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Mr. Randy Matty, P.E.
Air Management Engineer
Wisconsin Department of Natural Resources
2984 Shawano Ave.
Green Bay, WI 54313-6727

August 15, 2014

RE: Boiler B28 and B09 Stack Test Reports, Report No. 4784A

Dear Mr. Matty:

Enclosed are two copies of the stack test report required by Permit No.: 436035930-P22 condition ZZZ.4.(2). The report details the Total Particulate Compliance Tests performed on Manitowoc Public Utilities (MPU) Boiler No. 8 (B28) on June 19, 2014 and on Boiler No. 9 (B09) on June 17, 2014 in Manitowoc, WI. Airtech Environmental Services Inc. performed the compliance tests and the results are documented in the attached Airtech Environmental Services Inc. Report No. 4784A, dated August 14, 2014. The reported results purport to be elevated when compared to the total PM limit. As explained below, MPU and Airtech Environmental Services both believe these results are invalid. Therefore, we do not believe these results show an exceedance.

The summary of the test results are as follows:

Boiler	**Constituent**	**Average Emission Rate lb/mmBtu**	**Permit Limit lb/mmBtu**
B-28	$<PM_{2.5}$ filterable fraction	0.000967	------
B-28	$>PM_{2.5}$ fraction	0.00868	------
B-28	Condensable fraction	0.165	------
B-28	Total $PM_{2.5}$	0.166	------
B-28	**Total PM**	**0.175**	**0.03**

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Document: 2014-08-15 (WDNR) B8 and B9 Stack Test Report Cover Letter

8/15/2014

Boiler	Constituent	Average Emission Rate Lb/mmBtu	Permit Limit Lb/mmBtu
B-09	<$PM_{2.5}$ filterable fraction	0.00160	------
B-09	>$PM_{2.5}$ fraction	0.00877	------
B-09	Condensable fraction	0.0596	------
B-09	Total $PM_{2.5}$	0.0612	------
B-09	**Total PM**	**0.0699**	**0.03**

B28 Compliance Status:

- Total particulate test results exceeded the applicable permit limitation of Permit No.: 436035930-P22 condition I.E.1.a.(1). Total filterable particulate matter was 0.009647 Lb/mmBtu and is well below the 0.03 Lb/mmBtu limit indicating that the baghouse is performing well.

B09 Compliance Status:

- Total particulate test results exceeded the applicable permit limitation of Permit No.: 436035930-P22 condition I.D.1.a.(1). Total filterable particulate matter was 0.01037 Lb/mmBtu and is well below the 0.03 Lb/mmBtu limit indicating that the baghouse is performing well.

Discussion:

- Airtech Environmental Services Inc. reported that they used aluminum trays to dry the condensable samples and the trays were visibly corroded. We believe this accounts for the elevated results observed in the condensable fraction as non-PM material was captured on the tare tray.
- The variation between the runs was also significant with B-28 having a standard deviation of 0.08 Lb/mmBtu and B-09 having a standard deviation of 0.034 Lb/mmBtu
- MPU has tested both of these boilers several times and has never experienced condensable results of this magnitude, see historical test summary table below.

Unit	Test Date	Filterable PM Lb/mmBtu	Condensable PM Lb/mmBtu	Total PM Lb/mmBtu
B-28	8-8-2012	0.00458	0.00935	**0.01394**
B-28	4-19-2012	0.013	0.012	**0.025**
B-09	4-17-2012	0.009	0.008	**0.017**
B-28	1-12-2010	0.013	0.01	**0.023**
B-09	1-13-2010	0.009	0.007	**0.016**
B-28	9-19-2007	0.0109	0.0091	**0.0201**

- Note that the above historical data indicates filterable and condensable emission rates are normally about the same on both units. Test results on both units are not reasonable.

Recommendation:

- MPU believes that the neither test is representative of the actual total particulate matter emission rates and both tests should be considered void.
- Airtech Environmental Services Inc. agrees that this testing should be considered invalid for the purposes of proving compliance with the total PM emission limit.
- MPU will repeat testing of boilers B28 and B09 using Method 201 and 202 trains and specify that glass be used as the tare "tin" to complete the condensable analysis. The testing to be completed per the test protocol previously submitted.
- Alternately MPU will repeat testing of boilers B28 and B09 using conventional Method 5 and 202 trains as allowed in the permit to demonstrate compliance with the total particulate emission limit. Alternate test protocol for this method is attached.
- MPU is prepared to retest the units as soon as possible if the Department waives the 20-day notification requirement and indicates which method we should use.

If you have any questions regarding the stack test report, or require additional information, please contact me.

Sincerely,

Thomas E. Reed, P.E.
Environmental Engineer
Manitowoc Public Utilities
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8/15/2014

AIRTECH
Environmental
Services Inc.

Report on the
Air Emissions Test Program

Conducted for Manitowoc Public Utilities
At the Manitowoc Public Utilities Power Plant
Located in Manitowoc, Wisconsin

Report No. 4784A
August 14, 2014

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Project Overview

General

Airtech Environmental Services, Inc. (Airtech) was contracted by Manitowoc Public Utilities (MPU) to perform an air emissions test program at their facility located in Manitowoc, Wisconsin. The specific objective of this test program was to determine the emissions of filterable particulate matter (PM) equal to or less than a nominal aerodynamic diameter of 2.5 micrometers ($PM_{2.5}$) and total particulate matter (TPM) from the exhausts of two (2), circulating, fluidized-bed boilers designated as Boiler 8 (B28) and Boiler 9 (B09).

Testing was performed to meet the requirements of MPU, the Wisconsin Department of Natural Resources (WDNR), and the US Environmental Protection Agency (USEPA).

Testing on Boiler 8 was performed on June 19, 2014. Testing on Boiler 9 was performed on June 17, 2014. Coordinating the field portion of the test program were:

Thomas Reed – Manitowoc Public Utilities
Blu Kaput – Airtech Environmental Services Inc.

Methodology

EPA Methods 201A and 202 were used to determine the emissions of PM equal to or less than a nominal aerodynamic diameter of 2.5 micrometer ($PM_{2.5}$) and the concentration of total particulate at each test location. With this approach, a sample of the gas stream was withdrawn isokinetically from the source. The filterable PM was separated by an in-stack, stainless steel cyclone. Particles greater than 2.5 micron diameter were caught in the cyclone. PM less than or equal to 2.5 micron diameter passed through the cyclone assembly and were caught on an in-stack glass fiber filter. Condensible PM in the sample gas passed through the filter and collected in a dry impinger system. The weight of filterable $PM_{2.5}$ and condensable PM collected with the sample train combined with the volume of dry gas withdrawn from the source was then used to calculate the various PM concentrations.

The compliance PM testing of Boilers 28 and 09 was modified per guidance obtained from Andy Seeber (Wisconsin DNR) on July 3, 2012 as follows:

1. The configuration for the particulate train to determine both PM2.5 emissions and total particulate emissions was as follows:
    - $PM_{2.5}$ nozzle
    - $PM_{2.5}$ sampling head
    - $PM_{2.5}$ filter
    - Glass lined probe (heated to 248F +/- 25F)
    - Filter bypass (heated to 248F +/- 25F)
    - Impinger train setup per USEPA Method 202 requirements

2. Sampling was performed at the Method 1 required test points (normally 25 for B28) with a minimum of 60 dry standard cubic feet sampled, and an isokinetic variance of between 90%-110%.
3. Less than $PM_{2.5}$ emissions consisted of the total of the less than $PM_{2.}5$ filterable fraction plus the condensable (Method 202) fraction.
4. Total particulate emissions consisted of the less than $PM_{2.5}$ filterable fraction, plus the greater than $PM_{2.5}$ filterable fraction, plus condensable (Method 202) fraction.

In order to convert the various PM fractions to mass emissions rates, the volumetric gas flow rate through each test location was determined concurrently with each test run, using EPA Methods 1, 2, 3 and 4. Three test runs were performed at each test location. Each test run was 180 minutes in duration. Total PM, $PM_{2.5}$, and condensable PM is reported in units of pounds per hour (lb/hr), pounds per million British thermal unit of heat input, f-Factor method (lb/mmBtu) and lbs. per ton of fuel input (lb/ton).

Parameters
The following specific parameters were determined at each test location:

- gas temperature
- gas velocity
- carbon dioxide content
- oxygen content
- moisture content
- particulate matter less than a nominal aerodynamic diameter of 2.5 microns
- condensable particulate matter
- total particulate matter

Results

The results from this testing have been biased by a reactive deposition. Though the procedures in Method 202 were followed precisely, an obvious reaction between the final inorganic fraction condensate and the weighing tin required by Method 202 occurred. The bias was caused by chemicals reacting with the aluminum in the weighing tin. This resulted in a white precipitate forming at the bottom of the tin. The reaction was in fact so significant that it weakened the aluminum at the bottom of each weighing tin to the point that the structure of the tins was compromised.

For the reasons cited above, this testing and the associated condensable results should be considered invalid for the purposes of proving compliance with the total PM emission limit. It is the opinion of Airtech Environmental Services that any condensable PM determinations made at these particular sources be done using only glass components, including the vessels used for analysis.

A summary of test results is presented in Tables 1 and 2 on Pages 5 and 6.

Proximate and ultimate fuel analysis was conducted on all fuels used during the test program. An F_c factor was calculated based on the mass percentage of each fuel in the final fuel feed. The F_c factor used in the final emission calculation was 1,528 scf/mmBtu for Boiler B28 and 1,489 scf/mmBtu for Boiler B09. The results of the fuel analysis can be found in the Laboratory Data section of the Appendix. A summary of the resulting F_c factor can be found in the Parameters section of the Appendix.

Pounds per ton of fuel input emission rates are calculated using the fuel throughput provided in the Boiler Operating data and the measured pound per hour emission rates measured at the stack. All pertinent boiler operating parameters can be found in the Process Data section of the Appendix.

Submitted by:	Reviewed by:
Cathy Busse, Technical Writer	Michael Hess, CEMS Manager

Summary of Results

Table 1–Summary of Boiler B28 Results

Test Parameters	**Run 1**	**Run 2**	**Run 3**	**Average**
Date	6/19/2014	6/19/2014	6/19/2014	
Start Time	8:14	11:59	15:32	
Stop Time	11:16	15:01	18:34	
Process Data				
Fuel Input (lb/run)	68,972	72,642	68,135	
Fuel Input (lb/hr)	22,491	22,467	22,586	
Production Rate (MWh/hr)	22.11	22.18	22.71	
Gas Conditions				
Temperature (^{o}F)	300	297	296	**298**
Volumetric Flow Rate (acfm)	131,800	129,800	129,100	**130,200**
Volumetric Flow Rate (scfm)	87,400	86,500	86,000	**86,600**
Volumetric Flow Rate (dscfm)	79,200	78,100	79,900	**79,100**
Carbon Dioxide (% dry)	12.1	12.1	12.3	**12.2**
Oxygen (% dry)	6.9	6.8	6.7	**6.8**
Moisture (%)	9.39	9.75	7.12	**8.76**
Filterable $PM_{2.5}$ Results				
Concentration (grains/dscf)	0.0000993	0.000425	0.00111	**0.000544**
Emission Rate (lb/MMBtu)	0.000180	0.000764	0.00196	**0.000967**
Emission Rate (lb/hr)	0.0675	0.284	0.758	**0.370**
Emission Rate (lb/ton fuel input)	0.00000300	0.0000127	0.0000336	**0.0000164**
>$PM_{2.5}$ Results				
Concentration (grains/dscf)	0.00515	0.00406	0.00532	**0.00484**
Emission Rate (lb/MMBtu)	0.00932	0.00731	0.00941	**0.00868**
Emission Rate (lb/hr)	3.50	2.72	3.64	**3.29**
Emission Rate (lb/ton fuel input)	0.000156	0.000121	0.000161	**0.000146**
Condensable PM Results				
Concentration (grains/dscf)	0.0956	0.1353	0.0452	**0.0920**
Emission Rate (lb/MMBtu)	0.173	0.243	0.0800	**0.165**
Emission Rate (lb/hr)	64.9	90.5	31.0	**62.2**
Emission Rate (lb/ton fuel input)	0.00289	0.00403	0.00137	**0.00276**
Total $PM_{2.5}$ Results				
Concentration (grains/dscf)	0.0957	0.1357	0.0463	**0.0926**
Emission Rate (lb/MMBtu)	0.173	0.244	0.0820	**0.166**
Emission Rate (lb/hr)	65.0	90.8	31.7	**62.5**
Emission Rate (lb/ton fuel input)	0.00289	0.00404	0.00141	**0.00278**
Total Results				
Concentration (grains/dscf)	0.101	0.140	0.0517	**0.0974**
Emission Rate (lb/MMBtu)	0.182	0.251	0.0914	**0.175**
Emission Rate (lb/hr)	68.5	93.5	35.4	**65.8**
Emission Rate (lb/ton fuel input)	0.00305	0.00416	0.00157	**0.00293**

