.27	0.6	59533	
7/29/11 8:34:15	21.03	-0.08	5.4	0.28	1.2	59630	
7/29/11 8:34:30	21.03	-0.08	5.4	0.28	1.2	59307	
7/29/11 8:34:45	21.03	-0.08	5.2	0.28	0.5	59225	
7/29/11 8:35:00	21.04	-0.08	5.2	0.28	0.6	59322	
7/29/11 8:35:15	21.04	-0.08	5.1	0.28	1.1	59488	
7/29/11 8:35:30	21.04	-0.08	5.2	0.27	1.2	59431	
7/29/11 8:35:45	21.04	-0.08	5.2	0.25	0.3	59196	
7/29/11 8:36:00	21.04	-0.08	5.5	0.25	0.2	59877	
7/29/11 8:36:15	21.03	-0.08	5.4	0.27	0.7	59386	
7/29/11 8:36:30	21.03	-0.08	5.5	0.25	0.8	59506	
7/29/11 8:36:45	21.02	-0.08	5.4	0.26	0.2	59267	
7/29/11 8:37:00	21.02	-0.09	5.2	0.25	0.0	59135	
7/29/11 8:37:15	21.02	-0.09	5.1	0.25	0.4	59675	
7/29/11 8:37:30	21.02	-0.09	5.1	0.27	0.9	59529	
7/29/11 8:37:45	21.03	-0.09	5.2	0.25	0.4	59260	
7/29/11 8:38:00	21.03	-0.09	5.2	0.27	0.0	59083	
7/29/11 8:38:15	21.03	-0.09	5.4	0.27	0.6	59458	
7/29/11 8:38:30	21.03	-0.09	5.2	0.25	1.0	58841	
7/29/11 8:38:45	21.03	-0.09	5.3	0.27	0.7	59241	
7/29/11 8:39:00	21.03	-0.09	5.4	0.25	0.1	58876	
7/29/11 8:39:15	21.03	-0.09	5.1	0.27	0.3	59155	
7/29/11 8:39:30	21.03	-0.09	5.3	0.26	0.8	59329	
7/29/11 8:39:45	21.04	-0.09	5.2	0.26	0.7	59761	
7/29/11 8:40:00	21.04	-0.09	5.0	0.27	0.1	59177	
7/29/11 8:40:15	21.04	-0.09	5.1	0.25	0.3	58524	
7/29/11 8:40:30	21.04	-0.09	5.2	0.25	0.7	58447	
7/29/11 8:40:45	21.04	-0.09	5.4	0.25	0.8	58859	
7/29/11 8:41:00	21.04	-0.09	5.0	0.26	0.2	59362	
7/29/11 8:41:15	21.04	-0.09	5.2	0.25	0.1	58947	
7/29/11 8:41:30	21.04	-0.09	4.9	0.26	0.6	58936	
7/29/11 8:41:45	21.04	-0.09	4.9	0.25	1.0	59643	
7/29/11 8:42:00	21.04	-0.09	5.2	0.25	0.4	59099	
7/29/11 8:42:15	21.04	-0.09	5.2	0.27	0.1	59123	
7/29/11 8:42:30	21.04	-0.09	5.0	0.28	0.6	58886	
7/29/11 8:42:45	21.04	-0.09	5.0	0.25	0.9	59353	
7/29/11 8:43:00	21.04	-0.09	4.7	0.25	0.3	58985	
7/29/11 8:43:15	21.05	-0.08	4.7	0.28	-0.2	58920	
7/29/11 8:43:30	21.04	-0.08	4.9	0.25	0.3	58972	
7/29/11 8:43:45	21.05	-0.08	5.1	0.27	0.9	58847	
7/29/11 8:44:00	21.05	-0.08	5.1	0.25	0.5	58989	
7/29/11 8:44:15	21.05	-0.08	5.0	0.28	-0.1	59009	
7/29/11 8:44:30	21.05	-0.08	4.8	0.25	0.3	59045	
7/29/11 8:44:45	21.05	-0.08	4.9	0.25	0.9	59056	
7/29/11 8:45:00	21.05	-0.08	5.0	0.25	0.6	58679	
7/29/11 8:45:15	21.05	-0.08	4.9	0.27	0.0	58670	
7/29/11 8:45:30	21.05	-0.08	4.9	0.26	0.1	58594	
7/29/11 8:45:45	21.05	-0.08	4.7	0.25	0.7	58347	
7/29/11 8:46:00	21.05	-0.08	4.8	0.25	0.8	58434	
7/29/11 8:46:15	21.05	-0.08	4.7	0.25	0.1	58343	
7/29/11 8:46:30	21.05	-0.08	4.7	0.25	0.1	58082	
7/29/11 8:46:45	21.05	-0.08	4.8	0.25	0.6	57977	
7/29/11 8:47:00	21.05	-0.08	4.8	0.25	0.8	57732	
7/29/11 8:47:15	21.05	-0.08	4.8	0.25	0.3	58414	
7/29/11 8:47:30	21.05	-0.08	4.9	0.26	0.1	58171	
7/29/11 8:47:45	21.05	-0.08	4.7	0.25	0.6	57793	
7/29/11 8:48:00	21.06	-0.08	4.7	0.25	0.8	58202	
7/29/11 8:48:15	21.06	-0.08	4.7	0.25	0.5	58387	
7/29/11 8:48:30	21.06	-0.09	4.6	0.25	0.0	58221	
7/29/11 8:48:45	21.06	-0.09	4.4	0.25	0.2	58189	
7/29/11 8:49:00	21.06	-0.09	4.2	0.25	0.9	58443	
7/29/11 8:49:15	21.06	-0.09	4.3	0.30	0.7	58245	
7/29/11 8:49:30	21.06	-0.09	4.5	0.28	0.6	58456	
7/29/11 8:49:45	21.06	-0.08	4.6	0.28	1.3	58552	
7/29/11 8:50:00	21.07	-0.08	4.6	0.29	1.5	57935	
7/29/11 8:50:15	21.07	-0.08	4.7	0.28	1.3	58487	
7/29/11 8:50:30	21.07	-0.08	4.7	0.28	0.4	58468	
7/29/11 8:50:45	21.07	-0.09	4.5	0.28	0.7	59568	
7/29/11 8:51:00	21.07	-0.09	4.3	0.28	1.2	59079	
7/29/11 8:51:15	21.07	-0.08	4.4	0.28	1.2	58709	
7/29/11 8:51:30	21.07	-0.09	4.4	0.28	0.5	58068	
7/29/11 8:51:45	21.08	-0.09	4.6	0.28	0.6	57945	
7/29/11 8:52:00	21.08	-0.09	4.6	0.25	1.1	58001	
7/29/11 8:52:15	21.07	-0.08	4.4	0.26	1.3	58349	
7/29/11 8:52:30	21.08	-0.08	4.6	0.32	0.5	58224	
7/29/11 8:52:45	21.08	-0.08	4.8	0.26	0.3	58683	
7/29/11 8:53:00	21.08	-0.08	4.5	0.26	0.9	58238	
7/29/11 8:53:15	21.08	-0.08	4.4	0.28	1.2	57977	
7/29/11 8:53:30	21.08	-0.08	4.5	0.28	0.7	58487	
7/29/11 8:53:45	21.08	-0.08	4.5	0.27	0.6	59292	

Houston Refining: Houston, Texas
736 Coker
ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
7/29/11 8:54:00	21.08	-0.08	4.6	0.28	1.0	59745		
7/29/11 8:54:15	21.08	-0.08	4.5	0.28	1.3	60082		
7/29/11 8:54:30	21.08	-0.08	4.5	0.28	0.8	61973		
7/29/11 8:54:45	21.08	-0.08	4.6	0.28	0.5	63365		
7/29/11 8:55:00	21.08	-0.08	4.5	0.25	0.9	64520		
7/29/11 8:55:15	21.08	-0.08	4.5	0.26	1.5	64206		
7/29/11 8:55:30	21.08	-0.08	4.4	0.28	0.9	64468		
7/29/11 8:55:45	21.08	-0.08	4.5	0.27	0.4	63480		
7/29/11 8:56:00	21.08	-0.08	4.5	0.27	0.9	62746		
7/29/11 8:56:15	21.08	-0.08	4.5	0.26	1.3	62660		
7/29/11 8:56:30	21.08	-0.08	4.5	0.26	1.2	62103		
7/29/11 8:56:45	21.07	-0.08	4.4	0.27	0.6	61860		
7/29/11 8:57:00	21.08	-0.08	4.5	0.27	0.7	61258		
7/29/11 8:57:15	21.08	-0.08	4.7	0.25	1.2	60619		
7/29/11 8:57:30	21.07	-0.08	4.6	0.27	1.2	60119		
7/29/11 8:57:45	21.07	-0.08	4.3	0.25	0.7	59924		
7/29/11 8:58:00	21.07	-0.08	4.5	0.28	0.6	59889		
7/29/11 8:58:15	21.07	-0.08	4.4	0.28	1.1	59656		
7/29/11 8:58:30	21.08	-0.08	4.2	0.25	1.2	59748		
7/29/11 8:58:45	21.07	-0.08	4.4	0.27	0.6	59749		
7/29/11 8:59:00	21.07	-0.08	4.5	0.26	0.5	59251		
7/29/11 8:59:15	21.07	-0.08	4.5	0.26	1.0	59057		
7/29/11 8:59:30	21.07	-0.08	4.6	0.27	1.2	59138		
7/29/11 8:59:45	21.07	-0.08	4.4	0.28	0.7	58562		
7/29/11 9:00:00	21.07	-0.08	4.4	0.25	0.4	58881		
7/29/11 9:00:15	21.07	-0.09	4.6	0.28	1.0	58811		
7/29/11 9:00:30	21.07	-0.09	4.4	0.28	1.4	58477		
7/29/11 9:00:45	21.07	-0.09	4.4	0.28	0.8	58488		
7/29/11 9:01:00	21.07	-0.09	4.3	0.28	0.4	58308		
7/29/11 9:01:15	21.07	-0.09	4.4	0.28	0.8	57824		
7/29/11 9:01:30	21.07	-0.09	4.7	0.28	1.2	57246		
7/29/11 9:01:45	21.06	-0.09	4.5	0.32	1.0	56977		
7/29/11 9:02:00	21.06	-0.09	4.7	0.30	0.4	56550		
7/29/11 9:02:15	21.06	-0.09	4.7	0.30	0.7	56515		
7/29/11 9:02:30	21.06	-0.09	4.6	0.31	1.4	56618		
7/29/11 9:02:45	21.06	-0.09	4.4	0.30	1.2	56434		
7/29/11 9:03:00	21.06	-0.09	4.6	0.28	0.6	56209		
7/29/11 9:03:15	21.06	-0.09	4.8	0.31	0.8	56452		
7/29/11 9:03:30	21.06	-0.09	4.6	0.30	1.2	56344		
7/29/11 9:03:45	21.06	-0.09	4.7	0.30	1.3	56180		
7/29/11 9:04:00	21.06	-0.08	4.6	0.31	0.6	56259		
7/29/11 9:04:15	21.06	-0.08	4.4	0.31	0.6	56446		
7/29/11 9:04:30	21.06	-0.08	4.5	0.31	1.3	56598		
7/29/11 9:04:45	21.06	-0.08	4.5	0.33	1.5	56929		
7/29/11 9:05:00	21.06	-0.08	4.6	0.31	0.7	57056		
7/29/11 9:05:15	21.06	-0.08	4.9	0.31	0.5	56435		
7/29/11 9:05:30	21.06	-0.08	4.7	0.28	1.2	56329		
7/29/11 9:05:45	21.06	-0.08	4.5	0.32	1.4	57356		
7/29/11 9:06:00	21.06	-0.08	4.8	0.31	0.9	59510		
7/29/11 9:06:15	21.06	-0.08	4.9	0.32	0.4	57433		
7/29/11 9:06:30	21.06	-0.08	4.7	0.33	1.0	55856		
7/29/11 9:06:45	21.06	-0.08	4.7	0.35	1.4	55189		
7/29/11 9:07:00	21.06	-0.08	4.9	0.31	0.9	54929		
7/29/11 9:07:15	21.06	-0.08	4.7	0.31	0.5	55236		
7/29/11 9:07:30	21.06	-0.08	4.7	0.32	0.9	54779		
7/29/11 9:07:45	21.06	-0.08	4.4	0.32	1.2	54305		
7/29/11 9:08:00	21.06	-0.08	4.5	0.31	1.2	53602	End Run 7	
7/29/11 9:08:15	21.06	-0.08	4.7	0.34	0.6	53669		
7/29/11 9:08:30	21.05	-0.08	4.8	0.32	0.6	53308		
7/29/11 9:08:45	21.05	-0.08	4.5	0.34	1.1	52931		
7/29/11 9:09:00	21.05	-0.08	4.6	0.31	1.4	53269		
7/29/11 9:09:15	21.05	-0.08	4.7	0.31	0.8	53854		
7/29/11 9:09:30	21.06	-0.08	4.7	0.34	0.6	55406		
7/29/11 9:09:45	21.06	-0.08	4.7	0.35	1.2	54114		
7/29/11 9:10:00	21.06	-0.08	4.3	0.34	1.7	53884	End Run	
7/29/11 9:10:15	21.06	-0.08	4.4	0.31	1.3	53762		
7/29/11 9:10:30	21.06	-0.08	4.4	0.25	0.7	33552		
7/29/11 9:10:45	21.05	-0.09	4.5	0.26	0.8	11421	System Bias	
7/29/11 9:11:00	21.04	-0.09	4.5	0.25	0.9	3091	C_3H_8 Bias 2 Zero =	2829
7/29/11 9:11:15	21.04	-0.09	4.4	0.27	0.8	2746		
7/29/11 9:11:30	21.04	-0.09	4.5	0.25	0.1	2734		
7/29/11 9:11:45	21.04	-0.09	4.7	0.25	0.3	2745		
7/29/11 9:12:00	21.04	-0.09	4.7	0.25	1.0	12604		
7/29/11 9:12:15	21.04	-0.09	4.7	0.25	1.0	56804	System Bias	
7/29/11 9:12:30	21.04	-0.09	4.4	0.26	0.3	92626	C_3H_8 Bias 2 Low =	94271
7/29/11 9:12:45	21.04	-0.09	4.5	0.25	0.2	92602		
7/29/11 9:13:00	21.04	-0.09	4.4	0.25	0.8	92624		
7/29/11 9:13:15	21.04	-0.09	4.3	0.25	1.2	99234		
7/29/11 9:13:30	21.04	-0.09	4.1	0.25	0.5	97828		
7/29/11 9:13:45	21.04	-0.09	4.5	0.25	0.0	72632		
7/29/11 9:14:00	21.04	-0.09	4.3	0.27	0.5	72322		
7/29/11 9:14:15	21.05	-0.09	4.2	0.25	0.9	62025		
7/29/11 9:14:30	21.04	-0.09	4.4	0.25	0.5	52263		
7/29/11 9:14:45	21.04	-0.09	4.3	0.25	0.1	52264		
7/29/11 9:15:00	21.05	-0.09	4.3	0.25	0.5	52122		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
7/29/11 9:15:15	21.05	-0.09	4.2	0.25	0.8	52029	
7/29/11 9:15:30	21.05	-0.09	4.0	0.25	0.6	52171	
7/29/11 9:15:45	21.05	-0.09	4.2	0.25	0.0	52094	
7/29/11 9:16:00	21.05	-0.08	4.3	0.25	0.2	51861	
7/29/11 9:16:15	21.05	-0.08	4.1	0.26	0.8	51866	
7/29/11 9:16:30	21.05	-0.08	4.0	0.27	0.6	51802	
7/29/11 9:16:45	21.05	-0.08	4.1	0.25	0.0	51969	
7/29/11 9:17:00	21.05	-0.08	4.1	0.25	0.3	52118	
7/29/11 9:17:15	21.05	-0.08	4.0	0.27	0.8	51978	
7/29/11 9:17:30	21.05	-0.08	4.0	0.26	0.9	51754	
7/29/11 9:17:45	21.05	-0.08	4.1	0.27	0.3	50853	
7/29/11 9:18:00	21.05	-0.08	3.9	0.27	0.1	51497	
7/29/11 9:18:15	21.05	-0.08	4.1	0.26	0.6	54889	
7/29/11 9:18:30	21.04	-0.08	4.1	0.27	0.8	52315	
7/29/11 9:18:45	21.04	-0.08	4.0	0.25	0.5	51530	
7/29/11 9:19:00	21.04	-0.08	4.1	0.27	0.0	51077	
7/29/11 9:19:15	21.05	-0.08	4.0	0.25	0.5	51031	
7/29/11 9:19:30	21.05	-0.08	3.9	0.25	0.9	51093	
7/29/11 9:19:45	21.05	-0.08	4.1	0.25	0.6	50703	
7/29/11 9:20:00	21.05	-0.08	4.0	0.25	0.0	50978	
7/29/11 9:20:15	21.05	-0.09	3.9	0.25	0.3	51177	
7/29/11 9:20:30	21.05	-0.09	3.9	0.25	0.9	51260	
7/29/11 9:20:45	21.05	-0.09	3.9	0.26	0.9	50691	
7/29/11 9:21:00	21.05	-0.09	4.0	0.27	0.1	50721	
7/29/11 9:21:15	21.05	-0.09	3.8	0.25	0.2	50414	
7/29/11 9:21:30	21.05	-0.09	3.8	0.25	0.7	50714	
7/29/11 9:21:45	21.05	-0.09	3.7	0.25	0.8	50197	
7/29/11 9:22:00	21.05	-0.09	3.8	0.25	0.2	50404	
7/29/11 9:22:15	21.05	-0.09	3.6	0.25	0.1	50487	
7/29/11 9:22:30	21.05	-0.09	3.9	0.26	0.7	50605	
7/29/11 9:22:45	21.05	-0.09	3.7	0.25	0.9	50689	
7/29/11 9:23:00	21.05	-0.09	3.9	0.25	0.3	50202	
7/29/11 9:23:15	21.04	-0.09	3.9	0.25	0.0	49726	
7/29/11 9:23:30	21.05	-0.09	3.8	0.25	0.6	49810	
7/29/11 9:23:45	21.05	-0.09	3.7	0.25	0.9	49993	
7/29/11 9:24:00	21.05	-0.09	3.5	0.27	0.4	49982	
7/29/11 9:24:15	21.04	-0.09	3.5	0.25	-0.2	50111	
7/29/11 9:24:30	21.04	-0.09	3.6	0.25	0.3	50094	
7/29/11 9:24:45	21.05	-0.09	3.5	0.25	0.8	50105	
7/29/11 9:25:00	21.05	-0.09	3.4	0.25	0.6	49783	
7/29/11 9:25:15	21.05	-0.09	3.5	0.26	0.0	50045	
7/29/11 9:25:30	21.04	-0.09	3.7	0.25	0.4	49582	
7/29/11 9:25:45	21.05	-0.09	3.5	0.25	0.9	49581	
7/29/11 9:26:00	21.05	-0.09	3.5	0.26	0.8	49327	
7/29/11 9:26:15	21.05	-0.09	3.4	0.28	0.2	49393	
7/29/11 9:26:30	21.05	-0.09	3.4	0.26	0.2	49428	
7/29/11 9:26:45	21.05	-0.09	3.4	0.27	0.6	49143	
7/29/11 9:27:00	21.05	-0.09	3.4	0.25	0.9	49196	
7/29/11 9:27:15	21.05	-0.09	3.5	0.26	0.3	48717	
7/29/11 9:27:30	21.05	-0.08	3.4	0.26	0.0	48775	
7/29/11 9:27:45	21.05	-0.08	3.4	0.25	0.5	48441	
7/29/11 9:28:00	21.05	-0.08	3.4	0.27	1.0	48255	
7/29/11 9:28:15	21.05	-0.08	3.4	0.26	0.8	48401	
7/29/11 9:28:30	21.05	-0.08	3.5	0.25	0.1	48484	
7/29/11 9:28:45	21.05	-0.08	3.4	0.25	0.3	48313	
7/29/11 9:29:00	21.05	-0.08	3.2	0.25	0.8	48690	
7/29/11 9:29:15	21.05	-0.08	3.3	0.25	0.8	48414	
7/29/11 9:29:30	21.05	-0.08	3.3	0.25	0.2	48337	
7/29/11 9:29:45	21.05	-0.08	3.2	0.25	0.3	48089	
7/29/11 9:30:00	21.05	-0.08	3.3	0.25	0.9	48099	
7/29/11 9:30:15	21.05	-0.08	3.4	0.25	0.9	47983	
7/29/11 9:30:30	21.05	-0.09	3.5	0.25	0.4	47829	
7/29/11 9:30:45	21.05	-0.09	3.5	0.25	0.2	47976	
7/29/11 9:31:00	21.05	-0.09	3.1	0.25	0.8	48067	
7/29/11 9:31:15	21.05	-0.09	3.4	0.25	1.1	48091	
7/29/11 9:31:30	21.05	-0.09	3.4	0.25	0.6	48020	
7/29/11 9:31:45	21.05	-0.09	3.4	0.25	0.2	47857	
7/29/11 9:32:00	21.05	-0.09	3.4	0.25	0.5	48047	
7/29/11 9:32:15	21.05	-0.09	3.4	0.25	1.0	47871	
7/29/11 9:32:30	21.05	-0.09	3.3	0.25	1.0	47978	
7/29/11 9:32:45	21.05	-0.09	3.3	0.25	0.3	48053	
7/29/11 9:33:00	21.05	-0.09	3.1	0.25	0.4	47917	
7/29/11 9:33:15	21.05	-0.09	3.1	0.25	0.8	48213	
7/29/11 9:33:30	21.05	-0.09	3.2	0.25	0.8	48036	
7/29/11 9:33:45	21.05	-0.09	3.2	0.25	0.2	48013	
7/29/11 9:34:00	21.05	-0.09	3.0	0.25	0.2	48540	
7/29/11 9:34:15	21.05	-0.09	3.1	0.25	0.6	48076	
7/29/11 9:34:30	21.05	-0.09	3.0	0.25	0.8	47947	
7/29/11 9:34:45	21.05	-0.09	3.1	0.25	0.4	48211	
7/29/11 9:35:00	21.05	-0.09	3.3	0.27	0.1	47985	
7/29/11 9:35:15	21.05	-0.09	3.2	0.25	0.6	48123	
7/29/11 9:35:30	21.05	-0.09	3.1	0.25	1.0	48151	
7/29/11 9:35:45	21.05	-0.09	3.4	0.26	0.6	48464	
7/29/11 9:36:00	21.05	-0.09	3.3	0.25	0.1	48341	
7/29/11 9:36:15	21.05	-0.09	3.2	0.25	0.5	48625	

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
7/29/11 9:36:30	21.05	-0.09	3.1	0.25	0.9	48701		
7/29/11 9:36:45	21.05	-0.09	3.0	0.25	0.6	48701		
7/29/11 9:37:00	21.05	-0.09	3.2	0.27	0.1	48784		
7/29/11 9:37:15	21.05	-0.09	3.1	0.25	0.4	48800		
7/29/11 9:37:30	21.05	-0.09	2.8	0.26	0.9	48809		
7/29/11 9:37:45	21.05	-0.09	3.0	0.25	0.9	48979		
7/29/11 9:38:00	21.05	-0.09	2.9	0.25	0.1	48801		
7/29/11 9:38:15	21.05	-0.08	2.8	0.25	0.2	48956		
7/29/11 9:38:30	21.05	-0.08	3.0	0.25	0.6	48766		
7/29/11 9:38:45	21.05	-0.08	2.9	0.27	1.0	48966		
7/29/11 9:39:00	21.05	-0.08	2.8	0.25	1.9	48845		
7/29/11 9:39:15	21.05	-0.08	2.8	0.26	1.2	48843		
7/29/11 9:39:30	21.05	-0.08	2.8	0.25	0.2	49088		
7/29/11 9:39:45	21.05	-0.08	3.1	0.25	0.9	49069		
7/29/11 9:40:00	21.05	-0.08	2.9	0.25	0.5	48775		
7/29/11 9:40:15	21.05	-0.08	2.9	0.25	0.2	49062		
7/29/11 9:40:30	21.05	-0.08	2.8	0.25	0.5	48985		
7/29/11 9:40:45	21.06	-0.08	3.0	0.25	0.9	49277		
7/29/11 9:41:00	21.06	-0.08	2.8	0.25	0.8	49406		
7/29/11 9:41:15	21.06	-0.09	2.9	0.25	0.1	49342		
7/29/11 9:41:30	21.06	-0.08	3.0	0.25	0.2	49309		
7/29/11 9:41:45	21.06	-0.09	2.9	0.25	0.7	49261		
7/29/11 9:42:00	21.06	-0.09	2.8	0.25	0.8	49287		
7/29/11 9:42:15	21.06	-0.09	2.8	0.25	0.2	49853		
7/29/11 9:42:30	21.06	-0.09	2.6	0.25	0.0	58402		
7/29/11 9:42:45	21.06	-0.09	2.9	0.25	0.5	95280		
7/29/11 9:43:00	21.06	-0.09	2.6	0.25	0.7	80581		
7/29/11 9:43:15	21.06	-0.09	2.8	0.26	0.2	52193		
7/29/11 9:43:30	21.06	-0.09	2.8	0.25	0.0	53645		
7/29/11 9:43:45	21.06	-0.09	2.6	0.25	0.4	53528		
7/29/11 9:44:00	21.06	-0.09	2.6	0.25	0.8	53196		
7/29/11 9:44:15	21.07	-0.09	2.4	0.25	0.4	52444		
7/29/11 9:44:30	21.06	-0.09	2.9	0.25	-0.1	52149		
7/29/11 9:44:45	21.07	-0.09	2.9	0.25	0.2	51945		
7/29/11 9:45:00	21.06	-0.09	2.8	0.27	0.9	51335		
7/29/11 9:45:15	21.07	-0.09	2.7	0.26	0.7	51349		
7/29/11 9:45:30	21.07	-0.09	2.7	0.25	0.2	51125		
7/29/11 9:45:45	21.07	-0.09	2.5	0.25	0.2	50993		
7/29/11 9:46:00	21.07	-0.09	2.5	0.27	0.6	50958		
7/29/11 9:46:15	21.08	-0.09	2.5	0.25	0.8	51030		
7/29/11 9:46:30	21.08	-0.09	2.6	0.25	0.4	51258		
7/29/11 9:46:45	21.08	-0.09	2.7	0.27	0.3	51240		
7/29/11 9:47:00	21.09	-0.09	2.7	0.25	0.7	51015		
7/29/11 9:47:15	21.09	-0.09	2.7	0.25	1.1	50902		
7/29/11 9:47:30	21.10	-0.08	2.5	0.25	0.6	51053		
7/29/11 9:47:45	21.10	-0.08	2.5	0.26	0.1	51184		
7/29/11 9:48:00	21.11	-0.08	2.8	20.12	0.4	51407		
7/29/11 9:48:15	20.99	-0.08	3.6	19.96	0.9	51012		
7/29/11 9:48:30	15.64	-0.07	2.7	40.04	1.0	50549		
7/29/11 9:48:45	3.75	-0.08	1.8	43.23	0.2	50491		
7/29/11 9:49:00	0.34	-0.09	1.5	44.21	0.0	50273		
7/29/11 9:49:15	0.07	-0.09	1.6	44.67	0.6	50445	System Bias	
7/29/11 9:49:30	0.05	-0.09	1.5	**45.03**	**0.9**	50705	**NO_x Bias 2 Mid =**	**45.4**
7/29/11 9:49:45	0.05	-0.09	1.7	**45.29**	**0.3**	50375	**O_2 Bias 2 Zero =**	**0.044**
7/29/11 9:50:00	0.04	-0.09	1.6	**45.47**	**0.0**	50800	**CO_2 Bias 2 Zero =**	**-0.085**
7/29/11 9:50:15	0.04	-0.09	1.8	**45.62**	**0.5**	50742	**SO_2 Bias 2 Zero =**	**1.634**
7/29/11 9:50:30	0.04	-0.09	1.9	45.57	0.8	50995	**CO Bias 2 Zero =**	**0.40**
7/29/11 9:50:45	0.03	-0.09	7.2	95.17	0.3	50908		
7/29/11 9:51:00	0.52	-0.08	84.4	57.16	-0.2	50837		
7/29/11 9:51:15	1.41	-0.08	188.9	7.09	0.1	50835		
7/29/11 9:51:30	0.46	-0.08	234.7	2.56	0.3	51636	System Bias	
7/29/11 9:51:45	0.09	-0.08	**244.6**	2.13	0.0	52016	**SO_2 Bias 2 Mid =**	**244.4**
7/29/11 9:52:00	0.02	-0.08	**243.8**	1.91	-0.3	52026		
7/29/11 9:52:15	0.01	-0.08	**244.6**	1.74	0.2	51739		
7/29/11 9:52:30	0.01	-0.08	**244.8**	1.64	0.6	51737		
7/29/11 9:52:45	0.01	-0.08	246.6	1.53	0.6	51672		
7/29/11 9:53:00	0.01	-0.09	233.7	1.46	0.0	51658		
7/29/11 9:53:15	0.01	-0.09	222.5	1.40	-0.1	51965		
7/29/11 9:53:30	0.00	-0.09	180.9	1.34	0.4	51756		
7/29/11 9:53:45	0.00	-0.09	126.2	1.66	0.8	51746		
7/29/11 9:54:00	0.10	-0.09	59.4	2.94	1.1	51723		
7/29/11 9:54:15	3.63	0.04	33.6	1.00	10.9	51681		
7/29/11 9:54:30	6.04	1.59	5.3	0.93	29.4	51809		
7/29/11 9:54:45	5.31	3.62	2.7	0.91	41.6	51649	System Bias	
7/29/11 9:55:00	5.27	4.29	1.8	0.91	**45.3**	51836	**CO Bias 2 Mid =**	**46.2**
7/29/11 9:55:15	5.28	4.32	2.0	0.89	**45.6**	51575		
7/29/11 9:55:30	5.28	4.24	2.0	0.87	**46.3**	51629		
7/29/11 9:55:45	5.27	4.17	1.8	0.85	**47.4**	51589		
7/29/11 9:56:00	5.27	4.13	1.7	0.85	47.9	51527		
7/29/11 9:56:15	5.27	4.10	1.8	0.83	47.3	51391		
7/29/11 9:56:30	5.28	4.08	2.4	1.17	47.3	51250		
7/29/11 9:56:45	5.32	4.05	2.7	1.14	50.5	51111		
7/29/11 9:57:00	7.41	4.68	1.8	0.76	64.9	51291		
7/29/11 9:57:15	9.80	7.11	1.7	0.76	81.1	51183		
7/29/11 9:57:30	12.34	10.25	1.5	0.76	89.0	51411		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
7/29/11 9:57:45	12.41	10.57	1.6	0.76	90.3	51157		
7/29/11 9:58:00	12.42	10.75	1.6	0.74	90.2	51193		
7/29/11 9:58:15	12.43	10.85	1.3	0.75	89.2	51196		
7/29/11 9:58:30	12.44	10.91	1.5	0.75	88.4	51047		
7/29/11 9:58:45	12.44	10.94	1.6	0.73	88.8	51118		
7/29/11 9:59:00	12.44	10.95	1.4	0.73	89.2	50959		
7/29/11 9:59:15	12.44	10.96	1.5	0.73	88.8	50831		
7/29/11 9:59:30	12.44	10.96	1.6	0.71	87.6	50784		
7/29/11 9:59:45	12.37	10.86	1.4	0.71	84.8	50865		
7/29/11 10:00:00	11.76	10.31	1.5	0.70	82.0	50821		
7/29/11 10:00:15	11.43	10.12	1.3	0.71	80.7	50658		
7/29/11 10:00:30	11.40	10.10	1.4	0.70	79.5	49967		
7/29/11 10:00:45	11.39	10.10	1.4	0.70	79.4	50174		
7/29/11 10:01:00	11.39	10.10	1.6	0.70	80.0	50128		
7/29/11 10:01:15	11.39	10.10	1.7	0.70	80.4	50304		
7/29/11 10:01:30	11.32	10.10	1.7	0.70	79.8	49543		
7/29/11 10:01:45	11.22	10.10	1.6	0.69	79.3	49282		
7/29/11 10:02:00	11.22	10.01	1.4	0.71	79.8	49627		
7/29/11 10:02:15	11.22	9.73	1.5	0.68	80.3	49641		
7/29/11 10:02:30	11.22	9.73	1.3	0.69	80.1	49473		
7/29/11 10:02:45	11.22	9.73	1.5	0.68	79.6	49350		
7/29/11 10:03:00	11.22	9.73	1.4	0.67	79.8	49536		
7/29/11 10:03:15	11.22	9.73	1.4	0.67	80.3	49631		
7/29/11 10:03:30	11.22	9.73	1.5	0.67	80.2	49504		
7/29/11 10:03:45	11.22	9.73	1.3	0.67	79.5	49363		
7/29/11 10:04:00	11.22	9.73	1.2	0.67	79.6	49348		
7/29/11 10:04:15	11.22	9.73	1.5	0.67	80.3	49274		
7/29/11 10:04:30	11.22	9.73	1.5	0.67	80.4	49008		
7/29/11 10:04:45	11.22	9.74	1.7	0.66	79.6	48724		
7/29/11 10:05:00	11.22	9.73	1.7	0.67	79.5	48708		
7/29/11 10:05:15	11.22	9.74	1.5	0.64	80.3	49010	System Bias	
7/29/11 10:05:30	**11.22**	**9.74**	**1.3**	**0.64**	**80.5**	**48848**	**O_2 Bias 2 Mid =**	**11.22**
7/29/11 10:05:45	**11.22**	**9.74**	**1.2**	**0.64**	**79.7**	**48823**	**CO_2 Bias 2 Mid =**	**9.74**
7/29/11 10:06:00	**11.22**	**9.74**	**1.5**	**0.65**	**79.4**	**48821**	**NO_x Bias 2 Zero =**	**0.643**
7/29/11 10:06:15	**11.22**	**9.74**	**1.5**	**0.65**	**80.0**	**48763**		
7/29/11 10:06:30	11.22	9.74	1.5	0.64	80.5	48395		
7/29/11 10:06:45	11.22	9.74	1.5	0.64	79.9	48494		
7/29/11 10:07:00	11.22	9.74	1.7	0.64	79.3	48463		
7/29/11 10:07:15	11.22	9.74	1.5	0.64	79.9	48257		
7/29/11 10:07:30	11.22	9.74	1.5	0.64	80.5	48133		
7/29/11 10:07:45	11.22	9.74	1.2	0.64	79.9	47879		
7/29/11 10:08:00	11.22	9.73	1.4	0.65	79.1	47875		
7/29/11 10:08:15	11.22	9.72	2.2	0.74	77.6	47659		
7/29/11 10:08:30	11.47	9.45	2.7	0.74	65.3	47714		
7/29/11 10:08:45	12.70	4.93	2.8	0.74	39.0	47690		
7/29/11 10:09:00	17.98	1.80	9.7	0.79	17.9	47758		
7/29/11 10:09:15	19.63	1.08	18.1	0.87	13.2	47531		
	Stop							
8/1/11 11:12:00	0.04	-0.10	-1.3	0.25	0.9	10081	Calibration Error / System Bias	
8/1/11 11:12:15	**0.03**	**-0.09**	**-0.9**	**0.25**	**1.1**	**10191**	**O_2 Zero =**	**0.03**
8/1/11 11:12:30	**0.03**	**-0.09**	**-0.1**	**0.23**	**0.8**	**10132**	**CO_2 Zero =**	**-0.09**
8/1/11 11:12:45	**0.03**	**-0.09**	**-0.1**	**0.25**	**0.2**	**9979**	**SO_2 Zero =**	**-0.3**
8/1/11 11:13:00	**0.03**	**-0.09**	**-0.1**	**0.24**	**0.6**	**10351**	**NO_x Zero =**	**0.2**
8/1/11 11:13:15	0.02	-0.09	-0.1	2.34	1.0	9986	**CO Zero =**	**0.7**
8/1/11 11:13:30	0.02	-0.09	-0.1	3.54	1.1	10163		
8/1/11 11:13:45	0.03	-0.09	0.0	1.92	0.6	10153		
8/1/11 11:14:00	0.05	-0.09	0.3	0.57	-0.3	10495		
8/1/11 11:14:15	0.03	-0.09	0.3	0.47	-0.1	10424		
8/1/11 11:14:30	0.00	-0.09	0.1	0.46	0.7	10379		
8/1/11 11:14:45	-0.01	-0.09	-0.1	0.47	0.6	6976		
8/1/11 11:15:00	-0.02	-0.09	-0.1	0.46	0.1	13038		
8/1/11 11:15:15	-0.02	-0.09	-0.1	0.46	0.5	13068		
8/1/11 11:15:30	-0.02	-0.09	-0.1	0.47	0.9	13249		
8/1/11 11:15:45	-0.02	-0.09	-0.1	0.48	1.0	13432		
8/1/11 11:16:00	-0.02	-0.09	-0.2	0.44	0.4	13153		
8/1/11 11:16:15	-0.02	-0.09	-0.1	0.41	0.1	13202		
8/1/11 11:16:30	-0.02	-0.09	-0.1	0.53	0.6	13047		
8/1/11 11:16:45	-0.02	-0.09	-0.1	0.76	0.9	12972		
8/1/11 11:17:00	-0.02	-0.09	-0.1	2.91	1.1	13146		
8/1/11 11:17:15	-0.01	-0.09	-0.1	1.06	1.8	13034		
8/1/11 11:17:30	0.47	-0.05	0.0	0.55	7.9	13062		
8/1/11 11:17:45	1.69	0.38	0.0	0.48	14.0	13039		
8/1/11 11:18:00	2.17	1.17	0.0	0.56	28.2	12808		
8/1/11 11:18:15	6.23	6.64	-0.2	0.38	72.5	12873		
8/1/11 11:18:30	14.48	12.70	-0.2	0.37	100.0	12908		
8/1/11 11:18:45	19.89	16.48	-0.2	0.38	100.0	12928		
8/1/11 11:19:00	22.61	18.48	-0.2	0.38	100.0	12994		
8/1/11 11:19:15	23.32	19.05	-0.2	0.37	100.0	12603		
8/1/11 11:19:30	22.90	19.21	-0.2	0.37	100.0	13152		
8/1/11 11:19:45	22.82	19.31	-0.2	0.37	100.0	12741	Calibration Error / System Bias	
8/1/11 11:20:00	**22.83**	**19.61**	-0.1	0.37	100.0	13116	**O_2 Span =**	**22.8**
8/1/11 11:20:15	**22.83**	**19.63**	-0.1	0.36	100.0	12888	**CO_2 Span =**	**19.6**

