Gunter, Jason

From: James, Kevin <kjames@doerun.com>
Sent: Monday, October 13, 2014 8:48 AM
To: Gunter, Jason
Cc: Yingling, Mark; Neaville, Chris; Montgomery, Michael; roberf.hinkson@dnr.mo.gov; brandon.wiles@dnr.mo.gov; Ty Morris (TMorris@barr.com); Nations, Mark
Subject: OLB Air Monitoring - August
Attachments: Remediation Air Report - August 2014.pdf; 3rd Qtr 2014 Park Hills PM10 Lead Samplers Performance Audit Report.pdf

Jason -

Attached is the data for August and 3rd quarter air results for the OLB.

Kevin James on behalf of Mark Nations

Kevin James
THE DOE RUN COMPANY 150
Environmental Engineering
W: 573.626.2096
C: 573.247.6766

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OTCR 40482426 4.2
Superfund
0402

Monthly Ambient Air Monitoring Report

The Doe Run Company
Old Lead Belt Sites:
Federal, Rivermines, National, and Leadwood

August-2014

THE DOE RUN COMPANY | 150 YEARS

SUITE 300
1801 PARK 270 DRIVE
ST. LOUIS, MO 63146

Federal Site

Sample Results for **August-2014**

	St. Joe (Ballfields)		Big River#4		Water Treatment Plant	
Sample Date	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3
8/1/14	31	0.021	45	0.061	32	0.021
8/4/14	39	0.014	41	0.027	40	0.021
8/5/14	38	0.014	42	0.021	38	0.028
8/6/14	26	0.007	30	0.007	30	0.007
8/7/14	16	0.007	14	0.007	15	0.007
8/8/14	17	0.007	18	0.007	17	0.021
8/11/14	28	0.021	28	0.013	31	0.049
8/12/14	26	0.021	21	0.014	23	0.048
8/13/14	30	0.014	31	0.014	21	0.014
8/14/14	26	0.007	40	0.027	25	0.007
8/15/14	32	0.007	30	0.007	36	0.014
8/18/14	25	0.014	32	0.021	30	0.014
8/19/14	34	0.014	36	0.035	30	0.028
8/20/14	57	0.007	56	0.021	46	0.028
8/21/14	40	0.000	46	0.007	47	0.063
8/22/14	65	0.014	63	0.014	66	0.014
8/25/14	48	0.028	50	0.028	46	0.035
8/26/14	47	0.049	47	0.041	46	0.063
8/27/14	37	0.007	32	0.014	32	0.014
8/28/14	35	0.007	33	0.014	28	0.007
8/29/14	27	0.007	23	0.007	22	0.000

Monthly Avg. TSP	34	36	33
Monthly Avg. Pb	0.014	0.019	0.024
Jul-14	0.015	0.023	0.028
Jun-14	0.014	0.013	0.013
Rolling 3-Month	**0.014**	**0.018**	**0.022**

Three month rolling average must be less than 0.15 ug/m3

NOTES:

	Big River QA	
Sample Date	**TSP** ug/m3	**Lead** ug/m3
8/5/14	47	0.021
8/7/14	15	0.007
8/12/14	21	0.014
8/14/14	42	0.028
8/19/14	40	0.028
8/21/14	47	0.007
8/26/14	49	0.042
8/28/14	32	0.007

Rivermines

Sample Results for **August-2014**

	Big River #4		Rivermines South #1		Rivermines North #2		Rivermines East #3	
Sample Date	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3
8/1/14	45	0.061	invalid	invalid	30	0.014	32	0.021
8/4/14	41	0.027	50	0.075	35	0.021	40	0.021
8/5/14	42	0.021	48	0.062	35	0.035	38	0.028
8/6/14	30	0.007	31	0.055	25	0.014	30	0.007
8/7/14	14	0.007	14	0.007	15	0.007	15	0.007
8/8/14	18	0.007	invalid	invalid	11	0.000	17	0.021
8/11/14	28	0.013	56	0.144	21	0.000	31	0.049
8/12/14	21	0.014	69	0.279	15	0.000	23	0.048
8/13/14	31	0.014	42	0.123	40	0.097	21	0.014
8/14/14	40	0.027	36	0.062	25	0.007	25	0.007
8/15/14	30	0.007	invalid	invalid	30	0.014	36	0.014
8/18/14	32	0.021	68	0.048	25	0.049	30	0.014
8/19/14	36	0.035	59	0.104	32	0.056	30	0.028
8/20/14	56	0.021	67	0.083	74	0.192	46	0.028
8/21/14	46	0.007	43	0.007	49	0.078	47	0.063
8/22/14	63	0.014	invalid	invalid	57	0.007	66	0.014
8/25/14	50	0.028	57	0.104	54	0.092	46	0.035
8/26/14	47	0.041	51	0.124	57	0.169	46	0.063
8/27/14	32	0.014	44	0.110	36	0.007	32	0.014
8/28/14	33	0.014	27	0.007	25	0.007	28	0.007
8/29/14	23	0.007	invalid	invalid	20	0.042	22	0.000

