United States Environmental Protection Agency
Office Of Air Quality Planning And Standards Research Triangle Park, NC 27711
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May 2000

Air

HOT MIX ASPHALT PLANTS

TECHNICAL SYSTEMS AUDIT of TESTING at PLANT C

ASPHALT PLANT C
LOS ANGELES, CALIFORNIA

EPA-454/R-00-026

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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Preface

This report was produced by the Source Measurement Technology Group of EPA's Emissions Measurement Center located in Research Triangle Park, NC. It is one of a series of twelve reports prepared to document an EPA emission test program to characterize emissions to the air from hot mix asphalt plants. These twelve reports and their associated EPA document numbers and publication dates are:

Document Title	EPA Document Number	Publication Date
Hot Mix Asphalt Plants Emission Assessment Report	EPA 454/R-00-019	
Hot Mix Asphalt Plants Kiln Dryer Stack Instrumental Methods Testing Asphalt Plant A, Cary, North Carolina	EPA 454/R-00-020	April 2000
Hot Mix Asphalt Plants Kiln Dryer Stack Manual Methods Testing Asphalt Plant A, Cary, North Carolina		
Volume 1 of 2	EPA 454/R-00-021a	April 2000
Volume 2 of 2	EPA 454/R-00-021b	April 2000
Hot Mix Asphalt Plants Kiln Dryer Stack Instrumental Methods Testing Asphalt Plant B, Clayton, North Carolina	EPA 454/R-00-022	April 2000
Hot Mix Asphalt Plants Kiln Dryer Stack Manual Methods Testing Asphalt Plant B, Clayton, North Carolina		
Volume 1 of 2	EPA 454/R-00-023a	April 2000
Volume 2 of 2	EPA 454/R-00-023b	April 2000
Hot Mix Asphalt Plants Truck Loading and Silo Filling Instrumental Methods Testing Asphalt Plant C, Los Angeles, California	EPA 454/R-00-024	May 2000
Hot Mix Asphalt Plants Truck Loading and Silo Filling Manual Methods Testing Asphalt Plant C, Los Angeles, California		
Volume 1 of 8	EPA 454/R-00-025a	May 2000
Volume 2 of 8	EPA 454/R-00-025b	May 2000
Volume 3 of 8	EPA 454/R-00-025c	May 2000
Volume 4 of 8	EPA 454/R-00-025d	May 2000
Volume 5 of 8	EPA 454/R-00-025e	May 2000
Volume 6 of 8	EPA 454/R-00-025f	May 2000
Volume 7 of 8	EPA 454/R-00-025g	May 2000
Volume 8 of 8	EPA 454/R-00-025h	May 2000

Document Title	EPA Document Number	Publication Date
Hot Mix Asphalt Plants Technical Systems Audit of Testing at Asphalt Plant C Asphalt Plant C, Los Angeles, California	EPA 454/R-00-026	May 2000
Hot Mix Asphalt Plants Truck Loading Instrumental Methods Testing Asphalt Plant D, Barre, Massachusetts	EPA 454/R-00-027	May 2000
Hot Mix Asphalt Plants Truck Loading Manual Methods Testing Asphalt Plant D, Barre, Massachusetts	EPA 454/R-00-028	May 2000
Hot Mix Asphalt Plants Response to Comments on Testing Program for Asphalt Plants C and D	EPA 454/R-00-029	May 2000
Hot Mix Asphalt Plants Stakeholders Opinions Report	EPA 454/R-00-030	

These documents, including this Response to Comments document, are available for downloading, on CD-ROM and in paper.

Downloads can be made from:

http//www.epa.gov/ttn/emc/asphalt.html

Copies of the CD ROM can be requested by mail at:

Emission Measurement Center, MD-19
US Environmental Protection Agency
Research Triangle Park, NC 27711

Paper copies of the reports can be obtained from:

National Technical Information Service
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Phone orders 1-800-553-6847 or (703) 605-6000; FAX orders (703) 605-6900
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Acknowledgments

Many individuals contributed to the development of this report. Laura Autry of EPA's Air Quality Trends Analysis Group, R.K.M. Jayanty of Research Triangle Institute (RTI) and Robert S. Wright of RTI are the primary authors of the report. David Mobley, Acting Director of EPA's Emissions Monitoring and Analysis Division, Conniesue Oldham of EPA's Air Quality Trends Analysis Group, Bill Lamason and Gary McAlister of EPA's Emission Measurement Center provided advice in resolving some findings identified by the RTI audit team.

Glossary

ASTM	–	American Society for Testing Materials
CO	–	Carbon Monoxide
CTS	–	Calibration Transfer Standard
EPA	–	United States Environmental Protection Agency
FID	–	Flame Ionization Detector
FTIR	–	Fourier Transform Infrared Spectroscopy
HAP	–	Hazardous Air Pollutant
MCEM	–	Methylene Chloride Extractable Particulate Matter or Organic Extractable Particulate Matter
MQL	–	Minimum Quantitation Limit
MRI	–	Midwest Research Institute
NIST	–	National Institute of Standards and Technology
NOx	–	Nitrogen Oxides
OAQPS	–	Office of Air Quality Planning and Standards
PAH	–	Polynuclear Aromatic Hydrocarbons
PES	–	Pacific Environmental Services, Inc.
PM	–	Particulate Matter
ppb	–	parts per billion
ppm	–	parts per million
QAPP	–	Quality Assurance Project Plan
RAP	–	Recycled Asphalt Pavement
RSD	–	Relative Standard Deviations
RTI	–	Research Triangle Institute
SED	–	Silo Exhaust Duct
SF6	–	Sulfur Hexafluoride
SO2	–	Sulfur Dioxide
SSTP	–	Site Specific Test Plan
SVOHAP	–	Semi-volatile Organic Hazardous Air Pollutant
THC	–	Total Hydrocarbons
TSA	–	Technical Systems Audit
VOHAP	–	Volatile Organic Hazardous Air Pollutant
VOST	–	Volatile Organic Sampling Train

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Chapter 1

Quality Assurance Audit Results
Hot Mix Asphalt Plant C,
Los Angeles, CA

1.0 QUALITY ASSURANCE AUDIT RESULTS

1.1 Overview

The United States Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards (OAQPS) is investigating hot mix asphalt plants to characterize emissions during silo filling and truck loading operations. In support of this investigation, OAQPS issued work assignments to Pacific Environmental Services, Inc. (PES) and Midwest Research Institute (MRI) to conduct emission testing of these sources. Additionally, due to the complexity and importance of this testing, OAQPS issued a work assignment to Research Triangle Institute (RTI) to perform an independent technical audit of MRI and PES's emissions testing through a technical review. RTI conducted the audit according to the principles of the EPA Office of Research and Development's Quality Assurance Division. These principles are described in their working draft of *EPA Guidance for Technical Assessments for Environmental Data Operations* (EPA QA/G-7).

The primary objective of the emissions testing was to characterize the uncontrolled emissions of particulate matter (PM), organic extractable particulate matter (methylene chloride extractable particulate or MCEM) and organic hazardous air pollutants (HAP's) from silo filling and truck loading operations at a hot mix asphalt production plant. The organic HAP emissions quantified included polynuclear aromatic hydrocarbons (PAHs), semi-volatile organic hazardous air pollutants (SVOHAPs), and volatile organic hazardous air pollutants (VOHAPs). Other emissions that were characterized included methane, carbon monoxide (CO), sulfur dioxide (SO2), and nitrogen oxides (NOx).

It was concluded from the technical systems audit that the overall quality assurance objectives of the test were met. Except for some minor deviations, the test team members performed the testing according to the procedures outlined in the Site Specific Test Plan (SSTP) and Quality Assurance Project Plan (QAPP). These deviations from the QAPP or SSTP were discussed with and approved by the EPA Work Assignment Manager. The equipment used was appropriate for the emissions testing and was operated satisfactorily during the testing.

1.2 Process Description

An asphalt plant located south of Los Angeles, CA, (also called Asphalt Plant C or Plant C), was selected as the host facility. Testing was performed over five consecutive days beginning on July 24, 1998. Testing of transport truck loading operations was performed under two conditions - normal operations and a background condition. Additionally, a secondary objective of the emission testing was to characterize controlled emissions of VOHAPs, CO, SO2 and NOx from the aggregate dryer.

This plant was selected for the emissions testing due to its high production rate, ventilation of the storage silos and enclosure/ventilation of the load-out bay. The Plant C facility has a rated production capacity of 650 tons per hour (tph). Daily production varies from approximately 2,000 tons per day (tpd) to 6,000 tpd depending on demand. The plant produces five different categories of hot mix asphalt: 3/8 in, 1/2 in, 3/4 in, fines, and recycled asphalt (RAP). These categories indicate the average size and type of aggregate in the mix. In RAP, small amounts of recycled asphalt are added to the mix. The plant also adds small amounts of rubber to some products as a crack inhibitor. The plant uses two different kinds of liquid asphalt: AR-4000 and AR-8000. AR-4000 is a softer asphalt and is used approximately 90% of

the time. The percent by weight of liquid asphalt in the mix varies from 4.8% to 6.0% depending on the size of the aggregate (the smaller the aggregate, the higher the liquid asphalt content).

The following paragraphs describe the three operations tested at Plant C.

1.2.1 Aggregate Processing Operations

In this continuous process, cold aggregate is introduced to the rotary drum dryer. As the drum rotates, the aggregates move toward the other end of the drum. The cold aggregate is first dried and then is heated as it moves through the drum. After exiting the dryer drum into a mixing drum, the heated and dried aggregate is mixed with the liquid asphalt cement and recycled asphalt pavement (RAP). A ventilation system exhausts the gases and condensed particulate from the rotary drum dryer through a baghouse and exhaust stack.

1.2.2 Silo Filling Operations

Hot mix asphalt produced in the aggregate processing operation is transported by bucket elevator into temporary storage silos. Plant C has five 200-ton heated silos that sit on top of the load-out tunnel. The silos serve as a holding station between production and the loading of the hot mix asphalt into transport trucks. Depending on customer requirements, a different product can be stored in each silo. The hot mix asphalt in storage can have a temperature up to 160° C (320° F). A 10" inside diameter ventilation duct exhausts the gases and condensed particulate from each of the five silos to an exhaust duct that ventilates the load-out tunnel.

1.2.3 Load-Out Operations

The hot mix asphalt is dropped from the storage silos into transport trucks within a load-out tunnel that is approximately 183 ft long with open doorways at both ends. During a full load-out schedule, trucks enter the tunnel approximately every one to three minutes. Single bed trucks hold approximately 21 tons of asphalt cement. Dual bed trucks (i.e., a truck and trailer) hold approximately 25 tons. Typically, the temperature of the asphalt cement, after it drops from the silo into the truck, is approximately 300° F.

The truck is positioned under the silo containing the desired product where it is loaded into the truck bed. During loading, emissions are captured by activating a double-slotted capture hood at each silo. With the truck positioned under the silo, one freestanding slot will be at the forward edge and one at the aft edge of the truck bed. No more than one silo can operate at a given time and only the capture hood associated with that silo is activated to capture the emissions. It typically takes 15 to 30 seconds to load a truck. One capture hood is always active, even when no loading is occurring. Each of the capture hoods connects to the 32 inch inside diameter tunnel exhaust duct. Constant flow is maintained by the fan setting, thus, a constant airflow is always exhausted from the load-out tunnel to the emission abatement system. The tunnel, ventilation system, and capture hoods work together to form a near-total enclosure for the loading operations. The selected test site, however, did not meet all of the criteria for a permanent total enclosure as defined by EPA Method 204, "Criteria for Verification of a Permanent or Temporary Total Enclosure," *Federal Register*, Vol. 62, No. 115, June 16, 1997.

1.3 Emission Testing

The emissions testing consisted of triplicate runs of the silo and load-out ventilation systems. Additionally, a fourth test run was performed using two trucks that traversed the load-out area like normal operations, while no loading was occurring to determine background emissions contributed by diesel truck exhaust. For all four test runs, capture efficiency testing of the load-out system was performed. The silo ventilation system was tested intermittently whenever silo loading operations occurred. Two test runs were performed on the dryer stack using only instrumental test methods. The three ventilation systems are referred to as the load-out system, the silo storage system, and the hot mix dryer system. The specific tests performed at each ventilation system are summarized below:

- The Load-out system was tested for HAPs, CO, SO2, and NOx, using extractive Fourier Transform Infrared Spectroscopy (FTIR) (EPA Method 320) and FTIR with sample concentration. Total hydrocarbons (THC) were measured using a flame ionization detector (FID) (Method 25A). A single SW-846 Method 0010 Modified Method 5 (MM5) sampling train was used to collect both PAHs and SVOHAPs. Three different procedures were used to measure VOHAPs: 1) sampling procedure SW 846 Method 0030 in combination with analytical procedure SW 846 Method 8260, 2) EPA Method 18, and 3) on-site GC/MS. During background testing no measurements were made using the on-site GC/MS.

- The Silo storage system was tested for HAPs, CO, SO2, and NOx, using extractive FTIR (EPA Method 320) and FTIR with sample concentration. Total hydrocarbons (THC) were measured using a flame ionization detector (FID) (Method 25A). A single SW-846 Method 0010 Modified Method 5 (MM5) sampling train was used to collect both PAHs and SVOHAPs. Three different procedures were used to measure VOHAPs: 1) sampling procedure SW 846 Method 0030 in combination with analytical procedure SW 846 Method 8260, 2) EPA Method 18, and 3) on-site GC/MS.

- The Hot mix dryer system was tested for HAPs, CO, SO2, and NOx, using extractive FTIR (EPA Method 320) and FTIR with sample concentration. Total hydrocarbons (THC) were measured using a flame ionization detector (FID) (Method 25A).

- Capture efficiency tests of the load-out system were also performed simultaneously with the load-out system tests. Tracer gas was released from a manifold in the load-out bay, was collected by the ventilation system, and air concentrations were measured, allowing capture efficiency to be calculated.

The responsibilities for this testing were divided between PES and MRI. The instrumental test methods were performed by MRI under the direction of Scott Klamm. The manual test methods were performed by PES under the direction of Frank Phoenix. Mike Toney of EPA was on site and overall responsibile for the testing.

1.4 Technical Systems Audit

The technical systems audit (TSA) was performed by R.K.M. Jayanty and Robert S. Wright of Research Triangle Institute (RTI) under EPA Contract 68-D4-0091, work assignment 99-03, from July

20, through July 26, 1998. The purpose of the audit was to conduct an independent technical assessment of MRI and PES's emissions testing through a technical review. The review included an in-depth evaluation of documents, on-site activities, equipment, procedures, record keeping, data validation, data management, and reporting to ensure that established requirements are satisfied. The TSA was conducted following principles described in a working draft version of *EPA Guidance for Technical Assessments for Environmental Data Operations* (EPA QA/G-7), which was being developed by EPA's Quality Assurance Division at the time. Detailed findings and Technical Systems Audit Checklists as revised by EPA for the tests performed by MRI and PES are presented in Chapters 2 and 3 respectively. Summaries of the findings and descriptions of the EPA revisions are presented below.

1.4.1 General Reviews

In general, RTI found that the PES and MRI team members performed the testing according to the procedures outlined in the Site Specific Test Plan (SSTP) and Quality Assurance Project Plan (QAPP). Deviations from the QAPP or SSTP were discussed with the EPA Work Assignment Manager. RTI's assessment proceeded after approval of the deviations. The equipment used was found by RTI to be appropriate for the planned emissions testing and generally operated satisfactorily during the testing. RTI found that the PES and MRI team members, who were present at the site, to be well qualified and experienced to perform the emissions testing and conducted themselves in a professional manner.

Although RTI's assessment of the performance of the testing by MRI and PES is valid, a few revisions of their findings were made. While most of the revisions were made to clarify the finding or eliminate unnecessary comments, one revision was made that altered the determination of the potential effect on Data Quality. Some of the items in the TSA checklist for PES were not completed by RTI due to lack of information available at the on-site operations. After the field test, RTI requested this information from PES, but it was not received by RTI by the date of their report to EPA. The checklist was completed based on the RTI auditors' observations during sampling and their discussions with the PES task manager, sampling train operators, custodians, and PES quality assurance (QA) coordinator at the site. Additional information on the calibration of the equipment in the laboratory prior to the on-site testing was requested, but had not been received by RTI. Examples of blank data sheets, custody forms, and labels have been supplied to the auditors and were included with the draft version of the checklist.

The following paragraphs describe the revisions that EPA made to the findings and technical system audit checklists RTI submitted to EPA on September 29, 1998.

1.4.2 Technical Assessment of MRI's Testing

RTI identified as a finding, which may have a potential effect on data, that besides all reports generated by this project being reviewed formally by senior project personnel, quality control data should be audited by the project's quality assurance officer. While the letter RTI received from MRI did not address the auditing of quality control data, MRI's standard procedures require a senior project person to review raw test data and to randomly select data to be followed through the analysis and data processing. In addition, EPA performed a quality control audit of the data and reproduced the calculations from raw data to final results. As a result, the clarifying statements by RTI were removed and this finding was changed to one that is unlikely to have a effect on data quality.

In the findings which are unlikely to have an effect on data quality table, wording of the third finding was changed to better characterize the level of detail used to describe the FTIR procedures without indicating the adequacy of the procedures. The complexity of the FTIR procedures precludes a description as detailed and thorough as most other methods. In the Technical Systems Audit Checklist, sentences were removed from items 3 and 10 of the Quality System Documentation. In Item 3, the sentence indicating the QAPP and SSTP were not revised has been deleted. In Item 10, the sentence was completed by stating that the THC calibration data was recorded on a legal pad.

1.4.3 Technical Assessment of PES's Testing

In the findings that may have a potential effect on data quality, items 1 and 2 were revised. A sentence was added to Item 1 explaining that this was a research study and that testing was not meant to have validation. This was the first attempt to measure many of the pollutants at these sources. It would be highly unusual and expensive to also attempt to validate the test methods at these sources without some prior knowledge of the performance of some initial testing. The paragraph for Item 2 discussing the spiking of surrogate compounds for the VOST cartridges has been completely revised to properly reflect that the analytical laboratory spiked compounds before transport to the field-testing location. The sentence identifying a better spiking methodology was removed.

In the findings that are unlikely to have an effect on data quality, Items 1 and 2 have been revised. In Item 1, the sentence identifying a better spiking methodology was removed. In Item 2 one sentence was revised and one was removed. This corrects an incorrect and contradictory statement in one sentence that a dedicated notebook was not maintained to record any problems or process changes.

In the Technical Systems Audit Checklist, a clarifying statement was added to the comment for Item 2 under General Quality Assurance Information indicating that key personnel provided sample train operators with information from the QAPP and SSTP as needed for their tasks.

Chapter 2

Technical Systems Audit
Instrumental Test Methods Performed by
Midwest Research Institute at
Hot Mix Asphalt Plant C,
Los Angeles, CA

2.0 TECHNICAL SYSTEMS AUDIT - MIDWEST RESEARCH INSTITUTE

This chapter is the final technical systems audit (TSA) of the emissions testing performed by Midwest Research Institute (MRI) at Hot Mix Asphalt Plant C in the Los Angeles, California area. As explained in detail in Chapter 1, the final TSA includes revisions by the EPA Quality Assurance Officer. The draft TSA report from Research Triangle Institute (RTI) was delivered to the EPA Quality Assurance Officer on September 29, 1998. The TSA was performed by R.K.M. Jayanty and Robert S. Wright of RTI under EPA Contract 68-D4-0091, work assignment 99-03, from July 20, through July 26, 1998. The purpose of the TSA was to conduct an independent technical assessment of MRI's emissions testing through a technical review, which included an in-depth evaluation of documents, on-site activities, equipment, procedures, and record keeping to assure that quality assurance requirements were satisfied. The TSA was conducted in accordance with principles described in the EPA Quality Assurance Division's working draft version of *EPA Guidance for Technical Assessments for Environmental Data Operations* (EPA QA/G-7).

In general, MRI did a very good job during the emissions testing at the hot mix asphalt plant. The emissions testing was executed according to the quality assurance project plan (QAPP) and the site-specific test plan (SSTP) to a large degree. The equipment that was used is appropriate for the planned emissions testing and it generally operated satisfactorily. The on-site project personnel were well-qualified to perform the emissions testing and conducted themselves in a professional manner.

Checklist Section	Findings which may have a Potential Effect on Data Quality
G3, G31	The sample concentrator method for the FTIR instrument does not appear to have been throughly validated or throughly documented. In 1993, Entropy Environmentalists conducted a method validation at a coal-fired boiler, which was published as EPA Report No. EPA/454/R-95/004, July 1993 (NTIS Order No. PB95-193199INZ). This method validation found that EPA Method 301 validation criteria were met for toluene and xylenes in concentrated samples. Pacific Environmental Services found these compounds during its preliminary measurements at the hot-mix asphalt plant. If MRI discovers significant concentrations of other chemical compounds in the asphalt plant emissions, then the report of MRI's emissions testing should note that the FTIR sample concentrator method has not been validated for these additional compounds, which it does.

