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Investigation of Fugitive Emissions from Petrochemical Transport Barges Using Optical Remote Sensing

Final Report

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Investigation of Fugitive Emissions from Petrochemical Transport Barges Using Optical Remote Sensing

by

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TABLE OF CONTENTS

List of Appendices

List of Tables

List of Figures

List of Acronyms

AM	Alkane Mixture
BEM	Barge Emission Measurement
DQI	Data Quality Indicators
ECPB	Emissions Characterization and Prevention Branch
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
HLDS	Hawk Leak Detection System
LDEQ	Louisiana Department of Environmental Quality
LSI	Leak Surveys Inc.
MDL	Minimum Detection Limit
MOP	Miscellaneous Operating Procedures
MSCHD	Memphis and Shelby County Tennessee Health Department
NEdT	Noise Equivalent Delta Temperature
NERL	National Exposure Research Laboratory
NRMRL	National Risk Management Research Laboratory
OAQPS	Office of Air Quality Planning and Standards
OP-FTIR	Open-Path Fourier Transform Infrared
ORD	Office of Research and Development
ORS	Optical Remote Sensing
OTM 10	EPA ORS Test Method OTM 10
PAC	Path Averaged Concentration
PAMS	Photochemical Assessment Monitoring Station
PGIE	Passive Gas Imaging Equipment

PIC	Path Integrated Concentration
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
R4	EPA Region 4
R6	EPA Region 6
RSD	Relative Standard Deviation
SOP	Standard Operating Procedures
SSE	Sum of Squared Errors
TCEQ	Texas Commission on Environmental Quality
AM	Total Hydrocarbon
TNMHC	Total Non-methane Hydrocarbons
UV-DOAS	Ultraviolet Differential Optical Absorption Spectroscopy
VOC	Volatile Organic Compound
VRPM	Vertical Radial Plume Mapping
WAM	Work Assignment Manager
WC	Wind Criteria
WSC	Wind Speed Criteria

Executive Summary

Recent airborne remote sensing survey data acquired with passive gas imaging equipment (PGIE), also known as infrared cameras, have shown potentially significant fugitive volatile organic carbon (VOC) emissions from petrochemical transport barges. A collaborative group with members from the United States Environmental Protection Agency Region 6 (EPA R6), the EPA Office of Research and Development (ORD) National Risk Management Research Laboratory (NRMRL) and National Exposure Research Laboratory (NERL), the Louisiana Department of Environmental Quality (LDEQ) and the Texas Commission on Environmental Quality (TCEQ) was formed to further investigate this topic. The common goals of the collaboration centered on improving knowledge of fugitive emissions from this source category and advancing field application information for select remote sensing techniques useful for identification and assessment of fugitive emissions from difficult to monitor sources such as barges.

To meet these goals the group conducted a field campaign in Baton Rouge, Louisiana from September 24 through October 9, 2008. This field campaign is described in this report and involved several complementary remote sensing and onboard leak rate measurement efforts. The study included aerial PGIE surveys of barges located on the Mississippi River and inter-coastal Waterway to identify barges with significant fugitive emissions. Additional ground-based PGIE observations of barges from the Port Allen Lock wall and also onboard a number of barges were conducted to closely observe fugitive leaks and identify leaking components. To support this work, an LDEQ study quantified emission leak rates using a bagging technique from a total of eight barges that were identified by the aerial remote sensing PGIE survey. To complement these efforts, EPA method OTM 10 with open-path Fourier transform infrared spectroscopy was used at the Port Allen lock to produce hydrocarbon emission measurements from barge traffic traveling through the lock.

The aerial PGIE survey detected leaks from 45 different barges located in the Mississippi River and the Intracoastal Waterway over a five day period. The ground-based PGIE monitoring detected leaks from over 18 different barges in the Port Allen lock during the study. The remote sensing surveys provided significant information regarding the practical use of infrared cameras for detection of emissions from petrochemical transport barges. This study produced a PGIE image database that informs the use of this technology by providing a basis for comparison of the qualitative PGIE leak images with estimated leak rates. This comparison helps improve PGIE survey technique understanding for barge emissions and other source categories.

In general, the employed PGIE equipment was found to be robust, easy to use, and possessed sufficient detection sensitivity for this application. The PGIE remote sensing approach was judged to be extremely useful for both aerial survey and close range fugitive leak inspection of petrochemical transport barges. The PGIE technique was able to identify a large range of leaks with large leaks detectable from the air and smaller leaks more easily observed at close range. PGIE observations were easier to execute during mid-day to late afternoon time periods due to more favorable background imaging conditions (improved background radiance from hot barge surfaces and lower shadow interference) and because fugitive emissions were likely more pronounced as the barges became heated by solar radiation and ambient temperature during the day. PGIE observations were very useful for identification of specific leaking components and verification of subsequent leak repair activities.

Based on aerial observations, eight barges with observed large leaks were selected for onboard leak emission rate measurements as part of the LDEQ bagging survey. For this effort, a total of 23 leak points from eight barges were bagged to estimate mass emission rates. The measured total non-methane hydrocarbon emissions flux values from individual leaks during the bagging study ranged from 0.07 g/s to 5.77 g/s. Summing all measured leaks for each individual barge yielded a barge total leak rate ranging from 1.13 g/s to 6.24 g/s. The average value of total leak rate measurement for eight barges was 3.3 g/s.

EPA method OTM 10 monitoring was conducted at the Port Allen lock wall from September 24 through October 9. A total of 97 barge sets passed through the lock during the observation period. Six barge events showed significant fugitive hydrocarbon emissions as measured by OTM 10 with values ranging from 0.047 g/s to 3.39 g/s alkane mixture (AM) flux rate with an average value of 0.83 g/s. The instrumentation used to apply the OTM 10 method exhibited sufficient operational robustness and detection sensitivity during the current study. Additionally, the OTM 10 technique was able to identify and assess emission rates from a range of leak sizes as long as the prevailing wind brought the emitted plume through the vertical plane of the measurement configuration.

Due to project constraints, there was no opportunity to conduct simultaneous emission measurements by OTM 10 and the bagging technique on the same barge. A baseline comparison of measurement results on different barges shows that the average total barge emission estimate by OTM 10 (0.83 g/s) was lower than the similar average from the bagging study (3.3 g/s). The maximum total barge emission estimates from the two techniques were more comparable (3.39 g/s with OTM 10 and 6.24 g/s with the bagging method). The somewhat lower OTM 10 values may be partially explained by the fact that the barges selected for the bagging experiments were identified by airborne survey as having very significant leaks and may not represent an average emission case whereas the OTM 10 measurements were conducted on barges moving through the lock with no selection process and therefore may represent a more typical sample cross section.

Note that the emission estimates presented in this report represent a snapshot in time. Fugitive emissions from petrochemical barges are believed to vary significantly due to ambient temperature, thermal load, product mix, load state, and equipment condition and equipment design. Since there is limited information on how these variables affect fugitive emissions, extrapolation of data contained in this report is not recommended.

1. Introduction

1.1 Background

Recent airborne survey data using passive gas imaging equipment (PGIE), also known as infrared cameras, have shown potentially significant fugitive volatile organic compound (VOC) emissions from petrochemical transport barges. This is of interest as VOCs are precursors to ground-level ozone formation, contributing to the degradation of air quality, especially in urban areas. A collaboration of interested parties was formed to further investigate this issue. This group has common interests to expand knowledge of this source category and to further develop Optical Remote Sensing (ORS) techniques which facilitate fugitive emission identification and measurements from these and related sources.

The collaborative group consists of two main sub-groups which will individually sponsor and execute two separate Barge Emission Measurement (BEM) studies. Subgroup 1 consists of the United States Environmental Protection Agency Region 6 (EPA R6), the EPA Office of Research and Development (ORD) National Risk Management Research Laboratory (NRMRL) and National Exposure Research Laboratory (NERL), the Louisiana Department of Environmental Quality (LDEQ) and the Texas Commission on Environmental Quality (TCEQ). Subgroup 1 financially sponsored and executed BEM1 which occurred in Baton Rouge, Louisiana in September 24 through October 9, 2008 and is the subject of this report.

Subgroup 2 consists of EPA Region 4 (EPA R4) and the Memphis and Shelby County Tennessee Health Department (MSCHD) which was awarded an EPA Communities-Scale Monitoring Grant to plan and execute BEM2 in the fall of 2009. Each BEM project will benefit through active involvement of the above mentioned subgroups in addition to consultation from the EPA Office of Air Quality Planning and Standards (OAQPS), the BLF Consulting Group, and interested industry groups. The results of the studies will likely be compared in a separate publication.

1.2 Project Description

This report describes the BEM 1 field campaign conducted in Baton Rouge, Louisiana from September 24 to October 9, 2008. BEM 1 investigated VOC emissions from petro-chemical transport barges using portable gas imaging equipment PGIE (infrared cameras), EPA Method OTM 10 with Open-path Fourier transform infrared (OP-FTIR) spectrometers, in addition to leak bagging tests (manual leak rate measurements).

The objectives of the study were:

- To improve knowledge of fugitive VOC emissions from petrochemical transport barges.

- To demonstrate and advance the field application of select ORS techniques (EPA OTM 10 OP-FTIR and PGIE) for identification and quantification of fugitive emissions from difficult to monitor sources.

- Identify sources of fugitive leaks from multiple barges

To accomplish these goals, the project team conducted several complementary efforts:

1. Aerial PGIE surveys of barges located on the Mississippi River and inter-coastal water ways identified barges with significant fugitive emissions.

2. Ground-based PGIE observations of barges from the Port Allen Lock wall and also onboard several barges identified and closely observe fugitive leaks.

3. Onboard leak emission bagging measurements were conducted by LDEQ on several barges to quantify leak rates and allow comparison with PGIE images.

4. EPA Method OTM 10 with open-path Fourier transform infrared spectroscopy was used at the Port Allen lock to produce hydrocarbon emission measurements from barge traffic traveling through the lock.

The body of this report summarizes the main aspects of the BEM 1 study with collections of representative images and emission measurement details contained in the Appendices A through I. With the exceptions noted below, this project was conducted by ARCADIS U.S., Inc. (ARCADIS), Durham, NC, under EPA ORD contract No. EP-C-04-023, Work Assignment No. 4-47. ARCADIS executed the OTM 10 portion of the field campaign, analyzed the OP-FTIR and OTM 10 data, produced draft versions of data tables and image collections and contributed to descriptions continued in this report. EPA Personnel were primary authors on the main body and summary sections of the report.

Section 2 of this report describes the measurement methods, instruments, and field setup for the BEM1 campaign.

Section 3 of the report describes the aerial and ground-based PGIE observations of barges on the Mississippi River and Intracoastal Waterway and Port Allen Lock. This portion of the study was funded by EPA and was executed by Leak Surveys, Inc. (LSI), under subcontract to ARCADIS and by ARCADIS using PGIE owned by LDEQ. A summary of LSI results along with several representative PGIE screenshots are presented in Sections 3.1 (aerial) and 3.2 (ground-based). Section 3.3 presents this same information for the PGIE observations made on the lock wall by ARCADIS. Additional details and images from this part of the project are contained in Appendices A through E.

Section 4 of the report describes measurements made on the Port Allen Lock wall by ARCADIS using two scanning optical remote sensing instruments (OP-FTIR), in combination with the OTM 10 protocol (see http://www.epa.gov/ttn/emc/prelim.html). These measurements provided hydrocarbon emission estimates of a representative alkane mixture (AM) and speciated concentration measurements for several trace compounds for barges passing through the lock. Section 4 presents a description of notable events, the AM mass emission flux values measured during each event, a screenshot of the leaks from the PGIE observations, and the results of the trace compound analysis. Additional information on the OTM 10 portion of the study is contained in Appendices F and G.

Section 5 summarizes the findings of the onboard leak rate measurements performed by Sage Environmental for LDEQ on several barges during the study. The leak bagging measurements used U.S. EPA *Protocol for Equipment Leak Emission Estimates* (U.S. EPA, 1995), with some variations. The LDEQ report on the bagging experiments is reproduced in its entirety in Appendix H for reference. It is noted that a draft version of this BEM 1 study report was reviewed by the American Waterways Operators and their comments concerning the LDEQ bagging study along with responses from Sage Environmental Consulting are reproduced in Appendix J.

Section 6 of the report presents a general comparison of emissions levels from the set of barges passing through the Port Allen lock observed during the OTM 10 study with the barges measured during the LDEQ bagging study. Section 7 provides QA information including discussions on general uncertainty and data limitations. Section 8 summarizes the conclusions for the study.

This report has been reviewed by the Office of Research and Development, U.S. EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the agency nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

2. Description of Test Sites, Measurement Methods and Site Deployment

The experimental approach for BEM1 included three main elements: PGIE for aerial and ground-based observations, fugitive emission estimation by EPA Method OTM 10 at the Port Allen and leak bagging tests of emissions from several barges. Following a general description of PGIE, Sections 2.1 and 2.2 describe the details of the aerial and ground-based PGIE observations conducted for this study. Section 2.3 shows the U.S. Army Corps of Engineers Port Allen lock site and describes the EPA OTM 10 method used to assess the mass emission flux of a representative alkane mixture (AM) in addition to trace compound speciation. Section 2.4 describes the bagging procedure employed in the LDEQ effort to quantify fugitive emissions leaks onboard several barges.

Of special interest to this study is the use of PGIE remote sensing systems to investigate fugitive emissions from barges. The PGIE infrared cameras were used to qualitatively detect the presence of fugitive emissions and to observe the leaking component to inform emissions inventory knowledge. The details of the specific PGIE used in this study are provided in Section 2.1. In general, the infrared camera detects thermal energy emitted by objects in the optic field of view or scene as motion imagery or video. Thermal energy is absorbed by molecules in the camera's field of view. If the molecules are present in high concentrations, and if their infrared-active molecular vibrations are within the bandpass of the camera, the molecules are detected. The fugitive emission or leak is detected by the PGIE operator by observing the relative brightness of the camera pixels that comprise the scene. Gas leaks appear as black or very dark plumes in the video relative to other objects in the scene. These plumes are dynamic as well, which assists in discriminating gas leaks from other scene objects such as thermal shadows or cold objects. The camera video is recorded onto a solid state recorder for future analysis. More information on the PGIE camera can be found in the Texas Commission on Environmental Quality SOP #SAMP-020, *Operation of FLIR Systems THERMAGAS GasFindIR Camera,* presented as Appendix C of the project Quality Assurance Project Plan (QAPP) (EPA, 2008).

The study was conducted from September 24 through October 9, although measurements from each of the three study elements were not collected continuously during this time. The weather conditions observed during the study period were relatively normal conditions for the Port Allen area (normal average daytime high temperatures ranging from 86° F on September 24 to 82°F on October 9).

2.1 Aerial PGIE Observations

The aerial PGIE observations were made by Leak Surveys Inc. (LSI) from September 24 through October 1, 2008 (10 am to 5 pm). The crew used the Hawk Leak Detection System (HLDS), developed by LSI after 12 years of research and development on optical imaging.

The PGIE used was a modified Indigo (FLIR/Indigo Systems Corp., Goleta, CA) Merlin MID camera, which is a specialized thermal imaging camera that allows the operator to visualize a plume of VOC gases, allowing the leaking barge component to be identified. The PGIE was mounted on a helicopter using a FAA inspected and certified Tyler vibration isolating mount. The camera video was cabled to the operator inside the aircraft. The aircraft was generally deployed to conduct monitoring of barges upriver of the lock prior to actual arrival at the lock site. A standard digital camera was used for photographing the barge under surveillance for future reference. A GPS unit was used to log the location and time and date of the contact.

The PGIE has a nominal spectral range of 1 to 5.4 µm. Using a 30 × 30 µm InSb detector with a 320 × 240 pixel array, the camera has the capability to vary the integration times from 5 ms to 16.5 ms. The detector is operated at near liquid nitrogen temperatures using an integral Sterling cooler which provides the system with an NEdT of no more than 18 mK providing excellent sensitivity.

The spectral range is further limited with the use of a notch filter specifically designed for the detection of hydrocarbon infrared adsorption in the 3 micron region. The narrow bandpass range of the filter is less than the infrared spectral absorption of gas-phase hexane. The filter notch is positioned so that alkane gases have a significant response within the bandpass range.

Various lenses including a 25 mm, a 50 mm, and a 100 mm lens were used. The 25 mm lens provided a 22 × 16 degrees field of view with an f-number of 2.3. The 50 mm lens provided an 11 × 8 degrees field of view with an f-number of 2.3.

The use of a narrow bandpass filter provides spectral discrimination that allows the detection of compounds that have a vibration mode in the infrared region of the filter. Not all hydrocarbons have infrared absorptions within the filter range. Table 2-1 shows the theoretical relative response of various compounds of interest using 1 cm-1 resolution infrared spectra (Infrared Analysis, Inc., Anaheim, CA). Using propane as the reference spectrum with a relative response of 100, methane’s response is approximately 10 percent of the same concentration of propane and hexane is 1.5 times the response of propane at the same concentration. The filter is set to the infrared region of the spectrum that primarily corresponds to the infrared absorption of alkanes. Other hydrocarbons exhibit various degrees of absorption of infrared energy in this region as indicated in the table.

Table 2-1. Relative Response of Hydrocarbon with LSI Infrared Imaging Camera (FLIR)

Compound	Relative Response Propane = 100%
Methane	9
Ethane	43
Propane	100
Butane	118
Iso-Butane	137
Pentane	143
Hexane	155
Heptane	157
Octane	136
Ethylene	3
Propylene	20
Iso-Butylene	37
2-Methyl-2-Butane	4
1-Pentene	7
2-Methyl-2-Pentene	7
Benzene	4
Toluene	21
o-Xylene	38
p-Xylene	23
m-Xylene	32

The aerial surveys were performed using a two-person crew consisting of the pilot and the camera operator. The survey was conducted by focusing the PGIE on the river and searching for barge leaks. If a leak was found, the pilot circled back above the source and the camera operator recorded the leaking emissions for a period of approximately 2 minutes. The results of the aerial survey are presented in *Report: Leak Detection using LSI Infrared Gas Imaging, LDEQ Barge Study* (27 October 2008) which is included as Appendix A.

2.2 Ground-based PGIE Observations

The ground-based PGIE observations at the lock were made by LSI (September 24 and September 28-30, 2008) using a modified Indigo (FLIR/Indigo Systems Corp., Goleta, CA) GasfindIR MID camera and by ARCADIS using the LDEQ FLIR camera (September 28 and October 1-9, 2008). There were no FLIR observations made at the lock on September 25-27, 2008. LSI also made the observations at the onboard several barges during the LDEQ bagging study (September 24-28, 2008). The PGIE used to perform these optical imaging leak surveys was similar to the camera used for the aerial surveys described in Section 2.1.

The light weight and small size of the PGIE allowed it to be hand-carried for ground observations of barges. Leaking components on the barge (if present) were identified and logged. The potential source of the leak was identified (i.e., hatch cover, pressure relief valve) and the position on the barge (i.e., cargo tank #4) was determined.

The results of the LSI ground survey are presented in *Report: Leak Detection using LSI Infrared Gas Imaging, BEM1 Barge Study; Ground Crew Survey* (21 October 2008) which is included as Appendix C.

Images from the LSI and ARCADIS ground PGIE observations are presented in Appendices D and E.

2.3 Scanning OP-FTIRs and OTM 10 Protocol

Two scanning open path Fourier transform infrared (OP-FTIR) spectrometers, in combination with the OTM 10 protocol (see http://www.epa.gov/ttn/emc/prelim.html), were used to provide alkane mixture (AM) emission flux and speciated measurements for nine trace compounds (methane, methanol, benzene, ethylene, acetylene, propylene, propane, ethane, and carbon monoxide).

Supporting measurements for this phase of the study included meteorological data and distance measurements. Testing and measurement protocols included:

- PIC emission measurements with two OP-FTIR instruments
- Meteorological data collection with the R.M. Young heads
- Optical path length determination with a Topcon theodolite

- Calculation of AM emission flux using *Flux Calc* (ARCADIS software employing the VRPM method).

Figure 2-1 shows an overhead view of the U.S. Army Corps of Engineers Port Allen lock study site, with the approximate locations of the project measurement configurations. Two 3-beam OTM -10 configuration planes were deployed along the southern edge of the lock (denoted by the red lines, not to scale vertically) using one EPA and one ARCADIS scanning OP-FTIR. The end of the two planes was defined by one common scissor lift (tower in the middle), which was used to mount the two elevated mirrors of each OTM 10 configuration. The lowest mirror in each configuration was deployed on the surface of the lock wall walkway (0.1 m height) and the elevated mirrors were positioned at heights of approximately 3 m and 6 m above the walkway. The locations of the two scanning OP-FTIR instruments were near each end of the lock as indicated in the figure. The length of the EPA and ARCADIS OP-FTIR plane configurations were 169 m and 153 m, respectively. The overall length of the lock from gate to gate was approximately 360 m and the width of the lock was 25 m. The OTM 10 planes were located approximately 1 m away from the inside lock wall edge. Additional images illustrating the OTM 10 deployment and barge traffic in the lock are contained in Figures 2-2 and 2.4.

Two additional optical beam paths were deployed (one from each OP-FTIR instrument) across the surface of the lock to collect supplemental data on alkane mixture and trace VOC concentrations. Although the project Quality Assurance Project Plan stated that these data would be collected with ultraviolet differential optical absorption spectroscopy (UV-DOAS), the project team determined that the OP-FTIR data could be analyzed for trace VOC concentrations, so the UV-DOAS instrument was not deployed at the site due to limited project resources and eye safety concerns for lock personnel.

Originally, it was anticipated that the OTM 10 configuration would be deployed along the northern edge of the lock. However, at the time of the field campaign, the winds were largely from the north, and the configuration was deployed on the southern edge of the lock. The prevailing winds at the site during the measurements are denoted by the wind rose in the lower left hand corner of Figure 2-1. Note that in order for the OTM 10 configuration to measure fugitive emission from a particular barge, the wind vector must have a significant component from the north in order for the emitted plume to traverse the OTM 10 measurement plane.

OP-FTIR data were collected with each configuration from September 24 through October 9, 2008. Data from the barge traffic were recorded including the time of entry and exit from lock, reported cargo from the U.S. Army Corps of Engineers traffic log, and visual inspection of cargo labels on each barge. Emissions flux values were calculated for each event by summing the flux values measured from each configuration.

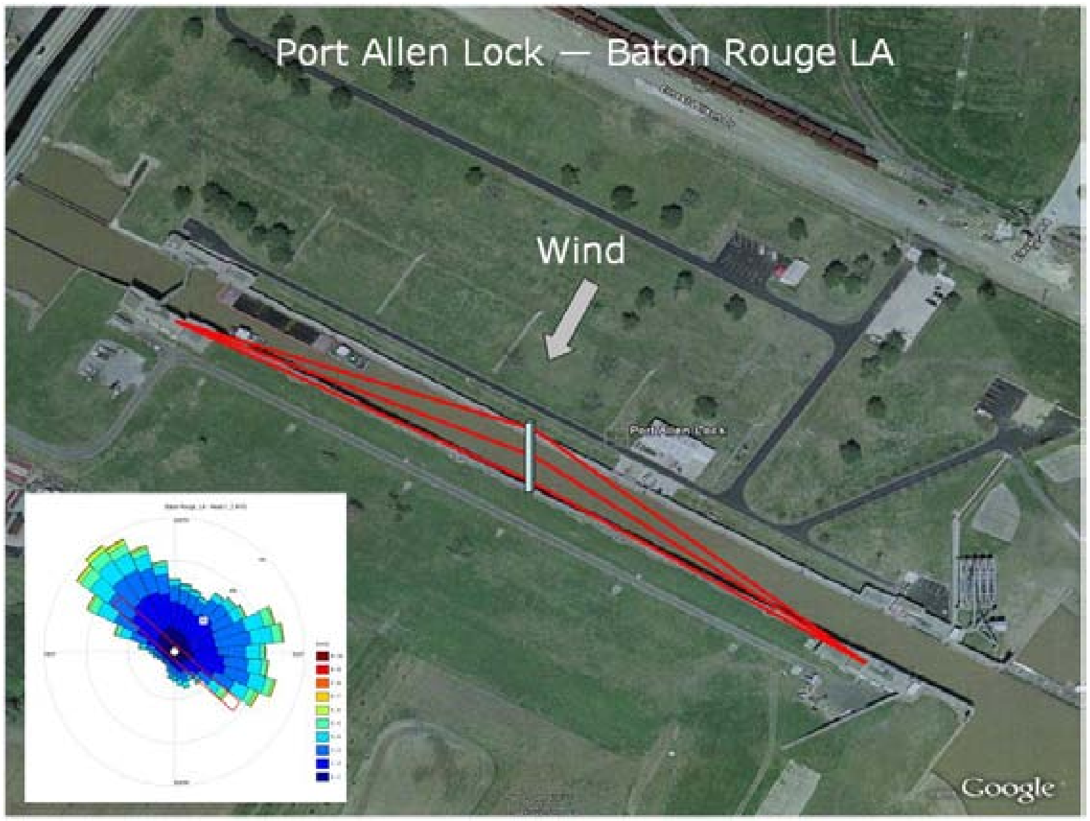

Figure 2-1. **U.S. Army Corps of Engineers Lock Study Site and Measurement Configurations**

Figure 2-2. Images Illustrating OTM 10 Setup and Barges at the Port Allen Lock

2.3.1 OTM 10 and the Vertical Radial Plume Mapping Method

The following is a general description of the ground-based barge measurements at the U.S. Army Corps of Engineers Port Allen lock. For this phase of the campaign, two OP-FTIR instruments were placed around the lock area to execute a modified version (3-beam) of EPA Method OTM 10 to quantify the mass emission flux of and alkane mixture (AM) from the barges located in the lock.

The project used two 3-beam OTM 10 flux measurement configurations to quantify the fugitive emissions from the barge. The Vertical Radial Plume Mapping (VRPM) method is the analytical part of the OTM 10 flux measurement and generally discussed in EPA OTM 10 *Optical remote sensing for emission characterization from non-point sources,* which describes direct measurement of pollutant mass emission flux from area sources using ground-based optical remote sensing (ORS). The OTM 10 technique utilizes open-path spectroscopic instrumentation to obtain path-integrated pollutant concentration information along multiple optical paths. The multi-path pollutant concentration data along with wind vector information are processed with a plane-integrating VRPM computer algorithm to yield a mass emission flux for the source. Figure 2-3 shows a general 5-beam TOM 10 VRPM measurement configuration. For this project, a 3-beam configuration was used having no intermediate mirrors with 3 beams extending along the ground (mirror deployed on surface of top of the lock wall), middle, and top scissor lift positions.

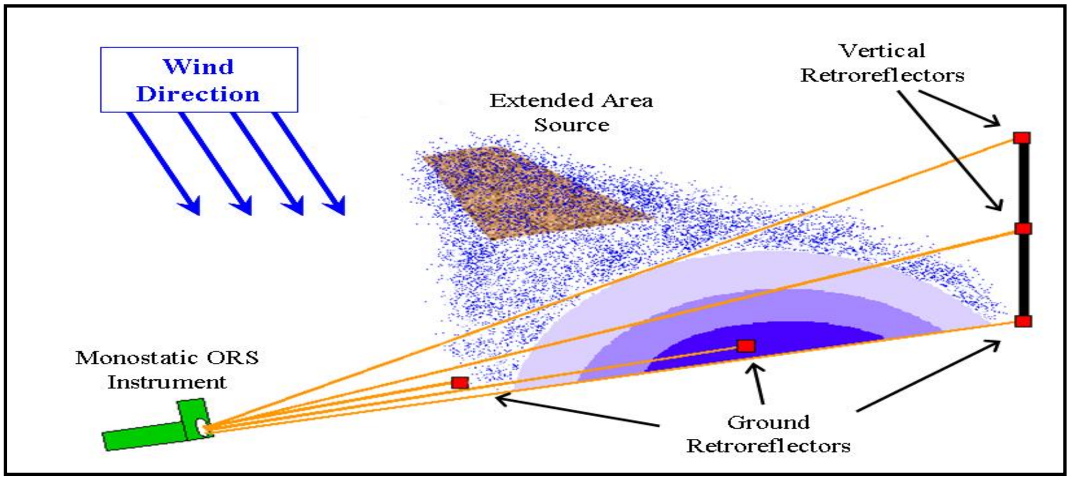

Figure 2-3. General OTM 10 VRPM Measurement Configuration

The VRPM computer algorithm uses a smooth basis function minimization routine of a bivariate Gaussian function to generate mass emission flux information from species concentration and wind data. For this measurement campaign, the VRPM configuration utilized a three-beam configuration which leads to a reduced form of the bivariate Gaussian in polar coordinates (*r, θ*). The standard deviation in the crosswind direction is assumed to be about four times the length of vertical plane (r_1).

$$G(A,\sigma_z,m_z)=\frac{A}{2\pi(4r_1)\sigma_z}\exp\left\{-\frac{1}{2}\left[\frac{(r\cdot\cos\theta-\tfrac{1}{2}r_1)^2}{(4r_1)^2}+\frac{(r\cdot\sin\theta-m_z)^2}{\sigma_z^2}\right]\right\} \qquad (1)$$

Where:

A = *normalizing coefficient, adjusts for the peak value of the bivariate surface;*

m_z = *peak location in Cartesian coordinates;*

σ_z = *vertical standard deviation in Cartesian coordinates;*

r_1 = *length of VRPM plane;*

A, m_z, and σ_z are the unknown parameters to be retrieved by the fitting procedure. An error function (sum of squared errors, SSE) for minimization is defined as:

$$SSE\left(A,\sigma_z,m_z\right)=\sum_i\left(PAC_i-\int_0^{r_i}G(r_i,\theta_i,A,\sigma_{m_z})dr/r_i\right)^2 \qquad (2)$$

Where PAC_i is the measured path-averaged concentration (PAC) value for the i^{th} beam. The SSE function is minimized using the Simplex method to solve for the three unknown parameters. This process is for determining the vertical gradient in concentration. It allows an accurate integration of concentrations across the vertical plane as the long-beam ground level PAC provides a direct integration of concentration at the lowest level.

Once the parameters of the function are found for a specific run, the VRPM procedure calculates the concentration values for every square elementary unit in a vertical plane. Then, the VRPM procedure integrates the values, incorporating wind speed data at each height level to compute the flux. This enables the direct calculation of the flux in grams per second (g/s), using wind speed data in meters per second (m/s). Further information on the VRPM method for fugitive source emission measurements in general can be found in Thoma 2005, U.S. EPA 2007a with specific details of this deployment in U.S. EPA 2007b.

This measurement project has several unique features regarding the use of EPA Method OTM 10 which is typically used for ground-level area source measurements using a 5-beam approach. Specifically, this field study utilized a 3-beam approach and the source was not the typical ground level area source. The 3-beam OTM 10 approach was chosen for this project since it was much more important to obtain a larger number of measurement cycles while the mobile source was contained in the lock rather than a fewer number of cycles with a five beam approach since the horizontal spatial location of the plume was not of primary importance. In analyzing the PIC data using the 3-beam approach, several assumptions are required. The peak plume concentration was assumed to be centered along the crosswind axis of the OTM 10 configuration, and the σ_y parameter (horizontal dispersion coefficient) of the measured plume was assumed to be equal to ½ the length of the OTM 10 configurations. It was necessary to make these assumptions because the 3-beam OTM 10 approach does not include two intermediate surface beam paths which are used to obtain information on the horizontal location and dispersion of the plume. Section 7.3 has contains a discussion of uncertainty associated with these assumptions.

The lock wall configuration was not a typical area source deployment however it was assumed that the emission form the barges acted similarly to a close-coupled area source. The emitted plumes from the barges were assumed to be initially small in spatial extent but would experience significant dispersion by eddy mixing before exiting the lock and passing through the OTM 10 plane. This is likely since the barges were significantly below the lock wall top (approximately 7m to 12 m) and the emitted plumes could experience several dispersive/mixing mechanisms (such as stagnation, turbulence, channeling) depending on ambient wind direction and speed so the plumes could evolve more than in a flat wind swept scenario with similar downwind standoff. This results in a relatively well-developed plume exiting the lock and being transported by the free-flowing winds to the OTM 10 plane. This is illustrated in Figure 2.4 and these assumptions are further discussed in Section 7.3. The distance range below the lock wall (≈ 7 m to 12 m) reflects the approximate lock operation water level height change during the study.

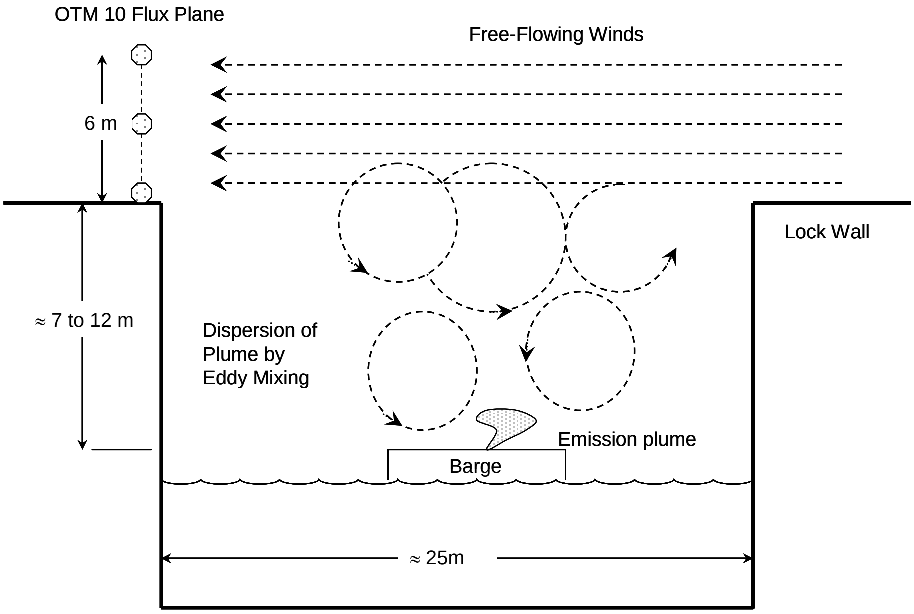

Figure 2-4. Representation of Lock Cross Section and Wind Flow

2.3.2 OTM 10 Fugitive Emission Quantification

The scanning OP-FTIR measurement system and associated OTM 10 planes employed a default configuration as described above. The default dwell time for each mirror was 30 seconds. In general, the OP-FTIR spectrometer is designed for both fence-line monitoring applications and real-time, on-site, remediation monitoring and source characterization. The OP-FTIR instrument consists of an infrared light beam, modulated by a Michelson interferometer. The infrared beam is transmitted from a single telescope to a retro-reflecting mirror target, which is usually set up at a range of 100 to 500 m. The returned light signal is received by the single telescope and directed to a detector. The light is absorbed by the molecules in the beam path as the light propagates to the retro-reflecting mirror and again as the light is reflected back to the analyzer. The advantage of OP-FTIR monitoring is that the concentrations of a multitude of infrared absorbing gaseous chemicals can be detected and measured simultaneously, with high temporal resolution. Figure 2-5 presents a picture of the OP-FTIR instrument.

2.3.3 Supporting Measurements for Ground-based ORS

2.3.3.1 Meteorological Data

Meteorological data including wind direction and wind speed were continuously collected during the measurement campaign with two R.M. Young model 05103 meteorological heads. The instrument is automated and collects real-time data from its sensors and records time-stamped data, which are transmitted to a desktop computer via a radio frequency modem R. M. Young model 32500. The meteorological heads were deployed to collect wind speed and wind direction data during the study. As part of each VRPM configuration, one head was deployed on the surface of the lock wall at a height of approximately 3 meters, and the other head was deployed on top of the scissor lift platform at a height of approximately 6 meters above the lock wall.

More information on deploying R.M. Young meteorological heads can be found in MOP 6803 “Guidance for Deploying and Using ORS Supplemental Instrumentation” of the Emissions Characterization and Prevention Branch (ECPB) *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004).

Figure 2-5. IMACC OP-FTIR Instrument and Scanner

2.3.3.2 OP-FTIR Instrument-Mirror Distance

The physical distance between the ORS instruments and the mirrors was measured using a Topcon, Inc. model GTS-211D theodolite. More information on setting up and operating the theodolite can be found in MOP 6822 “Determining the Geographical Locations of the ORS Measurement Locations” of the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004).

2.3.4 PIC Emission Measurements with OP-FTIR Instrument

To calculate the mass emission flux using the OTM 10 method, the acquired OP-FTIR data must be analyzed to produce a PIC value. For this project, OP-FTIR data reduction focused on the PIC values of a representative alkane mixture (AM) by spectroscopic analysis of the infrared absorption features in the C-H stretch spectral region around 2950 cm^{-1}. The analysis focused on an alkane mixture (butane, pentane, hexane, heptane, octane, nonane, decane) since performing spectral analysis of each individual compound is not possible due to the similarity in the shapes of the absorption bands. Additionally, the molecular weight of the target compound is necessary to calculate the mass emission flux using the OTM 10 method. Spectroscopic analysis of the AM also yielded the average molecular weight of AM for each concentration determination. More information on the method used for spectroscopic analysis of the AM can be found in Appendix F of this report.

In addition to the AM quantification, individually quantifiable hydrocarbons species (e.g., methane) were analyzed if present at concentrations above the MDL for the OP-FTIR.

The general measurement of the Path Integrated Concentration (PIC) of individually identifiable analyte gases using the IMACC OP-FTIR instrument is described in MOP 6808 “Multiple-Path Data Collection Using a Scanning IMACC Monostatic OP-FTIR” of the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004). A detailed description of the procedure used for PIC concentration analysis with *IMACCQuant* software is contained in MOP 6827 “Procedures for OP-FTIR Concentration Data Analysis Using IMACCQuant Software”. The estimated minimum detection levels for the target analytes of the OP-FTIR instrument are presented in Table 2-2.

Table 2-2. Target Compound List

Compound	OP-FTIR Estimated Detection Limit for Optical Path Length = 300 m, 1 min. averaging (ppb)
Alkane Mixture (AM)	2
Methane	2
Methanol	4
Benzene	20
Ethylene	1
Acetylene	2
Propylene	4
Propane	10
Ethane	10

2.3.5 Meteorological Data Collection with the R.M. Young Heads

Meteorological data including wind direction and wind speed were continuously collected during the sampling/measurement campaign with an R.M. Young Model 05103 meteorological head. The instrument is automated and collects real-time data from its sensors and records time-stamped data, which are transmitted to a desktop computer via a transmitter.

For this project, a wind direction and speed-sensing head was used to collect data at heights of approximately two and six meters above ground. The sensing head for wind direction incorporates an auto-northing function (automatically adjusts to magnetic north) that eliminates the errors associated with subjective field alignment to a compass heading. The sensing heads incorporate standard cup-type wind speed sensors. Post-collection, a linear interpolation between the two sets of data is done to estimate wind velocity as a function of height. More information on deploying and operating the R.M. Young Model 05103 meteorological instrumentation can be found in MOP 6803 of the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004).

2.3.6 Optical Path Length Determination with the Topcon Theodolite

The physical distance between an OP-FTIR instrument and a mirror was determined by measurement with a Topcon, Inc. model GTS-211D theodolite. The instrument manufacturer certifies the instrument accuracy and precision to better than 1 cm. Azimuth and elevation angles can also be determined using the theodolite. The measurement is a manual operation, with the results recorded by hand, and is followed by transcription to a spreadsheet for data archiving and calculations.

Due to folding of the optical beam by the mirror, the optical path length is twice the physical distance between the instrument and mirror. In other words, the optical beam passes through the physical path twice. More information on deploying and operating the Topcon theodolite can be found in MOP 6822 of the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004).

2.3.7 Calculating Emission Flux using the VRPM Method

The calculated emission flux is generated by inputting the measured PIC data into the VRPM algorithm. The algorithm is performed using Matlab software (MathWorks, Inc., Natick, MA). The VRPM method maps the concentrations in the plane of the measurement. The horizontal dimension of this plane is defined as the distance between the OP-FTIR instrument and the most distant mirror used in the configuration. The vertical dimension of this plane is defined as the distance from the surface to the point where the extrapolated concentration values (extrapolated based on the vertical concentration gradient) approaches zero. This height is not determined until the data are processed in the VRPM algorithm. By scanning in a vertical plane downwind from an area source, one can obtain plume concentration profiles and calculate the plane-integrated concentrations. The flux is calculated by multiplying the plane-integrated concentration by the wind speed component perpendicular to the vertical plane. The flux leads directly to a determination of the emission rate (Hashmonay et al., 1998; Hashmonay and Yost, 1999; Hashmonay et al., 2001; Thoma et al. 2005). More information on the procedures used to generate the plume maps and the calculated emission flux can be found in MOP 6842 “Using the vertical Radial Plume

Mapping (VRPM) Configuration with Wind Data to Create Plume Concentration Profiles and Calculate Emission Fluxes" of the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004).

2.3.8 Site Deployment Description at the Lock

The prevailing winds during the time of the field campaign were largely from the north, and the dual OP-FTIR configuration was deployed on the southern edge of the lock. Figure 2-1 shows the VRPM configurations at the U.S. Army Corps of Engineers lock. Following ORS instrument setup and Data Quality Indicator (DQI) checks, ORS data acquisition began, continuously, for a period of several hours each day. During the surveys, measurements were taken along each optical path length (mirror) sequentially. The averaging time for each optical path was thirty seconds. Emissions flux values were calculated for each event by summing the average flux values measured from each configuration.

Data from barge traffic were recorded including time of entry and exit from lock, reported cargo from the U.S. Army Corps of Engineers traffic log, and visual inspection of cargo labels on each barge. The ground-based PGIE (FLIR camera) measurements were conducted simultaneously with the ORS measurements for a period of several hours each day, for all but three days of the sampling campaign. It is noted that Barge traffic through the Port Allen lock was lighter than usual during the study due to repair activities on the Intracoastal Waterway Bayou Sorrel Bridge, which was damaged by a tug boat accident just prior to the start of the field campaign.

2.4 Bagging Tests

The onboard-barge leak bagging tests were performed by SAGE Environmental Consulting for LDEQ from September 24-28, 2008. Some of the results from this study are presented in Sections 5 and 6 for comparison purposes with the full LDEQ report reproduced as Appendix H for reference. For the bagging measurements, SAGE followed the vacuum method described in the U.S. EPA Protocol for Equipment Leak Emission Estimates (U.S. EPA, 1995), with some variations. For compositional analysis, samples were collected by LDEQ in aluminum Summa canisters. A maximum of one canister was filled for each point tested. One canister was sometimes used for multiple sampling points in the same product service on the same barge. The LDEQ laboratory did the analysis using EPA PAMS analysis by GC/FID. Figure 2.6 shows images from the LDEQ leak bagging study.

Figure 2-6. Images from LDEQ Leak Bagging Study

3. Aerial and Ground-based PGIE Results and Discussion

The aerial and ground-based PGIE observations of barges on the Mississippi River and Intracoastal Waterway are summarized in this section. Representative PGIE snapshots are presented in Sections 3.1 (aerial) and 3.2 (ground-based). Section 3.3 presents this same information for the PGIE observations made in the lock on several other days by ARCADIS, with the LDEQ camera. No PGIE observations were made at the lock on September 25-27, 2008. Note that it is not possible to reproduce the details of a visible leak (as captured with video footage) using a single representative snap shot as required for this report.

3.1 Aerial PGIE Observations by LSI

The aerial (helicopter) PGIE observations were made by Leak Surveys, Inc. (LSI) from September 24 through September 30, 2008. The helicopter was airborne for approximately 6 hours each day. The LSI aerial crew dataset contains movies showing leaks from a total of 45 different barges located in Mississippi River and Intracoastal Waterway. Table 3-1 lists the LSI snapshot identification number, barge number, and a description of the suspected source of the leak(s). Additional information is contained in Appendices A and B.

Table 3-1. Summary Table of Barge Leaks Identified by LSI Aerial Survey

Filename	Date	Part Leaking	Barge #
L000	9/24/2008	Two Large Valve Settings Towards Aft Side	A1
L001	9/24/2008	Vent Stack at Bow of Barge	A2
L002	9/24/2008	Vent Stack at Bow of Barge	A3
L003	9/24/2008	Top Loading Hatches	A4
L004	9/25/2008	Top Loading Hatches at Placid Refinery	A5
L005	9/25/2008	Top Loading Hatches to the Aft of Barge	A6
L006	9/25/2008	Top Loading Hatches at Bow of Barge	A7
L007	9/25/2008	Top Loading Hatches at Bow of Barge	A8
L008	9/25/2008	Top Loading Hatches at Bow of Barge	A9
L009	9/26/2008	Top Loading Hatch at Bow of Barge	A10
L010	9/26/2008	Top Loading Hatches and Vent	A11
L011	9/26/2008	Top Loading Hatches at Aft side of Barge at Placid Refinery	A12
L012	9/26/2008	Top Hatches on Barge	A13
L013	9/26/2008	Top Hatches on Barge	A14

Filename	Date	Part Leaking	Barge #
L014	9/26/2008	Top Hatches and Vent Stack on Barge	A15
	9/26/2008	Top Hatches and Vent Stack on Barge	A16
	9/26/2008	Top Hatches on Barge	A17
	9/26/2008	Top Hatches on Barge	A11
L015	9/27/2008	Vent Stack on Barge	A18
L016	9/27/2008	Repeat of Video 003, Boarded by Bagging Team	A4
L017	9/27/2008	Top Loading Hatches at Placid Refinery	A19
L018a	9/27/2008	Top Hatches on Barge	A20
L018b	9/27/2008	Top Hatches on Barge	A21
L018c	9/27/2008	Top Hatches on Barge	A22
L019	9/27/2008	Top Hatches at TT Barge Cleaning Facility --Refilm	A13
	9/27/2008	Top Hatches at TT Barge Cleaning Facility	A14
L020	9/27/2008	Vent Stack on Barge --Refilm	A23
	9/27/2008	Vent Stack on Barge	A24
L021	9/27/2008	Hatches at Aft Side --in Intracoastal Waterway	A25
	9/27/2008	Vent at Aft Side --in Intracoastal Waterway	A26
L022a	9/27/2008	Vent at Aft Side	A27
L022b	9/27/2008	Vent Stack on Bow of Barge	A28
L023a	9/27/2008	Center Vent on Barge	A29
L023b	9/27/2008	Cent Hatch on Barge	A30
L024	9/28/2008	Bow Hatch and Deck Hatch on Barge	A31
L025	9/28/2008	Two Aft Hatches and one Side Hatch	A32
L026	9/29/2008	Top Hatches on Barge --in Intracoastal Waterway	A33
L027	9/29/2008	Vent Stack in Center of Barge --in Intracoastal Waterway	A34
L028	9/29/2008	Vent Stack on Bow of Barge --Refilm	A1
L029	9/29/2008	Vent Stack on Bow of Barge	A35
L030	9/29/2008	Vent Stack on Bow of Barge --Refilm	A36
L031a	9/29/2008	Top Hatches on Barge --Across from Locks	A37
L031b	9/29/2008	Top Hatches on Bow --Across from Locks	A31
L032	9/30/2009	Vent at the Bow of Barge --North of Locks	A23
L033	9/30/2009	Forward Bow Hatch on Barge --in Intracoastal Waterway	A38

Figures 3-1 through 3-3 show three example snapshots from the LSI Aerial survey illustrating the type of leaks that were detected: Example #1 shows a vent on the aft side of Barge A27; Example #2 shows a vent stack in the center of Barge A34 from the Intracoastal Waterway; and Example #3 shows the top hatches on the bow of Barge A31across from the lock. Appendix B contains a larger collection of images providing information on various types of leaks identified during the helicopter survey.

Note that it is impossible to represent visual acuity of observed leaks with single image snapshots reproduced in this report. The leaks as viewed in moving video images are much more pronounced and generally easier to identify, particularly for small leaks.

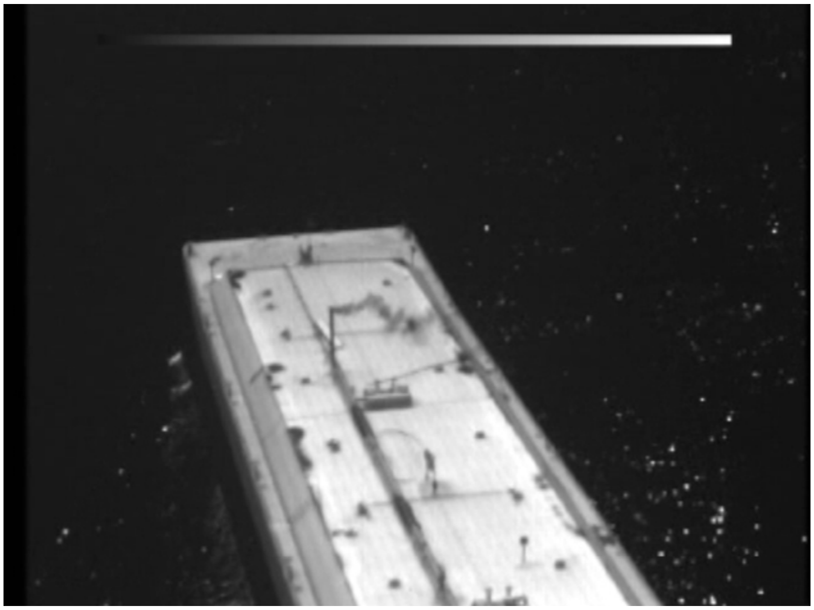

Figure 3-1. Example #1 from LSI Helicopter Survey – Leak from Vent on Aft Side of Barge A27

Figure 3-2. **Example #2 from LSI Helicopter Survey – Leak from Vent Stack in Center of Barge A34**

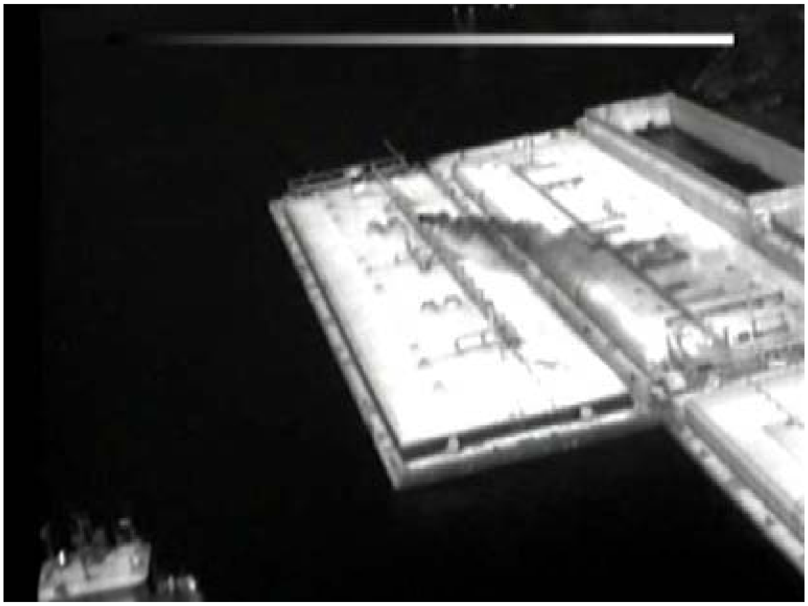

Figure 3-3. **Example #3 from LSI Helicopter Survey – Leak from Top Hatches on Bow of Barge A31**

The LSI aerial surveys provided the following general conclusions about this remote sensing approach for fugitive emission detection from petrochemical transport barges:

1. The deployed PGIE equipment and airborne platform exhibited sufficient mobility, operational robustness, and detection sensitivity and are judged to be extremely useful for airborne remote monitoring of this type. This conclusion agrees with previous similar studies using this technology.

2. The PGIE technique was able to easily identify apparent large leaks from the air with smaller leaks somewhat more difficult to identify likely requiring an expert operator.

3. Ground surveys indicated that the leaks seen from the air were many times composed of numerous individual leaks upon closer inspection.

4. In all studied cases, leaks identified from the air were verified as being VOC leaks of significant volume upon ground inspection.

5. Aerial observations were easier to execute during mid-day to late afternoon time periods due to more favorable background imaging conditions (improved background radiance from hot barge surfaces and lower shadow interference) and because fugitive emissions were likely more pronounced as the barges became heated by solar radiation and ambient temperature during the day.

3.2 On board Barge PGIE Observations by LSI

LSI conducted ground-based PGIE observations on board eight barges in conjunction with the LDEQ bagging studies (September 24-28, 2008). The barges where monitoring occurred represented a subset of those identified by the aerial survey (Section 3.1) having large apparent leaks as viewed from the air. The purpose of the onboard PGIE observations was to provide close-up views of leaks prior to and during the bagging measurements. Table 3-2 lists the LSI filename number, the date of the observation, a description of the leak source, and the barge number or other descriptor.

Table 3-2. Summary Table of Barge Leaks Identified by LSI Ground-based Observations

Filename	Date	Part Leaking	Barge # or Other Descriptor
7	9/24/2008	Hatch	Barge G1
8	9/24/2008	Hatch	Barge G1
9	9/24/2008	Hatch	Barge G1
10	9/24/2008	Hatch	Barge G1
11	9/24/2008	Hatch	Barge G1
12	9/24/2008	Hatch	Barge G1
13	9/24/2008	Hatch	Barge G1
14	9/24/2008	Hatch	Barge G1
15	9/25/2008	Ullage Hatch	Barge G2 #2 Port Lower
16	9/25/2008	Cargo Hatch	Barge G2 #2 Port
17	9/25/2008	Butterworth Hatch	Barge G2 #2 Starboard Middle
18	9/25/2008	Butterworth Hatch	Barge G2 #2 Port Middle
19	9/25/2008	Butterworth Hatch	Barge G2 #1 Starboard Lower
20	9/25/2008	Alarm Test Rod	Barge G2 #2 Starboard
21	9/25/2008	Butterworth Hatch	Barge G2 #1 Port Lower
22	9/25/2008	Alarm Test Rod	Barge G2 #2 Port
23	9/25/2008	Cargo Hatch	Barge G2 #1 Starboard
24	9/25/2008	Butterworth Hatch	Barge G2 #1 Starboard Middle
25	9/25/2008	Butterworth Hatch	Barge G2 #1 Port Middle
26	9/25/2008	Butterworth Hatch	Barge G2 #1 Starboard Upper
27	9/25/2008	Butterworth Hatch	Barge G2 #1 Port Upper
28	9/25/2008	Butterworth Hatch	Barge G2 #2 Port Lower
29	9/25/2008	Overview of Leaks	Barge G2
30	9/25/2008	Bagging Process	Showing Gas Venting Through Dry Gas Meter
31	9/25/2008	Vent	Barge G3
32	9/25/2008	Pressure Relief Valve	Barge G3
33	9/25/2008	Butterworth Hatch	Barge G3 #1 Port Forward
34	9/25/2008	Ullage Hatch	Barge G3 #1
35	9/25/2008	Butterworth Hatch	Barge G3 #1 Port Aft
36	9/25/2005	Cargo Hatch Control Valve	Barge G3 #1
37	9/25/2008	Butterworth Hatch	Barge G3 Starboard Forward

Filename	Date	Part Leaking	Barge # or Other Descriptor
38	9/25/2008	Butterworth Hatch	Barge G3 #2 Port Forward
39	9/25/2008	Cargo Hatch Control Valve	Barge G3 #2
40	9/25/2008	Butterworth Hatch	Barge G3 #3 Starboard Forward
41	9/25/2008	Butterworth Hatch	Barge G3 #3 Port Forward
42	9/25/2008	Butterworth Hatch	Barge G3 #3 Port Aft
43	9/25/2008	Cargo Hatch Control Valve	Barge G3 #3
44	9/26/2008	Ullage Hatch	Barge G4 #1 Port & #1 Starboard
45	9/26/2008	Both Hatches & Valve	Barge G4 #2 Port
46	9/26/2008	Both Hatches & Valve	Barge G4 #2 Starboard
47	9/26/2008	Ullage & Cargo Hatches	Barge G4 #3 Starboard
48	9/26/2008	Cargo Hatch Control Valve	Barge G4 #3 Port
49	9/26/2008	Alarm Test Rod	Barge G5 #1 Starboard
50	9/26/2008	Ullage Hatch	Barge G5 #1 Starboard
51	9/26/2008	Ullage Hatch & Valve	Barge G5 #1 Port
52	9/26/2008	Ullage Hatch	Barge G5 #2 Port
53	9/26/2008	Ullage & Cargo Hatches	Barge G5 #2 Starboard
54	9/26/2008	Ullage & Cargo Hatches	Barge G5 #3 Starboard
55	9/26/2008	Ullage Hatch	Barge G5 #3 Port
56	9/26/2008	Alarm Test Rod	Barge G5 #3 Starboard
57	9/26/2008	Same as Video 045	Barge G4 Filmed Again After Repair Attempt
58	9/26/2008	Same as Video 047	Barge G4 Filmed Again After Repair Attempt
59	9/27/2008	Vent	Barge G6
60	9/27/2008	Cofferdam Hatch	Barge G6 Forward
61	9/27/2008	Cargo Hatch	Barge G6 #3 Port
62	9/27/2008	Cargo Hatch	Barge G6 #3 Starboard
63	9/27/2008	Ullage Hatch	Barge G6 #4 Port
64	9/27/2008	Ullage Hatch	Barge G6 #4 Starboard
65	9/27/2008	Cargo Hatch	Barge G6 #4 Starboard
66	9/27/2008	Same as Video 063	Barge G6 Filmed Again
67	9/27/2008	Same as Video 063	Barge G6 Filmed Again After Vent Was Closed
68	9/27/2008	Same as Video 063	Barge G6 Filmed Again After Vent Was Closed
69	9/28/2008	Overview of Leaks	Barge G7 Overview of #2 & #3 Cargo Hatches

Filename	Date	Part Leaking	Barge # or Other Descriptor
87	9/28/2008	Pressure Relief Valve	Barge G8
88	9/28/2008	Cargo Hatch	Barge G8 #2 Port
89	9/28/2008	Cargo Hatch Control Valve	Barge G8 #2 Port
90	9/28/2008	Control Valve Grease Cert	Barge G8 #2 Starboard
91	9/28/2008	Hatch & Control Valve	Barge G8 #3 Starboard
92	9/28/2008	Hatch & Control Valve	Barge G8 #3 Port
93	9/28/2008	Overview of Leaks	Barge G8 Overview of Videos 87 thru 92
94	9/28/2008	Block Valve	Barge G8 #3
95	9/28/2008	Butterworth Hatch	Barge G8 #3 Port Rear
96	9/28/2008	Butterworth Hatch	Barge G8 #3 Starboard Rear
97	9/28/2008	Slop Tank Vent	Barge G8
98	9/28/2008	Master Suction Valve	Barge G8
99	9/28/2008	Butterworth Hatch	Barge G8 #2 Port Forward
100	9/28/2008	Cargo Hatch	Barge G8 #1 Port
101	9/28/2008	Cargo Hatch Control Valve	Barge G8 #1 Port
102	9/28/2008	Cargo Hatch Control Valve	Barge G8 #1 Starboard
103	9/28/2008	Slop Tank Hatch	Barge G8

Figures 3-4 through 3-14 show snapshots of LSI PGIE observations onboard several barges acquired in conjunction with the LDEQ bagging. The figure captions also show the emission rate estimates from the LDEQ bagging survey report (Appendix H) converted to g/s for comparison purposes.

Note that it is impossible to represent the visual acuity of observed leaks with single image snapshots reproduced in this report. The leaks as viewed in moving video images are much more pronounced and generally easier to identify, particularly for small leaks.

Figure 3-4. Example from LSI Ground Survey – Sampling During Bagging Test

Figure 3-5. Leak from Cargo Hatch on Barge G2- Mass Leak 1.86 g/s

Figure 3-6. Leak from Ullage Hatch on Barge G4- Mass Leak 0.31 g/s

Figure 3-7. Leak from Ullage Hatch on Barge G4- Mass Leak 0.19 g/s

Figure 3-8. **Leak from Ullage Hatch on Barge G4- Mass Leak 0.24 g/s**

Figure 3-9. **Leak from Ullage Hatch on Barge G5- Mass Leak 0.73 g/s**

Figure 3-10. Leak from Ullage Hatch on Barge G5- Mass Leak 1.43 g/s

Figure 3-11. Leak from Vent on Barge G6- Mass Leak 1.45 g/s

Figure 3-12. Leak from Cofferdam Hatch on Barge G6- Mass Leak 1.99 g/s

Figure 3-13. Leak from Cargo Hatch on Barge G7- Mass Leak 3.12 g/s

Figure 3-14. Leak from Pressure Relief Valve on Barge G8- Mass Leak 5.78 g/s

Additional information on LSI ground videos can be found in Appendices C and D. Note that the screenshots shown in Appendix D do not include all detected leak events, but are only from events where the leaks are easily apparent in the screenshots taken from the camera videos.

The LSI ground surveys onboard the barges provided the following general conclusions about this remote sensing approach for fugitive emission detection from petrochemical transport barges:

1. The deployed PGIE equipment exhibited sufficient operational robustness and detection sensitivity and was judged to be extremely useful for type of close range fugitive leak inspection. This conclusion agrees with previous similar studies using this technology.

2. The PGIE technique was able to easily identify apparent large leaks with smaller leaks somewhat more difficult to identify, likely requiring an expert operator.

3. Ground surveys on board the barges indicated that the leaks originally seen from the air were many times composed of numerous individual leaks upon closer inspection.

4. In all studied cases, leaks identified with the PGIE were verified as being significant by the LDEQ bagging study

5. Ground observations were easier to execute during mid-day to late afternoon time periods due to more favorable background imaging conditions (improved background radiance from hot barge surfaces and lower shadow interference) and because fugitive emissions were likely more pronounced as the barges became heated by solar radiation and ambient temperature during the day. Onboard observations were less sensitive to ambient conditions as compared to aerial observations (Section 3.1) due to the close-in nature of the inspection.

6. Onboard observations allow identification of much smaller leaks compared to airborne observations due to the close-in nature of the inspection and the ability to optimize viewing angles and focus.

7. Onboard PGIE observations are very useful for identification of specific leaking components and verification of subsequent leak repair activities.

3.3 PGIE Observations From the Lock Wall

Ground-based PGIE observations of fugitive emissions from petrochemical transport barges were made by LSI, LDEQ, and ARCADIS personnel from the Port Allen lock wall during the BEM 1 study. The purpose of the lock wall PGIE observations was to provide mid-range views of leaks from barges that were being measured by the OTM 10 OP-FTIR survey. PGIE Observations were conducted by LSI using the LSI FLIR camera on September 24 and September 28-30, 2008 and by LDEQ and ARCADIS using LDEQ FLIR camera on September 28 and October 1-9, 2008. The dataset contains multiple movies showing various leaks from several different barges. Table 3-3 lists the LSI observations with representative images contained in the Figures 3-15 through 3-17. Table 3-4 lists the LDEQ/ARCADIS PGIE observations from the lock wall with representative images contained in Figures 3-18 through 3-20. The tables contain video filename number, the date of the observation, and the barge number or other descriptor. Additional information and images are contained in Appendices C-E.

Table 3-3. Summary Table of Barge Leaks Identified by LSI Lock Wall Observations

Filename	Date	Part Leaking	Barge # or Other Descriptor
0	9/24/2008	Hatch	Barge L1
1	9/24/2008	Hatch	Barge L1
2	9/24/2008	Hatch	Barge L1
3	9/24/2008	Hatch	Barge L1
4	9/24/2008	Hatch	Barge L1
5	9/24/2008	Hatch	Barge L2
6	9/24/2008	Hatch	Barge L2
70	9/28/2008	Cargo Hatch	Barge L3 #2 Port
71	9/28/2008	Cargo Hatch	Barge L3 #2 Starboard
72	9/28/2008	Cargo Hatch	Barge L3 #3 Starboard
73	9/28/2008	Cargo Hatch	Barge L3 #3 Port
74	9/28/2008	Same as Video 71	Barge L3 Filmed Again With Bag On
75	9/28/2008	Pressure Relief Valve	Barge L3
76	9/28/2008	Overview of Leaks	Barge L3 Another Overview of #2 & #3 Cargo Hatches
77	9/28/2008	Cargo Hatch	Barge L4 #3 Starboard
78	9/28/2008	Alarm Test Rod	Barge L4 #3 Port
79	9/28/2008	Cargo Hatch	Barge L4 #2 Port
80	9/28/2008	Ullage Hatch	Barge L4 #2 Port
81	9/28/2008	Ullage Hatch	Barge L4 #2 Starboard
82	9/28/2008	Cargo Hatch	Barge L4 #1 Starboard
83	9/28/2008	Cargo Hatch	Barge L4 #1 Port
84	9/28/2008	Vent	Barge L4
85	9/28/2008	Ullage Hatch	Barge L4 #1 Port
86	9/28/2008	Ullage Hatch	Barge L4 #1 Starboard
104	9/29/2008	Cargo Hatch	Barge L5 #1 Port
105	9/29/2008	Cargo Hatch	Barge L5 #2 Port & #3 Starboard
106	9/29/2008	Hatch & Pressure Valve	Barge L6 #3 Port & Pressure Relief Valve
107	9/29/2008	Butterworth & Cargo	Barge L6 #2 Starboard Forward & #1 Starboard
108	9/29/2008	Butterworth Hatch	Barge L6 #1 Starboard Middle
109	9/29/2008	Cargo Hatch	Barge L7 #3 Starboard
110	9/30/2008	Hatch & Pressure Valve	Barge L8 Pressure Relief Valve & #2 Starboard
111	9/30/2008	Slop Tank Vent	Barge L9

Figures 3-15 through 3-17 show three example snapshots from the lock wall observation illustrating the types of leaks that were detected: Example #1 shows a leaking hatch on Barge L1; Example #2 shows a leaking valve on Barge L2; and Example #3 shows a leaking hatch on Barge L6. The OTM 10 measured emission rates from barges in the lock are discussed in Sections 4 and 5.

Note that it is impossible to represent visual acuity of observed leaks with single image snapshots reproduced in this report. The leaks as viewed in moving video images are much more pronounced and generally easier to identify, particularly for small leaks.

Figure 3-15. Example #1 from LSI Ground Survey – Leaking Hatch on Barge L1- Total Mass Emission from Barge 0.521 g/s

Figure 3-16. **Example #2 from LSI Ground Survey – Leaking Valve on Barge L2- Total Mass Emission from Barge 0.521 g/s**

Figure 3-17. **Example #3 from LSI Ground Survey – Leaking Hatch on Barge L6- Total Mass Emission from Barge 0.415 g/s**

Table 3-4. Summary Table of Barge Leaks Identified by LDEQ/ARCADIS Lock Wall Observations

Filename	Date	Part Leaking	Barge # or Other Descriptor
VIDEO_080928_002	9/28/2008	Hatch	L10
VIDEO_080928_002	9/28/2008	Hatch	L10
VIDEO_081001_001	10/1/2008	Hatch	L11
VIDEO_081001_002	10/1/2008	Hatch	L11
VIDEO_081001_003	10/1/2008	Hatch	L11
VIDEO_081001_004	10/1/2008	Hatch	L11
VIDEO_081001_005	10/1/2008	Hatch	L11
VIDEO_081001_006	10/1/2008	Valve	L12
VIDEO_081001_007	10/1/2008	Vent	L12
VIDEO_081002_001	10/2/2008	Hatch	L13
VIDEO_081002_002	10/2/2008	Hatch	L13
VIDEO_081002_003	10/2/2008	Hatch	L13
VIDEO_081002_004	10/2/2008	Hatch	L13
VIDEO_081002_005	10/2/2008	Hatch	L13
VIDEO_081002_006	10/2/2008	Hatch	L14
VIDEO_081002_007	10/2/2008	Hatch	L15
VIDEO_081004_001	10/4/2008	Hatch	L16
VIDEO_081004_002	10/4/2008	Hatch	L17
VIDEO_081005_001	10/5/2008	Valve	L18
VIDEO_081005_002	10/5/2008	Hatch	L19
VIDEO_081005_003	10/5/2008	Hatch	L20
VIDEO_081006_001	10/6/2008	Hatch	L21
VIDEO_081008_001	10/8/2008	Vent	L22
VIDEO_081008_002	10/8/2008	Vent	L22
VIDEO_081009_001	10/9/2008	Vent	L23
VIDEO_081009_002	10/9/2008	Vent	L23

Figures 3-18 through 3-20 are three example snapshots illustrating the types of leaks that were detected: Example #1 shows a leaking hatch on Barge L10; Example #2 shows a leaking vent on Barge L23; and Example #3 shows a leaking valve on Barge L18. Additional example screenshots from the LDEQ camera videos can be found in Appendix E with discussion on OTM 10 emission flux measurement in Sections 4 and 5.

Figure 3-18. Example #1 from Ground Survey with LDEQ Camera – Leaking Hatch from Barge L10 (there was no OTM 10 emission flux measurement for this time period)

Figure 3-19. Example #2 from Ground Survey with LDEQ Camera – Leaking Vent from Barge L23- Total OTM 10 Mass Emission from Barge 0.490 g/s

Figure 3-20. Example #3 from Ground Survey with LDEQ Camera – Leaking Valve from Barge L13- Total OTM 10 Mass Emission from Barge 0.106 g/s

The lock wall PGIE observations provided the following general conclusions about this remote sensing approach for fugitive emission detection from petrochemical transport barges:

1. The deployed PGIE equipment exhibited sufficient operational robustness and detection sensitivity and was judged to be extremely useful for this type of mid-range distance fugitive leak inspection. This conclusion agrees with previous similar studies using this technology.

2. The PGIE technique was able to easily identify apparent large leaks with smaller leaks somewhat more difficult to identify, likely requiring an expert operator.

3. Lock wall mid-range observations were easier to execute during mid-day to late afternoon time periods due to more favorable background imaging conditions (improved background radiance from hot barge surfaces and lower shadow interference) and because fugitive emissions were likely more pronounced as the barges became heated by solar radiation and ambient temperature during the day. Lock wall observations were affected by strong shadows present in the deep lock under certain lighting conditions.

4. Mid-range Lock wall PGIE observations allow identification of much smaller leaks compared to airborne observations but were not as sensitive as close-range inspection onboard the barges which benefited from shorter range and the ability to optimize viewing angles.

5. Lock wall PGIE observations are judged to be very useful for routine inspection of barges passing through the lock.

4. OTM 10 AM Emission Flux and Trace Compound Speciation Results

The OTM 10 measurement at the Port Allen lock was performed from September 24 through October 9, 2008 from approximately 8:00 a.m. to 5:00 p.m. each day. The OTM 10 measurement attempted to assess emissions from all barge traffic that passed through the lock during this time period. In addition to OTM 10 measurements, PGIE camera images were acquired to compare measured flux rates leak appearance (Section 3.3). OTM 10 measurements focused on quantification of an alkane mixture (AM) flux (Appendix F).

Recorded barge traffic data included time of lock entry and exit and visual inspection of cargo labels on each barge. The reported cargo from the U.S. Army Corps of Engineers traffic log was also recorded. Note that the Corps of Engineers lock staff advised that the lock traffic reports are not necessarily accurate with regard to barge cargo. Of the six highest emissions events recorded by OTM 10, two occurred during times with barges that coded as carrying petroleum pitches, two with barges coded as carrying crude petroleum, and two with barges coded as empty (however the field crew smelled aromatics during one of these events). All OTM measured events and barge information are contained in Appendix G with a subset of the most interesting events presented in this section

4.1 Data Graphs and Tables for Select Events

A total of 97 barge sets (one or more barges per tug) passed through the lock during the OTM 10 observation period. AM fluxes were measured in a total of 62 temporally defined events. Many of these events exhibited small but measureable AM fluxes (< 0.1 g/s) and occurred when non-petrochemical transport barges were in the lock indicating that the measured AM emissions were possibly associated with hydrocarbon emissions from the tug diesel engines from the tugs idling in the lock. A significant portion of the events exhibited high AM flux emissions and occurred in conjunction with PGIE leak identification from lock wall observations. These events are believed to be related to fugitive emissions from the barge with only a small relative component of AM emissions from tugs.

A subset of OTM 10 measurements is provided below with a complete listing contained in Appendix G. The summary contains a description of the event, the AM flux values measured during the event (presented in Tables 4-1 through 4-12), and a screenshot of a leak detected during the event from the PGIE observations when available (presented in Figures 4-1 through 4-6). The spectral data from each of these events were also screened for trace VOC compounds. The results of the trace compound analysis (when detected) are presented in Section 4.1.1. For some of the events, we report “WC” as the AM flux value. In these instances, AM concentrations were detected by the OP-FTIR instrumentation, but the prevailing winds during the time of the measurement did not meet minimum data quality indicator levels regarding normal wind direction so an AM flux value could not be calculated.

Table 4-1. 9/24/ 2008 – Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/24/2008	10:32	11:03	Two	Labeled as benzene. Reported as empty. Noticeable aromatic smell,

Table 4-2. AM Flux Values Measured during 9/24/ 2008, Event #1

Time	AM Flux (g/s)
10:36:59	0.124
10:39:37	0.237
10:42:17	0.321
10:44:56	0.431
10:47:35	0.558
10:50:13	0.637
10:52:53	0.730
10:55:33	0.912
10:58:12	0.956
11:00:15	0.308
Average:	*0.521*

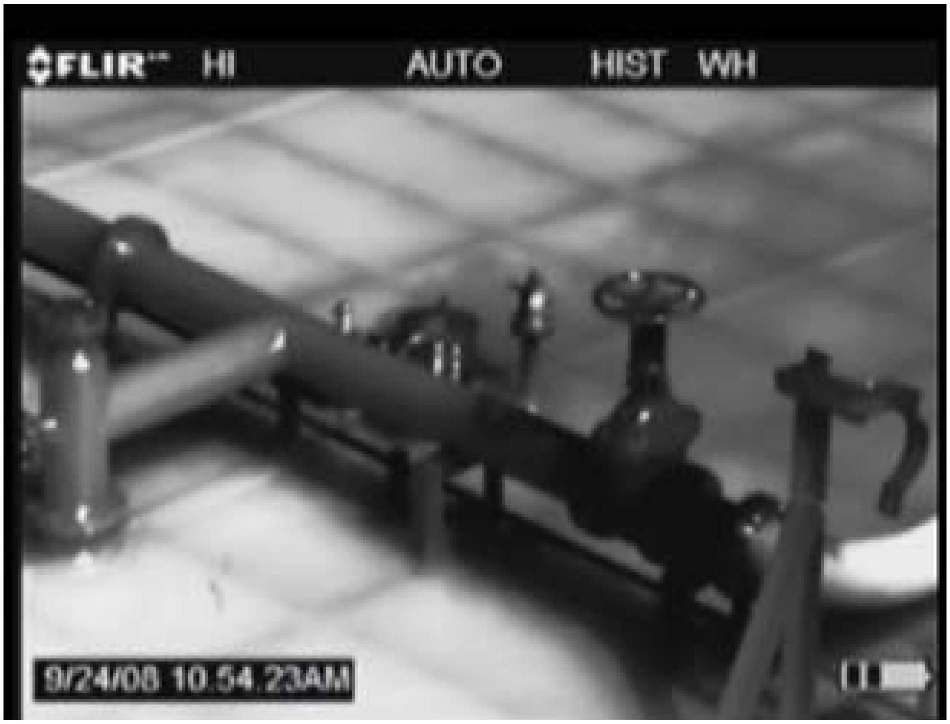

Figure 4-1. Screenshot from FLIR Camera Showing Leak from 9/24/ 2008, Event #1

Table 4-3. 9/29/ 2008 ─ Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	9:23	10:23	Three tugs with barges, one empty and two manned	Equipment/machinery/other

Table 4-4. AM Flux Values Measured during 9/29/ 2008, Event #2

Time	AM Flux (g/s)
9:39:26	0.514
9:42:06	0.374
9:44:45	0.305
9:47:23	0.325
9:50:00	0.410
9:52:39	0.457
9:55:16	0.596
9:57:55	0.590
10:00:33	0.463
10:03:11	0.324
10:05:50	0.297
10:08:29	0.389
10:11:09	0.374
10:13:48	0.390
Average:	*0.415*

Figure 4-2. Screenshot from FLIR Camera Showing Leak from 9/29/ 2008, Event #2

Table 4-5. 10/1/ 2008– Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/1/2008	9:10	9:58	Two	Organic industrial chemicals

Table 4-6. AM Flux Values Measured during 10/1/ 2008, Event #2

Time	AM Flux (g/s)
9:14:56	wc
9:17:33	wc
9:20:12	wc
9:22:51	wc
9:25:30	wc
9:28:09	0.019
9:30:52	wsc
9:33:30	0.035
9:36:09	0.046
9:38:54	0.067
9:41:31	0.065
9:44:12	0.058
9:46:48	0.04
9:49:23	wc
9:52:01	wc
Average:	*0.047*

wc = Wind criteria were not met.

wsc = Wind speed criteria not met.

Figure 4-3. **Screenshot from FLIR Camera Showing Leak from 10/1/ 2008, Event #2**

Table 4-7. **10/2/ 2008 – Event #2**

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/2/2008	9:45	10:42	One tug with one barge, one tug with two barges	Butane, propylene, one empty

Table 4-8. AM Flux Values Measured during 10/2/ 2008, Event #2

Time	AM Flux (g/s)
9:48:36	wc
9:51:16	wc
9:53:53	wc
9:56:31	wc
9:59:09	0.072
10:01:46	0.141
10:04:24	0.126
10:07:02	0.084
10:09:41	wc
10:12:18	wc
10:14:57	wc
10:17:35	wc
10:20:11	wc
10:22:48	wc
10:25:28	wc
10:28:05	wc
10:30:41	wc
10:33:21	wc
10:36:00	wc
10:38:38	wc
Average:	*0.106*

wc = Wind criteria were not met.

Figure 4-4. Screenshot from FLIR Camera Showing Leak from 10/2/ 2008, Event #3

Table 4-9. 10/5/ 2008 ─ Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/5/2008	9:23	10:04	Two	Petroleum

Table 4-10. AM Flux Values Measured during 10/5/ 2008, Event #1

Time	AM Flux (g/s)
9:26:53	2.48
9:29:31	4.07
9:32:09	4.84
9:34:48	4.02
9:37:25	4.03
9:41:21	4.31
9:43:59	3.30
9:46:40	3.00
9:49:18	2.85
9:51:56	2.90
9:54:35	2.33
9:57:13	2.57
Average:	*3.39*

Figure 4-5. Screenshot from FLIR Camera Showing Leak from 10/5/ 2008, Event #1

Table 4-11. 10/9/2008- Event #7

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	14:47	15:25	Two	Petroleum products, Empty

Table 4-12. AM Flux Values Measured during 10/9/ 2008, Event #7

Time	AM Flux (g/s)
14:51:46	0.286
14:54:24	0.331
14:57:02	0.635
14:59:40	0.794
15:02:17	0.819
15:04:55	0.877
15:07:32	0.661
15:10:11	0.432
15:12:49	0.206
15:15:28	0.18
15:18:05	0.174
Average:	*0.490*

Figure 4-6. Screenshot from FLIR Camera Showing Leak from 10/9/ 2008, Event #7

4.1.1 Summary of the Results of Analysis of Trace VOC Concentrations

As mentioned above, the spectral data from each of the six events described above were screened for the presence of trace VOC. The data were collected with the EPA OP-FTIR along an optical beam path that extended along the surface of the lock, from one side of the lock to the other. The results of this analysis are presented in Table 4-13. The table also includes the measured alkane mixture concentration for each event. The instrument minimum detection limit for each compound is shown in parentheses. Additional VOC analysis was performed for all other temporally defined events during the OTM 10 measurements. The results of this analysis are presented in Appendix G of this document.

Table 4-13. Summary of VOC Analysis

Event Date	Alkane Mixture (ppb)	Mol. Mass Alkane Mixture (g/mole)	Benzene (ppb)	Toluene (ppb)	*m*-Xylene (ppb)	Styrene (ppb)	Ethylene (ppb)	1,3-Butadiene (ppb)	Methane* (ppb)
9/24/08	1002	79	ND(47)	ND(77)	37(34)	ND(11)	ND(7)	ND(12)	115
9/29/08	736	61	ND(61)	ND(96)	ND(52)	ND(17)	ND(9)	ND(18)	ND
10/1/08	184	58	ND(41)	ND(51)	ND(26)	ND(16)	8(7)	17(13)	302
10/2/08	1954	68	ND(44)	73(51)	ND(27)	18(12)	ND(7)	ND(10)	114
10/5/08	3826	62	71(66)	ND(80)	ND(36)	ND(21)	ND(10)	16(15)	172
10/9/08	768	60	ND(55)	ND(85)	ND(39)	ND(13)	ND(7)	ND(18)	40

*Methane concentrations reported were measured along the ground-level beam path of the EPA OP- FTIR OTM 10 Configuration

ND = Not detected

4.2 Instances of Emissions Detected with the PGIE but not with ORS Measurements

An analysis of the PGIE observations made by the LSI Ground Crew and ARCADIS personnel in the lock revealed that there were instances where the PGIE detected barge leaks, but the events were not detected by the ORS instrumentation deployed on the southern side of the lock. Table 4-14 presents a summary of six events that were detected by the PGIE but not the ORS instrumentation. The table includes the date and time of the events, as well as the average prevailing wind direction during the time the PGIE detected the leaks.

Table 4-14. Summary of Leak Events Detected by the PGIE but not ORS Instrumentation

Date	Time	Barge Number(s)	Prevailing Wind Direction (degrees)
9/28/08	11:30 am	L10	120
9/29/08	4:32 pm	L7	320
9/30/08	2:46 pm	L8	300
10/2/08	10:25 am	L18, L19	140
10/2/08	1:00 pm	L14	180
10/2/08	2:35 pm	L15	150
10/8/08	9:21 am	L22	320

The orientation of the ORS measurement planes (when looking from the OP-FTIR to the scissor lift) were 133° and 311° for the EPA and ARCADIS OP-FTIR measurement planes, respectively. Considering the ORS configurations used in the study, a prevailing wind direction of approximately 41° is ideal for emissions measurements (perpendicular to the configuration planes). As can be seen in Table 4-14, the prevailing winds during the events not detected by the ORS instrumentation were close to parallel to the measurement configurations, or in some cases the winds were not from the direction of the lock (wind direction greater than 133° or less than 311°). The prevailing winds during the times the leaks were detected by the PGIE did not carry the winds through the ORS measurement plane, which explains why the leaks were not detected by the ORS instrumentation.

4.3 Evaluation of AM Emissions from Tugs

In order to evaluate the contribution of exhaust from the tugs to the alkane mixture (AM) emissions fluxes measured during the project, carbon monoxide concentrations were analyzed along the ground level beam path of the ARCADIS OP-FTIR VRPM configuration. Carbon monoxide was chosen for this analysis because it is a byproduct of combustion, and has relatively low detection limits with the OP-FTIR instrument. For the nine events detected from barges classified as “empty-no further information”, the carbon monoxide and alkane mixture concentrations measured along the ground level beam path were compared to investigate any possible correlations between the two compounds. A correlation between the two compounds would suggest that the source of the total hydrocarbon emissions measured was the emissions from the tug engines.

Of the nine events analyzed, eight of the events showed no correlation between the measured carbon monoxide and total hydrocarbon concentrations. The analysis did indicate a strong correlation between the concentrations of the two compounds during the 9/28/08

9:38 am to 10:11 am event (r^2 =0.83). However, the alkane mixture concentrations measured during this event were relatively low and close to the minimum detection limits of the OP-FTIR instrument. Based on these findings, we conclude that emissions of alkane mixture from the tug exhaust are negligible. The data from this analysis are presented in Appendix I of this document.

The OTM 10 lock wall mass flux measurements provided the following general conclusions about this remote sensing approach for fugitive emission detection and quantification from petrochemical transport barges:

(1) The deployed OTM 10 equipment exhibited sufficient operational robustness and detection sensitivity and was judged to be useful for this type of mid-range distance leak detection/quantification activities where compound speciation is important.

(2) The OTM 10 technique was able to identify and assess emission rates from a range of leak sizes as long as the prevailing wind brought the emitted plume through the vertical plane of the EPA OTM-10 measurement configuration.

5. Bagging Test Emission Estimate Results

As described previously, onboard leak bagging tests were performed by SAGE Environmental Consulting for LDEQ (Appendix H). The testing was performed directly at the source of the leak on each barge. During the five day bagging test, 23 leak points from a total of eight barges were measured to determine approximate THC mass emission rates. Table 5-1 reproduces the bagging test results contained in the LDEQ report including the measured total non-methane hydrocarbon emissions with values converted to g/s for comparison. The table shows that the measured total non-methane hydrocarbon emissions flux values ranged from 0.07 to 5.77 g/s.

Table 5-1. Summary of LDEQ Bagging Test Results

Test#	Barge#	Cargo	Mass Leak (g/s)
1	G1	Unleaded Gasoline	2.53
2	G2	Trans Mix	0.31
3	G2	Trans Mix	0.57
4	G2	Trans Mix	1.86
5	G2	Trans Mix	0.32
6	G3	Trans Mix	0.89
7	G3	Trans Mix	1.32
8	G4	Naphtha but cleaned	0.31
9	G4	Naphtha but cleaned	0.18
10	G4	Naphtha but cleaned	0.24
11	G4	Naphtha but cleaned	0.13
12	G4	Naphtha but cleaned	0.07
13	G4	Naphtha but cleaned	0.20
14	G5	Raffinate	2.11
15	G5	Raffinate	0.73
16	G5	Raffinate	1.42
17	G5	Raffinate	0.07
18	G6	Gasoline	1.45
19	G6	Gasoline	1.98
20	G7	Naphtha	3.12
21	G7	Naphtha	0.66
22	G8	Unleaded Gasoline	5.77
23	G8	Unleaded Gasoline	0.47

6. Comparison of OP-FTIR and Bagging Test Emission Flux Results

It is instructive to compare OTM 10 measurements and LDEQ bagging study results to help draw overall conclusions regarding the study. However, it is important to note that the results of the bagging method report emissions flux values from each individual leak, while the OTM 10 results report emissions flux values for each barge (possible multiple barges) and could consist of multiple leaks. Additionally, as mentioned in a previous section of the report, barge traffic through the Port Allen Lock was much lighter than normal due to repair activities on the Intracoastal Waterway Bayou Sorrel Bridge. Although study personnel originally planned to conduct bagging tests on barges immediately upon exiting the lock, this was not possible due to a lack of barge traffic through the lock during the period that Sage Environmental personnel were at the site. Instead, the barges selected for monitoring using the bagging method were chosen because they were identified as having very significant leaks from the airborne PGIE surveys. Therefore, the barges selected for the bagging experiments may not represent an average case, whereas the OTM 10 measurements were conducted on barges moving through the lock with no selection process and may represent a more typical sample cross-section. Even with these differences, it is useful to compare the results of emissions flux values determined from each method on different barges.

As discussed, the LDEQ bagging test results report findings for individual leaks on the barge as compared to the OTM 10 results which can include emissions from multiple leak points on a given barge or multiple barges. Table 6-1 presents results from the two measurement methods expressing the results of the LDEQ bagging test as a summation of measured leaks from a given barge and tabulating this with the most significant OTM 10 flux rate measurements. Note the measurements are from different barges so they serve as only a range comparison. The LDEQ bagging test results are labeled (Bag) and show leak rates of THC whereas the OTM 10 results, labeled (OTM 10), show AM flux rates.

Table 6-1. Summary of LDEQ Bagging Test Barge Totals and Most Significant OTM 10 Results

Test	Barge Number(s)	Cargo	Total Mass Leak Rate (g/s)
Bag	G1	Unleaded Gasoline	2.53
Bag	G2	Trans Mix	3.06
Bag	G3	Trans Mix	2.21
Bag	G4	Naphtha but cleaned	1.13
Bag	G5	Raffinate	4.33
Bag	G6	Gasoline	3.43
Bag	G7	Naphtha	3.78
Bag	G8	Unleaded Gasoline	6.24
OTM 10	L1	Benzene (Empty)	0.521
OTM 10	L5, L6	Equipment/Machinery/Other	0.415
OTM 10	L11	Organic industrial chemicals	0.047
OTM 10	L13	Butane, propylene, one empty	0.106
OTM 10	L18, L19	Petroleum	3.39
OTM 10	L23	Petroleum products, one empty	0.490

The above comparison is for different barges using different measurement techniques each of which can possess significant uncertainty due to the difficulty of the assessment. The primary sources of uncertainty are described in Section 7. With the difficulties these measurements present, the relative agreement between the two techniques may provide some confidence in the individual measures. From Table 6-1 the range of AM flux values found with the OTM 10 method was generally lower than the values found using the bagging method although the maximum flux values measured are comparable (3.39 with the OTM 10 method and 6.24 with the bagging method). The barges selected for the bagging experiments were identified as having very significant leaks from the airborne survey so they may not represent an average case whereas the OTM 10 measurements were conducted on barges moving through the lock with no selection process and therefore represent a more typical sample cross-section. This fact could help explain the lower values observed by OTM 10. Additionally, we would expect some underestimation of the alkane mixture (AM) flux measurement by OP-FTIR in comparison to the total non-methane hydrocarbon measurement produced in the bagging studies since non-alkane compounds can be somewhat underrepresented in the OP-FTIR AM approximation due to lack of signal in the spectral analysis region.

Note that these emission estimates presented in this report represent a snapshot in time. Fugitive emissions from petrochemical barges are believed to vary significantly due to ambient temperature, thermal load, product mix, load state, and equipment condition.

7. Quality Assurance/Quality Control

The following sections discuss the quality assurance methods used for the OTM 10 measurements. Note that quality assurance methods and procedures for the bagging tests can be found in Appendix H of this document.

7.1 Instrument Calibration

As stated in the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004), all equipment is calibrated annually and / or cal-checked at the U.S. EPA facility as part of standard operating procedures. Certificates of calibration are kept on file. Maintenance records are kept for any equipment adjustments or repairs in bound project notebooks that include the data and description of maintenance performed. Instrument calibration procedures and frequency are listed in Table 7-1 and further described in the text.

Table 7-1. Instrumentation Calibration Frequency and Description

Instrument	Measurement	Calibration Date	Calibration Detail
IMACC, Inc. OP-FTIR	Analyte PIC	Pre-deployment and in-field checks	MOP-6802 and 6823 of the ECPB Optical Remote Sensing *Facility Manual*
R.M. Young Model 05103 Meteorological Head	Wind Speed in miles/hour	6/21/08	U.S. EPA Wind Tunnel Cal. Records on file at EPA Metrology Lab
R.M. Young Model 05103 Meteorological Head	Wind direction in degrees from North	6/21/08	U.S. EPA Wind Tunnel Cal. Records on file at EPA Metrology Lab
Topcon Model GTS-211D Theodolite	Distance Measurement	6/17/08	Calibration of distance measurement. Actual distance = 42.5 ft Measured distance = 43.11 ft
Topcon Model GTS-211D Theodolite	Angle Measurement	6/17/08	Calibration of angle measurement. Actual angle = 360º Measured angle = 359º01’08”

7.2 Assessment of DQI Goals

The critical measurements associated with this project and the established data quality indicator (DQI) goals in terms of accuracy, precision, and completeness are listed in Table 7-2. More information on the procedures used to assess DQI goals can be found in Section 10 of the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004).

Table 7-2. Data Quality Indicator Goals for the Project

Measurement Parameter	Analysis Method	Accuracy	Precision	Completeness
Analyte PIC	OP-FTIR: Nitrous Oxide Concentrations	± 25%/15%/10% [a]	± 10%	90%
Ambient Wind Speed	R.M. Young Met heads pre-deployment calibration in EPA Metrology Lab	± 1 m/s	± 1 m/s	90%
Ambient Wind Direction	R.M. Young Met heads pre-deployment calibration in EPA Metrology Lab	± 10º	± 10º	90%
Distance Measurement	Theodolite- Topcon	± 1m	± 1m	100%
Gas plume relative opacity	PGIE: gasoline vapor release	N/A[b]	N/A[b]	100%

(a) The accuracy acceptance criterion of ± 25% is for path lengths of less than 50 m, ± 15% is for path lengths between 50 and 100 m, and ± 10% is for path lengths greater than 100 m.

(b) The PGIE is not a quantitative device and does not provide a numerical output.

7.2.1 DQI Check for Analyte PIC (OP-FTIR) Measurement

The precision and accuracy of the concentration data may be checked by looking at the analyzed nitrous oxide concentrations. The known atmospheric background nitrous oxide concentration is around 315 ppbv (this is an average value, as the value exhibits a slight seasonal variation). The acceptable range of nitrous oxide concentrations is 315 ppb ± 25% for path lengths of less than 50 m, 315 ppb ±15% for path lengths between 50 and 100 m, and 315 ppb ±10% for path lengths greater than 100 m. Verifying this background concentration provides a good QC check of the data collected. Obviously, this method is not valid for data collected at a site that is a source of nitrous oxide.

The precision of the analyte PIC measurements was evaluated by calculating the relative standard deviation (RSD) from one data subset collected near the surface of the suspected source. A subset is defined as the data collected along one particular path length during one particular survey in one survey sub-area.

The accuracy of the analyte PIC measurements was evaluated by comparing the calculated nitrous oxide concentrations from one data subset to the background value of 315 ppb. The number of calculated nitrous oxide concentrations that failed to meet the DQI accuracy criterion was recorded.

Overall, a total of three datasets were analyzed from three different time periods, one at the beginning of the project (September 24), one during the middle of the project (September 28), and one at the end of the project (October 9). Based on the DQI criterion set forth for precision of ±10%, all of the data subsets were found to be acceptable, for a completeness of 100%. The range of calculated relative standard deviations for the data subsets from this field campaign was 1.8 to 4.0 ppb, which represents 0.57 to 1.27% RSD.

Each data point (calculated nitrous oxide concentration) in the data subsets was analyzed to assess whether or not it met the DQI criterion for accuracy of ±10% (315 ± 32 ppb), as the path lengths used for measurements were greater than 100 meters. A total of 233 data points were analyzed, and 176 of the points met the DQI criteria for accuracy for a completeness of 76%.

7.2.2 PGIE Relative Opacity DQI Assessment

The PGIE used in this study are not quantitative instruments and therefore do not provide calibrated numerical data for images. The performance of the device can be assessed in a basic way by imaging a known gas release against a stable background, such as a concrete pad. During the current campaign, the vapors from an opened container of gasoline were used for the known gas release. Imaging this test release ensured the camera was operating properly and device firmware was set correctly.

7.2.3 Meteorological Head DQI Assessment

The meteorological head DQIs are checked annually as part of the routine annual calibration procedure. Before deployment to the field, the user verified the calibration date of the instrument by referencing the calibration sticker. If the date indicates the instrument is in need of calibration, it should be returned to the APPCD Metrology Laboratory before deployment to the field. The precision and accuracy of the heads is assessed by conducting a calibration in the EPA Metrology Lab using the exhaust from a bench top wind tunnel. This calibration procedure differs from the procedure used to perform the annual calibration of the instruments.

Additionally, a couple of reasonableness checks were performed in the field on the measured wind direction data. While data collection is occurring, the field team leader compares wind direction measured with the heads to the forecasted wind direction for that particular day. Another reasonableness check involves manually setting the vane on the meteorological heads to magnetic north (this is done with a hand held compass). The observed wind direction during this test should be very close to 360º.

7.2.4 Topcon Theodolite DQI Assessment

Before field deployment, ensure the battery packs are charged for this equipment. The following additional checks (which are performed at least annually) were made on June 17, 2008. The calibration of distance measurement was done at the EPA Facility using a tape measure. The actual distance was 42.5 feet, and the measured distance was 43.11 feet. The results indicate that instrument accuracy falls well within the DQI goals. The calibration of angle measurement was also performed. The actual angle was 360°, and the measured angle was 359°01’08”. The results indicate accuracy falls well within the DQI goals.

Additionally, there are several internal checks in the theodolite software that prevent data collection from occurring if the instrument is not properly aligned on the object being measured, or if the instrument has not been balanced correctly. When this occurs, it is necessary to re-initialize the instrument to collect data.

7.2.5 QC Checks of OP-FTIR Instrument Performance

At the beginning of the project, a series of QC checks were performed on both OP-FTIR instruments to assess the instrument performance. On September 25, 2008, the Single Beam Ratio, Baseline Stability, Noise Equivalent Absorbance, ZPD Stability, Saturation, Random Baseline Noise, and Stray Light diagnostic tests were performed. The results of the tests indicated that the ARCADIS and EPA OP-FTIR instruments were operating within the acceptable criteria for each QC check. More information on the diagnostic checks that are performed as part of a typical ORS field campaign can be found in MOP 6802 and 6823 of the *ECPD Optical Remote Sensing Facility Manual* (U.S. EPA, 2004).

In addition to the QC checks performed on the OP-FTIR instruments, the quality of the instrument signals (interferogram) was checked constantly during the field campaigns by ensuring that the intensity of the signal was at least 5 times the intensity of the stray light signal (the stray light signal is collected as background data prior to actual data collection, and measures internal stray light from the instrument itself). In addition to checking the strength of the signal, checks were done constantly in the field to ensure that the data were being collected and stored to the data collection computer. During the campaign, a member of the field team monitored the data collection computer to make sure these checks were completed.

7.3 Estimate of Uncertainty in the OTM 10 Emission Flux Measurements

As mentioned in Section 2, the OTM 10 measurement configurations consisted of three measurement paths which extended from the OP-FTIR instrument to the scissor lift. The 3-beam OTM 10 approach was chosen for this project since it was much more important to obtain a larger number of measurement cycles while the mobile source was contained in the lock rather than a fewer number of cycles with a five beam approach since the horizontal spatial location of the plume was not of primary importance. It was generally assumed that the plumes emitted from the barges would be initially small in spatial extent but would likely experience significant dispersion before exiting the lock and passing through the OTM 10 plane. It is likely that this assumption is correct since the barges were significantly below the lock wall top (approximately 7m to 12 m) and the emitted plumes could experience several dispersive/mixing mechanisms (such as stagnation, turbulence, channeling) depending on ambient wind direction and speed so the plumes could evolve more than in a flat wind swept scenario with similar downwind standoff.

In analyzing the PIC data using the 3-beam approach, the peak plume concentration was assumed to be centered along the crosswind axis of the OTM 10 configuration, and the σ_y parameter (horizontal dispersion coefficient) of the measured plume was assumed to be equal to ½ the length of the OTM 10 configurations. It was necessary to make these assumptions because the 3-beam OTM 10 approach does not include two intermediate surface beam paths which are used to obtain information on the horizontal location and dispersion of the plume.

In order to estimate the uncertainty associated with assuming a fixed peak plume concentration location and σ_y parameter, we used the VRPM Fit Explorer program (described by Abichou et al., 2009) to run a series of simulations to assess the variability in flux results from the OTM 10 method as a result of assuming different σ_y and peak plume concentration locations. In this simulation program, a downwind concentration field is generated from an area source using EPA ISC Gaussian dispersion model and then analyzed using OTM 10 algorithms and optical beam geometries.

Table 7-3 presents the results of a simulation done for three different assumed plume sizes where the σ_y parameter was varied, but the plume location was assumed to be fixed in the center of a 160 meter measurement configuration. The plume dimensions are shown in Table 7-3 as: *width (m) by crosswind distance (m).* The results are shown in units of g/s, and are compared to an OTM 10 calculation of 1.0 g/s for the same plume size assuming a σ_y value of 80 meters and a peak plume concentration location at 80 meters (as measured along the surface of the OTM 10 configuration plane from the OP-FTIR instrument), which is approximately equal to the parameters used for data analysis in the current study.

Table 7-3. Results of Flux Values Calculated by the VRPM Fit Explorer Program With a Fixed Peak Plume Concentration Location and Varying Values of the σ_y Parameter

σ_y Value	5 m × 40 m	5 m × 80 m	5 m × 120 m
σ_y = 8 m	1.002	1.030	1.068
σ_y = 80 m	0.921	0.945	0.978
σ_y = 800 m	0.914	0.938	0.970

The results of the simulation show that the OTM 10 calculation is insensitive to varying the value of the σ_y parameter (the OTM 10-derived flux values from the simulation were within ± 8.6% of control simulated values).

Table 7-4 presents the results of a second simulation done for three different assumed plume sizes where the plume center location was varied, but the σ_y parameter was assumed to be 80 m. The results are shown in units of g/s, and are compared to an OTM 10 calculation of 1.0 g/s for the same plume size assuming a σ_y value of 80 meters and a peak plume concentration location at 80 meters.

Table 7-4. Results of Flux Values Calculated by the VRPM Fit Explorer Program with a Fixed σ_y Parameter and Varying Peak Plume Concentration Locations

Peak Plume Concentration Location (m)	5 m × 40 m	5 m × 80 m	5 m × 120 m
20	3.651	N/A	N/A
40	2.066	1.910	N/A
60	1.305	1.322	1.300
80	0.921	0.945	0.978
100	0.700	0.718	0.743
120	0.545	0.554	N/A
140	0.412	N/A	N/A

N/A- Simulation results not included because plume would not be located within the confines of the OTM 10 configuration plane

The results of the simulation show that the 3-beam OTM 10 calculation is highly dependent upon the peak plume concentration location along the OTM 10 configuration plane. When the simulation was run with the peak concentration location close to the location of the OP-FTIR instrument (peak concentration location < 40 m), the OTM 10-derived flux values from the simulation were as much as 265% higher than control simulated values. However, the OTM 10-derived flux values from the simulation agreed better with control values as the plume becomes larger and is more centered on the optical configuration. Underestimation is evident closer to the end of the configuration defined by the location of the scissor lift.

Additional analysis was performed to compare the AM concentrations measured on the lowest beam path of each OTM 10 configuration during the AM emissions events described in Section 4.1. The analysis showed the average AM concentration ratio of the lowest OTM 10 beam paths for the two measurement planes for the several measurement periods presented in the report (in ppb) are: 324/63, 271/59, 244/39, 1563/945, 306/211, with baseline levels below 10 ppb. This suggests that the peak plume concentration location for each emissions event was located at a position along the OTM 10 configuration plane closer to the scissor lift (≥ 80 m) and/or that the effective plume size was more similar to the 120m (large plume) case. Based on the above plane to plane ratio analysis, a small plume located near the vertex of the beams (highly overestimated case) was not likely. Based on the simulation results and information on OTM 10 measurement accuracy from previous tracer-release validations studies, it is reasonable to assume that the overall uncertainty in the AM flux results for this effort are likely within ± 50%.

7.4 Uncertainty in the LDEQ Leak Bagging Estimates

The on-board leak bagging measurements conducted by SAGE Environmental Consultants for LDEQ is described in Appendix H of this report. Sage identifies several factors which can impact uncertainty in mass emission estimates including: sampling and analytical variability, leak capture/containment variability, inter-dependence of multiple leaks, and temperature effects. Additionally, this measurement campaign represented the first attempt, to our knowledge, to produce leak emission rate estimates from these source types using the component bagging technique. As a consequence, there is inherent uncertainty associated with novel application. To supplement Appendix H, further information on the execution of the bagging study and potential areas leading to uncertainty can be found in Appendix J which reproduces comments from the American Waterways Operators on this testing procedure along with responses from Sage Environmental Consulting.

7.5 General Data Limitations

One aspect of this report centers on the use of optical remote sensing equipment (especially PGIE) for identification of significant fugitive leaks from this difficult to measure source category in real-world scenarios. There are few perceived limitations on the use of the acquired remote sensing and imagery data in support the conclusion that these tools are generally useful for this purpose. Questions still remain as to the limits of detection and how these limits are affected by various field, target, and instrument parameters and these questions should be the subject of further study.

Another aspect of this report relates to estimates of emissions from this source category. Both measurement techniques, (EPA OTM 10 from the lock wall and the LDEQ bagging study) produced results which indicate a potentially significant level of short-term fugitive VOC emissions can occur. As discussed, measurements from this source category are difficult, and there is significant uncertainty in the absolute measurement results from both techniques and this should be considered a limitation of the data. Additionally, a more significant data limitation centers on the short-duration nature of these measurements which represent a snap-shot in time. Fugitive emissions from petrochemical barges are believed to vary significantly due to ambient temperature, thermal load, product mix, load state, and equipment condition. Since there is little information on the influence of these factors, extrapolation of these short term emission rate estimates is not recommended.

7.6 Deviations from the QAPP

The Quality Assurance Project Plan indicated that an ultraviolet differential optical absorption spectroscopy (UV-DOAS) instrument would be deployed to collect supplemental measurements of the BTEX compounds. The UV-DOAS instrument was not deployed at the site due to limited project resources and potential eye safety issues at the site. Instead, two additional OP-FTIR optical beam paths were deployed (one from each OP-FTIR instrument) across the surface of the lock to collect supplemental data on alkane mixture and trace VOC concentrations.

Also, it was originally anticipated that the VRPM configuration would be deployed along the northern edge of the lock. However, at the time of the field campaign, the winds were largely from the north, and the configuration was deployed on the southern edge of the lock.