Table 2– Summary of Boiler B09 Results

Test Parameters	**Run 1**	**Run 2**	**Run 3**	**Average**
Date	6/17/2014	6/17/2014	6/17/2014	
Start Time	10:54	14:49	18:41	
Stop Time	14:03	17:58	21:49	
Process Data				
Fuel Input (lb/run)	149,366	148,886	150,620	
Fuel Input (lb/hr)	46,677	47,017	48,070	
Production Rate (MWh/hr)	58.9	57.8	57.8	
Gas Conditions				
Temperature (^{o}F)	343	342	340	**342**
Volumetric Flow Rate (acfm)	229,400	234,300	233,700	**232,500**
Volumetric Flow Rate (scfm)	146,900	150,300	150,200	**149,100**
Volumetric Flow Rate (dscfm)	134,800	136,100	136,900	**135,900**
Carbon Dioxide (% dry)	12.7	12.7	12.7	**12.7**
Oxygen (% dry)	6.5	6.4	6.5	**6.5**
Moisture (%)	8.28	9.49	8.88	**8.89**
Filterable $PM_{2.5}$ Results				
Concentration (grains/dscf)	0.00108	0.00153	0.000246	**0.000955**
Emission Rate (lb/MMBtu)	0.00181	0.00258	0.000414	**0.00160**
Emission Rate (lb/hr)	1.25	1.79	0.289	**1.11**
Emission Rate (lb/ton fuel input)	0.0000268	0.0000381	0.00000601	**0.0000236**
>$PM_{2.5}$ Results				
Concentration (grains/dscf)	0.00419	0.00434	0.00715	**0.00523**
Emission Rate (lb/MMBtu)	0.00699	0.00729	0.0120	**0.00877**
Emission Rate (lb/hr)	4.84	5.06	8.40	**6.10**
Emission Rate (lb/ton fuel input)	0.000104	0.000108	0.000175	**0.000129**
Condensable PM Results				
Concentration (grains/dscf)	0.0129	0.0467	0.0469	**0.0355**
Emission Rate (lb/MMBtu)	0.0215	0.0784	0.0788	**0.0596**
Emission Rate (lb/hr)	14.9	54.4	55.1	**41.5**
Emission Rate (lb/ton fuel input)	0.000319	0.00116	0.00115	**0.000874**
Total $PM_{2.5}$ Results				
Concentration (grains/dscf)	0.0140	0.0482	0.0472	**0.0364**
Emission Rate (lb/MMBtu)	0.0233	0.0809	0.0792	**0.0612**
Emission Rate (lb/hr)	16.1	56.2	55.3	**42.6**
Emission Rate (lb/ton fuel input)	0.000346	0.00120	0.00115	**0.000898**
Total Results				
Concentration (grains/dscf)	0.0182	0.0525	0.0543	**0.0417**
Emission Rate (lb/MMBtu)	0.0303	0.0882	0.091	**0.0699**
Emission Rate (lb/hr)	21.0	61.3	63.7	**48.7**
Emission Rate (lb/ton fuel input)	0.000449	0.00130	0.00133	**0.00103**

Test Procedures

Method Listing

The test methods found in 40 CFR Part 60, Appendix A and 40 CFR Part 51, Appendix M were referenced during the test program. The following individual methods were used:

EPA Method 1	Sample and Velocity Traverse for Stationary Sources
EPA Method 2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S pitot tube)
EPA Method 3	Determination of oxygen and carbon dioxide concentrations in emissions from stationary sources
EPA Method 4	Determination of Moisture Content in Stack Gases
EPA Method 19	Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxides Emission Rates
EPA Method 201A	Determination of PM10 emissions (constant sampling rate procedure)
EPA Method 202	Dry impinger method for determining condensable particulate emissions from stationary sources

Method Descriptions

Method 1

Method 1 was used to determine the suitability of each test location and to determine the sample points used for the pollutant concentration determinations. Each test location conformed to the minimum requirements of being located at least 2.0 diameters downstream and at least 0.5 diameters upstream from the nearest flow disturbance.

The Boiler B28 (B08) test location was a rectangular, vertical duct with dimensions of 124.75 inches by 60.0 inches. Three points were sampled for each of the five test ports. The test ports were located approximately 4.4 equivalent diameters downstream and approximately 8.9 equivalent diameters upstream from the nearest flow disturbances. A cross section of the sampling location, showing the sample points, can be found in Figure 1 of the Appendix.

The Boiler B09 test location was a round, vertical stack with a diameter of 108 inches. Six points were sampled for each of the two test ports. The test ports were located approximately 3.3 diameters downstream and approximately 2.0 diameters upstream from the nearest flow disturbances. A cross section of the sampling location, showing the sample points, can be found in Figure 2 of the Appendix.

Method 2

Method 2 was used to determine the gas velocity through each test location using a Type-S pitot tube and an incline plane oil manometer. The values measured in Method 2, along with the measurements made in Methods 3 and 4, were used to calculate the volumetric flow rate through the test location. A diagram of the Method 2 apparatus is shown as part of the Method 201A/202 sampling train in Figure 3 of the Appendix.

The manometer was leveled and "zeroed" prior to each test run. The sample train was leak checked before and after each run by pressurizing the positive side, or "high" side, of the pitot tube, creating a deflection on the manometer of at least three inches H_2O. The leak check was considered valid if the manometer remained stable for 15 seconds. This procedure was repeated on the negative side by generating a vacuum of at least three inches H_2O. The velocity head pressure and gas temperature were then determined at each point specified in Method 1. The static pressure of the stack was measured using a water filled U-tube manometer. In addition, the barometric pressure was measured and recorded.

Method 3

The carbon dioxide and oxygen contents were determined at the test location using EPA Method 3. A gas sample was collected into a Tedlar bag from the dry gas meter exhaust of the Method 5 sampling train for the duration of each test run. Analysis was performed using an Orsat gas analyzer.

The gas analyzer was leak checked prior to analysis by raising the liquid levels in each pipette to a reference mark on the capillary tubes and then closing the pipette valves. The burette solution was then raised to bring the meniscus onto the graduated portion of the burette and the manifold valve was closed. After four minutes, the pipette meniscus did not fall below the reference mark and the burette meniscus did not fall by more than 0.2 percent, so the leak check was considered valid. The average of three gas analyses determined the carbon dioxide and oxygen contents.

The carbon dioxide content and oxygen content were used, along with the moisture content determined in Method 4 to calculate the gas stream molecular weight. The molecular weight was then used for the volumetric flow rate calculations. For these calculations, the balance of the gas stream was assumed to consist of nitrogen since other gas stream components are insignificant for the purposes of calculating molecular weight.

Method 4

EPA Method 4 was used to determine the moisture content at each test location. A known volume of sample gas was withdrawn from each source and the moisture was condensed and measured. The dry standard volume of the sample gas was then compared to the volume of moisture collected to determine the moisture content of the sample gas. The Method 4 apparatus is shown as part of the Method 201A/202 sample train in Figure 3 of the Appendix.

To condense the water vapor the gas sample passed through a series impingers. The impingers were charged as outlined in Method 201A/202. In all trains, the last impinger contained a known weight of silica gel to absorb any residual water vapor.

After the test run the sample train was leak checked at the highest vacuum encountered during the test run. The amount of water collected in the condenser system and the silica gel weight gain was determined gravimetrically. The net weight gain of water was converted to a volume of wet gas and then compared to the amount of dry gas sampled to determine the moisture content. The moisture content was used, along with the oxygen and carbon dioxide content determined by EPA Method 3A, for the calculation of the volumetric flow rate.

Method 19

The equations in EPA Method 19 were used to calculate the emission rates of PM from the test location in units of pounds per million British thermal units (lb/mmBtu). The calculation was based on the carbon dioxide content of the sample gas and an appropriate F factor, which is the ratio of combustion gas volumes to heat inputs.

Method 201A/ 202

Methods 201A and 202 were used to determine the emissions of particulate matter less than or equal to 2.5 microns ($PM_{2.5}$) in diameter, CPM and total PM. In Method 201A, a sample of the gas stream was withdrawn isokinetically from the stack. The particulate matter greater than 2.5 microns was separated by an in-stack cyclone. The particulate less than 2.5 microns was then collected on an insitu glass filter and in a glass impinger system. A diagram of the Method 201A/202 sampling train can be found in Figure 3 of the Appendix.

The in-stack cyclone and nozzle assembly were constructed of stainless steel. Sample gas passed through the nozzle and cyclone assembly and then through an in-stack glass filter. After exiting the filter, the sample gas passed through an EPA Method 23 type glass coil condenser and then through a series of four (4) glass impingers. The condenser was cooled with a water recirculation pump that was placed in a water bath. The recirculation pump and coiled condenser are used to maintain the gas temperature between 65°F and 85°F at the exit of the CPM filter. Impingers 1 and 2 were initially empty. A Teflon fiber CPM filter followed impinger 2. Impinger 3 contained 100ml of water. The fourth impinger contained a known mass of silica gel to absorb any remaining water vapor. The dry gas exiting the moisture condenser system then passed through a sample pump and a dry gas meter to measure the gas volume. After leaving the dry gas meter the sample stream passed through an orifice which was used to meter the flow rate through the sample train. The pressure drop across the orifice was measured with an incline plane oil manometer.

Prior to the test run, the filter was weighed to the nearest 0.0001 gram and loaded into the filter holder. The sample rate was calculated to maintain a 10 micron cut point with the

cyclone. The maximum and minimum velocity head pressures (ΔP min and ΔP max) for 11 different nozzle sizes were calculated based on the gas conditions of the test locations. A sample nozzle was chosen so that the velocity head pressures at each sample point fell within the calculated ΔP min and ΔP max. After assembly, the sample train was leak checked prior to the test run by capping the probe tip and pulling a vacuum greater than the highest vacuum expected during the test run. A leak check was considered valid if the leak rate was below the lesser of 0.02 cubic feet per minute or four percent of the average sample rate.

The probe tip was placed at the first of the sample points determined in Method 1. The velocity at the sample point was determined using Method 2 by reading the velocity pressure from the oil manometer. Sample was withdrawn from the source throughout the test at the pre-calculated sample rate. During the test run the train was moved to each of the Method 1 sample points. The sample time at each point was then calculated such that the time at each point was proportional to the gas velocity. The run time was determined such that a minimum sample volume of 60 dry standard cubic feet was collected. The gas velocity pressure, gas meter reading, gas meter inlet and outlet temperatures, gas meter orifice pressure and pump vacuum were recorded at each sample point.

After the test run, the cyclone and filter assembly were removed from the probe and the sample train was leak checked at the highest vacuum encountered during the test run. The sampling train was moved to the on-site lab and purged with zero grade nitrogen at a nominal flow rate of at least 14 liters per minute for a period of 60 minutes. The nozzle, probe and front half of the filter holder were washed with acetone and the rinse saved in a 250ml glass jar equipped with a Teflon lid. The glass fiber filter was removed from the filter holder, transferred to a labeled Petri dish and sealed. The tube leading from the cyclone to the filter holder, as well as the front half of the filter holder were washed with acetone and the rinse saved. The condensate weight gain of the impinger contents was determined as outlined in Method 4.

Upon completion of the purge, the contents of impingers one and two were transferred to a pre-cleaned 950 ml sample jar equipped with a Teflon lid. The condenser coil and all connecting glassware up to and including the front half of the CPM filter were rinsed twice with deionized ultra-filtered (DUIF) water and added to the sample jar. An acetone rinse of the above glassware was performed and saved in a separate pre-cleaned 500ml sample jar equipped with a Teflon lid. Finally, two (2) rinses of the above components were performed with hexane and added to the acetone container. The CPM filter was removed from the filter holder and placed in a 40ml glass jar.

Analysis of all sample fractions was performed at the Airtech laboratory located in Elk Grove Village, Illinois. The acetone rinses from the Method 5 portion of the sampling train were transferred to tared beakers, evaporated to dryness under ambient temperature and pressure conditions, desiccated for 24 hours and weighed to a constant weight. A weight was considered constant when the difference between two consecutive weights, taken a minimum of six hours apart, was less than or equal to 0.0005 grams. The weight

gain of the glassware rinses and glass fiber filter yielded the total weight of filterable particulate collected during sampling. The acetone fraction of the analysis was adjusted for the appropriate blank values.

Inorganic extraction of the CPM filter was performed by placing the filter into an extraction tube with DIUF water and placing it into a sonication bath for a minimum of 2 minutes. This extraction was done a total of 3 times and the water used each time was added to the impinger water container. After inorganic extraction of the CPM filter, an organic extraction of the impinger water was performed.

Organic CPM extraction of the filter was performed by placing the inorganic extracted filter into an extraction tube with hexane and placing it into a sonication bath for a minimum of 2 minutes. This extraction was done a total of 3 times and the hexane used was added to the acetone/hexane container.

The entire contents of the impinger water sample fraction were placed in a separatory funnel. A 30 ml aliquot of Hexane was added to the funnel and the funnel contents were thoroughly mixed. The organic layer was then allowed to separate from the water and the inorganic fraction was decanted from the bottom of the funnel into the impinger catch sample jar. This procedure was conducted three (3) times to complete the extraction.

The inorganic fraction was then transferred into a beaker and evaporated down to not less than 10 ml final volume at an elevated temperature. The remaining volume was evaporated to dryness at ambient temperature. The beaker was desiccated for 24 hours and then weighed to a constant weight.

The organic fraction was then transferred into a beaker and evaporated to dryness at ambient temperature and pressure. The beaker desiccated for 24 hours and then weighed to a constant weight.

The weight differences for the organic and inorganic fractions were combined to determine the total condensable particulate collected. All fractions of the CPM analysis were adjusted for the appropriate blank values.