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/1/11 11:20:30	**22.84**	**19.64**	-0.2	0.36	100.0	12876		
8/1/11 11:20:45	**22.84**	**19.64**	-0.2	0.35	100.0	13125		
8/1/11 11:21:00	22.69	19.26	-0.1	0.33	100.0	12795		
8/1/11 11:21:15	18.55	14.76	-0.2	0.34	100.0	13309		
8/1/11 11:21:30	13.10	10.73	-0.2	0.34	98.6	13406		
8/1/11 11:21:45	10.50	9.98	-0.2	0.39	91.9	12827		
8/1/11 11:22:00	11.05	9.73	-0.2	0.37	89.1	12639		
8/1/11 11:22:15	11.03	9.71	-0.2	0.35	89.4	12796		
8/1/11 11:22:30	11.03	9.71	-0.2	0.37	89.7	12873		
8/1/11 11:22:45	11.03	9.70	-0.2	0.37	89.1	12933	Calibration Error / System Bias	
8/1/11 11:23:00	**11.03**	**9.70**	-0.1	0.35	**88.5**	12611	O_2 Mid =	**11.03**
8/1/11 11:23:15	**11.03**	**9.70**	-0.2	0.37	**89.2**	12844	CO_2 Mid =	**9.70**
8/1/11 11:23:30	**11.03**	**9.70**	-0.2	0.37	**89.7**	12649	CO Span =	**89.2**
8/1/11 11:23:45	**11.04**	**9.70**	-0.2	0.37	**89.6**	12807		
8/1/11 11:24:00	11.04	9.70	-0.2	0.36	88.3	12826		
8/1/11 11:24:15	11.03	9.67	-0.2	0.40	82.8	12902		
8/1/11 11:24:30	8.61	7.00	-0.1	0.37	62.2	12688		
8/1/11 11:24:45	5.82	4.77	-0.1	0.37	51.1	12539		
8/1/11 11:25:00	5.11	4.36	-0.2	0.37	45.8	12744		
8/1/11 11:25:15	5.07	4.34	-0.2	0.35	45.0	12766	Calibration Error / System Bias	
8/1/11 11:25:30	5.07	4.34	-0.2	0.37	**45.5**	12789	CO Mid =	**45.6**
8/1/11 11:25:45	5.07	4.34	-0.2	0.35	**45.9**	12546		
8/1/11 11:26:00	5.07	4.34	-0.2	0.35	**45.9**	12397		
8/1/11 11:26:15	5.07	4.33	-0.2	0.36	**45.2**	12611		
8/1/11 11:26:30	5.07	4.34	-0.1	3.57	45.0	12645		
8/1/11 11:26:45	5.14	4.26	-0.2	49.03	38.1	12649		
8/1/11 11:27:00	4.10	2.69	-0.2	64.36	20.0	12630		
8/1/11 11:27:15	1.23	0.60	-0.1	86.87	7.6	12807		
8/1/11 11:27:30	0.18	0.02	0.0	90.23	1.1	12721		
8/1/11 11:27:45	0.05	-0.05	0.0	91.49	1.1	12749		
8/1/11 11:28:00	0.04	-0.06	-0.1	92.07	1.4	12720		
8/1/11 11:28:15	0.03	-0.06	-0.1	92.14	1.4	12555	Calibration Error / System Bias	
8/1/11 11:28:30	0.03	-0.07	-0.1	**90.56**	0.5	12620	NO_x Span =	**89.9**
8/1/11 11:28:45	0.02	-0.07	-0.2	**90.34**	0.8	12466		
8/1/11 11:29:00	0.02	-0.07	-0.2	**90.34**	1.3	12780		
8/1/11 11:29:15	0.02	-0.08	-0.1	**88.42**	1.4	12545		
8/1/11 11:29:30	0.02	-0.08	-0.2	51.69	1.0	12632	Calibration Error / System Bias	
8/1/11 11:29:45	0.02	-0.08	-0.1	**45.92**	0.7	12547	NO_x Mid =	**45.7**
8/1/11 11:30:00	0.01	-0.08	-0.1	**45.72**	1.0	12546		
8/1/11 11:30:15	0.01	-0.08	-0.2	**45.53**	1.3	12545		
8/1/11 11:30:30	0.01	-0.08	-0.2	**45.62**	1.4	12658		
8/1/11 11:30:45	0.01	-0.08	-0.2	45.07	0.7	12079		
8/1/11 11:31:00	0.01	-0.08	-0.2	86.05	1.4	12877		
8/1/11 11:31:15	0.33	0.13	-0.1	37.12	3.3	12694		
8/1/11 11:31:30	0.58	0.24	1.4	5.65	3.0	12500		
8/1/11 11:31:45	0.32	0.08	9.9	2.63	1.1	12663		
8/1/11 11:32:00	0.13	-0.02	34.2	1.95	0.5	12061		
8/1/11 11:32:15	-0.01	-0.08	206.5	1.65	1.2	12484		
8/1/11 11:32:30	-0.01	-0.09	179.5	1.54	0.4	12692		
8/1/11 11:32:45	-0.01	-0.09	174.4	1.47	0.4	12553		
8/1/11 11:33:00	-0.01	-0.09	173.4	1.41	0.9	12453		
8/1/11 11:33:15	-0.01	-0.09	172.2	1.35	1.4	12573		
8/1/11 11:33:30	-0.01	-0.09	170.2	1.31	1.1	12778		
8/1/11 11:33:45	-0.01	-0.09	168.7	1.27	0.4	12620		
8/1/11 11:34:00	-0.01	-0.09	168.3	1.23	0.7	12202		
8/1/11 11:34:15	-0.01	-0.09	176.5	1.20	1.3	12258	Calibration Error / System Bias	
8/1/11 11:34:30	-0.01	-0.09	**201.8**	1.16	1.3	12471	SO_2 Span =	**202.6**
8/1/11 11:34:45	-0.01	-0.09	**202.1**	1.14	0.5	12175		
8/1/11 11:35:00	-0.02	-0.09	**202.7**	1.12	0.4	12548		
8/1/11 11:35:15	-0.02	-0.09	**203.7**	4.77	1.1	12121		
8/1/11 11:35:30	-0.02	-0.09	205.3	21.56	1.3	12192		
8/1/11 11:35:45	-0.01	-0.08	206.4	1.50	0.9	12180		
8/1/11 11:36:00	0.00	-0.08	176.9	1.20	0.4	12632		
8/1/11 11:36:15	-0.01	-0.09	120.2	1.09	0.5	12509		
8/1/11 11:36:30	-0.02	-0.09	97.3	1.06	1.1	12135		
8/1/11 11:36:45	-0.02	-0.09	91.5	1.03	1.3	12412		
8/1/11 11:37:00	-0.02	-0.09	90.1	1.00	0.8	12309		
8/1/11 11:37:15	-0.02	-0.09	90.1	0.97	0.3	12255		
8/1/11 11:37:30	-0.02	-0.09	90.2	0.95	0.7	12206	Calibration Error / System Bias	
8/1/11 11:37:45	-0.02	-0.09	**99.9**	0.94	1.2	12427	SO_2 Mid =	**100.2**
8/1/11 11:38:00	-0.02	-0.09	**100.1**	0.93	1.2	12474		
8/1/11 11:38:15	-0.02	-0.09	**100.2**	0.91	0.6	11965		
8/1/11 11:38:30	-0.02	-0.09	**100.7**	0.95	0.5	12376		
8/1/11 11:38:45	-0.02	-0.09	101.2	1.33	0.9	13069		
8/1/11 11:39:00	0.17	-0.09	101.0	1.35	1.4	12317		
8/1/11 11:39:15	4.43	-0.05	96.0	1.15	1.2	12249		
8/1/11 11:39:30	9.60	-0.02	74.2	1.09	0.6	12292		
8/1/11 11:39:45	10.55	-0.01	57.6	2.89	0.8	11884		
8/1/11 11:40:00	12.85	0.00	50.4	0.96	-0.4	12152		
8/1/11 11:40:15	8.42	-0.03	46.3	0.85	-2.5	11971		
8/1/11 11:40:30	2.65	-0.06	40.4	0.81	-2.1	12435		
8/1/11 11:40:45	0.30	-0.08	20.3	0.87	-0.4	11952		
8/1/11 11:41:00	-0.06	-0.08	6.7	1.79	3.0	11999		
8/1/11 11:41:15	2.28	-0.07	2.3	1.16	14.0	11562		
8/1/11 11:41:30	13.65	-0.03	3.1	0.89	16.4	12029		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
8/1/11 11:41:45	20.00	-0.03	2.3	0.75	11.6	11824	
8/1/11 11:42:00	20.93	-0.04	0.9	0.69	9.3	11629	
8/1/11 11:42:15	20.98	-0.04	0.7	0.63	8.9	11963	
8/1/11 11:42:30	20.97	-0.04	0.4	0.61	9.0	11605	
8/1/11 11:42:45	20.97	-0.04	0.5	0.56	8.3	11420	
8/1/11 11:43:00	20.96	-0.04	0.4	0.53	7.8	12076	
8/1/11 11:43:15	20.95	-0.04	0.4	0.59	8.3	12081	
8/1/11 11:43:30	20.94	-0.04	0.4	0.72	8.6	12150	
8/1/11 11:43:45	20.89	-0.04	0.3	0.56	8.7	11558	
8/1/11 11:44:00	20.10	-0.04	-0.2	0.51	7.9	11571	
8/1/11 11:44:15	18.71	-0.04	-0.2	0.53	7.6	11766	
8/1/11 11:44:30	18.07	-0.04	-0.3	0.46	8.0	11763	
8/1/11 11:44:45	17.87	-0.04	0.0	0.46	8.2	11420	
8/1/11 11:45:00	17.81	-0.04	-0.2	0.46	7.9	15886	
8/1/11 11:45:15	17.78	-0.04	-0.5	0.45	7.4	15602	
8/1/11 11:45:30	17.76	-0.04	-0.4	0.43	7.6	11595	
8/1/11 11:45:45	17.75	-0.04	0.0	0.43	8.3	7249	
8/1/11 11:46:00	17.73	-0.04	0.0	0.45	8.4	13811	
8/1/11 11:46:15	17.71	-0.04	-0.2	0.41	7.4	12011	
8/1/11 11:46:30	17.71	-0.04	-0.1	0.41	7.3	10803	
8/1/11 11:46:45	17.71	-0.04	-0.3	0.39	7.8	111041	
8/1/11 11:47:00	17.70	-0.04	-0.5	0.31	7.5	11097	
8/1/11 11:47:15	18.07	-0.05	-0.5	0.29	4.5	10243	
8/1/11 11:47:30	19.67	-0.08	-0.2	0.31	2.2	9857	
8/1/11 11:47:45	20.26	-0.09	0.0	0.29	1.2	9873	
8/1/11 11:48:00	20.32	-0.09	-0.5	0.28	1.4	9672	
8/1/11 11:48:15	20.33	-0.09	-0.5	0.28	1.7	9784	
8/1/11 11:48:30	20.33	-0.09	-0.1	0.28	1.4	9699	
8/1/11 11:48:45	20.33	-0.09	-0.5	0.30	0.9	9807	
8/1/11 11:49:00	20.33	-0.09	-0.4	0.28	1.1	9778	
8/1/11 11:49:15	20.33	-0.09	-0.3	0.28	1.6	9720	
8/1/11 11:49:30	20.33	-0.09	-0.5	0.28	1.7	9679	
8/1/11 11:49:45	20.33	-0.09	-0.4	0.28	1.0	9842	
8/1/11 11:50:00	20.33	-0.09	-0.4	0.28	0.8	9645	
8/1/11 11:50:15	20.33	-0.09	-0.7	0.28	1.3	9791	
8/1/11 11:50:30	20.33	-0.09	-0.6	0.28	1.7	9581	
8/1/11 11:50:45	20.33	-0.10	-0.5	0.30	1.7	9877	
8/1/11 11:51:00	20.33	-0.10	-0.6	0.28	1.0	10422	
8/1/11 11:51:15	20.33	-0.10	-0.5	0.29	0.9	9709	
8/1/11 11:51:30	20.33	-0.10	-0.5	0.29	1.3	10035	
8/1/11 11:51:45	20.33	-0.10	-0.9	0.27	1.8	10215	
8/1/11 11:52:00	20.33	-0.10	-0.9	0.27	1.4	10164	
8/1/11 11:52:15	20.33	-0.10	-0.8	0.28	0.9	10257	
8/1/11 11:52:30	20.33	-0.10	-0.6	0.28	1.2	10340	
8/1/11 11:52:45	20.33	-0.10	-0.6	0.28	1.6	10014	
8/1/11 11:53:00	20.33	-0.10	-0.2	0.28	1.8	10223	
8/1/11 11:53:15	20.33	-0.10	-0.3	0.27	1.1	10311	
8/1/11 11:53:30	20.33	-0.10	-0.7	0.27	1.0	10624	
8/1/11 11:53:45	20.33	-0.10	-0.6	0.25	1.4	10194	
8/1/11 11:54:00	20.33	-0.10	-0.5	0.26	1.6	10347	
8/1/11 11:54:15	20.33	-0.10	-0.6	0.28	1.6	10078	
8/1/11 11:54:30	20.33	-0.10	-0.4	0.25	1.0	10102	
8/1/11 11:54:45	20.33	-0.10	-0.5	0.25	1.2	10556	
8/1/11 11:55:00	20.33	-0.10	-0.4	0.26	1.6	10246	
8/1/11 11:55:15	20.33	-0.10	-0.7	0.27	1.8	10312	
8/1/11 11:55:30	20.33	-0.10	-0.6	0.28	1.4	10510	
8/1/11 11:55:45	20.33	-0.10	-0.7	0.26	0.8	10587	
8/1/11 11:56:00	20.33	-0.10	-0.8	0.26	1.1	10543	
8/1/11 11:56:15	20.33	-0.10	-0.6	0.26	1.6	10500	
8/1/11 11:56:30	20.33	-0.10	-0.5	0.29	1.7	10494	
8/1/11 11:56:45	20.33	-0.09	-0.4	0.26	1.3	10298	
8/1/11 11:57:00	20.33	-0.09	-0.6	0.26	0.9	10127	
8/1/11 11:57:15	20.33	-0.09	-0.5	0.25	1.3	10352	
8/1/11 11:57:30	20.33	-0.09	-0.6	0.25	1.6	10155	
8/1/11 11:57:45	20.33	-0.09	-0.9	0.25	1.7	10679	
8/1/11 11:58:00	20.33	-0.09	-0.8	0.26	1.1	10348	
8/1/11 11:58:15	20.33	-0.09	-0.7	0.25	0.9	10320	
8/1/11 11:58:30	20.33	-0.09	-0.4	0.26	1.3	10309	
8/1/11 11:58:45	20.33	-0.09	-0.6	0.25	1.7	10072	
8/1/11 11:59:00	20.33	-0.09	-0.7	0.25	1.4	10477	
8/1/11 11:59:15	20.33	-0.09	-0.8	0.26	0.7	10958	
8/1/11 11:59:30	20.33	-0.09	-0.9	0.26	0.9	9931	
8/1/11 11:59:45	20.33	-0.09	-0.7	0.25	1.5	10682	
8/1/11 12:00:00	20.32	-0.09	-0.9	0.26	1.6	9994	
8/1/11 12:00:15	20.33	-0.09	-1.0	0.25	1.2	10723	
8/1/11 12:00:30	20.33	-0.09	-0.7	0.27	0.8	10498	
8/1/11 12:00:45	20.33	-0.09	-0.6	0.25	1.2	10172	
8/1/11 12:01:00	20.33	-0.10	-0.9	0.25	1.6	10550	
8/1/11 12:01:15	20.33	-0.10	-0.9	0.25	1.7	10633	
8/1/11 12:01:30	20.33	-0.10	-0.6	0.27	1.3	10378	
8/1/11 12:01:45	20.33	-0.10	-0.9	0.27	1.0	7852	
8/1/11 12:02:00	20.33	-0.10	-0.7	0.25	1.4	13328	
8/1/11 12:02:15	20.33	-0.10	-0.8	0.25	1.7	11562	
8/1/11 12:02:30	20.33	-0.10	-0.6	0.25	1.6	16047	
8/1/11 12:02:45	20.33	-0.10	-0.7	0.25	1.0	15251	

Houston Refining: Houston, Texas
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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/1/11 12:03:00	20.33	-0.10	-0.7	0.26	1.1	12399		
8/1/11 12:03:15	20.33	-0.10	-0.9	0.26	1.5	9894		
8/1/11 12:03:30	20.33	-0.10	-0.9	0.26	1.9	11998		
8/1/11 12:03:45	20.33	-0.10	-0.7	0.26	1.4	9920		
8/1/11 12:04:00	20.33	-0.10	-0.7	0.27	0.9	13426		
8/1/11 12:04:15	20.33	-0.10	-0.8	0.26	1.1	16097		
8/1/11 12:04:30	20.33	-0.10	-0.9	0.25	1.6	16478		
8/1/11 12:04:45	20.33	-0.10	-0.9	0.25	1.6	17358		
8/1/11 12:05:00	20.33	-0.10	-0.8	0.25	1.0	12974		
8/1/11 12:05:15	20.33	-0.10	-0.9	0.25	0.8	18240		
8/1/11 12:05:30	20.33	-0.10	-1.0	0.25	1.3	14887		
8/1/11 12:05:45	20.33	-0.10	-0.9	0.25	1.5	19161		
8/1/11 12:06:00	20.32	-0.10	-0.7	0.26	1.5	19013		
8/1/11 12:06:15	20.32	-0.10	-0.8	0.25	0.9	18350		
8/1/11 12:06:30	20.32	-0.10	-0.8	0.25	0.9	19170		
8/1/11 12:06:45	20.33	-0.10	-0.7	0.26	1.3	18272		
8/1/11 12:07:00	20.33	-0.10	-0.6	0.26	1.7	18861		
8/1/11 12:07:15	20.35	-0.09	-0.9	0.27	1.4	15896		
8/1/11 12:07:30	20.35	-0.09	-0.9	0.26	0.7	15658		
8/1/11 12:07:45	20.35	-0.09	-0.7	0.60	0.9	32604		
8/1/11 12:08:00	20.35	-0.09	-1.0	2.28	1.5	42931		
8/1/11 12:08:15	20.31	-0.09	-0.9	2.79	1.8	46746		
8/1/11 12:08:30	20.16	-0.09	-0.9	2.87	1.3	45390		
8/1/11 12:08:45	20.07	-0.09	-0.8	2.86	0.9	45141		
8/1/11 12:09:00	20.04	-0.09	-0.7	2.83	1.2	38074		
8/1/11 12:09:15	20.04	-0.09	-0.7	2.26	1.6	34206		
8/1/11 12:09:30	20.05	-0.09	-1.0	2.10	1.7	38706		
8/1/11 12:09:45	20.09	-0.09	-0.9	2.04	1.1	35513		
8/1/11 12:10:00	20.13	-0.09	-0.8	1.90	1.0	39798		
8/1/11 12:10:15	20.12	-0.09	-1.2	3.83	1.5	446767		
8/1/11 12:10:30	20.04	-0.09	-0.9	0.64	1.8	356238		
8/1/11 12:10:45	19.74	-0.09	-0.8	0.36	1.7	345544		
8/1/11 12:11:00	19.62	-0.09	-0.7	0.33	0.9	344350		
8/1/11 12:11:15	19.59	-0.09	-0.9	0.31	1.0	344206		
8/1/11 12:11:30	19.59	-0.09	-0.9	0.29	1.5	375793		
8/1/11 12:11:45	19.59	-0.10	-0.7	0.28	1.0	216479		
8/1/11 12:12:00	19.59	-0.10	-0.7	0.28	1.0	213998		
8/1/11 12:12:15	19.59	-0.10	-1.0	0.30	1.4	213045		
8/1/11 12:12:30								
8/1/11 12:12:45	19.59	-0.09	-1.2	0.30	1.4	4247		
8/1/11 12:13:00								
8/1/11 12:13:15								
8/1/11 12:13:30								
8/1/11 12:13:45								
8/1/11 12:14:00								
8/1/11 12:14:15								
8/1/11 12:14:30								
8/1/11 12:14:45								
8/1/11 12:15:00								
8/1/11 12:15:15								
8/1/11 12:15:30								
8/1/11 12:15:45								
8/1/11 12:16:00								
8/1/11 12:16:15								
8/1/11 12:16:30								
8/1/11 12:16:45								
8/1/11 12:17:00								
8/1/11 12:17:15							Calibration Error / System Bias	
8/1/11 12:17:30	20.16	-0.10	-1.0	1.18	1.7	**817**	C_3H_8 Zero =	**856.6**
8/1/11 12:17:45	20.18	-0.10	-0.9	1.19	1.8	**873**		
8/1/11 12:18:00	20.19	-0.10	-1.1	1.19	1.3	**874**		
8/1/11 12:18:15	20.19	-0.10	-1.2	1.20	0.9	**863**		
8/1/11 12:18:30	20.19	-0.10	-1.4	1.21	1.3	941		
8/1/11 12:18:45	20.19	-0.10	-1.4	1.22	1.9	860		
8/1/11 12:19:00	20.19	-0.10	-1.5	1.15	1.7	8020		
8/1/11 12:19:15	20.19	-0.10	-1.2	0.81	1.0	35784		
8/1/11 12:19:30	20.19	-0.10	-1.1	0.38	0.8	34296		
8/1/11 12:19:45	20.11	-0.10	-1.1	0.29	1.2	52092		
8/1/11 12:20:00	19.94	-0.10	-1.0	0.28	1.7	65312		
8/1/11 12:20:15	19.91	-0.10	-1.0	0.28	1.6	65027		
8/1/11 12:20:30								
8/1/11 12:20:45	19.92	-0.10	-1.2	0.28	1.0	164903		
8/1/11 12:21:00	19.92	-0.10	-1.4	0.28	1.6	170970		
8/1/11 12:21:15	19.92	-0.10	-1.5	0.26	1.8	210584		
8/1/11 12:21:30	19.92	-0.10	-1.3	0.25	1.3	180951		
8/1/11 12:21:45	19.88	-0.10	-1.2	0.26	1.3	100183		
8/1/11 12:22:00	19.91	-0.10	-0.9	0.26	1.5	100717		
8/1/11 12:22:15	19.92	-0.10	-1.2	0.25	1.4	97961		
8/1/11 12:22:30	19.92	-0.10	-1.3	0.25	0.6	99623		
8/1/11 12:22:45	19.92	-0.10	-1.5	0.25	0.7	96785		
8/1/11 12:23:00	19.92	-0.10	-1.5	0.25	1.2	91403		
8/1/11 12:23:15	19.92	-0.10	-1.4	0.25	1.6	92197	Calibration Error / System Bias	
8/1/11 12:23:30	19.92	-0.10	-1.2	0.25	1.5	**90832**	C_3H_8 mid =	**90976.1**
8/1/11 12:23:45	19.92	-0.10	-1.3	0.25	0.8	**90705**		
8/1/11 12:24:00	19.92	-0.10	-1.5	0.25	0.8	**92213**		

