

APPENDIX C

First Quarter 2011 IML Quality Assurance Shutdown Audit Report



**Energy Fuels Resources Corporation
Piñon Ridge Mill**

**Quality Assurance Shutdown Audit Report for
Meteorological Air Monitoring Network**

1st Quarter 2011

Prepared by:



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1 Introduction

Inter-Mountain Laboratories – Air Science Division performed quality assurance shutdown audits on March 22, 2011. The shutdown audits included the (2) meteorological 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

Site 2

- Meteorological Station – 30m Tower
 - Wind Speed
 - Wind Direction
 - Vertical Wind Speed
 - Temperature (2m & 30m)
 - Delta Temperature
 - Relative Humidity
 - Solar Radiation
 - Barometric Pressure

1.1 Audit References

The audits 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. I – A Field Guide to Environmental Quality Assurance, April 1994
- Quality Assurance Handbook for Air Pollution Measurements Systems, Vol. IV – Meteorological Measurements, March 2008
- 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 Nuclear Regulatory Research, Regulatory Guide 3.63 – Onsite Meteorological Measurement Program For Uranium Recovery Facilities – Data Acquisition and Reporting, March 1988.

2 Audit Methodology and Accuracy Goals

2.1 Meteorological Stations

2.1.1 Wind Speed

The wind speed was verified by rotating the sensor shaft using a DC-powered variable-speed motor equipped with an optical encoder output referenced to a crystal oscillator. A standard sensor speed was calculated based on the audit rotational speed and compared to the instantaneous logger reading. An R.M. Young Torque Disc was used to ensure bearing integrity of the wind speed sensor. All data were recorded on a standardized audit form.

2.1.2 Wind Direction

The wind direction sensor orientation was verified by using a Brunton precision magnetic compass. Instantaneous direction readings from the logger were compared to the standards and recorded on a standardized form.

2.1.3 Temperature

Proper operation of the temperature sensors was verified by placing the sensors and a precision NIST-traceable electronic thermometer in three equilibrated temperature baths (ice bath, warm bath, and ambient bath). Both reference thermometer and logger readings were recorded on a standardized form.

2.1.4 Delta Temperature

Proper operation of the temperature sensors was verified by placing the sensors and a precision NIST-traceable electronic thermometer in three equilibrated temperature baths (ice bath, warm bath, and ambient bath). Both reference thermometer and logger readings were recorded on a standardized form.

2.1.5 Relative Humidity

The relative humidity was checked by co-locating a reference sensor next to the station sensor. The reading was taken and the difference between the audit standard and the on-site data logger were compared to acceptance criteria.

2.1.6 Solar Radiation

The solar radiation was checked by co-locating a reference sensor next to the station sensor. The readings of covered and uncovered were taken and the differences between the audit standard and the on-site data logger were compared to acceptance criteria.

2.1.7 Barometric Pressure

The barometric pressure was checked by co-locating a reference sensor next to the station sensor. The reading was taken and the difference between the audit standard and the on-site data logger were compared to acceptance criteria.

2.1.8 Precipitation

The precipitation gauge was challenged three times using a lab quality burette and water. The volume of water required to cause the tipping bucket to activate was measured and volumes were recorded along with the calculated value for activation on a standardized form.

2.1.9 Evaporation

The evaporation pan was audit by recording the values from a yardstick measuring the depth of the pan and comparing the reading of the logger. All data were recorded on a standardized audit form.

2.2 Audit Thresholds

2.2.1 Meteorological Monitoring Systems

Audit goals for the parameters measured by the meteorological monitoring systems are those specified in the US EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV, Meteorological Measurements*, March 2008. Accuracy goals by parameter are shown below.

Table 2-1 – Meteorological Sensor Criteria

Sensor	Specifications
Wind Speed	±0.2 m/s
Wind Speed – Starting Threshold	< 0.5 gm-cm
Wind Direction	± 5.0 compass degrees
Vertical Wind Speed	±0.2 m/s
Temperature	±0.5 °C
Delta Temperature	±0.1 °C
Relative Humidity	±5.0 %
Solar Radiation	±5.0 percent of observed
Barometric Pressure	±0.09 in Hg
Precipitation	±10 percent of observed

3 Audit Results

Audit results for Site #1 – 2 can be found in Appendices A.