8. Summary

This report describes the BEM 1 field campaign conducted in Baton Rouge, Louisiana from September 24 to October 9, 2008. BEM 1 investigated VOC emissions from petrochemical transport barges using portable gas imaging equipment PGIE (infrared cameras), and EPA Method OTM 10 with Open-path Fourier transform infrared (OP-FTIR) spectrometers, in addition to leak bagging tests.

The objectives of the study were:

- To improve knowledge of fugitive VOC emissions from petrochemical transport barges.
- To demonstrate and advance the field application of select ORS techniques (EPA OTM 10 OP-FTIR and PGIE) for identification and quantification of fugitive emissions from difficult to monitor sources.
- Identify sources of fugitive leaks from multiple barges

To accomplish these goals, the project team conducted several complementary efforts:

1. Aerial PGIE surveys of barges located on the Mississippi River and inter-coastal water ways to identify barges with significant fugitive emissions.
2. Ground-based PGIE observations of barges from the Port Allen Lock wall and also onboard several barges to identify and closely observe fugitive leaks.
3. Onboard leak emission bagging measurements conducted by LDEQ on several barges to quantify leak rates and allow comparison with PGIE images.
4. EPA method OTM 10 with open-path Fourier transform infrared spectroscopy used at the Port Allen lock to produce hydrocarbon emission measurements from barge traffic traveling through the lock.

The aerial PGIE camera monitoring performed by LSI, Inc. detected leaks from 45 different barges located in the Mississippi River and the Intracoastal Waterway. The ground-based monitoring performed by LSI, Inc. detected leaks from 18 different barges in the U.S. Army Corps of Engineers lock and in the Mississippi River. Additional infrared camera monitoring performed by ARCADIS and LDEQ personnel in the lock detected multiple leaks from several barges. This report contains a number of leak images that serve to further understanding of fugitive emissions from various barge components.

The remote sensing surveys provided significant information regarding the use of infrared cameras for detection of fugitive emissions from petrochemical transport barges. The PGIE equipment was robust, easy to use, and possessed sufficient detection sensitivity for this application. The PGIE remote sensing approach is judged to be extremely useful for both aerial survey and close range fugitive leak inspection of petrochemical transport barges. The PGIE technique was able to identify a large range of leaks with large leaks detectable from the air and smaller leaks more easily observed at close range. PGIE observations were easier to execute during mid-day to late afternoon time periods due to more favorable background imaging conditions (improved background radiance from hot barge surfaces and lower shadow interference) and because fugitive emissions were likely more pronounced as the barges became heated by solar radiation and ambient temperature during the day. PGIE observations were very useful for identification of specific leaking components and verification of subsequent leak repair activities.

Based on aerial observations, eight barges with observed large leaks were selected for onboard leak emission rate measurements as part of the LDEQ on-board bagging survey. For this effort, a total of 23 leak points from eight barges were bagged to determine mass emission rates. The measured total non-methane hydrocarbon emissions flux values from individual leaks during the bagging study ranged from 0.07 g/s to 5.77 g/s. Summing all measured leaks for each individual barge yielded a barge total leak rate ranging from 1.13 to 6.24 g/s.

OTM 10 Monitoring was conducted at the Port Allen lock wall from September 24 through October 9. A total of 97 barge sets passed through the lock during the OTM 10 observation period. Six events showed significant fugitive hydrocarbon emissions as measured by OTM 10 with values ranging from 0.047g/s to 3.39 g/s AM flux rate. The equipment deployed to apply the OTM 10 approach exhibited sufficient operational robustness and detection sensitivity and was judged to be useful for mid-range distance leak detection/quantification activities where compound speciation is important. Additionally, the OTM 10 technique was able to identify and assess emission rates from a range of leak sizes as long as the prevailing wind brought the emitted plume through the vertical plane of the OTM-10 measurement configuration.

In comparing the LDEQ bagging measurements with the OTM 10 measurements (different barges), the range of AM flux values found with the OTM 10 method were generally lower than the values found using the bagging method although the maximum flux values measured are comparable (3.39 g/s with the OTM 10 method and 6.24 g/s with the bagging method). The barges selected for the bagging experiments were identified as having very significant leaks from the airborne survey so they may not represent an average case whereas the OTM 10 measurements were conducted on barges moving through the lock with no selection process and therefore represent a more typical sample cross-section. This fact could help explain the lower values observed by OTM 10.

An analysis of the infrared camera observations and ORS measurements made in the lock revealed that there were seven instances where the camera detected barge leaks, but the events were not detected by the ORS measurements. However, further analysis showed that the prevailing winds during the time of these events were parallel to the ORS measurement plane, or actually contained a southerly component (the lock was located to the north of the measurement configuration), so the barge emissions were not captured by the ORS measurement configuration.

A significant output of this project is represented in the image database which provides a comparison of PGIE images of leaks with measured leak rates which helps improve the understanding of the qualitative information provided by the infrared cameras for this source category.

Emission estimates contained in this report represent a snapshot in time. Fugitive emissions from petrochemical barges are believed to vary significantly due to ambient temperature, thermal load, product mix, load state, and equipment condition.

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APPENDIX A

LSI Report: Leak Detection using LSI Infrared Gas Imaging, BEM 1 Barge Study; Aerial

Report:
Leak Detection using LSI Infrared Gas Imaging

BEM1 Barge Study

David Furry, President, LSI
Date: October 27, 2008

Executive Summary

Leak Surveys Inc. (Early, TX) was commissioned by Arcadis to conduct an optical imaging survey on barges located in various waterways within the Mississippi River Delta as part of the BEM1 Project. The optical imaging survey looked at various components within these processes. The aerial optical imaging leak (smart LDAR) survey was conducted from September 24th thru October 1st, 2008. The Hawk Leak Detection System visualized a total of 40 leaks on the various barges. Carl Hacking, Pilot and David Varner, camera technician, performed the leak survey.

Standard Operating Procedure
Aerial Pipeline Survey

When performing an aerial pipeline survey, there are some standard operating procedures that must be followed in order to ensure the variables of the survey are constant and do not change according to user.

1. Fully charge all batteries and digital video recorders the night before starting the pipeline survey
2. Surveys will commence at 9:00 am unless unfavorable weather or other factors are involved.
3. The pilot will perform a preflight briefing prior to each day’s survey.
    a. Included in this preflight meeting are the following:
        i. Safety issues
        ii. Terrain evaluation
        iii. Survey Speed/Height
        iv. Emergency Procedures

4. Once the preflight briefing has been performed, the passenger door will need to be removed in preparation for the survey.
5. The camera crew will now check all equipment to make sure batteries are fully charged and ready to go. Once this has been checked all equipment will remain on and the survey will commence.
6. The camera operator will hold the camera outside the door focusing on the pipeline right of way.
7. If any leaks are found during the pipeline survey the following steps will be taken:
    a. Pilot will circle back around to approximately ½ mile before leak on pipeline for optimum video footage.
    b. The camera operator will record the leaking gas emissions for a predetermined amount of time.
    c. Once the leak has been recorded, a digital picture will be taken of the source where the leak is occurring.

    d. Finally GPS coordinates will be taken to ensure an accurate location of the leak.
8. At the completion of the pipeline survey, a daily briefing will take place to discuss any issues encountered during the day. All leak data will be relayed to the appropriate personnel for immediate remediation.
9. All of these actions must be taken into account each day to ensure the integrity of the pipeline patrol process.

Background

Leak Surveys Inc. is an international company with 4-½ years experience using the Hawk Leak Detection System (HLDS). LSI developed the HLDS after 12 years of research and development on optical imaging and has applied for international patents.

LSI and the API committee introduced using optical imaging to conduct surveys in refinery and chemical plants on a commercial basis to the industry in February of 2004.

Our international smart LDAR crews have performed actual leak surveys in the Asia Pacific area, Europe and North America for a variety of different customers over the past 3-½ years.

The human eye more readily perceives motion than contrast. Movie or real time images are used as the basis for leak detection in the data presented here. Image quality is affected by the temperature and emissivity difference between the gas cloud and the background.

At this point, no infrared gas imaging cameras are capable of providing quantitative measurements of gas concentration, however, studies funded by the American Petroleum Institute that shows the detection limits accomplished by passive gas imaging systems are within the bounds necessary for equivalent detection of leaks at less that 10,000 ppm (60 g/hr).

Gas imaging provides the user with a real time achievable record of leaking components as well as providing specific locations of leaks within a component.

Camera Description

The infrared gas imaging camera used by Leak Surveys, Inc., consists of a modified Indigo (FLIR/Indigo Systems Corp., Goleta CA) Merlin MID camera with a nominal spectra range of 1- 5.4 µm. Using a 30 x 30 m InSb detector with a 320 x 240 pixel array, the camera has capabilities of varying the integration times from 5 µs to 16.5 ms. The detector is operated at near liquid nitrogen temperatures using an integral Stirling cooler which provides the system with an NEdT of no more than an 18 mK providing excellent sensitivity.

The spectral range was further limited with the use of a notch filter specifically designed for the detection of hydrocarbon infrared absorptions in the 3 micron region. The narrow band pass range of the filter is less than the infrared spectral absorption of gas phase hexane. The filter notch is positioned such that alkane gases have a significant response within the band pass range.

Various lens including a 25 mm, a 50 mm and a 100 mm lens were used during the experiments. The 25 mm lens provides a 22 x 16 degrees field of view with an f-number of 2.3. The 50 mm lens provides an 11 x 8 degrees field of view with an f-number of 2.3.

The use of a narrow band pass filter provides spectral discrimination that allows the detection of compounds that have a vibration mode in the infrared region of the filter. Not all hydrocarbons have infrared absorptions within the filter range. Table I (below) shows the theoretical relative response of various compounds of interest using 1 cm-1 resolution infrared spectra (Infrared Analysis, Inc., Anaheim, CA). Using propane as the reference spectrum with a relative response of 100, methane's response is approximately 10% of the same concentration of propane and hexane is 1.5 times the response of propane at the same concentration. The filter is set to the infrared region of the spectrum that corresponds to the infrared absorption of alkanes, primarily. Other hydrocarbons exhibit various degrees of absorption of infrared energy in this region as indicated in the Table.

The infrared video images were recorded on digital tape recorder. A digital camera was used to document the components being observed with the infrared camera.

Table I - Relative Response of Hydrocarbon with LSI Infrared Imaging Camera

Compound	Relative Response Propane =100%
Methane	9
Ethane	43
Propane	100
Butane	118
Iso-Butane	137
Pentane	143
Hexane	155
Heptane	157
Octane	136

Compound	Relative Response Propane =100%
Ethylene	3
Propylene	20
Iso Butylene	37
2 Methyl 2 Butane	4
1 Pentene	7
2 Methyl 2 Pentene	7
Benzene	4
Toluene	21
o-Xylene	38
p-Xylene	23
m-Xylene	32

File Descriptions			Barge #	Description
SnapShot	Named	Unnamed		
L000	Video 000	NN000	A1	Two Large Valve Settings Towards Aft Side
L001	Video 001	NN001	A2	Vent Stack at Bow of Barge
L002	Video 002	NN002	A3	Vent Stack at Bow of Barge
L003	Video 003	NN003	A4	Top Loading Hatches
L004	Video 004	NN004	A5	Top Loading Hatches at Placid Refinery
L005	Video 005	NN005	A6	Top Loading Hatches to the Aft of Barge
L006	Video 006	NN006	A7	Top Loading Hatches at Bow of Barge
L007	Video 007	NN007	A8	Top Loading Hatches at Bow of Barge
L008	Video 008	NN008	A9	Top Loading Hatches at Bow of Barge
L009	Video 009	NN009	A10	Top Loading Hatch at Bow of Barge
L010	Video 010	NN010	A11	Top Loading Hatches and Vent
L011	Video 011	NN011	A12	Top Loading Hatches at Aft side of Barge at Placid Refinery
L012	Video 012	NN012	A13	Top Hatches on Barge
L013	Video 013	NN013	A14	Top Hatches on Barge
L014	Video 014	NN014	A15	Top Hatches and Vent Stack on Barge
			A16	Top Hatches and Vent Stack on Barge
			A17	Top Hatches on Barge
			A11	Top Hatches on Barge
L015	Video 015	NN015	A18	Vent Stack on Barge
L016	Video 016	NN016	A4	Repeat of Video 003, Boarded by Bagging Team
L017	Video 017	NN017	A19	Top Loading Hatches at Placid Refinery
L018a	Video 018a	NN018a	A20	Top Hatches on Barge
L018b	Video 018b	NN018b	A21	Top Hatches on Barge
L018c	Video 018c	NN018c	A22	Top Hatches on Barge
L019	Video 019	NN019	A13	Top Hatches at TT Barge Cleaning Facility -- Refilm
			A14	Top Hatches at TT Barge Cleaning Facility
L020	Video 020	NN020	A23	Vent Stack on Barge -- Refilm

File Descriptions			Barge #	Description
SnapShot	Named	Unnamed		
			A24	Vent Stack on Barge
L021	Video 021	NN021	A25	Hatches at Aft Side -- in Intercoastal Canal
			A26	Vent at Aft Side -- in Intercoastal Canal
L022a	Video 022a	NN022a	A27	Vent at Aft Side
L022b	Video 022b	NN022b	A28	Vent Stack on Bow of Barge
L023a	Video 023a	NN023a	A29	Center Vent on Barge
L023b	Video 023b	NN023b	A30	Cent Hatch on Barge
L024	Video 024	NN024	A31	Bow Hatch and Deck Hatch on Barge
L025	Video 025	NN025	A32	Two Aft Hatches and one Side Hatch
L026	Video 026	NN026	A33	Top Hatches on Barge -- in Intercoastal Canal
L027	Video 027	NN027	A34	Vent Stack in Center of Barge -- in Intercoastal Canal
L028	Video 028	NN028	A1	Vent Stack on Bow of Barge -- Refilm
L029	Video 029	NN029	A35	Vent Stack on Bow of Barge
L030	Video 030	NN030	A36	Vent Stack on Bow of Barge -- Refilm
L031a	Video 031a	NN031a	A37	Top Hatches on Barge -- Across from Locks
L031b	Video 031b	NN031b	A31	Top Hactches on Bow --Across from Locks
L032	Video 032	NN032	A23	Vent at the Bow of Barge -- North of Locks
L033	Video 033	NN033	A38	Forward Bow Hatch on Barge -- in Intercoastal Canal

Conclusion

The LSI crew was able to find a total of 40 barges leaking from either hatches or vents during the survey. It is in LSI's opinion that the major source of emissions for the barges came from the hatches and vents. These hatch leaks were very common amongst the various barges we surveyed. Had there been any sizable leaks on the barges, the Hawk Leak Detection System would have seen them.

I would also like to take this opportunity to thank you for allowing our leak survey crews to conduct the survey on your pipeline. We would like to have the opportunity to bid on future jobs whether it is aerial or ground level. We have the most experienced IR crews in the industry. If we can be of further assistance please do not hesitate to contact me.

David Furry
President -LSI
P.O. Box 3066
Early, Texas 76803

APPENDIX B

LSI Aerial PGIE Images

APPENDIX B: LSI Aerial PGIE Images

The following appendix contains a selection of screen shots from the LSI airborne potion of the BEM 1 study conducted in Baton Rouge LA September 24th through October 1st 2008.

Figure B-1. Leak from Barge A12

Figure B-2. Leak from Barge A13

Figure B-3. Leak from Barge A14

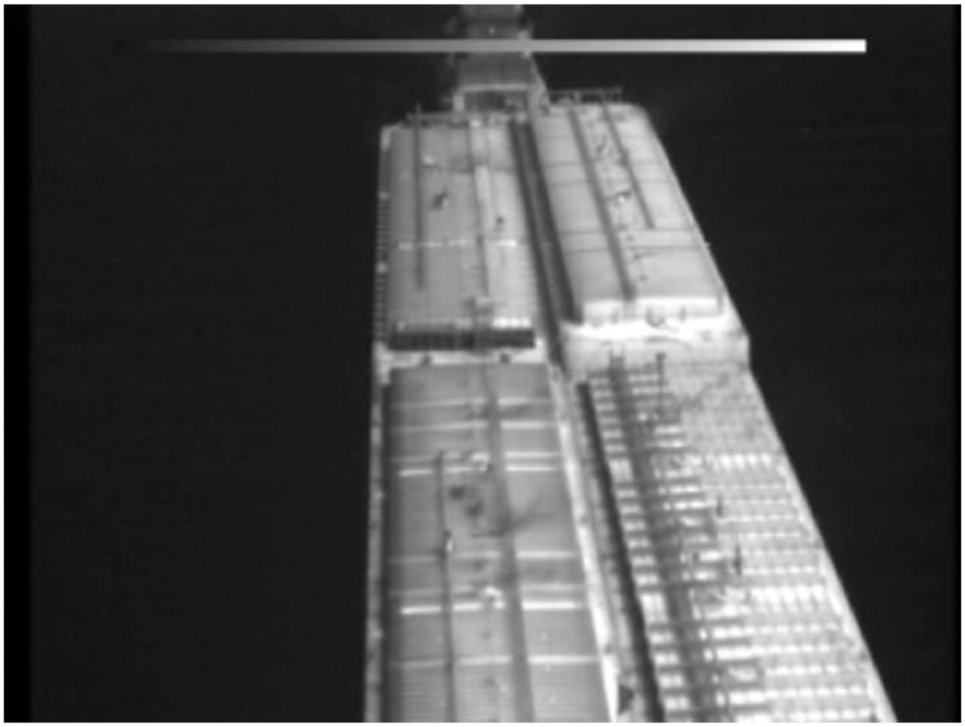

Figure B-4. Leak from Barge A15

Figure B-5. Leak from Barge A18

Figure B-6. Leak from Barge A19

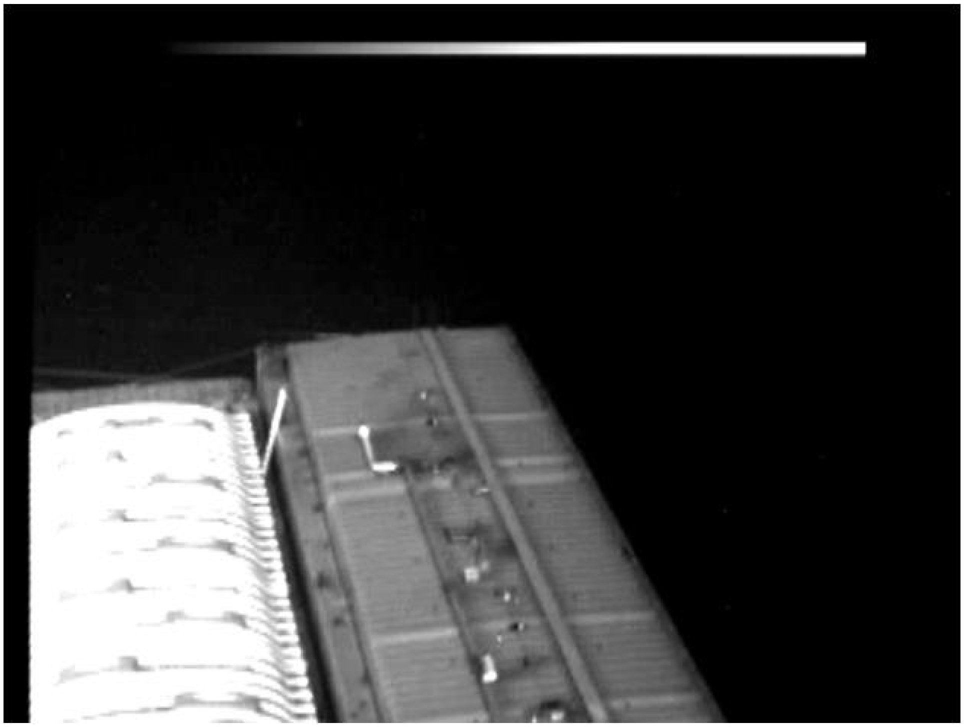

Figure B-7. Leak from Barge A22

Figure B-8. Leak from Barge A13

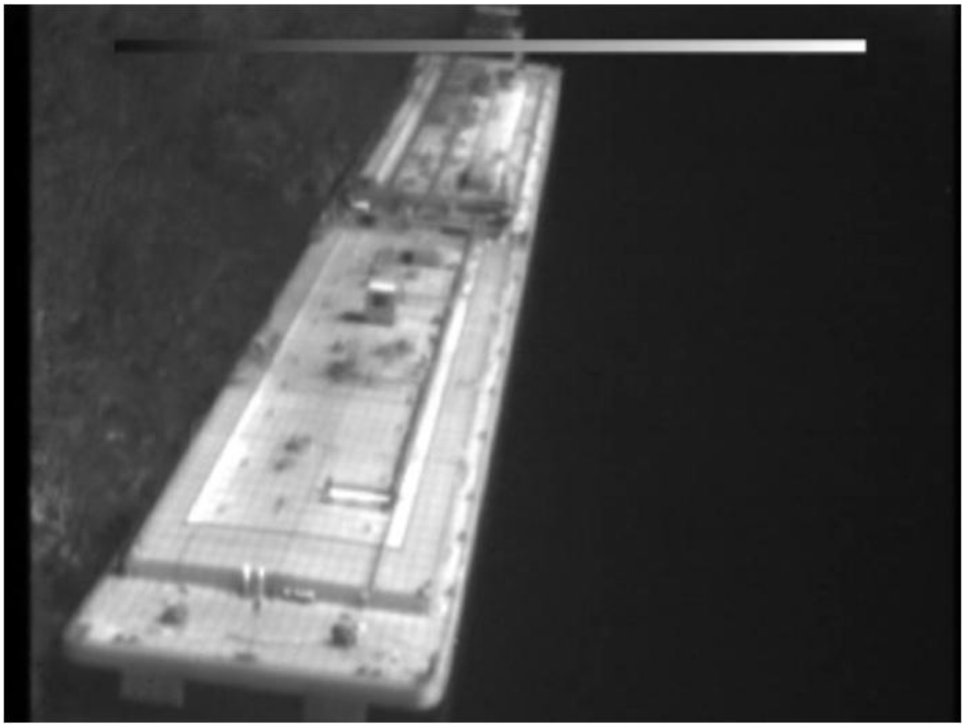

Figure B-9. Leak from Barge A23

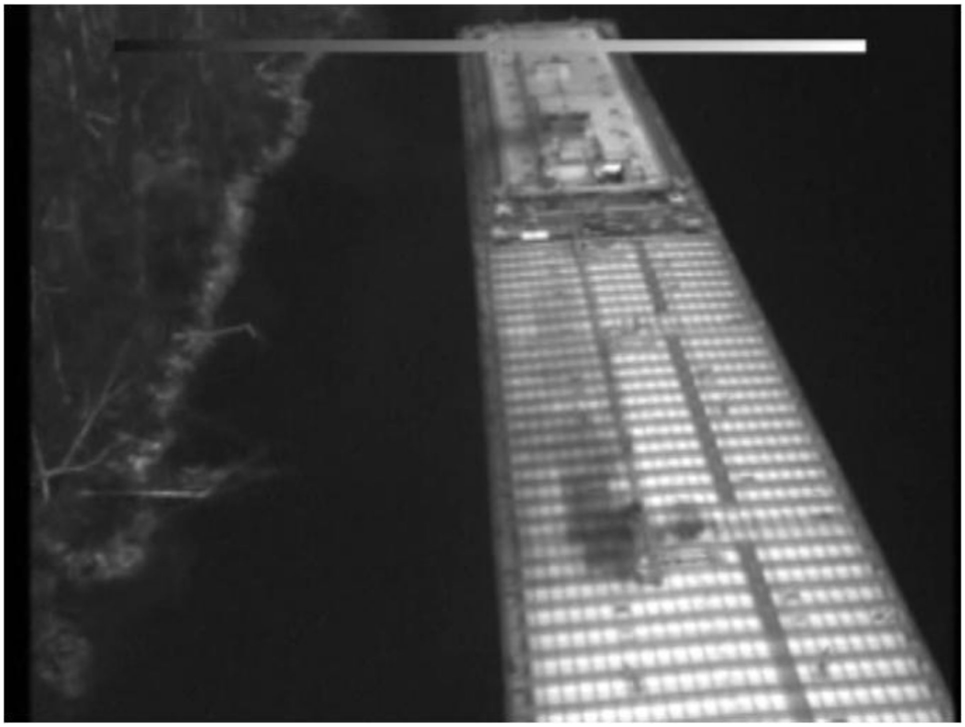

Figure B-10. Leak from Barge A25

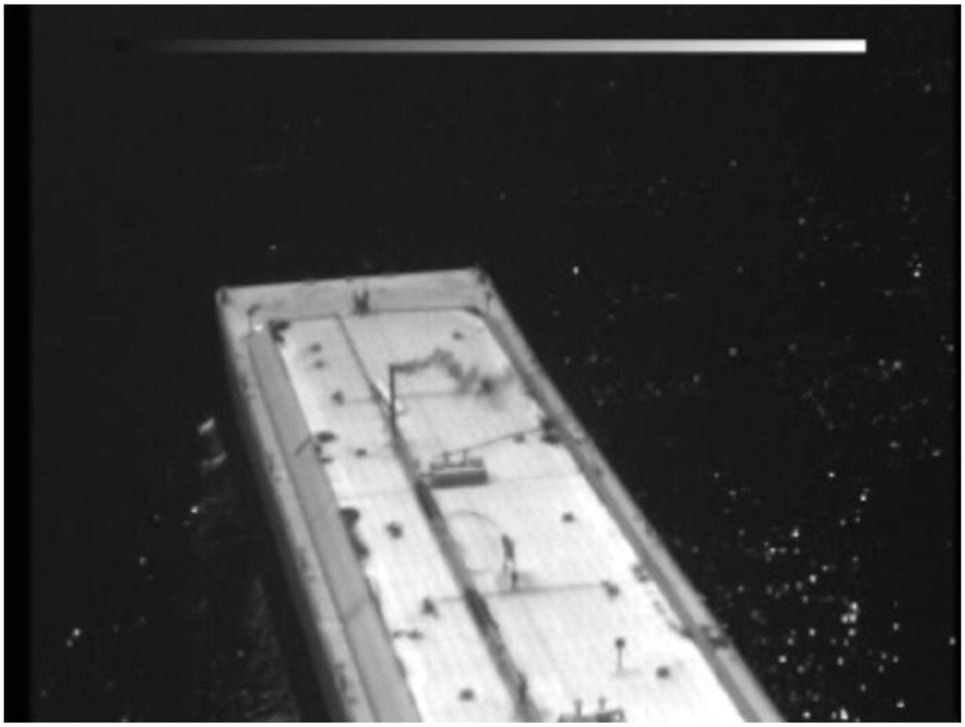

Figure B-11. Leak from Barge A27

Figure B-12. Leak from Barge A29

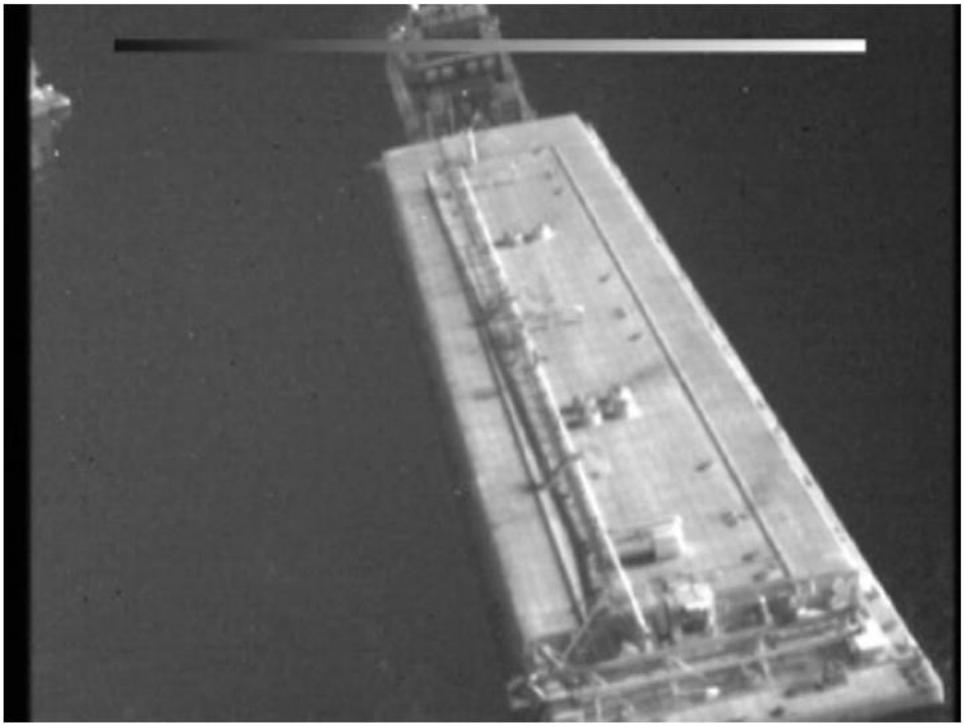

Figure B-13. Leak from Barge A31

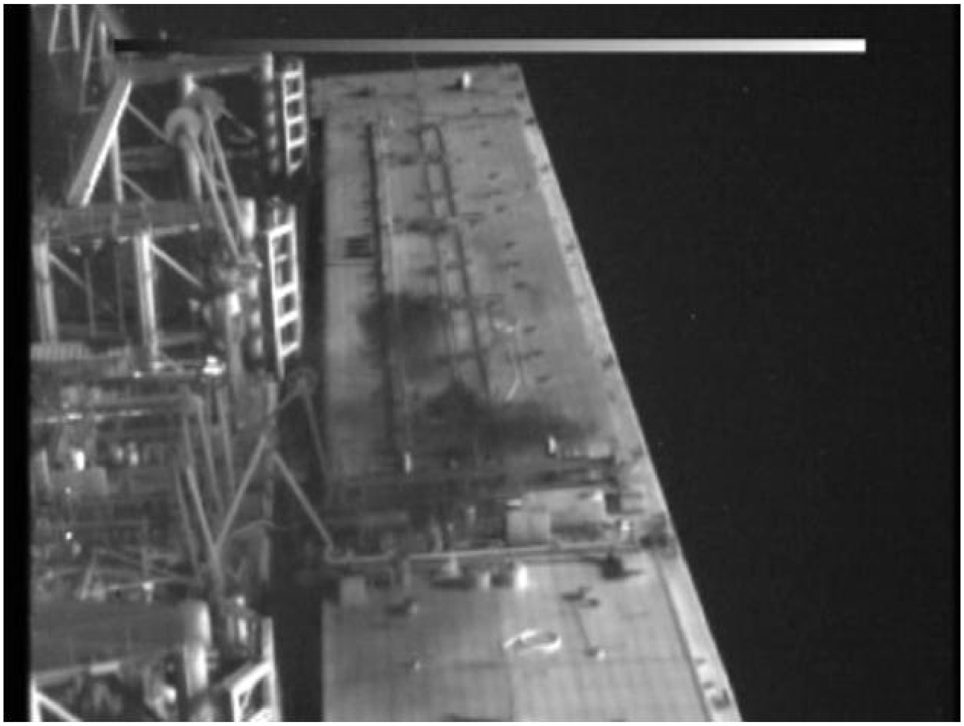

Figure B-14. Leak from Barge A32

Figure B-15. Leak from Barge A34

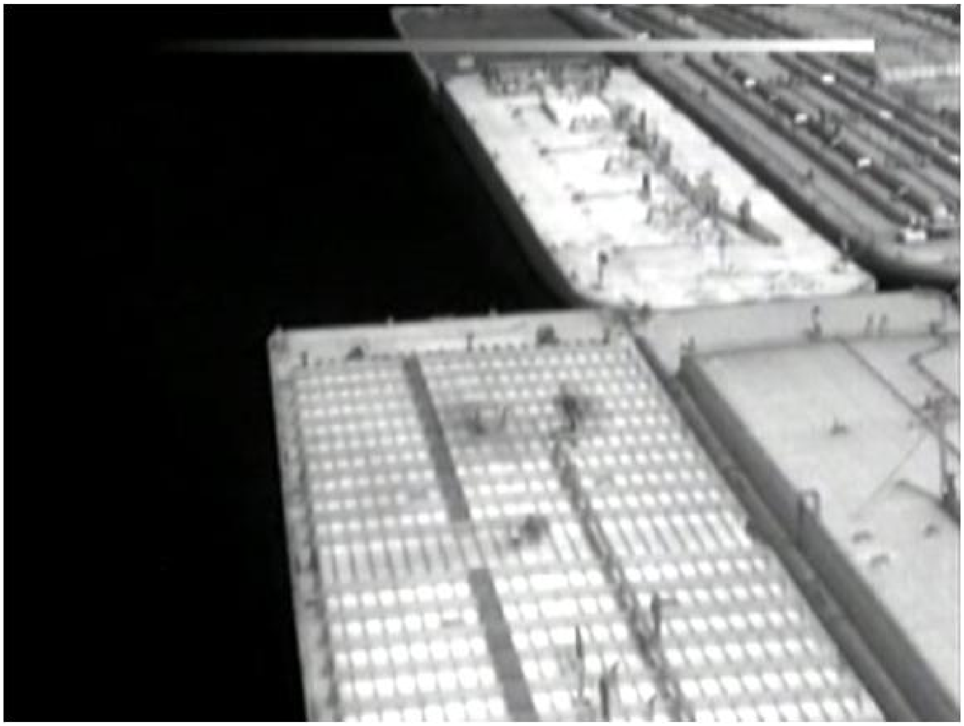

Figure B-16. Leak from Barge A1

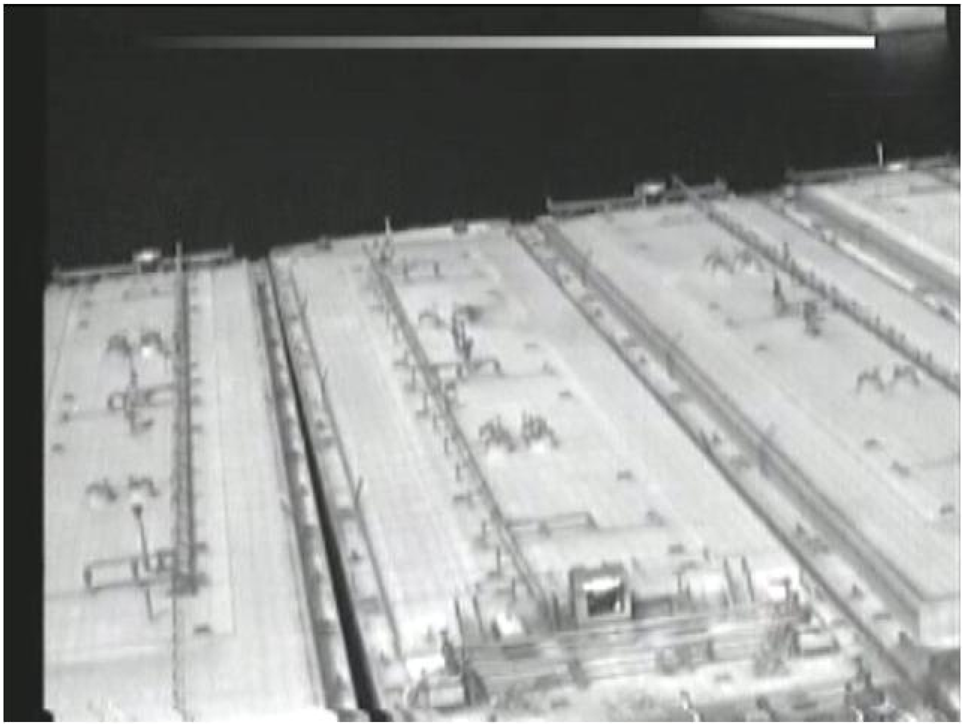

Figure B-17. Leak from Barge A36

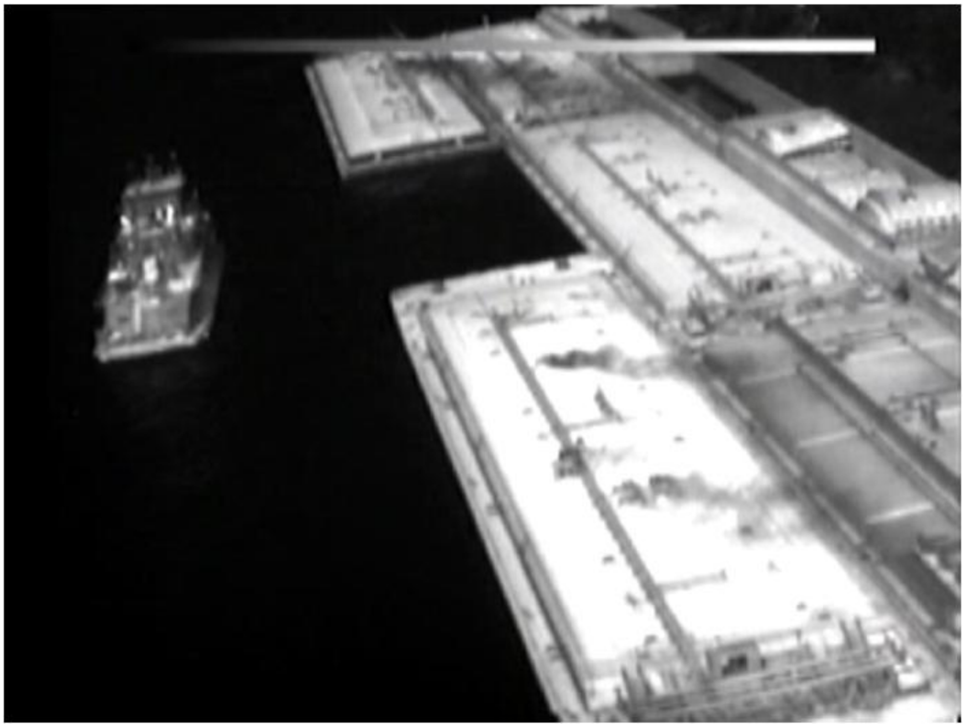

Figure B-18. Leak from Barge A37

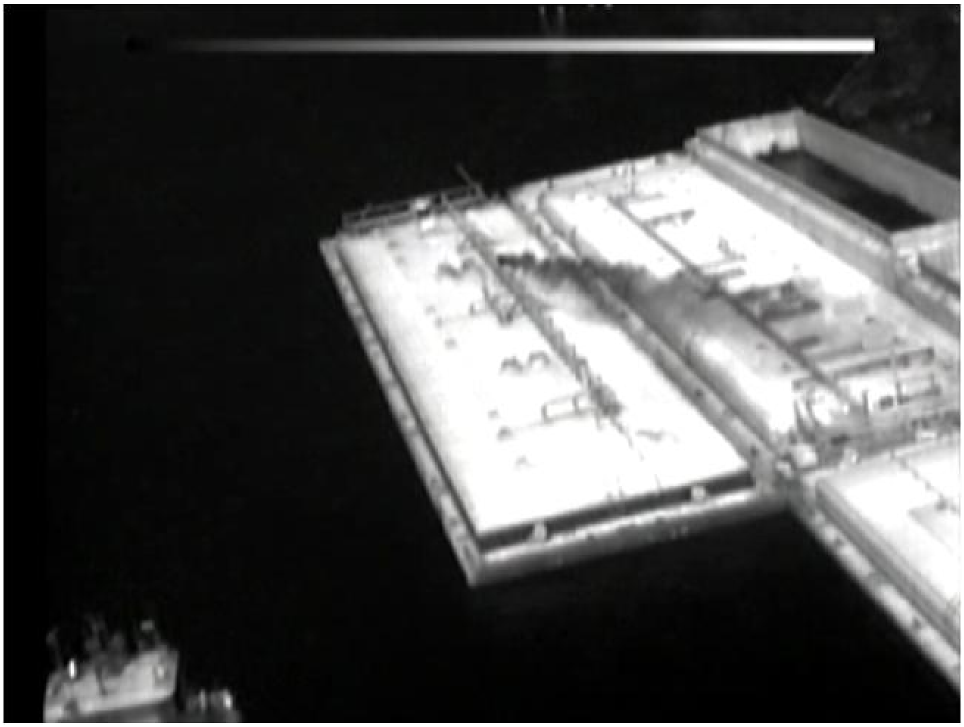

Figure B-19. Leak from Barge A31

Figure B-20. Leak from Barge A23

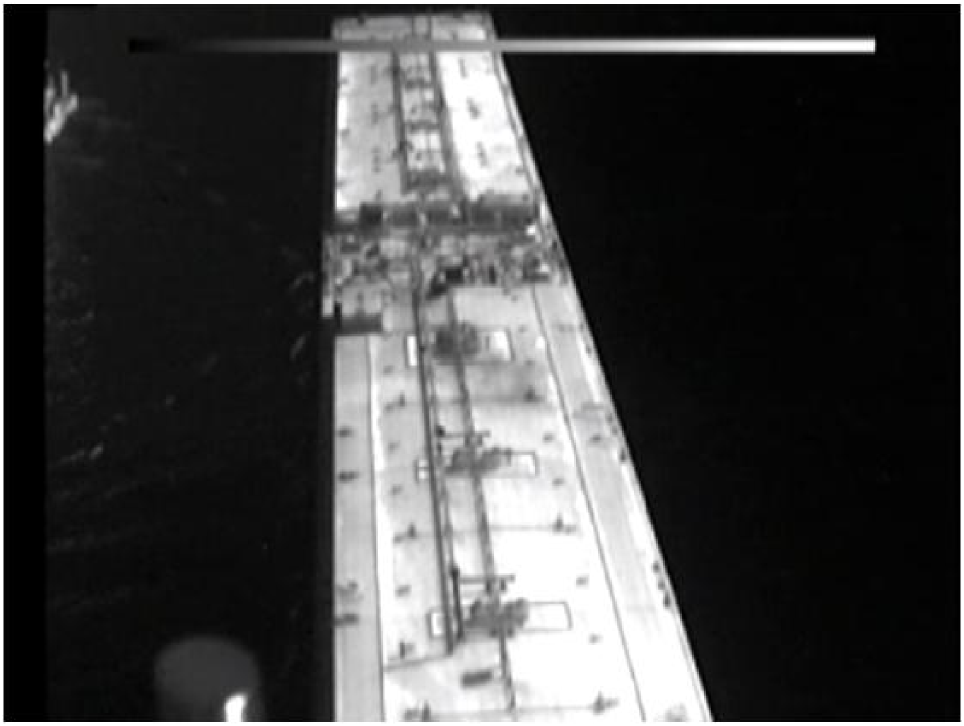

Figure B-21. Leak from Barge A12

APPENDIX C

LSI Report: Leak Detection using LSI Infrared Gas Imaging, BEM 1 Barge Study; Ground Crew Survey (October 21, 2008)

LSI

Report:
Leak Detection using LSI Infrared Gas Imaging

BEM1 Barge Study

Ground Crew Survey

David Furry, President, LSI
Date: October 21, 2008

Executive Summary

Leak Surveys Inc. (Early, TX) was commissioned by ARCADIS to conduct a leak survey at the Baton Rouge locks and on various barges as part of the BEM1 Project. The optical imaging survey looked at various components within each of these processes. The optical imaging leak (smart LDAR) survey was conducted on September 24th-30th, 2008. The Hawk Leak Detection System visualized numerous hydrocarbon gas leaks on various components.
Kevin McGinnis, a Leak Surveys' technician, performed the leak survey.

Background

Leak Surveys Inc. is an international company with 4-½ years experience using the Hawk Leak Detection System (HLDS). LSI developed the HLDS after 12 years of research and development on optical imaging and has applied for international patents.

LSI and the API committee introduced using optical imaging to conduct surveys in refinery and chemical plants on a commercial basis to the industry in February of 2004.

Our international smart LDAR crews have performed actual leak surveys in the Asia Pacific area, Europe and North America for a variety of different customers over the past 2-½ years.

The human eye more readily perceives motion than contrast. Movie or real time images are used as the basis for leak detection in the data presented here. Image quality is affected by the temperature and emissivity difference between the gas cloud and the background.

At this point, no infrared gas imaging cameras are capable of providing quantitative measurements of gas concentration, however, studies funded by the American Petroleum Institute that shows the detection limits accomplished by passive gas imaging systems are within the bounds necessary for equivalent detection of leaks at less than 10,000 ppm (60 g/hr). With 2 plus years of leak surveying experience LSI staff has a library of known gas leak quantifications. We have the ability to compare images of known leak amounts to images taken in the field and estimate the total gas quantity. This is only an estimate of the total leak and does not take into consideration any diluted streams. Again we can only estimate and the volumes are for information purposes only.

Gas imaging provides the user with a real time achievable record of leaking components as well as providing specific locations of leaks within a component.

Camera Description

The infrared gas imaging camera used by Leak Surveys, Inc., consists of a modified Indigo (FLIR/Indigo Systems Corp., Goleta CA) GasfindIR MID camera with a nominal spectra range of 1- 5.4 µm. Using a 30 x 30 m InSb detector with a 320 x 240 pixel array, the camera has capabilities of varying the integration times from 5 µs to 16.5 ms. The detector is operated at near liquid nitrogen temperatures using an integral Stirling cooler which provides the system with an NEdT of no more than an 18 mK providing excellent sensitivity.

The spectral range was further limited with the use of a notch filter specifically designed for the detection of hydrocarbon infrared absorptions in the 3 micron region. The narrow band pass range of the filter is less than the infrared spectral absorption of gas phase hexane. The filter notch is positioned such that alkane gases have a significant response within the band pass range.

Various lens including a 25 mm, a 50 mm and a 100 mm lens were used during the experiments. The 25 mm lens provides a 22 x 16 degrees field of view with an f-number of 2.3. The 50 mm lens provides an 11 x 8 degrees field of view with an f-number of 2.3.

The use of a narrow band pass filter provides spectral discrimination that allows the detection of compounds that have a vibration mode in the infrared region of the filter. Not all hydrocarbons have infrared absorptions within the filter range. Table I (below) shows the theoretical relative response of various compounds of interest using 1 cm-1 resolution infrared spectra (Infrared Analysis, Inc., Anaheim, CA). Using propane as the reference spectrum with a relative response of 100, methane's response is approximately 10% of the same concentration of propane and hexane is 1.5 times the response of propane at the same concentration. The filter is set to the infrared region of the spectrum that corresponds to the infrared absorption of alkanes, primarily. Other hydrocarbons exhibit various degrees of absorption of infrared energy in this region as indicated in the Table.

The infrared video images were recorded on digital hard drive. A digital camera was used to document the components being observed with the infrared camera.

Table I - Relative Response of Hydrocarbon with LSI Infrared Imaging Camera

Compound	Relative Response Propane =100%
Methane	9
Ethane	43
Propane	100
Butane	118
Iso-Butane	137
Pentane	143
Hexane	155
Heptane	157
Octane	136

Compound	Relative Response Propane =100%
Ethylene	3
Propylene	20
Iso Butylene	37
2 Methyl 2 Butane	4
1 Pentene	7
2 Methyl 2 Pentene	7
Benzene	4
Toluene	21
o-Xylene	38
p-Xylene	23
m-Xylene	32

Areas Examined

Below is a list of the areas surveyed relative to their location and the source of the leaking emission. All data shown below was taken directly off the field notes of the LSI technicians.

BEM1 Barge Study

File	Date	Process	Part Leaking	Barge #	Description of Leak
000	9/24/2008	BEM1 Barge Study	Hatch	L1	N/A
001	9/24/2008	BEM1 Barge Study	Hatch	L1	N/A
002	9/24/2008	BEM1 Barge Study	Hatch	L1	N/A
003	9/24/2008	BEM1 Barge Study	Hatch	L1	N/A
004	9/24/2008	BEM1 Barge Study	Hatch	L1	N/A
005	9/24/2008	BEM1 Barge Study	Hatch	L1	N/A
006	9/24/2008	BEM1 Barge Study	Hatch	L1	N/A

File	Date	Process	Part Leaking	Barge #	Description of Leak
007	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
008	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
009	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
010	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
011	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
012	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
013	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
014	9/24/2008	BEM1 Barge Study	Hatch	G1	N/A
015	9/25/2008	BEM1 Barge Study	Ullage Hatch	G2	#2 Port Lower
016	9/25/2008	BEM1 Barge Study	Cargo Hatch	G2	#2 Port
017	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#2 Starboard Middle
018	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#2 Port Middle
019	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#1 Starboard Lower
020	9/25/2008	BEM1 Barge Study	Alarm Test Rod	G2	#2 Starboard
021	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#1 Port Lower
022	9/25/2008	BEM1 Barge Study	Alarm Test Rod	G2	#2 Port
023	9/25/2008	BEM1 Barge Study	Cargo Hatch	G2	#1 Starboard
024	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#1 Starboard Middle
025	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#1 Port Middle
026	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#1 Starboard Upper

File	Date	Process	Part Leaking	Barge #	Description of Leak
027	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#1 Port Upper
028	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G2	#2 Port Lower
029	9/25/2008	BEM1 Barge Study	Overview of Leaks	G2	N/A
030	9/25/2008	BEM1 Barge Study	Bagging Process		Showing Gas Venting Through Dry Gas Meter
031	9/25/2008	BEM1 Barge Study	Vent	G3	N/A
032	9/25/2008	BEM1 Barge Study	Pressure Relief Valve	G3	N/A
033	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G3	#1 Port Forward
034	9/25/2008	BEM1 Barge Study	Ullage Hatch	G3	N/A
035	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G3	#1 Port Aft
036	9/25/2005	BEM1 Barge Study	Cargo Hatch Control Valve	G3	N/A
037	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G3	#2 Starboard Forward
038	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G3	#2 Port Forward
039	9/25/2008	BEM1 Barge Study	Cargo Hatch Control Valve	G3	N/A
040	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G3	#3 Starboard Forward
041	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G3	#3 Port Forward
042	9/25/2008	BEM1 Barge Study	Butterworth Hatch	G3	#3 Port Aft
043	9/25/2008	BEM1 Barge Study	Cargo Hatch Control Valve	G3	N/A
044	9/26/2008	BEM1 Barge Study	Ullage Hatch	G4	#1 Port & #1 Starboard
045	9/26/2008	BEM1 Barge Study	Both Hatches & Valve	G4	#2 Port
046	9/26/2008	BEM1 Barge Study	Both Hatches & Valve	G4	#2 Starboard

File	Date	Process	Part Leaking	Barge #	Description of Leak
047	9/26/2008	BEM1 Barge Study	Ullage & Cargo Hatches	G4	#3 Starboard
048	9/26/2008	BEM1 Barge Study	Cargo Hatch Control Valve	G4	#3 Port
049	9/26/2008	BEM1 Barge Study	Alarm Test Rod	G5	#1 Starboard
050	9/26/2008	BEM1 Barge Study	Ullage Hatch	G5	#1 Starboard
051	9/26/2008	BEM1 Barge Study	Ullage Hatch & Valve	G5	#1 Port
052	9/26/2008	BEM1 Barge Study	Ullage Hatch	G5	#2 Port
053	9/26/2008	BEM1 Barge Study	Ullage & Cargo Hatches	G5	#2 Starboard
054	9/26/2008	BEM1 Barge Study	Ullage & Cargo Hatches	G5	#3 Starboard
055	9/26/2008	BEM1 Barge Study	Ullage Hatch	G5	#3 Port
056	9/26/2008	BEM1 Barge Study	Alarm Test Rod	G5	#3 Starboard
057	9/26/2008	BEM1 Barge Study	Same as Video 045	G4	Filmed Again After Repair Attempt
058	9/26/2008	BEM1 Barge Study	Same as Video 047	G4	Filmed Again After Repair Attempt
059	9/27/2008	BEM1 Barge Study	Vent	G6	N/A
060	9/27/2008	BEM1 Barge Study	Cofferdam Hatch	G6	Forward
061	9/27/2008	BEM1 Barge Study	Cargo Hatch	G6	#3 Port
062	9/27/2008	BEM1 Barge Study	Cargo Hatch	G6	#3 Starboard
063	9/27/2008	BEM1 Barge Study	Ullage Hatch	G6	#4 Port
064	9/27/2008	BEM1 Barge Study	Ullage Hatch	G6	#4 Starboard
065	9/27/2008	BEM1 Barge Study	Cargo Hatch	G6	#4 Starboard
066	9/27/2008	BEM1 Barge Study	Same as Video 063	G6	Filmed Again

File	Date	Process	Part Leaking	Barge #	Description of Leak
067	9/27/2008	BEM1 Barge Study	Same as Video 063	G6	Filmed Again After Vent Was Closed
068	9/27/2008	BEM1 Barge Study	Same as Video 063	G6	Filmed Again After Vent Was Closed
069	9/28/2008	BEM1 Barge Study	Overview of Leaks	G7	Overview of #2 & #3 Cargo Hatches
070	9/28/2008	BEM1 Barge Study	Cargo Hatch	G7	#2 Port
071	9/28/2008	BEM1 Barge Study	Cargo Hatch	G7	#2 Starboard
072	9/28/2008	BEM1 Barge Study	Cargo Hatch	G7	#3 Starboard
073	9/28/2008	BEM1 Barge Study	Cargo Hatch	G7	#3 Port
074	9/28/2008	BEM1 Barge Study	Same as Video 71	G7	Filmed Again With Bag On
075	9/28/2008	BEM1 Barge Study	Pressure Relief Valve	G7	N/A
076	9/28/2008	BEM1 Barge Study	Overview of Leaks	G7	Another Overview of #2 & #3 Cargo Hatches
077	9/28/2008	BEM1 Barge Study	Cargo Hatch	L4	#3 Starboard
078	9/28/2008	BEM1 Barge Study	Alarm Test Rod	L4	#3 Port
079	9/28/2008	BEM1 Barge Study	Cargo Hatch	L4	#2 Port
080	9/28/2008	BEM1 Barge Study	Ullage Hatch	L4	#2 Port
081	9/28/2008	BEM1 Barge Study	Ullage Hatch	L4	#2 Starboard
082	9/28/2008	BEM1 Barge Study	Cargo Hatch	L4	#1 Starboard
083	9/28/2008	BEM1 Barge Study	Cargo Hatch	L4	#1 Port
084	9/28/2008	BEM1 Barge Study	Vent	L4	N/A
085	9/28/2008	BEM1 Barge Study	Ullage Hatch	L4	#1 Port
086	9/28/2008	BEM1 Barge Study	Ullage Hatch	L4	#1 Starboard

File	Date	Process	Part Leaking	Barge #	Description of Leak
087	9/28/2008	BEM1 Barge Study	Pressure Relief Valve	G8	N/A
088	9/28/2008	BEM1 Barge Study	Cargo Hatch	G8	#2 Port
089	9/28/2008	BEM1 Barge Study	Cargo Hatch Control Valve	G8	#2 Port
090	9/28/2008	BEM1 Barge Study	Control Valve Grease Cert	G8	#2 Starboard
091	9/28/2008	BEM1 Barge Study	Hatch & Control Valve	G8	#3 Starboard
092	9/28/2008	BEM1 Barge Study	Hatch & Control Valve	G8	#3 Port
093	9/28/2008	BEM1 Barge Study	Overview of Leaks	G8	Overview of Videos 87 thru 92
094	9/28/2008	BEM1 Barge Study	Block Valve	G8	#3
095	9/28/2008	BEM1 Barge Study	Butterworth Hatch	G8	#3 Port Rear
096	9/28/2008	BEM1 Barge Study	Butterworth Hatch	G8	#3 Starboard Rear
097	9/28/2008	BEM1 Barge Study	Slop Tank Vent	G8	N/A
098	9/28/2008	BEM1 Barge Study	Master Suction Valve	G8	N/A
099	9/28/2008	BEM1 Barge Study	Butterworth Hatch	G8	#2 Port Forward
100	9/28/2008	BEM1 Barge Study	Cargo Hatch	G8	#1 Port
101	9/28/2008	BEM1 Barge Study	Cargo Hatch Control Valve	G8	#1 Port
102	9/28/2008	BEM1 Barge Study	Cargo Hatch Control Valve	G8	#1 Starboard
103	9/28/2008	BEM1 Barge Study	Slop Tank Hatch	G8	N/A
104	9/29/2008	BEM1 Barge Study	Cargo Hatch	L5	#1 Port
105	9/29/2008	BEM1 Barge Study	Cargo Hatch	L5	#2 Port & #3 Starboard
106	9/29/2008	BEM1 Barge Study	Hatch & Pressure Valve	L6	#3 Port & Pressure Relief Valve

File	Date	Process	Part Leaking	Barge #	Description of Leak
107	9/29/2008	BEM1 Barge Study	Butterworth & Cargo	L6	#2 Starboard Forward & #1 Starboard
108	9/29/2008	BEM1 Barge Study	Butterworth Hatch	L6	#1 Starboard Middle
109	9/29/2008	BEM1 Barge Study	Cargo Hatch	L7	#3 Starboard
110	9/30/2008	BEM1 Barge Study	Hatch & Pressure Valve	L8	Pressure Relief Valve & #2 Starboard
111	9/30/2008	BEM1 Barge Study	Slop Tank Vent	L9	N/A

Conclusion

The LSI technician found and recorded a total of 112 videos during the seven-day survey.

I would also like to take this opportunity to thank you for allowing our leak survey crews to conduct the survey in your facility. If we can be of further assistance please do not hesitate to contact me.

David Furry
President –LSI
P.O. Box 3066
Early, Texas 76803

APPENDIX D

LSI Ground Survey PGIE Images

APPENDIX D: LSI Ground Survey PGIE Images

The following appendix contains a selection of screen shots from the LSI ground survey potion of the BEM 1 study conducted in Baton Rouge LA September 24th through September 30th 2008.

Figure D-1. Leak from Barge L1 (captured while barge in lock)

Figure D-2. Leak from Barge L1 (captured while barge in lock)

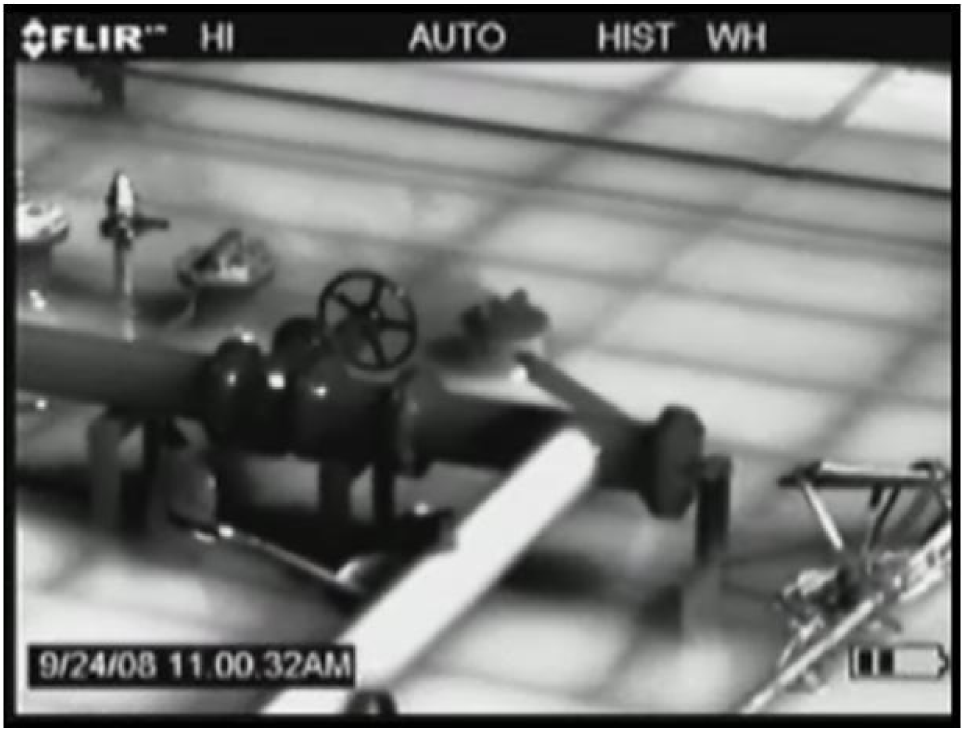

Figure D-3. Leak from Barge L2 (captured while barge in lock)

Figure D-4. Leak from Barge G1 (captured while onboard barge)

Figure D-5. Leak from Barge G1 (captured while onboard barge)

Figure D-6. Leak from Barge G2 (captured while onboard barge)

Figure D-7. Leak from Barge G2 (captured while onboard barge)

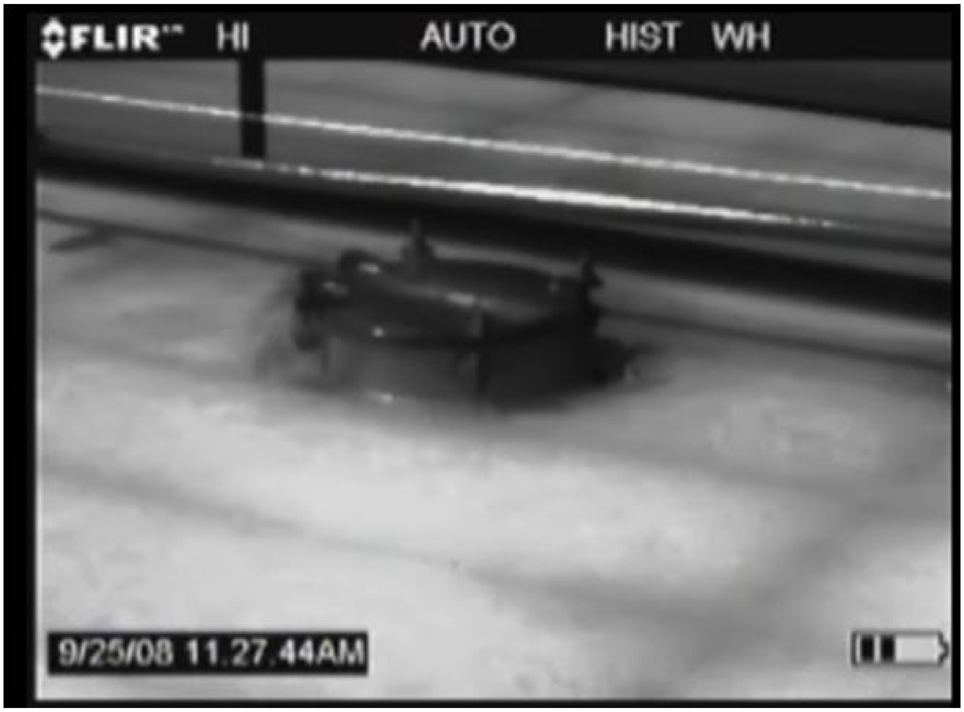

Figure D-8. Leak from Barge G2 (captured while onboard barge)

Figure D-9. Leak from Barge G2 (captured while onboard barge)

Figure D-10. Leak from Barge G2 (captured while onboard barge)

Figure D-11. Leak from Barge G2 (captured while onboard barge)

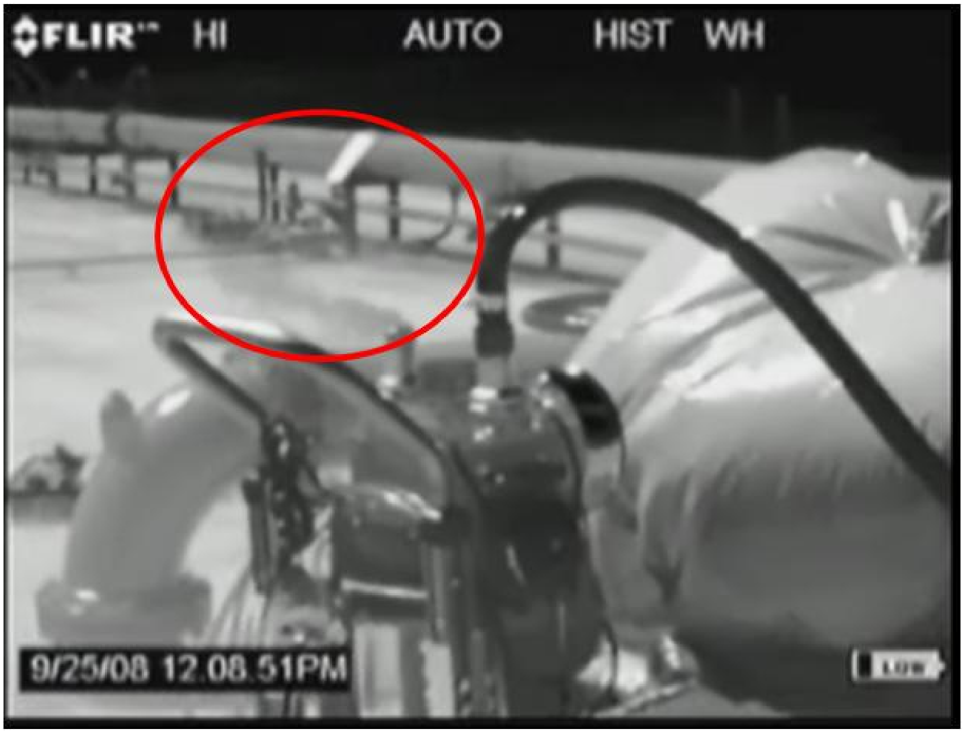

Figure D-12. Leak from Barge G3 (captured while onboard barge)

Figure D-13. Leak from Barge G3 (captured while onboard barge)

Figure D-14. Leak from Barge G3 (captured while onboard barge)

Figure D-15. Leak from Barge G3 (captured while onboard barge)

Figure D-16. Leak from Barge G3 (captured while onboard barge)

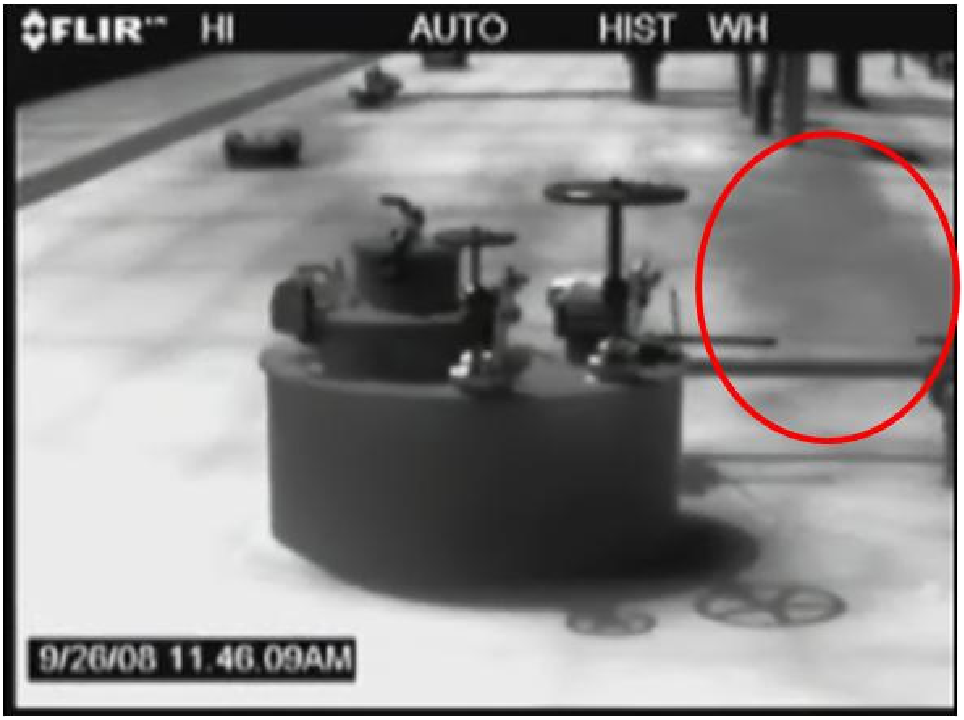

Figure D-17. Leak from Barge G5 (captured while onboard barge)

Figure D-18. Leak from Barge G5 (captured while onboard barge)

Figure D-19. Leak from Barge G6 (captured while onboard barge)

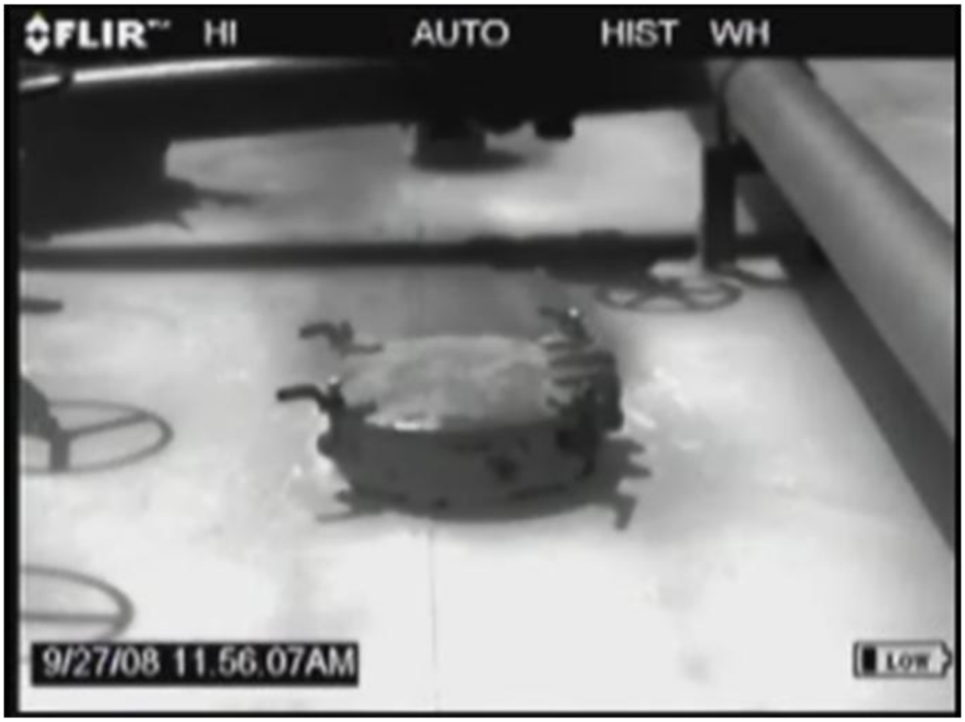

Figure D-20. Leak from Barge G6 (captured while onboard barge)

Figure D-21. Leak from Barge G6 (captured while onboard barge)

Figure D-22. Leak from Barge G6 (captured while onboard barge)

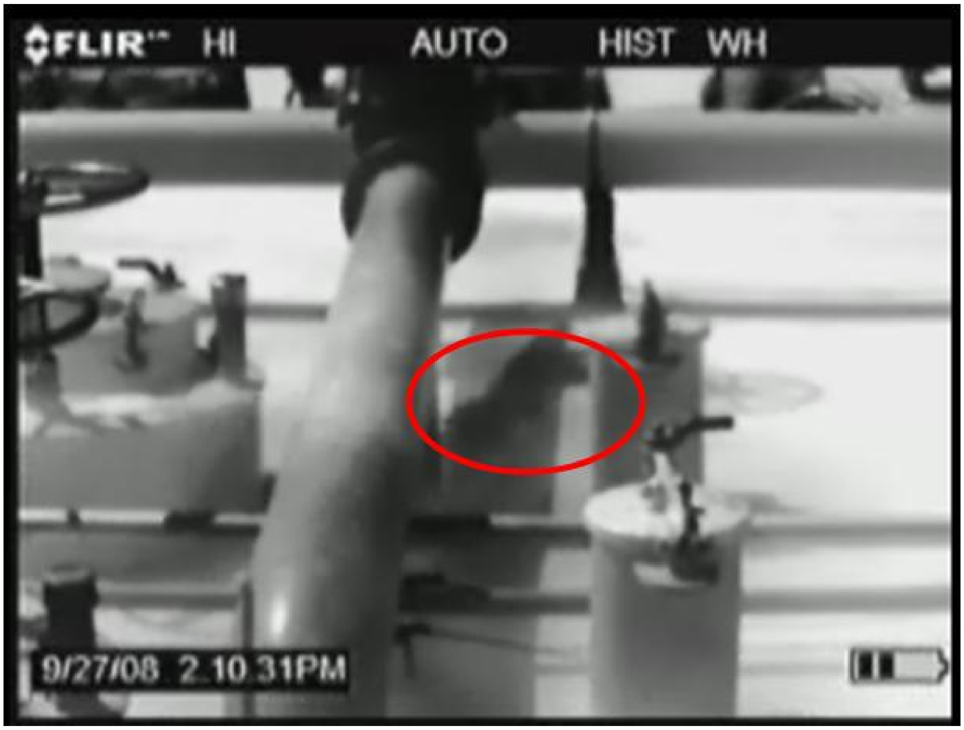

Figure D-23. Leak from Barge G6 (captured while onboard barge)

Figure D-24. Leak from Barge G7 (captured while onboard barge)

Figure D-25. Leak from Barge G7 (captured while onboard barge)

Figure D-26. Leak from Barge G7 (captured while onboard barge)

Figure D-27. Leak from Barge G8 (captured while onboard barge)

Figure D-28. Leak from Barge G8 (captured while onboard barge)

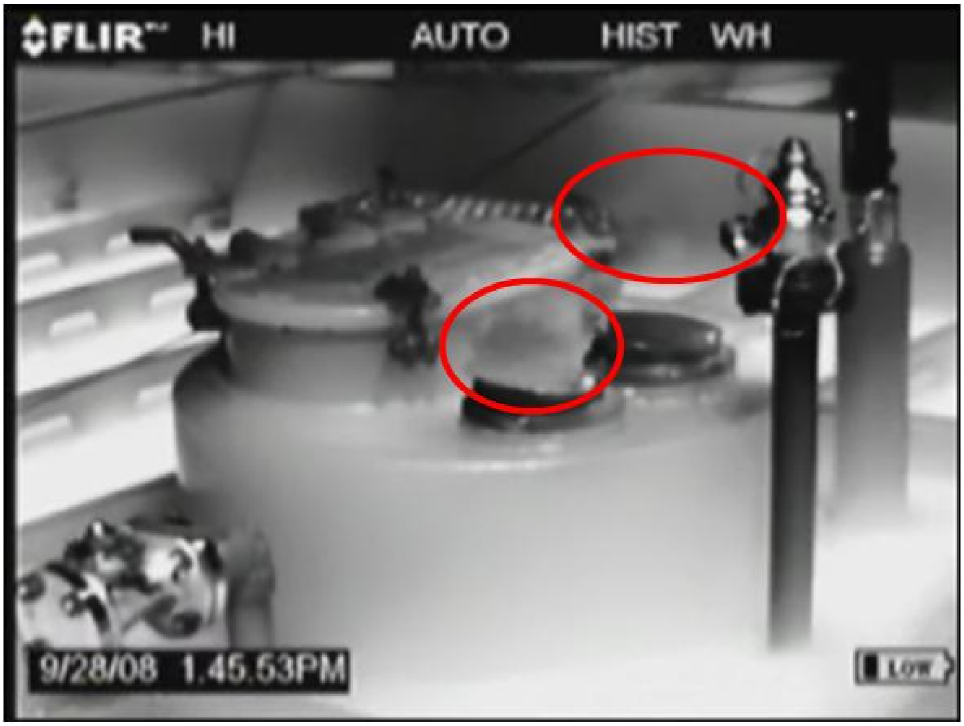

Figure D-29. Leak from Barge G8 (captured while onboard barge)

Figure D-30. Leak from Barge G8 (captured while onboard barge)

Figure D-31. Leak from Barge G8 (captured while onboard barge)

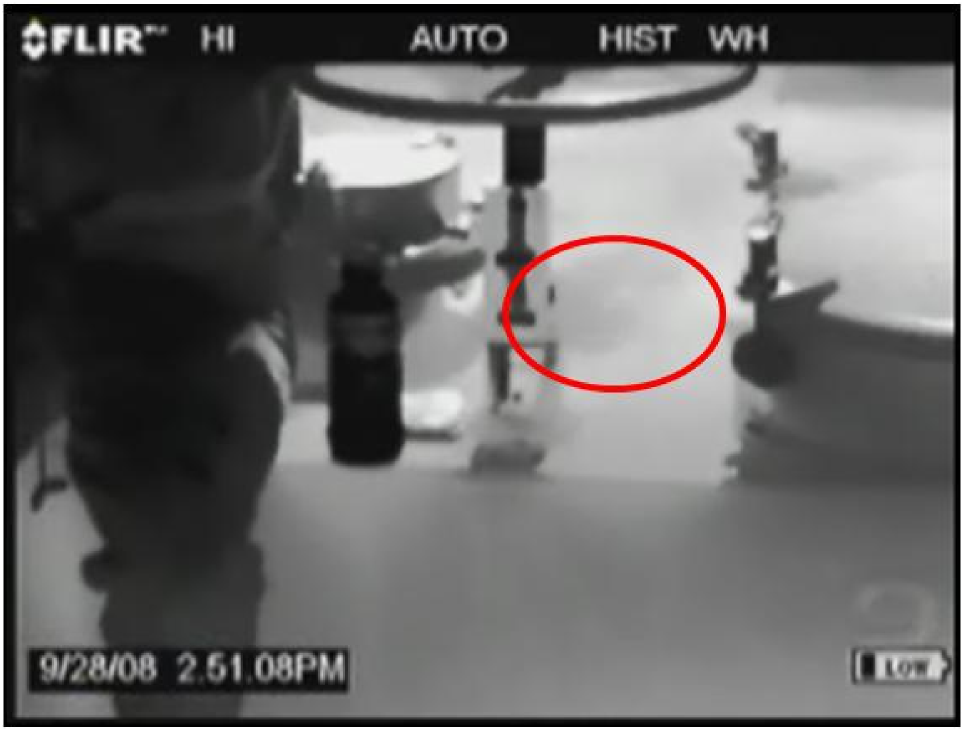

Figure D-32. Leak from Barge G8 (captured while onboard barge)

Figure D-33. Leak from Barge G8 (captured while onboard barge)

Figure D-34. Leak from Barge G8 (captured while onboard barge)

Figure D-35. Leak from Barge G8 (captured while onboard barge)

Figure D-36. Leak from Barge G8 (captured while onboard barge)

Figure D-37. Leak from Barge G8 (captured while onboard barge)

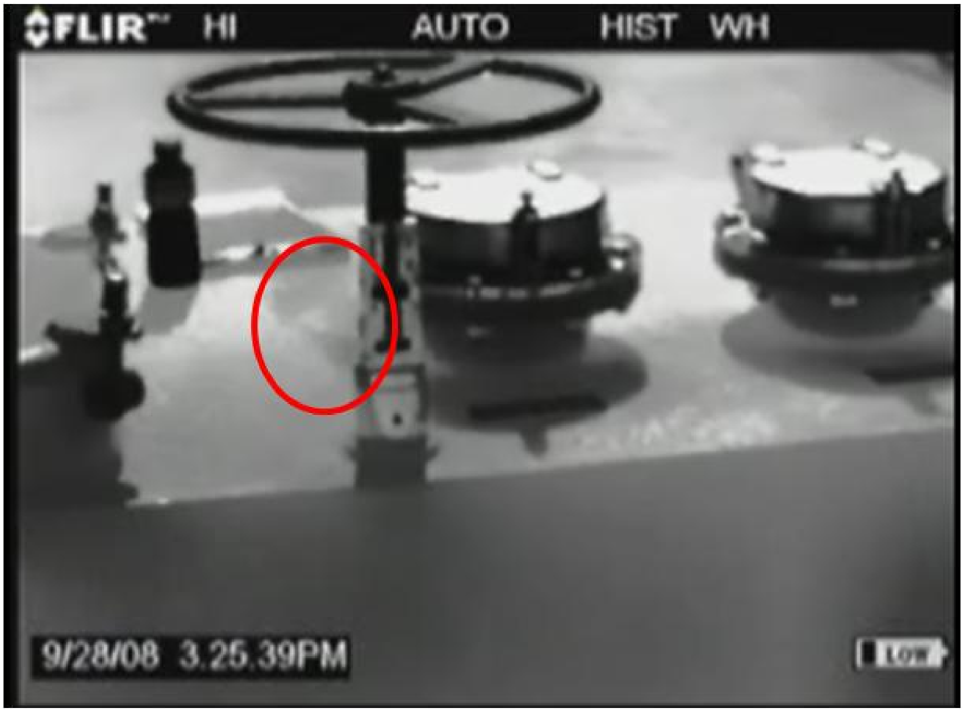

Figure D-38. Leak from Barge G8 (captured while onboard barge)

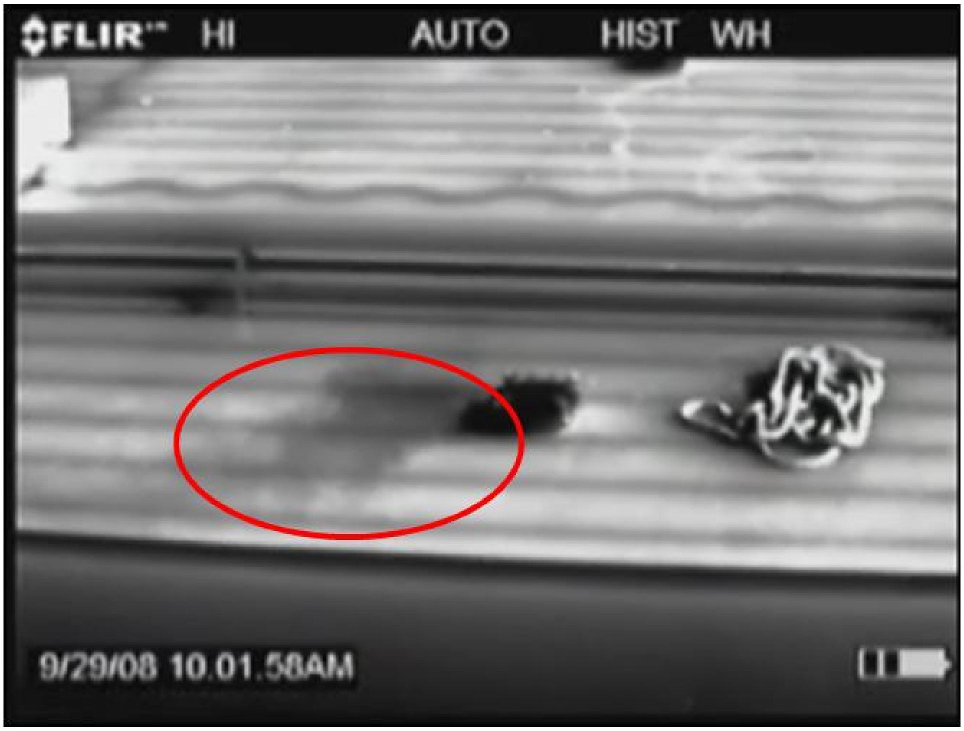

Figure D-39. Leak from Barge L6 (captured while barge in lock)

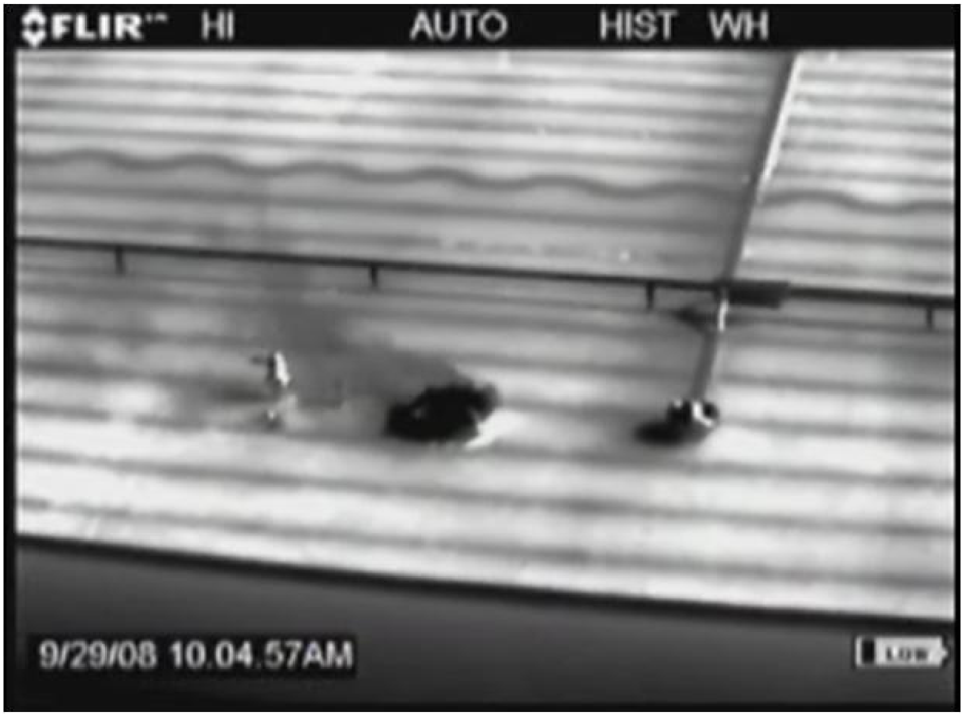

Figure D-40. Leak from Barge L6 (captured while barge in lock)

Figure D-41. Leak from Barge L8 (captured while barge in lock)

APPENDIX E

LDEQ/ARCADIS Lock Wall PGIE Images

APPENDIX E: LDEQ/ARCADIS Lock Wall PGIE Images

The following appendix contains a selection of screen shots from the Port Allen Lock wall survey portion of the potion of the BEM 1 study conducted in Baton Rouge LA September 24th through October 9th, 2008 using the LDEQ FLIR camera. These images were acquired by LDEQ and ARCADIS.

Figure E-1. Leak from Hatch 9/28

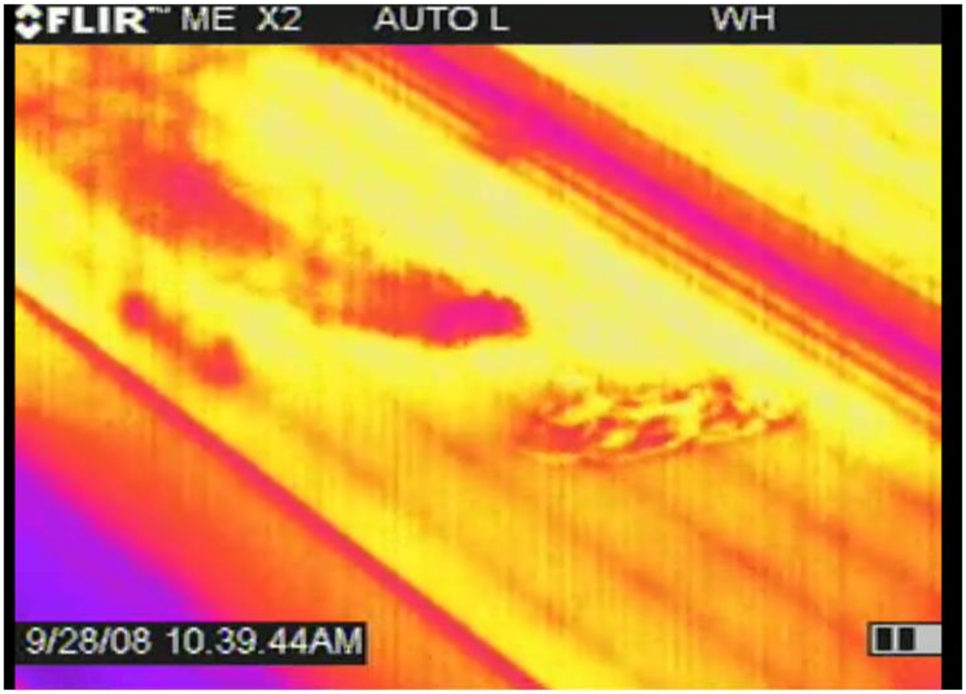

Figure E-2. Leak from Hatch 9/28

Figure E-3. Leak from Hatch 10/1

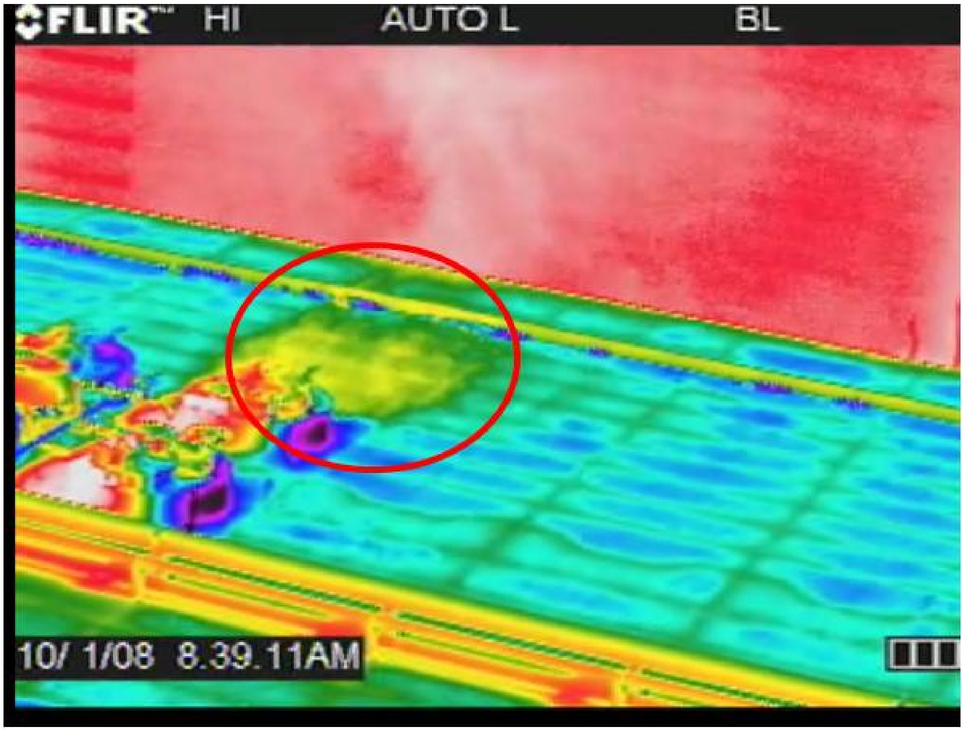

Figure E-4. Leak from Hatch 10/1

Figure E-5. Leak from Hatch 10/1

Figure E-6. Leak from Hatch 10/1

Figure E-7. Leak from Hatch 10/2

Figure E-8. Leak from Hatch 10/2

Figure E-11. Leak from Valve 10/2

Figure E-12. Leak from Hatches 10/2

Figure E-13. Leak from Hatches 10/2

Figure E-14. Leak from Valves 10/5

Figure E-15. Leak from Pipes 10/5

Figure E-16. Leak from Pipes 10/8

Figure E-17. Leak from Hatches 10/9

APPENDIX F

Alkane Mixture (AM) Measurement by OP-FTIR

APPENDIX F: Alkane Mixture (AM) Measurement by OP-FTIR

Emissions from fugitive or area sources containing fuel-based hydrocarbon mixtures can be estimated using EPA Method OTM 10 with OP-FITR by quantifying the infrared absorbance of the alkane mixture (AM) in the C-H stretch infrared vibration region around 2950 cm^{-1}. If some species of hydrocarbons are present at concentrations above the MDL for the OP-FTIR, they can be quantified individually in separate spectral regions using standard procedures.

This appendix describes the AM procedure to convert OP-FTIR volume-concentration determinations of alkane mixtures that originate from fuels to mass concentrations. The use of OTM 10 for the purpose of determination of emission fluxes and/or emission rates requires the conversion of the volume path-integrated concentrations (VPIC) to mass path-integrated concentrations (MPICs). The conversion requires knowledge of the molecular mass of the target gas so the analytical method for determining the mean molecular mass of alkane mixtures by OP-FTIR is therefore described. .

The shapes of the 3.3 µm absorption bands of the individual components of alkane mixtures, butane (C-4) to decane (C-10) are similar to each other. Figure 1 shows the comparison of the absorption bands of the straight-chain alkanes C-4 to C-8 (n-butane to n-octane). Starting with C-4, the similarity is greatest between the components with consecutive carbon numbers (e.g. butane and pentane) and the similarities decrease for components with greater difference in carbon numbers (e.g. C-4 and C-8, butane and octane). The similarity in band shapes makes it impossible to include all of the components of the mixture in the classic least squares (CLS) regression fit of measured absorbance to calibrated reference absorbance spectra to determine the concentration of the individual compounds.

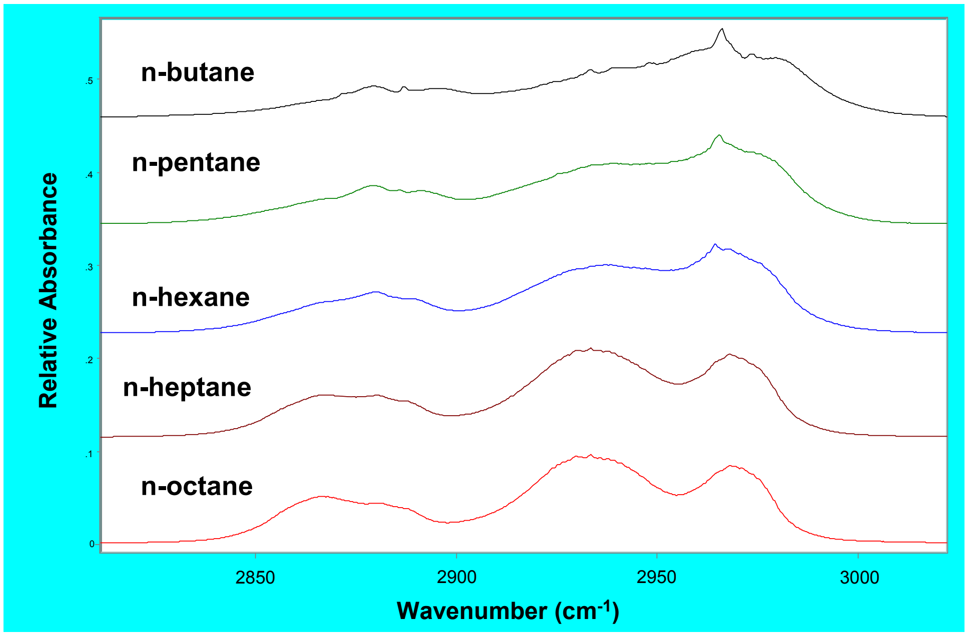

Figure F-1. Comparison of the Absorption Bands of Straight-chain Alkanes, C-4 (n-butane) to C-8 (n-octane), Measured with 0.5 cm^{-1} Resolution

The AM method provides a direct measurement-based determination of the mean carbon number that is required in order to convert the VPIC of the mixture to MPIC values. We assume that the vapor emitted from the alkane mixture is mainly composed of C-4, C-5, C-6, C-7, C-8. The alkanes with carbon numbers less than 4 (methane, ethane and propane) are not expected to be components of the mixture because these species are gases at standard atmospheric conditions and if present upon manufacture, would have outgassed from the liquid fuel. Alkanes with higher carbon numbers than C-8 (nonane, decane, etc) have low vapor pressures and therefore would not be present in the vapor at significant levels for most applications of the measurement.

Additional information on this analysis and associated QA procedures can be found in SOP that follows.

SOP TITLE: PROCEDURE TO CONVERT OP-FTIR VOLUME-CONCENTRATION DETERMINATIONS OF ALKANE MIXTURE THAT ORIGINATE FROM PETROLEUM-BASE FUELS TO MASS CONCENTRATIONS.

SCOPE: Describes the Optical Remote Sensing (ORS) analytical method for determining the mean molecular mass of alkane mixtures that are emitted from petroleum-based fuels.

PURPOSE: Quantitative measurements by OP-FTIR of vapors and gases are determined as volume path-integrated concentrations (VPICs). The use of VRPM for the purpose of determination of emission fluxes and/or emission rates required the conversion of the VPIC to mass path-integrated concentrations (MPICs). The conversion requires knowledge of the molecular mass of the target gas.

DEFINITIONS

Absolute Background	Absolute backgrounds are either zero-path or synthetic backgrounds and will contain little or no absorption features.
CLS	Classical Least Squares, regression fit of measured absorbance to calibrated reference absorbance spectra.
${}^{m}\hat{C}_{mix}$	Arbitrated mass path-integrated concentration of alkane mixture, usually with units of ppb· meter or ppm·meter. usually with units of mg/m^2 or g/m^2.
${}^{v}\hat{C}_{x}^{A}$	Volume path-integrated concentration of alkane component, x, analyzed in regions *A* (*A = LAL*, *HAL* or *arbitrated*), usually with units of ppm· meter or ppb·meter.
HAL	High Alkane Level region of analysis, 2694.0 to 2915.7 cm-1. This region contains weaker bands of n-butane and n-octane and is the region of choice when the alkane concentrations are high enough to distort the strong bands.
LAL	Low Alkane Level region of analysis, 2004.2 to 3001.2 cm-1. This region contains the strong bands n-butane and n-octane bands, and is the region of choice for low concentration levels.
$\overline{M}_{mix}$	Mean molecular mass of the alkane mixture in units of g/mole
Relative Background	Background that was measured over the same path as the sample, single beams. These background spectra will produce absorbance spectra in which the atmospheric absorption bands will be wholly or nearly cancelled. In some cases these backgrounds may contain absorption features of the target species that may require correction.

INTRODUCTION

The shapes of the 3.3 μm absorption bands of the individual components of alkane mixtures, butane (C-4) to decane (C-10) are similar to each other. Figure 1 shows the comparison of the absorption bands of the straight-chain alkanes C-4 to C-8 (n-butane to n-octane). Starting with C-4, the similarity is greatest between the components with consecutive carbon numbers (e.g. butane and pentane) and the similarities decrease for components with greater difference in carbon numbers (e.g. C-4 and C-8, butane and octane). The similarity in band shapes makes it impossible to include all of the components of the mixture in the CLS analysis. The CLS multi-component regression analysis requires that the absorption bands of the co-analyzed species do not correlate, i.e. the band shapes of the components are not too similar. When the bands of two or more co-analyzed species correlate, the respective concentration determinations become unreliable.

For the past twenty years, the analysis of alkane mixtures has been performed using a surrogate to represent the total volume concentration of the entire mixture. The surrogate species was often n-octane, but in some cases another alkane was chosen because its band had a better fit to the shape of the mixture band. However this method results in a volume concentration and to convert to mass concentration, one had to estimate (or guess) the mean carbon number of the mixture.

The present method provides a direct measurement-based determination of the mean carbon number that is required in order to convert the VPIC of the mixture to MPIC values. We assume that the vapor emitted from the alkane mixture is mainly composed of C-4, C-5, C-6, C-7, C-8. The alkanes with carbon numbers less than 4 (methane, ethane and propane) are not expected to be components of the mixture because these species are gases at standard atmospheric conditions and if present upon manufacture, would have outgassed from the liquid fuel . Alkanes with higher carbon numbers than C-8 (nonane, decane, etc) have low vapor pressures and therefore would not be present in the vapor at significant levels.

The fuel-alkane analysis method involves analyzing two of the straight-chain alkanes members of C-4 to C-8 that have the least correlated absorption bands, n-butane and n-octane (C-4 and C-8). The correlation between these two bands, at 0.5 cm^{-1} resolution, is low enough to ensure a statistically valid regression fit (see Figure 2).

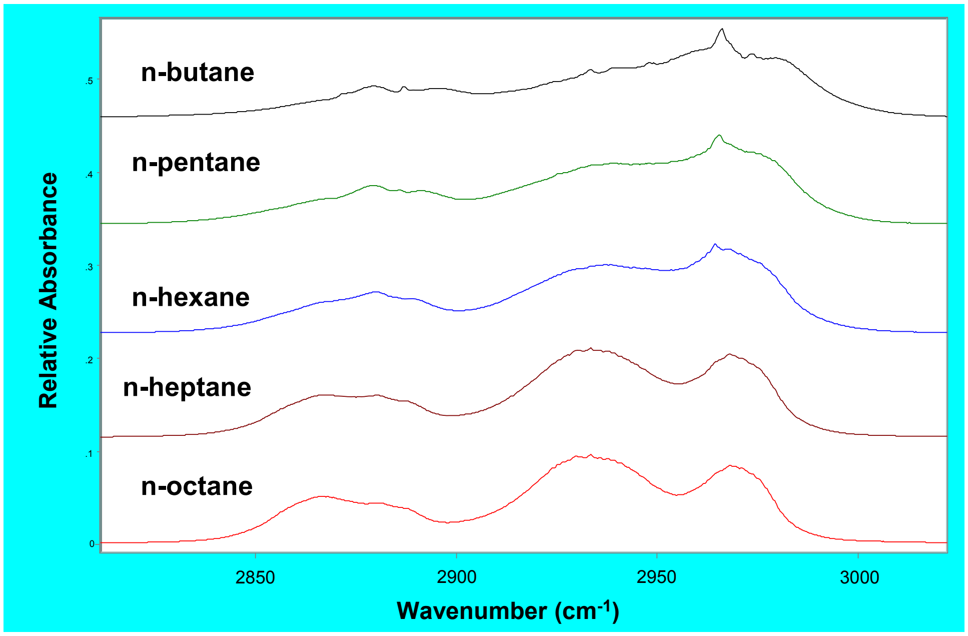

Figure 1. Comparison of the absorption bands of straight-chain alkanes, C-4 (n-butane) to C-8 (n-octane), measured with 0.5 cm^{-1} resolution.

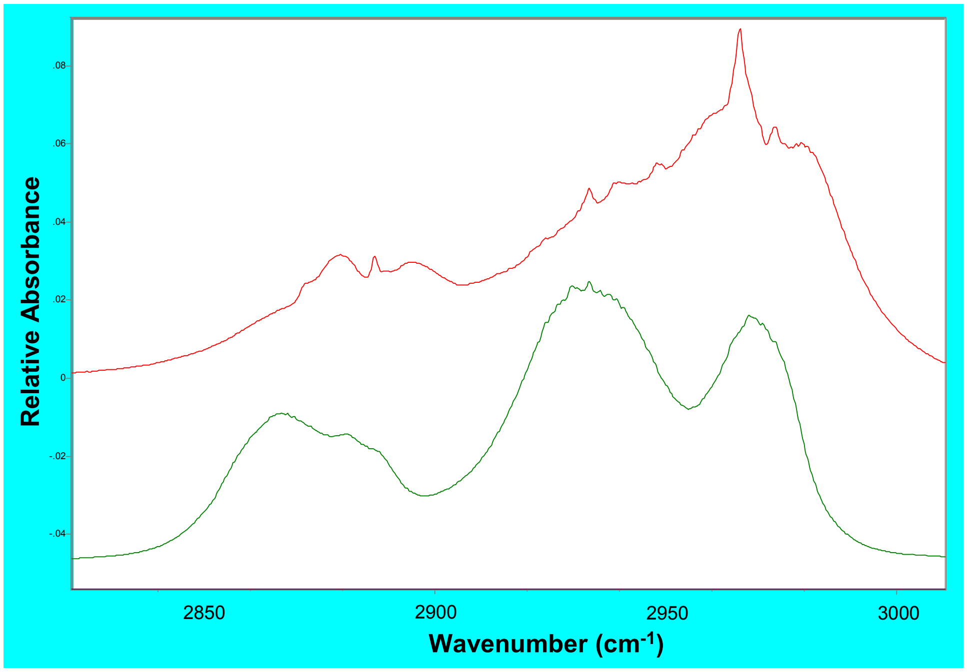

Figure 2. Comparison of the absorption bands of n-butane (red trace) and n-octane (green trace), measured with 0.5 cm^{-1} resolution.

1.0 PROCEDURE

1.1 Set Up Region(s) of Analysis.

The OP-FTIR field measurements should be performed along with the QA/QC procedures described in the EPA ORS Facility Manual (ECPB 2004). The primary region of analysis is 2004.2 to 3001.2 cm^{-1}. This region fully encumbers the main bands of the alkane mixture. If the path-average concentrations are expected to be high enough to distort the band-shapes, a second analysis, high alkane level (HAL) could be performed in the region from 2694.0 to 2915.7 cm^{-1}. Weaker bands of n-butane and n-octane lie in this region and they exhibit little correlation. Depending on the requirements of the field measurement, the HAL analysis could either be performed at the time of the measurements (in real-time) or in a post-measurement analysis.

1.2 Set Up the Chemical Species for Analysis.

The Two analytes are n-butane and n-Octane. The atmosphere interferences are methane and water vapor. If other species might be present that have absorption bands in the regions of analysis (e.g. methanol, formaldehyde, etc), they should be included in the analysis as interferents, providing that their absorption bands do not correlate with either the n-butane or the n-octane bands.