Checklist Section	Findings which are Unlikely to have an Effect on Data Quality
A3	Some equipment and procedures that were used during the emissions testing in July differ from those documented in the QAPP, which was submitted to EPA in March. In many cases, these changes are documented in the SSTP. Some changes were made as recently as 3 weeks before the testing and are not documented in either document. Revisions and/or amendments to both documents should have occurred, according to procedures outlined within the QAPP.

Checklist Section	Findings which are Unlikely to have an Effect on Data Quality
A8	The total hydrocarbon (THC) analyzer's calibration data were recorded on a legal pad, rather that on a formal data sheet as was used for other measurements. Section 5.1 of the QAPP states that information will be entered in standard data forms.
A14	A letter from MRI to RTI indicates that all reports that are generated by this project will be reviewed formally by senior project personnel. It is assumed these reports did receive review by senior personnel.
A-Comments	The QAPP does not describe the FTIR procedures in a lot of detail. It cites EPA Test Method 320 and the FTIR Protocol, which are pretty general to describe the specifics of the data collection effort at the hot-mix asphalt plant.
F31	Test Method 320 specifies an accuracy of ±2% for the CTS. The CTS used for this study had an accuracy of ±5%. The concentration of the CTS was not independently verified by MRI.
F-Comments	QAPP Section 3.1.1 states that the time for 5 cell volumes to pass through the cell is considered the minimum interval separating independent samples. If the cell volume is 8.5 L, then 5 cell volumes corresponds to 42.5 L. If the FTIR sample gas flow rate is 5 L/min and the FTIR sample interval is 2.5 minutes, only 12.5 L (or 1.5 cell volumes) of sample gas passes through the cell between measurements. Therefore, an individual FTIR measurement cannot be considered to be completely independent of the measurements that immediately precede it. Scott Klamm confirms that it takes 3 to 4 samples to flush the cell for CTS measurements.
F-Comments	During the emissions testing, MRI analyzed a nine-component hydrocarbon calibration standard (Spectra Gases cylinder number CC91245) that had been brought to the hot mix asphalt plant by Emissions Monitoring, Inc. The analysis of this calibration standard does not constitute a performance evaluation of the extractive FTIR method because MRI was not informed of the analysis prior to the emissions testing nor during our initial on-site meeting on 20 July 1998. The results of the analysis were not available during the RTI assessor's conversation with MRI's Thomas Geyer on August 27, 1998. RTI suggests that the results of the MRI's analysis of this calibration standard be included in MRI's emissions testing report, which will allow EPA to compare the MRI analytical results with the attached certificate of analysis for the calibration standard.
G21	The SSTP indicates that a preheated vapor-phase surrogate spike will be loaded onto the Tenax cartridge via the sampling probe. The surrogate spike was actually loaded in the monitoring trailer at room temperature.
G25	A duplicate train sample was collected on 25 July 1998, but the FTIR sample spectrum was not saved. A second attempt to collect a duplicate train sample was scheduled for 27 July 1998 after the assessors departure. The results of the post sampling analysis of this sample were not available for review as of 27 August 1998.

Checklist Section	Findings which are Unlikely to have an Effect on Data Quality
H-Comments	There appear to be some errors in the draft THC calibration data the MRI submitted for review. The span drift data for stack dryer Runs 1 and 2 are identical, which is an unlikely occurrence. There appear to be errors in the calculated span drifts for Dryer Stack Run 1 and Load-out Run 1. These errors do not appear to be major problems.

Technical Systems Audit Checklist

Project:	Emissions Testing at a Hot Mix Asphalt Plant
Organization:	Midwest Research Institute (Kansas City, Missouri)
Assessment Location:	Asphalt Plant C, Los Angeles, California
Assessors:	Robert S. Wright and R.K.M. Jayanty, Research Triangle Institute (Research Triangle Park, North Carolina)
Assessment Dates:	July 20 through July 26, 1998

Brief Project Description: EPA is investigating hot mix asphalt plants to identify and quantify particulate matter and hazardous air pollutants (HAPs) emitted from asphalt cement load-out operations. EPA has issued a work assignment to MRI to conduct an air emissions test program to collect data in support of the investigation. Asphalt Plant C in Los Angeles, California was chosen primarily because load-out emissions are controlled by a silo exhaust system and a load-out tunnel. The plant has a production capacity of more 650 tons per day. Approximately 2,000 tons per 4 hour period were produced, during the test. The primary objective of the project was to characterize air emissions of organic HAPs from the storage silos, the load-out tunnel, and the hot mix dryer.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
A. QUALITY SYSTEM DOCUMENTATION				
1. Is there an approved quality assurance project plan (QAPP) for the project and has it been reviewed by all appropriate personnel?	✓			A QAPP was submitted to EPA on March 27, 1998. Additionally, MRI submitted a site-specific test plan (SSTP) on June 22, 1998. Both documents have been approved by EPA.
2. Is a copy of the QAPP maintained at the field site? If not, briefly describe how and where QA and quality control (QC) requirements and procedures are documented.	✓			Copies of the QAPP and SSTP are available in plain sight in the monitoring trailer. No one has been observed consulting these documents.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
3. Is the design and conduct of the project as is specified in the QAPP?	✓			In general, the project is being implemented as was specified in the QAPP. However, some equipment and procedures have changed since the QAPP was submitted to EPA. In many cases, these changes are documented in the SSTP. Some changes were made as recently as 3 weeks before the testing and are not documented. Revisions and/or amendments to both documents should have occurred, according to procedures outlined within the QAPP.
4. Are there deviations from the QAPP?	✓			There are some noticeable deviations, which do not appear to affect the quality of the data being collected. For example, QAPP Section 3.1.2 states that Tenax will be spiked with an analyte or surrogate compound during sample collection if practical. The sample concentration description in the QAPP also mentions a post-test, laboratory gaseous spiking procedure and other procedures. SSTP Section 5.1.3 states that a vapor phase spike will be preheated and injected into the back of the sampling probe. However, the surrogate spike gas was loaded onto the Tenax trap in the trailer prior to sampling using the cool thermal desorption system for the traps.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
5. How are any deviations from the QAPP noted?			✓	QAPP Section 6.3 indicates that the QAPP will be amended to correct minor discrepancies that have no effect on the overall conduct of the study. The QAPP presents a form for documenting such amendments. An entire chapter of the QAPP will be revised if major changes in the conduct of the study occur. However, no amendments or revisions have been submitted to EPA. Any deviations that arise before or during the testing should be documented.
6. For each measured parameter, does the QAPP list the frequency of calibration, acceptance criteria for the calibration, and the process for calibration data reduction and review?	✓			QAPP Table 2-1 and SSTP Table 5-2 give the calibration frequencies and accuracy and precision objectives for some field test methods. SSTP Table 5-1 lists the calibration frequencies, acceptance limits, reference standards, and calibration techniques for other methods.
7. Are written and approved standard operating procedures (SOPs) used in the project? If so, list them and note whether they are available at the field site. If not, briefly describe how and where the project procedures are documented.		✓		No SOPs were observed at the testing site. The Fourier transform infrared (FTIR) sample concentration procedure is attached to the QAPP. EPA test methods are cited and, in some cases, attached to the QAPP and SSTP (i.e., Methods 25A and 320 and the FTIR Protocol).
8. Briefly describe how calibration and other QC data are documented.			✓	Operational parameters and calibration data were recorded on paper data sheets and Excel spreadsheets except for total hydrocarbon (THC) analyzer's operational parameters and calibration data, which were recorded on a legal pad.
9. Does the calibration documentation show that calibrations are being performed at the required frequency and in the required manner??	✓			MRI calibration data indicates that the extractive FTIR instrument and the THC analyzer were calibrated at the required frequency and in the required manner.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
10. Are there standard paper or electronic forms to record calibration data and operational parameters?	✓			Standard paper data sheets and Excel spreadsheets were used for all measurements except the THC measurements, which was recorded on a legal pad.
11. Are the standard data forms dated?	✓			The forms have a line for the entry of the date.
12. Is the person who recorded the data identified on the form?	✓			The forms have a line for the entry of the operator's name.
13. Are any paper records written in indelible ink?	✓			All reviewed data forms were filled out in ink.
14. Are the QC data reviewed by another qualified person such as the QA officer or the project leader? Who is this individual?		✓		A letter from MRI to RTI indicates that Scott Klamm, Thomas Geyer, John Hosenfeld, Bruce Diel, and Jack Balsinger will review formally all reports generated by this project. However, there is no indication whether the raw QC data are reviewed directly by any MRI personnel.
15. Is the project team adhering to the planned schedule? If not, explain the new schedule. Verify that all schedule changes have been authorized.		✓		The schedule is being followed to the extent allowed by unexpected equipment breakdowns in the asphalt plant and FTIR instrumentation problems. All schedule modifications were authorized by the EPA Work Assignment Manager.
Additional Questions or Comments: The QAPP does not describe the FTIR procedures in enough detail. It cites EPA Test Method 320 and the FTIR Protocol, which are too general to describe the specifics of the data collection effort at the test site. For example, QAPP Section 2.2.1.1 states that ethylene in nitrogen will be used as the FTIR calibration transfer standard (CTS) and FTIR Protocol Section 4.5 gives selection criteria for the CTS. However, nowhere is it stated why ethylene in nitrogen was selected as the CTS for this project. A similar problem exists for selection of the Tenax trap surrogate spike gas.				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
B. ORGANIZATION AND RESPONSIBILITIES Identify the following personnel and determine whether they have the listed responsibilities:				
1. MRI Work Assignment Leader: John Hosenfeld (Kansas City, MO) • responsible for overall performance of the project, and • communications with EPA			✓	Mr. Hosenfeld was not present at the emissions testing.
2. MRI Quality Assurance Officer: Jack Balsinger (Kansas City, MO) • prepare QAPP • review and monitor QA activities			✓	Mr. Balsinger was not present at the emissions testing.
3. MRI Project Task Leader: Scott Klamm (Kansas City, MO) • responsible for the on-site emissions testing effort • supervision of all MRI on-site and off-site staff • communication with other on-site personnel.			✓	Mr. Klamm is also responsible for the FTIR instrument.
4. MRI FTIR Oversight: Thomas Geyer (RTP) • guidance for FTIR field data collection • direct spectral analysis effort			✓	Mr. Geyer was not present at the emissions testing, but was available for consultation by telephone. After testing was completed, he analyzed the FTIR spectra to identify compounds and quantify concentrations.
5. MRI FTIR Operators: Scott Klamm and Andy Page • operation of FTIR instrument and sample concentrator, • calibration of FTIR instrument and sample concentrator, and • recording operational parameters			✓	Mr. Klamm has primary responsibility for operating the FTIR instrument during the emissions testing.
6. THC Analyzer Operators: Bob Gulick and Bobby Edwards • operation of THC analyzer, • calibration of THC analyzer, and • recording operational parameters			✓	Mr. Edwards is also a gas sampling train operator.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
7. MRI SF_6 Tracer Gas Operator: Dan Neal • operation of SF_6 tracer gas release manifold			✓	Mr. Neal is also a gas sampling train operator.
8. Other MRI Testing Staff: Jim Surman and Pam Murowchick			✓	Mr. Surman is a gas sampling train operator. Ms. Murowchick collects process monitor data in the asphalt plant control room and alerts the SF_6 tracer gas operator of load-out tunnel activities.
9. EPA Work Assignment Manager: Michael L. Toney • oversight of emissions testing and problem solving • communication with all on-site personnel			✓	Mr. Toney was present throughout the entire testing program and coordinated the efforts of the emissions testing teams. He authorized all changes in testing schedule and procedures.
10. EPA QA Officer: Lara P. Autry • review and approve QAPP • review and approve QA activities			✓	Ms. Autry was not present at the emissions testing.
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
C. TRAINING AND SAFETY				
1. Does the FTIR instrument operator have special training or experience for the operation of the instrument?	✓			Mr. Klamm has 8 years experience with extractive FTIR and open-path FTIR in laboratory and field applications.
2. Does the THC analyzer operator have special training or experience for the operation of the instrument?	✓			Mr. Gulick has 10 years experience with emissions testing and 5 additional years of experience with analytical instrumentation.
3. Does the project maintain current summaries of the training and qualifications of project personnel?	✓			A letter from MRI to RTI includes brief resumes for project personnel.
4. Does the project maintain descriptions of assignment responsibilities?		✓		The QAPP contains descriptions of senior project personnel. A letter from MRI to RTI states that the responsibilities for other personnel were assigned in meetings before and during the project.
5. Is there special safety equipment required to ensure the health and safety of project personnel?	✓			The asphalt plant required personnel to wear hard hats while walking under conveyor belts.
6. Is each project team member appropriately outfitted with safety gear?	✓			Each team member wore safety shoes and a hard hat when outside of the trailer. Eye and ear protection were worn on an as-needed basis.
7. Are project personnel adequately trained for their safety during the performance of the project?	✓			Question not asked, but observation of the team members demonstrates that they were adequately trained about safety.
8. Who is authorized to halt emissions testing in the event of a health or safety hazard?			✓	The EPA Work Assignment Manager retained authority to halt emissions testing as necessary to protect health and safety.
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
D. DATA QUALITY INDICATOR GOALS AND PERFORMANCE TESTING				
1. Is the anticipated use of the data known and documented in the QAPP?	✓			The study objectives are briefly described in the QAPP.
2. What are the critical measurements?			✓	The QAPP describes extractive Fourier transform infrared (FTIR) spectroscopy, FTIR by sample concentration, and total hydrocarbons (THC).
3. Have data quality indicator goals for each critical measurement been documented in the QAPP?	✓			QAPP Table 2-1 presents accuracy and precision goals for direct and indirect FTIR, THC, moisture, temperature, velocity, oxygen, and carbon dioxide.
4. Do the above data quality indicator goals appear to be based on documented performance criteria for the measured parameter or on actual QC data compiled for the particular measured parameter?	✓			The accuracy and precision goals for extractive FTIR and THC are based on EPA Test Methods 320 and 25A. The accuracy and precision goals for FTIR by sample concentration are based on EPA Method 301 validation criteria from Entropy Environmentalists' 1993 method validation at a coal-fired boiler.
5. Has the performance of each of the critical measurements been assessed and documented?	✓			Calibration data for direct and indirect FTIR and THC were obtained and recorded on a daily basis.
6. Are there established procedures for corrective or response actions when measurement performance criteria or the data quality indicator goals (e.g. out-of-control calibration data) are not met? If yes, briefly describe them.	✓			The corrective action procedures are informal and are implemented on an as-needed basis. For example, problems with the FTIR instrument prompted a call to a FTIR consultant, who was able to provide suggestions for corrective actions.
7. Are the corrective action procedures consistent with the QAPP?	✓			QAPP Section 4.6 describes general corrective action procedures that are followed when problems occur.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
8. Have any such corrective actions been taken?	✓			A few minor corrective actions have been taken, but none were significant enough to halt work on the project or to involve the MRI work assignment leader or the MRI quality assurance officer.
Additional Questions or Comments:				
E. EXTRACTIVE SAMPLING SYSTEM				
1. Describe locations of the sampling ports.			✓	During the testing of the hot mix drying exhaust, the sampling ports were located at the baghouse exhaust stack approximately 10 feet below the outlet. The sample ports for the testing of the load-out tunnel were located in the exhaust ducting between Silos 1 and 2. The sampling ports for the testing of the silos were located in the exhaust ducting of Silo 2 between the silo vent and the damper.
2. Describe the sampling probes.			✓	The sampling probes were short, straight lengths (i.e., 1 to 2 feet) of stainless steel tubing that were connected to the particulate filters.
3. Are the sampling probes heated to prevent condensation?		✓		The sampling probes were located inside the sampling ports and remained at that those temperatures. The dryer baghouse exhaust temperature was approximately 260° C, the silo duct temperature was approximately 240° C, and the load-out tunnel exhaust was near ambient air temperatures.
4. Does each of the sample probes have a calibration valve assembly for sampling system bias tests?	✓			The sample probes have calibration valve assemblies for delivering calibration gas to the FTIR and THC instruments via the sampling lines.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
5. Describe the sampling lines.			✓	Two 100-foot lengths of Technical Heaters Model 22129-02-01-01 sampling line containing three Teflon® tubes were used between the dryer baghouse exhaust sampling port and the sampling pumps outside of the trailer. One tube conveyed sample gas, another tube conveyed calibration gas, and the third tube was not used. For the load-out tunnel and silo testing, one length of sampling line was used between the silo and load-out sampling ports and another was used between the load-out tunnel sampling ports and the sampling pumps. Two Teflon® tubes conveyed sample gas and the third tube conveyed calibration gas. A Furon Unitherm Model 220-666 sampling line containing three Teflon® tubes was used between the sampling pumps and the sample distribution manifold inside the trailer.
6. Are the sampling lines heated to prevent condensation?	✓			The sampling line is heated to 300° C using a control and display box in the trailer.
7. Describe any sample conditioning/moisture removal/dilution air system.			✓	There was no sample conditioning or dilution system.
8. Describe how the instrument operators switch from sampling from one location to sampling to another location.			✓	FTIR and THC instrument operators switch between sampling lines using valves in the sample distribution manifold.
9. Is any sample conditioning system maintained according to schedule?			✓	Not applicable.
10. Describe the particulate filter.			✓	A Balston particulate filter is contained in a stainless steel housing.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
11. Is the filter changed according to schedule?			✓	Question not asked. There did not appear to be enough particulate matter in the sample streams to require changing the filter.
12. Describe the sample pump.			✓	Two KNF Model UN035ST.11I diaphragm pumps with stainless steel heads.
13. Describe the sample flow control apparatus.			✓	The sample flow rate was controlled by a shutoff valve in the sample distribution manifold and it was 12 L/min. The FTIR instrument required a sample flow rate of 5 L/min and the THC analyzer required a flow rate of 2.5 L/min. All three flow rates were indicated by a flow meter in the manifold. These flow rates were not critical measurements and were not recorded on data sheets. A back-pressure regulator maintained the manifold pressure at 4 to 5 psig. Excess sample not used by the two instruments was discarded through the sample distribution manifold vent.
14. Describe how the total sample volume is measured.			✓	Not applicable.
15. Describe how the sample volume meter is calibrated.			✓	Not applicable.
16. When was the last time that the sample volume meter was calibrated?			✓	Not applicable.
17. Is the volumetric calibration traceable to NIST standards?			✓	Not applicable.
18. How is the gas meter temperature measured?			✓	Not applicable.
19. How is the gas meter thermometer calibrated?			✓	Not applicable.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
20. When was the last time that the gas meter thermometer was calibrated?			✓	Not applicable.
21. Is the thermometer calibration traceable to NIST standards?			✓	Not applicable.
22. How is the stack gas stream temperature measured?			✓	A Type-K thermocouple was mounted on the Pitot tube and was measured with an Omega Model HH81 digital thermometer.
23. How is the temperature sensor calibrated?			✓	The thermocouple was calibrated in a boiling water bath, an ice water bath, or a newly-acquired dry well and the calibration temperature was measured with an ASTM mercury-in-glass thermometer.
24. When was the last time that the temperature sensor was calibrated?			✓	24 March 1998
25. Is the thermometer calibration traceable to NIST standards?	✓			ASTM thermometers are traceable to NIST standards.
26. How is barometric pressure measured?			✓	Taylor aneroid barometer (Asheville, NC) with a 600-foot altitude correction. The asphalt plant is 540 feet above mean sea level.
27. How is the barometer calibrated?			✓	The aneroid barometer is compared to a Sargent-Welch Model S-4519 mercury column barometer.
28. When was the last time that the barometer was calibrated?			✓	14 July 1998
29. Is the barometric pressure calibration traceable to NIST standards?		✓		The mercury column barometer is generally considered to be a primary standard.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
30. Describe the sample manifold.			✓	Sample gas enters the sample distribution manifold where it is distributed by switching valves, shutoff valves, and flow meters to the FTIR and THC instruments. A back-pressure regulator maintains the pressure in the manifold. Excess flow is vented outside the trailer.
31. Describe the calibration gas manifold and associated calibration gas lines to the sample probe and sample manifold.			✓	Calibration gas enters the sample distribution manifold where it is distributed by switching valves, needle valves and flow meters either directly to the FTIR and THC instruments or indirectly to them via the sampling lines and the calibration valves on the sampling probes.
Additional Questions or Comments:				
F. EXTRACTIVE FOURIER TRANSFORM INFRARED (FTIR) INSTRUMENT				
1. Describe the extractive FTIR instrument. List the brand, model number, and serial number.			✓	KVB Analect (Irvine, CA) Model RFX-40 FTIR instrument with a glow-bar light source and a liquid-nitrogen-cooled mercury-cadmium-telluride (MCT) detector. The FTIR instrument has a 1 cm^{-1} resolution, 400 to 4400 cm^{-1} spectral range.
2. Does the instrument operate according to an EPA method?	✓			EPA Test Method 320