Houston Refining: Houston, Texas
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ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/1/11 12:24:15	19.92	-0.10	-1.5	0.25	1.3	**90155**		
8/1/11 12:24:30	19.92	-0.10	-1.4	0.25	1.6	92873		
8/1/11 12:24:45	19.92	-0.10	-1.2	0.25	1.3	91569		
8/1/11 12:25:00	19.93	-0.10	-1.4	0.25	0.7	92465		
8/1/11 12:25:15	19.92	-0.10	-1.6	0.26	1.0	53869		
8/1/11 12:25:30	19.92	-0.10	-1.5	0.26	1.4	61068		
8/1/11 12:25:45	19.94	-0.10	-1.3	0.31	1.8	109560		
8/1/11 12:26:00	19.95	-0.07	-1.7	0.30	1.3	10190		
8/1/11 12:26:15	19.48	-0.07	-1.5	0.32	0.7	7069		
8/1/11 12:26:30	19.72	-0.08	-1.1	0.34	1.0	7477		
8/1/11 12:26:45	19.49	-0.06	-1.4	0.37	1.5	7274		
8/1/11 12:27:00	18.59	-0.05	-1.6	0.51	1.8	6689		
8/1/11 12:27:15	18.30	-0.04	-1.2	0.36	1.4	7234		
8/1/11 12:27:30	18.30	-0.04	-1.3	0.33	1.2	137238		
8/1/11 12:27:45	18.31	-0.04	-1.2	0.26	1.3	132810		
8/1/11 12:28:00	18.47	-0.06	-1.8	0.27	1.8	129993		
8/1/11 12:28:15	19.41	-0.09	-1.6	0.25	1.9	200325		
8/1/11 12:28:30	19.81	-0.09	-1.4	0.25	1.0	202253		
8/1/11 12:28:45	19.85	-0.10	-1.8	0.25	0.8	197747		
8/1/11 12:29:00	19.86	-0.10	-1.4	0.25	1.3	169324		
8/1/11 12:29:15	19.86	-0.10	-1.4	0.27	1.6	173104		
8/1/11 12:29:30	19.87	-0.10	-1.5	0.25	1.5	175976	Calibration Error / System Bias	
8/1/11 12:29:45	19.87	-0.10	-1.4	0.25	0.8	**178061**	C_3H_8 Span =	**179615.3**
8/1/11 12:30:00	19.87	-0.10	-1.0	0.25	0.9	**179791**		
8/1/11 12:30:15	19.87	-0.10	-1.5	0.25	1.3	**179637**		
8/1/11 12:30:30	19.87	-0.10	-1.4	0.25	1.6	**180971**		
8/1/11 12:30:45	19.87	-0.10	-1.2	0.25	1.3	181336		
8/1/11 12:31:00	19.87	-0.10	-1.2	0.25	0.7	181113		
8/1/11 12:31:15	19.87	-0.10	-1.4	0.25	0.8	180670		
8/1/11 12:31:30	19.87	-0.10	-1.4	0.25	1.2	177030		
8/1/11 12:31:45	19.87	-0.10	-1.3	0.25	1.5	110144		
8/1/11 12:32:00	19.88	-0.10	-1.4	0.25	1.3	102561		
8/1/11 12:32:15	19.88	-0.10	-1.6	0.25	0.6	101594		
8/1/11 12:32:30	19.87	-0.10	-1.7	0.25	0.9	101127		
8/1/11 12:32:45	19.87	-0.10	-1.7	0.25	1.4	94667		
8/1/11 12:33:00	19.87	-0.10	-1.8	0.26	1.7	89134		
8/1/11 12:33:15	19.87	-0.11	-1.6	0.26	1.2	83872		
8/1/11 12:33:30	19.87	-0.10	-1.6	0.24	0.7	86331		
8/1/11 12:33:45	19.87	-0.10	-1.5	0.25	1.1	89367		
8/1/11 12:34:00	19.87	-0.10	-1.4	0.25	1.7	89819		
8/1/11 12:34:15	19.87	-0.10	-1.8	0.25	1.7	89790		
8/1/11 12:34:30	19.87	-0.10	-1.8	0.25	1.0	89200		
8/1/11 12:34:45	19.87	-0.10	-1.6	0.26	0.8	89089		
8/1/11 12:35:00	19.87	-0.10	-1.4	0.25	1.2	88792		
8/1/11 12:35:15	19.87	-0.10	-1.3	0.25	1.5	87043		
8/1/11 12:35:30	19.87	-0.10	-1.7	0.25	1.7	78271		
8/1/11 12:35:45	19.87	-0.10	-1.6	0.25	1.1	82340		
8/1/11 12:36:00	19.87	-0.10	-1.6	0.25	0.8	98117		
8/1/11 12:36:15	19.87	-0.10	-1.8	0.25	1.3	109475		
8/1/11 12:36:30	19.87	-0.10	-2.0	0.25	1.8	91739		
8/1/11 12:36:45	19.87	-0.10	-2.0	0.25	1.6	63190		
8/1/11 12:37:00	19.88	-0.10	-1.9	0.25	1.0	44464	Calibration Error / System Bias	
8/1/11 12:37:15	19.88	-0.10	-2.1	0.25	1.0	**43935**	C_3H_8 Low =	**43480.0**
8/1/11 12:37:30	19.87	-0.10	-1.9	0.25	1.4	**43767**		
8/1/11 12:37:45	19.87	-0.10	-1.6	0.25	1.7	**43447**		
8/1/11 12:38:00	19.87	-0.10	-1.8	0.27	1.4	**42771**		
8/1/11 12:38:15	19.87	-0.10	-1.7	0.25	0.9	42480		
8/1/11 12:38:30	19.88	-0.10	-1.7	0.25	0.8	42332		
8/1/11 12:38:45	19.88	-0.10	-1.9	0.27	1.2	42267		
8/1/11 12:39:00	19.88	-0.10	-1.8	0.26	1.5	41885		
8/1/11 12:39:15	19.88	-0.10	-1.7	0.47	1.5	41233		
8/1/11 12:39:30	19.89	-0.10	-1.7	0.64	0.7	43236		
8/1/11 12:39:45	19.97	-0.10	-1.4	0.65	0.8	37135		
8/1/11 12:40:00	20.08	-0.10	-1.6	0.62	1.3	43759		
8/1/11 12:40:15	20.11	-0.10	-1.8	0.76	1.5	48418		
8/1/11 12:40:30	20.13	-0.10	-1.9	0.77	1.3	49665		
8/1/11 12:40:45	20.09	-0.10	-1.7	0.73	0.7	44336		
8/1/11 12:41:00	20.07	-0.10	-1.9	0.74	1.1	43389		
8/1/11 12:41:15	20.08	-0.10	-1.9	0.70	1.6	42601		
8/1/11 12:41:30	20.09	-0.10	-2.0	0.83	1.6	62481		
8/1/11 12:41:45	20.10	-0.10	-2.0	0.98	1.2	62649		
8/1/11 12:42:00	20.07	-0.10	-1.7	0.97	0.6	61979		
8/1/11 12:42:15	20.01	-0.10	-1.6	0.97	1.0	61792		
8/1/11 12:42:30	19.99	-0.10	-1.8	0.99	1.4	61512		
8/1/11 12:42:45	20.00	-0.10	-1.7	0.99	1.7	61128	Begin Run 8	
8/1/11 12:43:00	**20.00**	**-0.10**	**-1.7**	**0.97**	**1.2**	**60897**		
8/1/11 12:43:15	**20.00**	**-0.11**	**-1.3**	**0.98**	**0.7**	**60761**		
8/1/11 12:43:30	**20.00**	**-0.11**	**-1.7**	**0.98**	**1.1**	**60369**		
8/1/11 12:43:45	**20.00**	**-0.11**	**-1.9**	**0.97**	**1.7**	**60090**		
8/1/11 12:44:00	**20.00**	**-0.11**	**-1.8**	**0.97**	**1.8**	**59648**		
8/1/11 12:44:15	**20.00**	**-0.11**	**-1.8**	**0.98**	**1.2**	**59409**		
8/1/11 12:44:30	**20.00**	**-0.11**	**-1.7**	**0.98**	**0.9**	**59059**		
8/1/11 12:44:45	**20.01**	**-0.10**	**-1.8**	**0.97**	**1.4**	**58634**		
8/1/11 12:45:00	**20.01**	**-0.11**	**-2.0**	**0.97**	**1.7**	**58049**		
8/1/11 12:45:15	**20.01**	**-0.10**	**-2.1**	**0.98**	**1.8**	**57843**		

Houston Refining: Houston, Texas
736 Coker
ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
8/1/11 12:45:30	20.01	-0.10	-1.7	0.97	1.1	57359	
8/1/11 12:45:45	20.01	-0.10	-1.9	0.97	1.0	57086	
8/1/11 12:46:00	20.02	-0.10	-2.0	0.97	1.4	56447	
8/1/11 12:46:15	20.02	-0.10	-1.9	0.97	1.8	55957	
8/1/11 12:46:30	20.02	-0.10	-1.9	0.97	1.7	55676	
8/1/11 12:46:45	20.02	-0.10	-2.0	0.95	1.0	43130	
8/1/11 12:47:00	20.02	-0.10	-2.4	0.62	0.8	11503	
8/1/11 12:47:15	20.03	-0.10	-2.0	0.51	1.5	155109	
8/1/11 12:47:30	20.16	-0.10	-2.2	1.51	5.5	60139	
8/1/11 12:47:45	20.23	-0.09	-1.7	0.37	15.3	18692	
8/1/11 12:48:00	20.05	-0.06	1.3	0.31	14.6	16231	
8/1/11 12:48:15	20.20	-0.09	0.9	0.30	6.7	15744	
8/1/11 12:48:30	20.29	-0.10	-1.1	0.30	3.0	14877	
8/1/11 12:48:45	20.30	-0.10	-1.4	0.28	2.6	14465	
8/1/11 12:49:00	20.30	-0.10	-1.8	0.29	2.8	13222	
8/1/11 12:49:15	20.30	-0.10	-2.0	0.28	2.0	13231	
8/1/11 12:49:30	20.30	-0.10	-1.8	0.28	1.8	12659	
8/1/11 12:49:45	20.30	-0.10	-1.7	0.30	2.1	12469	
8/1/11 12:50:00	20.30	-0.10	-2.2	0.28	2.4	11885	
8/1/11 12:50:15	20.30	-0.10	-2.2	0.28	2.2	13079	
8/1/11 12:50:30	20.31	-0.10	-2.2	0.30	1.8	12814	
8/1/11 12:50:45	20.31	-0.10	-2.1	0.28	1.6	12651	
8/1/11 12:51:00	20.30	-0.10	-1.8	0.28	2.0	12912	
8/1/11 12:51:15	20.30	-0.10	-2.1	0.29	2.5	11937	
8/1/11 12:51:30	20.31	-0.10	-2.4	0.28	2.5	11720	
8/1/11 12:51:45	20.30	-0.10	-2.2	0.28	1.9	11755	
8/1/11 12:52:00	20.31	-0.10	-2.4	0.28	1.5	11609	
8/1/11 12:52:15	20.31	-0.10	-2.2	0.28	1.9	11644	
8/1/11 12:52:30	20.31	-0.10	-2.1	0.28	2.2	11427	
8/1/11 12:52:45	20.31	-0.10	-2.1	0.28	2.2	10824	
8/1/11 12:53:00	20.31	-0.11	-2.4	0.28	1.5	10854	
8/1/11 12:53:15	20.31	-0.11	-2.4	0.28	1.4	10647	
8/1/11 12:53:30	20.31	-0.11	-2.4	0.28	1.8	10462	
8/1/11 12:53:45	20.31	-0.11	-2.3	0.27	2.1	10920	
8/1/11 12:54:00	20.31	-0.11	-2.2	0.28	2.2	11044	
8/1/11 12:54:15	20.31	-0.11	-2.1	0.28	1.7	11191	
8/1/11 12:54:30	20.31	-0.11	-2.1	0.28	1.4	11267	
8/1/11 12:54:45	20.31	-0.11	-2.3	0.28	1.8	11123	
8/1/11 12:55:00	20.30	-0.11	-2.0	0.28	2.1	11396	
8/1/11 12:55:15	20.30	-0.11	-2.2	0.28	2.2	11333	
8/1/11 12:55:30	20.31	-0.11	-2.2	0.28	1.4	10532	
8/1/11 12:55:45	20.30	-0.11	-2.2	0.28	1.3	10824	
8/1/11 12:56:00	20.31	-0.11	-2.2	0.28	1.7	10714	
8/1/11 12:56:15	20.31	-0.11	-2.4	0.30	2.1	10683	
8/1/11 12:56:30	20.31	-0.11	-2.5	0.28	2.0	10426	
8/1/11 12:56:45	20.31	-0.11	-2.5	0.28	1.6	10103	
8/1/11 12:57:00	20.31	-0.11	-2.2	0.29	1.3	9865	
8/1/11 12:57:15	20.31	-0.11	-2.3	0.28	1.6	9606	
8/1/11 12:57:30	20.31	-0.10	-2.7	0.29	1.8	9357	
8/1/11 12:57:45	20.31	-0.10	-2.6	0.28	1.8	9356	
8/1/11 12:58:00	20.31	-0.10	-2.4	0.28	1.1	9317	
8/1/11 12:58:15	20.31	-0.10	-2.6	0.28	1.1	9240	
8/1/11 12:58:30	20.31	-0.10	-2.4	0.29	1.4	9363	
8/1/11 12:58:45	20.31	-0.10	-2.3	0.28	1.9	9110	
8/1/11 12:59:00	20.31	-0.10	-2.6	0.28	1.9	8932	
8/1/11 12:59:15	20.31	-0.10	-2.5	0.28	1.3	9054	
8/1/11 12:59:30	20.31	-0.10	-2.6	0.28	1.0	8863	
8/1/11 12:59:45	20.31	-0.10	-2.4	0.28	1.4	8690	
8/1/11 13:00:00	20.31	-0.10	-2.3	0.27	1.8	8721	
8/1/11 13:00:15	20.31	-0.10	-2.2	0.27	1.8	8535	
8/1/11 13:00:30	20.31	-0.10	-2.6	0.28	1.5	8436	End Run 8
8/1/11 13:00:45	20.31	-0.10	-2.5	0.28	1.1	8577	
8/1/11 13:01:00	20.31	-0.10	-2.6	0.28	1.4	8550	
8/1/11 13:01:15	20.30	-0.10	-2.6	0.28	1.8	8170	
8/1/11 13:01:30	20.31	-0.10	-2.7	0.28	1.9	8638	
8/1/11 13:01:45	20.31	-0.10	-2.5	0.27	1.1	8274	
8/1/11 13:02:00	20.31	-0.10	-2.6	0.26	1.0	8860	
8/1/11 13:02:15	20.31	-0.10	-2.2	0.28	1.6	8533	
8/1/11 13:02:30	20.30	-0.10	-2.4	0.26	1.9	8578	
8/1/11 13:02:45	20.31	-0.10	-2.4	0.25	1.7	8547	
8/1/11 13:03:00	20.31	-0.10	-2.5	0.25	1.0	8312	
8/1/11 13:03:15	20.30	-0.10	-2.6	0.27	1.1	8316	
8/1/11 13:03:30	20.30	-0.11	-2.4	0.25	1.5	8214	
8/1/11 13:03:45	20.30	-0.11	-2.7	0.28	1.7	7935	
8/1/11 13:04:00	20.31	-0.11	-2.6	0.27	1.6	7655	
8/1/11 13:04:15	20.31	-0.11	-2.7	0.25	1.0	7727	
8/1/11 13:04:30	20.30	-0.11	-2.5	0.25	1.0	7409	
8/1/11 13:04:45	20.30	-0.11	-2.6	0.25	1.4	7323	
8/1/11 13:05:00	20.30	-0.11	-2.3	0.25	1.6	7225	
8/1/11 13:05:15	20.30	-0.11	-2.4	0.25	1.7	7223	
8/1/11 13:05:30	20.30	-0.11	-2.6	0.27	1.0	7799	
8/1/11 13:05:45	20.31	-0.11	-2.7	0.25	0.9	8045	
8/1/11 13:06:00	20.31	-0.11	-2.7	0.25	1.2	8492	
8/1/11 13:06:15	20.31	-0.11	-2.7	0.26	1.6	8700	
8/1/11 13:06:30	20.31	-0.11	-2.7	0.26	1.6	7387	

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/1/11 13:06:45	20.31	-0.11	-2.7	0.25	0.8	6826		
8/1/11 13:07:00	20.30	-0.11	-2.6	0.25	0.8	6604		
8/1/11 13:07:15	20.31	-0.11	-2.6	0.26	1.2	6613		
8/1/11 13:07:30	20.31	-0.11	-2.4	0.25	1.4	6576		
8/1/11 13:07:45	20.31	-0.11	-2.7	0.25	1.4	6573		
8/1/11 13:08:00	20.31	-0.11	-3.2	0.26	0.9	6598		
8/1/11 13:08:15	20.31	-0.11	-3.3	0.28	1.0	6526		
8/1/11 13:08:30	20.31	-0.11	-2.9	0.25	1.3	6565		
8/1/11 13:08:45	20.31	-0.10	-2.7	0.25	1.5	6478		
8/1/11 13:09:00	20.31	-0.10	-2.7	0.25	1.5	6538		
8/1/11 13:09:15	20.31	-0.10	-2.7	0.26	0.9	6635		
8/1/11 13:09:30	20.31	-0.10	-2.6	0.25	0.8	6624		
8/1/11 13:09:45	20.31	-0.10	-2.6	0.25	1.3	6569		
8/1/11 13:10:00	20.31	-0.10	-2.8	0.25	1.6	6552		
8/1/11 13:10:15	20.31	-0.10	-2.7	0.26	1.6	6470		
8/1/11 13:10:30	20.31	-0.10	-3.0	0.25	1.1	15772		
8/1/11 13:10:45	20.31	-0.10	-3.2	0.25	0.8	12863		
8/1/11 13:11:00	20.30	-0.10	-2.9	0.25	1.3	6201	System Bias	
8/1/11 13:11:15	20.15	-0.10	-2.7	0.25	1.6	**5918**	C_3H_8 Zero =	5870.0
8/1/11 13:11:30	19.99	-0.10	-2.9	0.25	1.7	**5931**		
8/1/11 13:11:45	19.93	-0.10	-2.9	0.25	1.2	**5829**		
8/1/11 13:12:00	19.91	-0.10	-2.7	0.25	0.7	**5802**		
8/1/11 13:12:15	19.90	-0.10	-2.8	0.25	1.0	5768		
8/1/11 13:12:30	19.89	-0.10	-3.0	0.25	1.3	5747		
8/1/11 13:12:45	19.88	-0.10	-2.8	0.25	1.7	5892		
8/1/11 13:13:00	19.87	-0.10	-2.9	0.25	1.4	14115		
8/1/11 13:13:15	19.87	-0.11	-3.1	0.29	0.6	36126		
8/1/11 13:13:30	19.86	-0.11	-3.0	0.44	0.8	43138	System Bias	
8/1/11 13:13:45	19.85	-0.11	-2.9	0.28	1.4	**43556**	C_3H_8 Low =	44240.2
8/1/11 13:14:00	19.85	-0.11	-3.1	0.26	1.6	**44175**		
8/1/11 13:14:15	19.84	-0.11	-2.9	0.25	1.4	**44433**		
8/1/11 13:14:30	19.84	-0.11	-2.9	0.25	0.7	**44797**		
8/1/11 13:14:45	19.83	-0.11	-2.8	0.25	0.8	45177		
8/1/11 13:15:00	19.83	-0.11	-2.7	0.25	1.2	44997		
8/1/11 13:15:15	19.83	-0.11	-3.2	0.25	1.4	45534		
8/1/11 13:15:30	19.83	-0.11	-3.4	0.25	1.5	45718		
8/1/11 13:15:45	19.83	-0.11	-3.4	0.25	1.0	45953		
8/1/11 13:16:00	19.82	-0.11	-3.4	0.26	0.5	30253		
8/1/11 13:16:15	15.73	2.85	-3.2	0.27	-1.8	38733		
8/1/11 13:16:30	11.91	1.25	-3.1	0.34	-1.3	23174		
8/1/11 13:16:45	3.55	0.30	-3.2	0.99	-0.3	9705		
8/1/11 13:17:00	0.41	0.08	-2.9	0.77	-0.3	7439		
8/1/11 13:17:15	0.10	0.05	-2.9	0.13	-0.3	6954		
8/1/11 13:17:30	0.06	0.04	-3.1	0.17	-1.0	6633		
8/1/11 13:17:45	0.05	0.04	-2.9	0.20	-1.3	6595		
8/1/11 13:18:00	0.04	0.04	-3.1	0.21	-0.5	6385		
8/1/11 13:18:15	0.03	0.03	-3.1	0.21	-0.3	6340		
8/1/11 13:18:30	0.03	0.03	-3.4	0.23	-0.2	6346		
8/1/11 13:18:45	0.02	0.03	-3.4	0.23	-0.8	6314		
8/1/11 13:19:00	0.02	0.03	-3.4	0.24	-1.3	6173		
8/1/11 13:19:15	0.02	0.03	-3.3	0.28	-1.3	23050		
8/1/11 13:19:30	0.02	0.03	-3.5	0.58	-1.3	6892		
8/1/11 13:19:45	0.02	0.03	-3.3	0.08	-0.8	6130		
8/1/11 13:20:00	0.02	0.03	-3.5	0.24	-0.3	6056		
8/1/11 13:20:15	0.02	0.29	-3.3	0.34	-0.8	5974		
8/1/11 13:20:30	0.02	0.90	-3.5	0.38	-1.3	6009	System Bias	
8/1/11 13:20:45	**0.02**	**0.40**	**-3.1**	**0.44**	**-1.3**	**5945**	O_2 Zero =	0.02
8/1/11 13:21:00	**0.02**	**0.07**	**-3.3**	**0.45**	**-1.3**	**5899**	CO_2 Zero =	0.13
8/1/11 13:21:15	**0.02**	**0.03**	**-3.6**	**0.39**	**-1.3**	**5893**	SO_2 Zero =	-3.4
8/1/11 13:21:30	**0.02**	**0.02**	**-3.6**	**0.32**	**-1.3**	**5940**	NO_x Zero =	0.4
8/1/11 13:21:45	0.02	0.02	-3.5	0.49	-1.3	5898	CO Zero =	-1.3
8/1/11 13:22:00	0.00	0.02	-3.5	0.98	-0.5	5944		
8/1/11 13:22:15	0.00	0.02	-3.2	0.26	-0.3	5926		
8/1/11 13:22:30	0.00	0.02	-3.2	0.54	-1.0	5936		
8/1/11 13:22:45	0.00	0.02	-3.4	0.61	-1.3	5937		
8/1/11 13:23:00	0.00	0.02	-3.4	0.11	-1.3	5924		
8/1/11 13:23:15	0.00	0.02	-3.6	0.64	-1.3	6029		
8/1/11 13:23:30	0.28	0.12	-3.7	0.14	-0.5	6106		
8/1/11 13:23:45	5.01	1.37	-3.5	0.48	23.5	6151		
8/1/11 13:24:00	8.66	5.27	-3.5	0.65	57.4	6095		
8/1/11 13:24:15	10.17	8.11	-3.5	0.08	88.7	6015		
8/1/11 13:24:30	10.84	8.97	-3.4	0.58	96.1	5911		
8/1/11 13:24:45	10.90	8.99	-3.3	0.40	98.9	5849		
8/1/11 13:25:00	10.91	9.04	-3.5	0.44	98.9	5874		
8/1/11 13:25:15	10.94	9.16	-3.7	0.59	98.9	5957	System Bias	
8/1/11 13:25:30	**10.95**	**9.23**	-3.2	0.79	98.1	5919	O_2 Mid =	10.96
8/1/11 13:25:45	**10.96**	**9.26**	-3.4	0.81	97.9	5955	CO_2 Mid =	9.26
8/1/11 13:26:00	**10.97**	**9.27**	-3.6	0.46	97.9	6027		
8/1/11 13:26:15	**10.97**	**9.27**	-3.3	0.39	90.2	5972		
8/1/11 13:26:30	10.97	9.27	-3.3	0.62	69.7	5926		
8/1/11 13:26:45	8.61	7.00	-3.7	0.8	53.2	5788		
8/1/11 13:27:00	5.82	4.77	-3.7	0.7	47.9	5876		
8/1/11 13:27:15	5.11	4.36	-3.8	0.7	47.7	6098		
8/1/11 13:27:30	5.07	4.34	-3.6	0.6	48.1	5987	System Bias	
8/1/11 13:27:45	5.07	4.34	-3.4	0.6	**47.6**	6009	CO Mid =	47.2

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/1/11 13:28:00	5.07	4.34	-3.5	0.5	**47.6**	5984		
8/1/11 13:28:15	5.07	4.34	-3.8	0.5	**46.9**	5935		
8/1/11 13:28:30	5.07	4.33	-3.7	0.5	**46.6**	5954		
8/1/11 13:28:45	3.55	3.16	-3.5	0.4	47.6	5876		
8/1/11 13:29:00	0.41	2.85	-3.4	0.4	47.6	5926		
8/1/11 13:29:15	0.10	1.25	-3.6	0.4	29.7	5790		
8/1/11 13:29:30	0.06	0.30	-3.5	0.5	11.4	5798		
8/1/11 13:29:45	0.02	0.08	-3.4	15.6	1.4	5741		
8/1/11 13:30:00	0.02	0.05	-3.8	16.2	-1.2	5839		
8/1/11 13:30:15	0.02	0.04	-3.5	32.0	-1.8	5854		
8/1/11 13:30:30	0.01	0.03	-3.5	33.8	-1.3	5868		
8/1/11 13:30:45	0.01	0.03	-3.8	44.2	-1.3	5913		
8/1/11 13:31:00	0.08	0.29	-3.6	47.4	-1.3	6025		
8/1/11 13:31:15	0.06	0.90	-3.6	47.0	-1.8	5940	System Bias	
8/1/11 13:31:30	0.04	0.40	-4.1	**46.7**	-2.3	5892	NO_x Mid =	**46.6**
8/1/11 13:31:45	0.03	0.07	-3.8	**46.6**	-2.3	5970		
8/1/11 13:32:00	0.05	0.03	-3.6	**46.5**	-2.0	5943		
8/1/11 13:32:15	0.02	0.02	-3.5	**46.5**	-1.3	5879		
8/1/11 13:32:30	0.00	0.02	-4.0	46.3	-1.3	5926		
8/1/11 13:32:45	0.00	0.02	-3.9	46.2	-1.3	5889		
8/1/11 13:33:00	0.00	0.02	-3.6	48.7	-1.3	5917		
8/1/11 13:33:15	0.00	0.02	6.8	34.0	-1.3	5830		
8/1/11 13:33:30	0.00	0.02	32.3	2.0	-1.3	5882		
8/1/11 13:33:45	0.00	0.02	41.5	1.3	-1.3	5958		
8/1/11 13:34:00	0.00	0.02	80.9	7.22	-0.5	5954		
8/1/11 13:34:15	0.00	0.02	89.8	4.81	-0.3	6019		
8/1/11 13:34:30	0.00	0.02	89.6	3.69	-1.0	6000		
8/1/11 13:34:45	0.00	0.02	87.7	3.07	-1.3	5981		
8/1/11 13:35:00	0.00	0.02	83.2	2.59	-1.5	6015		
8/1/11 13:35:15	0.00	0.02	82.8	2.29	-1.8	6040		
8/1/11 13:35:30	0.00	0.02	85.7	2.03	-1.3	5962		
8/1/11 13:35:45	0.00	0.02	90.4	1.81	-0.5	5985		
8/1/11 13:36:00	0.00	0.02	93.4	1.61	-0.3	5925		
8/1/11 13:36:15	0.00	0.02	96.5	1.48	-1.0	5990		
8/1/11 13:36:30	0.00	0.02	98.3	1.39	-1.3	5972		
8/1/11 13:36:45	0.00	0.02	98.9	1.27	-1.5	5948	System Bias	
8/1/11 13:37:00	0.00	0.02	**99.4**	1.21	-1.8	5981	SO_2 Mid =	**99.7**
8/1/11 13:37:15	0.00	0.02	**99.6**	1.14	1.2	5981		
8/1/11 13:37:30	0.00	0.02	**100.6**	1.08	0.9	5953		
8/1/11 13:37:45	0.00	0.02	**99.4**	1.03	1.3	5977		
8/1/11 13:38:00	0.00	0.02	96.4	1.03	1.6	5973		
8/1/11 13:38:15	0.00	0.02	97.2	1.00	1.8	6063		
8/1/11 13:38:30	0.00	0.02	97.1	0.97	1.7	6071		
8/1/11 13:38:45	0.00	0.02	97.3	0.94	0.9	6033		
8/1/11 13:39:00	0.00	0.02	97.2	0.90	0.9	5998		
8/2/11 11:48:45	20.86	-0.03	-4.01	0.31	4.1	3221		
8/2/11 11:49:00	20.86	-0.03	-3.85	0.31	4.3	3261		
8/2/11 11:49:15	20.86	-0.03	-4.08	0.31	3.7	3191		
8/2/11 11:49:30	20.85	-0.04	-4.28	0.34	4.1	3250		
8/2/11 11:49:45	20.86	-0.04	-4.12	1.07	6.2	3282		
8/2/11 11:50:00	19.92	0.04	-4.24	0.41	16.6	3288		
8/2/11 11:50:15	12.29	1.88	-3.47	0.33	32.2	3327		
8/2/11 11:50:30	8.47	2.96	-3.24	0.25	25.6	3253		
8/2/11 11:50:45	4.23	0.95	-3.62	0.25	8.6	3322		
8/2/11 11:51:00	0.61	0.02	-4.01	0.25	3.3	3363		
8/2/11 11:51:15	0.09	-0.09	-4.01	0.24	0.9	3305		
8/2/11 11:51:30	0.05	-0.10	-4.24	0.25	0.7	3339		
8/2/11 11:51:45	0.04	-0.10	-4.24	0.25	1.5	3195		
8/2/11 11:52:00	0.04	-0.10	-4.51	0.25	1.8	3293		
8/2/11 11:52:15	0.03	-0.10	-4.28	0.25	1.1	3251		
8/2/11 11:52:30	0.03	-0.10	-4.09	0.24	0.8	3292		
8/2/11 11:52:45	0.03	-0.10	-4.35	0.25	1.4	3212		
8/2/11 11:53:00	0.02	-0.10	-4.39	0.25	1.8	3264		
8/2/11 11:53:15	0.02	-0.10	-4.28	0.23	1.4	3242		
8/2/11 11:53:30	0.02	-0.10	-4.12	0.24	1.0	3280		
8/2/11 11:53:45	0.02	-0.10	-4.20	0.25	1.3	3233		
8/2/11 11:54:00	0.02	-0.10	-4.36	0.23	1.6	3264		
8/2/11 11:54:15	0.02	-0.10	-4.40	0.25	1.5	3334		
8/2/11 11:54:30	0.01	-0.10	-2.39	0.24	1.0	3332		
8/2/11 11:54:45	0.01	-0.09	-0.50	0.23	0.9	3320	Calibration Error / System Bias	
8/2/11 11:55:00	**0.01**	**-0.09**	**-0.31**	**0.24**	**1.5**	3403	O_2 Zero =	**0.01**
8/2/11 11:55:15	**0.01**	**-0.09**	**-0.38**	**0.24**	**1.8**	3220	CO_2 Zero =	**-0.09**
8/2/11 11:55:30	**0.01**	**-0.09**	**-0.62**	**0.28**	**1.2**	3297	SO_2 Zero =	**-0.4**
8/2/11 11:55:45	**0.01**	**-0.06**	**-0.23**	**0.37**	**1.6**	3194	NO_x Zero =	**0.3**
8/2/11 11:56:00	4.64	5.68	-0.69	0.26	6.1	3213	CO Zero =	**1.5**
8/2/11 11:56:15	13.37	11.90	-0.89	0.25	100.0	3181		
8/2/11 11:56:30	19.07	15.62	-0.73	0.25	100.0	3321		
8/2/11 11:56:45	21.96	17.69	-0.54	0.25	100.0	3263		
8/2/11 11:57:00	22.73	18.51	-0.66	0.25	100.0	3309		
8/2/11 11:57:15	22.79	19.07	-0.70	0.25	100.0	3306		
8/2/11 11:57:30	22.79	19.42	-0.73	0.27	100.0	3204		
8/2/11 11:57:45	22.78	19.53	-0.42	0.25	100.0	3249		
8/2/11 11:58:00	22.78	19.56	-0.42	0.25	100.0	3272	Calibration Error / System Bias	
8/2/11 11:58:15	**22.78**	**19.57**	-0.35	0.25	100.0	3287	O_2 Span =	**22.8**
8/2/11 11:58:30	**22.78**	**19.58**	-0.35	0.25	100.0	3314	CO_2 Span =	**19.6**