1.3 Arbitration Rules for Combined LAL and HAL Analysis.

This step only applies if both LAL and HAL analyses on n-butane and n-octane have been performed. The volume PIC for the alkane mixture, ${}^{v}C_{mix}^{A}$, is the sum of the CLS determinations for n-butane and n-octane in region *A*, and the standard error of the ${}^{v}C_{mix}^{A}$ determination is the square root of the sum of the squares of the respective standard error for the n-butane and n-octane determinations. Using labels to depict the LAL and HAL analyses, we have four metrics,

$${}^{v}C_{mix}^{LAL} = {}^{v}C_{butane}^{LAL} + {}^{v}C_{octane}^{LAL},$$

$$\omega_{mix}^{LAL} = \sqrt{(\omega_{butane}^{LAL})^2 + (\omega_{octane}^{LAL})^2},$$

$${}^{v}C_{mix}^{HAL} = {}^{v}C_{butane}^{HAL} + {}^{v}C_{octane}^{HAL},$$

and

$$\omega_{mix}^{HAL} = \sqrt{(\omega_{butane}^{HAL})^2 + (\omega_{octane}^{HAL})^2}.$$

The arbitration between using the LAL or the HAL determinations is made for each measurement in the set, according to the following logic conditions,

1. **IF** ${}^{v}\hat{C}_{mix}^{LAL} \geq 3 \cdot \omega_{mix}^{LAL}$ **AND** ${}^{v}\hat{C}_{mix}^{HAL} \geq 3 \cdot \omega_{mix}^{HAL}$

   AND ${}^{v}\hat{C}_{mixture}^{HAL} \geq {}^{v}\hat{C}_{mixture}^{LAL}$

   THEN ${}^{v}\hat{C}_{mixture}^{Arbitrated} = {}^{V}\hat{C}_{mixture}^{HAL}$

2. **IF** ${}^{V}\hat{C}_{mix}^{LAL} \geq 3 \cdot \omega_{mix}^{LAL}$ **AND** ${}^{V}\hat{C}_{mix}^{HAL} \geq 3 \cdot \omega_{mix}^{HAL}$

   AND ${}^{V}\hat{C}_{mix}^{HAL} \leq {}^{V}\hat{C}_{mix}^{LAL}$

   THEN ${}^{V}\hat{C}_{mix}^{Arbitrated} = {}^{V}\hat{C}_{mix}^{LAL}$

3. **IF** ${}^{V}\hat{C}_{mix}^{LAL} \leq 3 \cdot \omega_{mix}^{LAL}$ **AND** ${}^{V}\hat{C}_{mix}^{HAL} \geq 3 \cdot \omega_{mix}^{HAL}$

   THEN ${}^{V}\hat{C}_{mix}^{Arbitrated} = {}^{V}\hat{C}_{mix}^{HAL}$

4. **IF** ${}^{V}\hat{C}_{mix}^{LAL} \geq 3 \cdot \omega_{mix}^{LAL}$ **AND** ${}^{V}\hat{C}_{mix}^{HAL} \leq 3 \cdot \omega_{mix}^{HAL}$

   THEN ${}^{V}\hat{C}_{mix}^{Arbitrated} = {}^{V}\hat{C}_{mix}^{LAL}$

5. **IF** ${}^{V}\hat{C}_{mix}^{LAL} \leq 2 \cdot \omega_{mix}^{LAL}$ **AND** ${}^{V}\hat{C}_{mix}^{HAL} \leq 2 \cdot \omega_{mix}^{HAL}$

   THEN ${}^{V}\hat{C}_{mix}^{Arbitrated}$ is below the Detection Limit

Criteria 1 and 2 address the issue of whether the strong band in LAL is saturated due to very high levels of alkanes. If saturation occurs, then the band intensity will grow at a rate that is less than linear resulting in a concentration determination that is less than the value that would occur if linearity prevailed. In this case one would expect that the analysis in the HAL region (where the bands are much weaker and more likely to maintain linearity) would yield a higher determination than in the saturated LAL region. This leads to the criterion, if both analysis results are above detection limits one chooses higher value. However, as stated below in the section on QA/QC, the analyst must validate the results in the HAL region when the concentration determinations are not much above detection limits.

1.4 Determination of the Mean Molecular Mass, $\overline{M}_{mix}$,

The mean molecular mass of the alkane mixture, $\overline{M}_{mix}$, is given as

$$\overline{M}_{mix} = \frac{M_{butane}\cdot {}^{V}\hat{C}^{Arbitrated}_{butane} + M_{octane}\cdot {}^{V}\hat{C}^{Arbitrated}_{octane}}{{}^{V}\hat{C}^{Arbitrated}_{mix}}, \qquad (1)$$

where M_{butane} =58.12 g/mole (molecular mass of butane),

M_{octane} = 114.23 g/mole (molecular mass of octane),

${}^{v}\hat{C}^{Arbitrated}_{butane}$ and ${}^{v}\hat{C}^{Arbitrated}_{octane}$ are the butane and octane determinations from the analysis of the arbitration-chosen region.

1.5 Determination of the Mass Path-Integrated Concentration, ${}^{m}\hat{C}_{mix}$,

The mass path-integrated concentration of the alkane mixture, ${}^{m}\hat{C}_{mix}$, is given as

$${}^{m}\hat{C}_{mix} = \frac{L(T,P)\cdot\overline{M}_{mix}}{A}\cdot{}^{v}\hat{C}^{Arbitrated}_{mix}$$

Where *L*(*T*) is Loschmidt's Number at temperature, *T* and pressure P,

$$L(T) = 2.4793X10^{25}\cdot\frac{296K}{T}\cdot\frac{P}{1\cdot atm}$$ molecules/m^3,

and *A* is Avogadro's number, 6.0220X10^{23} molecules/mole. The numerical solution is

$${}^{m}\hat{C}_{mix}[g/m^3] = 4.1171X10^{45}\cdot\overline{M}_{mix}\left(\frac{296K}{T}\right)\left(\frac{P}{1\cdot atm}\right){}^{v}\hat{C}^{Arbitrated}_{mix}[ppm] \qquad (2)$$

The procedure for converting the volume PICs of alkane vapor mixtures from petroleum-base fuels to mass PIC is summarized by Equations 1 and 2.

2.0 QA/QC CHECKS ON THE ANALYSIS

The QA/QC checks on the analysis must be carried out as a post-measurement procedure. If in performing the QA/QC checks, one finds quality problems that degrade the precision and accuracy analytical results to levels below those permitted by the Data Quality Objectives (DQOs) of the field project, the analysis should be repeated with corrections.

2.1 Check the Background Spectra

The QA/QC procedure on Relative Backgrounds is different than the procedure for Absolute Backgrounds. The Relative Backgrounds may contain the absorption bands due to the alkane, which would produce a negative bias on the alkane determinations. Many of the OP-FTIR systems produce single-beam spectra that have inherent hydrocarbon bands present, due to adsorption of oils on the optical surfaces. These “oil” bands are cancelled out in zero-path backgrounds, but may be present in the field absorbance spectra that were created using synthetic backgrounds. Therefore the QA/QC check on the zero-path Background should follow the same procedure as for Relative Backgrounds.

2.1.1 Relative and Zero-Path Backgrounds

1. **Create Synthetic Backgrounds**
   For each Relative Background create an associated synthetic background, taking care not to place any points in the region between 2804 and 3002 cm^{-1}.

2. **Create Absorbance Spectra**
   For each Relative Background create a absorbance spectrum using the relative background as the sample single beam and the synthetic background as the background.

3. **Analyze Absorbance Spectra**
   Analyze each of the absorbance spectra for the alkanes using the same method as used for the field measurement. Record the results as part of the QA/QC report.

4. **Correct Path-Integrated Concentrations (If Necessary)**
   If the path-integrated concentrations for n-butane and/or n-octane determined in Step 3 are above detection limits, determine whether the values are significant compared to the values determined on the field data. If they are, correct the field measurements by adding the background values that are above detection limits to the corresponding field values for n-butane and n-octane in the respective LAL and HAL regions. If corrections were made, then repeat the arbitration and mass integrated concentration determination procedures in Steps 1.3 to 1.5, above.

2.1.2 Synthetic Backgrounds

1. **Prepare an Absorbance Spectrum from Alkane-Free Single Beam**
   Create an absorbance spectrum using any available single-beam spectrum that was measured (in the time period of the project) in an environment in which no hydrocarbons were present in the atmosphere

and using the synthetic background as the background. Unless there is expectation that the adsorbed oils on the OP-FTIR optics will change over the course of the project, only one absorbance spectrum will be necessary for this check for the entire project.

2. **Analyze Absorbance Spectra**
   Follow Step 3 in Section 2.1.1

3. **Correct Path-Integrated Concentrations (If Necessary)**
   Follow Step 4 in Section 2.1.1

A single-beam spectrum from the project's quality assurance procedures could be used.

2.2 Check for Interfering Absorption Features

Check the LAL spectral region (and HAL region if used) for the presence of overlapping absorption bands by outlier species. Look for features that deviate from the band shapes of the C-4 to C-8 species shown in Figure 1. Search the Finger Print Region (723 to 1400 cm^{-1}) for absorption bands or lines due to the presence of unexpected species. If any are found determine if there are corresponding C-H stretch bands.

Add all the spectral references of any species, which have been found to have overlapping bands in the LAL region (or HAL region if used), to the CLS analysis as interferents. This procedure needs to be performed only on measurement sets in which the outlier features are present and cause the data quality to not meet the project DQO.

2.3 Check for Saturation in the LAL Region

Determine if any of the measured alkane absorption bands in the LAL region exhibit saturation. Generally, these bands become saturated at path-integrated concentration levels greater than 2000 ppm·m. Saturation can be recognized by view the peak band features and noting if they have a flattened appearance. This effect can be seen in Figure 3, which shows a saturated alkane mixture band measured at a refinery compared to a measured band that is still in the linear regime. The absorbance scales are different for the two traces. The scale for the green trace is greatly expanded compared to the red trace. If saturation is detected, then the analysis must be performed in the HAL region and the results must follow the arbitration procedure listed in Section 1.3.

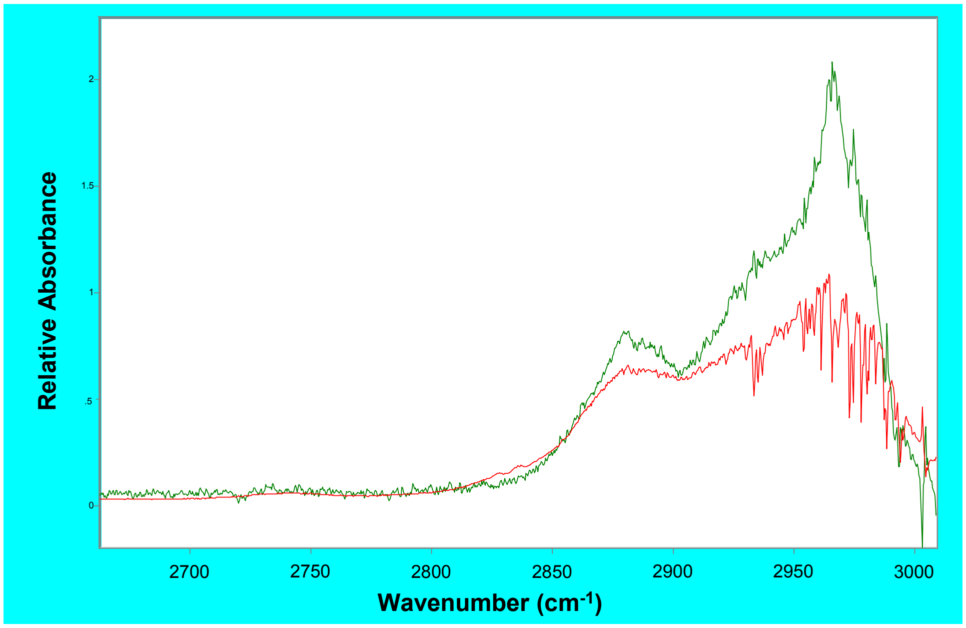

Figure 3. **Comparison of a saturated alkane-mixture band (red trace) to one that is not saturated (green trace). The two traces are on plotted on the same ordinate scale. Note the difference in noise.**

2.4 If Using HAL Region Check Arbitrated HAL Values Close to Detection Limits

Check all arbitrated values close to detection limits are valid. These values should smoothly transition to the lower values that arbitrate towards LAL. If these results seem to not connect to the HAL arbitrated values smoothly, then one may consider raising the detection-limit criterion for the HAL values $4 \cdot \omega$ or greater.

3.0 REFERENCE

ECPB 2004	ECPB (Emission Characterization Prevention Branch) Optical Remote Sensing Facility Manual, Prepared for the US EPA NRMRL Revision 1 April 2004

APPENDIX G

OTM 10 Data Graphs and Tables

Appendix G: OTM 10 Data Graphs and Tables

This Appendix contains the results of the OTM 10, OP-FTIR monitoring performed from September 24 to October 9, 2008 at the U.S. Army Corps of Engineers Port Allen Lock. A total of 97 lockings occurred during the OTM 10 observation period. Some of the lockings included multiple tugs and barges. There were a total of 62 defined events in which alkane mixture (AM) fluxes were measured. Many of these flux events occurred when non-petrochemical transport barges were in the lock indicating that the measured AM flux was associated with hydrocarbon emissions from the tug diesel engines. This confounding factor is further discussed at the end of the appendix.

Figure G-1 shows the distribution of barge types for these defined events based on the Corps of Engineers traffic log information. The six highest emissions events, two occurred during times with barges that were coded as carrying petroleum pitches, two with barges coded as carrying crude petroleum, and two with barges coded as empty (however the field crew smelled aromatics during one of these events).

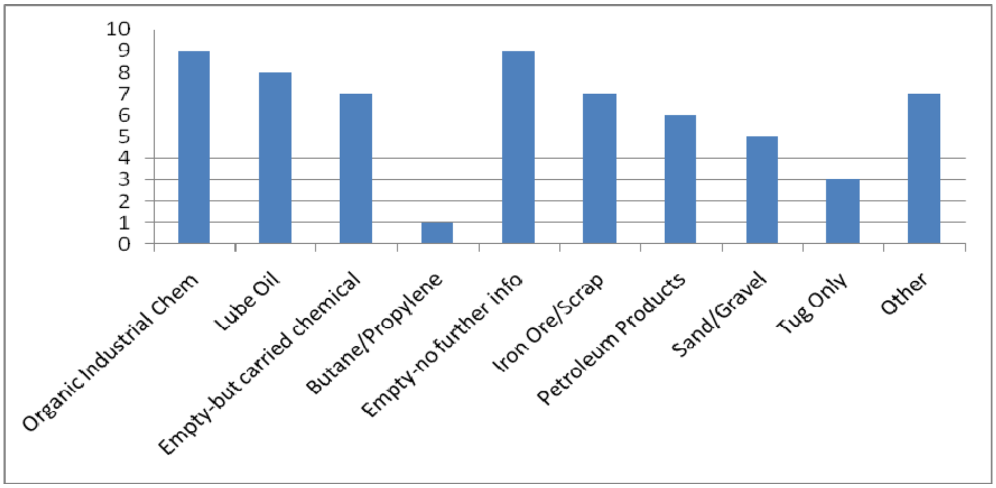

Figure G-1. **Distribution of Barge Types for Emission Events According to the U.S. Army Corps of Engineers Traffic Log**

For each of the 62 defined events, a description of the event, the AM flux values measured during the event, a screenshot of a leak detected during the event from the PGIE observations (when available), and the results of the trace compound analysis (when detected) are presented. For some of the events, we report "WC" as the AM flux value. In these instances, AM concentrations were detected by the OP-FTIR instrumentation, but the prevailing winds during the time of the measurement contained a southerly component, so a AM flux value could not be calculated. The trace compound concentrations presented represent the average concentration for the event measured along the ground level beam path of the VRPM configurations.

Table G-1. **9/24/ 2008 ь Event #1**

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/24/2008	10:32	11:03	Two	Labeled as benzene and smelled like benzene, but Corps of Engineers report said it was empty

Table G-2. AM Flux Values Measured during 9/24/ 2008, Event #1

Time	AM Flux (g/s)
10:33:48	0.060
10:36:59	0.124
10:39:37	0.237
10:42:17	0.321
10:44:56	0.431
10:47:35	0.558
10:50:13	0.637
10:52:53	0.730
10:55:33	0.912
10:58:12	0.956
11:00:15	0.308
11:02:54	0.067
Average:	***0.445***

Figure G-2. Screenshot from FLIR Camera Showing Leak from 9/24/ 2008, Event #1

Table G-3. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/24/ 2008, Event #1

Path	Methane	Acetylene	Propane	2-Methylbutane
EPA OP-FTIR (West)	115	11.1	92.1	96.1
ARCADIS OP-FTIR (East)	113	14.5	26.6	24.4

Table G-4. 9/25/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/25/2008	7:40	8:08	One	May be carrying lube oil, per LADEQ, labeled as empty

Table G-5. AM Flux Values Measured during 9/25/ 2008, Event #1

Time	AM Flux (g/s)
7:44:17	0.004
7:46:59	0.008
7:49:39	0.022
7:52:21	0.029
7:55:00	0.025
7:57:43	0.004
8:00:23	0.003
Average:	***0.014***

Table G-6. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/25/ 2008, Event #1

Path	Methane
EPA OP-FTIR (West)	ND
ARCADIS OP-FTIR (East)	122

Table G-7. 9/25/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/25/2008	8:34	9:15	Six	Gravel

Table G-8. AM Flux Values Measured during 9/25/ 2008, Event #2

Time	AM Flux (g/s)
8:38:00	0.009
8:40:38	0.006
8:43:15	0.008
8:45:53	0.006
8:48:30	0.009
8:51:12	0.009
8:53:50	0.009
8:56:31	0.007
8:59:11	0.007
9:01:50	0.008
9:04:28	0.008
9:07:08	0.016
Average:	***0.009***

Table G-9. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/25/ 2008, Event #2

Path	Methane
EPA OP-FTIR (West)	66.7
ARCADIS OP-FTIR (East)	109

Table G-10. 9/25/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/25/2008	9:52	10:36	Six	Visual as scrap, but Corps of Engineers report says Sugar/Iron Ore

Table G-11. AM Flux Values Measured during 9/25/ 2008, Event #3

Time	AM Flux (g/s)
9:56:08	0.010
10:14:43	0.008
10:17:21	0.008
10:20:00	0.011
10:22:39	0.010
10:25:17	0.010
10:27:55	0.008
10:30:33	0.007
Average:	***0.009***

Table G-12. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/25/ 2008, Event #3

Path	Methane
EPA OP-FTIR (West)	17.4
ARCADIS OP-FTIR (East)	44.4

Table G-13. 9/25/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/25/2008	11:14	11:51	One	Chemicals, but Corps of Engineers report says empty

Table G-14. AM Flux Values Measured during 9/25/ 2008, Event #4

Time	AM Flux (g/s)
11:19:05	0.008
11:21:46	0.009
11:24:25	0.009
11:27:06	0.008
11:29:46	0.007
11:32:27	0.007
11:35:09	0.009
11:37:50	0.013
11:40:33	0.012
11:43:17	0.007
Average:	***0.009***

Table G-15. 9/25/ 2008 ь Event #5

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/25/2008	15:09	16:00	Six	Corps of Engineers Report says sand, gravel, stone

Table G-16. AM Flux Values Measured during 9/25/ 2008, Event #5

Time	AM Flux (g/s)
15:11:53	0.007
15:14:30	0.007
15:17:08	0.006
15:19:45	0.005
15:22:24	0.005
15:25:01	0.005
15:27:40	0.006
15:30:18	0.003
15:32:54	0.005
15:35:34	0.006
15:38:11	0.005
15:40:49	0.007
15:44:44	0.005
15:47:21	0.005
15:50:00	0.003
15:52:37	0.004
15:55:14	0.003
Average:	***0.005***

Table G-17. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/25/ 2008, Event #5

Path	Methane
EPA OP-FTIR (West)	45.6
ARCADIS OP-FTIR (East)	18.5

Table G-18. 9/26/ 2008 Ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/26/2008	9:10	9:52	Two	Empty, per Corps of Engineers report, but may have carried benzene

Table G-19. AM Flux Values Measured during 9/26/ 2008, Event #1

Time	AM Flux (g/s)
9:13:45	0.045
9:16:19	0.053
9:18:54	0.060
9:21:29	0.070
9:24:40	0.159
9:27:15	0.105
9:29:50	0.137
9:32:25	0.179
9:34:59	0.113
9:37:34	0.045
9:40:45	0.048
9:43:21	0.064
9:45:56	0.063
Average:	***0.088***

Table G-20. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/26/ 2008, Event #1

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	220	23.6
ARCADIS OP-FTIR (East)	ND	ND

Table G-21. 9/27/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/27/2008	8:45	9:35	One tug with no barge, and one tug with six barges	Building cement and concrete; lime; glass

Table G-22. AM Flux Values Measured during 9/27/ 2008, Event #1

Time	AM Flux (g/s)
8:49:18	0.001
8:51:53	0
8:54:07	0
8:56:47	0
8:59:24	0
9:02:02	0
9:04:40	0
9:07:17	0.003
9:09:54	0
9:12:30	0.010
9:15:07	0.007
9:17:45	0.013
9:20:23	0.006
9:23:00	0.007
9:25:38	0.016
9:28:16	0.030
Average:	***0.006***

Table G-23. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/27/ 2008, Event #1

Path	Methane	Methanol	Benzene	2-Methylbutane	Ethylene
EPA OP-FTIR (West)	64.2	ND	ND	34.2	20.2
ARCADIS OP-FTIR (East)	459	24.3	198	34.8	ND

Table G-24. 9/27/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/27/2008	10:06	10:55	Six	Empty, per Corps of Engineers report and visual

Table G-25. **AM Flux Values Measured during 9/27/ 2008, Event #2**

Time	AM Flux (g/s)
10:08:58	0.079
10:11:36	0.057
10:14:13	0.008
10:16:50	0
10:19:27	0.011
10:22:05	0.051
10:24:42	0.060
10:27:20	0.065
10:29:58	0.085
10:32:35	0.112
10:35:12	0.136
10:37:51	0.120
10:40:28	0.108
10:43:06	0.078
10:45:45	0.060
10:47:44	0.040
Average:	***0.067***

Table G-26. **Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/27/ 2008, Event #2**

Path	Methane	Ethylene	Propane	2-Methylbutane
EPA OP-FTIR (West)	100	17.4	99.7	64.4
ARCADIS OP-FTIR (East)	570	18.4	110	69.1

Table G-27. **9/27/ 2008 Ь Event #3**

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/27/2008	11:21	11:58	Three	Per Corps of Engineers report and visual, lube oils or organic chemicals, possibly phenol

Table G-28. AM Flux Values Measured during 9/27/ 2008, Event #3

Time	AM Flux (g/s)
11:23:43	0.024
11:26:19	0.042
11:28:55	0.027
11:31:32	0.031
11:34:10	0.011
11:36:47	0.007
11:39:26	0.003
11:42:03	0
11:44:42	wc
11:47:19	wc
11:49:56	wc
11:52:33	0.001
Average:	***0.016***

wc = Wind criteria was not met.

Table G-29. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/27/ 2008, Event #3

Path	Propane	2-Methylbutane
EPA OP-FTIR (West)	ND	15.5
ARCADIS OP-FTIR (East)	32.3	18.4

Table G-30. 9/28/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/28/2008	8:44	9:28	Two	Organic industrial chemicals

Table G-31. AM Flux Values Measured during 9/28/ 2008, Event #1

Time	AM Flux (g/s)
8:46:56	0
8:49:34	0
8:52:12	0
8:54:50	0
8:57:28	0
9:00:06	0
9:02:44	0
9:05:22	0
9:08:01	0
9:10:40	0
9:13:18	0.195
9:15:55	0.071
9:18:33	0.025
9:21:11	0.07
Average:	***0.026***

Table G-32. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/28/ 2008, Event #1

Path	Methane	Ethylene	Acetylene	Propane	2-Methylbutane
EPA OP-FTIR (West)	861	27.7	ND	144	139
ARCADIS OP-FTIR (East)	751	ND	25.3	143	142

Table G-33. 9/28/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/28/2008	9:38	10:11	One	Possibly grain, although Corps of Engineers report said empty

Table G-34. AM Flux Values Measured during 9/28/ 2008, Event #2

Time	AM Flux (g/s)
9:41:12	0
9:43:31	0
9:46:09	0
9:48:47	0
9:51:24	0
9:54:03	0
9:56:42	0
9:59:21	0
10:01:59	0
10:04:39	0.012
Average:	***0.001***

Table G-35. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/28/ 2008, Event #2

Path	Methane	Ethylene	2-Methylbutane
EPA OP-FTIR (West)	271	16.5	44.4
ARCADIS OP-FTIR (East)	182	ND	19.9

Table G-36. 9/29/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	8:24	9:12	Two	Dry sulfur, iron and steel products

Table G-37. AM Flux Values Measured during 9/29/ 2008, Event #1

Time	AM Flux (g/s)
8:29:20	0.015
8:31:58	0.017
8:34:36	0.02
8:37:14	0.02
8:39:54	0.016
8:42:32	0.015
8:45:11	0.014
8:47:49	0.012
8:50:27	0.01
8:53:06	0.01
8:55:44	0.011
8:58:23	0.013
9:01:01	0.014
9:03:39	0.017
9:06:16	0.017
Average:	***0.015***

Table G-38. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/29/ 2008, Event #1

Path	Methane
EPA OP-FTIR (West)	ND
ARCADIS OP-FTIR (East)	148

Table G-39. 9/29/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	9:23	10:23	Three tugs with barges, one empty and two manned	Equipment/machinery

Table G-40. AM Flux Values Measured during 9/29/ 2008, Event #2

Time	AM Flux (g/s)
9:14:43	0.011
9:17:21	0.006
9:20:02	0.005
9:27:26	0.014
9:30:06	0.015
9:34:08	0.105
9:36:47	0.279
9:39:26	0.514
9:42:06	0.374
9:44:45	0.305
9:47:23	0.325
9:50:00	0.410
9:52:39	0.457
9:55:16	0.596
9:57:55	0.590
10:00:33	0.463
10:03:11	0.324
10:05:50	0.297
10:08:29	0.389
10:11:09	0.374
10:13:48	0.390
10:16:28	0.252
Average:	***0.295***

Figure G-3. Screenshot from FLIR Camera Showing Leak from 9/29/ 2008, Event #2

Table G-41. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/29/ 2008, Event #2

Path	Methane	Propane	2-Methylbutane
EPA OP-FTIR (West)	ND	220	140
ARCADIS OP-FTIR (East)	92.6	53.1	34.1

Table G-42. 9/29/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	11:01	11:51	Six	Clay, steel, ore scrap, machinery, fertilizer

Table G-43. AM Flux Values Measured during 9/29/ 2008, Event #3

Time	AM Flux (g/s)
11:04:35	0.008
11:07:17	0.003
11:09:57	0.002
11:12:38	0.004
11:15:19	0.003
11:17:59	0.002
11:20:07	0
11:22:45	0.002
11:25:23	0.006
11:28:01	0.006
11:30:39	0.005
11:34:34	0.005
11:37:13	0.006
11:39:51	0.005
11:42:30	0.005
11:45:09	0.005
11:59:44	0.003
12:02:22	0.002
12:05:01	0.004
Average:	***0.004***

Table G-44. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/29/ 2008, Event #3

Path	Methane	Acetylene
EPA OP-FTIR (West)	44.4	15.2
ARCADIS OP-FTIR (East)	41.7	ND

Table G-45. 9/29/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	12:15	13:00	Six	Sand, gravel

Table G-46. AM Flux Values Measured during 9/29/ 2008, Event #4

Time	AM Flux (g/s)
12:19:36	0.008
12:22:15	0.018
12:24:55	0.031
12:27:33	0.017
12:30:11	0.008
12:32:48	0.007
12:35:27	0.005
12:38:06	0.006
12:40:44	0.007
12:43:21	0.007
12:46:01	0.006
12:48:38	0.005
12:51:16	0.003
12:53:56	0.003
Average:	***0.009***

Table G-47. 9/29/ 2008 ь Event #5

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	13:07	14:06	Three	Empty , organic industrial chemicals, butane, propylene, propane

Table G-48. AM Flux Values Measured during 9/29/ 2008, Event #5

Time	AM Flux (g/s)
13:11:12	0.008
13:13:49	0.007
13:16:27	0.006
13:19:05	0.007
13:21:44	0.006
13:24:22	0.009
13:27:01	0.009
13:29:38	0.018
13:32:16	0.021
13:34:54	0.022
13:37:33	0.016
13:40:10	0.016
13:42:50	0.008
13:45:28	0.011
13:48:06	0.009
13:50:47	0.012
13:53:26	0.011
13:56:05	0.013
13:58:45	0.005
14:01:27	0.005
Average:	***0.011***

Table G-49. 9/29/ 2008 ь Event #6

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	14:13	14:57	One tug with no barge, one tug with two barges	Empty per Corps of Engineers report

Table G-50. AM Flux Values Measured during 9/29/ 2008, Event #6

Time	AM Flux (g/s)
14:17:21	0.011
14:20:01	0.007
14:22:41	0.017
14:25:19	0.013
14:28:00	0.012
14:30:39	0.007
14:33:18	0.011
14:36:36	0.011
14:38:40	0.011
14:41:18	0.009
14:43:59	0.011
14:47:55	0.003
14:50:34	0.002
Average:	***0.010***

Table G-51. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/29/ 2008, Event #6

Path	2-Methylbutane
EPA OP-FTIR (West)	10.4
ARCADIS OP-FTIR (East)	ND

Table G-52. 9/29/ 2008 ь Event #7

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/29/2008	15:10	15:51	One tug with no barges, one tug with six barges	Overlap, scrap ore and two with organic industrial chemicals

Table G-53. AM Flux Values Measured during 9/29/ 2008, Event #7

Time	AM Flux (g/s)
15:14:25	wc
15:17:03	0.002
15:19:41	0.004
15:22:19	0.006
15:24:58	0.008
15:27:38	0.008
15:30:17	0.008
15:33:12	0.008
15:35:34	0.005
15:38:12	0.008
15:40:50	0.007
15:43:27	0.006
15:46:05	0.007
Average:	***0.006***

wc Wind criteria was not met.

Table G-54. 9/30/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/30/2008	8:11	9:11	One tug with no barges, one tug with two barges	May be chemical barges, although the Corps of Engineers report said empty

Table G-55. AM Flux Values Measured during 9/30/ 2008, Event #1

Time	AM Flux (g/s)
8:26:54	0
8:28:53	0
8:30:12	0
8:36:54	0
8:39:33	0
8:41:32	0
8:42:34	0.007
8:44:12	0.012
8:45:19	0.021
8:46:51	0.018
8:48:04	0.016
8:49:31	0.017
8:52:10	0
8:54:50	0
9:02:00	0.002
9:03:20	0.003
9:04:40	0.007
9:06:06	0.006
Average:	***0.007***

Table G-56. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/30/ 2008, Event #1

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	ND	18.2
ARCADIS OP-FTIR (East)	458	ND

Table G-57. 9/30/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/30/2008	9:20	9:58	One	May be chemical barge, although the Corps of Engineers report said empty

Table G-58. AM Flux Values Measured during 9/30/ 2008, Event #2

Time	AM Flux (g/s)
9:23:40	0.014
9:25:02	0.021
9:34:37	0.017
9:36:36	0.025
9:41:30	0.021
9:42:52	0.040
9:44:13	0.017
9:45:33	0.013
9:46:54	0.012
9:48:16	0.010
9:49:37	0.002
9:55:04	wc
Average:	***0.017***

wc Wind criteria was not met.

Table G-59. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/30/ 2008, Event #2

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	ND	ND
ARCADIS OP-FTIR (East)	362	42.7

Table G-60. 9/30/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/30/2008	10:16	11:25	Six	Dry sulfur, clay

Table G-61. AM Flux Values Measured during 9/30/ 2008, Event #3

Time	AM Flux (g/s)
10:22:01	0.001
10:27:29	0.018
10:28:49	0.014
10:30:11	wc
10:31:31	wc
10:32:49	wc
10:34:13	wc
10:35:29	wc
10:38:08	0.005
10:39:38	0.005
10:40:47	wc
10:42:19	wc
10:43:26	wc
10:45:47	wc
10:46:21	wc
10:47:43	wc
10:48:44	wc
10:50:43	wc
10:51:46	wc
10:53:21	wc
10:54:24	wc
10:55:59	0.001
10:57:07	0.002
10:58:39	0.014
10:59:49	0.001
11:04:36	0.007
11:11:57	0
11:13:26	0.001
11:14:35	wc
11:16:07	wc
11:17:15	wc
11:18:48	wc
11:19:53	wc
11:21:31	wc
Average:	***0.006***

wc Wind criteria was not met.

Table G-62. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 9/30/ 2008, Event #3

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	133	20.1
ARCADIS OP-FTIR (East)	56.4	23.0

Table G-63. 9/30/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
9/30/2008	11:49	12:56	One tug with one barge, one tug with six barges	One barge lubricating oil, other barges gravel

Table G-64. AM Flux Values Measured during 9/30/ 2008, Event #4

Time	AM Flux (g/s)
11:51:51	wc
11:54:01	wc
11:56:39	wc
11:59:17	0.005
12:01:58	0.009
12:04:36	0.009
12:08:33	0.004
12:11:10	0.003
12:13:49	0.002
12:16:27	0.001
12:19:05	0.001
12:21:44	wc
12:24:23	wc
12:27:02	wc
12:29:40	0
12:32:20	0.004
12:34:58	0.005
12:37:37	0.002
12:40:15	0
12:42:55	wc
12:45:33	0.002
12:48:11	0.015
12:50:50	0.032
Average:	***0.006***

wc Wind criteria was not met.

Table G-65. 10/1/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/1/2008	8:00	8:21	One	Iron ore, scrap

Table G-66. AM Flux Values Measured during 10/1/ 2008, Event #1

Time	AM Flux (g/s)
8:11:19	0.002
8:14:53	0.002
Average:	***0.002***

Table G-67. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/1/ 2008, Event #1

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	220	ND
ARCADIS OP-FTIR (East)	268	22.0

Table G-68. 10/1/ 2008ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/1/2008	9:10	9:58	Two	Organic industrial chemicals

Table G-69. AM Flux Values Measured during 10/1/ 2008, Event #2

Time	AM Flux (g/s)
9:14:56	0
9:17:33	0
9:20:12	0.01
9:22:51	0.008
9:25:30	0.012
9:28:09	0.019
9:30:52	0
9:33:30	0.035
9:36:09	0.046
9:38:54	0.067
9:41:31	0.065
9:44:12	0.058
9:46:48	0.04
9:49:23	0.022

Time	AM Flux (g/s)
9:52:01	0.026
Average:	***0.027***

Figure G-4. **Screenshot from FLIR Camera Showing Leak from 10/1/ 2008, Event #2**

Table G-70. **Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/1/ 2008, Event #2**

Path	Methane	Ethylene	Propane	2-Methylbutane
EPA OP-FTIR (West)	302	15.4	66.1	63.6
ARCADIS OP-FTIR (East)	234	13.4	275	242

Table G-71. **10/1/ 2008 ь Event #3**

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/1/2008	10:43	11:43	One tug with no barges, one tug with five barges	Metal ores, scrap, organic industrial chemicals

Table G-72. AM Flux Values Measured during 10/1/ 2008, Event #3

Time	AM Flux (g/s)
10:47:09	0.011
10:49:47	0.010
10:52:25	0.027
10:55:03	0.029
10:57:39	0.037
11:00:18	0.022
11:02:56	0.022
11:05:34	0.014
11:08:12	0.019
11:10:53	0.011
11:13:32	0.012
11:16:10	0.008
11:18:51	0.008
11:21:29	0.003
11:24:09	0.006
11:26:48	0.013
11:29:26	0.034
11:32:08	0.034
11:34:46	0.024
11:36:54	0.006
Average:	***0.018***

Table G-73. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/1/ 2008, Event #3

Path	Methane	Propane	2-Methylbutane
EPA OP-FTIR (West)	68.8	ND	24.9
ARCADIS OP-FTIR (East)	62.5	24.4	21.4

Table G-74. 10/1/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/1/2008	12:33	13:29	Six	Empties and scrap

Table G-75. AM Flux Values Measured during 10/1/ 2008, Event #4

Time	AM Flux (g/s)
12:37:03	0
12:39:43	0.001
12:42:20	0.002
12:44:59	0.003
12:47:38	0.002
12:50:16	0.002
12:52:54	0.003
12:55:33	0.005
12:58:13	0.002
13:00:53	0.001
13:03:32	0.002
13:06:12	0.001
13:08:50	0.001
13:11:30	wc
13:14:08	wc
13:16:47	wc
13:19:27	0.003
13:22:03	0.006
13:24:15	0.002
Average:	***0.002***

wc Wind criteria was not met.

Table G-76. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/1/ 2008, Event #4

Path	Methane	Methanol
EPA OP-FTIR (West)	41.3	15.8
ARCADIS OP-FTIR (East)	33.6	15.7

Table G-77. 10/1/ 2008 ь Event #5

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/1/2008	13:40	14:37	One tug with one barge, one tug with six barges	Empty. Dry sulfur clay, organic industrial chemicals

Table G-78. AM Flux Values Measured during 10/1/ 2008, Event #5

Time	AM Flux (g/s)
13:44:27	0.009
13:47:06	0.006
13:49:45	0.021
13:52:24	0.008
13:55:06	0.002
13:57:45	wc
14:00:25	0.001
14:03:06	0.002
14:05:45	0.002
14:08:25	0
14:11:03	0.002
14:13:41	0.004
14:16:21	0.004
14:18:58	0.002
14:21:38	0.003
14:24:16	0.001
14:26:54	0.002
14:29:49	0.001
14:32:30	0.004
Average:	***0.004***

wc Wind criteria was not met.

Table G-79. 10/1/ 2008 ь Event #6

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/1/2008	15:04	15:51	Two	Distillate, lube oils

Table G-80. AM Flux Values Measured during 10/1/ 2008, Event #6

Time	AM Flux (g/s)
15:09:26	0.001
15:12:05	0
15:14:42	wc
15:17:21	0
15:20:02	0.001
15:22:41	0.001
15:25:21	0.002
15:28:01	0.004
15:30:41	0.005
15:33:21	0.007
15:36:01	0.006
15:38:41	0.004
15:41:19	0.001
15:43:59	wc
15:46:05	0
Average:	***0.002***

wc Wind criteria was not met.

Figure G-5. Screenshot from FLIR Camera Showing Leak from 10/1/ 2008, Event #6

Table G-81. 10/2/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/2/2008	7:45	8:03	Three	Empty. Organic industrial chemicals

Table G-82. AM Flux Values Measured during 10/2/ 2008, Event #1

Time	AM Flux (g/s)
7:51:45	0.05
7:54:21	0.022
7:56:57	0
Average:	***0.024***

Table G-83. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/2/ 2008, Event #1

Path	Methane	Methanol	2-Methylbutane
EPA OP-FTIR (West)	642	18.4	60.0
ARCADIS OP-FTIR (East)	No Data	No Data	No Data

Table G-84. 10/2/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/2/2008	9:45	10:42	One tug with one barge, one tug with two barges	Butane, propylene, one empty

Table G-85. AM Flux Values Measured during 10/2/ 2008, Event #2

Time	AM Flux (g/s)
9:48:36	wc
9:51:16	wc
9:53:53	wc
9:56:31	0
9:59:09	0.072
10:01:46	0.141
10:04:24	0.126
10:07:02	0.084
10:09:41	0.014
10:12:18	wc
10:14:57	wc
10:17:35	wc
10:20:11	wc
10:22:48	wc
10:25:28	wc
10:28:05	wc
10:30:41	wc
10:33:21	wc
10:36:00	wc
10:38:38	wc
Average:	***0.073***

wc Wind criteria was not met.

Figure G-6. Screenshot from FLIR Camera Showing Leak from 10/2/ 2008, Event #3

Table G-86. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/2/ 2008, Event #2

Path	Methane	Propane	2-Methylbutane
EPA OP-FTIR (West)	114	266	351
ARCADIS OP-FTIR (East)	216	ND	123

Table G-87. 10/3/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/3/2008	9:20	10:20	Five	Empties and distillate lube oil

Table G-88. AM Flux Values Measured during 10/3/ 2008, Event #1

Time	AM Flux (g/s)
9:23:32	wc
9:26:11	wc
9:28:49	wc
9:31:27	wc
9:34:05	wc
9:36:42	wc
9:39:21	wc
9:42:01	wc
9:44:39	wc
9:47:36	wc
9:50:17	wc
9:52:27	wc
9:54:32	wc
9:57:10	wc
9:59:50	wc
10:02:29	wc
10:05:08	wc
10:07:47	wc
10:10:25	wc
10:13:06	wc
Average:	***wc***

wc Wind criteria was not met.

Table G-89. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/3/ 2008, Event #1

Path	Methane
EPA OP-FTIR (West)	117
ARCADIS OP-FTIR (East)	106

Table G-90. 10/3/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/3/2008	10:31	10:51	Tug, no barges	N/A

Table G-91. AM Flux Values Measured during 10/3/ 2008, Event #2

Time	AM Flux (g/s)
10:34:19	wc
10:36:58	wc
10:39:36	wc
10:42:15	wc
10:44:54	wc
10:47:12	***wc***
Average:	wc

wc Wind criteria was not met.

Table G-92. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/3/ 2008, Event #2

Path	Methane
EPA OP-FTIR (West)	56.1
ARCADIS OP-FTIR (East)	ND

Table G-93. 10/3/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/3/2008	11:09	11:52	Six	Empties, lube oil, organic industrial chemicals

Table G-94. AM Flux Values Measured during 10/3/ 2008, Event #3

Time	AM Flux (g/s)
11:12:42	wc
11:15:24	wc
11:18:02	wc
11:20:40	wc
11:23:18	wc
11:25:57	0
11:28:36	wc
11:31:15	wc
11:33:55	wc
11:36:34	wc
11:39:12	wc
11:41:52	wc
11:44:30	wc
Average:	***0.000***

wc Wind criteria was not met.

Table G-95. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/3/ 2008, Event #3

Path	Methane
EPA OP-FTIR (West)	76.6
ARCADIS OP-FTIR (East)	74.7

Table G-96. 10/3/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/3/2008	12:39	13:17	Two	Empty

Table G-97. AM Flux Values Measured during 10/3/ 2008, Event #4

Time	AM Flux (g/s)
12:42:43	wc
12:44:43	wc
12:46:39	wc
12:49:20	wc
12:51:59	wc
12:54:37	wc
12:57:15	0
12:59:53	0
13:02:31	0
13:05:08	wc
13:07:47	wc
13:10:45	wc
Average:	***0.000***

wc Wind criteria was not met.

Table G-98. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/3/ 2008, Event #4

Path	Methane
EPA OP-FTIR (West)	45.1
ARCADIS OP-FTIR (East)	57.1

Table G-99. 10/3/ 2008 ь Event #5

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/3/2008	13:25	14:26	One tug with one barge, one tug with two barges	Organic industrial chemicals/ butane propellant. One empty

Table G-100. AM Flux Values Measured during 10/3/ 2008, Event #5

Time	AM Flux (g/s)
13:17:16	wc
13:19:51	wc
13:22:29	wc
13:28:54	0
13:31:32	wc
13:34:11	wc
13:36:50	wc
13:39:28	wc
13:42:07	wc
13:44:46	0
13:47:26	wc
13:50:04	wc
13:52:43	wc
13:55:24	wc
13:58:04	0
14:00:42	0.001
14:03:20	0
14:05:59	wc
14:08:38	wc
14:11:17	wc
14:13:55	wc
14:16:35	wc
14:19:12	0
14:21:16	0
Average:	***0.000***

wc Wind criteria was not met.

Table G-101. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/3/ 2008, Event #5

Path	Methane
EPA OP-FTIR (West)	45.3
ARCADIS OP-FTIR (East)	59.7

Table G-102. 10/4/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	8:35	9:14	Six	Sand, gravel

Table G-103. AM Flux Values Measured during 10/4/ 2008, Event #1

Time	AM Flux (g/s)
8:54:54	0.004
8:58:35	0.002
9:01:14	0.002
Average:	***0.003***

Table G-104. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/4/ 2008, Event #1

Path	Methane
EPA OP-FTIR (West)	136
ARCADIS OP-FTIR (East)	442

Table G-105. 10/4/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	9:42	10:20	Six	Coal, iron ore scrap, empty

Table G-106. AM Flux Values Measured during 10/4/ 2008, Event #2

Time	AM Flux (g/s)
9:46:51	wc
9:49:32	0
9:52:14	0.001
9:54:56	0.001
9:57:38	0.002
10:00:17	0.002
10:02:58	0.002
10:05:40	0.002
10:08:20	0.002
10:11:01	0.001
10:13:41	0.002
Average:	***0.002***

wc Wind criteria was not met.

Table G-107. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/4/ 2008, Event #2

Path	Methane
EPA OP-FTIR (West)	ND
ARCADIS OP-FTIR (East)	248

Table G-108. 10/4/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	11:01	11:41	Five	Lube oil

Table G-109. AM Flux Values Measured during 10/4/ 2008, Event #3

Time	AM Flux (g/s)
11:04:32	0.004
11:07:11	0.005
11:09:48	0.003
11:12:26	0.001
11:15:03	0
11:17:42	0
11:20:21	0
11:22:59	0
11:25:40	wc
11:28:20	wc
11:31:01	wc
11:33:39	wc
Average:	***0.002***

wc Wind criteria was not met.

Figure G-7. **Screenshot from FLIR Camera Showing Leak from 10/4/ 2008, Event #3**

Table G-110. **Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/4/ 2008, Event #3**

Path	Methane
EPA OP-FTIR (West)	46.2
ARCADIS OP-FTIR (East)	41.5

Table G-111. **10/4/ 2008 ь Event #4**

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	12:23	12:54	Two	Petroleum, iron ore scrap

Table G-112. AM Flux Values Measured during 10/4/ 2008, Event #4

Time	AM Flux (g/s)
12:28:04	0.001
12:30:42	0.001
12:33:20	0.002
12:35:59	0.005
12:38:38	0.005
12:41:16	0.005
12:43:54	0.003
12:46:32	0.002
Average:	***0.003***

Table G-113. 10/4/ 2008 ь Event #5

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	13:12	13:46	Two	Empty

Table G-114. AM Flux Values Measured during 10/4/ 2008, Event #5

Time	AM Flux (g/s)
13:15:41	0
13:18:19	0
13:20:59	0
13:23:38	0.003
13:26:17	0.004
13:28:57	0.005
13:31:36	0.004
13:34:15	0.003
13:36:56	0.003
13:39:35	0.003
Average:	***0.003***

Table G-115. 10/4/ 2008 ь Event #6

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	14:21	14:52	Three	Dry sulfur, clay

Table G-116. AM Flux Values Measured during 10/4/ 2008, Event #6

Time	AM Flux (g/s)
14:25:49	0.012
14:28:29	0.011
14:31:08	0.009
14:33:46	0.009
14:36:27	0.006
14:39:05	0.007
14:41:43	0.008
14:44:20	0.007
14:46:59	0.007
Average:	***0.008***

Table G-117. Average Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/4/ 2008, Event #6

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	ND	11.9
ARCADIS OP-FTIR (East)	70.5	10.0

Table G-118. 10/4/ 2008 ь Event #7

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	15:09	15:44	Two	Welding barges/machinery

Table G-119. AM Flux Values Measured during 10/4/ 2008, Event #7

Time	AM Flux (g/s)
15:13:25	0.012
15:16:04	0.012
15:18:42	0.009
15:21:21	0.012
15:24:24	0.009
15:26:38	0.008
15:29:16	0.01
15:31:54	0
15:34:32	0.012
15:37:09	0
Average:	***0.008***

Table G-120. 10/4/ 2008 ь Event #8

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/4/2008	15:53	16:15	Tug with no barges	N/A

Table G-121. AM Flux Values Measured during 10/4/ 2008, Event #8

Time	AM Flux (g/s)
15:56:57	0
15:59:35	0
16:02:13	0.009
16:04:53	0.01
16:07:31	0.007
16:10:10	0.002
Average:	***0.005***

Table G-122. 10/5/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/5/2008	9:23	10:04	Two	Petroleum

Table G-123. AM Flux Values Measured during 10/5/ 2008, Event #1

Time	AM Flux (g/s)
9:26:53	2.483
9:29:31	4.074
9:32:09	4.840
9:34:48	4.023
9:37:25	4.033
9:41:21	4.305
9:43:59	3.302
9:46:40	3.001
9:49:18	2.854
9:51:56	2.895
9:54:35	2.325
9:57:13	2.566
Average:	***3.392***

Figure G-8. Screenshot from FLIR Camera Showing Leak from 10/5/ 2008, Event #1

Table G-124. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/5/ 2008, Event #1

Path	Methane	Propane	2-Methylbutane
EPA OP-FTIR (West)	172	1159	1157
ARCADIS OP-FTIR (East)	367	757	781

Table G-125. 10/5/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/5/2008	12:04	12:53	Five	Lube oils, organic industrial chemicals

Table G-126. AM Flux Values Measured during 10/5/ 2008, Event #2

Time	AM Flux (g/s)
12:08:06	0.003
12:10:46	0.003
12:13:27	0.003
12:16:08	0.004
12:18:47	0.005
12:21:29	0.007
12:24:09	0.007
12:26:49	0.007
12:29:31	0.006
12:32:12	0.009
12:34:51	0.009
12:37:32	0.008
12:40:12	0.004
12:42:52	0.004
12:45:33	0.003
12:48:14	0.005
Average:	***0.005***

Figure G-9. Screenshot from FLIR Camera Showing Leak from 10/5/ 2008, Event #2

Table G-127. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/5/ 2008, Event #2

Path	Methane
EPA OP-FTIR (West)	39.7
ARCADIS OP-FTIR (East)	43.2

Table G-128. 10/6/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/6/2008	9:18	10:03	Two	Petroleum

Table G-129. AM Flux Values Measured during 10/6/ 2008, Event #1

Time	AM Flux (g/s)
9:22:14	0.014
9:24:51	0.018
9:27:30	0.018
9:30:07	0.022
9:34:03	0.023
9:36:42	0.022
9:39:19	0.014
9:41:57	0.011
9:44:36	0.012
9:47:15	0.013
9:49:53	0.012
9:52:31	0.011
9:55:09	0.010
9:57:47	0.009
Average:	***0.015***

Table G-130. 10/6/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/6/2008	10:07	10:28	One tug	N/A

Table G-131. AM Flux Values Measured during 10/6/ 2008, Event #2

Time	AM Flux (g/s)
10:11:00	0.006
10:13:37	0.007
10:16:14	0.003
10:18:52	0.014
10:21:30	0.012
Average:	***0.008***

Table G-132. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/6/ 2008, Event #2

Path	Methane
EPA OP-FTIR (West)	ND
ARCADIS OP-FTIR (East)	60.9

Table G-133. 10/6/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/6/2008	12:28	13:00	Six	Empty

Table G-134. AM Flux Values Measured during 10/6/ 2008, Event #3

Time	AM Flux (g/s)
12:33:11	0.005
12:35:49	0.005
12:38:27	0.006
12:41:06	0.004
12:43:43	0.002
12:46:22	0
12:49:00	0
12:51:38	0.002
12:54:18	0.006
Average:	***0.003***

Table G-135. 10/6/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/6/2008	13:15	13:51	One	Lube oils

Table G-136. AM Flux Values Measured during 10/6/ 2008, Event #4

Time	AM Flux (g/s)
13:18:09	0.004
13:20:48	0.003
Average:	***0.004***

Table G-137. 10/6/ 2008 ь Event #5

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/6/2008	14:29	15:11	Six	Gravel

Table G-138. AM Flux Values Measured during 10/6/ 2008, Event #5

Time	AM Flux (g/s)
14:31:47	0.005
14:34:26	0.004
14:37:06	0.004
14:39:47	0.004
14:42:27	0.004
14:45:06	0.003
14:47:48	0.002
14:50:29	0.002
14:53:07	0.002
14:55:49	0.003
14:58:29	0.003
15:01:08	0.002
15:03:49	0.001
15:06:29	0.002
Average:	***0.003***

Table G-139. 10/8/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/8/2008	10:10	10:42	Three	Iron Ore Scrap

Table G-140. AM Flux Values Measured during 10/8/ 2008, Event #1

Time	AM Flux (g/s)
10:13:59	wc
10:16:36	wc
10:19:18	wc
10:21:56	wc
10:24:34	wc
10:27:15	wc
10:29:53	wc
10:32:33	wc
10:35:12	wc
10:37:50	wc
Average:	***wc***

wc Wind criteria was not met.

Table G-141. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/8/ 2008, Event #1

Path	Methane
EPA OP-FTIR (West)	ND
ARCADIS OP-FTIR (East)	46.7

Table G-142. 10/8/ 2008 ь Event #2 [Exit time does not match end time]

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/8/2008	11:05	11:40	Five	Empty, corn, organic chemicals. Dry sulfur, clay. Lube oils.

Table G-143. AM Flux Values Measured during 10/8/ 2008, Event #2

Time	AM Flux (g/s)
11:10:18	0.001
11:15:42	0.001
11:21:06	wc
11:23:48	wc
11:26:30	wc
11:31:51	wc
11:34:33	wc
11:38:34	wc
11:41:17	wc
11:44:02	wc
Average:	***0.001***

wc Wind criteria was not met.

Table G-144. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/8/ 2008, Event #2

Path	Methane
EPA OP-FTIR (West)	70.5
ARCADIS OP-FTIR (East)	49.2

Table G-145. 10/8/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/8/2008	12:02	12:37	Six	Dry Sulfur, clay

Table G-146. AM Flux Values Measured during 10/8/ 2008, Event #3

Time	AM Flux (g/s)
12:04:36	0.001
12:07:21	0.001
12:10:02	0.001
12:18:19	0.002
12:21:02	0.001
12:23:52	0.001
12:26:34	wc
12:31:57	0.001
12:34:36	0.002
12:37:16	0.001
Average:	***0.001***

Table G-147. 10/8/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/8/2008	12:52	13:25	One	Empty

Table G-148. AM Flux Values Measured during 10/8/ 2008, Event #4

Time	AM Flux (g/s)
12:53:39	wc
12:56:21	wc
12:58:59	wc
13:04:23	0.001
13:07:03	0.005
13:09:41	0.001
13:20:24	0.001
13:31:04	0.001
Average:	***0.002***

Table G-149. 10/9/ 2008 ь Event #1

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	8:07	8:38	One	Empty

Table G-150. AM Flux Values Measured during 10/9/ 2008, Event #1

Time	AM Flux (g/s)
8:11:33	0.002
8:15:14	0.002
8:17:56	0.001
8:20:35	0.001
8:23:18	wc
8:25:59	wc
8:28:41	wc
8:34:05	wc
Average:	***0.002***

wc Wind criteria was not met.

Table G-151. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/9/ 2008, Event #1

Path	Methane
EPA OP-FTIR (West)	211
ARCADIS OP-FTIR (East)	346

Table G-152. 10/9/ 2008 ь Event #2

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	8:51	9:34	One	Petroleum products

Table G-153. AM Flux Values Measured during 10/9/ 2008, Event #2

Time	AM Flux (g/s)
8:55:28	0.002
8:58:09	0.002
9:00:52	0.003
9:03:32	0.003
9:06:15	0.006
9:08:54	0.008
9:11:36	0.010
9:16:57	0.005
9:19:39	0.006
9:22:20	0.017
9:25:00	0.018
9:27:42	0.014
Average:	***0.008***

Table G-154. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/9/ 2008, Event #2

Path	Methane
EPA OP-FTIR (West)	ND
ARCADIS OP-FTIR (East)	236

Table G-155. 10/9/ 2008 ь Event #3

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	10:05	10:52	Four	Organic industrial chemicals.

Table G-156. AM Flux Values Measured during 10/9/ 2008, Event #3

Time	AM Flux (g/s)
10:08:00	0.006
10:10:40	0.005
10:13:20	0.003
10:16:01	0.004
10:18:42	0.003
10:21:21	0.003
10:23:43	0.004
10:26:50	0.006
10:29:27	0.009
10:32:05	0.007
10:34:42	0.004
10:37:21	0.004
10:39:58	0.005
10:42:36	0.006
10:45:14	0.013
10:48:15	0.012
10:50:29	0.005
Average:	***0.006***

Table G-157. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/9/ 2008, Event #3

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	147	14.1
ARCADIS OP-FTIR (East)	183	16.0

Table G-158. 10/9/ 2008 ь Event #4

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	11:36	12:13	One	Petroleum Products

Table G-159. AM Flux Values Measured during 10/9/ 2008, Event #4

Time	AM Flux (g/s)
11:36:32	0.017
11:39:10	0.012
11:41:48	0.007
11:44:27	0.014
11:47:05	0.037
11:49:43	0.051
11:52:21	0.059
11:55:01	0.049
11:57:37	0.033
12:00:15	0.018
12:02:52	0.025
12:05:30	0.029
12:08:08	0.024
12:10:45	0.011
12:13:22	0.008
12:15:59	0.009
12:18:37	0.009
Average:	***0.024***

Table G-160. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/9/ 2008, Event #4

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	104	22.5
ARCADIS OP-FTIR (East)	72.8	25.0

Table G-161. 10/9/ 2008 ь Event #5

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	12:23	13:45	One tug two barges, One tug with four barges	Five empty barges, one with petroleum,

Table G-162. AM Flux Values Measured during 10/9/ 2008, Event #5

Time	AM Flux (g/s)
12:23:52	0.011
12:26:30	0.009
12:29:08	0.013
12:31:47	0.011
12:34:26	0.013
12:37:04	0.009
12:39:42	0.014
12:42:21	0.019
12:45:45	0.018
12:47:38	0.019
12:50:16	0.016
12:54:13	0.012
12:56:51	0.022
12:59:29	0.021
13:02:07	0.015
13:04:45	0.017
13:07:23	0.015
13:10:01	0.018
13:12:38	0.017
13:15:17	0.015
13:17:56	0.012
13:20:34	0.014
13:23:13	0.017
13:25:51	0.020
13:28:31	0.017
13:31:08	0.017
13:33:49	0.020
13:36:28	0.018
13:39:07	0.014
Average:	***0.016***

Table G-163. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/9/ 2008, Event #5

Path	Methane	2-Methylbutane
EPA OP-FTIR (West)	71.2	ND
ARCADIS OP-FTIR (East)	61.0	14.8

Table G-164. 10/9/ 2008 ь Event #6

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	14:05	14:34	Four	Empty

Table G-165. AM Flux Values Measured during 10/9/ 2008, Event #6

Time	AM Flux (g/s)
14:08:10	0.016
14:10:50	0.018
14:13:28	0.021
14:16:06	0.024
14:20:03	0.018
14:22:41	0.019
14:25:19	0.02
14:28:00	0.026
Average:	***0.020***

Table G-166. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/9/ 2008, Event #6

Path	Methane
EPA OP-FTIR (West)	44.0
ARCADIS OP-FTIR (East)	39.7

Table G-167. 10/9/ 2008 ь Event #7

Date	Entry Time	Exit Time	Number of Barges	Description of Commodity
10/9/2008	14:47	15:25	Two	Petroleum products, Empty

Table G-168. AM Flux Values Measured during 10/9/ 2008, Event #7

Time	AM Flux (g/s)
14:37:13	0.015
14:39:52	0.053
14:42:32	0.143
14:51:46	0.286
14:54:24	0.331
14:57:02	0.635
14:59:40	0.794
15:02:17	0.819
15:04:55	0.877
15:07:32	0.661
15:10:11	0.432
15:12:49	0.206
15:15:28	0.18
15:18:05	0.174
15:20:44	0.064
Average:	***0.378***

Figure G-10. Screenshot from FLIR Camera Showing Leak from 10/9/ 2008, Event #7

Table G-169. Trace Compound Concentrations (ppb) Detected Along the Ground Level Beam Path of the VRPM Configurations during 10/9/ 2008, Event #7

Path	Methane	Propane	2-Methylbutane
EPA OP-FTIR (West)	40.3	258	228
ARCADIS OP-FTIR (East)	46.0	160	158

Instances of Emissions Detected with the PGIE but not with ORS Measurements

An analysis of the PGIE observations made by the LSI Ground Crew and ARCADIS personnel in the lock revealed that there were instances where the PGIE detected barge leaks, but the events were not detected by the ORS instrumentation deployed on the southern side of the lock. Table G-170 presents a summary of seven events that were detected by the PGIE but not the ORS instrumentation. The table includes the date and time of the events, as well as the average prevailing wind direction during the time the PGIE detected the leaks.

Table G-170. Summary of Leak Events Detected by the PGIE but not ORS Instrumentation

Date	Time	Barge Number(s)	Prevailing Wind Direction (degrees)
9/28	11:30 am	323, 348	120
9/29	4:32 pm	28038	320
9/30	2:46 pm	28068, 29030	300
10/2	10:25 am	3001, 3003	140
10/2	1:00 pm	00217, 9977, 500, 9, 230	180
10/2	2:35 pm	3027, 3116, 3168	150
10/8	9:21 am	940B, 1842, 5214	320

The orientation of the ORS measurement planes (when looking from the OP-FTIR to the scissor lift) was 133° and 311° for the EPA and ARCADIS OP-FTIR measurement planes, respectively. Considering the ORS configurations used in the study, a prevailing wind direction of approximately 41° is ideal for emissions measurements (perpendicular to the configuration planes). As can be seen in Table G-170, the prevailing winds during the events not detected by the ORS instrumentation were close to parallel to the measurement configurations, or in some cases the winds were not from the direction of the lock (wind direction greater than 133° or less than 311°). The prevailing winds during the times the leaks were detected by the PGIE did not carry the winds through the ORS measurement plane, which explains why the leaks were not detected by the ORS instrumentation.

Evaluation of AM Emissions from Tugs

In order to evaluate the contribution of exhaust from the tugs to the Alkane Mixture (AM) hydrocarbon emissions fluxes measured during the project, carbon monoxide concentrations were analyzed along the ground level beam path of the ARCADIS OP-FTIR VRPM configuration. Carbon monoxide was chosen for this analysis because it is a by-product of combustion, and has relatively low detection limits with the OP-FTIR instrument. For the nine events detected from barges classified as “empty-no further information”, the carbon monoxide and total hydrocarbon concentrations measured along the ground level beam path were compared to investigate any possible correlations between the two compounds. A correlation between the two compounds would suggest that the source of the total hydrocarbon emissions measured was the emissions from the tug engines.

Of the nine events analyzed, eight of the events showed no correlation between the measured carbon monoxide and total hydrocarbon concentrations. The analysis did indicate a strong correlation between the concentrations of the two compounds during the 9/28/08 9:38 am to 10:11 am event ($r^2=0.87$). However, the total hydrocarbon concentrations measured during this event were relatively low and close to the minimum detection limits of the OP-FTIR instrument. Based on these findings, we conclude that emissions of total hydrocarbons from the tug exhaust are negligible.

APPENDIX H

LDEQ Onboard Leak Bagging Test Report: Barge Emissions Measurement Project Final Report; SAGE Environmental Consulting (December 29, 2008)

SAGE
ENVIRONMENTAL CONSULTING
"Friendly Service, No Surprises!"

BAGGING TEST REPORT:
Barge Emission Measurement Project
Final Report

Prepared for:

Louisiana Department of Environmental Quality
Baton Rouge, Louisiana

Prepared by:

Graham Harris
Sage Environmental
Austin, Texas

Field Testing	September 2008
Report	December 2008

Table of Contents

List of Tables

Appendices

Appendix A – Bagging Field Data

Appendix B – EPA Protocol Bagging Procedures

Appendix C –Laboratory Results with QC Data

1.0 INTRODUCTION

This report documents the results of bagging tests performed on low vapor pressure tank barges in the Baton Rouge, Louisiana area from September 24 to 28, 2008, while under contract to the Louisiana Department of Environmental Quality. The bagging tests were intended to determine the mass of hydrocarbon emissions that would add to the VOC emission inventory around Baton Rouge and could be contributing to excess ozone formation. This report includes sections describing the results, methodology, and QA/QC related to the bagging tests.

2.0 RESULTS

During the five day bagging program, a total of 23 leak points from a total of 8 barges were bagged to determine mass emission rates. The total hydrocarbon emission results of the bagging tests are summarized in Table 1 and individual compound emission rates are presented in Table 2. Two sets of sampling data were collected from each bagged component, along with a single canister sample for analysis. The reported emission rates represent the average of the two sampling runs. The bagging field data was recorded electronically, and copies of the data sheets for each test are included as Appendix A. The laboratory analytical data are presented in Appendix C, including a list of all chemical compounds for which a specific analysis was performed (presented in both alpha-numeric and carbon number order).

The emission figures in Tables 1 and 2 are presented in pounds per hour. The leak rates from these barge tanks are driven by vapor pressure and volume expansion, both of which vary with temperature. The ambient temperature has both seasonal and diurnal variations, so there is considerable uncertainty in extrapolating the measured emissions to an annual basis. As a rough assumption, if the measured rates persist for 12 hours per day (daylight warming time) and 365 days per year, the total emissions for the 23 leak points tested would be around 465 tons per year. See Section 5 for additional discussion of uncertainties.

Table 1. Summary of Total Non-Methane Hydrocarbon Mass Emission Results

Test #	Barge #	Cargo	Canister Number	Point Tested	Test Type[1]	Total Non-Methane Hydrocarbon	
						Volumetric Leak, scfm	Mass Leak, lb/hour
1	G1	Unleaded Gasoline	1481	#2 Center Ullage Hatch	DGM	1.93	20.12
2	G2	Trans Mix	1374	#3 Starboard Cargo Hatch	DGM	0.22	2.48
3	G2	Trans Mix	1322	#2 Starboard Cargo Hatch	Vacuum	0.41	4.56
4	G2	Trans Mix	1397	#2 Port Cargo Hatch	Vacuum	1.95	14.77
5	G2	Trans Mix	1490	Starboard Lower Butterworth Hatch	Vacuum	0.23	2.58
6	G3	Trans Mix	1502	PV Bullet Valve	DGM	0.63	7.09
7	G3	Trans Mix	1375	Vent Stack (leaking Butterfly valve)	DGM	0.94	10.50
8	G4	Naphtha but cleaned	1470	#1 Port Cargo & Ullage Hatch	DGM	0.19	2.48
9	G4	Naphtha but cleaned	1478	#2 Starboard Cargo Ullage Hatch	DGM	0.11	1.46
10	G4	Naphtha but cleaned	1418	#3 Starboard Cargo Ullage Hatch	Vacuum	0.14	1.89
11	G4	Naphtha but cleaned	1394	#2 Port Cargo Valve	DGM	0.08	1.01
12	G4	Naphtha but cleaned	None	# Starboard Stripping Valve	DGM	0.05	0.59
13	G4	Naphtha but cleaned	None	#3 Port Cargo Valve	DGM	0.13	1.62
14	G5	Raffinate	1396	#1 Port Cargo Valve	DGM	1.26	16.78
15	G5	Raffinate	1348	#1 Port Ullage Hatch	Vacuum	0.44	5.81
16	G5	Raffinate	1431	#3 Starboard Cargo Ullage Hatch	Vacuum	0.85	11.32
17	G5	Raffinate	1347	Starboard High Level Alarm Test	Vacuum	0.04	0.52
18	G6	Gasoline	1376	Vent Stack	DGM	1.05	11.54
19	G6	Gasoline	1482	Forward Cofferdam Hatch	Vacuum	1.51	15.77
20	G7	Naphtha	1462	No. 2 Starboard Cargo Hatch	DGM	2.12	24.80
21	G7	Naphtha	None	PV Vent	DGM	0.45	5.26
22	G8	Unleaded Gasoline	1359	PV Vent	DGM	4.32	45.92
23	G8	Unleaded Gasoline	1491	Slop Tank PV Vent	DGM	0.36	3.70
Totals						19.40	212.56

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[1] DGM means “dry gas meter direct drive test”. Vacuum means “vacuum bagging method”.

Table 2. Summary of Chemical Compound Mass Emission Results

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		1,2,3-Trimethylbenzene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	1,3-butadiene	1-Butene	1-Hexene
1	Unleaded Gasoline	8.85E-04	5.21E-03	2.10E-03	2.03E-03	7.18E-02	1.36E-02
2	Trans Mix	7.51E-05	4.06E-04	1.89E-04	6.85E-04	2.47E-02	8.08E-03
3	Trans Mix	3.59E-05	8.92E-04	4.02E-04	1.02E-03	4.00E-02	1.50E-02
4	Trans Mix	1.33E-04	4.03E-03	1.59E-03	3.26E-03	1.25E-01	4.91E-02
5	Trans Mix	5.78E-05	1.84E-03	6.84E-04	4.74E-04	2.05E-02	9.20E-03
6	Trans Mix	1.25E-04	7.57E-04	3.49E-04	1.13E-03	3.74E-02	1.21E-02
7	Trans Mix	4.28E-05	1.61E-03	7.01E-04	1.47E-03	5.42E-02	1.73E-02
8	Naphtha but cleaned	4.52E-04	5.92E-03	3.82E-03	2.11E-04	1.44E-04	5.30E-04
9	Naphtha but cleaned	2.98E-04	3.14E-03	2.52E-03	1.11E-04	2.63E-04	2.53E-04
10	Naphtha but cleaned	8.98E-04	6.91E-03	4.71E-03	1.59E-04	2.60E-04	5.39E-04
11	Naphtha but cleaned	3.58E-04	1.56E-03	2.00E-03	6.87E-05	6.87E-05	2.01E-04
12	Naphtha but cleaned	2.11E-04	9.16E-04	1.18E-03	4.04E-05	4.04E-05	1.18E-04
13	Naphtha but cleaned	5.77E-04	2.51E-03	3.23E-03	1.11E-04	1.11E-04	3.24E-04
14	Raffinate	2.23E-04	2.32E-03	1.50E-03	9.74E-04	4.55E-04	5.65E-03
15	Raffinate	1.00E-04	1.39E-03	7.19E-04	0.00E+00	4.30E-04	9.40E-03
16	Raffinate	4.11E-04	3.15E-03	1.82E-03	2.74E-04	6.50E-04	1.26E-02
17	Raffinate	1.45E-05	9.35E-05	5.20E-05	2.54E-05	1.06E-05	6.67E-04
18	Gasoline	1.65E-03	8.47E-03	3.25E-03	7.34E-04	3.50E-02	2.28E-02
19	Gasoline	1.38E-04	7.14E-03	2.44E-03	1.56E-03	5.46E-02	1.50E-02
20	Naphtha	2.62E-03	2.94E-02	8.46E-03	5.27E-04	2.08E-02	3.65E-03
21	Naphtha	5.56E-04	6.23E-03	1.80E-03	1.12E-04	4.43E-03	7.75E-04
22	Unleaded Gasoline	2.07E-04	1.22E-02	4.94E-03	3.68E-02	9.21E-01	4.29E-02
23	Unleaded Gasoline	4.30E-05	1.15E-03	5.56E-04	3.34E-03	8.55E-02	8.05E-04
Totals, pounds per hour		1.01E-02	1.07E-01	4.90E-02	5.51E-02	1.50E+00	2.41E-01

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		1-Pentene	2,2,4-Trimethylpentane	2,2-Dimethylbutane	2,3,4-Trimethylpentane	2,3-Dimethylbutane	2,3-Dimethylpentane
1	Unleaded Gasoline	1.47E-01	1.21E-01	4.89E-03	2.75E-02	1.40E-01	3.25E-02
2	Trans Mix	5.03E-02	4.82E-03	1.23E-03	8.20E-04	2.68E-02	4.04E-03
3	Trans Mix	9.69E-02	8.54E-03	2.39E-03	9.52E-04	7.80E-03	9.98E-04
4	Trans Mix	3.11E-01	2.92E-02	7.63E-03	3.38E-03	2.55E-02	3.44E-03
5	Trans Mix	5.38E-02	5.52E-03	8.09E-03	6.75E-04	4.63E-03	6.32E-04
6	Trans Mix	1.03E-01	8.62E-03	9.07E-03	1.19E-03	1.31E-02	3.32E-02
7	Trans Mix	1.52E-01	1.27E-02	1.32E-02	1.80E-03	1.92E-02	4.94E-02
8	Naphtha but cleaned	2.45E-04	5.27E-05	4.88E-03	6.42E-04	1.32E-02	1.44E-02
9	Naphtha but cleaned	1.16E-04	4.49E-05	2.60E-03	6.22E-05	7.28E-03	8.72E-03
10	Naphtha but cleaned	1.27E-04	5.05E-05	3.73E-03	3.61E-04	1.06E-02	1.12E-02
11	Naphtha but cleaned	1.01E-04	1.01E-02	1.90E-03	3.03E-04	5.23E-03	3.84E-03
12	Naphtha but cleaned	5.93E-05	5.96E-03	1.12E-03	1.79E-04	3.08E-03	2.26E-03
13	Naphtha but cleaned	1.62E-04	1.63E-02	3.06E-03	4.89E-04	8.43E-03	6.18E-03
14	Raffinate	2.59E-03	1.16E-02	7.96E-01	2.59E-04	6.42E-01	4.28E-01
15	Raffinate	1.06E-03	3.42E-03	2.56E-01	1.43E-04	9.51E-01	5.35E-02
16	Raffinate	2.16E-03	5.60E-03	5.24E-01	2.05E-04	1.80E+00	9.79E-02
17	Raffinate	9.30E-05	2.56E-04	2.23E-02	1.43E-05	8.57E-02	4.59E-03
18	Gasoline	1.20E-01	1.08E-01	3.56E-02	2.53E-03	2.85E-01	2.92E-02
19	Gasoline	1.65E-01	8.64E-02	4.43E-02	1.66E-03	1.28E-02	1.59E-03
20	Naphtha	4.78E-02	4.93E-02	3.09E-01	2.00E-03	2.04E-01	1.46E-02
21	Naphtha	1.02E-02	1.05E-02	6.57E-02	4.24E-04	4.34E-02	3.09E-03
22	Unleaded Gasoline	2.14E-01	9.97E-02	2.16E-01	2.61E-02	3.74E-01	9.99E-02
23	Unleaded Gasoline	1.55E-02	5.53E-03	1.40E-02	1.09E-04	2.11E-02	5.06E-03
Totals, pounds per hour		1.49E+00	6.03E-01	2.35E+00	7.18E-02	4.71E+00	9.08E-01

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		2,4π Dimethylpentane	2πMethylheptane	2πMethylhexane	2πMethylpentane	3πMethylheptane	3πMethylhexane
1	Unleaded Gasoline	2.91Eπ02	1.07Eπ02	6.56Eπ02	2.03Eπ02	1.09Eπ02	6.46Eπ02
2	Trans Mix	2.66Eπ03	2.96Eπ03	1.28Eπ02	1.04Eπ01	1.99Eπ03	1.17Eπ02
3	Trans Mix	4.70Eπ03	6.90Eπ04	2.27Eπ02	1.21Eπ02	1.05Eπ04	6.73Eπ04
4	Trans Mix	1.59Eπ02	2.41Eπ03	7.76Eπ02	3.93Eπ02	3.74Eπ04	2.29Eπ03
5	Trans Mix	2.92Eπ03	1.83Eπ03	1.47Eπ02	7.43Eπ03	1.00Eπ03	4.48Eπ04
6	Trans Mix	7.02Eπ02	6.26Eπ04	1.29Eπ03	2.31Eπ02	5.84Eπ05	2.82Eπ02
7	Trans Mix	1.04Eπ01	9.53Eπ04	1.89Eπ03	3.35Eπ02	8.70Eπ05	4.20Eπ02
8	Naphtha but cleaned	6.27Eπ03	2.82Eπ03	3.20Eπ02	6.65Eπ02	1.40Eπ03	3.85Eπ02
9	Naphtha but cleaned	3.72Eπ03	1.85Eπ03	1.94Eπ02	3.68Eπ02	9.19Eπ04	2.34Eπ02
10	Naphtha but cleaned	5.11Eπ03	1.76Eπ03	2.46Eπ02	5.43Eπ02	8.51Eπ04	2.94Eπ02
11	Naphtha but cleaned	2.53Eπ03	1.15Eπ03	1.27Eπ02	2.64Eπ02	5.86Eπ04	1.54Eπ02
12	Naphtha but cleaned	1.49Eπ03	6.79Eπ04	7.49Eπ03	1.55Eπ02	3.45Eπ04	9.06Eπ03
13	Naphtha but cleaned	4.07Eπ03	1.86Eπ03	2.05Eπ02	4.25Eπ02	9.44Eπ04	2.48Eπ02
14	Raffinate	1.20Eπ01	5.39Eπ03	1.99Eπ03	2.63E+00	3.78Eπ03	4.62Eπ01
15	Raffinate	3.77Eπ02	4.20Eπ04	1.27Eπ01	6.95Eπ03	3.30Eπ04	1.37Eπ01
16	Raffinate	7.08Eπ02	1.13Eπ03	2.35Eπ01	1.29Eπ02	6.59Eπ04	2.53Eπ01
17	Raffinate	3.29Eπ03	3.89Eπ05	1.08Eπ02	6.63Eπ04	2.70Eπ05	1.17Eπ02
18	Gasoline	2.22Eπ02	7.59Eπ03	6.67Eπ02	1.82Eπ02	5.05Eπ03	6.52Eπ02
19	Gasoline	2.16Eπ02	9.24Eπ03	5.79Eπ02	2.06Eπ02	8.51Eπ03	1.54Eπ03
20	Naphtha	1.97Eπ02	1.93Eπ02	8.07Eπ02	7.97Eπ01	4.20Eπ02	9.75Eπ02
21	Naphtha	4.19Eπ03	4.10Eπ03	1.71Eπ02	1.69Eπ01	8.92Eπ03	2.07Eπ02
22	Unleaded Gasoline	3.29Eπ02	3.20Eπ03	1.23Eπ03	1.27E+00	6.37Eπ03	1.00Eπ01
23	Unleaded Gasoline	1.75Eπ03	1.00Eπ03	4.02Eπ05	7.76Eπ02	8.57Eπ04	5.07Eπ03
Totals, pounds per hour		5.87Eπ01	8.18Eπ02	9.13Eπ01	5.48E+00	9.61Eπ02	1.44E+00

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		3-Methylpentane	Acetylene	Benzene	cis-2-Butene	cis-2-Pentene	Cumene
1	Unleaded Gasoline	2.28E-01	0.00E+00	1.41E-01	2.60E-01	1.54E-01	1.09E-03
2	Trans Mix	5.37E-02	2.20E-05	1.01E-02	2.36E-02	4.76E-02	8.65E-05
3	Trans Mix	9.74E-02	9.05E-05	1.91E-02	4.40E-02	9.07E-02	1.61E-04
4	Trans Mix	3.21E-01	1.40E-04	6.47E-02	1.40E-01	2.90E-01	5.36E-04
5	Trans Mix	5.87E-02	6.81E-05	1.24E-02	2.27E-02	5.15E-02	1.71E-04
6	Trans Mix	1.49E-01	4.78E-05	2.41E-02	9.70E-02	1.84E-01	9.80E-05
7	Trans Mix	2.20E-01	1.33E-04	3.58E-02	1.42E-01	2.74E-01	2.24E-04
8	Naphtha but cleaned	4.81E-02	1.92E-04	2.20E-02	1.53E-04	1.92E-04	3.53E-03
9	Naphtha but cleaned	2.70E-02	1.24E-04	1.25E-02	0.00E+00	2.60E-04	2.29E-03
10	Naphtha but cleaned	3.96E-02	2.02E-04	1.77E-02	1.73E-04	1.85E-04	3.42E-03
11	Naphtha but cleaned	1.93E-02	9.92E-05	7.76E-03	6.49E-05	7.02E-05	1.50E-03
12	Naphtha but cleaned	1.13E-02	5.84E-05	4.57E-03	3.82E-05	4.13E-05	8.84E-04
13	Naphtha but cleaned	3.10E-02	1.60E-04	1.25E-02	1.05E-04	1.13E-04	2.42E-03
14	Raffinate	2.03E+00	1.76E-04	2.51E+00	8.70E-04	4.77E-03	7.16E-04
15	Raffinate	7.19E-01	0.00E+00	8.31E-01	3.22E-04	1.83E-03	2.62E-04
16	Raffinate	1.37E+00	0.00E+00	1.64E+00	7.19E-04	3.99E-03	4.41E-04
17	Raffinate	6.47E-02	1.47E-05	7.67E-02	2.78E-05	1.61E-04	2.22E-05
18	Gasoline	1.76E-01	1.47E-04	1.24E-01	1.80E-01	2.94E-01	1.40E-03
19	Gasoline	1.98E-01	1.73E-04	1.18E-01	2.67E-01	1.75E-01	9.52E-04
20	Naphtha	4.38E-01	5.59E-04	8.01E-02	1.81E-02	4.35E-02	7.01E-03
21	Naphtha	9.30E-02	1.19E-04	1.70E-02	3.85E-03	9.24E-03	1.49E-03
22	Unleaded Gasoline	6.97E-01	8.42E-03	1.06E-01	8.13E-01	2.30E-01	1.30E-03
23	Unleaded Gasoline	4.08E-02	7.83E-04	5.52E-03	6.39E-02	1.60E-02	1.64E-04
Totals, pounds per hour		7.13E+00	1.17E-02	5.89E+00	2.08E+00	1.87E+00	3.02E-02

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		Cyclohexane	Cyclopentane	Ethane	Ethylbenzene	Ethylene	Isobutane
1	Unleaded Gasoline	1.62E-02	5.66E-02	1.39E-01	1.50E-02	0.00E+00	4.46E+00
2	Trans Mix	4.92E-03	1.78E-02	4.77E-02	6.20E-04	1.73E-03	6.18E-02
3	Trans Mix	1.99E-03	3.31E-02	7.53E-02	2.75E-03	2.83E-03	9.63E-03
4	Trans Mix	6.70E-03	1.07E-01	2.05E-01	1.07E-02	7.40E-03	2.86E-02
5	Trans Mix	1.08E-03	1.93E-02	2.89E-02	2.69E-03	9.41E-04	7.21E-03
6	Trans Mix	9.62E-04	3.46E-02	5.12E-02	2.52E-03	9.88E-04	1.02E-01
7	Trans Mix	1.40E-03	5.13E-02	7.51E-02	4.05E-03	1.44E-03	1.46E-01
8	Naphtha but cleaned	7.85E-02	1.57E-02	3.38E-02	1.05E-02	1.92E-04	4.16E-02
9	Naphtha but cleaned	4.65E-02	8.53E-03	1.86E-02	6.33E-03	1.24E-04	1.98E-02
10	Naphtha but cleaned	6.42E-02	1.26E-02	2.47E-02	7.53E-03	2.02E-04	2.67E-02
11	Naphtha but cleaned	5.09E-05	6.17E-03	1.27E-02	3.13E-03	1.15E-04	1.45E-02
12	Naphtha but cleaned	2.99E-05	3.63E-03	7.45E-03	1.84E-03	6.74E-05	8.51E-03
13	Naphtha but cleaned	8.20E-05	9.94E-03	2.04E-02	5.05E-03	1.85E-04	2.33E-02
14	Raffinate	4.42E-03	1.28E-01	3.43E-03	3.67E-03	1.12E-04	4.60E-02
15	Raffinate	5.08E-03	2.79E-01	2.30E-03	1.44E-03	1.02E-04	1.34E-02
16	Raffinate	7.65E-03	5.49E-01	3.94E-03	2.28E-03	1.88E-04	2.92E-02
17	Raffinate	3.86E-04	2.46E-02	3.34E-04	1.31E-04	1.15E-05	1.18E-03
18	Gasoline	1.69E-02	1.01E-01	6.52E-02	1.90E-02	1.47E-04	1.59E+00
19	Gasoline	2.39E-03	4.52E-02	9.92E-02	1.13E-02	1.73E-04	2.47E+00
20	Naphtha	1.32E-01	4.04E-01	8.80E-02	1.56E-02	1.28E-03	1.55E+00
21	Naphtha	2.79E-02	8.57E-02	1.87E-02	3.31E-03	2.72E-04	3.29E-01
22	Unleaded Gasoline	1.54E-03	3.28E-01	1.71E-01	1.81E-02	1.37E-02	5.62E+00
23	Unleaded Gasoline	1.72E-03	2.04E-02	2.64E-05	1.39E-03	0.00E+00	5.58E-01
Totals, pounds per hour		4.22E-01	2.34E+00	1.19E+00	1.49E-01	3.22E-02	1.71E+01

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene	Methylcyclohexane	Methylcyclopentane
1	Unleaded Gasoline	3.35E+00	1.21E-02	4.46E-02	1.25E-04	1.29E-02	1.01E-01
2	Trans Mix	7.33E-01	3.27E-03	3.02E-03	2.06E-05	6.59E-03	2.89E-02
3	Trans Mix	1.28E+00	6.48E-03	9.20E-03	1.81E-05	1.26E-03	5.26E-02
4	Trans Mix	4.18E+00	2.09E-02	3.47E-02	1.44E-04	4.31E-03	1.74E-01
5	Trans Mix	7.03E-01	3.58E-03	9.08E-03	9.41E-05	8.34E-04	3.28E-02
6	Trans Mix	2.53E+00	3.92E-03	1.16E-02	3.72E-05	4.38E-03	6.71E-04
7	Trans Mix	3.74E+00	5.49E-03	1.44E-02	5.48E-05	6.62E-03	1.01E-03
8	Naphtha but cleaned	1.23E-01	0.00E+00	6.16E-02	1.65E-04	1.33E-01	7.70E-02
9	Naphtha but cleaned	6.25E-02	0.00E+00	3.86E-02	9.12E-05	8.53E-02	4.41E-02
10	Naphtha but cleaned	8.95E-02	0.00E+00	4.78E-02	3.17E-04	1.02E-01	6.38E-02
11	Naphtha but cleaned	4.50E-02	1.83E-04	1.37E-02	7.63E-05	5.38E-02	3.08E-02
12	Naphtha but cleaned	2.64E-02	1.08E-04	8.07E-03	4.49E-05	3.16E-02	1.81E-02
13	Naphtha but cleaned	7.25E-02	2.95E-04	2.21E-02	1.23E-04	8.67E-02	4.96E-02
14	Raffinate	1.56E+00	7.21E-04	1.50E-02	8.62E-05	1.21E-02	1.41E-01
15	Raffinate	5.71E-01	1.06E-03	3.84E-03	6.35E-05	2.92E-03	4.69E-02
16	Raffinate	1.18E+00	8.35E-04	8.50E-03	1.13E-04	4.00E-03	8.83E-02
17	Raffinate	5.12E-02	1.35E-04	4.33E-04	4.58E-06	2.42E-04	4.23E-03
18	Gasoline	1.79E+00	9.71E-03	6.46E-02	3.19E-04	6.28E-03	9.21E-02
19	Gasoline	2.49E+00	1.30E-02	3.92E-02	2.87E-04	1.56E-03	9.51E-02
20	Naphtha	7.19E+00	4.19E-03	9.19E-02	1.25E-03	2.21E-01	2.69E-01
21	Naphtha	1.53E+00	8.89E-04	1.95E-02	2.65E-04	4.70E-02	5.72E-02
22	Unleaded Gasoline	7.56E+00	2.13E-02	6.71E-02	4.77E-04	4.28E-02	2.70E-01
23	Unleaded Gasoline	5.68E-01	1.62E-03	4.72E-03	5.98E-05	2.24E-03	1.41E-02
Totals, pounds per hour		4.14E+01	1.10E-01	6.33E-01	4.24E-03	8.69E-01	1.75E+00

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		m-Ethyltoluene	n-Butane	n-Decane	n-Heptane	n-Hexane	n-Nonane
1	Unleaded Gasoline	5.03E-03	4.40E+00	1.16E-04	3.38E-02	1.63E-01	1.09E-03
2	Trans Mix	3.76E-04	1.33E-01	4.92E-05	1.04E-02	3.52E-02	4.45E-04
3	Trans Mix	7.99E-04	2.22E-01	1.67E-04	5.07E-03	8.10E-03	1.10E-03
4	Trans Mix	3.18E-03	7.03E-01	6.66E-04	2.23E-02	2.68E-02	4.34E-03
5	Trans Mix	1.26E-03	1.14E-01	3.33E-04	4.33E-03	5.05E-03	1.14E-03
6	Trans Mix	7.34E-04	1.91E-01	8.29E-05	2.34E-03	1.35E-02	7.21E-04
7	Trans Mix	1.34E-03	2.78E-01	2.77E-04	3.50E-03	1.99E-02	1.46E-03
8	Naphtha but cleaned	6.18E-03	1.11E-01	3.48E-03	7.52E-02	1.01E-01	2.53E-02
9	Naphtha but cleaned	3.89E-03	5.44E-02	2.44E-03	4.64E-02	5.74E-02	1.64E-02
10	Naphtha but cleaned	7.04E-03	7.47E-02	6.04E-03	5.43E-02	8.33E-02	2.36E-02
11	Naphtha but cleaned	2.43E-03	3.92E-02	2.07E-03	2.95E-02	3.99E-02	1.05E-02
12	Naphtha but cleaned	1.43E-03	2.31E-02	1.22E-03	1.74E-02	2.35E-02	6.16E-03
13	Naphtha but cleaned	3.92E-03	6.33E-02	3.33E-03	4.75E-02	6.43E-02	1.69E-02
14	Raffinate	2.03E-03	2.08E-01	1.34E-03	1.74E-01	2.01E+00	4.45E-03
15	Raffinate	9.46E-04	7.25E-02	6.02E-04	5.06E-02	6.81E-01	1.38E-03
16	Raffinate	2.07E-03	1.55E-01	2.02E-03	9.27E-02	1.29E+00	1.73E-03
17	Raffinate	6.91E-05	6.44E-03	7.37E-05	4.16E-03	6.10E-02	1.29E-04
18	Gasoline	7.16E-03	2.61E+00	4.59E-04	3.55E-02	1.32E-01	1.98E-03
19	Gasoline	5.14E-03	3.96E+00	7.63E-04	1.43E-02	1.68E-02	1.75E-03
20	Naphtha	2.12E-02	2.73E+00	1.05E-02	1.50E-01	6.39E-01	2.94E-02
21	Naphtha	4.51E-03	5.80E-01	2.24E-03	3.17E-02	1.36E-01	6.25E-03
22	Unleaded Gasoline	9.67E-03	1.48E+01	1.31E-03	5.63E-02	5.14E-01	4.36E-03
23	Unleaded Gasoline	1.03E-03	1.30E+00	2.74E-04	2.89E-03	2.87E-02	6.61E-04
Totals, pounds per hour		9.15E-02	3.28E+01	3.99E-02	9.64E-01	6.15E+00	1.61E-01

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		n-Octane	n-Pentane	n-Propylbenzene	n-Undecane	o Xylene	o-Ethyltoluene
1	Unleaded Gasoline	7.88E-03	8.43E-01	1.97E-03	0.00E+00	1.74E-02	1.75E-03
2	Trans Mix	3.75E-03	2.60E-01	1.08E-04	1.20E-05	1.06E-03	1.23E-04
3	Trans Mix	5.34E-04	4.87E-01	1.94E-04	2.23E-05	3.11E-03	2.69E-04
4	Trans Mix	1.89E-03	1.57E+00	7.40E-04	1.34E-04	1.22E-02	9.80E-04
5	Trans Mix	9.37E-04	2.76E-01	3.18E-04	1.67E-04	3.33E-03	4.21E-04
6	Trans Mix	4.61E-04	4.35E-01	1.75E-04	1.23E-04	2.94E-03	2.14E-04
7	Trans Mix	7.24E-04	6.43E-01	3.82E-04	6.33E-05	4.91E-03	4.15E-04
8	Naphtha but cleaned	7.53E-02	1.34E-01	2.52E-03	8.02E-05	2.29E-02	2.25E-03
9	Naphtha but cleaned	4.82E-02	6.99E-02	1.58E-03	4.52E-05	1.31E-02	1.39E-03
10	Naphtha but cleaned	5.11E-02	1.01E-01	1.73E-03	2.52E-04	1.42E-02	2.67E-03
11	Naphtha but cleaned	1.39E-03	5.06E-02	5.29E-04	4.72E-05	5.17E-03	8.26E-04
12	Naphtha but cleaned	8.16E-04	2.98E-02	3.11E-04	2.78E-05	3.04E-03	4.86E-04
13	Naphtha but cleaned	2.24E-03	8.16E-02	8.53E-04	7.61E-05	8.33E-03	1.33E-03
14	Raffinate	6.84E-03	1.05E+00	9.47E-04	1.07E-04	6.20E-03	7.66E-04
15	Raffinate	1.45E-03	4.39E-01	2.96E-04	5.21E-05	1.75E-03	3.41E-04
16	Raffinate	1.04E-03	8.81E-01	5.59E-04	2.18E-04	2.70E-03	9.28E-04
17	Raffinate	1.11E-04	3.90E-02	1.35E-05	7.74E-06	1.58E-04	2.62E-05
18	Gasoline	1.38E-03	5.65E-01	2.59E-03	1.03E-04	2.17E-02	2.54E-03
19	Gasoline	8.11E-04	7.58E-01	1.69E-03	5.40E-04	1.30E-02	1.98E-03
20	Naphtha	9.22E-02	6.45E+00	1.05E-02	6.70E-04	3.78E-02	9.23E-03
21	Naphtha	1.96E-02	1.37E+00	2.23E-03	1.42E-04	8.03E-03	1.96E-03
22	Unleaded Gasoline	1.53E-03	4.64E+00	2.64E-03	2.09E-04	2.08E-02	3.02E-03
23	Unleaded Gasoline	1.30E-03	3.39E-01	3.57E-04	6.16E-05	1.98E-03	3.40E-04
Totals, pounds per hour		3.21E-01	2.15E+01	3.32E-02	3.16E-03	2.26E-01	3.43E-02

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour					
		p-Diethylbenzene	p-Ethyltoluene	Propane	Propylene	Styrene	Toluene
1	Unleaded Gasoline	1.99E-04	2.15E-03	1.92E+00	2.15E-02	4.95E-04	1.55E-01
2	Trans Mix	3.01E-05	1.96E-05	9.79E-02	2.06E-02	6.43E-05	1.16E-02
3	Trans Mix	9.18E-05	3.88E-05	1.46E-01	3.00E-02	3.10E-04	2.45E-02
4	Trans Mix	3.99E-04	1.60E-04	4.16E-01	8.35E-02	1.31E-03	9.09E-02
5	Trans Mix	8.05E-05	6.33E-05	6.60E-02	1.27E-02	2.11E-04	1.92E-02
6	Trans Mix	4.67E-05	3.07E-05	5.66E-02	2.24E-02	1.46E-04	2.70E-02
7	Trans Mix	3.85E-05	7.73E-05	8.26E-02	3.22E-02	2.83E-04	4.11E-02
8	Naphtha but cleaned	2.61E-04	1.44E-03	8.94E-02	2.94E-04	1.36E-03	5.20E-02
9	Naphtha but cleaned	9.68E-05	9.22E-04	4.21E-02	1.66E-04	8.67E-04	3.13E-02
10	Naphtha but cleaned	1.21E-04	1.62E-03	5.65E-02	2.50E-04	1.12E-03	3.61E-02
11	Naphtha but cleaned	6.11E-05	6.53E-04	3.20E-02	9.67E-05	5.61E-04	1.72E-02
12	Naphtha but cleaned	3.59E-05	3.84E-04	1.88E-02	5.69E-05	3.30E-04	1.01E-02
13	Naphtha but cleaned	9.84E-05	1.05E-03	5.16E-02	1.56E-04	9.04E-04	2.78E-02
14	Raffinate	1.63E-04	3.51E-04	5.58E-03	1.17E-04	7.26E-04	4.67E-01
15	Raffinate	7.78E-05	1.11E-04	1.88E-03	0.00E+00	1.33E-04	1.47E-01
16	Raffinate	1.51E-04	2.09E-04	3.99E-03	0.00E+00	1.37E-04	3.13E-01
17	Raffinate	5.24E-06	1.09E-05	1.98E-04	0.00E+00	1.35E-05	1.42E-02
18	Gasoline	1.94E-04	3.02E-04	7.72E-01	3.25E-03	5.04E-04	1.71E-01
19	Gasoline	2.97E-04	2.20E-04	1.22E+00	5.38E-03	1.86E-04	1.20E-01
20	Naphtha	1.18E-03	2.39E-03	3.75E-01	1.51E-02	3.43E-03	1.11E-01
21	Naphtha	2.51E-04	5.08E-04	7.97E-02	3.20E-03	7.28E-04	2.37E-02
22	Unleaded Gasoline	3.56E-04	4.51E-04	5.21E-01	9.62E-02	5.35E-04	1.42E-01
23	Unleaded Gasoline	5.46E-05	7.92E-05	5.30E-02	9.03E-03	5.50E-05	8.17E-03
Totals, pounds per hour		4.29E-03	1.32E-02	6.10E+00	3.56E-01	1.44E-02	2.06E+00

Table 2. Summary of Chemical Compound Mass Emission Results (Cont'd)

Test #	Cargo	Individual Compound Emissions, pounds per hour			
		trans-2-Butene	trans-2-Pentene	Unidentified[2]	Total NMOC
1	Unleaded Gasoline	2.71E-01	2.85E-01	2.23E+00	2.01E+01
2	Trans Mix	2.69E-02	8.97E-02	4.83E-01	2.48E+00
3	Trans Mix	4.79E-02	1.71E-01	1.47E+00	4.56E+00
4	Trans Mix	1.52E-01	5.48E-01	4.83E+00	1.48E+01
5	Trans Mix	2.45E-02	9.73E-02	8.65E-01	2.58E+00
6	Trans Mix	1.29E-01	4.56E-01	2.21E+00	7.09E+00
7	Trans Mix	1.89E-01	6.79E-01	3.30E+00	1.05E+01
8	Naphtha but cleaned	2.59E-04	2.53E-04	9.31E-01	2.48E+00
9	Naphtha but cleaned	2.14E-04	1.11E-04	5.89E-01	1.46E+00
10	Naphtha but cleaned	4.18E-04	1.50E-04	7.19E-01	1.89E+00
11	Naphtha but cleaned	3.59E-04	1.04E-04	4.79E-01	1.01E+00
12	Naphtha but cleaned	2.11E-04	6.11E-05	2.82E-01	5.92E-01
13	Naphtha but cleaned	5.78E-04	1.67E-04	7.73E-01	1.62E+00
14	Raffinate	1.94E-03	9.14E-03	1.26E+00	1.68E+01
15	Raffinate	5.48E-04	3.32E-03	3.45E-01	5.81E+00
16	Raffinate	1.12E-03	7.76E-03	6.54E-01	1.13E+01
17	Raffinate	3.68E-05	2.99E-04	3.04E-02	5.21E-01
18	Gasoline	1.55E-01	2.43E-01	1.44E+00	1.15E+01
19	Gasoline	2.36E-01	3.26E-01	2.56E+00	1.58E+01
20	Naphtha	6.38E-02	8.83E-02	1.65E+00	2.48E+01
21	Naphtha	1.35E-02	1.87E-02	3.50E-01	5.26E+00
22	Unleaded Gasoline	1.16E+00	5.42E-01	4.00E+00	4.59E+01
23	Unleaded Gasoline	9.50E-02	3.81E-02	2.84E-01	3.70E+00
Totals, pounds per hour		2.57E+00	3.61E+00	3.17E+01	2.13E+02

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[2] "Unidentified" would include any hydrocarbon peak for which there was no standard. These compounds are quantified but not identified.

3.0 BAGGING METHODOLOGY

The bagging technique is used to measure the mass emissions from equipment leaks. It is documented in the US EPA *Protocol for Equipment Leak Emission Estimates*, 1995 (EPA Protocol, see Appendix B), and those procedures are adopted here by reference. There are two basic variations in the bagging approach: the vacuum method and the blow-through method. Both methods have advantages in certain circumstances, however, during this test program the vacuum method was used exclusively. The only variations from this procedure include:

- No background bags were taken, since they would have a negligible effect on the results from high leaking components that are the focus of this work;
- No analytical tests were performed on any liquid leak materials collected, since the objective was to only quantify the vapor leaks;
- A single canister sample was taken for analysis for most of the points tested; and
- The dry gas meter was driven directly on components leaking at a rate greater than the pump capacity.

4.0 ANALYTICAL PROCEDURES

Samples were collected in evacuated aluminum summa canisters provided by LDEQ. A maximum of one canister was filled for each point tested. One canister was sometimes used for multiple sampling points in the same product service on the same barge. The LDEQ laboratory did the analysis using EPA PAMS analysis by GC/FID. The detailed laboratory results are presented in Appendix C.

Analytical data were compiled for 56 individual chemical compounds, plus an unidentified hydrocarbon and total non-methane hydrocarbons (TNMHC). Compound concentrations were reported in parts per billion as carbon (ppbC). The carbon numbers for each chemical compound were used to calculate the average carbon number for the TNMHC, along with an assumed carbon number of 4.5 for category of unidentified hydrocarbons, The molecular weight of the TNMHC was then calculated as the average carbon number times 14 plus 2, which corresponds to alkane hydrocarbons. This value comes from the generalized alkane formula of C_nH_{2n+2}, and substituting a carbon atomic weight of 12 and hydrogen of 1, the molecular weight can be expressed as 14n + 2.

5.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

A variety of QA/QC checks were run on both the sampling and analytical portions of this work. This section presents the results of those QA/QC tests. In general the QC activities consisted of the following:

- Duplicate sampling data collection;
- Analytical QA/QC;
- Known leak rate testing; and
- Dry gas meter calibration check.

Duplicate/Triplicate Sampling Data

Each component tested had sampling data collected in duplicate and about half the runs were tested in triplicate. The duplicate/triplicate data was for flow rate (time elapsed for a given flow volume), temperature, and pressure at the dry gas meter. The flow rates in liters per minute at actual conditions were compared across the duplicate or triplicate runs. The bagging procedure requires that the individual runs agree within ±20%, in which case the runs are averaged as the final result. These tests showed a variation from -17.3% to +9.8%. The -17.3% result was the first run on a vacuum bagging train run where the plastic bag was observed to collapse around the suction line reducing flow. Two other sampling runs were performed with the plastic held away from the suction line, which showed ±5.8% variation. The first run at -17.3% was discarded because of the known flaw. With that one sampling run discarded, the range of variation in flow data were ±9.8%. The duplicate/triplicate sampling data is given in Table 3.

Analytical QA/QC Data

A total of 20 canisters were sent to the laboratory for analysis. Standard cylinder gases were used to calibrate the instrument and to check for calibration drift 3 to 4 times during each day of analysis on the barge test canisters. A total of 6 canister blanks were tested. A total of 6 canisters were analyzed in duplicate. Two system blanks were tested. All these QA/QC test results fell within the ranges allowed for the analytical method. Detailed documentation of the analytical data can be found in Appendix C.

Known Leak Rate Tests

A known leak rate check of the bagging system was performed before and after the sampling effort. The known leak-rate test involved introducing a known artificial leak rate into a dummy bag, and then running the bagging test in the normal fashion. The emission rate calculated from the bagging test was then compared to the known artificial leak rate, with a criterion of ∂ 20% (80% to 120% recovery) of the known rate to pass the test.

The known artificial leak was generated by connecting a cylinder of calibration gas to the dummy bag and operating the bagging test using standard procedures. The flow rate into the bag was measured before and after each leak check using a Dry-Cal flow-measuring device traced to a primary standard.

In Table 4, we present the results of the known leak rate checks done before and after the set of barge bagging tests. The known leak rate tests were done at the beginning of the study before any field samples were collected and again following the completion of the bagging study. The initial and final vacuum method tests showed good results for methane at both the high and low concentration levels. However, it should be noted that the high level calibration gas did not match the concentrations of the large leaks encountered in the barge testing.

Dry Gas Meter Calibration Checks

On 15 out of 23 component tests, the leak rate from the component exceeded the pump rate of the dry gas meter. For these tests, the dry gas meter was disconnected from the pump and the component leak rate was routed directly through the dry gas meter (i.e., the leak was driving the meter with no external driving force). Since this mode of measurement does not use the entire bagging train, the dry gas meter was sent to Carl Poe Company for a calibration check against a National Institute of Standards (NIST) traceable prover. In Table 5, we present the results of testing the dry gas meter at three different flow rates, which cover almost the entire range of flow rates encountered during the barge testing. The dry gas meter was found to have minimal error rates of +1% to +1.5% throughout this range. Since the dry gas meter was found to have a bias toward reading slightly high, the measured flow rates were corrected by a factor of 0.99 (for flow rates under 30 liters/minute) and by a factor of 0.985 (for flow rates greater than 30 liters/minute).