Monthly Avg. TSP	36	48	34	33
Monthly Avg. Pb	0.019	0.087	0.043	0.024
Jul-14	0.023	0.112	0.029	0.028
Jun-14	0.013	0.029	0.047	0.013
Rolling 3-Month	**0.018**	**0.076**	**0.040**	**0.022**

Three month rolling average must be less than 0.15 ug/m3

NOTES: Rivermines South - 8/1, 8/8, 8/22, 8/29: >25hr run time
Rivermines South - 8/15: <23hr run time - motor bearing failure

	Big River QA	
Sample Date	**TSP** ug/m3	**Lead** ug/m3
8/5/14	47	0.021
8/7/14	15	0.007
8/12/14	21	0.014
8/14/14	42	0.028
8/19/14	40	0.028
8/21/14	47	0.007
8/26/14	49	0.042
8/28/14	32	0.007

National Site

Sample Results for **August-2014**

	Big River #4		Ozark #1		Soccer Park #2		Water Treatment Plant	
Sample Date	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3
8/1/14	45	0.061	30	0.014	38	0.027	32	0.021
8/4/14	41	0.027	42	0.056	40	0.021	40	0.021
8/5/14	42	0.021	37	0.007	41	0.014	38	0.028
8/6/14	30	0.007	22	0.007	31	0.021	30	0.007
8/7/14	14	0.007	17	0.007	17	0.014	15	0.007
8/8/14	18	0.007	29	0.007	22	0.007	17	0.021
8/11/14	28	0.013	23	0.000	26	0.007	31	0.049
8/12/14	21	0.014	16	0.007	21	0.007	23	0.048
8/13/14	31	0.014	29	0.014	31	0.014	21	0.014
8/14/14	40	0.027	31	0.007	28	0.007	25	0.007
8/15/14	30	0.007	30	0.000	29	0.007	36	0.014
8/18/14	32	0.021	26	0.014	28	0.028	30	0.014
8/19/14	36	0.035	30	0.014	36	0.014	30	0.028
8/20/14	56	0.021	52	0.028	53	0.021	46	0.028
8/21/14	46	0.007	49	0.007	49	0.014	47	0.063
8/22/14	63	0.014	57	0.007	63	0.007	66	0.014
8/25/14	50	0.028	40	0.007	44	0.021	46	0.035
8/26/14	47	0.041	41	0.021	39	0.021	46	0.063
8/27/14	32	0.014	32	0.007	29	0.014	32	0.014
8/28/14	33	0.014	27	0.007	30	0.014	28	0.007
8/29/14	23	0.007	28	0.007	26	0.007	22	0.000

Monthly Avg. TSP	36	33	34	33
Monthly Avg. Pb	0.019	0.012	0.015	0.024
Jul-14	0.023	0.009	0.014	0.028
Jun-14	0.013	0.008	0.010	0.013
Rolling 3-Month	**0.018**	**0.010**	**0.013**	**0.022**

Three month rolling average must be less than 0.15 ug/m3

NOTES:

	Big River QA	
Sample Date	**TSP** ug/m3	**Lead** ug/m3
8/5/14	47	0.021
8/7/14	15	0.007
8/12/14	21	0.014
8/14/14	42	0.028
8/19/14	40	0.028
8/21/14	47	0.007
8/26/14	49	0.042
8/28/14	32	0.007