Houston Refining: Houston, Texas
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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/2/11 11:58:45	**22.79**	**19.58**	-0.54	0.25	100.0	3210		
8/2/11 11:59:00	**22.79**	**19.58**	-0.73	0.25	100.0	3212		
8/2/11 11:59:15	22.30	18.65	-0.46	0.25	100.0	3193		
8/2/11 11:59:30	17.26	13.72	-0.42	0.25	100.0	3237		
8/2/11 11:59:45	12.27	10.13	-0.23	0.26	96.8	3191		
8/2/11 12:00:00	10.26	8.82	-0.58	0.26	90.7	3147	Calibration Error / System Bias	
8/2/11 12:00:15	**10.01**	**8.69**	-0.54	0.25	**89.6**	3281	O_2 Mid =	10.00
8/2/11 12:00:30	**10.00**	**8.68**	-0.62	0.25	**89.9**	3333	CO_2 Mid =	8.68
8/2/11 12:00:45	**10.00**	**8.68**	-0.62	0.24	**89.7**	3185	CO Span =	89.6
8/2/11 12:01:00	**10.00**	**8.67**	-0.35	0.25	**89.0**	3213		
8/2/11 12:01:15	10.00	8.67	-0.35	0.25	89.4	3187		
8/2/11 12:01:30	10.00	8.67	-0.46	0.25	90.0	3191		
8/2/11 12:01:45	10.00	8.67	-0.52	0.25	83.8	3301		
8/2/11 12:02:00	9.20	7.62	-0.46	0.25	68.7	3290		
8/2/11 12:02:15	6.33	5.13	-0.43	0.24	51.0	3304		
8/2/11 12:02:30	5.16	4.39	-0.31	0.24	46.9	3216		
8/2/11 12:02:45	5.05	4.33	-0.31	0.25	46.5	3277	Calibration Error / System Bias	
8/2/11 12:03:00	5.05	4.33	-0.23	0.25	**45.9**	3263	CO Mid =	45.9
8/2/11 12:03:15	5.04	4.33	-0.39	0.25	**45.4**	3199		
8/2/11 12:03:30	5.04	4.33	-0.15	0.24	**45.9**	3217		
8/2/11 12:03:45	5.04	4.32	-0.74	0.25	**46.5**	3266		
8/2/11 12:04:00	5.04	4.32	-0.42	0.24	46.1	3212		
8/2/11 12:04:15	5.04	4.32	-0.46	0.24	45.6	3312		
8/2/11 12:04:30	5.04	4.32	-0.31	0.24	45.8	3197		
8/2/11 12:04:45	5.04	4.31	-0.50	0.24	46.4	3387		
8/2/11 12:05:00	5.04	4.30	-0.62	0.42	45.3	3341		
8/2/11 12:05:15	5.88	3.91	-0.38	0.44	30.7	3350		
8/2/11 12:05:30	13.09	1.94	-0.12	0.32	20.6	3288		
8/2/11 12:05:45	8.75	1.31	9.39	0.29	10.2	3269		
8/2/11 12:06:00	1.99	0.27	59.00	0.28	4.8	3258		
8/2/11 12:06:15	0.34	-0.01	144.67	0.29	1.5	3306		
8/2/11 12:06:30	0.11	-0.05	211.96	0.31	1.1	3267		
8/2/11 12:06:45	0.08	-0.06	232.66	0.31	1.6	3340		
8/2/11 12:07:00	0.10	-0.06	236.39	0.29	1.6	3333		
8/2/11 12:07:15	0.11	-0.06	232.61	0.28	1.1	3321		
8/2/11 12:07:30	0.09	-0.06	222.19	0.29	0.7	3332		
8/2/11 12:07:45	0.08	-0.07	205.21	0.29	1.1	3295		
8/2/11 12:08:00	0.07	-0.07	190.65	0.28	1.5	3210		
8/2/11 12:08:15	0.06	-0.07	181.21	0.28	1.3	3234		
8/2/11 12:08:30	0.06	-0.07	174.86	0.28	0.8	3258		
8/2/11 12:08:45	0.05	-0.07	171.17	0.28	0.9	3245		
8/2/11 12:09:00	0.05	-0.07	169.35	0.28	1.5	3331		
8/2/11 12:09:15	0.05	-0.08	169.47	0.26	1.8	3260		
8/2/11 12:09:30	0.04	-0.08	171.20	0.29	1.3	3289		
8/2/11 12:09:45	0.03	-0.08	173.40	0.26	0.7	3416		
8/2/11 12:10:00	0.02	-0.08	175.44	0.36	1.1	3244		
8/2/11 12:10:15	0.01	-0.08	176.83	0.27	1.7	3247		
8/2/11 12:10:30	0.00	-0.08	177.09	0.26	1.6	3241		
8/2/11 12:10:45	-0.01	-0.09	177.55	0.25	0.9	2703		
8/2/11 12:11:00	-0.01	-0.09	178.90	0.26	0.9	2073		
8/2/11 12:11:15	-0.01	-0.09	180.20	0.25	1.6	2056		
8/2/11 12:11:30	-0.01	-0.09	197.57	0.25	1.7	1959		
8/2/11 12:11:45	-0.02	-0.09	205.55	0.25	1.2	1850		
8/2/11 12:12:00	-0.02	-0.09	208.31	0.25	0.9	1557		
8/2/11 12:12:15	-0.02	-0.09	210.44	0.25	1.5	1736		
8/2/11 12:12:30	-0.02	-0.09	212.52	0.25	1.8	1892		
8/2/11 12:12:45	-0.02	-0.09	214.83	0.25	1.4	1869		
8/2/11 12:13:00	-0.02	-0.09	216.67	0.25	0.9	1892		
8/2/11 12:13:15	-0.02	-0.09	210.05	0.25	1.4	2040		
8/2/11 12:13:30	-0.02	-0.09	202.69	0.26	1.8	2085		
8/2/11 12:13:45	-0.03	-0.09	203.27	0.25	1.5	2117		
8/2/11 12:14:00	-0.02	-0.09	204.01	0.26	1.1	2119		
8/2/11 12:14:15	-0.03	-0.09	204.63	0.27	1.1	1976		
8/2/11 12:14:30	-0.03	-0.09	204.89	0.29	1.6	1962		
8/2/11 12:14:45	-0.03	-0.09	205.47	0.26	1.9	1902		
8/2/11 12:15:00	-0.03	-0.09	206.12	0.25	1.4	1958		
8/2/11 12:15:15	-0.03	-0.09	205.97	0.25	0.9	2071		
8/2/11 12:15:30	-0.03	-0.09	205.97	0.25	1.2	1884		
8/2/11 12:15:45	-0.03	-0.09	205.80	0.25	1.7	1942		
8/2/11 12:16:00	-0.03	-0.09	205.70	0.25	1.6	1998		
8/2/11 12:16:15	-0.03	-0.09	205.70	0.25	0.8	2084		
8/2/11 12:16:30	-0.03	-0.09	206.00	0.26	1.0	1957		
8/2/11 12:16:45	-0.03	-0.09	204.80	0.25	1.6	2114		
8/2/11 12:17:00	-0.03	-0.09	201.62	0.25	1.7	2111		
8/2/11 12:17:15	-0.03	-0.09	201.42	0.25	1.0	2124		
8/2/11 12:17:30	-0.03	-0.09	201.23	0.25	0.9	2287		
8/2/11 12:17:45	-0.03	-0.09	201.77	0.25	1.5	2147		
8/2/11 12:18:00	-0.03	-0.09	201.42	0.25	1.8	2095		
8/2/11 12:18:15	-0.03	-0.09	201.11	0.26	1.2	2103		
8/2/11 12:18:30	-0.03	-0.09	201.03	0.25	0.9	1760		
8/2/11 12:18:45	-0.03	-0.09	201.19	0.25	1.3	1752		
8/2/11 12:19:00	-0.03	-0.09	201.34	0.25	1.7	1852		
8/2/11 12:19:15	-0.03	-0.09	201.22	0.25	1.5	2149		
8/2/11 12:19:30	-0.03	-0.09	201.00	0.25	0.9	2181		
8/2/11 12:19:45	-0.03	-0.09	200.88	0.25	1.1	2141		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/2/11 12:20:00	-0.03	-0.09	200.99	0.25	1.7	2028		
8/2/11 12:20:15	-0.03	-0.09	201.03	0.75	2.0	2081		
8/2/11 12:20:30	-0.03	-0.09	200.99	4.02	1.5	2051		
8/2/11 12:20:45	-0.03	-0.09	201.05	0.50	1.0	1939		
8/2/11 12:21:00	-0.01	-0.08	180.32	0.38	1.5	2158		
8/2/11 12:21:15	-0.02	-0.09	125.57	0.38	1.8	2095		
8/2/11 12:21:30	-0.03	-0.10	91.25	0.35	1.6	2107		
8/2/11 12:21:45	-0.03	-0.10	77.22	0.35	1.1	1994		
8/2/11 12:22:00	-0.03	-0.10	70.68	0.31	1.1	2241		
8/2/11 12:22:15	-0.03	-0.10	66.97	0.31	1.7	2301		
8/2/11 12:22:30	-0.03	-0.10	64.08	0.28	1.9	2119		
8/2/11 12:22:45	-0.03	-0.10	62.66	0.29	1.4	2032		
8/2/11 12:23:00	-0.03	-0.10	61.49	0.28	0.9	2245		
8/2/11 12:23:15	-0.03	-0.10	60.03	0.29	1.2	1812		
8/2/11 12:23:30	-0.03	-0.10	59.15	0.28	1.7	1996		
8/2/11 12:23:45	-0.03	-0.10	58.42	0.29	1.5	2094		
8/2/11 12:24:00	-0.04	-0.10	57.80	0.28	0.8	2236		
8/2/11 12:24:15	-0.03	-0.10	57.46	0.28	0.8	1853		
8/2/11 12:24:30	-0.04	-0.10	56.84	0.28	1.4	1748		
8/2/11 12:24:45	-0.04	-0.10	55.87	0.28	1.6	1929		
8/2/11 12:25:00	-0.04	-0.10	55.03	0.28	1.0	1932		
8/2/11 12:25:15	-0.03	-0.10	54.22	0.28	0.7	1866		
8/2/11 12:25:30	-0.03	-0.10	53.84	0.31	1.0	1834		
8/2/11 12:25:45	0.01	-0.10	53.10	0.28	1.5	1761		
8/2/11 12:26:00	0.79	-0.09	51.83	0.28	1.5	1907		
8/2/11 12:26:15	0.43	-0.09	51.25	0.28	0.7	2064		
8/2/11 12:26:30	0.02	-0.10	51.40	0.28	0.8	1696		
8/2/11 12:26:45	-0.03	-0.10	50.50	0.25	1.4	1686		
8/2/11 12:27:00	-0.04	-0.09	58.82	0.27	1.7	1664		
8/2/11 12:27:15	-0.04	-0.09	117.48	0.25	1.3	1881		
8/2/11 12:27:30	-0.04	-0.09	180.63	0.26	0.8	1983		
8/2/11 12:27:45	-0.03	-0.09	207.04	0.35	1.2	1976		
8/2/11 12:28:00	-0.04	-0.09	214.82	0.28	1.7	1913		
8/2/11 12:28:15	-0.03	-0.09	187.32	0.28	1.8	1640		
8/2/11 12:28:30	-0.03	-0.10	120.20	0.28	1.2	2498		
8/2/11 12:28:45	-0.03	-0.10	80.91	0.29	0.9	2016		
8/2/11 12:29:00	-0.03	-0.10	66.91	0.35	1.3	1306		
8/2/11 12:29:15	2.07	0.71	61.26	0.24	22.4	-4249		
8/2/11 12:29:30	10.05	4.60	53.14	0.30	51.8	-8503		
8/2/11 12:29:45	11.24	5.68	40.98	0.29	45.3	-7899		
8/2/11 12:30:00	8.96	2.94	27.12	0.29	26.9	-4621		
8/2/11 12:30:15	2.85	0.85	82.27	0.25	8.5	-576		
8/2/11 12:30:30	0.33	0.07	92.87	0.28	3.3	277		
8/2/11 12:30:45	0.02	-0.06	100.10	0.28	1.1	433		
8/2/11 12:31:00	-0.02	-0.08	111.95	0.25	0.9	553		
8/2/11 12:31:15	-0.02	-0.08	107.79	0.25	1.2	504		
8/2/11 12:31:30	-0.03	-0.09	123.27	0.25	1.5	282		
8/2/11 12:31:45	-0.03	-0.09	177.81	0.27	1.4	146		
8/2/11 12:32:00	-0.03	-0.09	212.48	0.26	0.8	214		
8/2/11 12:32:15	-0.03	-0.09	225.03	0.26	1.0	263		
8/2/11 12:32:30	-0.03	-0.10	228.72	0.25	1.4	108		
8/2/11 12:32:45	-0.03	-0.10	229.60	0.25	1.4	268		
8/2/11 12:33:00	-0.04	-0.10	229.48	0.26	0.9	273		
8/2/11 12:33:15	-0.03	-0.10	228.91	0.25	0.8	306		
8/2/11 12:33:30	-0.04	-0.10	228.64	0.25	1.3	308		
8/2/11 12:33:45	-0.04	-0.10	221.67	0.26	1.6	244	Calibration Error / System Bias	
8/2/11 12:34:00	-0.04	-0.10	**201.59**	0.25	1.2	207	**SO_2 Span =**	**201.6**
8/2/11 12:34:15	-0.04	-0.10	**201.28**	0.26	0.6	265		
8/2/11 12:34:30	-0.04	-0.10	**201.51**	0.26	0.9	373		
8/2/11 12:34:45	-0.04	-0.10	**201.89**	0.26	1.2	508		
8/2/11 12:35:00	-0.04	-0.10	202.55	0.25	1.4	303		
8/2/11 12:35:15	-0.04	-0.10	202.93	0.25	0.7	580		
8/2/11 12:35:30	-0.04	-0.10	202.62	0.26	0.6	498		
8/2/11 12:35:45	-0.04	-0.10	197.04	0.27	1.0	491		
8/2/11 12:36:00	-0.04	-0.10	152.75	0.25	1.4	396		
8/2/11 12:36:15	-0.04	-0.10	153.83	0.25	1.1	511		
8/2/11 12:36:30	-0.04	-0.10	135.44	0.24	0.7	450		
8/2/11 12:36:45	-0.04	-0.10	125.58	0.25	1.1	506		
8/2/11 12:37:00	-0.04	-0.10	111.96	0.25	1.4	394		
8/2/11 12:37:15	-0.04	-0.10	105.23	0.26	1.4	465		
8/2/11 12:37:30	-0.04	-0.10	103.65	0.25	0.8	545		
8/2/11 12:37:45	-0.04	-0.10	102.53	0.25	0.6	650	Calibration Error / System Bias	
8/2/11 12:38:00	-0.04	-0.10	**101.88**	0.25	1.1	615	**SO_2 Mid =**	**101.3**
8/2/11 12:38:15	-0.04	-0.10	**101.27**	0.25	1.4	409		
8/2/11 12:38:30	-0.04	-0.10	**101.00**	0.44	1.3	164		
8/2/11 12:38:45	-0.04	-0.10	**101.19**	0.29	0.7	478		
8/2/11 12:39:00	-0.04	-0.09	105.88	0.26	0.9	611		
8/2/11 12:39:15	-0.04	-0.10	94.89	0.26	1.2	391		
8/2/11 12:39:30	-0.04	-0.10	71.77	0.25	1.4	447		
8/2/11 12:39:45	-0.04	-0.10	58.11	0.25	0.8	466		
8/2/11 12:40:00	-0.04	-0.10	51.72	0.25	0.5	398		
8/2/11 12:40:15	-0.04	-0.10	60.45	0.26	1.0	360		
8/2/11 12:40:30	-0.04	-0.10	95.89	0.25	1.5	263		
8/2/11 12:40:45	-0.04	-0.10	118.03	0.25	1.3	373		
8/2/11 12:41:00	-0.04	-0.10	123.96	0.25	0.2	677		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
8/2/11 12:41:15	-0.05	-0.09	113.93	0.25	-0.5	680	
8/2/11 12:41:30	-0.07	-0.09	79.45	0.25	0.3	613	
8/2/11 12:41:45	-0.07	-0.09	57.10	0.25	1.2	642	
8/2/11 12:42:00	-0.07	-0.09	60.67	0.25	0.8	463	
8/2/11 12:42:15	-0.06	-0.10	63.18	0.25	0.3	571	
8/2/11 12:42:30	-0.06	-0.10	62.95	0.25	0.7	479	
8/2/11 12:42:45	-0.07	-0.10	62.29	0.25	1.2	451	
8/2/11 12:43:00	-0.07	-0.10	61.91	0.33	1.1	539	
8/2/11 12:43:15	-0.02	-0.10	61.87	0.41	0.7	510	
8/2/11 12:43:30	5.54	-0.05	59.29	0.44	0.8	483	
8/2/11 12:43:45	15.82	0.01	40.06	0.46	1.4	451	
8/2/11 12:44:00	19.71	0.03	18.43	0.31	0.7	505	
8/2/11 12:44:15	18.24	0.01	13.19	0.25	-0.9	714	
8/2/11 12:44:30	7.63	-0.06	48.72	0.25	-0.2	536	
8/2/11 12:44:45	0.82	-0.10	81.49	0.25	0.7	634	
8/2/11 12:45:00	0.01	-0.10	77.59	0.25	1.2	419	
8/2/11 12:45:15	-0.05	-0.10	72.89	0.25	1.3	437	
8/2/11 12:45:30	-0.05	-0.10	71.31	0.26	0.8	688	
8/2/11 12:45:45	-0.05	-0.10	70.60	0.52	0.3	750	
8/2/11 12:46:00	2.29	-0.08	69.30	16.70	1.0	653	
8/2/11 12:46:15	5.43	-0.07	56.53	61.28	1.3	599	
8/2/11 12:46:30	1.36	-0.10	34.44	84.39	1.0	674	
8/2/11 12:46:45	0.12	-0.11	14.73	86.97	0.6	682	
8/2/11 12:47:00	0.00	-0.11	5.80	88.27	0.8	460	
8/2/11 12:47:15	-0.01	-0.11	3.33	88.59	1.3	388	
8/2/11 12:47:30	-0.01	-0.11	2.68	88.63	1.6	538	
8/2/11 12:47:45	-0.01	-0.11	2.18	88.81	1.1	673	
8/2/11 12:48:00	-0.01	-0.10	1.75	88.88	0.6	709	
8/2/11 12:48:15	-0.01	-0.10	1.60	88.97	1.0	645	
8/2/11 12:48:30	-0.01	-0.10	1.45	89.05	1.5	551	
8/2/11 12:48:45	-0.01	-0.10	1.41	89.00	1.4	529	
8/2/11 12:49:00	-0.01	-0.10	1.37	89.02	0.9	672	
8/2/11 12:49:15	-0.01	-0.10	1.34	88.89	0.7	675	
8/2/11 12:49:30	-0.01	-0.10	1.10	88.67	1.2	472	
8/2/11 12:49:45	-0.01	-0.10	1.01	88.57	1.5	395	
8/2/11 12:50:00	-0.01	-0.10	1.37	89.30	1.2	493	
8/2/11 12:50:15	-0.01	-0.10	1.03	90.36	0.6	717	**Calibration Error / System Bias**
8/2/11 12:50:30	-0.02	-0.10	1.03	**90.56**	1.0	611	**NO_x Span = 90.7**
8/2/11 12:50:45	-0.02	-0.10	1.07	**90.65**	1.3	459	
8/2/11 12:51:00	-0.01	-0.10	0.80	**90.72**	1.5	602	
8/2/11 12:51:15	-0.02	-0.10	1.07	**90.81**	1.0	543	
8/2/11 12:51:30	-0.01	-0.10	1.07	90.89	0.7	464	
8/2/11 12:51:45	-0.01	-0.10	0.91	90.98	1.1	418	
8/2/11 12:52:00	-0.01	-0.10	0.76	91.09	1.4	345	
8/2/11 12:52:15	-0.02	-0.10	0.87	90.45	1.2	465	
8/2/11 12:52:30	-0.02	-0.10	1.07	54.71	0.6	628	**Calibration Error / System Bias**
8/2/11 12:52:45	-0.02	-0.10	0.87	**46.56**	0.8	696	**NO_x Mid = 46.2**
8/2/11 12:53:00	-0.02	-0.10	0.95	**46.39**	1.4	510	
8/2/11 12:53:15	-0.02	-0.10	0.80	**46.11**	1.6	306	
8/2/11 12:53:30	-0.02	-0.11	0.84	**45.87**	1.0	449	
8/2/11 12:53:45	-0.02	-0.11	0.87	17.66	0.6	685	
8/2/11 12:54:00	0.96	-0.10	0.87	4.58	1.1	412	
8/2/11 12:54:15	10.12	-0.05	0.99	11.12	1.8	419	
8/2/11 12:54:30	18.29	-0.07	1.22	22.64	1.8	484	
8/2/11 12:54:45	20.61	-0.10	1.03	25.87	1.0	461	
8/2/11 12:55:00	20.60	-0.11	1.03	25.26	0.9	402	
8/2/11 12:55:15	20.55	-0.11	1.33	31.35	1.4	501	
8/2/11 12:55:30	20.78	-0.11	1.56	36.50	1.6	474	
8/2/11 12:55:45	21.02	-0.11	1.53	38.73	1.4	404	
8/2/11 12:56:00	21.10	-0.11	1.30	39.94	0.9	399	
8/2/11 12:56:15	21.13	-0.11	1.30	40.71	1.0	431	
8/2/11 12:56:30	21.14	-0.11	1.45	41.20	1.6	528	
8/2/11 12:56:45	21.15	-0.11	1.56	41.54	1.9	440	
8/2/11 12:57:00	21.15	-0.11	1.56	41.90	1.3	390	
8/2/11 12:57:15	21.16	-0.11	1.41	42.10	1.0	402	
8/2/11 12:57:30	21.16	-0.11	1.60	42.65	1.3	390	
8/2/11 12:57:45	21.16	-0.11	1.56	41.10	1.7	320	
8/2/11 12:58:00	21.16	-0.11	1.60	39.34	1.6	292	
8/2/11 12:58:15	21.17	-0.11	1.83	39.26	0.8	601	
8/2/11 12:58:30	21.18	-0.11	1.68	44.17	0.9	638	
8/2/11 12:58:45	21.17	-0.10	1.45	45.16	1.4	380	
8/2/11 12:59:00	21.17	-0.10	1.52	45.32	1.6	565	**NO_2 Converter Check**
8/2/11 12:59:15	21.18	-0.10	1.49	**45.44**	1.3	444	**Cyl = AAL13927**
8/2/11 12:59:30	21.18	-0.10	1.68	**45.47**	0.8	469	**Conc. = 49.8**
8/2/11 12:59:45	21.18	-0.10	1.64	**45.47**	1.0	395	**Response = 45.47**
8/2/11 13:00:00	21.18	-0.10	1.71	**45.48**	1.4	361	**eff. = 91.3%**
8/2/11 13:00:15	21.19	-0.10	1.49	45.47	1.5	402	
8/2/11 13:00:30	21.19	-0.10	1.60	45.49	1.0	567	
8/2/11 13:00:45	21.19	-0.10	1.56	45.51	0.7	632	
8/2/11 13:01:00	21.20	-0.10	1.41	45.72	1.3	626	
8/2/11 13:01:15	21.18	-0.10	1.83	34.46	1.6	605	
8/2/11 13:01:30	21.18	-0.10	1.95	12.12	1.3	492	
8/2/11 13:01:45	21.14	-0.07	1.68	4.90	0.6	488	
8/2/11 13:02:00	21.03	-0.01	1.41	32.38	0.8	382	
8/2/11 15:29:45							

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/2/11 15:30:00								
8/2/11 15:30:15	20.71	-0.12	-3.57	0.22	1.1	-32	Calibration Error / System Bias	
8/2/11 15:30:30	20.71	-0.12	-3.45	0.22	1.1	**-53**	C_3H_8 Zero =	-47.2
8/2/11 15:30:45	20.71	-0.12	-3.49	0.23	0.5	**-21**		
8/2/11 15:31:00	20.71	-0.12	-3.57	0.24	0.6	**-72**		
8/2/11 15:31:15	20.71	-0.12	-3.46	0.24	1.0	**-43**		
8/2/11 15:31:30	20.71	-0.12	-2.73	0.22	1.2	3802		
8/2/11 15:31:45	20.71	-0.12	-0.37	0.23	1.4	24464		
8/2/11 15:32:00	20.71	-0.12	-0.29	0.30	1.1	28143		
8/2/11 15:32:15	20.71	-0.12	-0.18	0.26	0.5	28099		
8/2/11 15:32:30	20.72	-0.12	-0.41	0.25	0.7	28730		
8/2/11 15:32:45	20.72	-0.12	-0.41	0.24	1.2	29203		
8/2/11 15:33:00	20.72	-0.12	-0.76	0.24	1.3	29534	Calibration Error / System Bias	
8/2/11 15:33:15	20.72	-0.11	-0.41	0.24	1.2	**30152**	C_3H_8 Span =	30320.2
8/2/11 15:33:30	20.72	-0.11	-0.45	0.25	0.6	**30242**		
8/2/11 15:33:45	20.72	-0.11	-0.52	0.24	0.7	**30395**		
8/2/11 15:34:00	20.72	-0.11	-0.56	0.24	1.1	**30491**		
8/2/11 15:34:15	20.72	-0.11	-0.52	0.25	1.2	30524		
8/2/11 15:34:30	20.72	-0.11	-0.18	0.22	1.2	30370		
8/2/11 15:34:45	20.71	-0.11	-0.33	0.22	0.9	21033		
8/2/11 15:35:00	20.72	-0.11	-0.37	0.23	0.3	15198	Calibration Error / System Bias	
8/2/11 15:35:15	20.72	-0.11	-0.42	0.24	0.5	**15023**	C_3H_8 mid =	14989.7
8/2/11 15:35:30	20.72	-0.11	-0.14	0.25	1.0	**14851**		
8/2/11 15:35:45	20.71	-0.11	-0.14	0.24	1.2	**14989**		
8/2/11 15:36:00	20.71	-0.11	-0.68	0.24	1.3	**15096**		
8/2/11 15:36:15	20.71	-0.11	-0.61	0.27	0.8	14902		
8/2/11 15:36:30	20.71	-0.11	-0.57	0.25	0.4	14940		
8/2/11 15:36:45	20.71	-0.11	-0.41	0.25	0.6	13051	Calibration Error / System Bias	
8/2/11 15:37:00	20.71	-0.11	-0.37	0.24	0.9	**10038**	C_3H_8 Low =	9941.4
8/2/11 15:37:15	20.71	-0.11	-0.49	0.24	1.3	**10047**		
8/2/11 15:37:30	20.71	-0.11	-0.49	0.24	1.4	**9861**		
8/2/11 15:37:45	20.71	-0.11	-0.53	0.24	0.7	**9819**		
8/2/11 15:38:00	20.71	-0.12	-0.49	0.24	0.4	9773		
8/2/11 15:38:15	20.71	-0.12	-0.33	0.24	0.8	9671		
8/2/11 15:38:30	20.71	-0.12	-0.60	0.26	1.1	9718		
8/2/11 15:38:45	20.71	-0.12	-0.68	0.24	1.2	9283		
8/2/11 15:39:00	20.71	-0.12	-0.53	0.24	1.1	1177		
8/2/11 15:39:15	20.71	-0.12	-0.53	0.22	0.5	234		
8/2/11 15:39:30	20.71	-0.12	-0.60	0.23	0.6	181		
8/2/11 15:39:45	20.71	-0.12	-0.60	0.22	0.9	140		
8/2/11 15:40:00	20.71	-0.12	-0.99	0.24	1.2	115		
8/2/11 15:40:15	20.71	-0.12	-0.64	0.22	1.4	150		
8/2/11 15:40:30	20.71	-0.12	-0.53	0.25	1.2	7821		
8/2/11 15:40:45	20.71	-0.12	-0.72	0.24	0.5	9869		
8/2/11 15:41:00	20.71	-0.12	-0.64	0.25	0.6	9494		
8/2/11 15:41:15	20.71	-0.12	-0.68	0.25	1.2	9441		
8/2/11 15:41:30	20.71	-0.12	-0.64	0.24	1.5	9572		
8/2/11 15:41:45	20.71	-0.12	-0.72	0.24	1.5	9704		
8/2/11 15:42:00	20.71	-0.12	-1.14	0.25	1.3	9714		
8/2/11 15:42:15	20.71	-0.12	-0.64	0.25	0.5	9773		
8/2/11 15:42:30	20.71	-0.12	-0.64	0.22	0.6	9793		
8/2/11 15:42:45	20.71	-0.12	-0.68	0.24	1.0	9855		
8/2/11 15:43:00	20.71	-0.12	-0.76	0.25	1.3	8928		
8/2/11 15:43:15	20.71	-0.12	-0.88	0.25	1.2	987		
8/2/11 15:43:30	20.71	-0.12	-0.64	0.23	0.7	117		
8/2/11 15:43:45	20.71	-0.12	-0.95	0.22	0.3	41		
8/2/11 15:44:00	20.71	-0.12	-0.99	0.23	0.7	110		
8/2/11 15:44:15	20.71	-0.12	-1.10	0.24	1.1	1853		
8/2/11 15:44:30	20.71	-0.11	-1.10	0.23	1.2	9242		
8/2/11 15:44:45	20.71	-0.11	-1.06	0.25	1.3	9631		
8/2/11 15:45:00	20.71	-0.11	-0.95	0.24	0.6	9747		
8/2/11 15:45:15	20.71	-0.11	-0.91	0.25	0.4	9940		
8/2/11 15:45:30	20.71	-0.11	-0.84	0.24	0.8	9915		
8/2/11 15:45:45	20.71	-0.11	-0.53	0.22	1.0	9922		
8/2/11 15:46:00	20.72	-0.11	-0.76	0.23	1.3	9972		
8/2/11 15:46:15	20.72	-0.11	-1.10	0.23	1.2	6406		
8/2/11 15:46:30	20.72	-0.11	-0.95	0.24	0.3	484		
8/2/11 15:46:45	20.72	-0.11	-0.80	0.24	0.5	227		
8/2/11 15:47:00	20.72	-0.11	-0.91	0.22	0.8	243		
8/2/11 15:47:15	20.71	-0.11	-0.91	0.22	1.2	165		
8/2/11 15:47:30	20.72	-0.11	-0.68	0.22	1.3	141		
8/2/11 15:47:45	20.72	-0.11	-0.76	0.23	1.0	160		
8/2/11 15:48:00	20.71	-0.12	-1.07	0.24	0.4	197		
8/2/11 15:48:15	20.71	-0.12	-1.18	0.22	0.7	244		
8/2/11 15:48:30	20.71	-0.12	-0.84	0.22	1.1	1190		
8/2/11 15:48:45	20.71	-0.12	-0.99	0.24	1.2	8851		
8/2/11 15:49:00	20.71	-0.12	-0.99	0.22	1.3	9444		
8/2/11 15:49:15	20.71	-0.12	-0.99	0.24	0.7	9139		
8/2/11 15:49:30	20.71	-0.12	-1.07	0.25	0.4	9285		
8/2/11 15:49:45	20.72	-0.12	-0.95	0.26	0.8	8964		
8/2/11 15:50:00	20.72	-0.12	-1.06	0.52	1.1	8511		
8/2/11 15:50:15	20.73	-0.12	-1.22	0.64	1.4	8582		
8/2/11 15:50:30	20.77	-0.12	-1.10	0.64	1.3	8602		
8/2/11 15:50:45	20.82	-0.12	-0.99	0.64	0.8	8671		
8/2/11 15:51:00	20.84	-0.12	-0.99	0.65	0.7	8787		