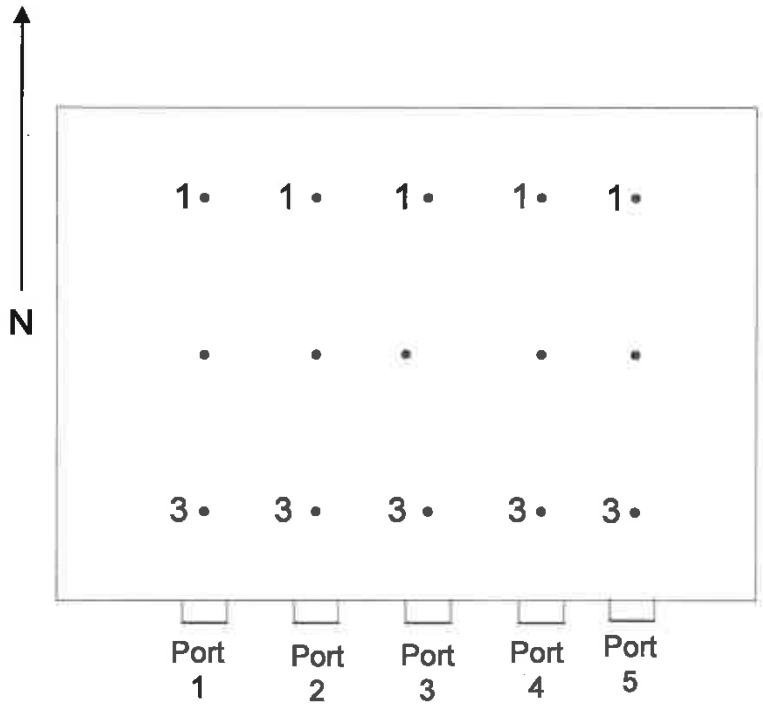
Description of Installation

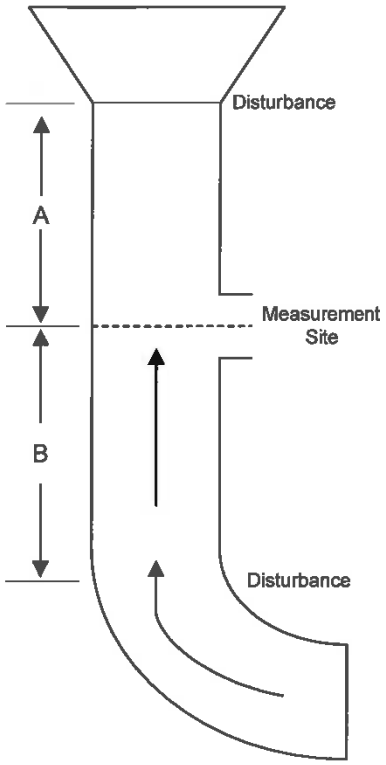
Manitowoc Public Utilities (MPU) is an electric cogenerating facility located in the city of Manitowoc Wisconsin. This plant includes two atmospheric pressure, circulating fluidized bed (CFB) boilers, designated as Boilers 8 (B28) and 9 (B09). Boiler 8 was installed in 1990, and is permitted to fire coal, petroleum coke, paper pellets, biomass, rubber waste derived fuels, natural gas, or other alternative fuels as approved by the Department. The Foster Wheeler Fluidized Bed Boiler is rated at 200,000 lbs. of superheated steam per hour at 975 psig and 905 degrees F. It is equipped with an economizer and air preheater and exhausts through a baghouse.

The plant also includes Boiler B10, a natural gas-fired package boiler fired with a heat input rating of 33 mmBtu/hr. Boiler B10 does not have the ability to power the existing MPU electrical steam turbines and only serves as an auxiliary boiler for the heating plant. Boiler B10 discharges into stack S10 along with boiler 9 and diesel unit #2.

Appendix

Figures





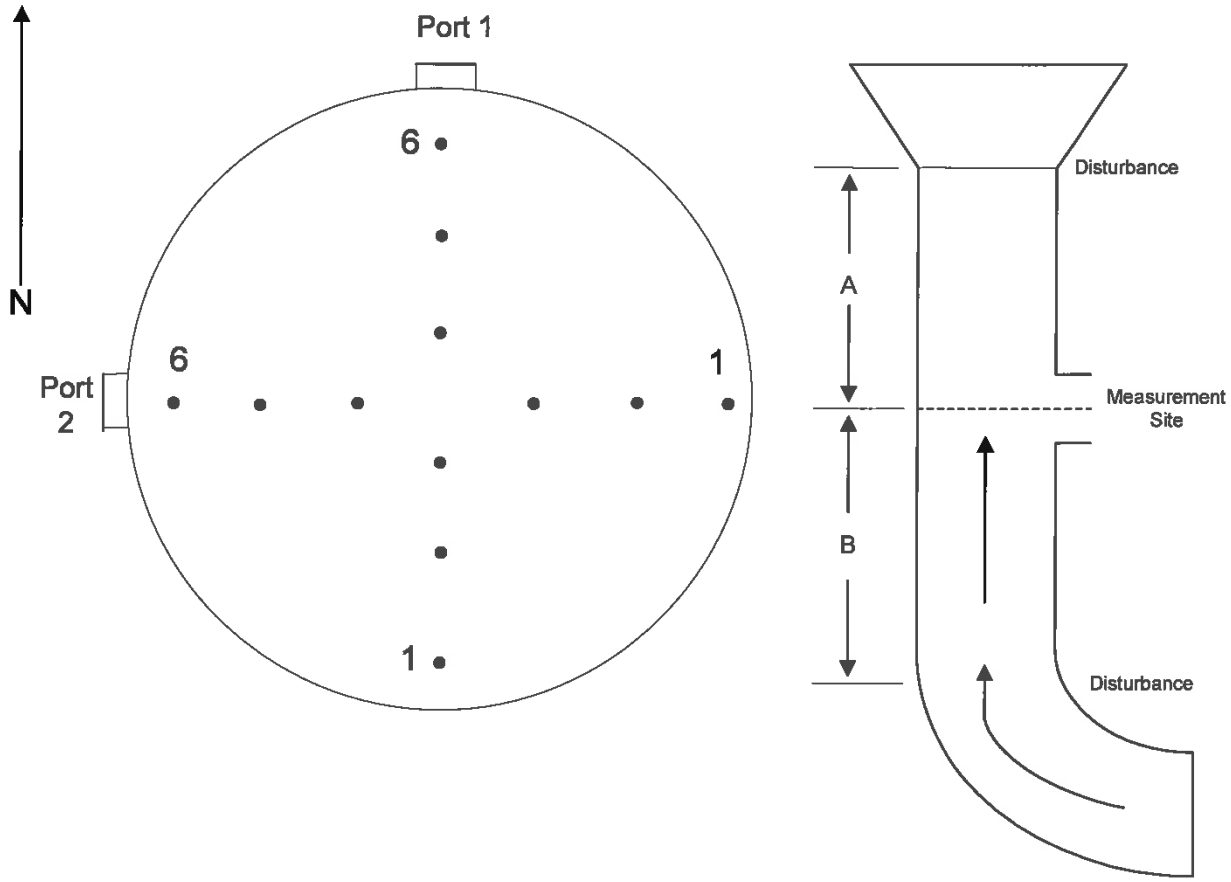
Dimensions (in.)	124.75 X 60.0
Port Length (in.)	11.0
Distance A (Duct Diameters)	8.9
Distance B (Duct Diameters)	4.4

Point	Distance From Wall (in.)
1	20.8
2	62.4
3	104.0

Cross Section of the Boiler 8 (B28) Test Location
Manitowoc Public Utilities

Figure 1

AIRTECH Environmental Services Inc.



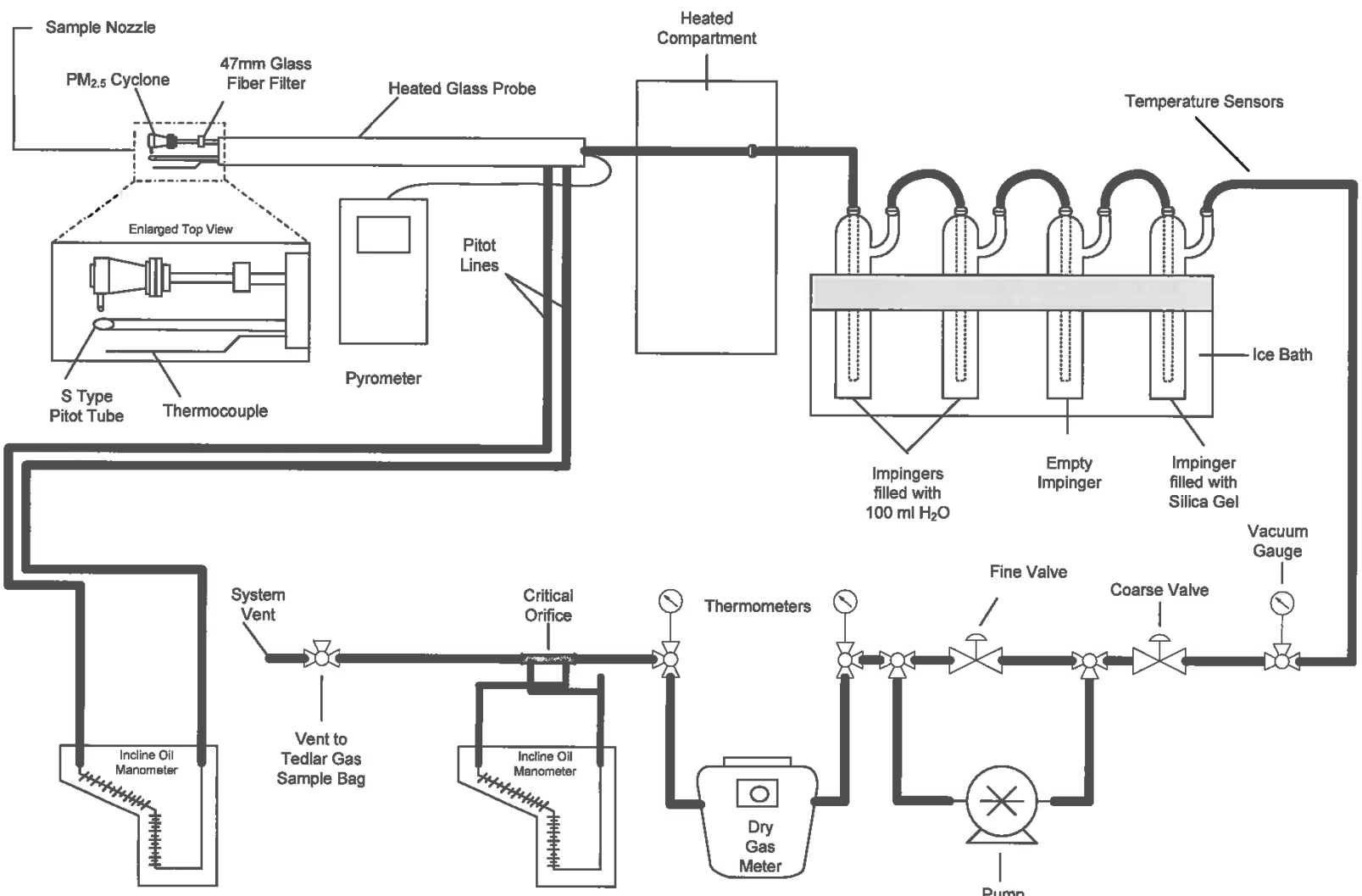
Diameter (in.)	108
Port Length (in.)	11.0
Distance A (Duct Diameters)	2.0
Distance B (Duct Diameters)	3.3

Point	Distance From Wall (in.)
1	4.7
2	15.8
3	31.9
4	76.1
5	92.2
6	103.3

Cross Section of the Boiler 9 (B9) Test Location
Manitowoc Public Utilities

Figure 2

AIRTECH
Environmental
Services Inc.



EPA Methods 2, 3, 4, 201A and 202:
$PM_{2.5}$ and Total PM Sampling Train

Figure 3

AIRTECH Environmental Services Inc.

MPU04042

Sample Calculations

Sample Calculations, Boiler 28, Run 1

Area of Sample Location

$$A_s = \frac{l}{12} \times \frac{w}{12}$$

$$A_s = \frac{124.75}{12} \times \frac{60}{12}$$

$$A_s = 52.0\,ft^2$$

where:

A_s	= area of sample location (ft^2)
d_s	= diameter of sample location (in)
12	= conversion factor (in/ft)
2	= conversion factor (diameter to radius)

Stack Pressure Absolute

$$P_a = P_b + \frac{P_s}{13.6}$$

$$P_a = 29.50 + \frac{-12.6}{13.6}$$

$$P_a = 28.57\,in.Hg$$

where:

P_a	= stack pressure absolute (in. Hg)
P_b	= barometric pressure (in. Hg)
P_s	= static pressure (in. H_2O)
13.6	= conversion factor (in. H_2O/in. Hg)

Volume of Dry Gas Collected Corrected to Standard Temperature and Pressure

$$V_{m(std)} = \frac{17.64(V_m)(Y_d)\left(P_b + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{m(std)} = \frac{17.64(62.54)(1.0024)\left(29.50 + \frac{0.410}{13.6}\right)}{(65.5 + 460)}$$

$$V_{m(std)} = 62.14 scf$$

where:

$V_{m(std)}$	= volume of gas collected at standard temperature and pressure (scf)
V_m	= volume of gas sampled at meter conditions (ft^3)
Y_d	= gas meter correction factor (dimensionless)
P_b	= barometric pressure (in. Hg)
ΔH	= average sample pressure (in. H_2O)
T_m	= average gas meter temperature (^oF)
13.6	= conversion factor (in. H_2O/in. Hg)
17.64	= ratio of standard temperature over standard pressure (^oR/in. Hg)
460	= conversion (^oF to ^oR)

Volume of Water Vapor Collected Corrected to Standard Temperature and Pressure

$$V_{w(std)} = 0.04715 \times (V_{wc} + V_{wsg})$$

$$V_{w(std)} = 0.04715 \times (114.3 + 22.3)$$

$$V_{w(std)} = 6.44 scf$$

where:

$V_{w(std)}$	= volume of water vapor at standard conditions (scf)
V_{wc}	= weight of liquid collected (g)
V_{wsg}	= weight gain of silica gel (g)
0.04715	= volume occupied by one gram of water at standard temperature and pressure (ft^3/g)

Percent Moisture[1]

$$B_{ws} = 100 \times \left[\frac{V_{w(std)}}{\left(V_{m(std)} + V_{w(std)}\right)} \right]$$

$$B_{ws} = 100 \times \left[\frac{6.44}{(62.14 + 6.44)} \right]$$

$$B_{ws} = 9.39\%$$

where:

B_{ws}	= moisture content of the gas stream (%)
$V_{m(std)}$	= volume of gas collected at standard temperature and pressure (scf)
$V_{w(std)}$	= volume of water vapor at standard conditions (scf)
100	= conversion factor

Molecular Weight of Dry Gas Stream[2]

$$M_d = \left(44 \times \frac{\%CO_2}{100}\right) + \left(32 \times \frac{\%O_2}{100}\right) + \left(28 \times \frac{(\%N_2)}{100}\right)$$

$$M_d = \left(44 \times \frac{12.1}{100}\right) + \left(32 \times \frac{6.9}{100}\right) + \left(28 \times \frac{(81.0)}{100}\right)$$

$$M_d = 30.21 lb / lbmole$$

where:

M_d	= molecular weight of the dry gas stream (lb/lb-mole)
$\%CO_2$	= carbon dioxide content of the dry gas stream (%)
44	= molecular weight of carbon dioxide (lb/lb-mole)
$\%O_2$	= oxygen content of the dry gas stream (%)
32	= molecular weight of oxygen (lb/lb-mole)
$\%N_2$	= nitrogen content of the dry gas stream (%)
28	= molecular weight of nitrogen and carbon monoxide (lb/lb-mole)
100	= conversion factor

[1] The moisture saturation point is used for all calculations if it is exceeded by the actual moisture content.
[2] The remainder of the gas stream after subtracting carbon dioxide and oxygen is assumed to be nitrogen.