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
3. Describe the gas containment cell.			✓	Infrared Analysis Model D-22H variable pathlength White cell inside an Infrared Analysis G-5-22-V-BA-AU heated gas cell oven that was maintained at a temperature of 250° C. The light path was aligned with a laser. The pathlength was approximately 9 to 10 meters and was determined on a daily basis by measurement of the calibration transfer standard (CTS).
4. Is the pressure in the gas containment cell monitored?	✓			The cell pressure was monitored with an Edwards Model W60041111 Barocel pressure sensor with a 0 to 1000 mm Hg range. This sensor is calibrated annually at the factory and its readings were verified using the barometer.
5. Describe the sample lines between the sample distribution manifold and the gas cell.			✓	A 20-foot length of Technical Heaters sampling line connected the FTIR instrument to the sample distribution manifold. The sampling line was maintained at a temperature of 300° F.
6. How are FTIR data recorded (e.g., data acquisition system)? Briefly describe the system, giving its brand, model, and serial number.			✓	Interferograms and sample spectra were recorded on the hard drive of the personal computer running the FTIR software and on an external Iomega Jaz drive.
7. Does the data recording system have a provision for documenting operating parameters (e.g., resolution, pathlength, scan number, sampling time, etc.) for individual spectra? If not, are these parameters documented in some other manner?	✓			The data recording system recorded parameters (e.g., resolution) that were directly related to the operation of the FTIR instrument. Parameters (e.g., pathlength) that were not related to the operation of the FTIR instrument were recorded on a paper data sheet.
8. Is there a back-up for the data recording system?	✓			The external Iomega Jaz drive was the back-up data recording system.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
9. Can raw FTIR spectra be recovered from the backup?	✓			Interferograms and sample spectra could be recovered from the back-up data recording system.
10. Describe the routine sampling and analysis procedure for the instrument.			✓	Sample gas flowed through the gas containment cell on a continuous basis. The sample flow rate was 5 liters per minute. Over a 2- to 2.5-minute sampling interval, 100 interferometer scans were coadded. The FTIR instrument converted the coadded Interferograms into sample spectra.
11. What is the leak volume for the gas containment cell?			✓	Daily leak checks indicate that the cell leak rate meets the acceptance criterion of less than 4 %/minute.
12. What is the noise level in each analytical region?			✓	Typical noise levels range between 10^{-3} and 10^{-4}. On the morning of 22 July 98, the noise level was 10^{-4} in the 1000 to 1300 cm^{-1} spectral region in which volatile organic compounds (VOC) absorb light. In general, noise levels are dependent on sample moisture levels, which will vary from source to source.
13. What is the sample absorption pathlength for each analytical region?				The nominal pathlength is 10.5 meters. The actual pathlength was determined from measurements of the CTS. See Item G35 below.
14. What is the fractional analysis uncertainty for each analytical region?				The calculated uncertainty in the measured concentration of the CTS because of errors in the mathematical comparison of reference and sample spectra will be determined during the post sampling analysis phase of the project .
15. What is the calibration frequency?			✓	The CTS was measured at the beginning and end of each test. The sulfur hexafluoride (SF_6) calibration gas and the SF_6/toluene sampling bias check gas were measured daily.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
16. Describe the routine calibration procedure for the instrument.			✓	The gas containment cell was evacuated to a pressure of 10 mm Hg and then was filled to atmospheric pressure with the CTS. The mean CTS concentration across the entire project was compared with the certified value to determine the pathlength of the cell. The SF_6 standard was used for the capture efficiency tests. The SF_6/toluene sampling bias check was used to determine sampling line losses by comparing the ratio of direct FTIR measurements of the two compounds in the gas mixture with the corresponding ratio for measurements of the same gas mixture after it passed through the sample probe calibration valve and the sampling line.
17. Does the calibration documentation show that the calibration procedures are being followed?				A letter from MRI to RTI presents CTS calibration data which were collected several times each day. No SF_6 or SF_6/toluene calibration data were presented in the letter because they will be determined during the post sampling analysis phase of the project.
18. What is the sampling system bias according to the calibration documentation?				The SF_6/toluene calibration mixture is delivered to the calibration valve on the sample probe and directly to the FTIR instrument. The bias will be determined during the post sampling analysis phase of the project by comparison of the two sets of SF_6/toluene data.
19. How frequently are background spectra collected?			✓	Background spectra using pure nitrogen were collected at the beginning and end of the day. The first spectrum was used routinely for the entire day unless the second spectrum seemed to be more representative.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
20. Are emissions measurements corrected for background interference?	✓			Sample spectra were corrected for background interferences associated with the light source, the gas cell, and the detector.
21. How are compounds in the sample identified?			✓	Thomas Geyer will analyze sample spectra and will identify detected compounds after the completion of the testing using reference spectra or other spectroscopic analysis techniques.
22. What is the source of reference spectra and absorption coefficients for identified compounds?			✓	The EPA reference spectra database will be the primary source of reference spectra. Other spectral databases will be used if necessary.
23. What will be done for compounds without reference spectra?			✓	If MRI discovers significant, unidentified spectral features in the sample spectra, the EPA Work Assignment Manager will be consulted regarding whether these features are to be identified by laboratory measurements.
24. How will unidentified peaks be reported?			✓	The primary goal of the testing was not to identify all compounds in the sample spectra, but to determine the concentrations in the emissions of a specific list of hazardous air pollutants (HAPs) and other compounds.
25. How are concentrations calculated?			✓	QAPP Section 4.4 states that a K-matrix analytical procedure used uses sample spectra collected during the emissions testing and reference spectra for identified compounds from the EPA library to calculate a least-squares fit of the spectral features and to determine a concentration for each identified compound.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
26. What are the minimum detectable concentration for the compounds of interest?			✓	Scott Klamm estimated that the minimum detectable concentration ranges between 0.5 and 5 ppm depending on the compound. Thomas Geyer noted that the sensitivity limit is at low ppb-levels and the minimum quantitation limit (MQL) is in low ppm-levels for samples containing considerable amounts of water and carbon dioxide. For toluene and the xylenes, the MQL is estimated to be greater than the 100 ppb that was measured during preliminary testing.
27. Does the FTIR instrument have any spectral interferants for the compounds of interest?	✓			Water vapor and carbon dioxide are common analytical interferants in sample spectra.
28. How are the FTIR data corrected for analytical interferants?			✓	An integrated bag sample of the emissions was collected for each test run. The bag's moisture and carbon dioxide levels were determined with an Orsat analyzer. The measured levels were used to select appropriate water vapor and carbon dioxide reference spectra for use in sample spectra analysis by Thomas Geyer after completion of the field portion of the project.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
29. List the calibration transfer standards (CTSs) for the FTIR instrument			✓	The CTS was Scott Specialty Gases cylinder number ALM005893 containing 99.9 parts per million (ppm) ethylene in nitrogen. This gas mixture was analyzed on 31 March 1998. The SF_6 tracer calibration gas was Scott Specialty Gases cylinder number ALM033887 containing 0.205 ppm SF_6 in nitrogen. It was analyzed 7 April 1998. The sampling bias check gas was Scott Specialty Gases cylinder number AAL17264 containing 3.83 ppm SF_6 and 105 ppm toluene in nitrogen. It was analyzed on 7 April 1998.
30. Do the CTSs have appropriate gas mixtures and concentrations for the sample gas mixtures and concentrations?				FTIR Protocol Section 4.5.1 specifies that each analytical region lie within 25% of the CTS position. The CTS for this testing is a compressed gas calibration standard containing 100 ppm (±2 %) ethylene in nitrogen. This gas mixture was selected as the CTS because it has an light absorption line at 949 cm^{-1}, which meets the specification for SF_6 (942 cm^{-1}), toluene (727 cm^{-1}), and xylenes (740 to 797 cm^{-1}).
31. What is the analytical uncertainty of the CTSs?			✓	A letter from MRI to RTI presents certificates of analysis for CTS, SF_6, and SF_6/toluene calibration standards. All three standards have an analytical uncertainty of ±5%. Section 7.2 of Test Method 320 directs the analyst to "obtain a NIST-traceable, gravimetric standard of the CTS (±2 percent)".

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
32. Are the CTSs traceable to NIST SRMs or otherwise traceable to NIST? EPA Test Method 320 specifies that the CTS be a NIST-traceable gravimetric standard (± 2%).		✓		A letter from MRI to RTI states that the calibration standards are traceable to the specialty gas producer's primary reference standards, which are prepared using gravimetric procedures. These calibration standards are not traceable to NIST as NIST defines traceability for compressed gas standards. NIST does not have SRMs for this gas mixture.
33. Have the CTSs been independently verified by MRI?		✓		The calibration standards were not independently verified by MRI.
34. Are the CTS regulators and delivery system properly maintained?	✓			The pressure regulators and the associated gas handling equipment appear to be well-maintained.
35. What is the variation of successive CTS absorbency measurements relative to their mean value?			✓	A letter from MRI to RTI presents the CTS calibration data, which yielded a mean pathlength of 10.475 meters and a maximum deviation from the mean of 0.337 neters or 3.2% of the mean. These data meet the QAPP's precision specification of agreement to within ±%5 of the mean.
36. Is there a schedule of preventive maintenance for the FTIR instrument?		✓		The instrument is three years old and Scott Klamm indicated that it had not been serviced by a factory representative during that period. All maintenance is done on an as-needed basis.
37. Are calibration and maintenance logs kept for the FTIR instrument?		✓		Calibration data are recorded on data sheets, rather than in logbooks. There are no maintenance logs.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
38. Review any maintenance and operational records for the FTIR instrument. Based on these records, does the instrument appear to be in good operating condition?	✓			The FTIR instrument was manufactured by KVB Analect, which is located in Irvine, California. A factory service representative optimized the interferometer on 20 July 1998 in the presence of the assessors. The FTIR instrument appeared to be in good operating condition after it was optimized.
39. Are the manufacturer's operating manuals readily available to the FTIR instrument operators?		✓		Neither MRI's FTIR operator nor the KVB Analect factory service representative had a copy of the operating manual.

Additional Questions or Comments: QAPP Section 3.1.1 states that the time for 5 cell volumes to pass through the cell is considered the minimum interval separating independent samples. If the cell volume is 8.5 L, then 5 cell volumes corresponds to 42.5 L. If the FTIR sample gas flow rate is 5 L/min and the FTIR sample interval is 2.5 minutes, only 12.5 L (or 1.5 cell volumes) of sample gas passes through the cell between measurements. Therefore, a individual FTIR measurement cannot be considered to be completely independent of the measurements that immediately precede it. Scott Klamm confirms that it takes 3 to 4 samples to flush the cell for CTS measurements.

During the emissions testing, MRI analyzed a nine-component hydrocarbon calibration standard (Spectra Gases cylinder number CC91245) that had been brought to the hot mix asphalt plant by Emissions Monitoring, Inc. The analysis of this calibration standard does not constitute a performance evaluation of the extractive FTIR method because MRI was not informed of the analysis prior to the emissions testing nor during our initial on-site meeting on 20 July 1998. The results of the analysis were not available during the RTI assessor's conversation with MRI's Thomas Geyer on August 27, 1998. RTI suggests that the results of the MRI's analysis of this calibration standard be included in MRI's emissions testing report, which will allow EPA to compare the MRI analytical results with the attached certificate of analysis for the calibration standard.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
G. SAMPLE CONCENTRATOR FOR FTIR INSTRUMENT				
1. Describe the sample concentrator.			✓	Samples were concentrated for FTIR analysis by pulling source gas through two traps containing 20 grams of Tenax adsorbent. VOCs that were collected on the Tenax were desorbed by heating the trap to 220° C. Nitrogen flowing through the heated trap transferred the VOCs to an evacuated gas containment cell, which has a volume of 8.5 L. If the source gas flowed through the Tenax trap for 4 hours at a flow rate of 1.5 L/min, source gas samples were concentrated by a factor of about 42.
2. Does the concentrator operate according to an EPA method?		✓		The method is still experimental and has not been standardized as an EPA test method.
3. If it is not an EPA method, what documentation exists concerning laboratory and field validations of the concentrator?				See comment below Item G32.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
4. Have the validations involved the compounds of interest to this study?	✓			SSTP Section 4.1.2 states that preliminary measurements by Pacific Environmental Services (PES) at the asphalt plant indicated the presence of toluene and xylenes at concentrations below 100 ppb. The 1993 FTIR method validation report by Entropy Environmentalists included the following correction factors and relative standard deviations (RSDs) in concentrated samples: Compound / Correction Factor / RSD(%) toluene 0.83 10.31 m-xylene 0.78 4.85 p-xylene 1.16 14.25 For the method to be acceptable, the correction factor must be between 0.70 and 1.30 and the RSD must be < 50%. MRI does not plan to correct the indirect FTIR data for the surrogate spike gas collection efficiency.
5. Describe the sample lines between the sample distribution manifold and the concentrator.			✓	The sample concentrator was not connected to the sample distribution manifold. It was mounted on a separate VOST sampling train at the sampling port.
6. Describe how sample is drawn through the Tenax adsorbent trap.			✓	Source gas is pulled through the sampling probe, a 5-foot run of heated sampling line, an intake manifold, a condenser, one Tenax trap, a water drop-out trap, a second condenser, a second Tenax trap, and a Nutech Model 280/01BVOST pump box.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
7. What are the sample flow rate, sample duration, and sample volume?			✓	The sample flow rate was 1.5 L/min, the sample duration was 4 hours, and the sample volume was 360 L.
8. Describe how the flow rate is measured and controlled.			✓	A Matheson rotameter measured the sample flow rate and a needle valve controlled the flow rate.
9. Describe how the total sample volume is measured.			✓	A Single Model 802 dry gas meter in the VOST pump box measured the sample volume.
10. Describe how the sample volume meter is calibrated.			✓	The dry gas meter and the rotameter were calibrated by a wet test meter in three separate runs of 14 to 21 L each
11. When was the last time that the sample volume meter was calibrated?			✓	13 July 1998
12. Is the volumetric calibration traceable to NIST standards?				The wet test meter was calibrated on an annual basis with a calibrated water volume, which MRI considers to be a primary standard. A wet test meter calibration data sheet dated 2 May 1997 shows that it was calibrated according to ASTM Method D1071-83.
13. How is the first condenser's temperature measured?			✓	The temperature was measured with a Type-K thermocouple and a Omega Model HH81 digital thermometer.
14. How is the first condenser's thermometer calibrated?			✓	The thermocouple was calibrated with a boiling water bath, an ice water bath, or a recently-acquired dry well as appropriate. An ASTM mercury-in-glass thermometer was the reference standard.
15. When was the last time that the first condenser's thermometer was calibrated?			✓	24 March 1998
16. Is the thermometer calibration traceable to NIST standards?	✓			ASTM thermometers are traceable to NIST.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
17. How is Tenax cleaned prior to sampling?			✓	Precleaned Tenax was purchased for the emissions testing. Before a Tenax trap was used, it was further cleaned by being heated in the thermal desorber to 180° C for 1 hour while nitrogen removed any residual VOCs. The Tenax trap was then desorbed into the FTIR instrument and a blank spectrum for the cleaned trap was recorded.
18. Has the Tenax used in this project passed the 5-ppb THC pass/fail criterion for cleanliness?		✓		Cleanliness for cleaned Tenax traps was verified by field FTIR checks, rather than by laboratory FID checks, which are associated with the 5 ppb cleanliness criterion.
19. What is the surrogate spike gas?			✓	Scott Specialty Gases cylinder number ALM031809, 10.6 ppm toluene-d8 in nitrogen, analyzed 2 April 1998. The attached certificate of analysis lists the analytical accuracy of ±5%. Section 9.1 of Test Method 320 specifies the use of "a certified standard (accurate to ±2 percent) of the target analyte, if one can be obtained".