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Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments
8/2/11 15:51:15	20.84	-0.12	-1.03	0.64	1.0	4688	
8/2/11 15:51:30	20.84	-0.12	-0.84	0.60	1.2	-194	
8/2/11 15:51:45	20.85	-0.12	-0.91	0.91	1.4	-83	
8/2/11 15:52:00	20.81	-0.10	-0.84	1.22	1.2	-378	
8/2/11 15:52:15	20.57	-0.08	-0.72	1.41	0.4	-557	
8/2/11 15:52:30	20.25	-0.08	-0.91	1.62	0.6	-666	
8/2/11 15:52:45	20.02	-0.07	-0.80	1.61	1.0	-546	
8/2/11 15:53:00	19.82	-0.07	-0.76	1.64	1.4	-591	
8/2/11 15:53:15	19.76	-0.07	-0.84	1.61	1.5	-688	
8/2/11 15:53:30	19.76	-0.07	-0.65	1.63	0.9	-674	
8/2/11 15:53:45	19.76	-0.07	-0.72	1.65	0.6	-743	
8/2/11 15:54:00	19.77	-0.07	-0.80	1.63	1.1	-724	
8/2/11 15:54:15	19.77	-0.07	-0.91	1.65	1.4	-758	
8/2/11 15:54:30	19.76	-0.07	-0.99	1.63	1.5	-801	
8/2/11 15:54:45	19.75	-0.07	-0.95	1.63	1.5	-670	
8/2/11 15:55:00	19.75	-0.07	-0.84	1.63	1.0	-878	
8/2/11 15:55:15	19.74	-0.06	-1.07	1.63	0.6	-710	
8/2/11 15:55:30	19.74	-0.06	-0.99	1.63	1.1	-585	
8/2/11 15:55:45	19.73	-0.06	-0.57	1.63	1.3	-813	
8/2/11 15:56:00	19.73	-0.06	-0.72	1.63	1.5	-747	
8/2/11 15:56:15	19.73	-0.06	-0.61	1.63	1.6	-758	
8/2/11 15:56:30	19.72	-0.06	-0.80	1.62	0.8	-657	
8/2/11 15:56:45	19.72	-0.06	-0.99	1.63	0.8	-704	
8/2/11 15:57:00	19.73	-0.06	-0.95	1.68	1.2	-692	
8/2/11 15:57:15	19.73	-0.06	-0.76	1.68	1.5	-493	
8/2/11 15:57:30	19.73	-0.06	-0.88	1.72	1.8	-675	
8/2/11 15:57:45	19.72	-0.06	-0.76	1.70	1.7	-337	
8/2/11 15:58:00	19.72	-0.06	-0.88	1.72	1.0	-177	
8/2/11 15:58:15	19.72	-0.06	-0.95	1.73	1.0	-362	
8/2/11 15:58:30	19.72	-0.06	-0.72	1.72	1.4	-292	
8/2/11 15:58:45	19.72	-0.06	-0.80	1.73	1.6	-127	
8/2/11 15:59:00	19.72	-0.06	-1.14	1.73	1.8	-279	
8/2/11 15:59:15	19.72	-0.07	-0.80	1.72	1.3	-302	
8/2/11 15:59:30	19.72	-0.07	-1.03	1.69	1.0	-339	
8/2/11 15:59:45	19.72	-0.07	-0.76	1.67	1.2	-402	
8/2/11 16:00:00	19.73	-0.07	-0.57	1.69	1.5	-638	
8/2/11 16:00:15	19.74	-0.07	-0.92	1.68	1.7	-718	
8/2/11 16:00:30	19.74	-0.07	-0.99	1.69	1.7	-612	
8/2/11 16:00:45	19.73	-0.07	-0.91	1.69	0.9	-759	
8/2/11 16:01:00	19.72	-0.07	-0.65	1.69	0.8	-631	
8/2/11 16:01:15	19.72	-0.07	-0.88	1.68	1.2	-735	
8/2/11 16:01:30	19.72	-0.07	-0.76	1.68	1.6	-648	
8/2/11 16:01:45	19.72	-0.07	-0.84	1.67	1.7	-721	
8/2/11 16:02:00	19.72	-0.07	-0.91	1.65	1.5	-763	
8/2/11 16:02:15	19.72	-0.07	-0.91	1.66	1.0	-654	
8/2/11 16:02:30	19.72	-0.07	-0.80	1.71	0.8	-790	
8/2/11 16:02:45	19.71	-0.07	-0.76	1.66	1.2	-831	
8/2/11 16:03:00	19.71	-0.07	-0.91	1.67	1.5	-887	
8/2/11 16:03:15	19.71	-0.07	-0.57	1.66	1.6	-818	
8/2/11 16:03:30	19.71	-0.07	-0.88	1.65	1.4	-688	
8/2/11 16:03:45	19.72	-0.07	-0.84	1.66	0.7	-375	
8/2/11 16:04:00	19.72	-0.07	-0.84	1.67	0.7	-77	
8/2/11 16:04:15	19.72	-0.07	-1.03	1.71	1.3	-109	
8/2/11 16:04:30	19.72	-0.07	-0.76	1.68	1.6	34	
8/2/11 16:04:45	19.72	-0.07	-0.91	1.68	1.6	32	
8/2/11 16:05:00	19.72	-0.07	-0.91	1.68	1.2	322	
8/2/11 16:05:15	19.72	-0.07	-0.72	1.69	0.8	697	
8/2/11 16:05:30	19.73	-0.07	-0.61	1.68	1.1	485	
8/2/11 16:05:45	19.73	-0.07	-0.92	1.70	1.4	697	
8/2/11 16:06:00	19.73	-0.06	-0.91	1.68	1.5	621	
8/2/11 16:06:15	19.73	-0.06	-0.91	1.68	1.6	646	
8/2/11 16:06:30	19.73	-0.06	-0.80	1.70	1.2	687	
8/2/11 16:06:45	19.73	-0.06	-0.80	1.71	0.8	284	
8/2/11 16:07:00	19.73	-0.06	-0.64	1.71	1.3	-186	
8/2/11 16:07:15	19.73	-0.06	-1.37	1.73	1.5	-151	
8/2/11 16:07:30	19.73	-0.06	-0.99	1.71	1.7	-245	
8/2/11 16:07:45	19.73	-0.06	-0.84	1.75	1.8	6627	
8/2/11 16:08:00	19.74	-0.06	-0.76	1.10	1.2	8626	
8/2/11 16:08:15	19.75	-0.07	-0.80	0.69	0.8	8554	
8/2/11 16:08:30	20.17	-0.10	-0.92	0.69	1.0	8348	
8/2/11 16:08:45	20.63	-0.11	-0.80	0.69	1.2	8361	
8/2/11 16:09:00	20.72	-0.12	-0.88	0.69	1.3	8170	
8/2/11 16:09:15	20.73	-0.12	-0.99	0.68	1.0	7867	
8/2/11 16:09:30	20.74	-0.12	-0.99	0.67	0.4	7740	
8/2/11 16:09:45	20.74	-0.12	-0.91	0.65	0.6	7627	
8/2/11 16:10:00	20.74	-0.12	-0.76	0.67	0.9	7625	
8/2/11 16:10:15	20.75	-0.12	-1.14	0.68	1.2	7676	
8/2/11 16:10:30	20.75	-0.12	-1.18	0.65	1.3	7558	
8/2/11 16:10:45	20.75	-0.12	-1.03	0.68	0.9	7487	Start Drain on Drum A
8/2/11 16:11:00	**20.75**	**-0.12**	**-1.07**	**0.68**	**0.3**	**7417**	
8/2/11 16:11:15	**20.75**	**-0.12**	**-0.88**	**0.67**	**0.5**	**7411**	
8/2/11 16:11:30	**20.75**	**-0.12**	**-0.92**	**0.65**	**0.9**	**7344**	
8/2/11 16:11:45	**20.75**	**-0.12**	**-0.72**	**0.65**	**1.1**	**7180**	
8/2/11 16:12:00	**20.76**	**-0.12**	**-0.68**	**0.68**	**1.2**	**6893**	
8/2/11 16:12:15	**20.76**	**-0.12**	**-0.84**	**0.63**	**0.7**	**6346**	

Houston Refining: Houston, Texas
736 Coker
ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/2/11 16:12:30	**20.76**	**-0.12**	**-1.11**	**0.63**	**0.2**	**5523**		
8/2/11 16:12:45	**20.77**	**-0.12**	**-1.22**	**0.46**	**0.6**	**17394**		
8/2/11 16:13:00	**20.79**	**-0.12**	**-0.95**	**0.41**	**1.6**	**40818**		
8/2/11 16:13:15	**20.89**	**-0.12**	**-0.84**	**0.48**	**9.7**	**35256**		
8/2/11 16:13:30	**20.84**	**-0.11**	**-0.65**	**0.27**	**18.5**	**18386**		
8/2/11 16:13:45	**20.79**	**-0.11**	**-0.95**	**0.22**	**14.1**	**12814**		
8/2/11 16:14:00	**20.95**	**-0.12**	**-0.95**	**0.22**	**6.3**	**10323**		
8/2/11 16:14:15	**21.02**	**-0.12**	**-0.76**	**0.23**	**3.4**	**9055**		
8/2/11 16:14:30	**21.03**	**-0.12**	**-0.88**	**0.23**	**2.8**	**7849**		
8/2/11 16:14:45	**21.04**	**-0.12**	**-0.80**	**0.23**	**2.7**	**4777**		
8/2/11 16:15:00	**21.04**	**-0.12**	**-0.76**	**0.23**	**2.5**	**6395**		
8/2/11 16:15:15	**21.04**	**-0.12**	**-0.76**	**0.23**	**1.5**	**7514**		
8/2/11 16:15:30	**21.04**	**-0.12**	**-1.11**	**0.23**	**1.4**	**5989**		
8/2/11 16:15:45	**21.05**	**-0.12**	**-0.95**	**0.23**	**1.9**	**5336**		
8/2/11 16:16:00	21.04	-0.12	-1.03	0.24	2.2	8840		
8/2/11 16:16:15	21.05	-0.12	-0.64	0.23	2.3	13056		
8/2/11 16:16:30	21.05	-0.12	-0.92	0.23	2.1	9865		
8/2/11 16:16:45	21.04	-0.11	-0.84	0.22	2.0	597		
8/2/11 16:17:00	21.03	-0.11	-0.88	0.22	1.9	-126	**System Bias**	
8/2/11 16:17:15	21.04	-0.11	-0.65	0.21	1.6	**-120**	**C_3H_8 Zero =**	**-104.1**
8/2/11 16:17:30	21.05	-0.11	-0.80	0.20	1.3	**-147**		
8/2/11 16:17:45	21.06	-0.12	-1.11	0.20	1.2	**-80**		
8/2/11 16:18:00	21.06	-0.12	-0.96	0.21	0.8	**-69**		
8/2/11 16:18:15	21.05	-0.12	-0.93	0.21	0.2	21		
8/2/11 16:18:30	21.05	-0.12	-1.15	0.21	0.4	36		
8/2/11 16:18:45	21.05	-0.12	-1.14	0.22	0.8	-118		
8/2/11 16:19:00	21.05	-0.12	-1.14	0.22	1.0	-185		
8/2/11 16:19:15	21.05	-0.12	-0.76	0.22	1.0	2856		
8/2/11 16:19:30	21.05	-0.12	-0.92	0.22	0.6	10		
8/2/11 16:19:45	21.03	-0.12	-0.88	0.22	0.3	-704		
8/2/11 16:20:00	20.85	-0.12	-0.99	0.22	0.6	-757		
8/2/11 16:20:15	20.72	-0.12	-1.07	0.22	0.8	-543		
8/2/11 16:20:30	20.69	-0.12	-0.99	0.20	0.9	-414		
8/2/11 16:20:45	20.68	-0.12	-0.95	0.20	1.1	857		
8/2/11 16:21:00	20.68	-0.12	-1.07	0.20	0.4	5730		
8/2/11 16:21:15	20.67	-0.12	-1.14	0.22	0.4	6330		
8/2/11 16:21:30	20.67	-0.12	-1.03	0.25	0.8	6172		
8/2/11 16:21:45	20.66	-0.12	-0.95	0.34	1.0	7854		
8/2/11 16:22:00	20.66	-0.12	-0.99	0.27	1.1	8344		
8/2/11 16:22:15	20.66	-0.12	-0.95	0.25	1.0	9191		
8/2/11 16:22:30	20.65	-0.12	-1.07	0.20	0.4	9323		
8/2/11 16:22:45	20.65	-0.12	-1.14	0.20	0.4	9460		
8/2/11 16:23:00	20.65	-0.12	-1.18	0.22	0.9	9526		
8/2/11 16:23:15	20.65	-0.12	-1.34	0.22	1.2	9606		
8/2/11 16:23:30	20.64	-0.12	-1.45	0.20	1.3	9616		
8/2/11 16:23:45	20.64	-0.12	-1.24	0.21	1.2	9723	**System Bias**	
8/2/11 16:24:00	20.64	-0.12	-1.64	0.20	0.4	**9771**	**C_3H_8 Low =**	**9817.4**
8/2/11 16:24:15	20.64	-0.12	-1.64	0.23	0.4	**9828**		
8/2/11 16:24:30	20.63	-0.12	-1.49	0.22	0.8	**9885**		
8/2/11 16:24:45	20.63	-0.12	-1.49	0.21	1.2	**9785**		
8/2/11 16:25:00	20.63	-0.12	-1.34	0.20	1.2	9578		
8/2/11 16:25:15	20.63	-0.12	-1.26	0.20	1.0	9442		
8/2/11 16:25:30	20.63	-0.12	-1.26	0.21	0.4	6543		
8/2/11 16:25:45	20.62	-0.12	-1.03	0.29	0.4	737		
8/2/11 16:26:00	20.63	-0.10	-1.15	0.29	0.7	31		
8/2/11 16:26:15	20.66	-0.03	-1.11	0.29	1.1	-4		
8/2/11 16:26:30	20.66	0.00	-1.22	4.16	1.1	-175		
8/2/11 16:26:45	19.53	0.00	-0.99	0.87	-0.4	-382		
8/2/11 16:27:00	9.67	0.10	-1.49	0.61	-1.5	-205		
8/2/11 16:27:15	1.83	0.05	-1.53	0.27	-0.8	-157		
8/2/11 16:27:30	0.47	0.06	-1.38	0.23	-0.5	447		
8/2/11 16:27:45	1.14	0.06	-0.45	0.23	0.0	254		
8/2/11 16:28:00	1.67	-0.07	-0.65	0.23	0.8	-174		
8/2/11 16:28:15	1.77	-0.10	-1.22	0.24	0.6	-70		
8/2/11 16:28:30	1.78	-0.11	-1.26	0.24	0.2	-708		
8/2/11 16:28:45	1.78	-0.11	-1.26	0.26	0.1	-833		
8/2/11 16:29:00	1.78	-0.11	-1.42	0.29	0.4	-642		
8/2/11 16:29:15	1.80	-0.11	-1.34	0.31	0.8	-702		
8/2/11 16:29:30	6.02	-0.08	-1.61	0.44	1.2	-864		
8/2/11 16:29:45	11.07	-0.06	-1.49	4.42	1.1	-891		
8/2/11 16:30:00	3.85	-0.10	-1.46	21.54	0.4	-792		
8/2/11 16:30:15	0.44	-0.11	-1.26	28.06	0.2	-667		
8/2/11 16:30:30	0.10	-0.11	-1.03	30.48	0.6	-697		
8/2/11 16:30:45	0.04	-0.12	-0.76	35.69	0.9	-423		
8/2/11 16:31:00	0.03	-0.12	-0.53	41.23	1.1	-532		
8/2/11 16:31:15	0.02	-0.12	-0.45	45.53	0.9	-757	**System Bias**	
8/2/11 16:31:30	0.01	-0.12	-0.41	**45.95**	0.4	-609	**O_2 Zero =**	**0.00**
8/2/11 16:31:45	0.00	-0.12	-0.57	**45.63**	0.3	-384	**CO_2 Zero =**	**-0.12**
8/2/11 16:32:00	0.00	-0.12	-0.88	**45.42**	0.5	-264	**SO_2 Zero =**	**-0.8**
8/2/11 16:32:15	0.00	-0.12	-1.38	**45.29**	0.9	-378	**NO_x Mid =**	**45.6**
8/2/11 16:32:30	0.00	-0.12	-1.34	35.20	1.0	-394	**CO Zero =**	**0.5**
8/2/11 16:32:45	0.74	-0.12	-1.18	43.70	1.0	-387		
8/2/11 16:33:00	4.89	-0.09	-1.49	5.04	0.6	-177		
8/2/11 16:33:15	2.92	-0.10	-1.03	1.68	0.2	-108		
8/2/11 16:33:30	1.77	-0.11	-1.11	1.34	0.4	-205		

Houston Refining: Houston, Texas
736 Coker
ARI Reference Method Monitoring Data

Date/Time	O_2 % db by vol.	CO_2 % db by vol.	SO_2 ppmv db	NO_x ppmv db	CO ppmv db	C_3H_8 ppmv wb	Comments	
8/2/11 16:33:45	1.74	-0.12	-1.34	1.16	0.9	-48		
8/2/11 16:34:00	1.75	-0.12	-1.61	0.95	0.9	7		
8/2/11 16:34:15	1.75	-0.12	-1.49	0.90	1.0	-221		
8/2/11 16:34:30	1.34	-0.12	-1.45	1.27	0.7	-124		
8/2/11 16:34:45	0.32	-0.12	-1.65	1.10	0.1	-146		
8/2/11 16:35:00	0.02	-0.12	-1.80	0.81	0.4	40		
8/2/11 16:35:15	-0.01	-0.12	-1.68	1.69	-0.1	-96		
8/2/11 16:35:30	-0.03	-0.12	-2.11	0.45	0.1	-53		
8/2/11 16:35:45	0.24	0.30	-2.30	0.39	14.1	-359		
8/2/11 16:36:00	2.22	2.25	-1.15	0.42	28.8	-657		
8/2/11 16:36:15	4.13	3.69	-1.15	0.41	40.4	-906		
8/2/11 16:36:30	4.78	4.12	-1.76	0.44	43.5	-769	System Bias	
8/2/11 16:36:45	4.92	4.22	-1.88	**0.45**	**45.0**	-821	CO Mid =	45.3
8/2/11 16:37:00	4.95	4.24	-1.88	**0.45**	**45.3**	-663	NO_x Zero =	0.5
8/2/11 16:37:15	4.96	4.24	-1.80	**0.48**	**45.6**	-678		
8/2/11 16:37:30	4.97	4.23	-1.53	**0.47**	**45.4**	-624		
8/2/11 16:37:45	4.97	4.23	-1.42	0.27	44.5	-608		
8/2/11 16:38:00	5.81	3.85	-1.80	0.25	43.7	-630		
8/2/11 16:38:15	8.43	2.15	-1.38	0.20	44.2	-411		
8/2/11 16:38:30	7.05	6.74	-1.34	0.20	54.3	-378		
8/2/11 16:38:45	9.86	8.77	-1.18	0.22	76.7	-394		
8/2/11 16:39:00	9.81	8.36	-1.49	0.22	92.4	-387	System Bias	
8/2/11 16:39:15	**9.93**	**8.43**	-1.03	0.20	**97.2**	-177	O_2 Mid =	9.94
8/2/11 16:39:30	**9.94**	**8.44**	-1.38	0.21	**96.9**	-378	CO_2 Mid =	8.44
8/2/11 16:39:45	**9.94**	**8.45**	-1.34	0.20	**96.9**	-394		
8/2/11 16:40:00	**9.94**	**8.45**	-1.18	0.27	**97.6**	-387		
8/2/11 16:40:15	9.94	8.45	-1.49	0.25	97.9	-177		
8/2/11 16:40:30	9.97	8.39	-1.03	0.20	97.9	-108		
8/2/11 16:40:45	9.71	6.88	-1.11	0.20	90.2	-642		
8/2/11 16:41:00	10.01	3.33	-1.34	0.22	69.7	-702		
8/2/11 16:41:15	10.46	0.83	-1.61	0.22	53.2	-864		
8/2/11 16:41:30	10.45	0.83	-1.49	0.20	47.9	-891		
8/2/11 16:41:45	10.28	0.78	-1.45	0.21	11.9	-792		
8/2/11 16:42:00	8.76	0.42	-1.65	0.20	4.0	-667		
8/2/11 16:42:15	1.40	0.10	-1.45	0.23	1.7	-697		
8/2/11 16:42:30	0.72	0.10	-1.65	0.22	0.6	-423		
8/2/11 16:42:45	0.19	0.10	-1.80	0.21	0.9	-532		
8/2/11 16:43:00	0.00	0.10	1.24	0.20	1.0	-270		
8/2/11 16:43:15	0.02	0.03	4.85	0.20	1.7	-288		
8/2/11 16:43:30	0.00	-0.07	2.16	0.21	0.6	-356		
8/2/11 16:43:45	-0.03	-0.09	-0.84	0.29	0.1	-211		
8/2/11 16:44:00	-0.03	-0.09	-1.49	0.69	0.4	-236		
8/2/11 16:44:15	-0.04	-0.10	-1.65	1.03	0.8	-101		
8/2/11 16:44:30	-0.03	-0.07	-1.84	1.24	1.4	-264		
8/2/11 16:44:45	0.17	0.11	0.85	1.01	1.6	-35		
8/2/11 16:45:00	0.18	0.01	32.42	0.92	0.9	-79		
8/2/11 16:45:15	0.06	-0.09	74.52	0.87	0.1	35		
8/2/11 16:45:30	-0.03	-0.10	91.89	0.84	0.2	-14	System Bias	
8/2/11 16:45:45	-0.05	-0.11	**94.30**	0.84	0.6	21	SO_2 Mid =	94.7
8/2/11 16:46:00	-0.05	-0.11	**94.74**	0.81	0.9	146		
8/2/11 16:46:15	-0.06	-0.11	**94.81**	0.79	0.9	205		
8/2/11 16:46:30	-0.06	-0.11	**95.00**	0.77	0.5	34		
8/2/11 16:46:45	-0.06	-0.11	93.54	0.75	0.1	64		

APPENDIX E

Calibration Data

CEMS CALIBRATION DATA

Plant Name	Houston Refining
Sampling Location	736 Coker
Date	7/29/2011
Run Number	1
Start Time	7:52
Stop Time	9:07

Plant Rep.	Chris Towe
Team Leader	Greg Burch
CEM Operator	Greg Burch

Analyzer Span Values (% or ppm)		
CO	90.0	ppm
CO_2	19.60	%
O_2	22.70	%
THC	300000	ppm
NO_x	90.0	ppm
SO_2	500.0	ppm

	CALIBRATION ERROR -		5:38 hrs		SYSTEM BIAS CHECK					Calibration
					Pretest: 6:56		Posttest: 9:11 hrs			Correction
	Cylinder Value (% or ppm)	Cylinder Number	Analyzer Calibration Response	Difference (% of Span)	System Response	Syst. Bias (% of Span)	System Response	Syst. Bias (% of Span)	Drift (% of Span)	Factors
CO Zero	0.0	CC64098	0.9	1.0	0.8	-0.1	0.4	-0.5	-0.5	Co=
CO Low		Diluted from								**0.61**
CO Mid	45.0	ALM016321	45.5	0.6	45.0	-0.6	46.2	0.7	1.3	Cm=
CO High	90.0	203 ppm	89.9	-0.1						**45.58**
CO_2 Zero	0.00	CC64098	-0.08	-0.4	-0.09	-0.1	-0.09	0.0	0.0	Co=
CO_2 Low		Diluted from								**-0.087**
CO_2 Mid	9.50	ALM016321	9.65	0.8	9.73	0.4	9.74	0.4	0.0	Cm=
CO_2 High	19.60	19.60 %	19.50	-0.5						**9.736**
O_2 Zero	0.00	CC64098	0.04	0.2	-0.02	-0.2	0.04	0.0	0.3	Co=
O_2 Low		Diluted from								**0.013**
O_2 Mid	11.00	ALM016321	10.81	-0.8	11.22	1.8	11.22	1.8	0.0	Cm=
O_2 High	22.70	22.70 %	22.63	-0.3						**11.219**
THC Zero	0	CC64098	479	0.2	478.7	0.0	2,829.1	0.8	0.8	Co=
THC Low	100000	Diluted from	97522	-0.8	97,522.1	0.0	94,271.4	-1.1	-1.1	**1653.89**
THC Mid	150000	BAL4181	151524	0.5						Cm=
THC High	300000	99.9%	300921	0.3						**95896.71**
NO_x Zero	0.0		0.3	0.3	0.3	0.0	0.6	0.4	0.4	Co=
NO_x Low		Diluted from								**0.46**
NO_x Mid	45.0	cc149689	45.7	0.8	45.0	-0.8	45.4	-0.4	0.4	Cm=
NO_x High	90.0	9939.0	90.7	0.8						**45.19**
SO_2 Zero	0.0		0.0	0.0	3.3	0.7	1.6	0.3	-0.3	Co=
SO_2 Low		Diluted from								**2.47**
SO_2 Mid	250.0	CC102277	253.6	0.7	245.2	-1.7	244.4	-1.8	-0.2	Cm=
SO_2 High	500.0	1001	502.4	0.5						**244.79**

CEMS CALIBRATION DATA

Plant Name	Houston Refining
Sampling Location	736 Coker
Date	8/1/2011
Run Number	2
Start Time	12:42
Stop Time	13:09

Plant Rep.	Chris Towe
Team Leader	Greg Burch
CEM Operator	Greg Burch

Analyzer Span Values (% or ppm)

CO	90.0	ppm
CO_2	19.60	%
O_2	22.70	%
THC	180000.0	ppm
NO_x	90.0	ppm
SO_2	200.0	ppm

	CALIBRATION ERROR - 11:12 hrs				SYSTEM BIAS CHECK					Calibration
					Pretest: 11:12		Posttest: 13:11 hrs			Correction
	Cylinder Value (% or ppm)	Cylinder Number	Analyzer Calibration Response	Difference (% of Span)	System Response	Syst. Bias (% of Span)	System Response	Syst. Bias (% of Span)	Drift (% of Span)	Factors
CO Zero	0.0	CC64098	0.7	0.8	0.7	0.0	-1.3	-2.2	-2.2	Co=
CO Low		Diluted from								**-0.28**
CO Mid	45.0	ALM016321	45.6	0.7	45.6	0.0	47.2	1.7	1.7	Cm=
CO High	90.0	203 ppm	89.2	-0.8						**46.39**
CO_2 Zero	0.00	CC64098	-0.09	-0.5	-0.09	0.0	0.13	1.2	1.2	Co=
CO_2 Low		Diluted from								**0.019**
CO_2 Mid	9.50	ALM016321	9.70	1.0	9.70	0.0	9.26	-2.3	-2.3	Cm=
CO_2 High	19.60	19.60 %	19.63	0.2						**9.478**
O_2 Zero	0.00	CC64098	0.03	0.1	0.03	0.0	0.02	-0.1	-0.1	Co=
O_2 Low		Diluted from								**0.024**
O_2 Mid	11.00	ALM016321	11.03	0.1	11.03	0.0	10.96	-0.3	-0.3	Cm=
O_2 High	22.70	22.70 %	22.83	0.6						**10.998**
THC Zero	0.0	CC64098	856.6	0.5	856.6	0.0	5,870.0	2.8	2.8	Co=
THC Low	40000.0	Diluted from	43480.0	1.9	43,480.0	0.0	44,240.2	0.4	0.4	**3363.33**
THC Mid	90000.0	BAL4181	90976.1	0.5						Cm=
THC High	180000.0	99.9%	179615.3	-0.2						**43860.12**
NO_x Zero	0.0		0.2	0.3	0.2	0.0	0.4	0.2	0.2	Co=
NO_x Low		Diluted from								**0.32**
NO_x Mid	45.0	CC222540	45.7	0.8	45.7	0.0	46.6	1.0	1.0	Cm=
NO_x High	90.0	1988 ppm	89.9	-0.1						**46.16**
SO_2 Zero	0.0		-0.3	-0.2	-0.3	0.0	-3.4	-1.5	-1.5	Co=
SO_2 Low		Diluted from								**-1.85**
SO_2 Mid	100.0	CC8757	100.2	0.1	100.2	0.0	99.7	-0.3	-0.3	Cm=
SO_2 High	200.0	2105 ppm	202.6	1.3						**100.00**

CEMS CALIBRATION DATA

Plant Name	Houston Refining
Sampling Location	736 Coker
Date	8/2/2011
Run Number	3
Start Time	8/2/11 16:11
Stop Time	8/2/11 16:16

Plant Rep.	Chris Towe
Team Leader	Greg Burch
CEM Operator	Greg Burch

Analyzer Span Values (% or ppm)

CO	90.0	ppm
CO_2	19.60	%
O_2	22.70	%
THC	300000.0	ppm
NO_x		ppm
SO_2		ppm

	CALIBRATION ERROR -		11:55 hrs		SYSTEM BIAS CHECK					Calibration
					Pretest: 7:22		Posttest: 12:18 hrs			Correction
	Cylinder Value (% or ppm)	Cylinder Number	Analyzer Calibration Response	Difference (% of Span)	System Response	Syst. Bias (% of Span)	System Response	Syst. Bias (% of Span)	Drift (% of Span)	Factors
CO Zero	0.0	CC64098	1.5	1.7	1.5	0.0	0.5	-1.1	-1.1	Co=
CO Low		Diluted from								**1.01**
CO Mid	45.0	ALM016321	45.9	1.0	45.9	0.0	45.3	-0.6	-0.6	Cm=
CO High	90.0	203 ppm	89.6	-0.5						**45.62**
CO_2 Zero	0.00	CC64098	-0.09	-0.4	-0.09	0.0	-0.12	-0.2	-0.2	Co=
CO_2 Low		Diluted from								**-0.104**
CO_2 Mid	8.63	ALM016321	8.68	0.2	8.68	0.0	8.44	-1.2	-1.2	Cm=
CO_2 High	19.60	19.60 %	19.58	-0.1						**8.560**
O_2 Zero	0.00	CC64098	0.01	0.1	0.01	0.0	0.00	0.0	0.0	Co=
O_2 Low		Diluted from								**0.007**
O_2 Mid	10.00	ALM016321	10.00	0.0	10.00	0.0	9.94	-0.3	-0.3	Cm=
O_2 High	22.70	22.70 %	22.79	0.4						**9.970**
THC Zero	0.0	CC64098	-47.2	0.0	-47.2	0.0	-104.1	0.0	0.0	Co=
THC Low	10000	Diluted from	9941.4	0.0	9,941.4	0.0	9,817.4	0.0	0.0	**-75.671**
THC Mid	15000	BAL4181	14989.7	0.0						Cm=
THC High	30000	1.0	30320.2	0.1						**9879.366**
NO_x Zero	0.0		0.3	0.3	0.3	0.0	0.5	0.2	0.2	Co=
NO_x Low		Diluted from								**0.37**
NO_x Mid	45.0	cc149689	46.2	1.4	46.2	0.0	45.6	-0.7	-0.7	Cm=
NO_x High	90.0	9939.0	90.7	0.8						**45.91**
SO_2 Zero	0.0		-0.4	-0.1	-0.4	0.0	-0.8	-0.1	-0.1	Co=
SO_2 Low		Diluted from								**-0.60**
SO_2 Mid	100.0	CC102277	101.3	0.3	101.3	0.0	94.7	-1.3	-1.3	Cm=
SO_2 High	200.0	1001.0	201.6	0.3						**98.02**

USEPA Method 205 Dilution System Verification
15-second data

Date/Time	O_2 % db by vol.	Comments	
8/2/11 11:48:45	20.86		
8/2/11 11:49:00	20.86		
8/2/11 11:49:15	20.86		
8/2/11 11:49:30	20.85		
8/2/11 11:49:45	20.86		
8/2/11 11:50:00	19.92		
8/2/11 11:50:15	12.29		
8/2/11 11:50:30	8.47		
8/2/11 11:50:45	4.23		
8/2/11 11:51:00	0.61		
8/2/11 11:51:15	0.09		
8/2/11 11:51:30	0.05		
8/2/11 11:51:45	0.04		
8/2/11 11:52:00	0.04		
8/2/11 11:52:15	0.03		
8/2/11 11:52:30	0.03		
8/2/11 11:52:45	0.03		
8/2/11 11:53:00	0.02		
8/2/11 11:53:15	0.02		
8/2/11 11:53:30	0.02		
8/2/11 11:53:45	0.02		
8/2/11 11:54:00	0.02		
8/2/11 11:54:15	0.02		
8/2/11 11:54:30	0.01		
8/2/11 11:54:45	0.01	Calibration Error	
8/2/11 11:55:00	**0.01**	**O_2 Zero =**	**0.01**
8/2/11 11:55:15	**0.01**		
8/2/11 11:55:30	**0.01**		
8/2/11 11:55:45	**0.01**		
8/2/11 11:56:00	4.64		
8/2/11 11:56:15	13.37		
8/2/11 11:56:30	19.07		
8/2/11 11:56:45	21.96		
8/2/11 11:57:00	22.73		
8/2/11 11:57:15	22.79		
8/2/11 11:57:30	22.79		
8/2/11 11:57:45	22.78		
8/2/11 11:58:00	22.78	Calibration Error	
8/2/11 11:58:15	**22.78**	**O_2 Span =**	**22.79**
8/2/11 11:58:30	**22.78**		
8/2/11 11:58:45	**22.79**		
8/2/11 11:59:00	**22.79**		
8/2/11 11:59:15	22.30		
8/2/11 11:59:30	17.26		
8/2/11 11:59:45	12.27		
8/2/11 12:00:00	10.26	Calibration Error	
8/2/11 12:00:15	**10.01**	**O_2 Mid =**	**10.00**
8/2/11 12:00:30	**10.00**		
8/2/11 12:00:45	**10.00**		
8/2/11 12:01:00	**10.00**		
8/2/11 12:01:15	10.00		
8/2/11 12:01:30	10.00		
8/2/11 12:01:45	10.00		
8/2/11 12:02:00	9.20		
8/2/11 12:02:15	6.33		
8/2/11 12:02:30	5.16		
8/2/11 13:01:45	21.14		
8/2/11 13:02:00	21.03		
8/2/11 13:02:15	20.91		
8/2/11 13:02:30	16.69		
8/2/11 13:02:45	12.20		
8/2/11 13:03:00	13.36		
8/2/11 13:03:15	14.55	Target Concentration No. 2; Trial No. 1	
8/2/11 13:03:30	**14.91**	**High Level Trial 1 = 14.95**	
8/2/11 13:03:45	**14.96**		
8/2/11 13:04:00	**14.96**		
8/2/11 13:04:15	**14.96**		
8/2/11 13:04:30	14.96		
8/2/11 13:04:45	14.97		
8/2/11 13:05:00	14.96		
8/2/11 13:05:15	13.21		
8/2/11 13:05:30	9.34		
8/2/11 13:05:45	7.70		
8/2/11 13:06:00	7.52		
8/2/11 13:06:15	7.51		
8/2/11 13:06:30	7.51	Target Concentration No. 1; Trial No. 1	
8/2/11 13:06:45	**7.51**	**Mid Level Trial 1 = 7.51**	
8/2/11 13:07:00	**7.51**		
8/2/11 13:07:15	**7.51**		
8/2/11 13:07:30	**7.51**		
8/2/11 13:07:45	7.51		
8/2/11 13:08:00	7.51		
8/2/11 13:08:15	7.51		
8/2/11 13:08:30	7.52		
8/2/11 13:08:45	7.25		
8/2/11 13:09:00	3.95		