Molecular Weight of Wet Gas Stream

$$M_s = \left(M_d \times \left(1 - \frac{B_{ws}}{100}\right)\right) + \left(18 \times \frac{B_{ws}}{100}\right)$$

$$M_s = \left(30.21 \times \left(1 - \frac{9.39}{100}\right)\right) + \left(18 \times \frac{9.39}{100}\right)$$

$$M_s = 29.06 lb / lbmole$$

where:

M_s	= molecular weight of the wet gas stream (lb/lb-mole)
M_d	= molecular weight of the dry gas stream (lb/lb-mole)
B_{ws}	= moisture content of the gas stream (%)
18	= molecular weight of water (lb/lb-mole)
100	= conversion factor

Velocity of Gas Stream

$$V_s = 85.49(C_p)\left(\sqrt{\overline{\Delta P}}\right)\sqrt{\frac{(T_s + 460)}{(M_s)\left(P_b + \frac{P_s}{13.6}\right)}}$$

$$V_s = 85.49(0.84)(0.615)\sqrt{\frac{(300 + 460)}{(29.06)\left(29.50 + \frac{-12.6}{13.6}\right)}}$$

$$V_s = 42.3 ft / \sec$$

where:

V_s	= average velocity of the gas stream (ft/sec)
C_p	= pitot tube coefficient dimensionless
$\sqrt{\Delta P}$	= average square root of velocity pressures (in. $H_2O)^{1/2}$
T_s	= average stack temperature (^oF)
M_s	= molecular weight of the wet gas stream (lb/lb-mole)
P_b	= barometric pressure (in. Hg)
P_s	= static pressure of gas stream (in. H_2O)
85.49	= pitot tube constant (ft/sec)([(lb/lb-mole)(in. Hg)]/[(^{0}R)(in. H_2O)]) $^{1/2}$
460	= conversion (^oF to ^oR)
13.6	= conversion factor (in. H_2O/in. Hg)

Volumetric Flow of Gas Stream - Actual Conditions

$$Q_a = 60(V_s)(A_s)$$

$$Q_a = 60(42.3)(52.0)$$

$$Q_a = 131{,}849 acfm$$

where:

Q_a	= volumetric flow rate of the gas stream at actual conditions (acfm)
V_s	= average velocity of the gas stream (ft/sec)
A_s	= area of duct or stack (ft^2)
60	= conversion factor (min/hr)

Volumetric Flow of Gas Stream - Standard Conditions

$$Q_{std} = \frac{17.64(Q_a)\left(P_b + \frac{P_s}{13.6}\right)}{(T_s + 460)}$$

$$Q_{std} = \frac{17.64(131{,}849)\left(29.50 + \frac{-12.6}{13.6}\right)}{(300 + 460)}$$

$$Q_{std} = 87{,}420 scfm$$

where:

Q_{std}	= volumetric flow rate of the gas stream at standard conditions (scfm)
Q_a	= volumetric flow rate of the gas stream at actual conditions (acfm)
T_s	= average stack temperature (^oF)
P_b	= barometric pressure (in. Hg)
P_s	= static pressure of gas stream (in. H_2O)
13.6	= conversion factor (in. H_2O/in. Hg)
17.64	= ratio of standard temperature over standard pressure (^oR/in. Hg)
460	= conversion (^oF to ^oR)

Volumetric Flow of Gas Stream - Standard Conditions - Dry Basis

$$Q_{dstd} = Q_{std}\left(1 - \frac{B_{ws}}{100}\right)$$

$$Q_{dstd} = 87{,}420\left(1 - \frac{9.39}{100}\right)$$

$$Q_{dstd} = 79{,}242 dscfm$$

where:

Q_{dstd}	= volumetric flow rate of the gas stream at standard conditions, on a dry basis (dscfm)
Q_{std}	= volumetric flow rate of the gas stream at standard conditions (scfm)
B_{ws}	= moisture content of the gas stream (%)
100	= conversion factor

Area of Nozzle

$$A_n = \pi \times \left(\frac{d_n}{2 \times 12}\right)^2$$

$$A_n = \pi \times \left(\frac{0.200}{2 \times 12}\right)^2$$

$$A_n = 0.000218 ft^2$$

where:

A_n	= area of nozzle (ft^2)
d_n	= diameter of nozzle (in)
12	= conversion factor (in/ft)
2	= conversion factor (diameter to radius)

Percent Isokinetic

$$I = \frac{0.0945(T_s + 460)(V_{m(std)})}{\left(P_b + \frac{P_s}{13.6}\right)(v_s)(A_n)(\Theta)\left(1 - \frac{B_{ws}}{100}\right)}$$

$$I = \frac{0.0945(300 + 460)(62.14)}{\left(29.50 + \frac{-12.6}{13.6}\right)(42.3)(2.18 \times 10^{-4})(180)\left(1 - \frac{9.39}{100}\right)}$$

$$I = 103.9\%$$

where:

I	= percent isokinetic (%)
T_s	= average stack temperature (^oF)
$V_{m(std)}$	= volume of gas collected at standard temperature and pressure (scf)
P_b	= barometric pressure (in. Hg)
P_s	= static pressure of gas stream (in. H_2O)
V_s	= average velocity of the gas stream (ft/sec)
A_n	= cross sectional area of nozzle (ft^2)
Θ	= sample time (min)
B_{ws}	= moisture content of the gas stream (%)
0.0945	= constant (^0R/in. Hg)
460	= conversion (^oF to ^oR)
13.6	= conversion factor (in. H_2O/in Hg)
100	= conversion factor

Acetone Wash Blank Correction[3]

$$W_a = \frac{(m_{ab})(v_{aw})}{v_{awb}}$$

$$W_a = \frac{(0.0000)(38)}{200}$$

$$W_a = 0.0000g$$

where:

W_a	= wash blank correction (g)
m_{ab}	= mass of particulate in acetone wash blank (g)
v_{aw}	= volume of acetone wash (g)
v_{awb}	= volume of acetone wash blank (g)

Mass in Front Half, Acetone Blank Corrected

$$m_f = m_{fil} + (m_a - W_a)$$

$$m_f = 0.0001 + (0.0003 - 0.0000)$$

$$m_f = 0.0004g$$

where:

m_f	= mass in front half filter, and acetone wash, blank corrected (g)
m_{fil}	= mass in front half filter (g)
m_a	= mass in acetone wash (g)
W_a	= particulate mass in acetone wash blank (g)

[3] Blank corrections for all particulate matter are performed in the same manner.

Filterable $PM_{2.5}$ Concentration, grains/dscf

$$C_{gr/dscf} = \frac{(M_n)(15.43)}{V_{m,std}}$$

$$C_{gr/dscf} = \frac{(0.0004)(15.43)}{62.14}$$

$$C_{gr/dscf} = 0.0000993 grains/dscf$$

where:

$C_{gr/dscf}$	= particulate concentration (grains/dscf)
M_n	= total particulate catch (g)
$V_{m(std)}$	= volume of gas collected at standard conditions (scf)
15.43	= conversion factor (grains/g)

Filterable $PM_{2.5}$ Emission Rate, lb/mmBtu[4]

$$E_{lb/mmBtu} = \frac{(M_n)(F_c)(100)}{(V_{m(std)})(453.6)(CO_2)}$$

$$E_{lb/mmBtu} = \frac{(0.0004)(1,528)(100)}{(62.14)(453.6)(12.1)}$$

$$E_{lb/mmBtu} = 0.000180 lb/mmBtu$$

where:

$E_{lb/mmBtu}$	= particulate emission rate (lb/mmBtu)
M_n	= total particulate catch (g)
Fc	= carbon dioxide based fuel factor for natural gas (scf.mmBtu)
100	= conversion factor (%)
453.6	= conversion factor (g/lb)
CO_2	= carbon dioxide concentration in sample gas (%)

[4] All lb/mmBtu emission rates were calculated in a similar manner.

Filterable $PM_{2.5}$ Emission Rate, lb/hr[5]

$$E_{lb/hr} = \frac{(M_n)(Q_{dstd})(60)}{(V_{m(std)})(453.6)}$$

$$E_{lb/hr} = \frac{(0.0004)(79{,}242)(60)}{(62.14)(453.6)}$$

$$E_{lb/hr} = 0.0675 lb/hr$$

where:

$E_{lb/hr}$	= particulate emission rate (lb/hr)
M_n	= total particulate catch (g)
$V_{m(std)}$	= volume of gas collected at standard conditions (scf)
Q_{dstd}	= volumetric flow rate of the dry gas stream at standard conditions (dscfm)
60	= conversion factor (min/hr)
453.6	= conversion factor (g/lb)

[5] All PM lb/hr emission rates were calculated in a similar manner.

Sample Calculations, Method 201A, Run 1

Stack Gas Viscosity

$$u_s = 51.05 + (0.207(T_s + 460)) + \left(3.24 \times 10^{-5} (T_s + 460)^2\right) + \left(\frac{53.147 \times \%O_2}{100}\right) - \left(\frac{74.143 \div B_{ws}}{100}\right)$$

$$u_s = 51.05 + (0.207(300 + 460)) + \left(3.24 \times 10^{-5} (300 + 460)^2\right) + \left(\frac{53.147 \times 6.9}{100}\right) - \left(\frac{74.143 \times 9.39}{100}\right)$$

$$u_s = 224 micropoise$$

where:

u_s	= stack gas viscosity (micropoise)
51.05	= viscosity constant (micropoise)
0.207	= viscosity constant (micropoise/°R)
T_s	= average stack temperature (°F)
460	= conversion factor (°F to °R)
3.24×10^{-5}	= viscosity constant (micropoise/°R^2)
53.147	= viscosity constant (micropoise/fraction O_2)
$\%O_2$	= oxygen content of the dry gas stream (%)
74.143	= viscosity constant (micropoise/fraction H_2O)
B_{ws}	= moisture content of the gas stream (%)

Actual Flow Rate at the Nozzle

$$Q_{s(noz)} = \frac{T_s + 460}{(17.64)(P_a)} \times \left(\frac{V_{m(std)}}{\Theta} + \frac{V_{w(std)}}{\Theta}\right)$$

$$Q_{s(noz)} = \frac{300 + 460}{(17.64)(28.57)} \times \left(\frac{62.14}{180} + \frac{6.44}{180}\right)$$

$$Q_{s(noz)} = 0.575 acfm$$

where:

$Q_{s(noz)}$	= flow rate at actual cyclone conditions (acfm)
T_s	= average stack temperature (°F)
460	= conversion (°F to °R)
17.64	= conversion factor (°R/in.Hg)
P_a	= absolute stack pressure (in.Hg)
$V_{m(std)}$	= volume of gas collected at standard conditions (scf)
$V_{w(std)}$	= volume of water vapor at standard conditions (scf)
Θ	= sample time (min)

D_{50} Cut Point

$$D_{50} = 0.15625\left(\frac{T_s + 460}{(M_s)(P_a)}\right)^{0.2091}\left(\frac{u_s}{Q_{s(noz)}}\right)^{0.7091}$$

$$D_{50} = 0.15625\left(\frac{300 + 460}{(29.06)(28.57)}\right)^{0.2091}\left(\frac{224}{0.575}\right)^{0.7091}$$

$$D_{50} = 2.48um$$

where:

D_{50}	= diameter of particles having a 50% probability of penetration (um)
T_s	= average stack temperature (°F)
460	= conversion factor (°F to °R)
M_s	= molecular weight of the wet gas stream (lb/lb-mole)
P_a	= absolute stack pressure (in.Hg)
u_s	= stack gas viscosity (micropoise)
$Q_{s(noz)}$	= flow rate at actual cyclone conditions (acfm)

