Report
Air Quality
Performance Audits
for
Energy Fuels Resources Corporation

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Pinyon Ridge Mill Site
Montrose County, CO

July 2008

Prepared by

VSI
729 W. Lynwood St
Phoenix, AZ 85007

EXECUTIVE SUMMARY

A performance audit of the air quality systems at five locations near the Energy Fuels Resources Corporation's Pinyon Ridge Mill Site in Montrose County, Colorado was accomplished on July 30, 2008; personnel from VSI performed the audits. Results of the audit indicated compliance with the EPA Guidelines or Manufacturer's Recommendations for all air quality parameters. Details of the audit results are discussed in latter sections of this report.

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INTRODUCTION

A performance audit of the air quality systems at five locations near the Energy Fuels Resources Corporation's Pinyon Ridge Mill Site in Montrose County, Colorado was accomplished on July 30, 2008. The location of the project and monitoring sites are presented in Figures 1 and 2. The monitoring locations, the parameters monitored and their latitude/longitude are listed below.

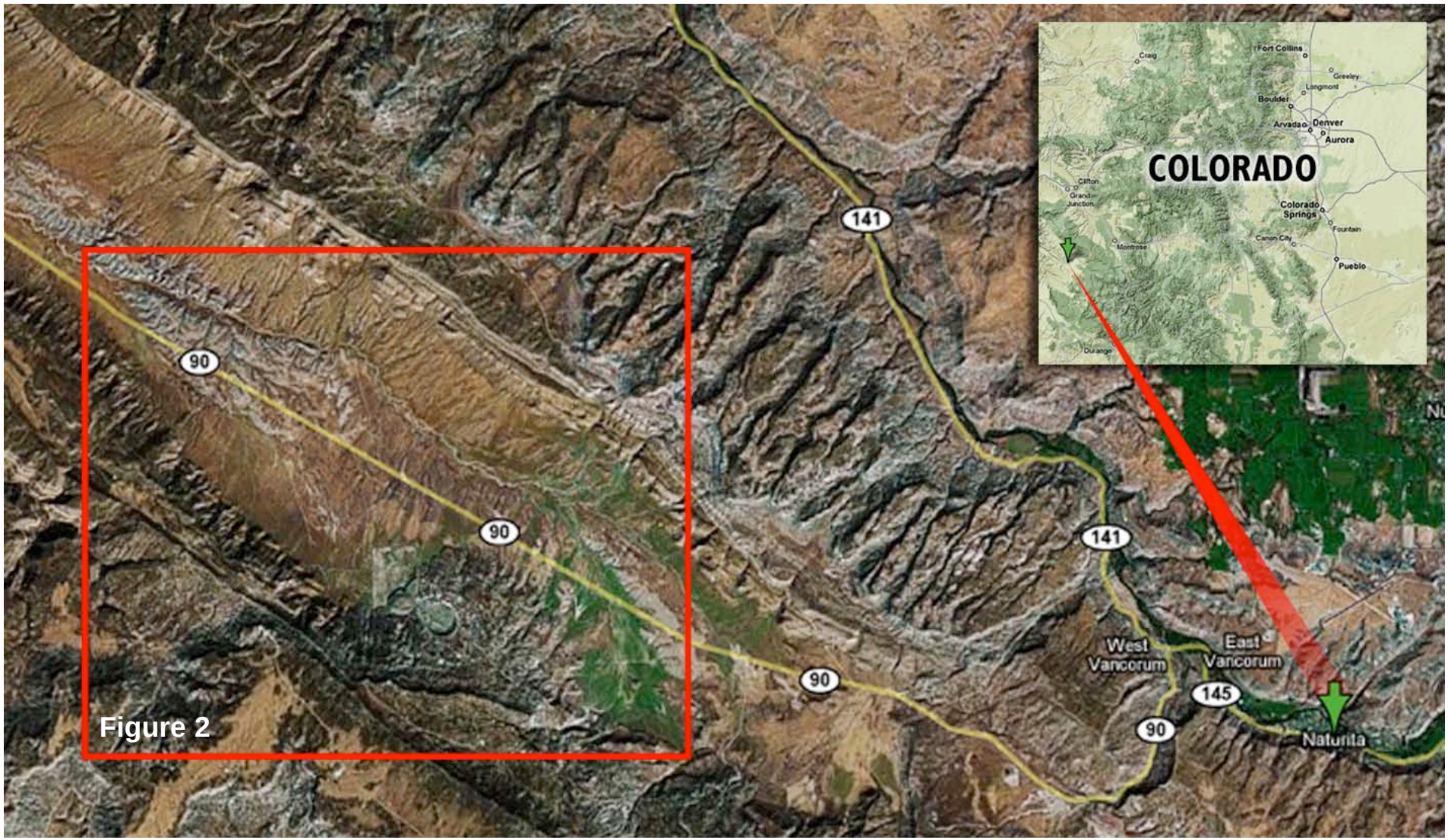
Site No.	Description / Parameters
1	North Site: 10-meter tower (Met/Air Quality) Latitude/Longitude: N 38° 15.862' W 108° 46.091'
2	East Site: 30-meter tower (Met/Air Quality) Latitude/Longitude: N 38° 14.729' W 108° 45.626'
3	West Site (Air Quality) Latitude/Longitude: N 38° 14.912' W 108° 46.638'
4.	Northwest Residence: (Air Quality) Latitude/Longitude N 38° 16.881' W 108° 48.392'
5.	Southeast Residence: (Air Quality) Latitude/Longitude N 38° 13.335' W 108° 42.789'

All equipment and forms required for the audit were provided by VSI. Copies of the certificates of traceability to the National Institute of Standards and Technology (NIST) for the audit devices are included in Appendix A; copies of the completed audit forms are provided in Appendix B.

The procedures and tolerances used during the audit followed the general guidelines of *EPA-600/R-94/038d, Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Meteorological Measurements; EPA-450/4-87-007, Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-454/R-99-005, Meteorological Monitoring Guidance for Regulatory Modeling Applications;* and equipment manufacturer recommendations.

The discussions that follow describe those activities performed by VSI in the completion of the audit, the associated results, and instrumentation accuracies.

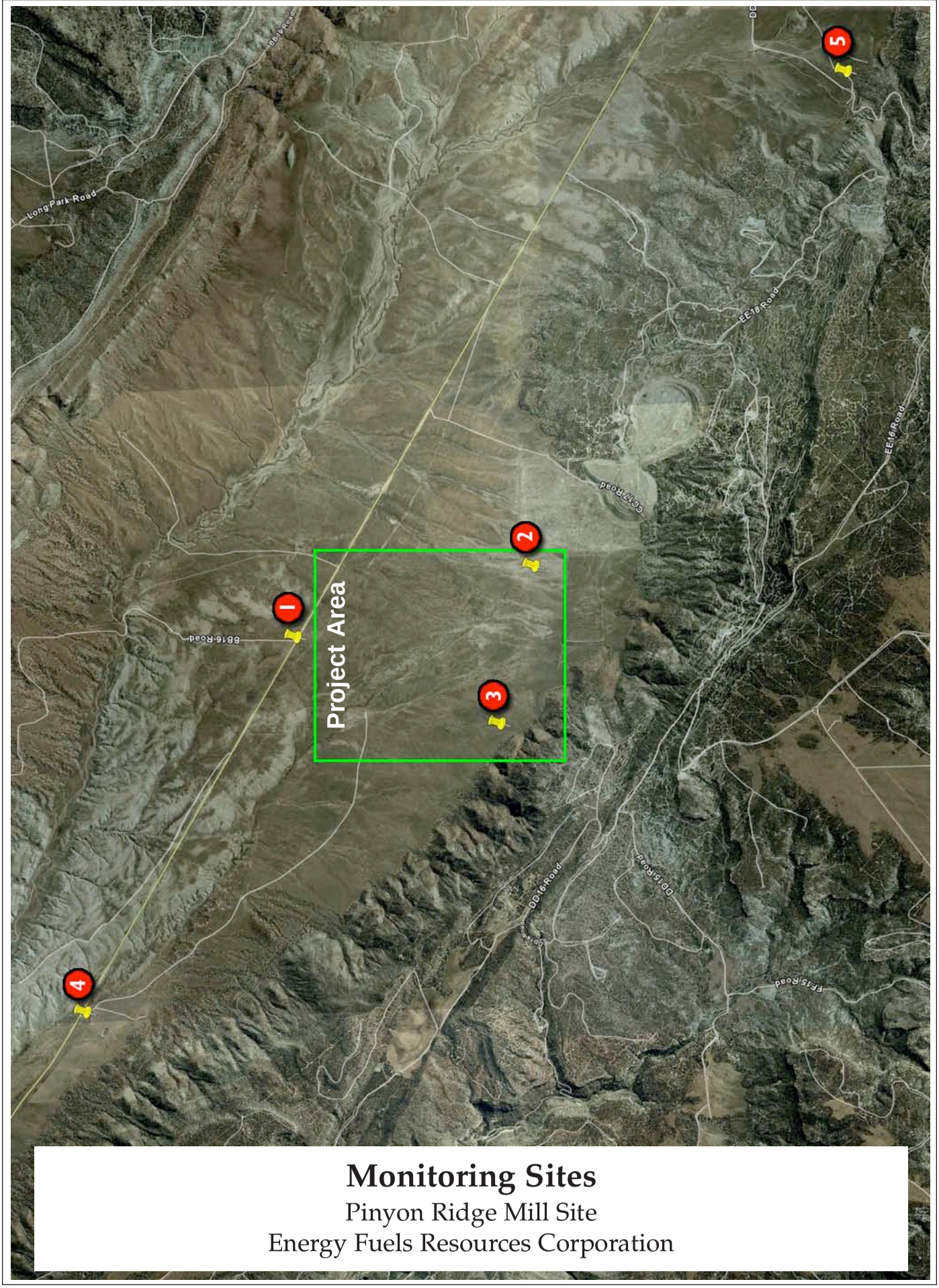
Not to scale



Project Location

Pinyon Ridge Mill Site
Energy Fuels Resources Corporation

Figure 1



Monitoring Sites

Pinyon Ridge Mill Site

Energy Fuels Resources Corporation

Figure 2

AUDIT ACTIVITIES AND RESULTS

AIR QUALITY INSTRUMENTATION

PM_{10}

The audit of the PM_{10} Partisol Samplers at Sites 1 and 2 included checks of the samplers' flows, internal and external temperature sensors and pressure sensors. The audit of the samplers' flows was accomplished by removing the inlet, installing a flow adapter and flow meter. The sampler was then activated and allowed to operate for a few minutes. Five flow readings, each an average of 10 readings, were then recorded to provide an indication of the sampler flow rate and stability. Audit flows from samplers at both locations were within the manufacturer's guidelines; copies of the audit forms are included in Appendix B.