Table 3. Summary of Duplicate/Triplicate Sampling Variability

Test #	Run #1		Run #2		Run #3		Average
	Liter/min.	% Deviation	Liter/min.	% Deviation	Liter/min.	% Deviation	
1	66.67	-3.1%	72.99	+6.1%	66.77	-3.0%	68.81
2	14.75	-0.7%	14.96	+0.7%	NA	NA	14.85
3	36.23	+0.1%	36.17	-0.1%	NA	NA	36.20
4	127.90	+1.1%	125.00	-1.1%	NA	NA	126.45
5	36.79	-2.2%	38.41	+2.2%	NA	NA	37.60
6	25.43	-0.8%	25.84	+0.8%	NA	NA	25.64
7	37.71	+3.0%	35.50	-3.0%	NA	NA	36.61
8	81.30	-1.1%	83.45	+1.5%	81.91	-0.4%	82.22
9	63.16	+2.0%	61.16	-1.2%	61.44	-0.8%	61.92
10	114.94	-0.3%	111.73	-3.1%	119.28	+3.4%	115.32
11	36.52	-0.02%	36.28	-0.6%	36.74	+0.6%	36.51
12	21.65	0.0%	21.65	0.0%	NA	NA	21.65
13	59.82	+0.7%	58.94	-0.7%	NA	NA	59.38
14	69.77	+2.4%	66.45	-2.4%	NA	NA	68.11
15	31.53	-17.3%[3]	40.35	+5.8%	35.93	-5.8%	38.14
16	68.81	-4.7%	74.17	+4.7%	NA	NA	71.49
17	6.43	+9.3%	5.33	-9.3%	NA	NA	5.88
18	86.45	-1.2%	88.89	+1.5%	87.27	-0.3%	87.54
19	127.25	+1.2%	124.35	-1.2%	NA	NA	125.80
20	136.99	-3.7%	142.18	-0.1%	147.78	+3.8%	142.32
21	36.36	-1.4%	37.57	+1.9%	36.71	-0.5%	36.88
22	123.95	-8.8%	139.73	+3.6%	141.84	+5.2%	134.88
23	13.93	+0.8%	13.23	-4.3%	14.32	+3.5%	13.83

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[3] The suction line was observed to be partially blocked by plastic from the enclosure. The plastic was held away in the next two runs, and a funnel was added inside the bag to minimize this effect in future tests. This run was discarded and was not used to calculate the average for this test.

Table 4. Summary of Bagging System Known Leak Rate Tests

Sample Description	Known Leak, kg/hr	Bag Test, kg/hr	Percent Error
Pre-Test QA Vacuum - High Range	0.000163	0.000151	-7.5%
Pre-Test QA Vacuum - Low Range	0.000017	0.0000148	-13.3%
Post-Test QA Vacuum - High Range	0.00175	0.00160	-8.2%
Post-Test QA Vacuum - Low Range	0.000431	0.000423	-2.0%

Table 5. Summary of Dry Gas Meter Calibration Tests

Test #	Flow Rate Tested, liter/min.	DGM Percent Error	DGM Correction Factor
1	5	+1%	0.99
2	20	+1%	0.99
3	85	+1.5%	0.985

Overall Analysis of Uncertainty in Mass Emission Estimates

There are a number of factors which contribute to uncertainty in the measured mass emission estimates, including:

- Sampling variability;
- Analytical variability;
- Leak capture/containment variability;
- Inter-dependence of multiple leak sites on a barge; and
- Temperature effects (both diurnal and seasonal).

In addition to these factors causing uncertainty in the measured emissions, there is additional uncertainty in an extrapolation of measured emissions to total emissions from barges in the Baton Rouge area. Each of these uncertainties is discussed below.

Sampling and Analytical Variability

Sampling variability has been addressed quantitatively in the preceding subsections and falls within the acceptable range for the method. The analytical data provided by the laboratory at the Louisiana Department of Environmental Quality (LDEQ) in Baton Rouge is documented in Appendix C. The analytical procedures included testing blank canisters (6 total), duplicate analyses (6 total), and standard calibration gases (4) with results that fall within the acceptable ranges for the method. Sampling variability is generally greater than analytical variability, and the bagging method is expected to have better than ±20% variability overall.

Capture Efficiency

Another part of sampling variability that is outside the quantitative QA/QC tests presented earlier is variability in the capture efficiency of the bag enclosure. There were cases where the FLIR camera could detect leakage around the area where the bag was secured to the component by a combination of duct tape and turnbuckle compression. In most cases, any visible leaks were corrected before sample data were collected. Some bagged components were not imaged with the FLIR camera during bagging, so we do not know if there may have been detectable leakage around the bag on those components. Some other bagged components were imaged, but we could not completely eliminate detectable leakage. Any of these leaks around the bag enclosure would not be directed through the dry gas meter on the 15 direct drive tests. This variable capture efficiency cannot be quantitatively estimated, but it is clear that this factor would cause the measured emissions to be biased low.

Inter-Dependence of Leaking Components

The next area of uncertainty is the inter-dependence of leaking components on the barges. The barges have multiple storage compartments that can isolate the stored liquid materials, but we understand, based on conversations with several barge company representatives, that the vapor spaces of all the compartments are connected to a common header going to the pressure/vacuum (P/V) relief valve and the vent stack. The barges tested all operated at low pressures, with P/V relief valves starting to vent at pressures of 1 psig to 6 psig. The seals on the hatches and valve packing are designed to minimize leakage at these low pressure differentials. During the testing, we came to realize that everything we did to one sample point affected the emissions from the other potential leak points around it. The dry gas meter creates only a few inches of water back pressure, but we bagged many leaking components that would inflate the bag, but would not drive the dry gas meter. Presumably this happened because the slight increase in back pressure from the dry gas meter caused the leak to move from the bagged component to a neighboring component. Conversely, when we did a vacuum bagging test, there was the potential to pull hydrocarbons that might have been emitted from another component through the bagged component. Both of these phenomena were verified by imaging with the FLIR camera. We believe that if the vacuum bagging test had been run for all the components on a barge, the sum of the emissions measured could have been greater than the total actual emissions. We did not perform vacuum bagging on all or even a majority of components on any given barge, however, and most of the vacuum bagging emission rates were lower than other direct drive dry gas meter tests on the same barge. Since the majority of the tests were done by direct drive of the dry gas meter, we believe this factor would result in biasing the calculated emissions on the low side.

Diurnal Temperature Effects

The ambient temperature was observed to have an effect on emission rates from the barges. The helicopter-based FLIR camera found few, if any, leaks during flights before 10 AM, and progressively more leaks as the ambient temperature rose in the afternoon. The barge storage compartments can be likened to atmospheric storage tanks with P/V relief valves that activate at low pressures to protect the structural integrity of the compartment. When ambient temperatures are increasing, the vapor pressure of the stored material increases and the volume of the gas above the stored material expands. This results in higher concentrations of hydrocarbon in the vapor space and gas escaping through the P/V valve or other imperfectly sealed fittings. Conversely when ambient temperature is decreasing, vapor pressure of the stock is decreasing and the gas volume contracts, which should result in negligible emissions. The P/V valve opens to allow air into the cargo compartment during decreasing temperature operation to protect the compartment from the destructive effects of vacuum, which likely explains the lower TNMHC concentrations found in the laboratory analyses. The bagging tests were performed between about 11:00 AM and 4:00 PM. These times were all during the increasing temperature portion of the day, but not at the peak temperature for the day during daylight savings time with sunset around 7:00 PM. The leak rates measured would likely underestimate the peak leak rate. It is difficult to extrapolate the short-term measured emissions to a daily average basis.

Seasonal Temperature Effects

The barge measurements reported here were performed in late September. The weather during that week of testing was unseasonably cool, with average daily temperatures ranging from 67.1 °F to 73.2 °F vs. a historical average of about 75 °F for that time period in Baton Rouge. It would be difficult to extrapolate the short-term measured emissions to an annual basis because of seasonal temperature variations, but the leak rates measured are undoubtedly well below the maximum summer emission rates for similarly sealed barges. It is the ozone exceedance times in the summer that are of primary interest to this study, however, so we can say that the measured emission rates would underestimate barge emissions during those critical ozone exceedance days.

Extrapolation to Untested Components and Barges

The 23 leaking components measured in this project represent less than half of the components on the 8 barges tested for which leaks could be detected by using the Hawk Leak Detection System from the deck of the barge. The components selected for testing were biased towards the larger leaks, but some components with large leaks were not tested because of difficulty in access / making a good seal for the bag and some components with relatively low leak rates were selected to better characterize the range of imaged leaks.

The Leak Surveys, Inc. helicopter crew flying with the Hawk Leak Detection System mounted with a Taylor mount onboard their Robinson 44 Raven II helicopter found numerous other “leaking” barges; however, time did not permit the leak measurement of all the leaking tank barges found. When the Hawk camera was used from the deck of the selected barges, many more leaking components could typically be imaged than were imaged from the air. It is likely that there were leaks on tank barges not imaged from the air that could have been imaged from the deck of the barge.

In summary, the net emission rate from the 23 components tested was about 212 pounds per hour. Since most of the recognized sources of uncertainty identified in this study would tend to bias the sample results low, it is likely that the actual emissions rate was well in excess of the 212 pounds per hour for the 23 points measured. The total emissions from the dozens of imaged leaks that were not measured, and the hundreds of barges in the Baton Rouge area that were not tested, would be difficult to estimate, but would likely contribute significant emissions beyond the tested components.

APPENDIX A

Bagging Field Data Sheets

Notes:

These are the field data recorded, and format and types of data included may vary from one test to the next.

Temperature was measured by a dial thermometer mounted in the gas flow path, and many readings exceeded the apparent ambient temperature.

Barometric pressure was measured by a dial barometer mounted to the supports for the dry gas meter.

A Thermo Environmental TVA-1000B analyzer was used to check for approach to steady-state conditions and to provide a rough idea of the concentration of the samples to act as a guide for the laboratory. The TVA proved to be of minimal use for this project, because it flamed out for almost every test. Flame out occurs when the hydrocarbon concentration in the sample is so high that oxygen is displaced to the point where the hydrogen flame in the flame ionization detector is extinguished. An attempt was made to fashion a dilution probe to prevent flame out and get on-scale TVA readings, but the dilution ratio could not be kept constant, and the vast majority of tests experienced flame out even with the dilution probe. None of the TVA data were used in calculation of emission rates.

Abbreviations used on the data sheets include:

Sec	seconds
mmHg	millimeters of mercury barometric pressure
F	° Farenheit
baro	barometric pressure
FO	flame out of the TVA
FO w Dil	flame out of the TVA when using the dilution probe
Pure HC	pure hydrocarbon, an assumption for direct flow through the dry gas meter

DGM Test		Test 1	
Barge G1		Unleaded Gasoline	
No. 2 Center Ullage Hatch			
10 liter time		9	sec
10 liter time		8.22	
20 liter time		17.97	
temp	104	F	
baro	759	mm Hg	
canister	1481		

DGM Test		No. 2	
Barge	G2		
	No. 3 starboard cargo hatch		
	Trans Mix		
10 liter time	No. 1	40.68	sec
	No. 2	40.12	sec
	No. 3		sec
Temp	96	F	97
Baro press	764	mm hg	764
TVA	FO w Dil	ppm	
Canister	1374		

Vacuum Bagging Test		No. 3	
Barge	G2		
	No. 2 starboard cargo hatch		
	Trans Mix		
10 liter time	No. 1	14.91	sec
	No. 2	16.56	sec
	No. 3	16.59	
Temp	94	F	94
Baro press	764	mm hg	764
TVA	about 400000 ppm	ppm	
		ppm	
Canister	1322		

Vacuum Bagging Test		No. 4	
Barge	G2		
	No. 2 port cargo hatch		
	Trans Mix		
100 liter time	No. 1	46.91	sec
	No. 2	48	sec
	No. 3		
Temp	99	F	96
Baro press	764	mm hg	763
TVA	FO w Dil	ppm	
		ppm	
Canister	1397		

Vacuum Bagging Test		No. 5	
Barge	G2		
	Starboard Lower Butterworth Hatch		
	Trans Mix		
10 liter time	No. 1	16.31	sec
	No. 2	15.62	sec
	No. 3		
Temp	93	F	93
Baro press	763	mm hg	763
TVA	FO w Dil	ppm	
		ppm	
Canister	1490		

DGM Test		No. 6	
Barge	G3		
	PV Bullet Valve		
	Trans Mix		
10 liter time	No. 1	23.59	sec
	No. 2	23.22	sec
	No. 3		sec
Temp	92	F	94
Baro press	762	mm hg	762
TVA	pure HC	ppm	
Canister	1502		

	No. 7	
G3		
Vent stack		
Trans Mix		
No. 1	15.91	sec
No. 2	16.9	sec
No. 3	21	sec
92	F	92
762	mm hg	762
pure HC	ppm	
1375		

DGM Test		No. 8	9/26/2008	
Barge	G4		11	AM
	No. 1 Port Cargo/Ullage Hatch			
	Naphtha but cleaned			
10 liter time	No. 1	7.38	sec	
10	No. 2	7.19	sec	
20 liter	No. 3	14.65	sec	
Temp	90	F	90	
Baro press	762	mm hg	762	
TVA	pure HC	ppm		
Canister	1470			

DGM Test		No. 9	9/26/2008	
Barge	G4		1120	AM
	No. 2 Starboard Cargo/Ullage Hatch			
	Naphtha but cleaned			
10 liter time	No. 1	9.5	sec	
10	No. 2	9.81	sec	
20 liter	No. 3	19.53	sec	
Temp	95	F	95	
Baro press	763	mm hg	763	
TVA	pure HC	ppm		
Canister	1478			

Vacuum Bag Train		No. 10	9/26/2008	
Barge	G4		1145	AM
	No. 3 Starboard Cargo/Ullage Hatch			
Liter Time	Naphtha but cleaned			
10	No. 1	5.22	sec	
10	No. 2	5.37	sec	
20	No. 3	10.06	sec	
Temp	91	F	91	
Baro press	763	mm hg	763	
TVA	FO w Dil	ppm		
Canister	1418			

DGM Direct		No. 11	9/26/2008	
Barge	G4		12	PM
	No. 2 Port Cargo Valve			
	Naphtha but cleaned			
10 liter time	No. 1	16.43	sec	
10	No. 2	16.54	sec	
20 liter	No. 3	32.66	sec	
Temp	93	F	93	
Baro press	763	mm hg	763	
TVA	pure HC	ppm		
Canister	1394			

DGM Direct		No. 12	9/26/2008	
Barge	G4		1220	PM
	No. 2 Starboard Stripping Valve			
	Naphtha but cleaned			
10 liter time	No. 1	27.72	sec	
10	No. 2	27.72	sec	
20 liter	No. 3		sec	
Temp	100	F	100	
Baro press	763	mm hg	763	
TVA	pure HC	ppm		
Canister	None			

DGM Direct		No. 13	9/26/2008	
Barge	G4		1235	PM
	No. 3 Port Cargo Valve			
	Naphtha but cleaned			
10 liter time	No. 1	10.03	sec	
10	No. 2	10.18	sec	
20 liter	No. 3		sec	
Temp	95	F	95	
Baro press	759	mm hg	759	
TVA	pure HC	ppm		
Canister	None			

DGM Direct		No. 14	9/26/2008	
Barge	G5		1335	PM
	No. 1 Port Cargo Valve			
	Raffinate			
10 liter time	No. 1	8.6	sec	
10	No. 2	9.03	sec	
20 liter	No. 3		sec	
Temp	95	F	95	
Baro press	757	mm hg	757	
TVA	pure HC	ppm		
Canister	1396			

Vacuum Bagging		No. 15	9/26/2008	
Barge	G5		1410	PM
	No. 1 Port Ullage Hatch			
	Raffinate			
10 liter time	No. 1	19.03	sec	
10	No. 2	14.87	sec	
20 liter	No. 3	33.4	sec	
Temp	96	F	96	
Baro press	752.5	mm hg	752	
TVA	FO w Dil	ppm		
Canister	1348			

Vacuum Bagging		No. 16	9/26/2008	
Barge	G5		1450	PM
	No. 3 Starboard Cargo Ullage Hatch			
	Raffinate			
10 liter time	No. 1	8.72	sec	
10	No. 2	8.09	sec	
20 liter	No. 3		sec	
Temp	98	F	98	
Baro press	749	mm hg	749	
TVA	3	ppm		
Canister	1431			

Vacuum Bagging		No. 17	9/26/2008	
Barge	G5		1530	PM
	No. 3 Starboard High Level Alarm Tester			
	8			
5 liter time	No. 1	46.65	sec	
5	No. 2	56.25	sec	
	No. 3		sec	
Temp	98	F	98	
Baro press	758	mm hg	758	
TVA		ppm		
Canister	1347			

DGM Test		No. 18	9/27/2008	
Barge	G6		1205	PM
	Vent stack		Gasoline	
Liters Timed				
10	No. 1	6.94	sec	
10	No. 2	6.75	sec	
20	No. 3	13.75	sec	
Temp	90	F	90	
Baro press	758	mm hg	758	
TVA	pure HC	ppm		
Canister	1376			

Vacuum Bag Test		No. 19	9/27/2008	
Barge	G6		1250	PM
	Forward Cofferdam		Gasoline	
Liters Timed				
20	No. 1	9.43	sec	
20	No. 2	9.65	sec	
20	No. 3		sec	
Temp	98	F	100	
Baro press	762	mm hg	762	
TVA	FO w Dil	ppm		
Canister	1482			

DGM		No. 20	9/28/2008	
Barge	G7		1140	PM
	No. 2 Starboard Cargo Hatch		Naphtha	
Liters Timed				
10	No. 1	4.38	sec	
10	No. 2	4.22	sec	
20	No. 3	8.12	sec	
Temp	99	F	100	
Baro press	751.5	mm hg	751	
TVA	Pure HC	ppm		
Canister	1462			
Comments- all hatches and PV connected in vapor space.				
Had to tighten other hatches to get this one to drive DGM.				

DGM		No. 21	9/28/2008	
Barge	G7			PM
	PV Vent		Naphtha	
Liters Timed				
10	No. 1	16.5	sec	
10	No. 2	15.97	sec	
20	No. 3	32.69	sec	
Temp	90	F	90	
Baro press	759	mm hg	760	
TVA	Pure HC	ppm		
Canister				
Comments- all hatches and PV connected in vapor space.				
Had to tighten other hatches to get this one to drive DGM.				

DGM		No. 22	9/28/2008	
Barge	G8		1450	PM
	PV Vent		Unleaded Gasoline	
Liters Timed				
50	No. 1	24.38	sec	
50	No. 2	21.47	sec	
50	No. 3	21.15	sec	
Temp	98	F	98	
Baro press	755	mm hg	754	
TVA	Pure HC	ppm		
Canister	1359			

DGM		No. 23	9/28/2008	
Barge	G8		1550	PM
	Slop Tank PV Vent		Unleaded Gasoline	
Liters Timed				
10	No. 1	43.06	sec	
10	No. 2	45.34	sec	
10	No. 3	41.91	sec	
Temp	98	F	100	
Baro press	754	mm hg	755	
TVA	Pure HC	ppm		
Canister	1491			

APPENDIX B

EPA Protocol Bagging Procedures

Extracted from EPA *Protocol for Equipment Leaks Emission Estimating, 1995:*

4.0 MASS EMISSION SAMPLING

4.1 INTRODUCTION

This chapter describes the procedures for "bagging" equipment to measure mass emissions of organic compounds. An equipment component is bagged by enclosing the component to collect leaking vapors. Measured emission rates from bagged equipment coupled with screening values can be used to develop unit-specific screening value/mass emission rate correlation equations. Unit-specific correlations can provide precise estimates of mass emissions from equipment leaks at the process unit. However, it is recommended that unit-specific correlations are only developed in cases where the existing EPA correlations do not give reasonable mass emission estimates for the process unit. The focus of the chapter is on bagging equipment containing organic compounds, but similar procedures can be applied to bag equipment containing inorganic compounds as long as there are comparable analytical techniques for measuring the concentration of the inorganic compound.

This chapter is divided into four sections. In section 4.2, the methods for bagging equipment are discussed. Considerations for bagging each equipment type are discussed in section 4.3. In section 4.4, techniques used in the laboratory analysis of bagged samples are discussed. Section 4.4 also includes a description of a rigorous calibration procedure for the portable monitoring device that must be followed. Finally, in section 4.5, quality assurance and quality control (QA/QC) guidelines are provided.

4.2 SAMPLING METHODS

The emission rate from an equipment component is measured by bagging the component--that is, isolating the component from ambient air to collect any leaking compound(s). A tent (i.e., bag) made of material impermeable to the compound(s) of interest is constructed around the leak interface of the piece of equipment. A known rate of carrier gas is induced through the bag and a sample of the gas from the bag is collected and analyzed to determine the concentration (in parts per million by volume [ppmv]) of leaking material. The concentration is measured using laboratory instrumentation and procedures. Mass emissions are calculated based on the measured concentration and the flow rate of carrier gas through the bag. In some cases, it may be necessary to collect liquid leaking from a bagged equipment piece. Liquid can either be dripping from the equipment piece prior to bagging, and/or be formed as condensate within the bag. If liquid accumulates in the bag, then the bag should be configured so that there is a low point to collect the liquid. The time in which the liquid accumulates should be recorded. The accumulated liquid should then be taken to the laboratory and transferred to a graduated cylinder to measure the volume of organic material. Based on the volume of organic material in the cylinder (with the volume of water or non-organic material subtracted out), the density of the organic material, and the time in which the liquid accumulated, the organic liquid leak rate can be calculated. Note that the density can be assumed to be equivalent to the density of organic material in the equipment piece, or, if sufficient volume is collected, can be measured using a hydrometer. It should be noted that in some cases condensate may form a light coating on the inside surface of the bag, but will not accumulate. In these cases, it can be assumed that an equilibrium between condensate in and evaporation has been reached and that the vapor emissions are equivalent to total emissions from the source. When bagging an equipment piece, the enclosure should be kept as small as practical. This has several beneficial effects:

- The time required to reach equilibrium is kept to a minimum;
- The time required to construct the enclosure is minimized;
- A more effective seal results from the reduced seal area; and
- Condensation of heavy organic compounds inside the enclosure is minimized or prevented due to reduced residence time and decreased surface area available for heat transfer.

Two methods are generally employed in sampling source enclosures: the vacuum method and the blow-through method. Both methods involve enclosing individual equipment pieces with a bag and setting up a sampling train to collect two samples of leaking vapors to be taken to the laboratory for analysis. Both methods require that a screening value be obtained from the equipment piece prior to and after the equipment piece is enclosed. The methods differ in the ways in which the carrier gas is conveyed through the bag. In the vacuum method, a vacuum pump is used to pull air through the bag. In the blow-through method, a carrier gas such as nitrogen (or other inert gas) is blown into the bag.

In general, the blow-through method has advantages over the vacuum method. These advantages are as follows.

(1) The blow-through method is more conducive to better mixing in the bag.
(2) The blow-through method minimizes ambient air in the bag and thus reduces potential error associated with background organic compound concentrations. (For this reason the blow-through method is especially preferable when measuring the leak rate from components with zero or very low screening values.)
(3) The blow-through method minimizes oxygen concentration in the bag (assuming air is not used as the carrier gas) and the risk of creating an explosive environment.
(4) In general, less equipment is required to set up the blow-through method sampling train.

However, the blow-through method does require a carrier gas source, and preferably the carrier gas should be inert and free of any organic compounds and moisture. The vacuum method does not require a special carrier gas.

Details of the sampling train of each of these bagging methods are discussed in sections 4.2.1 and 4.2.2, respectively. These sections also contain summaries of the steps of the sampling procedure for each method. For both methods, the approach described above for collecting and measuring liquid leak rates can be utilized. In addition to the sampling descriptions presented in the following sections, the quality control and assurance guidelines presented in section 4.5 must also be followed when bagging equipment.

4.2.1 Vacuum Method

The sampling train used in the vacuum method is depicted in figure 4-1. The train can be mounted on a portable cart, which can be moved around the process unit from component to component. The major equipment items in the sampling train are the vacuum pump used to draw air through the system, and the dry gas meter used to measure the flow rate of gas through the train. In previous studies that the EPA conducted, a 4.8-cubic feet per minute Teflon® ring piston-type vacuum pump equipped with a 3/4-horsepower, air-driven motor was used. Other equipment that may be used in the train includes valves, copper and stainless steel tubing, Teflon® tubing and tape, thermometer, pressure-reading device, liquid collection device, and air-driven diaphragm sampling pumps. It also may be necessary to use desiccant preceding the dry gas meter to remove any moisture.

The bag is connected by means of a bulkhead fitting and Teflon® tubing to the sampling train. A separate line is connected from the bag to a pressure-reading device to allow continuous monitoring of the pressure inside the bag. If a significant vacuum exists inside the bag when air is being pulled through, a hole is made in the opposite side of the bag from the outlet to the sampling train. This allows air to enter the bag more easily and, thus, reduces the vacuum in the enclosure. However, it is important to maintain a vacuum in the bag, since VOC could be lost through the hole if the bag became pressurized.

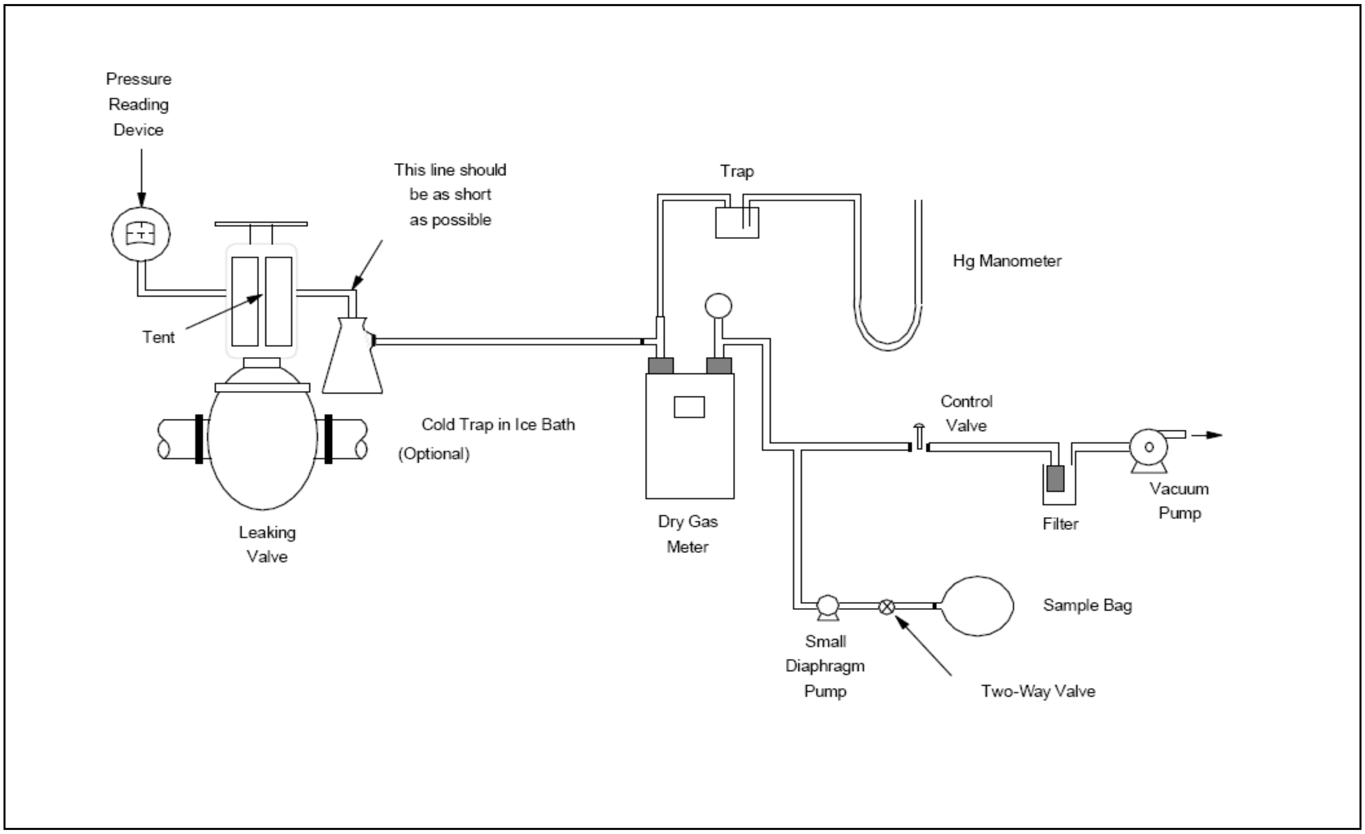

Figure 4-1. Sampling train for bagging a source using the vacuum method.

In practice, it has been found that only a very slight vacuum (0.1 inches of water) is present in the bag during most of the sampling, even in the absence of a hole through the bag wall. Sufficient air enters around the seals to prevent the development of a significant vacuum in the bag. A small diaphragm sampling pump can be used to collect two samples into sample bags or canisters, which are then transported to the laboratory for analysis.

The diaphragm pump can also be used to collect a background sample of the ambient air near the bagged component. The concentration in the background bag is subtracted from the average concentration in the sample bags when calculating the leak rate. Often this correction is insignificant (particularly for components with high leak rates or in cases where there is no detectable volatile organic compound (VOC) concentration measured by the portable monitoring device), and collection of a background bag is optional. However, in some cases collection of a background bag is important so that emission rates are not biased high.

Any liquid that accumulates in the bag should be collected using the approach described in section 4.2. Note that if there is a concern that condensation will occur in equipment downstream from the bag outlet, a cold trap can be placed as close to the bag outlet as possible to remove water or heavy organic compounds that may condense downstream. Any organic condensate that collects in the cold trap must be measured to calculate the total leak rate.

The flow rate through the system can be varied by throttling the flow with a control valve immediately upstream of the vacuum pump. Typical flow rates are approximately 60 liters per minute (l/min) or less. A good flow rate to use is one in which a balance can be found between reaching equilibrium conditions and having a high enough concentration of organic compounds in the bag outlet to accurately measure the concentration in the laboratory. As the flow rate is decreased, the concentration of organic compounds increases in the gas flowing through the sampling system. The flow rate should be adjusted to avoid any operations with an explosive mixture of organic compounds in air. It may also be possible to increase the flow rate in order to minimize liquid condensation in the bag.

The flow rate should be set to a constant rate and kept at that rate long enough for the system to reach equilibrium. To determine if equilibrium conditions have been reached, a portable monitoring device can be used to indicate if the outlet concentration has stabilized.

It is not recommended that the vacuum method be used to measure the leak rate from equipment that have low screening values (approximately 10 ppmv or less), because considerable error can be introduced due to the background organic concentration in the ambient air that is pulled through the bag.

In summary, the vacuum sampling procedure consists of the following steps.

(1) Determine the composition of material in the designated equipment component, and the operating conditions of the component.
(2) Obtain and record a screening value with the portable monitoring instrument.
(3) Cut a bag from appropriate material (see section 4.3) that will easily fit over the equipment component.

(4) Connect the bag to the sampling train.
(5) If a cold trap is used, immerse the trap in an ice bath.
(6) Note the initial reading of the dry gas meter.
(7) Start the vacuum pump and a stopwatch simultaneously. Make sure a vacuum exists within the bag.
(8) Record the temperature and pressure at the dry gas meter.
(9) Observe the VOC concentration at the vacuum pump exhaust with the monitoring instrument. Make sure concentration stays below the lower explosive limit.
(10) Record the temperature, pressure, dry gas meter reading, outlet VOC concentration and elapsed time every 2 to 5 minutes.
(11) Collect 2 gas samples from the discharge of the diaphragm sampling pump when the outlet concentration stabilizes (i.e., the system is at equilibrium).
(12) Collect a background bag (optional).
(13) Collect any liquid that accumulated in the bag as well as in the cold trap (if used) in a sealed container.
(14) Take a final set of readings and stop the vacuum pump.
(15) Transport all samples to the laboratory, along with the data sheet.
(16) Remove the bag.
(17) Rescreen the source with the portable monitoring instrument and record.

Based on the data collected in the steps described above, mass emissions are calculated using the equation presented in Table 4-1.

TABLE 4-1. CALCULATION PROCEDURES FOR LEAK RATE WHEN USING THE VACUUM METHOD

$$\underset{(\mathrm{kg/hr})}{\text{Leak Rate}} = \frac{9.63 \times 10^{-10}\,(Q)(MW)(GC)(P)}{T + 273.15} + \frac{(\rho)(V_L)}{16.67(t)}$$

where:

9.63×10^{-10} = A conversion factor using the gas constant: $\dfrac{°K \times 10^{6} \times \text{kg-mol} \times \text{min}}{\ell \times \text{hour} \times \text{mmHg}}$;

Q = Flow rate out of bag (ℓ/min);

MW^a = Molecular weight of organic compound(s) in the sample bag[c] or alternatively in the process stream contained within the equipment piece being bagged (kg/kg-mol);

GC^b = Sample bag organic compound concentration (ppmv) minus background bag organic compound concentration[c] (ppmv);

P = Absolute pressure at the dry gas meter (mmHg);

T = Temperature at the dry gas meter (°C);

ρ = Density of organic liquid collected (g/mℓ);

V_L = Volume of liquid collected (mℓ);

16.67 = A conversion factor to adjust term to units of kilograms per hour (g × hr)/(kg × min)

t = Time in which liquid is collected (min); and

---

[a] For mixtures calculate MW as:

$$= \sum_{i=1}^{n} MW_i\, X_i \;/\; \sum_{i=1}^{n} X_i$$

where:

MW_i = Molecular weight of organic compound i;
X_i = Mole fraction of organic compound i; and
n = Number of organic compounds in mixture.

[b] For mixtures, the value of GC is the total concentration of all the organic compounds in the mixture.

[c] Collection of a background bag is optional. If a background bag is not collected, assume the background concentration is zero.

4.2.2 Blow-Through Method

The sampling train for the blow-through method is presented in figure 4-2. The temperature and oxygen concentrations are measured inside the bag with a thermocouple (or thermometer) and an oxygen/combustible gas monitor. The carrier gas is metered into the bag through one or two tubes (two tubes provide for better mixing) at a steady rate throughout the sampling period. The flow rate of the carrier gas is monitored in a gas rotameter calibrated to the gas. Typical flow rates are approximately 60 /min or less. It is preferable to use an inert gas such as nitrogen for the blow-through method so as to minimize the risk of creating an explosive environment inside the bag. Also, the carrier gas should be free of any organic compounds and moisture. The pressure in the bag should never exceed 1 pound per square inch gauge (psig).

The flow rate through the bag can be varied by adjusting the carrier gas regulator. As mentioned in section 4.2.1, a good flow rate to use is one in which a balance can be found between reaching equilibrium conditions and having a high enough concentration of organic compounds in the bag outlet to accurately measure the concentration in the laboratory. Adjustments to the flow rate may also help minimize liquid condensation in the bag. Any liquid that does accumulate in the bag should be collected using the approach described in Sec.4.2.

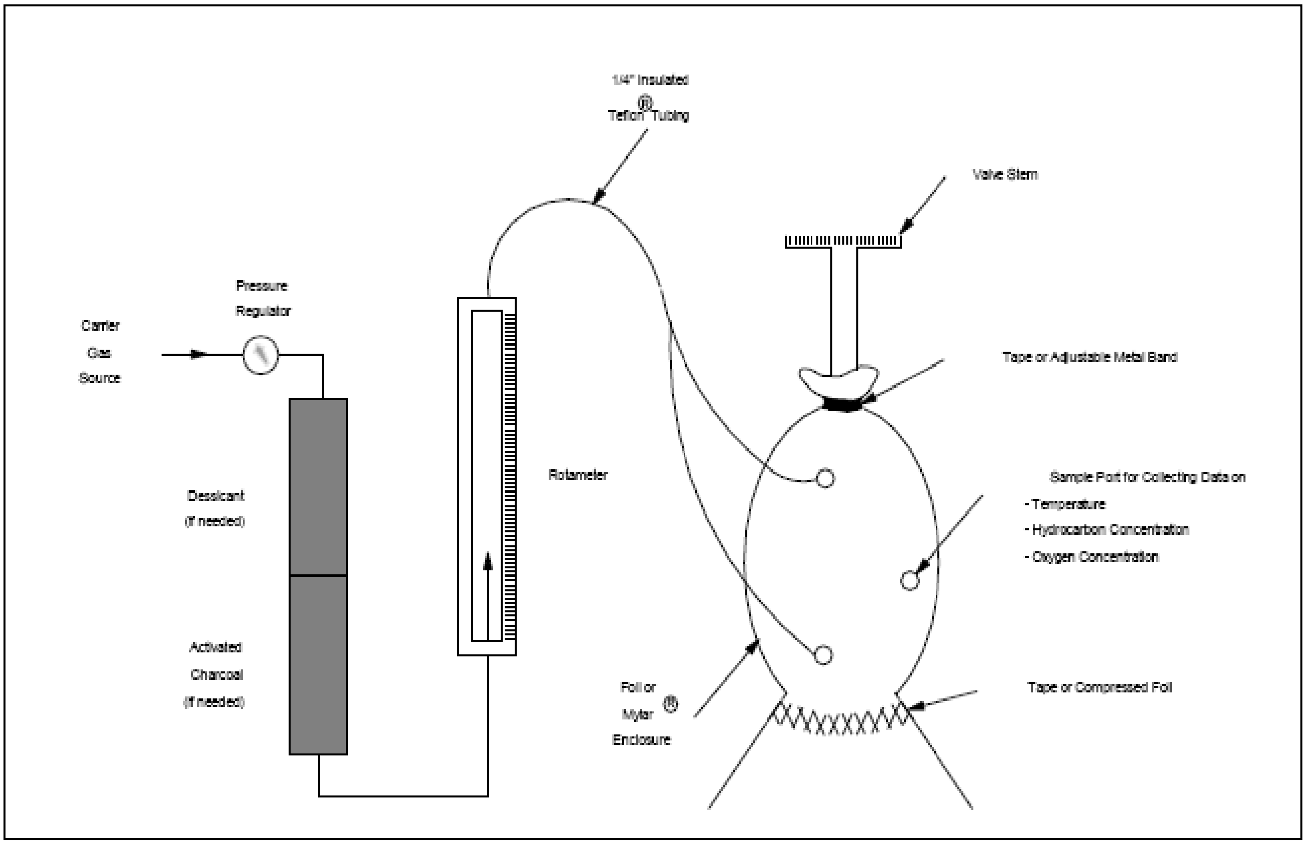

Figure 4-2. Equipment Required for the Blow-Through Sampling Technique

The carrier gas flow rate should be set to a constant rate and kept at that rate long enough for the system to reach equilibrium. In addition to the carrier gas flow through the bag, some ambient air may enter the bag if it is not airtight. The oxygen measurements are used to determine the flow of ambient air through the bag. The oxygen measurements are also an indication of the quality of the bagging procedure (the lower the oxygen concentration the better). Once oxygen concentration falls below 5 percent, the portable monitoring instrument is used to check organic compound concentrations at several locations within the bag to ensure that the bag contents are at steady state. Once the bag contents are at steady state, two gas samples are drawn out of the bag for laboratory analysis using a portable sampling pump. It may also be necessary to collect a background bag sample, particularly if the source had screened at zero and if there is still a detectable level of oxygen in the bag. However, collection of a background bag is optional. In summary, the blow-through method consists of the following steps, which assume nitrogen is used as the carrier gas.

(1) Determine the composition of the material in the designated equipment component, and the operating conditions of the component.
(2) Screen the component using the portable monitoring instrument.
(3) Cut a bag that will easily fit over the equipment component.
(4) Connect tubing from the nearest nitrogen source to a rotameter stand.
(5) Run tubing from the rotameter outlet to a "Y" that splits the nitrogen flow into two pieces of tubing and insert the tubes into openings located on either side of the bag.
(6) Turn on the nitrogen flow and regulate it at the rotameter to a constant rate and record the time.
(7) After the nitrogen is flowing, wrap aluminum foil around those parts of the component where air could enter the bag-enclosed volume.
(8) Use duct tape, wire, and/or rope to secure the bag to the component.
(9) Put a third hole in the bag roughly equidistant from the two carrier gas-fed holes.
(10) Measure the oxygen concentration in the bag by inserting the lead from an oxygen meter into the third hole. Adjust the bag (i.e., modify the seals at potential leak points) until the oxygen concentration is less than 5 percent.
(11) Measure the temperature in the bag.
(12) Check the organic compound concentration at several points in the bag with the portable monitoring instrument to ensure that carrier gas and VOC are well mixed throughout the bag.
(13) Collect samples in sample bags or canisters by drawing a sample out of the bag with a portable sampling pump.
(14) Collect a background bag (optional).
(15) Remove the bag and collect any liquid that accumulated in the bag in a sealed container. Note the time over which the liquid accumulated.
(16) Rescreen the source.

Table 4-2 gives equations used to calculate mass emission rates when using the blow-through method. An adjustment is provided for the leak rate equation in table 4-2 to account for the total flow through the bag. This adjustment is recommended and represents an improvement over previous versions.

TABLE 4-2. CALCULATION PROCEDURES FOR LEAK RATE WHEN USING THE BLOW-THROUGH METHOD

$$\underset{(\text{kg/hr})}{\text{Leak Rate}} = \left(\frac{1.219 \times 10^{-5}\ (Q)\ (MW)\ (GC)}{T + 273.15} + \frac{(\rho)\ (V_L)}{16.67\ (t)}\right) \times \left(\frac{10^{6}\text{ppmv}}{10^{6}\text{ppmv-GC}}\right)$$

where:

1.219×10^{-5} = A conversion factor taking into account the gas constant and assuming a pressure in the tent of 1 atmosphere:

$$\frac{{}^{\circ}\text{K} \times 10^{6} \times \text{kg-mol}}{\text{m}^{3}}\ ;$$

Q = flow rate out of tent (m^3/hr);

$$= \frac{N_2 \text{ Flow Rate } (\ell/\text{min})}{1 - [\text{Tent Oxygen Conc. (volume \%)}/21]} \times \frac{[0.06\ (\text{m}^3/\text{min})]}{(\ell/\text{hr})}$$

MW^a = Molecular weight of organic compounds in the sample bag or alternatively in the process stream contained within the equipment piece being bagged (kg/kg-mol);

GC^b = Sample bag organic compound concentration (ppmv), corrected for background bag organic compound concentration (ppmv);[c]

T = Temperature in tent (°C);

ρ = Density of organic liquid collected (g/mℓ);

V_L = Volume of liquid collected (mℓ);

16.67 = A conversion factor to adjust term to units of Kilograms per hour (g × hr)/(kg × min); and

t = Time in which liquid is collected (min).

---

[a] For mixtures calculate MW as:

$$= \sum_{i=1}^{n} MW_i\ X_i \ \Big/ \ \sum_{i=1}^{n} X_i$$

where:

MW_i = Molecular weight of organic compound i;

TABLE 4-2. CALCULATION PROCEDURES FOR LEAK RATE WHEN USING THE BLOW-THROUGH METHOD
(Continued)

X_i = Mole fraction of organic compound i; and
n = Number of organic compounds in mixture.

[b] For mixtures, the value of GC is the total concentration of all the organic compounds in the mixture.

[c] Collection of a background bag is optional. If a background bag is not collected, assume the background concentration is zero. To correct for background concentration, use the following equation:

$$\underset{(\text{ppmv})}{\text{GC}} = \text{SB} - \left(\frac{\text{TENT}}{21} \times \text{BG}\right)$$

where:

SB = Sample bag concentration (ppmv);
TENT = Tent oxygen concentration (volume %); and
BG = Background bag concentration (ppmv)

4.3 SOURCE ENCLOSURE

In this section, choosing a bagging material and the approach for bagging specific equipment types are discussed. An important criteria when choosing the bagging material is that it is impermeable to the specific compounds being emitted from the equipment piece. This criteria is also applicable for sample gas bags that are used to transport samples to the laboratory. A bag stability test over time similar to the Flexible Bag Procedure described in section 5.3.2 of the EPA method 18 is one way to check the suitability of a bagging material. After a bag has been used, it must be purged. Bags containing residual organic compounds that cannot be purged should be discarded. Mylar®, Tedlar®, Teflon®, aluminum foil, or aluminized Mylar® are recommended potential bagging materials. The thickness of the bagging material can range from 1.5 to 15 millimeters (mm), depending on the bagging configuration needed for the type of equipment being bagged, and the bagging material. Bag construction for individual sources is discussed in sections 4.3.1 through 4.3.5. For convenience, Mylar® will be used as an example of bagging material in the following discussions.

4.3.1 Valves

When a valve is bagged, only the leak points on the valve should be enclosed. Do not enclose surrounding flanges. The most important property of the valve that affects the type of enclosure selected for use is the metal skin temperature where the bag will be sealed. At skin temperatures of approximately 200 ∀C or less, the valve stem and/or stem support can be wrapped with 1.5- to 2.0-mm Mylar® and sealed with duct tape at each end and at the seam. The Mylar® bag must be constructed to enclose the valve stem seal and the packing gland seal. When skin temperatures are in excess of 200 ∀C, a different method of bagging the valve should be utilized. Metal bands, wires, or foil can be wrapped around all hot points that would be in contact with the Mylar® bag material. Seals are then made against the insulation using duct tape or adjustable metal bands of stainless steel. At extremely high temperatures, metal foil can be used as the bagging material and metal bands used to form seals. At points where the shape of the equipment prevent a satisfactory seal with metal bands, the foil can be crimped to make a seal.

4.3.2 Pumps and Agitators

As with valves, a property of concern when preparing to sample a pump or agitator is the metal skin temperature at areas or points that are in contact with the bag material. At skin temperatures below 200 oC, Mylar® plastic and duct tape are satisfactory materials for constructing a bag around a pump or agitator seal. If the temperature is too high or the potential points of contact are too numerous to insulate, an enclosure made of aluminum foil can be constructed. This enclosure is sealed around the pump and bearing housing using silicone fabric insulating tape, adjustable metal bands, or wire. The configuration of the bag will depend upon the type of pump. Most centrifugal pumps have a housing or support that connects the pump drive (or bearing housing) to the pump itself. The support normally encloses about one-half of the area between the pump and drive motor, leaving open areas on the sides. The pump can be bagged by cutting panels to fit these open areas. These panels can be made using thicker bagging material such as 14-mm Mylar®. In cases where supports are absent or quite narrow, a cylindrical enclosure around the seal can be made so that it extends from the pump housing to the motor or bearing support. As with the panels, this enclosure should be made with thicker bagging material to provide strength and rigidity.

Reciprocating pumps can present a somewhat more difficult bagging problem. If supports are present, the same type of two-panel Mylar® bag can be constructed as that for centrifugal pumps. In many instances, however, sufficiently large supports are not provided, or the distance between pump and driver is relatively long. In these cases, a cylindrical enclosure as discussed above can be constructed. If it is impractical to extend the enclosure all the way from the pump seal to the pump driver, a seal can be made around the reciprocating shaft. This can usually be best completed by using heavy aluminum foil and crimping it to fit closely around the shaft. The foil is attached to the Mylar® plastic of the enclosure and sealed with the duct tape.

In cases where liquid is leaking from a pump, the outlet from the bag to the sampling train should be placed at the top of the bag and as far away from spraying leaks as practical. A low point should be formed in the bag to collect the liquid so that the volume of the liquid can be measured and converted to a mass rate.

4.3.3 Compressors

In general, the same types of bags that are suitable for pumps can be directly applied to compressors. However, in some cases, compressor seals are enclosed and vented to the atmosphere at a high-point vent. If the seals are vented to a high-point vent, this vent line can be sampled. A Mylar® bag can be constructed and sealed around the outlet of the vent and connected to the sampling train. If the high-point vents are inaccessible, the vent lines from the compressor seal enclosures can be disconnected at some convenient point between the compressor and the normal vent exit. Sampling is then conducted at this intermediate point. In other cases, enclosed compressor seals are vented by means of induced draft blowers or fans. In these cases, if the air flow rate is know or can be determined, the outlet from the blower/fan can be sampled to determine the emission rate.

4.3.4 Connectors

In most cases, the physical configurations of connectors lend themselves well to the determination of leak rates. The same technique can be used for a connector whether it is a flanged or a threaded fitting. To bag a connector with a skin temperature below 200 oC, a narrow section of Mylar® film is constructed to span the distance between the two flange faces or the threaded fitting of the leaking source. The Mylar® is attached and sealed with duct tape. When testing connectors with skin temperatures above 200 oC, the outside perimeter of both sides of the connector are wrapped with heat-resistant insulating tape. Then, a narrow strip of aluminum foil can be used to span the distance between the connection. This narrow strip of foil can be sealed against the insulating tape using adjustable bands of stainless steel.

4.3.5 Relief Valves

Relief devices in gas/vapor service generally relieve to the atmosphere through a large-diameter pipe that is normally located at a high point on the process unit that it serves. The "horns" can be easily bagged by placing a Mylar® plastic bag over the opening and sealing it to the horn with duct tape. Because may of these devices are above grade level, accessibility to the sampling train may be limited or prevented. It is sometimes possible to run a long piece of tubing from the outlet connection on the bag to the sampling train located at grade level or on a stable platform.

As discussed previously in section 3.0, the purpose of pressure relief devices makes them inherently dangerous to sample, especially over a long period of time. If these equipment are to be sampled for mass emissions, special care and precautions should be taken to ensure the safety of the personnel conducting the field sampling.

4.4 ANALYTICAL TECHNIQUES

The techniques used in the laboratory analysis of the bagged samples will depend on the type of processes sampled. The following sections describe the analytical instrumentation and calibration, and analytical techniques for condensate. These are guidelines and are not meant to be a detailed protocol for the laboratory personnel. Laboratory personnel should be well-versed in the analysis of organic compound mixtures and should design their specific analyses to the samples being examined. Also discussed is the calibration protocol for the portable monitoring instrument. When bagging data are collected, it is critical that the screening value associated with mass emission rates is accurate. For this reason, a more rigorous calibration of the portable monitoring instrument is required than if only screening data are being collected.

4.4.1 Analytical Instrumentation

The use of analytical instrumentation in a laboratory is critical to accurately estimate mass emissions. The analytical instrument of choice depends on the type of sample being processed. Gas chromatographs (GC’s) equipped with a flame ionization detector or electron capture detector are commonly used to identify individual constituents of a sample. Other considerations besides instrument choice are the type of column used, and the need for temperature programming to separate individual constituents in the process stream with sufficient resolution. For some process streams, total hydrocarbon analyses may be satisfactory.

4.4.2 Calibration of Analytical Instruments

Gas chromatographs should be calibrated with either gas standards generated from calibrated permeation tubes containing individual VOC components, or bottled standards of common gases. Standards must be in the range of the concentrations to be measured. If cylinder calibration gas mixtures are used, they must be analyzed and certified by the manufacturer to be within ± 2 percent accuracy, and a shelf life must be specified. Cylinder standards beyond the shelf life must either be reanalyzed or replaced.

Field experience indicates that certified accuracies of ± 2 percent are difficult to obtain for very low-parts per million (ppm) calibration standards (< 10 ppm). Users of low-parts per million calibration standards should strive to obtain calibration standards that are as accurate as possible. The accuracy must be documented for each concentration standard. The results of all calibrations should be recorded on prepared data sheets. Table 4-3 provides an example of a data collection form for calibrating a GC. If other analytical instruments are used to detect the organic compounds from liquid samples, they should be calibrated according to standard calibration procedures for the instrument.

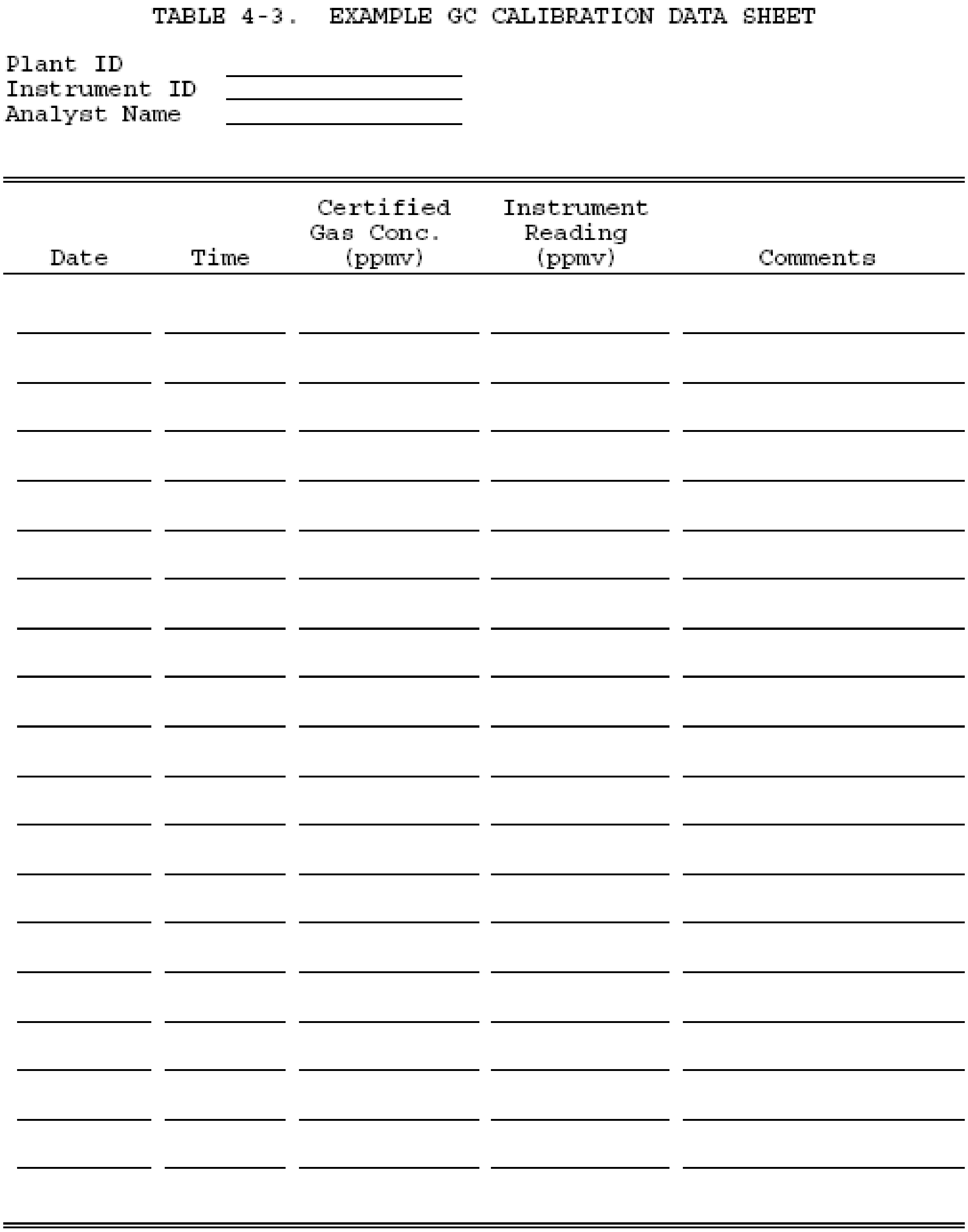

TABLE 4-3. EXAMPLE GC CALIBRATION DATA SHEET

Plant ID ____________

Instrument ID ____________

Analyst Name ____________

Date	Time	Certified Gas Conc. (ppmv)	Instrument Reading (ppmv)	Comments

4.4.3 Analytical Techniques for Condensate

Any condensate collected should be brought to the laboratory sealed in the cold trap flask. This material is transferred to a graduated cylinder to measure the volume collected. If there is enough volume to make it feasible, the organic layer should be separated from the aqueous layer (if present) and weighed to determine its density. If water-miscible organic compounds are present, both the aqueous and organic phases should be analyzed by GC to determine the total volume of organic material.

4.4.4. Calibration Procedures for the Portable Monitoring Instrument

To generate precise screening values, a rigorous calibration of the portable monitoring instrument is necessary. Calibrations must be performed at the start and end of each working day, and the instrument reading must be within 10 percent of each of the calibration gas concentrations. A minimum of five calibration gas standards must be prepared including a zero gas standard, a standard approaching the maximum readout of the screening instrument, and three standards between these values. If the monitoring instrument range is from 0 to 10,000 ppmv, the following calibration gases are required:

- A zero gas (0-0.2 ppm) organic in air standard;
- A 9.0 ppm (8-10 ppm) organic in air standard;
- A 90 ppm (80-100 ppm) organic in air standard;
- A 900 ppm (800-1,000 ppm) organic in air standard; and
- A 9,000 ppm (8,000-10,000 ppm) organic in air standard.

The same guidelines for the analysis and certification of the calibration gases as described for calibrating laboratory analytical instruments must be followed for calibrating the portable monitoring instrument.

4.5 QUALITY CONTROL AND QUALITY ASSURANCE GUIDELINES

To ensure that the data collected during the bagging program is of the highest quality, the following QC/QA procedures must be followed. Quality control requirements include procedures to be 4-21 followed when performing equipment leak mass emissions sampling. Quality assurance requirements include accuracy checks of the instrumentation used to perform mass emissions sampling. Each of these QC/QA requirements are discussed below.

4.5.1 Quality Control Procedures

A standard data collection form must be prepared and used when collecting data in the field. Tables 4-4 and 4-5 are examples of data collection forms for the blow-through and vacuum methods of mass emissions sampling, respectively. In addition to completing the data collection forms, the following guidelines need to be adhered to when performing the bagging analysis:

- Background levels near equipment that is selected for bagging must not exceed 10 ppmv, as measured with the portable monitoring device.
- Screening values for equipment that is selected for bagging must be readable within the spanned range of the monitoring instruments. If a screening value exceeds the highest reading on the meter (i.e., "pegged reading"), a dilution probe should be used, or in the event that this is not possible, the reading should be identified as pegged.
- Only one piece of equipment can be enclosed per bag; a separate bag must be constructed for each equipment component.
- A separate sample bag must be used for each equipment component that is bagged. Alternatively, bags should be purged and checked for contamination prior to reuse.
- A GC must be used to measure the concentrations from gas samples.
- Gas chromatography analyses of bagged samples must follow the analytical procedures outlined in the EPA Method 18.
- To ensure adequate mixing within the bag when using the blow-through method, the dilution gas must be directed onto the equipment leak interface.
- To ensure that steady-state conditions exist within the bag, wait at least five time constants (volume of bag dilution/gas flow rate) before withdrawing a sample for recording the analysis.
- The carrier gas used in the blow-through method of bagging should be analyzed by GC before it is used, and the concentration of organic compounds in the sample should be documented. For cylinder purge gases, one gas sample should be analyzed. For plant purge gas systems, gas samples should be analyzed with each bagged sample unless plant personnel can demonstrate that the plant gas remains stable enough over time to allow a one-time analysis.
- The portable monitoring instrument calibration procedure described in section 4.4.4 should be performed at the beginning and end of each day.

TABLE 4-5. EXAMPLE DATA COLLECTION FORM FOR FUGITIVE EMISSIONS BAGGING TEST (VACUUM METHOD)

Equipment Type ____________________ Component ID ____________

Equipment Category ________________ Plant ID ________________

Line Size __________________________ Date ____________________

Stream Phase (G/V, LL, HL) _______ Analysis Team ___________

Barometric Pressure ______________ ________________________

Ambient Temperature ______________ Instrument ID ___________

Stream Temperature _______________ Stream Pressure _________

Stream Composition (Wt %) __________________, ____________________

_____________________, ____________________, ____________________

Time Bagging Test Measurement Data

______ Initial Screening (ppmv) Equipment Piece[a] _____ Bkgd.______

______ Background Bag Organic Compound Conc. (ppmv)[b] ____________

______ Dry Gas Meter Reading (ℓ/min) ____________

______ Sample Bag 1 Organic Compound Conc. (ppmv) _______________

______ Vacuum Check in Bag (Y/N) (Must be YES to collect sample.)

______ Dry Gas Meter Temperature[c] (°C) ________

______ Dry Gas Meter Pressure[c] (mmHg) ________

______ Dry Gas Meter Reading (ℓ/min) ________

______ Sample Bag 2 Organic Compound Conc. (ppmv) _______________

______ Vacuum Check in Bag (Y/N) (Must be YES to collect sample.)

______ Dry Gas Meter Temperature[c] (°C) ________

______ Dry Gas Meter Pressure[c] (mmHg) ________

Condensate Accumulation: Starting Time ______ Final Time ______

Organic Condensate Collected (mℓ) ____________

Density of Organic Condensate (g/mℓ) ____________

______ Final Screening (ppmv) Equip. Piece[a] ________ Bkgd. ______

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[a] The vacuum method is not recommended if the screening value is approximately 10 ppmv or less.

[b] Collection of a background bag is optional.

[c] Pressure and temperature are measured at the dry gas meter.

4.5.2 Quality Assurance Procedures

Accuracy checks on the laboratory instrumentation and portable monitoring device must be performed to ensure data quality. These checks include a leak rate check performed in the laboratory, blind standards to be analyzed by the laboratory instrumentation, and drift checks on the portable monitoring device.

4.5.2.1 Leak Rate Check

A leak rate check is normally performed in the laboratory by sampling an artificially induced leak rate of a known gas. This can clarify the magnitude of any bias in the combination of sampling/test method, and defines the variance in emissions estimation due to the sampling. If the result is outside the 80 to 120 percent recovery range, the problem must be investigated and corrected before sampling continues. The problems and associated solutions should be noted in the test report.

Leak rate checks should be performed at least two times per week during the program. The leak rate checks should be conducted at two concentrations: (1) within the range of 10 multiplied by the calculated lower limit of detection for the laboratory analytical instrument; and (2) within 20 percent of the maximum concentration that has been or is expected to be detected in the field during the bagging program.

To perform a leak rate check, first induce a known flow rate with one of the known gas concentrations into a sampling bag. For example, this can be done using a gas permeation tube of a known organic compound constituent. Next, determine the concentration of the gas using a laboratory analytical instrument and compare the results to the known gas concentration. If the calculated leak rate is not within ± 20 percent of the induced leak rate, further analysis should be performed to determine the reason. Areas that can potentially induce accuracy problems include:

- Condensation,
- Pluggage,
- Seal of bag not tight (leakage),
- Adsorption onto bag, and
- Permeation of bag.

The results of all accuracy checks should be recorded on prepared data sheets.

4.5.2.2 Blind Standards Preparation and Performance

Blind standards are analyzed by the laboratory instrumentation to ensure that the instrument is properly calibrated. Blind standards must be prepared and submitted at least two times per week during the program. The blind standards are prepared by diluting or mixing known gas concentrations in a prescribed fashion so that the resulting concentrations are known. The analytical results should be within ± 25 percent of the blind standard gas concentration. If the results are not within 25 percent of the blind standard concentration, further analyses must be performed to determine the reason. Use of blind standards not only defines the analytical variance component and analytical accuracy, but it can serve to point out equipment malfunctions and/or operator error before questionable data are generated.

4.5.2.3 Drift Checks

Drift checks need to be performed to ensure that the portable monitoring instrument remains calibrated. At a minimum, drift checks must be performed before and after a small group of components (i.e., two or three) are bagged. Preferably, drift checks should be performed on the screening instrument immediately before and after each component is bagged. These checks should be performed by analyzing one of the calibration gases used to calibrate the portable monitoring instrument. The choice of calibration gas concentration should reflect the anticipated screening value of the next component to be monitored. For example, if a component had previously screened at 1,000 ppmv and been identified for bagging, the calibration standard should be approximately 900 ppmv. Drift check data must be recorded on data sheets containing the information shown in the example in table 4-6. If the observed instrument reading is different from the certified value by greater than ± 20 percent, then a full multipoint calibration must be performed (see section 3.2.4.1). Also, all those components analyzed since the last drift check must be retested. Drift checks should also be performed if flameout of the portable monitoring instrument occurs. Using the lowest calibration gas standard (i.e., approximately 9 ppmv standard), determine the associated response on the portable monitoring instrument. If the response is not within ± 10 percent of the calibration gas concentration, a full multipoint calibration is required before testing resumes.

TABLE 4-6. EXAMPLE DRIFT TEST REPORT FORM

Plant ID________________________

Instrument ID __________________

Analyst Name __________________

Date	Standard Gas Conc. (ppmv)	Time	Measured Conc. (ppmv)	% Error[a]	ID Number of Component Bagged Since Last Test

[a] $\% \text{ Error} = \frac{\text{Certified Conc.} - \text{Measured Conc.}}{\text{Certified Conc.}} * 100$

4.6 REFERENCES

1. Code of Federal Regulations, Title 40, Part 60, Appendix A. Reference Method 21, Determination of Volatile Organic Compound Leaks. Washington, DC. U.S. Government Printing Office. Revised June 22, 1990.

APPENDIX C

Laboratory Results with QC Data

Listing of Chemical Compounds Analyzed

Sorted Alpha-Numerically

Compound	Carbon #
1,2,3πTrimethylbenzene	9
1,2,4πTrimethylbenzene	9
1,3,5πTrimethylbenzene	9
1,3πbutadiene	4
1πButene	4
1πHexene	6
1πPentene	5
2,2,4πTrimethylpentane	8
2,2πDimethylbutane	6
2,3,4πTrimethylpentane	8
2,3πDimethylbutane	6
2,3πDimethylpentane	7
2,4πDimethylpentane	7
2πMethylheptane	8
2πMethylhexane	7
2πMethylpentane	6
3πMethylheptane	8
3πMethylhexane	7
3πMethylpentane	6
Acetylene	2
Benzene	6
cisπ2πButene	4
cisπ2πPentene	5
Cumene	9
Cyclohexane	6
Cyclopentane	5
Ethane	2
Ethylbenzene	8
Ethylene	2
Isobutane	4
Isopentane	5
Isoprene	5
m/p Xylene	8
mπDiethylbenzene	10
Methylcyclohexane	7
Methylcyclopentane	6
mπEthyltoluene	9

Sorted by Carbon Number

Compound	Carbon #
Acetylene	2
Ethane	2
Ethylene	2
Propane	3
Propylene	3
1,3πbutadiene	4
1πButene	4
cisπ2πButene	4
Isobutane	4
nπButane	4
transπ2πButene	4
UnπIdentified	4.5
1πPentene	5
cisπ2πPentene	5
Cyclopentane	5
Isopentane	5
Isoprene	5
nπPentane	5
transπ2πPentene	5
1πHexene	6
2,2πDimethylbutane	6
2,3πDimethylbutane	6
2πMethylpentane	6
3πMethylpentane	6
Benzene	6
Cyclohexane	6
Methylcyclopentane	6
nπHexane	6
2,3πDimethylpentane	7
2,4πDimethylpentane	7
2πMethylhexane	7
3πMethylhexane	7
Methylcyclohexane	7
nπHeptane	7
Toluene	7
2,2,4πTrimethylpentane	8
2,3,4πTrimethylpentane	8

Compound	Carbon #
n-Butane	4
n-Decane	10
n-Heptane	7
n-Hexane	6
n-Nonane	9
n-Octane	8
n-Pentane	5
n-Propylbenzene	9
n-Undecane	11
o Xylene	8
o-Ethyltoluene	9
p-Diethylbenzene	10
p-Ethyltoluene	9
Propane	3
Propylene	3
Styrene	8
Toluene	7
Total NMOC	
trans-2-Butene	4
trans-2-Pentene	5
Un-Identified	4.5

Compound	Carbon #
2-Methylheptane	8
3-Methylheptane	8
Ethylbenzene	8
m/p Xylene	8
n-Octane	8
o Xylene	8
Styrene	8
1,2,3-Trimethylbenzene	9
1,2,4-Trimethylbenzene	9
1,3,5-Trimethylbenzene	9
Cumene	9
m-Ethyltoluene	9
n-Nonane	9
n-Propylbenzene	9
o-Ethyltoluene	9
p-Ethyltoluene	9
m-Diethylbenzene	10
n-Decane	10
p-Diethylbenzene	10
n-Undecane	11
Total NMOC	

APPENDIX C

Laboratory Results with QC Data

Lab Results: EPA PAMS Analysis via GC/FID, reported in ppbC

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21640	9/24/2008	Test # 1	14:55	.02	347518.50	2047337.25
Can ID	1481					
#2 Center Ullage Hatch				Area%ppbC	0.01%	0.05%
Unleaded Gasoline				ppbC*#C	3127666.5	18426035.25
				ppbv	38613.16667	227481.9167

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21641	9/25/2008	Test #2	12:08	.02	122461.20	661556.70
Can ID	1374					
#3 Starboard Cargo Hatch				Area%ppbC	0.01%	0.03%
Trans Mix				ppbC*#C	1102150.8	5954010.3
				ppbv	13606.8	73506.3

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21695	9/26/2008	Test #14	13:40	.02	68429.97	710368.26
Can ID	1396					
No. 1 Port Cargo Valve				Area%ppbC	0.00%	0.02%
Raffinate				ppbC*#C	615869.73	6393314.34
				ppbv	7603.33	78929.80667

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21703	9/28/2008	Test 23	15:50	.02	83609.24	2234646.96
Can ID	1491					
Slop Tank PV Vent				Area%ppbC	0.00%	0.06%
Unleaded Gasoline				ppbC*#C	752483.16	20111822.64
				ppbv	9289.915556	248294.1067

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21642	9/25/2008	Test 3	12:44	.02	24738.25	614498.13
Can ID	1322					
#2 Starboard Cargo Hatch				Area%ppbC	0.00%	0.04%
Trans Mix				ppbC*#C	222644.25	5530483.17
				ppbv	2748.694444	68277.57

carbon					9	9

Lab Results: EPA PAMS Analysis via GC/

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21640	9/24/2008	Test # 1	824547.00	353562.30	12533977.80	3559798.20
Can ID	1481					
#2 Center Ullage Hatch			0.02%	0.01%	0.33%	0.09%
Unleaded Gasoline			7420923	1414249.2	50135911.2	21358789.2
			91616.33333	88390.575	3133494.45	593299.7

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21641	9/25/2008	Test #2	308815.20	496500.30	17937903.60	8783928.90
Can ID	1374					
#3 Starboard Cargo Hatch			0.01%	0.02%	0.83%	0.41%
Trans Mix			2779336.8	1986001.2	71751614.4	52703573.4
			34312.8	124125.075	4484475.9	1463988.15

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21695	9/26/2008	Test #14	459458.37	132515.18	61912.83	1154619.97
Can ID	1396					
No. 1 Port Cargo Valve			0.01%	0.00%	0.00%	0.03%
Raffinate			4135125.33	530060.72	247651.32	6927719.82
			51050.93	33128.795	15478.2075	192436.6617

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21703	9/28/2008	Test 23	1081219.49	2888319.20	73847861.23	1043215.29
Can ID	1491					
Slop Tank PV Vent			0.03%	0.08%	2.08%	0.03%
Unleaded Gasoline			9730975.41	11553276.8	295391444.9	6259291.74
			120135.4989	722079.8	18461965.31	173869.215

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21642	9/25/2008	Test 3	277068.40	310712.42	12227622.21	6875254.44
Can ID	1322					
#2 Starboard Cargo Hatch			0.02%	0.02%	0.74%	0.42%
Trans Mix			2493615.6	1242849.68	48910488.84	41251526.64
			30785.37778	77678.105	3056905.553	1145875.74

carbon			9	4	4	6

Lab Results: EPA PAMS Analysis via GC/

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpent	,2-Dimethylbutan	,4-Trimethylpent
AL21640	9/24/2008	Test # 1	32049192.15	42161117.10	1279342.95	9608346.90
Can ID	1481					
#2 Center Ullage Hatch			0.83%	1.10%	0.03%	0.25%
Unleaded Gasoline			160245960.8	337288936.8	7676057.7	76866775.2
			6409838.43	5270139.638	213223.825	1201043.363

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpent	,2-Dimethylbutan	,4-Trimethylpent
AL21641	9/25/2008	Test #2	45622121.40	6982950.60	1337755.50	1188672.30
Can ID	1374					
#3 Starboard Cargo Hatch			2.11%	0.32%	0.06%	0.05%
Trans Mix			228110607	55863604.8	8026533	9509378.4
			9124424.28	872868.825	222959.25	148584.0375

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpent	,2-Dimethylbutan	,4-Trimethylpent
AL21695	9/26/2008	Test #14	439906.95	3158640.52	162589608.72	70602.35
Can ID	1396					
No. 1 Port Cargo Valve			0.01%	0.10%	4.91%	0.00%
Raffinate			2199534.75	25269124.16	975537652.3	564818.8
			87981.39	394830.065	27098268.12	8825.29375

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpent	,2-Dimethylbutan	,4-Trimethylpent
AL21703	9/28/2008	Test 23	16714247.16	9554255.88	18169808.02	188120.79
Can ID	1491					
Slop Tank PV Vent			0.47%	0.27%	0.51%	0.01%
Unleaded Gasoline			83571235.8	76434047.04	109018848.1	1504966.32
			3342849.432	1194281.985	3028301.337	23515.09875

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpent	,2-Dimethylbutan	,4-Trimethylpent
AL21642	9/25/2008	Test 3	37064825.21	5225707.93	1097388.77	582833.17
Can ID	1322					
#2 Starboard Cargo Hatch			2.25%	0.32%	0.07%	0.04%
Trans Mix			185324126.1	41805663.44	6584332.62	4662665.36
			7412965.042	653213.4913	182898.1283	72854.14625

carbon			5	8	6	8

Lab Results: EPA PAMS Analysis via GC/

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21640	9/24/2008	Test # 1	36714142.35	9915285.60	8900790.60	3744997.50
Can ID	1481					
#2 Center Ullage Hatch			0.95%	0.26%	0.23%	0.10%
Unleaded Gasoline			220284854.1	69406999.2	62305534.2	29959980
			6119023.725	1416469.371	1271541.514	468124.6875

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21641	9/25/2008	Test #2	29181705.30	5123403.90	3375669.60	4290135.30
Can ID	1374					
#3 Starboard Cargo Hatch			1.35%	0.24%	0.16%	0.20%
Trans Mix			175090231.8	35863827.3	23629687.2	34321082.4
			4863617.55	731914.8429	482238.5143	536266.9125

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21695	9/26/2008	Test #14	131167218.21	101993241.00	28666726.48	1467442.69
Can ID	1396					
No. 1 Port Cargo Valve			3.96%	3.08%	0.87%	0.04%
Raffinate			787003309.3	713952687	200667085.4	11739541.52
			21861203.04	14570463	4095246.64	183430.3363

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21703	9/28/2008	Test 23	27382026.10	7654045.88	2645092.32	1731091.31
Can ID	1491					
Slop Tank PV Vent			0.77%	0.22%	0.07%	0.05%
Unleaded Gasoline			164292156.6	53578321.16	18515646.24	13848730.48
			4563671.017	1093435.126	377870.3314	216386.4138

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21642	9/25/2008	Test 3	3582098.60	534346.20	2516374.79	422529.31
Can ID	1322					
#2 Starboard Cargo Hatch			0.22%	0.03%	0.15%	0.03%
Trans Mix			21492591.6	3740423.4	17614623.53	3380234.48
			597016.4333	76335.17143	359482.1129	52816.16375

carbon			6	7	7	8

Lab Results: EPA PAMS Analysis via GC/

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21640	9/24/2008	Test # 1	20030232.45	5313147.75	3822919.35	19742936.10
Can ID	1481					
#2 Center Ullage Hatch			0.52%	0.14%	0.10%	0.51%
Unleaded Gasoline			140211627.2	31878886.5	30583354.8	138200552.7
			2861461.779	885524.625	477864.9188	2820419.443

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21641	9/25/2008	Test #2	16278021.90	113178108.60	2881831.50	14793845.40
Can ID	1374					
#3 Starboard Cargo Hatch			0.75%	5.23%	0.13%	0.68%
Trans Mix			113946153.3	679068651.6	23054652	103556917.8
			2325431.7	18863018.1	360228.9375	2113406.486

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21695	9/26/2008	Test #14	474665.03	536463810.05	1028621.93	110035391.76
Can ID	1396					
No. 1 Port Cargo Valve			0.01%	16.20%	0.03%	3.32%
Raffinate			3322655.21	3218782860	8228975.44	770247742.3
			67809.29	89410635.01	128577.7413	15719341.68

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21703	9/28/2008	Test 23	60806.72	100523009.21	1480263.59	7661646.72
Can ID	1491					
Slop Tank PV Vent			0.00%	2.83%	0.04%	0.22%
Unleaded Gasoline			425647.04	603138055.3	11842108.72	53631527.04
			8686.674286	16753834.87	185032.9488	1094520.96

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21642	9/25/2008	Test 3	12135595.92	5570064.37	64319.45	360188.92
Can ID	1322					
#2 Starboard Cargo Hatch			0.74%	0.34%	0.00%	0.02%
Trans Mix			84949171.44	33420386.22	514555.6	2521322.44
			1733656.56	928344.0617	8039.93125	51455.56

carbon			7	6	8	7

Lab Results: EPA PAMS Analysis via GC/

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21640	9/24/2008	Test # 1	59592083.85	0.00	36843220.65	45418509.45
Can ID	1481					
#2 Center Ullage Hatch			1.55%	0.00%	0.96%	1.18%
Unleaded Gasoline			357552503.1	0	221059323.9	181674037.8
			9932013.975	0	6140536.775	11354627.36

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21641	9/25/2008	Test #2	58376721.60	7986.60	11018845.80	17124601.50
Can ID	1374					
#3 Starboard Cargo Hatch			2.70%	0.00%	0.51%	0.79%
Trans Mix			350260329.6	15973.2	66113074.8	68498406
			9729453.6	3993.3	1836474.3	4281150.375

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21695	9/26/2008	Test #14	414326089.31	11948.09	511921347.00	118394.71
Can ID	1396					
No. 1 Port Cargo Valve			12.51%	0.00%	15.46%	0.00%
Raffinate			2485956536	23896.18	3071528082	473578.84
			69054348.22	5974.045	85320224.5	29598.6775

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21703	9/28/2008	Test 23	52899946.19	338237.38	7150490.23	55187799.03
Can ID	1491					
Slop Tank PV Vent			1.49%	0.01%	0.20%	1.55%
Unleaded Gasoline			317399677.1	676474.76	42902941.38	220751196.1
			8816657.698	169118.69	1191748.372	13796949.76

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21642	9/25/2008	Test 3	44731703.65	13853.42	8750413.79	13466513.77
Can ID	1322					
#2 Starboard Cargo Hatch			2.72%	0.00%	0.53%	0.82%
Trans Mix			268390221.9	27706.84	52502482.74	53866055.08
			7455283.942	6926.71	1458402.298	3366628.443

carbon			6	2	6	4

Lab Results: EPA PAMS Analysis via GC/

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21640	9/24/2008	Test # 1	33656627.10	429757.35	4250302.35	12358275.90
Can ID	1481					
#2 Center Ullage Hatch			0.87%	0.01%	0.11%	0.32%
Unleaded Gasoline			168283135.5	3867816.15	25501814.1	61791379.5
			6731325.42	47750.81667	708383.725	2471655.18

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21641	9/25/2008	Test #2	43131633.30	141096.60	5353684.20	16114296.60
Can ID	1374					
#3 Starboard Cargo Hatch			1.99%	0.01%	0.25%	0.74%
Trans Mix			215658166.5	1269869.4	32122105.2	80571483
			8626326.66	15677.4	892280.7	3222859.32

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21695	9/26/2008	Test #14	811383.93	219410.38	901537.70	21817212.34
Can ID	1396					
No. 1 Port Cargo Valve			0.02%	0.01%	0.03%	0.66%
Raffinate			4056919.65	1974693.42	5409226.2	109086061.7
			162276.786	24378.93111	150256.2833	4363442.468

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21703	9/28/2008	Test 23	17312813.31	319235.28	2225145.91	22067138.73
Can ID	1491					
Slop Tank PV Vent			0.49%	0.01%	0.06%	0.62%
Unleaded Gasoline			86564066.55	2873117.52	13350875.46	110335693.7
			3462562.662	35470.58667	370857.6517	4413427.746

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21642	9/25/2008	Test 3	34711722.87	110827.36	915315.25	12650151.52
Can ID	1322					
#2 Starboard Cargo Hatch			2.11%	0.01%	0.06%	0.77%
Trans Mix			173558614.4	997446.24	5491891.5	63250757.6
			6942344.574	12314.15111	152552.5417	2530030.304

carbon			5	9	6	5

Lab Results: EPA PAMS Analysis via GC/

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21640	9/24/2008	Test # 1	12150412.35	5231988.15	0.00	778192564.95
Can ID	1481					
#2 Center Ullage Hatch			0.32%	0.14%	0.00%	20.22%
Unleaded Gasoline			24300824.7	41855905.2	0	3112770260
			6075206.175	653998.5188	0	194548141.2

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21641	9/25/2008	Test #2	17296313.40	898492.50	628279.20	44818137.00
Can ID	1374					
#3 Starboard Cargo Hatch			0.80%	0.04%	0.03%	2.07%
Trans Mix			34592626.8	7187940	1256558.4	179272548
			8648156.7	112311.5625	314139.6	11204534.25

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21695	9/26/2008	Test #14	233530.85	998208.61	7603.33	6258626.78
Can ID	1396					
No. 1 Port Cargo Valve			0.01%	0.03%	0.00%	0.19%
Raffinate			467061.7	7985668.88	15206.66	25034507.12
			116765.425	124776.0763	3801.665	1564656.695

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21703	9/28/2008	Test 23	11401.26	2407566.07	0.00	481809646.76
Can ID	1491					
Slop Tank PV Vent			0.00%	0.07%	0.00%	13.56%
Unleaded Gasoline			22802.52	19260528.56	0	1927238587
			5700.63	300945.7588	0	120452411.7

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21642	9/25/2008	Test 3	11519118.73	1684180.06	432424.61	2946820.34
Can ID	1322					
#2 Starboard Cargo Hatch			0.70%	0.10%	0.03%	0.18%
Trans Mix			23038237.46	13473440.48	864849.22	11787281.36
			5759559.365	210522.5075	216212.305	736705.085

carbon			2	8	2	4

Lab Results: EPA PAMS Analysis via GC/

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21640	9/24/2008	Test # 1	730255949.40	2645025.90	15574009.20	54394.20
Can ID	1481					
#2 Center Ullage Hatch			18.98%	0.07%	0.40%	0.00%
Unleaded Gasoline			3651279747	13225129.5	124592073.6	543942
			146051189.9	529005.18	1946751.15	5439.42

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21641	9/25/2008	Test #2	664075141.20	2964359.70	4381981.20	37270.80
Can ID	1374					
#3 Starboard Cargo Hatch			30.68%	0.14%	0.20%	0.00%
Trans Mix			3320375706	14821798.5	35055849.6	372708
			132815028.2	592871.94	547747.65	3727.08

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21695	9/26/2008	Test #14	265133548.05	122739.47	4097108.68	29327.13
Can ID	1396					
No. 1 Port Cargo Valve			8.01%	0.00%	0.12%	0.00%
Raffinate			1325667740	613697.35	32776869.44	293271.3
			53026709.61	24547.894	512138.585	2932.713

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21703	9/28/2008	Test 23	613049550.62	1751993.62	8161401.95	129214.28
Can ID	1491					
Slop Tank PV Vent			17.25%	0.05%	0.23%	0.00%
Unleaded Gasoline			3065247753	8759968.1	65291215.6	1292142.8
			122609910.1	350398.724	1020175.244	12921.428

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21642	9/25/2008	Test 3	488623976.82	2478772.65	5628446.64	13853.42
Can ID	1322					
#2 Starboard Cargo Hatch			29.67%	0.15%	0.34%	0.00%
Trans Mix			2443119884	12393863.25	45027573.12	138534.2
			97724795.36	495754.53	703555.83	1385.342

carbon			5	5	8	10

Lab Results: EPA PAMS Analysis via GC/

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentar	m-Ethyltoluene	n-Butane
AL21640	9/24/2008	Test # 1	3954803.70	26352694.80	1975243.35	769015270.50
Can ID	1481					
#2 Center Ullage Hatch			0.10%	0.68%	0.05%	19.98%
Unleaded Gasoline			27683625.9	158116168.8	17777190.15	3076061082
			564971.9571	4392115.8	219471.4833	192253817.6

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentar	m-Ethyltoluene	n-Butane
AL21641	9/25/2008	Test #2	8355314.70	31391331.30	613637.10	96587278.20
Can ID	1374					
#3 Starboard Cargo Hatch			0.39%	1.45%	0.03%	4.46%
Trans Mix			58487202.9	188347987.8	5522733.9	386349112.8
			1193616.386	5231888.55	68181.9	24146819.55

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentar	m-Ethyltoluene	n-Butane
AL21695	9/26/2008	Test #14	2881662.07	28756880.25	620214.49	28285473.79
Can ID	1396					
No. 1 Port Cargo Valve			0.09%	0.87%	0.02%	0.85%
Raffinate			20171634.49	172541281.5	5581930.41	113141895.2
			411666.01	4792813.375	68912.72111	7071368.448

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentar	m-Ethyltoluene	n-Butane
AL21703	9/28/2008	Test 23	3384274.01	18236315.37	2006621.76	1122176616.34
Can ID	1491					
Slop Tank PV Vent			0.10%	0.51%	0.06%	31.57%
Unleaded Gasoline			23689918.07	109417892.2	18059595.84	4488706465
			483467.7157	3039385.895	222957.9733	280544154.1

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentar	m-Ethyltoluene	n-Butane
AL21642	9/25/2008	Test 3	672880.40	24161354.01	550178.68	67863946.46
Can ID	1322					
#2 Starboard Cargo Hatch			0.04%	1.47%	0.03%	4.12%
Trans Mix			4710162.8	144968124.1	4951608.12	271455785.8
			96125.77143	4026892.335	61130.96444	16965986.62

carbon			7	6	9	4

Lab Results: EPA PAMS Analysis via GC/

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21640	9/24/2008	Test # 1	50724.75	10327559.10	42735709.80	429757.35
Can ID	1481					
#2 Center Ullage Hatch			0.00%	0.27%	1.11%	0.01%
Unleaded Gasoline			507247.5	72292913.7	256414258.8	3867816.15
			5072.475	1475365.586	7122618.3	47750.81667

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21641	9/25/2008	Test #2	89183.70	13191201.00	38299740.30	725449.50
Can ID	1374					
#3 Starboard Cargo Hatch			0.00%	0.61%	1.77%	0.03%
Trans Mix			891837	92338407	229798441.8	6529045.5
			8918.37	1884457.286	6383290.05	80605.5

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21695	9/26/2008	Test #14	456199.80	41485940.86	410553751.44	1363168.45
Can ID	1396					
No. 1 Port Cargo Valve			0.01%	1.25%	12.40%	0.04%
Raffinate			4561998	290401586	2463322509	12268516.05
			45619.98	5926562.98	68425625.24	151463.1611

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21703	9/28/2008	Test 23	590965.31	4372383.21	37192810.33	1284541.96
Can ID	1491					
Slop Tank PV Vent			0.02%	0.12%	1.05%	0.04%
Unleaded Gasoline			5909653.1	30606682.47	223156862	11560877.64
			59096.531	624626.1729	6198801.722	142726.8844

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21642	9/25/2008	Test 3	127649.37	2713291.26	3718653.74	758969.51
Can ID	1322					
#2 Starboard Cargo Hatch			0.01%	0.16%	0.23%	0.05%
Trans Mix			1276493.7	18993038.82	22311922.44	6830725.59
			12764.937	387613.0371	619775.6233	84329.94556

carbon			10	7	6	9

Lab Results: EPA PAMS Analysis via GC/

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21640	9/24/2008	Test # 1	2751008.25	183877866.30	775549.05	0.00
Can ID	1481					
#2 Center Ullage Hatch			0.07%	4.78%	0.02%	0.00%
Unleaded Gasoline			22008066	919389331.5	6979941.45	0
			343876.0313	36775573.26	86172.11667	0

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21641	9/25/2008	Test #2	5436212.40	235455616.80	175705.20	23959.80
Can ID	1374					
#3 Starboard Cargo Hatch			0.25%	10.88%	0.01%	0.00%
Trans Mix			43489699.2	1177278084	1581346.8	263557.8
			679526.55	47091123.36	19522.8	2178.163636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21695	9/26/2008	Test #14	1861729.66	178515326.50	290012.73	40189.03
Can ID	1396					
No. 1 Port Cargo Valve			0.06%	5.39%	0.01%	0.00%
Raffinate			14893837.28	892576632.5	2610114.57	442079.33
			232716.2075	35703065.3	32223.63667	3653.548182

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21703	9/28/2008	Test 23	2251748.85	365566200.22	693576.65	146316.17
Can ID	1491					
Slop Tank PV Vent			0.06%	10.29%	0.02%	0.00%
Unleaded Gasoline			18013990.8	1827831001	6242189.85	1609477.87
			281468.6063	73113240.04	77064.07222	13301.47

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21642	9/25/2008	Test 3	326544.90	186376985.97	133586.55	18801.07
Can ID	1322					
#2 Starboard Cargo Hatch			0.02%	11.32%	0.01%	0.00%
Trans Mix			2612359.2	931884929.9	1202278.95	206811.77
			40818.1125	37275397.19	14842.95	1709.188182

carbon			8	5	9	11

Lab Results: EPA PAMS Analysis via GC/

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21640	9/24/2008	Test # 1	6072292.20	686187.15	86771.70	843973.50
Can ID	1481					
#2 Center Ullage Hatch			0.16%	0.02%	0.00%	0.02%
Unleaded Gasoline			48578337.6	6175684.35	867717	7595761.5
			759036.525	76243.01667	8677.17	93774.83333

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21641	9/25/2008	Test #2	1538751.60	200996.10	54575.10	31946.40
Can ID	1374					
#3 Starboard Cargo Hatch			0.07%	0.01%	0.00%	0.00%
Trans Mix			12310012.8	1808964.9	545751	287517.6
			192343.95	22332.9	5457.51	3549.6

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21695	9/26/2008	Test #14	1686853.07	234617.04	55395.69	107532.81
Can ID	1396					
No. 1 Port Cargo Valve			0.05%	0.01%	0.00%	0.00%
Raffinate			13494824.56	2111553.36	553956.9	967795.29
			210856.6338	26068.56	5539.569	11948.09

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21703	9/28/2008	Test 23	3418477.79	661273.08	117813.02	153917.01
Can ID	1491					
Slop Tank PV Vent			0.10%	0.02%	0.00%	0.00%
Unleaded Gasoline			27347822.32	5951457.72	1178130.2	1385253.09
			427309.7238	73474.78667	11781.302	17101.89

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21642	9/25/2008	Test 3	1904845.25	185042.11	70256.63	26717.31
Can ID	1322					
#2 Starboard Cargo Hatch			0.12%	0.01%	0.00%	0.00%
Trans Mix			15238762	1665378.99	702566.3	240455.79
			238105.6563	20560.23444	7025.663	2968.59

carbon			8	9	10	9

Lab Results: EPA PAMS Analysis via GC/

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21640	9/24/2008	Test # 1	250978508.25	2821591.20	172680.00	47240067.60
Can ID	1481					
#2 Center Ullage Hatch			6.52%	0.07%	0.00%	1.23%
Unleaded Gasoline			752935524.8	8464773.6	1381440	330680473.2
			83659502.75	940530.4	21585	6748581.086

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21641	9/25/2008	Test #2	53236013.40	11218510.80	93177.00	14712648.30
Can ID	1374					
#3 Starboard Cargo Hatch			2.46%	0.52%	0.00%	0.68%
Trans Mix			159708040.2	33655532.4	745416	102988538.1
			17745337.8	3739503.6	11647.125	2101806.9

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21695	9/26/2008	Test #14	569163.56	11948.09	197686.58	111174805.07
Can ID	1396					
No. 1 Port Cargo Valve			0.02%	0.00%	0.01%	3.36%
Raffinate			1707490.68	35844.27	1581492.64	778223635.5
			189721.1867	3982.696667	24710.8225	15882115.01

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21703	9/28/2008	Test 23	34317792.60	5848846.38	95010.50	12347564.58
Can ID	1491					
Slop Tank PV Vent			0.97%	0.16%	0.00%	0.35%
Unleaded Gasoline			102953377.8	17546539.14	760084	86432952.06
			11439264.2	1949615.46	11876.3125	1763937.797

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21642	9/25/2008	Test 3	33431271.05	6894055.51	189989.76	13097419.08
Can ID	1322					
#2 Starboard Cargo Hatch			2.03%	0.42%	0.01%	0.80%
Trans Mix			100293813.2	20682166.53	1519918.08	91681933.56
			11143757.02	2298018.503	23748.72	1871059.869

carbon			3	3	8	7

Lab Results: EPA PAMS Analysis via GC/

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21640	9/24/2008	Test # 1	3848454405.00	47302448.25	62206459.05	438194926.50
Can ID	1481					
#2 Center Ullage Hatch			100.00%	1.23%	1.62%	11.39%
Unleaded Gasoline			17584987597	189209793	311032295.3	1971877169
			878021886.7	11825612.06	12441291.81	97376650.33

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21641	9/25/2008	Test #2	2164634820.00	19509932.70	81247681.80	393531728.40
Can ID	1374					
#3 Starboard Cargo Hatch			100.00%	0.90%	3.75%	18.18%
Trans Mix			10791861304	78039730.8	406238409	1770892778
			448876329.7	4877483.175	16249536.36	87451495.2

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21695	9/26/2008	Test #14	3311032977.00	263944.17	1554337.89	192914947.33
Can ID	1396					
No. 1 Port Cargo Valve			100.00%	0.01%	0.05%	5.83%
Raffinate			19475864081	1055776.68	7771689.45	868117263
			570959543	65986.0425	310867.578	42869988.3

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21703	9/28/2008	Test 23	3554152784.00	82030165.49	41105342.72	276389344.92
Can ID	1491					
Slop Tank PV Vent			100.00%	2.31%	1.16%	7.78%
Unleaded Gasoline			16201327275	328120662	205526713.6	1243752052
			799270393.8	20507541.37	8221068.544	61419854.43

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21642	9/25/2008	Test 3	1646874779.00	14655928.83	65532613.78	505299536.38
Can ID	1322					
#2 Starboard Cargo Hatch			100.00%	0.89%	3.98%	30.68%
Trans Mix			7977154477	58623715.32	327663068.9	2273847914
			348536242.9	3663982.208	13106522.76	112288785.9

carbon				4	5	4.5

Lab Results: EPA PAMS Analysis via GC/

carbon

SAMPNO	COLDATE	LOCCODE				
AL21640	9/24/2008	Test # 1			1.77	scfm
Can ID	1481				50.46673	liters/min
#2 Center Ullage Hatch					1.812307	moles/min
Unleaded Gasoline			4.569363632	average C	119.5598	grams/min
					0.263348	lbs/min
			87.80%	by volume	15.80086	lbs/hr
					0.18961	tons/day
					69.20777	tons/year

carbon

SAMPNO	COLDATE	LOCCODE				
AL21641	9/25/2008	Test #2			0.390589	scfm
Can ID	1374				11.11206	liters/min
#3 Starboard Cargo Hatch					0.204006	moles/min
Trans Mix			4.985534375	average C	14.6471	grams/min
					0.032262	lbs/min
			44.89%	by volume	1.93574	lbs/hr
					0.023229	tons/day
					8.478539	tons/year

carbon

SAMPNO	COLDATE	LOCCODE				
AL21695	9/26/2008	Test #14			0.390589	scfm
Can ID	1396				50.62509	liters/min
No. 1 Port Cargo Valve					1.182204	moles/min
Raffinate			5.882111177	average C	99.71835	grams/min
					0.219644	lbs/min
			57.10%	by volume	13.17864	lbs/hr
					0.158144	tons/day
					57.72243	tons/year

carbon

SAMPNO	COLDATE	LOCCODE				
AL21703	9/28/2008	Test 23			0.357524	scfm
Can ID	1491				10.17139	liters/min
Slop Tank PV Vent					0.332503	moles/min
Unleaded Gasoline			4.558421728	average C	21.88462	grams/min
					0.048204	lbs/min
			79.93%	by volume	2.892241	lbs/hr
					0.034707	tons/day
					12.66801	tons/year

carbon

SAMPNO	COLDATE	LOCCODE		
AL21642	9/25/2008	Test 3		
Can ID	1322			
#2 Starboard Cargo Hatch				
Trans Mix			4.843813615	average C
			34.85%	by volume

carbon

Lab Results: EPA PAMS Analysis via GC/

carbon

SAMPNO	COLDATE	LOCCODE
AL21640	9/24/2008	Test # 1

Can ID 1481
#2 Center Ullage Hatch
Unleaded Gasoline

carbon

SAMPNO	COLDATE	LOCCODE
AL21641	9/25/2008	Test #2

Can ID 1374
#3 Starboard Cargo Hatch
Trans Mix)

carbon

SAMPNO	COLDATE	LOCCODE
AL21695	9/26/2008	Test #14

Can ID 1396
No. 1 Port Cargo Valve
Raffinate)

carbon

SAMPNO	COLDATE	LOCCODE
AL21703	9/28/2008	Test 23

Can ID 1491
Slop Tank PV Vent
Unleaded Gasoline)

carbon

SAMPNO	COLDATE	LOCCODE
AL21642	9/25/2008	Test 3

Can ID 1322
#2 Starboard Cargo Hatch
Trans Mix

carbon

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21643	9/25/2008	Test 4	13:27	.02	38475.00	1167075.00

Can ID 1397

#2 Port Cargo Hatch	Area%ppbC	0.00%	0.05%
Trans Mix	ppbC*#C	346275	10503675
	ppbv	4275	129675
carbon		9	9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21644	9/25/2008	Test 5	14:16	.02	37769.76	1200538.80

Can ID 1490

Starboard Lower Butterworth Hatch	Area%ppbC	0.00%	0.13%
Trans Mix	ppbC*#C	339927.84	10804849.2
	ppbv	4196.64	133393.2
carbon		9	9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21645	9/25/2008	Test 6	14:45	.02	119774.70	724297.95

Can ID 1502

PV Bullet Valve	Area%ppbC	0.00%	0.02%
Trans Mix	ppbC*#C	1077972.3	6518681.55
	ppbv	13308.3	80477.55
carbon		9	9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21646	9/25/2008	Test 7	15:05	.02	28623.40	1074478.40

Can ID 1375

Vent Stack (leaking Butterfly Valve)	Area%ppbC	0.00%	0.03%
Trans Mix	ppbC*#C	257610.6	9670305.6
	ppbv	3180.377778	119386.4889
carbon		9	9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21691	9/26/2008	Test 8	10:58	.02	115018.48	1508261.20

Can ID 1470

No. 1 Port Cargo/Ullage Hatch	Area%ppbC	0.03%	0.40%
Naphtha but cleaned	ppbC*#C	1035166.32	13574350.8
	ppbv	12779.83111	167584.5778
carbon		9	9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21692	9/26/2008	Test 9	11:17	.02	100853.81	1061564.33

Can ID 1478

SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21643	9/25/2008	Test 4	460417.50	419377.50	16022272.50	9461002.50
Can ID	1397					
#2 Port Cargo Hatch			0.02%	0.02%	0.71%	0.42%
Trans Mix			4143757.5	1677510	64089090	56766015
			51157.5	104844.375	4005568.125	1576833.75
carbon			9	4	4	6

SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21644	9/25/2008	Test 5	446942.16	137589.84	5953233.60	4006292.40
Can ID	1490					
Starboard Lower Butterworth Hatch			0.05%	0.02%	0.66%	0.45%
Trans Mix			4022479.44	550359.36	23812934.4	24037754.4
			49660.24	34397.46	1488308.4	667715.4
carbon			9	4	4	6

SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21645	9/25/2008	Test 6	334465.20	479098.80	15892746.75	7729987.95
Can ID	1502					
PV Bullet Valve			0.01%	0.01%	0.44%	0.21%
Trans Mix			3010186.8	1916395.2	63570987	46379927.7
			37162.8	119774.7	3973186.688	1288331.325
carbon			9	4	4	6

SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21646	9/25/2008	Test 7	468983.40	435956.40	16130386.80	7711804.50
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.01%	0.01%	0.43%	0.21%
Trans Mix			4220850.6	1743825.6	64521547.2	46270827
			52109.26667	108989.1	4032596.7	1285300.75
carbon			9	4	4	6

SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21691	9/26/2008	Test 8	972231.68	23871.76	16276.20	90061.64
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			0.26%	0.01%	0.00%	0.02%
Naphtha but cleaned			8750085.12	95487.04	65104.8	540369.84
			108025.7422	5967.94	4069.05	15010.27333
carbon			9	4	4	6

SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21692	9/26/2008	Test 9	851538.87	16635.68	39509.74	57185.15
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21643	9/25/2008	Test 4	49991850.00	7505190.00	1471027.50	869535.00
Can ID	1397					
#2 Port Cargo Hatch			2.22%	0.33%	0.07%	0.04%
Trans Mix			249959250	60041520	8826165	6956280
			9998370	938148.75	245171.25	108691.875
carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21644	9/25/2008	Test 5	19526965.92	3207731.76	3525177.60	392086.08
Can ID	1490					
Starboard Lower Butterworth Hatch			2.18%	0.36%	0.39%	0.04%
Trans Mix			97634829.6	25661854.08	21151065.6	3136688.64
			3905393.184	400966.47	587529.6	49010.76
carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21645	9/25/2008	Test 6	54767546.55	7329985.65	5786473.95	1011305.25
Can ID	1502					
PV Bullet Valve			1.51%	0.20%	0.16%	0.03%
Trans Mix			273837732.8	58639885.2	34718843.7	8090442
			10953509.31	916248.2063	964412.325	126413.1563
carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21646	9/25/2008	Test 7	56379290.80	7552174.00	5897521.30	1068973.90
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			1.50%	0.20%	0.16%	0.03%
Trans Mix			281896454	60417392	35385127.8	8551791.2
			11275858.16	944021.75	982920.2167	133621.7375
carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21691	9/26/2008	Test 8	34722.56	11935.88	827916.04	145400.72
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			0.01%	0.00%	0.22%	0.04%
Naphtha but cleaned			173612.8	95487.04	4967496.24	1163205.76
			6944.512	1491.985	137986.0067	18175.09
carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21692	9/26/2008	Test 9	21834.33	13516.49	587447.45	18715.14
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21643	9/25/2008	Test 4	4924800.00	773347.50	3575610.00	620730.00
Can ID	1397					
#2 Port Cargo Hatch			0.22%	0.03%	0.16%	0.03%
Trans Mix			29548800	5413432.5	25029270	4965840
			820800	110478.2143	510801.4286	77591.25

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21644	9/25/2008	Test 5	2017085.04	321042.96	1482013.44	1064747.52
Can ID	1490					
Starboard Lower Butterworth Hatch			0.22%	0.04%	0.17%	0.12%
Trans Mix			12102510.24	2247300.72	10374094.08	8517980.16
			336180.84	45863.28	211716.2057	133093.44

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21645	9/25/2008	Test 6	8339031.00	24714266.40	52263577.35	532206.45
Can ID	1502					
PV Bullet Valve			0.23%	0.68%	1.44%	0.01%
Trans Mix			50034186	172999864.8	365845041.5	4257651.6
			1389838.5	3530609.486	7466225.336	66525.80625

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21646	9/25/2008	Test 7	8582616.40	25686198.80	54206114.20	566963.50
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.23%	0.68%	1.44%	0.02%
Trans Mix			51495698.4	179803391.6	379442799.4	4535708
			1430436.067	3669456.971	7743730.6	70870.4375

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21691	9/26/2008	Test 8	2240690.20	2853760.40	1242416.60	638027.04
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			0.59%	0.76%	0.33%	0.17%
Naphtha but cleaned			13444141.2	19976322.8	8696916.2	5104216.32
			373448.3667	407680.0571	177488.0857	79753.38

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21692	9/26/2008	Test 9	1642773.40	2295723.84	979425.66	557295.28
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21643	9/25/2008	Test 4	17459955.00	7575727.50	96187.50	515565.00
Can ID	1397					
#2 Port Cargo Hatch			0.77%	0.34%	0.00%	0.02%
Trans Mix			122219685	45454365	769500	3608955
			2494279.286	1262621.25	12023.4375	73652.14286

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21644	9/25/2008	Test 5	7489203.84	3234710.16	583632.72	227517.84
Can ID	1490					
Starboard Lower Butterworth Hatch			0.83%	0.36%	0.07%	0.03%
Trans Mix			52424426.88	19408260.96	4669061.76	1592624.88
			1069886.263	539118.36	72954.09	32502.54857

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21645	9/25/2008	Test 6	957067.65	14720988.60	49717.80	21004640.55
Can ID	1502					
PV Bullet Valve			0.03%	0.41%	0.00%	0.58%
Trans Mix			6699473.55	88325931.6	397742.4	147032483.9
			136723.95	2453498.1	6214.725	3000662.936

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21646	9/25/2008	Test 7	982002.80	14946919.30	51742.30	21855066.80
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.03%	0.40%	0.00%	0.58%
Trans Mix			6874019.6	89681515.8	413938.4	152985467.6
			140286.1143	2491153.217	6467.7875	3122152.4

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21691	9/26/2008	Test 8	6342292.60	11287002.16	317928.44	7634622.88
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			1.68%	2.99%	0.08%	2.02%
Naphtha but cleaned			44396048.2	67722012.96	2543427.52	53442360.16
			906041.8	1881167.027	39741.055	1090660.411

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21692	9/26/2008	Test 9	5096756.46	8312641.35	276568.18	6162479.71
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21643	9/25/2008	Test 4	61999897.50	8977.50	12480007.50	18019125.00
Can ID	1397					
#2 Port Cargo Hatch			2.75%	0.00%	0.55%	0.80%
Trans Mix			371999385	17955	74880045	72076500
			10333316.25	4488.75	2080001.25	4504781.25

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21644	9/25/2008	Test 5	25586314.56	9892.08	5401974.96	6585427.44
Can ID	1490					
Starboard Lower Butterworth Hatch			2.85%	0.00%	0.60%	0.73%
Trans Mix			153517887.4	19784.16	32411849.76	26341709.76
			4264385.76	4946.04	900329.16	1646356.86