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
20. Does the surrogate spike gas have an appropriate gas mixture and concentration for the sample gas mixture and concentration?	✓			SSTP Section 5.2 states that toluene was chosen as the surrogate spiking gas based on results reported by PES from preliminary sampling conducted during their pretest site survey. These measurements indicated the presence of toluene and xylenes at concentrations below 100 ppb. Item G1 above determines the Tenax concentration factor to be 42. If the sample concentration method had been used during PES' preliminary measurements, the toluene concentration in the gas cell would have been less than 4.2 ppm. This calculated concentration differs from the surrogate spiking gas concentration by a factor of 2.5. Appendix D in the QAPP states that surrogate spiking gas concentrations should approximate the levels expected in the trap after sample collection.
21. How is the surrogate spike gas added to the sample?			✓	Approximately 1 gas cell volume of the surrogate spike gas was loaded onto the Tenax trap before sampling using the thermal desorber at ambient temperature. Note that this spiking procedure deviated from QAPP Section 5.1.3, which states that the vapor-phase spike will be heated and injected into the back of the sampling probe, similar to the Method 320 analyte spike procedure. This deviation was necessary because a VOST train was used to pull source gas directly from the source through about 5 feet of heated sample line into the Tenax trap.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
22. Describe any ambient air samples that are collected.			✓	An ambient air sample was collected on the morning of Wednesday, 22 July 1998 using VOST Control Box #3. The sample was collected at the load-out tunnel entrance where diesel trucks wait to be loaded.
23. Describe any train blanks that are collected.			✓	A train blank was collected in the trailer at the beginning of the emissions testing by passing 90 L (1.5 L/min for 1 hour) of nitrogen through the Tenax train
24. Describe any preliminary sampling that occurs.			✓	No preliminary sampling was conducted due to time delays at the beginning of the emissions testing due to asphalt plant equipment breakdowns.
25. Describe any duplicate train samples that are collected.			✓	A duplicate train sample was collected on 25 July 1998, but the FTIR sample spectrum was not saved. A second attempt to collect a duplicate train sample was scheduled for 27 July 1998 after the assessors departure. The results of the post sampling analysis of this sample were not available for review as of 27 August 1998.
26. Describe any breakthrough traps that are used in the sample train.			✓	A second Tenax trap was mounted downstream of the first trap to collect any VOCs that might break through.
27. Describe how Tenax samples are stored prior to analysis.			✓	Tenax traps were capped after sampling and then were stored on ice until they were analyzed.
28. How much time elapses between sampling and analysis of Tenax samples?			✓	In general, the Tenax traps are analyzed within an hour or two of the end of a test run. However, the traps of 24 July 1998 were not analyzed until 25 July 1998 due to the need to produce cleaned traps for the next day.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
29. How are Tenax samples identified?			✓	All Tenax traps had an engraved number on their bodies. Additionally, green sticky tape with the intended usage was attached to the traps after cleaning.
30. How is the sample desorbed from the Tenax and transferred to the gas containment cell?			✓	The FTIR gas containment cell was evacuated to a pressure of 10 mm Hg. The Tenax trap was heated to 220° C in the thermal desorber. A heated transfer line at 250° C was opened between the thermal desorber. Nitrogen carried the VOCs into the 8.5-L gas cell at a flow rate of 1 L/min until the cell returned to atmospheric pressure.
31. What current or previous data are available concerning the desorption efficiencies for the compounds of interest and the surrogate gas?			✓	The 1993 FTIR method validation report by Entropy Environmentalists included the following correction factors: toluene 0.83 m-xylene 0.78 p-xylene 1.16 For the method to be acceptable, the correction factor must be between 0.70 and 1.30 as per EPA Method 301. No information is available for the desorption efficiencies for other compounds that might be found in the asphalt plant.
32. What is the detection limit for the compounds of interest using the sample concentrator?			✓	The attached letter from MRI implies that sampling parameters were chosen to obtain minimum detectable concentrations of 100 ppb for toluene and xylene, which were identified by PES' preliminary measurements.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
Additional Questions or Comments: The sample for the morning of 22 July 1998 had an ambient air leak for an unknown period of time (10 minutes?) due to the first condenser separating from the inlet manifold. There is little documentation for the FTIR sample concentration method. The QAPP contains a fairly general discussion of the method that only briefly mentions the validations of the method. The validations were reported to EPA in project reports by Entropy Environmentalists and MRI. In 1993, Entropy performed a FTIR method validation at a coal-fired boiler. Multi component gas mixtures were spiked into boiler emissions, which were sampled by four parallel sample concentrators similar to the one used in this emissions testing. This method validation found that EPA Method 301 validation criteria were met for toluene and xylenes in concentrated samples. Pacific Environmental Services found these compounds during its preliminary measurements at the hot-mix asphalt plant. If MRI discovers significant concentrations of other chemical compounds in the asphalt plant emissions, then the report of MRI's emissions testing should note that the FTIR sample concentrator method has not been validated for these additional compounds. The 1993 tests used a KVB Analect Model RFX-40 FTIR instrument with a MCT detector and an Infrared Analysis Model 5-22H gas containment cell with a pathlength of 22 m. The sample volume was 280 L. The target gas mixture concentrations in the FTIR gas cell were 20 ppm. The CTS was 100 ppm ethylene in nitrogen.				
H. TOTAL HYDROCARBONS (THC) ANALYZER				
1. Describe the THC analyzer. List the brand, model number, and serial number.			✓	Two J.U.M. Engineering Model VE7 total hydrocarbon analyzers were used for the emissions testing. A third analyzer was rented when one of the original analyzers failed.
2. Does the THC analyzer operate according to an EPA method?	✓			EPA Test Method 25A
3. How are THC data recorded (e.g., data acquisition system)? Briefly describe the system, giving its brand, model, and serial number.			✓	THC data were recorded with a Winbook XP laptop computer with a data acquisition system docking station and Labtech Notebook software. Data were collected at 1-second intervals and 1-minute mean concentrations were stored on the computers hard drive.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
4. Does the THC data recording system have a provision for documenting changes in operating parameters? If not, are changes in operating parameters documented in some other manner?		✓		The data recording system collected the date and time, but not other operational parameters. Other parameters, including calibration data, were recorded on a legal pad.
5. Is there a hard copy back-up for the THC data recording system?	✓			A paper copy of data from the computer is printed by a Panasonic KX-P1180i printer.
6. Can THC data be recovered from the hard copy backup?	✓			Data would have to be reduced by hand from the paper copy.
7. Describe the sample lines between the sample distribution manifold and the THC analyzer.			✓	Approximately 6 feet of heated sampling line connect the sample distribution manifold to the THC analyzer. The sampling line was maintained at 300° C.
8. Describe how sample is drawn through the THC analyzer.			✓	A pump pulled sample into an oven heated to 300° C and through a sample filter at a flow rate of approximately 2.5 L/min. The pump pushed sample through a sample capillary into the flame ionization detector (FID). The excess sample was vented through a bypass capillary. A back-pressure regulator and a pressure gauge controls the sample pressure to approximately 200 millibar (or 3 psig) inside the instrument.
9. What is the sample flow rate and the bypass flow rate?			✓	The total sample flow rate was approximately 2.5 L/min and the flow rate into the FID was approximately 20 mL/min.
10. Describe how the flow rates are measured and controlled.			✓	The flow rates are controlled by the capillaries and the back-pressure regulator. The flow rates are not measured.
11. Describe how the flow rate meters is calibrated.			✓	Not applicable.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
12. When was the last time that the flow rate meters were calibrated?			✓	Not applicable.
13. List the flame ionization detector hydrogen (vendor, grade, etc.).			✓	Air Products cylinder number SGKK064 (40%hydrogen, 60% helium, analyzed on 11 June 1998).
14. List the flame ionization detector burner air (vendor, grade, etc.).			✓	Ambient air is drawn through a charcoal scrubber by an internal pump and hydrocarbons in the air are removed. Bob Gulick indicated that methane passes through the scrubber.
15. What is the THC analyzer calibration frequency?			✓	As per Method 25A, the THC analyzer is calibrated at the beginning of the test run and a drift check is done at the end of the run. Bob Gulick will do more frequent drift checks if he is concerned about possible drift during a test run.
16. Describe the routine THC analyzer calibration procedure.			✓	Calibration gas mixtures of varying concentrations (e.g., 0, 25, 50, and 90 ppm) are prepared in the Environics Model 2020 gas dilution system from a propane calibration standard and nitrogen. The calibration gas mixtures flow through the sample line to the calibration valve in the sample probe.
17. Does the THC analyzer calibration documentation show that the calibration procedures are being followed?	✓			The attached letter from MRI presents draft calibration data for the THC analyzer, which indicate that the calibration procedures were followed.
18. List the THC calibration gases (including zero gas).			✓	Air Products and Chemicals cylinder number SG9168085, 3690 ± 23 ppm propane in nitrogen (EPA Protocol Gas), analyzed by gas chromatography-FID on 5 August 1996.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
19. Do the THC calibration gases have appropriate gas mixtures and concentrations for the sample gas mixtures and concentrations?	✓			The THC calibration gas mixture is appropriate. The concentration is appropriate because the gas mixture is diluted by an Environics Model 2020 gas dilution system, whose flow meters were calibrated at the factory using a Sierra Cal Bench on 23 April 1998.
20. What is the analytical uncertainty of the THC calibration gases?			✓	The analytical uncertainty of the THC calibration gas is 23 ppm or 0.6 percent of the certified concentration. The specified uncertainty of the gas dilution system's flow rates is 0.5 percent.
21. Are the THC calibration gases traceable to NIST SRMs or otherwise traceable to NIST?	✓			The THC calibration gas is traceable via a 4723 ppm propane gas manufacturer's internal standard (GMIS), which is directly traceable to a NIST SRM.
22. Have the THC calibration gases been independently verified by MRI?		✓		An independent verification is not necessary because the THC calibration gas is an EPA Protocol Gas.
23. Are the THC calibration gas regulators and delivery system properly maintained?	✓			No problems were observed.
24. What is the THC analyzer calibration error according to the calibration documentation?			✓	The attached letter from MRI presents draft calibration data for the THC analyzer, which indicate that the calibration error ranged between 0.0% and 4.8%, which is less than the ±5% criterion specified in Test Method 25A.
25. What is the THC analyzer linear error according to the calibration documentation?			✓	Section 2.2.1.2 of the QAPP specifies a ±2% accuracy criterion for linear. However, this criterion does not appear in Test Method 25A and appears to be an error in the QAPP.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
26. What are the THC analyzer zero and calibration drifts according to the calibration documentation?			✓	The attached letter from MRI presents draft calibration data for the THC analyzer, which indicate that zero drift ranged between 0.0% and 1.0%, which is less than the ±3% criterion specified in Test Method 25A. Span drift ranged between 0.0% and 1.4%, which is less than the ±3% criterion.
27. What is the sampling system bias according to the THC analyzer calibration documentation?			✓	Section 2.2.1.2 of the QAPP specifies a ±5% accuracy criterion for systems bias. However this criterion does not appear in Test Method 25A and appears to be an error in the QAPP.
28. Is there a schedule of preventive maintenance for the THC analyzer?		✓		Maintenance is performed on an as-needed basis in MRI's laboratories and in the field.
29. Are calibration and maintenance logs kept for the THC analyzer?		✓		No logs are available.
30. Review maintenance and operational records for the THC analyzer. Based on your findings, does it appear to be in good operating condition?	✓			Visual Inspection of the two THC analyzers indicates that they were in good operating condition at the beginning of the project. See additional comment below.
31. Are the manufacturer's operating manuals readily available to the THC analyzer operator?	✓			The operator has a manual for the THC analyzer.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
Additional Questions or Comments: Something associated with emissions from the silo seemed to be damaging THC analyzers. Beginning on 23 July 1998, one THC analyzer sampled the load-out tunnel and another THC analyzer sampler the silo. On 24 July 1998, the silo THC analyzer's FID flamed out and could not be relighted. The remaining THC analyzer sampled both locations until early afternoon on 25 July 1998 when it also flamed out. A rental THC analyzer arrived at noon on 25 July 1998 and was used for the remainder of the day. The second THC analyzer's FID was baked at high temperature and appeared to be operational on 26 July 1998, although it was not used for that day's sampling. One hypothesis is that heavy hydrocarbons from the silo or their oxidation products may be clogging the FID burner tip. However, a 20 August 1996 e-mail message from a JUM Engineering representative to RTI indicates that a number of their THC instruments are operating at asphalt plants for raw emissions as well as for emissions after treatment. There appear to be some errors in the draft THC calibration data the MRI submitted for review. The span drift data for stack dryer Runs 1 and 2 are identical, which is an unlikely occurrence. There appear to be errors in the calculated span drifts for Dryer Stack Run 1 and Load-out Run1. These errors do not appear to be major problems.				
I. CAPTURE EFFICIENCY TEST				
1. Describe the apparatus for releasing the tracer gas.			✓	Tracer gas passes from a compressed gas cylinder through a pressure gauge and a mass flow meter to four sets of toggle valves and needle valves, which are set to deliver 4 L/min. Teflon® tubing goes from each needle valve to six critical orifices that are set at the base of one asphalt silo. Each critical orifice has a maximum flow rate of 0.8 L/min.
2. How is the tracer gas measured?			✓	Tracer gas is measured by the extractive FTIR instrument.
3. How does the tracer gas operator switch from one release point to another release point?			✓	The tracer gas operator uses the toggle valves to control silo at which tracer gas is being released. Information about which silo is being used is radioed to the operator from an observer in the asphalt plant's control room.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
4. Describe the tracer gas.			✓	Scott Specialty Gases cylinder number ALM013870, 1.99 percent sulfur hexafluoride (SF_6) in nitrogen (certified working standard), analyzed on 2 April 1998.
5. Does the tracer gas have an appropriate gas mixture and concentration for the capture efficiency test?	✓			If the load-out tunnel emissions control system has a flow rate of 15,000 dscm, the FTIR instrument will sample a SF_6 concentration of 0.19 ppm, which is easily detected by the extractive FTIR instrument with a 10-meter pathlength. The SF_6 calibration gas has a concentration of 0.205 ppm , which closely matches the sample's SF_6 concentration
6. What is the analytical uncertainty of the tracer gas?			✓	±5 percent
7. Is the tracer gas traceable to NIST SRMs or otherwise traceable to NIST?		✓		The tracer gas is traceable to the specialty gas producer's primary standards.
8. Has the tracer gas been independently verified by MRI?		✓		
9. Is the tracer gas regulator and delivery system properly maintained?	✓			The equipment appears to have been properly maintained.
10. What is the tracer gas flow rate?			✓	4 L/min
11. Describe how the tracer gas flow rate is measured and controlled.			✓	The flow rate is measured by a mass flow meter and is controlled by a needle valve.
12. Describe how the tracer gas flow rate meter is calibrated.			✓	The flow meter was calibrated with a Sierra Instruments Cal-Bench™ (serial number AN0125), which has a 1% accuracy.
13. When was the last time that the tracer gas flow rate meter was calibrated?			✓	30 April 1998

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
14. Is the tracer gas flow rate calibration traceable to NIST standards?	✓			The Sierra Instruments Cal-Bench™ automated primary gas flow calibration system is traceable to NIST length and time standards.
Additional Questions or Comments:				

Midwest Research Institute Standard Data Forms for Emissions Testing at a Hot Mix Asphalt Plant

C1717-37
Copy 2

DECLASSIFIED Date: 5/20/99 (S34-E21-01)

Copy 1

MIDWEST RESEARCH INSTI
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Telephone (816) 753
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August 14, 1998

SUBJECT TO CAA CONFIDENTIAL BUSINESS INFORMATION CLAIM
Does Not Contain National Security Information

Mr. Robert Wright
Research Triangle Institute
3040 Comwallis Road
Post Office Box 12 194
Research Triangle Park, NC 27709

Dear Mr. Wright,

Enclosed are responses to your request for technical information related to the technical system audit of the recent emissions testing at a hot-mix asphalt plant performed by Midwest Research Institute (MRI). In attempting to respond to your need for timeliness of a draft report (August 21), all issues easily completed have been included in this response. Several issues, however, cannot be completed at this time, and are expected to be available through our report to EPA, which is due by September 30, 1998. These issues have been appropriately marked in the following list. I have also included your original references to "checklist section" for clarity.

1. (A9) Raw quality control/calibration data sheets and/or calculated calibration data for the FTIR instrument (e.g. CTS, SF6, or SF6/toluene measurements) and the total hydrocarbon instrument (e.g. calibration error, linearity error, zero and calibration drift, sampling system bias.

   Both the FTIR and THC met all calibration requirements during the test program, FTIR pathlength determination and CTS calculations are attached. Criteria for pass/fail for the CTS spectra are +/- 5%, which all of the CTS spectra met. SF6/toluene determinations are not yet complete, but will be included in the final report.

   THC calibration error, zero drill and calibration drift calculations are also attached. The THC analyzer met all criteria, which include +/- 5% for calibration error, and +/- 3% for zero drift and calibration drift. Procedures followed EPA Method 25A, which requires calibrations through the sample line. Thus, there are no other linearity or system bias checks associated with this method.

   Note that the attached data have not been finalized and approved by MRI's QA procedures and have been stamped as "Draft."

24. (H18) A copy of the certificate of analysis for the THC analyzer's calibration gas and information about its analytical uncertainty, traceability, and any independent concentration verifications.

    The THC calibration gas certificate of analysis is attached. The gas is an EPA Protocol gas, and meets all requirements of that certification.

25. **(H18)** Information about the annual factory calibration of the Environics Model 2020 gas dilution system and any field evaluations according to EPA Test Method 205.

    Calibration records for the Environics gas dilution system are attached

26. **(H30)** Information about any maintenance logs for the THC analyzer

    THC maintenance is performed on an as needed basis in MRI's laboratories and in the field. No other maintenance logs are available.

I hope you find the attached information helpful and allow you to complete those sections of your audit. If you have additional questions, please feel free to call me at 816-753-7600, ext. 1228.

Sincerely,

MIDWEST RESEARCH INSTITUTE

Scott W. Klamm

Scott W. Klamm
Environmental Engineer

cc: J. Hosenfeld
J. Balsinger
T. Geyer
M. Toney

2. (A10) Blank copies of data sheets used for recording load-out operations data and tracer gas release data.

   Blank copies of data sheets used for recording load-out operations data and tracer gas release data are attached.

3. (A14) Identification of any MRI personnel performing reviews of QC data from the emissions testing.

   MRI has a formal review process for all reports generated under this contract. The review process includes a review and signature requirement by the Work Assignment Leader, Program Manager, and Senior Quality Assurance Officer. Specific to this project, these individuals would be Mr. Scott Klamm (Field Team Leader), Dr. Tom Geyer (FTIR Oversight), Mr. John Hosenfeld (Work Assignment Leader), Dr. Bruce Diel (OPPT Program Manager), and Mr. Jack Balsinger (Senior Quality Assurance Officer). These individuals are in accordance with the organizational chart (Figure 1-1) of the QAPP.

4. (C3) Information about any current summaries (e.g. training files) of the training and qualifications of each project team member.

   MRI maintains a file of personnel resumes and curriculum vitae for each project team member detailing their experience and qualifications. Single page summaries for each team member are attached.

5. (C4) Information about any descriptions of individual project team member responsibilities.

   Individual project team member responsibilities are briefly summarized in the QAPP, Section 1.4. Specific responsibilities not described in the QAPP were assigned at MRI project coordination meetings prior to the field phase, and were updated on a daily basis during the field effort

6. (D4) Information about the source (e.g. documented performance criteria or actual QC data) for the data quality indicator goals for the sample concentration FTIR method.

   This comment will be addressed in the report

7. (F12) Information about noise levels for each FTIR analytical region

   As demonstrated to RTI in the field, RMSD noise levels in the sample spectra were on the order ofO.OOO1 absorbance units in the 1000-1300 wavenumber region, In the report, RMSD in the residual (subtracted) spectra will also be calculated (i.e. after analysis).

8. (F13) Information about sample absorption pathlengths for each FTIR analytical region.

   The average pathlength for the test program was determined from the daily CTS spectra, and is included in the CTS stability calculations described earlier in Item 1, and contained in the attachment for Item 1. These preliminary pathlengths were calculated from raw field parameters and are subject to revision in the report,

9. (F14) Information about fractional analysis uncertainties for each FTIR analytical region.

   This comment will be addressed in the report.

10. (F25) A description about how analyte concentrations are quantitated from FTIR absorption spectra.

    These procedures are outlined in EPA Method 320 and the FTIR Protocol included in the QAPP. Specific aspects of the analyses and deviations from the methods will be included in the report.

11. (F26) Information about minimum detectable concentrations for the compounds found during the emissions testing by the extractive FTIR method.

    A summary of minimum detectable concentrations for non-detects will be included in the report

12. (F29) A copy of the certificates of analysis for the CTS, the SF6, and the SF6/toluene standards.

    Copies of certificates of analysis for the CTS, SF6, and SF6/toluene gases have been attached.

13. (F30) Information relating to the basis for selection of the CTS gas mixture and concentration relative to the selection criteria given in Section 4.5 of the FTIR Protocol.

    Ethylene has been used as a CTS gas on numerous EPA test programs, and meets the criteria given by the FTIR Protocol.

14. (F3 1) Information about the uncertainty of the analysis of the CTS, the SF6, and the SF6/toluene standards.

    Analytical accuracy for each of these gas standards is contained on their respective certificates of analyses. All are listed as +/- 5%.

15. (F32) Information about the traceability of the analysis of the CTS, the SF6, and the SF6/toluene standards to NIST.

    Scott Specialty Gases uses gravimetric procedures to generate their gas standards. They do not claim NIST traceability, but, rather, are certified by their own internal calibrations and standard procedures.

16. (F33) Information about any independent concentration verifications of the CTS, the SF6, and the SF6/toluene standards by MRI.

    See Items 14 and 15, above

17. (F34) Information about the variability of successive CTS measurements.

    Variability of successive CTS measurements will be included in the report, and can be seen from the calculations presented earlier in Item 1. The CTS measurements met the Protocol requirements of +/- 5% precision.

18. (F37) Information about any maintenance logs for the FTIR instrument

    CTS stability is the primary indicator of instrument operations. When necessary, FTIR maintenance is performed on an as needed basis in MRI's laboratories and in the field. For this particular test program, the instrument was serviced by an Analect representative on July 20, was found to be in good working order, and did not require any corrective actions.

19. (G3) Information about any Entropy Environmentalists or MRI laboratory or field validations of the sample concentration FTIR method for the compounds found during the emissions testing.

This information was provided to RTI while in the field (Fourier Transform Infrared Method Validation at a Coal-tired Boiler, Entropy Environmentalists, July 1993, published by EPA in 1994).

20. (G12) Information about the calibration traceability of the wet test meter used to calibrate dry gas meters in the VOST sampling trains associated with the sample concentration FTIR method.

MRI calibrates the dry gas meters versus a wet test meter located at our Kansas City laboratories, The wet test meter is calibrated according to the displacement method and is, therefore, considered a primary standard. Calibration records for the wet test meter and the VOST consoles are kept on tile and are available upon request.

21. (G19) A copy of the certificate of analysis for the toluene-d8 surrogate spiking gas and information about its analytical uncertainty, traceability, and any independent concentration verifications.

A copy of the toluene-d8 certificate of analysis is attached. The gas is certified to +/- 5%.

22. (G3 1) Information about any Entropy Environmentalists or MRI laboratory and/or field determinations of the collection and desorption efficiencies of the sample concentration FTIR method for the compounds found during the emissions testing.

See Item 19. above.

23. (G32) Information about minimum detectable concentrations for the compounds found during the emissions testing by the sample concentration FTIR method.

Minimum detectable concentrations for this method are, by nature, dependent upon the compound and sampling parameters, and will be estimated in the report. For this test, sampling parameters were chosen to obtain 100 ppb of toluene and xylene, which were identified by PES in a preliminary screening.

Attachment 1

Item 1 (A9)

CTS Pathlength and % Difference Calculations

Filename	ctspath	Temp. (C)	Pathlength (m)	% Diff.
c0721b	2.7207	124	10.812	3.22
c0721c	2.6321	124	10.460	-0.14
c0721d	2.6718	124	10.618	1.37
c0721e	2.6181	124	10.404	-0.67
c0722a	2.6234	124	10.425	-0.47
c0722b	2.6280	124	10.444	-0.30
c0723a	2.6131	124	10.364	-0.86
c0723b	2.6162	124	10.397	-0.74
c0723c	2.6420	124	10.499	0.24
c0724a	2.6242	124	10.429	-0.44
c0724b	2.6536	124	10.545	0.68
c0725a	2.6122	124	10.381	-0.89
c0725b	2.6247	124	10.430	-0.42
c0725c	2.6582	124	10.564	0.85
c0726a	2.6390	124	I0.487	0.12
c0726b	2.6378	124	10.483	0.08
c0727a	2.6220	124	10.420	-0.52
c0727b	2.6268	124	10.439	-0.34
c0727c	2.6283	124	10.445	-0.28
c0727d	2.6234	124	10.425	-0.47
		Average =	10.475	

Pathlength is based on use of a 99.9 ppm ethylene standard.
% Difference is based on the average calculated pathlength.