The audit of the internal and external temperature sensors was accomplished by measuring the ambient temperature adjacent to the sensor probe. The audit device was a mercury thermometer with a resolution of $0.2^{o}F$. Results of the audit indicated that the temperature sensors from both samplers were within the manufacturer's guidelines.

The audit of the barometric pressure sensors of both units indicated agreement with a collocated transfer standard (CTS) within the manufacturer's guideline of $\pm$10 mmHg.

TSP

Volumetric flow-controlled (VFC) samplers are used to collect total suspended particulate matter (TSP) at all five sites. The audit of the samplers was accomplished by placing an audit orifice and faceplate directly on the filter cassette and a new, clean filter. The sampler was then activated and allowed to operate for a few minutes. After allowing the sampler to operate for approximately 5 minutes, a manometer reading was taken from the audit orifice and, based on the calibration curve for the orifice, audit flow rates were determined for the site conditions, Q_a. The site flow was derived using a pressure-temperature factor to correct the orifice-indicated flow rate from standard conditions to the site conditions. The audit flow (Q_a) was then compared with the indicated flow derived by the operator during the audit.

The audit of the samplers at all sites showed that the audit flow rates were within tolerance with the indicated flow rates. A summary of the results for the samplers is provided in a later section; copies of the forms are included in Appendix B.

INSTRUMENTATION ACCURACIES

Previously each of the parameters was reported as either meeting or a given tolerance. This section lists the accuracies for each parameter and the corresponding tolerance; the accuracies are for the audited range, not necessarily for the total range of the sensor.

SITE 1

Air Quality Instrumentation

Partisol-PM_{10}

Flow Difference (%)	Tolerance
+0.00/-0.27	±5%

Temp (ext) Difference (^{o}C)	Tolerance
+0.0/-0.3	±2^{o}C

Temp (int) Difference (^{o}C)	Tolerance
+0.0/-0.1	±2^{o}C

Pressure Difference (mmHg)	Tolerance
+0.0/-4.0	±10mmHg

TSP

Audit Flow Difference (%)	Tolerance
+3.44 / -0.00	±7%

SITE 2

Air Quality Instrumentation

Partisol-PM_{10}

Flow Difference (%)	Tolerance
+0.00/-1.15	±5%

Temp (ext) Difference (^oC)	Tolerance
+0.0/-0.1	±2^oC

Temp (int) Difference (^oC)	Tolerance
+0.0/-0.2	±2^oC

Pressure Difference (mmHg)	Tolerance
+0.0/-2.8	±10mmHg

TSP

Audit Flow Difference (%)	Tolerance
+0.00 / -0.80	±7%

Site 3

Air Quality Instrumentation

TSP

Audit Flow Difference (%)	Tolerance
+0.00 / -3.33	±7%

Site 4

Air Quality Instrumentation

TSP

Audit Flow Difference (%)	Tolerance
+0.00 / -0.95	±7%

Site 5

Air Quality Instrumentation

TSP

Audit Flow Difference (%)	Tolerance
+0.00 / -1.86	±7%

APPENDIX A

Certificates of Traceability

TISCH ENVIROMENTAL, INC.
145 SOUTH MIAMI AVE.
VILLAGE OF CLEVES, OH 45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX
WWW.TISCH-ENV.COM

AIR POLLUTION MONITORING EQUIPMENT

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5028A

Date - Oct 05, 2007 Rootsmeter S/N 9833620 Ta (K) - 296
Operator Tisch Orifice I.D. - E62 Pa (mm) - 755.65

PLATE OR VDC #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.3080	4.0	1.50
2	NA	NA	1.00	1.0160	6.5	2.50
3	NA	NA	1.00	0.9300	7.8	3.00
4	NA	NA	1.00	0.8640	9.2	3.50
5	NA	NA	1.00	0.6530	15.7	6.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
0.9956	0.7612	1.2254		0.9946	0.7604	0.7665
0.9923	0.9767	1.5819		0.9913	0.9757	0.9896
0.9906	1.0651	1.7329		0.9896	1.0641	1.0840
0.9888	1.1445	1.8718		0.9878	1.1433	1.1709
0.9802	1.5010	2.4507		0.9792	1.4995	1.5331
Qstd slope (m) =		1.65810		Qa slope (m) =		1.03828
intercept (b) =		-0.03437		intercept (b) =		-0.02150
coefficient (r) =		0.99987		coefficient (r) =		0.99987
y axis = SQRT[H2O(Pa/760)(298/Ta)]				y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
Qa = Va/Time

For subsequent flow rate calculations:

Qstd = 1/m{[SQRT(H2O(Pa/760)(298/Ta))]- b}
Qa = 1/m{[SQRT H2O(Ta/Pa)]- b}

Bios International Corporation • 10 Park Place, Butler, NJ 07405 USA
Phone (973) 492 8400 Fax (973) 492 8270 Web www.biosint.com

calibration certificate

Report No. 21360
Product DCL-H
Serial No. 4916
Mfg. Date October 30, 2003

DryCal DC1, DC2 and DC Lite Flow Calibrators are all calibrated using the same methodology. Each device is dynamically tested by comparing it to a Laboratory Standard primary piston prover of much higher accuracy, (±0.25%) but of similar operating principles. Flow generators of ±0.003% stability (included in prover accuracy) are used for the comparison. Use of provers of similar construction to the devices under test assures the validity of the flow generator as a transfer standard.

The primary Laboratory Standards are qualified by direct measurement of their dimensions (diameter, length of measured path, time base) against NIST-traceable gauges and instruments. A rigorous analysis of their accuracy in accordance with the International Guide to Uncertainty in Measurements has been performed assuring their traceable accuracy. Test procedures assure temperature matching of the Laboratory Standards and the devices under test.

Calibration Standards Used

Asset Number	Description	Cal Date	Due Date
ML-500-10 1064	ML-500 Low Flow Cell	4/1/2003	4/1/2004
ML-500-24 1086	ML-500 Medium Flow Cell	4/1/2003	4/1/2004
ML-500-44 1070	ML-500 High Flow Cell	4/1/2003	4/1/2004

All units calibrated in accordance with Bios International Corporation test number PR01-10 Rev B.
Expanded uncertainty ±0.25% at two times coverage.

As Shipped Test Data:

Laboratory Environment:

Temperature Ambient: 22.78°C Pressure Ambient: 757.27 mmHg Humidity Ambient: 40 %

Instrument Reading ml/min	Lab Standard Reading ml/min	Lab Standard Unit #	Deviation Percentage	Allowable Deviation	Condition Shipped
503.2	500.4	1086	0.56	1.00%	in tolerance
2018	2007.5	1070	0.52	1.00%	in tolerance
4967	5007.5	1070	-0.81	1.00%	In tolerance
17080	17060	1070	0.12	1 00%	in tolerance
30160	30085	1070	0.25	1 00%	in tolerance

Calibration Notes

By: _____ Calibration Date: 10/30/03

Zenaida Ortiz
Calibration Technician

All calibrations performed in accordance with ISO 17025.

The Quality People
Since 1955

National Calibration Inc.

3737 East Broadway Road
Phoenix, AZ 85040
(602) 437-0114

ONLINE RECORDS powered by CalHub

Calibration Report

Report No: 97229 Order No: 20688-82012

Customer:	David Pekara 3810 W. Walt Ann Ln. Phoenix, AZ 85053	**Calibration Date:**	07/13/2008
		Recall Date:	07/13/2009
		Ambient Temperature:	71°F
		Relative Humidity:	41%
Equipment Type:	Precision Thermometer	**Received:**	In Tolerance
Make:	Ertco	**Returned:**	In Tolerance
Model:	1002-3	**Received Condition:**	Fair
Asset Number:	98-207	**Accuracy:**	±0.2°F
Serial Number:	98-207		
Procedure:	33K5-4-42-1		
Technician:	Thomas, Danny	**Authorized By:**	

The accuracy of this instrument has been verified under the conditions stated above in ANSI/ISO/IEC 17025:2005. Our standards have traceability to NIST or an international, or intrinsic standard and evidence is on file at our Metrology Laboratory. Unless stated otherwise, the collective uncertainty of the measurement process does not exceed 25% of the tolerance allowed for the individual characteristics measured. The stated uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. The results relate only to the item being calibrated. This certificate shall not be reproduced, except in full, without the written approval of National Calibration Inc.