Leadwood

Sample Results for **August-2014**

	Big River #4		Leadwood South #1		Leadwood East #2		Leadwood North #3	
Sample Date	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3	**TSP** ug/m3	**Lead** ug/m3
8/1/14	45	0.061	33	0.027	33	0.047	23	0.007
8/4/14	41	0.027	64	0.034	65	0.090	37	0.007
8/5/14	42	0.021	32	0.014	36	0.014	26	0.007
8/6/14	30	0.007	32	0.027	42	0.021	26	0.007
8/7/14	14	0.007	15	0.000	13	0.007	16	0.000
8/8/14	18	0.007	14	0.014	13	0.062	13	0.000
8/11/14	28	0.013	27	0.007	29	0.049	25	0.000
8/12/14	21	0.014	27	0.014	16	0.000	14	0.000
8/13/14	31	0.014	48	0.027	24	0.007	22	0.007
8/14/14	40	0.027	55	0.027	26	0.007	21	0.000
8/15/14	30	0.007	94	0.041	31	0.007	26	0.000
8/18/14	32	0.021	28	0.007	28	0.007	28	0.000
8/19/14	36	0.035	34	0.014	31	0.007	24	0.007
8/20/14	56	0.021	50	0.007	68	0.021	44	0.000
8/21/14	46	0.007	101	0.028	60	0.014	44	0.007
8/22/14	63	0.014	83	0.014	67	0.014	60	0.007
8/25/14	50	0.028	71	0.042	69	0.063	43	0.007
8/26/14	47	0.041	60	0.034	40	0.014	33	0.007
8/27/14	32	0.014	41	0.020	41	0.041	27	0.007
8/28/14	33	0.014	40	0.014	36	0.014	25	0.007
8/29/14	23	0.007	34	0.007	39	0.034	22	0.000

Monthly Avg. TSP	36	47	38	29
Monthly Avg. Pb	0.019	0.020	0.026	0.004
Jul-14	0.023	0.025	0.028	0.004
Jun-14	0.013	0.010	0.016	0.004
Rolling 3-Month	**0.018**	**0.018**	**0.023**	**0.004**

Three month rolling average must be less than 0.15 ug/m3

NOTES:

	Big River QA	
Sample Date	**TSP** ug/m3	**Lead** ug/m3
8/5/14	47	0.021
8/7/14	15	0.007
8/12/14	21	0.014
8/14/14	42	0.028
8/19/14	40	0.028
8/21/14	47	0.007
8/26/14	49	0.042
8/28/14	32	0.007

Federal Site

Sample Results for **August-2014**

Sample Date	St. Joe (Ballfields) **PM10** (ug/m3)	Big River#4 **PM10** (ug/m3)	Water Treatment **PM10** (ug/m3)
8/3/14	30	28	31
8/6/14	22	invalid	22
8/9/14	22	21	15
8/12/14	18	15	18
8/15/14	20	22	25
8/18/14	20	22	18
8/21/14	42	40	41
8/24/14	27	38	43
8/27/14	21	27	33
8/30/14	13	14	12

Compliance with NAAQS is less than 150 ug/m3

Monthly Avg. PM10	24	25	26

NOTES: Big River #4 - 8/6: >25hr run time

Sample Date	Big River QA **PM10** (ug/m3)
8/3/14	25
8/9/14	27
8/15/14	23
8/21/14	41
8/27/14	24

Rivermines

Sample Results for **August-2014**

Sample Date	Big River #4 **PM10** (ug/m3)	Rivermines South #1 **PM10** (ug/m3)	Rivermines North #2 **PM10** (ug/m3)	Rivermines East #3 **PM10** (ug/m3)
8/3/14	28	39	27	31
8/6/14	invalid	23	20	22
8/9/14	21	21	20	15
8/12/14	15	37	11	18
8/15/14	22	15	18	25
8/18/14	22	27	18	18
8/21/14	40	38	57	41
8/24/14	38	40	37	43
8/27/14	27	37	37	33
8/30/14	14	12	12	12

Compliance with NAAQS is less than 150 ug/m3

Monthly Avg. PM10	25	29	26	26

NOTES: Big River #4 - 8/6: >25hr run time

Sample Date	Big River QA **PM10** (ug/m3)
8/3/14	25
8/9/14	27
8/15/14	23
8/21/14	41
8/27/14	24

National Site

Sample Results for **August-2014**

Sample Date	Big River #4 **PM10** (ug/m3)	Ozark #1 **PM10** (ug/m3)	Soccer Park #2 **PM10** (ug/m3)	Water Treatment **PM10** (ug/m3)
8/3/14	28	30	31	31
8/6/14	invalid	23	26	22
8/9/14	21	20	19	15
8/12/14	15	14	15	18
8/15/14	22	20	23	25
8/18/14	22	19	17	18
8/21/14	40	39	38	41
8/24/14	38	34	38	43
8/27/14	27	28	20	33
8/30/14	14	13	15	12