4 Findings/Recommendations

The shutdown audits of the Meteorological Monitoring equipment at Site #1 and Site #2 were within the specifications during the 1st Quarter of 2011. Results of the audits can be found in Appendix A.

Appendix A

Meteorological System Audits

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: EFRC - Site #1
 Audit Performed By: W. Adler, E. Scott -- IML Air Science

Audit Date: 22-Mar-11

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Wind Speed 10m (WS):	RM Young Wind Monitor AQ	82346	quartz referenced drive motor	IML 1407
Wind Direction 10m (WD):	RM Young Wind Monitor AQ	82346	transit, compass	IML 1405
Temperature @ 2 Meters:	RM Young Platinum RTD Temp Probe	13638	digital thermistor	IML 0885
Temperature @ 10 Meters:	RM Young Platinum RTD Temp Probe	13639	digital thermistor	IML 0885
Relative Humidity (RH):	CSI CS 500	C2430074	digital hygrometer	IML 0890
Barometric Pressure (BP):	PTB 101B	C2430048	digital barometer	IML 0968
Solar Radiation:	LI-COR LI200SZ	PY57101	collocated LI200X	PY65374
Precipitation:	Met One 12" tipping bucket	G6356	lab grade burette	N/A
Data acquisition system:	CSI CR3000 datalogger	2397	N/A	N/A

Audit Results

	Reference RPM	Reference m/s	DAS Value	Difference	Specification		
AQ WS 10 meters (cm/s)	0	0.00	0.00	0.00	below threshold		
	300	1.54	1.54	0.00	0.20	(2)	
	800	4.10	4.10	0.00	0.20	(2)	
	3000	15.36	15.36	0.00	0.20	(2)	
	8000	40.96	40.96	0.00	0.20	(2)	
WS 10 m start torque (gm-cm)		Reference $\tau < 0.5$	DAS Value N/A	Difference N/A	Specification 1.0	(3)	
	WD 10 meters (degrees)	0.0	0.2	0.2	5.0	(2)	
		90.0	90.6	0.6	5.0	(2)	
		180.0	179.7	0.3	5.0	(2)	
		270.0	269.8	0.2	5.0	(2)	
Vertical WS 10 meters (cm/s) (Clockwise)	Reference RPM	Reference cm/s	DAS Value	Difference	Specification		
	0	0.00	-0.29	0.29	below threshold		
	20	10.00	9.88	0.12	20.00	(2)	
	200	100.00	99.05	0.95	20.00	(2)	
	300	150.00	146.98	3.02	20.00	(2)	
	500	250.00	245.16	4.84	20.00	(2)	
	0	0.00	0.00	0.00	below threshold		
	20	10.00	0.30	9.70	20.00	(2)	
	200	100.00	99.51	0.49	20.00	(2)	
	300	150.00	152.35	2.35	20.00	(2)	
	500	250.00	245.11	4.89	20.00	(2)	
	Vertical WS 10 meters (cm/s) (Counter-Clockwise)	0	0.00	-0.29	0.29	below threshold	
		20	-10.00	-9.87	0.13	20.00	(2)
		200	-100.00	-99.05	0.95	20.00	(2)
300		-150.00	-148.43	1.57	20.00	(2)	
500		-250.00	-245.74	4.26	20.00	(2)	
0		0.00	0.00	0.00	below threshold		
20		-10.00	-9.78	0.22	20.00	(2)	
200		-100.00	-98.41	1.60	20.00	(2)	
300		-150.00	-147.05	2.95	20.00	(2)	
500		-250.00	-247.08	2.92	20.00	(2)	
WS 10 m start torque (gm-cm)			$\tau < 0.5$	N/A	N/A	1.0	(3)