Parameters

EPA Methods 1-4, 201A Parameters	Run 1	Run 2	Run 3
Date	6/19/2014	6/19/2014	6/19/2014
Start Time	8:14	11:59	15:32
Stop Time	11:16	15:01	18:34
Dimensions of Sample Location, D_a (in)	124.75 X 60	124.75 X 60	124.75 X 60
Velocity Pressure, $\Delta P^{1/2}$ avg (in. $H_2O^{1/2}$)	0.615	0.607	0.607
Barometric Pressure, P_b (Inches Hg)	29.50	29.50	29.50
Static Pressure, P_s (Inches H_2O)	-12.6	-12.6	-12.6
Pitot Coefficient, C_p	0.84	0.84	0.84
Sample Location Temperature, T_s (^oF)	300	297	296
Volume Metered, V_m (ft^3)	62.54	63.58	63.93
Meter Temperature, T_m (^oF)	65.5	77.9	84.1
Average Sample Pressure, ΔH_{avg} (in. H_2O)	0.410	0.410	0.410
Gas Meter Correction Factor, Y_d	1.0024	1.0024	1.0024
Carbon Dioxide (% dry)	12.1	12.1	12.3
Oxygen (% dry)	6.9	6.8	6.7
Weight of Water Collected, V_{wc} (g)	114.3	116.2	85.8
Silica Gel Net Weight, V_{wsg} (g)	22.3	25.3	14.0
Diameter of Nozzle, D_n (in)	0.200	0.200	0.200
Run Time, θ (minutes)	180	180	180
EPA METHODS 1-4, 201A RESULTS			
Area of Sample Location, A_s (ft^2)	52.0	52.0	52.0
Stack Pressure Absolute (inches Hg)	28.57	28.57	28.57
Volume Metered Standard, $V_{m(std)}$ (ft^3)	62.14	61.72	61.35
Volume of Water Vapor, $V_{w(std)}$ (ft^3)	6.44	6.67	4.71
Percent Moisture, B_{ws} (%)	9.39	9.75	7.12
Moisture Saturation Point, B_{wsat} (%)	100	100	100
Dry Molecular Weight, M_d (lbs/lb mole)	30.21	30.21	30.24
Wet Molecular Weight, M_s (lbs/lb mole)	29.06	29.02	29.37
Gas Velocity, V_s (ft/sec)	42.3	41.6	41.4
Average Flowrate, Q_a (acfm)	131,849	129,797	129,083
Standard Flowrate, Q_{std} (scfm)	87,420	86,477	86,016
Dry Standard Flowrate, Q_{dstd} (dscfm)	79,242	78,073	79,921
Area of Nozzle, A_n (ft^2)	0.000218	0.000218	0.000218
Actual Flow Rate (cfm)	0.575	0.570	0.551
Viscosity (u_a)	224	223	224
Isokinetics (%)	103.9	104.7	101.7
Viscosity (u_a)	224	223	225
Cunningham Correction Factor , C	1.10	1.10	1.10
Sampling Rate, Q_s (acfm)	0.575	0.570	0.551
Dry Sampling Rate, Q_{ds} (dscfm)	0.345	0.343	0.341
Velocity of Gas in Nozzle, V_n (ft/sec)	43.9	43.6	42.1
Minimum Nozzle / Stack Velocity Ratio Parameter, R_{min}	0.639	0.639	0.630
Max Nozzle / Stack Velocity Ratio Parameter, R_{max}	1.29	1.30	1.30
Minimum Gas Velocity, V_{min} (ft/sec)	28.1	27.8	26.5
Maximum Gas Velocity, V_{max}, (ft/sec)	56.8	56.4	54.7
Minimum Velocity Pressure, ΔP_{min} (in H2O)	0.167	0.165	0.151
Maximum Velocity Pressure, ΔP_{max} (in H2O)	0.685	0.677	0.643
Particle Cut Diameter for N_{re} < 3,162 for 2.5 Cyclone D_{50}	2.48	2.48	2.59
Re-estimated Cunningham Correction Factor (Cr)	1.09	1.09	1.09
Re-calulated Particle Cut Diameter for N_{re} < 3,162 for 2.5 Cyclone D_{50-1}	2.49	2.49	2.60
Ratio (Z) Between D50 and D50-1	1.00	1.00	1.01
D_{50} (um)	10.5	10.5	10.8

EPA METHOD 201A/202 RESULTS	Run 1	Run 2	Run 3
Filterable $PM_{2.5}$			
Filter (g)	0.0001	0.0001	0.0000
PM<2.5 Front-Half Wash (g)	0.0003	0.0015	0.0044
Front-Half Particulate (g)	0.0004	0.0017	0.0044
Concentration (grains/dscf)	0.0000993	0.000425	0.00111
Emission Rate, Fc (lb/mmBtu)	0.000180	0.000764	0.00196
Emission Rate (lb/hr)	0.0675	0.284	0.758
> $PM_{2.5}$			
Front-Half Particulate (g)	0.0207	0.0162	0.0212
Concentration (grains/dscf)	0.00515	0.00406	0.00532
Emission Rate, Fc (lb/mmBtu)	0.00932	0.00731	0.00941
Emission Rate (lb/hr)	3.50	2.72	3.64
Condensable PM			
Back-Half Inorganic Fraction (g)	0.3819	0.5282	0.1736
Back-Half Organic Fraction (g)	0.0051	0.0129	0.0063
Ammonium Hydroxide Correction (g)	0.0000	0.0000	0.0000
Ammonium Hydroxide Corrected Inorganic Fraction (g)	0.3819	0.5282	0.1736
Field Blank Correction (g)	0.0020	0.0000	0.0000
Back-Half Particulate (g)	0.3850	0.5411	0.1798
Concentration (grains/dscf)	0.0956	0.135	0.0452
Emission Rate, Fc (lb/mmBtu)	0.173	0.243	0.0800
Emission Rate (lb/hr)	64.9	90.5	31.0

EPA Methods 1-4, 201A Parameters	Run 1	Run 2	Run 3
Date	6/17/2014	6/17/2014	6/17/2014
Start Time	10:54	14:49	18:41
Stop Time	14:03	17:58	21:49
Dimensions of Sample Location, D_s (in)	108	108	108
Velocity Pressure, $\Delta P^{1/2}$ avg (in. $H_2O^{1/2}$)	0.863	0.880	0.879
Barometric Pressure, P_b (Inches Hg)	29.15	29.15	29.15
Static Pressure, P_s (Inches H_2O)	0.1	0.1	0.1
Pitot Coefficient, C_p	0.84	0.84	0.84
Sample Location Temperature, T_s (°F)	343	342	340
Volume Metered, V_m (ft^3)	67.14	67.47	65.73
Meter Temperature, T_m (°F)	99.5	98.2	81.3
Average Sample Pressure, ΔH_{avg} (in. H_2O)	0.457	0.464	0.450
Gas Meter Correction Factor, Y_d	1.0024	1.0024	1.0024
Carbon Dioxide (% dry)	12.7	12.7	12.7
Oxygen (% dry)	6.5	6.4	6.5
Weight of Water Collected, V_{wc} (g)	97.3	116.2	114.4
Silica Gel Net Weight, V_{wsg} (g)	21.3	22.5	15.2
Diameter of Nozzle, D_n (in)	0.175	0.175	0.175
Run Time, θ (minutes)	180	180	180

EPA METHODS 1-4, 201A RESULTS			
Area of Sample Location, A_s (ft^2)	63.6	63.6	63.6
Stack Pressure Absolute (inches Hg)	29.16	29.16	29.16
Volume Metered Standard, $V_{m(std)}$ (ft^3)	61.92	62.38	62.67
Volume of Water Vapor, $V_{w(std)}$ (ft^3)	5.59	6.54	6.11
Percent Moisture, B_{ws} (%)	8.28	9.49	8.88
Moisture Saturation Point, B_{wsat} (%)	100	100	100
Dry Molecular Weight, M_d (lbs/lb mole)	30.30	30.28	30.29
Wet Molecular Weight, M_s (lbs/lb mole)	29.28	29.12	29.20
Gas Velocity, V_s (ft/sec)	60.1	61.4	61.2
Average Flowrate, Q_a (acfm)	229,379	234,317	233,657
Standard Flowrate, Q_{std} (scfm)	146,876	150,303	150,207
Dry Standard Flowrate, Q_{dstd} (dscfm)	134,764	136,095	136,916
Area of Nozzle, A_n (ft^2)	0.000167	0.000167	0.000167
Actual Flow Rate (cfm)	0.586	0.597	0.594
Viscosity (u_s)	236	234	234
Isokinetics (%)	97.3	97.0	96.9
Viscosity (u_s)	235	233	233
Cunningham Correction Factor , C	1.11	1.11	1.11
Sampling Rate, Q_s (acfm)	0.586	0.597	0.594
Dry Sampling Rate, Q_{ds} (dscfm)	0.344	0.347	0.348
Velocity of Gas in Nozzle, V_n (ft/sec)	58.4	59.6	59.3
Minimum Nozzle / Stack Velocity Ratio Parameter, R_{min}	0.696	0.699	0.698
Max Nozzle / Stack Velocity Ratio Parameter, R_{max}	1.27	1.26	1.27
Minimum Gas Velocity, V_{min} (ft/sec)	40.7	41.6	41.4
Maximum Gas Velocity, V_{max}, (ft/sec)	74.0	75.3	75.0
Minimum Velocity Pressure, ΔP_{min} (in H2O)	0.341	0.356	0.354
Maximum Velocity Pressure, ΔP_{max} (in H2O)	1.13	1.17	1.16
Particle Cut Diameter for N_{re} < 3,162 for 2.5 Cyclone D_{50}	2.60	2.53	2.54
Re-estimated Cunningham Correction Factor (Cr)	1.09	1.09	1.09
Re-calulated Particle Cut Diameter for N_{re} < 3,162 for 2.5 Cyclone D_{50-1}	2.61	2.54	2.55
Ratio (Z) Between D50 and D50-1	1.01	1.01	1.01
D_{50} (um)	10.8	10.7	10.7

EPA METHOD 201A/202 RESULTS	Run 1	Run 2	Run 3
Filterable $PM_{2.5}$			
Filter (g)	0.0001	0.0000	0.0000
PM<2.5 Front-Half Wash (g)	0.0043	0.0062	0.0010
Front-Half Particulate (g)	0.0044	0.0062	0.0010
Concentration (grains/dscf)	0.00108	0.00153	0.000246
Emission Rate, Fc (lb/mmBtu)	0.00181	0.00258	0.000414
Emission Rate (lb/hr)	1.25	1.79	0.289
> $PM_{2.5}$			
Front-Half Particulate (g)	0.0168	0.0176	0.0291
Concentration (grains/dscf)	0.00419	0.00434	0.00715
Emission Rate, Fc (lb/mmBtu)	0.00699	0.00729	0.0120
Emission Rate (lb/hr)	4.84	5.06	8.40
Condensable PM			
Back-Half Inorganic Fraction (g)	0.0497	0.1869	0.1885
Back-Half Organic Fraction (g)	0.0040	0.0038	0.0041
Ammonium Hydroxide Correction (g)	0.0000	0.0000	0.0000
Ammonium Hydroxide Corrected Inorganic Fraction (g)	0.0497	0.1869	0.1885
Field Blank Correction (g)	0.0020	0.0020	0.0020
Back-Half Particulate (g)	0.0517	0.1886	0.1905
Concentration (grains/dscf)	0.0129	0.0467	0.0469
Emission Rate, Fc (lb/mmBtu)	0.0215	0.0784	0.0788
Emission Rate (lb/hr)	14.9	54.4	55.1

Coal Analysis Parameters

Fd and Fc Parameters	Boiler B28	Boiler B09
Hydrogen (%)	6.06	5.11
Carbon (%)	62.19	63.24
Sulfur (%)	2.61	3.98
Nitrogen (%)	0.73	1.07
Oxygen (%)	23.34	22.34
Heating Valu (Btu/lb)	13,069	13,633

Result	Sample 1	Run 3
Fd (dscf/MBtu)	8,269	7,885
Fc (dscf/MBtu)	1,528	1,489

Field Data Printouts

Project Number	4784
Client	MPU
Plant	Manitowoc
Location	B28
Date	6/19/2014
Meter ID	M-30
Y_d	1.0024
Pitot C_p	0.84

Nozzle Diameter (in)	0.200
Filter ID	4915
Train Type	IMP
Train ID	IB 202-1
P_b (Inches Hg)	29.50
P_s (Inches H_2O)	-12.6
Start Time	8:14
Stop Time	11:16

Circular?	
Rectangular?	x
Diameter	
Length	124.75
Width	60.0

Moisture	Final Wt (g)	Tare Wt (g)	Net Wt (g)
Impinger 1	626.9	538.3	88.6
Impinger 2	643.1	638.6	4.5
Impinger 3	623.2	602.0	21.2
Silica Gel	965.7	943.4	22.3
Weight of Water Collected, V_{wc} (g)			114.3
Silica Gel Net Weight, V_{wsg} (g)			22.3

Analyzer	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$
Trial 1	12.0	19.0	7.0
Trial 2	12.0	19.0	7.0
Trial 3	12.2	19.0	6.8
Average	12.1	NA	6.9