Compliance with NAAQS is less than 150 ug/m3

Monthly Avg. PM10	25	24	24	26

NOTES: Big River #4 - 8/6: >25hr run time

Sample Date	Big River QA **PM10** (ug/m3)
8/3/14	25
8/9/14	27
8/15/14	23
8/21/14	41
8/27/14	24

Leadwood

Sample Results for **August-2014**

Sample Date	Big River #4 **PM10** (ug/m3)	Leadwood South #1 **PM10** (ug/m3)	Leadwood East #2 **PM10** (ug/m3)	Leadwood North #3 **PM10** (ug/m3)
8/3/14	28	32	38	28
8/6/14	invalid	21	26	23
8/9/14	21	24	10	20
8/12/14	15	16	12	12
8/15/14	22	28	20	17
8/18/14	22	26	22	17
8/21/14	40	46	44	38
8/24/14	38	33	42	35
8/27/14	27	25	28	23
8/30/14	14	10	6	14

Compliance with NAAQS is less than 150 ug/m3

Monthly Avg. PM10	25	26	25	23

NOTES: Big River #4 - 8/6: >25hr run time

Sample Date	Big River QA **PM10** (ug/m3)
8/3/14	25
8/9/14	27
8/15/14	23
8/21/14	41
8/27/14	24

Meterological Data - Old Lead Belt
Aug-2014

24hr average

Date	Wind Speed (MPH)	Wind Direction	Sigma-Theta	Temperature (C)	Air Pressure (mmHg)	Rain (Inches)	Power Supply (Volts)
01-Aug-14	2.197	26.42	42.9	22.83	746	0	13.2
02-Aug-14	2.139	35.26	34.9	22.6	748	0	13.19
03-Aug-14	1.868	148.3	36.29	22.46	748	0	13.2
04-Aug-14	1.794	190.3	38.23	24.25	746	0	13.19
05-Aug-14	2.015	250.5	36.52	25.21	745	0.14	13.18
06-Aug-14	2.406	143.4	31.01	24.83	745	0	13.18
07-Aug-14	4.029	169.8	28.69	22.92	742	0.85	13.18
08-Aug-14	2.038	279.2	37.41	25.36	742	0	13.19
09-Aug-14	2.144	348.4	30.7	24.83	744	0	13.19
10-Aug-14	1.749	338.9	34.18	25.45	744	0	13.19
11-Aug-14	2.765	310.3	36.81	24.75	743	0.63	13.17
12-Aug-14	3.984	295.7	25.95	21.15	744	0	13.21
13-Aug-14	2.35	276.1	31.56	20.31	747	0	13.22
14-Aug-14	1.6	159	40.12	21.38	745	0	13.21
15-Aug-14	2.026	204.7	29.87	24.26	745	0	13.18
16-Aug-14	4.114	189.9	28.13	23.91	742	0.47	13.2
17-Aug-14	2.533	290.7	36.75	23.21	742	0	13.19
18-Aug-14	1.355	301.3	37.26	23.87	741	0	13.2
19-Aug-14	1.542	231.6	32.82	25.46	740	0	13.2
20-Aug-14	1.812	187.4	39.67	26.61	743	0.01	13.17
21-Aug-14	4.081	218.7	28.88	30.37	744	0	13.13
22-Aug-14	2.459	207	33.75	29.63	744	0	13.12
23-Aug-14	1.982	223.8	35.69	30.48	743	0	13.12
24-Aug-14	1.753	159.8	35.74	29.45	744	0	13.12
25-Aug-14	1.789	157	37.93	29.15	744	0	13.12
26-Aug-14	1.747	160.6	42.39	28.31	746	0	13.13
27-Aug-14	1.847	229.2	47.55	25.44	746	0.57	13.15
28-Aug-14	2.199	145.4	36.35	25.37	745	0.17	13.18
29-Aug-14	4.125	183.9	28.62	25.9	743	0	13.18
30-Aug-14	4.222	201.3	26.58	24.85	744	0.02	13.2
31-Aug-14	3.987	188.8	26.79	25.15	743	0	13.19

INQUEST
ENVIRONMENTAL INC.