Run 1 - Dryer Stack - 7/21/98

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC	0.0	0.0	0.0	Pass
	90.3	90.2	0.1	Pass
	50.2	50.9	1.4	Pass
	25.0	25.0	0.0	Pass

Instrument Span for THC is 100 ppm
Pass/Fail Criteria is +/- 5% of Cal Gas for THC

Zero Drift

Initial Value	1 st Drift Check Value	Difference As % Error	Pass/Fail
0.0	0.3	0.3	Pass

1 st Drift Check Value	Final Value	Difference As % Error	Pass/Fail
0.3	0.3	0.0	Pass

Span Drift

Initial Value	1 st Drift Check Value	Difference As % Error	Pass/Fail
90.2	89.9	0.7	Pass

1 st Drift Check Value	Final Value	Difference As % Error	Pass/Fail
89.9	89.5	0.4	Pass

Run 2 -Dryer Stack - 7122198

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC	0.0	0.2	0.2	Pass
	90.3	90.1	0.2	Pass
	50.2	50.6	0.8	Pass
	25.0	25.6	2.4	Pass

Instrument Span for THC is 100 ppm
Pass/Fail Criteria is +/- 5% of Cal Gas for THC

Zero Drift

Initial Value	1 st Drift Check Value	Difference As % Error	Pass/Fail
0.2	-0.1	0.3	Pass

1 st Drift Check Value	Final Value	Difference As % Error	Pass/Fail
-0.1	0.3	0.4	Pass

Span Drift

initial Value	1 st Drift Check Value	Difference As % Error	Pass/Fail
90.2	89.9	0.7	Pass

1 st Drift Check Value	Final Value	Difference As % Error	Pass/Fail
89.9	89.5	0.4	Pass

Run 1 - Load Out - 7/23/98 (aborted)

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC Silo	0.0	3.6	0.4	Pass
	899.0	900.0	0.0	Pass
	498.0	504.0	1.2	Pass
	249.0	256.0	2.8	Pass

Instrument Span for THC Silo is 1000 ppm

Pass/Fail Criteria is +/- 5% of Cal Gas for THC

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC Tunnel	0.0	0.2	0.2	Pass
	90.4	90.2	0.2	Pass
	50.2	49.8	0.8	Pass
	25.0	27.7	1.2	Pass

Instrument Span for THC Tunnel is 100 ppm

Pass/Fail Criteria is +/- 5% of Cal Gas for THC

Zero Drift

	Initial Value	Final Value	Difference As % Error	Pas&Fail
THC Silo	0.0	9.8	1.0	Pass

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Tunnel	0.0	0.5	0.5	Pass

Span Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Silo	900.0	914.0	1.4	Pass

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Tunnel	90.2	89.7	0.5	Pass

Pass/Fail Criteria for Drift is +/-3% of THC Span

Run 1 - Load Out - 7124198

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC	0.0	1.2	0.1	Pass
	899.0	905.0	0.7	Pass
	498.0	508.0	2.0	Pass
	249.0	246.0	1.2	Pass

instrument Span for THC Silo is 1000 ppm

Pass/Fail Criteria is +/- 5% of Cal Gas for THC

Zero Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC	1.2	-0.2	0.1	Pass

Span Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Silo	905.0	907.0	0.0	Pass

Pass/Fail Criteria for Drift is +/-3% of THC Span

Run 2 - Load Out - 7/25/98

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC	0.0	1.7	0.2	Pass
	899.0	902.0	0.3	Pass
	498.0	506.0	1.6	Pass
	249.0	254.0	2.0	Pass

Instrument Span for THC is 1000 ppm

Pass/Fail Criteria is +I- 5% of Cal Gas for THC

Zero Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
I-HC	1.7	2.0	0.0	Pass

Span Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Silo	902.0	900.0	0.0	Pass

Pass/Fail Criteria for Drift is +/-3% of THC Span

Intermittant Load Dump - 7/25/98

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC	0.0	0.2	0.2	Pass
	90.4	90.7	0.3	Pass
	50.2	50.9	1.4	Pass
	25.0	25.7	2.8	Pass

Instrument Span for THC is 100 ppm

Pass/Fail Criteria is +/- 5% of Cal Gas for THC

Zero Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC	0.2	0.4	0.2	Pass

Span Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Silo	90.7	90.4	0.3	Pass

Pass/Fail Criteria for Drift is +/-3% of THC Span

Run 4 - Baseline - 7126198

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC	**0.0**	0.2	0.2	Pass
	90.3	90.5	0.2	Pass
	50.2	51.1	1.8	Pass
	25.0	25.5	2.0	Pass

Instrument Span for THC is 100 ppm

Pass/Fail Criteria is +/- 5% of Cal Gas for THC

Zero Drift

Initial Value	1 st Drift Check Value	Difference As % Error	Pass/Fail
0.2	**0.1**	**0.1**	**Pass**

1st Drift Check Value	Final Value	Difference As % Error	Pass/Fail
0.1	**0.1**	**0.0**	**Pass**

Span Drift

Initial Value	1st Drift Check Value	Difference As % Error	Pass/Fail
90.5	**90.4**	0.3	Pass

1st Drift Check Value	Final Value	Difference As % Error	Pass/Fail
90.4	**90.8**	0.4	Pass

Run 3 • Load Out • 7/23/98

DRAFT

Calibration Error Determination

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC Silo	0.0	1.1	0.1	Pass
	899.0	907.0	0.9	Pass
	498.0	504.0	1.2	Pass
	249.0	260.0	4.0	Pass

Instrument Span for THC Silo is 1000 ppm

Pass/Fail Criteria is +/- 5% of Cal Gas for THC

	Cal Gas Value	Measured Value	Difference As % Error	Pass/ Fail
THC Tunnel	0.0	0.2	0.2	Pass
	90.4	90.4	0.0	Pass
	50.2	50.9	1.3	Pass
	25.0	25.5	2.0	Pass

Instrument Span for THC Tunnel is 100 ppm

Pass/Fail Criteria is +/- 5% of Cal Gas for THC

Zero Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Silo	1.1	-0.1	0.1	Pass

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Tunnel	0.2	0.1	0.1	Pass

Span Drift

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Silo	907.0	903.0	0.0	Pass

	Initial Value	Final Value	Difference As % Error	Pass/Fail
THC Tunnel	90.4	90.6	0.2	Pass

Pass/Fail Criteria for Drift is +/-3% of THC Span

DRAFT

Response Times

Analyzer	Response Time
THC Silo	1 min. 25 sec.
THC Tunnel	35 sec.
THC Dryer Stack	1 min. 30 sec.

Attachment 2

Item 2 (A10)

Load-Out Log Spreadsheet

Sheet __ of

Mn Project No 4701-08-03-04 Run No.

Client/Source Date

Data Recorded By

Product ID	Product Description	Job Name	Time Of Loading	Actual Tons Loaded	Truck No	Silo No.	Mix Temp. in Truck	Comments

SF6 Gas Delivery data Spreadsheet

Sheet ____ of ____

Mri Project No: 4701-08-03-04

Client/Source: ____

Sampling Location: PTE Loadout

Dry Gas Meter No: ____

Run No: ____

Date: ____

Operator: ____

Gas Cylinder No: ____

Time	Silo No.	DGM Reading	Pres. PSI	Comments

Attachment 3

Item 4 (C3)

Thomas J. Geyer

Principal Chemist

Dr. Geyer specializes in molecular spectroscopy, FTIR test method development and validation, EPA protocol development, FTIR data analysis, analytical software development, and project management. Dr. Geyer has developed EPA FTIR applications for emissions testing in the field and managed the first field evaluation of an FTIR continuous emission monitoring system for measuring HAPs. He has led many field test programs and developed analyte spiking procedures for hazardous air pollutants (HAPs). Dr. Geyer helped develop the EPA FTIR analytical protocol to measure reference spectra and to apply spectra for field measurements.

Recently, Dr. Geyer developed FTIR test Methods 3 18 for wool fiberglass, 320 for hazardous air pollutants and Performance Specification 15 for FTIR continuous emissions monitoring applications. He also does analytical programming for instrumental methods. Based at MRI's North Carolina Office, Dr. Geyer develops hardware, software, and measurement techniques using FTIR spectrometry for the analysis of pollutant emissions. His project assignments have included a number of FTIR method development and test programs.

Before joining MRI in 1995, Dr. Geyer was a Senior Chemist and Group Leader in the Research Division of Entropy, Inc. He directed an EPA FTIR emission test project at five electric utilities, conducted field studies with FTIR emissions tests, and managed in-house laboratory projects. He helped develop procedures to analyze FTIR validation data and helped develop FTIR validation sampling procedures. He directed laboratory and field evaluations to expand the capabilities of FTIR emissions testing.

From 1989 to 1991, Dr. Geyer was Assistant Professor of Chemistry at the U.S. Naval Academy. Previously, he spent a year as an Office of Naval Technology Postdoctoral Felllow at China Lake, California, He performed studies to characterize material ejected by laser ablation from the surface of $YBa_2Cu_3O_7$ high-temperature superconductor. As a Research Assistant at the University of South Carolina from 1984 to 1988, he conducted original research in molecular spectroscopy to determine structures and conformational equilibria of substituted cyclobutane and cyclopentane molecules.

Dr. Geyer has a Ph.D. in Physical Chemistry from the University of South Carolina (1988). He is a member of the American Chemical Society, American Physical Society, Air and Waste Management Association, and Sigma Xi (Scientific Research Society of North America). Entropy honored him with an Outstanding Contribution Award in 1992. He is the coauthor of more than 20 technical publications and presentations. 12399

Scott W. Klamm

Senior Environmental Engineer

Mr. Klamm specializes in air toxics, combustion processes, emission control technologies, and related environmental engineering programs. He has worked extensively on the development and operation of laboratory and field equipment for point source and ambient testing. His recent activities at MRI include leading an EPA field method comparison project on acetaldehyde, performing data analysis for a comparison of three methods for HF, and leading the data analysis and reporting activities for an EPA incineration project to identify and measure products of incomplete combustion using a wide range of field and analytical methods. Mr. Klamm has also recently led field studies for two industrial clients to demonstrate collection efficiency on a control device in one, and to determine measurement errors of an on-line mass spectrometer for emission monitoring in the other.

Mr. Klamm developed an experimental extended-period ambient organic sampler and carried out laboratory testing of the system. For the electronics industry, he examined the use of CFC solvents and alternative technologies for emission control. Mr. Klamm prepared the test plan and matrix design as well as special sampling equipment for a field study of organic compound adsorption in boiler soot for EPA. On several occasions, he has served as an EPA field auditor for the disposal of chemical agents and munitions at an Army facility. He ran tests on stack sampling equipment and emissions monitors and made recommendations on the equipment and monitors. Mr. Klamm has also been field auditor and reviewer of trial bum data as part of permit review assistance to the states of Utah and Kansas, EPA Headquarters, and EPA Region VII.

As part of an evaluation of the Alaska CO inventory, Mr. Klamm tested various locations in an urban area for mobile-source CO emissions, applied meteorological information, assisted in modeling, determined accuracy of existing monitors compared to MRI-gathered data, and helped prepare recommendations to the State of Alaska. For the U.S. Air Force, Mr. Klamm designed a test matrix to study airborne pollutants and toxic gases formed during extinguishment of jet fuel fires with Halon agents at firefighter training exercises. He assisted in operation of SUMMA, ambient VOST, open-path FTIR, PUF, particulate, and CO monitors. He also performed data reduction, coauthored reports and papers, and assisted in risk assessment and dispersion modeling,

Regulatory work has involved coauthoring EPA guidance documents on setting permit conditions, reporting trial bum results, and related incineration topics, such as combustion gas velocity, treatment of gasoline-contaminated soils, and solid waste feed systems.

Mr. Klamm graduated magna cum laude from the University of Missouri-Rolla with a B.S. in Chemical Engineering in 1985. He has taken additional courses in solid and hazardous waste management, human environmental biology, and dispersion modeling. He is a member of the Air and Waste Management Association. He received the 1990 Bidstrup Award from MRI for outstanding technical contribution and the 1997 Achievement Award from MRI's Council of Principal Scientists. 11612: 1/98

Robert G. Gulick

Supervisor of Field Programs

Mr. Gulick specializes in the operation and maintenance of continuous emission monitors in compliance with appropriate EPA methods. As Supervisor of Field Programs, Mr. Gulick is responsible for assuring that all equipment for source sampling is available, calibrated, and in working condition. In addition, he has responsibility for operating and maintaining continuous emission monitors during field sampling at industrial facilities. Recent programs include:

- Performed continuous emission monitoring of carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxides, total hydrocarbons, and hydrogen chloride on source sampling projects. These have included a hysteresis boiler study in Pennsylvania and a kiln study in Nebraska.

- Evaluated 24-hour sampling for total hydrocarbons to determine capture efficiency in the development of total temporary enclosure model.

- Project Leader on a study that assessed and recommended a full complement of continuous emission monitors for a hazardous waste facility's continuous emission monitor replacements.

In 1988 and 1989, Mr. Gulick was a Technical Sales Engineer with Torotel Products of Grandview, Missouri. He negotiated price and delivery of electronic components, expedited production to meet delivery schedules, and monitored engineering changes to meet customer specifications. During 1986 and 1987, Mr. Gulick was the owner and manager of a home electronics retail sales and service business. He was responsible for retail sales, inventory purchase and control, service and repair of audiovisual and computer products, advertising, and personnel management.

Mr. Gulick's background includes rive years as a Field Service Engineer with Perkin-Elmer. He installed and repaired analog and digital test instrumentation, computers, and peripherals. He handled inventory control, trained junior engineers, and sold service contracts.

In 1981, Mr. Gulick received an A.A.S. in Electronic Engineering Technology from Western Iowa Technical College. In 1990, he completed special training in hazardous waste operations. He has certification of OSHA safety and health training.

Andrew E. Page

Assistant Environmental Scientist

Mr. Page performs work in the Air Quality Engineering Section of the Applied Engineering Department. His experience includes field and laboratory testing for fugitive dust sources as well as ducted emission sources using various types of sampling equipment. He performs laboratory analysis on emission sources; Method 18 analysis on ducted emission sources by gas chromatography, including data reduction for these analyses; and assists in operation and maintenance of mobile laboratory and field sampling equipment and analytical instrumentation (IR and GC with FID, PID, and ECD).

From 1994 to March of 1997, Mr. Page worked for Ken Wilcox Associates where he tested leak detection systems and prepared certification reports according to EPA protocols. While at KWA he gamed extensive experience in working with and testing leak detection equipment for aboveground and underground storage tanks and pipeline systems. His other responsibilities included assistance in development of a fuels management research center; product development testing for clients; data reduction and analysis for various types of testing; preparation of estimates for analysis on environmental cleanup projects; soil and water analysis using gas chromatography (GC) and infrared spectrometry (IR); and maintenance of GC and IR, calibration, troubleshooting, and repair.

As a research and teaching assistant at the University of Missouri, from 1992 to 1994, he worked on various research projects, namely development of reverse-bum gasification as a thermal treatment process for petroleum sludge, sewage sludge, and other wastes. Presented research at various conferences. As a teaching assistant, he taught help sessions and laboratory sessions for general chemistry courses.

Mr. Page received a B.A. in Chemistry from Central Methodist College in 1993

Pamela S. Murowchick

Associate Environmental Engineer

Ms. Murowchick provides engineering support on environmental contracts ranging from incinerator trial bums to protocol development to test monitoring systems. The diversity of her assignments has required versatility in applying her engineering knowledge and the ability to work effectively with project management, project team members, and client personnel. Her experience at MN has included:

- Prepared trial bum plans and associated QA plans.
- Operated the sampling console for Modified Method 5 testing during RCRA and TSCA trial bums of hazardous waste incinerators.
- Performed laboratory preparation and recovery tasks for incinerator sampling and analysis projects.
- Performed test data reduction and reporting.
- Assisted on EPA regulatory support assignments involving waste management.
- Coauthored a conference presentation on incineration options for waste management.
- Coauthored a conference presentation on emissions of organic compounds and combustion gases from an industrial boiler during hazardous waste cofiring.
- Assisted with EPA protocol development work for underground storage tanks at MRI's Experimental Tank Facility.
- Assisted with evaluations of commercial equipment for tank tightness testing.
- Assisted on a study of solar energy for waste disposal.

From 1988 to 1989, Ms. Murowchick was a Plant Chemist with Lubripac in Kansas City, Kansas. She performed routine physical and chemical testing of oil in the Quality Control Laboratory. Ms. Murowchick monitored the progress of special projects involving cleanup in the tank farm, and she tested and adjusted new oil formulations in the laboratory before full-scale production was begun.

Ms. Murowchick received a B.S. (with honors and distinction) in Chemical Engineering from Pennsylvania State University in 1985. In 1987 and 1988 she did course work in Secondary Education and Chemistry at Mercyhurst College. She is certified in CPR and completed OSHA's RCRA safety training. Her computer skills include Fortran programming and WordPerfect, Quattro, and Lotus applications.

James S. Surman, Jr.

Senior Environmental Scientist

Mr. Surman has over 28 years of direct experience in stationary source air emissions testing, continuous emission monitoring, and related QA/QC procedures. His work at MRI focuses on the evaluation of hazardous waste incinerators, municipal waste combustors, boilers and industrial furnaces, and other sources of air pollution. He has been Field Sampling Task Leader on 63 projects and Project Leader on 8 emission studies of incinerators, boilers, and kilns, Mr. Surman has also participated as an operator and sampler on numerous field programs and has audited RCRA trial bums of hazardous waste incinerators and emissions tests at power plants for regulatory agencies. In addition to field assignments, he participates in EPA-sponsored work assignments relevant to quality assurance and emissions standards development.

Field assignments have involved sampling for volatile and semivolatile organic compounds; particulate matter, including PM,, by the EGR method; particle size distribution; multiple metals, including hexavalent chromium, acid gases, and other emissions. Mr. Surman has prepared and assisted engineers in preparing proposals, test plans, work plans, QA plans, and project final reports. He also has been responsible for the hands-on preparation and execution of field sampling projects involving as many as 15 field personnel for periods up to one month at a test site.

From 1978 to 1987, Mr. Surman was Quality Assurance Manager and Project Supervisor with Mostardi-Platt Associates of Bensenville, Illinois. He evaluated all testing procedures, equipment maintenance and calibrations, and techniques in the performance of new or innovative test methods. He helped implement EPA reference methods as they became available and supervised air pollution source testing and air pollution control evaluation for various industries. He also conducted ambient air monitoring studies and audits and developed a QA plan for testing activities.

Earlier experience with air pollution source testing was with Kin Associates at Chicago Heights, Illinois (1977) and Commercial Testing and Engineering Company in South Holland, Illinois (1973-1977). Mr. Surman initially worked in Commercial Testing and Engineering Company's services for the sampling and analysis of coal, iron ore, water, soils, and other materials for chemical and physical characteristics (1970-1973). With Rand Development Corporation in Cleveland, Ohio (1966- 1970), he aided in field investigations related to water pollution control, groundwater contamination, and strip mine reclamation.

Mr. Surman received the B.S. in Biology with a minor in Chemistry from Cleveland State University (1966). He is a member of the Source Evaluation Society and coauthor of a municipal waste combustion multipollutant study (EPA-600/8-89-064)

Bob J. Edwards

Senior Technician

Mr. Edwards joined MRI's Field Measurements Section in 1992. He has participated in a number of industrial projects around the country for hazardous waste incinerator testing and analysis services. He also has worked on assignments under MRI's subcontract for technical assistance to EPA for the implementation of RCRA regulations for hazardous waste management facilities.
In support of various field sampling and analysis programs, Mr. Edwards calibrates equipment, performs routine and corrective maintenance on equipment, operates an EPA Method S console during stack sampling, performs Orsat analysis on gas streams, and titrates EPA Method 6 samples. He stages and destages equipment for field sampling and sets up the equipment on-site. In addition, he performs data entry for reports, investigates equipment and vendors to assist with equipment purchasing decisions, and orders materials.

His background includes six years in the U.S. Navy, followed by three years in manufacturing and industrial facilities. He has worked extensively in environmental maintenance, pneumatics, hydraulics, and electrical and mechanical equipment and systems. Mr. Edwards also has experience with quality assurance, radiological controls, gauge calibration, hazardous materials, and security and safety issues.

In the Navy, Mr. Edwards was a missile technician. He operated and maintained the Poseidon Ballistic Missile System as launcher operations supervisor. He performed colateral duties, such as nuclear weapons handling supervisor, departmental coordinator for maintenance and material management, nuclear weapons radiological controls assistant, missile and readiness equipment expert, departmental publications coordinator, quality assurance inspector, field metrology technician, and nuclear weapons security guard. He completed several training programs in the Navy that covered electricity, electronics, hydraulics, pneumatics, digital computers, radiological controls, QA, gauge calibration, theory and practice of equipment maintenance, and related specific disciplines. He has also taken courses in electronic engineering at Maple Woods Community College in Kansas City.

With a division of Kraft-General Foods, Mr. Edwards worked as plant maintenance supervisor/trainee. He oversaw maintenance aspects of production and packaging, interacted with contractors and the company upgrade team in monitoring progress during equipment improvement and expansion, and served on the plant's hazardous materials response team after required OSHA training.

Daniel 0. Neal

Senior Technician

Mr. Neal provides technical support on programs for environmental monitoring, sampling, and analysis in the Field Measurements Section of MRI's Environmental Technology and Engineering Department. His responsibilities include staging and destaging equipment for field tests, setup and operation of equipment, and calibration and maintenance of test equipment.

Since joining MRI in 1993, Mr. Neal has accompanied field measurement teams on several projects for clients in government and industry. In addition to equipment setup, he performs various tasks, including running the Method 5 console and operating the stack probe. Project work has included an emissions test of a kiln at a brick manufacturing plant for EPA, compliance. and performance tests of cooling towers, and various trial burn, miniburn, and performance tests for industrial clients.