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21645	9/25/2008	Test 6	95159869.20	10169.55	15379749.45	41283853.20
Can ID	1502					
PV Bullet Valve			2.62%	0.00%	0.42%	1.14%
Trans Mix			570959215.2	20339.1	92278496.7	165135412.8
			15859978.2	5084.775	2563291.575	10320963.3

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21646	9/25/2008	Test 7	98043952.20	19816.20	15957545.50	42112727.70
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			2.61%	0.00%	0.42%	1.12%
Trans Mix			588263713.2	39632.4	95745273	168450910.8
			16340658.7	9908.1	2659590.917	10528181.93

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21691	9/26/2008	Test 8	8173907.64	10850.80	3739185.68	17361.28
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			2.16%	0.00%	0.99%	0.00%
Naphtha but cleaned			49043445.84	21701.6	22435114.08	69445.12
			1362317.94	5425.4	623197.6133	4340.32

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21692	9/26/2008	Test 9	6085539.69	9357.57	2825986.14	0.00
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21643	9/25/2008	Test 4	46625287.50	155182.50	1291477.50	17253472.50
Can ID	1397					
#2 Port Cargo Hatch			2.07%	0.01%	0.06%	0.77%
Trans Mix			233126437.5	1396642.5	7748865	86267362.5
			9325057.5	17242.5	215246.25	3450694.5
carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21644	9/25/2008	Test 5	18697829.76	111510.72	471222.72	7008089.04
Can ID	1490					
Starboard Lower Butterworth Hatch			2.08%	0.01%	0.05%	0.78%
Trans Mix			93489148.8	1003596.48	2827336.32	35040445.2
			3739565.952	12390.08	78537.12	1401617.808
carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21645	9/25/2008	Test 6	97655928.75	93785.85	613562.85	18414795.15
Can ID	1502					
PV Bullet Valve			2.69%	0.00%	0.02%	0.51%
Trans Mix			488279643.8	844072.65	3681377.1	92073975.75
			19531185.75	10420.65	102260.475	3682959.03
carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21646	9/25/2008	Test 7	101673619.50	149722.40	626412.10	19084101.50
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			2.70%	0.00%	0.02%	0.51%
Trans Mix			508368097.5	1347501.6	3758472.6	95420507.5
			20334723.9	16635.82222	104402.0167	3816820.3
carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21691	9/26/2008	Test 8	27127.00	899531.32	13326952.56	2216818.44
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			0.01%	0.24%	3.53%	0.59%
Naphtha but cleaned			135635	8095781.88	79961715.36	11084092.2
			5425.4	99947.92444	2221158.76	443363.688
carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21692	9/26/2008	Test 9	48867.31	774598.85	10489835.97	1604303.39
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21643	9/25/2008	Test 4	13175122.50	2745832.50	475807.50	3683340.00
Can ID	1397					
#2 Port Cargo Hatch			0.58%	0.12%	0.02%	0.16%
Trans Mix			26350245	21966660	951615	14733360
			6587561.25	343229.0625	237903.75	920835

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21644	9/25/2008	Test 5	4201436.16	1559351.52	136690.56	2093523.84
Can ID	1490					
Starboard Lower Butterworth Hatch			0.47%	0.17%	0.02%	0.23%
Trans Mix			8402872.32	12474812.16	273381.12	8374095.36
			2100718.08	194918.94	68345.28	523380.96

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21645	9/25/2008	Test 6	10891588.05	2148034.95	210170.70	43540363.35
Can ID	1502					
PV Bullet Valve			0.30%	0.06%	0.01%	1.20%
Trans Mix			21783176.1	17184279.6	420341.4	174161453.4
			5445794.025	268504.3688	105085.35	10885090.84

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21646	9/25/2008	Test 7	11167529.60	2408769.20	214675.50	43411789.70
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.30%	0.06%	0.01%	1.15%
Trans Mix			22335059.2	19270153.6	429351	173647158.8
			5583764.8	301096.15	107337.75	10852947.43

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21691	9/26/2008	Test 8	1911910.96	2366559.48	10850.80	4710332.28
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			0.51%	0.63%	0.00%	1.25%
Naphtha but cleaned			3823821.92	18932475.84	21701.6	18841329.12
			955955.48	295819.935	5425.4	1177583.07

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21692	9/26/2008	Test 9	1398436.85	1904785.36	9357.57	2978826.45
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21643	9/25/2008	Test 4	672115927.50	3353737.50	8921070.00	46170.00
Can ID	1397					
#2 Port Cargo Hatch			29.81%	0.15%	0.40%	0.00%
Trans Mix			3360579638	16768687.5	71368560	461700
			134423185.5	670747.5	1115133.75	4617
carbon			5	5	8	10

SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21644	9/25/2008	Test 5	255035808.00	1300358.88	5275176.48	68345.28
Can ID	1490					
Starboard Lower Butterworth Hatch			28.41%	0.14%	0.59%	0.01%
Trans Mix			1275179040	6501794.4	42201411.84	683452.8
			51007161.6	260071.776	659397.06	6834.528
carbon			5	5	8	10

SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21645	9/25/2008	Test 6	1345633726.05	2087017.65	9870113.25	39548.25
Can ID	1502					
PV Bullet Valve			37.05%	0.06%	0.27%	0.00%
Trans Mix			6728168630	10435088.25	78960906	395482.5
			269126745.2	417403.53	1233764.156	3954.825
carbon			5	5	8	10

SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21646	9/25/2008	Test 7	1388414346.70	2038866.80	8558396.60	40733.30
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			36.93%	0.05%	0.23%	0.00%
Trans Mix			6942071734	10194334	68467172.8	407333
			277682869.3	407773.36	1069799.575	4073.33
carbon			5	5	8	10

SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21691	9/26/2008	Test 8	17382981.60	0.00	13933512.28	46658.44
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			4.60%	0.00%	3.69%	0.01%
Naphtha but cleaned			86914908	0	111468098.2	466584.4
			3476596.32	0	1741689.035	4665.844
carbon			5	5	8	10

SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21692	9/26/2008	Test 9	11746869.54	0.00	11621062.21	34311.09
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21643	9/25/2008	Test 4	970852.50	33622020.00	919552.50	90344430.00
Can ID	1397					
#2 Port Cargo Hatch			0.04%	1.49%	0.04%	4.01%
Trans Mix			6795967.5	201732120	8275972.5	361377720
			138693.2143	5603670	102172.5	22586107.5

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21644	9/25/2008	Test 5	423560.88	14272472.88	825539.04	33123180.24
Can ID	1490					
Starboard Lower Butterworth Hatch			0.05%	1.59%	0.09%	3.69%
Trans Mix			2964926.16	85634837.28	7429851.36	132492721
			60508.69714	2378745.48	91726.56	8280795.06

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21645	9/25/2008	Test 6	3258775.80	428251.05	702828.90	81124760.25
Can ID	1502					
PV Bullet Valve			0.09%	0.01%	0.02%	2.23%
Trans Mix			22811430.6	2569506.3	6325460.1	324499041
			465539.4	71375.175	78092.1	20281190.06

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21646	9/25/2008	Test 7	3446917.90	452469.90	899435.30	82756854.80
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.09%	0.01%	0.02%	2.20%
Trans Mix			24128425.3	2714819.4	8094917.7	331027419.2
			492416.8429	75411.65	99937.25556	20689213.7

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21691	9/26/2008	Test 8	26318615.40	13069788.60	1574451.08	12518567.96
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			6.97%	3.46%	0.42%	3.31%
Naphtha but cleaned			184230307.8	78418731.6	14170059.72	50074271.84
			3759802.2	2178298.1	174939.0089	3129641.99

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21692	9/26/2008	Test 9	22458168.00	9954375.02	1318377.64	8186834.02
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21643	9/25/2008	Test 4	214177.50	5024835.00	5159497.50	1256850.00
Can ID	1397					
#2 Port Cargo Hatch			0.01%	0.22%	0.23%	0.06%
Trans Mix			2141775	35173845	30956985	11311650
			21417.75	717833.5714	859916.25	139650

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21644	9/25/2008	Test 5	241906.32	2201437.44	2197840.32	747301.68
Can ID	1490					
Starboard Lower Butterworth Hatch			0.03%	0.25%	0.24%	0.08%
Trans Mix			2419063.2	15410062.08	13187041.92	6725715.12
			24190.632	314491.0629	366306.72	83033.52

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21645	9/25/2008	Test 6	88136.10	1740123.00	8584230.15	690399.45
Can ID	1502					
PV Bullet Valve			0.00%	0.05%	0.24%	0.02%
Trans Mix			881361	12180861	51505380.9	6213595.05
			8813.61	248589	1430705.025	76711.05

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21646	9/25/2008	Test 7	205868.30	1820888.60	8872153.10	976498.30
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.01%	0.05%	0.24%	0.03%
Trans Mix			2058683	12746220.2	53232918.6	8788484.7
			20586.83	260126.9429	1478692.183	108499.8111

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21691	9/26/2008	Test 8	985252.64	14893808.08	17220219.60	6447545.36
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			0.26%	3.94%	4.56%	1.71%
Naphtha but cleaned			9852526.4	104256656.6	103321317.6	58027908.24
			98525.264	2127686.869	2870036.6	716393.9289

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21692	9/26/2008	Test 9	916002.13	12214748.04	12944638.50	5544880.09
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21643	9/25/2008	Test 4	484785.00	252643522.50	214177.50	47452.50
Can ID	1397					
#2 Port Cargo Hatch			0.02%	11.20%	0.01%	0.00%
Trans Mix			3878280	1263217613	1927597.5	521977.5
			60598.125	50528704.5	23797.5	4313.863636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21644	9/25/2008	Test 5	544064.40	100025115.84	207733.68	133093.44
Can ID	1490					
Starboard Lower Butterworth Hatch			0.06%	11.14%	0.02%	0.01%
Trans Mix			4352515.2	500125579.2	1869603.12	1464027.84
			68008.05	20005023.17	23081.52	12099.40364

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21645	9/25/2008	Test 6	392092.65	231529014.90	167232.60	143503.65
Can ID	1502					
PV Bullet Valve			0.01%	6.38%	0.00%	0.00%
Trans Mix			3136741.2	1157645075	1505093.4	1578540.15
			49011.58125	46305802.98	18581.4	13045.78636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21646	9/25/2008	Test 7	430451.90	238889795.50	255408.80	51742.30
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.01%	6.35%	0.01%	0.00%
Trans Mix			3443615.2	1194448978	2298679.2	569165.3
			53806.4875	47777959.1	28378.75556	4703.845455

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21691	9/26/2008	Test 8	17040096.32	18919454.88	642367.36	24956.84
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			4.51%	5.01%	0.17%	0.01%
Naphtha but cleaned			136320770.6	94597274.4	5781306.24	274525.24
			2130012.04	3783890.976	71374.15111	2268.803636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21692	9/26/2008	Test 9	14514630.80	13141147.47	533381.49	18715.14
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21643	9/25/2008	Test 4	3149820.00	283432.50	128250.00	46170.00
Can ID	1397					
#2 Port Cargo Hatch			0.14%	0.01%	0.01%	0.00%
Trans Mix			25198560	2550892.5	1282500	415530
			393727.5	31492.5	12825	5130

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21644	9/25/2008	Test 5	1935250.56	275179.68	58453.20	41366.88
Can ID	1490					
Starboard Lower Butterworth Hatch			0.22%	0.03%	0.01%	0.00%
Trans Mix			15482004.48	2476617.12	584532	372301.92
			241906.32	30575.52	5845.32	4596.32

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21645	9/25/2008	Test 6	2497189.50	204520.95	49717.80	29378.70
Can ID	1502					
PV Bullet Valve			0.07%	0.01%	0.00%	0.00%
Trans Mix			19977516	1840688.55	497178	264408.3
			312148.6875	22724.55	4971.78	3264.3

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21646	9/25/2008	Test 7	2919586.80	277426.80	28623.40	51742.30
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.08%	0.01%	0.00%	0.00%
Trans Mix			23356694.4	2496841.2	286234	465680.7
			364948.35	30825.2	2862.34	5749.144444

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21691	9/26/2008	Test 8	5184512.24	572922.24	73785.44	365671.96
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			1.37%	0.15%	0.02%	0.10%
Naphtha but cleaned			41476097.92	5156300.16	737854.4	3291047.64
			648064.03	63658.02667	7378.544	40630.21778

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21692	9/26/2008	Test 9	3939536.97	469957.96	36390.55	311919.00
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21643	9/25/2008	Test 4	40129425.00	8055382.50	336015.00	20450745.00
Can ID	1397					
#2 Port Cargo Hatch			1.78%	0.36%	0.01%	0.91%
Trans Mix			120388275	24166147.5	2688120	143155215
			13376475	2685127.5	42001.875	2921535
carbon			3	3	8	7

SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21644	9/25/2008	Test 5	14373192.24	2769782.40	122302.08	9776072.88
Can ID	1490					
Starboard Lower Butterworth Hatch			1.60%	0.31%	0.01%	1.09%
Trans Mix			43119576.72	8309347.2	978416.64	68432510.16
			4791064.08	923260.8	15287.76	1396581.84
carbon			3	3	8	7

SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21645	9/25/2008	Test 6	18069030.45	7145803.80	124294.50	20091640.95
Can ID	1502					
PV Bullet Valve			0.50%	0.20%	0.00%	0.55%
Trans Mix			54207091.35	21437411.4	994356	140641486.7
			6023010.15	2381934.6	15536.8125	2870234.421
carbon			3	3	8	7

SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21646	9/25/2008	Test 7	18422460.60	7186675.20	168437.70	21375074.40
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			0.49%	0.19%	0.00%	0.57%
Trans Mix			55267381.8	21560025.6	1347501.6	149625520.8
			6140820.2	2395558.4	21054.7125	3053582.057
carbon			3	3	8	7

SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21691	9/26/2008	Test 8	7591219.68	24956.84	308162.72	10296324.12
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			2.01%	0.01%	0.08%	2.73%
Naphtha but cleaned			22773659.04	74870.52	2465301.76	72074268.84
			2530406.56	8318.946667	38520.34	1470903.446
carbon			3	3	8	7

SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21692	9/26/2008	Test 9	4753645.56	18715.14	260972.23	8232582.14
Can ID	1478					

SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21643	9/25/2008	Test 4	2254763250.00	19552995.00	88144942.50	698285340.00
Can ID	1397					
#2 Port Cargo Hatch			100.00%	0.87%	3.91%	30.97%
Trans Mix			10969390508	78211980	440724712.5	3142284030
			474705970.1	4888248.75	17628988.5	155174520

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21644	9/25/2008	Test 5	897751224.00	7103412.72	35318322.72	282637409.04
Can ID	1490					
Starboard Lower Butterworth Hatch			100.00%	0.79%	3.93%	31.48%
Trans Mix			4411936475	28413650.88	176591613.6	1271868341
			187395802.1	1775853.18	7063664.544	62808313.12

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21645	9/25/2008	Test 6	3631546305.00	54914440.05	242296308.45	1057485176.55
Can ID	1502					
PV Bullet Valve			100.00%	1.51%	6.67%	29.12%
Trans Mix			17798670138	219657760.2	1211481542	4758683294
			753951469.3	13728610.01	48459261.69	234996705.9

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21646	9/25/2008	Test 7	3759463410.00	56204247.70	252398939.40	1103822889.50
Can ID	1375					
Vent Stack (leaking Butterfly Valve)			100.00%	1.50%	6.71%	29.36%
Trans Mix			18428357571	224816990.8	1261994697	4967203003
			780363080.6	14051061.93	50479787.88	245293975.4

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21691	9/26/2008	Test 8	377716348.00	29297.16	35807.64	118501586.80
Can ID	1470					
No. 1 Port Cargo/Ullage Hatch			100.00%	0.01%	0.01%	31.37%
Naphtha but cleaned			2178030085	117188.64	179038.2	533257140.6
			70055849.14	7324.29	7161.528	26333685.96

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21692	9/26/2008	Test 9	299130321.00	32231.63	20794.60	99683074.02
Can ID	1478					

SAMPNO	COLDATE	LOCCODE
AL21643	9/25/2008	Test 4

Can ID 1397

#2 Port Cargo Hatch

Trans Mix

4.864985496 average C

47.47% by volume

carbon

SAMPNO	COLDATE	LOCCODE
AL21644	9/25/2008	Test 5

Can ID 1490

Starboard Lower Butterworth Hatch

Trans Mix

4.914431033 average C

18.74% by volume

carbon

SAMPNO	COLDATE	LOCCODE
AL21645	9/25/2008	Test 6

Can ID 1502

PV Bullet Valve

Trans Mix

4.901127135 average C

75.40% by volume

0.68	scfm
19.25197	liters/min
0.593663	moles/min
41.92194	grams/min
0.092339	lbs/min
5.540345	lbs/hr
0.066484	tons/day
24.26671	tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21646	9/25/2008	Test 7

Can ID 1375

Vent Stack (leaking Butterfly Valve)

Trans Mix

4.901858473 average C

78.04% by volume

0.97	scfm
27.53988	liters/min
0.878982	moles/min
62.07898	grams/min
0.136738	lbs/min
8.204271	lbs/hr
0.098451	tons/day
35.93471	tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21691	9/26/2008	Test 8

Can ID 1470

No. 1 Port Cargo/Ullage Hatch

Naphtha but cleaned

5.766311405 average C

7.01% by volume

2.18	scfm
62.07941	liters/min
0.177874	moles/min
14.71525	grams/min
0.032412	lbs/min
1.944746	lbs/hr
0.023337	tons/day
8.517989	tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21692	9/26/2008	Test 9

Can ID 1478

1.630694	scfm
46.39243	liters/min

SAMPNO	COLDATE	LOCCODE
AL21643	9/25/2008	Test 4

Can ID 1397
#2 Port Cargo Hatch
Trans Mix

carbon

SAMPNO	COLDATE	LOCCODE
AL21644	9/25/2008	Test 5

Can ID 1490
Starboard Lower Butterworth Hatch
Trans Mix

carbon

SAMPNO	COLDATE	LOCCODE
AL21645	9/25/2008	Test 6

Can ID 1502
PV Bullet Valve
Trans Mix)

carbon

SAMPNO	COLDATE	LOCCODE
AL21646	9/25/2008	Test 7

Can ID 1375
Vent Stack (leaking Butterfly Valve)
Trans Mix)

carbon

SAMPNO	COLDATE	LOCCODE
AL21691	9/26/2008	Test 8

Can ID 1470
No. 1 Port Cargo/Ullage Hatch
Naphtha but cleaned)

carbon

SAMPNO	COLDATE	LOCCODE
AL21692	9/26/2008	Test 9

Can ID 1478

#2 Starboard Cargo & Ullage Hatch	Area%ppbC	0.03%	0.35%
Naphtha but cleaned	ppbC*#C	907684.29	9554078.97
	ppbv	11205.97889	117951.5922

carbon 9 9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21693	9/26/2008	Test 10	11:45	.02	161702.80	1243956.54

Can ID 1418

No. 3 Starboard Cargo/Ullage Hatch	Area%ppbC	0.08%	0.60%
Naphtha but cleaned	ppbC*#C	1455325.2	11195608.86
	ppbv	17966.97778	138217.3933

carbon 9 9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21694	9/26/2008	Test 11	12:04	.02	214344.35	932550.30

Can ID 1394

No. 2 Port Cargo Valve	Area%ppbC	0.06%	0.27%
Naphtha but cleaned	ppbC*#C	1929099.15	8392952.7
	ppbv	23816.03889	103616.7

carbon 9 9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21696	9/26/2008	Test 15	14:10	.02	55547.36	770088.40

Can ID 1348

No. 1 Port Ullage Hatch	Area%ppbC	0.00%	0.04%
Raffinate	ppbC*#C	499926.24	6930795.6
	ppbv	6171.928889	85565.37778

carbon 9 9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21697	9/26/2008	Test 16	14:50	.02	122804.64	942639.32

Can ID 1431

No. 3 Starboard Cargo Ullage Hatch	Area%ppbC	0.01%	0.04%
Raffinate	ppbC*#C	1105241.76	8483753.88
	ppbv	13644.96	104737.7022

carbon 9 9

SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21698	9/26/2008	Test 17	15:30	.02	51880.80	333334.14

Can ID 1347

No. 3 Starboard High Level Alarm Tester	Area%ppbC	0.00%	0.03%
Raffinate	ppbC*#C	466927.2	3000007.26

#2 Starboard Cargo & Ullage Hatch			0.28%	0.01%	0.01%	0.02%
Naphtha but cleaned			7663849.83	66542.72	158038.96	343110.9
			94615.43	4158.92	9877.435	9530.858333

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21693	9/26/2008	Test 10	847784.68	12705.22	20790.36	64681.12
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			0.41%	0.01%	0.01%	0.03%
Naphtha but cleaned			7630062.12	50820.88	83161.44	388086.72
			94198.29778	3176.305	5197.59	10780.18667

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21694	9/26/2008	Test 11	1199718.85	18285.30	18285.30	80252.15
Can ID	1394					
No. 2 Port Cargo Valve			0.34%	0.01%	0.01%	0.02%
Naphtha but cleaned			10797469.65	73141.2	73141.2	481512.9
			133302.0944	4571.325	4571.325	13375.35833

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21696	9/26/2008	Test 15	398931.04	0.00	106044.96	3479284.64
Can ID	1348					
No. 1 Port Ullage Hatch			0.02%	0.00%	0.01%	0.17%
Raffinate			3590379.36	0	424179.84	20875707.84
			44325.67111	0	26511.24	579880.7733

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21697	9/26/2008	Test 16	544661.32	36386.56	86418.08	2508398.48
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.03%	0.00%	0.00%	0.12%
Raffinate			4901951.88	145546.24	345672.32	15050390.88
			60517.92444	9096.64	21604.52	418066.4133

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21698	9/26/2008	Test 17	185473.86	40207.62	16861.26	1586255.46
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.02%	0.00%	0.00%	0.13%
Raffinate			1669264.74	160830.48	67445.04	9517532.76

#2 Starboard Cargo & Ullage Hatch			0.01%	0.00%	0.20%	0.01%
Naphtha but cleaned			109171.65	108131.92	3524684.7	149721.12
			4366.866	1689.56125	97907.90833	2339.3925

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21693	9/26/2008	Test 10	12705.22	8085.14	448147.76	57751.00
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			0.01%	0.00%	0.22%	0.03%
Naphtha but cleaned			63526.1	64681.12	2688886.56	462008
			2541.044	1010.6425	74691.29333	7218.875

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21694	9/26/2008	Test 11	33523.05	5388068.40	758839.95	161520.15
Can ID	1394					
No. 2 Port Cargo Valve			0.01%	1.55%	0.22%	0.05%
Naphtha but cleaned			167615.25	43104547.2	4553039.7	1292161.2
			6704.61	673508.55	126473.325	20190.01875

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21696	9/26/2008	Test 15	326971.96	1689144.72	94781470.32	70696.64
Can ID	1348					
No. 1 Port Ullage Hatch			0.02%	0.08%	4.59%	0.00%
Raffinate			1634859.8	13513157.76	568688821.9	565573.12
			65394.392	211143.09	15796911.72	8837.08

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21697	9/26/2008	Test 16	359317.28	1487300.64	104407822.68	54579.84
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.02%	0.07%	4.83%	0.00%
Raffinate			1796586.4	11898405.12	626446936.1	436638.72
			71863.456	185912.58	17401303.78	6822.48

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21698	9/26/2008	Test 17	184176.84	811934.52	53080543.50	45395.70
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.02%	0.07%	4.46%	0.00%
Raffinate			920884.2	6495476.16	318483261	363165.6

#2 Starboard Cargo & Ullage Hatch			0.55%	0.77%	0.33%	0.19%
Naphtha but cleaned			9856640.4	16070066.88	6855979.62	4458362.24
			273795.5667	327960.5486	139917.9514	69661.91

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21693	9/26/2008	Test 10	1268211.96	1571982.22	716112.40	281824.88
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			0.62%	0.76%	0.35%	0.14%
Naphtha but cleaned			7609271.76	11003875.54	5012786.8	2254599.04
			211368.66	224568.8886	102301.7714	35228.11

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21694	9/26/2008	Test 11	2086555.90	1786880.15	1176354.30	614589.25
Can ID	1394					
No. 2 Port Cargo Valve			0.60%	0.51%	0.34%	0.18%
Naphtha but cleaned			12519335.4	12508161.05	8234480.1	4916714
			347759.3167	255268.5929	168050.6143	76823.65625

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21696	9/26/2008	Test 15	351900100.24	23076140.76	16274114.04	207040.16
Can ID	1348					
No. 1 Port Ullage Hatch			17.04%	1.12%	0.79%	0.01%
Raffinate			2111400601	161532985.3	113918798.3	1656321.28
			58650016.71	3296591.537	2324873.434	25880.02

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21697	9/26/2008	Test 16	359589042.12	22773438.24	16452410.52	300189.12
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			16.64%	1.05%	0.76%	0.01%
Raffinate			2157534253	159414067.7	115166873.6	2401512.96
			59931507.02	3253348.32	2350344.36	37523.64

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21698	9/26/2008	Test 17	203716446.30	12743221.50	9133614.84	123216.90
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			17.12%	1.07%	0.77%	0.01%
Raffinate			1222298678	89202550.5	63935303.88	985735.2

#2 Starboard Cargo & Ullage Hatch			1.70%	2.78%	0.09%	2.06%
Naphtha but cleaned			35677295.22	49875848.1	2212545.44	43137357.97
			728108.0657	1385440.225	34571.0225	880354.2443

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21693	9/26/2008	Test 10	3451199.76	6520087.90	136292.36	4121111.36
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			1.68%	3.17%	0.07%	2.00%
Naphtha but cleaned			24158398.32	39120527.4	1090338.88	28847779.52
			493028.5371	1086681.317	17036.545	588730.1943

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21694	9/26/2008	Test 11	5931548.15	10531316.95	311865.95	7174948.55
Can ID	1394					
No. 2 Port Cargo Valve			1.70%	3.02%	0.09%	2.06%
Naphtha but cleaned			41520837.05	63187901.7	2494927.6	50224639.85
			847364.0214	1755219.492	38983.24375	1024992.65

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21696	9/26/2008	Test 15	55004510.80	2570327.84	162854.76	59218535.52
Can ID	1348					
No. 1 Port Ullage Hatch			2.66%	0.12%	0.01%	2.87%
Raffinate			385031575.6	15421967.04	1302838.08	414529748.6
			7857787.257	428387.9733	20356.845	8459790.789

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21697	9/26/2008	Test 16	54693548.00	2574349.12	175110.32	58742689.88
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			2.53%	0.12%	0.01%	2.72%
Raffinate			382854836	15446094.72	1400882.56	411198829.2
			7813364	429058.1867	21888.79	8391812.84

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21698	9/26/2008	Test 17	29996181.54	1575879.30	85603.32	32380104.30
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			2.52%	0.13%	0.01%	2.72%
Raffinate			209973270.8	9455275.8	684826.56	226660730.1

#2 Starboard Cargo & Ullage Hatch			2.03%	0.00%	0.94%	0.00%
Naphtha but cleaned			36513238.14	18715.14	16955916.84	0
			1014256.615	4678.785	470997.69	0

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21693	9/26/2008	Test 10	4756372.36	8085.14	2128701.86	13860.24
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			2.31%	0.00%	1.03%	0.01%
Naphtha but cleaned			28538234.16	16170.28	12772211.16	55440.96
			792728.7267	4042.57	354783.6433	3465.06

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21694	9/26/2008	Test 11	7688968.65	13206.05	3098342.50	17269.45
Can ID	1394					
No. 2 Port Cargo Valve			2.21%	0.00%	0.89%	0.00%
Naphtha but cleaned			46133811.9	26412.1	18590055	69077.8
			1281494.775	6603.025	516390.4167	4317.3625

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21696	9/26/2008	Test 15	265914049.40	0.00	307376366.32	79533.72
Can ID	1348					
No. 1 Port Ullage Hatch			12.88%	0.00%	14.89%	0.00%
Raffinate			1595484296	0	1844258198	318134.88
			44319008.23	0	51229394.39	19883.43

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21697	9/26/2008	Test 16	272196484.56	0.00	326294202.64	95514.72
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			12.60%	0.00%	15.10%	0.00%
Raffinate			1633178907	0	1957765216	382058.88
			45366080.76	0	54382367.11	23878.68

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21698	9/26/2008	Test 17	153858997.50	11673.18	182281893.78	44098.68
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			12.93%	0.00%	15.32%	0.00%
Raffinate			923153985	23346.36	1093691363	176394.72

#2 Starboard Cargo & Ullage Hatch			0.02%	0.26%	3.51%	0.54%
Naphtha but cleaned			244336.55	6971389.65	62939015.82	8021516.95
			9773.462	86066.53889	1748305.995	320860.678

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21693	9/26/2008	Test 10	18480.32	616780.68	7702828.38	1258971.80
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			0.01%	0.30%	3.74%	0.61%
Naphtha but cleaned			92401.6	5551026.12	46216970.28	6294859
			3696.064	68531.18667	1283804.73	251794.36

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21694	9/26/2008	Test 11	23364.55	900043.10	20317.00	2052017.00
Can ID	1394					
No. 2 Port Cargo Valve			0.01%	0.26%	0.01%	0.59%
Naphtha but cleaned			116822.75	8100387.9	121902	10260085
			4672.91	100004.7889	3386.166667	410403.4

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21696	9/26/2008	Test 15	565573.12	145180.60	1881035.60	86065584.56
Can ID	1348					
No. 1 Port Ullage Hatch			0.03%	0.01%	0.09%	4.17%
Raffinate			2827865.6	1306625.4	11286213.6	430327922.8
			113114.624	16131.17778	313505.9333	17213116.91

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21697	9/26/2008	Test 16	662917.64	131901.28	1524824.28	91182445.20
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.03%	0.01%	0.07%	4.22%
Raffinate			3314588.2	1187111.52	9148945.68	455912226
			132583.528	14655.69778	254137.38	18236489.04

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21698	9/26/2008	Test 17	319066.92	79118.22	918290.16	48793892.40
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.03%	0.01%	0.08%	4.10%
Raffinate			1595334.6	712063.98	5509740.96	243969462

#2 Starboard Cargo & Ullage Hatch			0.47%	0.64%	0.00%	1.00%
Naphtha but cleaned			2796873.7	15238282.88	18715.14	11915305.8
			699218.425	238098.17	4678.785	744706.6125

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21693	9/26/2008	Test 10	989852.14	1204685.86	8085.14	2134476.96
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			0.48%	0.59%	0.00%	1.04%
Naphtha but cleaned			1979704.28	9637486.88	16170.28	8537907.84
			494926.07	150585.7325	4042.57	533619.24

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21694	9/26/2008	Test 11	1684279.30	1667009.85	15237.75	3850071.50
Can ID	1394					
No. 2 Port Cargo Valve			0.48%	0.48%	0.00%	1.11%
Naphtha but cleaned			3368558.6	13336078.8	30475.5	15400286
			842139.65	208376.2313	7618.875	962517.875

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21696	9/26/2008	Test 15	284049.00	709491.28	12624.40	3298755.72
Can ID	1348					
No. 1 Port Ullage Hatch			0.01%	0.03%	0.00%	0.16%
Raffinate			568098	5675930.24	25248.8	13195022.88
			142024.5	88686.41	6312.2	824688.93

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21697	9/26/2008	Test 16	261528.40	606063.64	12507.88	3879716.96
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.01%	0.03%	0.00%	0.18%
Raffinate			523056.8	4848509.12	25015.76	15518867.84
			130764.2	75757.955	6253.94	969929.24

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21698	9/26/2008	Test 17	264592.08	415046.40	9079.14	1863817.74
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.02%	0.03%	0.00%	0.16%
Raffinate			529184.16	3320371.2	18158.28	7455270.96

#2 Starboard Cargo & Ullage Hatch			3.93%	0.00%	3.88%	0.01%
Naphtha but cleaned			58734347.7	0	92968497.68	343110.9
			2349373.908	0	1452632.776	3431.109

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21693	9/26/2008	Test 10	8956025.08	0.00	7649697.46	63526.10
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			4.35%	0.00%	3.72%	0.03%
Naphtha but cleaned			44780125.4	0	61197579.68	635261
			1791205.016	0	956212.1825	6352.61

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21694	9/26/2008	Test 11	14954327.85	60951.00	7302945.65	50792.50
Can ID	1394					
No. 2 Port Cargo Valve			4.29%	0.02%	2.10%	0.01%
Naphtha but cleaned			74771639.25	304755	58423565.2	507925
			2990865.57	12190.2	912868.2063	5079.25

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21696	9/26/2008	Test 15	175974036.48	326971.96	1892397.56	39135.64
Can ID	1348					
No. 1 Port Ullage Hatch			8.52%	0.02%	0.09%	0.00%
Raffinate			879870182.4	1634859.8	15139180.48	391356.4
			35194807.3	65394.392	236549.695	3913.564

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21697	9/26/2008	Test 16	196534044.28	138723.76	2259377.96	37523.64
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			9.09%	0.01%	0.10%	0.00%
Raffinate			982670221.4	693618.8	18075023.68	375236.4
			39306808.86	27744.752	282422.245	3752.364

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21698	9/26/2008	Test 17	101521646.46	267186.12	1370950.14	18158.28
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			8.53%	0.02%	0.12%	0.00%
Raffinate			507608232.3	1335930.6	10967601.12	181582.8

#2 Starboard Cargo & Ullage Hatch			7.51%	3.33%	0.44%	2.74%
Naphtha but cleaned			157207176	59726250.12	11865398.76	32747336.08
			3208309.714	1659062.503	146486.4044	2046708.505

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21693	9/26/2008	Test 10	14217141.18	7654317.54	1268211.96	5981848.58
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			6.91%	3.72%	0.62%	2.91%
Naphtha but cleaned			99519988.26	45925905.24	11413907.64	23927394.32
			2031020.169	1275719.59	140912.44	1495462.145

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21694	9/26/2008	Test 11	25051876.85	12294832.55	1457744.75	10444969.70
Can ID	1394					
No. 2 Port Cargo Valve			7.19%	3.53%	0.42%	3.00%
Naphtha but cleaned			175363138	73768995.3	13119702.75	41779878.8
			3578839.55	2049138.758	161971.6389	2611242.425

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21696	9/26/2008	Test 15	1262440.00	17339613.40	525175.04	17879937.72
Can ID	1348					
No. 1 Port Ullage Hatch			0.06%	0.84%	0.03%	0.87%
Raffinate			8837080	104037680.4	4726575.36	71519750.88
			180348.5714	2889935.567	58352.78222	4469984.43

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21697	9/26/2008	Test 16	928994.36	17605409.64	619708.60	20627768.28
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.04%	0.81%	0.03%	0.95%
Raffinate			6502960.52	105632457.8	5577377.4	82511073.12
			132713.48	2934234.94	68856.51111	5156942.07

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21698	9/26/2008	Test 17	670559.34	10055796.06	246433.80	10214032.50
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.06%	0.85%	0.02%	0.86%
Raffinate			4693915.38	60334776.36	2217904.2	40856130

#2 Starboard Cargo & Ullage Hatch			0.31%	4.08%	4.33%	1.85%
Naphtha but cleaned			9160021.3	85503236.28	77667831	49903920.81
			91600.213	1744964.006	2157439.75	616097.7878

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21693	9/26/2008	Test 10	1209305.94	7600031.60	10001318.18	4257403.72
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			0.59%	3.69%	4.86%	2.07%
Naphtha but cleaned			12093059.4	53200221.2	60007909.08	38316633.48
			120930.594	1085718.8	1666886.363	473044.8578

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21694	9/26/2008	Test 11	1374445.05	13734292.00	15913290.25	6265762.80
Can ID	1394					
No. 2 Port Cargo Valve			0.39%	3.94%	4.57%	1.80%
Naphtha but cleaned			13744450.5	96140044	95479741.5	56391865.2
			137444.505	1962041.714	2652215.042	696195.8667

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21696	9/26/2008	Test 15	371157.36	21840212.00	251875716.60	763776.20
Can ID	1348					
No. 1 Port Ullage Hatch			0.02%	1.06%	12.20%	0.04%
Raffinate			3711573.6	152881484	1511254300	6873985.8
			37115.736	3120030.286	41979286.1	84864.02222

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21697	9/26/2008	Test 16	670877.20	21554488.48	256588924.48	518508.48
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.03%	1.00%	11.87%	0.02%
Raffinate			6708772	150881419.4	1539533547	4666576.32
			67087.72	3079212.64	42764820.75	57612.05333

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21698	9/26/2008	Test 17	291829.50	11540883.96	144961440.30	460442.10
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.02%	0.97%	12.19%	0.04%
Raffinate			2918295	80786187.72	869768641.8	4143978.9

#2 Starboard Cargo & Ullage Hatch			4.85%	4.39%	0.18%	0.01%
Naphtha but cleaned			116117046.4	65705737.35	4800433.41	205866.54
			1814328.85	2628229.494	59264.61	1701.376364

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21693	9/26/2008	Test 10	8179851.64	10151470.78	311855.40	55440.96
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			3.97%	4.93%	0.15%	0.03%
Naphtha but cleaned			65438813.12	50757353.9	2806698.6	609850.56
			1022481.455	2030294.156	34650.6	5040.087273

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21694	9/26/2008	Test 11	738522.95	16837713.75	316945.20	34538.90
Can ID	1394					
No. 2 Port Cargo Valve			0.21%	4.83%	0.09%	0.01%
Naphtha but cleaned			5908183.6	84188568.75	2852506.8	379927.9
			92315.36875	3367542.75	35216.13333	3139.9

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21696	9/26/2008	Test 15	715803.48	135420676.36	164117.20	35348.32
Can ID	1348					
No. 1 Port Ullage Hatch			0.03%	6.56%	0.01%	0.00%
Raffinate			5726427.84	677103381.8	1477054.8	388831.52
			89475.435	27084135.27	18235.24444	3213.483636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21697	9/26/2008	Test 16	276310.44	146285342.00	167150.76	79595.60
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.01%	6.77%	0.01%	0.00%
Raffinate			2210483.52	731426710	1504356.84	875551.6
			34538.805	29257068.4	18572.30667	7235.963636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21698	9/26/2008	Test 17	352789.44	77328332.40	47989.74	33722.52
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.03%	6.50%	0.00%	0.00%
Raffinate			2822315.52	386641662	431907.66	370947.72

#2 Starboard Cargo & Ullage Hatch			1.32%	0.16%	0.01%	0.10%
Naphtha but cleaned			31516295.76	4229621.64	363905.5	2807271
			492442.1213	52217.55111	3639.055	34657.66667

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21693	9/26/2008	Test 10	2276544.42	481643.34	24255.42	292220.06
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			1.11%	0.23%	0.01%	0.14%
Naphtha but cleaned			18212355.36	4334790.06	242554.2	2629980.54
			284568.0525	53515.92667	2425.542	32468.89556

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21694	9/26/2008	Test 11	2749905.95	494718.95	40634.00	391102.25
Can ID	1394					
No. 2 Port Cargo Valve			0.79%	0.14%	0.01%	0.11%
Naphtha but cleaned			21999247.6	4452470.55	406340	3519920.25
			343738.2438	54968.77222	4063.4	43455.80556

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21696	9/26/2008	Test 15	860984.08	189366.00	47972.72	61859.56
Can ID	1348					
No. 1 Port Ullage Hatch			0.04%	0.01%	0.00%	0.00%
Raffinate			6887872.64	1704294	479727.2	556736.04
			107623.01	21040.66667	4797.272	6873.284444

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21697	9/26/2008	Test 16	718634.56	277447.52	50031.52	62539.40
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.03%	0.01%	0.00%	0.00%
Raffinate			5749076.48	2497027.68	500315.2	562854.6
			89829.32	30827.50222	5003.152	6948.822222

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21698	9/26/2008	Test 17	499352.70	93385.44	20752.32	38910.60
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.04%	0.01%	0.00%	0.00%
Raffinate			3994821.6	840468.96	207523.2	350195.4

#2 Starboard Cargo & Ullage Hatch			1.59%	0.01%	0.09%	2.75%
Naphtha but cleaned			14260936.68	56145.42	2087777.84	57628074.98
			1584548.52	6238.38	32621.52875	1176083.163

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21693	9/26/2008	Test 10	3389983.70	15015.26	179028.10	5057832.58
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			1.65%	0.01%	0.09%	2.46%
Naphtha but cleaned			10169951.1	45045.78	1432224.8	35404828.06
			1129994.567	5005.086667	22378.5125	722547.5114

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21694	9/26/2008	Test 11	6391728.20	19301.15	298659.90	8020135.75
Can ID	1394					
No. 2 Port Cargo Valve			1.83%	0.01%	0.09%	2.30%
Naphtha but cleaned			19175184.6	57903.45	2389279.2	56140950.25
			2130576.067	6433.716667	37332.4875	1145733.679

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21696	9/26/2008	Test 15	348433.44	0.00	65646.88	63500732.00
Can ID	1348					
No. 1 Port Ullage Hatch			0.02%	0.00%	0.00%	3.08%
Raffinate			1045300.32	0	525175.04	444505124
			116144.48	0	8205.86	9071533.143

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21697	9/26/2008	Test 16	397978.00	0.00	36386.56	72829974.00
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			0.02%	0.00%	0.00%	3.37%
Raffinate			1193934	0	291092.48	509809818
			132659.3333	0	4548.32	10404282

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21698	9/26/2008	Test 17	234760.62	0.00	42801.66	39489070.92
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			0.02%	0.00%	0.00%	3.32%
Raffinate			704281.86	0	342413.28	276423496.4

#2 Starboard Cargo & Ullage Hatch			100.00%	0.01%	0.01%	33.32%
Naphtha but cleaned			1736775389	128926.52	103973	448573833.1
			55061185.28	8057.9075	4158.92	22151794.23

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21693	9/26/2008	Test 10	205824564.00	33495.58	15015.26	64715770.60
Can ID	1418					
No. 3 Starboard Cargo/Ullage Hatch			100.00%	0.02%	0.01%	31.44%
Naphtha but cleaned			1197420784	133982.32	75076.3	291220967.7
			37841457.04	8373.895	3003.052	14381282.36

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21694	9/26/2008	Test 11	348334965.00	95489.90	34538.90	143515224.60
Can ID	1394					
No. 2 Port Cargo Valve			100.00%	0.03%	0.01%	41.20%
Naphtha but cleaned			1929664978	381959.6	172694.5	645818510.7
			66930177.85	23872.475	6907.78	31892272.13

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21696	9/26/2008	Test 15	2064846864.00	135081.08	1025101.28	95761123.76
Can ID	1348					
No. 1 Port Ullage Hatch			100.00%	0.01%	0.05%	4.64%
Raffinate			12064660615	540324.32	5125506.4	430925056.9
			358545192.4	33770.27	205020.256	21280249.72

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21697	9/26/2008	Test 16	2161134248.00	148957.48	1289448.72	97730888.92
Can ID	1431					
No. 3 Starboard Cargo Ullage Hatch			100.00%	0.01%	0.06%	4.52%
Raffinate			12605114554	595829.92	6447243.6	439789000.1
			376002141.9	37239.37	257889.744	21717975.32

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21698	9/26/2008	Test 17	1189626744.00	58365.90	591441.12	54225812.16
Can ID	1347					
No. 3 Starboard High Level Alarm Tester			100.00%	0.00%	0.05%	4.56%
Raffinate			6950645874	233463.6	2957205.6	244016154.7

#2 Starboard Cargo & Ullage Hatch
Naphtha but cleaned

5.806082725 average C

5.51% by volume

0.104475 moles/min
8.701247 grams/min
0.019166 lbs/min
1.149944 lbs/hr
0.013799 tons/day
5.036757 tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21693	9/26/2008	Test 10

Can ID 1418
No. 3 Starboard Cargo/Ullage Hatch
Naphtha but cleaned

5.817676768 average C

3.78% by volume

carbon

SAMPNO	COLDATE	LOCCODE
AL21694	9/26/2008	Test 11

Can ID 1394
No. 2 Port Cargo Valve
Naphtha but cleaned

5.539682123 average C

6.69% by volume

0.965023 scfm
27.45442 liters/min
0.075155 moles/min
5.978964 grams/min
0.01317 lbs/min
0.790171 lbs/hr
0.009482 tons/day
3.460951 tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21696	9/26/2008	Test 15

Can ID 1348
No. 1 Port Ullage Hatch
Raffinate

5.842883957 average C

35.85% by volume

carbon

SAMPNO	COLDATE	LOCCODE
AL21697	9/26/2008	Test 16

Can ID 1431
No. 3 Starboard Cargo Ullage Hatch
Raffinate

5.832638377 average C

37.60% by volume

carbon

SAMPNO	COLDATE	LOCCODE
AL21698	9/26/2008	Test 17

Can ID 1347
No. 3 Starboard High Level Alarm Tester
Raffinate

5.842711513 average C

#2 Starboard Cargo & Ullage Hatch
Naphtha but cleaned)

carbon

SAMPNO	COLDATE	LOCCODE
AL21693	9/26/2008	Test 10

Can ID 1418
No. 3 Starboard Cargo/Ullage Hatch
Naphtha but cleaned

carbon

SAMPNO	COLDATE	LOCCODE
AL21694	9/26/2008	Test 11

Can ID 1394
No. 2 Port Cargo Valve
Naphtha but cleaned)

carbon

SAMPNO	COLDATE	LOCCODE
AL21696	9/26/2008	Test 15

Can ID 1348
No. 1 Port Ullage Hatch
Raffinate

carbon

SAMPNO	COLDATE	LOCCODE
AL21697	9/26/2008	Test 16

Can ID 1431
No. 3 Starboard Cargo Ullage Hatch
Raffinate

carbon

SAMPNO	COLDATE	LOCCODE
AL21698	9/26/2008	Test 17

Can ID 1347
No. 3 Starboard High Level Alarm Tester
Raffinate

				ppbv	5764.533333	37037.12667

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21699	9/27/2008	Test 18	12:10	.02	470453.96	2419810.22
Can ID	1376					
Vent Stack				Area%ppbC	0.03%	0.14%
Gasoline				ppbC*#C	4234085.64	21778291.98
				ppbv	52272.66222	268867.8022

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21700	9/27/2008	Test 19	12:50	.02	29240.50	1518166.76
Can ID	1482					
Forward Cofferdam				Area%ppbC	0.00%	0.09%
Gasoline				ppbC*#C	263164.5	13663500.84
				ppbv	3248.944444	168685.1956

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21701	9/28/2008	Test 20	11:45	.02	445183.74	4991529.42
Can ID	1462					
No. 2 Starboard Cargo Hatch				Area%ppbC	0.02%	0.21%
Naphtha				ppbC*#C	4006653.66	44923764.78
				ppbv	49464.86	554614.38

carbon					9	9
SAMPNO	COLDATE	LOCCODE	TART_HOU	DURATION	,3-Trimethylbenz	,4-Trimethylbenz
AL21702	9/28/2008	Test 22	14:50	.02	41264.78	2421271.65
Can ID	1359					
Slop Tank PV Vent				Area%ppbC	0.00%	0.05%
Unleaded Gasoline				ppbC*#C	371383.02	21791444.85
				ppbv	4584.975556	269030.1833

			20608.20667	10051.905	4215.315	264375.91

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21699	9/27/2008	Test 18	929263.02	93159.20	4442529.35	4345876.68
Can ID	1376					
Vent Stack			0.06%	0.01%	0.26%	0.26%
Gasoline			8363367.18	372636.8	17770117.4	26075260.08
			103251.4467	23289.8	1110632.338	724312.78

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21700	9/27/2008	Test 19	518141.66	147372.12	5156854.58	2122860.30
Can ID	1482					
Forward Cofferdam			0.03%	0.01%	0.31%	0.13%
Gasoline			4663274.94	589488.48	20627418.32	12737161.8
			57571.29556	36843.03	1289213.645	353810.05

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21701	9/28/2008	Test 20	1438764.21	39792.96	1575552.51	414095.49
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.06%	0.00%	0.07%	0.02%
Naphtha			12948877.89	159171.84	6302210.04	2484572.94
			159862.69	9948.24	393888.1275	69015.915

carbon			9	4	4	6
SAMPNO	COLDATE	LOCCODE	,5-Trimethylbenz	1,3-butadiene	1-Butene	1-Hexene
AL21702	9/28/2008	Test 22	984286.37	3256276.61	81581683.73	5703035.33
Can ID	1359					
Slop Tank PV Vent			0.02%	0.07%	1.77%	0.12%
Unleaded Gasoline			8858577.33	13025106.44	326326734.9	34218211.98
			109365.1522	814069.1525	20395420.93	950505.8883

			36835.368	101491.815	8846757.25	5674.4625

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21699	9/27/2008	Test 18	19089484.57	27339896.22	6781989.76	641633.99
Can ID	1376					
Vent Stack			1.13%	1.62%	0.40%	0.04%
Gasoline			95447422.85	218719169.8	40691938.56	5133071.92
			3817896.914	3417487.028	1130331.627	80204.24875

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21700	9/27/2008	Test 19	19497565.40	16312690.14	6276180.92	313458.16
Can ID	1482					
Forward Cofferdam			1.19%	1.00%	0.38%	0.02%
Gasoline			97487827	130501521.1	37657085.52	2507665.28
			3899513.08	2039086.268	1046030.153	39182.27

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21701	9/28/2008	Test 20	4517744.49	7458692.94	35072520.12	302177.79
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.19%	0.32%	1.50%	0.01%
Naphtha			22588722.45	59669543.52	210435120.7	2417422.32
			903548.898	932336.6175	5845420.02	37772.22375

carbon			5	8	6	8
SAMPNO	COLDATE	LOCCODE	1-Pentene	,4-Trimethylpenta	,2-Dimethylbutan	,4-Trimethylpenta
AL21702	9/28/2008	Test 22	23741812.54	17660112.17	28641398.33	4621655.36
Can ID	1359					
Slop Tank PV Vent			0.52%	0.38%	0.62%	0.10%
Unleaded Gasoline			118709062.7	141280897.4	171848390	36973242.88
			4748362.508	2207514.021	4773566.388	577706.92

			33952741.05	1820460.214	1304802.12	15402.1125

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21699	9/27/2008	Test 18	54283865.84	6496689.71	4923463.72	1928395.44
Can ID	1376					
Vent Stack			3.22%	0.38%	0.29%	0.11%
Gasoline			325703195	45476827.97	34464246.04	15427163.52
			9047310.973	928098.53	703351.96	241049.43

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21700	9/27/2008	Test 19	1809402.14	261994.88	3570849.86	1745073.04
Can ID	1482					
Forward Cofferdam			0.11%	0.02%	0.22%	0.11%
Gasoline			10856412.84	1833964.16	24995949.02	13960584.32
			301567.0233	37427.84	510121.4086	218134.13

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21701	9/28/2008	Test 20	23178155.67	1924984.44	2610169.47	2922295.50
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.99%	0.08%	0.11%	0.13%
Naphtha			139068934	13474891.08	18271186.29	23378364
			3863025.945	274997.7771	372881.3529	365286.9375

carbon			6	7	7	8
SAMPNO	COLDATE	LOCCODE	,3-Dimethylbutan	3-Dimethylpenta	4-Dimethylpenta	2-Methylheptane
AL21702	9/28/2008	Test 22	49693718.15	15482788.19	5101055.01	566783.89
Can ID	1359					
Slop Tank PV Vent			1.08%	0.34%	0.11%	0.01%
Unleaded Gasoline			298162308.9	108379517.3	35707385.07	4534271.12
			8282286.358	2211826.884	728722.1443	70847.98625

			4285168.791	262646.55	10700.415	4625729.186

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21699	9/27/2008	Test 18	14827451.17	3462028.77	1283267.98	14495571.52
Can ID	1376					
Vent Stack			0.88%	0.21%	0.08%	0.86%
Gasoline			103792158.2	20772172.62	10266143.84	101469000.6
			2118207.31	577004.795	160408.4975	2070795.931

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21700	9/27/2008	Test 19	9573339.70	2922880.38	1608227.50	254977.16
Can ID	1482					
Forward Cofferdam			0.58%	0.18%	0.10%	0.02%
Gasoline			67013377.9	17537282.28	12865820	1784840.12
			1367619.957	487146.73	201028.4375	36425.30857

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21701	9/28/2008	Test 20	10669487.40	90323801.55	6350707.71	12899136.69
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.46%	3.87%	0.27%	0.55%
Naphtha			74686411.8	541942809.3	50805661.68	90293956.83
			1524212.486	15053966.93	793838.4638	1842733.813

carbon			7	6	8	7
SAMPNO	COLDATE	LOCCODE	2-Methylhexane	2-Methylpentane	3-Methylheptane	3-Methylhexane
AL21702	9/28/2008	Test 22	190546.19	168283841.19	1127499.43	15511916.27
Can ID	1359					
Slop Tank PV Vent			0.00%	3.66%	0.02%	0.34%
Unleaded Gasoline			1333823.33	1009703047	9019995.44	108583413.9
			27220.88429	28047306.87	140937.4288	2215988.039

			25643166.25	5836.59	30380315.63	11024.67

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21699	9/27/2008	Test 18	33433672.39	9315.92	23648462.92	22913669.73
Can ID	1376					
Vent Stack			1.98%	0.00%	1.40%	1.36%
Gasoline			200602034.3	18631.84	141890777.5	91654678.92
			5572278.732	4657.96	3941410.487	5728417.433

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21700	9/27/2008	Test 19	28073219.24	8187.34	16654219.18	25231042.64
Can ID	1482					
Forward Cofferdam			1.71%	0.00%	1.02%	1.54%
Gasoline			168439315.4	16374.68	99925315.08	100924170.6
			4678869.873	4093.67	2775703.197	6307760.66

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21701	9/28/2008	Test 20	49682754.09	21140.01	9076525.47	1369126.53
Can ID	1462					
No. 2 Starboard Cargo Hatch			2.13%	0.00%	0.39%	0.06%
Naphtha			298096524.5	42280.02	54459152.82	5476506.12
			8280459.015	10570.005	1512754.245	342281.6325

carbon			6	2	6	4
SAMPNO	COLDATE	LOCCODE	3-Methylpentane	Acetylene	Benzene	cis-2-Butene
AL21702	9/28/2008	Test 22	92595738.98	372596.69	14088281.36	72002186.42
Can ID	1359					
Slop Tank PV Vent			2.01%	0.01%	0.31%	1.57%
Unleaded Gasoline			555574433.9	745193.38	84529688.16	288008745.7
			15432623.16	186298.345	2348046.893	18000546.61

			63813.384	8790.913333	153048.36	9758778.48

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21699	9/27/2008	Test 18	46698377.98	400584.56	3219814.85	16002421.58
Can ID	1376					
Vent Stack			2.77%	0.02%	0.19%	0.95%
Gasoline			233491889.9	3605261.04	19318889.1	80012107.9
			9339675.596	44509.39556	536635.8083	3200484.316

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21700	9/27/2008	Test 19	20619230.98	202344.26	339189.80	5341654.54
Can ID	1482					
Forward Cofferdam			1.26%	0.01%	0.02%	0.33%
Gasoline			103096154.9	1821098.34	2035138.8	26708272.7
			4123846.196	22482.69556	56531.63333	1068330.908

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21701	9/28/2008	Test 20	4111110.18	1192545.27	14924847.06	38147769.81
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.18%	0.05%	0.64%	1.63%
Naphtha			20555550.9	10732907.43	89549082.36	190738849.1
			822222.036	132505.03	2487474.51	7629553.962

carbon			5	9	6	5
SAMPNO	COLDATE	LOCCODE	cis-2-Pentene	Cumene	Cyclohexane	Cyclopentane
AL21702	9/28/2008	Test 22	25423959.16	259725.38	203896.56	36344561.82
Can ID	1359					
Slop Tank PV Vent			0.55%	0.01%	0.00%	0.79%
Unleaded Gasoline			127119795.8	2337528.42	1223379.36	181722809.1
			5084791.832	28858.37556	33982.76	7268912.364

			132296.04	51880.8	4539.57	465954.435

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21699	9/27/2008	Test 18	4138597.46	4834962.48	9315.92	201385736.11
Can ID	1376					
Vent Stack			0.25%	0.29%	0.00%	11.93%
Gasoline			8277194.92	38679699.84	18631.84	805542944.4
			2069298.73	604370.31	4657.96	50346434.03

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21700	9/27/2008	Test 19	4684328.10	2140404.60	8187.34	233354395.06
Can ID	1482					
Forward Cofferdam			0.29%	0.13%	0.00%	14.24%
Gasoline			9368656.2	17123236.8	16374.68	933417580.2
			2342164.05	267550.575	4093.67	58338598.77

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21701	9/28/2008	Test 20	3325199.22	2358976.41	48497.67	117162909.54
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.14%	0.10%	0.00%	5.02%
Naphtha			6650398.44	18871811.28	96995.34	468651638.2
			1662599.61	294872.0513	24248.835	29290727.39

carbon			2	8	2	4
SAMPNO	COLDATE	LOCCODE	Ethane	Ethylbenzene	Ethylene	Isobutane
AL21702	9/28/2008	Test 22	7563591.44	3198020.45	608048.67	497196906.88
Can ID	1359					
Slop Tank PV Vent			0.16%	0.07%	0.01%	10.81%
Unleaded Gasoline			15127182.88	25584163.6	1216097.34	1988787628
			3781795.72	399752.5563	304024.335	124299226.7

			20304329.29	53437.224	171368.7675	1815.828

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21699	9/27/2008	Test 18	284218238.79	1540620.27	16411157.57	101310.63
Can ID	1376					
Vent Stack			16.84%	0.09%	0.97%	0.01%
Gasoline			1421091194	7703101.35	131289260.6	1013106.3
			56843647.76	308124.054	2051394.696	10131.063

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21700	9/27/2008	Test 19	293414382.06	1538050.30	7411881.94	67837.96
Can ID	1482					
Forward Cofferdam			17.90%	0.09%	0.45%	0.00%
Gasoline			1467071910	7690251.5	59295055.52	678379.6
			58682876.41	307610.06	926485.2425	6783.796

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21701	9/28/2008	Test 20	679161370.68	395442.54	13884012.45	236270.70
Can ID	1462					
No. 2 Starboard Cargo Hatch			29.08%	0.02%	0.59%	0.01%
Naphtha			3395806853	1977212.7	111072099.6	2362707
			135832274.1	79088.508	1735501.556	23627.07

carbon			5	5	8	10
SAMPNO	COLDATE	LOCCODE	Isopentane	Isoprene	m/p Xylene	m-Diethylbenzene
AL21702	9/28/2008	Test 22	837224762.43	2354519.80	11889111.32	105589.29
Can ID	1359					
Slop Tank PV Vent			18.20%	0.05%	0.26%	0.00%
Unleaded Gasoline			4186123812	11772599	95112890.56	1055892.9
			167444952.5	470903.96	1486138.915	10558.929

			95794.19143	1675966.01	27381.53333	2553508.125

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21699	9/27/2008	Test 18	1396223.51	17543041.85	2044844.44	331980960.63
Can ID	1376					
Vent Stack			0.08%	1.04%	0.12%	19.67%
Gasoline			9773564.57	105258251.1	18403599.96	1327923843
			199460.5014	2923840.308	227204.9378	82995240.16

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21700	9/27/2008	Test 19	257316.40	13475192.02	1091255.46	373708795.06
Can ID	1482					
Forward Cofferdam			0.02%	0.82%	0.07%	22.80%
Gasoline			1801214.8	80851152.12	9821299.14	1494835180
			36759.48571	2245865.337	121250.6067	93427198.77

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21701	9/28/2008	Test 20	29286375.03	30534879.15	3612454.65	206443389.42
Can ID	1462					
No. 2 Starboard Cargo Hatch			1.25%	1.31%	0.15%	8.84%
Naphtha			205004625.2	183209274.9	32512091.85	825773557.7
			4183767.861	5089146.525	401383.85	51610847.36

carbon			7	6	9	4
SAMPNO	COLDATE	LOCCODE	Methylcyclohexan	Methylcyclopentan	m-Ethyltoluene	n-Butane
AL21702	9/28/2008	Test 22	6626638.20	35817829.04	1927307.96	1308035269.84
Can ID	1359					
Slop Tank PV Vent			0.14%	0.78%	0.04%	28.44%
Unleaded Gasoline			46386467.4	214906974.2	17345771.64	5232141079
			946662.6	5969638.173	214145.3289	327008817.5

			29182.95	1648697.709	24160240.05	51160.23333

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21699	9/27/2008	Test 18	145561.25	7892913.22	25199563.60	565942.14
Can ID	1376					
Vent Stack			0.01%	0.47%	1.49%	0.03%
Gasoline			1455612.5	55250392.54	151197381.6	5093479.26
			14556.125	1127559.031	4199927.267	62882.46

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21700	9/27/2008	Test 19	180121.48	2355614.68	2381346.32	371939.16
Can ID	1482					
Forward Cofferdam			0.01%	0.14%	0.15%	0.02%
Gasoline			1801214.8	16489302.76	14288077.92	3347452.44
			18012.148	336516.3829	396891.0533	41326.57333

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21701	9/28/2008	Test 20	1993378.59	19777101.12	72479146.05	5005208.25
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.09%	0.85%	3.10%	0.21%
Naphtha			19933785.9	138439707.8	434874876.3	45046874.25
			199337.859	2825300.16	12079857.68	556134.25

carbon			10	7	6	9
SAMPNO	COLDATE	LOCCODE	n-Decane	n-Heptane	n-Hexane	n-Nonane
AL21702	9/28/2008	Test 22	290067.13	8726287.30	68226459.05	868987.72
Can ID	1359					
Slop Tank PV Vent			0.01%	0.19%	1.48%	0.02%
Unleaded Gasoline			2900671.3	61084011.1	409358754.3	7820889.48
			29006.713	1246612.471	11371076.51	96554.19111

			44098.68	15465666.48	5332.193333	3065.683636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21699	9/27/2008	Test 18	349347.00	89663401.02	740615.64	36099.19
Can ID	1376					
Vent Stack			0.02%	5.31%	0.04%	0.00%
Gasoline			2794776	448317005.1	6665540.76	397091.09
			43668.375	17932680.2	82290.62667	3281.744545

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21700	9/27/2008	Test 19	153220.22	89502831.26	359073.34	140354.40
Can ID	1482					
Forward Cofferdam			0.01%	5.46%	0.02%	0.01%
Gasoline			1225761.76	447514156.3	3231660.06	1543898.4
			19152.5275	17900566.25	39897.03778	12759.49091

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21701	9/28/2008	Test 20	13933753.65	609388145.91	1784465.55	139275.36
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.60%	26.10%	0.08%	0.01%
Naphtha			111470029.2	3046940730	16060189.95	1532028.96
			1741719.206	121877629.2	198273.95	12661.39636

carbon			8	5	9	11
SAMPNO	COLDATE	LOCCODE	n-Octane	n-Pentane	n-Propylbenzene	n-Undecane
AL21702	9/28/2008	Test 22	270648.41	514043860.15	526732.78	50974.14
Can ID	1359					
Slop Tank PV Vent			0.01%	11.18%	0.01%	0.00%
Unleaded Gasoline			2165187.28	2570219301	4740595.02	560715.54
			33831.05125	102808772	58525.86444	4634.012727

			62419.0875	10376.16	2075.232	4323.4

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21699	9/27/2008	Test 18	5517353.62	726641.76	61717.97	86172.26
Can ID	1376					
Vent Stack			0.33%	0.04%	0.00%	0.01%
Gasoline			44138828.96	6539775.84	617179.7	775550.34
			689669.2025	80737.97333	6171.797	9574.695556

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21700	9/27/2008	Test 19	2451523.52	419893.58	70177.20	46784.80
Can ID	1482					
Forward Cofferdam			0.15%	0.03%	0.00%	0.00%
Gasoline			19612188.16	3779042.22	701772	421063.2
			306440.44	46654.84222	7017.72	5198.311111

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21701	9/28/2008	Test 20	5715263.88	1569334.86	223835.40	406634.31
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.24%	0.07%	0.01%	0.02%
Naphtha			45722111.04	14124013.74	2238354	3659708.79
			714407.985	174370.54	22383.54	45181.59

carbon			8	9	10	9
SAMPNO	COLDATE	LOCCODE	o Xylene	o-Ethyltoluene	p-Diethylbenzene	p-Ethyltoluene
AL21702	9/28/2008	Test 22	3688343.13	601980.32	78888.55	89811.58
Can ID	1359					
Slop Tank PV Vent			0.08%	0.01%	0.00%	0.00%
Unleaded Gasoline			29506745.04	5417822.88	788885.5	808304.22
			461042.8913	66886.70222	7888.855	9979.064444

			78253.54	0	5350.2075	5641295.846

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21699	9/27/2008	Test 18	73528227.58	309754.34	128093.90	37996144.21
Can ID	1376					
Vent Stack			4.36%	0.02%	0.01%	2.25%
Gasoline			220584682.7	929263.02	1024751.2	265973009.5
			24509409.19	103251.4467	16011.7375	5428020.601

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21700	9/27/2008	Test 19	86178771.22	381296.12	35088.60	19802836.22
Can ID	1482					
Forward Cofferdam			5.26%	0.02%	0.00%	1.21%
Gasoline			258536313.7	1143888.36	280708.8	138619853.5
			28726257.07	127098.7067	4386.075	2828976.603

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21701	9/28/2008	Test 20	21274311.24	855548.64	518552.01	14740804.62
Can ID	1462					
No. 2 Starboard Cargo Hatch			0.91%	0.04%	0.02%	0.63%
Naphtha			63822933.72	2566645.92	4148416.08	103185632.3
			7091437.08	285182.88	64819.00125	2105829.231

carbon			3	3	8	7
SAMPNO	COLDATE	LOCCODE	Propane	Propylene	Styrene	Toluene
AL21702	9/28/2008	Test 22	34621150.42	6389972.55	94666.26	22017187.47
Can ID	1359					
Slop Tank PV Vent			0.75%	0.14%	0.00%	0.48%
Unleaded Gasoline			103863451.3	19169917.65	757330.08	154120312.3
			11540383.47	2129990.85	11833.2825	3145312.496

			206568106.1	14591.475	118288.224	12050180.48

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21699	9/27/2008	Test 18	1687811806.00	19721802.64	38608665.95	206347628.00
Can ID	1376					
Vent Stack			100.00%	1.17%	2.29%	12.23%
Gasoline			8153774118	78887210.56	193043329.8	928564326
			366343553.1	4930450.66	7721733.19	45855028.44

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21700	9/27/2008	Test 19	1638871544.00	22257868.60	38533130.90	271989282.90
Can ID	1482					
Forward Cofferdam			100.00%	1.36%	2.35%	16.60%
Gasoline			7474667726	89031474.4	192665654.5	1223951773
			372367817.8	5564467.15	7706626.18	60442062.87

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21701	9/28/2008	Test 20	2335224987.00	4818678.75	8337868.65	140153292.18
Can ID	1462					
No. 2 Starboard Cargo Hatch			100.00%	0.21%	0.36%	6.00%
Naphtha			11984918305	19274715	41689343.25	630689814.8
			468504665.8	1204669.688	1667573.73	31145176.04

carbon				4	5	4.5
SAMPNO	COLDATE	LOCCODE	Total NMOC	trans-2-Butene	trans-2-Pentene	unID
AL21702	9/28/2008	Test 22	4599930667.00	102570892.71	60032972.88	398291297.57
Can ID	1359					
Slop Tank PV Vent			100.00%	2.23%	1.31%	8.66%
Unleaded Gasoline			21401691114	410283570.8	300164864.4	1792310839
			1016476766	25642723.18	12006594.58	88509177.24

20.66% by volume

carbon

SAMPNO	COLDATE	LOCCODE
AL21699	9/27/2008	Test 18

Can ID 1376
Vent Stack
Gasoline

4.830973506 average C

36.63% by volume

2.311047 scfm
65.74815 liters/min
0.985129 moles/min
68.59813 grams/min
0.151097 lbs/min
9.065832 lbs/hr
0.10879 tons/day
39.70834 tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21700	9/27/2008	Test 19

Can ID 1482
Forward Cofferdam
Gasoline

4.560862475 average C

37.24% by volume

carbon

SAMPNO	COLDATE	LOCCODE
AL21701	9/28/2008	Test 20

Can ID 1462
No. 2 Starboard Cargo Hatch
Naphtha

5.132232813 average C

46.85% by volume

3.660502 scfm
104.1395 liters/min
1.995494 moles/min
147.3697 grams/min
0.324603 lbs/min
19.47618 lbs/hr
0.233714 tons/day
85.30565 tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21702	9/28/2008	Test 22

Can ID 1359
Slop Tank PV Vent
Unleaded Gasoline

4.652611673 average C

101.65% by volume

3.493477 scfm
99.38769 liters/min
4.131913 moles/min
277.4024 grams/min
0.611019 lbs/min
36.66112 lbs/hr
0.439933 tons/day
160.5757 tons/year

carbon

SAMPNO	COLDATE	LOCCODE
AL21699	9/27/2008	Test 18

Can ID 1376
Vent Stack
Gasoline)

carbon

SAMPNO	COLDATE	LOCCODE
AL21700	9/27/2008	Test 19

Can ID 1482
Forward Cofferdam
Gasoline

carbon

SAMPNO	COLDATE	LOCCODE
AL21701	9/28/2008	Test 20

Can ID 1462
No. 2 Starboard Cargo Hatch
Naphtha)

carbon

SAMPNO	COLDATE	LOCCODE
AL21702	9/28/2008	Test 22

Can ID 1359
Slop Tank PV Vent
Unleaded Gasoline)

GC/FID Daily Worksheet FID 2

Date 10/06/08 **Operator** JPC

Batch # 192548 **QC #** AL21990

Working Gases and Quality Control Standards:

Carrier Gas Helium Pressure 225 Pulse Gas Pressure 18

Combustion Air Pressure 90 Hydrogen Pressure 55

Nitrogen Pressure for dewar 22

ZAB Pressure 20; Preparation Date 9-8-08; Canister ID G259

HAB Pressure 21; Preparation date 9-8-08; Canister ID S1503

LCS: Std ID 05760175; Preparation Date 9-9-08; Pressure 22;

Canister ID G1083

PAMS: Std ID 250112; Preparation Date 9-8-08; Pressure 17;

Canister ID S1364

SRM: Std ID 125072; Preparation Date 9-8-08; Pressure 18;

Canister ID G1281

Entech Setup:

Name of Sequence: SQ100608

Sequence Saved? ✓ Sequence Printed? ✓

Leak Check Performed? ✓

GC/FID Chemstation Setup:

Name of Sequence: SQ100608

Sequence Saved? ✓ Sequence Printed? ✓

Bakeout.M Loaded at End? ✓

Acquisition Startup:

Do Both Sequences Match? ✓ Canister Valves Open? ✓

Entech Sequence Started? ✓ Chemstation Sequence Started? ✓

Total Runs in the sequences:

Number of Std: 4

Number of Blanks: 2

Number of Samples 13

Number of Duplicates: 1

Number of Sys Blanks: 0

Number of Cert Cans: 0

Total Runs in the sequences: 20

Date and Time Sequence Started: 10/6/08 / 12:40

Comments:

PAMS Analysis - FID2

10-06-08 Batch#192543

Site/desc	Port	Canister	LIMS#	Test Code#	Datafile#
SRM	S1	G1083	AL21990	$I_SRM	HJ060801 ✓
PAMS	1	51381	↓	↓	2 ✓
HAB	S3	S1503	↓	↓	3 ✓
LCS	16	G1083	↓	↓	4 ✓
ZAB	S4	S1259	↓	↓	5 ✓
PRI 9/27/08	2	2350	AL21758	$PPFID	6 ✓
↓	3	3675	9	↓	7 ✓
↓	4	6994	60	↓	8 ✓
↓	5	8085	1	↓	9 ✓
↓	6	7026	2	↓	10 ✓
CAP 9-29-08	7	1627	AL21779	↓	11 ✓
↓	8	1453	80	↓	12 ✓
↓	9	1458	1	↓	13 ✓
↓	10	6981	2	↓	14 ✓
↓	11	1436	3	↓	15 ✓
↓	12	8076	4	↓	16 ✓
↓	13	TS3178	5	↓	17 ✓
↓	14	10017	6	↓	18 ✓
- Repl.	2	2350	AL21758	$D_PPFID	19 ✓
CCV	S1	G1083		$C_SRM	20 ✓
← Recheck of prev. result	15	8108	AL21154	$PPFID	21 ✓
			(CAP 18-21:00 9/15/08)	sample run labeled AL21171, and V. Versk. JPC	
Grab.	4	S1481	AL21640	$PPFID	22 ✓
CleanOut	S3	S1503	———	$HBPPFID	23 -OK

All Files transfered 10/08/08

10-08 08

```
---------------SEQUENCE TABLE ---------------

Sequence Name:  C:\Smart\SQ100608.SEQ
Date:           10-06-2008
Time:           11:17:06
Int. Std Volume: 0 cc


          Inlet  Auto   Samp   Cal Std
 Sample Name  #   Pos   Vol.   Vol.      Method          Time

 AL21990 $I_SRM  1   1    0    200    C:\Smart\PAMS.MPT 12:00
AL21990 $I_PPFID  1   1   200    0    C:\Smart\PAMS.MPT 12:00
AL21990 $HBPPFID 3   1   200    0    C:\Smart\PAMS.MPT 12:00
AL21990 $L1PPFID 1  16   200    0    C:\Smart\PAMS.MPT 12:00
AL21990 $B_PPFID 4   1   200    0    C:\Smart\PAMS.MPT 12:00
 AL21758 $PPFID  1   2   200    0    C:\Smart\PAMS.MPT 12:00
 AL21759 $PPFID  1   3   200    0    C:\Smart\PAMS.MPT 12:00
 AL21760 $PPFID  1   4   200    0    C:\Smart\PAMS.MPT 12:00
 AL21761 $PPFID  1   5   200    0    C:\Smart\PAMS.MPT 12:00
 AL21762 $PPFID  1   6   200    0    C:\Smart\PAMS.MPT 12:00
 AL21779 $PPFID  1   7   200    0    C:\Smart\PAMS.MPT 12:00
 AL21780 $PPFID  1   8   200    0    C:\Smart\PAMS.MPT 12:00
 AL21781 $PPF01  1   9   200    0    C:\Smart\PAMS.MPT 12:00
 AL21782 $PPF02  1  10   200    0    C:\Smart\PAMS.MPT 12:00
 AL21783 $PPF03  1  11   200    0    C:\Smart\PAMS.MPT 12:00
 AL21784 $PPF03  1  12   200    0    C:\Smart\PAMS.MPT 12:00
 AL21785 $PPF04  1  13   200    0    C:\Smart\PAMS.MPT 12:00
 AL21786 $PPF05  1  14   200    0    C:\Smart\PAMS.MPT 12:00
AL21758 $D_PPFID 1   2   200    0    C:\Smart\PAMS.MPT 12:00
 AL21990 $C_SRM  1   1    0    200    C:\Smart\PAMS.MPT 12:00
```

batch modified
— see Logbook copy

rr
11/24/08

```
Sequence: C:\HPCHEM\1\SEQUENCE\SQ100608.S


  Sequence Parameters:

    Operator:                        JPC

    Data File Naming:                Prefix/Counter
    Signal 1  Prefix:                HJ0608
              Counter:               01
    Signal 2  Prefix:                0
              Counter:               0000000
    Data Directory:                  C:\HPCHEM\1\DATA\

    Data Subdirectory:

    Part of Methods to run:          According to Runtime Checklist

    Barcode Reader:                  not used

    Shutdown Cmd/Macro:              none

    Sequence Comment:
      Running 5 PRI, 8 CAP.



  Sequence Table (Front Injector):

    Method and Injection Info Part:

    Line Location SampleName       Method   Inj SampleType InjVolume DataFile
    ==== ======== ================ ======== === ========== ========= ==========

       1 Vial 1   AL21990 $I_SRM   PAMS      1  Calib
       2 Vial 3   AL21990 $I_PPFID PAMS      1  Calib
       3 Vial 2   AL21990 $HBPPFID PAMS      1  Ctrl Samp
       4 Vial 4   AL21990 $L1PPFID PAMS      1  Ctrl Samp
       5 Vial 1   AL21990 $B_PPFID PAMS      1  Ctrl Samp
       6 Vial 2   AL21758 $PPFID   PAMS      1  Sample
       7 Vial 3   AL21759 $PPFID   PAMS      1  Sample
       8 Vial 4   AL21760 $PPFID   PAMS      1  Sample
       9 Vial 5   AL21761 $PPFID   PAMS      1  Sample
      10 Vial 6   AL21762 $PPFID   PAMS      1  Sample
      11 Vial 7   AL21779 $PPFID   PAMS      1  Sample
      12 Vial 8   AL21780 $PPFID   PAMS      1  Sample
      13 Vial 9   AL21781 $PPFID   PAMS      1  Sample
      14 Vial 10  AL21782 $PPFID   PAMS      1  Sample
      15 Vial 11  AL21783 $PPFID   PAMS      1  Sample
      16 Vial 12  AL21784 $PPFID   PAMS      1  Sample
      17 Vial 13  AL21785 $PPFID   PAMS      1  Sample
      18 Vial 14  AL21786 $PPFID   PAMS      1  Sample
      19 Vial 2   AL21758 $D_PPFID PAMS      1  Sample
      20 Vial 1   AL21990 $C_SRM   PAMS      1  Calib
      21 Vial 15  AL21154 $PPFID   PAMS      1  Sample
      22 Vial 1   BAKEOUT          BAKEOUT   1  Sample

  Sequence Table (Back Injector):

    No entries - empty table!
```

batch modified
– see Logbook copy

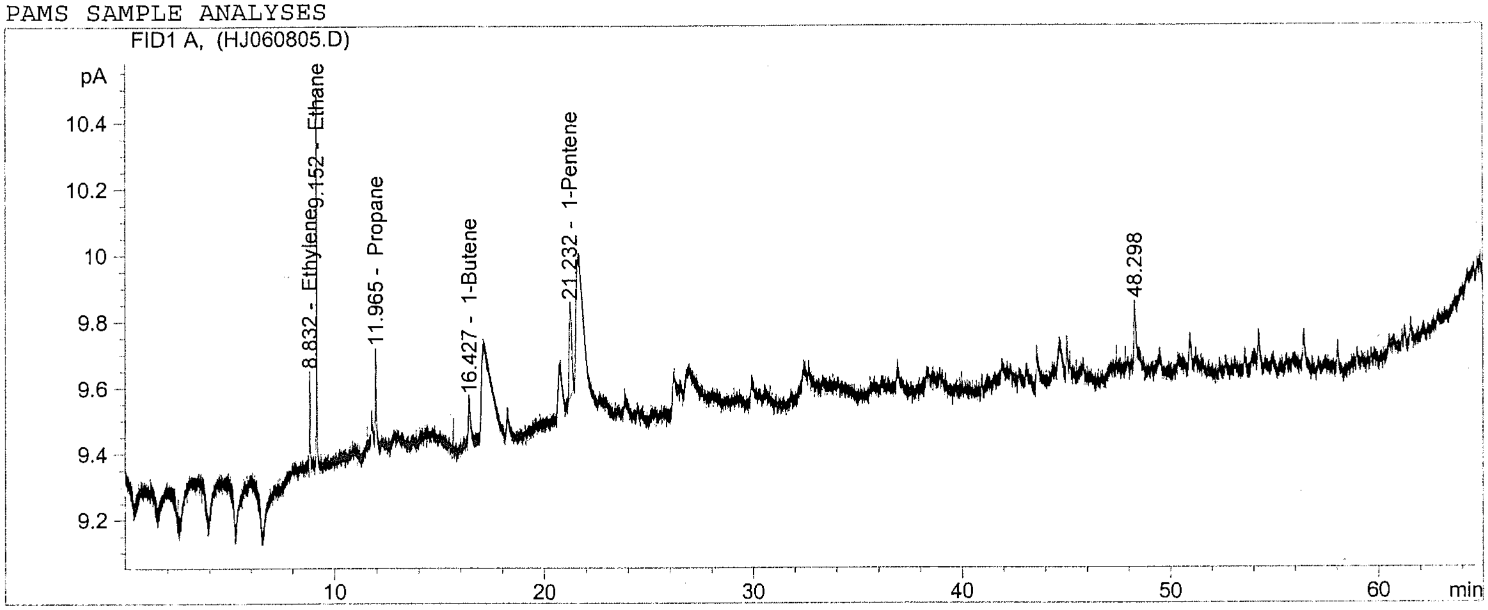
11/24/08

```
----------------------- Leak Check Report ----------------------


10/6/2008 11:38:46 AM
Leak Check for C:\Smart\SQ100608.SEQ
Report File: C:\Smart\SQ100608.LCR
Leak Check Method: Evacuation
Pressurize/Evacuate time(sec) 30
Equilibration time(sec) 10
Maintanance   time(sec) 30


 Sample
 Inlet  Auto1   Auto2   Auto3  Start  End     Rate(psi/min)
  1      1   ---   ---   0.5   0.6   0.20
  3      1   ---   ---   0.3   0.4   0.20
  1     16   ---   ---   0.4   0.4   0.00
  4     16   ---   ---   0.3   0.3   0.00
  1      2   ---   ---   0.4   0.4   0.00
  1      3   ---   ---   0.3   0.4   0.20
  1      4   ---   ---   0.3   0.3   0.00
  1      5   ---   ---   0.3   0.3   0.00
  1      6   ---   ---   0.3   0.3   0.00
  1      7   ---   ---   0.3   0.4   0.20
  1      8   ---   ---   0.3   0.4   0.20
  1      9   ---   ---   0.3   0.3   0.00
  1     10   ---   ---   0.3   0.4   0.20
  1     11   ---   ---   0.3   0.3   0.00
  1     12   ---   ---   0.3   0.3   0.00
  1     13   ---   ---   0.3   0.4   0.20
  1     14   ---   ---   0.3   0.4   0.20
```

```
=====================================================================
Injection Date   : 10/6/2008 6:46:13 PM          Seq. Line :    5
Sample Name      : AL21990 $B_PPFID               Location : Vial 1
Acq. Operator    : JPC                                 Inj :    1
Acq. Instrument  : HP_FID2 SOP 1026             Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/8/2008 2:20:02 PM by JPC
                   (modified after loading)
PAMS SAMPLE ANALYSES
```



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/7/2008 2:28:57 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.832 PBA    6.73536e-1    1.00000 3.43975e-1    Ethylene
  8.950             -          -          -        Acetylene
  9.152 PBA       2.60473    1.00000    1.33024    Ethane
 11.762             -          -          -        Propylene
 11.965 PBA       1.03681    1.00000 5.29498e-1    Propane
 15.083             -          -          -        Isobutane
 16.427 PB     8.12684e-1    1.00000 4.15038e-1    1-Butene
 16.566             -          -          -        1,3-butadiene
 16.751             -          -          -        n-Butane
 17.433             -          -          -        t2-Butene
 18.083             -          -          -        c2-Butene
 20.238             -          -          -        Isopentane
 21.232 PP        2.36850    1.00000    1.20959    1-Pentene
 21.657             -          -          -        n-Pentane
 21.797             -          -          -        Isoprene
 22.050             -          -          -        t2-Pentene
 22.387             -          -          -        c2-Pentene
 23.432             -          -          -        2,2-Dimethylbutane
 24.821             -          -          -        Cyclopentane
```

```
RetTime  Type     Area      Amt/Area    Amount   Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.901            -          -          -          2,3-dimethylbutane
 25.385            -          -          -          2-Methylpentane
 26.100            -          -          -          3-Methylpentane
 26.351            -          -          -          1-Hexene
 27.004            -          -          -          n-Hexane
 28.659            -          -          -          Methylcyclopentane
 28.825            -          -          -          2,4-dimethylpentane
 30.256            -          -          -          Benzene
 30.740            -          -          -          Cyclohexane
 31.187            -          -          -          2-Methylhexane
 31.320            -          -          -          2,3-Dimethylpentane
 31.775            -          -          -          3-Methylhexane
 32.601            -          -          -          2,2,4-Trimethylpentane
 33.282            -          -          -          n-Heptane
 34.752            -          -          -          Methylcyclohexane
 36.580            -          -          -          2,3,4-Trimethylpentane
 37.101            -          -          -          Toluene
 37.524            -          -          -          2-Methylheptane
 38.029            -          -          -          3-Methylheptane
 39.666            -          -          -          n-Octane
 43.059            -          -          -          Ethylbenzene
 43.617            -          -          -          m/p-Xylene
 44.781            -          -          -          Styrene
 45.064            -          -          -          o-Xylene
 45.851            -          -          -          n-Nonane
 46.921            -          -          -          Cumene
 48.671            -          -          -          n-Propylbenzene
 49.070            -          -          -          m-Ethyltoluene
 49.350            -          -          -          p-Ethyltoluene
 49.565            -          -          -          1,3,5-Trimethylbenzene
 50.165            -          -          -          o-Ethyltoluene
 50.999            -          -          -          1,2,4-Trimethylbenzene
 51.558            -          -          -          n-Decane
 52.863            -          -          -          1,2,3-Trimethylbenzene
 54.045            -          -          -          m-Diethylbenzene
 54.417            -          -          -          p-Diethylbenzene
 56.931            -          -          -          n-Undecane

Totals :                                3.82834

Uncalibrated Peaks    :      using compound Propane

RetTime  Type     Area      Amt/Area    Amount   Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 48.298 PB    9.82796e-1    1.00000 5.01914e-1      ?

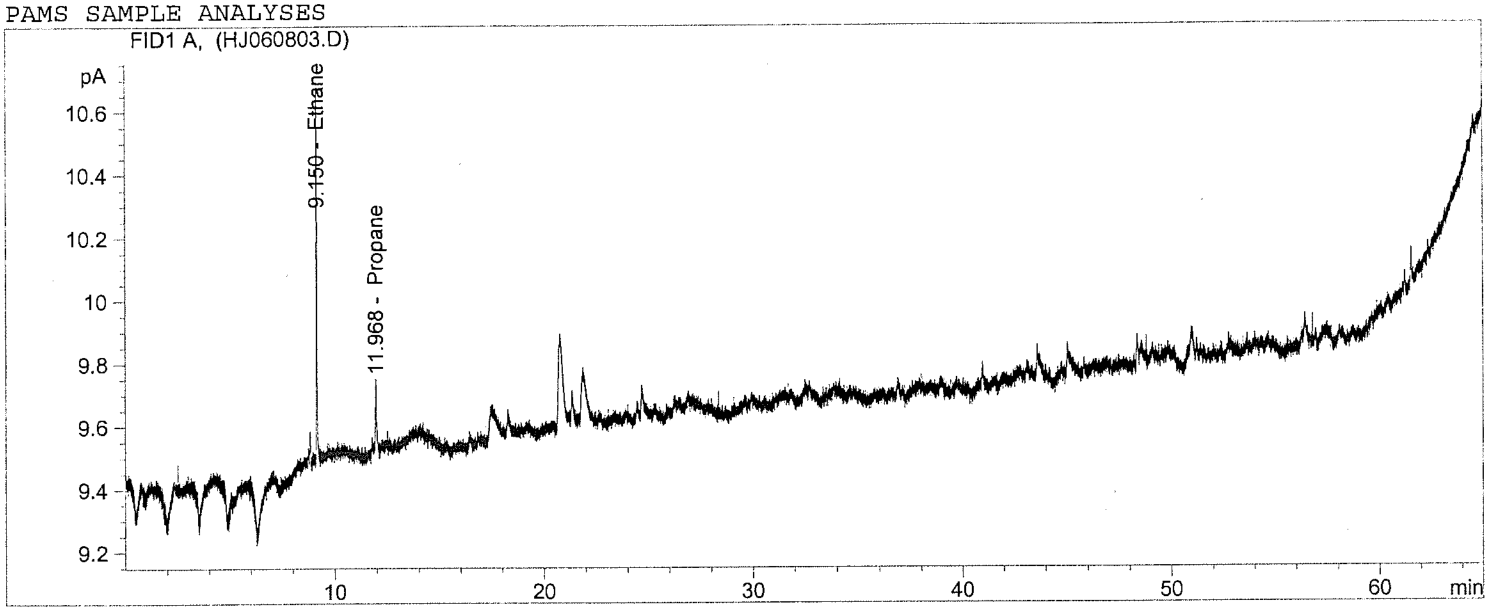
Uncalib. totals :                    5.01914e-1

 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

```
=====================================================================
Injection Date   : 10/6/2008 4:09:23 PM          Seq. Line :   3
Sample Name      : AL21990 $HBPPFID               Location : Vial 2
Acq. Operator    : JPC                                 Inj :   1
Acq. Instrument  : HP_FID2 SOP 1026             Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/8/2008 2:20:02 PM by JPC
                   (modified after loading)
PAMS SAMPLE ANALYSES
```



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/7/2008 2:28:57 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.837            -          -           -         Ethylene
  8.950            -          -           -         Acetylene
  9.150 BBA      2.82180    1.00000    1.44110      Ethane
 11.762            -          -           -         Propylene
 11.968 BBA   7.72749e-1    1.00000 3.94643e-1      Propane
 15.083            -          -           -         Isobutane
 16.411            -          -           -         1-Butene
 16.566            -          -           -         1,3-butadiene
 16.751            -          -           -         n-Butane
 17.433            -          -           -         t2-Butene
 18.083            -          -           -         c2-Butene
 20.238            -          -           -         Isopentane
 21.060            -          -           -         1-Pentene
 21.657            -          -           -         n-Pentane
 21.797            -          -           -         Isoprene
 22.050            -          -           -         t2-Pentene
 22.387            -          -           -         c2-Pentene
 23.432            -          -           -         2,2-Dimethylbutane
 24.821            -          -           -         Cyclopentane
```

```
RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.901             -          -          -        2,3-dimethylbutane
 25.385             -          -          -        2-Methylpentane
 26.100             -          -          -        3-Methylpentane
 26.351             -          -          -        1-Hexene
 27.004             -          -          -        n-Hexane
 28.659             -          -          -        Methylcyclopentane
 28.825             -          -          -        2,4-dimethylpentane
 30.256             -          -          -        Benzene
 30.740             -          -          -        Cyclohexane
 31.187             -          -          -        2-Methylhexane
 31.320             -          -          -        2,3-Dimethylpentane
 31.775             -          -          -        3-Methylhexane
 32.601             -          -          -        2,2,4-Trimethylpentane
 33.282             -          -          -        n-Heptane
 34.752             -          -          -        Methylcyclohexane
 36.580             -          -          -        2,3,4-Trimethylpentane
 37.101             -          -          -        Toluene
 37.524             -          -          -        2-Methylheptane
 38.029             -          -          -        3-Methylheptane
 39.666             -          -          -        n-Octane
 43.059             -          -          -        Ethylbenzene
 43.617             -          -          -        m/p-Xylene
 44.781             -          -          -        Styrene
 45.064             -          -          -        o-Xylene
 45.851             -          -          -        n-Nonane
 46.921             -          -          -        Cumene
 48.671             -          -          -        n-Propylbenzene
 49.070             -          -          -        m-Ethyltoluene
 49.350             -          -          -        p-Ethyltoluene
 49.565             -          -          -        1,3,5-Trimethylbenzene
 50.165             -          -          -        o-Ethyltoluene
 50.999             -          -          -        1,2,4-Trimethylbenzene
 51.558             -          -          -        n-Decane
 52.863             -          -          -        1,2,3-Trimethylbenzene
 54.045             -          -          -        m-Diethylbenzene
 54.417             -          -          -        p-Diethylbenzene
 56.931             -          -          -        n-Undecane

Totals :                                 1.83574

Uncalibrated Peaks    :      using compound Propane

 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

Date: 10/06/2008	Analyst: JPC	Batch: 192548	LIMS: AL21990
	%RECOVERY		
SRM concentration:	100.00		
SRM range:	90.00	110.00	
$I_SRM Result	Recovery %	In Range? (T/F)	
100.36	100.36	TRUE	
$C_SRM Result	Recovery %	In Range? (T/F)	
101.57	101.57	TRUE	
	RESPONSE FACTORS		
SRM concentration:	100.00		
SRM range (RF):	0.4594	0.5615	
$I_SRM area	Response Factor	In Range? (y/n)	
196.52	0.5089	TRUE	
$C_SRM area	Response Factor	In Range? (y/n)	
198.88	0.5028	TRUE	
RPD (I vs.C)	1.194		

From: Jianzhong Liu
Environmental Scientist Supervisor
Air Organics, LSD, DEQ

Date: May 13, 2008

Re: FID SRM PREPARATION

Stock Standard:

Manufacturer:	Spectra Gases, Inc.
Cylinder #:	CC-162783
Certified Concentration:	1.18 ppm
Expiration Date:	2/25/2009

Working SRM:

Target Concentration:	100.00 ppbC
Flow Rate of the Stock Std:	40 cc/min
Flow Rate of Nitrogen:	1376 cc/min

Spectra
Spectra Gases, Inc.

3434 Route 22 West, Branchburg, New Jersey 08876 USA
ISO 9001:2000

SHIPPED FROM: 80 INDUSTRIAL DRIVE ALPHA, NJ. 08865

SHIPPED TO:
Environmental Quality - LA
Air Organics Lab, LDEQ
1209 Leesville Road
Baton Rouge, LA 70802

CERTIFICATE OF ANALYSIS

SGI ORDER # :	125072	**CYLINDER # :**	CC-162783
ITEM# :	1	**CYLINDER PRES:**	2000 psig
CERTIFICATION DATE:	02/25/2008	**CYLINDER VALVE:**	CGA 350
P.O.# :	CC - J Liu	**PRODUCT EXPIRATION DATE:**	02/25/2009
BLEND TYPE:	CERTIFIED		

ANALYTICAL ACCURACY: + / - 2%

COMPONENT	REQUESTED GAS CONC	ANALYSIS
Propane	1.20 ppm	1.18 ppm
Nitrogen	Balance	Balance

Received on 3/7/08
opened on 3/7/58 M

NIST TRACEABLE

ANALYST: CP
Cheryl Patino

DATE: 02/25/2008

```
=====================================================================
Injection Date   : 10/6/2008 1:32:38 PM          Seq. Line :   1
Sample Name      : AL21990 $I_SRM                 Location : Vial 1
Acq. Operator    : JPC                                 Inj :   1
Acq. Instrument  : HP_FID2 SOP 1026             Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/8/2008 11:00:02 AM by JPC
                   (modified after loading)
PAMS SAMPLE ANALYSES
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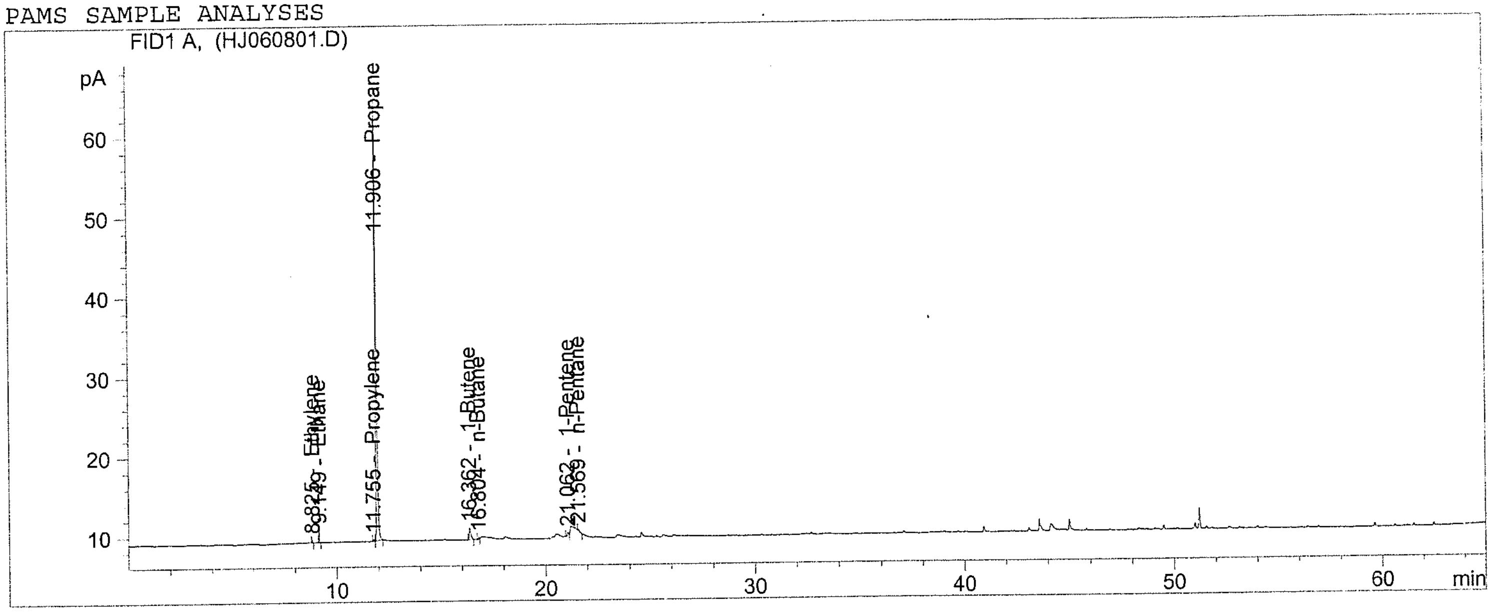


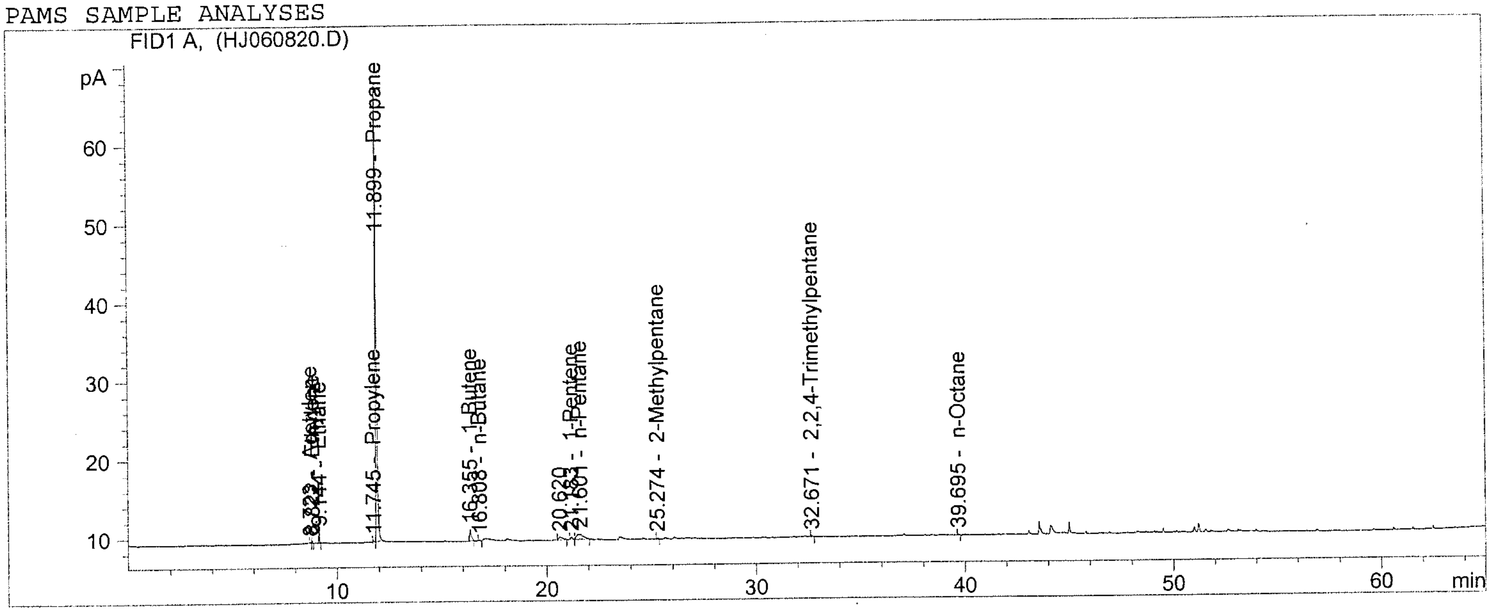
```
=====================================================================
                        External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/7/2008 2:28:57 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area     Amount    Grp   Name
 [min]         [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.825 PBA   7.49608e-1    1.00000 3.82825e-1    Ethylene
  8.950           -            -         -        Acetylene
  9.149 BBA      3.69022    1.00000    1.88459    Ethane
 11.755 PB    9.80980e-1    1.00000 5.00987e-1    Propylene
 11.906 BBA    196.51662    1.00000  100.36104    Propane
 15.083           -            -         -        Isobutane
 16.362 PB       8.18215    1.00000    4.17862    1-Butene
 16.566           -            -         -        1,3-butadiene
 16.804 PV    6.76274e-1    1.00000 3.45373e-1    n-Butane
 17.433           -            -         -        t2-Butene
 18.083           -            -         -        c2-Butene
 20.238           -            -         -        Isopentane
 21.062 PP       1.74923    1.00000 8.93330e-1    1-Pentene
 21.569 PB    9.99140e-1    1.00000 5.10261e-1    n-Pentane
 21.797           -            -         -        Isoprene
 22.050           -            -         -        t2-Pentene
 22.387           -            -         -        c2-Pentene
 23.432           -            -         -        2,2-Dimethylbutane
 24.821           -            -         -        Cyclopentane
```

```
=====================================================================
Injection Date  : 10/7/2008 3:52:46 PM          Seq. Line :  20
Sample Name     : AL21990 $C_SRM                  Location : Vial 1
Acq. Operator   : JPC                                  Inj :    1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/7/2008 11:39:44 AM by JPC
                  (modified after loading)
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/8/2008 2:20:02 PM by JPC
                  (modified after loading)
PAMS SAMPLE ANALYSES
```



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/7/2008 2:28:57 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,
```

RetTime [min]	Type	Area [pA*s]	Amt/Area	Amount [ppbc]	Grp	Name
8.723	PB	3.48399e-1	1.00000	1.77928e-1		Acetylene
8.822	BBA	6.55641e-1	1.00000	3.34836e-1		Ethylene
9.144	PBA	3.15885	1.00000	1.61322		Ethane
11.745	PB	1.01210	1.00000	5.16881e-1		Propylene
11.899	BBA	198.87964	1.00000	101.56783		Propane
15.083		-	-	-		Isobutane
16.355	PB	7.84820	1.00000	4.00808		1-Butene
16.566		-	-	-		1,3-butadiene
16.808	PP	5.05109e-1	1.00000	2.57959e-1		n-Butane
17.433		-	-	-		t2-Butene
18.083		-	-	-		c2-Butene
20.238		-	-	-		Isopentane
21.183	PB	2.01423	1.00000	1.02866		1-Pentene
21.601	BB	14.17153	1.00000	7.23740		n-Pentane
21.797		-	-	-		Isoprene
22.050		-	-	-		t2-Pentene
22.387		-	-	-		c2-Pentene
23.432		-	-	-		2,2-Dimethylbutane

Initial Calibration Verification (LCS)   FID #2

DATE: 10/6/2008   QC NO: AL21990   BATCH NO: 192548

JPC

Prep'd 9/09/08

COMPONENTS	STD (ppbc)	$I (ppbc)	REC% $I
Ethylene	49.20	53.23	108.2
Actetylene	48.90	35.37	72.3
Ethane	48.90	54.92	112.3
Propylene	48.90	44.40	90.8
Propane	49.00	50.28	102.6
n-Butane	48.90		
Isobutane	48.90	50.95	104.2
1-Butene	49.90	50.21	100.6
1,3-Butadiene	48.80	41.06	84.1
n-Butane	48.90	59.31	121.3
t2-butene	48.90	51.02	104.3
c2-butene	48.90	47.95	98.1
Isopentane	49.40	55.93	113.2
1-Pentene	50.70	54.00	106.5
n-Pentane	49.10	52.82	107.6
Isoprene	49.40	49.63	100.5
t2-Pentene	50.30	52.86	105.1
c2-Pentene	49.50	49.00	99.0
2,2-Dimethylbutane	49.90	52.77	105.7
Cyclopentane	59.60	51.95	87.2
2,3-Dimethylbutane	49.50	54.71	110.5
2-Methylpentane	49.10	51.77	105.4
3-Methylpentane	49.50	52.61	106.3
1-Hexene	49.30	44.52	90.3
1-Hexane	49.70	50.49	101.6
Methylcyclopentane	49.10	51.22	104.3
2,4-Dimethylpentane	49.50	51.50	104.0
Benzene	49.30	49.81	101.0
Cyclohexane	48.50	52.22	107.7
2-Methylhexane	48.80	50.08	102.6
2,3-Dimethylpentane	48.60	53.43	109.9
3-Methylhexane	48.80	51.16	104.8
2,2,4-Trimethylpentane	53.70	58.66	109.2
n-Heptane	49.00	48.26	98.5
Methylcyclohexane	49.60	52.99	106.8
2,3,4-Trimethylpentane	48.90	51.59	105.5
Toluene	49.80	48.38	97.1
2-Methylheptane	49.10	51.15	104.2
3-Methylheptane	50.70	51.91	102.4
n-Octane	48.50	48.80	100.6
Ethylbenzne	49.70	48.49	97.6
m/p-Xylene	98.50	97.62	99.1
Styrene	49.30	41.26	83.7
o Xylene	49.00	50.09	102.2
n-Nonane	48.60	47.11	96.9
Cumene	49.40	49.56	100.3
n-Propylbenzene	49.00	46.25	94.4
m-Ethyltoluene	48.70	45.97	94.4
p-Ethyltoluene	48.10	44.88	93.3
1,3,5-Trimethylbenzene	48.70	48.88	100.4
o-Ethyltouene	48.50	47.51	98.0
1,2,4-trimethylbenzene	49.00	47.02	96.0
n-Decane	48.90	45.96	94.0
1,2,3-Trimethylbenzene	48.70	42.56	87.4
m-Diethylbenzene	48.40	41.86	86.5
p-Diethylbenzene	48.40	34.17	70.6
n-Undecane	48.90	41.34	84.5

From: Jianzhong Liu
Environmental Scientist Supervisor
Air Organics, LSD, DEQ

Date: June 3, 2008

Re: Low Recovery of p-Diethylbenzene in PAMS LCS Standard

Stock Standard:

Manufacturer:	Matheson Tri-Gas, Inc.
Cylinder #:	SX39238D
Lot#:	1057610175
Expiration Date:	12/03/2009

From the studies of runs in different GC/FIDs, the recovery of p-diethylbenzene is constantly low (~ 75%). However, the recovery of this compound in PAMS standard is normal (~100%). Therefore, 60% (75%*80%) recovery for this compound in LCS is acceptable.