			Reference (°C):	DAS Value	Difference	Specification		
Temp. (°C): 2 meter			0.08	0.01	0.07	0.5	(2)	
			15.08	14.85	0.23	0.5	(2)	
			25.98	25.56	0.42	0.5	(2)	
Temp. (°C): 10 meter			0.08	0.01	0.07	0.5	(2)	
			15.08	14.89	0.19	0.5	(2)	
			25.98	25.61	0.37	0.5	(2)	
			Reference	DAS Value	Difference	Specification		
Relative Humidity (%)	Hourly Averages		48.7	51.4	2.7	5.0	(2)	
RH Sensor Temp (°F):	Hourly Averages		45.2	44.3	0.9			
Solar Radiation (W/m ²)	Hourly Averages	un-covered	169.0	165.0	4.0	8.5	(4)	
		covered	0.0	0.2	0.2			
Barometric Pressure ("Hg)			24.46	24.46	0.00	0.09	(4)	
			DAS Value (in)	Reference (ml)	DAS Equivalent	Difference	Specification	
Precipitation (0.1" equiv.)			0.10	187.8	185.3	2.5	18.5	(2)
			0.10	191.0	185.3	5.7	18.5	(2)
			0.10	189.8	185.3	4.5	18.5	(2)
					Average Diff:	4.2	18.5	(2)
			2m sensor	10m sensor	ΔT - B	Specification		
Delta Temperature (°C):			0.01	0.01	0.01	0.1	(2)	
			14.85	14.89	0.03	0.1	(2)	
			25.56	25.61	0.05	0.1	(2)	
BOLD difference values exceed performance specifications								
(1)= Performance specification listed in facilities' Quality Assurance Project Plan								
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 2008								
(3)= Manufacturer's Specifications								
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications								
Notes, Recommendations								
Time Offline: 14:20 MST								
Time Online: 15:18 MST								

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: EFRC - Site #2
 Audit Performed By: W. Adler, E. Scott -- IML Air Science

Audit Date: 22-Mar-11

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Wind Speed 30m (WS):	RM Young Wind Monitor AQ	82347	quartz referenced drive motor	IML 1407
Wind Direction 30m (WD):	RM Young Wind Monitor AQ	82347	transit, compass	IML 1405
Temperature @ 2 Meters:	RM Young Platinum RTD Temp Probe	13640	digital thermistor	IML 0885
Temperature @ 30 Meters:	RM Young Platinum RTD Temp Probe	13641	digital thermistor	IML 0885
Relative Humidity (RH):	CSI CS 500	C2730148	digital hygrometer	IML 0890
Barometric Pressure (BP):	PTB 101B	C2750056	digital barometer	IML 0968
Solar Radiation:	LI-COR LI200SZ	PY57102	collocated LI200X	PY65374
Data acquisition system:	CSI CR3000 datalogger	2421	N/A	N/A