Standards Used

Asset	Make	Model	Description	Cal Date	Due Date
7000400	Hart Scientific	1502A	Digital Thermometer Readout	07/14/2008	7/14/2009

Test Data

Standard Equipment Reading	Unit Under Test Reading	Error	Standard Equipment Reading	Unit Under Test Reading	Error
°F	°F	°F			
32.121	32	0.121			
60.109	60	0.109			
90.076	90	0.076			
120.114	120	0.114			

Readings are as found / as left

CHECK OF BAROMETRIC PRESSURE SENSOR

Manuf./Model: Garmin/Etrex GPS
Serial No.: 79524134

DATE	READING	NWS-El PASO	Garmin GPS
04/17/02	Station Prs.	873 mb	873 mb
10/20/02	Station Prs.	872 mb	873 mb
04/14/03	Station Prs.	873 mb	873 mb
07/14/03	Station Prs.	873 mb	873 mb
01/26/04	Station Prs.	877 mb	877 mb
07/27/04	Station Prs.	875 mb	875 mb
01/24/05	Station Prs.	883 mb	882 mb
07/18/05	Station Prs.	872 mb	871 mb
10/24/05	Station Prs.	881 mb	880 mb
01/30/06	Station Prs.	876 mb	875 mb
07/17/06	Station Prs.	878 mb	877 mb
01/29/07	Station Prs.	872 mb	873 mb
07/16/07	Station Prs.	873 mb	872 mb
01/21/08	Station Prs.	874 mb	873 mb
7/21/08	Station Prs.	874 mb	873 mb

Appendix B

Performance Audit Forms

Appendix B – 1

Site 1

PERFORMANCE AUDIT: TSP SAMPLER (VFC)

SAMPLER:

MANUF./MODEL: Tisch/TE-5170V-BL

SERIAL NO: 7152

OWNER: ENERGY FUELS

LOCATION: SITE 1

DATE: 07/30/08

BY: VSI

			INITIAL	FINAL	AVERAGE
ORIFICE MODEL:	25A	TEMPERATURE (T_0):	31.2	32.0	31.6 ^{0}C
SERIAL NO.:	E62	PRESSURE (P_0):	625.0	624.9	625.0 mmHg
CAL DATE:	10/05/07				
SLOPE (m):	1.03828				
INTERCEPT (b):	-0.02150				
CORRELATION (r):	0.99987				

ORIFICE MANOMETER (in. H_20)			FLOWS	
LEFT	RIGHT	TOTAL	Q_a (cmm)	Q_{ind} (cmm)
1.50	1.40	2.90	1.166	1.206

AUDIT FLOW % DIFF.
3.44

GUIDELINE: ± 7%

T_0 : Ambient Temperature (^{0}C)

$^0C = (^0F-32)*5/9$

P_0 : Ambient Pressure (mm Hg)

mm Hg = inches Hg * 25.4

$P_1 = P_o - \Delta P$

ΔH = Total Manometer (inches H_2O)

$Q_a = [1/m]*[[(\Delta H*(T_0+273.16)/P_o]^{1/2} - b]$

Audit % Difference = $[(Q_{ind} - Q_a)/Q_a] * 100$

where: Q_a = actual flow (from orifice)

Q_{ind} = indicated flow

PERFORMANCE AUDIT: PARTICULATE MATTER (PM_{10})

SENSOR:
Manuf./Model: R&P/Partisol 2000 - PM_{10}
Serial No.: 200FB208060708

OWNER: ENERGY FUELS
LOCATION: SITE 1 (10M)
DATE: 07/30/08
BY: VSI

AUDIT DEVICES:

FLOW:
Manuf./Model: BIOS/DCL-H
Serial Nc 4916

TEMP:
Manuf./Model: ERTCO/1003-3
Serial No.: 7296

FLOW AUDIT:

INDICATED FLOW (lpm)	AUDIT FLOW (lpm)	DIFFERENCE (%)
16.6	16.6	0.27

TOLERANCE: ±5%

TEMP (EXT) AUDIT:

INDICATED TEMP (°C)	AUDIT TEMP (°C)	DIFFERENCE (°C)
30.9	31.2	-0.3

TOLERANCE: ±2°C

TEMP (INT) AUDIT:

INDICATED TEMP (°C)	AUDIT TEMP (°C)	DIFFERENCE (°C)
31.6	31.7	-0.1

TOLERANCE: ±2°C

PRESSURE AUDIT:

INDICATED PRS. (mmHg)	AUDIT PRS.(mmHg)	DIFFERENCE (mmHg)
621	625.0	-4.0

TOLERANCE: ±10mmHg

Appendix B – 2

Site 2

PERFORMANCE AUDIT: TSP SAMPLER (VFC)

SAMPLER:

MANUF./MODEL: Tisch/TE-5170V-BL

SERIAL NO: 7152

OWNER: ENERGY FUELS

LOCATION: SITE 2

DATE: 07/30/08

BY: VSI

			INITIAL	FINAL	AVERAGE
ORIFICE MODEL:	25A	TEMPERATURE (T_0):	33.8	33.9	33.9 ^{0}C
SERIAL NO.:	E62	PRESSURE (P_0):	622.8	622.5	622.6 mmHg
CAL DATE:	10/05/07				
SLOPE (m):	1.03828				
INTERCEPT (b):	-0.02150				
CORRELATION (r):	0.99987				

ORIFICE MANOMETER (in. H_20)			FLOWS	
LEFT	RIGHT	TOTAL	Q_a (cmm)	Q_{ind} (cmm)
1.50	1.40	2.90	1.172	1.163

AUDIT FLOW % DIFF.
-0.80

GUIDELINE: ± 7%

T_0 : Ambient Temperature (^{0}C)

$^0C = (^0F-32)*5/9$

P_0 : Ambient Pressure (mm Hg)

mm Hg = inches Hg * 25.4

$P_1 = P_o - \Delta P$

ΔH = Total Manometer (inches H_2O)

$Q_a = [1/m]*[[(\Delta H*(T_0+273.16)/P_o]^{1/2} - b]$

Audit % Difference = $[(Q_{ind} - Q_a)/Q_a] * 100$

where: Q_a = actual flow (from orifice)

Q_{ind} = indicated flow

PERFORMANCE AUDIT: PARTICULATE MATTER (PM_{10})

SENSOR:
Manuf./Model: R&P/Partisol 2000 - PM_{10}
Serial No.: 200FB208130708

OWNER: ENERGY FUELS
LOCATION: SITE 2 (30M)
DATE: 07/30/08
BY: VSI

AUDIT DEVICES:

FLOW:
Manuf./Model: BIOS/DCL-H
Serial Nc 4916

TEMP:
Manuf./Model: ERTCO/1003-3
Serial No.: 7296

FLOW AUDIT:

INDICATED FLOW (lpm)	AUDIT FLOW (lpm)	DIFFERENCE (%)
16.7	16.9	-1.15

TOLERANCE: ±5%

TEMP (EXT) AUDIT:

INDICATED TEMP (ºC)	AUDIT TEMP (ºC)	DIFFERENCE (ºC)
32.9	33.0	-0.1

TOLERANCE: ±2ºC

TEMP (INT) AUDIT:

INDICATED TEMP (ºC)	AUDIT TEMP (ºC)	DIFFERENCE (ºC)
33.6	33.8	-0.2

TOLERANCE: ±2ºC

PRESSURE AUDIT:

INDICATED PRS. (mmHg)	AUDIT PRS.(mmHg)	DIFFERENCE (mmHg)
620	622.8	-2.8

TOLERANCE: ±10mmHg

Appendix B – 3

Site 3

PERFORMANCE AUDIT: TSP SAMPLER (VFC)

SAMPLER:

MANUF./MODEL: Tisch/TE-5170V-BL

SERIAL NO: 7152

OWNER: ENERGY FUELS

LOCATION: SITE 3

DATE: 07/30/08

BY: VSI

			INITIAL	FINAL	AVERAGE	
ORIFICE MODEL:	25A	TEMPERATURE (T_0):	33.8	33.8	33.8	^{0}C
SERIAL NO.:	E62	PRESSURE (P_0):	622.2	622.2	622.18	mmHg
CAL DATE:	10/05/07					
SLOPE (m):	1.03828					
INTERCEPT (b):	-0.02150					
CORRELATION (r):	0.99987					

ORIFICE MANOMETER (in. H_20)			FLOWS	
LEFT	RIGHT	TOTAL	Q_a (cmm)	Q_{ind} (cmm)
1.50	1.40	2.90	1.173	1.133

AUDIT FLOW % DIFF.
-3.36

GUIDELINE: ± 7%

T_0 : Ambient Temperature (^{0}C)

$^0C = (^0F-32)*5/9$

P_0 : Ambient Pressure (mm Hg)

mm Hg = inches Hg * 25.4

$P_1 = P_o - \Delta P$

ΔH = Total Manometer (inches H_2O)

$Q_a = [1/m]*[[(\Delta H*(T_0+273.16)/P_o]^{1/2} - b]$

Audit % Difference = $[(Q_{ind} - Q_a)/Q_a] * 100$

where: Q_a = actual flow (from orifice)

Q_{ind} = indicated flow

Appendix B – 4

Site 4

PERFORMANCE AUDIT: TSP SAMPLER (VFC)

SAMPLER:

MANUF./MODEL: Tisch/TE-5170V-BL

SERIAL NO: 7152

OWNER: ENERGY FUELS

LOCATION: SITE 4

DATE: 07/30/08

BY: VSI

			INITIAL	FINAL	AVERAGE
ORIFICE MODEL:	25A	TEMPERATURE (T_0):	36.1	36.3	36.2 ^{0}C
SERIAL NO.:	E62	PRESSURE (P_0):	628.9	628.9	628.9 mmHg
CAL DATE:	10/05/07				
SLOPE (m):	1.03828				
INTERCEPT (b):	-0.02150				
CORRELATION (r):	0.99987				

ORIFICE MANOMETER (in. $H_2$0)			FLOWS	
LEFT	RIGHT	TOTAL	Q_a (cmm)	Q_{ind} (cmm)
1.50	1.40	2.90	1.171	1.160

AUDIT FLOW % DIFF.
-0.95

GUIDELINE: ± 7%

T_0 : Ambient Temperature (^{0}C)

$^0C = (^0F-32)*5/9$

P_0 : Ambient Pressure (mm Hg)

mm Hg = inches Hg * 25.4

$P_1 = P_o - \Delta P$

ΔH = Total Manometer (inches H_2O)

$Q_a = [1/m]*[[(\Delta H*(T_0+273.16)/P_o]^{1/2} - b]$

Audit % Difference = $[(Q_{ind} - Q_a)/Q_a] * 100$

where: Q_a = actual flow (from orifice)

Q_{ind} = indicated flow

Appendix B – 5

Site 5

PERFORMANCE AUDIT: TSP SAMPLER (VFC)