3609 Mojave Ct., Ste E ◆ COLUMBIA, MO 65202
(573) 474-8110 ◆ FAX: (573) 474-8371

July 21, 2014

Mr. Greg Henson
Chemist
The Doe Run Company
881 Main Street
Herculaneum, MO 63048

RE: 3rd Quarter 2014 Park Hills Network Lead/PM10 Samplers Flow Rate Verifications Performance Audit Report.

Dear Mr. Henson,

Please find enclosed the worksheets detailing the Lead/PM10 sampler's one-point flow verifications that were recently performed on the Doe Run Park Hills Monitoring Network. A copy of the current certification for the audit device that was used has also been enclosed.

All of the flow rate verification checks of the samplers were found to be within guidelines.

After reviewing the enclosed information, please feel free to call with any comments or questions. Thank you for your business.

Sincerely,

John A. Kunkel
Inquest Environmental, Inc.

PM10 Sampler Flow Rate Verifications

INQUEST
Environmental, Inc.

PM10 Sampler Audit
Volumetric Flow Control

3609 Mojave Court, Suite E
Columbia, Missouri 65202
573-474-8110

Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Big River	Intercept (Qa)	-0.00227
Sampler	#4 Primary PM10	Temperature	20.0 °C 293.2 °K
Flow Controller	P2952	Station Pressure	30.11 "Hg 764.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.20	1.072	24.50	45.76	0.940	1.128	**5.22**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
24.20	45.20	0.941	1.129	1.070	**-5.31**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

INQUEST
Environmental, Inc.

PM10 Sampler Audit
Volumetric Flow Control

3609 Mojave Court, Suite E
Columbia, Missouri 65202
573-474-8110

Date	July 16, 2014	Auditor	John Kunkel		
Operator	The Doe Run Company	Transfer Orifice	1882		
Location	Park Hills Network	Slope (Qa)	1.03497		
Station	Big River	Intercept (Qa)	-0.00227		
Sampler	#4 QA PM10	Temperature	20.0 °C	293.2	°K
Flow Controller	P1019	Station Pressure	30.11 "Hg	764.8	mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.30	1.089	25.20	47.06	0.938	1.139	**4.59**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
25.10	46.88	0.939	1.140	1.088	**-3.72**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

INQUEST
Environmental, Inc.

PM10 Sampler Audit
Volumetric Flow Control

3609 Mojave Court, Suite E
Columbia, Missouri 65202
573-474-8110

Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	National - Ozark Insulation	Intercept (Qa)	-0.00227
Sampler	#1 PM10	Temperature	20.3 °C 293.5 °K
Flow Controller	P2950	Station Pressure	30.11 "Hg 764.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.20	1.073	24.00	44.82	0.941	1.127	**5.03**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
24.30	45.38	0.941	1.127	1.070	**-5.31**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	St Joe Park	Intercept (Qa)	-0.00227
Sampler	#4 PM10	Temperature	21.4 °C 294.6 °K
Flow Controller	P4353	Station Pressure	30.10 "Hg 764.5 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.20	1.075	24.50	45.76	0.940	1.120	**4.19**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
24.30	45.38	0.941	1.121	1.074	**-4.96**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	National - Crane Street	Intercept (Qa)	-0.00227
Sampler	#2 PM10	Temperature	21.4 °C 294.6 °K
Flow Controller	P2949	Station Pressure	30.10 "Hg 764.5 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.20	1.075	24.00	44.82	0.941	1.128	**4.93**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
24.10	45.01	0.941	1.128	1.072	**-5.13**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Rivermines Water Plant	Intercept (Qa)	-0.00227
Sampler	#3 PM10	Temperature	21.8 °C 295.0 °K
Flow Controller	P2951	Station Pressure	30.08 "Hg 764.0 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.20	1.076	23.70	44.26	0.942	1.135	**5.48**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
23.90	44.64	0.942	1.135	1.073	**-5.04**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Rivermines Quarry	Intercept (Qa)	-0.00227
Sampler	#1 PM10	Temperature	21.8 °C 295.0 °K
Flow Controller	P4601	Station Pressure	30.08 "Hg 764.0 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.10	1.059	25.40	47.44	0.938	1.102	**4.06**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
25.30	47.25	0.938	1.102	1.057	**-6.46**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Rivermines Wood Street	Intercept (Qa)	-0.00227
Sampler	#2 PM10	Temperature	21.8 °C 295.0 °K
Flow Controller	P4507	Station Pressure	30.08 "Hg 764.0 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.20	1.076	25.30	47.25	0.938	1.122	**4.28**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
25.00	46.69	0.939	1.123	1.075	**-4.87**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Leadwood Mill Street	Intercept (Qa)	-0.00227
Sampler	#2 PM10	Temperature	27.4 °C 300.6 °K
Flow Controller	P1018	Station Pressure	30.07 "Hg 763.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.40	1.120	24.00	44.82	0.941	1.157	**3.30**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
24.10	45.01	0.941	1.157	1.119	**-0.97**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Leadwood School	Intercept (Qa)	-0.00227
Sampler	#3 PM10	Temperature	27.4 °C 300.6 °K
Flow Controller	P6071	Station Pressure	30.07 "Hg 763.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.40	1.120	24.40	45.57	0.940	1.166	**4.11**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
24.40	45.57	0.940	1.166	1.118	**-1.06**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Leadwood South	Intercept (Qa)	-0.00227
Sampler	#1 PM10	Temperature	25.5 °C 298.7 °K
Flow Controller	P1500	Station Pressure	30.07 "Hg 763.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Flow Rate Percent Difference	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.70	1.164	23.10	43.14	0.944	1.156	**-0.69**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Design % Difference	Acceptable Range
23.00	42.96	0.944	1.156	1.164	**3.01**	± 10%