Audit Results

	Reference		DAS Value	Difference	Specification	
	RPM	m/s				
AQ WS 30 meters (cm/s)	0	0.00	0.00	0.00	below threshold	
	300	1.54	1.54	0.00	0.20	(2)
	800	4.10	4.10	0.00	0.20	(2)
	3000	15.36	15.36	0.00	0.20	(2)
	8000	40.96	40.96	0.00	0.20	(2)
WS 30 m start torque (gm-cm)	Reference		DAS Value	Difference	Specification	
	$\tau < 0.5$		N/A	N/A	1.0	(3)
WD 30 meters (degrees)	Reference		DAS Value	Difference	Specification	
	0.0		0.2	0.2	5.0	(2)
	90.0		89.1	0.9	5.0	(2)
	180.0		179.5	0.5	5.0	(2)
	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		10.00	9.96	0.04	20.00 (2)
	200		100.00	98.14	1.86	20.00 (2)
Vertical WS 30 meters (cm/s) (Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		10.00	9.56	0.44	20.00 (2)
	200		100.00	98.65	1.35	20.00 (2)
Vertical WS 30 meters (cm/s) (Counter-Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		-10.00	-9.66	0.34	20.00 (2)
	200		-100.00	-98.15	1.85	20.00 (2)
Vertical WS 30 meters (cm/s) (Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		10.00	9.56	0.44	20.00 (2)
	200		100.00	98.65	1.35	20.00 (2)
Vertical WS 30 meters (cm/s) (Counter-Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		-10.00	-9.86	0.14	20.00 (2)
	200		-100.00	-100.45	0.45	20.00 (2)
Vertical WS 30 meters (cm/s) (Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		10.00	9.56	0.44	20.00 (2)
	200		100.00	98.65	1.35	20.00 (2)
Vertical WS 30 meters (cm/s) (Counter-Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		-10.00	-9.86	0.14	20.00 (2)
	200		-100.00	-100.45	0.45	20.00 (2)
Vertical WS 30 meters (cm/s) (Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		10.00	9.56	0.44	20.00 (2)
	200		100.00	98.65	1.35	20.00 (2)
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	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
	20		-10.00	-9.86	0.14	20.00 (2)
	200		-100.00	-100.45	0.45	20.00 (2)
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	RPM		cm/s			
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	200		100.00	98.65	1.35	20.00 (2)
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	0		0.00	0.00	0.00	below threshold
	20		-10.00	-9.86	0.14	20.00 (2)
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	RPM		cm/s			
	0		0.00	0.00	0.00	below threshold
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	0		0.00	0.00	0.00	below threshold
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	0		0.00	0.00	0.00	below threshold
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	200		100.00	98.65	1.35	20.00 (2)
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	RPM		cm/s			
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	20		10.00	9.56	0.44	20.00 (2)
	200		100.00	98.65	1.35	20.00 (2)
Vertical WS 30 meters (cm/s) (Counter-Clockwise)	Reference		DAS Value	Difference	Specification	
	RPM		cm/s			
	0		0.00	0.00	0.00	

			Reference (°C):	DAS Value	Difference	Specification	
Temp. (°C): 2 meter			0.00	-0.05	0.05	0.5	(2)
			15.52	15.47	0.05	0.5	(2)
			29.38	29.19	0.19	0.5	(2)
Temp. (°C): 30 meter			0.00	-0.13	0.13	0.5	(2)
			15.52	15.40	0.12	0.5	(2)
			29.38	29.13	0.25	0.5	(2)
			Reference	DAS Value	Difference	Specification	
Relative Humidity (%)	Hourly Averages		49.4	46.8	2.6	5.0	(2)
RH Sensor Temp (°F):	Hourly Averages		45.7	45.9	0.2		
Solar Radiation (W/m ²)	Hourly Averages	un-covered	271.0	270.0	1.0	13.6	(4)
		covered	0.0	0.0	0.0		
Barometric Pressure ("Hg)			24.39	24.40	0.01	0.09	(4)
			2m sensor	10m sensor	ΔT - B	Specification	
Delta Temperature (°C):			-0.05	-0.13	0.09	0.1	(2)
			15.47	15.40	0.07	0.1	(2)
			29.19	29.13	0.06	0.1	(2)
BOLD difference values exceed performance specifications							
(1)= Performance specification listed in facilities' Quality Assurance Project Plan							
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989							
(3)= Manufacturer's Specifications							
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications							
Notes, Recommendations							
Time Offline: 11:48 MST							
Time Online: 15:43 MST							

Evaporation Pan Verification Sheet

Evap Span 9.7221
Evap Offset 1.48158

Yardstick Reading (in)*	Logger Reading	Percent Difference
N/A	N/A	N/A

Notes:
* Yard Stick Reading - taken at the pan outlet to the gauge
Offline: System offline due to the Winter Season.

Appendix B

Transfer Standard Certifications

Certificate of As-Received Condition

Transfer Standard Type: Electronic Thermometer

Certificate No: T 122710. 01

Transfer standard, model/type: Cole Parmer Digi-Sense ThermoLogR Thermistor Thermometer

Serial number: 374476

IML 0885

Probe S/N: 10L42126

submitted by/owner: Inter-Mountain Laboratories, Inc.