SAMPLER:

MANUF./MODEL: Tisch/TE-5170V-BL

SERIAL NO: 7152

OWNER: ENERGY FUELS

LOCATION: SITE 5

DATE: 07/30/08

BY: VSI

			INITIAL	FINAL	AVERAGE
ORIFICE MODEL:	25A	TEMPERATURE (T_0):	26.7	27.9	27.3 ^{0}C
SERIAL NO.:	E62	PRESSURE (P_0):	620.2	620.2	620.2 mmHg
CAL DATE:	10/05/07				
SLOPE (m):	1.03828				
INTERCEPT (b):	-0.02150				
CORRELATION (r):	0.99987				

ORIFICE MANOMETER (in. H_20)			FLOWS	
LEFT	RIGHT	TOTAL	Q_a (cmm)	Q_{ind} (cmm)
1.60	1.40	3.00	1.182	1.160

AUDIT FLOW % DIFF.
-1.86

GUIDELINE: ± 7%

T_0 : Ambient Temperature (^{0}C)

$^0C = (^0F-32)*5/9$

P_0 : Ambient Pressure (mm Hg)

mm Hg = inches Hg * 25.4

$P_1 = P_o - \Delta P$

ΔH = Total Manometer (inches H_2O)

$Q_a = [1/m]*[[(\Delta H*(T_0+273.16)/P_o]^{1/2} - b]$

Audit % Difference = $[(Q_{ind} - Q_a)/Q_a] * 100$

where: Q_a = actual flow (from orifice)

Q_{ind} = indicated flow

Energy Fuels Resources Corporation
Piñon Ridge Mill

Calibration Report for
Ambient Air Monitoring Network

3rd Quarter 2008

Prepared by:

IML Air Science
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka
Sheridan, Wyoming 82801
(307) 674-7506
www.imlairscience.com

1 Introduction

Inter-Mountain Laboratories – Air Science Division performed calibrations on July 30, 2008. The calibrations included all (5) of the ambient air monitoring systems at the Piñon Ridge Mill Site located approximately 15 miles from Naturita, Colorado. The Piñon Ridge Mill Site is operated by Energy Fuels Resources Corporation. This is a list of the monitoring sites and the associated equipment:

Site 1

- Meteorological Station – 10m Tower
  - Wind Speed
  - Wind Direction
  - Vertical Wind Speed
  - Temperature (2m & 10m)
  - Delta Temperature
  - Relative Humidity
  - Solar Radiation
  - Barometric Pressure
  - Precipitation
  - Evaporation
- PM_{10} Sampler – Thermo FRM 2000 PM_{10}
- TSP Sampler – Tisch Hi-Vol 5170

Site 2

- Meteorological Station – 30m Tower
  - Wind Speed
  - Wind Direction
  - Vertical Wind Speed
  - Temperature (2m & 30m)
  - Delta Temperature
  - Relative Humidity
  - Solar Radiation
  - Barometric Pressure
- PM_{10} Sampler – Thermo FRM 2000 PM_{10}
- TSP Sampler – Tisch Hi-Vol 5170

Site 3

- TSP Sampler – Tisch Hi-Vol 5170

Site 4

- TSP Sampler – Tisch Hi-Vol 5170

Site 5

- TSP Sampler – Tisch Hi-Vol 5170

1.1 Calibration Reference

The calibrations were conducted in accordance with the following guideline documents:

- Ambient Monitoring Guidelines for the Prevention of Significant Deterioration (PSD), May 1987
- Environmental Protection Agency (EPA) Meteorological Monitoring Guidance for Regulatory Modeling Applications, February 2000 (MMGRMA) (EPA-454/R-99-005)
- Quality Assurance Handbook for Air Pollution Measurements Systems, Vol. IV – Meteorological Measurements, September 1989
- Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. V, Meteorological Measurements, EPA 1995
- Ambient Air Monitoring Requirements for the Air Pollution Control Division of the Colorado Department of Public Health and Environment, Technical Services Program Air Pollution Control Division, April 2001
- U.S. Nuclear Regulatory Commission Regulatory Guide, Office of Standards Development, Regulatory Guide 4.14 – Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1, April 1980
- U.S. Nuclear Regulatory Commission Regulatory Guide, Office of Nuclear Regulatory Research, Regulatory Guide 3.63 – Onsite Meteorological Measurement Program For Uranium Recovery Facilities – Data Acquisition and Reporting, March 1988.

2 Calibration Methodology and Accuracy Goals

2.1 Ambient Air Monitoring

2.1.1 PM_{10} FRM Partisol Samplers

The PM_{10} FRM Partisol Sampler calibrations included a verification of the flow, barometric pressure, ambient temperature, and filter temperature. The flow calibration was completed by removing the inlet of the sampler and installing a Flow Transfer Standard (FTS) with an associated digital manometer. The calculated flow of the FTS and the sampler flow were compared to the acceptance criteria.

Proper operation of the temperature sensors (ambient and filter) in the sampler were verified by comparing the sensors and a precision NIST-traceable electronic thermometer. Both reference thermometer and sampler readings were recorded on a standardized form.

The barometric pressure was checked by co-locating a reference sensor next to the sampler. The reading was taken and the difference between the calibration standard and the sampler was compared to acceptance criteria.

2.1.2 TSP Hi-Volume Samplers

A calibration of the Hi-Volume Sampler was completed by finding the numerical relationship between the sampler output (volumetric flow rate) and its flow indicator (stagnation pressure

ratio). The stagnation pressure is an area of low pressure underneath the filter caused by the resistance to airflow through the filter. The stagnation pressure ratio is a mathematical relationship of stagnation and ambient pressures. To find the numerical relationship a multiple point (multi-point) calibration was completed on the sampler. The multi-point calibration uses the five points to calculate the calibration flow rates, resulting slope and intercept for the sampler. The following equipment was required for the calibration:

1) National Institute of Standards and Technology (NIST) traceable variable resistance transfer standard (calibration orifice) with faceplate.
2) Portable thermometer, capable of accurately measuring temperature over the range of 0 to 50 ℃ to the nearest ±1 ℃ and referenced to a N IST or American Society for Testing and Materials (ASTM) thermometer within ±2 ℃ at le ast annually.
3) Portable barometer, capable of accurately measuring ambient barometric pressure over the range of 500 to 800 millimeters of mercury (mm Hg) to the nearest millimeter of mercury, and referenced within ±5 mm Hg to a barometer of known accuracy at least annually.
4) Digital manometers (0 – 20" and 0 – 40") with tubing.

2.2 Calibration Thresholds

Calibration goals for the parameters measured by the meteorological monitoring system are those specified in the US EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV, Meteorological Measurements*, March 1995. Accuracy goals by parameter are shown below.

Table 2-1 – PM_{10} Sampler Criteria

Sensor	Specifications
Ambient Temperature	±2.0 ℃
Filter Temperature	±2.0 ℃
Pressure	± 10 mm Hg
Flow Rate	±2.0 percent of observed (±0.33 lpm)
External Leak Check	<5.0 in Hg / 60 seconds
Internal Leak Check	<8.5 in Hg / 30 seconds

Table 2-2 – TSP Sampler Criteria

Sensor	Specifications
Flow Rate between 1.1 to 1.7 m^3/min	Three (3) points
Difference Percentage	±2.0 percent
Correlation Coefficient	>0.990

3 Calibration Results

Calibration results for Site #1 – 5 can be found in Appendices A, B, and C.

4 Findings/Recommendations

The calibrations of the Ambient Air Monitoring equipment were within the calibration specifications during the 3rd Quarter of 2008.

Appendix A

PM_{10} Sampler Calibrations and Verifications

IML Air Science
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka, Sheridan, WY 82801

Partisol FRM Single Point Verification

Network:	Energy Fuels
Date:	7/30/2008
Time:	1120 MST
Verified by:	M. Butler
Streamline FTS ID:	D000201
Streamline FTS cal. expires:	1/16/2009
Streamline FTS "m":	0.4120
Streamline FTS "b":	-0.6382

Sampler ID: 1-2

As-Found Calibration Values

Parameter	Offset	Span
A/I	-0.0003	0.9993
Amb. Temp.	0.0031	
Filter Temp.	0.0017	
Pressure	0.0053	
Flow	0.0198	0.9620

Notes as found:

Sensors Verification

Sensor	Indicated	ΔP	Actual	Difference	Specification
Amb. Temp.	33.4		33.7	0.3	±2℃
Filter Temp.	35.2		35.6	0.4	±2℃
Pressure	621		626.6	5.6	± 10 mmHg
Flow	16.70	4.75	16.69	0.01	16.7 lpm ± 2% (± 0.33 lpm)

External Leak Check: Pass
(<5"Hg/60 sec.)

Internal Leak Check: Pass
(<8.5"Hg/30 sec.)

Notes:

IML Air Science
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka, Sheridan, WY 82801

Partisol FRM Single Point Verification

Network:	Energy Fuels
Date:	7/30/2008
Time:	1216 MST
Verified by:	M. Butler
Streamline FTS ID:	D000201
Streamline FTS cal. expires:	1/16/2009
Streamline FTS "m":	0.4120
Streamline FTS "b":	-0.6382

Sampler ID: 2-2

As-Found Calibration Values

Parameter	Offset	Span
A/I	-0.0020	0.9996
Amb. Temp.	-0.0003	
Filter Temp.	-0.0032	
Pressure	0.0407	
Flow	-0.0115	0.9898

Notes as found:

Sensors Verification

Sensor	Indicated	ΔP	Actual	Difference	Specification
Amb. Temp.	34.4		34.0	0.4	±2℃
Filter Temp.	35.1		34.8	0.3	±2℃
Pressure	620		623.8	3.8	± 10 mmHg
Flow	16.70	4.72	16.68	0.02	16.7 lpm ± 2% (± 0.33 lpm)

External Leak Check: Pass
(<5"Hg/60 sec.)