Prior to joining MRI, Mr. Neal worked as a sales representative for a publishing company and an appliance company. From 1976 to 1984, he worked for the Power Division of Burns and McDonnell Engineers in Kansas City, Missouri. As a Design Detailer and Electrical Substation Drafting Supervisor, Mr. Neal assisted with design and layout of power substations, Mr. Neal has completed undergraduate courses at Kansas State University, Johnson County Community College, and Longview College.

Attachment 4

Items 12, 21, and 24 (F29, G19, and H18)

Scott Specialty Gases

Shipped From: 6141 EASTON ROAD PO BOX 310
PLUMSTEADVILLE ?A 18949-0310
Phone: 215-766-8861 -Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

MIDWEST RESEARCH
SCOTT KLAMM
425 VOLKER BLVD

KANSAS CITY MO 64110

PROJECT #: 01-01788-004
PO#: 033452
ITEM #: 01023822 5AL
DATE: 4/07/98

CYLINDER #: ALM033887
FILL PRESSURE: 2000 PSIG

ANALYTICAL ACCURACY: +/-5%

BLEND TYPE : CERTIFIED WORKING STD

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
SULFUR HEXAFLUORIDE	.2	PPM	0.205	PPM
NITROGEN		BALANCE		BALANCE

ANALYST: AL ROJAS

Scott Specialty Gases

Shipped From: 6141 EASTON ROAD PLUMSTEADVILLE PA 18949-0310 PO BOX 310
Phone: 215-766-8861 Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

MIDWEST RESEARCH
SCOTT KLAMM
425 VOLKER BLVD

KANSAS CITY MO 64110

PROJECT #: 01-01788-001
PO#: 033452
ITEM #: 0102S3000815AL
DATE: 4/07/98

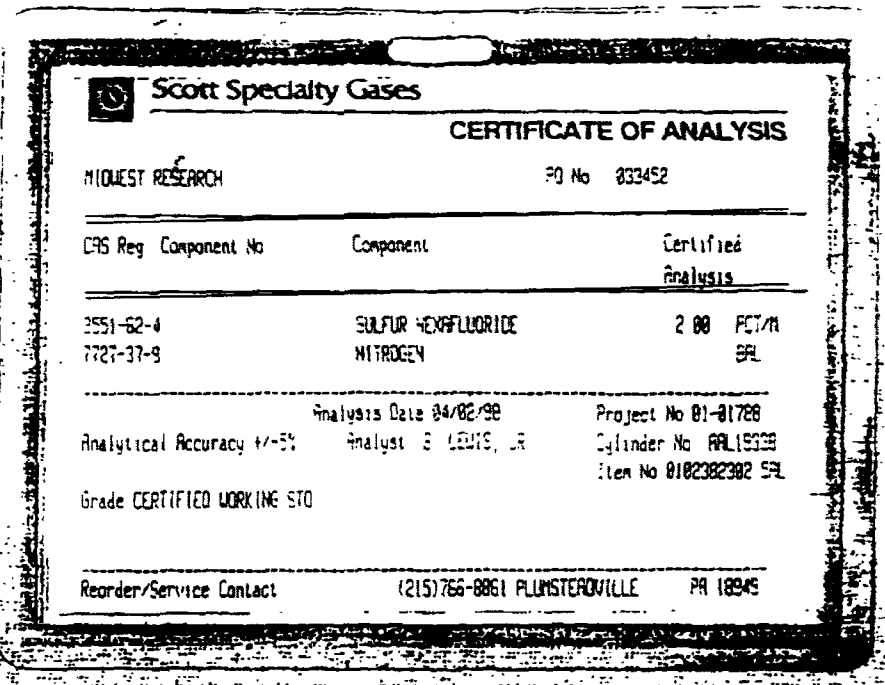
CYLINDER #: AAL17264
FILL PRESSURE: 1280 PSIG

ANALYTICAL ACCURACY: +/-5%

BLEND TYPE : CERTIFIED WORKING STD

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
SULFUR HEXAFLUORIDE	4.	PPM	3.83	PPM
TOLUENE	100.	PPM	105.	PPM
NITROGEN		BALANCE		BALANCE

ANALYST: T. Ludwig
T.LUDWIG



Scott Specialty Gases

CERTIFICATE OF ANALYSIS

MIDWEST RESEARCH PO No 033452

CAS Reg	Component No	Component	Certified Analysis	
2551-62-4		SULFUR HEXAFLUORIDE	2 00	PCT/M
7727-37-9		NITROGEN		BAL

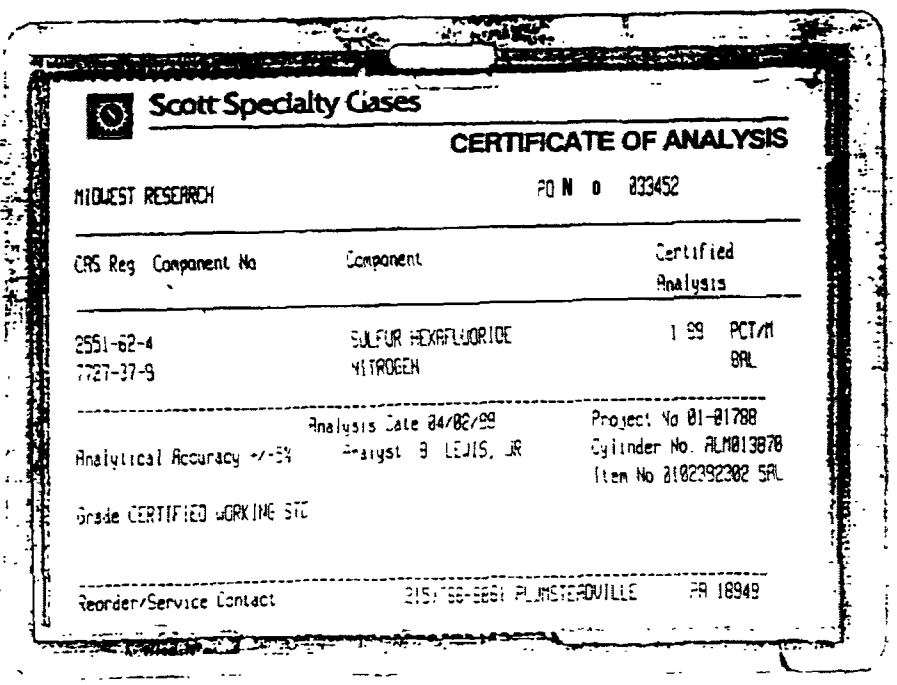
Analysis Date 04/02/99 Project No 01-01788

Analytical Accuracy +/-5% Analyst B LEWIS, JR Cylinder No AAL15338

Item No 0102382302 SAL

Grade CERTIFIED WORKING STD

Reorder/Service Contact (215)766-8861 PLUMSTEADVILLE PA 18949



Scott Specialty Gases

CERTIFICATE OF ANALYSIS

MIDWEST RESEARCH PO No 033452

CAS Reg	Component No	Component	Certified Analysis	
2551-62-4		SULFUR HEXAFLUORIDE	1 99	PCT/M
7727-37-9		NITROGEN		BAL

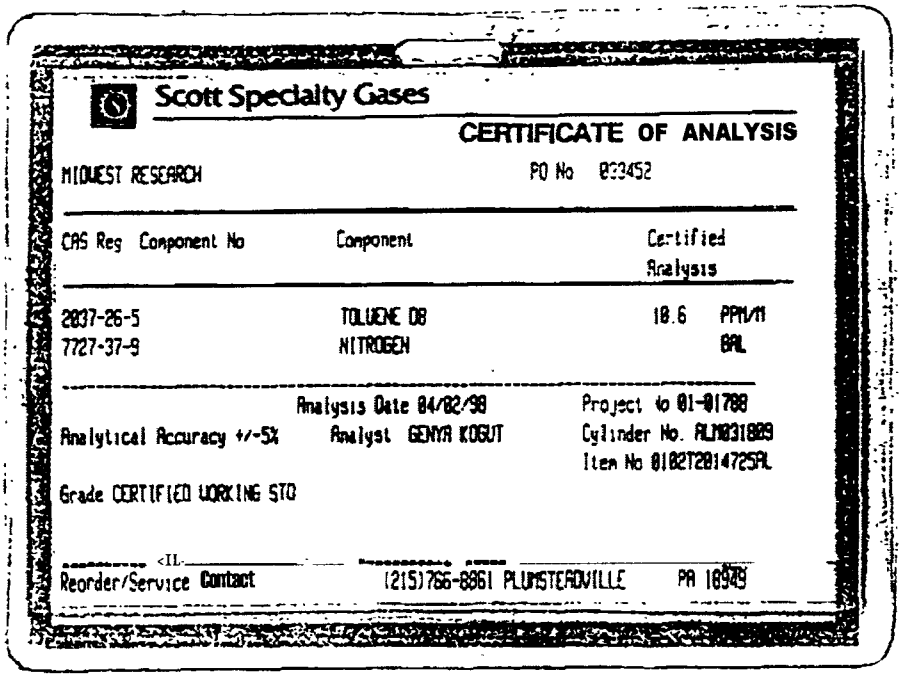
Analysis Date 04/02/99 Project No 01-01788

Analytical Accuracy +/-5% Analyst B LEWIS, JR Cylinder No. ALM013878

Item No 0102382302 SAL

Grade CERTIFIED WORKING STD

Reorder/Service Contact 215-766-8861 PLUMSTEADVILLE PA 18949



Scott Specialty Gases

CERTIFICATE OF ANALYSIS

MIDWEST RESEARCH PO No 033452

CAS Reg	Component No	Component	Certified Analysis	
2037-26-5		TOLUENE DB	18.6	PPMV
7727-37-9		NITROGEN		BAL

Analysis Date 04/02/98 Project No 01-01788

Analytical Accuracy +/-5% Analyst GENYA KOGUT Cylinder No. ALM031809

Item No 0102T2014725PL

Grade CERTIFIED WORKING STD

Reorder/Service Contact (215)766-8861 PLUMSTEADVILLE PA 18949

Scott Specialty Gases

6141 EASTON ROAD PO BOX 310
Shipped From: PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861 Fw: 215-766-2070

CERTIFICATE OF ANALYSIS

MIDWEST RESEARCH
SCOTT KLAMM
425 VOLKER BLVD
KANSAS CITY MO 64110

PROJECT #: 01-017:8-005
PO#: 033452
ITEM #: 01021951 5AL
DATE: 3/31/98

CYLINDER #: AU4005893
FILL PRESSURE: 2000 PSIG

ANALYTICAL ACCURACY: +/-5%

BLEND TYPE : CERTIFIED WORKING STD

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
ETHYLENE	100.	PPM	99.9	PPM
NITROGEN		BALANCE		BALANCE

ANALYST: GENYA KOGUT

Air Products and Chemicals, Inc.
PLANT [illegible] DEPARTMENT
[illegible] NORTH AVENUE
[illegible], IL 60628

Certificate of Analysis - EPA Protocol Gas Standard

REFORMULATION ACCORDING TO EPA 'TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS (PROCEDURE #G1)

Sold To:
AIR PRODUCTS AND CHEMICALS, INC.
[illegible] CAMDEN STREET
PARKERSBURG WV 26101-

Ship To:
[illegible]

Cust. Ref:

Notes:

Order No: 312-020638-01
Batch No: 861-33582
Cylinder No: SG9168085BAL
Cylinder Pressure*: 2000 psig
Certification Date: 08/05/96
Expiration Date: 08/05/99

** Certified Concentration ***			********* Reference Standards *********			********** Analytical Instrumentation **********			
Component	Certified Concentration	Cylinder #	Standard Number	Concentration		Instrument Make/Model	Serial Number	Last Calibration	Measurement Principal
PROPANE	3690 +23	PPM SG9164860BAL	GMIS	4723.0000	PPM	Gow-Mac 750	59405U	07/20/96	GC-FID

Balance Gas: NITROGEN

* Cylinder should not be used below 150 psig

Analyst: James Laas

Approved By: Richard Fry

Attachment 5

Item 25 (H18)

Environics

ISO - 9001
CERT. #97-1068

Daniel A. Kaplinski
Sales Engineer

vironics Inc.
Industrial Park Road East Tolland, CT 06084
(860) 872-1111. FAX: (860) 870-9333
World Wide Web: http://www.environics.com
E-mail: dkaplinski@environics.com

Computerized Gas Mixing/Dilution/Calibration Systems

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

Mf #: 1, Description: AIR , Sire: 10000. SCCM, K-factor: 1.0

SERIAL # AW9502156

This flaw controller was calibrated using a Sierra Cal Bench(TM), a traceable Primary Flow Standard Calibration System. This calibration is referenced to dry air at a temperature af 32 F (__C) and a pressure of 29.92 in.Hg (760Torr).

	Set Flow	True Flow
5 %	500.0 CCM	468.02 CCM
10 %	1000.0 CCM	971.62 CCM
20 %	2000.0 CCM	1988.1 CCM
30 %	3000.0 CCM	3010.5 CCM
40 %	4000.0 CCM	4033.6 CCM
50 %	5000.0 CCM	5057.8 CCM
60 %	6000.0 CCM	6076.6 CCM
70 %	7000.0 CCM	7100.2 CCM
80 %	8000.0 CCM	8113.5 CCM
90 %	9000.0 CCM	9125.9 CCM
100%	10000. CCM	10149. CCM

Calibration data was last saved on Thursday 23 April 98 at 07:04:00

Verified by: [signature] Date: 4-23-98

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

Mf #: 2. Description: AIR , Size: 10000. SCCM, K-factor: 1.0

SERIAL # AW9502157

This flow controller was calibrated using a Sierra Cal Bench(TM), a traceable Primary Flow Standard Calibration System. This calibration is referenced to dry air at a temperature of 32F (__C) and a pressure of 29.92 in.Hg (760Torr).

	Set Flow	True Flow
5 %	500.0 CCM	477.98 CCM
10 %	1000.0 CCM	983.77 CCM
20 %	2000.0 CCM	1991.6 CCM
30 %	3000.0 CCM	3021.6 CCM
40 %	4000.0 CCM	4027.6 CCM
50 %	5000.0 CCM	5071.8 CCM
60 %	6000.0 CCM	6063.2 CCM
70 %	7000.0 CCM	7072.1 CCM
80 %	8000.0 CCM	8110.2 CCM
90 %	9000.0 CCM	9117.1 CCM
100%	10000. CCM	10134. CCM

Calibration data was last saved on Thursday 23 April 98 at 07:51:00

Verified by: [signature] Date: 4-23-98

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

Mf #: 3, Description: AIR , Size: 1000.0 SCCM, K-factor: 1. 0

SERIAL # Aw 950 2153

This flow controller was calibrated using a Sierra Cal Bench(TM) , a traceable Primary Flow Standard Calibration System. This calibration is referenced to dry air at a temperature of 32F (C) and a pressure of 29.92 in.Hg (760Torr).

	Set Flow	True Flow
5 %	50.0 CCM	44.233 CCM
10 %	100.0 CCM	94.868 CCM
20 %	200.0 CCM	196.38 CCM
30 %	300.0 CCM	298.36 CCM
40 %	400.0 CCM	399.54 CCM
50 %	500.0 CCM	498.17 CCM
60 %	600.0 CCM	598.72 CCM
70 %	700.0 CCM	698.88 CCM
80 %	800.0 CCM	799.52 CCM
90 %	900.0 CCM	901.61 CCM
100%	1000.0 CCM	1003.6 CCM

Calibration data was last saved on Thursday 23 April 98 at 08:39:

Verified by: [signature] Date: 4 - 23 - 98

ENVIRONICS FLOW CONTROLLER CALIBRATION SHEET

Mf #: 4, Description: AIR , Size: 100.0 SCCM, K-factor: 1.0

SERIAL # AW 9612049

This flow controller **was calibrated using a Sierra** Cal Bench (TM), a traceable **Primary Flow Standard Calibration** System. **This** calibration **is referenced to** dry air **at a temperature of** 72 F (__C) **and** a pressure of 29.92 in.Hg (760Torr)

	Set Flow		True Flow	
5 %	5.0	CCM	5.013	CCM
10 %	10.0	CCM	10.033	CCM
20 %	20.0	CCM	20.078	CCM
30 %	30.0	CCM	30.135	CCM
40 %	40.0	CCM	40.196	CCM
50 %	50.0	CCM	50.254	CCM
60 %	60.0	CCM	60.312	CCM
70 %	70.0	CCM	70.371	CCM
80 %	80.0	CCM	80.44	CCM
90 %	90.0	CCM	90.504	CCM
100%	100.0	CCM	100.57	CCM

Calibration data was last saved on Thursday 23 April 98 at 13:28:0

Verified by: [signature] Date: 4 - 23 - 98

Chapter 3

Technical Systems Audit
Manual Emissions Test Methods Performed by
Pacific Environmental Services Inc.
at Hot Mix Asphalt Plant C,
Los Angeles, CA

3.0 TECHNICAL SYSTEMS AUDIT - PACIFIC ENVIRONMENTAL SERVICES INC.

This Chapter is the final technical systems audit (TSA) of the manual emissions testing at Hot Mix Asphalt Plant C in the Los Angeles, California area performed by Pacific Environmental Services, Inc. (PES). As explained in detail in Chapter 1, the final TSA includes revisions by the EPA Quality Assurance Officer. The draft TSA report from Research Triangle Institute (RTI) was delivered to the EPA Quality Assurance Officer on September 29, 1998. The TSA was performed by R.K.M. Jayanty and Robert S. Wright of Research Triangle Institute (RTI) under EPA Contract 68-D4-0091, work assignment 99-03, from July 20, through July 26, 1998. The TSA was conducted in accordance with principles described in the EPA Quality Assurance Division's working draft version of *EPA Guidance for Technical Assessments for Environmental Data Operations* (EPA QA/G-7).

In general, PES and its team members have performed the testing according to the procedures outlined in the Site Specific Test Plan (SSTP) and Quality Assurance Project Plan (QAPP). Any deviations from the QAPP or SSTP have been discussed with the EPA Work Assignment Manager. PES and its team members who are present at the site are well qualified and experienced in the work to which they are assigned.

Item	Findings that may have a potential effect on data quality
1	The EPA Methods, VOST and Modified Method 5 (MM5), have not been validated for all the chemical compounds of interest in the asphalt plant emissions. Some of the compounds may have been recovered during the laboratory testing in other programs, but none have been validated in the asphalt plant emissions matrices. This was a research study, however, and not meant to have validation.
2	The VOST cartridges were spiked with surrogate compound(s) before field sampling at Triangle Labs.
3	The precision and accuracy goals indicated in the QAPP are based on estimates from the VOST and semi-VOST methods, but they are not established values for many of the compounds of interest in this program.

Item	Findings that are unlikely to have an effect on data quality
1	The spikes into the XAD-2 resin (MM5) and Anasorb 747 (M-18) were loaded directly onto the cartridges in the field.
2	The train operators have noted the readings on the data sheets. The data sheets do not have any column to note any comments during sampling. Similarly, a notebook was maintained at the site to record any problems or process changes, etc., during sampling.
3	The flow rates used for VOST at the tunnel exhaust were too low to maintain constant on the rotameter or VOST console, which may cause some error in the total volume collected.