Air Science Division

555 Absaraka Street

Sheridan, WY 82801

Was compared to:

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: 12/27/10

Lab temperature: 22.1 °C

Barometric Pressure: 660.0 mmHG

Post-calibration measurements:

Reference Standard (°C)	Transfer Standard (°C)	Difference from Reference (°C)	Transfer Standard Correction* (°C)
0.0	-0.03	-0.03	0.03
10.3	10.30	0.00	0.00
20.8	20.88	0.08	-0.08
41.4	41.40	0.00	0.00

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

12/27/2010 Calibration

Pre-calibration measurements:

Reference Thermistor (°C)	Transfer Standard (°C)	Difference from Reference (°C)	Transfer Standard Correction* (°C)
0.00	0.00	0.00	0.00
44.8	44.20	-0.60	0.60

Certified By: 

Date: December 27, 2010

Roger L. Sanders, PE

Chinook Engineering

a division of Inter-Mountain Laboratories, Inc.

555 Absaraka Street

Sheridan, Wyoming 82801 USA

(307) 674-7506

chinook@imlinc.com

Certificate of Accuracy

Transfer Standard Type: Barometric Pressure/Altimeter

Certificate No: B 091510. 02

Transfer standard model: Pretel AltiPlus A2
Serial number: 27604 IML 0968
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: 09/15/10 Lab temperature 22.7 °C
Lab pressure 664.3 mm Hg

Reference barometer ("Hg)	Transfer Standard ("Hg)	Difference from Reference ("Hg)	Transfer Standard Correction* ("Hg)
24.00	24.02	0.02	-0.02
25.00	25.02	0.02	-0.02
26.15	26.17	0.02	-0.02
27.00	27.02	0.02	-0.02
28.00	28.02	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 barometer ("Hg)	Transfer Standard ("Hg)	Difference from Reference ("Hg)	Transfer Standard Correction* ("Hg)

Certified By:  Date: September 15, 2010

Roger L. Sanders, PE

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chinook@imlinc.com

Certificate of Accuracy

Transfer Standard Type: Electronic Hygrometer

Certificate No: H 111910. 01

Transfer standard, model/type: Dwyer Series 485 Digital Hygrometer

Serial number: IML 0890

submitted by/owner: Inter-Mountain Laboratories, Inc.

Air Science Division

555 Absaraka Street

Sheridan, WY 82801

Was compared to Saturated Salt Solution Standards using ASTM Method E 104 - 02, Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions, using Temperature Reference Standard Streamline™ Pro MultiCal™ System Remote Temperature Probe S/N: T030301

Dates: 11/18/2010 - 11/19/2010

Lab temperature: 19 - 23 °C

Barometric Pressure: 651.4 - 659.7 mmHg

Lab %RH: 35 - 45%

Reference Salt Standard	Reference Temperature °C	Reference Standard (%RH)	Uncertainty	Transfer Standard (%RH)	Difference from Reference (%RH)	Transfer Standard Correction* (%RH)
Lithium Chloride						
Potassium Acetate						
Magnesium Chloride	19.7	33.08	±0.21	35.8	2.7	-2.7
Magnesium Nitrate	19.7	54.47	±0.23	54.4	-0.1	0.1
Sodium Chloride	19.8	75.48	±0.20	72.5	-3.0	3.0

Temperature Reference Standard (°C)	Transfer Standard (°C)	Difference from Reference (°C)	Transfer Standard Correction* (°C)
19.7	19.6	-0.1	0.1
19.7	20.0	0.3	-0.3
19.8	20.0	0.2	-0.2

Certified by: 

Date: November 19, 2010

Roger L. Sanders, PE

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555 Absaraka Street

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(307) 674-7506

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CERTIFICATE OF CALIBRATION

Test Unit

Model: 18802
Motor SN: IML 1407
Control Unit SN: IML 1410
Range: 200 - 15000 RPM

Motor RPM	Indicated RPM					
	Clockwise Output Range			Counter Clockwise Output Range		
	Low	High	Average	Low	High	Average
600	599.7	600.1	599.9	599.9	600.1	600.0
1200	1199.7	1199.9	1199.8	1199.0	1200.3	1199.9
2400	2399.8	2399.8	2399.8	2399.8	2399.8	2399.8
4200	4198.2	4199.8	4199.5	4199.7	4200.6	4199.7
6000	5999.7	5999.7	5999.7	5999.7	5999.7	5999.7
8100	8099.6	8099.6	8099.6	8099.6	8099.6	8099.6
9900	9899.5	9899.5	9899.5	9899.5	9899.5	9899.5