Internal Leak Check: Pass
(<8.5"Hg/30 sec.)

Notes:

Appendix B

TSP Sampler Calibrations

High Volume Sampler Flow Rate Calibration

Network: Energy Fuels Resource
Sampler ID: 1-1-TSP
AIRS Site ID: N/A
Sampler Type: Tisch TE5009 TSP
Sampler Calibration Date: 7/30/08
Calibrated By: Will Adler
Orifice ID: V1
Orifice Calibration Date: 12/14/07
Ambient Temperature (℃): 33.8
Ambient Pressure ("Hg): 24.64
Ambient Temperature (℃): 307.0
Ambient Pressure (mmHg): 626

Orifice Relationship: Qa = [SQRT{(ΔP)*(Ta/Pa)}-b]*[1/m]
where m = 0.954 and b = 0.005

Sampler:

Calibration Point	ΔP	Pstg/13.6	P1	P1/Pa
1	4.8	0.35	24.29	0.9857
2	13.4	0.99	23.65	0.9600
3	16.5	1.21	23.43	0.9508
4	25.8	1.90	22.74	0.9230
5	31.4	2.31	22.33	0.9063

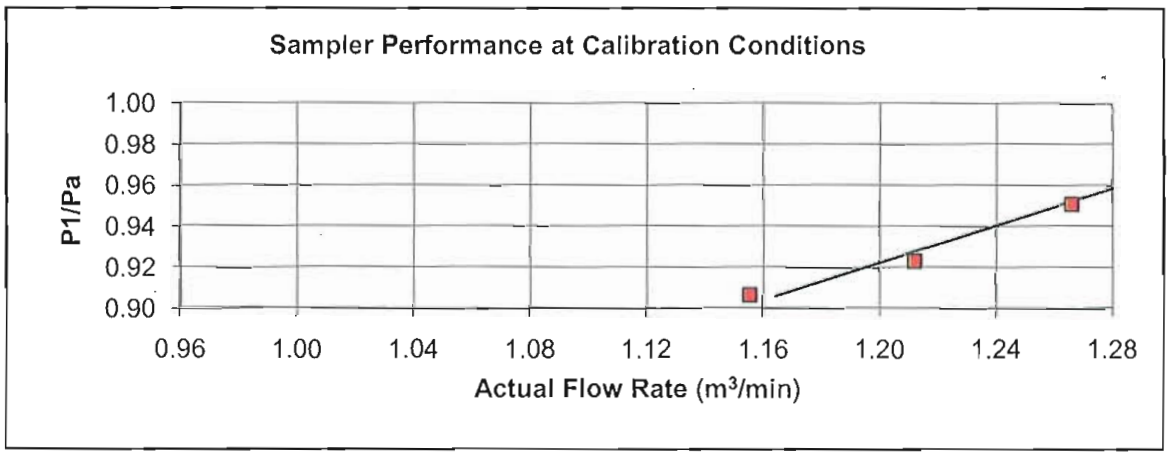
Orifice:

Calibration Point	ΔP	Qa(orf)	Qa/sqrt(Ta)	Qa(eq)	% diff
1	3.32	1.3320	0.0760	1.3400	0.6%
2	3.10	1.2869	0.0735	1.2832	-0.3%
3	3.00	1.2659	0.0723	1.2628	-0.3%
4	2.75	1.2118	0.0692	1.2013	-0.9%
5	2.50	1.1552	0.0660	1.1643	0.8%

Sampler Calibration:

Slope	**7.9143**
Intercept	**0.3802**
r	**0.9926**
Failure Temp (℃)	**-69.3**

Use this equation for subsequent flow calculations:
Qa = {[P1/Pa - 0.3802] * [SQRT(Ta)]} * {1/7.9143}



Notes:

High Volume Sampler Flow Rate Calibration

Network: Energy Fuels Resource
Sampler ID: 2-1-TSP
AIRS Site ID: N/A
Sampler Type: Tisch TE5009 TSP
Sampler Calibration Date: 7/9/08
Calibrated By: Marty Olson
Orifice ID: 1258
Orifice Calibration Date: 1/22/08
Ambient Temperature (℃): 39.4
Ambient Pressure ("Hg): 25.59
Ambient Temperature (℃): 312.6
Ambient Pressure (mmHg): 650

Orifice Relationship: Qa = [SQRT{(ΔP)*(Ta/Pa)}-b]*[1/m]
where m = 0.991 and b = -0.015

Sampler:

Calibration Point	ΔP	Pstg/13.6	P1	P1/Pa
1	5.2	0.38	25.21	0.9850
2	7.7	0.56	25.03	0.9780
3	11.9	0.88	24.71	0.9657
4	19.6	1.44	24.15	0.9436
5	27.0	1.99	23.60	0.9223

Orifice:

Calibration Point	ΔP	Qa(orf)	Qa/sqrt(Ta)	Qa(eq)	% diff
1	3.13	1.2528	0.0709	1.2536	0.1%
2	3.09	1.2449	0.0704	1.2404	-0.4%
3	2.94	1.2146	0.0687	1.2175	0.2%
4	2.73	1.1710	0.0663	1.1762	0.4%
5	2.59	1.1410	0.0646	1.1365	-0.4%

Sampler Calibration:

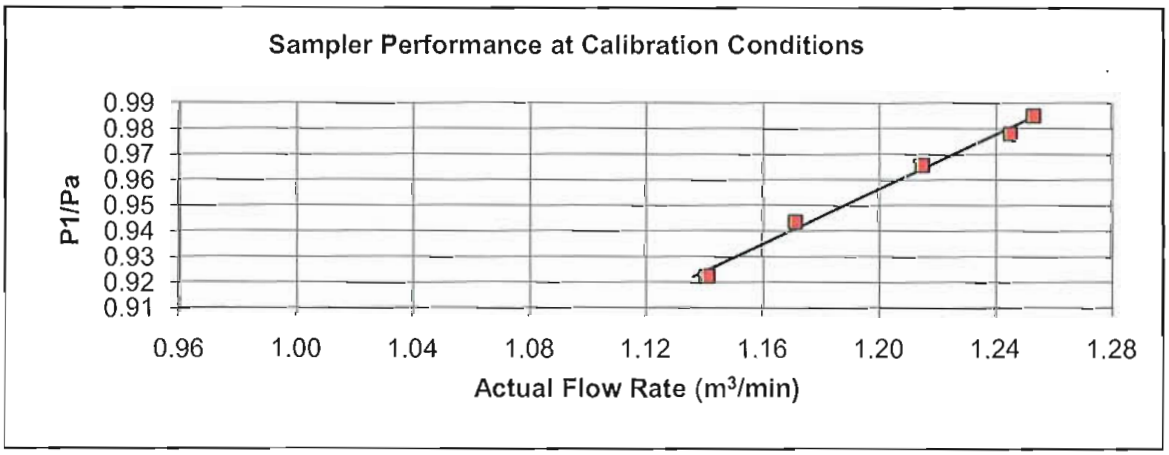
Slope	**9.4653**
Intercept	**0.3137**
r	**0.9960**
Failure Temp (℃)	**-39.7**

Use this equation for subsequent flow calculations:

Qa = {[P1/Pa - 0.3137] * [SQRT(Ta)]} * {1/9.4653}

Operational Flow Rate:

ΔP	Pstg/13.6	P1	P1/Pa	Qa (oper.)
17.24	1.27	24.32	0.9505	1.1893



Notes:

High Volume Sampler Flow Rate Calibration

Network: Energy Fuels Resource
Sampler ID: 2-1-TSP
AIRS Site ID: N/A
Sampler Type: Tisch TE5009 TSP
Sampler Calibration Date: 7/30/08
Calibrated By: Will Adler
Orifice ID: V1
Orifice Calibration Date: 12/14/07
Ambient Temperature (℃): 33.8
Ambient Pressure ("Hg): 24.54
Ambient Temperature (℃): 307.0
Ambient Pressure (mmHg): 623

Orifice Relationship: Qa = [SQRT{(ΔP)*(Ta/Pa)}-b]*[1/m]
where m = 0.954 and b = 0.005

Sampler:

Calibration Point	ΔP	Pstg/13.6	P1	P1/Pa
1	4.6	0.34	24.20	0.9862
2	7.5	0.55	23.99	0.9775
3	11.5	0.85	23.69	0.9655
4	21.6	1.59	22.95	0.9353
5	33.7	2.48	22.06	0.8990

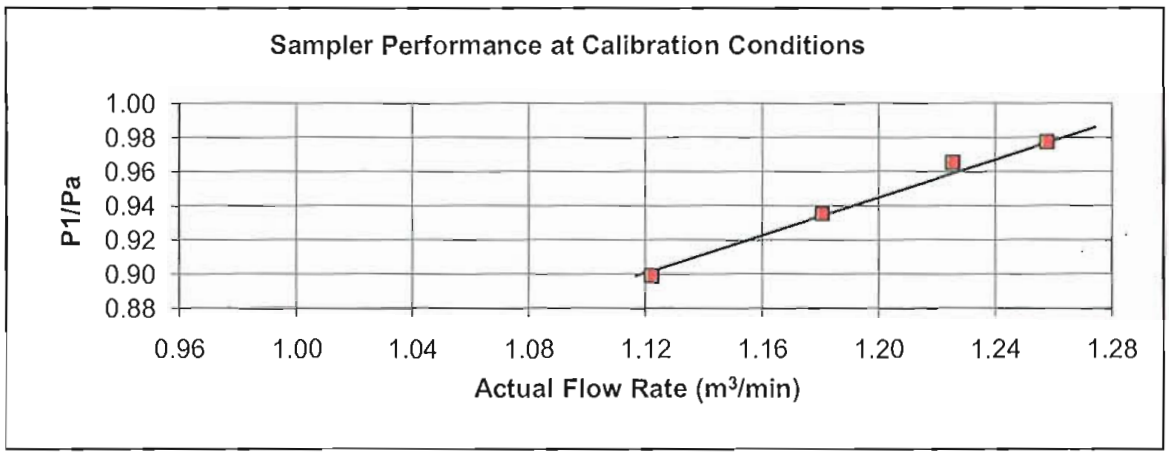
Orifice:

Calibration Point	ΔP	Qa(orf)	Qa/sqrt(Ta)	Qa(eq)	% diff
1	3.07	1.2833	0.0733	1.2744	-0.7%
2	2.95	1.2579	0.0718	1.2587	0.1%
3	2.80	1.2253	0.0700	1.2370	1.0%
4	2.60	1.1806	0.0674	1.1823	0.1%
5	2.35	1.1221	0.0641	1.1167	-0.5%

Sampler Calibration:

Slope	**9.6801**
Intercept	**0.2819**
r	**0.9925**
Failure Temp (℃)	**-51.8**

Use this equation for subsequent flow calculations:
Qa = {[P1/Pa - 0.2819] * [SQRT(Ta)]} * {1/9.6801}



Notes:

High Volume Sampler Flow Rate Calibration

Network: Energy Fuels Resource
Sampler ID: 3-1-TSP
AIRS Site ID: N/A
Sampler Type: Tisch TE5009 TSP
Sampler Calibration Date: 7/30/08
Calibrated By: Will Adler
Orifice ID: V1
Orifice Calibration Date: 12/14/07
Ambient Temperature (℃): 35.5
Ambient Pressure ("Hg): 24.51
Ambient Temperature (℃): 308.7
Ambient Pressure (mmHg): 623

Orifice Relationship: Qa = [SQRT{(ΔP)*(Ta/Pa)}-b]*[1/m]
where m = 0.954 and b = 0.005

Sampler:

Calibration Point	ΔP	Pstg/13.6	P1	P1/Pa
1	4.7	0.35	24.16	0.9859
2	8.6	0.63	23.88	0.9742
3	14.1	1.04	23.47	0.9577
4	21.5	1.58	22.93	0.9355
5	28.2	2.07	22.44	0.9154

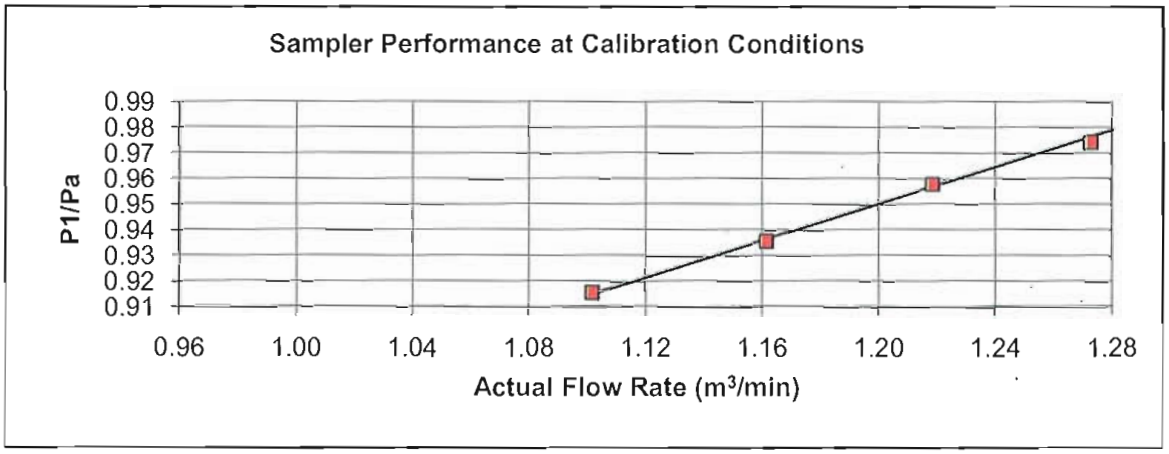
Orifice:

Calibration Point	ΔP	Qa(orf)	Qa/sqrt(Ta)	Qa(eq)	% diff
1	3.10	1.2939	0.0737	1.2989	0.4%
2	3.00	1.2728	0.0725	1.2664	-0.5%
3	2.75	1.2184	0.0694	1.2205	0.2%
4	2.50	1.1615	0.0661	1.1589	-0.2%
5	2.25	1.1016	0.0627	1.1030	0.1%

Sampler Calibration:

Slope	**6.3218**
Intercept	**0.5184**
r	**0.9984**
Failure Temp (℃)	**-45.3**

Use this equation for subsequent flow calculations:
Qa = {[P1/Pa - 0.5184] * [SQRT(Ta)]} * {1/6.3218}



Notes:

High Volume Sampler Flow Rate Calibration

Network: Energy Fuels Resource
Sampler ID: 4-1-TSP
AIRS Site ID: N/A
Sampler Type: Tisch TE5009 TSP
Sampler Calibration Date: 7/30/08
Calibrated By: Will Adler
Orifice ID: V1
Orifice Calibration Date: 12/14/07
Ambient Temperature (℃): 37.1
Ambient Pressure ("Hg): 24.77
Ambient Temperature (K): 310.3
Ambient Pressure (mmHg): 629

Orifice Relationship: Qa = [SQRT{(ΔP)*(Ta/Pa)}-b]*[1/m]
where m = 0.954 and b = 0.005

Sampler:

Calibration Point	ΔP	Pstg/13.6	P1	P1/Pa
1	4.7	0.35	24.42	0.9860
2	9.2	0.68	24.09	0.9727
3	19.2	1.41	23.36	0.9430
4	26.1	1.92	22.85	0.9225
5	33.4	2.46	22.31	0.9009

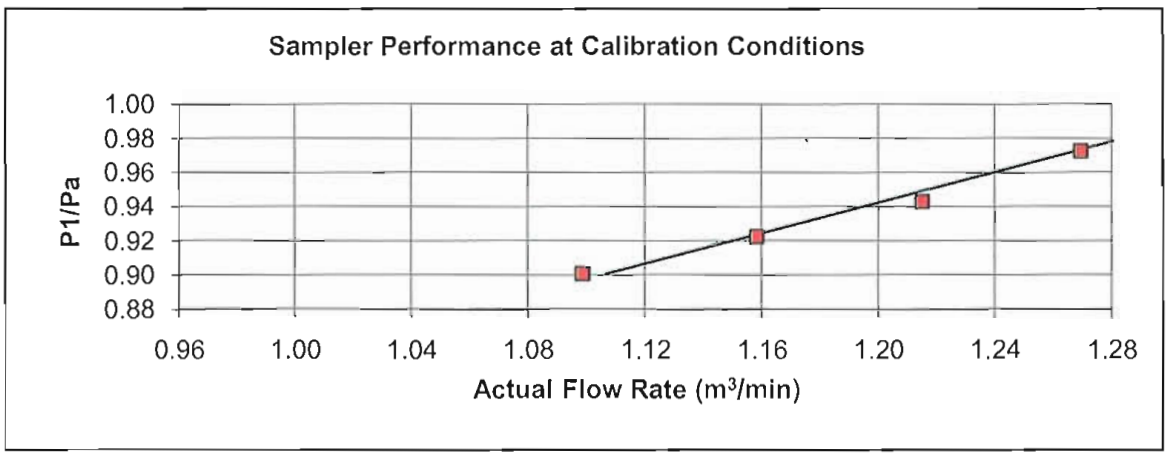
Orifice:

Calibration Point	ΔP	Qa(orf)	Qa/sqrt(Ta)	Qa(eq)	% diff
1	3.08	1.2863	0.0730	1.2976	0.9%
2	3.00	1.2694	0.0721	1.2676	-0.1%
3	2.75	1.2151	0.0690	1.2009	-1.2%
4	2.50	1.1583	0.0658	1.1549	-0.3%
5	2.25	1.0986	0.0624	1.1063	0.7%

Sampler Calibration:

Slope	**7.8435**
Intercept	**0.4081**
r	**0.9918**
Failure Temp (℃)	**-51.6**

Use this equation for subsequent flow calculations:
Qa = {[P1/Pa - 0.4081] * [SQRT(Ta)]} * {1/7.8435}



Notes:

High Volume Sampler Flow Rate Calibration

Network: Energy Fuels Resource
Sampler ID: 5-1-TSP
AIRS Site ID: N/A
Sampler Type: Tisch TE5009 TSP
Sampler Calibration Date: 7/30/08
Calibrated By: Will Adler
Orifice ID: V1
Orifice Calibration Date: 12/14/07
Ambient Temperature (℃): 28.3
Ambient Pressure ("Hg): 24.45
Ambient Temperature (℃): 301.5
Ambient Pressure (mmHg): 621

Orifice Relationship: Qa = [SQRT{(ΔP)*(Ta/Pa)}-b]*[1/m]
where m = 0.954 and b = 0.005

Sampler:

Calibration Point	ΔP	Pstg/13.6	P1	P1/Pa
1	4.7	0.35	24.10	0.9859
2	9.3	0.68	23.77	0.9720
3	16.7	1.23	23.22	0.9498
4	23.4	1.72	22.73	0.9296
5	29.6	2.18	22.27	0.9110

Orifice:

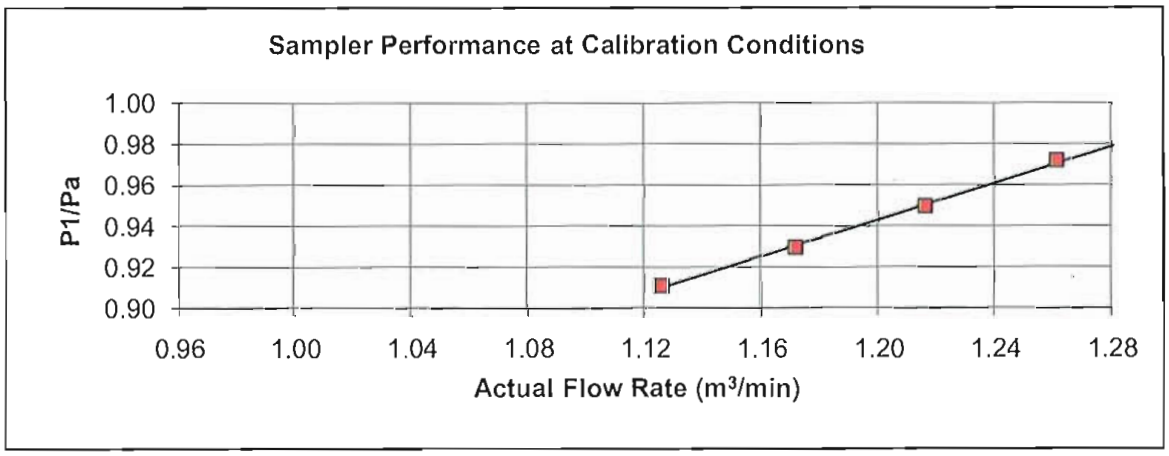
Calibration Point	ΔP	Qa(orf)	Qa/sqrt(Ta)	Qa(eq)	% diff
1	3.18	1.2968	0.0747	1.2958	-0.1%
2	3.01	1.2615	0.0727	1.2647	0.3%
3	2.80	1.2165	0.0701	1.2148	-0.1%
4	2.60	1.1720	0.0675	1.1696	-0.2%
5	2.40	1.1259	0.0649	1.1278	0.2%

Sampler Calibration:

Slope	**7.7384**
Intercept	**0.4082**
r	**0.9994**
Failure Temp (℃)	**-57.4**

Use this equation for subsequent flow calculations:

Qa = {[P1/Pa - 0.4082] * [SQRT(Ta)]} * {1/7.7384}



Notes:

Appendix C

Transfer Standard Certifications

Certificate of Calibration

Streamline™ flow transfer standard (FTS) # D000201 was calibrated against NIST traceable critical flow venturis sn10961, sn10962, sn10963 on: 1/16/2008

This calibration expires: ***1/16/2009*** ***r9***

The actual flow rate (Q_a) through the FTS is:

$$Qa = \left[m \times \left(\sqrt{\frac{(\Delta P)(T_{amb})}{(P_{amb})}} \right) \right] + b$$

m= 0.4120
b= -0.6382

Q_a = actual flow rate in liters/minute

ΔP = pressure reading from the manometer in "H_2O

T_{amb} = ambient temperature in Kelvins

P_{amb} = ambient pressure in atmospheres*

* 1 atmosphere = 760 mmHg, = 29.92"Hg, =101,325 Pa

Reviewed: RLS Date: 1/16/2008

Quality Assurance Check

Primary Standard Q_{actual} (l/min)	Streamline FTS ΔP ("H_2O)	Streamline FTS $Q_{line\ fit}$ (l/min)	Absolute Difference (l/min)	% Difference* full scale
20.04	7.45	20.05	0.01	0.07%
17.51	5.75	17.53	0.02	0.10%
15.00	4.25	15.00	0.00	-0.01%
12.49	2.98	12.45	-0.04	-0.19%
9.98	1.95	9.96	-0.03	-0.13%
7.48	1.14	7.47	-0.01	-0.05%
4.98	0.56	5.03	0.04	0.21%

T_a (°C)= 22.8
Pa (atm)= 0.874 r= 1.0000

*all points must be within ±2%

Chinook Engineering
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555 Absaraka Street
Sheridan, Wyoming 82801 USA
(307) 672-7790
chinook@imlinc.com

Streamline™ FTS, US Patent #5792966

CERTIFICATE OF CALIBRATION

Orifice Transfer Standard - **1258**

Kleinfelder Albuquerque, NM

1258 orifice transfer standard was calibrated on the NIST traceable Dresser rootsmeter serial # 9217756 on 22-Jan-08

Calibration expires 22-Jan-09

The reference flow rate (Qr) through the orifice, in cubic meters per minute, is:

$$Q_r = A(\Delta P_o)^B \qquad r = 0.9998$$

where: A= **0.645**
B= **0.493**
ΔPo = pressure drop across orifice, in inches of water

The actual flow rate (Qa) through the orifice, in cubic meters per minute, is:

$$Q_a = \frac{\left[\left(\sqrt{(\Delta P_o)\left(\frac{T_a}{P_a}\right)}\right) - b\right]}{m} \qquad r = 0.9999$$

where: m= **0.991**
b= **-0.015**
ΔPo = pressure drop across orifice, inches of water
Ta = ambient temperature, Kelvin
Pa = ambient pressure, mm Hg

The flow rate through the orifice corrected to standard conditions (Qstd), in cubic meters per minute, is:

$$Q_{std} = \frac{\left[\left(\sqrt{\Delta P_o\left(\frac{P_a}{T_a}\right)\left(\frac{298}{760}\right)}\right) - b\right]}{m} \qquad r = 0.9999$$

where: m= **1.582**
b= **-0.021**
ΔPo = pressure drop across orifice, inches of water
Ta = ambient temperature, Kelvin
Pa = ambient pressure, mm Hg

SH — Reviewed

1/22/2008 — Date

ORIFICE TRANSFER STANDARD CALIBRATION
QUALITY ASSURANCE

Orifice Transfer Standard# **1258**

The following table is a comparison of measured flow rate versus the flow rate calculated from the new calibration equation. Quality Assurance guidelines require the difference at each point to be less than 2% for a valid calibration. A minimum of three measurment points are required within the operational flow rate interval (1.019 to 1.246 m3/min for PM10 samplers and 1.1 to 1.7 m3/min for TSP samplers.

Q_a measured	Q_a calculated	difference
0.967	0.966	-0.08%
1.041	1.035	-0.52%
1.132	1.141	0.77%
1.184	1.180	-0.32%
1.382	1.385	0.27%
1.557	1.556	-0.07%
1.783	1.782	-0.07%

References: 40 CFR 50, Appendix B, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method); 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere; and Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II. Ambient Air Specific Methods, (EPA 600/4-77/027a, June 1992), Sections 2.2.2.5 and 2.11.2.2.1.

Data Input

Roots Meter SN: 629846

DATE: 22-Jan-08
ORIFICE #: 1258
TECH: Cory Medill
TEMP (℃): 20.10
PRES("Hg): 26.00
CLIENT: Kleinfelder
LOCATION: Albuquerque, NM

POINT	DELTA VOLUME m^3	TIME MIN	DELTA H roots mmHg	DELTA H orifice "H2O
1	3.3985	3.4833	5.6979	2.0000
2	3.3985	3.2333	6.5386	2.3000
3	3.3985	2.9667	7.8463	2.8000
4	3.3985	2.8333	8.5002	3.0000
5	3.3985	2.4167	11.5827	4.1500
6	3.3985	2.1333	14.7585	5.2500
7	3.3985	1.8500	19.3356	6.9000

	Actual Flow				Standard Flow		
POINT	Va m^3	Qa m^3/min	Y-AXIS	POINT	Vstd m^3	Qstd m^3/min	Y-AXIS
1	3.369	0.967	0.942	1	2.975	0.854	1.329
2	3.365	1.041	1.011	2	2.971	0.919	1.425
3	3.358	1.132	1.115	3	2.965	1.000	1.572
4	3.355	1.184	1.154	4	2.962	1.046	1.628
5	3.339	1.382	1.357	5	2.948	1.220	1.914
6	3.323	1.557	1.527	6	2.934	1.375	2.153
7	3.299	1.783	1.750	7	2.913	1.575	2.468

CERTIFICATE OF CALIBRATION

Orifice Transfer Standard - **V1**

IML Air Science Sheridan, WY

V1 orifice transfer standard was calibrated on the NIST traceable Dresser rootsmeter serial # 9217756 on 14-Dec-07

Calibration expires 14-Dec-08

The reference flow rate (Qr) through the orifice, in cubic meters per minute, is:

$$Q_r = A(\Delta P_o)^B$$ r = 0.9999

where: A= **0.653**
B= **0.501**
ΔPo = pressure drop across orifice, in inches of water

The actual flow rate (Qa) through the orifice, in cubic meters per minute, is:

$$Q_a = \frac{\left[\left(\sqrt{(\Delta P_o)\left(\frac{T_a}{P_a}\right)}\right) - b\right]}{m}$$ r = 0.9999

where: m= **0.954**
b= **0.005**
ΔPo = pressure drop across orifice, inches of water
Ta = ambient temperature, Kelvin
Pa = ambient pressure, mm Hg

The flow rate through the orifice corrected to standard conditions (Qstd), in cubic meters per minute, is:

$$Q_{std} = \frac{\left[\left(\sqrt{\Delta P_o\left(\frac{P_a}{T_a}\right)\left(\frac{298}{760}\right)}\right) - b\right]}{m}$$ r = 0.9999

where: m= **1.523**
b= **0.007**
ΔPo = pressure drop across orifice, inches of water
Ta = ambient temperature, Kelvin
Pa = ambient pressure, mm Hg

SE
Reviewed

12/14/2007
Date

ORIFICE TRANSFER STANDARD CALIBRATION
QUALITY ASSURANCE

Orifice Transfer Standard# **V1**

The following table is a comparison of measured flow rate versus the flow rate calculated from the new calibration equation. Quality Assurance guidelines require the difference at each point to be less than 2% for a valid calibration. A minimum of three measurment points are required within the operational flow rate interval (1.019 to 1.246 m3/min for PM10 samplers and 1.1 to 1.7 m3/min for TSP samplers.

Q_a measured	Q_a calculated	difference
0.811	0.809	-0.24%
1.074	1.081	0.67%
1.133	1.131	-0.14%
1.242	1.234	-0.64%
1.411	1.417	0.42%
1.595	1.594	-0.05%
1.849	1.848	-0.05%

References: 40 CFR 50, Appendix B, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method); 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere; and Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II. Ambient Air Specific Methods, (EPA 600/4-77/027a, June 1992), Sections 2.2.2.5 and 2.11.2.2.1.