USEPA Method 205 Dilution System Verification
15-second data

Date/Time	O_2 % db by vol.	Comments
8/2/11 13:09:15	0.80	
8/2/11 13:09:30	0.08	
8/2/11 13:09:45	0.62	
8/2/11 13:10:00	1.90	
8/2/11 13:10:15	2.53	
8/2/11 13:10:30	2.64	
8/2/11 13:10:45	2.71	
8/2/11 13:11:00	4.50	
8/2/11 13:11:15	7.14	
8/2/11 13:11:30	7.61	**Mid-Level Concentration; Trial No. 1**
8/2/11 13:11:45	**7.63**	**Mid Std. Trial 1 = 7.64**
8/2/11 13:12:00	**7.64**	
8/2/11 13:12:15	**7.64**	
8/2/11 13:12:30	**7.64**	
8/2/11 13:12:45	7.64	
8/2/11 13:13:00	7.64	
8/2/11 13:13:15	7.63	
8/2/11 13:13:30	7.80	
8/2/11 13:13:45	12.58	
8/2/11 13:14:00	16.94	
8/2/11 13:14:15	15.47	
8/2/11 13:14:30	18.08	
8/2/11 13:14:45	20.29	
8/2/11 13:15:00	14.72	
8/2/11 13:15:15	5.62	
8/2/11 13:15:30	6.02	
8/2/11 13:15:45	7.18	
8/2/11 13:16:00	7.44	
8/2/11 13:16:15	7.47	**Target Concentration No. 1; Trial No. 2**
8/2/11 13:16:30	**7.48**	**Mid Level Trial 2 = 7.49**
8/2/11 13:16:45	**7.49**	
8/2/11 13:17:00	**7.49**	
8/2/11 13:17:15	**7.49**	
8/2/11 13:17:30	7.50	
8/2/11 13:17:45	7.50	
8/2/11 13:18:00	8.81	
8/2/11 13:18:15	12.39	
8/2/11 13:18:30	14.43	
8/2/11 13:18:45	14.89	
8/2/11 13:19:00	14.94	**Target Concentration No. 2; Trial No. 2**
8/2/11 13:19:15	**14.95**	**High Level Trial 2 = 14.95**
8/2/11 13:19:30	**14.95**	
8/2/11 13:19:45	**14.95**	
8/2/11 13:20:00	**14.95**	
8/2/11 13:20:15	14.95	
8/2/11 13:20:30	14.96	
8/2/11 13:20:45	14.96	
8/2/11 13:21:00	14.95	
8/2/11 13:21:15	14.95	
8/2/11 13:21:30	14.93	
8/2/11 13:21:45	14.44	
8/2/11 13:22:00	8.58	
8/2/11 13:22:15	2.12	
8/2/11 13:22:30	0.32	
8/2/11 13:22:45	0.03	
8/2/11 13:23:00	-0.05	
8/2/11 13:23:15	-0.09	
8/2/11 13:23:30	0.37	
8/2/11 13:23:45	4.17	
8/2/11 13:24:00	6.63	
8/2/11 13:24:15	7.47	
8/2/11 13:24:30	7.62	**Mid-Level Concentration; Trial No. 2**
8/2/11 13:24:45	**7.63**	**Mid Std. Trial 2 = 7.63**
8/2/11 13:25:00	**7.63**	
8/2/11 13:25:15	**7.63**	
8/2/11 13:25:30	**7.63**	
8/2/11 13:25:45	7.63	
8/2/11 13:26:00	7.63	
8/2/11 13:26:15	7.63	
8/2/11 13:26:30	7.72	
8/2/11 13:26:45	10.62	
8/2/11 13:27:00	15.51	
8/2/11 13:27:15	18.03	
8/2/11 13:27:30	20.21	
8/2/11 13:27:45	17.75	
8/2/11 13:28:00	12.39	
8/2/11 13:28:15	13.58	
8/2/11 13:28:30	14.70	
8/2/11 13:28:45	14.91	**Target Concentration No. 2; Trial No. 3**
8/2/11 13:29:00	**14.94**	**High Level Trial 3 = 14.94**
8/2/11 13:29:15	**14.94**	
8/2/11 13:29:30	**14.94**	
8/2/11 13:29:45	**14.94**	
8/2/11 13:30:00	14.89	
8/2/11 13:30:15	12.38	
8/2/11 13:30:30	8.81	

USEPA Method 205 Dilution System Verification
15-second data

Date/Time	O_2 % db by vol.	Comments
8/2/11 13:30:45	7.63	
8/2/11 13:31:00	7.52	Target Concentration No. 1; Trial No. 3
8/2/11 13:31:15	**7.51**	Mid Level Trial 3 = 7.51
8/2/11 13:31:30	**7.51**	
8/2/11 13:31:45	**7.52**	
8/2/11 13:32:00	**7.52**	
8/2/11 13:32:15	7.52	
8/2/11 13:32:30	7.52	
8/2/11 13:32:45	7.52	
8/2/11 13:33:00	7.52	
8/2/11 13:33:15	7.53	
8/2/11 13:33:30	7.53	
8/2/11 13:33:45	7.52	
8/2/11 13:34:00	7.52	
8/2/11 13:34:15	7.52	
8/2/11 13:34:30	7.52	
8/2/11 13:34:45	7.52	
8/2/11 13:35:00	7.51	
8/2/11 13:35:15	7.51	
8/2/11 13:35:30	7.41	
8/2/11 13:35:45	6.12	
8/2/11 13:36:00	3.00	
8/2/11 13:36:15	0.58	
8/2/11 13:36:30	0.07	
8/2/11 13:36:45	0.00	
8/2/11 13:37:00	0.00	
8/2/11 13:37:15	0.36	
8/2/11 13:37:30	9.46	
8/2/11 13:37:45	16.76	
8/2/11 13:38:00	15.04	
8/2/11 13:38:15	10.50	
8/2/11 13:38:30	8.18	
8/2/11 13:38:45	7.69	
8/2/11 13:39:00	7.64	
8/2/11 13:39:15	7.63	
8/2/11 13:39:30	7.63	Mid-Level Concentration; Trial No. 3
8/2/11 13:39:45	**7.63**	Mid Std. Trial 3 = 7.62
8/2/11 13:40:00	**7.62**	
8/2/11 13:40:15	**7.62**	
8/2/11 13:40:30	**7.62**	
8/2/11 13:40:45	7.62	
8/2/11 13:41:00	7.62	
8/2/11 13:41:15	7.62	
8/2/11 13:41:30	7.62	
8/2/11 13:41:45	7.62	
8/2/11 13:42:00	7.63	
8/2/11 13:42:15	7.71	
8/2/11 13:42:30	9.30	
8/2/11 13:42:45	16.29	
8/2/11 13:43:00	19.99	
8/2/11 13:43:15	20.30	
8/2/11 13:43:30	13.35	
8/2/11 13:43:45	3.50	
8/2/11 13:44:00	0.74	
8/2/11 13:44:15	0.37	

ARI REFERENCE METHOD CEMS DATA
USEPA METHOD 205
DILUTION SYSTEM VERIFICATION

Company: Houston Refining
Location: Houston, Texas
Source: 736 Coker
Dilution System ID: 3712
Dilution Flow Rate: 5.0 Lpm
Verification date: 8/2/2011

Analyzer Info

Monitor type: O_2
Monitor Span: 22.9 %
Monitor Serial No.: 01440D1/3840

Initial Calibration Data

Calibration Concentration		Calibration results		% Difference	
Zero:	0.00	Zero:	0.01	Zero:	0.05%
Low:		Low:		Low:	
Mid:	10.00	Mid:	10.00	Mid:	0.01%
High:	22.90	High:	22.79	High:	0.50%

Dilution System Verification

Mid level gas type: EPA Protocol 1
Mid level concentration: 7.61
Mid level tank serial #: AAL5614

High level dilution gas type: O_2/N_2
High level concentration: 22.9
High level tank serial #: ALM016321
Target concentration No. 1: 7.50
Target concentration No. 2: 15.00

Dilution System Results

	Target Concentration No. 1			Target Concentration No. 2	
	Instrument Response	% difference from average*		Instrument Response	% difference from average*
Trial No. 1:	7.51	0.09	Trial No. 1:	14.95	0.02
Trial No. 2:	7.49	0.22	Trial No. 2:	14.95	0.03
Trial No. 3:	7.51	0.13	Trial No. 3:	14.94	0.05
Average:	7.505		Average:	14.946	

% Difference from target concentration: 0.06%

% Difference from target concentration: 0.36%

Mid Level Calibration Gas Results

	Instrument Response
Trial No. 1:	7.64
Trial No. 2:	7.63
Trial No. 3:	7.62

Mid Level calibration gas concentration: 7.61%
Average analyzer response: 7.63
Percent difference: 0.26 *

* Must be less than 2 %

Instrument: 3712 **MFC: 1**

MAX Flow: 10,000.00 CCM
Cal Date: 12/17/2010 , 13:55:29
Reference Gas: NITROGEN
Description: Factory MFC #1 Calibration Table

Set Flow	True Flow	- Table is selected
500.00	497.47	
1,000.00	1,009.10	
2,000.00	2,035.90	
3,000.00	3,046.80	
4,000.00	4,058.70	
5,000.00	5,065.00	
6,000.00	6,069.10	
7,000.00	7,076.50	
8,000.00	8,099.70	
9,000.00	9,125.00	
10,000.00	10,162.00	

Instrument: 3712 **MFC: 2**

MAX Flow: 10,000.00 CCM
Cal Date: 12/17/2010 , 13:55:41
Reference Gas: NITROGEN
Description: Factory MFC #2 Calibration Table

Set Flow	True Flow	- Table is selected
500.00	502.75	
1,000.00	1,028.70	
2,000.00	2,075.00	
3,000.00	3,104.10	
4,000.00	4,127.30	
5,000.00	5,138.70	
6,000.00	6,149.10	
7,000.00	7,154.10	
8,000.00	8,170.20	
9,000.00	9,170.30	
10,000.00	10,193.00	

Instrument: 3712 **MFC: 3**

MAX Flow: 1,000.00 CCM
Cal Date: 12/17/2010 , 13:55:52
Reference Gas: NITROGEN
Description: Factory MFC #3 Calibration Table

Set Flow	True Flow	- Table is selected
50.00	46.16	
100.00	96.16	

200.00	197.03
300.00	297.95
400.00	399.12
500.00	500.71
600.00	601.81
700.00	704.55
800.00	808.37
900.00	913.04
1,000.00	1,019.70

Instrument: 3712 **MFC: 4**

MAX Flow: 100.00 CCM
Cal Date: 12/17/2010 , 13:56:15
Reference Gas: NITROGEN
Description: Factory MFC #4 Calibration Table

Set Flow	True Flow - Table is selected
5.00	2.66
10.00	7.95
20.00	18.51
30.00	28.90
40.00	39.22
50.00	49.48
60.00	59.70
70.00	69.89
80.00	80.19
90.00	90.63
100.00	101.15

Interference Response

Analyzer Type:	Oxygen (O_2)
Manufacturer:	Servomex
Detector Type:	Paramagnetic
Model No.:	1440
Serial No.:	1420C/2765
Calibration Span (%):	11.27

Test Gas	Test Gas Conc.	High Standard			Zero			Maximum % Interference
		O_2 without interferent	O_2 with interferent	% Interference	Zero without interferent	Zero with interferent	% Interference	
NH_3	10 ppm	11.27	11.27	0.00	0.03	0.01	0.18	0.18
SO_2	20 ppm	11.25	11.25	0.00	0.01	0.01	0.00	0.00
CH_4	50 ppm	11.24	11.25	0.09	0.02	0.04	-0.18	0.18
CO	50 ppm	11.23	11.24	0.09	0.00	0.01	-0.09	0.09
CO_2	5%	11.23	11.26	0.27	0.00	-0.01	0.09	0.27
CO_2	12.55%	11.25	11.27	0.18	0.03	-0.02	0.44	0.44
NO_2	15 ppm	11.22	11.24	0.18	0.01	0.00	0.09	0.18
NO_x	15 ppm	11.22	11.25	0.27	0.01	0.01	0.00	0.27
H_2	1,020 ppm	11.24	11.23	-0.09	0.02	0.01	0.09	0.09
HCl	10 ppm	11.29	11.31	0.18	0.00	-0.01	0.09	0.18

Sum of the highest absolute value obtained with and without the pollutant present: 1.88 %
Allowable interference response: 2.5 %

Certification Date: 8/9/2006
Operator: 

Interference Response

Analyzer Type:	Carbon Dioxide (CO_2)
Manufacturer:	Servomex
Detector Type:	Paramagnetic
Model No.:	1440
Serial No.:	1415C
Calibration Span (%):	11.41

Test Gas	Test Gas Conc.	High Standard			Zero			Maximum % Interference
		CO_2 without interferent	CO_2 with interferent	% Interference	Zero without interferent	Zero with interferent	% Interference	
NH_3	10 ppm	11.41	11.39	-0.18	0.01	0.01	0.00	0.18
SO_2	20 ppm	11.37	11.37	0.00	0.01	0.01	0.00	0.00
CH_4	50 ppm	11.37	11.37	0.00	0.01	0.01	0.00	0.00
CO	50 ppm	11.41	11.41	0.00	0.01	0.01	0.00	0.00
NO_2	15 ppm	11.37	11.37	0.00	0.01	0.01	0.00	0.00
NO_x	15 ppm	11.37	11.37	0.00	0.01	0.01	0.00	0.00
H_2	1,020 ppm	11.37	11.37	0.00	0.01	0.01	0.00	0.00
HCl	10 ppm	11.41	11.38	-0.26	0.01	0.01	0.00	0.26

Sum of the highest absolute value obtained with and without the pollutant present: 0.44 %

Allowable interference response: 2.5 %

Certification Date: 8-9-06

Operator: [signature]

Interference Response

Analyzer Type:	Sulfur Dioxide (SO_2)
Manufacturer:	Bovar Engineered Products (Western Research)
Detector Type:	Pulsed Fluorescence
Model No.:	721-ATM
Serial No.:	92-721ATM-7947-1-1
Calibration Span (%):	100

Test Gas	Test Gas Conc.	High Standard			Zero			Maximum % Interference
		SO_2 without interferent	SO_2 with interferent	% Interference	Zero without interferent	Zero with interferent	% Interference	
NH_3	10 ppm	100.1	100.1	0.0	0.1	0.1	0.0	0.0
CH_4	50 ppm	102.6	103.1	0.5	0.1	0.3	0.2	0.5
CO	50 ppm	100.5	100.5	0.0	0.3	0.3	0.0	0.0
CO_2	5%	100.9	101.1	0.2	0.1	0.1	0.0	0.2
CO_2	12.55%	100.9	101.2	0.3	0.1	0.2	0.1	0.3
NO_2	15 ppm	101.6	102.2	0.6	0.3	0.5	0.2	0.6
NO_x	15 ppm	101.4	101.4	0.0	0.3	0.3	0.0	0.0
H_2	1020 ppm	100.6	100.6	0.0	0.4	0.4	0.0	0.0
HCl	10 ppm	100.8	100.6	-0.2	0.1	0.3	0.2	0.2

Sum of the highest absolute value obtained with and without the pollutant present: 1.80 %
Allowable interference response: 2.5 %

Certification Date: 8/9/2006
Operator: _____

Interference Response

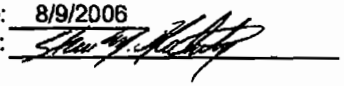
Analyzer Type:	Oxides of Nitrogen (NO_x)
Manufacturer:	Thermo Environmental Instruments Inc.
Detector Type:	Chemiluminescent
Model No.:	42C
Serial No.:	42CHL64932-345
Calibration Span (ppm):	100

Test Gas	Test Gas Conc.	High Standard			Zero			Maximum % Interference
		NO_x without interferent	NO_x with interferent	% Interference	Zero without interferent	Zero with interferent	% Interference	
NH_3	10 ppm	100.02	100.00	-0.02	0.08	-0.06	-0.14	0.14
CH_4	50 ppm	100.10	100.04	-0.06	0.08	0.05	-0.03	0.06
CO_2	5%	100.07	99.92	-0.15	0.08	-0.13	-0.21	0.21
CO_2	12.55%	100.11	99.07	-1.04	0.08	-0.42	-0.50	1.04
SO_2	20 ppm	100.10	100.08	-0.02	0.08	0.09	0.01	0.02
CO	50 ppm	100.09	99.96	-0.13	0.08	0.07	-0.01	0.13
H_2	1,020 ppm	100.11	100.10	-0.01	0.08	0.01	-0.07	0.07
HCl	10 ppm	100.02	99.94	-0.08	0.08	0.01	-0.07	0.08

Sum of the highest absolute value obtained with and without the pollutant present: 1.75 %

Allowable interference response: 2.5 %

Certification Date: 8/9/2006

Operator: 

Interference Response

Analyzer Type: Carbon Monoxide (CO)
Manufacturer: Thermo Environmental Instruments Inc.
Detector Type: Non-Dispersive Infrared (NDIR)
Model No.: 48H
Serial No.: 000632
Calibration Span (ppm): 100

Test Gas	Test Gas Conc.	High Standard			Zero			Maximum % Interference
		CO without interferent	CO with interferent	% Interference	Zero without interferent	Zero with Interferent	% Interference	
NH_3	10 ppm	101.5	101.7	0.2	1.6	1.5	-0.1	0.2
SO_2	20 ppm	101.5	101.6	0.1	1.6	1.9	0.3	0.3
CH_4	50 ppm	101.5	101.6	0.1	1.6	1.8	0.2	0.2
CO_2	5%	101.5	101.4	-0.1	1.6	1.6	0.0	0.1
CO_2	12.55%	101.5	101.1	-0.4	1.6	1.4	-0.2	0.4
NO_2	15 ppm	101.5	101.6	0.1	1.6	1.6	0.0	0.1
NO_x	15 ppm	101.5	101.8	0.3	1.6	1.9	0.3	0.3
H_2	1,020 ppm	101.5	101.7	0.2	1.6	1.8	0.2	0.2
HCl	10 ppm	101.5	101.6	0.1	1.6	1.8	0.2	0.2

Sum of the highest absolute value obtained with and without the pollutant present: 2.0 %
Allowable interference response: 2.5 %

Certification Date: 8-9-06
Operator: [signature]

AIR LIQUIDE Air Liquide America Specialty Gases LLC SCOTT™

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.: 03-031-10
Project No.: 04-83032-009

Customer

ARI ENVIRONMENTAL, INC.
PO# 03-031-10
1710 C PRESTON RD
PASADENA TX 77503

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: CC102277 **Certification Date:** 09Apr2010 **Exp. Date:** 08Apr2013
Cylinder Pressure*:** 1900 PSIG **Batch No:** LAP0014028

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ANALYTICAL ACCURACY**	TRACEABILITY
SULFUR DIOXIDE *	1,001 PPM	+/- 1%	Direct NIST and VSL
NITROGEN	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1662	15May2010	KAL003122	975.0 PPM	SULFUR DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//000929060	01Apr2010	FTIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

SULFUR DIOXIDE *

First Triad Analysis

Date: 02Apr2010 Response Unit: PPM

Z1 = 0.04628	R1 = 973.5997	T1 = 999.4752
R2 = 973.7617	Z2 = 0.07089	T2 = 999.8500
Z3 = 0.29218	T3 = 1000.016	R3 = 974.0854

Avg. Concentration: 1001. PPM

Second Triad Analysis

Date: 09Apr2010 Response Unit: PPM

Z1 = -0.31001	R1 = 975.1909	T1 = 1001.608
R2 = 975.6375	Z2 = 0.10122	T2 = 1001.619
Z3 = 0.25661	T3 = 1002.101	R3 = 975.7456

Avg. Concentration: 1001. PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 9.99994E-1

Constants:	A = 0.00000E+0
B = 9.93708E-1	C = 3.00000E-6
D = 0.00000E+0	E = 0.00000E+0

APPROVED BY: _____
Ron Stitt

AIR LIQUIDE Air Liquide America Specialty Gases LLC SCOTT™

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.: 03-031-10
Project No.: 04-83032-006

Customer

ARI ENVIRONMENTAL, INC.
PO# 03-031-10
1710 C PRESTON RD
PASADENA TX 77503

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: CC149689 **Certification Date:** 09Apr2010 **Exp. Date:** 08Apr2012
Cylinder Pressure*:** 1900 PSIG **Batch No:** LAP0014139

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ANALYTICAL ACCURACY**	TRACEABILITY
NITRIC OXIDE	993.9	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	1,002.	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1687	02Oct2012	AAL070258	970.3 PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//000929060	11Mar2010	FTIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

NITRIC OXIDE

Date: 02Apr2010 Response Unit: PPM

Z1 = 0.00160	R1 = 966.5002	T1 = 988.4431
R2 = 967.5684	Z2 = 0.84577	T2 = 990.2120
Z3 = 0.97668	T3 = 992.0400	R3 = 967.8732

Avg. Concentration: 993.3 PPM

Second Triad Analysis

Date: 09Apr2010 Response Unit: PPM

Z1 = -0.03177	R1 = 966.6850	T1 = 990.9666
R2 = 967.2875	Z2 = -0.02486	T2 = 991.2590
Z3 = 0.83149	T3 = 992.2364	R3 = 968.0659

Avg. Concentration: 994.5 PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 9.99999E-1

Constants:	A = 0.00000E+0
B = 9.08129E-1	C = 1.68000E-4
D = 0.00000E+0	E = 0.00000E+0

APPROVED BY: _____
Ron Stitt

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott™

COMPLIANCE CLASS

Dual-Analyzed Calibration Standard

500 WEAVER PARK RD, LONGMONT, CO 80501 Phone: 888-253-1635 Fax: 303-772-7673

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
500 WEAVER PARK RD
LONGMONT, CO 80501

P.O. No.: 03-008-11
Document # : 40557418-001

Customer

ARI ENVIRONMENTAL, INC.
ATTN: GREG BURCH
1710 C PRESTON RD
PASADENA TX 77503
US

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: AAL13927 **Certification Date:** 14Feb2011 **Exp. Date:** 15Aug2011
Cylinder Pressure*:** 1900 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
NITROGEN DIOXIDE	49.8	PPM	+/- 2%	GMIS
AIR		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol procedures , September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NO2/AIR GMIS	16Nov2012	ALM032519	48.30 PPM	NITROGEN DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
NONOX/CLA-220/41528750062	17Jan2011	CHEMILUMINESCENT

APPROVED BY: _____
JON WITZAK

AIR LIQUIDE Air Liquide America Specialty Gases LLC | Scott

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.: TBA
Document # : 40354688-003

Customer

ARI ENVIRONMENTAL, INC.

1710 C PRESTON RD
PASADENA TX 77503
US

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM031524 **Certification Date:** 28Jan2011 **Exp. Date:** 27Jan2014
Cylinder Pressure*:** 2000 PSIG **Batch No:** LAP0032799

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
CARBON MONOXIDE	997	PPM	+/- 1%	Direct NIST and VSL
NITROGEN		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1681	01Apr2012	ALM023610	1013. PPM	CARBON MONOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//000929060	21Jan2011	FTIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

CARBON MONOXIDE

First Triad Analysis

Date: 21Jan2011 Response Unit: PPM

Z1 = -0.00707	R1 = 1015.935	T1 = 1000.797
R2 = 1016.311	Z2 = 0.09054	T2 = 1001.078
Z3 = 0.09225	T3 = 1001.515	R3 = 1017.136

Avg. Concentration: 997.7 PPM

Second Triad Analysis

Date: 28Jan2011 Response Unit: PPM

Z1 = -0.02814	R1 = 1017.274	T1 = 1000.279
R2 = 1017.474	Z2 = 0.07741	T2 = 1000.662
Z3 = 0.12370	T3 = 1000.762	R3 = 1017.629

Avg. Concentration: 996.2 PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 9.99988E-1

Constants:	A = 0.00000E+0
B = 1.21463E-1	C = 1.71000E-4
D = 0.00000E+0	E = 0.00000E+0

APPROVED BY: _____
Ron Stitt

Scott Specialty Gases

Shipped From:
9810 BAY AREA BLVD
PASADENA TX 77507
Phone: 281-474-5800 Fax: 281-474-5857

CERTIFICATE OF ANALYSIS

ARI ENVIRONMENTAL, INC.

1710 C PRESTON RD

PASADENA TX 77503

PROJECT #: 04-57540-001
PO#: 03-080-07
ITEM #: 0401910 BL
DATE: 06Sep2007

CYLINDER #: BAL4181
FILL PRESSURE: 00000

PURE MATERIAL: PROPANE CAS# 74-98-6

GRADE: RESEARCH

PURITY: 99.9% *

IMPURITY	ACTUAL CONCENTRATIONS
NITROGEN	1.6 PPM +/- 20%
OXYGEN	0.2 PPM +/- 20%
WATER	7.3 PPM +/- 5%
METHANE	29.4 PPM +/- 2%
ETHANE	246 PPM +/- 2%
PROPYLENE	54 PPM +/- 2%
BUTANE	32.4 PPM +/- 2%
ISOBUTANE	524 PPM +/- 2%

QC BATCH : 4090

ANALYST: Susan J. Brandon
SUSAN BRANDON

AIR LIQUIDE Air Liquide America Specialty Gases LLC | Scott

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE™ OF ACCURACY: Interference Free Multi-Component EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.: 03-008-11
Document # : 40555687-001

Customer

ARI ENVIRONMENTAL, INC.

1710 C PRESTON RD
PASADENA TX 77503
US

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM016321 **Certification Date:** 19Feb2011 **Exp. Date:** 19Feb2014
Cylinder Pressure*:** 1850 PSIG **Batch No:** LAP0034897

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
CARBON MONOXIDE	203	PPM	+/- 1%	
CARBON DIOXIDE	19.6	%	+/- 1%	Direct NIST and VSL
OXYGEN	22.7	%	+/- 1%	
NITROGEN		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION		COMPONENT
NTRM 2636	02Oct2011	KAL003851	240.8	PPM	CARBON MONOXIDE
NTRM 2300	02Jan2012	K002682	23.01	%	CARBON DIOXIDE
NTRM 2350	01May2013	K026427	23.50	%	OXYGEN

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
SIEMENS CO/ULTRAMAT 6E-HIGH/WO355	02Mar2011	NDIR
FTIR//MG-09-149	11Feb2011	FTIR
SERVOMEX/MODEL 244A/701/716	20Jan2011	PARAMAGNETIC

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

CARBON MONOXIDE

First Triad Analysis			Second Triad Analysis			Calibration Curve	
Date: 17Feb2011	Response Unit: PPM		Date: 02Mar2011	Response Unit: PPM		Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=0.00000	R1=240.8000	T1=202.8500	Z1=0.00000	R1=241.1000	T1=203.0500	r=0.9999998	
R2=240.8000	Z2=0.00000	T2=202.8500	R2=241.2000	Z2=0.00000	T2=203.0500	Constants:	A=-0.00359496
Z3=0.00000	T3=202.8500	R3=240.9000	Z3=0.00000	T3=203.0500	R3=241.2000	B=0.999310841	C=
Avg. Concentration:	202.8	PPM	Avg. Concentration:	202.7	PPM	D=	E=

CARBON DIOXIDE

Date: 19Feb2011	Response Unit: %					Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=0.00251	R1=22.99574	T1=19.60792				r=9.99989E-1	
R2=22.99665	Z2=0.00414	T2=19.63312				Constants:	A=0.00000E+0
Z3=0.00424	T3=19.63369	R3=23.07062				B=5.49122E-1	C=3.87100E-3
Avg. Concentration:	19.61	%				D=0.00000E+0	E=0.00000E+0

OXYGEN

Date: 17Feb2011	Response Unit: VOLTS					Concentration=A+Bx+Cx2+Dx3+Ex4	
Z1=0.00000	R1=0.94000	T1=0.90800				r=0.9999971	
R2=0.94050	Z2=0.00000	T2=0.90900				Constants:	A=-0.01046095
Z3=0.00000	T3=0.90900	R3=0.94060				B=24.96589325	C=
Avg. Concentration:	22.69	%				D=	E=

APPROVED BY: DAVID KELLY

AIR LIQUIDE Air Liquide America Specialty Gases LLC SCOTT™

RATA CLASS

Dual-Analyzed Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
11426 FAIRMONT PKWY
LA PORTE, TX 77571

P.O. No.: 03-127-09
Project No.: 04-77649-003

Customer

ARI ENVIRONMENTAL, INC.
03-127-09
1710 C PRESTON RD
PASADENA TX 77503

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: AAL5614 **Certification Date:** 04Nov2009 **Exp. Date:** 04Nov2012
Cylinder Pressure*:** 1850 PSIG **Batch No:** LAP0003619

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ANALYTICAL ACCURACY**	TRACEABILITY
OXYGEN	7.609 %	+/- 1%	Direct NIST and VSL
NITROGEN	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2350	01Apr2012	A6820	23.51 %	OXYGEN

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
BIG SERVOMEX/1101-4605C/4605C	16Oct2009	PARAMAGNETIC

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis

OXYGEN

Date: 04Nov2009 Response Unit: %
Z1=0.00000 R1=23.58000 T1=7.64000
R2=23.58000 Z2=0.01000 T2=7.64000
Z3=0.00000 T3=7.64000 R3=23.56000
Avg. Concentration: 7.609 %

Second Triad Analysis

Calibration Curve

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.9999997
Constants: A=-0.00811775
B=1.000029704 C=
D= E=

APPROVED BY: DAVID KELLY

CERTIFIED MASTER CLASS

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott™

Single-Certified Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE OF ACCURACY: Certified Master Class Calibration Standard

Product Information
Document # : 41403901-001
Item No.: M0004060-P-30AL
P.O. No.: 09-024-11

Cylinder Number: CC105969
Cylinder Size: 30AL
Certification Date: 25Apr2011
Expiration Date: 24Apr2012
Lot Number: LAP0039741

Customer

ARI ENVIRONMENTAL, INC.
1710 C PRESTON RD
PASADENA, TX 77503
US

CERTIFIED CONCENTRATION

Component Name	Concentration (Moles)		Accuracy (+/-%)
CARBON DISULFIDE	524.	PPM	2
CARBONYL SULFIDE	510.	PPM	2
HYDROGEN SULFIDE	495.	PPM	2
NITROGEN		BALANCE	

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY: _____ DATE: 4/25/11
YANG QIN

SPECIFICATIONS

Component Name	Requested Concentration (Moles)		Certified Concentration (Moles)		Blend Tolerance Result (+/- %)	Certified Accuracy Result (+/- %)
CARBON DISULFIDE	500.	PPM	524.	PPM	4.8	2.00
CARBONYL SULFIDE	500.	PPM	510.	PPM	2.0	2.00
HYDROGEN SULFIDE	500.	PPM	495.	PPM	1.0	2.00
NITROGEN		BAL		BAL		

TRACEABILITY

Traceable To
Scott Reference Standard

PHYSICAL PROPERTIES

Cylinder Size: 30AL

Pressure: 2000 PSIG
Expiration Date: 24Apr2012

SPECIAL HANDLING INSTRUCTIONS

Do not use or store cylinder at or below the stated dew point temperature. Possible condensation of heavier components could result. In the event the cylinder has been exposed to temperatures at or below the dew point, place cylinder in heated area for 24 hours and then roll cylinder for 15 minutes to re-mix.

Use of calibration standards at or below dew point temperature may result in calibration error.