The instrument above has been presented for inspection and test as shown
The indicated work was performed using standards traceable to the National Institute of Standards and Technologies (NIST)

Standard SN: 51892014
Technician: C. Medill
Date: 1/4/2011

THE BRUNTON COMPANY

Certificate Of Calibration

IML 1405

Equipment Owner:

Name: Inter-Mountain Labs

Address: 555 Absarada St

City, State, Zip: Sheridan Wyo. 82801

Calibration traceable to the National Institute of Standards and Technology in accordance with Mil-STD-45662A has been accomplished on the instrument listed below by comparison with standards maintained by The Brunton Co. The accuracy and stability of all standards maintained by The Brunton Co. are traceable to national standards maintained by the National Institute of Standards and Technology in Washington, D.C. and Boulder, CO. Complete record of all work performed is maintained by The Brunton Co. and is available for inspection upon request.

This Unit has been calibrated to Lietz TM10E serial number 30937 traceable to N.B.S. no. 738 227675 this 18 Day of November 20 10

DESCRIPTION: Pocket transit

PURCHASE ORDER: 2556399

ORDER NUMBER: 2873647

LOT NUMBER: 2330119

MODEL NUMBER: F-2061

SERIAL NUMBER: 2610409451

CALIBRATION DATE: 11/18/2010

RECALIBRATION DUE DATE: 11/18/2011

Signed: Edeco [Signature]
QUALITY CONTROL MANAGER



721 West 1800 North
Logan, UT 84321

Certificate of Calibration

LI-COR PYRANOMETER MODEL LI-200X

Customer Name : Kristy Kola

Serial Number : PY65374

Calibration Date : 20-Apr-2011

Previous Calibration Date : 25-Jun-2009

Recommended Recalibration Date : 20-Apr-2013

Calibration Factor : 194.80 W m⁻² per mV

Output : 83.1 μA per 1000 W m⁻²

Calibration Factor as Received : 199.10 W m⁻² per mV

Output as Received : 81.3 μA per 1000 W m⁻²

Resistance (Measured) : 61.8 Ω

Output Change (%) : 2.21% Change/Year (%) : 1.21%

Calibration Procedure

The calibration is based on a side-by-side comparison under a high intensity discharge metal halide lamp using (4) LI-COR silicon transfer standard pyranometers. The LI-COR transfer standards are calibrated annually under clear sky conditions at Apogee Instruments in Logan, UT against a minimum of (2) ISO Classified pyranometers, recalibrated on a biennial schedule at NREL in Boulder, CO. NREL reference standards are calibrated to the World Radiometric Reference in Davos, Switzerland.

Traceability			
Instrument (Serial #)	ISO Classification	Calibration Date	Calibration Due Date
Kipp & Zonen CMP11 (60089)	Secondary Standard	6/18/2010	6/18/2012
Kipp & Zonen CMP11 ⁽¹⁾ (101625)	Secondary Standard	4/8/2010	4/8/2012
Hukseflux ⁽²⁾ (7175)	First Class	2/8/2010	2/8/2012
LICOR (68849)	Silicon Transfer Standard	7/24/2010	7/24/2011
LICOR (68890)	Silicon Transfer Standard	7/24/2010	7/24/2011
LICOR (68891)	Silicon Transfer Standard	7/24/2010	7/24/2011
LICOR (68892)	Silicon Transfer Standard	7/24/2010	7/24/2011

⁽¹⁾ CMP11 purchased new in 2010. Initial calibration conducted by Kipp and Zonen against a CMP21 (serial# 70114) due for recalibration by 8/1/2010.

⁽²⁾ SR11-05 purchased new in 2010. Initial calibration conducted by Hukseflux with traceability to the outdoor World Radiometric Reference.

Calibration Technician : Kyle Berzig

Date : 4.21.11