Data Input

Roots Meter SN:	629846
DATE:	14-Dec-07
ORIFICE #:	V1
TECH:	Cory Medill
TEMP (℃):	20.70
PRES("Hg):	26.11
CLIENT:	IML Air Science
LOCATION:	Sheridan, WY

POINT	DELTA VOLUME m^3	TIME MIN	DELTA H roots mmHg	DELTA H orifice "H2O
1	3.3985	4.1667	3.8297	1.3600
2	3.3985	3.1333	6.7254	2.4200
3	3.3985	2.9667	7.3793	2.6500
4	3.3985	2.7000	8.9672	3.1500
5	3.3985	2.3667	11.5827	4.1500
6	3.3985	2.0833	14.7585	5.2500
7	3.3985	1.7833	19.7092	7.0500

	Actual Flow				Standard Flow		
POINT	Va m^3	Qa m^3/min	Y-AXIS	POINT	Vstd m^3	Qstd m^3/min	Y-AXIS
1	3.379	0.811	0.776	1	2.990	0.718	1.097
2	3.364	1.074	1.036	2	2.977	0.950	1.463
3	3.361	1.133	1.084	3	2.974	1.002	1.531
4	3.353	1.242	1.181	4	2.967	1.099	1.670
5	3.339	1.411	1.356	5	2.955	1.249	1.916
6	3.323	1.595	1.525	6	2.941	1.411	2.155
7	3.297	1.849	1.767	7	2.918	1.636	2.498

Certificate of Accuracy

Transfer Standard Type: Electronic Thermometer Certificate No: **T 012908. 01**

Transfer standard, model/type: Cole Parmer Thermistor Thermometer 8402-00 Model 7000H TH
Serial number: JC 13255 IML 0876 Probe S/N: 07M18477
submitted by/owner: Inter-Mountain Laboratories, Inc.
Air Science Division
555 Absaraka Street
Was compared to: Sheridan, WY 82801

NIST Traceable Hg-in-glass thermometers, serial numbers 2J3106, 2Y6027, 3L9452.
Miller & Weber Hg-in-glass thermometer sn 2J3106 and 2Y6027 are traceable to NIST Test No. 209621, Test Method ASTM E-77. 2J3106 is traceable through Standard No. 1S1262. 2Y6027 is traceable through Standard No. 9C8072. Miller & Weber Hg-in-glass thermometer sn 3L9452 is traceable to NIST Thermometer 40350, through Transfer Standards 3C4465 & 1Y9716.

Date: 01/29/08 Lab temperature: 72.5 °F
Barometric Pressure: 652.4 mmHG

Reference Standard (°C)	Transfer Standard (°C)	Difference from Reference (°C)	Transfer Standard Correction* (°C)
0.0	0.1	0.1	-0.1
10.0	10.1	0.1	-0.1
25.0	25.1	0.1	-0.1
41.4	41.4	0.0	0.0

Note:
If no sign is given on the correction, the true temperature is higher than the indicated temperature. If the sign is negative, the true temperature is lower than the indicated temperature.

Transfer Standard adjustments made? YES ☐ NO ☒
Post-calibration measurements:

Reference Thermistor (°C)	Transfer Standard (°C)	Difference from Reference (°C)	Transfer Standard Correction* (°C)

Reviewed: R Sanders Date: 1/29/08

Roger L. Sanders, PE

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chinook@imlinc.com

Certificate of Accuracy

Transfer Standard Type: Barometric Pressure/Altimeter

Certificate No: B 012808. 03

Transfer standard model: Pretel AltiPlus A2
Serial number: 13785 IML 0913 Kit B
submitted by/owner: Inter-Mountain Laboratories, Inc.
Air Science Division
555 Absaraka Street
Sheridan, WY 82801

Was compared to Precision Absolute Reference Barometer:
Model number: 355-AI0900 Serial number: 913930-M1
Certified accuracy of ± 0.007"Hg
NIST traceable to Ruska Deadweight Tester SN 38342/C-85

Date: 01/28/08 Lab temperature 73.5 °F
Lab pressure 644.1 mm Hg

Reference barometer ("Hg)	Transfer Standard ("Hg)	Difference from Reference ("Hg)	Transfer Standard Correction* ("Hg)
24.00	24.04	0.04	-0.04
25.00	25.03	0.03	-0.03
25.36	25.39	0.03	-0.03
27.50	27.51	0.01	-0.01
30.00	30.00	0.00	0.00

Note:
If no sign is given on the correction, the true pressure is higher than the Indicated pressure. If the sign is negative, the true pressure is lower than the indicated pressure.

Transfer Standard adjustments made? YES ☐ NO ☒

Post-calibration measurements:

Reference barometer ("Hg)	Transfer Standard ("Hg)	Difference from Reference ("Hg)	Transfer Standard Correction* ("Hg)

Reviewed: R Sf Date: 1/28/08

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Certificate of Accuracy

Transfer Standard Type: Electronic Manometer Certificate No: M 011708. 02

Transfer standard, model: Dwyer Series 475-1 Mark III Digital Manometer
Serial number: IML 0949
submitted by/owner: Inter-Mountain Laboratories, Inc.
Air Science Division
555 Absaraka Street
Sheridan, WY 82801

Was compared to Chinook Engineering Streamline Pro Multi Cal System Serial Number BENCH 1.
BENCH 1 is traceable through Meriam Instrument Reference Manometers:
Model number: 30EBX25TM Ser. No.: 131760-M1 Scale number: SC-4208-12
Model number: 30EBX25TM Ser. No.: 158411-S1 Scale number: SC-4208-17
Certified accuracy of ± 0.02 "H_2O
Scale is NIST Traceable to Optical Comparator, SN E37618, and Gage Rod, SN 3388A

Date: 01/17/08 Lab temperature: 69.0 °F
Lab pressure: 656.6 mm Hg

Reference Manometer ("H_2O)	Transfer Standard ("H_2O)	Difference from Reference ("H_2O)	Transfer Standard Correction* ("H_2O)
0.50	0.48	-0.02	0.02
2.00	1.96	-0.04	0.04
5.00	4.93	-0.07	0.07
10.00	9.94	-0.06	0.06
19.50	19.48	-0.02	0.02

Note:
If no sign is given on the correction, the true pressure is higher than the indicated pressure. If the sign is negative, the true pressure is lower than the indicated pressure.

Transfer Standard adjustments made? YES ☐ NO ☒
Post-calibration measurements:

Reference Manometer ("H_2O)	Transfer Standard ("H_2O)	Difference from Reference ("H_2O)	Transfer Standard Correction* ("H_2O)

Reviewed: Date: 1/17/08

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Certificate of Accuracy

Transfer Standard Type: Electronic Manometer Certificate No: M 121707. 03

Transfer standard, model: Dwyer Series 475-1 Mark III Digital Manometer
Serial number: IML 0984
submitted by/owner: Inter-Mountain Laboratories, Inc.
Air Science Division
555 Absaraka Street
Sheridan, WY 82801

Was compared to Chinook Engineering Streamline Pro Multi Cal System Serial Number BENCH 1.
BENCH 1 is traceable through Meriam Instrument Reference Manometers:

Model number: 30EBX25TM Ser. No.: 131760-M1 Scale number: SC-4208-12
Model number: 30EBX25TM Ser. No.: 158411-S1 Scale number: SC-4208-17

Certified accuracy of ± 0.02 "H_2O

Scale is NIST Traceable to Optical Comparator, SN E37618, and Gage Rod, SN 3388A

Date: 12/17/07 Lab temperature: 69.5 ℉
Lab pressure: 653.0 mm Hg

Reference Manometer ("H_2O)	Transfer Standard ("H_2O)	Difference from Reference ("H_2O)	Transfer Standard Correction* ("H_2O)
0.50	0.50	0.00	0.00
2.00	2.02	0.02	-0.02
5.00	5.06	0.06	-0.06
7.50	7.60	0.10	-0.10
10.00	10.17	0.17	-0.17
15.00	15.22	0.22	-0.22
19.50	19.75	0.25	-0.25

Note:
If no sign is given on the correction, the true pressure is higher than the indicated pressure. If the sign is negative, the true pressure is lower than the indicated pressure.

Transfer Standard adjustments made? YES **NO**

Post-calibration measurements:

Reference Manometer ("H_2O)	Transfer Standard ("H_2O)	Difference from Reference ("H_2O)	Transfer Standard Correction* ("H_2O)

Reviewed: Date:

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Certificate of Accuracy

Transfer Standard Type: Electronic Manometer Certificate No: M 011708. 03

Transfer standard, model: Dwyer Series 475-2 Mark III Digital Manometer
Serial number: IML 0985
submitted by/owner: Inter-Mountain Laboratories, Inc.
Air Science Division
555 Absaraka Street
Sheridan, WY 82801

Was compared to Chinook Engineering Streamline Pro Multi Cal System Serial Number BENCH 1.
BENCH 1 is traceable through Meriam Instrument Reference Manometers:
Model number: 30EBX25TM Ser. No.: 131760-M1 Scale number: SC-4208-12
Model number: 30EBX25TM Ser. No.: 158411-S1 Scale number: SC-4208-17
Certified accuracy of ± 0.02 "H_2O
Scale is NIST Traceable to Optical Comparator, SN E37618, and Gage Rod, SN 3388A

Date: 01/17/08 Lab temperature: 69.0 ℉
Lab pressure: 656.6 mm Hg

Reference Manometer ("H_2O)	Transfer Standard ("H_2O)	Difference from Reference ("H_2O)	Transfer Standard Correction* ("H_2O)
0.50	0.3	-0.2	0.2
2.00	1.8	-0.2	0.2
5.00	4.8	-0.2	0.2
10.00	9.9	-0.1	0.1
19.50	19.5	0.0	0.0

Note:
If no sign is given on the correction, the true pressure is higher than the indicated pressure. If the sign is negative, the true pressure is lower than the indicated pressure.

Transfer Standard adjustments made? YES **NO**
Post-calibration measurements:

Reference Manometer ("H_2O)	Transfer Standard ("H_2O)	Difference from Reference ("H_2O)	Transfer Standard Correction* ("H_2O)

Reviewed: Date:

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