Run 1

Traverse Point	Min/Pt 12 Elapsed Time	Velocity Pressure Δ P (in. H_2O)	Orifice Setting Δ H (in. H_2O)	Gas Sample Volume Initial (ft^3) 310.88	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root Δ P	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
1-1	8.00	0.17	0.41	313.70	302	63	61	0.412	28.4	2.821	105.7
1-2	19.00	0.32	0.41	317.40	303	63	61	0.566	38.9	3.701	101.1
1-3	35.15	0.69	0.41	323.02	303	64	61	0.831	57.2	5.616	104.5
2-1	43.45	0.19	0.41	326.15	300	65	61	0.436	29.9	3.125	110.6
2-2	55.75	0.37	0.41	330.26	300	65	61	0.608	41.8	4.103	104.0
2-3	71.50	0.70	0.41	335.75	301	65	62	0.837	57.5	5.476	101.0
3-1	80.25	0.22	0.41	338.77	299	66	63	0.469	32.2	3.007	98.8
3-2	92.50	0.39	0.41	343.02	299	68	64	0.624	42.9	4.219	104.1
3-3	109.00	0.71	0.41	348.77	300	69	64	0.843	57.9	5.703	104.4
4-1	117.75	0.18	0.41	351.82	299	70	64	0.424	29.1	3.022	109.8
4-2	128.00	0.28	0.41	354.87	300	71	65	0.529	36.4	3.016	87.9
4-3	143.50	0.65	0.41	360.36	300	71	65	0.806	55.4	17.148	328.1
5-1	151.75	0.18	0.41	363.45	299	71	66	0.424	29.1	14.504	526.9
5-2	163.25	0.34	0.41	367.92	299	72	66	0.583	40.0	15.892	420.1
5-3	180.00	0.70	0.41	373.72	299	72	66	0.837	57.4	18.606	342.8

	Port 1 to 2	Port 2 to 3	Port 3 to 4	Port 4 to 5
Less Volumes for Between port Leak Checks	0.06	0.07	0.09	0.08

Totals and Averages

180		0.410	62.54	300	65.5	0.615	42.3	62.14	103.9

Project Number	4784
Client	MPU
Plant	Manitowoc
Location	B28
Date	6/19/2014
Meter ID	M-30
Y_d	1.0024
Pitot C_p	0.84

Nozzle Diameter (in)	0.200
Filter ID	4916
Train Type	IMP
Train ID	IB 202-6
P_b (Inches Hg)	29.50
P_g (Inches H_2O)	-12.6
Start Time	11:59
Stop Time	15:01

Circular?	
Rectangular?	x
Diameter	
Length	124.75
Width	60.0

Moisture	Final Wt (g)	Tare Wt (g)	Net Wt (g)
Impinger 1	608.6	526.6	82.0
Impinger 2	641.6	636.3	5.3
Impinger 3	779.9	751.0	28.9
Silica Gel	857.3	832.0	25.3
Weight of Water Collected, V_{wc} (g)			116.2
Silica Gel Net Weight, V_{wsg} (g)			25.3

Analyzer	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$
Trial 1	12.2	19.0	6.8
Trial 2	12.0	18.8	6.8
Trial 3	12.2	19.0	6.8
Average	12.1	NA	6.8

Run 2

Traverse Point	Min/Pt 12 Elapsed Time	Velocity Pressure Δ P (in. H_2O)	Orifice Setting Δ H (in. H_2O)	Gas Sample Volume Initial (ft^3) 374.85	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root Δ P	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
5-1	8.45	0.20	0.41	377.74	297	76	75	0.447	30.7	3.013	104.1
5-2	19.25	0.29	0.41	381.42	298	77	75	0.539	37.0	3.585	102.9
5-3	35.00	0.67	0.41	386.67	298	77	75	0.819	56.2	5.114	96.6
4-1	43.50	0.19	0.41	389.99	297	78	75	0.436	29.9	3.231	114.5
4-2	54.50	0.30	0.41	393.89	297	78	75	0.548	37.6	3.796	107.0
4-3	70.50	0.65	0.41	399.36	298	79	76	0.806	55.4	5.314	101.9
3-1	79.75	0.22	0.41	402.88	296	79	76	0.469	32.2	3.420	112.5
3-2	92.00	0.38	0.41	407.22	296	79	76	0.616	42.3	4.216	105.6
3-3	108.50	0.69	0.41	413.03	297	80	77	0.831	57.0	5.634	104.7
2-1	117.00	0.19	0.41	416.02	295	80	77	0.436	29.9	2.899	102.6
2-2	127.25	0.27	0.41	419.71	296	81	77	0.520	35.6	3.575	106.2
2-3	143.25	0.66	0.41	425.42	297	81	78	0.812	55.7	5.526	105.1
1-1	152.25	0.18	0.41	428.72	295	81	78	0.424	29.1	3.194	116.1
1-2	163.75	0.33	0.41	432.75	295	82	78	0.574	39.4	3.897	104.6
1-3	180.00	0.68	0.41	438.54	296	82	78	0.825	56.5	18.208	340.8

	Port 1 to 2	Port 2 to 3	Port 3 to 4	Port 4 to 5
Less Volumes for Between port Leak Checks	0.09	0.08	0.07	0.07

Totals and Averages

180	0.410	63.58	297	77.9	0.607	41.6	61.72	104.7

Project Number	4784
Client	MPU
Plant	Manitowoc
Location	B28
Date	6/19/2014
Meter ID	M-30
Y_d	1.0024
Pitot C_p	0.84

Nozzle Diameter (in)	0.200
Filter ID	4917
Train Type	IMP
Train ID	IB 202-1
P_b (Inches Hg)	29.50
P_s (Inches H_2O)	-12.6
Start Time	15:32
Stop Time	18:34

Circular?	
Rectangular?	x
Diameter	
Length	124.75
Width	60.0

Moisture	Final Wt (g)	Tare Wt (g)	Net Wt (g)
Impinger 1	611.0	539.6	71.4
Impinger 2	637.3	635.7	1.6
Impinger 3	633.7	620.9	12.8
Silica Gel	951.9	937.9	14.0
Weight of Water Collected, V_{wc} (g)			85.8
Silica Gel Net Weight, V_{wsg} (g)			14.0

Analyzer	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$
Trial 1	12.4	19.0	6.6
Trial 2	12.2	19.0	6.8
Trial 3	12.4	19.0	6.6
Average	12.3	NA	6.7

Run 3

Traverse Point	Min/Pt 12 Elapsed Time	Velocity Pressure Δ P (in. H_2O)	Orifice Setting Δ H (in. H_2O)	Gas Sample Volume Initial (ft^3) 438.84	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root Δ P	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
1-1	8.75	0.19	0.41	441.91	296	81	81	0.436	29.7	2.963	102.6
1-2	19.50	0.30	0.41	445.77	296	82	81	0.548	37.3	3.722	102.5
1-3	33.75	0.68	0.41	451.57	297	83	81	0.825	56.2	5.588	102.3
2-1	44.25	0.18	0.41	454.59	296	84	82	0.424	28.9	2.904	103.3
2-2	55.25	0.31	0.41	458.50	297	84	82	0.557	38.0	3.760	101.9
2-3	71.25	0.66	0.41	464.16	297	85	82	0.812	55.4	5.438	101.0
3-1	80.75	0.23	0.41	467.53	296	85	82	0.480	32.7	3.238	101.8
3-2	92.75	0.37	0.41	471.78	297	86	83	0.608	41.5	4.076	101.1
3-3	109.00	0.69	0.41	477.56	297	87	83	0.831	56.7	5.538	100.6
4-1	117.75	0.19	0.41	480.55	296	87	83	0.436	29.7	2.865	99.1
4-2	128.00	0.28	0.41	484.39	296	87	83	0.529	36.1	3.679	104.9
4-3	144.00	0.65	0.41	489.99	297	88	84	0.806	55.0	5.356	100.3
5-1	152.25	0.18	0.41	493.06	296	88	84	0.424	28.9	2.936	104.4
5-2	163.75	0.32	0.41	497.09	296	88	84	0.566	38.6	3.854	102.8
5-3	180.00	0.68	0.41	503.06	296	89	84	0.825	56.2	17.839	326.4

	Port 1 to 2	Port 2 to 3	Port 3 to 4	Port 4 to 5
Less Volumes for Between port Leak Checks	0.07	0.08	0.07	0.07

Totals and Averages

180	0.410	63.93	296	84.1	0.607	41.4	61.35	101.7

Project Number	4784
Client	MPU
Plant	Manitowoc
Location	B09
Date	6/17/2014
Meter ID	M-30
Y_d	1.0024
Pitot C_p	0.84

Nozzle Diameter (in)	0.175
Filter ID	4912
Train Type	IMP
Train ID	IB 202-1
P_b (Inches Hg)	29.15
P_s (Inches H_2O)	0.1
Start Time	10:54
Stop Time	14:03

Circular?	x
Rectangular?	
Diameter	108
Length	
Width	

Moisture	Final Wt (g)	Tare Wt (g)	Net Wt (g)
Impinger 1	715.0	636.1	78.9
Impinger 2	519.5	518.8	0.7
Impinger 3	749.2	731.5	17.7
Silica Gel	846.0	824.7	21.3
Weight of Water Collected, V_{wc} (g)			97.3
Silica Gel Net Weight, V_{wsg} (g)			21.3

Analyzer	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$
Trial 1	12.8	19.2	6.4
Trial 2	12.6	19.2	6.6
Trial 3	12.8	19.2	6.4
Average	12.7	NA	6.5

Run 1

Traverse Point	Min/Pt 15 Elapsed Time	Velocity Pressure Δ P (in. H_2O)	Orifice Setting Δ H (in. H_2O)	Gas Sample Volume Initial (ft^3) 953.23	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root Δ P	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
1-1	13.00	0.55	0.45	958.01	338	88	87	0.742	51.5	4.505	98.5
1-2	26.25	0.55	0.45	962.96	338	91	88	0.742	51.5	4.648	101.6
1-3	39.75	0.60	0.45	967.91	340	96	90	0.775	53.8	4.619	96.8
1-4	56.00	0.83	0.45	974.17	343	99	92	0.911	63.5	5.815	103.8
1-5	72.50	0.91	0.46	980.13	343	103	96	0.954	66.4	5.497	93.7
1-6	90.25	1.00	0.46	986.80	344	106	99	1.000	69.7	6.119	99.6
2-1	104.25	0.64	0.46	993.95	345	106	101	0.800	55.8	6.548	133.3
2-2	118.75	0.71	0.46	999.37	345	107	101	0.843	58.8	4.959	95.8
2-3	133.50	0.73	0.46	1004.88	345	107	102	0.854	59.6	5.037	96.0
2-4	148.50	0.78	0.46	1010.49	346	108	102	0.883	61.6	5.124	94.5
2-5	163.75	0.83	0.46	1016.16	346	108	102	0.911	63.6	5.179	92.6
2-6	180.00	0.88	0.46	1022.25	346	108	102	0.938	65.5	5.562	96.6

Port 1 to 2

Less Volumes for Between port Leak Checks 1.88

Totals and Averages

180	0.457	67.14	343	99.5	0.863	60.1	61.92	97.3

Project Number	4784
Client	MPU
Plant	Manitowoc
Location	B09
Date	6/17/2014
Meter ID	M-30
Y_d	1.0024
Pitot C_p	0.84

Nozzle Diameter (in)	0.175
Filter ID	4913
Train Type	IMP
Train ID	IB 202-6
P_b (Inches Hg)	29.15
P_s (Inches H_2O)	0.1
Start Time	14:49
Stop Time	17:58

Circular?	x
Rectangular?	
Diameter	108
Length	
Width	

Moisture	Final Wt (g)	Tare Wt (g)	Net Wt (g)
Impinger 1	686.4	598.7	87.7
Impinger 2	501.5	500.1	1.4
Impinger 3	763.1	736.0	27.1
Silica Gel	999.1	976.6	22.5
Weight of Water Collected, V_{wc} (g)			116.2
Silica Gel Net Weight, V_{wsg} (g)			22.5

Analyzer	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$
Trial 1	12.6	19.0	6.4
Trial 2	12.8	19.2	6.4
Trial 3	12.6	19.0	6.4
Average	12.7	NA	6.4

Run 2

Traverse Point	Min/Pt 15 Elapsed Time	Velocity Pressure Δ P (in. H_2O)	Orifice Setting Δ H (in. H_2O)	Gas Sample Volume Initial (ft^3) 22.74	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root Δ P	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
1-1	13.00	0.57	0.46	27.62	345	99	98	0.755	52.8	4.509	98.3
1-2	26.00	0.54	0.46	32.49	348	102	99	0.735	51.5	4.484	100.6
1-3	39.50	0.63	0.46	37.53	348	105	99	0.794	55.6	4.628	96.1
1-4	55.50	0.85	0.47	43.62	347	106	100	0.922	64.5	5.582	99.7
1-5	72.15	0.93	0.47	49.98	342	107	101	0.964	67.3	5.819	99.1
1-6	90.00	1.10	0.47	56.72	342	107	101	1.049	73.2	6.167	96.6
2-1	103.75	0.67	0.47	63.45	339	101	99	0.819	57.0	6.202	124.2
2-2	118.25	0.72	0.47	68.91	339	101	97	0.849	59.1	5.040	97.4
2-3	133.25	0.77	0.46	74.50	339	99	95	0.877	61.1	5.179	96.7
2-4	148.25	0.82	0.46	80.05	338	94	92	0.906	63.0	5.179	93.7
2-5	164.00	0.86	0.46	85.87	338	91	89	0.927	64.6	5.461	96.5
2-6	180.00	0.92	0.46	91.75	337	88	86	0.959	66.7	5.547	94.7

Port 1 to 2

Less Volumes for Between port Leak Checks 1.54

Totals and Averages

180	0.464	67.47	342	98.2	0.880	61.4	62.38	97.0

Project Number	4784
Client	MPU
Plant	Manitowoc
Location	B09
Date	6/17/2014
Meter ID	M-30
Y_d	1.0024
Pitot C_p	0.84