Technical Systems Audit Checklist

Project: Emissions Testing at a Hot Mix Asphalt Plant
Organization: Pacific Environmental Services
Location: Asphalt Plant C - Los Angeles, CA
Assessors: R.K.M. Jayanty and R.S. Wright (Research Triangle Institute; Research Triangle Park, North Carolina)
Audit Dates: July 20 through July 26, 1998

Brief Project Description: EPA is investigating hot mix asphalt plants to identify and quantify particulate matter and hazardous air pollutants (HAPs) emitted from asphalt cement load-out operations. EPA has issued a work assignment to PES to conduct an air emissions test program to collect data in support of the investigation. Asphalt Plant C in Los Angeles, California was chosen primarily because load-out emissions are controlled by a silo exhaust system and a load-out tunnel. The plant has a production capacity of more 650 tons per day. Approximately 2,000 tons per 4 hour period were produced, during the test. The primary objective of the project will be to characterize air emissions of organic HAPs from asphalt cement load-out operations and operation of the hot mix dryer; however, PES is not responsible for the testing of the hot mix dryer stack. Testing will be performed to characterize emissions from the storage silos, the load-out tunnel, and the hot mix dryer.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
A. GENERAL QUALITY ASSURANCE INFORMATION				
1. Is there an approved quality assurance (QA) plan for the overall project and has it been reviewed by all appropriate personnel?	✓			A QAPP was submitted to EPA in January 1998. Subsequently, two revisions have been made and a final QAPP was submitted on July 14, 1998. Additionally, PES submitted a SSTP in June 1998. Both documents have been approved by EPA.
2. Is a copy of the approved QA plan maintained at the field site? If not, briefly describe how and where QA and quality control (QC) requirements and procedures are documented at the field site.	✓			Copies of the QAPP and SSTP are available in the trailer. Few operators of the trains have used these documents; however, key personnel provided them with information from these documents as needed for their tasks.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
3. Is the design and conduct of the project as specified in the QA plan? Are there deviations from the QA plan? How are any deviations from the QA plan noted?	✓			In general, the project is being implemented as was specified in the QAPP. However, some procedures have changed since the revised QAPP was submitted to EPA. This was communicated to EPA WAM in a letter form on July 8, 1998. The proposed deviations do not appear to affect the quality of the data being generated.
4. Are written and approved standard operating procedures (SOPs) used in the project? If so, list them and note whether they are available at the field site. If not, briefly describe how and where the project procedures are documented.		✓		No SOPs were observed at the testing site. EPA test methods are used as they are and those methods are attached to the QAPP.
5. For each measured parameter, do any SOPs clearly define the data quality indicator goals for precision and accuracy?			✓	Data quality indicator goals defined in the EPA methods were used.
6. Do the above data quality indicator goals appear to be based on documented performance criteria for the measured parameter or on actual QC data compiled for the particular measured parameter?			✓	Data quality indicator goals appear to be based on EPA methods.
7. Are there established procedures for corrective or response actions when measurement performance criteria or the data quality indicator goals (e.g. out-of-control calibration data) are not met? If yes, briefly describe them. Are they consistent with the QA plan?	✓			Whenever there are deviations from the QAPP or established procedures in EPA methods, the EPA Work Assignment Manager was informed by the PES Task Manager.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
8. For each measured parameter, do the SOPs specify the frequency of calibration, acceptance criteria for the calibration, and the process for calibration data reduction and review?			✓	PES used the specifications established in the EPA methods. All calibration data sheets will be given to RTI at a later date. Mr. Dennis Holzschuh, Sr., will be responsible for QA coordination and review of the calibration data.
9. Briefly describe how calibration and other QC data are documented.			✓	Operational parameters and calibration data were recorded on paper data sheets.
10. Does the calibration documentation show that calibrations are being performed at the required frequency and in the required manner?				
11. Are there standard paper or electronic forms to record QC data and operational data? Are the records dated? Is the person who completed the record identified? Are paper records written in indelible ink?	✓			Standard paper data sheets were used for all measurements and blank data sheets were supplied to RTI. The data sheets are dated and the operator name was noted. All data forms were filled out in ink.
12. Are the QC data reviewed by another qualified person such as the QA officer or the plant manager? Who is this individual?	✓			Mr. Dennis P. Holzschuh, Sr., PES QA Coordinator, will review all QA data sheets. He performed internal QA at the field site.
13. Is the project team adhering to the planned schedule? If not, explain the new schedule. Verify that all schedule changes have been authorized.	✓			The schedule is being followed to the extent allowed by unexpected equipment breakdown and process changes in the asphalt plant. All schedule modifications were authorized by the EPA Work Assignment Manager.
14. Are there written plans to report changes in the QAPP during data-gathering activities?		✓		There are no written plans to report changes in the QAPP during sampling. However, the PES Task Manager informed EPA WAM and other staff verbally concerning schedule modifi-cations and any deviations from the QAPP.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
Additional Questions or Comments:				
B. ORGANIZATION AND RESPONSIBILITIES				
1. Identify the following personnel and determine whether they have the listed responsibilities: **PES Principal Investigator:** C. Wayne Westbrook • responsible for overall performance of the project, and • communications with EPA			✓	Wayne Westbrook was identified as Program Manager for PES in the QAPP, whereas the SSTP identified John Chehaske as the Program Manager for PES. In either case, it will not affect the data quality or scope of the project.
2. **PES QA Officer:** Dennis Falgout • assist with and will be responsible for review and monitoring of all QA/QC activities			✓	Dennis Falgout was not present at the emissions testing.
3. **PES Project On-Site Manager**: Frank Phoenix • coordination with PES principal investigator, • Planning and scheduling the demonstration project			✓	Frank Phoenix is the Task Manager and is responsible for all the project activities at the emissions testing site.
4. **PES On-Site Quality Assurance Coordinator:** Dennis P. Holzschuh, Sr. • QC activities			✓	Mr. Holzschuh is responsible for the on-site QA/QC activities and was present.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
5. Have there been any changes in the project organization and the personnel as outlined in the QAPP?		✓		In general, there are no significant changes except staff from Atlantic Technical Services, Inc., were not present. MM5 train samples for the Analysis of PAHs will be analyzed by Quanterra laboratories instead of Triangle Labs. This was approved by EPA WAM prior to the field testing. Quanterra labs have high resolution GC/MS analysis capability for PAHs.
6. **Manual Test Methods Operators**: Mike Maret, VOST at TED Troy Abernathy, VOST M18 at SED Dennis Holzschuh, Jr., MM5 at SED Joe Rubio, MM5& M315 at SED Brian Purser, M18 at TED Nick Neilson, M315 at TED Jessica Swift, MetStation Jairo Barreda, Shipping & Sample Custodian			✓	Laura Kinner, GC/MS Operator Jim Peeler, GC/MS Operator Josh Letomeau, Process Monitor Each identified operator was responsible for sample collection and sample recovery for that method.
7. **EPA Work Assignment - Manager** Michael L. Toney			✓	Mr. Toney was present throughout the entire testing program and coordinated the efforts of the emissions testing teams. He authorized all changes in testing schedule and procedures.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
8. **EPA QA Officer:** Lara P. Autry • review and approve QAPP • review and approve QA activities			✓	Ms. Autry was not present at the emissions testing.
9. Does the project maintain a current summary of the training and experience of each individual engaged in the project?		✓		Training and experience of each assigned person were maintained at the office.
10. Does the project maintain descriptions of assignment responsibilities and required proficiency levels?	✓			Responsibilities are assigned for each person and it appears that they are all well qualified. Only two persons, Jessica Swift and Jairo Barreda, are summer interns and they have been given sufficient training for the work assigned to them.
Additional Questions or Comments:				
C. METHOD SPECIFIC - EPA Method 1				
1. Is stack diameter properly determined?	✓			The tunnel exhaust is a horizontal 32 inch diameter duct which leads from the load-out tunnel to the Smog Hog.
2. Is distance to nearest upstream disturbance properly determined?	✓			
3. Is distance to nearest downstream disturbance properly determined?	✓			
4. Is number of sampling points properly selected?	✓			For isokinetic testing, a 24-point traverse matrix consisting of 12 traverse points on each of two perpendicular traverse lines was used.
5. Is points properly marked on pitot tube?	✓			Points are noted on the tape which is attached to the pitot tube and probe.
6. Verification of cyclonic flow is acceptable?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
7. Prior to sampling, all duct dimensions are checked against preliminary information to verify measurement at locations, location of test ports, and stack inside dimensions?	✓			The stack dimensions and locations of the traverse points were verified prior to sampling.
8. Are the stack inside dimensions, wall thickness, and sample post depths measured to the nearest 1/16 inch?	✓			Performed prior to the testing.

Additional Questions or Comments:

The new silo exhaust duct was installed at Silo 2 instead of Silo 3. Since the new SED is 10 inches in diameter, Method 1A was used instead of Method 1. This change was approved by EPA WAM. Some of the work was performed prior to the auditor's arrival to the site.

The silo exhaust and tunnel exhaust duct dimensions and locations of the traverse points were verified prior to testing. Prior to testing, the silo exhaust and tunnel exhaust ducts were checked for the presence of nonparallel flow by recording yaw angle misalignment at each isokinetic sampling point. The details are in the PES site-specific Test Plan.

D. METHOD SPECIFIC - EPA Method 2				
1. Is pitot tube, lines and manometer assembled correctly?	✓			A type S pitot tube is connected to an inclined-vertical manometer.
2. Is manometer leveled and zeroed before and after each test?	✓			The box containing the manometers is kept on a bench. Noticed zero before and after each run.
3. Is pitot tube checked for chips? Performed leak checks before and after each test run?	✓			Leak checks were performed before and after each test run. Leak rates are noted in data sheets.
4. Is cyclonic flow checked properly?	✓			
5. Is orientation of pitot tube correct during traverse?	✓			Noticed the orientation of pitot tube and found to be acceptable during traverse.
6. Is sampling port adequately sealed around pitot tube?	✓			It is sealed either with gloves or a cloth.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
7. Is process operating at correct conditions?			✓	Sampling was done whenever the process was operating properly and at correct conditions (determined prior to the sampling).
8. Is stable reading taken at each traverse point?	✓			Readings are noted in the data sheets.
9. Is static pressure measured?	✓			
10. Is temperature measured?	✓			The effluent gas temperature is recorded at each traverse point using type-K thermocouple.
11. Is moisture content determined? If so, what method used?	✓			Moisture content was measured by EPA Method 315.
12. Is data recorded properly?	✓			Data are recorded in data sheets.
13. Are calculations correct?			✓	Calculations will be performed in the office and not at the site.
Additional Questions and Comments:				
E. METHOD SPECIFIC - EPA Method 4				
1. Is method conducted in conjunction with pollutant test methods 315 and MM-5?	✓			Method 315 and MM-5 trains were run simultaneously both at the silo tunnel and silo exhaust.
2. Are impingers properly placed? Impinger contents - 1, 2, 3, 4, 5.	✓			For Method 315, the first and second impingers contained 100 mL of DI water each, the third impinger is empty, and the fourth and fifth impingers contained 200 g of silica gel.
3. Sampling time per point?				10 min at the silo tunnel 5 min at the silo exhaust
4. Number of points?			✓	24 points
5. Is probe heater on? What temperature? Is it stable?	✓			Probe is heated at 250 °F. Temperature readings are noted in the data sheets.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
6. Is filter heater on? What temperature? Is it stable?	✓			Filter is heated at 250 °F. Temperature readings are noted every 10 min in the data sheets.
7. Is crushed ice in ice bath around impingers?	✓			Crushed ice added periodically to maintain the impingers at 0 °C.
8. Is the exit temperature being kept below 68°F?	✓			Temperatures are periodically recorded in the data sheets (every 5 min).
9. Is pretest leak check conducted? Leakage rate?	✓			Data sheets will be provided. Leakage rate was within the acceptable limits.
10. Is sampling rate constant? Is it isokinetic sampling?	✓			Sampling rate is 1.5 ft^3/min and found to be within the specifications. Isokinetic sampling was followed.
11. Is port leak check performed? Leakage rate?	✓			Data sheets will be provided. Leakage rate was within the acceptable limits.
12. Is electronic balance calibrated with reading within 0.1 grams of known reference standard?			✓	Calibration was performed in the laboratory but not at the site. Calibration data will be provided.
13. All data are recorded properly?	✓			Noted in data sheets.
Additional Questions and Comments: Moisture was determined from EPA Method 315 instead of EPA Method 5. Audit questions were completed based on EPA Method 315 sampling procedures. Method 4 was performed in conjunction with each EPA Method 315 test run.				
F. METHOD SPECIFIC - EPA Method 315				
Apparatus				
1. Is the probe nozzle made of glass or glass lined? What is its design? Is it clean?	✓			Probe nozzle was made of glass. Cleaned with methylene chloride and methanol (50:50 mixture). It appears to be clean.
2. Is the probe liner made of borosilicate or quartz and is it clean?	✓			Probe liner is made of borosilicate. Cleaned with methylene chloride and methanol mixture (50:50). It appears to be clean.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
3. Is it type S pitot tube and is it properly attached?	✓			S-type pitot tube was used and it is properly attached.
4. Is the differential pressure gauge as two inclined manometers?	✓			The meter box contained two inclined manometers.
5. Is the filter holder borosilicate glass; glass frit-support; or silicone rubber gasket?	✓			The filter holder is a borosilicate glass.
6. Describe number of impingers in the condenser and its contents?	✓			The first and second impingers contained 200 mL of DI water, the third impinger is empty, and the fourth impinger contained 200 g of silica gel.
7. What type of barometer? Mercury or Aneroid?			✓	Aneroid barometer was used. It was calibrated against mercury manometer.
8. What type of gas density determination equipment used? - sensor type _____ - pressure gauge _____ Temperature sensor attached to probe?			✓	
9. Has filters checked visually for inequalities?	✓			Glass fiber filter appears to be good.
10. Has filters properly labeled?	✓			Filters after collection were kept in an amber glass bottle and labeled.
11. Has pretest and post-test leak check performed properly?	✓			Leak checks performed properly before and after each run and noted in the data sheets.
12. Has impingers properly assembled?	✓			Impingers were assembled according to the Method 315 specifications.
13. Has pitot tube lines checked for plugging or leaks?	✓			Leak-checked before and after each run.
14. Has meter box leveled periodically?	✓			Meter box was kept on a horizontal surface.
15. Have manometers zeroed?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
16. Has acetone-insoluble head-stable silicone grease added to all ground glass joints?			✓	No silicone grease was used to the ground glass joints. They are used only when it leaks.
17. Is probe heat uniform along length of probe?	✓			Probe is kept at 250 °F and the temperatures are noted in the data sheets every 5 min.
18. Has effective seal made around probe when in-stack?	✓			Sealed with hand gloves or a cloth and found to be acceptable.
19. Nozzle & pitot tube parallel to stack wall at all times.	✓			
20. Has filter changed during run? Any particulate lost?		✓		No filter changed during the run. No particulate was lost.
21. Have data sheets complete and data properly recorded?	✓			Data sheets are filled out properly with a legible ink pen.

Additional Questions and Comments:

1. Due to problems in the silo tunnel and silo exhaust, the samples collected on the first day (7/23/98) were voided after approval from EPA WAM. After 2 hr sampling, it was noted that the silo exhaust damper was closed. Therefore, the damper was operated and continued the sampling for another 2 hr. The first day run will be repeated on 7/27/98.

2. Observed the Method 315 sampling run at the silo 2 exhaust at the roof on 7/25/98. Flow rate 0.75 ft^3/min. Sampling was done only for 2 hr due to expected high concentrations. Method 315 and MM5 trains were operated at two different times. Due to smaller stack diameter, traverse readings were taken from one place and probe was kept in another hole and readings were noted for every 5 min. Stack is at negative pressure. Stack hole is covered with gloves.

3. 4-hr sampling was performed from the silo 2 tunnel while two trucks were going through the tunnel to get the background emissions.

LABORATORY INFORMATION NECESSARY FOR EPA METHOD 315				
1. Was the calibration information documented in log books?	✓			
2. Have the previous calibrations met the acceptable tolerances?				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
3. Has the Type-S pitot tube been verified using standards outside of the laboratory?				
4. Describe the pitot tube calibration apparatus.				

Additional Questions and Comments:

Calibrations were performed in the laboratory prior to the testing on the site. Calibration sheets will be supplied to the auditors after the field test.

Calibration and General				
1. Have the dry gas meters been calibrated against a standard? (If so, which standard?)	✓			
2. Have the stack and train temperature sensors been calibrated against a reference thermometer?	✓			
3. Has the nozzle been calibrated to nearest 0.025 mm (0.001 in), and has the nozzle size been properly selected?	✓			
4. Is the train correctly setup up and leak-checked to less than 4% or 0.00057 m^3/min (0.02 ft^3/ min), whichever is less?	✓			Leak checks were performed before and after the sample collection and found to be acceptable.
5. Are the train components clean and free of breaks, cracks and leaks, and is the probe liner clean and leak free at 380 mm (15 in) Hg?	✓			
6. Are the pitot tube lines free of plugs or leaks?	✓			
7. Is the probe heating system operating correctly?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
8. Are the pitot tube and temperature sensors properly attached to probe?	✓			
9. Are the nozzle and pitot tube located parallel to stack wall? Observe handling and positioning of the probe.	✓			
10. Is the filter holder temperature maintained at 120 ± 14°C (248 ± 25°F) throughout the tests?	✓			
11. Is the sample gas temperature at the last impinger maintained at < 20°C (68°F) throughout the tests?	✓			
12. Is isokinetic sampling maintained within ± 10% and checked every five minutes?	✓			
13. Is the sample site selection an appropriate distance downstream from any flow disturbance?	✓			
14. Are filters free of irregularities, properly installed, and properly labeled?	✓			
15. Do the equipment operators have access to test protocols and methods, are data sheets available, and is equipment in good repair.	✓			Equipment operators have copies of the protocols and methods. Data sheets are available to each train operator.
16. Are all data recorded and calculations checked? Is at least one decimal point beyond that of acquired data retained?	✓			Calculations will be checked in the office.
17. Are all impingers cooled in an ice bath at all times?	✓			Crushed ice was added periodically to maintain the temperature.
18. Is full stack traversing being conducted?	✓			
19. Do recovery methods prevent contamination?	✓			Sample recovery was performed in the trailer, which is relatively clean.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
20. Are graduated cylinders within 2 ml (or less) subdivisions used?		✓		Graduated cylinders within 2 mL subdivisions were not used. However, standard impingers were used and a known volume of solutions was added.
21. Are all openings capped during train disassembly?	✓			Capped with Teflon tape.
22. Is the clean-up area clean and protected from the wind?	✓			It was performed in the trailer. The area is relatively clean.
23. Are any particulates spilled?		✓		The operators are very careful in transferring the filter paper to the glass jar.
24. Do any visible particles remain inside the probe?		✓		None was noticed inside the probe.
25. How is the pitot tube cleaned?			✓	Cleaned with methylene chloride and methanol (50:50) mixture.
26. Are sample containers labeled and sealed tight, and is the liquid level marked?	✓			Electronically printed labels were affixed to the containers. Liquid level is marked with a pen and sealed with Teflon tape.
27. What is the history of the S-type pitot being calibrated against a std pitot?				The calibration was performed in the laboratory and the calibration data will be supplied to the auditors after the field test.
28. How was the inside diameter of the stack measured?				It was measured prior to the testing and noted to be 32 inches.
29. How is the probe marked to ensure proper sampling locations?	✓			Probe is wrapped with tape at each traverse point and marked with a pen.
30. How long does the probe remain at each sample point? Is the reading stable?	✓			The probe remained at 10 min at each sample point. Readings are noted in the data sheets.
31. How is alignment ensured while sampling? Guidance manuals specify visual observations and not the highest delta p.			✓	Visual observations indicate that alignment appears to be QC.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
32. Were the unused ports plugged while sampling occurred?	✓			Unused ports were sealed with electric tape.
33. Was the equipment damaged during the test? Explain.		✓		A few of the glass nozzles were broken during recovery operation. They were replaced with new ones for the next run.
34. How is static pressure measured, and what is it? ...sampling?				Static pressure was measured with an inclined manometer.
35. How is steady state process indicated during sampling? ....would be the impact?			✓	It will not be a steady-state process. Impact will be minimal due to an integrated sample.
36. Were they any changes in the facility emissions during sampling?	✓			Emissions may vary at the facility due to the nature of the operation.
37. If changes in emissions did occur during sampling, what was the impact?				Impact will be minimal due to an integrated sample collection method.
Additional Questions and Comments:				