Calculations:

Pressure mmHg (Pf) - ("H_2O/13.6) * 25.4

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Flow Rate Percent Difference- (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Percent Difference)/100)

Design Percent Difference- (Corrected Flow Rate-1.13)/1.13*100

Lead/TSP Sampler's Flow Rate Verifications

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Lead Sampler Audit
Volumetric Flow Control

3609 Mojave Court, Suite E
Columbia, Missouri 65202
573-474-8110

Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Big River	Intercept (Qa)	-0.00227
Sampler	#4 Primary TSP	Temperature	20.0 °C 293.2 °K
Flow Controller	P4557	Station Pressure	30.11 "Hg 764.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.80	1.168	23.20	43.35	0.943	1.225	**4.88**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
23.40	43.72	0.943	1.225	**1.165**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

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Lead Sampler Audit
Volumetric Flow Control

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573-474-8110

Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Big River	Intercept (Qa)	-0.00227
Sampler	#4 QA TSP	Temperature	20.0 °C 293.2 °K
Flow Controller	P4558	Station Pressure	30.11 "Hg 764.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.75	1.161	22.00	41.10	0.946	1.222	**5.25**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
22.20	41.48	0.946	1.222	**1.158**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	National Ozark Insulation	Intercept (Qa)	-0.00227
Sampler	#1 TSP	Temperature	20.3 °C 293.5 °K
Flow Controller	P2939	Station Pressure	30.11 "Hg 764.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
4.00	1.199	22.50	42.04	0.945	1.224	**2.09**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
22.50	42.04	0.945	1.224	**1.198**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	St Joe Park	Intercept (Qa)	-0.00227
Sampler	#4 TSP	Temperature	21.4 °C 294.6 °K
Flow Controller	P6792	Station Pressure	30.10 "Hg 764.5 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.70	1.156	22.80	42.60	0.944	1.222	**5.71**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
22.20	41.48	0.946	1.225	**1.155**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	National Crane Street	Intercept (Qa)	-0.00227
Sampler	#2 TSP	Temperature	21.4 °C 294.6 °K
Flow Controller	P4474	Station Pressure	30.10 "Hg 764.5 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.70	1.156	23.20	43.35	0.943	1.211	**4.76**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
23.10	43.16	0.944	1.212	**1.154**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Rivermines Water Plant	Intercept (Qa)	-0.00227
Sampler	#3 TSP	Temperature	21.8 °C 295.0 °K
Flow Controller	P4475	Station Pressure	30.08 "Hg 764.0 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.90	1.188	22.10	41.29	0.946	1.221	**2.78**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
22.40	41.85	0.945	1.220	**1.186**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Rivermines Quarry	Intercept (Qa)	-0.00227
Sampler	#1 TSP	Temperature	21.8 °C 295.0 °K
Flow Controller	P2940	Station Pressure	30.08 "Hg 764.0 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.65	1.149	23.50	43.91	0.943	1.222	**6.35**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
23.60	44.09	0.942	1.221	**1.143**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Rivermines Wood Street	Intercept (Qa)	-0.00227
Sampler	#2 TSP	Temperature	21.8 °C 295.0 °K
Flow Controller	P2941	Station Pressure	30.08 "Hg 764.0 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.70	1.157	22.90	42.78	0.944	1.226	**5.96**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
22.90	42.78	0.944	1.226	**1.153**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

INQUEST
Environmental, Inc.