Nozzle Diameter (in)	0.175
Filter ID	4914
Train Type	IMP
Train ID	IB 202-1
P_b (Inches Hg)	29.15
P_g (Inches H_2O)	0.1
Start Time	18:41
Stop Time	21:49

Circular?	x
Rectangular?	
Diameter	108
Length	
Width	

Moisture	Final Wt (g)	Tare Wt (g)	Net Wt (g)
Impinger 1	728.5	637.8	90.7
Impinger 2	520.2	520.1	0.1
Impinger 3	777.7	754.1	23.6
Silica Gel	861.2	846.0	15.2
Weight of Water Collected, V_{wc} (g)			114.4
Silica Gel Net Weight, V_{wsg} (g)			15.2

Analyzer	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$
Trial 1	12.6	19.2	6.6
Trial 2	12.6	19.2	6.6
Trial 3	12.8	19.2	6.4
Average	12.7	NA	6.5

Run 3

Traverse Point	Min/Pt 15 Elapsed Time	Velocity Pressure Δ P (in. H_2O)	Orifice Setting Δ H (in. H_2O)	Gas Sample Volume Initial (ft^3) 92.00	Stack Temp. (°F)	DGM Inlet (°F)	DGM Outlet (°F)	Square Root Δ P	Stack Gas Velocity Vs (ft/sec)	Volume Metered Vmstd (ft^3)	Isokinetics (%)
1-1	12.75	0.56	0.45	96.63	338	75	75	0.748	52.0	4.466	97.2
1-2	25.50	0.56	0.45	101.29	339	80	75	0.748	52.1	4.474	97.5
1-3	39.25	0.65	0.45	106.33	340	82	76	0.806	56.1	4.825	97.6
1-4	55.00	0.85	0.45	112.08	340	84	77	0.922	64.2	5.490	97.1
1-5	71.25	0.94	0.45	118.01	340	85	80	0.970	67.5	5.641	94.9
1-6	88.75	1.00	0.45	124.41	340	85	79	1.000	69.6	6.093	99.4
2-1	102.75	0.65	0.45	130.95	339	84	80	0.806	56.1	6.227	125.9
2-2	117.25	0.72	0.45	136.24	341	87	80	0.849	59.1	5.023	96.6
2-3	132.25	0.79	0.45	141.71	341	87	80	0.889	61.9	5.193	95.4
2-4	147.75	0.84	0.45	147.37	341	86	80	0.917	63.8	5.379	95.8
2-5	163.50	0.86	0.45	153.11	341	86	80	0.927	64.6	5.455	96.0
2-6	180.00	0.94	0.45	159.15	341	87	80	0.970	67.5	5.735	96.6

Port 1 to 2

Less Volumes for Between port Leak Checks 1.42

Totals and Averages

180		0.450	65.73	340	81.3	0.879	61.2	62.67	96.9

Field Data

AIRTECH ENVIRONMENTAL SERVICES INC.

General Testing Datasheet

TESTING TYPE: PARTICULATE SIZING

RUN NO. 1

METHOD NO. 201A/202

Page 1 of 2

Client	M.P.U.				
Plant	MANITOWOC, WI				
Location	BOILER 8				
Date	06-19-14	Project No.	4794		
Meter Operator	J.D.				
Probe Operator	B.K.				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84 ✓
ΔH@	1.770	Kf	—	Leak check	✓
Pre Leak Check	0.000	[cfm] [lpm] @	18	(inHg)	
Post Leak Check	—	[cfm] [lpm] @	—	(inHg)	

(N) [Up]

12345
00000

First point all the way [in] [out]

Gas flow [in] [out] of page

Cross Section of Duct

Barometric (in. Hg)	29.50	Water (ml) (g)	114.30
Ambient Temp. (°F)	63.00	Silica gel (g)	22.30
Static (in. H_2O)	-12.6	Total Vlc	136.60
Probe ID	AES-10-6	Liner Type	TFE
Nozzle ID	.200	Nozzle Dia (in.)	.200
Filter ID	N/A	—	—
Train ID	IB-202-1	Train Type	IMP
Duct Dim. (in.)	124.75 x 60	Port Lgth. (in.)	12.0
Start Time	08:14	Stop Time	11:16

Traverse Point	Min/Point DWELL Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [ft³] [l] 310.86	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	JD Notes
1-1	8:00	.17	.41	313.70	302	251	248	42	63	61	5	~~N/A~~ 65	
2	19:00	.32	.41	317.40	303	252	250	43	64	61	5	66	PORT CHANGE: ↓ J.D.
3	35:15	.69	.41	323.02	303	251	252	44	64	61	5	67	RESTART: VOLUME - 323.08 = SUBTRACT 0.05
2-1	43:45	.19	.41	326.15	300	253	250	45	65	61	5	67	
2	55:45	.37	.41	330.26	300	252	251	46	65	61	5	67	
3	71:30	.70	.41	335.75	301	251	252	47	65	62	5	68	PORT CHANGE ↓ J.D.
3-1	80:15	.22	.41	338.77	299	250	251	48	66	63	5	68	RESTART VOLUME - 335.82/SUB .07
2	92:30	.39	.41	343.02	299	251	253	48	68	64	5	68	
3	109:00	.71	.41	348.77	300	252	255	49	69	64	5	69	PORT CHANGE ↓ JD
4-1	117:45	.18	.41	351.82	299	252	254	50	70	64	5	69	RESTART VOLUME - 348.86/SUB .09
2	128:00	.28	.41	354.87	300	251	254	51	71	65	5	70	
3	143:30	.65	.41	360.36	300	250	253	51	71	65	5	70	PORT CHANGE ↓ JD
Total	180.00	9.2293	6.15	62.84	4503.00				1016.00	950.00			RESTART VOLUME - 360.44/SUB .08
Average		.6153	.41		300.20				65.53				

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

-.30 / 62.54 DB

104.2%

TOTAL SUBTRACTED VOLUME: .31

.30 DB

MPU04070

AIRTECH ENVIRONMENTAL SERVICES INC.

General Testing Datasheet

TESTING TYPE: PARTICULATE SIZING

RUN NO. 1

METHOD NO. 201A/202

Client	M.P.U.				
Plant	MANITOWOC, WI				
Location	BOILER 8				
Date	06-19-14	Project No.	4794		
Meter Operator	J.D.				
Probe Operator	B.K.				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84
ΔH@	1.770	Kf	—	Leak check	✓
Pre Leak Check	0.000	[cfm] [lpm] @	18	(inHg)	
Post Leak Check	—	[cfm] [lpm] @	—	(inHg)	

(IN) [Up]

12 345
00000

First point all the way [in] [out]

Gas flow [in] [out] of page

Cross Section of Duct

Barometric (in. Hg)	29.50	Water (ml) (g)	
Ambient Temp. (°F)	63.00	Silica gel (g)	
Static (In. H_2O)	-12.6	Total Vlc	
Probe ID	AES-10-6	Liner Type	TFE
Nozzle ID	.200	Nozzle Dia (In.)	.200
Filter ID	N/A	—	—
Train ID	IB-202-1	Train Type	IMP
Duct Dim. (in.)	124.75 x 60	Port Lgth. (in.)	12.00
Start Time	08:14	Stop Time	11:16

Traverse Point	Min/Point Dwell Elapsed Time	Velocity Pressure ΔP (In H_2O)	Orifice Setting ΔH (In H_2O)	Gas Sample Volume Initial [m^3] [l] 310.88	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
S-1	151:45	.18	.41	363.45	299	251	254	52	71	66	5	71	
2	163:15	.34	.41	367.92	299	251	253	53	72	66	5	71	
3	180:00	.70	.41	373.72	299	250	253	54	72	66	5	72	
Total													
Average													

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

MPU04071

AIRTECH ENVIRONMENTAL SERVICES INC.

General Testing Datasheet

TESTING TYPE: PARTICULATE SIZING

RUN NO. 2 METHOD NO. 201A/202

Page 1 of 2

Client	M.P.U.		
Plant	MANITOWOC, WI		
Location	BOILER 8		
Date	06-19-14	Project No.	4794
Meter Operator	J.D.		
Probe Operator	B.K.		

Meter ID	M-30	Yd	1.0024	Pitot Cp	.84	
ΔH@	1.770	Kf	—	Leak check	✓	
Pre Leak Check	0.000	cfm/lpm @	19	(inHg)		
Post Leak Check	—	cfm/lpm @	—	(inHg)		

(IN) [Up]

12345 00000

First point all the way (in) [out]

Gas flow [in] (out) of page

Cross Section of Duct

Barometric (in. Hg)	29.50	Water (ml) (g)	116.2
Ambient Temp. (°F)	69.00	Silica gel (g)	25.3
Static (in. H_2O)	-12.6	Total Vlc	
Probe ID	AES-10-6	Liner Type	TFE
Nozzle ID	.200	Nozzle Dia (in.)	.200
Filter ID	N/A	—	—
Train ID	IB-202-6	Train Type	IMP
Duct Dim. (in.)	124.75 x 60	Port Lgth. (in.)	12.00
Start Time	11:59	Stop Time	15:01

Traverse Point	Min/Point DWELL Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (In H_2O)	Gas Sample Volume Initial [ft³] [l] 374.65	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
S-1	8:45	.20	.41	377.74	297	250	252	46	76	75	6	68	
2	19:15	.29	.41	381.42	298	250	255	46	77	75	6	68	PORT CHANGE ↓
3	35:00	.67	.41	386.67	298	249	258	46	79	75	6	69	RESTART VOLUME – 386.76/SUBTRACT .09
4-1	43:30	.19	.41	389.99	297	251	256	47	78	75	6	70	
2	54:30	.30	.41	393.89	297	251	255	47	78	75	6	70	
3	70:30	.65	.41	399.36	298	250	254	48	79	76	6	71	PORT CHANGE ↓
3-1	79:45	.22	.41	402.88	296	250	252	48	79	76	6	71	RESTART VOLUME – 399.44/SUB .08
2	92:00	.38	.41	407.22	296	252	253	49	79	76	6	72	
3	108:30	.69	.41	413.03	297	248	255	50	80	77	6	72	PORT CHANGE ↓
2-1	117:00	.19	.41	416.62	295	249	252	50	80	77	6	71	RESTART VOLUME – 413.10/SUB .07
2	127:15	.27	.41	419.71	296	253	251	51	81	77	6	70	
3	143:15	.66	.41	425.42	297	251	250	51	81	78	6	71	PORT CHANGE ↓
Total	180:00	9.1015	6.15	63.58	4448.00				1190.00	1146.00			RESTART VOLUME – 425.49/SUB .07
Average		.6068	.41		296.53				77.87				

TOTAL SUB. VOL.: 0.31

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

104.5%

MPU04072

AIRTECH ENVIRONMENTAL SERVICES INC.

General Testing Datasheet

TESTING TYPE: PARTICULATE SIZING

RUN NO. 2

METHOD NO. 201A/202

Page 2 of 2

Client	M.P.U.				
Plant	MANITOWOC, WI				
Location	BOILER 8				
Date	06-19-14	Project No.	4794		
Meter Operator	J.D.				
Probe Operator	B.K.				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84
ΔH@	1.770	Kf	—	Leak check	✓
Pre Leak Check	0.000	cfm/lpm] @	19	(inHg)	
Post Leak Check	—	cfm/lpm] @	—	(inHg)	

(IN) [Up]

12345
00066

First point all the way (in) [out]

Gas flow [in] (out) of page

Cross Section of Duct

Barometric (In. Hg)	29.50	Water (ml) (g)	116.2
Ambient Temp. (°F)	69.00	Silica gel (g)	25.3
Static (In. H_2O)	-12.6	Total Vlc	
Probe ID	AES-10-6	Liner Type	TFE
Nozzle ID	.200	Nozzle Dia (in.)	.200
Filter ID	N/A	—	—
Train ID	IB-202-6	Train Type	IMP
Duct Dim. (in.)	124.75 x 60	Port Lgth. (in.)	12.00
Start Time	11:59	Stop Time	15:01

Traverse Point	Min/Point Dwell Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (In H_2O)	Gas Sample Volume Initial (ft³) [l] 374.65	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
1-1	152:15	.18	.41	424.72	295	250	250	52	81	78	6	71	
2	163:45	.33	.41	432.75	295	249	252	53	82	78	6	71	
3	180:00	.68	.41	438.54	296	250	251	53	82	78	6	72	
Total													
Average													

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

MPU04073

AIRTECH ENVIRONMENTAL SERVICES INC.