COMMENTS

PI# 52297 CMC CERTS AND TAGS TO REFLECT ARI52297

CERTIFIED MASTER CLASS

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott

Single-Certified Calibration Standard

11426 FAIRMONT PKWY, LA PORTE, TX 77571 Phone: 800-248-1427 Fax: 281-474-8419

CERTIFICATE OF ACCURACY: Certified Master Class Calibration Standard

Product Information
Document # : 40432820-003
Item No.: M0004060-P-30AL
P.O. No.: 09-005-11

Cylinder Number: CC188284
Cylinder Size: 30AL
Certification Date: 28Jan2011
Expiration Date: 27Jan2012
Lot Number: LAP0033304

Customer

ARI ENVIRONMENTAL, INC.
1710 C PRESTON RD
PASADENA, TX 77503
US

CERTIFIED CONCENTRATION

Component Name	Concentration (Moles)		Accuracy (+/-%)
CARBON DISULFIDE	103.	PPM	2
CARBONYL SULFIDE	103.	PPM	2
HYDROGEN SULFIDE	100.	PPM	2
NITROGEN		BALANCE	

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY: YANG QIN DATE: 1/28/11

SPECIFICATIONS

Component Name	Requested Concentration (Moles)		Certified Concentration (Moles)		Blend Tolerance Result (+/- %)	Certified Accuracy Result (+/- %)
CARBON DISULFIDE	100.	PPM	103.	PPM	3.0	2.00
CARBONYL SULFIDE	100.	PPM	103.	PPM	3.0	2.00
HYDROGEN SULFIDE	100.	PPM	100.	PPM	.0	2.00
NITROGEN		BAL		BAL		

TRACEABILITY

Traceable To
Scott Reference Standard

PHYSICAL PROPERTIES

Cylinder Size: 30AL

Pressure: 2000 PSIG
Expiration Date: 27Jan2012

SPECIAL HANDLING INSTRUCTIONS

Do not use or store cylinder at or below the stated dew point temperature. Possible condensation of heavier components could result. In the event the cylinder has been exposed to temperatures at or below the dew point, place cylinder in heated area for 24 hours and then roll cylinder for 15 minutes to re-mix.

Use of calibration standards at or below dew point temperature may result in calibration error.

COMMENTS

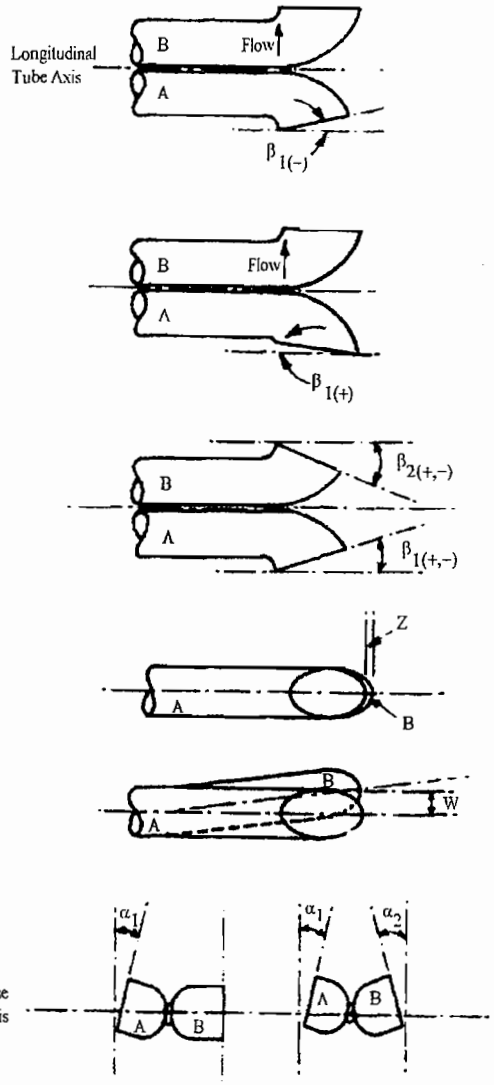
100ppm TRS Std

		Nozzle Diameter, Dn (inches)					
Date	Nozzle ID#	(1)	(2)	(3)	Hi - Lo	Avg.	Location
7/15/2011	DCU-1A	0.188	0.188	0.189	0.001	0.188	
7/15/2011	DCU-1B	0.188	0.187	0.188	0.000	0.188	
7/15/2011	DCU-1C	0.187	0.189	0.188	0.002	0.188	
7/15/2011	DCU-2A	0.249	0.250	0.251	0.001	0.250	
7/15/2011	DCU-2B	0.250	0.250	0.250	0.000	0.250	
7/15/2011	DCU-2C	0.249	0.250	0.252	0.003	0.250	

Pitot Tube Inspection Data

Client Name: _____

	Pre-Sample		Post-Sample
Date:	5/5/2011	**Date:**	8/8/2011



y	level?	y
n	obstructions?	n
n	damaged?	n
1	$-10° < \alpha_1 < +10°$	1
2	$-10° < \alpha_2 < +10°$	1
2	$-5° < \beta_1 < +5°$	2
1	$-5° < \beta_2 < +5°$	2
2	γ	2
2	θ	1
0.650	A	0.65
0.325	$0.2625 < P_A < 0.375$	0.325
0.323	$0.2625 < P_B < 0.375$	0.323
0.250	$0.1875 \leq D_t \leq 0.375$	0.250
0.023	A tan $\gamma < 0.125$"	0.023
0.02269	A tan $\theta < 0.03125$"	0.01134
TRUE	$P_A = P_B$ +/- 0.063	TRUE
PASS	**PASS/FAIL**	PASS

Comments:

Pitot tube/probe number P93 meets or exceeds all specifications and criteria and/or applicable design features (per 40CFR60 Appendix A; Method 2) and is heareby assigned a pitot tube calibration factor of 0.84.

Signature: Michael Agnello

Date: 8/8/11

POST TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 1105002
BAROMETRIC PRESSURE: 31.01
DATE: 8/8/2011
CALIBRATED BY: RC
PRETEST Y FACTOR: 1.000

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE L/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
1.0	1.060	10.00	0.0	10.977	10.98	10.60	0.966
1.0	1.055	10.00	0.0	10.942	10.94	10.55	0.964
1.0	1.053	10.03	0.0	10.976	10.98	10.57	0.963
						Average =	0.964

PRETEST Y FACTOR = 1.000
POSTTEST Y FACTOR = 0.964
DIFFERENCE, % = -3.7 (Must be < 5%)

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: RC
Date: 8/8/2011

Meterbox No.: 1105002
Calibrator No.: CL-300-21001

Calibrator	Digital Temperature Readout									
Setting	PROBE		Blank		FILTER		Blank		AUX	
°F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	-1	0.22	-1	0.22	-1	0.22	-1	0.22	-1	0.22
200	199	0.15	199	0.15	199	0.15	199	0.15	199	0.15
400	399	0.12	396	0.23	396	0.23	396	0.23	398	0.23
600	599	0.09	599	0.09	599	0.09	599	0.09	599	0.09
800	799	0.08	799	0.08	799	0.08	799	0.08	799	0.08
1000	999	0.07	999	0.07	999	0.07	999	0.07	999	0.07
1200	1199	0.06	1199	0.06	1199	0.06	1199	0.06	1199	0.06
1400	1399	0.05	1399	0.05	1399	0.05	1399	0.05	1399	0.05
1600	1599	0.05	1599	0.05	1599	0.05	1599	0.05	1599	0.05
1800	1799	0.04	1799	0.04	1799	0.04	1799	0.04	1799	0.04

Actual Maximum Difference = 0.23 %
Allowable Maximum Difference = 1.50 %

APEX INSTRUMENTS METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING WET-TEST METER #11AE6
5-POINT ENGLISH UNITS

Meter Console Information	
Console Model Number	XC-522
Console Serial Number	1104027
DGM Model Number	T-110
DGM Serial Number	26158

Calibration Conditions			
Date	Time	18-Apr-11	9:45
Barometric Pressure		29.7	in Hg
Calibration Technician		EW	
Calibration Meter Gamma		0.9999	

Factors/Conversions		
Std Temp	528	°R
Std Press	29.92	in Hg
K_f	17.647	°R/in Hg

Calibration Data

Run Time	Metering Console						Calibration Meter				
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Sample Volume	Outlet Temp Initial	Outlet Temp Final
(Θ)	(P_m)	(V_{mi})	(V_{mf})	(V_m)	(t_{mi})	(t_{mf})	(Vw_i)	(Vw_f)	(V_m)	(t_{wi})	(t_{wf})
min	in H_2O	cubic feet	cubic feet	cubic feet	°F	°F	cubic feet	cubic feet	cubic feet	°F	°F
5.00	5.0	33.777	40.202	6.425	74	75	426.720	433.155	6.435	70.5	70.5
6.00	3.0	46.216	52.223	6.007	75	77	439.145	445.110	5.965	70.5	70.5
7.00	2.0	52.223	57.908	5.685	77	78	445.110	450.730	5.620	70.5	70.5
10.00	1.0	57.908	63.646	5.738	78	78	450.730	456.410	5.680	70.5	70.5
15.00	0.5	40.202	46.216	6.014	75	75	433.155	439.145	5.990	70.5	70.5

Results

Standardized Data				Dry Gas Meter				
				Calibration Factor		Flowrate	ΔH @	
Dry Gas Meter		Calibration Meter		Value	Variation	Std & Corr	0.75 SCFM	Variation
($V_{m(std)}$)	($Q_{m(std)}$)	($Vw_{(std)}$)	($Qw_{(std)}$)	(Y)	(ΔY)	($Q_{m(std)(corr)}$)	(ΔH@)	(ΔΔH@)
cubic feet	cfm	cubic feet	cfm			cfm	in H2O	
6.378	1.276	6.357	1.271	0.9967	-0.002	1.271	1.750	-0.005
5.917	0.986	5.893	0.982	0.9958	-0.003	0.982	1.738	-0.018
5.571	0.796	5.552	0.793	0.9966	-0.002	0.793	1.763	0.007
5.604	0.560	5.611	0.561	1.0013	0.003	0.561	1.750	-0.005
5.899	0.393	5.917	0.394	1.0031	0.004	0.394	1.776	0.021
				0.9987	Y Average		1.755	ΔH@ Average

APEX SOURCE TESTING EQUIPMENT INSTRUMENTS

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

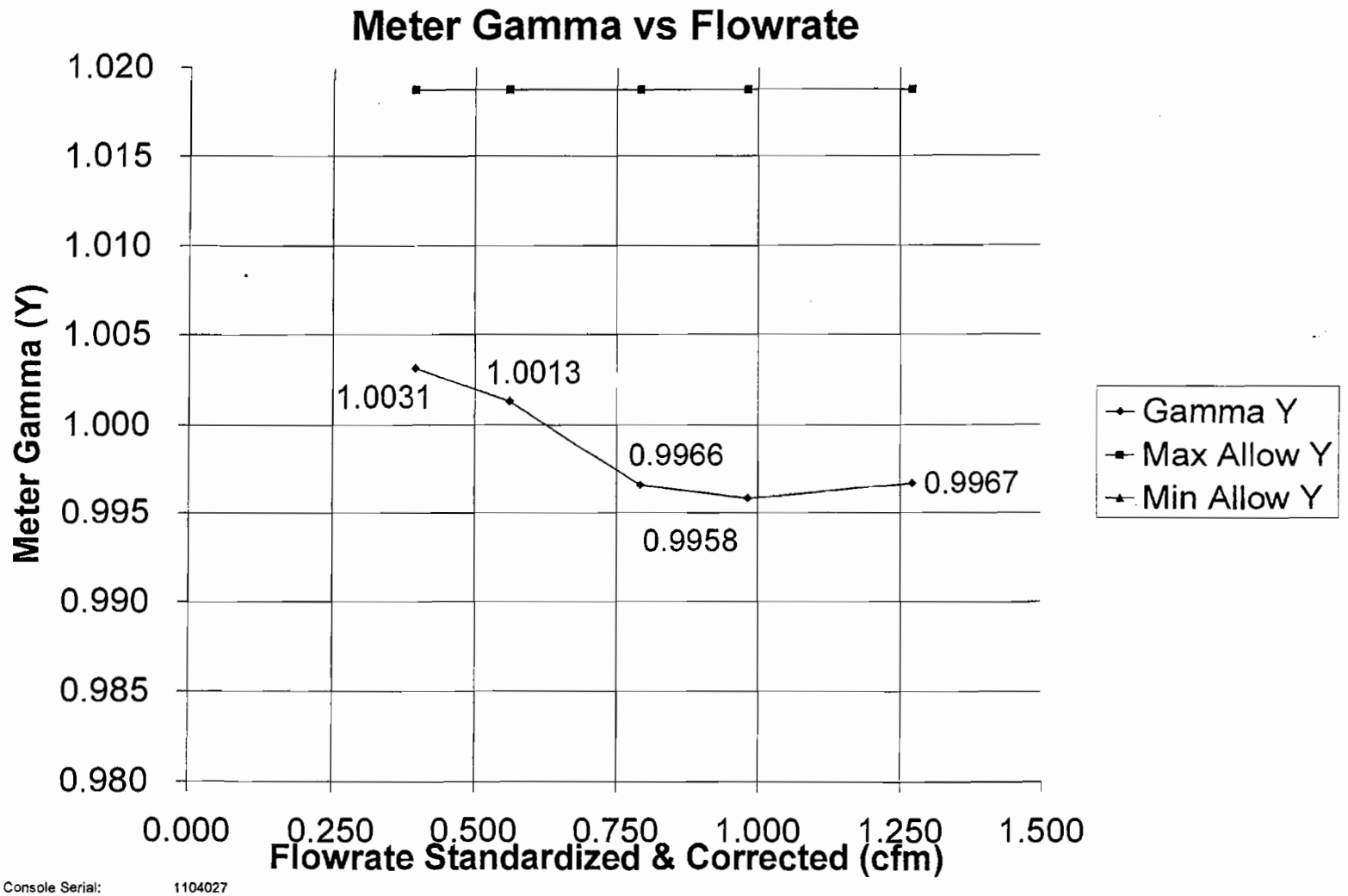
Note: For $\Delta H_@$, orifice pressure differential that equates to 0.75cfm (0.0212m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_2O.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 157, certified 05/26/2006 using PI Tape S/N 20700139, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature Eric Weber Date 4/18/11

Calibration Date: 4-18-2011

Calibration Technician: EW

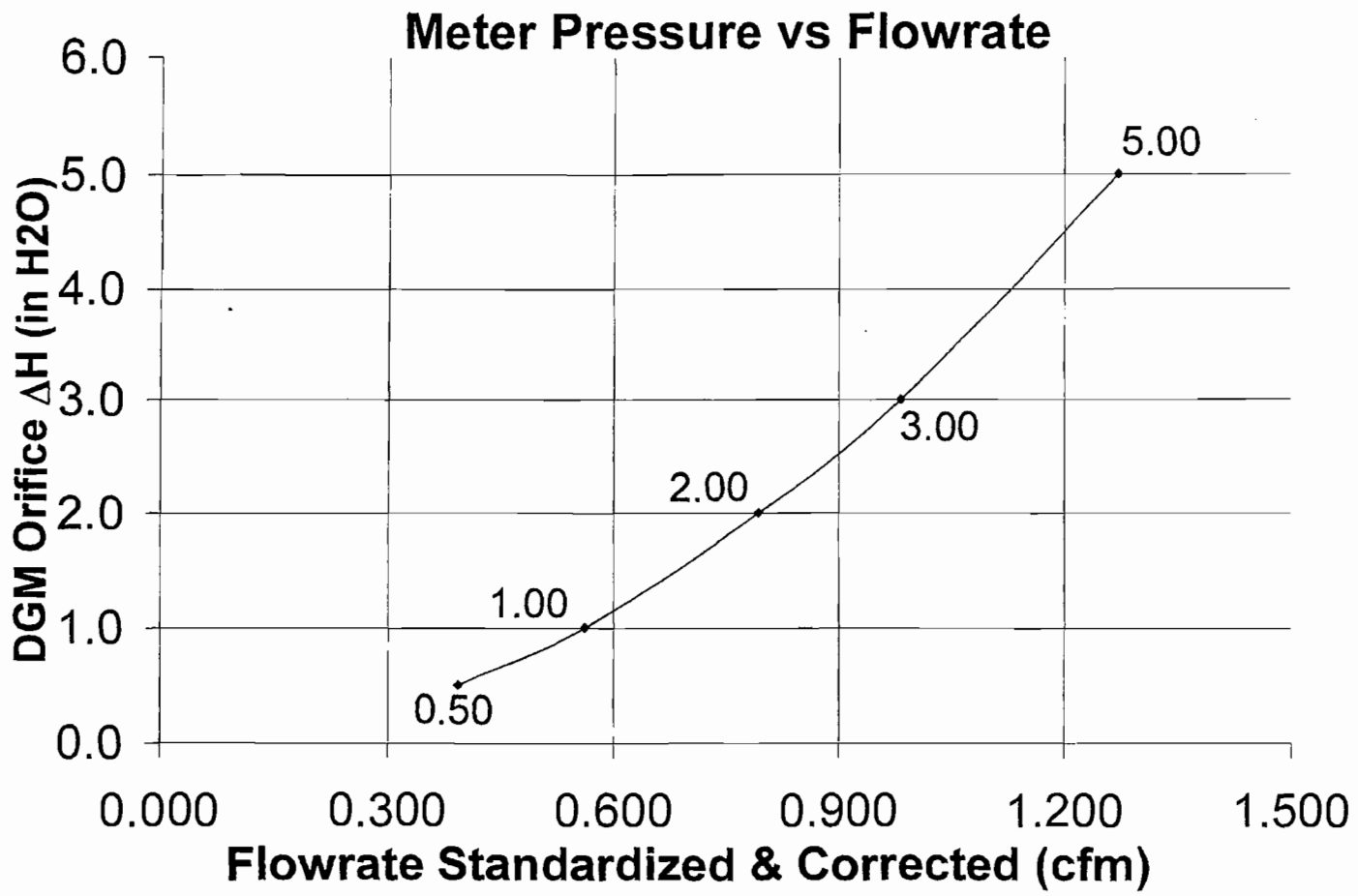


Console Serial: 1104027

Console Model: XC-522

Calibration Date: 4-18-2011

Calibration Technician: EW



Console Serial: 1104027

Console Model: XC-522

Temperature Sensor Calibration Data Sheet

Unit	XC-522	Serial #	1104027
Date	4/18/2011	ThermoCouple No	Model Altek Series 22 Type K
Personnel	EW	Reference	105795
Ambient temp		ASTM Mercury-In-Glass ID	
		NIST Reference TC ID	90728323

Date	Reference Point Number	Source (specify)	Reference Thermometer Temperature F	Thermocouple Display Temperature F	Absolute Temperature Difference %
	1		100	98	0.4
	2		200	200	0.0
	3		300	300	0.0
	4		500	497	0.3
	5		700	700	0.0
	6		900	900	0.0
	7		1100	1100	0.0
	8		1500	1499	0.1
	9		1900	1900	0.0
	10				
	11				
	12				
					0.080
					<1.5

NIST Reference TC ID	**90728323**
Ice Water	**Meter TC**
32° F / 0°	**Reading**
32.0	31.0

Checked By Ew Wt 4/18/11
(Personnel (Sign/Date)

MC-623-1105002 ARI Environmental AIO0050644.xls

APEX INSTRUMENTS METER CONSOLE CALIBRATION

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

Meter Console Information					
Console Model	MC-623	Console Serial Number	1105002	Encoder Model	HEDS-5701-A02
Gas Meter Model	AP25	Totalizer Scale Factor (Initial)	3.9000	Totalizer Model	Red Lion
Gas Meter Serial#	1900905	Totalizer Scale Factor (Final)	**3.9203**	Temp Display Model	Watlow SD31

Calibration Conditions							
WTM ID	539784	Calibration Technician		EW		Calibration Date	5-May-11
WTM Cal Factor	1.0024	Barometric Pressure	(Pb)	759	mm Hg		

	Calibration Data									Results		
	Run Time	Dry Gas Meter			Wet Test Meter		Standardized Volumes			Totalizer Gamma	Totalizer Gamma	Corrected Flowrate
	Elapsed	Gas Pressure	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Wet Test Meter	Value	Variation	
	(Θ)	(P_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	°C	liters	liters	°C	std liters	std liters	std liters			slm
Run 1 - Initial	0.00	100.0	21.0	0.000	901.971	21.0						
Final	5.00	100.0	21.0	18.408	920.752	21.0						
Total/Avg	5.00	100.0	21.0	18.408	18.781	21.0	18.512	18.608	18.751	1.0077	0.008	3.76
Run 2 - Initial	0.00	80.0	21.0	18.408	920.752	21.0						
Final	5.00	80.0	21.0	33.524	935.917	21.0						
Total/Avg	5.00	80.0	21.0	15.116	15.165	21.0	15.172	15.251	15.140	0.9928	-0.007	3.04
Run 3 - Initial	0.00	50.0	21.0	33.524	935.917	21.0						
Final	6.00	50.0	22.0	46.305	948.822	21.0						
Total/Avg	6.00	50.0	21.5	12.781	12.905	21.0	12.770	12.836	12.884	1.0037	0.004	2.15
Run 4 - Initial	0.00	27.0	22.0	46.305	948.822	21.0						
Final	12.00	27.0	22.0	61.148	963.662	21.0						
Total/Avg	12.00	27.0	22.0	14.843	14.840	21.0	14.772	14.849	14.816	0.9978	-0.002	1.24
Run 5 - Initial	0.00	18.0	22.0	61.148	963.662	21.0						
Final	24.00	18.0	22.0	78.484	981.013	22.0						
Total/Avg	24.00	18.0	22.0	17.336	17.351	21.5	17.238	17.328	17.294	0.9980	-0.002	0.72

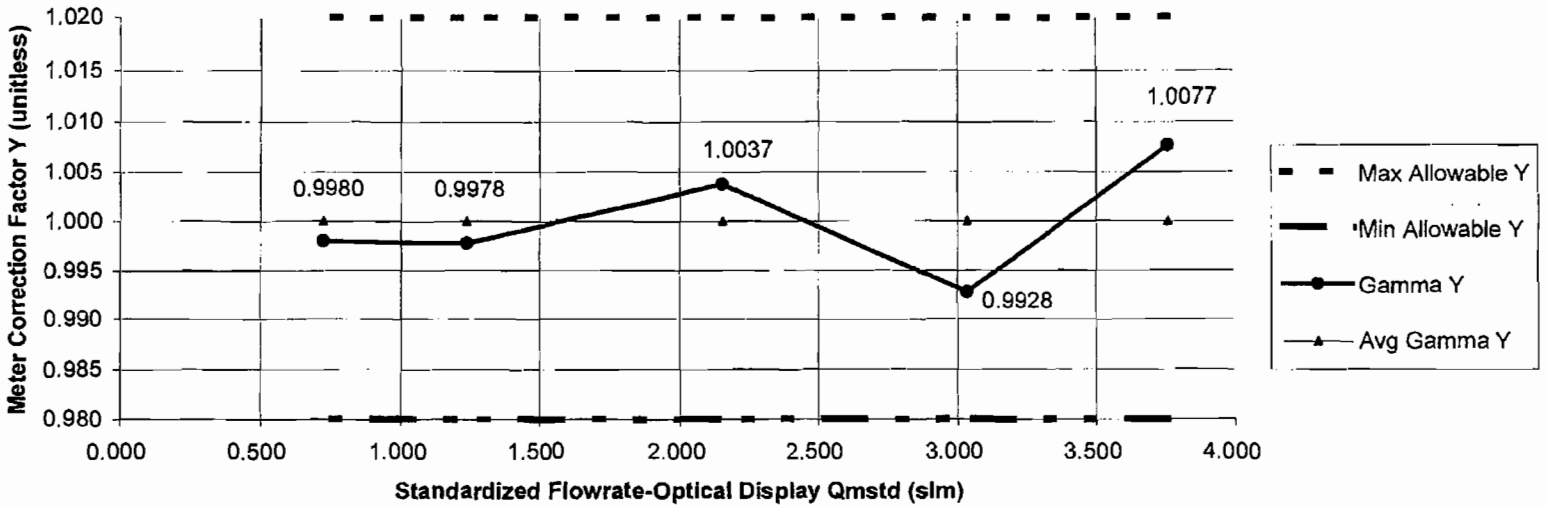
Average Meter Calibration Factor Y	**1.0000**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using a Precision Wet Test Meter, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature Eric Weber Date 5/6/11

Electronic Totalizer Y vs Standardized Flowrate

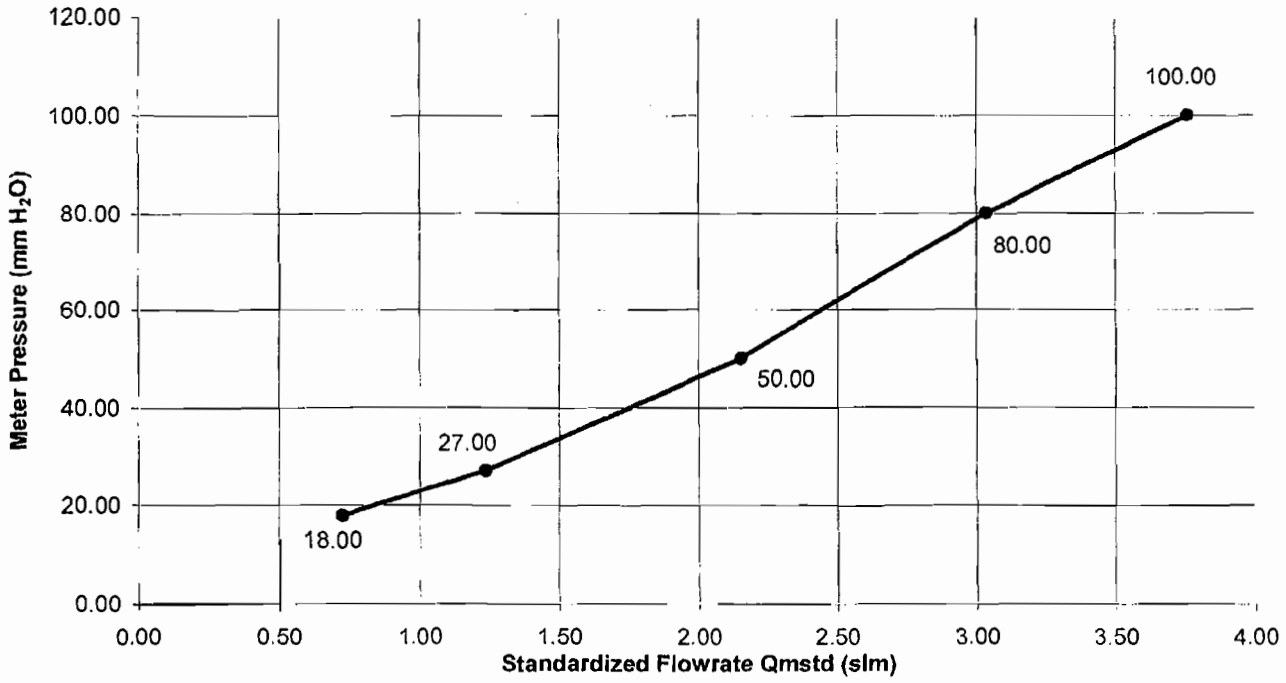


Console Serial: *1105002*

MC-623-1105002 ARI Environmental AIO0050644.xls

Calibration Technician: *EW* *Calibration Date:* *5-5-2011*

Meter Pressure vs Standardized Flowrate

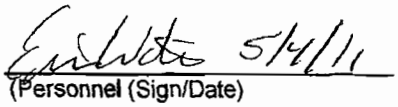


Temperature Sensor Calibration Data Sheet

Unit	MC-623	Serial #	1105002
Date	5/4/2011	ThermoCouple No	Model Altek Series 22 Type K
Personnel	EW	Reference	105795

Reference Point Number	Reference Thermometer Temperature C	Thermocouple Display Temperature C	Absolute Temperature Difference %
1	38	38	0.0
2	93	93	0.0
3	149	149	0.0
4	260	259	0.2
5	371	370	0.2
6	482	482	0.0
7	593	594	-0.1
8	816	816	0.0
9	1038	1038	0.0
10			
11			
12			
			0.025
			<1.5

NIST Reference TC ID	**90728323**
Ice Water	**Meter TC**
32° F / 0° C	**Reading**
0.00	0.000

Checked By  5/4/11
(Personnel (Sign/Date)

ARI Environmental, Inc.
EPA METHOD 5
Post-test Meter Box Calibration

Model #: Apex 522
Serial #: 504019
Pretest Y: 1.005
Pretest ΔH@: 1.87

Operator: RC
Date: 8/3/2011

Post-Test, Orifice Method
English Units

Barometric Pressure: 30.09 in.Hg

ΔH	Time		DRY GAS METER VOLUME			METER TEMPERATURE INLET Initial / Final	METER TEMPERATURE OUTLET Initial / Final	ORIFICE		VAC.	AMBIENT TEMPERATURE		
	Minutes	Seconds	Initial	Final	Total[1]			Number	K factor	in. Hg[2]	Inital	Final	Avg.
1.65	10	0	899.600	906.575	6.975	88 / 89	88 / 89	AJ63	0.5482	9.0	98	98	98.0
1.65	10	0	906.575	913.556	6.981	89 / 91	89 / 91	AJ63	0.5482	9.0	98	98	98.0
1.65	10	0	913.556	920.548	6.992	91 / 93	91 / 93	AJ63	0.5482	9.0	98	98	98.0

METER FLOW (cubic feet)	ORIFICE FLOW (cubic feet)	METER CALIBRATION FACTOR, Yc[3]	DH @[4]
6.780	6.983	1.0300	1.859
6.767	6.983	1.0319	1.854
6.753	6.983	1.0340	1.847

AVG. POST-TEST METER CALIBRATION FACTOR =	**1.032**	**1.85**

PERCENT DIFFERENCE FROM PRETEST Y= 2.69
MAXIMUM ALLOWABLE DIFFERENCE= 5.00

1 Must pull at least 5 cubic feet per orifice

2 Vacuum must be 15" of Hg or greater

3 Individual Ys can not vary from +/-0.02Y of the average

4 Delta H@ can not be more than +/- 0.15 of average dealta H

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: RC
Date: 8/3/2011

Meterbox No.: 504019
Calibrator No.: CL-300-21001

Calibrator	Digital Temperature Readout									
Setting	PROBE		STACK		FILTER		EXIT		AUX	
° F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	0	0.00	1	0.22	0	0.00	0	0.00	0	0.00
200	199	0.15	198	0.30	198	0.30	199	0.15	198	0.30
400	398	0.23	398	0.23	397	0.35	398	0.23	397	0.35
600	598	0.19	598	0.19	597	0.28	598	0.19	598	0.19
800	800	0.00	797	0.24	798	0.16	799	0.08	799	0.08
1000	999	0.07	999	0.07	999	0.07	999	0.07	999	0.07
1200	1199	0.06	1198	0.12	1198	0.12	1198	0.12	1199	0.06
1400	1399	0.05	1397	0.16	1398	0.11	1398	0.11	1399	0.05
1600	1598	0.10	1599	0.05	1597	0.15	1598	0.10	1598	0.10
1800	1799	0.04	1799	0.04	1798	0.09	1799	0.04	1799	0.04

Actual Maximum Difference = 0.35 %
Allowable Maximum Difference = 1.50 %

ARI Environmental, Inc.
EPA METHOD 5
Initial Meter Box Calibration

Model No: Apex 522
Serial No. 504019

Operator: ZRM
Date: 11/12/2010

Pre-Test, Orifice Method
English Units

Barometric Pressure: 30.16 in.Hg

ΔH	Time		DRY GAS METER VOLUME			METER TEMPERATURE INLET Initial / Final	METER TEMPERATURE OUTLET Initial / Final	ORIFICE		VAC.	AMBIENT TEMPERATURE		
in. H2O	Minutes	Seconds	Initial	Final	Total[1]			Number	K factor	in. Hg[2]	Inital	Final	Avg.
0.57	10	51	437.100	441.572	4.472	71 / 72	71 / 72	AJ47	0.3164	18.5	73	73	73.0
1.05	10	5	441.700	447.350	5.650	72 / 72	72 / 72	AJ55	0.4303	16.5	73	73	73.0
1.75	10	5	447.500	454.698	7.198	72 / 74	72 / 74	AJ63	0.5482	14.5	73	73	73.0
3.20	11	52	455.100	466.780	11.680	74 / 76	74 / 76	AJ73	0.7621	11.5	74	74	74.0
4.70	10	5	467.100	479.123	12.023	76 / 77	76 / 77	AJ81	0.9339	10.0	74	74	74.0

METER FLOW (cubic feet)	ORIFICE FLOW (cubic feet)	METER CALIBRATION FACTOR, Yc[3]	DH @[4]
4.484	4.485	1.0001	1.886
5.667	5.668	1.0002	1.881
7.218	7.221	1.0004	1.934
11.710	11.803	1.0079	1.840
12.064	12.290	1.0188	1.807