Lead Sampler Audit
Volumetric Flow Control

3609 Mojave Court, Suite E
Columbia, Missouri 65202
573-474-8110

Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Leadwood Mill Street	Intercept (Qa)	-0.00227
Sampler	#2 TSP	Temperature	27.4 °C 300.6 °K
Flow Controller	P4476	Station Pressure	30.07 "Hg 763.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.80	1.184	22.10	41.29	0.946	1.233	**4.14**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
22.40	41.85	0.945	1.232	**1.181**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

INQUEST
Environmental, Inc.

Lead Sampler Audit
Volumetric Flow Control

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Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Leadwood School	Intercept (Qa)	-0.00227
Sampler	#3 TSP	Temperature	27.4 °C 300.6 °K
Flow Controller	P6793	Station Pressure	30.07 "Hg 763.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.70	1.168	22.60	42.22	0.945	1.230	**5.31**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
22.70	42.41	0.944	1.228	**1.163**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

INQUEST
Environmental, Inc.

Lead Sampler Audit
Volumetric Flow Control

3609 Mojave Court, Suite E
Columbia, Missouri 65202
573-474-8110

Date	July 16, 2014	Auditor	John Kunkel
Operator	The Doe Run Company	Transfer Orifice	1882
Location	Park Hills Network	Slope (Qa)	1.03497
Station	Leadwood South	Intercept (Qa)	-0.00227
Sampler	#1 TSP	Temperature	25.5 °C 298.7 °K
Flow Controller	P4559	Station Pressure	30.07 "Hg 763.8 mmHg

Flow Rate Audit

Transfer Orifice		Sampler				Calibration Error %	Acceptable Range
Manometer "H_2O	Flow Rate m^3/min	Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min		
3.70	1.164	23.10	43.16	0.943	1.242	**6.70**	± 7%

Sampler Operating Flow Rate

Manometer "H_2O	Pressure (Pf)	Press. Ratio (Po/Pa)	Flow Rate m^3/min	Corrected Flow Rate	Acceptable Range
23.00	42.97	0.944	1.244	**1.161**	1.10 - 1.70

Calculations:

Pressure mmHg (Pf) - "H_2O * 1.86832

Pressure Ratio (Po/Pa) - 1-Pf/Pa

Orifice Flow Rate (Qa) - 1/Slope*(Sqrt("H2O*(Ta/Pa))-Intercept)

Sampler Flow Rate (Qa) - Taken from the look-up tables

Calibration Error - (Sampler Flow-Orifice Flow)/Orifice Flow*100

Corrected Flow Rate - Operating Flow*((100-Calibration Error)/100)

Calibration Orifice Certification Worksheet

TISCH ENVIRONMENTAL, INC.
145 SOUTH MIAMI AVE
VILLAGE OF CLEVES, OH
45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX

TISCH Environmental

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5028A

Date - Jan 09, 2014 Rootsmeter S/N 0438320 Ta (K) - 292
Operator Tisch Orifice I.D. - 1882 Pa (mm) - 759.46

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	1.3530	4.1	1.50
2	NA	NA	1.00	1.0430	6.8	2.50
3	NA	NA	1.00	0.9510	8.1	3.00
4	NA	NA	1.00	0.8790	9.5	3.50
5	NA	NA	1.00	0.6660	16.3	6.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
1.0143	0.7496	1.2368		0.9945	0.7350	0.7594
1.0106	0.9690	1.5967		0.9910	0.9501	0.9804
1.0089	1.0608	1.7491		0.9893	1.0402	1.0740
1.0070	1.1456	1.8893		0.9874	1.1233	1.1600
0.9978	1.4983	2.4736		0.9784	1.4691	1.5188

Qstd slope (m) = 1.65282
intercept (b) = -0.00370
coefficient (r) = 0.99999

Qa slope (m) = 1.03497
intercept (b) = -0.00227
coefficient (r) = 0.99999

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}