Concentrations (ppbC) of Different Diluton of Matheson Stock Standard

Cylinder #: SX39238D; Lot #: 1057610175; Expiration Date: 12/3/2008

COMPONENTS	Stock Std	10 times	71.425 times	166.65 times	250 times	500 times
Ethylene	492.00	49.20	6.89	2.95	1.97	0.98
Actetylene	489.00	48.90	6.85	2.93	1.96	0.98
Ethane	489.00	48.90	6.85	2.93	1.96	0.98
Propylene	489.00	48.90	6.85	2.93	1.96	0.98
Propane	490.00	49.00	6.86	2.94	1.96	0.98
n-Butane	489.00	48.90	6.85	2.93	1.96	0.98
Isobutane	489.00	48.90	6.85	2.93	1.96	0.98
1-Butene	499.00	49.90	6.99	2.99	2.00	1.00
1,3-Butadiene	488.00	48.80	6.83	2.93	1.95	0.98
n-Butane	489.00	48.90	6.85	2.93	1.96	0.98
t2-butene	489.00	48.90	6.85	2.93	1.96	0.98
c2-butene	489.00	48.90	6.85	2.93	1.96	0.98
Isopentane	494.00	49.40	6.92	2.96	1.98	0.99
1-Pentene	507.00	50.70	7.10	3.04	2.03	1.01
n-Pentane	491.00	49.10	6.87	2.95	1.96	0.98
Isoprene	494.00	49.40	6.92	2.96	1.98	0.99
t2-Pentene	503.00	50.30	7.04	3.02	2.01	1.01
c2-Pentene	495.00	49.50	6.93	2.97	1.98	0.99
2,2-Dimethylbutane	499.00	49.90	6.99	2.99	2.00	1.00
Cyclopentane	596.00	59.60	8.34	3.58	2.38	1.19
2,3-Dimethylbutane	495.00	49.50	6.93	2.97	1.98	0.99
2-Methylpentane	491.00	49.10	6.87	2.95	1.96	0.98
3-Methylpentane	495.00	49.50	6.93	2.97	1.98	0.99
1-Hexene	493.00	49.30	6.90	2.96	1.97	0.99
1-Hexane	497.00	49.70	6.96	2.98	1.99	0.99
Methylcyclopentane	491.00	49.10	6.87	2.95	1.96	0.98
2,4-Dimethylpentane	495.00	49.50	6.93	2.97	1.98	0.99
Benzene	493.00	49.30	6.90	2.96	1.97	0.99
Cyclohexane	485.00	48.50	6.79	2.91	1.94	0.97
2-Methylhexane	488.00	48.80	6.83	2.93	1.95	0.98
2,3-Dimethylpentane	486.00	48.60	6.80	2.92	1.94	0.97
3-Methylhexane	488.00	48.80	6.83	2.93	1.95	0.98
2,2,4-Trimethylpentane	537.00	53.70	7.52	3.22	2.15	1.07
n-Heptane	490.00	49.00	6.86	2.94	1.96	0.98
Methylcyclohexane	496.00	49.60	6.94	2.98	1.98	0.99
2,3,4-Trimethylpentane	489.00	48.90	6.85	2.93	1.96	0.98
Toluene	498.00	49.80	6.97	2.99	1.99	1.00
2-Methylheptane	491.00	49.10	6.87	2.95	1.96	0.98
3-Methylheptane	507.00	50.70	7.10	3.04	2.03	1.01
n-Octane	485.00	48.50	6.79	2.91	1.94	0.97
Ethylbenzne	497.00	49.70	6.96	2.98	1.99	0.99
m/p-Xylene	985.00	98.50	13.79	5.91	3.94	1.97
Styrene	493.00	49.30	6.90	2.96	1.97	0.99
o Xylene	490.00	49.00	6.86	2.94	1.96	0.98
n-Nonane	486.00	48.60	6.80	2.92	1.94	0.97
Cumene	494.00	49.40	6.92	2.96	1.98	0.99
n-Propylbenzene	490.00	49.00	6.86	2.94	1.96	0.98
m-Ethyltoluene	487.00	48.70	6.82	2.92	1.95	0.97
p-Ethyltoluene	481.00	48.10	6.73	2.89	1.92	0.96
1,3,5-Trimethylbenzene	487.00	48.70	6.82	2.92	1.95	0.97
o-Ethyltouene	485.00	48.50	6.79	2.91	1.94	0.97
1,2,4-trimethylbenzene	490.00	49.00	6.86	2.94	1.96	0.98
n-Decane	489.00	48.90	6.85	2.93	1.96	0.98
1,2,3-Trimethylbenzene	487.00	48.70	6.82	2.92	1.95	0.97
m-Diethylbenzene	484.00	48.40	6.78	2.90	1.94	0.97
p-Diethylbenzene	484.00	48.40	6.78	2.90	1.94	0.97
n-Undecane	489.00	48.90	6.85	2.93	1.96	0.98

Matheson 500 ppbC PAMS dilutions

MATHESON TRI•GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057610175

PRODUCT:

CYLINDER NUMBER: SX39238D
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	500 ppbC	498 ppbC	+/- 5%
2-Methylheptane	500 ppbC	491 ppbC	+/- 5%
3-Methylheptane	500 ppbC	507 ppbC	+/- 5%
n-Octane	500 ppbC	485 ppbC	+/- 5%
Ethylbenzene	500 ppbC	497 ppbC	+/- 5%
p-Xylene	500 ppbC	490 ppbC	+/- 5%
m-Xylene	500 ppbC	495 ppbC	+/- 5%
Styrene	500 ppbC	493 ppbC	+/- 5%
o-Xylene	500 ppbC	490 ppbC	+/- 5%
n-Nonane	500 ppbC	486 ppbC	+/- 5%
Isopropylbenzene	500 ppbC	494 ppbC	+/- 5%
n-Propylbenzene	500 ppbC	490 ppbC	+/- 5%
n-Decane	500 ppbC	489 ppbC	+/- 5%
m-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
p-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
n-Dodecane	500 ppbC	492 ppbC	+/- 5%
m-Ethyltoluene	500 ppbC	487 ppbC	+/- 5%
o-Ethyltoluene	500 ppbC	485 ppbC	+/- 5%
p-Ethyltoluene	500 ppbC	481 ppbC	+/- 5%
n-Undecane	500 ppbC	489 ppbC	+/- 5%
1,2,3-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,3,5-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,2,4-Trimethylbenzene	500 ppbC	490 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received on 12/16/07 [illegible]

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck
ANALYST

Derek St

12/4/2007
DATE SIGNED

MATHESON TRI·GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057610175

PRODUCT:

CYLINDER NUMBER: SX39238D
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	500 ppbC	498 ppbC	+/- 5%
2-Methylheptane	500 ppbC	491 ppbC	+/- 5%
3-Methylheptane	500 ppbC	507 ppbC	+/- 5%
n-Octane	500 ppbC	485 ppbC	+/- 5%
Ethylbenzene	500 ppbC	497 ppbC	+/- 5%
p-Xylene	500 ppbC	490 ppbC	+/- 5%
m-Xylene	500 ppbC	495 ppbC	+/- 5%
Styrene	500 ppbC	493 ppbC	+/- 5%
o-Xylene	500 ppbC	490 ppbC	+/- 5%
n-Nonane	500 ppbC	486 ppbC	+/- 5%
Isopropylbenzene	500 ppbC	494 ppbC	+/- 5%
n-Propylbenzene	500 ppbC	490 ppbC	+/- 5%
n-Decane	500 ppbC	489 ppbC	+/- 5%
m-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
p-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
n-Dodecane	500 ppbC	492 ppbC	+/- 5%
m-Ethyltoluene	500 ppbC	487 ppbC	+/- 5%
o-Ethyltoluene	500 ppbC	485 ppbC	+/- 5%
p-Ethyltoluene	500 ppbC	481 ppbC	+/- 5%
n-Undecane	500 ppbC	489 ppbC	+/- 5%
1,2,3-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,3,5-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,2,4-Trimethylbenzene	500 ppbC	490 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received on 12/16/07 [illegible]

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck
ANALYST

Derek St

12/4/2007
DATE SIGNED

```
=====================================================================
Injection Date   : 10/6/2008 5:27:43 PM          Seq. Line :    4
Sample Name      : AL21990 $L1PPFID               Location : Vial 4
Acq. Operator    : JPC                                 Inj :    1
Acq. Instrument  : HP_FID2 SOP 1026             Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/8/2008 2:27:02 PM by JPC
                   (modified after loading)
PAMS SAMPLE ANALYSES
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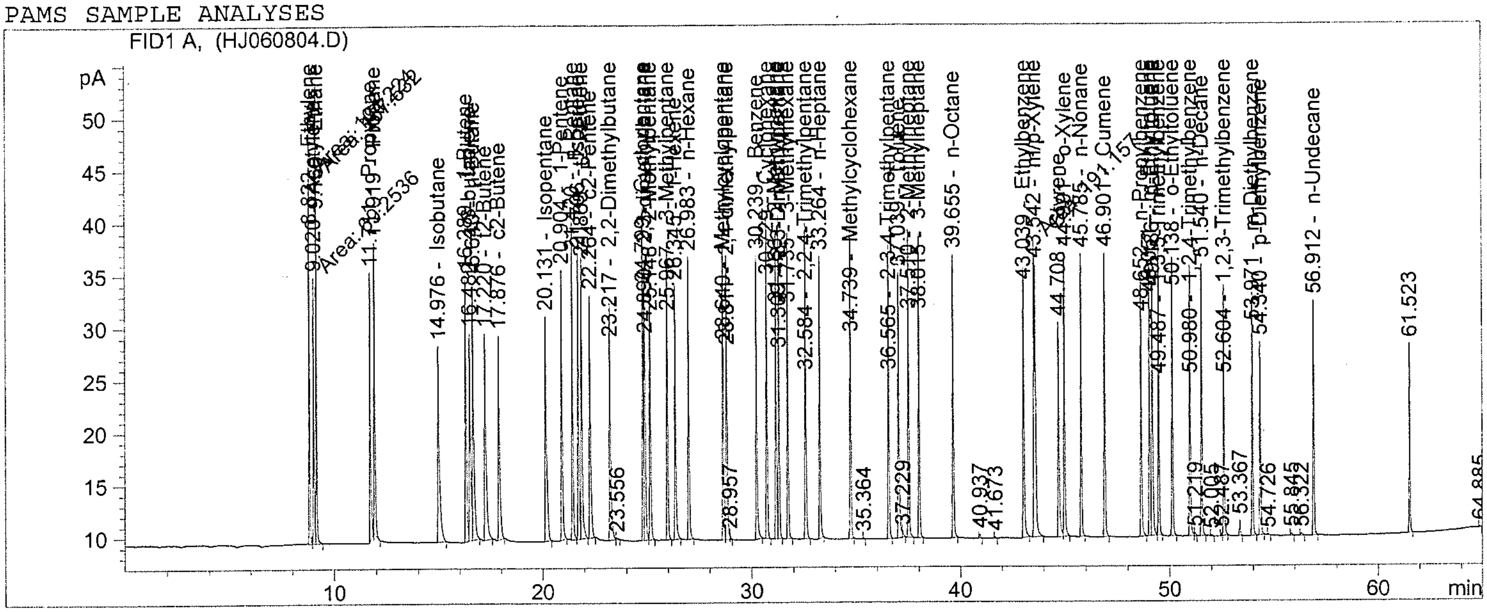

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=====================================================================
                   External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/8/2008 2:27:00 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,
```

RetTime [min]	Type	Area [pA*s]	Amt/Area	Amount [ppbc]	Grp	Name
8.822	MF	104.22430	1.00000	53.22735		Ethylene
9.020	FM	69.25359	1.00000	35.36781		Acetylene
9.150	FM	107.53191	1.00000	54.91655		Ethane
11.711	PB	86.94897	1.00000	44.40484		Propylene
11.919	BBA	98.45387	1.00000	50.28039		Propane
14.976	PB +	99.75800	1.00000	50.94641		Isobutane
16.289	PV	98.32315	1.00000	50.21363		1-Butene
16.482	VV	80.40062	1.00000	41.06060		1,3-butadiene
16.640	VB	116.12728	1.00000	59.30620		n-Butane
17.220	PB	99.90575	1.00000	51.02187		t2-Butene
17.876	PB	93.89185	1.00000	47.95057		c2-Butene
20.131	BB	109.51743	1.00000	55.93055		Isopentane
20.904	PB	105.74088	1.00000	54.00186		1-Pentene
21.420	VB	103.42786	1.00000	52.82061		n-Pentane
21.706	BV	97.19004	1.00000	49.63495		Isoprene
21.865	VB	103.50215	1.00000	52.85855		t2-Pentene
22.264	PP	95.93831	1.00000	48.99569		c2-Pentene
23.217	BB	103.32272	1.00000	52.76691		2,2-Dimethylbutane
24.799	BV	101.73061	1.00000	51.95382		Cyclopentane

```
RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.890 VV      107.13717    1.00000   54.71495    2,3-dimethylbutane
 25.148 VB      101.36118    1.00000   51.76515    2-Methylpentane
 25.967 PB      103.01171    1.00000   52.60808    3-Methylpentane
 26.345 BB       87.16730    1.00000   44.51634    1-Hexene
 26.983 PB       98.86594    1.00000   50.49083    n-Hexane
 28.640 BV      100.29522    1.00000   51.22077    Methylcyclopentane
 28.811 VV      100.83565    1.00000   51.49677    2,4-dimethylpentane
 30.239 PB  +    97.53899    1.00000   49.81316    Benzene
 30.729 PB      102.25732    1.00000   52.22282    Cyclohexane
 31.166 BV       98.05479    1.00000   50.07658    2-Methylhexane
 31.309 VB      104.61568    1.00000   53.42723    2,3-Dimethylpentane
 31.735 BB      100.18056    1.00000   51.16221    3-Methylhexane
 32.584 BB      114.87085    1.00000   58.66454    2,2,4-Trimethylpentane
 33.264 PB       94.49777    1.00000   48.26001    n-Heptane
 34.739 BB      103.76786    1.00000   52.99425    Methylcyclohexane
 36.565 BB      101.02585    1.00000   51.59390    2,3,4-Trimethylpentane
 37.039 BV  +    94.72859    1.00000   48.37789    Toluene
 37.510 BB      100.16042    1.00000   51.15192    2-Methylheptane
 38.015 BB      101.65383    1.00000   51.91461    3-Methylheptane
 39.655 BB       95.54650    1.00000   48.79560    n-Octane
 43.039 BB       94.95210    1.00000   48.49204    Ethylbenzene
 43.542 MM      191.15706    1.00000   97.62391    m/p-Xylene
 44.708 BV       80.79482    1.00000   41.26192    Styrene
 44.991 VB       98.08223    1.00000   50.09059    o-Xylene
 45.785 BB       92.23728    1.00000   47.10558    n-Nonane
 46.901 BB       97.04679    1.00000   49.56180    Cumene
 48.652 BB       90.55850    1.00000   46.24823    n-Propylbenzene
 49.051 PV       90.00822    1.00000   45.96720    m-Ethyltoluene
 49.186 VV       87.88163    1.00000   44.88115    p-Ethyltoluene
 49.487 VB       95.70393    1.00000   48.87600    1,3,5-Trimethylbenzene
 50.138 VB       93.03803    1.00000   47.51452    o-Ethyltoluene
 50.980 BB       92.07362    1.00000   47.02200    1,2,4-Trimethylbenzene
 51.540 BB       89.99635    1.00000   45.96114    n-Decane
 52.604 VB       83.34243    1.00000   42.56298    1,2,3-Trimethylbenzene
 53.971 BB       81.96743    1.00000   41.86077    m-Diethylbenzene
 54.340 BB       66.90073    1.00000   34.16620    p-Diethylbenzene
 56.912 BB  +    80.93950    1.00000   41.33580    n-Undecane

Totals :                             2803.45860

Uncalibrated Peaks     :       using compound Propane

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
 23.556 BB        1.24691    1.00000 6.36796e-1    ?
 28.957 VB        1.57230    1.00000 8.02974e-1    ?
 35.364 BP     3.84897e-1    1.00000 1.96567e-1    ?
 37.229 VB        2.65673    1.00000    1.35679    ?
 40.937 BB        1.58487    1.00000 8.09393e-1    ?
 41.673 PP     5.33042e-1    1.00000 2.72224e-1    ?
 51.219 BB        1.39878    1.00000 7.14358e-1    ?
 52.005 PB     6.07205e-1    1.00000 3.10099e-1    ?
 52.487 PV     7.31412e-1    1.00000 3.73532e-1    ?
 53.367 PB        5.23272    1.00000    2.67235    ?
 54.726 BP     3.53976e-1    1.00000 1.80775e-1    ?
 55.845 PP        1.01993    1.00000 5.20876e-1    ?
 56.322 PB        1.10409    1.00000 5.63859e-1    ?
 61.523 BB       53.39899    1.00000   27.27087    ?
 64.885 PB     3.42649e-1    1.00000 1.74991e-1    ?

Uncalib. totals :                      36.85645

 Results obtained with enhanced integrator!
1 Warnings or Errors :
```

```
    Warning : Calibration warnings (see calibration table listing)

    =====================================================================
                              *** End of Report ***
```

PAMS RETENTION TIME STD FID #2 lot #1057410185

DATE: 10/6/2008 QC NO: AL21990 BATCH NO: 192548

COMPONENTS	STD (ppbc)	$I (ppbc)	REC% $I
Ethylene	21.00	**22.94**	**109.2**
Actetylene	42.00	**11.16**	**26.6**
Ethane	26.00	**27.84**	**107.1**
Propylene	26.00	**19.11**	**73.5**
Propane	40.00	**40.26**	**100.6**
n-Butane	43.00		
Isobutane	25.00	**26.05**	**104.2**
1-Butene	32.00	**30.48**	**95.2**
1,3-Butadiene	32.00	**23.30**	**72.8**
n-Butane	43.00	**46.18**	**107.4**
t2-butene	26.00	**24.66**	**94.8**
c2-butene	38.00	**35.48**	**93.4**
Isopentane	40.00	**42.05**	**105.1**
1-Pentene	25.00	**24.17**	**96.7**
n-Pentane	26.00	**24.95**	**96.0**
Isoprene	42.00	**35.83**	**85.3**
t2-Pentene	25.00	**25.78**	**103.1**
c2-Pentene	34.00	**32.29**	**95.0**
2,2-Dimethylbutane	40.00	**42.64**	**106.6**
Cyclopentane	21.00	**19.84**	**94.5**
2,3-Dimethylbutane	51.00	**54.99**	**107.8**
2-Methylpentane	21.00	**21.84**	**104.0**
3-Methylpentane	41.00	**41.57**	**101.4**
1-Hexene	61.00	**57.10**	**93.6**
1-Hexane	30.00	**30.03**	**100.1**
Methylcyclopentane	26.00	**26.16**	**100.6**
2,4-Dimethylpentane	40.00	**40.34**	**100.8**
Benzene	31.00	**28.75**	**92.7**
Cyclohexane	42.00	**42.30**	**100.7**
2-Methylhexane	25.00	**24.48**	**97.9**
2,3-Dimethylpentane	54.00	**52.95**	**98.0**
3-Methylhexane	26.00	**25.09**	**96.5**
2,2,4-Trimethylpentane	31.00	**31.52**	**101.7**
n-Heptane	26.00	**24.10**	**92.7**
Methylcyclohexane	31.00	**31.03**	**100.1**
2,3,4-Trimethylpentane	25.00	**24.86**	**99.4**
Toluene	40.00	**36.01**	**90.0**
2-Methylheptane	25.00	**24.24**	**97.0**
3-Methylheptane	25.00	**24.82**	**99.3**
n-Octane	31.00	**28.01**	**90.4**
Ethylbenzne	25.00	**22.21**	**88.8**
m/p-Xylene	42.00	**35.72**	**85.0**
Styrene	41.00	**31.12**	**75.9**
o Xylene	26.00	**23.90**	**91.9**
n-Nonane	25.00	**22.68**	**90.7**
Cumene	40.00	**37.05**	**92.6**
n-Propylbenzene	30.00	**26.45**	**88.2**
m-Ethyltoluene	25.00	**22.79**	**91.2**
p-Ethyltoluene	43.00	**36.53**	**84.9**
1,3,5-Trimethylbenzene	26.00	**22.69**	**87.3**
o-Ethyltouene	27.00	**31.10**	**115.2**
1,2,4-trimethylbenzene	39.00	**35.81**	**91.8**
n-Decane	30.00	**26.87**	**89.6**
1,2,3-Trimethylbenzene	25.00	**23.31**	**93.3**
m-Diethylbenzene	40.00	**35.58**	**88.9**
p-Diethylbenzene	27.00	**22.03**	**81.6**
n-Undecane	41.00	**24.55**	**59.9**

PAms

MATHESON TRI•GAS

Certified Mixture Grade

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057410185

PRODUCT:

CYLINDER NUMBER: CC-250112
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Ethylene	20 ppbC	21 ppbC	+/- 5%
Ethane	25 ppbC	26 ppbC	+/- 5%
Acetylene	40 ppbC	42 ppbC	+/- 5%
Propylene	25 ppbC	26 ppbC	+/- 5%
Propane	40 ppbC	40 ppbC	+/- 5%
Isobutane	25 ppbC	25 ppbC	+/- 5%
1-Butene	30 ppbC	32 ppbC	+/- 5%
1,3-Butadiene	30 ppbC	32 ppbC	+/- 5%
n-Butane	40 ppbC	43 ppbC	+/- 5%
trans-2-Butene	25 ppbC	26 ppbC	+/- 5%
cis-2-Butene	35 ppbC	38 ppbC	+/- 5%
Isopentane	40 ppbC	40 ppbC	+/- 5%
1-Pentene	25 ppbC	25 ppbC	+/- 5%
n-Pentane	25 ppbC	26 ppbC	+/- 5%
Isoprene	40 ppbC	42 ppbC	+/- 5%
trans-2-Pentene	25 ppbC	25 ppbC	+/- 5%
cis-2-Pentene	35 ppbC	34 ppbC	+/- 5%
Cyclopentene	20 ppbC	21 ppbC	+/- 5%
2,2-Dimethylbutane	40 ppbC	40 ppbC	+/- 5%
2-Methylpentane	20 ppbC	21 ppbC	+/- 5%
3-Methylpentane	40 ppbC	41 ppbC	+/- 5%
2,3-Dimethylbutane	50 ppbC	51 ppbC	+/- 5%
1-Hexene	60 ppbC	61 ppbC	+/- 5%
n-Hexane	30 ppbC	30 ppbC	+/- 5%
Methylcyclopentane	25 ppbC	26 ppbC	+/- 5%
2,4-Dimethylpentane	40 ppbC	40 ppbC	+/- 5%
Benzene	30 ppbC	31 ppbC	+/- 5%
Cyclohexane	40 ppbC	42 ppbC	+/- 5%
2,3-Dimethylpentane	50 ppbC	54 ppbC	+/- 5%
2-Methylhexane	25 ppbC	25 ppbC	+/- 5%
3-Methylhexane	25 ppbC	26 ppbC	+/- 5%
n-Heptane	25 ppbC	26 ppbC	+/- 5%
2,2,4-Trimethylpentane	30 ppbC	31 ppbC	+/- 5%
Methylcyclohexane	30 ppbC	31 ppbC	+/- 5%
2,3,4-Trimethylpentane	25 ppbC	25 ppbC	+/- 5%

Received on 12/4/07

TRACEABLE TO REFERENCE STANDARD SOURCE/NUMBER:
TRACEABLE TO NIST TRACEABLE WEIGHT CERTIFICATE:

MATHESON TRI•GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd

Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057410185

PRODUCT:

CYLINDER NUMBER: CC-250112
SIZE: 1I
CGA/DISS OUTLET: 350
CONTENT: 131 liters
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	40 ppbC	40 ppbC	+/- 5%
2-Methylheptane	25 ppbC	25 ppbC	+/- 5%
3-Methylheptane	25 ppbC	25 ppbC	+/- 5%
n-Octane	30 ppbC	31 ppbC	+/- 5%
Ethylbenzene	25 ppbC	25 ppbC	+/- 5%
p-Xylene	20 ppbC	21 ppbC	+/- 5%
m-Xylene	20 ppbC	21 ppbC	+/- 5%
Styrene	40 ppbC	41 ppbC	+/- 5%
o-Xylene	25 ppbC	26 ppbC	+/- 5%
n-Nonane	25 ppbC	25 ppbC	+/- 5%
Isopropylbenzene	40 ppbC	40 ppbC	+/- 5%
n-Propylbenzene	30 ppbC	30 ppbC	+/- 5%
n-Decane	30 ppbC	30 ppbC	+/- 5%
m-Diethylbenzene	40 ppbC	40 ppbC	+/- 5%
p-Diethylbenzene	25 ppbC	27 ppbC	+/- 5%
n-Dodecane	30 ppbC	31 ppbC	+/- 5%
m-Ethyltoluene	25 ppbC	25 ppbC	+/- 5%
o-Ethyltoluene	30 ppbC	27 ppbC	+/- 5%
p-Ethyltoluene	40 ppbC	43 ppbC	+/- 5%
n-Undecane	40 ppbC	41 ppbC	+/- 5%
1,2,3-Trimethylbenzene	25 ppbC	25 ppbC	+/- 5%
1,3,5-Trimethylbenzene	25 ppbC	26 ppbC	+/- 5%
1,2,4-Trimethylbenzene	40 ppbC	39 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received 12/6/07

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck
ANALYST

Derek

12/4/2007
DATE SIGNED

```
=====================================================================
Injection Date   : 10/6/2008 2:50:58 PM          Seq. Line :    2
Sample Name      : AL21990 $I_PPFID                Location : Vial 3
Acq. Operator    : JPC                                  Inj :    1
Acq. Instrument  : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/8/2008 2:18:27 PM by JPC
                   (modified after loading)
PAMS SAMPLE ANALYSES
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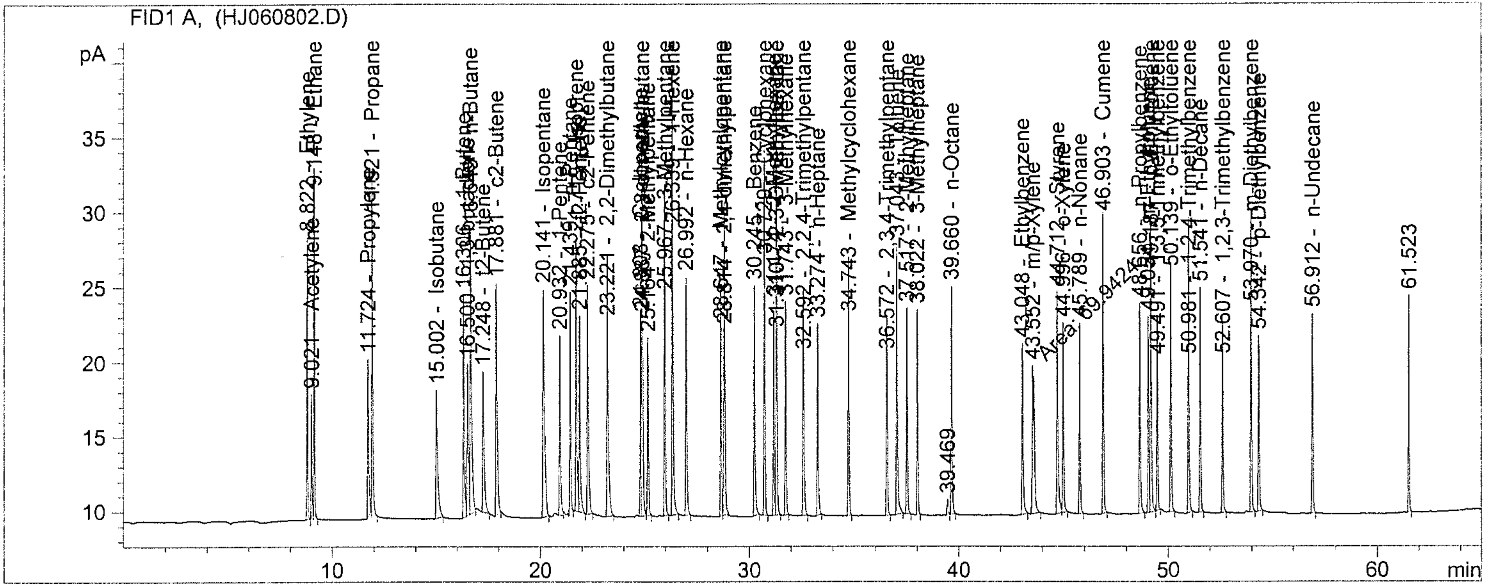

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=====================================================================
                      External Standard Report
=====================================================================

Sorted By              :      Signal
Calib. Data Modified   :      10/7/2008 2:28:57 PM
Multiplier             :      0.5107
Dilution               :      1.0000
Sample Amount          :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.822 BBA     44.92053    1.00000   22.94091    Ethylene
  9.021 BB      21.85233    1.00000   11.15999    Acetylene
  9.148 BBA     54.52073    1.00000   27.84374    Ethane
 11.724 PB      37.41565    1.00000   19.10817    Propylene
 11.921 BBA     78.83289    1.00000   40.25996    Propane
 15.002 PB   +  51.00570    1.00000   26.04861    Isobutane
 16.306 PV      59.67336    1.00000   30.47518    1-Butene
 16.500 VV      45.61602    1.00000   23.29610    1,3-butadiene
 16.649 VV      90.43373    1.00000   46.18451    n-Butane
 17.248 PB      48.28507    1.00000   24.65918    t2-Butene
 17.881 PB      69.47704    1.00000   35.48192    c2-Butene
 20.141 PB      82.33052    1.00000   42.04620    Isopentane
 20.932 BV      47.33178    1.00000   24.17234    1-Pentene
 21.439 VB      48.85149    1.00000   24.94846    n-Pentane
 21.719 BV      70.16476    1.00000   35.83315    Isoprene
 21.885 VB      50.48055    1.00000   25.78042    t2-Pentene
 22.275 PB      63.22242    1.00000   32.28769    c2-Pentene
 23.221 PB      83.49139    1.00000   42.63905    2,2-Dimethylbutane
 24.808 BV      38.84512    1.00000   19.83820    Cyclopentane
```

```
RetTime  Type     Area     Amt/Area    Amount    Grp   Name
 [min]           [pA*s]                [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.887 VV     107.66957    1.00000   54.98685    2,3-dimethylbutane
 25.164 VB      42.76157    1.00000   21.83834    2-Methylpentane
 25.967 PB      81.40124    1.00000   41.57161    3-Methylpentane
 26.339 PB     111.81145    1.00000   57.10211    1-Hexene
 26.992 BB      58.80105    1.00000   30.02970    n-Hexane
 28.647 PV      51.22998    1.00000   26.16315    Methylcyclopentane
 28.814 VB      78.98666    1.00000   40.33849    2,4-dimethylpentane
 30.245 BB  +   56.29302    1.00000   28.74885    Benzene
 30.729 PB      82.83351    1.00000   42.30307    Cyclohexane
 31.174 BV      47.93708    1.00000   24.48147    2-Methylhexane
 31.310 VB     103.67268    1.00000   52.94564    2,3-Dimethylpentane
 31.743 BB      49.13598    1.00000   25.09375    3-Methylhexane
 32.592 BB      61.71513    1.00000   31.51791    2,2,4-Trimethylpentane
 33.274 BB      47.18862    1.00000   24.09923    n-Heptane
 34.743 BB      60.76443    1.00000   31.03239    Methylcyclohexane
 36.572 BB      48.67302    1.00000   24.85731    2,3,4-Trimethylpentane
 37.043 PB  +   70.50365    1.00000   36.00622    Toluene
 37.517 BB      47.46110    1.00000   24.23838    2-Methylheptane
 38.022 BB      48.59916    1.00000   24.81959    3-Methylheptane
 39.660 BB      54.85380    1.00000   28.01383    n-Octane
 43.048 BB      43.48153    1.00000   22.20602    Ethylbenzene
 43.552 MM      69.94241    1.00000   35.71959    m/p-Xylene
 44.712 BV      60.93937    1.00000   31.12174    Styrene
 44.996 VB      46.80718    1.00000   23.90443    o-Xylene
 45.789 BB      44.40535    1.00000   22.67781    n-Nonane
 46.903 BB      72.55196    1.00000   37.05229    Cumene
 48.656 BB      51.79570    1.00000   26.45206    n-Propylbenzene
 49.054 BV      44.63218    1.00000   22.79365    m-Ethyltoluene
 49.187 VP      71.52545    1.00000   36.52805    p-Ethyltoluene
 49.491 VB      44.43419    1.00000   22.69254    1,3,5-Trimethylbenzene
 50.139 BB      60.89012    1.00000   31.09658    o-Ethyltoluene
 50.981 BB      70.12561    1.00000   35.81315    1,2,4-Trimethylbenzene
 51.541 BB      52.62347    1.00000   26.87481    n-Decane
 52.607 BB      45.64962    1.00000   23.31326    1,2,3-Trimethylbenzene
 53.970 BB      69.66376    1.00000   35.57728    m-Diethylbenzene
 54.342 PB      43.14646    1.00000   22.03490    p-Diethylbenzene
 56.912 BB  +   48.08060    1.00000   24.55476    n-Undecane

Totals :                            1705.60458

Uncalibrated Peaks     :      using compound Propane

RetTime  Type     Area     Amt/Area    Amount    Grp   Name
 [min]           [pA*s]                [ppbc]
-------|------|----------|----------|----------|--|------------------
 39.469 PP       3.90622    1.00000    1.99490    ?
 61.523 BB      42.26542    1.00000   21.58495    ?

Uncalib. totals :                     23.57986

 Results obtained with enhanced integrator!
1 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)

=====================================================================
                          *** End of Report ***
```

GC/FID Daily Worksheet FID 2

Date Oct. 9, 2008
Batch # 192687(A)
Operator JPC/JAK
QC # AL22195

Dup= AL21743 (Port 5)

Working Gases and Quality Control Standards:

Carrier Gas Helium Pressure ______ Pulse Gas Pressure 15.0
Combustion Air Pressure 80.0 Hydrogen Pressure 55.0
Nitrogen Pressure for dewar 25.0
ZAB Pressure 29.5; Preparation Date 10-2-08; Canister ID GCR44
HAB Pressure 24.0; Preparation date 10-6-08; Canister ID GCR24
LCS: Std ID 105760175 Preparation Date 10-7-08 JAK; Pressure 29.5;
Canister ID S1404
PAMS: Std ID CC250112 Preparation Date 10-2-08; Pressure 30.5;
Canister ID G1152
SRM: Std ID CC162783; Preparation Date 10-2-08; Pressure 30.0;
Canister ID G1124

Entech Setup:

Name of Sequence: 100908
Sequence Saved? Y Sequence Printed? Y
Leak Check Performed? Y

GC/FID Chemstation Setup:

Name of Sequence: 100908
Sequence Saved? Y Sequence Printed? Y
Bakeout.M Loaded at End? Y

Acquisition Startup:

Do Both Sequences Match? Y Canister Valves Open? Y
Entech Sequence Started? Y Chemstation Sequence Started? Y

Total Runs in the sequences:

Number of Std: 3
Number of Blanks: 2
Number of Samples 13
Number of Duplicates: 2
Number of Sys Blanks: —
Number of Cert Cans: —
Total Runs in the sequences: 20

Date and Time Sequence Started: 10-9-08 / 8:45AM

Comments: ReBoot: ?

PROJECT NAME Oct. 9, 2008 NOTEBOOK NO HP_FID2

Site/Desc	Run Date	Port#	Can ID #	LIMS#	Analysis Code#	Data File #
SRM	Oct. 9, 2008	S1	G1124	AL22195	$I_SRM	HJ090801 ✓
PAMS	↓	1-1	G1152	↓	$I_PPFID	2 ✓
HAB	↓	S3	GCR24	↓	$HBPPFID	3 ✓
LCS	↓	16	S1404	↓	$L1PPFID	4 ✓
ZAB	↓	S4	GCR44	↓ ΔΔ	$B_PPFID	5 ✓
LSU	9-27-08	2	10002	AL 21711	$PPFID	6 ✓
CARV	9-20-08	3	GCR42	712	↓	7 ✓ ✓
CARV	9-21-08	4	CCR7	713	↓	8 ✓
*CAP	9-26-08	5	G1241	743	↓	9 ✓
CAP	9-27-08	6	G1049	744	↓	10 ✓
BAKER	9-27-08	7	3323	763	↓	11 ✓
SCL	9-27-08	8	7025	764	↓	12 ✓
PAL	9-27-08	9	S6416	765	↓	13 ✓
CARV	9-26-08	10	1388	839	↓	14 ✓
CARV	9-27-08	11	G1250	840	↓	15 ✓
HAHN	9-27-08	12	G1028	850	↓	16 ✓
Chal High	9-21-08	13	G1219	862	↓	17 ✓
Chal Vista	9-21-08	14	G1215	864	↓	18 ✓
Shr. Air	9-21-08	15.	G1205	AL21897	↓	19 ✓
Dup/CAP	9-26-08	5	G1241	AL 21743	$D_PPFID	20 ✓
Cont	10-9-08	S1	G1124	AL22195	$C_SRM	21 ✓ Trans
Transferred to Lims						
LHL	9-27-08	2	5727	AL 22411	$PPFID	22 ✓
Shr. Air	9-27-08	3	1467	AL 22413	↓	23 ✓
23 Grab	9-28-08	6	1491	AL21703	↓	24 ✓
74 Grab	9-26-08	7	1396	AL21655	↓	25 ✓
7/2 Grab	9-25-08	8	S1374	AL 21641	↓	26 ✓
Cleanup/HAB	10-9-08	S3	GCR24	AL22195	$HBPPFID	27 ✓
Cont	10-9-08	S1	G1124	AL 22195	$C_SRM	28 ✓

SIGNATURE JAK DATE Oct. 9 2008

READ AND UNDERSTOOD DATE 20

```
----------------------- Leak Check Report ----------------------

10/9/2008 8:41:22 AM
Leak Check for C:\Smart\SQ100908.SEQ
Report File: C:\Smart\SQ100908.LCR
Leak Check Method: Evacuation
Pressurize/Evacuate time(sec) 30
Equilibration time(sec) 10
Maintanance   time(sec) 30

 Sample
 Inlet  Auto1   Auto2   Auto3  Start  End    Rate(psi/min)
 1      1   ---   ---   0.5   0.6   0.20
 3      1   ---   ---   0.3   0.3   0.00
 1     16   ---   ---   0.4   0.5   0.20
 4     16   ---   ---   0.2   0.3   0.20
 1      2   ---   ---   0.3   0.4   0.20
 1      3   ---   ---   0.3   0.3   0.00
 1      4   ---   ---   0.3   0.3   0.00
 1      5   ---   ---   0.2   0.3   0.20
 1      6   ---   ---   0.2   0.3   0.20
 1      7   ---   ---   0.2   0.3   0.20
 1      8   ---   ---   0.2   0.3   0.20
 1      9   ---   ---   0.3   0.3   0.00
 1     10   ---   ---   0.3   0.3   0.00
 1     11   ---   ---   0.3   0.3   0.00
 1     12   ---   ---   0.3   0.3   0.00
 1     13   ---   ---   0.3   0.3   0.00
 1     14   ---   ---   0.3   0.3   0.00
```

```
---------------SEQUENCE TABLE ---------------


Sequence Name:  C:\Smart\SQ100908.SEQ
Date:           10-11-2008
Time:           08:02:23
Int. Std Volume: 0 cc


             Inlet  Auto   Samp   Cal Std
  Sample Name  #    Pos    Vol.   Vol.     Method          Time

 AL22195 $I_SRM   1    1     0    200    C:\Smart\PAMS.MPT 12:00
 AL22195 $I_PPFID 1    1   200      0    C:\Smart\PAMS.MPT 12:00
 AL22195 $HBPPFID 3    1   200      0    C:\Smart\PAMS.MPT 12:00
 AL22195 $L1PPFID 1   16   200      0    C:\Smart\PAMS.MPT 12:00
 AL22195 $B_PPFID 4    1   200      0    C:\Smart\PAMS.MPT 12:00
 AL21711 $PPFID   1    2   200      0    C:\Smart\PAMS.MPT 12:00
 AL21712 $PPFID   1    3   200      0    C:\Smart\PAMS.MPT 12:00
 AL21713 $PPFID   1    4   200      0    C:\Smart\PAMS.MPT 12:00
 AL21743 $PPFID   1    5   200      0    C:\Smart\PAMS.MPT 12:00
 AL21744 $PPFID   1    6   200      0    C:\Smart\PAMS.MPT 12:00
 AL21763 $PPFID   1    7   200      0    C:\Smart\PAMS.MPT 12:00
 AL21764 $PPFID   1    8   200      0    C:\Smart\PAMS.MPT 12:00
 AL21765 $PPFID   1    9   200      0    C:\Smart\PAMS.MPT 12:00
 AL21839 $PPFID   1   10   200      0    C:\Smart\PAMS.MPT 12:00
 AL21840 $PPFID   1   11   200      0    C:\Smart\PAMS.MPT 12:00
 AL21850 $PPFID   1   12   200      0    C:\Smart\PAMS.MPT 12:00
 AL21862 $PPFID   1   13   200      0    C:\Smart\PAMS.MPT 12:00
 AL21864 $PPFID   1   14   200      0    C:\Smart\PAMS.MPT 12:00
 AL21897 $PPFID   1   15   200      0    C:\Smart\PAMS.MPT 12:00
 AL21743 $D_PPFID 1    5   200      0    C:\Smart\PAMS.MPT 12:00
 AL22195 $C_SRM   1    1     0    200    C:\Smart\PAMS.MPT 12:00
 AL22411 $PPFID   1    2   200      0    C:\Smart\PAMS.MPT 12:00
 AL22413 $PPFID   1    3   200      0    C:\Smart\PAMS.MPT 12:00
 AL21703 $PPFID   1    6    40      0    C:\Smart\PAMS.MPT 12:00
 AL21695 $PPFID   1    7    40      0    C:\Smart\PAMS.MPT 12:00
 AL21641 $PPFID   1    8    40      0    C:\Smart\PAMS.MPT 12:00
 CLEANUP $HBPPFID 3    1   200      0    C:\Smart\PAMS.MPT 12:00
 AL22195 $C_SRM   1    1     0    200    C:\Smart\PAMS.MPT 12:00
```

```
\SEQUENCE\SQ100908.S


Sequence Parameters:

  Operator:                        JPC

  Data File Naming:                Prefix/Counter
  Signal 1  Prefix:                HJ0908
           Counter:                01
  Signal 2  Prefix:                0
           Counter:                0000000
  Data Directory:                  C:\HPCHEM\1\DATA\

  Data Subdirectory:

  Part of Methods to run:          According to Runtime Checklist

  Barcode Reader:                  not used

  Shutdown Cmd/Macro:              none

  Sequence Comment:
    11 SINGLES!



Sequence Table (Front Injector):

  Method and Injection Info Part:

  Line Location SampleName       Method   Inj SampleType InjVolume DataFile
  ==== ======== ================ ======== === ========== ========= ==========

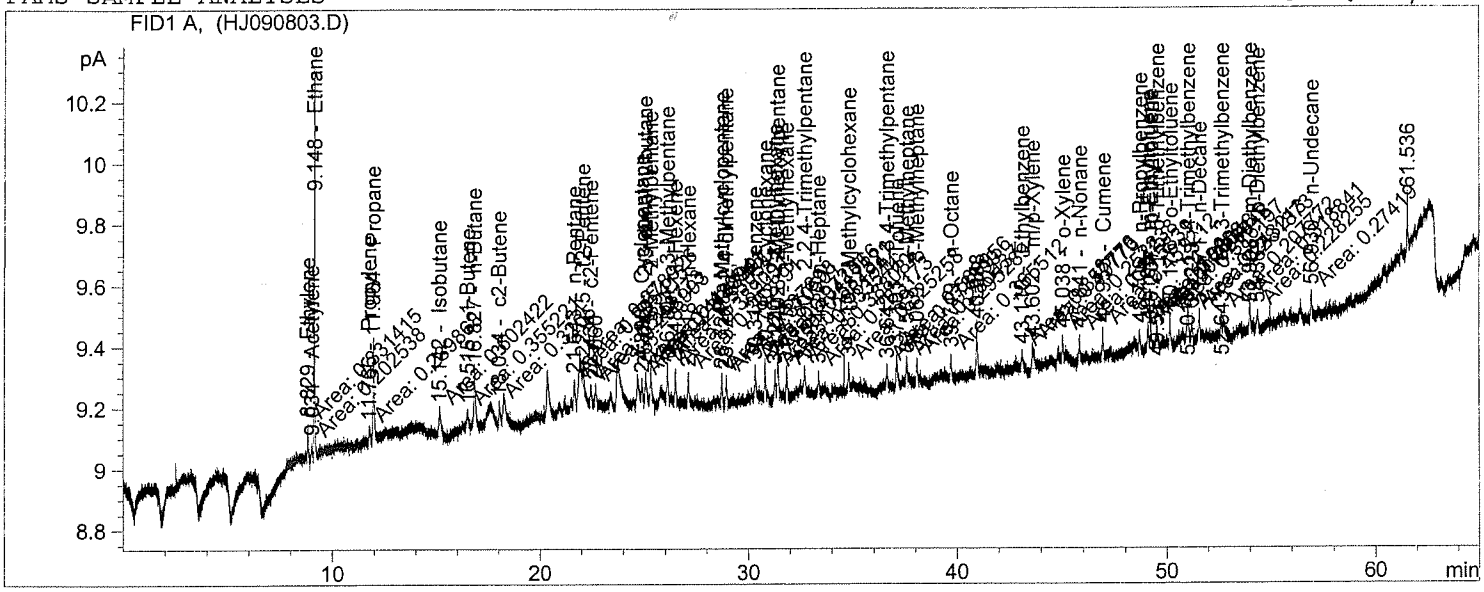
    1  Vial 1   AL22195 $I_SRM   PAMS      1   Calib
    2  Vial 3   AL22195 $I_PPFID PAMS      1   Calib
    3  Vial 2   AL22195 $HBPPFID PAMS      1   Ctrl Samp
    4  Vial 4   AL22195 $L1PPFID PAMS      1   Ctrl Samp
    5  Vial 1   AL22195 $B_PPFID PAMS      1   Ctrl Samp
    6  Vial 2   AL21711 $PPFID   PAMS      1   Sample
    7  Vial 3   AL21712 $PPFID   PAMS      1   Sample
    8  Vial 4   AL21713 $PPFID   PAMS      1   Sample
    9  Vial 5   AL21743 $PPFID   PAMS      1   Sample
   10  Vial 6   AL21744 $PPFID   PAMS      1   Sample
   11  Vial 7   AL21763 $PPFID   PAMS      1   Sample
   12  Vial 8   AL21764 $PPFID   PAMS      1   Sample
   13  Vial 9   AL21765 $PPFID   PAMS      1   Sample
   14  Vial 10  AL21839 $PPFID   PAMS      1   Sample
   15  Vial 11  AL21840 $PPFID   PAMS      1   Sample
   16  Vial 12  AL21850 $PPFID   PAMS      1   Sample
   17  Vial 13  AL21862 $PPFID   PAMS      1   Sample
   18  Vial 14  AL21864 $PPFID   PAMS      1   Sample
   19  Vial 15  AL21897 $PPFID   PAMS      1   Sample
   20  Vial 5   AL21743 $D_PPFID PAMS      1   Sample
   21  Vial 1   AL22195 $C_SRM   PAMS      1   Calib
   22  Vial 2   AL22411 $PPFID   PAMS      1   Sample
   23  Vial 3   AL22413 $PPFID   PAMS      1   Sample
   24  Vial 6   AL21703 $PPFID   PAMS      1   Sample
   25  Vial 7   AL21695 $PPFID   PAMS      1   Sample
   26  Vial 8   AL21641 $PPFID   PAMS      1   Sample
   27  Vial 2   CLEANUP $HBPPFID PAMS      1   Ctrl Samp
   28  Vial 1   AL22195 $C_SRM   PAMS      1   Calib
   29  Vial 1   BAKEOUT          BAKEOUT   1   Sample

Sequence Table (Back Injector):

  No entries - empty table!
```

```
=====================================================================
Injection Date  : 10/9/2008 11:43:01 AM          Seq. Line :    3
Sample Name     : AL22195 $HBPPFID                Location : Vial 2
Acq. Operator   : JPC                                   Inj :    1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/9/2008 12:15:17 PM by JPC
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

GCR24



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.829 MM     3.31415e-1   1.00000 1.69254e-1    Ethylene
  9.034 MM     2.02538e-1   1.00000 1.03436e-1    Acetylene
  9.148 PBA       2.93498   1.00000    1.49889    Ethane
 11.766 MM     2.89868e-1   1.00000 1.48036e-1    Propylene
 11.964 PBA       1.20321   1.00000 6.14482e-1    Propane
 15.142 MM   + 6.02422e-1   1.00000 3.07657e-1    Isobutane
 16.515 MM     3.55221e-1   1.00000 1.81412e-1    1-Butene
 16.613            -           -          -       1,3-butadiene
 16.827 BB     8.54704e-1   1.00000 4.36497e-1    n-Butane
 17.473            -           -          -       t2-Butene
 18.034 MM     3.20500e-1   1.00000 1.63679e-1    c2-Butene
 20.256            -           -          -       Isopentane
 21.072            -           -          -       1-Pentene
 21.643 MM     2.95415e-1   1.00000 1.50868e-1    n-Pentane
 21.803            -           -          -       Isoprene
 22.075 MM T   2.78926e-1   1.00000 1.42447e-1    t2-Pentene
 22.434 MM T   2.43773e-1   1.00000 1.24495e-1    c2-Pentene
 23.425            -           -          -       2,2-Dimethylbutane
 24.890 MM T   2.30574e-1   1.00000 1.17754e-1    Cyclopentane
```

10-9-08

```
  RetTime  Type     Area      Amt/Area    Amount   Grp   Name
   [min]           [pA*s]                 [ppbc]
  -------|------|----------|----------|----------|--|------------------
   25.049 MM T   4.43899e-1    1.00000 2.26699e-1    2,3-dimethylbutane
   25.305 MM T   4.30941e-1    1.00000 2.20081e-1    2-Methylpentane
   26.104 MM T   5.30541e-1    1.00000 2.70947e-1    3-Methylpentane
   26.481 MM T   3.89091e-1    1.00000 1.98709e-1    1-Hexene
   27.118 MM T   3.02891e-1    1.00000 1.54686e-1    n-Hexane
   28.721 MM T   4.37898e-1    1.00000 2.23635e-1    Methylcyclopentane
   28.926 MM T   3.70501e-1    1.00000 1.89215e-1    2,4-dimethylpentane
   30.312 MM T+  3.97231e-1    1.00000 2.02866e-1    Benzene
   30.790 MM T   3.41066e-1    1.00000 1.74182e-1    Cyclohexane
   31.270 MF T   2.96194e-1    1.00000 1.51266e-1    2-Methylhexane
   31.402 FM T   5.82521e-1    1.00000 2.97493e-1    2,3-Dimethylpentane
   31.816 MM T   3.33544e-1    1.00000 1.70341e-1    3-Methylhexane
   32.690 MM T   3.88084e-1    1.00000 1.98195e-1    2,2,4-Trimethylpentane
   33.345 MM T   2.83173e-1    1.00000 1.44617e-1    n-Heptane
   34.810 MM     3.25258e-1    1.00000 1.66109e-1    Methylcyclohexane
   36.642 MM     2.78899e-1    1.00000 1.42434e-1    2,3,4-Trimethylpentane
   37.101 MM   + 5.69956e-1    1.00000 2.91077e-1    Toluene
   37.589 MM     2.80437e-1    1.00000 1.43219e-1    2-Methylheptane
   38.069 MM     2.95289e-1    1.00000 1.50804e-1    3-Methylheptane
   39.719 MM     3.65512e-1    1.00000 1.86667e-1    n-Octane
   43.110 MM     3.57776e-1    1.00000 1.82716e-1    Ethylbenzene
   43.602 MM     4.97730e-1    1.00000 2.54191e-1    m/p-Xylene
   44.781             -          -          -        Styrene
   45.038 MM     2.52238e-1    1.00000 1.28818e-1    o-Xylene
   45.841 MM     2.75839e-1    1.00000 1.40871e-1    n-Nonane
   46.953 MM     4.53212e-1    1.00000 2.31455e-1    Cumene
   48.706 MM     1.88630e-1    1.00000 9.63335e-2    n-Propylbenzene
   49.109 MM     1.90640e-1    1.00000 9.73597e-2    m-Ethyltoluene
   49.237 MM     2.80481e-1    1.00000 1.43242e-1    p-Ethyltoluene
   49.532 MM     3.27042e-1    1.00000 1.67021e-1    1,3,5-Trimethylbenzene
   50.176 MM     3.16197e-1    1.00000 1.61482e-1    o-Ethyltoluene
   51.018 BB     5.35016e-1    1.00000 2.73233e-1    1,2,4-Trimethylbenzene
   51.571 MM     2.81873e-1    1.00000 1.43953e-1    n-Decane
   52.643 MM     2.07772e-1    1.00000 1.06109e-1    1,2,3-Trimethylbenzene
   53.998 MM     3.18841e-1    1.00000 1.62832e-1    m-Diethylbenzene
   54.365 MM     2.28255e-1    1.00000 1.16570e-1    p-Diethylbenzene
   56.930 MM   + 2.74190e-1    1.00000 1.40029e-1    n-Undecane

  Totals :                               10.60837

  Uncalibrated Peaks     :       using compound Propane

  RetTime  Type     Area      Amt/Area    Amount   Grp   Name
   [min]           [pA*s]                 [ppbc]
  -------|------|----------|----------|----------|--|------------------
   22.660 MM T   2.98993e-1    1.00000 1.52696e-1    ?
   40.958 PP     7.15209e-1    1.00000 3.65257e-1    ?
   51.223 MM     2.43213e-1    1.00000 1.24209e-1    ?
   61.536 PB     5.76165e-1    1.00000 2.94248e-1    ?

  Uncalib. totals :                      9.36409e-1

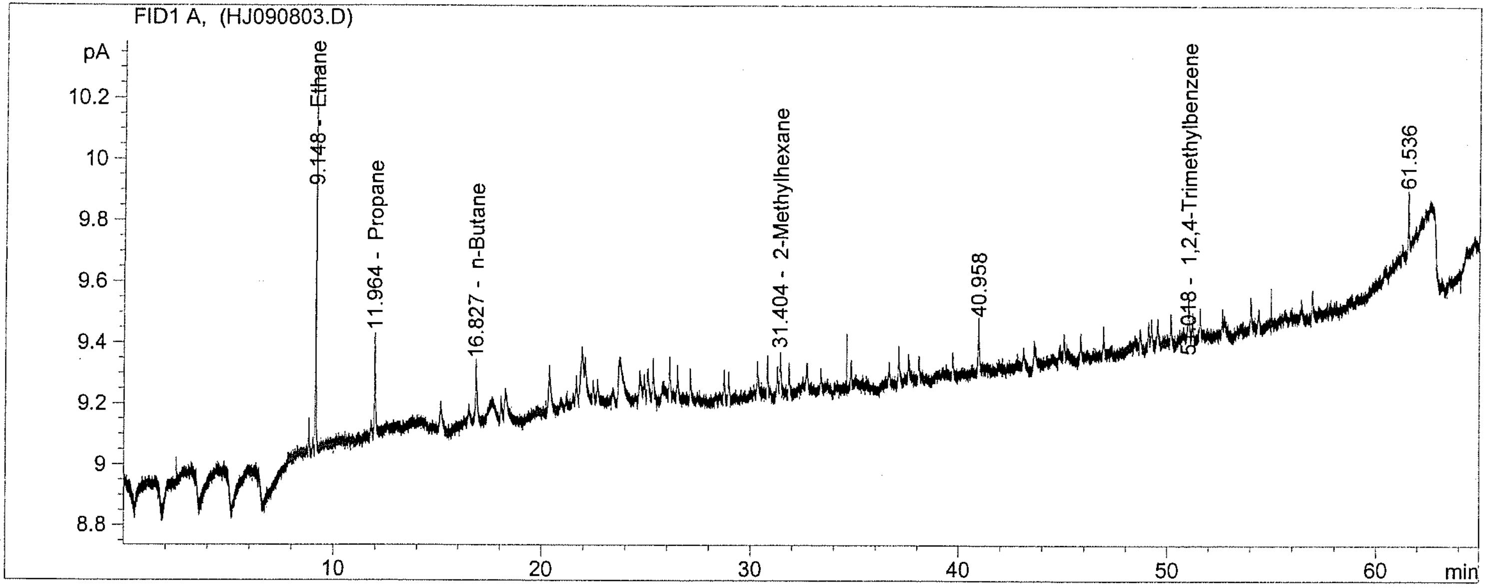
   Results obtained with enhanced integrator!
  2 Warnings or Errors :

  Warning : Calibration warnings (see calibration table listing)
  Warning : Calibrated compound(s) not found

  ===================================================================
                            *** End of Report ***
```

```
=====================================================================
Injection Date  : 10/9/2008 11:43:01 AM          Seq. Line :   3
Sample Name     : AL22195 $HBPPFID                Location : Vial 2
Acq. Operator   : JPC                                  Inj :   1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/9/2008 12:15:17 PM by JPC
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

GCR24



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area    Amount   Grp   Name
 [min]         [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.837             -          -          -        Ethylene
  8.950             -          -          -        Acetylene
  9.148 PBA      2.93498    1.00000    1.49889     Ethane
 11.762             -          -          -        Propylene
 11.964 PBA      1.20321    1.00000 6.14482e-1     Propane
 15.083             -          -          -        Isobutane
 16.411             -          -          -        1-Butene
 16.566             -          -          -        1,3-butadiene
 16.827 BB    8.54704e-1    1.00000 4.36497e-1     n-Butane
 17.433             -          -          -        t2-Butene
 18.083             -          -          -        c2-Butene
 20.238             -          -          -        Isopentane
 21.060             -          -          -        1-Pentene
 21.657             -          -          -        n-Pentane
 21.797             -          -          -        Isoprene
 22.050             -          -          -        t2-Pentene
 22.420             -          -          -        c2-Pentene
 23.432             -          -          -        2,2-Dimethylbutane
 24.903             -          -          -        Cyclopentane
```

```
RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 25.101            -          -          -       2,3-dimethylbutane
 25.385            -          -          -       2-Methylpentane
 26.200            -          -          -       3-Methylpentane
 26.576            -          -          -       1-Hexene
 27.237            -          -          -       n-Hexane
 28.764            -          -          -       Methylcyclopentane
 28.914            -          -          -       2,4-dimethylpentane
 30.373            -          -          -       Benzene
 31.008            -          -          -       Cyclohexane
 31.404 BP     5.13805e-1   1.00000 2.62400e-1   2-Methylhexane
 31.584            -          -          -       2,3-Dimethylpentane
 32.010            -          -          -       3-Methylhexane
 32.869            -          -          -       2,2,4-Trimethylpentane
 33.543            -          -          -       n-Heptane
 35.039            -          -          -       Methylcyclohexane
 36.868            -          -          -       2,3,4-Trimethylpentane
 37.101            -          -          -       Toluene
 37.806            -          -          -       2-Methylheptane
 38.313            -          -          -       3-Methylheptane
 39.949            -          -          -       n-Octane
 43.059            -          -          -       Ethylbenzene
 43.617            -          -          -       m/p-Xylene
 44.781            -          -          -       Styrene
 45.064            -          -          -       o-Xylene
 45.851            -          -          -       n-Nonane
 46.921            -          -          -       Cumene
 48.671            -          -          -       n-Propylbenzene
 49.070            -          -          -       m-Ethyltoluene
 49.350            -          -          -       p-Ethyltoluene
 49.565            -          -          -       1,3,5-Trimethylbenzene
 50.165            -          -          -       o-Ethyltoluene
 51.018 BB     5.35016e-1   1.00000 2.73233e-1   1,2,4-Trimethylbenzene
 51.558            -          -          -       n-Decane
 52.863            -          -          -       1,2,3-Trimethylbenzene
 54.045            -          -          -       m-Diethylbenzene
 54.417            -          -          -       p-Diethylbenzene
 56.931            -          -          -       n-Undecane

Totals :                                3.08551

Uncalibrated Peaks     :       using compound Propane

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 40.958 PP     7.15209e-1   1.00000 3.65257e-1    ?
 61.536 PB     5.76165e-1   1.00000 2.94248e-1    ?

Uncalib. totals :                    6.59505e-1

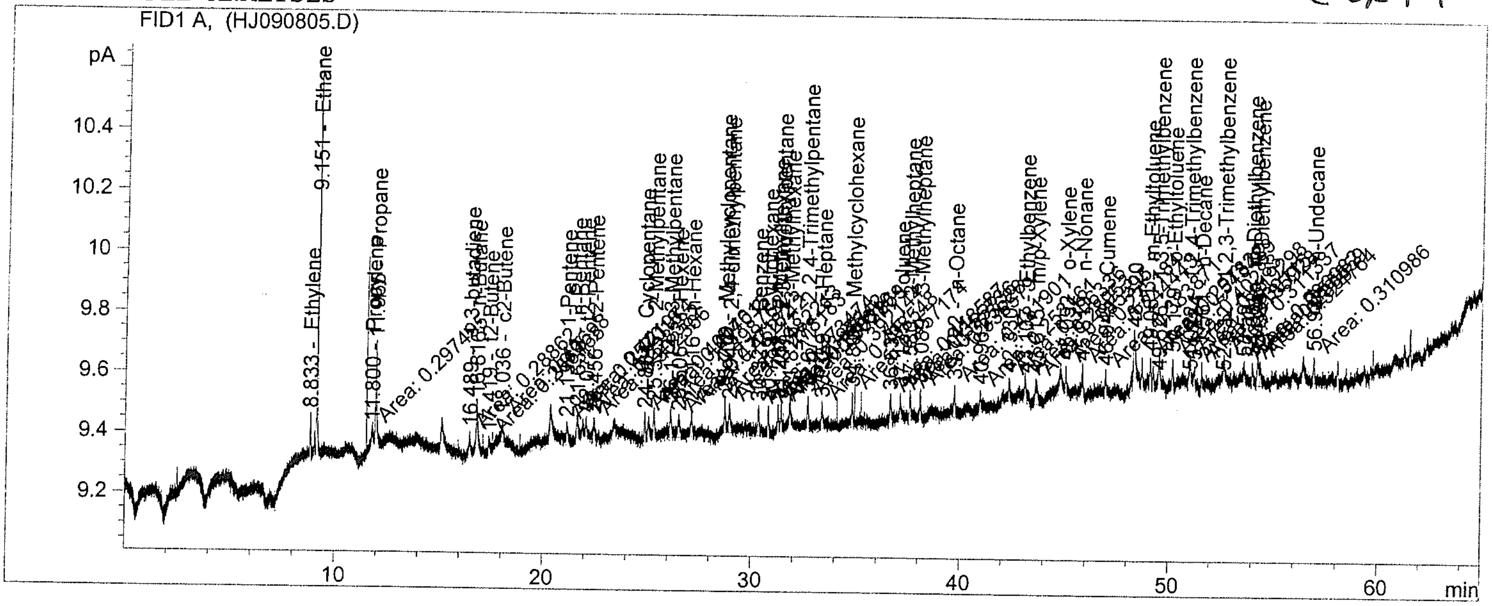
 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

```
=====================================================================
Injection Date  : 10/9/2008 2:22:03 PM           Seq. Line :   5
Sample Name     : AL22195 $B_PPFID                Location : Vial 1
Acq. Operator   : JPC                                  Inj :   1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/9/2008 2:20:47 PM by JPC
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

GCR44



```
=====================================================================
                   External Standard Report
=====================================================================

Sorted By             :     Signal
Calib. Data Modified  :     10/9/2008 2:20:52 PM
Multiplier            :     0.5107
Dilution              :     1.0000
Sample Amount         :     1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.833 BBA   3.01725e-1    1.00000 1.54091e-1    Ethylene
  9.001            -           -         -        Acetylene
  9.151 BBA      3.08258    1.00000    1.57427    Ethane
 11.800 MM    2.97495e-1    1.00000 1.51931e-1    Propylene
 11.965 PBA      1.18665    1.00000 6.06020e-1    Propane
 15.083            -           -         -        Isobutane
 16.386            -           -         -        1-Butene
 16.489 MM    2.88620e-1    1.00000 1.47398e-1    1,3-butadiene
 16.816 BB    6.86147e-1    1.00000 3.50415e-1    n-Butane
 17.419 MM    2.66165e-1    1.00000 1.35931e-1    t2-Butene
 18.036 MM    4.06980e-1    1.00000 2.07844e-1    c2-Butene
 20.207            -           -         -        Isopentane
 21.139 MM    2.57018e-1    1.00000 1.31259e-1    1-Pentene
 21.639 MM    4.21974e-1    1.00000 2.15502e-1    n-Pentane
 21.764            -           -         -        Isoprene
 22.072 MM    2.28382e-1    1.00000 1.16635e-1    t2-Pentene
 22.456 MM    3.02366e-1    1.00000 1.54418e-1    c2-Pentene
 23.396            -           -         -        2,2-Dimethylbutane
 24.884 MM    4.00460e-1    1.00000 2.04515e-1    Cyclopentane
```

10-10-08
JPC

M

```
 RetTime  Type     Area      Amt/Area     Amount    Grp   Name
  [min]           [pA*s]                  [ppbc]
 -------|------|----------|----------|----------|--|------------------
  25.063             -          -          -          2,3-dimethylbutane
  25.325 MM     4.17015e-1   1.00000 2.12970e-1      2-Methylpentane
  26.114 MM     4.98762e-1   1.00000 2.54718e-1      3-Methylpentane
  26.506 MM     4.72182e-1   1.00000 2.41143e-1      1-Hexene
  27.116 MM     4.62742e-1   1.00000 2.36323e-1      n-Hexane
  28.716 MM     4.82213e-1   1.00000 2.46266e-1      Methylcyclopentane
  28.949 MM     4.78183e-1   1.00000 2.44208e-1      2,4-dimethylpentane
  30.327 MM   + 4.73474e-1   1.00000 2.41803e-1      Benzene
  30.789 MM     3.97342e-1   1.00000 2.02923e-1      Cyclohexane
  31.268 MM     1.99819e-1   1.00000 1.02048e-1      2-Methylhexane
  31.417 MM     3.13386e-1   1.00000 1.60046e-1      2,3-Dimethylpentane
  31.826 MM     3.02259e-1   1.00000 1.54364e-1      3-Methylhexane
  32.672 MM     3.92144e-1   1.00000 2.00268e-1      2,2,4-Trimethylpentane
  33.359 MM     4.08548e-1   1.00000 2.08646e-1      n-Heptane
  34.806 MM     4.57174e-1   1.00000 2.33479e-1      Methylcyclohexane
  36.889             -          -          -          2,3,4-Trimethylpentane
  37.125 MM   + 3.55736e-1   1.00000 1.81675e-1      Toluene
  37.580 MM     3.25628e-1   1.00000 1.66298e-1      2-Methylheptane
  38.089 MM     3.36579e-1   1.00000 1.71891e-1      3-Methylheptane
  39.722 MM     4.81901e-1   1.00000 2.46107e-1      n-Octane
  43.107 MM     2.89530e-1   1.00000 1.47863e-1      Ethylbenzene
  43.615 MM     5.85595e-1   1.00000 2.99063e-1      m/p-Xylene
  44.793             -          -          -          Styrene
  45.052 MM     2.75184e-1   1.00000 1.40537e-1      o-Xylene
  45.819 MM     2.44443e-1   1.00000 1.24837e-1      n-Nonane
  46.945 MM     3.83871e-1   1.00000 1.96043e-1      Cumene
  48.677             -          -          -          n-Propylbenzene
  49.081 MM     2.97822e-1   1.00000 1.52098e-1      m-Ethyltoluene
  49.355             -          -          -          p-Ethyltoluene
  49.526 MM     5.43489e-1   1.00000 2.77560e-1      1,3,5-Trimethylbenzene
  50.179 MM     4.02830e-1   1.00000 2.05725e-1      o-Ethyltoluene
  51.022 MM     3.19298e-1   1.00000 1.63066e-1      1,2,4-Trimethylbenzene
  51.561 MM     1.85928e-1   1.00000 9.49537e-2      n-Decane
  52.632 MM     3.11337e-1   1.00000 1.59000e-1      1,2,3-Trimethylbenzene
  54.002 MM     2.35900e-1   1.00000 1.20474e-1      m-Diethylbenzene
  54.357 FM     3.24764e-1   1.00000 1.65857e-1      p-Diethylbenzene
  56.924 MM   + 3.10986e-1   1.00000 1.58820e-1      n-Undecane

Totals :                                10.26130

Uncalibrated Peaks    :      using compound Propane

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]           [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 36.635 MM     4.18587e-1   1.00000 2.13772e-1      ?
 40.962 MM     2.53161e-1   1.00000 1.29290e-1      ?
 42.330 MM     3.06336e-1   1.00000 1.56446e-1      ?
 48.320 PB     9.16084e-1   1.00000 4.67844e-1      ?
 51.224 MM     2.39115e-1   1.00000 1.22116e-1      ?
 53.597 MM     2.36982e-1   1.00000 1.21027e-1      ?
 54.269 MF     5.58590e-1   1.00000 2.85272e-1      ?

Uncalib. totals :                        1.49577

 Results obtained with enhanced integrator!
2 Warnings or Errors :

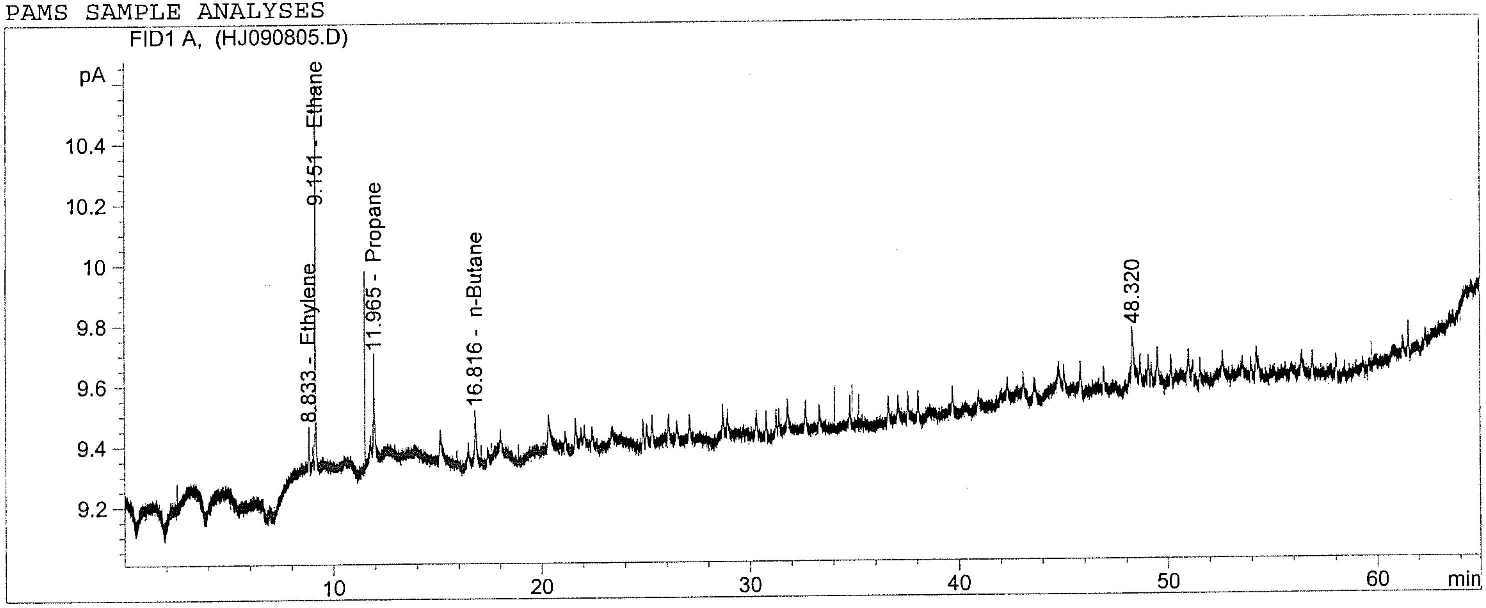
Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

```
=====================================================================
Injection Date     : 10/9/2008 2:22:03 PM            Seq. Line :    5
Sample Name        : AL22195 $B_PPFID                 Location : Vial 1
Acq. Operator      : JPC                                   Inj :    1
Acq. Instrument    : HP_FID2 SOP 1026               Inj Volume : Manually
Acq. Method        : C:\HPCHEM\1\METHODS\PAMS.M
Last changed       : 8/4/2008 1:18:53 PM by JPC
Analysis Method    : C:\HPCHEM\1\METHODS\PAMS.M
Last changed       : 10/9/2008 2:20:47 PM by JPC
                     (modified after loading)
```

GCR44

PAMS SAMPLE ANALYSES



```
=====================================================================
                         External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/9/2008 2:20:52 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area    Amount    Grp   Name
 [min]           [pA*s]                 [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.833 BBA   3.01725e-1   1.00000 1.54091e-1    Ethylene
  9.015            -          -          -       Acetylene
  9.151 BBA      3.08258   1.00000    1.57427    Ethane
 11.762            -          -          -       Propylene
 11.965 PBA      1.18665   1.00000 6.06020e-1    Propane
 15.083            -          -          -       Isobutane
 16.411            -          -          -       1-Butene
 16.566            -          -          -       1,3-butadiene
 16.816 BB    6.86147e-1   1.00000 3.50415e-1    n-Butane
 17.433            -          -          -       t2-Butene
 18.083            -          -          -       c2-Butene
 20.238            -          -          -       Isopentane
 21.060            -          -          -       1-Pentene
 21.657            -          -          -       n-Pentane
 21.797            -          -          -       Isoprene
 22.050            -          -          -       t2-Pentene
 22.420            -          -          -       c2-Pentene
 23.432            -          -          -       2,2-Dimethylbutane
 24.903            -          -          -       Cyclopentane
```

```
 RetTime  Type     Area      Amt/Area     Amount   Grp   Name
  [min]          [pA*s]                   [ppbc]
 -------|------|----------|----------|----------|--|------------------
  25.101              -          -          -        2,3-dimethylbutane
  25.385              -          -          -        2-Methylpentane
  26.200              -          -          -        3-Methylpentane
  26.576              -          -          -        1-Hexene
  27.237              -          -          -        n-Hexane
  28.764              -          -          -        Methylcyclopentane
  28.914              -          -          -        2,4-dimethylpentane
  30.373              -          -          -        Benzene
  31.008              -          -          -        Cyclohexane
  31.348              -          -          -        2-Methylhexane
  31.584              -          -          -        2,3-Dimethylpentane
  32.010              -          -          -        3-Methylhexane
  32.869              -          -          -        2,2,4-Trimethylpentane
  33.543              -          -          -        n-Heptane
  35.039              -          -          -        Methylcyclohexane
  36.868              -          -          -        2,3,4-Trimethylpentane
  37.101              -          -          -        Toluene
  37.806              -          -          -        2-Methylheptane
  38.313              -          -          -        3-Methylheptane
  39.949              -          -          -        n-Octane
  43.059              -          -          -        Ethylbenzene
  43.617              -          -          -        m/p-Xylene
  44.781              -          -          -        Styrene
  45.064              -          -          -        o-Xylene
  45.851              -          -          -        n-Nonane
  46.921              -          -          -        Cumene
  48.671              -          -          -        n-Propylbenzene
  49.070              -          -          -        m-Ethyltoluene
  49.350              -          -          -        p-Ethyltoluene
  49.565              -          -          -        1,3,5-Trimethylbenzene
  50.165              -          -          -        o-Ethyltoluene
  50.999              -          -          -        1,2,4-Trimethylbenzene
  51.558              -          -          -        n-Decane
  52.863              -          -          -        1,2,3-Trimethylbenzene
  54.045              -          -          -        m-Diethylbenzene
  54.417              -          -          -        p-Diethylbenzene
  56.931              -          -          -        n-Undecane

Totals :                                 2.68480

Uncalibrated Peaks     :      using compound Propane

RetTime  Type     Area      Amt/Area     Amount   Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
 48.320 PB     9.16084e-1    1.00000 4.67844e-1    ?

Uncalib. totals :                     4.67844e-1

 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

Date: 10/09/2008	Analyst: JAK	Batch: 192687	LIMS: AL22195
	%RECOVERY		
SRM concentration:	100.00		
SRM range:	90.00	110.00	
$I_SRM Result	Recovery %	In Range? (T/F)	
99.34	99.34	TRUE	
$C_SRM Result	Recovery %	In Range? (T/F)	
101.02	101.02	TRUE	
	RESPONSE FACTORS		
SRM concentration:	100.00		
SRM range (RF):	0.4594	0.5615	
$I_SRM area	Response Factor	In Range? (y/n)	
194.52	0.5141	TRUE	
$C_SRM area	Response Factor	In Range? (y/n)	
197.80	0.5056	TRUE	
RPD (I vs.C)	1.674		

From: Jianzhong Liu
Environmental Scientist Supervisor
Air Organics, LSD, DEQ

Date: May 13, 2008

Re: FID SRM PREPARATION

Stock Standard:

Manufacturer:	Spectra Gases, Inc.
Cylinder #:	CC-162783
Certified Concentration:	1.18 ppm
Expiration Date:	2/25/2009

Working SRM:

Target Concentration:	100.00 ppbC
Flow Rate of the Stock Std:	40 cc/min
Flow Rate of Nitrogen:	1376 cc/min

Spectra
Spectra Gases, Inc.

3434 Route 22 West, Branchburg, New Jersey 08876 USA
ISO 9001:2000

SHIPPED FROM: 80 INDUSTRIAL DRIVE ALPHA, NJ. 08865

SHIPPED TO:
Environmental Quality - LA
Air Organics Lab, LDEQ
1209 Leesville Road
Baton Rouge, LA 70802

CERTIFICATE OF ANALYSIS

SGI ORDER # : 125072
ITEM# : 1
CERTIFICATION DATE: 02/25/2008
P.O.# : CC - J Liu
BLEND TYPE: CERTIFIED

CYLINDER # : CC-162783
CYLINDER PRES: 2000 psig
CYLINDER VALVE: CGA 350
PRODUCT EXPIRATION DATE: 02/25/2009

ANALYTICAL ACCURACY: + / - 2%

COMPONENT	REQUESTED GAS CONC	ANALYSIS
Propane	1.20 ppm	1.18 ppm
Nitrogen	Balance	Balance

Received on 3/7/08
opened on 3/7/08

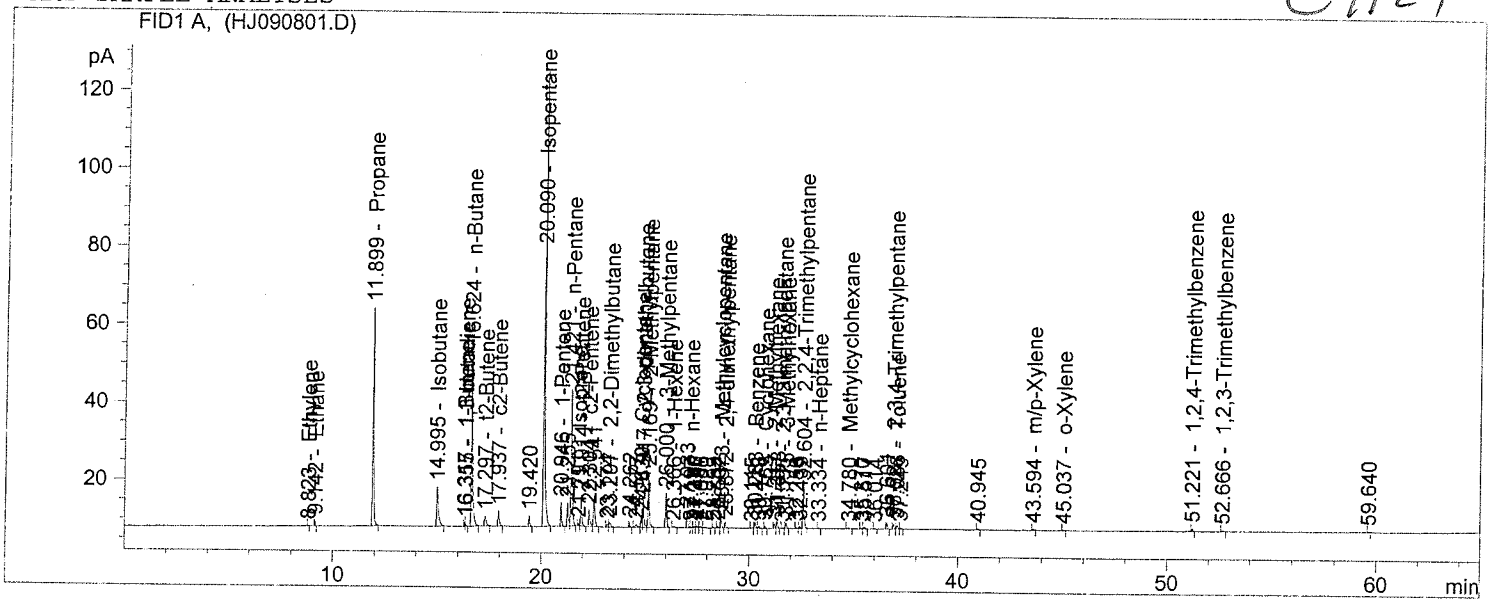
NIST TRACEABLE

ANALYST: Cheryl Patino

DATE: 02/25/2008

```
=====================================================================
 Injection Date   : 10/9/2008 9:04:16 AM           Seq. Line :    1
 Sample Name      : AL22195 $I_SRM                  Location : Vial 1
 Acq. Operator    : JPC                                  Inj :    1
 Acq. Instrument  : HP_FID2 SOP 1026               Inj Volume : Manually
 Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
 Last changed     : 8/4/2008 1:18:53 PM by JPC
 Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
 Last changed     : 10/9/2008 9:17:54 AM by JPC
                    (modified after loading)
PAMS SAMPLE ANALYSES
```

G1124



```
=====================================================================
                    External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.823 BBA    2.61487e-1    1.00000 1.33541e-1    Ethylene
  8.897             -           -          -       Acetylene
  9.142 PBA       2.93590    1.00000    1.49936    Ethane
 11.693             -           -          -       Propylene
 11.899 PBA     194.51570    1.00000   99.33917    Propane
 14.995 PB   +   59.44752    1.00000   30.35985    Isobutane
 16.317 PV        2.59695    1.00000    1.32626    1-Butene
 16.355 VB        2.90993    1.00000    1.48610    1,3-butadiene
 16.624 PB      201.51773    1.00000  102.91511    n-Butane
 17.297 PB       14.00146    1.00000    7.15054    t2-Butene
 17.937 PP       18.09837    1.00000    9.24284    c2-Butene
 20.090 PB      442.96112    1.00000  226.22024    Isopentane
 20.946 BB       19.75955    1.00000   10.09120    1-Pentene
 21.421 VB      150.20596    1.00000   76.71019    n-Pentane
 21.791 PV        1.96637    1.00000    1.00423    Isoprene
 21.914 VP       29.56368    1.00000   15.09817    t2-Pentene
 22.304 PV       18.83040    1.00000    9.61668    c2-Pentene
 23.297 VB        7.87133    1.00000    4.01989    2,2-Dimethylbutane
 24.830 VV        8.01592    1.00000    4.09373    Cyclopentane
```

10-9-08
JAK

F/M

```
 RetTime  Type    Area      Amt/Area    Amount    Grp   Name
  [min]         [pA*s]                  [ppbc]
 -------|------|----------|----------|----------|--|------------------
  24.917 VV     28.82772    1.00000   14.72232   2,3-dimethylbutane
  25.169 VB     57.93069    1.00000   29.58520   2-Methylpentane
  26.000 BB     35.87003    1.00000   18.31883   3-Methylpentane
  26.366 PB      1.65476    1.00000 8.45087e-1   1-Hexene
  27.197 BB   8.01157e-1    1.00000 4.09151e-1   n-Hexane
  28.673 VB     11.00994    1.00000    5.62278   Methylcyclopentane
  28.872 BB      6.39602    1.00000    3.26645   2,4-dimethylpentane
  30.283 BB  +   6.25712    1.00000    3.19551   Benzene
  30.765 BB      1.86090    1.00000 9.50359e-1   Cyclohexane
  31.217 BV      4.17835    1.00000    2.13388   2-Methylhexane
  31.595 BP   4.61146e-1    1.00000 2.35507e-1   2,3-Dimethylpentane
  31.775 BB      4.96585    1.00000    2.53606   3-Methylhexane
  32.604 VB     43.81662    1.00000   22.37715   2,2,4-Trimethylpentane
  33.334 PP   5.83060e-1    1.00000 2.97769e-1   n-Heptane
  34.780 BB      2.05122    1.00000    1.04756   Methylcyclohexane
  36.927 BV      5.04707    1.00000    2.57754   2,3,4-Trimethylpentane
  37.086 VV  +   4.28318    1.00000    2.18742   Toluene
  37.791             -          -          -     2-Methylheptane
  38.298             -          -          -     3-Methylheptane
  39.933             -          -          -     n-Octane
  43.042             -          -          -     Ethylbenzene
  43.594 PB      1.48484    1.00000 7.58308e-1   m/p-Xylene
  44.763             -          -          -     Styrene
  45.037 PP   6.97252e-1    1.00000 3.56086e-1   o-Xylene
  45.833             -          -          -     n-Nonane
  46.902             -          -          -     Cumene
  48.652             -          -          -     n-Propylbenzene
  49.051             -          -          -     m-Ethyltoluene
  49.330             -          -          -     p-Ethyltoluene
  49.545             -          -          -     1,3,5-Trimethylbenzene
  50.145             -          -          -     o-Ethyltoluene
  51.221 BP      2.91077    1.00000    1.48653   1,2,4-Trimethylbenzene
  51.538             -          -          -     n-Decane
  52.666 BB      1.69162    1.00000 8.63911e-1   1,2,3-Trimethylbenzene
  54.024             -          -          -     m-Diethylbenzene
  54.395             -          -          -     p-Diethylbenzene
  56.931             -          -          -     n-Undecane

Totals :                              714.08050

Uncalibrated Peaks    :      using compound Propane

RetTime  Type    Area      Amt/Area    Amount    Grp   Name
 [min]         [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 19.420 PB      9.45925    1.00000    4.83084    ?
 21.255 PV     23.64181    1.00000   12.07387    ?
 22.541 VP     36.31593    1.00000   18.54655    ?
 23.174 PV      3.03796    1.00000    1.55149    ?
 24.262 PB      3.61210    1.00000    1.84470    ?
 24.577 PV      5.55780    1.00000    2.83837    ?
 27.033 PB     13.81527    1.00000    7.05546    ?
 27.370 BV      1.16094    1.00000 5.92892e-1    ?
 27.497 VV      2.56494    1.00000    1.30991    ?
 27.686 VV      1.97282    1.00000    1.00752    ?
 27.929 VB      1.08036    1.00000 5.51740e-1    ?
 28.292 BB   9.77552e-1    1.00000 4.99236e-1    ?
 28.502 BV      2.25036    1.00000    1.14926    ?
 30.115 PB   5.48365e-1    1.00000 2.80050e-1    ?
 30.473 BP      2.08192    1.00000    1.06324    ?
 31.358 VB      6.41636    1.00000    3.27683    ?
 32.256 PP   9.34638e-1    1.00000 4.77320e-1    ?
 32.439 BV      1.83783    1.00000 9.38580e-1    ?
 35.370 PP   7.36042e-1    1.00000 3.75897e-1    ?
 35.517 VB      2.49518    1.00000    1.27429    ?
```

```
 RetTime  Type     Area      Amt/Area     Amount    Grp   Name
  [min]          [pA*s]                   [ppbc]
 -------|------|----------|----------|----------|--|------------------
  36.014 BB     5.08486e-1   1.00000 2.59684e-1     ?
  36.601 PB        6.00512   1.00000    3.06681     ?
  37.249 VB        1.36379   1.00000 6.96490e-1     ?
  40.945 PP        1.65974   1.00000 8.47630e-1     ?
  59.640 BB     6.65468e-1   1.00000 3.39854e-1     ?

Uncalib. totals :                      66.74851

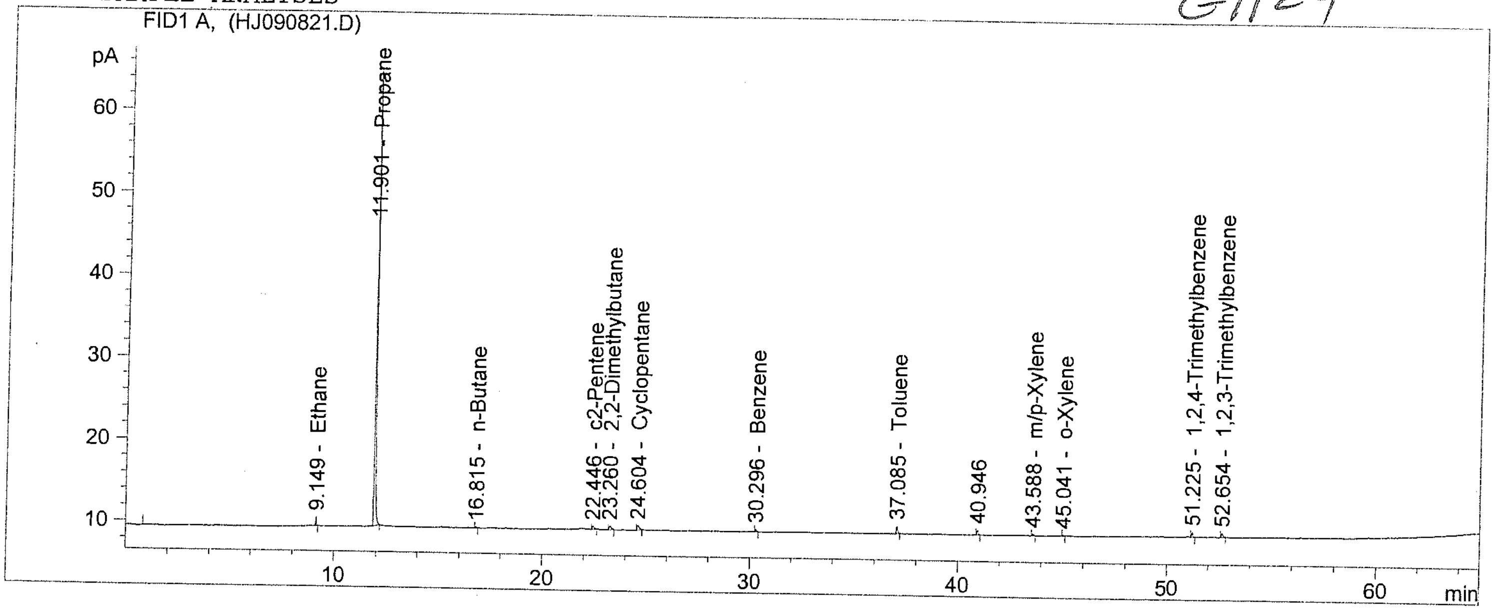
 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

```
=====================================================================
Injection Date   : 10/10/2008 11:49:34 AM          Seq. Line :   21
Sample Name      : AL22195 $C_SRM                   Location : Vial 1
Acq. Operator    : JPC                                   Inj :   1
Acq. Instrument  : HP_FID2 SOP 1026               Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/10/2008 11:50:57 AM by JPC
                   (modified after loading)
PAMS SAMPLE ANALYSES
```

G1124



```
=====================================================================
                     External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/10/2008 11:51:05 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.688              -         -           -          Ethylene
  8.927              -         -           -          Acetylene
  9.149 PBA      2.48618    1.00000     1.26969       Ethane
 11.670              -         -           -          Propylene
 11.901 PBA    191.07982    1.00000    97.58446       Propane
 15.000              -         -           -          Isobutane
 16.369              -         -           -          1-Butene
 16.524              -         -           -          1,3-butadiene
 16.815 PB    6.31383e-1    1.00000 3.22447e-1        n-Butane
 17.389              -         -           -          t2-Butene
 18.037              -         -           -          c2-Butene
 20.187              -         -           -          Isopentane
 21.007              -         -           -          1-Pentene
 21.602              -         -           -          n-Pentane
 21.795              -         -           -          Isoprene
 21.994              -         -           -          t2-Pentene
 22.446 PP       2.49812    1.00000     1.27579       c2-Pentene
 23.260 PB       3.51899    1.00000     1.79715       2,2-Dimethylbutane
 24.604 PB       3.93857    1.00000     2.01143       Cyclopentane
```

10-10-08
DAH

```
 RetTime  Type     Area       Amt/Area     Amount    Grp   Name
  [min]          [pA*s]                    [ppbc]
 -------|------|----------|----------|----------|--|------------------
  24.937            -            -          -        2,3-dimethylbutane
  25.126            -            -          -        2-Methylpentane
  26.134            -            -          -        3-Methylpentane
  26.509            -            -          -        1-Hexene
  26.932            -            -          -        n-Hexane
  28.691            -            -          -        Methylcyclopentane
  28.841            -            -          -        2,4-dimethylpentane
  30.296 PB  +   1.34777      1.00000  6.88305e-1    Benzene
  30.937            -            -          -        Cyclohexane
  31.280            -            -          -        2-Methylhexane
  31.518            -            -          -        2,3-Dimethylpentane
  31.948            -            -          -        3-Methylhexane
  32.815            -            -          -        2,2,4-Trimethylpentane
  33.300            -            -          -        n-Heptane
  35.004            -            -          -        Methylcyclohexane
  36.850            -            -          -        2,3,4-Trimethylpentane
  37.085 PB  +   3.61052      1.00000    1.84389     Toluene
  37.790            -            -          -        2-Methylheptane
  38.297            -            -          -        3-Methylheptane
  39.932            -            -          -        n-Octane
  43.041            -            -          -        Ethylbenzene
  43.588 PB      1.00328      1.00000  5.12374e-1    m/p-Xylene
  44.762            -            -          -        Styrene
  45.041 PP   5.15547e-1      1.00000  2.63290e-1    o-Xylene
  45.831            -            -          -        n-Nonane
  46.901            -            -          -        Cumene
  48.650            -            -          -        n-Propylbenzene
  49.049            -            -          -        m-Ethyltoluene
  49.329            -            -          -        p-Ethyltoluene
  49.544            -            -          -        1,3,5-Trimethylbenzene
  50.144            -            -          -        o-Ethyltoluene
  51.225 PP      2.27219      1.00000    1.16041     1,2,4-Trimethylbenzene
  51.536            -            -          -        n-Decane
  52.654 PB      2.96308      1.00000    1.51324     1,2,3-Trimethylbenzene
  54.022            -            -          -        m-Diethylbenzene
  54.394            -            -          -        p-Diethylbenzene
  56.931            -            -          -        n-Undecane

Totals :                                110.24248

Uncalibrated Peaks    :     using compound Propane

RetTime  Type     Area       Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                    [ppbc]
-------|------|----------|----------|----------|--|------------------
 40.946 BB      2.52436     1.00000     1.28919      ?

Uncalib. totals :                        1.28919

 Results obtained with enhanced integrator!
2 Warnings or Errors :

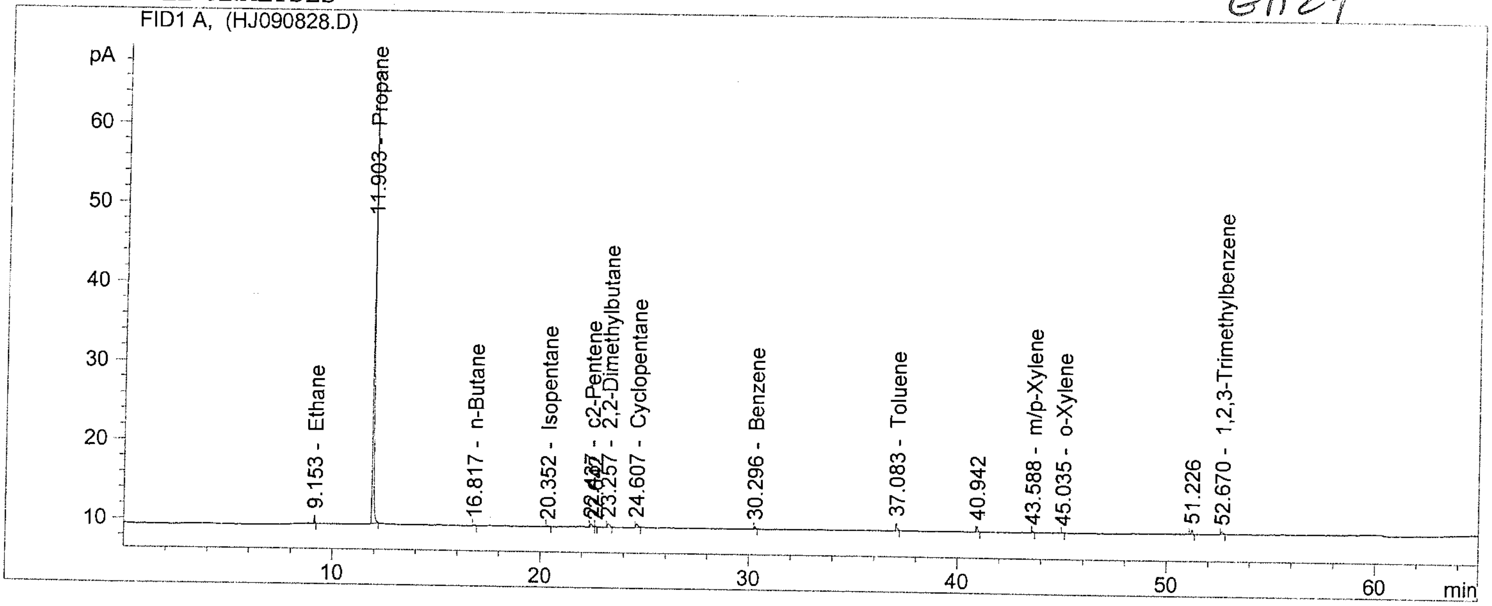
Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                        *** End of Report ***
```

```
Data File C:\HPCHEM\1\DATA\HJ090828.D                              Sample Name: AL22195 $C_SRM

=================================================================================
 Injection Date    : 10/10/2008 9:01:56 PM                Seq. Line :  28
 Sample Name       : AL22195 $C_SRM                        Location : Vial 1
 Acq. Operator     : JPC                                        Inj :   1
 Acq. Instrument   : HP_FID2 SOP 1026                     Inj Volume : Manually
 Acq. Method       : C:\HPCHEM\1\METHODS\PAMS.M
 Last changed      : 8/4/2008 1:18:53 PM by JPC
 Analysis Method   : C:\HPCHEM\1\METHODS\PAMS.M
 Last changed      : 10/10/2008 11:50:57 AM by JPC
                     (modified after loading)
PAMS SAMPLE ANALYSES
```

G1124



```
===============================================================================
                         External Standard Report
===============================================================================

Sorted By              :      Signal
Calib. Data Modified   :      10/10/2008 11:51:05 AM
Multiplier             :      0.5107
Dilution               :      1.0000
Sample Amount          :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area     Amount    Grp   Name
 [min]         [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.688            -           -           -          Ethylene
  8.927            -           -           -          Acetylene
  9.153 PBA      2.50638    1.00000    1.28001        Ethane
 11.670            -           -           -          Propylene
 11.903 PBA    197.79846    1.00000  101.01567        Propane
 15.000            -           -           -          Isobutane
 16.369            -           -           -          1-Butene
 16.524            -           -           -          1,3-butadiene
 16.817 BB    7.47370e-1    1.00000 3.81682e-1        n-Butane
 17.389            -           -           -          t2-Butene
 18.037            -           -           -          c2-Butene
 20.352 PB    8.45592e-1    1.00000 4.31844e-1        Isopentane
 21.007            -           -           -          1-Pentene
 21.602            -           -           -          n-Pentane
 21.795            -           -           -          Isoprene
 21.994            -           -           -          t2-Pentene
 22.437 PV       3.23404    1.00000    1.65162        c2-Pentene
 23.257 PB       3.45859    1.00000    1.76630        2,2-Dimethylbutane
 24.607 PB       3.47418    1.00000    1.77426        Cyclopentane
```

10-13-08
JAK

I/M

```
  RetTime  Type     Area      Amt/Area     Amount    Grp   Name
   [min]           [pA*s]                  [ppbc]
  -------|------|----------|----------|----------|--|------------------
   24.937           -          -          -          2,3-dimethylbutane
   25.126           -          -          -          2-Methylpentane
   26.134           -          -          -          3-Methylpentane
   26.509           -          -          -          1-Hexene
   26.932           -          -          -          n-Hexane
   28.691           -          -          -          Methylcyclopentane
   28.841           -          -          -          2,4-dimethylpentane
   30.296 PB  +     1.39032    1.00000 7.10035e-1    Benzene
   30.937           -          -          -          Cyclohexane
   31.280           -          -          -          2-Methylhexane
   31.518           -          -          -          2,3-Dimethylpentane
   31.947           -          -          -          3-Methylhexane
   32.814           -          -          -          2,2,4-Trimethylpentane
   33.299           -          -          -          n-Heptane
   35.003           -          -          -          Methylcyclohexane
   36.848           -          -          -          2,3,4-Trimethylpentane
   37.083 PP  +     3.84051    1.00000    1.96135    Toluene
   37.788           -          -          -          2-Methylheptane
   38.294           -          -          -          3-Methylheptane
   39.929           -          -          -          n-Octane
   43.038           -          -          -          Ethylbenzene
   43.588 PB     9.46518e-1    1.00000 4.83387e-1    m/p-Xylene
   44.759           -          -          -          Styrene
   45.035 PP     5.59634e-1    1.00000 2.85805e-1    o-Xylene
   45.829           -          -          -          n-Nonane
   46.898           -          -          -          Cumene
   48.647           -          -          -          n-Propylbenzene
   49.046           -          -          -          m-Ethyltoluene
   49.326           -          -          -          p-Ethyltoluene
   49.541           -          -          -          1,3,5-Trimethylbenzene
   50.141           -          -          -          o-Ethyltoluene
   50.974           -          -          -          1,2,4-Trimethylbenzene
   51.533           -          -          -          n-Decane
   52.670 PB        2.11982    1.00000    1.08259    1,2,3-Trimethylbenzene
   54.019           -          -          -          m-Diethylbenzene
   54.391           -          -          -          p-Diethylbenzene
   56.931           -          -          -          n-Undecane

 Totals :                               112.82457

 Uncalibrated Peaks     :       using compound Propane

 RetTime  Type     Area      Amt/Area     Amount    Grp   Name
  [min]           [pA*s]                  [ppbc]
 -------|------|----------|----------|----------|--|------------------
  22.642 VB     5.43828e-1    1.00000 2.77733e-1     ?
  40.942 BB        2.93792    1.00000    1.50040     ?
  51.226 VB        2.29285    1.00000    1.17096     ?