AVG. PRETEST METER CALIBRATION FACTOR: Y[5] = 1.005 ΔH@[6] = 1.87

1 Must pull at least 5 cubic feet per orifice
2 Vacuum must be 15" of Hg or greater
3 Individual Ys can not vary from +/-0.02Y of the average
4 Delta H@ can not be more than +/- 0.15 of average delta H
5 Ideal Y is 1.000 and can vary no more than +/- 0.05
6 Ideal Delta H@ is 1.84 and should not vary more than 0.2

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: ZRM
Date: 11/12/2010

Meterbox No.: 504019
Calibrator No.: CL-300-21001

Calibrato	Digital Temperature Readout									
Setting	PROBE		STACK		FILTER		EXIT		AUX	
° F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	-2	0.43	0	0.00	0	0.00	-1	0.22	-1	0.22
200	198	0.30	200	0.00	200	0.00	200	0.00	201	0.15
400	397	0.35	397	0.35	397	0.35	397	0.35	397	0.35
600	600	0.00	600	0.00	600	0.00	600	0.00	600	0.00
800	801	0.08	802	0.16	802	0.16	802	0.16	803	0.24
1000	1001	0.07	1001	0.07	1001	0.07	1001	0.07	1002	0.14
1200	1198	0.12	1198	0.12	1198	0.12	1198	0.12	1199	0.06
1400	1399	0.05	1400	0.00	1400	0.00	1401	0.05	1401	0.05
1600	1599	0.05	1599	0.05	1598	0.10	1600	0.00	1599	0.05
1800	1800	0.00	1801	0.04	1801	0.04	1801	0.04	1801	0.04

Actual Maximum Difference = **0.43** **%**
Allowable Maximum Difference = 1.50 %

ARI Environmental, Inc.
EPA METHOD 5
Post-test Meter Box Calibration

Model #: Apex 522
Serial #: 40828
Pretest Y: 0.997
Pretest ΔH@: 1.85

Operator: RC
Date: 8/3/2011

Post-Test, Orifice Method
English Units

Barometric Pressure: 30.09 in.Hg

ΔH	Time		DRY GAS METER VOLUME			METER TEMPERATURE INLET Initial / Final	METER TEMPERATURE OUTLET Initial / Final	ORIFICE		VAC.	AMBIENT TEMPERATURE		
	Minutes	Seconds	Initial	Final	Total[1]			Number	K factor	in. Hg[2]	Inital	Final	Avg.
1.80	10	30	691.400	699.460	8.060	104 / 105	97 / 98	AJ63	0.5482	16.0	98	98	98.0
1.80	10	0	699.460	707.145	7.685	105 / 106	98 / 99	AJ63	0.5482	16.0	98	98	98.0
1.80	10	20	707.145	715.075	7.930	106 / 107	99 / 100	AJ63	0.5482	15.0	98	98	98.0

METER FLOW (cubic feet)	ORIFICE FLOW (cubic feet)	METER CALIBRATION FACTOR, Yc[3]	DH @[4]
7.663	7.332	0.9569	1.984
7.293	6.983	0.9575	1.981
7.512	7.216	0.9606	1.977

AVG. POST-TEST METER CALIBRATION FACTOR =	**0.958**	**1.98**

PERCENT DIFFERENCE FROM PRETEST Y= 3.88
MAXIMUM ALLOWABLE DIFFERENCE= 5.00

Vacuum must be 15" of Hg or greater

4

Delta H@ can not be more than +/- 0.15 of average dealta H

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: RC
Date: 8/3/2011

Meterbox No.: 40828
Calibrator No.: CL-300-21001

Calibrator	Digital Temperature Readout									
Setting	PROBE		STACK		FILTER		EXIT		AUX	
° F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	2	0.43	2	0.43	2	0.43	2	0.43	2	0.43
200	201	0.15	201	0.15	201	0.15	201	0.15	201	0.15
400	399	0.12	399	0.12	399	0.12	399	0.12	399	0.12
600	599	0.09	599	0.09	599	0.09	599	0.09	599	0.09
800	799	0.08	799	0.08	799	0.08	800	0.00	799	0.08
1000	999	0.07	999	0.07	1000	0.00	1000	0.00	1000	0.00
1200	1199	0.06	1199	0.06	1199	0.06	1199	0.06	1199	0.06
1400	1396	0.22	1396	0.22	1396	0.22	1396	0.22	1396	0.22
1600	1597	0.15	1597	0.15	1597	0.15	1597	0.15	1597	0.15
1800	1795	0.22	1794	0.27	1795	0.22	1793	0.31	1795	0.22

ARI Environmental, Inc.
EPA METHOD 5
Initial Meter Box Calibration

Model No: Apex 522
Serial No. 40828

Operator: ZRM
Date: 11/12/2010

Pre-Test, Orifice Method
English Units

Barometric Pressure: 30.16 in.Hg

ΔH	Time		DRY GAS METER VOLUME			METER TEMPERATURE		ORIFICE		VAC.	AMBIENT TEMPERATURE		
						INLET	OUTLET						
						Initial	Initial						
in. H2O	Minutes	Seconds	Initial	Final	Total[1]	Final	Final	Number	K factor	in. Hg[2]	Inital	Final	Avg.
						84	81						
0.55	20	15	948.250	956.890	8.640	84	81	AJ47	0.3164	19.5	77	77	77.0
						84	81						
1.05	11	6	957.200	963.421	6.221	85	81	AJ55	0.4303	17.0	77	77	77.0
						86	81						
1.70	14	21	964.100	974.739	10.639	88	82	AJ63	0.5482	15.5	77	77	77.0
						88	82						
3.40	10	4	975.000	985.222	10.222	92	83	AJ73	0.7621	12.5	77	77	77.0
						93	83						
4.80	10	8	986.200	998.612	12.412	98	84	AJ81	0.9339	10.5	77	77	77.0

METER FLOW (cubic feet)	ORIFICE FLOW (cubic feet)	METER CALIBRATION FACTOR, Yc[3]	DH @[4]
8.488	8.339	0.9824	1.796
6.116	6.216	1.0164	1.858
10.447	10.238	0.9800	1.854
10.042	9.985	0.9943	1.927
12.163	12.317	1.0127	1.813

AVG. PRETEST METER CALIBRATION FACTOR: Y[5] = 0.997 ΔH@[6] = 1.85

1 Must pull at least 5 cubic feet per orifice
2 Vacuum must be 15" of Hg or greater
3 Individual Ys can not vary from +/-0.02Y of the average
4 Delta H@ can not be more than +/- 0.15 of average delta H
5 Ideal Y is 1.000 and can vary no more than +/- 0.05
6 Ideal Delta H@ is 1.84 and should not vary more than 0.2

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: ZRM
Date: 11/12/2010

Meterbox No.: 40828
Calibrator No.: CL-300-21001

Calibrato	Digital Temperature Readout									
Setting	PROBE		STACK		FILTER		EXIT		AUX	
° F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
200	201	0.15	201	0.15	201	0.15	201	0.15	201	0.15
400	397	0.35	397	0.35	397	0.35	397	0.35	397	0.35
600	600	0.00	600	0.00	599	0.09	599	0.09	600	0.00
800	801	0.08	801	0.08	801	0.08	801	0.08	801	0.08
1000	1001	0.07	1001	0.07	1000	0.00	1000	0.00	1000	0.00
1200	1198	0.12	1198	0.12	1198	0.12	1198	0.12	1198	0.12
1400	1396	0.22	1396	0.22	1396	0.22	1396	0.22	1396	0.22
1600	1598	0.10	1598	0.10	1597	0.15	1598	0.10	1597	0.15
1800	1795	0.22	1795	0.22	1795	0.22	1795	0.22	1795	0.22

Actual Maximum Difference = **0.35** %
Allowable Maximum Difference = 1.50 %

POST TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 100196
BAROMETRIC PRESSURE: 30
DATE: 8/4/2011
CALIBRATED BY: RC
PRETEST Y FACTOR: 0.975

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE L/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
1.0	1.020	10.00	0.0	10.133	10.13	10.20	1.007
1.0	1.020	10.50	0.0	10.785	10.79	10.71	0.993
1.0	1.070	10.33	0.0	11.083	11.08	11.06	0.998
						Average =	0.999

PRETEST Y FACTOR = 0.975
POSTTEST Y FACTOR = 0.999
DIFFERENCE, % = 2.4 (Must be < 5%)

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: RC
Date: 8/4/2011

Meterbox No.: 100198
Calibrator No.: CL-300-21001

Calibrator	Digital Temperature Readout									
Setting	PROBE		STACK		FILTER		EXIT		AUX	
* F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	-1	0.22	-1	0.22	-1	0.22	-1	0.22	-1	0.22
200	199	0.15	199	0.15	199	0.15	199	0.15	199	0.15
400	399	0.12	399	0.12	399	0.12	399	0.12	399	0.12
600	601	0.09	601	0.09	601	0.09	601	0.09	601	0.09
800	810	0.79	810	0.79	809	0.71	809	0.71	809	0.71
1000	1020	1.37	1019	1.30	1019	1.30	1019	1.30	1020	1.37
1200	1220	1.20	1220	1.20	1220	1.20	1220	1.20	1220	1.20
1400	1426	1.40	1426	1.40	1426	1.40	1426	1.40	1426	1.40
1600	1628	1.36	1628	1.36	1628	1.36	1628	1.35	1628	1.36
1800	1832	1.42	1832	1.42	1832	1.42	1832	1.42	1832	1.42

Actual Maximum Difference = **1.42** %
Allowable Maximum Difference = 1.50 %

PRE TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 100196
BAROMETRIC PRESSURE: 30.15
DATE: 7/20/2010
CALIBRATED BY: DWM

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE ml/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
0.5	556.1	10.0	0.1	5.8	5.67	5.56	0.981
1.0	992.3	10.0	11.4	21.7	10.34	9.92	0.960
1.5	1,555.0	10.0	23.6	39.7	16.09	15.55	0.966
2.0	2,323.0	10.5	64.0	88.5	24.51	24.39	0.995
						Average =	0.975

THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: DWM
Date: 7/20/2010

Meterbox No.: 100196
Calibrator No.: CL-300-21001

Calibrator Setting	Digital Temperature Readout									
	PROBE		FILTER		AUX		BLANK		BLANK	
°F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	-2	0.43	-2	0.43	-1	0.22	0	0.00	-2	0.43
200	200	0.00	201	0.15	200	0.00	201	0.15	200	0.00
400	398	0.23	399	0.12	399	0.23	398	0.12	398	0.23
600	603	0.28	604	0.38	603	0.28	604	0.38	603	0.28
800	811	0.87	812	0.95	811	0.87	813	1.03	812	0.95
1000	1021	1.44	1022	1.51	1021	1.44	1022	1.51	1021	1.44
1200	1228	1.89	1230	1.81	1229	1.75	1230	1.81	1229	1.75
1400	1436	1.94	1437	1.99	1436	1.94	1438	2.04	1437	1.99
1600	1637	1.80	1639	1.89	1628	1.36	1640	1.94	1638	1.84
1800	1832	1.42	1834	1.50	1833	1.46	1835	1.55	1834	1.50

Actual Maximum Difference = 2.04 %
Allowable Maximum Difference = 1.50 %

PRE TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 100196
BAROMETRIC PRESSURE: 29.98
DATE: 11/12/2010
CALIBRATED BY: ZrM

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE ml/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
0.5	562.1	10.0	0.1	5.8	5.67	5.62	0.991
1.0	998.8	10.0	11.4	21.7	10.34	9.99	0.966
1.5	1,563.0	10.0	23.6	39.7	16.09	15.63	0.971
2.0	2,331.1	10.5	64.0	88.5	24.51	24.48	0.999
						Average =	0.982

THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: ZrM
Date: 11/12/2010

Meterbox No.: 100196
Calibrator No.: CL-300-21001

Calibrator Setting	Digital Temperature Readout									
	PROBE		FILTER		AUX		BLANK		BLANK	
° F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	-2	0.43	-2	0.43	-1	0.22	0	0.00	-2	0.43
200	200	0.00	201	0.15	200	0.00	201	0.15	200	0.00
400	398	0.23	399	0.12	399	0.23	398	0.12	398	0.23
600	603	0.28	604	0.38	603	0.28	604	0.38	603	0.28
800	811	0.87	812	0.95	811	0.87	813	1.03	812	0.95
1000	1021	1.44	1022	1.51	1021	1.44	1022	1.51	1021	1.44
1200	1228	1.89	1230	1.81	1229	1.75	1230	1.81	1228	1.75
1400	1436	1.94	1437	1.99	1436	1.94	1439	2.04	1437	1.99
1600	1637	1.80	1639	1.89	1628	1.36	1640	1.94	1638	1.84
1800	1832	1.42	1834	1.50	1833	1.46	1835	1.55	1834	1.50

Actual Maximum Difference = 2.04 %
Allowable Maximum Difference = 1.50 %

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POST TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 8003208
BAROMETRIC PRESSURE: 30
DATE: 8/4/2011
CALIBRATED BY: RC
PRETEST Y FACTOR: 0.951

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE L/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
1.0	1.027	10.0	211.8	222.4	**10.60**	**10.27**	**0.969**
1.0	1.006	10.0	222.4	232.8	**10.40**	**10.06**	**0.967**
1.0	1.011	10.0	232.8	243.2	**10.40**	**10.11**	**0.972**
						Average =	**0.969**

PRETEST Y FACTOR = **0.951**
POSTTEST Y FACTOR = **0.969**
DIFFERENCE, % = **1.9 (Must be < 5%)**

PRE TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 8003208
BAROMETRIC PRESSURE: 30.15
DATE: 2/16/2011
CALIBRATED BY: RM

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE ml/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
0.5	508.0	10.0	267.4	272.8	**5.40**	**5.08**	**0.941**
1.0	1,043.0	10.0	272.8	284.2	**11.40**	**10.43**	**0.915**
1.5	1,502.0	10.0	284.2	299.8	**15.60**	**15.02**	**0.963**
2.0	2,078.0	11.5	299.8	324.0	**24.20**	**23.90**	**0.987**
						Average =	**0.951**

ARI Environmental, Inc.
EPA METHOD 5
Post-test Meter Box Calibration

Model #: Apex 522
Serial #: 1104027
Pretest Y: 0.999
Pretest ΔH@: 1.76

Operator: RC
Date: 8/3/2011

Post-Test, Orifice Method
English Units

Barometric Pressure: 30.12 in.Hg

ΔH	Time		DRY GAS METER VOLUME			METER TEMPERATURE		ORIFICE		VAC.	AMBIENT TEMPERATURE		
						INLET	OUTLET						
						Initial	Initial						
	Minutes	Seconds	Initial	Final	Total[1]	Final	Final	Number	K factor	in. Hg[2]	Inital	Final	Avg.
						88	89						
1.65	10	0	377.600	385.033	7.433	88	89	AJ63	0.5482	17.0	95	96	95.5
						89	91						
1.65	10	0	385.033	392.325	7.292	89	91	AJ63	0.5482	17.0	96	96	96.0
						91	92						
1.65	10	0	392.325	399.610	7.285	91	92	AJ63	0.5482	17.0	96	97	96.5

METER FLOW (cubic feet)	ORIFICE FLOW (cubic feet)	METER CALIBRATION FACTOR, Yc[3]	DH @[4]
7.232	7.006	0.9687	1.849
7.075	7.003	0.9897	1.845
7.049	6.999	0.9929	1.842

. POST-TEST METER CALIBRATION FACTOR =	**0.984**	**1.85**

PERCENT DIFFERENCE FROM PRETEST Y= 1.50
MAXIMUM ALLOWABLE DIFFERENCE= 5.00

1 Must pull at least 5 cubic feet per orifice

2 Vacuum must be 15" of Hg or greater

3 Individual Ys can not vary from +/-0.02Y of the average

4 Delta H@ can not be more than +/- 0.15 of average dealta H

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: RC
Date: 8/3/2011

Meterbox No.: 1104027
Calibrator No.: CL-300-21001

Calibrator	Digital Temperature Readout									
Setting	PROBE		STACK		FILTER		EXIT		AUX	
° F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
200	200	0.00	200	0.00	200	0.00	200	0.00	200	0.00
400	399	0.12	400	0.00	400	0.00	400	0.00	400	0.00
600	599	0.09	598	0.19	599	0.09	599	0.09	598	0.19
800	800	0.00	800	0.00	799	0.08	799	0.08	799	0.08
1000	999	0.07	999	0.07	999	0.07	999	0.07	999	0.07
1200	1200	0.00	1200	0.00	1200	0.00	1200	0.00	1200	0.00
1400	1399	0.05	1399	0.05	1399	0.05	1399	0.05	1400	0.00
1600	1599	0.05	1599	0.05	1600	0.00	1598	0.10	1599	0.05
1800	1799	0.04	1799	0.04	1800	0.00	1800	0.00	1800	0.00

Actual Maximum Difference = 0.19 %
Allowable Maximum Difference = 1.50 %

POST TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 1105003
BAROMETRIC PRESSURE: 30.09
DATE: 8/3/2011
CALIBRATED BY: RC
PRETEST Y FACTOR: 1.000

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE L/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
1.0	1.045	10.00	0.0	10.816	10.82	10.45	0.966
1.0	1.055	10.00	0.0	10.882	10.88	10.55	0.969
1.0	1.070	10.00	0.0	11.033	11.03	10.70	0.970
						Average =	0.968

PRETEST Y FACTOR = 1.000
POSTTEST Y FACTOR = 0.968
DIFFERENCE, % = -3.3 (Must be < 5%)

ARI ENVIRONMENTAL, INC.
EPA METHOD 5
THERMOCOUPLE DIGITIAL INDICATOR CALIBRATION DATA SHEET

Operator: RC
Date: 8/3/2011

Meterbox No.: 1105003
Calibrator No.: CL-300-21001

Calibrator	Digital Temperature Readout									
Setting	PROBE		Blank		FILTER		Blank		AUX	
°F	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.	Acutal	Diff.
0	-2	0.43	-2	0.43	-2	0.43	-2	0.43	-2	0.43
200	198	0.15	199	0.15	199	0.15	199	0.15	199	0.15
400	399	0.12	399	0.12	398	0.23	399	0.12	398	0.23
600	599	0.09	599	0.09	598	0.19	599	0.09	598	0.19
800	799	0.08	799	0.08	799	0.08	798	0.16	798	0.16
1000	999	0.07	999	0.07	999	0.07	999	0.07	999	0.07
1200	1199	0.06	1199	0.06	1199	0.06	1199	0.06	1199	0.06
1400	1399	0.05	1399	0.05	1399	0.05	1399	0.05	1399	0.05
1600	1599	0.05	1599	0.05	1599	0.05	1599	0.05	1599	0.05
1800	1800	0.00	1800	0.00	1800	0.00	1800	0.00	1800	0.00

Actual Maximum Difference = 0.43 %
Allowable Maximum Difference = 1.50 %

MC-623-1105003 ARI Environmental AIO0050644.xls

APEX INSTRUMENTS METER CONSOLE CALIBRATION

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

Meter Console Information					
Console Model	MC-623	Console Serial Number	1105003	Encoder Model	HEDS-5701-A02
Gas Meter Model	AP25	Totalizer Scale Factor (Initial)	3.9000	Totalizer Model	Red Lion
Gas Meter Serial#	N/A	Totalizer Scale Factor (Final)	3.8671	Temp Display Model	Watlow SD31

Calibration Conditions							
WTM ID	539784	Calibration Technician		EW		Calibration Date	5-May-11
WTM Cal Factor	1.0024	Barometric Pressure	(Pb)	759	mm Hg		

	Calibration Data									Results		
	Run Time	Dry Gas Meter			Wet Test Meter		Standardized Volumes			Totalizer Gamma	Totalizer Gamma	Corrected Flowrate
	Elapsed	Gas Pressure	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Wet Test Meter	Value	Variation	
	(Θ)	(P_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	°C	liters	liters	°C	std liters	std liters	std liters			slm
Run 1 - Initial	0.00	100.0	23.0	0.000	205.800	22.0						
Final	5.00	100.0	23.0	18.763	224.408	22.5						
Total/Avg	5.00	100.0	23.0	18.763	18.608	22.3	18.741	18.584	18.499	0.9955	-0.005	3.71
Run 2 - Initial	0.00	77.0	23.0	18.763	224.408	22.5						
Final	5.00	77.0	24.0	34.320	239.876	22.5						
Total/Avg	5.00	77.0	23.5	15.557	15.468	22.5	15.479	15.348	15.365	1.0011	0.001	3.08
Run 3 - Initial	0.00	48.0	24.0	34.320	239.876	22.5						
Final	6.00	48.0	24.0	47.280	252.737	22.5						
Total/Avg	6.00	48.0	24.0	12.960	12.861	22.5	12.837	12.729	12.775	1.0036	0.004	2.13
Run 4 - Initial	0.00	26.0	24.0	47.280	252.737	22.5						
Final	12.00	26.0	24.0	60.961	266.253	23.0						
Total/Avg	12.00	26.0	24.0	13.681	13.516	22.8	13.523	13.409	13.414	1.0004	0.000	1.12
Run 5 - Initial	0.00	17.0	24.0	60.961	266.253	23.0						
Final	24.00	17.0	24.0	77.860	282.931	23.0						
Total/Avg	24.00	17.0	24.0	16.899	16.678	23.0	16.689	16.548	16.539	0.9994	-0.001	0.69

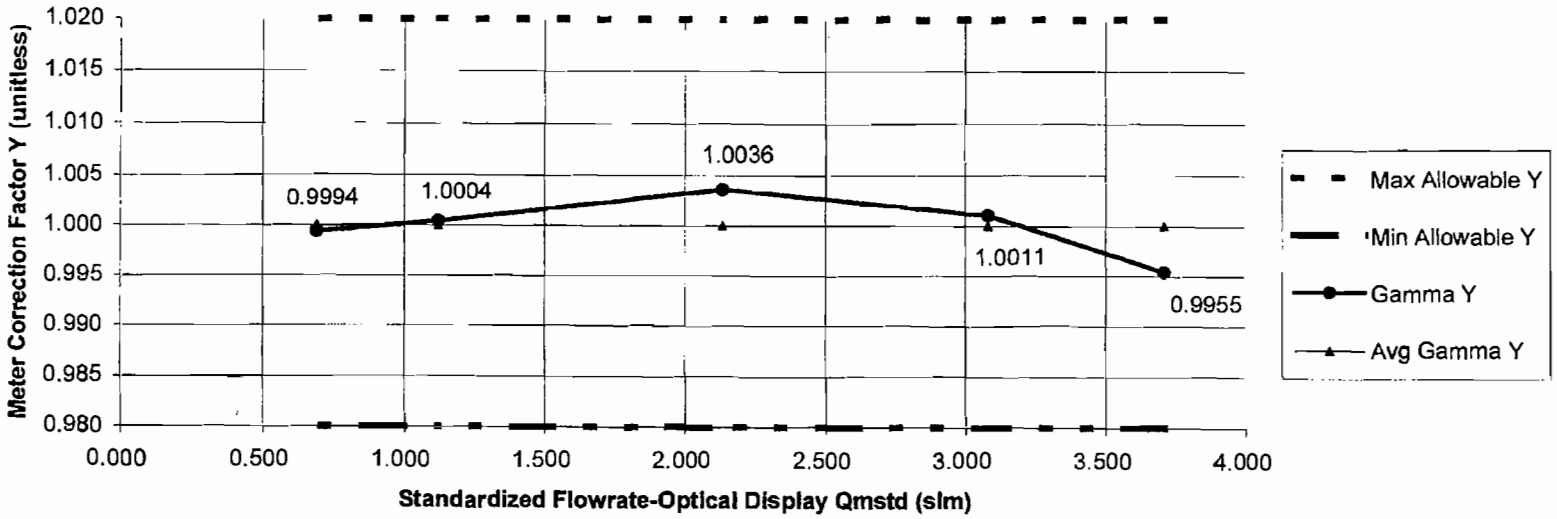
Average Meter Calibration Factor Y	1.0000

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using a Precision Wet Test Meter, which in turn was calibrated using the American Bell Prover # 3785, certificate # I-107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature Carl Webb Date 5/5/11

Electronic Totalizer Y vs Standardized Flowrate

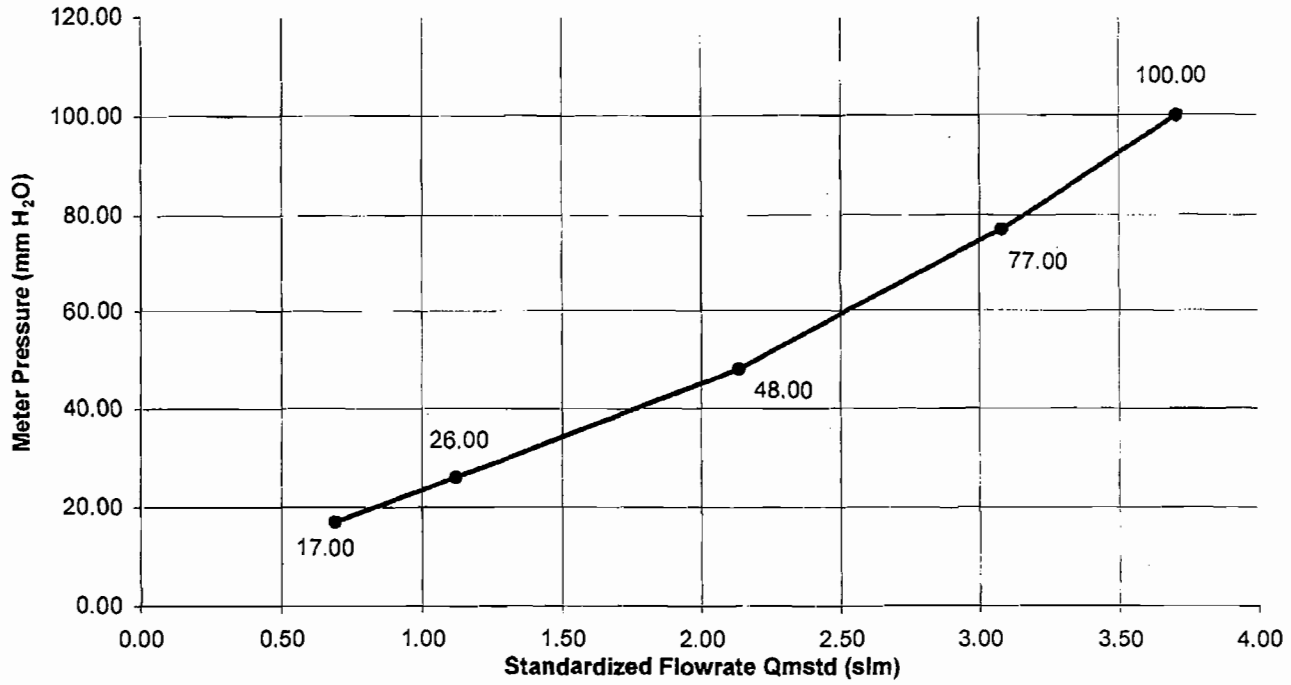


Console Serial: *1105003*

MC-623-1105003 ARI Environmental AIO0050644.xls

Calibration Technician: *EW* *Calibration Date:* *5-5-2011*

Meter Pressure vs Standardized Flowrate



Temperature Sensor Calibration Data Sheet

Unit	MC-623	Serial #	1105003
Date	5/5/2011	ThermoCouple No	Model Altek Series 22 Type K
Personnel	EW	Reference	105795

Reference Point Number	Reference Thermometer Temperature C	Thermocouple Display Temperature C	Absolute Temperature Difference %
1	38	38	0.0
2	93	93	0.0
3	149	149	0.0
4	260	260	0.0
5	371	371	0.0
6	482	482	0.0
7	593	593	0.0
8	816	816	0.0
9	1038	1038	0.0
10			
11			
12			
			0.000
			<1.5

NIST Reference TC ID	**90728323**
Ice Water	**Meter TC**
32° F / 0° C	**Reading**
0.00	0.000

Checked By Eric Wats 5/5/11
(Personnel (Sign/Date)

POST TEST METER CALIBRATION DATA AND CALCULATION FORM

COMPANY: ARI Environmental

METER NUMBER: 8003208
BAROMETRIC PRESSURE: 29.91
DATE: 8/12/2011
CALIBRATED BY: RC
PRETEST Y FACTOR: 0.951

ROTAMETER SETTING liters/min	GILIBRATOR FLOWRATE L/min	TIME minutes	PK III INITIAL READING liters	PK III FINAL READING liters	PK III VOLUME (Vm) liters	CALCULATED GILIBRATOR VOLUME (Vw) liters	CALCULATED Y
1.0	1.034	10.0	30.0	40.6	**10.60**	**10.34**	**0.975**
1.0	1.021	10.0	40.6	51.1	**10.50**	**10.21**	**0.972**
1.0	0.998	10.0	51.1	61.4	**10.30**	**9.98**	**0.969**
						Average =	**0.972**

PRETEST Y FACTOR = 0.951
POSTTEST Y FACTOR = 0.972
DIFFERENCE, % = 2.2 (Must be < 5%)

APPENDIX F

Test Program Qualifications

Test Program Qualifications

ARI Environmental's offices in Wauconda, Illinois and Pasadena, Texas specialize in conducting stack emission, fugitive leak detection, ambient air and in-plant OSHA type testing for industrial clients.

ARI is organized so that its facilities and resources meet the requirements of ASTM D7036, Standard Practice for Competence of Air Emission Testing Bodies. ARI's laboratories in Pasadena, Texas and Wauconda, Illinois hold TCEQ NELAP Certificate No. T104704428-10-2.

During the past 27 years, ARI personnel have conducted over 5,000 separate stack emission tests for a variety of industrial clients throughout North America for the determination of degree of source compliance and to yield emissions data and control equipment performance data for in-house engineering purposes.

ARI presently has over 80 trained personnel for conducting source emission sampling, fugitive leak detection monitoring, ambient air monitoring and OSHA sampling programs. All test programs are supervised and conducted by onsite Qualified Individuals (QI) and/or Qualified Source Testing Individuals (QSTI) pursuant to ASTM D7036.

The key personnel involved in the test program were as follows:

Greg Burch
Mr. Burch is ARI's Source Testing Division South Central Regional Manager and is responsible for planning and managing sampling programs, sample analysis, data reduction, QA/QC reviews, and reporting activity for the regional office. He is certified as a QSTI through the Source Evaluation Society (SES). Mr. Burch has been involved with source testing since 1990. He has accumulated extensive experience in flow stream characterization for engineering purposes; emissions sampling for regulatory compliance demonstration and emissions sampling for system audit requirements of CEMS and PEMS.

Jeff Knapp
Mr. Knapp is a Project Manager with ARI. His 20 years experience includes emission compliance and CEM certification testing for a wide variety of industries including petrochemical, steel mills, electric utilities, cement plants, asphalt plants and general manufacturing plants.

Zack McCain
Mr. McCain is a Source Sampling Field Technician. Mr. McCain is well versed in the operation and maintenance of manual source sampling equipment and has performed these functions on numerous tests for various clients.

Mr. McCain's responsibilities include field sampling, sample analysis, data reduction and interpretation, and maintenance and calibration of continuous and manual source sampling equipment.

Ronnie Mullins
Mr. Mullins is a Source Sampling Field Technician. Mr. Mullins is well versed in the operation and maintenance of manual source sampling equipment and has performed these functions on numerous tests for various clients.

Mr. Mullins' responsibilities include field sampling, sample analysis, data reduction and interpretation, and maintenance and calibration of continuous and manual source sampling equipment.

Chris Hall
Mr. Hall is a Source Sampling Field Technician. Mr. Hall is well versed in the operation and maintenance of manual source sampling equipment and has performed these functions on numerous tests for various clients.

Mr. Hall's responsibilities include field sampling, sample analysis, data reduction and interpretation, and maintenance and calibration of continuous and manual source sampling equipment.

Richard Brank-Campbell
Mr. Brank-Campbell is a Source Sampling Field Technician. Mr. Brank-Campbell is well versed in the operation and maintenance of manual source sampling equipment and has performed these functions on numerous tests for various clients.

Mr. Brank-Campbell's responsibilities include field sampling, sample analysis, data reduction and interpretation, and maintenance and calibration of continuous and manual source sampling equipment.

Ron White
Mr. White is the Laboratory Manager with ARI. He is experienced in wet chemistry and chromatography work. He conducts routine analysis of Appendix A reference method samples as well as comprehensive characterization of water samples for a variety of volatile organics. In addition to his analytical responsibilities, Mr. White coordinates the collection, documentation, storage and chain of custody for many of ARI's more comprehensive compliance test programs.