G. METHOD SPECIFIC - EPA Method 18				
1. Have you performed presurvey sampling using Method 18 procedures?		✓		Presurvey sampling was not performed using Method 18 procedures. However, grab samples were collected and analyzed using canisters. Method SW 846 M0030 VOST data were collected at the hot mix dryer stack.
2. What are the approximate concentrations of the targeted compounds?				
3. What is the sampling rate? Is it constant or proportional?			✓	Sampling rate was 1 L/min and sampled for 4 hr at silo tunnel, whereas 2 hr sampling was done at silo exhaust.
4. What is the sample time?			✓	4 hr at the silo tunnel, 2 hr at the silo exhaust.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
5. Probe heat or not. If so, what temperature?			✓	Not heated. Teflon lines were used. Ambient temperature.
Additional Questions and Comments:				
Apparatus				
6. What type of probe is used—stainless steel, glass or Teflon?			✓	Teflon lines were used.
7. Is it heated and any filter used?			✓	No filter was used and Teflon lines are not heated.
8. Silica gel tube or extra adsorption tube used prior to adsorption tube when moisture content is > 3 percent.			✓	None was used at the silo 2 tunnel emissions sampling. However, two impingers at ice path temperature were used at the silo exhaust.
9. Is the leakless sample pump calibrated within limiting (sonic) orifice or flow meter?				KNS Teflon pump was used to pull the sample gas. The pump was calibrated in the laboratory with a bubble flow meter.
10. Is rotameter used to detect changes in flow?	✓			
11. Are the two sampling trains run in parallel?	✓			The gas is pulled through a T-connection into spiked and unspiked sampling tubes.
12. Are the pre-spiked adsorbent tubes used in one train and non-spiked adsorbent tubes used in the second train?	✓			Two different probes but pulled through a common pump.
13. What are the compounds spiked and at what concentrations?			✓	200 µg each of benzene, toluene, xylene, hexane, and cumene was spiked. Liquid mixture was spiked onto the cartridge prior to sampling.
14. Is accurately measured sample time with a stop watch?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
15. Is the sampling pump and flow meter recently calibrated with bubble meter?	✓			
16. Whether extreme care is taken to ensure that no sample is lost in the probe or sample line prior to the adsorption tube.	✓			
17. Is pretest leak check acceptable? (No flow indicated or meter.)	✓			
18. Total sample time, sample flow rate, barometric pressure, and ambient temperature are recorded?	✓			Recorded in data sheets.
19. Total sample volume commensurate with expected concentration and recommended sample loading factors?			✓	4 hr sampling was performed at the silo tunnel. 2 hr sampling at the silo exhaust.
20. Is post-test leak check and volume rate meter check acceptable? (No flow indicated on meter, post-test calculated flow rate is within 5 percent of pretest flow rate?)			✓	The gas sample is pulled into spiked and unspiked sampling tubes.
21. Is desorption efficiency determined for adsorbent to be used for field sampling? If so, what are the desorption efficiencies?	✓			The analyst reported that the desorption efficiencies were determined in the lab prior to the testing and they are 95 percent for each compound.
22. Is collection efficiency determined for adsorption tubes used for actual field sampling?				The analyst reported that the collection efficiencies were determined in the lab. The acceptable range is 70-130 percent. However, 85 percent was found.
23. Are the adsorbent tubes stored properly after sampling?	✓			They were stored in an ice cooler after sampling.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
Additional Questions and Comments: AnaSorb 747 (1,000 mg front + 1,000 mg backtrap) was used. Carbon disulfide + dimethyl formanide will be used for desorption. No glass wool was used in the Teflon lines. Sample gas is pulled through a vacuum pump and maintained a flow through a critical orifice. There may be a small pulsation and the impact is minimal. Method 18 was performed for two losses at 1 L/min at the silo exhaust. Impingers were used prior to the sampling tubes at the silo exhaust to condense the water vapor.				
H. METHOD SPECIFIC - SW-846 Method 0030 (VOST)				
1. Will the total run time be a minimum of 2 hours?		✓		The total run time is 20 min. Four runs were performed on each day.
2. Is the maximum load time 20 min. For each pair of cartridges? At 1L/min sampling rate?	✓			Generally, 1 L/min sampling rate was used at silo 2 tunnel emissions. However, 0.25 L/min for 10 min was used at the silo exhaust emissions.
3. Is a quartz liner wed inside the stainless steel probe?	✓			Glass wool was inserted in the front of the quartz liner to remove any particulates.
4. Is the probe maintained at a temperature greater than 150°C?		✓		Probe temperature was maintained at 255 °F.
5. Do the sorbent cartridges appear to be sealed tightly in their carry cases?	✓			The sealed cartridges were kept in carrying cases.
6. Have the sorbent cartridges been placed correctly in the sample train (1^{st} cartridge Tenax; 2^{nd} cartridge Tenax/charcoal)?	✓			
7. Do all vacuum gauges, pump connections, calibrated rotameters, and dry gas meters appear in good working order with leak-tight seals?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
8. Is there an available thermal couple reading between the first condenser and first Tenax cartridge? CHECK TEMPERATURE. MUST BE LESS THAN 20°C.	✓			Temperature was measured and it is less than 20 °C.
9. Is the sample line between the probe and the first condenser less than 5 ft.? — Is it Teflon? — Is it heat traced to 150°C? — Are compression fittings used?	✓			Teflon line was used. It is not heat traced.
10. Does each individual cartridge have its own unique ID number and flow direction arrow marked on it?	✓			
11. Were the sorbent cartridges received in the field on cold packs (~4°C)?	✓			
12. Is the cooling water to the condenser being maintained at or near 0°C?		✓		Higher than 0 °C, but lower than 20 °C. Ice water circulated.
13. Is the train leak-checked at the beginning of a run to the following specifications? (1) pull a vacuum to 250 mm Hg (10 in Hg), (2) leak rate less than 2.5 mm Hg after 1 minute?	✓			
14. Is a charcoal canister used to filter the ambient air used to return system to ambient pressure after the leak check?	✓			
15. Was the sample train leak-checked after 20L of gas was sampled and was the highest pressure drop encountered recorded so that his value can be used during the second leak test?	✓			Leak test was performed before and after each run. The sampling rate and volume are different at the silo exhaust emissions testing. It was approved by the EPA WAM.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
16. Are the field blanks exposed for the same amount of time as it takes to change sorbent cartridges in the VOST?	✓			Field blank was performed on 7/25/98.
17. Was there a field blank exposed for each run?		✓		Field blank was performed on 7/25/98.

Additional Questions and Comments:

7/25/98. Due to higher concentrations at the silo exhaust, it was authorized to run VOST at 0.25 L/min for 10 min. Four runs were done each day. Stack is at negative pressure. No moisture condensation was observed in the impinger. The flow rate of 0.25 L/min is at low setting in the VOST console box. Rotameter setting is 0.2, which is the bottom of the scale.

I. METHOD SPECIFIC - SW-846-0010 (Modified Method 5)				
1. Is the probe nozzle made of 316 stainless steel or glass with a sharp, tapered (30° angle) leading edge?			✓	The probe nozzle is made of glass.
2. Is the nozzle of buttonhook or elbow design and seamless?			✓	The nozzle is buttonhook.
3. Is the nozzle calibrated?	✓			It is calibrated in the laboratory.
4. Is the probe glass lined and heated to 120 ± 14°C at the exit end during sampling?	✓			
5. Is the type s pitot tube on a plane even with or above the nozzle entry plane during sampling?	✓			
6. Does the pitot tube have a known coefficient? What is it?	✓			The coefficient is 0.84.
7. Does the train have two manometers: one for velocity-head (ΔP) readings and one for orifice differential pressure readings (ΔH)?	✓			Two inclined manometers were used.
8. Is the filter holder made of glass, and the gasket of Teflon?	✓			Glass

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
9. Is the XAD-2 module cooled to 17 ± 3°C?	✓			Ice water bath was maintained.
10. Is there a thermocouple in the glass well of the sorbent module to monitor temperature of the trap?	✓			The temperature is 42 °F.
Additional Questions and Comments:				
Train Components				
1. Is the sorbent module followed by a condensate knockout trap?	✓			
2. Is stack gas moisture being monitored with four 500 mL impingers following the knockout trap? List the impinger solutions.				First impinger is empty. Second and third impingers contained 200 mL of HPLC-DI water. Fourth impinger is empty. Fifth impinger 200 g of silica gel.
3. Is the metering system consisting of vacuum gauge, leak-free pump, thermometer, and dry gas meter, keeping the sampling rate of the MM5 train within 10% of isokinekticity?	✓			
4. Is the metering system determining the sample volume within 2% of the true volume?	✓			
5. Is the barometric pressure being recorded and corrected for elevation differences between the location of the barometric and the sampling point at a rate of -2.5 mm Hg per 30-m elevation increase (or +2.5 mm Hg per 30-m elevation decrease)?	✓			Barometric pressure is noted from the Met Station and at the truck.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
6. Is the stack gas temperature sensor attached to the pitot tube, such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not interfere with the pitot tube opening?	✓			
7. Are calibration and preparation data being recorded in a permanently bound laboratory notebook (i.e., filter and silica get tare weights, clean XAD-2, QA/QC check results, dry-gas meter, and thermocouple calibrations)?	✓			Noted in the data sheets but not in the bound notebook.
8. Is the train grease-free upstream of the module?	✓			
Additional Questions and Comments:				
Preparation of the Train				
1. Are the probe liner brushes provided at least as long as the probe?	✓			
2. Are the probe brushes made of nylon bristles and stainless steel wire handles with extensions?			✓	Probe brushes were made of nylon bristles.
3. Are the wash bottles made of Teflon or glass?			✓	Teflon bottles were used.
4. Are the sample storage bottles made of amber glass and screw-type Teflon lined caps?	✓			Amber glass bottles with Teflon-lined caps were used.
5. Are the filters made of glass or quartz fiber?	✓			Glass fiber filters were used.
6. Has the XAD-2 resin been cleaned prior to use and QC to a blank less than 4 mg/kg?	✓			Quanterra labs provided the XAD-2 cartridges.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
7. Is distilled organic-free water (Type II) provided for the impinger solutions?	✓			HPLC grade DI water was used.
8. Are the clean up solvents pesticide grade?	✓			Methylene chloride + methanol (50:50) pesticide grade solvents were used.
9. Are the filters desiccated at 20 ± 5.6 °C and ambient pressure for at least 24 hours, weighed at intervals of at least 6 hours to a constant weight (± 0.5 mg), and recorded at 0.1 mg?		✓		Weight of particulates is not measured with MM5 train.
10. Have the number of minimum sampling points been determined for each sampling location (inlet, outlet, and stack): What are the numbers?	✓			24 points.
11. Have the pitot lines been leak checked?	✓			Leak checked before and after the run and found to be leak free within the specifications.
12. Has the stack gas moisture content been determined? What is it?	✓			Stack gas moisture content at the silo tunnel is ~1-2 percent. The moisture is higher at silo exhaust.
13. Were there any nozzle changes during sampling?		✓		No nozzle changes during sampling. Nozzle diameter is 0.252 inches.
14. Is the sample volume as outlined in the sampling plan being pulled? What is it?	✓			0.75 ft^3/min for 4 hr at the silo tunnel. 0.75 ft^3/min for 2 hr at the silo exhaust.
15. Are all openings to the train kept covered with Teflon film prior to assembly?	✓			
16. Are the XAD-2 modules assembled off-site?	✓			XAD-2 modules were supplied by Quanterra labs. Assembled in the rack.
17. Is the filter placed in the filter holder with tweezers or while wearing surgical gloves?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
18. Is a pre-test leak check of the train administered?	✓			Noted in the data sheets.
19. If a train component is changed during sampling, is the train leak-checked prior to the change? Is the leakage rate less than 4% of the average sampling rate?		✓		No components were changed during sampling.
20. Is a post-test leak check performed? Is the leakage rate less than 4% of the sampling rate?	✓			Leak rate is 0.02 inch.
Additional Questions and Comments:				
Running the Train				
1. Is the sampling rate maintained within 10% of true isokinetic?	✓			
2. Is the filter maintained at 120 ± 14°C?	✓			
3. Is the sorbent module maintained at 17 ± 3°C?	✓			Ice water temperature was maintained. The module is covered with aluminum foil.
4. Are the dry gas meter readings recorded on field data sheets?	✓			Noted in the data sheets.
Additional Questions and Comments:				
Sample Recovery				
1. Is the filter removed from the filter holder and placed in an identified Petri dish container with tweezers?			✓	The filter was kept in an amber glass jar.
2. Is the filter folded with the filter cake inside?	✓			The filter is folded and kept in an amber glass jar.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
3. Is any particular matter adhering to the filter-holder gasket transferred to the Petri dish?	✓			The particulate matter adhering to the filter-holder gasket was transferred into the glass jar.
4. Is the Petri dish sealed and labeled container No. 1?			✓	The amber glass jar is sealed and labeled.
5. Is the particulate matter from the probe nozzle, probe fitting, probe liner, and front half of the filter holder recovered quantitatively by washing with (1:1 v/v) methanol/methylene chloride into a glass container? Labeled container No. 2?	✓			Collected into amber glass container and labeled. The liquid level is marked on the container with a pen.
6. Is a solvent blank retained and analyzed?	✓			
7. Is the sorbent module labeled container No. 3, capped, and packaged cold for shipment?	✓			The sorbent module weighed, labeled, and kept in blue ice.
8 Is the condensate from the back half of the filter module and the knockout trap measured and transferred to container No. 4?	✓			Collected into amber glass jar and labeled. The liquid level is marked on the jar with a pen.
9. Are the sample train components between the filter and the first wet impinger rinsed into container No. 5?	✓			
10. Is the silica gel transferred to container No. 6?	✓			Weighed for the moisture content; silica gel changed for each train.
11. Is the volume of the impinger water in the first three impingers measured to ± 1 ml and any color or film noted? Is the impinger catch discarded?	✓			No color or film was noticed. The impinger catch is saved in the glass jars.
12. Are all containers sealed and all shipped refrigerated except the filter?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
Additional Questions and Comments:				
J. SAMPLING GENERAL				
1. Is the duration of sampling sufficient to detect all important pollutant(s) generated by the process under investigation?	✓			Sampling for 4 hr at the silo 2 tunnel and 2 hr at the silo exhaust is quite sufficient.
2. Are there specified limits for which sampling will be stopped? Describe.			✓	Sampling will be stopped only when loading or process problems experienced at the site.
3. Were duplicate or replicate samples taken for each sampling location?		✓		One run was performed on each day.
4. Was the sampling performed in accordance with the approved QAPP?	✓			Generally followed the approved QAPP. However, few changes such as sampling rate at the silo exhaust testing were made at the site after EPA WAM authorization.
5. Do sample tracking numbers indicate when, how, and where the samples were collected?	✓			Labels were attached to the glass jars.
6. Are records available of who collected the sample?	✓			Noted in the data sheets.
7. Are field log books and laboratory log notebooks recorded in ink?		✓		Data sheets were used. Recorded legibly with ink.
8. Are audit histories recorded in the field log notebooks? — thermocouple — solid state temperature — wood scale performance — other			✓	Noted in the data sheets in the office.
Additional Questions and Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
K. QUALITY ASSURANCE/QUALITY CONTROL/GENERAL				
1. Have there been any changes in the project organization and the personnel as outlined in the QAPP?		✓		
2. Are there written plans to report changes in the QAPP during data-gathering activities?	✓			
3. Were field biased blanks and/or trip blanks used?	✓			One field blank was collected.
4. Calibration information and data sheets available for: — Probe/nozzle — Type-S pitot — Meter Box including: dry gas meter and thermocouple — Barometer			✓	Data sheets will be given.
Additional Questions and Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
L. SAMPLE CUSTODY AND INTEGRITY				
1. Is there an SOP or other source of documentation which describes the organization's sample custody procedures?	✓			There is no SOP at the site. However, sample custody data sheets and procedures are available.
2. Are records available of when, how, and where the sample was collected?	✓			Data sheets are available. Information is noted in the data sheets and labeled on the bottles.
3. Are records available of who collected the sample?	✓			Recorded on the data sheets.
4. Who is the field custodian for the samples? (Name)			✓	Jairo Barreda, a summer intern, is responsible for the shipping and sample custody.
5. Are samples individually identified by number or code so that they can be traced?	✓			Labels are electronically made, printed for each run with identification, and affixed to the glass jars.
6. Were deviations (if any) from all SOPs or protocols properly documented?			✓	Recorded by the Task Manager in a small notebook. It would have been better if the train operators noted on the data sheets also.
7. Sample liquid levels marked on each container such that the mark can be seen on the container or on the label itself.	✓			Marked with a pen on the container.
8. Sample container lids sealed on outside with Teflon tape and sample label covered with solvent resistant tape?	✓			Solvent-resistant tape is not used to cover the sample label.
9. Are integrity seals affixed over the caps of each container?		✓		Labels are affixed on the side of the glass jar.
10. Are seals signed and numbered by recovery person?		✓		Seals are not signed. Numbered on the labels.
Additional Questions and Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
M. MISCELLANEOUS MEASUREMENTS - Wind Speed, Wind Direction, Ambient Temperature and Humidity				
1. Is the meteorological station operated according to the manufacturer's specification?	✓			
2. Is the manufacturer's specifications manual available at the site?	✓			
3. Are the readings recorded continuously through out the test period?	✓			Recorded on a data-logger.
4. Was the wind speed measured and calibrated?	✓			Calibrated at the office but not at the site.
5. How the wind direction measured and calibrated?			✓	Calibrated at the office but not at the site.
6. How the temperature is measured and what is the range?			✓	Thermometer -50 to 50 °C
7. Is the ambient humidity measured once per test run by wet bulb using a sling psychrometer and properly recorded?			✓	Measured once in the beginning and once at the end of the day.
Additional Questions and Comments: The MET Station was kept at the top of the load-out tunnel near the entrance.				
N. Estimation of Particulate Deposition on the Ceiling of the Load-Out Tunnel Downstream and Silo No. 5				
1. Is one test plate for each section is installed properly in the beginning of the test program?	✓			
2. Are the test plates and ceiling sections cleaned with acetone properly in the beginning and at the end of the test program?	✓			

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
3. Have they collected three acetone rinse samples and analyzed gravimetrically?				Analysis will be performed in the office.

Additional Questions and Comments:

Measured the distance from Silo No. 5 to the end of the tunnel which is approximately 57 feet. Divided the distance into three equal areas. Three test plates and ceiling sections were cleaned with acetone. Each test plate is screwed to the top of the roof at 19 feet distance from one another on 7/2/98 morning. They were removed on 7/26/98 and rinsed with acetone and will be analyzed gravimetrically.

O. Estimation of Particulate Deposition on the Inside Walls of Loud-Out-Tunnel Exhaust Plenum

1. Are six pieces of box pipe installed properly inside the exhaust plenum under Silo No. 3 in the beginning of the test program?	✓			Charged under Silo No. 2 on 7/23/98 and removed on 7/26/98 morning.
2. Are the box pipes and installation sections cleaned with acetone properly in the beginning and at the end of the test program?	✓			Installation sections were not cleaned at the end of the test program.
3. Have they collected six acetone rinse samples and analyzed gravimetrically?	✓			Acetone rinse samples will be analyzed later in the laboratory.

Additional Questions and Comments:

Installed at the downstream of the exhaust plenum.

P. Estimation of Particulate Deposition on the Inside Walls of the Temporary Silo Exhaust and Wind Tunnel Exhaust

1. Have they collected one acetone rinse sample from inside walls of the temporary silo exhaust and four samples from the wind tunnel exhaust?	✓			One was kept at the silo exhaust and three samples were taken from the wind tunnel exhaust.

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
2. Have they cleaned the areas and installed the test plates properly?	✓			
Additional Questions and Comments: Old silo exhaust pipe was cleaned and taken for metals analysis.				
Q. Direct Interface Portable GC/MS				
1. Is heated sample line used to draw the sample into the GC/MS?		✓		Teflon lines were used at ambient temperature.
2. How the instrument was calibrated?			✓	Calibrated with 36 compounds in the laboratory. Checked with 9 component mixture at the field site daily.
3. What is the flow rate and sample volume collected?			✓	Sample is drawn at 2 L/min. Subsequently 150 cm^3/min is diverted into the mass spectrometer. A 20-30 µL sample was used to inject into the GC.
4. How is the sample concentrated?			✓	No concentration step.
5. Is the thermal desorption technique used and at what temperature it was desorbed?			✓	No concentration step. Therefore, thermal desorption is not required.
6. Are there blank runs performed?	✓			Nitrogen blank daily was performed.
7. How is the moisture interference that was eliminated or minimized during the analysis?				Up to 8 percent moisture levels, no conditioning is required. Above that day the sample used an impinger before introducing it into GC/MS.
Additional Questions and Comments: 1. GC/MS runs were done at silo tunnel, silo exhaust, ambient air, end of the tunnel, and dryer exhaust. 2. Lot of moisture was condensed at the silo exhaust and dryer exhaust. Impinger was used to collect the water. Linearity checked in the laboratory, 6 injections ±20 percent RSD.				

AUDIT QUESTIONS	RESPONSE			COMMENT
	Y	N	N A	
Additional Questions and Comments: Column used: SPB-1 3-inch wound capillary column sample drawn through 0.3 μm glass fiber filter. Detection limits vary from compound to compound.				

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

1 REPORT NO	2	3 RECIPIENT'S ACCESSION NO.
EPA-454/R-00-026		

4 TITLE AND SUBTITLE	5 REPORT DATE
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15 SUPPLEMENTARY NOTES

16 ABSTRACT

The United States Environmental Protection Agency (EPA) Emission Factors and Inventory Group (EFIG) is investigating the Hot Mix Asphalt industry to identify and quantify criteria and hazardous air pollutants (HAP's) emitted from transport truck loading and silo filling. EFIG requested that EPA's Emission Measurement Center (EMC) conduct the required testing. Under separate EPA contracts, Midwest Research Institute (MRI) and Pacific Environmental Services (PES) performed this emissions testing. An independent technical systems audit was performed as part of the quality assurance evaluation of this testing effort. The EMC issued a work assignment to Research Triangle Institute (RTI) to perform this technical system audit. The primary objective of the testing program was to characterize uncontrolled emissions of the criteria pollutants particulate matter (PM) and total hydrocarbons (THC) and emissions of volatile and semi-volatile organic HAP's including polycyclic organic matter, phenol, benzene, toluene, xylene, ethylbenzene, 2-butanone, cumene, formaldahyde, hexane, isooctane and others.

This report includes a summary of the independent audit results and detailed Technical Systems Audit checklists of the evaluations RTI performed of the testing by MRI and PES.

17 KEY WORDS AND DOCUMENT ANALYSIS

a DESCRIPTORS	b IDENTIFIERS/OPEN ENDED TERMS	c COSATI Field/Group
Hot Mix Asphalt Silo Filling Truck Loading Particulate Matter Volatile Organic Compounds Total Hydrocarbons Hazardous Air Pollutants Polycyclic Organic Matter	Air Pollution control	

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