 Uncalib. totals :                        2.94909

  Results obtained with enhanced integrator!
 2 Warnings or Errors :

 Warning : Calibration warnings (see calibration table listing)
 Warning : Time reference compound(s) not found

 =====================================================================
                          *** End of Report ***
```

Initial Calibration Verification (LCS) FID #2

DATE: 10/9/2008 QC NO: AL22195 BATCH NO: 192687

JPC

COMPONENTS	STD (ppbc)	$I (ppbc)	REC% $I
Ethylene	49.20	51.25	104.2
Actetylene	48.90	54.47	111.4
Ethane	48.90	47.51	97.2
Propylene	48.90	45.53	93.1
Propane	49.00	52.67	107.5
n-Butane	48.90		
Isobutane	48.90	57.67	117.9
1-Butene	49.90	51.54	103.3
1,3-Butadiene	48.80	42.06	86.2
n-Butane	48.90	55.64	113.8
t2-butene	48.90	51.92	106.2
c2-butene	48.90	49.17	100.6
Isopentane	49.40	50.23	101.7
1-Pentene	50.70	55.19	108.9
n-Pentane	49.10	56.57	115.2
Isoprene	49.40	50.08	101.4
t2-Pentene	50.30	55.14	109.6
c2-Pentene	49.50	51.52	104.1
2,2-Dimethylbutane	49.90	54.43	109.1
Cyclopentane	59.60	53.33	89.5
2,3-Dimethylbutane	49.50	56.07	113.3
2-Methylpentane	49.10	53.56	109.1
3-Methylpentane	49.50	54.18	109.4
1-Hexene	49.30	45.50	92.3
1-Hexane	49.70	51.90	104.4
Methylcyclopentane	49.10	51.99	105.9
2,4-Dimethylpentane	49.50	51.90	104.9
Benzene	49.30	51.29	104.0
Cyclohexane	48.50	53.10	109.5
2-Methylhexane	48.80	51.21	104.9
2,3-Dimethylpentane	48.60	54.28	111.7
3-Methylhexane	48.80	52.09	106.7
2,2,4-Trimethylpentane	53.70	60.06	111.8
n-Heptane	49.00	49.36	100.7
Methylcyclohexane	49.60	53.90	108.7
2,3,4-Trimethylpentane	48.90	52.38	107.1
Toluene	49.80	48.79	98.0
2-Methylheptane	49.10	51.86	105.6
3-Methylheptane	50.70	52.61	103.8
n-Octane	48.50	49.44	101.9
Ethylbenzne	49.70	48.62	97.8
m/p-Xylene	98.50	95.39	96.8
Styrene	49.30	41.39	83.9
o Xylene	49.00	50.22	102.5
n-Nonane	48.60	47.85	98.5
Cumene	49.40	49.47	100.1
n-Propylbenzene	49.00	46.04	94.0
m-Ethyltoluene	48.70	45.85	94.2
p-Ethyltoluene	48.10	44.84	93.2
1,3,5-Trimethylbenzene	48.70	48.69	100.0
o-Ethyltouene	48.50	46.99	96.9
1,2,4-trimethylbenzene	49.00	46.72	95.3
n-Decane	48.90	46.14	94.4
1,2,3-Trimethylbenzene	48.70	41.96	86.2
m-Diethylbenzene	48.40	41.29	85.3
p-Diethylbenzene	48.40	33.79	69.8
n-Undecane	48.90	41.65	85.2

From: Jianzhong Liu
Environmental Scientist Supervisor
Air Organics, LSD, DEQ

Date: June 3, 2008

Re: Low Recovery of p-Diethylbenzene in PAMS LCS Standard

Stock Standard:

Manufacturer: Matheson Tri-Gas, Inc.
Cylinder #: SX39238D
Lot#: 1057610175
Expiration Date: 12/03/2009

From the studies of runs in different GC/FIDs, the recovery of p-diethylbenzene is constantly low (~ 75%). However, the recovery of this compound in PAMS standard is normal (~100%). Therefore, 60% (75%*80%) recovery for this compound in LCS is acceptable.

Concentrations (ppbC) of Different Diluton of Matheson Stock Standard

Cylinder #: SX39238D; Lot #: 1057610175; Expiration Date: 12/3/2008

COMPONENTS	Stock Std	10 times	71.425 times	166.65 times	250 times	500 times
Ethylene	492.00	49.20	6.89	2.95	1.97	0.98
Actetylene	489.00	48.90	6.85	2.93	1.96	0.98
Ethane	489.00	48.90	6.85	2.93	1.96	0.98
Propylene	489.00	48.90	6.85	2.93	1.96	0.98
Propane	490.00	49.00	6.86	2.94	1.96	0.98
n-Butane	489.00	48.90	6.85	2.93	1.96	0.98
Isobutane	489.00	48.90	6.85	2.93	1.96	0.98
1-Butene	499.00	49.90	6.99	2.99	2.00	1.00
1,3-Butadiene	488.00	48.80	6.83	2.93	1.95	0.98
n-Butane	489.00	48.90	6.85	2.93	1.96	0.98
t2-butene	489.00	48.90	6.85	2.93	1.96	0.98
c2-butene	489.00	48.90	6.85	2.93	1.96	0.98
Isopentane	494.00	49.40	6.92	2.96	1.98	0.99
1-Pentene	507.00	50.70	7.10	3.04	2.03	1.01
n-Pentane	491.00	49.10	6.87	2.95	1.96	0.98
Isoprene	494.00	49.40	6.92	2.96	1.98	0.99
t2-Pentene	503.00	50.30	7.04	3.02	2.01	1.01
c2-Pentene	495.00	49.50	6.93	2.97	1.98	0.99
2,2-Dimethylbutane	499.00	49.90	6.99	2.99	2.00	1.00
Cyclopentane	596.00	59.60	8.34	3.58	2.38	1.19
2,3-Dimethylbutane	495.00	49.50	6.93	2.97	1.98	0.99
2-Methylpentane	491.00	49.10	6.87	2.95	1.96	0.98
3-Methylpentane	495.00	49.50	6.93	2.97	1.98	0.99
1-Hexene	493.00	49.30	6.90	2.96	1.97	0.99
1-Hexane	497.00	49.70	6.96	2.98	1.99	0.99
Methylcyclopentane	491.00	49.10	6.87	2.95	1.96	0.98
2,4-Dimethylpentane	495.00	49.50	6.93	2.97	1.98	0.99
Benzene	493.00	49.30	6.90	2.96	1.97	0.99
Cyclohexane	485.00	48.50	6.79	2.91	1.94	0.97
2-Methylhexane	488.00	48.80	6.83	2.93	1.95	0.98
2,3-Dimethylpentane	486.00	48.60	6.80	2.92	1.94	0.97
3-Methylhexane	488.00	48.80	6.83	2.93	1.95	0.98
2,2,4-Trimethylpentane	537.00	53.70	7.52	3.22	2.15	1.07
n-Heptane	490.00	49.00	6.86	2.94	1.96	0.98
Methylcyclohexane	496.00	49.60	6.94	2.98	1.98	0.99
2,3,4-Trimethylpentane	489.00	48.90	6.85	2.93	1.96	0.98
Toluene	498.00	49.80	6.97	2.99	1.99	1.00
2-Methylheptane	491.00	49.10	6.87	2.95	1.96	0.98
3-Methylheptane	507.00	50.70	7.10	3.04	2.03	1.01
n-Octane	485.00	48.50	6.79	2.91	1.94	0.97
Ethylbenzne	497.00	49.70	6.96	2.98	1.99	0.99
m/p-Xylene	985.00	98.50	13.79	5.91	3.94	1.97
Styrene	493.00	49.30	6.90	2.96	1.97	0.99
o Xylene	490.00	49.00	6.86	2.94	1.96	0.98
n-Nonane	486.00	48.60	6.80	2.92	1.94	0.97
Cumene	494.00	49.40	6.92	2.96	1.98	0.99
n-Propylbenzene	490.00	49.00	6.86	2.94	1.96	0.98
m-Ethyltoluene	487.00	48.70	6.82	2.92	1.95	0.97
p-Ethyltoluene	481.00	48.10	6.73	2.89	1.92	0.96
1,3,5-Trimethylbenzene	487.00	48.70	6.82	2.92	1.95	0.97
o-Ethyltouene	485.00	48.50	6.79	2.91	1.94	0.97
1,2,4-trimethylbenzene	490.00	49.00	6.86	2.94	1.96	0.98
n-Decane	489.00	48.90	6.85	2.93	1.96	0.98
1,2,3-Trimethylbenzene	487.00	48.70	6.82	2.92	1.95	0.97
m-Diethylbenzene	484.00	48.40	6.78	2.90	1.94	0.97
p-Diethylbenzene	484.00	48.40	6.78	2.90	1.94	0.97
n-Undecane	489.00	48.90	6.85	2.93	1.96	0.98

Matheson 500 ppbC PAMS dilutions

MATHESON TRI•GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057610175

PRODUCT:

CYLINDER NUMBER: SX39238D
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	500 ppbC	498 ppbC	+/- 5%
2-Methylheptane	500 ppbC	491 ppbC	+/- 5%
3-Methylheptane	500 ppbC	507 ppbC	+/- 5%
n-Octane	500 ppbC	485 ppbC	+/- 5%
Ethylbenzene	500 ppbC	497 ppbC	+/- 5%
p-Xylene	500 ppbC	490 ppbC	+/- 5%
m-Xylene	500 ppbC	495 ppbC	+/- 5%
Styrene	500 ppbC	493 ppbC	+/- 5%
o-Xylene	500 ppbC	490 ppbC	+/- 5%
n-Nonane	500 ppbC	486 ppbC	+/- 5%
Isopropylbenzene	500 ppbC	494 ppbC	+/- 5%
n-Propylbenzene	500 ppbC	490 ppbC	+/- 5%
n-Decane	500 ppbC	489 ppbC	+/- 5%
m-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
p-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
n-Dodecane	500 ppbC	492 ppbC	+/- 5%
m-Ethyltoluene	500 ppbC	487 ppbC	+/- 5%
o-Ethyltoluene	500 ppbC	485 ppbC	+/- 5%
p-Ethyltoluene	500 ppbC	481 ppbC	+/- 5%
n-Undecane	500 ppbC	489 ppbC	+/- 5%
1,2,3-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,3,5-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,2,4-Trimethylbenzene	500 ppbC	490 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received on 12/6/07

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck
ANALYST

Derek St

12/4/2007
DATE SIGNED

MATHESON TRI·GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

To: Environmental Quality
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TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057610175

PRODUCT:

CYLINDER NUMBER: SX39238D
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	500 ppbC	498 ppbC	+/- 5%
2-Methylheptane	500 ppbC	491 ppbC	+/- 5%
3-Methylheptane	500 ppbC	507 ppbC	+/- 5%
n-Octane	500 ppbC	485 ppbC	+/- 5%
Ethylbenzene	500 ppbC	497 ppbC	+/- 5%
p-Xylene	500 ppbC	490 ppbC	+/- 5%
m-Xylene	500 ppbC	495 ppbC	+/- 5%
Styrene	500 ppbC	493 ppbC	+/- 5%
o-Xylene	500 ppbC	490 ppbC	+/- 5%
n-Nonane	500 ppbC	486 ppbC	+/- 5%
Isopropylbenzene	500 ppbC	494 ppbC	+/- 5%
n-Propylbenzene	500 ppbC	490 ppbC	+/- 5%
n-Decane	500 ppbC	489 ppbC	+/- 5%
m-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
p-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
n-Dodecane	500 ppbC	492 ppbC	+/- 5%
m-Ethyltoluene	500 ppbC	487 ppbC	+/- 5%
o-Ethyltoluene	500 ppbC	485 ppbC	+/- 5%
p-Ethyltoluene	500 ppbC	481 ppbC	+/- 5%
n-Undecane	500 ppbC	489 ppbC	+/- 5%
1,2,3-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,3,5-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,2,4-Trimethylbenzene	500 ppbC	490 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received on 12/16/07

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck
ANALYST

Derek St

12/4/2007
DATE SIGNED

```
=====================================================================
Injection Date  : 10/9/2008 1:02:00 PM          Seq. Line :   4
Sample Name     : AL22195 $L1PPFID               Location : Vial 4
Acq. Operator   : JPC                                 Inj :   1
Acq. Instrument : HP_FID2 SOP 1026             Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/9/2008 2:20:47 PM by JPC
                  (modified after loading)
PAMS SAMPLE ANALYSES
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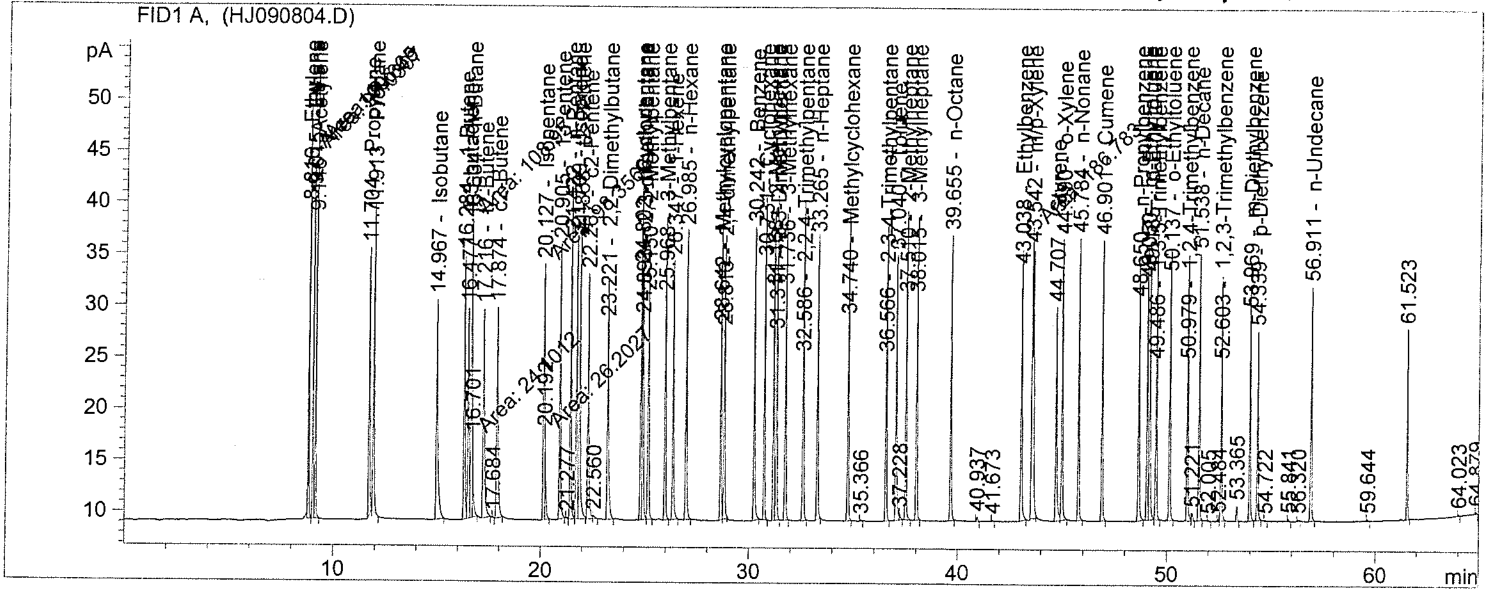
S1404



```
=====================================================================
                    External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/9/2008 2:20:52 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,
```

RetTime [min]	Type	Area [pA*s]	Amt/Area	Amount [ppbc]	Grp	Name
8.816	FM	100.34872	1.00000	51.24809		Ethylene
9.015	MF	93.03070	1.00000	47.51078		Ethane
9.146	FM	106.65022	1.00000	54.46627		Acetylene
11.704	PB	89.15047	1.00000	45.52915		Propylene
11.913	BBA	103.12894	1.00000	52.66795		Propane
14.967	PB +	112.93295	1.00000	57.67486		Isobutane
16.284	PV	100.92325	1.00000	51.54150		1-Butene
16.477	VV	82.35313	1.00000	42.05774		1,3-butadiene
16.634	MF	108.95028	1.00000	55.64091		n-Butane
17.216	PB	101.66692	1.00000	51.92130		t2-Butene
17.874	PB	96.28265	1.00000	49.17155		c2-Butene
20.127	MF	98.35686	1.00000	50.23085		Isopentane
20.905	PB	108.06710	1.00000	55.18987		1-Pentene
21.422	VV	110.76101	1.00000	56.56565		n-Pentane
21.709	VV	98.06431	1.00000	50.08144		Isoprene
21.868	VB	107.97594	1.00000	55.14331		t2-Pentene
22.267	BV	100.88352	1.00000	51.52121		c2-Pentene
23.221	BB	106.57977	1.00000	54.43029		2,2-Dimethylbutane
24.802	BV	104.42488	1.00000	53.32979		Cyclopentane

```
   RetTime  Type     Area      Amt/Area    Amount    Grp   Name
    [min]          [pA*s]                  [ppbc]
   -------|------|----------|----------|----------|--|------------------
    24.893 VV     109.78324    1.00000   56.06630    2,3-dimethylbutane
    25.150 VB     104.88356    1.00000   53.56403    2-Methylpentane
    25.968 PB     106.08242    1.00000   54.17629    3-Methylpentane
    26.347 PB      89.08646    1.00000   45.49645    1-Hexene
    26.985 PB     101.61629    1.00000   51.89544    n-Hexane
    28.642 PV     101.79911    1.00000   51.98881    Methylcyclopentane
    28.813 VB     101.62882    1.00000   51.90184    2,4-dimethylpentane
    30.242 PB  +  100.42205    1.00000   51.28554    Benzene
    30.731 PB     103.97024    1.00000   53.09760    Cyclohexane
    31.168 BV     100.26856    1.00000   51.20715    2-Methylhexane
    31.311 VB     106.27980    1.00000   54.27709    2,3-Dimethylpentane
    31.736 PB     101.99803    1.00000   52.09039    3-Methylhexane
    32.586 VB     117.60405    1.00000   60.06039    2,2,4-Trimethylpentane
    33.265 PB      96.64803    1.00000   49.35815    n-Heptane
    34.740 BB     105.54245    1.00000   53.90053    Methylcyclohexane
    36.566 BB     102.55840    1.00000   52.37657    2,3,4-Trimethylpentane
    37.040 BV  +   95.53142    1.00000   48.78790    Toluene
    37.510 BB     101.54941    1.00000   51.86128    2-Methylheptane
    38.015 BB     103.01980    1.00000   52.61221    3-Methylheptane
    39.655 BB      96.80012    1.00000   49.43582    n-Octane
    43.038 BB      95.20465    1.00000   48.62102    Ethylbenzene
    43.542 MM     186.78299    1.00000   95.39007    m/p-Xylene
    44.707 BV      81.03667    1.00000   41.38543    Styrene
    44.990 VB      98.32851    1.00000   50.21637    o-Xylene
    45.784 BB      93.69817    1.00000   47.85166    n-Nonane
    46.901 BB      96.85818    1.00000   49.46547    Cumene
    48.650 BB      90.14754    1.00000   46.03835    n-Propylbenzene
    49.050 BV      89.78224    1.00000   45.85179    m-Ethyltoluene
    49.185 VV      87.80960    1.00000   44.84436    p-Ethyltoluene
    49.486 VB      95.34503    1.00000   48.69271    1,3,5-Trimethylbenzene
    50.137 VB      92.00356    1.00000   46.98622    o-Ethyltoluene
    50.979 BB      91.48391    1.00000   46.72083    1,2,4-Trimethylbenzene
    51.538 BB      90.34567    1.00000   46.13954    n-Decane
    52.603 VB      82.16355    1.00000   41.96093    1,2,3-Trimethylbenzene
    53.969 BB      80.84151    1.00000   41.28576    m-Diethylbenzene
    54.339 BB      66.15607    1.00000   33.78591    p-Diethylbenzene
    56.911 BB  +   81.54855    1.00000   41.64685    n-Undecane

Totals :                                2848.24554

Uncalibrated Peaks     :       using compound Propane

RetTime  Type     Area      Amt/Area    Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 16.701 FM     24.10120    1.00000   12.30848    ?
 17.684 PB   3.09042e-1    1.00000 1.57828e-1    ?
 20.192 FM     26.20266    1.00000   13.38170    ?
 21.277 PP   4.50500e-1    1.00000 2.30070e-1    ?
 22.560 VB      2.07857    1.00000    1.06153    ?
 35.366 PP   3.92693e-1    1.00000 2.00548e-1    ?
 37.228 VB      2.81350    1.00000    1.43685    ?
 40.937 PB      1.71027    1.00000 8.73434e-1    ?
 41.673 BB   5.29109e-1    1.00000 2.70216e-1    ?
 51.221 BB      3.36630    1.00000    1.71917    ?
 52.005 PP   4.53053e-1    1.00000 2.31374e-1    ?
 52.484 PV   8.35210e-1    1.00000 4.26542e-1    ?
 53.365 BB      5.12836    1.00000    2.61905    ?
 54.722 PB   3.95335e-1    1.00000 2.01898e-1    ?
 55.841 PB   8.10484e-1    1.00000 4.13914e-1    ?
 56.320 PB   8.49413e-1    1.00000 4.33795e-1    ?
 59.644 BP   5.23619e-1    1.00000 2.67412e-1    ?
 61.523 BB     53.80622    1.00000   27.47884    ?
 64.023 PP   5.51542e-1    1.00000 2.81672e-1    ?
 64.879 PP   5.57680e-1    1.00000 2.84807e-1    ?
```

```
RetTime  Type     Area      Amt/Area    Amount    Grp   Name
 [min]           [pA*s]                 [ppbc]
-------|------|----------|----------|----------|--|------------------
Uncalib. totals :                       64.27913

 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Elution order of calibrated compounds may have changed

======================================================================
                          *** End of Report ***
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```
=====================================================================
Injection Date   : 10/9/2008 1:02:00 PM             Seq. Line :   4
Sample Name      : AL22195 $L1PPFID                  Location : Vial 4
Acq. Operator    : JPC                                    Inj :   1
Acq. Instrument  : HP_FID2 SOP 1026                Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/9/2008 12:15:17 PM by JPC
                   (modified after loading)
PAMS SAMPLE ANALYSES
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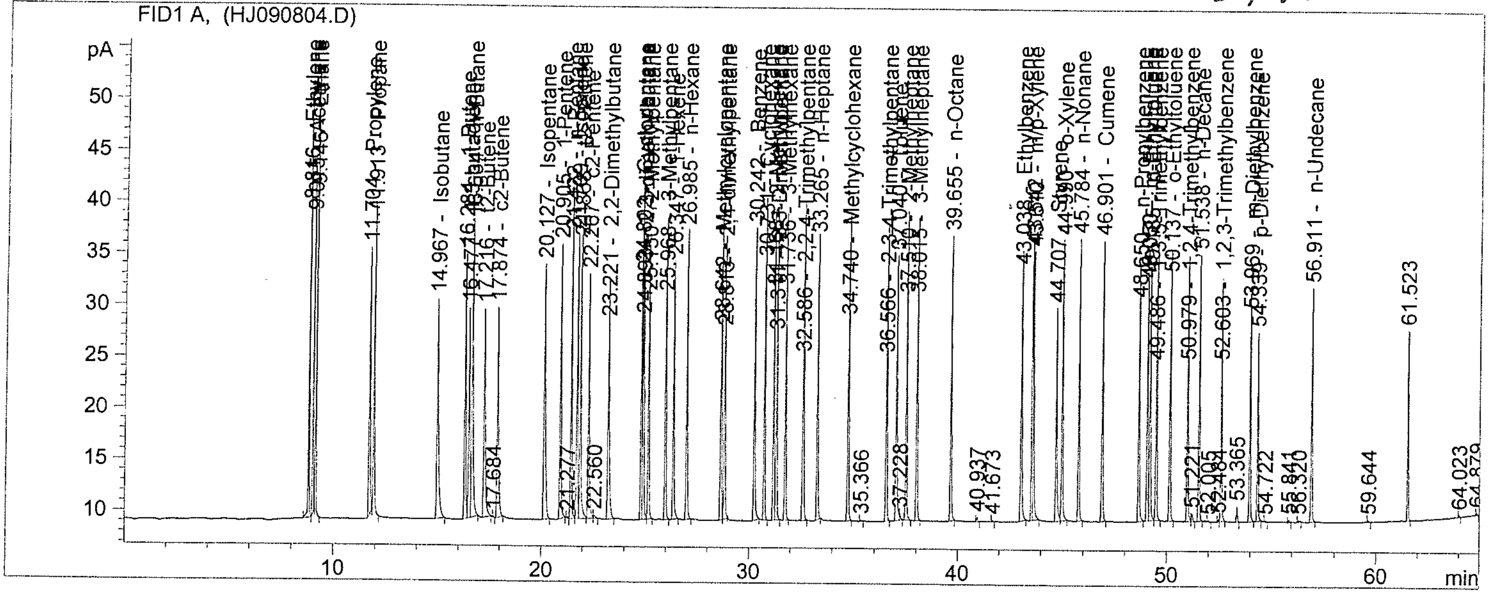
S1404



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=====================================================================
                    External Standard Report
=====================================================================

Sorted By              :     Signal
Calib. Data Modified   :     8/4/2008 10:57:02 AM
Multiplier             :     0.5107
Dilution               :     1.0000
Sample Amount          :     1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.816 BBA    103.10838    1.00000   52.65745     Ethylene
  9.015 PB      89.34997    1.00000   45.63103     Acetylene
  9.146 BBA    100.08290    1.00000   51.11234     Ethane
 11.704 PB      89.15047    1.00000   45.52915     Propylene
 11.913 BBA    103.12894    1.00000   52.66795     Propane
 14.967 PB   + 112.93295    1.00000   57.67486     Isobutane
 16.284 PV     100.92325    1.00000   51.54150     1-Butene
 16.477 VV      82.35313    1.00000   42.05774     1,3-butadiene
 16.634 VB     133.08276    1.00000   67.96537     n-Butane
 17.216 PB     101.66692    1.00000   51.92130     t2-Butene
 17.874 PB      96.28265    1.00000   49.17155     c2-Butene
 20.127 PB     124.55920    1.00000   63.61238     Isopentane
 20.905 PB     108.06710    1.00000   55.18987     1-Pentene
 21.422 VV     110.76101    1.00000   56.56565     n-Pentane
 21.709 VV      98.06431    1.00000   50.08144     Isoprene
 21.868 VB     107.97594    1.00000   55.14331     t2-Pentene
 22.267 BV     100.88352    1.00000   51.52121     c2-Pentene
 23.221 BB     106.57977    1.00000   54.43029     2,2-Dimethylbutane
 24.802 BV     104.42488    1.00000   53.32979     Cyclopentane
```

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```
  RetTime  Type      Area      Amt/Area     Amount    Grp   Name
   [min]          [pA*s]                    [ppbc]
  -------|------|----------|----------|----------|--|------------------
   24.893 VV       109.78324    1.00000   56.06630     2,3-dimethylbutane
   25.150 VB       104.88356    1.00000   53.56403     2-Methylpentane
   25.968 PB       106.08242    1.00000   54.17629     3-Methylpentane
   26.347 PB        89.08646    1.00000   45.49645     1-Hexene
   26.985 PB       101.61629    1.00000   51.89544     n-Hexane
   28.642 PV       101.79911    1.00000   51.98881     Methylcyclopentane
   28.813 VB       101.62882    1.00000   51.90184     2,4-dimethylpentane
   30.242 PB   +   100.42205    1.00000   51.28554     Benzene
   30.731 PB       103.97024    1.00000   53.09760     Cyclohexane
   31.168 BV       100.26856    1.00000   51.20715     2-Methylhexane
   31.311 VB       106.27980    1.00000   54.27709     2,3-Dimethylpentane
   31.736 PB       101.99803    1.00000   52.09039     3-Methylhexane
   32.586 VB       117.60405    1.00000   60.06039     2,2,4-Trimethylpentane
   33.265 PB        96.64803    1.00000   49.35815     n-Heptane
   34.740 BB       105.54245    1.00000   53.90053     Methylcyclohexane
   36.566 BB       102.55840    1.00000   52.37657     2,3,4-Trimethylpentane
   37.040 BV   +    95.53142    1.00000   48.78790     Toluene
   37.510 BB       101.54941    1.00000   51.86128     2-Methylheptane
   38.015 BB       103.01980    1.00000   52.61221     3-Methylheptane
   39.655 BB        96.80012    1.00000   49.43582     n-Octane
   43.038 BB        95.20465    1.00000   48.62102     Ethylbenzene
   43.542 PV        88.68321    1.00000   45.29052     m/p-Xylene
   44.707 BV        81.03667    1.00000   41.38543     Styrene
   44.990 VB        98.32851    1.00000   50.21637     o-Xylene
   45.784 BB        93.69817    1.00000   47.85166     n-Nonane
   46.901 BB        96.85818    1.00000   49.46547     Cumene
   48.650 BB        90.14754    1.00000   46.03835     n-Propylbenzene
   49.050 BV        89.78224    1.00000   45.85179     m-Ethyltoluene
   49.185 VV        87.80960    1.00000   44.84436     p-Ethyltoluene
   49.486 VB        95.34503    1.00000   48.69271     1,3,5-Trimethylbenzene
   50.137 VB        92.00356    1.00000   46.98622     o-Ethyltoluene
   50.979 BB        91.48391    1.00000   46.72083     1,2,4-Trimethylbenzene
   51.538 BB        90.34567    1.00000   46.13954     n-Decane
   52.603 VB        82.16355    1.00000   41.96093     1,2,3-Trimethylbenzene
   53.969 BB        80.84151    1.00000   41.28576     m-Diethylbenzene
   54.339 BB        66.15607    1.00000   33.78591     p-Diethylbenzene
   56.911 BB   +    81.54855    1.00000   41.64685     n-Undecane

 Totals :                               2820.02765

 Uncalibrated Peaks     :       using compound Propane

 RetTime  Type      Area      Amt/Area     Amount    Grp   Name
  [min]          [pA*s]                    [ppbc]
 -------|------|----------|----------|----------|--|------------------
  17.684 PB     3.09042e-1    1.00000 1.57828e-1    ?
  21.277 PP     4.50500e-1    1.00000 2.30070e-1    ?
  22.560 VB        2.07857    1.00000    1.06153    ?
  35.366 PP     3.92693e-1    1.00000 2.00548e-1    ?
  37.228 VB        2.81350    1.00000    1.43685    ?
  40.937 PB        1.71027    1.00000 8.73434e-1    ?
  41.673 BB     5.29109e-1    1.00000 2.70216e-1    ?
  43.610 VB      101.86528    1.00000   52.02260    ?
  51.221 BB        3.36630    1.00000    1.71917    ?
  52.005 PP     4.53053e-1    1.00000 2.31374e-1    ?
  52.484 PV     8.35210e-1    1.00000 4.26542e-1    ?
  53.365 BB        5.12836    1.00000    2.61905    ?
  54.722 PB     3.95335e-1    1.00000 2.01898e-1    ?
  55.841 PB     8.10484e-1    1.00000 4.13914e-1    ?
  56.320 PB     8.49413e-1    1.00000 4.33795e-1    ?
  59.644 BP     5.23619e-1    1.00000 2.67412e-1    ?
  61.523 BB       53.80622    1.00000   27.47884    ?
  64.023 PP     5.51542e-1    1.00000 2.81672e-1    ?
  64.879 PP     5.57680e-1    1.00000 2.84807e-1    ?
```

```
Uncalib. totals :                       90.61155

 Results obtained with enhanced integrator!
1 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)

=====================================================================
                          *** End of Report ***
```

PAMS RETENTION TIME STD FID #2 lot #1057410185

DATE: 10/9/2008 QC NO: AL22195 BATCH NO: 192687

COMPONENTS	STD (ppbc)	SI (ppbc)	REC% SI
Ethylene	21.00	23.96	114.1
Actetylene	42.00	18.87	44.9
Ethane	26.00	30.93	119.0
Propylene	26.00	21.11	81.2
Propane	40.00	44.55	111.4
n-Butane	43.00		
Isobutane	25.00	27.35	109.4
1-Butene	32.00	31.41	98.1
1,3-Butadiene	32.00	24.35	76.1
n-Butane	43.00	50.43	117.3
t2-butene	26.00	25.38	97.6
c2-butene	38.00	37.65	99.1
Isopentane	40.00	44.07	110.2
1-Pentene	25.00	25.23	100.9
n-Pentane	26.00	26.90	103.5
Isoprene	42.00	38.29	91.2
t2-Pentene	25.00	28.21	112.8
c2-Pentene	34.00	33.94	99.8
2,2-Dimethylbutane	40.00	43.77	109.4
Cyclopentane	21.00	20.28	96.5
2,3-Dimethylbutane	51.00	56.71	111.2
2-Methylpentane	21.00	22.58	107.5
3-Methylpentane	41.00	42.93	104.7
1-Hexene	61.00	59.88	98.2
1-Hexane	30.00	31.31	104.4
Methylcyclopentane	26.00	27.05	104.0
2,4-Dimethylpentane	40.00	42.56	106.4
Benzene	31.00	31.28	100.9
Cyclohexane	42.00	43.52	103.6
2-Methylhexane	25.00	25.99	104.0
2,3-Dimethylpentane	54.00	55.69	103.1
3-Methylhexane	26.00	26.78	103.0
2,2,4-Trimethylpentane	31.00	32.15	103.7
n-Heptane	26.00	26.29	101.1
Methylcyclohexane	31.00	32.69	105.5
2,3,4-Trimethylpentane	25.00	26.33	105.3
Toluene	40.00	38.76	96.9
2-Methylheptane	25.00	25.60	102.4
3-Methylheptane	25.00	26.20	104.8
n-Octane	31.00	29.76	96.0
Ethylbenzne	25.00	24.13	96.5
m/p-Xylene	42.00	38.96	92.8
Styrene	41.00	34.05	83.1
o Xylene	26.00	25.62	98.5
n-Nonane	25.00	24.36	97.4
Cumene	40.00	40.68	101.7
n-Propylbenzene	30.00	29.05	96.8
m-Ethyltoluene	25.00	25.00	100.0
p-Ethyltoluene	43.00	40.64	94.5
1,3,5-Trimethylbenzene	26.00	25.65	98.7
o-Ethyltouene	27.00	30.75	113.9
1,2,4-trimethylbenzene	39.00	39.32	100.8
n-Decane	30.00	29.29	97.6
1,2,3-Trimethylbenzene	25.00	25.70	102.8
m-Diethylbenzene	40.00	39.31	98.3
p-Diethylbenzene	27.00	24.15	89.4
n-Undecane	41.00	27.53	67.2

PAms

MATHESON TRI•GAS

Certified Mixture Grade

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057410185

PRODUCT:

CYLINDER NUMBER: CC-250112
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Ethylene	20 ppbC	21 ppbC	+/- 5%
Ethane	25 ppbC	26 ppbC	+/- 5%
Acetylene	40 ppbC	42 ppbC	+/- 5%
Propylene	25 ppbC	26 ppbC	+/- 5%
Propane	40 ppbC	40 ppbC	+/- 5%
Isobutane	25 ppbC	25 ppbC	+/- 5%
1-Butene	30 ppbC	32 ppbC	+/- 5%
1,3-Butadiene	30 ppbC	32 ppbC	+/- 5%
n-Butane	40 ppbC	43 ppbC	+/- 5%
trans-2-Butene	25 ppbC	26 ppbC	+/- 5%
cis-2-Butene	35 ppbC	38 ppbC	+/- 5%
Isopentane	40 ppbC	40 ppbC	+/- 5%
1-Pentene	25 ppbC	25 ppbC	+/- 5%
n-Pentane	25 ppbC	26 ppbC	+/- 5%
Isoprene	40 ppbC	42 ppbC	+/- 5%
trans-2-Pentene	25 ppbC	25 ppbC	+/- 5%
cis-2-Pentene	35 ppbC	34 ppbC	+/- 5%
Cyclopentene	20 ppbC	21 ppbC	+/- 5%
2,2-Dimethylbutane	40 ppbC	40 ppbC	+/- 5%
2-Methylpentane	20 ppbC	21 ppbC	+/- 5%
3-Methylpentane	40 ppbC	41 ppbC	+/- 5%
2,3-Dimethylbutane	50 ppbC	51 ppbC	+/- 5%
1-Hexene	60 ppbC	61 ppbC	+/- 5%
n-Hexane	30 ppbC	30 ppbC	+/- 5%
Methylcyclopentane	25 ppbC	26 ppbC	+/- 5%
2,4-Dimethylpentane	40 ppbC	40 ppbC	+/- 5%
Benzene	30 ppbC	31 ppbC	+/- 5%
Cyclohexane	40 ppbC	42 ppbC	+/- 5%
2,3-Dimethylpentane	50 ppbC	54 ppbC	+/- 5%
2-Methylhexane	25 ppbC	25 ppbC	+/- 5%
3-Methylhexane	25 ppbC	26 ppbC	+/- 5%
n-Heptane	25 ppbC	26 ppbC	+/- 5%
2,2,4-Trimethylpentane	30 ppbC	31 ppbC	+/- 5%
Methylcyclohexane	30 ppbC	31 ppbC	+/- 5%
2,3,4-Trimethylpentane	25 ppbC	25 ppbC	+/- 5%

Received on 12/6/07

TRACEABLE TO REFERENCE STANDARD SOURCE/NUMBER:
TRACEABLE TO NIST TRACEABLE WEIGHT CERTIFICATE:

MATHESON TRI•GAS

Certified Mixture Grade

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd

Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057410185

PRODUCT:

CYLINDER NUMBER: CC-250112
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 liters
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	40 ppbC	40 ppbC	+/- 5%
2-Methylheptane	25 ppbC	25 ppbC	+/- 5%
3-Methylheptane	25 ppbC	25 ppbC	+/- 5%
n-Octane	30 ppbC	31 ppbC	+/- 5%
Ethylbenzene	25 ppbC	25 ppbC	+/- 5%
p-Xylene	20 ppbC	21 ppbC	+/- 5%
m-Xylene	20 ppbC	21 ppbC	+/- 5%
Styrene	40 ppbC	41 ppbC	+/- 5%
o-Xylene	25 ppbC	26 ppbC	+/- 5%
n-Nonane	25 ppbC	25 ppbC	+/- 5%
Isopropylbenzene	40 ppbC	40 ppbC	+/- 5%
n-Propylbenzene	30 ppbC	30 ppbC	+/- 5%
n-Decane	30 ppbC	30 ppbC	+/- 5%
m-Diethylbenzene	40 ppbC	40 ppbC	+/- 5%
p-Diethylbenzene	25 ppbC	27 ppbC	+/- 5%
n-Dodecane	30 ppbC	31 ppbC	+/- 5%
m-Ethyltoluene	25 ppbC	25 ppbC	+/- 5%
o-Ethyltoluene	30 ppbC	27 ppbC	+/- 5%
p-Ethyltoluene	40 ppbC	43 ppbC	+/- 5%
n-Undecane	40 ppbC	41 ppbC	+/- 5%
1,2,3-Trimethylbenzene	25 ppbC	25 ppbC	+/- 5%
1,3,5-Trimethylbenzene	25 ppbC	26 ppbC	+/- 5%
1,2,4-Trimethylbenzene	40 ppbC	39 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received 12/6/07

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

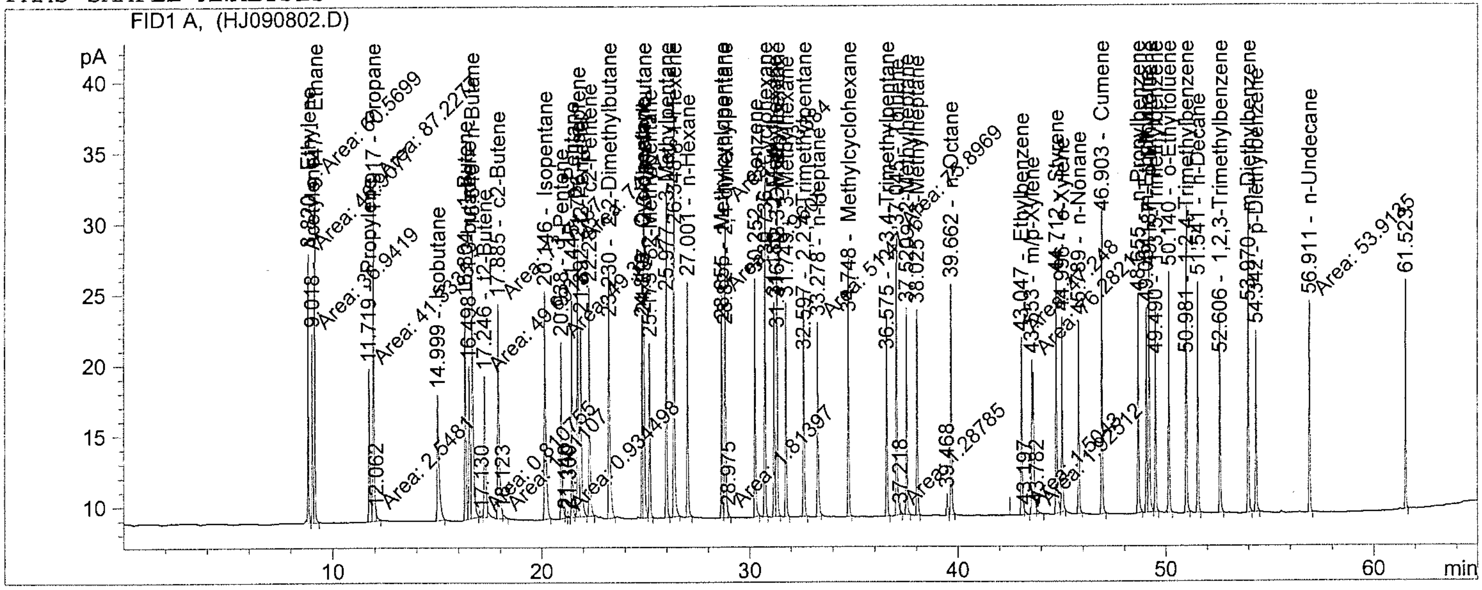
Derek Stuck
ANALYST

Derek St

12/4/2007
DATE SIGNED

```
=====================================================================
Injection Date  : 10/9/2008 10:23:44 AM         Seq. Line :   2
Sample Name     : AL22195 $I_PPFID               Location : Vial 3
Acq. Operator   : JPC                                 Inj :   1
Acq. Instrument : HP_FID2 SOP 1026             Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/9/2008 12:15:17 PM by JPC
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

G1152



```
=====================================================================
                       External Standard Report
=====================================================================

Sorted By              :      Signal
Calib. Data Modified   :      8/4/2008 10:57:02 AM
Multiplier             :      0.5107
Dilution               :      1.0000
Sample Amount          :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area    Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.820 FM      46.90773    1.00000   23.95578     Ethylene
  9.018 MF      36.94192    1.00000   18.86624     Acetylene
  9.147 FM      60.56993    1.00000   30.93306     Ethane
 11.719 MF      41.33355    1.00000   21.10904     Propylene
 11.917 MF      87.22768    1.00000   44.54718     Propane
 14.999 PB  +   53.55767    1.00000   27.35190     Isobutane
 16.304 BV      61.49738    1.00000   31.40671     1-Butene
 16.498 VV      47.68173    1.00000   24.35106     1,3-butadiene
 16.646 VB      98.74651    1.00000   50.42984     n-Butane
 17.246 MF      49.69148    1.00000   25.37744     t2-Butene
 17.885 MF      73.71873    1.00000   37.64815     c2-Butene
 20.146 PB      86.29390    1.00000   44.07029     Isopentane
 20.938 MF      49.39668    1.00000   25.22688     1-Pentene
 21.445 VV      52.67418    1.00000   26.90070     n-Pentane
 21.726 FM      74.97482    1.00000   38.28964     Isoprene
 21.892 VB      55.23119    1.00000   28.20657     t2-Pentene
 22.283 PP      66.45922    1.00000   33.94072     c2-Pentene
 23.230 PB      85.71204    1.00000   43.77314     2,2-Dimethylbutane
 24.818 BV      39.70129    1.00000   20.27545     Cyclopentane
```

10-9-08
OAK

```
 RetTime  Type    Area      Amt/Area    Amount    Grp   Name
  [min]          [pA*s]                 [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.897 VV     111.04067    1.00000   56.70847    2,3-dimethylbutane
 25.175 VB      44.21571    1.00000   22.58096    2-Methylpentane
 25.977 BB      84.06284    1.00000   42.93089    3-Methylpentane
 26.348 BB     117.24971    1.00000   59.87943    1-Hexene
 27.001 BB      61.30326    1.00000   31.30758    n-Hexane
 28.655 MF      52.96046    1.00000   27.04691    Methylcyclopentane
 28.821 MF      83.33839    1.00000   42.56091    2,4-dimethylpentane
 30.252 BB  +   61.24808    1.00000   31.27939    Benzene
 30.736 PB      85.21915    1.00000   43.52142    Cyclohexane
 31.180 BV      50.89335    1.00000   25.99123    2-Methylhexane
 31.316 VB     109.04791    1.00000   55.69077    2,3-Dimethylpentane
 31.749 BB      52.42933    1.00000   26.77566    3-Methylhexane
 32.597 BB      62.96000    1.00000   32.15367    2,2,4-Trimethylpentane
 33.278 MF      51.47957    1.00000   26.29062    n-Heptane
 34.748 BB      64.01354    1.00000   32.69172    Methylcyclohexane
 36.575 BB      51.54708    1.00000   26.32509    2,3,4-Trimethylpentane
 37.045 MF  +   75.89687    1.00000   38.76053    Toluene
 37.520 BB      50.13625    1.00000   25.60458    2-Methylheptane
 38.025 BB      51.29396    1.00000   26.19582    3-Methylheptane
 39.662 VB      58.27401    1.00000   29.76053    n-Octane
 43.047 MF      47.24795    1.00000   24.12953    Ethylbenzene
 43.553 MF      76.28214    1.00000   38.95729    m/p-Xylene
 44.712 PV      66.67661    1.00000   34.05174    Styrene
 44.996 VB      50.16097    1.00000   25.61721    o-Xylene
 45.789 BB      47.69715    1.00000   24.35894    n-Nonane
 46.903 BB      79.66508    1.00000   40.68495    Cumene
 48.655 BB      56.87860    1.00000   29.04790    n-Propylbenzene
 49.054 BV      48.94999    1.00000   24.99876    m-Ethyltoluene
 49.187 VV      79.58132    1.00000   40.64218    p-Ethyltoluene
 49.490 VB      50.22721    1.00000   25.65103    1,3,5-Trimethylbenzene
 50.140 VB      60.22029    1.00000   30.75450    o-Ethyltoluene
 50.981 BB      77.00002    1.00000   39.32391    1,2,4-Trimethylbenzene
 51.541 BB      57.35054    1.00000   29.28892    n-Decane
 52.606 BB      50.31715    1.00000   25.69697    1,2,3-Trimethylbenzene
 53.970 BB      76.97448    1.00000   39.31087    m-Diethylbenzene
 54.342 BB      47.28868    1.00000   24.15033    p-Diethylbenzene
 56.911 MM  +   53.91354    1.00000   27.53365    n-Undecane

Totals :                               1824.91467

Uncalibrated Peaks     :       using compound Propane

 RetTime  Type    Area      Amt/Area    Amount    Grp   Name
  [min]          [pA*s]                 [ppbc]
-------|------|----------|----------|----------|--|------------------
 12.062 FM       2.54810    1.00000    1.30131     ?
 17.130 MF     8.10755e-1   1.00000 4.14053e-1     ?
 18.123 FM       1.91107    1.00000 9.75981e-1     ?
 21.140 FM     9.34498e-1   1.00000 4.77248e-1     ?
 21.300 PP     4.08646e-1   1.00000 2.08696e-1     ?
 28.975 FM       1.81397    1.00000 9.26393e-1     ?
 37.218 FM       1.28785    1.00000 6.57706e-1     ?
 39.468 BV       5.73210    1.00000    2.92738     ?
 43.197 FM       1.50430    1.00000 7.68244e-1     ?
 43.782 FM       1.92512    1.00000 9.83159e-1     ?
 61.523 BB      47.62742    1.00000   24.32332     ?

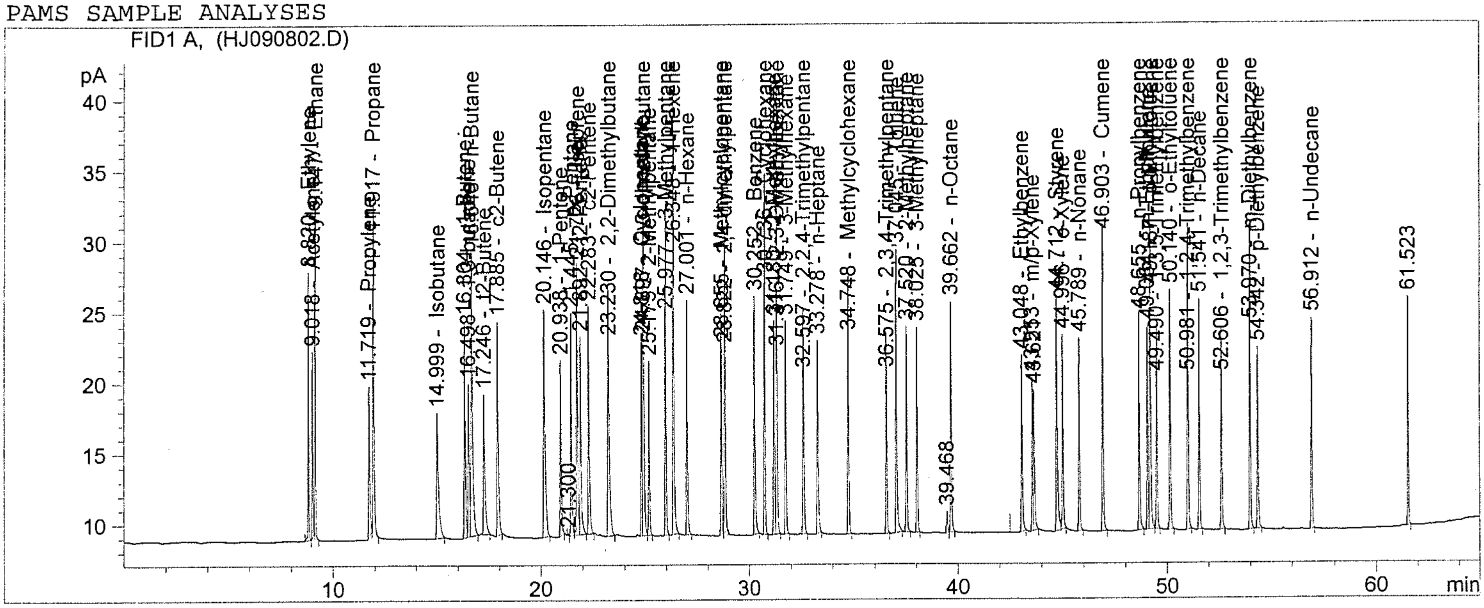
Uncalib. totals :                        33.96350

  Results obtained with enhanced integrator!
 1 Warnings or Errors :

 Warning : Calibration warnings (see calibration table listing)

 ===================================================================
```

```
=====================================================================
Injection Date  : 10/9/2008 10:23:44 AM          Seq. Line :   2
Sample Name     : AL22195 $I_PPFID                 Location : Vial 3
Acq. Operator   : JPC                                   Inj :   1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/9/2008 12:15:17 PM by JPC
                  (modified after loading)
PAMS SAMPLE ANALYSES
```



```
=====================================================================
                     External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area    Amount    Grp   Name
 [min]          [pA*s]                 [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.820 BBA    47.14820    1.00000   24.07859    Ethylene
  9.018 PB     34.26736    1.00000   17.50034    Acetylene
  9.147 BBA    56.03752    1.00000   28.61836    Ethane
 11.719 PB     37.91744    1.00000   19.36444    Propylene
 11.917 BBA    82.64924    1.00000   42.20897    Propane
 14.999 PB  +  53.55767    1.00000   27.35190    Isobutane
 16.304 BV     61.49738    1.00000   31.40671    1-Butene
 16.498 VV     47.68173    1.00000   24.35106    1,3-butadiene
 16.646 VB     98.74651    1.00000   50.42984    n-Butane
 17.246 BB     50.79647    1.00000   25.94176    t2-Butene
 17.885 PB     72.19682    1.00000   36.87092    c2-Butene
 20.146 PB     86.29390    1.00000   44.07029    Isopentane
 20.938 PB     48.09455    1.00000   24.56189    1-Pentene
 21.445 VV     52.67418    1.00000   26.90070    n-Pentane
 21.726 VV     75.91888    1.00000   38.77177    Isoprene
 21.892 VB     55.23119    1.00000   28.20657    t2-Pentene
 22.283 PP     66.45922    1.00000   33.94072    c2-Pentene
 23.230 PB     85.71204    1.00000   43.77314    2,2-Dimethylbutane
 24.818 BV     39.70129    1.00000   20.27545    Cyclopentane
```

```
  RetTime  Type     Area      Amt/Area     Amount    Grp   Name
   [min]          [pA*s]                   [ppbc]
  -------|------|----------|----------|----------|--|------------------
   24.897 VV     111.04067    1.00000   56.70847     2,3-dimethylbutane
   25.175 VB      44.21571    1.00000   22.58096     2-Methylpentane
   25.977 BB      84.06284    1.00000   42.93089     3-Methylpentane
   26.348 BB     117.24971    1.00000   59.87943     1-Hexene
   27.001 BB      61.30326    1.00000   31.30758     n-Hexane
   28.655 PV      52.26686    1.00000   26.69269     Methylcyclopentane
   28.822 VB      80.18160    1.00000   40.94874     2,4-dimethylpentane
   30.252 BB  +   61.24808    1.00000   31.27939     Benzene
   30.736 PB      85.21915    1.00000   43.52142     Cyclohexane
   31.180 BV      50.89335    1.00000   25.99123     2-Methylhexane
   31.316 VB     109.04791    1.00000   55.69077     2,3-Dimethylpentane
   31.749 BB      52.42933    1.00000   26.77566     3-Methylhexane
   32.597 BB      62.96000    1.00000   32.15367     2,2,4-Trimethylpentane
   33.278 PB      50.60601    1.00000   25.84449     n-Heptane
   34.748 BB      64.01354    1.00000   32.69172     Methylcyclohexane
   36.575 BB      51.54708    1.00000   26.32509     2,3,4-Trimethylpentane
   37.045 BB  +   77.18384    1.00000   39.41779     Toluene
   37.520 BB      50.13625    1.00000   25.60458     2-Methylheptane
   38.025 BB      51.29396    1.00000   26.19582     3-Methylheptane
   39.662 VB      58.27401    1.00000   29.76053     n-Octane
   43.048 PB      46.80545    1.00000   23.90354     Ethylbenzene
   43.553 PV      34.56858    1.00000   17.65417     m/p-Xylene
   44.712 PV      66.67661    1.00000   34.05174     Styrene
   44.996 VB      50.16097    1.00000   25.61721     o-Xylene
   45.789 BB      47.69715    1.00000   24.35894     n-Nonane
   46.903 BB      79.66508    1.00000   40.68495     Cumene
   48.655 BB      56.87860    1.00000   29.04790     n-Propylbenzene
   49.054 BV      48.94999    1.00000   24.99876     m-Ethyltoluene
   49.187 VV      79.58132    1.00000   40.64218     p-Ethyltoluene
   49.490 VB      50.22721    1.00000   25.65103     1,3,5-Trimethylbenzene
   50.140 VB      60.22029    1.00000   30.75450     o-Ethyltoluene
   50.981 BB      77.00002    1.00000   39.32391     1,2,4-Trimethylbenzene
   51.541 BB      57.35054    1.00000   29.28892     n-Decane
   52.606 BB      50.31715    1.00000   25.69697     1,2,3-Trimethylbenzene
   53.970 BB      76.97448    1.00000   39.31087     m-Diethylbenzene
   54.342 BB      47.28868    1.00000   24.15033     p-Diethylbenzene
   56.912 BB  +   53.52686    1.00000   27.33617     n-Undecane

  Totals :                             1793.39645

  Uncalibrated Peaks    :      using compound Propane

  RetTime  Type     Area      Amt/Area     Amount    Grp   Name
   [min]          [pA*s]                   [ppbc]
  -------|------|----------|----------|----------|--|------------------
   21.300 PP    4.08646e-1    1.00000 2.08696e-1     ?
   39.468 BV       5.73210    1.00000    2.92738     ?
   43.621 VB      41.12904    1.00000   21.00460     ?
   61.523 BB      47.62742    1.00000   24.32332     ?

  Uncalib. totals :                       48.46401

   Results obtained with enhanced integrator!
  1 Warnings or Errors :

  Warning : Calibration warnings (see calibration table listing)

  =====================================================================
                            *** End of Report ***
```

GC/FID Daily Worksheet FID 2

Date Oct, 15, 2008
Operator JAK
Batch # 193024(A)
QC # AL22735

Dup = AL22014 (Port 2)

Working Gases and Quality Control Standards:

Carrier Gas Helium Pressure 2100/200
Pulse Gas Pressure 15.0
Combustion Air Pressure 87.0
Hydrogen Pressure 55.0
Nitrogen Pressure for dewar 30.0

ZAB Pressure 26.0; Preparation Date 10-2-08; Canister ID GCR 44
HAB Pressure 20.5; Preparation date 10-6-08; Canister ID GCR 24
LCS: Std ID 1057610175 Preparation Date 10-7-08; Pressure 26.5;
– Canister ID S1404
PAMS: Std ID CC250112 Preparation Date 10-2-08; Pressure 26.5;
Canister ID G-1152,
SRM: Std ID CC162783 Preparation Date 10-2-08; Pressure 24.5;
Canister ID G1124

Entech Setup:

Name of Sequence: 101508
Sequence Saved? Y
Sequence Printed? Y
Leak Check Performed? Y

GC/FID Chemstation Setup:

Name of Sequence: 10-15-08
Sequence Saved? Y
Sequence Printed? Y
Bakeout.M Loaded at End? Y

Acquisition Startup:

Do Both Sequences Match? Y
Canister Valves Open? Y
Entech Sequence Started? Y
Chemstation Sequence Started? Y

Total Runs in the sequences:

Number of Std: 3
Number of Blanks: 2
Number of Samples 17
Number of Duplicates: 3
Number of Sys Blanks: 2
Number of Cert Cans: 0
Total Runs in the sequences: 27

Date and Time Sequence Started: 10/15/08 / 8:00AM

Comments: ReBoot: No / close + Reopen - Yes / Chemstation ONLINE OFFLINE "OFFLINE had A "FATAL Exception" ON→10-14-08

PROJECT NAME October 15, 2008 NOTEBOOK NO. HP.FID2

Site/Desc	RunDate	Port #	CanID #	LIMS #	AnalysisCode #	DataFile #	
SRM	Oct. 15, 2008	S1	G1124	AL22735	$I_SRM	HJ150801	✓
PAMS	↓	1-1	G1152	↓	$I_PPFID	2	✓
HAB		S3	GCR24		$HBPPFID	3	✓ 1.8
LCS		16	S1404		$L1PPFID	4	X Re-Run
ZAB		S4	GCR44	ΔΔ	$B-PPFID	5	✓ 1.8
*PAL	10-3-08	2	G1269	AL22014	$PPFID	6	✓
T3 GRAB	9-25-08	3	S1322	AL21642	↓	7	✓
~~T10~~ T4 Grab T4	9-25-08	4	~~S14185~~ S1397	643		8	✓
T5 Grab T5	9-25-08	5	~~S1394~~ S1490	644		9	✓
T6 GRAB	9-25-08	6	S1502	645		10	✓
T7 GRAB	9-25-08	7	S1375	646		11	✓
T8 GRAB	9-26-08	8	S1470	691		12	✓
T25 GRAB	9-26-08	9	S1478	692		13	✓
T10 GRAB	9-26 08	10	S1418	693		14	✓
SysBlnk	10-15-08	0	—	AL22735	$SysBlnk	15	✓ 2.2
Dup/PAL	10-3-08	2	G1269	AL22014	$D_PPFID	16	✓
Cont	10-15-08	S1	G1124	AL22735	$C_SRM	17	✓
T11 GRAB	9-26-08	11	S1394	AL21694	$PPFID	18	✓
T15 GRAB	9-26-08	12	S1348	AL21696 ΔΔ		19	✓
T16 GRAB	9-26-08	13	S1431	AL21697		20	✓
T17 GRAB	9-26-08	14	S1347	AL21698		21	✓
T18 GRAB	9-27-08	15	S1376	AL21699		22	✓
T19 GRAB	9-27-08	2	S1482	AL21700		23	✓
T20 GRAB	9-28-08	3	S1462	AL21701		24	✓
T22 GRAB	9-28-08	4	S1359	AL21202	ReRun	25	ReRun
SysBlnk	10-15-08	0	—	AL22735	$SysBlnk	26	✓ 2.3
Cont	10-15-08	S1	G1124	AL22735	$C-SRM	27	✓
LCS	10-15-08	S3	S1452	AL22735	$L1PPFID	28	✓
SysBlnk	10-15-08	0	—	AL22735	$SysBlnk	29	✓ 2.2
BoBSTD	10-16-08	1	Serial#1574	BoBSTD	$PPFID	30	ReRun
BoB STD	10-16-08	1	Serial#1574	BoBSTD	↓	31	R ✓
T22 GRAB	9-28-0	4	S1359	AL21702		32	✓
~~SysBlnk~~	~~10-15-08~~	~~0~~	~~—~~	~~AL22735~~	~~$SysBlnk~~	~~33~~	10/17/08
T10 GRAB	9-26-08	10	S1418	AL21693	$PPFID	33	** ✓
Cont	10-15-08	S1	S1124	AL22735	$C-PPFID	34	✓

*: Autosampler positions not correct, re-load program and Re-run. Replaced Power Supply on Tower

SIGNATURE JAK DATE Oct. 15, 08

READ AND UNDERSTOOD DATE 20

```
----------------------- Leak Check Report ----------------------

10/15/2008 7:59:09 AM
Leak Check for C:\Smart\SQ101508.SEQ
Report File: C:\Smart\SQ101508.LCR
Leak Check Method: Evacuation
Pressurize/Evacuate time(sec) 30
Equilibration time(sec) 10
Maintanance   time(sec) 30


  Sample
  Inlet Auto1  Auto2  Auto3  Start  End    Rate(psi/min)
  1    1   ---   ---   0.6   0.6   0.00
  3    1   ---   ---   0.3   0.4   0.20
  1    16   ---   ---   0.5   0.6   0.20
  4    16   ---   ---   0.3   0.4   0.20
  1    2   ---   ---   0.4   0.5   0.20
  1    3   ---   ---   0.4   0.4   0.00
  1    4   ---   ---   0.4   0.4   0.00
  1    5   ---   ---   0.3   0.4   0.20
  1    6   ---   ---   0.3   0.4   0.20
  1    7   ---   ---   0.3   0.4   0.20
  1    8   ---   ---   0.3   0.4   0.20
  1    9   ---   ---   0.3   0.4   0.20
  1    10   ---   ---   0.4   0.4   0.00
  1    11   ---   ---   0.4   0.4   0.00
  1    12   ---   ---   0.4   0.4   0.00
  1    13   ---   ---   0.4   0.5   0.20
  1    14   ---   ---   0.4   0.4   0.00
  1    15   ---   ---   0.4   0.4   0.00
```

```
---------------SEQUENCE TABLE ---------------

Sequence Name:  C:\Smart\SQ101508.SEQ
Date:           10-17-2008
Time:           12:05:16
Int. Std Volume: 0 cc


          Inlet  Auto   Samp   Cal Std
 Sample Name   #   Pos   Vol.    Vol.       Method         Time

 AL22735 $I_SRM  1    1     0    200     C:\Smart\PAMS.MPT  12:00
AL22735 $I_PPFID  1    1   200     0     C:\Smart\PAMS.MPT  12:00
AL22735 $HBPPFID  3    1   200     0     C:\Smart\PAMS.MPT  12:00
AL22735 $L1PPFID  1   16   200     0     C:\Smart\PAMS.MPT  12:00
AL22735 $B_PPFID  4    1   200     0     C:\Smart\PAMS.MPT  12:00
 AL22014 $PPFID  1    2   200     0    C:\Smart\PAMS.MPT  12:00
 AL21642 $PPFID  1    3    40     0    C:\Smart\PAMS.MPT  12:00
 AL21643 $PPFID  1    4    40     0    C:\Smart\PAMS.MPT  12:00
 AL21644 $PPFID  1    5    40     0    C:\Smart\PAMS.MPT  12:00
 AL21645 $PPFID  1    6    40     0    C:\Smart\PAMS.MPT  12:00
 AL21646 $PPFID  1    7    40     0    C:\Smart\PAMS.MPT  12:00
 AL21691 $PPFID  1    8    40     0    C:\Smart\PAMS.MPT  12:00
 AL21692 $PPFID  1    9    40     0    C:\Smart\PAMS.MPT  12:00
 AL21693 $PPFID  1   10    40     0    C:\Smart\PAMS.MPT  12:00
AL22735 $SYSBLNK  1    1     0     0     C:\Smart\PAMS.MPT  12:00
AL22014 $D_PPFID  1    2   200     0     C:\Smart\PAMS.MPT  12:00
 AL22735 $C_SRM  1    1     0   200     C:\Smart\PAMS.MPT  12:00
 AL21694 $PPFID  1   11    40     0    C:\Smart\PAMS.MPT  12:00
 AL21696 $PPFID  1   12    40     0    C:\Smart\PAMS.MPT  12:00
 AL21697 $PPFID  1   13    40     0    C:\Smart\PAMS.MPT  12:00
 AL21698 $PPFID  1   14    40     0    C:\Smart\PAMS.MPT  12:00
 AL21699 $PPFID  1   15    40     0    C:\Smart\PAMS.MPT  12:00
 AL21700 $PPFID  1    2    40     0    C:\Smart\PAMS.MPT  12:00
 AL21701 $PPFID  1    3    40     0    C:\Smart\PAMS.MPT  12:00
 AL21702 $PPFID  1    4    40     0    C:\Smart\PAMS.MPT  12:00
AL22735 $SYSBLNK  1    1     0     0     C:\Smart\PAMS.MPT  12:00
 AL22735 $C_SRM  1    1     0   200     C:\Smart\PAMS.MPT  12:00
AL22735 $L1PPFID  3    1   200     0     C:\Smart\PAMS.MPT  12:00
AL22735 $SYSBLNK  1    1     0     0     C:\Smart\PAMS.MPT  12:00
  BOBSTD $PPFID  1    1   200     0     C:\Smart\PAMS.MPT  12:00
  BOBSTD $PPFID  1    1   200     0     C:\Smart\PAMS.MPT  12:00
 AL21702 $PPFID  1    4    40     0    C:\Smart\PAMS.MPT 12:00
 AL21693 $PPFID  1   10    40     0    C:\Smart\PAMS.MPT 12:00
 AL22735 $C_SRM  1    1     0   200     C:\Smart\PAMS.MPT 12:00
```

```
Sequence: C:\HPCHEM\1\SEQUENCE\SQ101508.S


 Sequence Parameters:

   Operator:                         JAK

   Data File Naming:                 Prefix/Counter
   Signal 1  Prefix:                 HJ1508
             Counter:                01
   Signal 2  Prefix:                 0
             Counter:                0000000
   Data Directory:                   C:\HPCHEM\1\DATA\

   Data Subdirectory:

   Part of Methods to run:           According to Runtime Checklist

   Barcode Reader:                   not used

   Shutdown Cmd/Macro:               none

   Sequence Comment:
     PAL & 16 BARGE GRAB SAMPLES.



 Sequence Table (Front Injector):

   Method and Injection Info Part:

   Line Location SampleName       Method   Inj SampleType InjVolume DataFile
   ==== ======== ================ ======== === ========== ========= ==========

     1  Vial 1   AL22735 $I_SRM   PAMS      1   Calib
     2  Vial 3   AL22735 $I_PPFID PAMS      1   Calib
     3  Vial 2   AL22735 $HBPPFID PAMS      1   Ctrl Samp
     4  Vial 4   AL22735 $L1PPFID PAMS      1   Ctrl Samp
     5  Vial 1   AL22735 $B_PPFID PAMS      1   Ctrl Samp
     6  Vial 2   AL22014 $PPFID   PAMS      1   Sample
     7  Vial 3   AL21642 $PPFID   PAMS      1   Sample
     8  Vial 4   AL21643 $PPFID   PAMS      1   Sample
     9  Vial 5   AL21644 $PPFID   PAMS      1   Sample
    10  Vial 6   AL21645 $PPFID   PAMS      1   Sample
    11  Vial 7   AL21646 $PPFID   PAMS      1   Sample
    12  Vial 8   AL21691 $PPFID   PAMS      1   Sample
    13  Vial 9   AL21692 $PPFID   PAMS      1   Sample
    14  Vial 10  AL21693 $PPFID   PAMS      1   Sample
    15  Vial 0   AL22525 $SYSBLNK PAMS      1   Calib
    16  Vial 2   AL22014 $D_PPFID PAMS      1   Sample
    17  Vial 1   AL22735 $C_SRM   PAMS      1   Calib
    18  Vial 11  AL21694 $PPFID   PAMS      1   Sample
    19  Vial 12  AL21696 $PPFID   PAMS      1   Sample
    20  Vial 13  AL21697 $PPFID   PAMS      1   Sample
    21  Vial 14  AL21698 $PPFID   PAMS      1   Sample
    22  Vial 15  AL21699 $PPFID   PAMS      1   Sample
    23  Vial 2   AL21700 $PPFID   PAMS      1   Sample
    24  Vial 3   AL21701 $PPFID   PAMS      1   Sample
    25  Vial 4   AL21702 $PPFID   PAMS      1   Sample
    26  Vial 0   AL22735 $SYSBLNK PAMS      1   Calib
    27  Vial 1   AL22735 $C_SRM   PAMS      1   Calib
    28  Vial 1   BAKEOUT          BAKEOUT   1   Sample

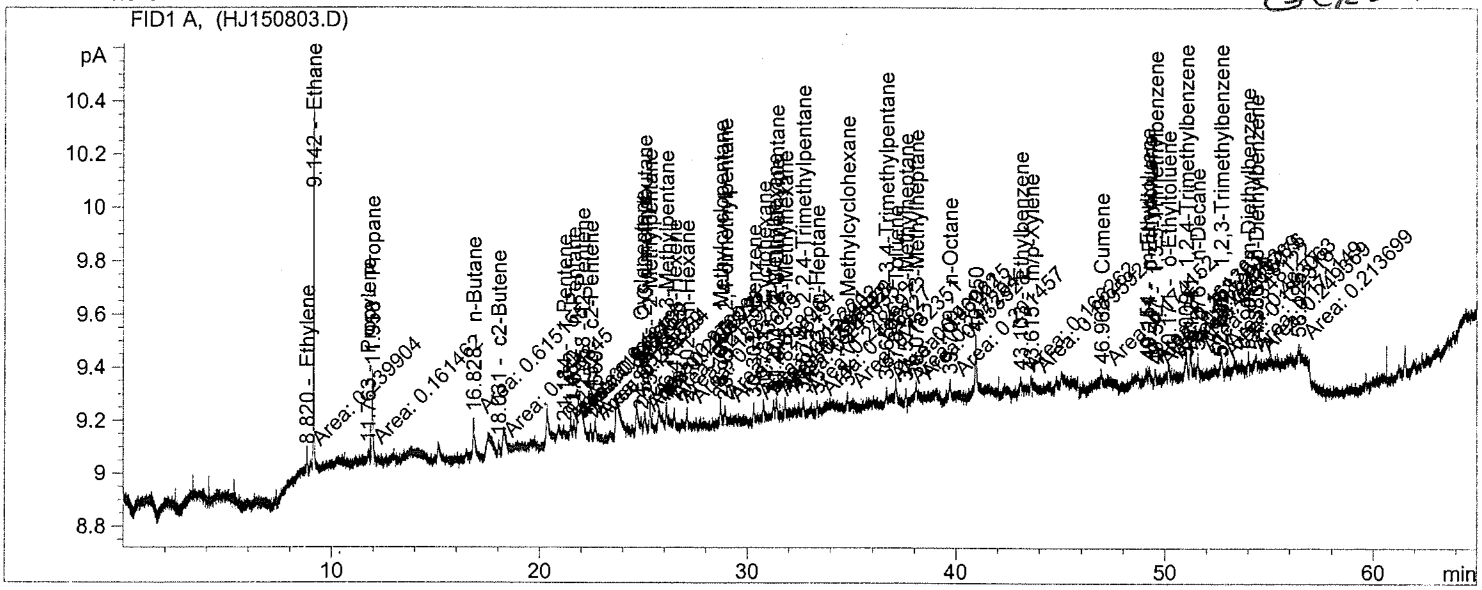
 Sequence Table (Back Injector):

   No entries - empty table!
```

Batch modified
– see Logbook copy
11/24/08

```
=====================================================================
Injection Date  : 10/15/2008 10:56:16 AM          Seq. Line :   3
Sample Name     : AL22735 $HBPPFID                 Location : Vial 2
Acq. Operator   : JAK                                   Inj :   1
Acq. Instrument : HP_FID2 SOP 1026               Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/15/2008 6:38:05 AM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

GCR24



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.820 MM     2.39904e-1   1.00000 1.22519e-1    Ethylene
  8.929            -           -          -       Acetylene
  9.142 BBA      3.47531    1.00000    1.77484    Ethane
 11.763 MM     1.61462e-1   1.00000 8.24585e-2    Propylene
 11.958 BBA      1.21404    1.00000 6.20009e-1    Propane
 15.083            -           -          -       Isobutane
 16.372            -           -          -       1-Butene
 16.527            -           -          -       1,3-butadiene
 16.828 MM     6.15155e-1   1.00000 3.14160e-1    n-Butane
 17.392            -           -          -       t2-Butene
 18.031 MM     1.56845e-1   1.00000 8.01010e-2    c2-Butene
 20.190            -           -          -       Isopentane
 21.184 MM     1.64445e-1   1.00000 8.39820e-2    1-Pentene
 21.632 MM     2.12765e-1   1.00000 1.08659e-1    n-Pentane
 21.745            -           -          -       Isoprene
 22.058 MM     1.81990e-1   1.00000 9.29422e-2    t2-Pentene
 22.452 MM     1.78859e-1   1.00000 9.13431e-2    c2-Pentene
 23.376            -           -          -       2,2-Dimethylbutane
 24.880 MM     1.10830e-1   1.00000 5.66008e-2    Cyclopentane
```

10-15-08
JAK

M

```
RetTime  Type    Area      Amt/Area    Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 25.043 MM     2.05822e-1   1.00000 1.05113e-1    2,3-dimethylbutane
 25.301 MM     2.79095e-1   1.00000 1.42534e-1    2-Methylpentane
 26.100 MM     2.17946e-1   1.00000 1.11305e-1    3-Methylpentane
 26.479 MM     1.88211e-1   1.00000 9.61193e-2    1-Hexene
 27.102 MM     2.43689e-1   1.00000 1.24452e-1    n-Hexane
 28.705 MM     3.58964e-1   1.00000 1.83323e-1    Methylcyclopentane
 28.932 MM     2.96450e-1   1.00000 1.51397e-1    2,4-dimethylpentane
 30.301 MM   + 2.15221e-1   1.00000 1.09914e-1    Benzene
 30.781 MM     2.26902e-1   1.00000 1.15879e-1    Cyclohexane
 31.277 MM     2.24192e-1   1.00000 1.14495e-1    2-Methylhexane
 31.401 MM     3.15928e-1   1.00000 1.61344e-1    2,3-Dimethylpentane
 31.815 MM     2.43635e-1   1.00000 1.24424e-1    3-Methylhexane
 32.674 MM     2.42697e-1   1.00000 1.23945e-1    2,2,4-Trimethylpentane
 33.353 MM     1.96827e-1   1.00000 1.00520e-1    n-Heptane
 34.799 MM     1.82351e-1   1.00000 9.31268e-2    Methylcyclohexane
 36.654 MM     1.96062e-1   1.00000 1.00129e-1    2,3,4-Trimethylpentane
 37.095 MM   + 4.30215e-1   1.00000 2.19711e-1    Toluene
 37.575 MM     2.17294e-1   1.00000 1.10972e-1    2-Methylheptane
 38.075 MM     1.53528e-1   1.00000 7.84070e-2    3-Methylheptane
 39.709 MM     2.01457e-1   1.00000 1.02884e-1    n-Octane
 43.103 MM     1.66262e-1   1.00000 8.49100e-2    Ethylbenzene
 43.615 MM     1.79592e-1   1.00000 9.17174e-2    m/p-Xylene
 44.773             -          -          -       Styrene
 45.056             -          -          -       o-Xylene
 45.843             -          -          -       n-Nonane
 46.968 MM     1.74152e-1   1.00000 8.89396e-2    Cumene
 48.663             -          -          -       n-Propylbenzene
 49.154 MM     1.61363e-1   1.00000 8.24079e-2    m-Ethyltoluene
 49.241 MM     1.58781e-1   1.00000 8.10894e-2    p-Ethyltoluene
 49.547 MM     2.17294e-1   1.00000 1.10972e-1    1,3,5-Trimethylbenzene
 50.171 MM     2.24793e-1   1.00000 1.14802e-1    o-Ethyltoluene
 51.009 MM     2.93789e-1   1.00000 1.50038e-1    1,2,4-Trimethylbenzene
 51.576 MM     3.48122e-1   1.00000 1.77786e-1    n-Decane
 52.712 FM     4.03063e-1   1.00000 2.05844e-1    1,2,3-Trimethylbenzene
 53.997 MM     1.71149e-1   1.00000 8.74056e-2    m-Diethylbenzene
 54.380 MM     2.49369e-1   1.00000 1.27353e-1    p-Diethylbenzene
 56.931             -          -          -       n-Undecane

Totals :                               7.30087

Uncalibrated Peaks    :      using compound Propane

RetTime  Type    Area      Amt/Area    Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 21.482 MM     1.95602e-1   1.00000 9.98937e-2    ?
 22.660 MM     2.82934e-1   1.00000 1.44495e-1    ?
 40.950 BB     8.20845e-1   1.00000 4.19206e-1    ?
 51.241 MM     3.26076e-1   1.00000 1.66527e-1    ?
 52.636 MF     1.32318e-1   1.00000 6.75746e-2    ?
 56.425 MM     2.13699e-1   1.00000 1.09136e-1    ?

Uncalib. totals :                      1.00683

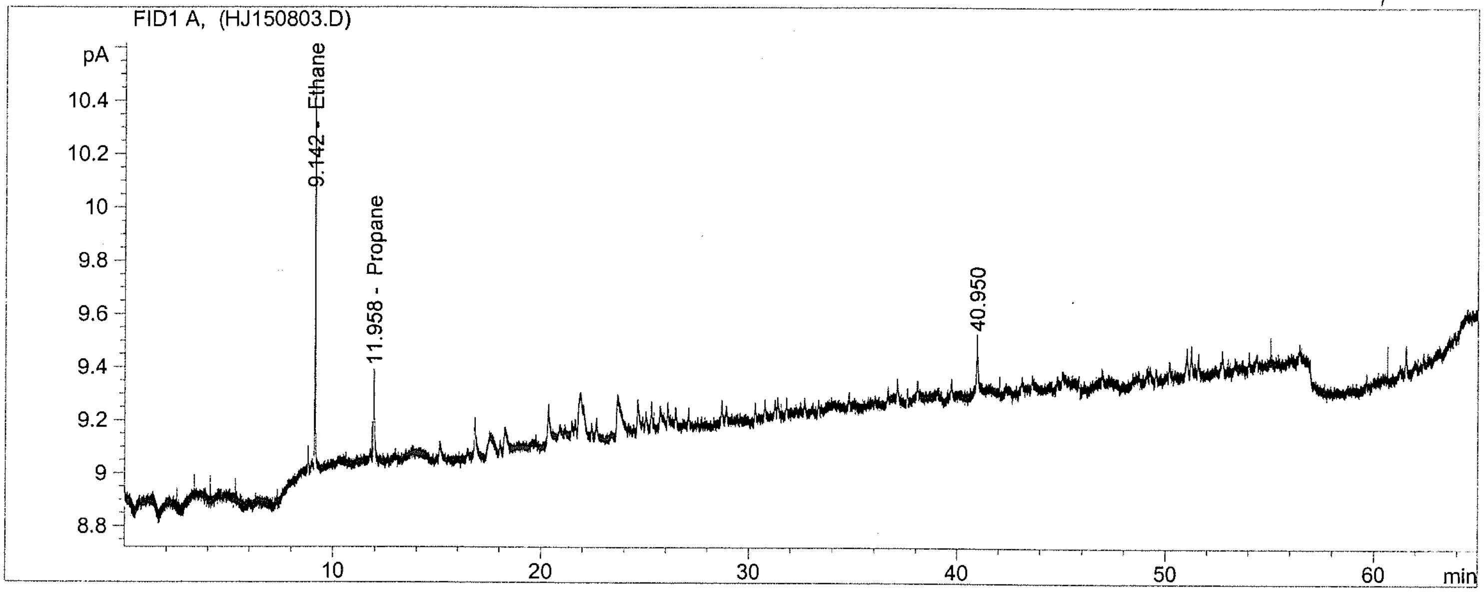
 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

```
=====================================================================
Injection Date  : 10/15/2008 10:56:16 AM         Seq. Line :   3
Sample Name     : AL22735 $HBPPFID                Location : Vial 2
Acq. Operator   : JAK                                  Inj :   1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/15/2008 6:38:05 AM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

GCR24



```
=====================================================================
                     External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.837           -          -          -           Ethylene
  8.950           -          -          -           Acetylene
  9.142 BBA     3.47531    1.00000    1.77484       Ethane
 11.762           -          -          -           Propylene
 11.958 BBA     1.21404    1.00000 6.20009e-1       Propane
 15.083           -          -          -           Isobutane
 16.411           -          -          -           1-Butene
 16.566           -          -          -           1,3-butadiene
 16.751           -          -          -           n-Butane
 17.433           -          -          -           t2-Butene
 18.083           -          -          -           c2-Butene
 20.238           -          -          -           Isopentane
 21.060           -          -          -           1-Pentene
 21.657           -          -          -           n-Pentane
 21.797           -          -          -           Isoprene
 22.050           -          -          -           t2-Pentene
 22.420           -          -          -           c2-Pentene
 23.432           -          -          -           2,2-Dimethylbutane
 24.903           -          -          -           Cyclopentane
```

```
 RetTime  Type     Area      Amt/Area     Amount    Grp    Name
  [min]          [pA*s]                   [ppbc]
 -------|------|----------|----------|----------|--|------------------
  25.101            -          -          -         2,3-dimethylbutane
  25.385            -          -          -         2-Methylpentane
  26.200            -          -          -         3-Methylpentane
  26.576            -          -          -         1-Hexene
  27.237            -          -          -         n-Hexane
  28.764            -          -          -         Methylcyclopentane
  28.914            -          -          -         2,4-dimethylpentane
  30.373            -          -          -         Benzene
  31.008            -          -          -         Cyclohexane
  31.348            -          -          -         2-Methylhexane
  31.584            -          -          -         2,3-Dimethylpentane
  32.010            -          -          -         3-Methylhexane
  32.869            -          -          -         2,2,4-Trimethylpentane
  33.543            -          -          -         n-Heptane
  35.039            -          -          -         Methylcyclohexane
  36.868            -          -          -         2,3,4-Trimethylpentane
  37.101            -          -          -         Toluene
  37.806            -          -          -         2-Methylheptane
  38.313            -          -          -         3-Methylheptane
  39.949            -          -          -         n-Octane
  43.059            -          -          -         Ethylbenzene
  43.617            -          -          -         m/p-Xylene
  44.781            -          -          -         Styrene
  45.064            -          -          -         o-Xylene
  45.851            -          -          -         n-Nonane
  46.921            -          -          -         Cumene
  48.671            -          -          -         n-Propylbenzene
  49.070            -          -          -         m-Ethyltoluene
  49.350            -          -          -         p-Ethyltoluene
  49.565            -          -          -         1,3,5-Trimethylbenzene
  50.165            -          -          -         o-Ethyltoluene
  50.999            -          -          -         1,2,4-Trimethylbenzene
  51.558            -          -          -         n-Decane
  52.863            -          -          -         1,2,3-Trimethylbenzene
  54.045            -          -          -         m-Diethylbenzene
  54.417            -          -          -         p-Diethylbenzene
  56.931            -          -          -         n-Undecane

Totals :                                 2.39485

Uncalibrated Peaks     :       using compound Propane

RetTime  Type     Area      Amt/Area     Amount    Grp    Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
 40.950 BB    8.20845e-1    1.00000 4.19206e-1     ?

Uncalib. totals :                     4.19206e-1

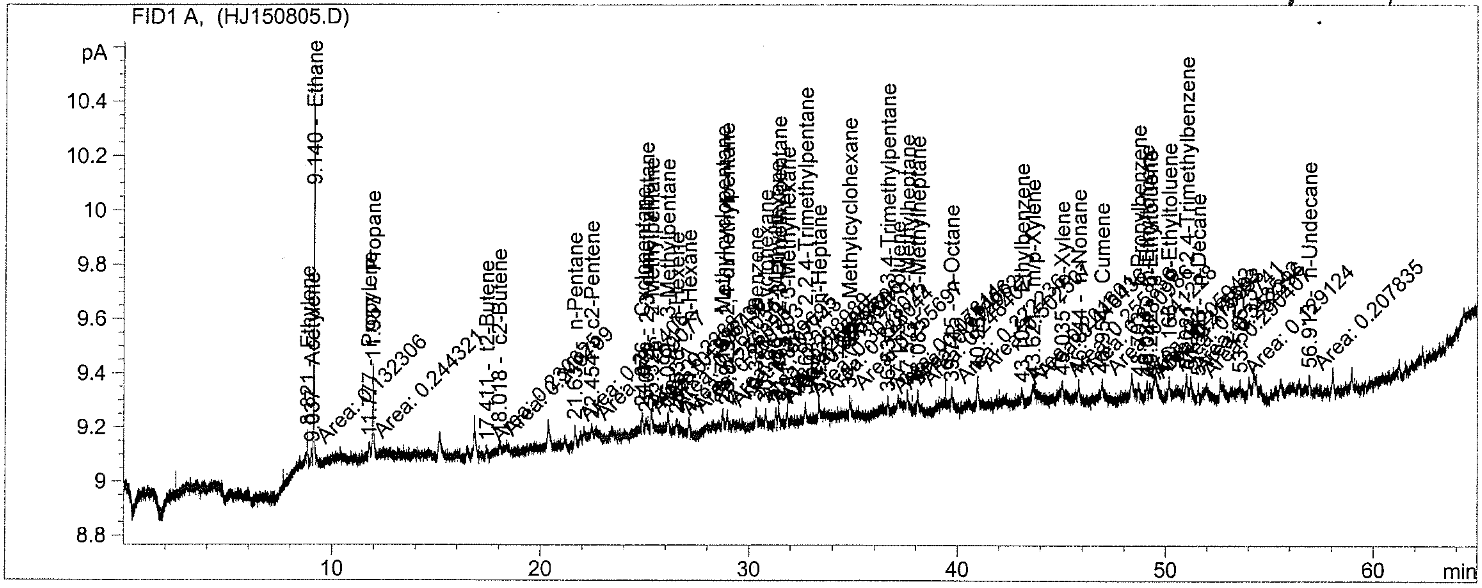
 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                         *** End of Report ***
```

```
=====================================================================
Injection Date   : 10/15/2008 1:35:11 PM            Seq. Line :    5
Sample Name      : AL22735 $B_PPFID                   Location : Vial 1
Acq. Operator    : JAK                                     Inj :    1
Acq. Instrument  : HP_FID2 SOP 1026                 Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 8/4/2008 1:18:53 PM by JPC
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/15/2008 3:00:39 PM by JAK
                   (modified after loading)
PAMS SAMPLE ANALYSES
```

GCR44



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By              :      Signal
Calib. Data Modified   :      10/15/2008 3:00:43 PM
Multiplier             :      0.5107
Dilution               :      1.0000
Sample Amount          :      1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,
```

RetTime [min]	Type	Area [pA*s]	Amt/Area	Amount [ppbc]	Grp	Name
8.821	BBA	2.74667e-1	1.00000	1.40272e-1		Ethylene
9.037	MM	1.32306e-1	1.00000	6.75686e-2		Acetylene
9.140	BBA	3.42998	1.00000	1.75169		Ethane
11.777	MM	2.44321e-1	1.00000	1.24775e-1		Propylene
11.957	PBA	1.10603	1.00000	5.64852e-1		Propane
15.083		-	-	-		Isobutane
16.385		-	-	-		1-Butene
16.540		-	-	-		1,3-butadiene
16.725		-	-	-		n-Butane
17.411	MM	2.30825e-1	1.00000	1.17882e-1		t2-Butene
18.018	MM	2.49799e-1	1.00000	1.27572e-1		c2-Butene
20.206		-	-	-		Isopentane
21.027		-	-	-		1-Pentene
21.633	MM	2.56406e-1	1.00000	1.30946e-1		n-Pentane
21.763		-	-	-		Isoprene
22.015		-	-	-		t2-Pentene
22.454	MM	1.69077e-1	1.00000	8.63477e-2		c2-Pentene
23.395		-	-	-		2,2-Dimethylbutane
24.876	MM	2.26800e-1	1.00000	1.15827e-1		Cyclopentane

10-15-08
JAK

```
 RetTime  Type     Area      Amt/Area     Amount    Grp    Name
  [min]          [pA*s]                   [ppbc]
 -------|------|----------|----------|----------|--|------------------
   25.079 MM     1.33649e-1    1.00000 6.82545e-2    2,3-dimethylbutane
   25.328 MM     3.08738e-1    1.00000 1.57672e-1    2-Methylpentane
   26.092 MM     2.64055e-1    1.00000 1.34853e-1    3-Methylpentane
   26.536 MM     2.56096e-1    1.00000 1.30788e-1    1-Hexene
   27.127 MM     2.60703e-1    1.00000 1.33141e-1    n-Hexane
   28.719 MM     2.79695e-1    1.00000 1.42840e-1    Methylcyclopentane
   28.929 MM     3.07743e-1    1.00000 1.57164e-1    2,4-dimethylpentane
   30.325 MM  +  2.98989e-1    1.00000 1.52694e-1    Benzene
   30.784 MM     2.66905e-1    1.00000 1.36308e-1    Cyclohexane
   31.286 MF     2.86962e-1    1.00000 1.46552e-1    2-Methylhexane
   31.419 FM     3.55854e-1    1.00000 1.81735e-1    2,3-Dimethylpentane
   31.849 MM     2.77696e-1    1.00000 1.41819e-1    3-Methylhexane
   32.695 MM     3.07802e-1    1.00000 1.57194e-1    2,2,4-Trimethylpentane
   33.332 MM     2.28044e-1    1.00000 1.16462e-1    n-Heptane
   34.795 MM     2.55697e-1    1.00000 1.30584e-1    Methylcyclohexane
   36.630 MM     2.07814e-1    1.00000 1.06130e-1    2,3,4-Trimethylpentane
   37.113 MM  +  1.65466e-1    1.00000 8.45036e-2    Toluene
   37.577 MM     2.12952e-1    1.00000 1.08754e-1    2-Methylheptane
   38.085 MM     2.48407e-1    1.00000 1.26862e-1    3-Methylheptane
   39.715 MM     2.22236e-1    1.00000 1.13496e-1    n-Octane
   43.105 MM     2.01601e-1    1.00000 1.02958e-1    Ethylbenzene
   43.621 MM     4.46436e-1    1.00000 2.27995e-1    m/p-Xylene
   44.781             -          -          -        Styrene
   45.035 MM     2.55836e-1    1.00000 1.30655e-1    o-Xylene
   45.844 MM     3.80986e-1    1.00000 1.94569e-1    n-Nonane
   46.954 MM     2.41228e-1    1.00000 1.23195e-1    Cumene
   48.703 MM     2.05942e-1    1.00000 1.05174e-1    n-Propylbenzene
   49.084 MM     2.18883e-1    1.00000 1.11783e-1    m-Ethyltoluene
   49.242 MM     1.75993e-1    1.00000 8.98797e-2    p-Ethyltoluene
   49.558             -          -          -        1,3,5-Trimethylbenzene
   50.166 MM     2.25741e-1    1.00000 1.15286e-1    o-Ethyltoluene
   51.021 MM     3.48542e-1    1.00000 1.78001e-1    1,2,4-Trimethylbenzene
   51.566 MM     2.90407e-1    1.00000 1.48311e-1    n-Decane
   52.851             -          -          -        1,2,3-Trimethylbenzene
   54.032             -          -          -        m-Diethylbenzene
   54.403             -          -          -        p-Diethylbenzene
   56.913 MM  +  2.07835e-1    1.00000 1.06141e-1    n-Undecane

 Totals :                                 7.48949

 Uncalibrated Peaks     :       using compound Propane

 RetTime  Type     Area      Amt/Area     Amount    Grp    Name
  [min]          [pA*s]                   [ppbc]
 -------|------|----------|----------|----------|--|------------------
   40.954 MM     5.02507e-1    1.00000 2.56630e-1    ?
   51.222 MM     2.52296e-1    1.00000 1.28847e-1    ?
   53.585 MM     1.29124e-1    1.00000 6.59434e-2    ?

 Uncalib. totals :                        4.51421e-1

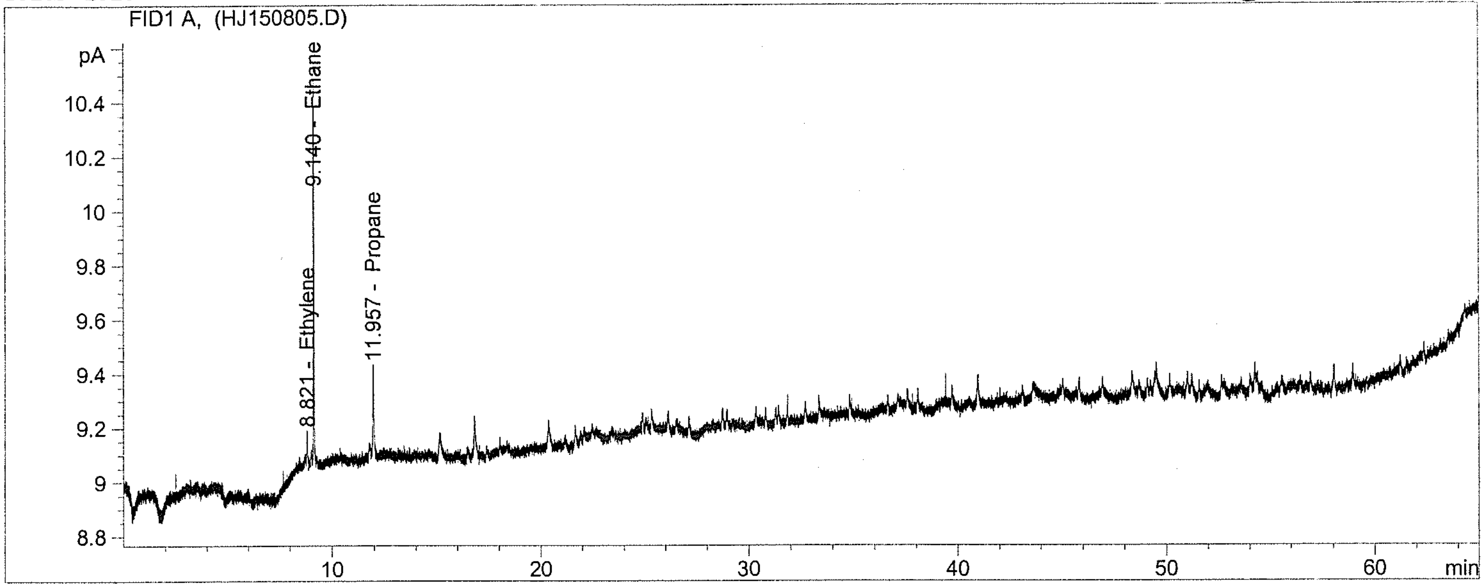
  Results obtained with enhanced integrator!
 2 Warnings or Errors :

 Warning : Calibration warnings (see calibration table listing)
 Warning : Time reference compound(s) not found

 =================================================================
                            *** End of Report ***
```

```
=====================================================================
Injection Date  : 10/15/2008 1:35:11 PM          Seq. Line :    5
Sample Name     : AL22735 $B_PPFID                Location : Vial 1
Acq. Operator   : JAK                                  Inj :    1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/15/2008 3:00:39 PM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

GC244



```
=====================================================================
                     External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/15/2008 3:00:43 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.821 BBA   2.74667e-1    1.00000 1.40272e-1    Ethylene
  9.000           -            -         -        Acetylene
  9.140 BBA      3.42998    1.00000    1.75169    Ethane
 11.762           -            -         -        Propylene
 11.957 PBA      1.10603    1.00000 5.64852e-1    Propane
 15.083           -            -         -        Isobutane
 16.411           -            -         -        1-Butene
 16.566           -            -         -        1,3-butadiene
 16.751           -            -         -        n-Butane
 17.433           -            -         -        t2-Butene
 18.083           -            -         -        c2-Butene
 20.238           -            -         -        Isopentane
 21.060           -            -         -        1-Pentene
 21.657           -            -         -        n-Pentane
 21.797           -            -         -        Isoprene
 22.050           -            -         -        t2-Pentene
 22.420           -            -         -        c2-Pentene
 23.432           -            -         -        2,2-Dimethylbutane
 24.903           -            -         -        Cyclopentane
```

```
 RetTime  Type     Area      Amt/Area     Amount    Grp   Name
  [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  25.101           -          -          -          2,3-dimethylbutane
  25.385           -          -          -          2-Methylpentane
  26.200           -          -          -          3-Methylpentane
  26.576           -          -          -          1-Hexene
  27.237           -          -          -          n-Hexane
  28.764           -          -          -          Methylcyclopentane
  28.914           -          -          -          2,4-dimethylpentane
  30.373           -          -          -          Benzene
  31.008           -          -          -          Cyclohexane
  31.348           -          -          -          2-Methylhexane
  31.584           -          -          -          2,3-Dimethylpentane
  32.010           -          -          -          3-Methylhexane
  32.869           -          -          -          2,2,4-Trimethylpentane
  33.543           -          -          -          n-Heptane
  35.039           -          -          -          Methylcyclohexane
  36.868           -          -          -          2,3,4-Trimethylpentane
  37.101           -          -          -          Toluene
  37.806           -          -          -          2-Methylheptane
  38.313           -          -          -          3-Methylheptane
  39.949           -          -          -          n-Octane
  43.059           -          -          -          Ethylbenzene
  43.617           -          -          -          m/p-Xylene
  44.781           -          -          -          Styrene
  45.064           -          -          -          o-Xylene
  45.851           -          -          -          n-Nonane
  46.921           -          -          -          Cumene
  48.671           -          -          -          n-Propylbenzene
  49.070           -          -          -          m-Ethyltoluene
  49.350           -          -          -          p-Ethyltoluene
  49.565           -          -          -          1,3,5-Trimethylbenzene
  50.165           -          -          -          o-Ethyltoluene
  50.999           -          -          -          1,2,4-Trimethylbenzene
  51.558           -          -          -          n-Decane
  52.863           -          -          -          1,2,3-Trimethylbenzene
  54.045           -          -          -          m-Diethylbenzene
  54.417           -          -          -          p-Diethylbenzene
  56.931           -          -          -          n-Undecane

Totals :                               2.45681

Uncalibrated Peaks     :      using compound Propane

 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

Date: 10/15/2008	Analyst: JAK	Batch: 193024	LIMS: AL22735
	%RECOVERY		
SRM concentration:	100.00		
SRM range:	90.00	110.00	
$I_SRM Result	Recovery %	In Range? (T/F)	
101.44	101.44	TRUE	
$C_SRM Result	Recovery %	In Range? (T/F)	
101.63	101.63	TRUE	
	RESPONSE FACTORS		
SRM concentration:	100.00		
SRM range (RF):	0.4594	0.5615	
$I_SRM area	Response Factor	In Range? (y/n)	
198.63	0.5035	TRUE	
$C_SRM area	Response Factor	In Range? (y/n)	
198.99	0.5025	TRUE	
RPD (I vs.C)	0.183		

From: Jianzhong Liu
Environmental Scientist Supervisor
Air Organics, LSD, DEQ

Date: May 13, 2008

Re: FID SRM PREPARATION

Stock Standard:

Manufacturer:	Spectra Gases, Inc.
Cylinder #:	CC-162783
Certified Concentration:	1.18 ppm
Expiration Date:	2/25/2009

Working SRM:

Target Concentration:	100.00 ppbC
Flow Rate of the Stock Std:	40 cc/min
Flow Rate of Nitrogen:	1376 cc/min

Spectra
Spectra Gases, Inc.

3434 Route 22 West, Branchburg, New Jersey 08876 USA
ISO 9001:2000

SHIPPED FROM: 80 INDUSTRIAL DRIVE ALPHA, NJ. 08865

SHIPPED TO:

Environmental Quality - LA
Air Organics Lab, LDEQ
1209 Leesville Road
Baton Rouge, LA 70802

CERTIFICATE OF ANALYSIS

SGI ORDER # :	125072		
ITEM# :	1	**CYLINDER # :**	CC-162783
CERTIFICATION DATE:	02/25/2008	**CYLINDER PRES:**	2000 psig
P.O.# :	CC - J Liu	**CYLINDER VALVE:**	CGA 350
BLEND TYPE:	CERTIFIED	**PRODUCT EXPIRATION DATE:**	02/25/2009

ANALYTICAL ACCURACY: + / - 2%

COMPONENT	REQUESTED GAS CONC	ANALYSIS
Propane	1.20 ppm	1.18 ppm
Nitrogen	Balance	Balance

Received on 3/7/08
opened on 3/7/58 m

NIST TRACEABLE

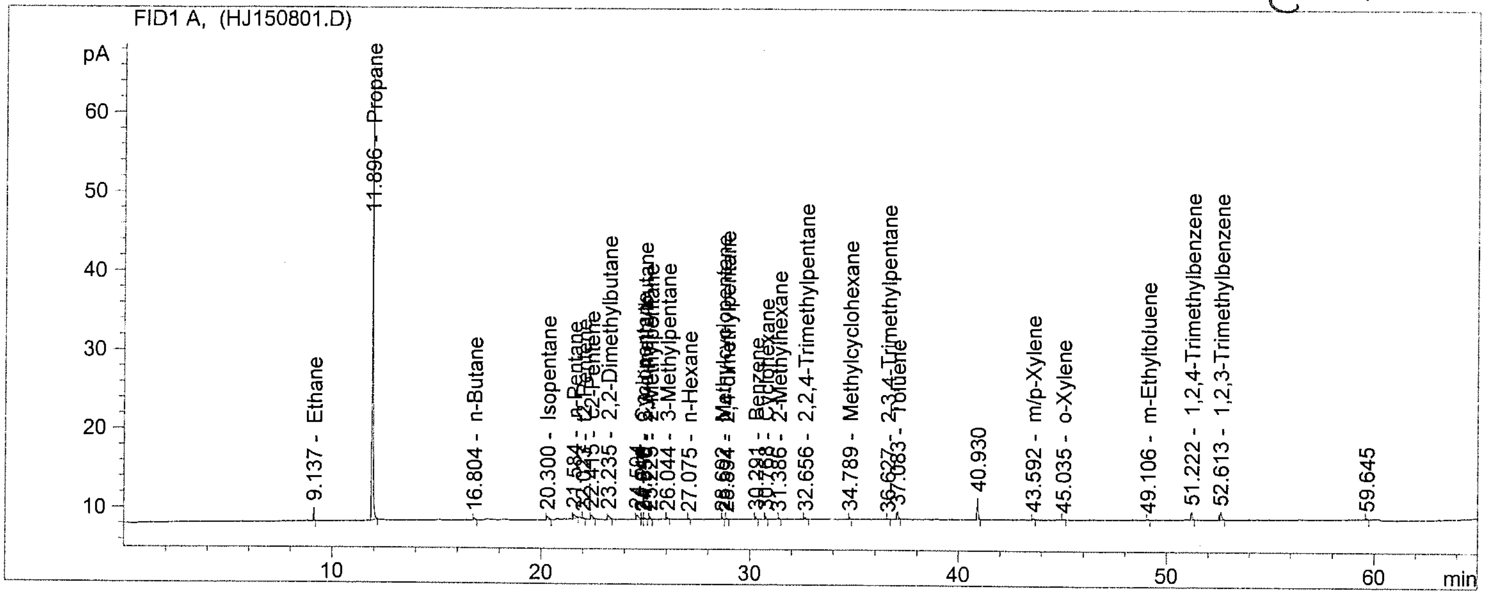
ANALYST: CP
Cheryl Patino

DATE: 02/25/2008

```
Data File C:\HPCHEM\1\DATA\HJ150801.D                          Sample Name: AL22735 $I_SRM

    =====================================================================
    Injection Date   : 10/15/2008 8:17:16 AM          Seq. Line :   1
    Sample Name      : AL22735 $I_SRM                  Location : Vial 1
    Acq. Operator    : JAK                                  Inj :   1
    Acq. Instrument  : HP_FID2 SOP 1026              Inj Volume : Manually
    Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
    Last changed     : 8/4/2008 1:18:53 PM by JPC
    Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
    Last changed     : 10/15/2008 6:38:05 AM by JAK
                       (modified after loading)
    PAMS SAMPLE ANALYSES
```

G 1124



```
    =====================================================================
                          External Standard Report
    =====================================================================

    Sorted By             :      Signal
    Calib. Data Modified  :      8/4/2008 10:57:02 AM
    Multiplier            :      0.5107
    Dilution              :      1.0000
    Sample Amount         :      1.00000  [ppbc]   (not used in calc.)
    Use Multiplier & Dilution Factor with ISTDs

    Signal 1: FID1 A,

    RetTime  Type    Area      Amt/Area     Amount    Grp   Name
     [min]          [pA*s]                  [ppbc]
    -------|------|----------|----------|----------|--|------------------
      8.813            -          -          -           Ethylene
      8.926            -          -          -           Acetylene
      9.137 PBA     3.93938    1.00000    2.01184        Ethane
     11.730            -          -          -           Propylene
     11.896 PBA   198.62938    1.00000  101.44002        Propane
     15.083            -          -          -           Isobutane
     16.367            -          -          -           1-Butene
     16.521            -          -          -           1,3-butadiene
     16.804 PB      1.38990    1.00000 7.09822e-1        n-Butane
     17.386            -          -          -           t2-Butene
     18.034            -          -          -           c2-Butene
     20.300 BB      3.09414    1.00000    1.58018        Isopentane
     21.003            -          -          -           1-Pentene
     21.584 PB      3.94511    1.00000    2.01477        n-Pentane
     21.738            -          -          -           Isoprene
     22.023 PB    5.66477e-1   1.00000 2.89300e-1        t2-Pentene
     22.415 PP      3.15199    1.00000    1.60972        c2-Pentene
     23.235 PB      3.38502    1.00000    1.72873        2,2-Dimethylbutane
     24.846 BV    9.21160e-1   1.00000 4.70436e-1        Cyclopentane
```

~~1.0000~~

10-15-08
JAK

I/M

```
RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.956 VB       1.01160    1.00000 5.16624e-1    2,3-dimethylbutane
 25.225 BB       1.25152    1.00000 6.39153e-1    2-Methylpentane
 26.044 PB    9.83369e-1    1.00000 5.02207e-1    3-Methylpentane
 26.504             -          -          -       1-Hexene
 27.075 BB    4.34532e-1    1.00000 2.21915e-1    n-Hexane
 28.692 PB    8.22332e-1    1.00000 4.19965e-1    Methylcyclopentane
 28.894 PP    6.03021e-1    1.00000 3.07963e-1    2,4-dimethylpentane
 30.291 PB  +    1.32527    1.00000 6.76814e-1    Benzene
 30.768 BB       1.33293    1.00000 6.80726e-1    Cyclohexane
 31.386 BB    8.08716e-1    1.00000 4.13011e-1    2-Methylhexane
 31.513             -          -          -       2,3-Dimethylpentane
 31.943             -          -          -       3-Methylhexane
 32.656 PP       1.28984    1.00000 6.58723e-1    2,2,4-Trimethylpentane
 33.491             -          -          -       n-Heptane
 34.789 BB    9.86934e-1    1.00000 5.04027e-1    Methylcyclohexane
 36.627 PB    5.23825e-1    1.00000 2.67517e-1    2,3,4-Trimethylpentane
 37.083 PB  +    3.95224    1.00000    2.01841    Toluene
 37.787             -          -          -       2-Methylheptane
 38.294             -          -          -       3-Methylheptane
 39.929             -          -          -       n-Octane
 43.038             -          -          -       Ethylbenzene
 43.592 PB       1.18093    1.00000 6.03100e-1    m/p-Xylene
 44.759             -          -          -       Styrene
 45.035 PB    5.46907e-1    1.00000 2.79306e-1    o-Xylene
 45.828             -          -          -       n-Nonane
 46.898             -          -          -       Cumene
 48.647             -          -          -       n-Propylbenzene
 49.106 BP    5.85634e-1    1.00000 2.99083e-1    m-Ethyltoluene
 49.326             -          -          -       p-Ethyltoluene
 49.540             -          -          -       1,3,5-Trimethylbenzene
 50.140             -          -          -       o-Ethyltoluene
 51.222 PB       3.93070    1.00000    2.00741    1,2,4-Trimethylbenzene
 51.533             -          -          -       n-Decane
 52.613 PB       5.65562    1.00000    2.88832    1,2,3-Trimethylbenzene
 54.018             -          -          -       m-Diethylbenzene
 54.390             -          -          -       p-Diethylbenzene
 56.931             -          -          -       n-Undecane

Totals :                                 125.75910

Uncalibrated Peaks     :      using compound Propane

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.594 PB       4.34410    1.00000    2.21853     ?
 40.930 BB      11.18780    1.00000    5.71361     ?
 59.645 PP    8.48758e-1    1.00000 4.33461e-1     ?

Uncalib. totals :                          8.36561

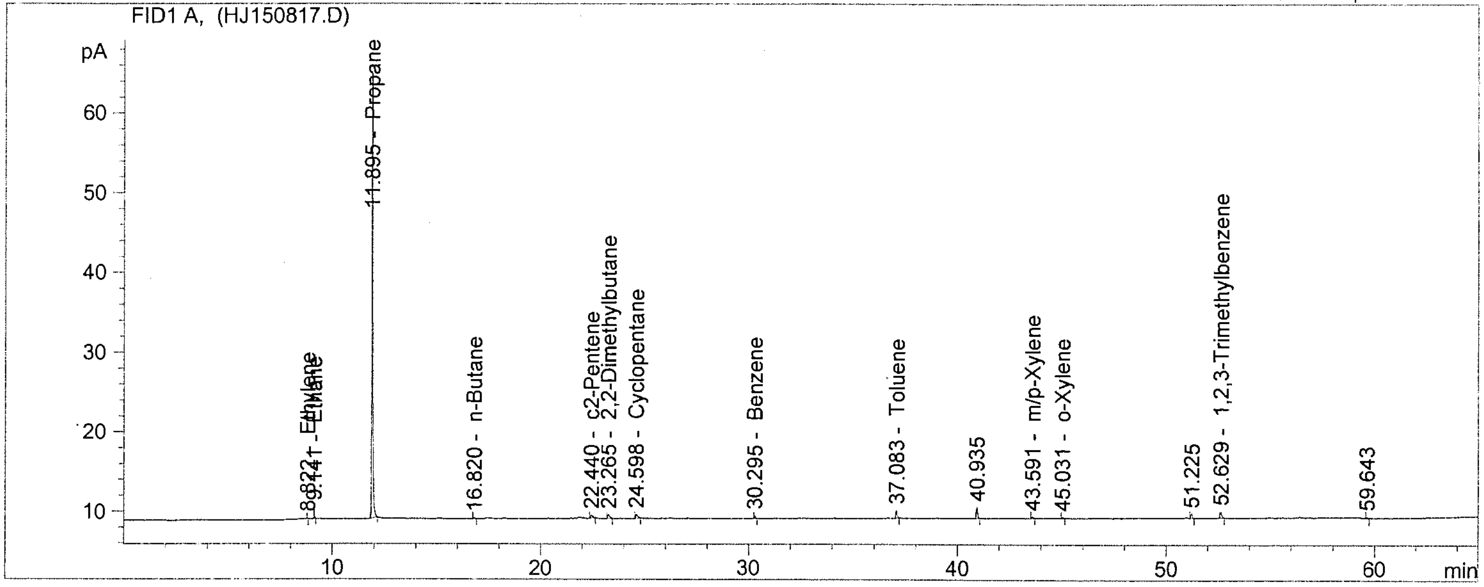
 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                         *** End of Report ***
```

```
=====================================================================
Injection Date  : 10/16/2008 5:13:51 AM          Seq. Line :  17
Sample Name     : AL22735 $C_SRM                  Location : Vial 1
Acq. Operator   : JAK                                  Inj :   1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/15/2008 3:00:39 PM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

G1124



```
=====================================================================
                       External Standard Report
=====================================================================

Sorted By              :        Signal
Calib. Data Modified   :        10/15/2008 3:00:43 PM
Multiplier             :        0.5107
Dilution               :        1.0000
Sample Amount          :        1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.822 BBA    2.24036e-1   1.00000 1.14415e-1    Ethylene
  8.977             -          -          -       Acetylene
  9.141 BBA       3.51669   1.00000    1.79598    Ethane
 11.732             -          -          -       Propylene
 11.895 PBA     196.73717   1.00000  100.47367    Propane
 15.083             -          -          -       Isobutane
 16.369             -          -          -       1-Butene
 16.524             -          -          -       1,3-butadiene
 16.820 PB     7.32985e-1   1.00000 3.74336e-1    n-Butane
 17.388             -          -          -       t2-Butene
 18.037             -          -          -       c2-Butene
 20.186             -          -          -       Isopentane
 21.006             -          -          -       1-Pentene
 21.602             -          -          -       n-Pentane
 21.741             -          -          -       Isoprene
 21.994             -          -          -       t2-Pentene
 22.440 PB        2.46730   1.00000    1.26005    c2-Pentene
 23.265 PB        3.51717   1.00000    1.79622    2,2-Dimethylbutane
 24.598 PB        3.72463   1.00000    1.90217    Cyclopentane
```

10-16-08
JAH

```
RetTime  Type      Area     Amt/Area    Amount   Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 25.037              -          -          -         2,3-dimethylbutane
 25.320              -          -          -         2-Methylpentane
 26.133              -          -          -         3-Methylpentane
 26.508              -          -          -         1-Hexene
 27.167              -          -          -         n-Hexane
 28.691              -          -          -         Methylcyclopentane
 28.840              -          -          -         2,4-dimethylpentane
 30.295 PB  +     1.38403    1.00000 7.06826e-1      Benzene
 30.936              -          -          -         Cyclohexane
 31.279              -          -          -         2-Methylhexane
 31.517              -          -          -         2,3-Dimethylpentane
 31.947              -          -          -         3-Methylhexane
 32.814              -          -          -         2,2,4-Trimethylpentane
 33.494              -          -          -         n-Heptane
 35.003              -          -          -         Methylcyclohexane
 36.848              -          -          -         2,3,4-Trimethylpentane
 37.083 PB  +     3.85212    1.00000    1.96728      Toluene
 37.788              -          -          -         2-Methylheptane
 38.295              -          -          -         3-Methylheptane
 39.929              -          -          -         n-Octane
 43.038              -          -          -         Ethylbenzene
 43.591 PB        1.04057    1.00000 5.31420e-1      m/p-Xylene
 44.760              -          -          -         Styrene
 45.031 PB     5.37611e-1    1.00000 2.74558e-1      o-Xylene
 45.829              -          -          -         n-Nonane
 46.899              -          -          -         Cumene
 48.648              -          -          -         n-Propylbenzene
 49.046              -          -          -         m-Ethyltoluene
 49.326              -          -          -         p-Ethyltoluene
 49.541              -          -          -         1,3,5-Trimethylbenzene
 50.141              -          -          -         o-Ethyltoluene
 50.975              -          -          -         1,2,4-Trimethylbenzene
 51.533              -          -          -         n-Decane
 52.629 PB        4.39412    1.00000    2.24408      1,2,3-Trimethylbenzene
 54.019              -          -          -         m-Diethylbenzene
 54.391              -          -          -         p-Diethylbenzene
 56.931              -          -          -         n-Undecane

Totals :                                113.44099

Uncalibrated Peaks     :      using compound Propane

RetTime  Type      Area     Amt/Area    Amount   Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 40.935 PB        5.96588    1.00000    3.04678      ?
 51.225 BP        2.34146    1.00000    1.19578      ?
 59.643 PP     7.09156e-1    1.00000 3.62166e-1      ?

Uncalib. totals :                         4.60472

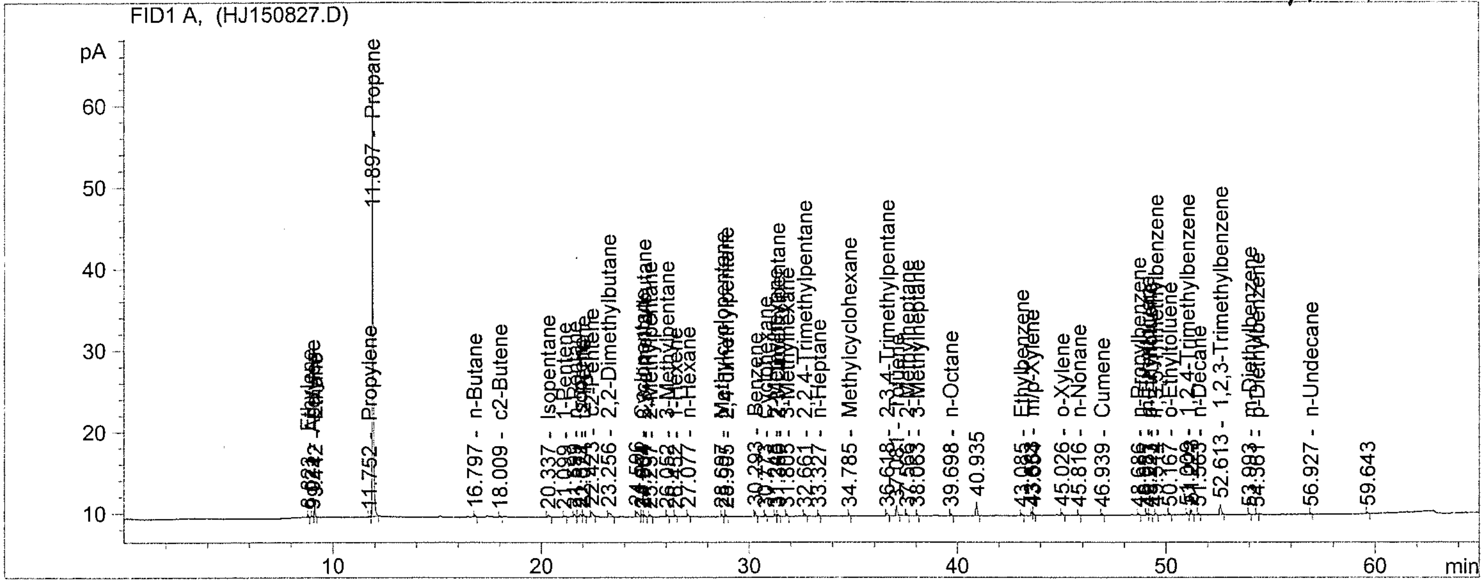
 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                         *** End of Report ***
```

```
=====================================================================
Injection Date  : 10/16/2008 7:06:42 PM           Seq. Line :  10
Sample Name     : AL22735 $C_SRM                   Location : Vial 1
Acq. Operator   : JAK                                   Inj :  1
Acq. Instrument : HP_FID2 SOP 1026               Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/16/2008 2:49:51 PM by JAK
                  (modified after loading)
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/17/2008 6:32:13 AM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

G1124



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.823 BBA   7.93821e-1   1.00000 4.05404e-1     Ethylene
  9.021 BB    4.76038e-1   1.00000 2.43112e-1     Acetylene
  9.142 BBA      4.11750   1.00000    2.10281     Ethane
 11.752 PB    5.41346e-1   1.00000 2.76466e-1     Propylene
 11.897 BBA    192.80481   1.00000   98.46542     Propane
 15.083             -         -          -        Isobutane
 16.368             -         -          -        1-Butene
 16.522             -         -          -        1,3-butadiene
 16.797 BB       1.50979   1.00000 7.71048e-1     n-Butane
 17.387             -         -          -        t2-Butene
 18.009 PP    7.29622e-1   1.00000 3.72618e-1     c2-Butene
 20.337 PB       1.71260   1.00000 8.74625e-1     Isopentane
 21.099 PB    7.59638e-1   1.00000 3.87947e-1     1-Pentene
 21.599 BV       1.43838   1.00000 7.34581e-1     n-Pentane
 21.871 VV       2.59908   1.00000    1.32735     Isoprene
 22.024 VB       1.61021   1.00000 8.22332e-1     t2-Pentene
 22.423 PP       3.35658   1.00000    1.71421     c2-Pentene
 23.256 BB       4.74432   1.00000    2.42293     2,2-Dimethylbutane
```

10-17-08
JAK

I/m

```
 RetTime  Type     Area      Amt/Area     Amount    Grp   Name
  [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  24.854 BV        1.34449    1.00000 6.86631e-1    Cyclopentane
  24.964 VB        1.36218    1.00000 6.95667e-1    2,3-dimethylbutane
  25.237 PB        1.21187    1.00000 6.18904e-1    2-Methylpentane
  26.052 PB        1.01165    1.00000 5.16648e-1    3-Methylpentane
  26.452 BB     7.80066e-1    1.00000 3.98380e-1    1-Hexene
  27.077 BB        1.23685    1.00000 6.31661e-1    n-Hexane
  28.697 BB        1.18669    1.00000 6.06043e-1    Methylcyclopentane
  28.905 BP        1.03437    1.00000 5.28253e-1    2,4-dimethylpentane
  30.293 PB   +    2.28682    1.00000    1.16788    Benzene
  30.773 PB        1.13142    1.00000 5.77817e-1    Cyclohexane
  31.245 BV        1.11731    1.00000 5.70609e-1    2-Methylhexane
  31.386 VP        1.12893    1.00000 5.76543e-1    2,3-Dimethylpentane
  31.805 BB        1.18118    1.00000 6.03231e-1    3-Methylhexane
  32.661 PB        1.38191    1.00000 7.05743e-1    2,2,4-Trimethylpentane
  33.327 PB        1.10115    1.00000 5.62356e-1    n-Heptane
  34.785 BP        1.24123    1.00000 6.33897e-1    Methylcyclohexane
  36.618 BB        1.62238    1.00000 8.28551e-1    2,3,4-Trimethylpentane
  37.081 PB   +    4.87525    1.00000    2.48979    Toluene
  37.566 PB        1.09294    1.00000 5.58162e-1    2-Methylheptane
  38.063 PB        1.09079    1.00000 5.57064e-1    3-Methylheptane
  39.698 BP        1.19115    1.00000 6.08319e-1    n-Octane
  43.085 PB        1.26408    1.00000 6.45568e-1    Ethylbenzene
  43.583 BV        1.65149    1.00000 8.43414e-1    m/p-Xylene
  44.767              -          -          -       Styrene
  45.026 PB        1.51419    1.00000 7.73295e-1    o-Xylene
  45.816 PP     9.76644e-1    1.00000 4.98772e-1    n-Nonane
  46.939 PP        1.06222    1.00000 5.42474e-1    Cumene
  48.686 PP     8.63902e-1    1.00000 4.41195e-1    n-Propylbenzene
  49.087 BV        1.16538    1.00000 5.95161e-1    m-Ethyltoluene
  49.223 VB     8.06003e-1    1.00000 4.11626e-1    p-Ethyltoluene
  49.514 BP        1.05815    1.00000 5.40399e-1    1,3,5-Trimethylbenzene
  50.167 PB     9.00950e-1    1.00000 4.60115e-1    o-Ethyltoluene
  51.009 BB        1.14839    1.00000 5.86481e-1    1,2,4-Trimethylbenzene
  51.563 PB     9.20273e-1    1.00000 4.69984e-1    n-Decane
  52.613 PB        6.87596    1.00000    3.51155    1,2,3-Trimethylbenzene
  53.993 BP     7.07392e-1    1.00000 3.61265e-1    m-Diethylbenzene
  54.361 BP     4.57058e-1    1.00000 2.33419e-1    p-Diethylbenzene
  56.927 PB   + 5.28609e-1    1.00000 2.69961e-1    n-Undecane

Totals :                                137.22767

Uncalibrated Peaks     :      using compound Propane

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  24.596 PB        4.79303    1.00000    2.44780     ?
  40.935 PB        7.02902    1.00000    3.58972     ?
  43.654 VB        1.49541    1.00000 7.63704e-1     ?
  51.223 BB        2.42487    1.00000    1.23838     ?
  59.643 PB     7.50064e-1    1.00000 3.83058e-1     ?

Uncalib. totals :                         8.42266

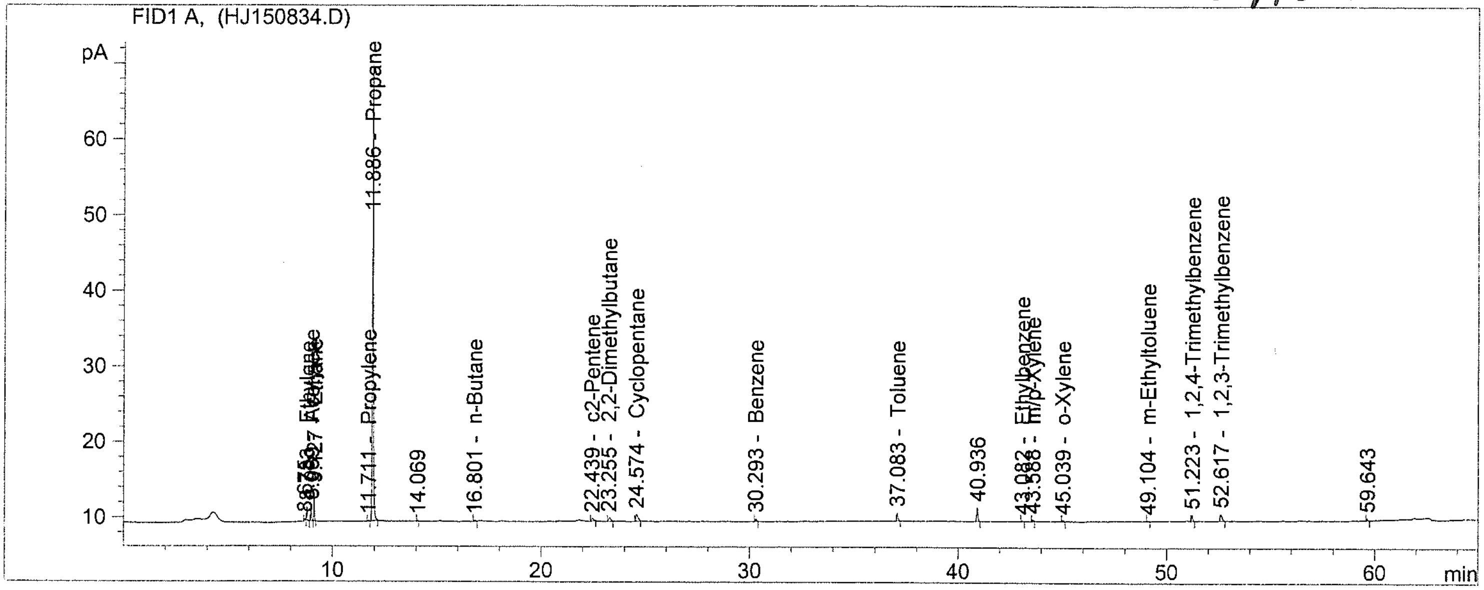
 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                         *** End of Report ***
```

```
=====================================================================
Injection Date  : 10/17/2008 1:00:50 PM          Seq. Line :   4
Sample Name     : AL22735 $C_PPFID                 Location : Vial 0
Acq. Operator   : JAK                                   Inj :   1
Acq. Instrument : HP_FID2 SOP 1026               Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/17/2008 8:23:46 AM by JAK
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/17/2008 12:56:59 PM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

G1124



```
=====================================================================
                     External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      10/17/2008 12:57:01 PM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type    Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.783 BBA      4.08677    1.00000    2.08711     Ethylene
  8.989 BBA      5.02441    1.00000    2.56597     Acetylene
  9.127 BBA      9.39811    1.00000    4.79962     Ethane
 11.711 BBA    3.99607e-1   1.00000 2.04079e-1     Propylene
 11.886 PBA    198.99361    1.00000  101.62603     Propane
 14.960              -          -          -       Isobutane
 16.257              -          -          -       1-Butene
 16.447              -          -          -       1,3-butadiene
 16.801 PP     9.22642e-1   1.00000 4.71193e-1     n-Butane
 17.387              -          -          -       t2-Butene
 18.036              -          -          -       c2-Butene
 20.185              -          -          -       Isopentane
 21.005              -          -          -       1-Pentene
 21.600              -          -          -       n-Pentane
 21.740              -          -          -       Isoprene
 21.992              -          -          -       t2-Pentene
 22.439 PP       2.58524    1.00000    1.32028     c2-Pentene
 23.255 PB       3.56825    1.00000    1.82230     2,2-Dimethylbutane
 24.574 PB       6.42842    1.00000    3.28300     Cyclopentane
```

10-17-08
JAK

```
RetTime  Type     Area     Amt/Area    Amount   Grp   Name
 [min]           [pA*s]               [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.885            -          -          -          2,3-dimethylbutane
 25.134            -          -          -          2-Methylpentane
 26.131            -          -          -          3-Methylpentane
 26.271            -          -          -          1-Hexene
 26.929            -          -          -          n-Hexane
 28.689            -          -          -          Methylcyclopentane
 28.838            -          -          -          2,4-dimethylpentane
 30.293 BP  +     1.38236    1.00000 7.05971e-1     Benzene
 30.656            -          -          -          Cyclohexane
 31.078            -          -          -          2-Methylhexane
 31.330            -          -          -          2,3-Dimethylpentane
 31.734            -          -          -          3-Methylhexane
 32.531            -          -          -          2,2,4-Trimethylpentane
 33.493            -          -          -          n-Heptane
 34.706            -          -          -          Methylcyclohexane
 36.848            -          -          -          2,3,4-Trimethylpentane
 37.083 PB  +     4.41837    1.00000    2.25646     Toluene
 37.492            -          -          -          2-Methylheptane
 37.982            -          -          -          3-Methylheptane
 39.641            -          -          -          n-Octane
 43.082 PB     4.93319e-1    1.00000 2.51938e-1     Ethylbenzene
 43.588 PB        1.20612    1.00000 6.15967e-1     m/p-Xylene
 44.760            -          -          -          Styrene
 45.039 PP     7.91625e-1    1.00000 4.04283e-1     o-Xylene
 45.829            -          -          -          n-Nonane
 46.899            -          -          -          Cumene
 48.648            -          -          -          n-Propylbenzene
 49.104 BB     4.93205e-1    1.00000 2.51880e-1     m-Ethyltoluene
 49.326            -          -          -          p-Ethyltoluene
 49.541            -          -          -          1,3,5-Trimethylbenzene
 50.141            -          -          -          o-Ethyltoluene
 51.223 PP        3.31232    1.00000    1.69160     1,2,4-Trimethylbenzene
 51.533            -          -          -          n-Decane
 52.617 BB        5.25361    1.00000    2.68302     1,2,3-Trimethylbenzene
 54.019            -          -          -          m-Diethylbenzene
 54.391            -          -          -          p-Diethylbenzene
 56.931            -          -          -          n-Undecane

Totals :                                127.04071

Uncalibrated Peaks     :      using compound Propane

RetTime  Type     Area     Amt/Area    Amount   Grp   Name
 [min]           [pA*s]               [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.675 PB     8.95369e-1    1.00000 4.57265e-1     ?
 14.069 PB     3.58859e-1    1.00000 1.83269e-1     ?
 40.936 BB        7.44692    1.00000    3.80314     ?
 59.643 PB        1.10320    1.00000 5.63404e-1     ?

Uncalib. totals :                         5.00708

 Results obtained with enhanced integrator!
2 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)
Warning : Time reference compound(s) not found

=====================================================================
                          *** End of Report ***
```

Initial Calibration Verification (LCS) FID #2

DATE: 10/15/2008 QC NO: AL22735 BATCH NO: 193024

JPC

COMPONENTS	STD (ppbc)	$I (ppbc)	REC% $I
Ethylene	49.20	55.61	113.0
Actetylene	48.90	45.59	93.2
Ethane	48.90	57.12	116.8
Propylene	48.90	47.77	97.7
Propane	49.00	55.47	113.2
n-Butane	48.90		
Isobutane	48.90	50.09	102.4
1-Butene	49.90	49.54	99.3
1,3-Butadiene	48.80	41.28	84.6
n-Butane	48.90	57.29	117.2
t2-butene	48.90	49.65	101.5
c2-butene	48.90	48.40	99.0
Isopentane	49.40	54.58	110.5
1-Pentene	50.70	53.85	106.2
n-Pentane	49.10	52.15	106.2
Isoprene	49.40	49.17	99.5
t2-Pentene	50.30	54.13	107.6
c2-Pentene	49.50	50.58	102.2
2,2-Dimethylbutane	49.90	51.49	103.2
Cyclopentane	59.60	50.92	85.4
2,3-Dimethylbutane	49.50	53.52	108.1
2-Methylpentane	49.10	51.20	104.3
3-Methylpentane	49.50	51.91	104.9
1-Hexene	49.30	45.31	91.9
1-Hexane	49.70	50.71	102.0
Methylcyclopentane	49.10	50.67	103.2
2,4-Dimethylpentane	49.50	51.52	104.1
Benzene	49.30	50.60	102.6
Cyclohexane	48.50	51.51	106.2
2-Methylhexane	48.80	50.95	104.4
2,3-Dimethylpentane	48.60	53.37	109.8
3-Methylhexane	48.80	51.55	105.6
2,2,4-Trimethylpentane	53.70	59.30	110.4
n-Heptane	49.00	50.21	102.5
Methylcyclohexane	49.60	53.23	107.3
2,3,4-Trimethylpentane	48.90	52.43	107.2
Toluene	49.80	49.65	99.7
2-Methylheptane	49.10	52.33	106.6
3-Methylheptane	50.70	52.96	104.5
n-Octane	48.50	50.09	103.3
Ethylbenzne	49.70	50.25	101.1
m/p-Xylene	98.50	101.86	103.4
Styrene	49.30	43.87	89.0
o Xylene	49.00	51.82	105.8
n-Nonane	48.60	49.18	101.2
Cumene	49.40	51.57	104.4
n-Propylbenzene	49.00	48.73	99.5
m-Ethyltoluene	48.70	48.79	100.2
p-Ethyltoluene	48.10	47.71	99.2
1,3,5-Trimethylbenzene	48.70	51.92	106.6
o-Ethyltouene	48.50	49.77	102.6
1,2,4-trimethylbenzene	49.00	49.95	101.9
n-Decane	48.90	48.32	98.8
1,2,3-Trimethylbenzene	48.70	45.53	93.5
m-Diethylbenzene	48.40	44.96	92.9
p-Diethylbenzene	48.40	37.38	77.2
n-Undecane	48.90	45.36	92.8

MATH LCS CONC 10 15 08

From: Jianzhong Liu
Environmental Scientist Supervisor
Air Organics, LSD, DEQ

Date: June 3, 2008

Re: Low Recovery of p-Diethylbenzene in PAMS LCS Standard

Stock Standard:

Manufacturer:	Matheson Tri-Gas, Inc.
Cylinder #:	SX39238D
Lot#:	1057610175
Expiration Date:	12/03/2009

From the studies of runs in different GC/FIDs, the recovery of p-diethylbenzene is constantly low (~ 75%). However, the recovery of this compound in PAMS standard is normal (~100%). Therefore, 60% (75%*80%) recovery for this compound in LCS is acceptable.

Concentrations (ppbC) of Different Diluton of Matheson Stock Standard

Cylinder #: SX39238D; Lot #: 1057610175; Expiration Date: 12/3/2008

COMPONENTS	Stock Std	10 times	71.425 times	166.65 times	250 times	500 times
Ethylene	492.00	49.20	6.89	2.95	1.97	0.98
Actetylene	489.00	48.90	6.85	2.93	1.96	0.98
Ethane	489.00	48.90	6.85	2.93	1.96	0.98
Propylene	489.00	48.90	6.85	2.93	1.96	0.98
Propane	490.00	49.00	6.86	2.94	1.96	0.98
n-Butane	489.00	48.90	6.85	2.93	1.96	0.98
Isobutane	489.00	48.90	6.85	2.93	1.96	0.98
1-Butene	499.00	49.90	6.99	2.99	2.00	1.00
1,3-Butadiene	488.00	48.80	6.83	2.93	1.95	0.98
n-Butane	489.00	48.90	6.85	2.93	1.96	0.98
t2-butene	489.00	48.90	6.85	2.93	1.96	0.98
c2-butene	489.00	48.90	6.85	2.93	1.96	0.98
Isopentane	494.00	49.40	6.92	2.96	1.98	0.99
1-Pentene	507.00	50.70	7.10	3.04	2.03	1.01
n-Pentane	491.00	49.10	6.87	2.95	1.96	0.98
Isoprene	494.00	49.40	6.92	2.96	1.98	0.99
t2-Pentene	503.00	50.30	7.04	3.02	2.01	1.01
c2-Pentene	495.00	49.50	6.93	2.97	1.98	0.99
2,2-Dimethylbutane	499.00	49.90	6.99	2.99	2.00	1.00
Cyclopentane	596.00	59.60	8.34	3.58	2.38	1.19
2,3-Dimethylbutane	495.00	49.50	6.93	2.97	1.98	0.99
2-Methylpentane	491.00	49.10	6.87	2.95	1.96	0.98
3-Methylpentane	495.00	49.50	6.93	2.97	1.98	0.99
1-Hexene	493.00	49.30	6.90	2.96	1.97	0.99
1-Hexane	497.00	49.70	6.96	2.98	1.99	0.99
Methylcyclopentane	491.00	49.10	6.87	2.95	1.96	0.98
2,4-Dimethylpentane	495.00	49.50	6.93	2.97	1.98	0.99
Benzene	493.00	49.30	6.90	2.96	1.97	0.99
Cyclohexane	485.00	48.50	6.79	2.91	1.94	0.97
2-Methylhexane	488.00	48.80	6.83	2.93	1.95	0.98
2,3-Dimethylpentane	486.00	48.60	6.80	2.92	1.94	0.97
3-Methylhexane	488.00	48.80	6.83	2.93	1.95	0.98
2,2,4-Trimethylpentane	537.00	53.70	7.52	3.22	2.15	1.07
n-Heptane	490.00	49.00	6.86	2.94	1.96	0.98
Methylcyclohexane	496.00	49.60	6.94	2.98	1.98	0.99
2,3,4-Trimethylpentane	489.00	48.90	6.85	2.93	1.96	0.98
Toluene	498.00	49.80	6.97	2.99	1.99	1.00
2-Methylheptane	491.00	49.10	6.87	2.95	1.96	0.98
3-Methylheptane	507.00	50.70	7.10	3.04	2.03	1.01
n-Octane	485.00	48.50	6.79	2.91	1.94	0.97
Ethylbenzne	497.00	49.70	6.96	2.98	1.99	0.99
m/p-Xylene	985.00	98.50	13.79	5.91	3.94	1.97
Styrene	493.00	49.30	6.90	2.96	1.97	0.99
o Xylene	490.00	49.00	6.86	2.94	1.96	0.98
n-Nonane	486.00	48.60	6.80	2.92	1.94	0.97
Cumene	494.00	49.40	6.92	2.96	1.98	0.99
n-Propylbenzene	490.00	49.00	6.86	2.94	1.96	0.98
m-Ethyltoluene	487.00	48.70	6.82	2.92	1.95	0.97
p-Ethyltoluene	481.00	48.10	6.73	2.89	1.92	0.96
1,3,5-Trimethylbenzene	487.00	48.70	6.82	2.92	1.95	0.97
o-Ethyltouene	485.00	48.50	6.79	2.91	1.94	0.97
1,2,4-trimethylbenzene	490.00	49.00	6.86	2.94	1.96	0.98
n-Decane	489.00	48.90	6.85	2.93	1.96	0.98
1,2,3-Trimethylbenzene	487.00	48.70	6.82	2.92	1.95	0.97
m-Diethylbenzene	484.00	48.40	6.78	2.90	1.94	0.97
p-Diethylbenzene	484.00	48.40	6.78	2.90	1.94	0.97
n-Undecane	489.00	48.90	6.85	2.93	1.96	0.98

Matheson 500 ppbC PAMS dilutions

MATHESON TRI•GAS

Certified Mixture Grade

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057610175

PRODUCT:

CYLINDER NUMBER: SX39238D
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	500 ppbC	498 ppbC	+/- 5%
2-Methylheptane	500 ppbC	491 ppbC	+/- 5%
3-Methylheptane	500 ppbC	507 ppbC	+/- 5%
n-Octane	500 ppbC	485 ppbC	+/- 5%
Ethylbenzene	500 ppbC	497 ppbC	+/- 5%
p-Xylene	500 ppbC	490 ppbC	+/- 5%
m-Xylene	500 ppbC	495 ppbC	+/- 5%
Styrene	500 ppbC	493 ppbC	+/- 5%
o-Xylene	500 ppbC	490 ppbC	+/- 5%
n-Nonane	500 ppbC	486 ppbC	+/- 5%
Isopropylbenzene	500 ppbC	494 ppbC	+/- 5%
n-Propylbenzene	500 ppbC	490 ppbC	+/- 5%
n-Decane	500 ppbC	489 ppbC	+/- 5%
m-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
p-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
n-Dodecane	500 ppbC	492 ppbC	+/- 5%
m-Ethyltoluene	500 ppbC	487 ppbC	+/- 5%
o-Ethyltoluene	500 ppbC	485 ppbC	+/- 5%
p-Ethyltoluene	500 ppbC	481 ppbC	+/- 5%
n-Undecane	500 ppbC	489 ppbC	+/- 5%
1,2,3-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,3,5-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,2,4-Trimethylbenzene	500 ppbC	490 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received on 12/06/07

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck
ANALYST

Derek St

12/4/2007
DATE SIGNED

MATHESON TRI•GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
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Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
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2-Methylheptane	500 ppbC	491 ppbC	+/- 5%
3-Methylheptane	500 ppbC	507 ppbC	+/- 5%
n-Octane	500 ppbC	485 ppbC	+/- 5%
Ethylbenzene	500 ppbC	497 ppbC	+/- 5%
p-Xylene	500 ppbC	490 ppbC	+/- 5%
m-Xylene	500 ppbC	495 ppbC	+/- 5%
Styrene	500 ppbC	493 ppbC	+/- 5%
o-Xylene	500 ppbC	490 ppbC	+/- 5%
n-Nonane	500 ppbC	486 ppbC	+/- 5%
Isopropylbenzene	500 ppbC	494 ppbC	+/- 5%
n-Propylbenzene	500 ppbC	490 ppbC	+/- 5%
n-Decane	500 ppbC	489 ppbC	+/- 5%
m-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
p-Diethylbenzene	500 ppbC	484 ppbC	+/- 5%
n-Dodecane	500 ppbC	492 ppbC	+/- 5%
m-Ethyltoluene	500 ppbC	487 ppbC	+/- 5%
o-Ethyltoluene	500 ppbC	485 ppbC	+/- 5%
p-Ethyltoluene	500 ppbC	481 ppbC	+/- 5%
n-Undecane	500 ppbC	489 ppbC	+/- 5%
1,2,3-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,3,5-Trimethylbenzene	500 ppbC	487 ppbC	+/- 5%
1,2,4-Trimethylbenzene	500 ppbC	490 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received on 12/16/07

The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck	Derek St	12/4/2007
ANALYST		**DATE SIGNED**

```
=====================================================================
Injection Date   : 10/16/2008 8:28:13 PM          Seq. Line :  11
Sample Name      : AL22735 $L1PPFID                Location : Vial 31
Acq. Operator    : JAK                                  Inj :  1
Acq. Instrument  : HP_FID2 SOP 1026             Inj Volume : Manually
Acq. Method      : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/16/2008 2:49:51 PM by JAK
                   (modified after loading)
Analysis Method  : C:\HPCHEM\1\METHODS\PAMS.M
Last changed     : 10/17/2008 6:32:13 AM by JAK
                   (modified after loading)
PAMS SAMPLE ANALYSES
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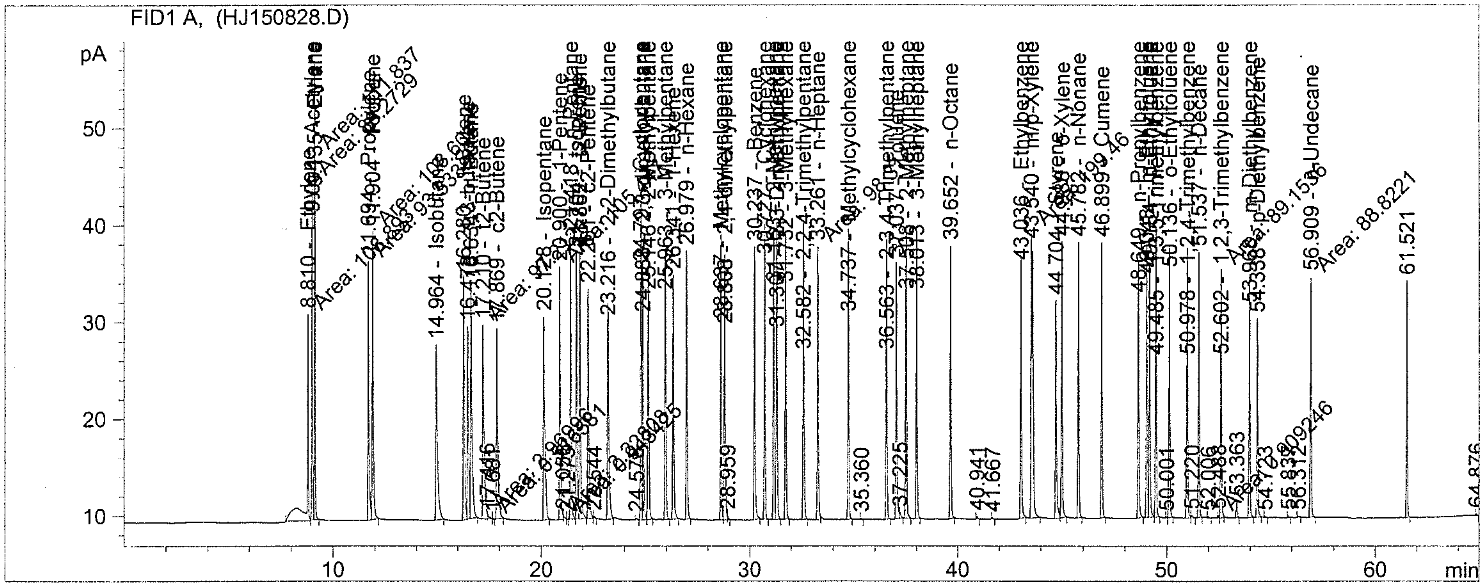
51452



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=====================================================================
                     External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]           [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.810 MM     108.89320    1.00000   55.61176    Ethylene
  9.004 MF      89.27295    1.00000   45.59170    Acetylene
  9.135 FM     111.83705    1.00000   57.11518    Ethane
 11.694 MF      93.53393    1.00000   47.76778    Propylene
 11.904 FM     108.60664    1.00000   55.46541    Propane
 14.964 PB   +  98.08557    1.00000   50.09230    Isobutane
 16.280 PV      96.99831    1.00000   49.53704    1-Butene
 16.473 VV      80.82842    1.00000   41.27908    1,3-butadiene
 16.634 VB     112.18735    1.00000   57.29408    n-Butane
 17.210 MF      97.21261    1.00000   49.64648    t2-Butene
 17.869 PB      94.78104    1.00000   48.40468    c2-Butene
 20.128 BB     106.86475    1.00000   54.57583    Isopentane
 20.900 MF     105.44742    1.00000   53.85200    1-Pentene
 21.418 VV     102.11597    1.00000   52.15063    n-Pentane
 21.704 VV      96.28439    1.00000   49.17244    Isoprene
 21.862 VB     105.98328    1.00000   54.12566    t2-Pentene
 22.261 BB      99.03815    1.00000   50.57878    c2-Pentene
 23.216 PV     100.81549    1.00000   51.48647    2,2-Dimethylbutane
```

10-17-08
JAK

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RetTime  Type     Area      Amt/Area    Amount    Grp   Name
 [min]          [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 61.521 BB       70.57325    1.00000   36.04176    ?
 64.876 PP     5.35105e-1    1.00000 2.73278e-1    ?

Uncalib. totals :                      49.78753

 Results obtained with enhanced integrator!
1 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)

====================================================================
                          *** End of Report ***
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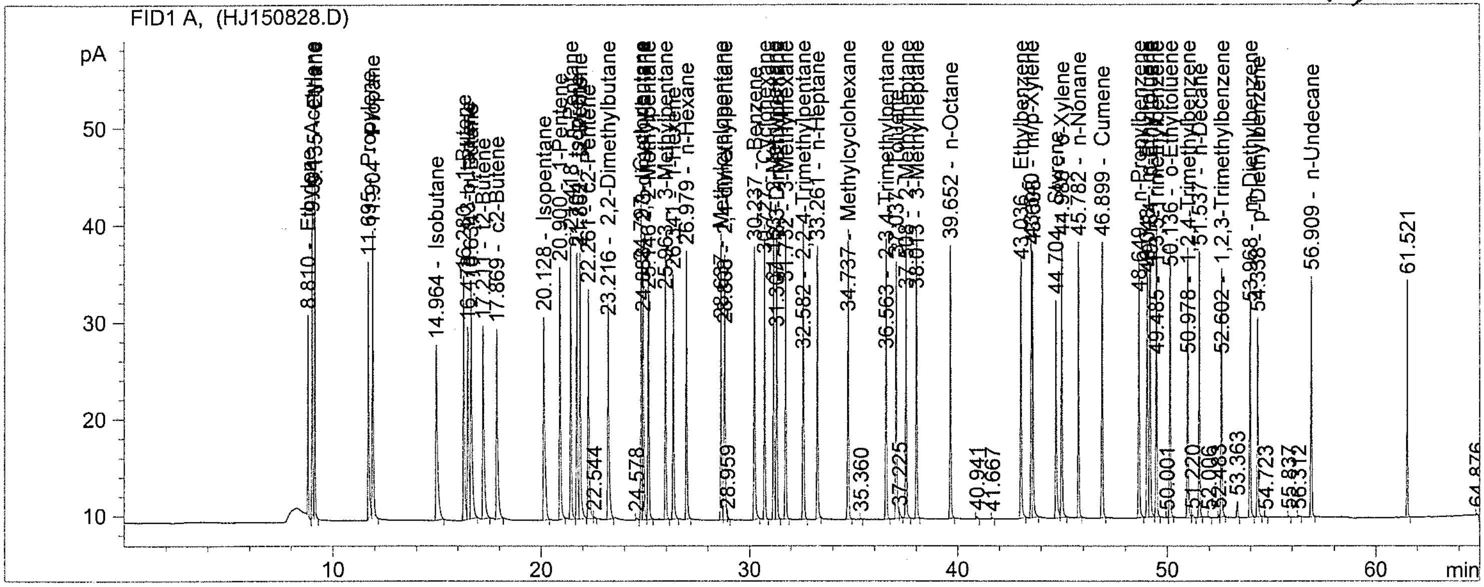
```
=====================================================================
Injection Date  : 10/16/2008 8:28:13 PM          Seq. Line :  11
Sample Name     : AL22735 $L1PPFID                Location : Vial 31
Acq. Operator   : JAK                                  Inj :   1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/16/2008 2:49:51 PM by JAK
                  (modified after loading)
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/17/2008 6:32:13 AM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

S1452



```
=====================================================================
                      External Standard Report
=====================================================================

Sorted By              :      Signal
Calib. Data Modified   :      8/4/2008 10:57:02 AM
Multiplier             :      0.5107
Dilution               :      1.0000
Sample Amount          :      1.00000   [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.810 BB      48.36698    1.00000    24.70102    Ethylene
  9.004 BB      85.67876    1.00000    43.75614    Acetylene
  9.135 BBA    106.03226    1.00000    54.15068    Ethane
 11.695 PB      88.75471    1.00000    45.32703    Propylene
 11.904 BBA    100.49319    1.00000    51.32187    Propane
 14.964 PB  +   98.08557    1.00000    50.09230    Isobutane
 16.280 PV      96.99831    1.00000    49.53704    1-Butene
 16.473 VV      80.82842    1.00000    41.27908    1,3-butadiene
 16.634 VB     112.18735    1.00000    57.29408    n-Butane
 17.211 PB      98.03780    1.00000    50.06791    t2-Butene
 17.869 PB      94.78104    1.00000    48.40468    c2-Butene
 20.128 BB     106.86475    1.00000    54.57583    Isopentane
 20.900 PB     106.23857    1.00000    54.25604    1-Pentene
 21.418 VV     102.11597    1.00000    52.15063    n-Pentane
 21.704 VV      96.28439    1.00000    49.17244    Isoprene
 21.862 VB     105.98328    1.00000    54.12566    t2-Pentene
 22.261 BB      99.03815    1.00000    50.57878    c2-Pentene
 23.216 PV     100.81549    1.00000    51.48647    2,2-Dimethylbutane
```

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```
 RetTime  Type     Area      Amt/Area    Amount    Grp   Name
  [min]           [pA*s]                 [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.797 BV      99.70258    1.00000   50.91811     Cyclopentane
 24.888 VV     104.79393    1.00000   53.51826     2,3-dimethylbutane
 25.146 VB     100.25581    1.00000   51.20064     2-Methylpentane
 25.963 BB     101.64356    1.00000   51.90937     3-Methylpentane
 26.341 PB      88.71393    1.00000   45.30620     1-Hexene
 26.979 PB      99.29967    1.00000   50.71234     n-Hexane
 28.637 BV      99.22535    1.00000   50.67439     Methylcyclopentane
 28.808 VV     100.87298    1.00000   51.51583     2,4-dimethylpentane
 30.237 PB  +   99.08167    1.00000   50.60101     Benzene
 30.727 PB     100.85815    1.00000   51.50826     Cyclohexane
 31.163 PV      99.76077    1.00000   50.94782     2-Methylhexane
 31.307 VB     104.50134    1.00000   53.36883     2,3-Dimethylpentane
 31.732 BB     100.93217    1.00000   51.54606     3-Methylhexane
 32.582 BB     116.11399    1.00000   59.29942     2,2,4-Trimethylpentane
 33.261 PB      96.57597    1.00000   49.32135     n-Heptane
 34.737 BB     104.23523    1.00000   53.23293     Methylcyclohexane
 36.563 BB     102.65385    1.00000   52.42532     2,3,4-Trimethylpentane
 37.037 BV  +   97.22409    1.00000   49.65234     Toluene
 37.508 BB     102.46342    1.00000   52.32807     2-Methylheptane
 38.013 BB     103.69798    1.00000   52.95856     3-Methylheptane
 39.652 BB      98.07506    1.00000   50.08693     n-Octane
 43.036 PB      98.39761    1.00000   50.25166     Ethylbenzene
 43.540 PV      92.93414    1.00000   47.46146     m/p-Xylene
 44.704 BV      85.90063    1.00000   43.86945     Styrene
 44.988 VB     101.47527    1.00000   51.82342     o-Xylene
 45.782 BB      96.29155    1.00000   49.17609     n-Nonane
 46.899 BB     100.98366    1.00000   51.57235     Cumene
 48.649 BB      95.42062    1.00000   48.73131     n-Propylbenzene
 49.048 BV      95.52940    1.00000   48.78687     m-Ethyltoluene
 49.184 VV      93.41511    1.00000   47.70710     p-Ethyltoluene
 49.485 VB     101.65474    1.00000   51.91508     1,3,5-Trimethylbenzene
 50.136 VB      97.44906    1.00000   49.76723     o-Ethyltoluene
 50.978 BB      97.81036    1.00000   49.95175     1,2,4-Trimethylbenzene
 51.537 BB      94.62080    1.00000   48.32284     n-Decane
 52.602 VB      88.41506    1.00000   45.15357     1,2,3-Trimethylbenzene
 53.968 BB      88.04417    1.00000   44.96416     m-Diethylbenzene
 54.338 BB      73.19059    1.00000   37.37843     p-Diethylbenzene
 56.909 BB  +   88.71956    1.00000   45.30908     n-Undecane

Totals :                                2777.45156

Uncalibrated Peaks    :      using compound Propane

RetTime  Type     Area      Amt/Area    Amount    Grp   Name
 [min]           [pA*s]                 [ppbc]
-------|------|----------|----------|----------|--|------------------
 22.544 BB       1.17554    1.00000 6.00349e-1     ?
 24.578 PB       1.26304    1.00000 6.45037e-1     ?
 28.959 VB       1.64351    1.00000 8.39343e-1     ?
 35.360 BB    3.91656e-1    1.00000 2.00019e-1     ?
 37.225 VB       2.82216    1.00000    1.44128     ?
 40.941 PB       1.10559    1.00000 5.64624e-1     ?
 41.667 PB    6.27572e-1    1.00000 3.20501e-1     ?
 43.608 VB     105.08286    1.00000   53.66581     ?
 50.001 PP    3.40748e-1    1.00000 1.74020e-1     ?
 51.220 BB       1.26381    1.00000 6.45429e-1     ?
 52.006 PB    5.54539e-1    1.00000 2.83203e-1     ?
 52.483 PV    8.54311e-1    1.00000 4.36297e-1     ?
 53.363 BB       5.73396    1.00000    2.92833     ?
 54.723 PB    4.31328e-1    1.00000 2.20279e-1     ?
 55.837 PB    6.35686e-1    1.00000 3.24645e-1     ?
 56.312 PB    8.24003e-1    1.00000 4.20818e-1     ?
 61.521 BB      70.57325    1.00000   36.04176     ?
 64.876 PP    5.35105e-1    1.00000 2.73278e-1     ?
```

```
Uncalib. totals :                    100.02502

 Results obtained with enhanced integrator!
1 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)

=====================================================================
                          *** End of Report ***
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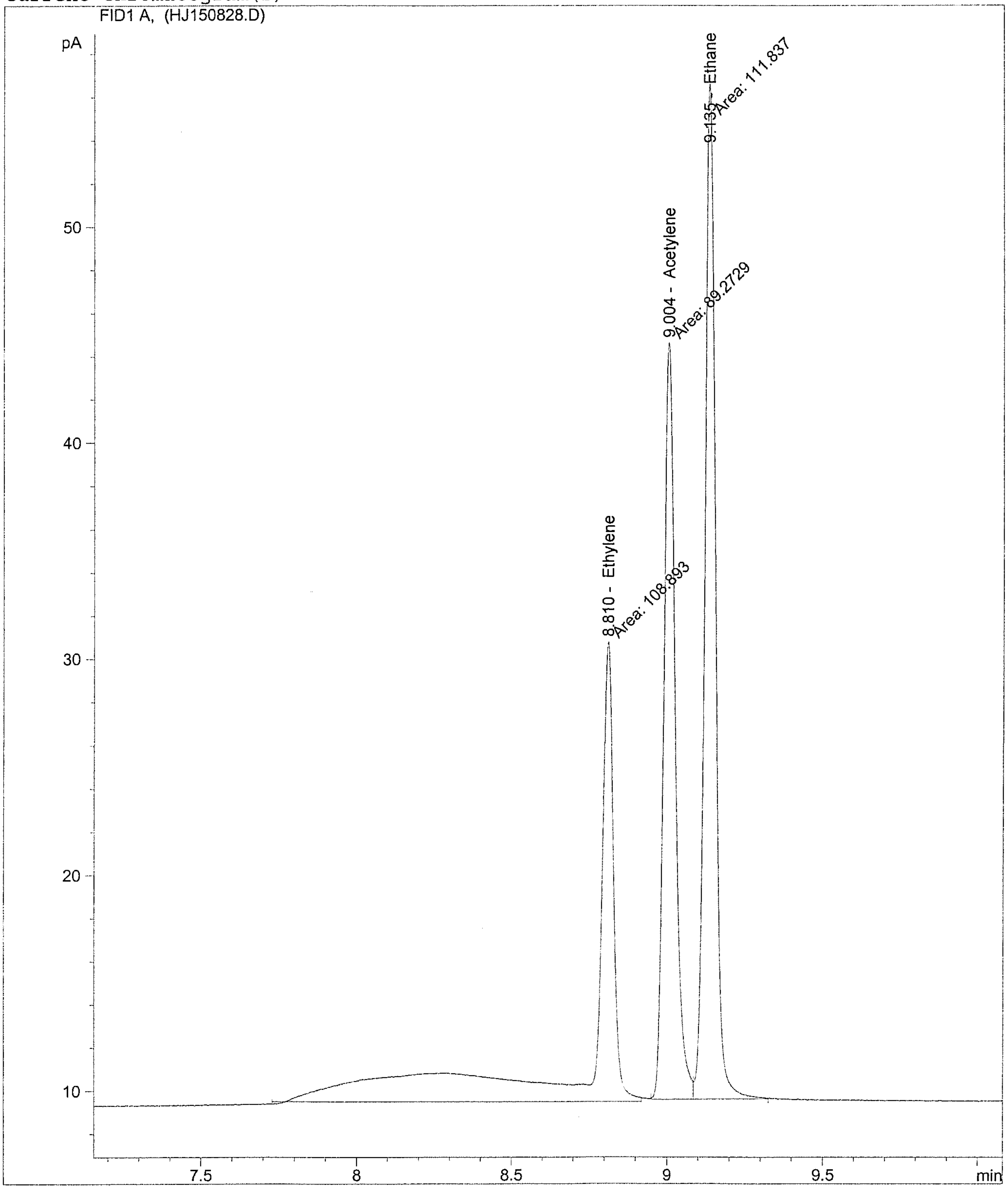
```
Print of window 38: Current Chromatogram(s)
================================================================================
Injection Date  : 10/16/2008 8:28:13 PM           Seq. Line :  11
Sample Name     : AL22735 $L1PPFID                  Location : Vial 31
Acq. Operator   : JAK                                    Inj :   1
Acq. Instrument : HP_FID2 SOP 1026                Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/16/2008 2:49:51 PM by JAK
                  (modified after loading)
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/17/2008 6:32:13 AM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

Current Chromatogram(s)



10-17-08
JAK

M

PAMS RETENTION TIME STD FID #2 lot #1057410185

DATE: 10/15/2008 QC NO: AL22735 BATCH NO: 193024

COMPONENTS	STD (ppbc)	SI (ppbc)	REC% SI
Ethylene	21.00	**18.60**	**88.6**
Actetylene	42.00	**18.70**	**44.5**
Ethane	26.00	**30.32**	**116.6**
Propylene	26.00	**20.99**	**80.7**
Propane	40.00	**44.26**	**110.7**
n-Butane	43.00		
Isobutane	25.00	**26.01**	**104.0**
1-Butene	32.00	**30.24**	**94.5**
1,3-Butadiene	32.00	**24.34**	**76.1**
n-Butane	43.00	**49.04**	**114.0**
t2-butene	26.00	**25.24**	**97.1**
c2-butene	38.00	**35.74**	**94.1**
Isopentane	40.00	**41.39**	**103.5**
1-Pentene	25.00	**25.38**	**101.5**
n-Pentane	26.00	**25.75**	**99.1**
Isoprene	42.00	**37.32**	**88.9**
t2-Pentene	25.00	**27.65**	**110.6**
c2-Pentene	34.00	**33.45**	**98.4**
2,2-Dimethylbutane	40.00	**42.30**	**105.8**
Cyclopentane	21.00	**19.51**	**92.9**
2,3-Dimethylbutane	51.00	**55.18**	**108.2**
2-Methylpentane	21.00	**21.98**	**104.7**
3-Methylpentane	41.00	**42.00**	**102.4**
1-Hexene	61.00	**59.56**	**97.6**
1-Hexane	30.00	**30.90**	**103.0**
Methylcyclopentane	26.00	**26.54**	**102.1**
2,4-Dimethylpentane	40.00	**41.76**	**104.4**
Benzene	31.00	**29.94**	**96.6**
Cyclohexane	42.00	**42.73**	**101.7**
2-Methylhexane	25.00	**25.71**	**102.9**
2,3-Dimethylpentane	54.00	**54.89**	**101.6**
3-Methylhexane	26.00	**26.39**	**101.5**
2,2,4-Trimethylpentane	31.00	**31.68**	**102.2**
n-Heptane	26.00	**25.67**	**98.7**
Methylcyclohexane	31.00	**32.15**	**103.7**
2,3,4-Trimethylpentane	25.00	**26.08**	**104.3**
Toluene	40.00	**37.60**	**94.0**
2-Methylheptane	25.00	**25.74**	**103.0**
3-Methylheptane	25.00	**26.37**	**105.5**
n-Octane	31.00	**30.10**	**97.1**
Ethylbenzne	25.00	**23.59**	**94.4**
m/p-Xylene	42.00	**37.92**	**90.3**
Styrene	41.00	**33.75**	**82.3**
o Xylene	26.00	**25.16**	**96.8**
n-Nonane	25.00	**24.62**	**98.5**
Cumene	40.00	**39.60**	**99.0**
n-Propylbenzene	30.00	**28.33**	**94.4**
m-Ethyltoluene	25.00	**24.39**	**97.6**
p-Ethyltoluene	43.00	**39.57**	**92.0**
1,3,5-Trimethylbenzene	26.00	**24.83**	**95.5**
o-Ethyltouene	27.00	**29.88**	**110.7**
1,2,4-trimethylbenzene	39.00	**38.24**	**98.0**
n-Decane	30.00	**29.34**	**97.8**
1,2,3-Trimethylbenzene	25.00	**25.73**	**102.9**
m-Diethylbenzene	40.00	**38.37**	**95.9**
p-Diethylbenzene	27.00	**23.68**	**87.7**
n-Undecane	41.00	**28.30**	**69.0**

PAms

MATHESON TRI•GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

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DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd
Baton Rouge, LA 70802
Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057410185

PRODUCT:

CYLINDER NUMBER: CC-250112
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 cu. ft.
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Ethylene	20 ppbC	21 ppbC	+/- 5%
Ethane	25 ppbC	26 ppbC	+/- 5%
Acetylene	40 ppbC	42 ppbC	+/- 5%
Propylene	25 ppbC	26 ppbC	+/- 5%
Propane	40 ppbC	40 ppbC	+/- 5%
Isobutane	25 ppbC	25 ppbC	+/- 5%
1-Butene	30 ppbC	32 ppbC	+/- 5%
1,3-Butadiene	30 ppbC	32 ppbC	+/- 5%
n-Butane	40 ppbC	43 ppbC	+/- 5%
trans-2-Butene	25 ppbC	26 ppbC	+/- 5%
cis-2-Butene	35 ppbC	38 ppbC	+/- 5%
Isopentane	40 ppbC	40 ppbC	+/- 5%
1-Pentene	25 ppbC	25 ppbC	+/- 5%
n-Pentane	25 ppbC	26 ppbC	+/- 5%
Isoprene	40 ppbC	42 ppbC	+/- 5%
trans-2-Pentene	25 ppbC	25 ppbC	+/- 5%
cis-2-Pentene	35 ppbC	34 ppbC	+/- 5%
Cyclopentene	20 ppbC	21 ppbC	+/- 5%
2,2-Dimethylbutane	40 ppbC	40 ppbC	+/- 5%
2-Methylpentane	20 ppbC	21 ppbC	+/- 5%
3-Methylpentane	40 ppbC	41 ppbC	+/- 5%
2,3-Dimethylbutane	50 ppbC	51 ppbC	+/- 5%
1-Hexene	60 ppbC	61 ppbC	+/- 5%
n-Hexane	30 ppbC	30 ppbC	+/- 5%
Methylcyclopentane	25 ppbC	26 ppbC	+/- 5%
2,4-Dimethylpentane	40 ppbC	40 ppbC	+/- 5%
Benzene	30 ppbC	31 ppbC	+/- 5%
Cyclohexane	40 ppbC	42 ppbC	+/- 5%
2,3-Dimethylpentane	50 ppbC	54 ppbC	+/- 5%
2-Methylhexane	25 ppbC	25 ppbC	+/- 5%
3-Methylhexane	25 ppbC	26 ppbC	+/- 5%
n-Heptane	25 ppbC	26 ppbC	+/- 5%
2,2,4-Trimethylpentane	30 ppbC	31 ppbC	+/- 5%
Methylcyclohexane	30 ppbC	31 ppbC	+/- 5%
2,3,4-Trimethylpentane	25 ppbC	25 ppbC	+/- 5%

Received on 12/6/07

TRACEABLE TO REFERENCE STANDARD SOURCE/NUMBER:
TRACEABLE TO NIST TRACEABLE WEIGHT CERTIFICATE:

MATHESON TRI•GAS

Matheson Tri-Gas
6874 S Main Street
Morrow, GA 30260
Phone: (770) 961-7891
Fax: (770) 968-1268

Certified Mixture Grade

To: Environmental Quality
DEQ Laboratory Sevices
Central Receiving
1209 Leesville Rd

Phone:
Fax:

TO AVOID BACKFILL, CYLINDER PRESSURE MUST BE GREATER THAN PROCESS PRESSURE.

SALES ORDER NUMBER: 427497
P.O. NUMBER: 3243638
LOT NUMBER: 1057410185

PRODUCT:

CYLINDER NUMBER: CC-250112
SIZE: 1l
CGA/DISS OUTLET: 350
CONTENT: 131 liters
PRESSURE: 1850 psig

Fill Date: 12/3/2007
Certification Date: 12/3/2007
Expiration Date: 12/3/2008

COMPONENT	REQUESTED CONCENTRATION	CERTIFIED CONCENTRATION	CERTIFICATION ACCURACY
Toluene	40 ppbC	40 ppbC	+/- 5%
2-Methylheptane	25 ppbC	25 ppbC	+/- 5%
3-Methylheptane	25 ppbC	25 ppbC	+/- 5%
n-Octane	30 ppbC	31 ppbC	+/- 5%
Ethylbenzene	25 ppbC	25 ppbC	+/- 5%
p-Xylene	20 ppbC	21 ppbC	+/- 5%
m-Xylene	20 ppbC	21 ppbC	+/- 5%
Styrene	40 ppbC	41 ppbC	+/- 5%
o-Xylene	25 ppbC	26 ppbC	+/- 5%
n-Nonane	25 ppbC	25 ppbC	+/- 5%
Isopropylbenzene	40 ppbC	40 ppbC	+/- 5%
n-Propylbenzene	30 ppbC	30 ppbC	+/- 5%
n-Decane	30 ppbC	30 ppbC	+/- 5%
m-Diethylbenzene	40 ppbC	40 ppbC	+/- 5%
p-Diethylbenzene	25 ppbC	27 ppbC	+/- 5%
n-Dodecane	30 ppbC	31 ppbC	+/- 5%
m-Ethyltoluene	25 ppbC	25 ppbC	+/- 5%
o-Ethyltoluene	30 ppbC	27 ppbC	+/- 5%
p-Ethyltoluene	40 ppbC	43 ppbC	+/- 5%
n-Undecane	40 ppbC	41 ppbC	+/- 5%
1,2,3-Trimethylbenzene	25 ppbC	25 ppbC	+/- 5%
1,3,5-Trimethylbenzene	25 ppbC	26 ppbC	+/- 5%
1,2,4-Trimethylbenzene	40 ppbC	39 ppbC	+/- 5%
Nitrogen, Balance			

SPECIAL INFORMATION / ADDITIONAL COMMENTS

Received 12/6/07 m

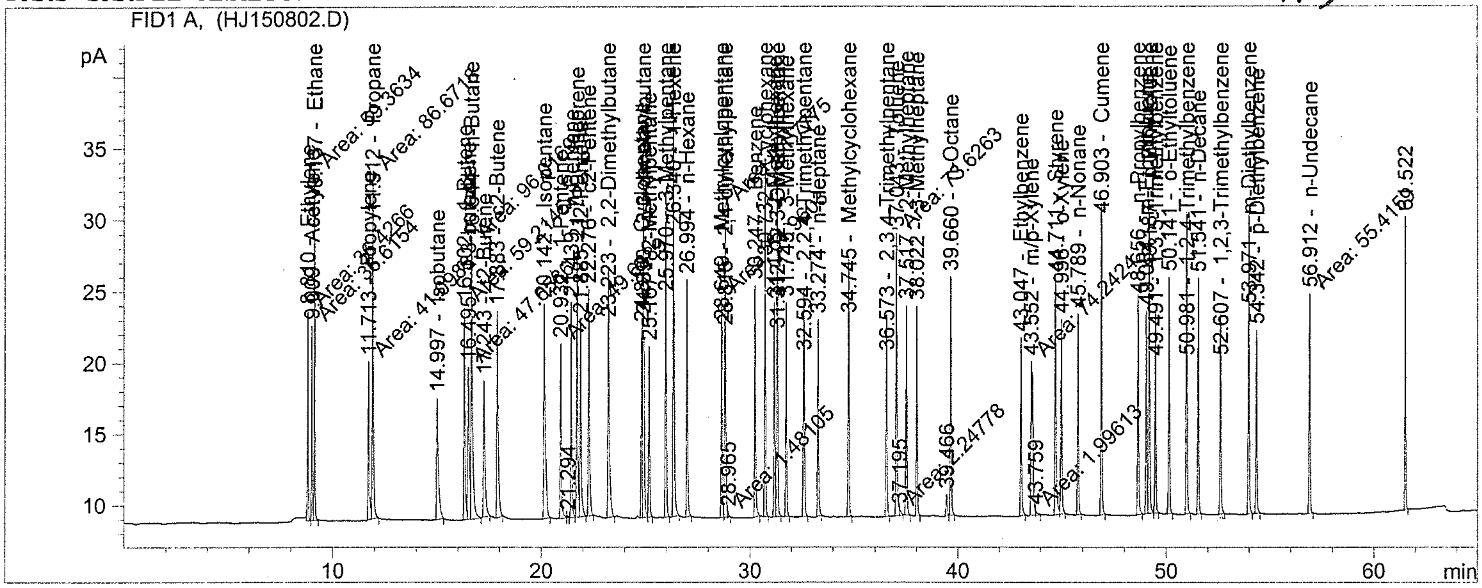
The product listed above and furnished under the referenced purchase order has been tested and found to contain the component concentration listed above. All values in mole/mole basis gas phase unless otherwise indicated. Matheson Tri-Gas warrants that the above product(s) conform at the time of shipment to the above description. Matheson Tri-Gas' liability does not exceed the value of the product purchased.

Derek Stuck
ANALYST

12/4/2007
DATE SIGNED

```
=====================================================================
Injection Date  : 10/15/2008 9:36:44 AM          Seq. Line :   2
Sample Name     : AL22735 $I_PPFID                Location : Vial 3
Acq. Operator   : JAK                                  Inj :   1
Acq. Instrument : HP_FID2 SOP 1026              Inj Volume : Manually
Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 8/4/2008 1:18:53 PM by JPC
Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
Last changed    : 10/15/2008 6:38:05 AM by JAK
                  (modified after loading)
PAMS SAMPLE ANALYSES
```

6152



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                      External Standard Report
=====================================================================

Sorted By             :      Signal
Calib. Data Modified  :      8/4/2008 10:57:02 AM
Multiplier            :      0.5107
Dilution              :      1.0000
Sample Amount         :      1.00000  [ppbc]    (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

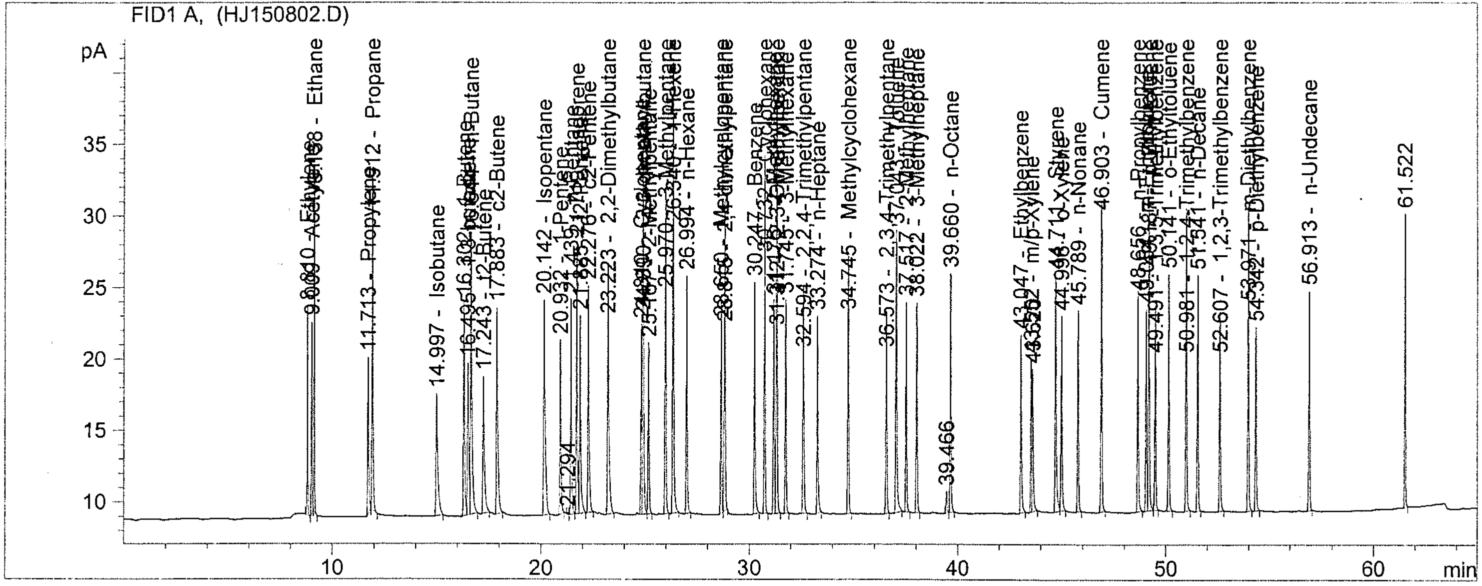
RetTime  Type     Area      Amt/Area     Amount    Grp   Name
 [min]          [pA*s]                   [ppbc]
-------|------|----------|----------|----------|--|------------------
  8.810 MF      36.42662    1.00000   18.60307    Ethylene
  9.009 MF      36.61538    1.00000   18.69948    Acetylene
  9.137 FM      59.36336    1.00000   30.31687    Ethane
 11.713 MF      41.09826    1.00000   20.98888    Propylene
 11.912 FM      86.67178    1.00000   44.26328    Propane
 14.997 PB   +  50.92107    1.00000   26.00539    Isobutane
 16.302 MF      59.21451    1.00000   30.24085    1-Butene
 16.495 MF      47.65863    1.00000   24.33926    1,3-butadiene
 16.644 FM      96.01686    1.00000   49.03581    n-Butane
 17.243 BB      49.41847    1.00000   25.23801    t2-Butene
 17.883 PB      69.98669    1.00000   35.74220    c2-Butene
 20.142 PB      81.05223    1.00000   41.39337    Isopentane
 20.932 MM      49.68890    1.00000   25.37612    1-Pentene
 21.439 VB      50.42939    1.00000   25.75429    n-Pentane
 21.719 BV      73.07383    1.00000   37.31880    Isoprene
 21.885 VB      54.14959    1.00000   27.65420    t2-Pentene
 22.276 PB      65.50764    1.00000   33.45475    c2-Pentene
 23.223 BB      82.83418    1.00000   42.30341    2,2-Dimethylbutane
 24.810 BV      38.20219    1.00000   19.50986    Cyclopentane
```

10-15-08
JAK

```
Data File C:\HPCHEM\1\DATA\HJ150802.D                       Sample Name: AL22735 $I_PPFID

    =====================================================================
    Injection Date  : 10/15/2008 9:36:44 AM          Seq. Line :   2
    Sample Name     : AL22735 $I_PPFID                Location : Vial 3
    Acq. Operator   : JAK                                  Inj :   1
    Acq. Instrument : HP_FID2 SOP 1026               Inj Volume : Manually
    Acq. Method     : C:\HPCHEM\1\METHODS\PAMS.M
    Last changed    : 8/4/2008 1:18:53 PM by JPC
    Analysis Method : C:\HPCHEM\1\METHODS\PAMS.M
    Last changed    : 10/15/2008 6:38:05 AM by JAK
                      (modified after loading)
    PAMS SAMPLE ANALYSES
```

G1152



```
    =====================================================================
                          External Standard Report
    =====================================================================

    Sorted By              :      Signal
    Calib. Data Modified   :      8/4/2008 10:57:02 AM
    Multiplier             :      0.5107
    Dilution               :      1.0000
    Sample Amount          :      1.00000   [ppbc]    (not used in calc.)
    Use Multiplier & Dilution Factor with ISTDs

    Signal 1: FID1 A,

    RetTime  Type      Area       Amt/Area      Amount    Grp   Name
     [min]           [pA*s]                     [ppbc]
    -------|------|----------|----------|----------|--|------------------
      8.810 BBA     35.39693     1.00000    18.07721     Ethylene
      9.009 PB      34.71106     1.00000    17.72694     Acetylene
      9.138 BBA     55.52883     1.00000    28.35857     Ethane
     11.713 PB      38.56823     1.00000    19.69679     Propylene
     11.912 BBA     82.35966     1.00000    42.06108     Propane
     14.997 PB   +  50.92107     1.00000    26.00539     Isobutane
     16.302 BV      59.12079     1.00000    30.19299     1-Butene
     16.495 VV      46.62464     1.00000    23.81120     1,3-butadiene
     16.644 VB      93.29193     1.00000    47.64419     n-Butane
     17.243 BB      49.41847     1.00000    25.23801     t2-Butene
     17.883 PB      69.98669     1.00000    35.74220     c2-Butene
     20.142 PB      81.05223     1.00000    41.39337     Isopentane
     20.932 PB      47.55657     1.00000    24.28714     1-Pentene
     21.439 VB      50.42939     1.00000    25.75429     n-Pentane
     21.719 BV      73.07383     1.00000    37.31880     Isoprene
     21.885 VB      54.14959     1.00000    27.65420     t2-Pentene
     22.276 PB      65.50764     1.00000    33.45475     c2-Pentene
     23.223 BB      82.83418     1.00000    42.30341     2,2-Dimethylbutane
     24.810 BV      38.20219     1.00000    19.50986     Cyclopentane
```

```
 RetTime  Type      Area      Amt/Area     Amount    Grp   Name
  [min]            [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 24.890 VV      108.04584    1.00000   55.17901    2,3-dimethylbutane
 25.167 VB       43.03400    1.00000   21.97746    2-Methylpentane
 25.970 BB       82.23936    1.00000   41.99964    3-Methylpentane
 26.340 BB      116.62192    1.00000   59.55881    1-Hexene
 26.994 PB       60.49696    1.00000   30.89580    n-Hexane
 28.650 PV       51.14455    1.00000   26.11952    Methylcyclopentane
 28.815 VB       79.06260    1.00000   40.37727    2,4-dimethylpentane
 30.247 BB   +   58.62331    1.00000   29.93892    Benzene
 30.732 BB       83.66541    1.00000   42.72792    Cyclohexane
 31.176 BV       50.34966    1.00000   25.71357    2-Methylhexane
 31.312 VB      107.47405    1.00000   54.88700    2,3-Dimethylpentane
 31.745 BB       51.67727    1.00000   26.39158    3-Methylhexane
 32.594 BB       62.03165    1.00000   31.67956    2,2,4-Trimethylpentane
 33.274 BB       50.27158    1.00000   25.67369    n-Heptane
 34.745 BB       62.95742    1.00000   32.15235    Methylcyclohexane
 36.573 BB       51.06190    1.00000   26.07731    2,3,4-Trimethylpentane
 37.043 PB   +   74.92414    1.00000   38.26376    Toluene
 37.517 BB       50.40670    1.00000   25.74270    2-Methylheptane
 38.022 BB       51.63241    1.00000   26.36867    3-Methylheptane
 39.660 BB       58.93094    1.00000   30.09603    n-Octane
 43.047 BB       46.18818    1.00000   23.58830    Ethylbenzene
 43.552 BV       34.00242    1.00000   17.36504    m/p-Xylene
 44.711 BV       66.07603    1.00000   33.74503    Styrene
 44.996 VB       49.26915    1.00000   25.16175    o-Xylene
 45.789 BB       48.20452    1.00000   24.61805    n-Nonane
 46.903 BB       77.54693    1.00000   39.60322    Cumene
 48.656 BB       55.46711    1.00000   28.32705    n-Propylbenzene
 49.054 BV       47.76506    1.00000   24.39362    m-Ethyltoluene
 49.187 VV       77.47455    1.00000   39.56625    p-Ethyltoluene
 49.491 VB       48.61859    1.00000   24.82951    1,3,5-Trimethylbenzene
 50.141 VB       58.51747    1.00000   29.88487    o-Ethyltoluene
 50.981 BB       74.87322    1.00000   38.23775    1,2,4-Trimethylbenzene
 51.541 BB       57.45391    1.00000   29.34171    n-Decane
 52.607 BB       50.38995    1.00000   25.73415    1,2,3-Trimethylbenzene
 53.971 BB       75.13081    1.00000   38.36930    m-Diethylbenzene
 54.342 BB       46.36736    1.00000   23.67981    p-Diethylbenzene
 56.913 BB   +   55.06075    1.00000   28.11952    n-Undecane

Totals :                               1752.61597

Uncalibrated Peaks     :      using compound Propane

RetTime  Type      Area      Amt/Area     Amount    Grp   Name
 [min]            [pA*s]                  [ppbc]
-------|------|----------|----------|----------|--|------------------
 21.294 PP     4.32705e-1    1.00000 2.20982e-1    ?
 39.466 PB        5.65023    1.00000    2.88557    ?
 43.620 VB       39.99233    1.00000   20.42408    ?
 61.522 BB       59.42428    1.00000   30.34798    ?

Uncalib. totals :                        53.87862

 Results obtained with enhanced integrator!
1 Warnings or Errors :

Warning : Calibration warnings (see calibration table listing)

=====================================================================
                        *** End of Report ***
```

APPENDIX I

Comparison of Carbon Monoxide and Alkane Mixture Concentrations for 9 Barge Emissions Events to Investigate the Contribution of Emissions from Tugs

Appendix I: Comparison of Carbon Monoxide and Alkane Mixture Concentrations for 9 Barge Emissions Events to Investigate the Contribution of Emissions from Tugs

This appendix presents the results of a comparison of carbon monoxide and alkane mixture concentrations analyzed along the ground level beam path of the ARCADIS OP-FTIR VRPM configuration during nine emissions events from barges classified as empty. The analysis was performed to evaluate the contribution of exhaust from the tugs to the Alkane Mixture (AM) emissions fluxes measured during the project.

Table I-1. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 9/28/2009 9:38 to 10:11 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
9/28/2008 9:40	33.4	240
9/28/2008 9:43	38.4	404
9/28/2008 9:45	31.0	252
9/28/2008 9:48	34.5	228
9/28/2008 9:51	21.9	136
9/28/2008 9:53	18.6	103
9/28/2008 9:56	18.3	93.0
9/28/2008 9:59	17.7	92.3
9/28/2008 10:01	29.3	95.4
9/28/2008 10:04	5.93	82.1
9/28/2008 10:07	7.12	72.4
9/28/2008 10:09	7.27	73.0

Table I-2. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 9/29/2009 14:13 to 14:57 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
9/29/2008 14:14	11.5	22.1
9/29/2008 14:17	ND	16.3
9/29/2008 14:20	6.46	ND
9/29/2008 14:22	7.18	20.9
9/29/2008 14:25	13.7	29.8
9/29/2008 14:28	13.0	30.6
9/29/2008 14:31	10.7	29.5
9/29/2008 14:33	13.4	19.3
9/29/2008 14:36	18.7	22.4
9/29/2008 14:39	26.0	20.1
9/29/2008 14:41	26.9	28.1
9/29/2008 14:44	25.6	18.4
9/29/2008 14:47	20.7	31.1
9/29/2008 14:49	20.1	41.2
9/29/2008 14:52	26.5	45.1
9/29/2008 14:55	27.7	136

ND= not detected

Table I-3. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 10/2/2009 8:32 to 9:23 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
10/2/2008 8:33	12.8	347
10/2/2008 8:36	36.5	376
10/2/2008 8:39	47.8	419
10/2/2008 8:41	27.2	350
10/2/2008 8:44	34.3	333
10/2/2008 8:47	12.7	315
10/2/2008 8:49	30.4	336
10/2/2008 8:52	22.3	325
10/2/2008 8:55	37.1	328
10/2/2008 8:57	55.4	331
10/2/2008 9:00	54.7	368
10/2/2008 9:02	53.1	344
10/2/2008 9:05	44.3	354
10/2/2008 9:08	39.1	346
10/2/2008 9:10	25.8	310
10/2/2008 9:13	28.0	306
10/2/2008 9:16	25.1	299
10/2/2008 9:18	48.2	404
10/2/2008 9:21	24.2	304

Table I-4. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 10/4/2009 13:12 to 13:46 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
10/4/2008 13:13	ND	19.6
10/4/2008 13:15	ND	27.2
10/4/2008 13:18	ND	58.2
10/4/2008 13:21	ND	151
10/4/2008 13:23	5.00	26.6
10/4/2008 13:26	ND	27.2
10/4/2008 13:29	5.18	23.9
10/4/2008 13:31	ND	22.7
10/4/2008 13:34	ND	31.3
10/4/2008 13:37	ND	32.6
10/4/2008 13:39	4.63	32.8
10/4/2008 13:42	ND	27.6
10/4/2008 13:45	4.37	30.3

ND= not detected

Table I-5. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 10/6/2009 12:28 to 13:00 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
10/6/2008 12:29	ND	ND
10/6/2008 12:32	ND	ND
10/6/2008 12:35	ND	ND
10/6/2008 12:37	6.56	ND
10/6/2008 12:40	7.89	ND
10/6/2008 12:43	ND	ND
10/6/2008 12:45	10.8	ND
10/6/2008 12:48	ND	ND
10/6/2008 12:51	ND	ND
10/6/2008 12:53	ND	12.4
10/6/2008 12:56	12.5	ND
10/6/2008 12:59	6.44	9.93

ND= not detected

Table I-6. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 10/8/2009 12:53 to 13:25 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
10/8/2008 12:53	5.80	32.2
10/8/2008 12:56	ND	43.7
10/8/2008 12:58	ND	44.7
10/8/2008 13:01	ND	66.1
10/8/2008 13:04	ND	58.7
10/8/2008 13:06	36.5	59.1
10/8/2008 13:09	28.7	51.7
10/8/2008 13:12	ND	80.0
10/8/2008 13:14	ND	32.8
10/8/2008 13:17	ND	32.6
10/8/2008 13:20	ND	59.5
10/8/2008 13:22	8.71	74.3
10/8/2008 13:25	8.49	53.1

ND= not detected

Table I-7. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 10/9/2009 8:07 to 8:38 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
10/9/2008 8:07	ND	128
10/9/2008 8:12	12.0	118
10/9/2008 8:15	ND	140
10/9/2008 8:17	21.9	119
10/9/2008 8:20	32.7	110
10/9/2008 8:23	45.1	146
10/9/2008 8:25	ND	134
10/9/2008 8:28	ND	159
10/9/2008 8:31	7.11	140
10/9/2008 8:33	28.1	143
10/9/2008 8:36	21.8	122

ND= not detected

Table I-8. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 10/9/2009 12:23 to 13:45 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
10/9/2008 12:23	18.5	33.6
10/9/2008 12:26	22.9	34.4
10/9/2008 12:29	18.9	47.2
10/9/2008 12:31	31.8	23.7
10/9/2008 12:34	41.6	45.0
10/9/2008 12:37	31.8	29.0
10/9/2008 12:40	23.3	35.2
10/9/2008 12:42	24.4	39.8
10/9/2008 12:45	22.0	30.5
10/9/2008 12:48	16.2	22.6
10/9/2008 12:50	17.9	13.5
10/9/2008 12:53	16.5	18.7
10/9/2008 12:56	22.5	30.7
10/9/2008 12:58	23.0	46.6
10/9/2008 13:01	32.3	59.5
10/9/2008 13:04	26.9	36.2
10/9/2008 13:06	25.6	39.1
10/9/2008 13:09	23.1	42.3
10/9/2008 13:12	31.0	33.9
10/9/2008 13:14	26.1	40.0
10/9/2008 13:17	26.7	30.1
10/9/2008 13:20	33.0	47.8
10/9/2008 13:22	27.1	31.6
10/9/2008 13:25	11.3	23.2
10/9/2008 13:28	13.0	ND
10/9/2008 13:30	30.2	54.1
10/9/2008 13:33	28.7	34.8
10/9/2008 13:36	26.3	59.4
10/9/2008 13:38	28.1	36.1
10/9/2008 13:41	20.7	31.6
10/9/2008 13:44	11.4	19.6

ND= not detected

Table I-9. Comparison of Carbon Monoxide and Alkane Mixture Concentrations from the 10/9/2009 14:05 to 14:34 Event

Time	Alkane Mixture Concentration (ppb)	Carbon Monoxide Concentration (ppb)
10/9/2008 14:05	7.55	ND
10/9/2008 14:08	5.05	ND
10/9/2008 14:11	7.76	ND
10/9/2008 14:13	22.3	34.8
10/9/2008 14:16	19.4	28.4
10/9/2008 14:19	13.5	ND
10/9/2008 14:21	20.1	30.7
10/9/2008 14:24	24.1	ND
10/9/2008 14:27	26.4	ND
10/9/2008 14:30	26.1	ND
10/9/2008 14:32	23.1	31.9

ND= not detected

APPENDIX J

Comments from The American Waterways Operators and Response to Comments by Sage Environmental.

The American Waterways Operators
www.americanwaterways.com

Midcontinent Office
1113 Mississippi Avenue
Suite 108
St. Louis, MO 63104

PHONE: (314) 446-6474
CELL: (314) 308-0378
Fax: (314) 446-6479
E-MAIL: lmuench@vesselalliance.com

Lynn M. Muench
Senior Vice President - Regional Advocacy

August 3, 2009

Dr. Eben Thoma
Office of Research and Development
National Risk Management Laboratory
U.S. Environmental Protection Agency
109 TW Alexander Drive
Research Triangle Park, NC 27711

RE: Suggested Revisions to EPA Report:
"Investigation of Fugitive Emissions from
Petrochemical Transport Barges using Optical
Remote Sensing"

Dear Dr. Thoma:

I would like to begin first by thanking EPA for allowing industry to peer review EPA's draft report entitled, "Investigation of Fugitive Emissions from Petrochemical Transport Barges using Optical Remote Sensing." As you well know, the members of The American Waterways Operators (AWO) have been and will continue to be proactive in addressing inadvertent tank barge emissions.

In 2006, AWO members created the Tank Barge Emissions Working Group (Working Group). The group has collaborated with the Louisiana Department of Environmental Quality (LDEQ), the Texas Commission for Environmental Quality (TCEQ), the Coast Guard and the Chemical Transportation Advisory Committee (CTAC) to implement necessary changes to mitigate inadvertent emissions. The group first developed Best Management Practices (BMPs) to reduce inadvertent emissions from tank barges in 2006. This document is not only an AWO member standard but was also cited in TCEQ's State Implementation Plan as an initiative that contributes to emissions reductions in Texas. To work towards continual improvement, the Working Group updated and improved the BMP in 2009 and forwarded the draft to CTAC for review. AWO also has a history of working closely with LDEQ. In April AWO formally partnered with the agency through a Memorandum of Understanding (MOU) to monitor emissions from tank barges in the Baton Rouge nonattainment area.

It is in the same spirit of proactive environmental stewardship that the Working Group reached out to EPA in March 2009 to request the opportunity for a peer review of the EPA Report. That review was granted on June 24, and representatives from the Working Group were invited to participate. On behalf of the Working Group, I would like to express our concerns with the LDEQ report prepared by Sage Environmental entitled, “Bagging Test Report: Barge Emission Measurement Project Final Report” (Bagging Test Report), included as Appendix H of the EPA Report. ***We believe that: 1) It is improper to extrapolate quantitative conclusions about tank barge emissions from such a small sample set, as was done on page 3 of the Bagging Test Report; and, 2) The methodologies employed to assess the emissions from the sample set cannot be accurately replicated.*** The Working Group suggests the following revisions.

Bagging Test Report

The Bagging Test Report states that “US EPA Protocol for Equipment Leak Emission Estimates 1995” (Appendix B of the LDEQ Bagging Test Report) was employed to measure the samples’ mass emissions. It also noted that the vacuum method was to be used exclusively. However, in reviewing the Bagging Test Report, the Working Group has come to the conclusion that the vacuum method was *not* used exclusively and, in fact, was not even employed properly. The Working Group has made the following observations regarding the Bagging Test Report:

- The vacuum method was only used for 8 of the 23 pieces of equipment sampled; 15 samples were not taken using the cited vacuum method and should therefore be considered invalid, as use of the sampling apparatus without the vacuum pump does not adhere to the prescribed method.

- In Appendix A of the Bagging Test Report it states that samples and/or pieces of equipment were tightened and/or manipulated in certain areas of the barge to increase the flow through other sample locations (i.e. hatches). This directly manipulated the piece of equipment prior to sampling and undoubtedly skewed the results.

- The aluminum summa canisters cited in the Bagging Test Report were used for multiple sample points so as to speciate emissions. Canisters should *not* have been used for multiple sample points across the barge, as this risks tainting the results of each sample analysis. To attain actual, valid results, one to three canisters should have been taken per sample point. We have concerns as to the type of bags employed and the way in which they were used during the study. The brand and type of bag is not referenced in the methods section of the report. The EPA Protocol suggests that impermeable material such as Mylar®, Tedlar®, Teflon®, aluminum foil, or aluminized Mylar® with a thickness ranging from 1.5 to 15 millimeters (mm) be used for the vacuum method. We are concerned that the samples may have reacted with the bagging material if the preceding materials were not used. Additionally, it is known that barge company personnel were asked to provide trash bags for sampling efforts and that these bags did not meet the minimum requirements of the EPA method as referenced above.

Also, we do not believe a correlation can be made between EPA’s Other Test Method (OTM 10) study, “Optical Remote Sensing for Emission Characterization from Non-Point Sources,” and the

LDEQ's bagging study for the following reasons: 1) Different barges/samples were used for the studies; 2) Meteorological conditions were not equivalent during the two studies; 3) The method of sample selection greatly differed between the two studies; and, 4) The EPA's OTM 10 study did not focus upon individual pieces of equipment like that of the LDEQ's bagging study.

The Working Group has significant concerns as to the lack of adherence to the cited method used to generate the data, the validity of the reported concentrations and the manner in which concentrations and observations were described. On behalf of the Working Group, ***I ask that the Bagging Test Report, Appendix H of the EPA Report, be removed and that all reference to the Bagging Test Report also be removed.***

Barge Identification/Company Identification

Additionally, AWO believes that it is inappropriate to single out a particular company by specifically referring to the company or unique barge number. These identification numbers are company specific and can be recognized. ***We ask that the barge identification numbers in Table 1 of the Bagging Test Report be removed.*** The identification numbers can simply be replaced with a sample number. ***We also request that any reference to specific company names be removed from the body of the main EPA Report, tables, and appendices.*** When the Working Group first reached out to EPA to request an opportunity to peer review this report, it was in the spirit of collaboration; and it is in that same spirit that I submit the suggested revisions on the Working Group's behalf. It is not in the best interests of either EPA or the tank barge industry to release a report with misleading or otherwise inappropriate data, and for this reason it is imperative that the concerns of the Working Group be reflected in the final EPA Report.

We greatly appreciate the opportunity to review and provide comments to the EPA on this draft. If you have any questions or would like further assistance in this matter please do not hesitate to contact me or any member of the Working Group.

Sincerely,

Lynn M Muench

Lynn M. Muench

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Sage Responses to the American Waterways Operators (AWO) Comments

AWO Comment: We believe that: 1) It is improper to extrapolate quantitative conclusions about tank barge emissions from such a small sample set, as was done on page 3 of the Bagging Test Report; and, 2) The methodologies employed to assess the emissions from the sample set cannot be accurately replicated.

Response to 1: Sage stated in our report that there is uncertainty in extrapolating emissions from the barge measurements. We did not assume that the measured emissions would continue at the same rate for 24 hours per day and 365 days per year. We assumed that the measured emissions would only take place during the daylight warming times of the day, which we assumed would be an annual average of 12 hours per day (longer in the summer and shorter in the winter). The testing took place in late September, but the weather was unseasonably cool for that time period. As a result, the measured emission rates would have been less than a summer measurement and more than a winter measurement. As a rough estimate (which we called it in the report), the emissions as measured were considered to be close to an annual average rate. We extrapolated these emission rates for 12 hours per day and 365 days per year to arrive at the 465 tons per year estimate. There are obviously a number of uncertainties in this estimate, which is why it was called a rough estimate, but it does help to put the potential emission rates of the barges measured into terms that allow comparison to stationary facilities. There are uncertainties in every measurement and estimate. It is not improper to make an estimate that includes uncertainty if those uncertainties are noted as they were in the Sage report.

Response to 2: Sage personnel have tremendous experience and credibility in performing emission measurements, including personnel on the barge test project that were personally involved in the development of the bagging methodology during the middle 1970s. The barge emission points are quite different than components in stationary facilities, so some of the materials and methods had to be adapted to this new type of measurement. All of the methods used during the barge testing have been used in prior EPA testing, such as in the natural gas plant work. These methods provide technically sound measurements that could be replicated with reasonable accuracy.

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AWO Comment: The Bagging Test Report states that “US EPA Protocol for Equipment Leak Emission Estimates 1995” (Appendix B of the LDEQ Bagging Test Report) was employed to measure the samples’ mass emissions. It also noted that the vacuum method was to be used exclusively. However, in reviewing the Bagging Test Report, the Working Group has come to the conclusion that the vacuum method was *not* used exclusively and, in fact, was not even employed properly.

Response: Sage and LDEQ had never intended to use the vacuum bagging method exclusively. The commenter may be confusing a statement that, when performing the bagging test, we would only use the vacuum method and not the blow-through method. The blow-through method is best suited for measuring default zero components, where the background VOC in ambient air would interfere with the low level measurements using the vacuum test. Sage and LDEQ had originally planned to use a number of measurement approaches, including the Hi-Flow Sampler™, the vacuum bagging method, direct dry gas meter (DGM) method, and a chimney/pitot tube method. A subcontractor, Heath Consultants, Inc, was to perform the Hi-Flow Sampler measurements, but they were unable to participate when the barge test was delayed because of Hurricane Ike. In hind sight, the Hi-Flow Sampler would not have been a good measurement tool for the barge emissions, since its high flow rate would have had the potential to over-estimate emissions by pulling emission from other points through the current test point. The chimney/pitot tube method was prepared for the field, but was not used because the vacuum bagging method and the direct DGM methods were able to accommodate the emissions encountered. The tests conducted were done using the vacuum bagging test and the direct DGM methods, both of which were conducted properly, with minor adjustments for the large sample points like hatches and stacks.

Comment: The vacuum method was only used for 8 of the 23 pieces of equipment sampled; 15 samples were not taken using the cited vacuum method and should therefore be considered invalid, as use of the sampling apparatus without the vacuum pump does not adhere to the prescribed method.

Response: The direct DGM method has been used in approved EPA testing for industries with large leaks, such as natural gas plants and compressor stations. Sage performed the direct DGM method using all the same equipment as the vacuum bagging test except for the pump. The direct DGM method was applied only where the bagged component was emitting at a rate faster than the pump could keep up with. The same component containment was used, the same flow measurement was used, the same temperature measurement was used, and the same pressure measurement was used for the direct DGM method as for the other components tested with the vacuum bagging method. The only difference is the component leak provided all the motive force for the flow measurement, which put the bag under positive pressure rather than the negative pressure of the vacuum bagging method. Having the bag under positive pressure would result in the leakage of gas around the bag seals, as well as displacement of leaks from the component being tested to other nearby leaking components. All factors that are different for the direct DGM test would cause a potential under-estimation, as was noted in the uncertainty discussion. The direct DGM method has not been written up as an EPA method, because it is

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based on fundamental physics: contain the leak, route it through a flow measurement device, measure temperature/pressure to allow conversion to standard conditions, convert to moles, and apply the concentration and molecular weight of each compound to calculate the emissions. There is no reason to discount the 15 samples done by the direct DGM method so long as it is understood that this measurement could be biased low and represents the lower bound of the actual emission rate.

Comment: In Appendix A of the Bagging Test Report it states that samples and/or pieces of equipment were tightened and/or manipulated in certain areas of the barge to increase the flow through other sample locations (i.e. hatches). This directly manipulated the piece of equipment prior to sampling and undoubtedly skewed the results.

Response: The barge operators made some attempts to stop or reduce leakage from points where our measurements were complete. This was done to try to fix the leaks, as well as to see to what degree leaks visible to the FLIR camera could be eliminated. Some of these actions were noted to increase leak rates from nearby components, which was noted by seeing an increase in visible leak plumes using the FLIR camera. Most repair attempts were done after we had moved to other areas or left the barge entirely. While these repair attempts add another layer of uncertainty to the measurements, they were few enough in number that they are likely to only partially offset the under-estimating inherent in the direct DGM bagging (as described in the previous response).

Comment: The aluminum summa canisters cited in the Bagging Test Report were used for multiple sample points so as to speciate emissions. Canisters should *not* have been used for multiple sample points across the barge, as this risks tainting the results of each sample analysis. To attain actual, valid results, one to three canisters should have been taken per sample point.

Response: LDEQ handled the sample collection in summa canisters and their analyses, but Sage can comment briefly on this. No canister was filled for more than one sample point on a barge. Based on the assumption that the vapor spaces of the compartments, the relief header, and the stack were all connected, the LDEQ personnel began to only take one summa canister sample for every few components tested on the same barge. Some of the early barges tested had a sample taken for component bagged, and these showed that concentrations were very close to the same from point to point on the same barge (see results for tests 3, 4, and 5 for example). While it is possible that the barge vapor space is not perfectly mixed, the uncertainty associated with this assumption should not prevent attaining valid results.

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Comment: We have concerns as to the type of bags employed and the way in which they were used during the study. The brand and type of bag is not referenced in the methods section of the report. The EPA Protocol suggests that impermeable material such as Mylar®, Tedlar®, Teflon®, aluminum foil, or aluminized Mylar® with a thickness ranging from 1.5 to 15 millimeters (mm) be used for the vacuum method. We are concerned that the samples may have reacted with the bagging material if the preceding materials were not used. Additionally, it is known that barge company personnel were asked to provide trash bags for sampling efforts and that these bags did not meet the minimum requirements of the EPA method as referenced above.

Response: The EPA Protocol is based on the work done over several decades at fixed facilities, and the materials recommended were based on what was reasonable for component sizes in stationary facilities. Materials such as Mylar, Tedlar, and Teflon were specified to minimize adsorption on the surface of the bag and diffusion through the bag. Sage brought supplies of Mylar to the test that had been sufficient for many previous tests at stationary facilities, but none were in sizes that would fit the large hatches and other large irregularly shaped components we faced on the barges. We shifted to use of heavy duty garbage bags to try to minimize the use of taped seams and poor conformance to irregular shapes that was noted for the heavier Mylar sheet. It is possible that surface adsorption occurred on the bag material, as it does to some extent regardless of the type of material. The components were bagged and allowed to fill the bag and emit for a period of time which allowed for a steady-state coating of bag surfaces to occur, which should minimize the effect of adsorption on the results. It is likely that more diffusion of hydrocarbons through the bag occurred with the polyethylene bags than would have happened with Mylar, but not necessarily more than through Mylar with multiple panels taped together and through crimped seals around the base of the hatches. The adaptation of large polyethylene bags was the best overall approach to bagging the extremely large components found on the barges. The flow rates through the bags (as measured with the dry gas meter) were high enough that reaction with the bag material should not have been a significant issue. If there were any reaction, it would have been as a solvent action reducing the thickness of the bag and allowing more diffusion. Again the measured results should be considered as a valid lower bound for actual emissions.

Response Summary: This was a first attempt to make measurements of vapor emissions from barges. We would likely approach the measurements somewhat differently based on the experience of that first test. Components in stationary facilities show very little difference in emission rate as a factor of pressure on the outside of the seal and the emission rates from one component are not affected by changes around a nearby component on the same line. Barge components, on the other hand, are very much affected by conditions on nearby components. The barges are mostly rated for 1 psi and will start to leak at the pressure relief valve even if all other potential leak points are sealed. The most valid way to make field measurements of total barge emissions would be to perfectly seal all emission points except the pressure relief valve, and then to measure the emission rate at the pressure relief valve. Unfortunately, it is not really possible to achieve perfect seals on all potential leak areas or to simultaneously measure all potential leak areas. An alternate approach in the future might be to use the TANKS software to model emissions from a barge as if it were an atmospheric storage tank(s).

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As might be expected in making the first set of measurements for a source category, there were a number of difficulties encountered, a number of adaptations to the Protocol methods, and many uncertainties. Taken as a whole, there are more uncertainties that indicate the emissions were under-estimated than that indicate over-estimation. The tests done should be considered a valid first attempt to measure a new source category and be interpreted roughly as a lower bound of the actual emissions.

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19 August 2009