General Testing Datasheet

TESTING TYPE: PARTICULATE SIZING

RUN NO. 3 **METHOD NO.** 201A/202 **Page** 1 **of** 2

Client	M.P.U.				
Plant	MANITOWOC, WI				
Location	BOILER 8				
Date	06-19-14	Project No.	4794		
Meter Operator	J.D.				
Probe Operator	B.K.				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84 ✓
ΔH@	1.770	Kf	—	Leak check	✓
Pre Leak Check	0.000	cfm [lpm] @	17	(inHg)	
Post Leak Check	—	cfm [lpm] @	—	(inHg)	

(IN) [Up]

12345
00000

First point all the way [in] [out]

Gas flow [in] [out] of page

Cross Section of Duct

Barometric (in. Hg)	29.50	Water (ml) (g)	85.8
Ambient Temp. (°F)	77.00	Silica gel (g)	13.2
Static (in. H_2O)	-12.6	Total Vlc	99.8
Probe ID	AES-10-6	Liner Type	TFE
Nozzle ID	.200	Nozzle Dia (in.)	.200
Filter ID	N/A	—	—
Train ID	IB-202-1	Train Type	IMP
Duct Dim. (in.)	124.75 x 60	Port Lgth. (in.)	12.00
Start Time	15:32	Stop Time	18:34

Traverse Point	Min/Point DWELL Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [ft³] [l] 438.84	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
1-1	8:45	.19	.41	441.91	296	254	253	60	81	81	5	69	
2	19:30	.30	.41	445.77	296	253	255	58	82	81	5	69	
3	35:45	.68	.41	451.57	297	253	256	55	83	81	5	68	PORT CHANGE ↓
2-1	44:15	.18	.41	454.59	296	255	258	53	84	82	5	69	RESTART VOL - 451.64/SUB .07
2	55:15	.31	.41	458.50	297	252	256	53	84	82	5	70	
3	71:15	.66	.41	464.16	297	254	254	53	85	82	5	70	PORT CHANGE ↓
3-1	80:45	.23	.41	467.53	296	255	256	54	85	82	5	70	RESTART VOLUME - 464.24/SUB .08
2	92:45	.37	.41	471.78	297	253	255	55	86	83	5	71	
3	109:00	.69	.41	477.56	297	252	253	55	87	83	5	71	PORT CHANGE ↓
4-1	117:45	.19	.41	480.55	296	253	254	56	87	83	5	71	RESTART VOL - 477.63/SUB. .07
2	128:00	.28	.41	484.39	296	251	252	56	87	83	5	72	
3	144:00	.65	.41	489.99	297	250	252	57	88	84	5	72	PORT CHANGE ↓
Total	180.00	9.1060	6.15	64.22	4446.00				1284.00	1239.00			RESTART VOL - 490.06/SUB. .07
Average		.6071	.41		296.40				84.10				

vol -.29 / 63.93 OB

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

MPU04074

AIRTECH ENVIRONMENTAL SERVICES INC.

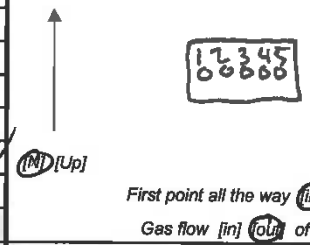
General Testing Datasheet

TESTING TYPE: PARTICULATE SIZING

RUN NO. 3

METHOD NO. 201A/202

Client	M.P.U.				
Plant	MANITOWOC, WI				
Location	BOILER 8				
Date	06-19-14	Project No.	4794		
Meter Operator	J.D.				
Probe Operator	B.K.				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84
ΔH@	1.770	Kf	—	Leak check	✓
Pre Leak Check	0.000	(cfm) [lpm] @	17	(inHg)	
Post Leak Check	—	(cfm) [lpm] @	—	(inHg)	



Cross Section of Duct

Barometric (in. Hg)	29.50	Water (ml) (g)	85.8
Ambient Temp. (°F)	77.00	Silica gel (g)	13.2
Static (in. H_2O)	-12.6	Total Vlc	99.8
Probe ID	AES-10-6	Liner Type	TFE
Nozzle ID	.200	Nozzle Dia (in.)	.200
Filter ID	N/A	—	—
Train ID	IB-202-1	Train Type	IMP
Duct Dim. (in.)	124.75 x 60	Port Lgth. (in.)	12.00
Start Time	15:32	Stop Time	18:34

Traverse Point	Min/Point Dwell Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial (ft³) [l] 438.84	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	Auxiliary Temp (°F)	Notes
5-1	152:15	.18	.41	493.06	296	250	252	57	88	84	5	72	
2	163:45	.32	.41	497.09	296	253	251	58	88	84	5	73	
3	180:00	.68	.41	503.06	296	251	249	58	89	84	5	73	
Total													
Average													

Circle correct bracketed [ ] units
Train Type denotes impingers, knockouts, etc.

MPU04075

AIRTECH ENVIRONMENTAL SERVICES INC.

Impinger Weights Datasheet

PROJECT NO. 4794

Client	MPU		
Plant	MANITOWOC, WI		
Location	B28		
Date	6/18/14 - 6/19/14	Unit	B28
Operator	RK		

Run No.	1				
Method No.	201A/202	Train ID	1B202-1	Filter No.	N/A
	Contents	Tare with Contents (g)	Final (g)	Total (g)	Notes
Impinger No. 1	EMPTY	538.3	626.9	88.6	ADDED 327.2 mL DEGASSED WATER
Impinger No. 2	EMPTY	638.6	643.1	4.5	
Impinger No. 3	100 mL DI	602.0	623.2	21.2	
Impinger No. 4	SILICA	943.4	965.7	22.3	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse					
			Net Weight (g)	136.6	

Run No.	2				
Method No.	201A/202	Train ID	1B202-6	Filter No.	N/A
	Contents	Tare with Contents (g)	Final (g)	Total (g)	Notes
Impinger No. 1	EMPTY	526.6	608.6	82.0	ADDED 402.5 mL DEGASSED WATER
Impinger No. 2	EMPTY	636.3	641.6	5.3	
Impinger No. 3	100 mL DI	751.0	779.9	28.9	
Impinger No. 4	SILICA	832.0	857.3	25.3	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse					
			Net Weight (g)	141.5	

Run No.	3				
Method No.	201A/202	Train ID	1B202-1	Filter No.	N/A
	Contents	Tare with Contents (g)	Final (g)	Total (g)	Notes
Impinger No. 1	EMPTY	539.6	611.0	71.4	ADDED 385.6 mL DEGASSED WATER
Impinger No. 2	EMPTY	635.7	637.3	1.6	
Impinger No. 3	100 mL DI	620.9	633.7	12.8	
Impinger No. 4	SILICA	937.9	951.9	14.0	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse					
			Net Weight (g)	99.8	

AIRTECH ENVIRONMENTAL SERVICES INC.

Method 3B, Orsat Analyzer Datasheet

PROJECT NO. 4794

Page	1	of	1

Client	M.P.U.		
Plant	MANITOWAC, WI		
Location	BOS	Date	06-19-14
Analyzer Type	ORSAT	Leak Check	✓

$F_O = \frac{(20.9 - O_2\%)}{CO2\%}$

Run No.	Trial No.	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$	F_O	Analyst	Date	Time
Ambient Air	Check							
Run No.	Trial No.	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$	F_O	Analyst	Date	Time
1	1	12.0	19.0	7.0		JD	06-19-14	
	2	12.0	19.0	7.0				
	3	12.2	19.0	6.8				
	Average	12.1	19.0	6.9				
2	1	12.2	19.0	6.8		JD	06-19-14	
	2	12.0	18.8	6.8				
	3	12.2	19.0	6.8				
	Average	12.1	18.9	6.8				
3	1	12.4	19.0	6.6		JD	06-19-14	
	2	12.2	19.0	6.4				
	3	12.4	19.0	6.6				
	Average	12.3	19.0	6.7				
	1							
	2							
	3							
	Average							
	1							
	2							
	3							
	Average							
	1							
	2							
	3							
	Average							
	1							
	2							
	3							
	Average							
	1							
	2							
	3							
	Average							
	1							
	2							
	3							
	Average							

Notes:

Run an ambient air check to verify Oxsorb.

Measurements must be made to the nearest 0.2%.

Three different trails should be performed for each sample.

The differences between the trials must not be greater than 0.2% overall.

Expected F_o Ranges

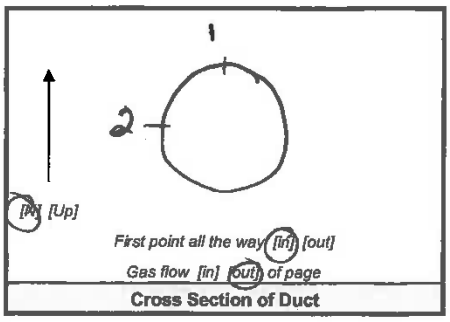
Anthracite/Lignite	1.015-1.130	Nat. Gas	1.600-1.836
Bituminous	1.083-1.230	Wood Bark	1.000-1.120
Distillate Oil	1.260-1.413	Municiple	
Residual Oil	1.210-1.370	Garbage	1.043-1.177

AIRTECH ENVIRONMENTAL SERVICES INC

Method 1, Sample and Velocity Traverses Datasheet

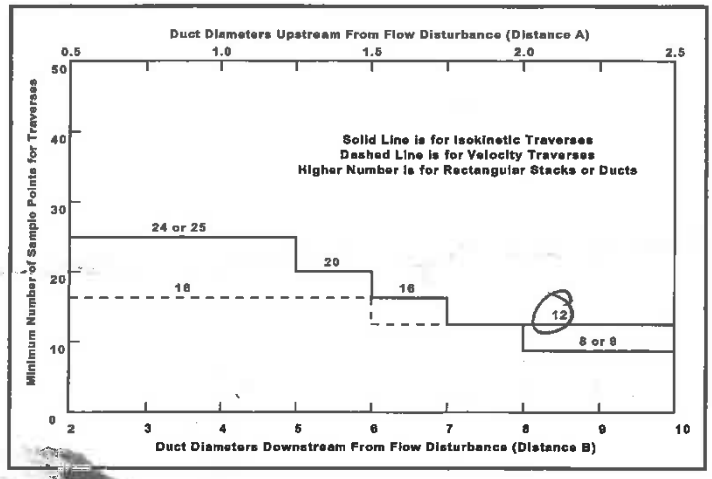
LOCATION Boiler 9 (M-201A/202)

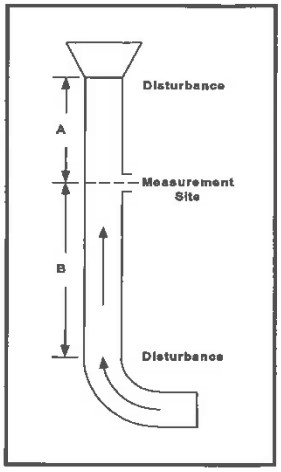
Client	Manitowoc ~~Power~~ Public Utilities
Project No:	4794
Plant	Manitowoc, WI
Date	06-17-14
Technician	J.D.
Duct Diameter (in.)	108"
Port Diameter (in.)	4"
Port Length (in.)	11"
Port Type	M. Flange
Distance A (ft)	216" = 18'
Distance B (ft)	356.4" = 29'7"
Distance A (Duct Diameters)	2.0
Distance B (Duct Diameters)	3.3



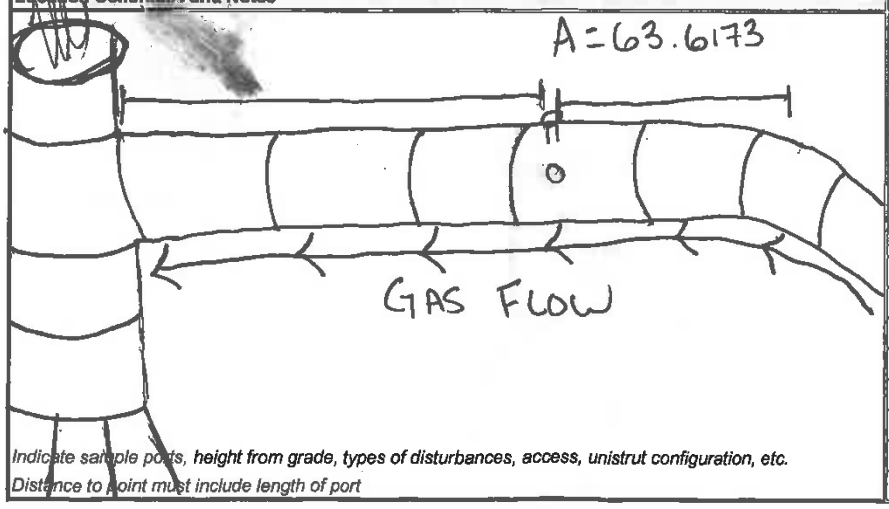
Cross Section of Duct

For rectangular ducts $$ED = \frac{2LW}{(L+W)}$$





Location Schematic and Notes



Indicate sample ports, height from grade, types of disturbances, access, unistrut configuration, etc.
Distance to point must include length of port

Traverse Point	Distance (in.)
1	15.70
2	26.82
3	42.92
4	87.05
5	103.18
6	114.30
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

AIRTECH ENVIRONMENTAL SERVICES INC.

General Testing Datasheet

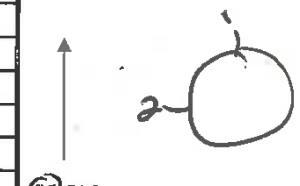
TESTING TYPE: PARTICULATE

RUN NO. 1

METHOD NO. 201A / 202

Page	1	of	1

Client	MPU				
Plant	MANITOWOC, WI				
Location	B09				
Date	6-17-14	Project No.	4794		
Meter Operator	BK				
Probe Operator	JD				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84
ΔH@	1.770	Kf	N/A	Leak check	✓
Pre Leak Check	0.001	(cfm) [lpm] @	17	(inHg)	
Post Leak Check	N/A	[cfm] [lpm] @	N/A	(inHg)	



First point all the way (in) [out]

Gas flow [in] (out) of page

Cross Section of Duct

Barometric (in. Hg)	29.15	Water (ml) (g)	
Ambient Temp. (°F)	91	Silica gel (g)	
Static (in. H_2O)	.10	Total Vlc	
Probe ID	AE5-10-6	Liner Type	TEF ~~GLASS~~
Nozzle ID	.175	Nozzle Dia (in.)	.175
Filter ID	N/A	—	—
Train ID	TB202-1	Train Type	IGP
Duct Dim. (in.)	108"	Port Lgth. (in.)	11"
Start Time	1054	Stop Time	1403

Traverse Point	Min/Point ~~VARIOUS~~ Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [ft^3] [l] 953.23	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	~~Auxiliary~~ CPM Temp (°F)	Notes
1-1	13	.55	.45	958.01	338	258	249	54	88	87	5	69	
2	26.15	.55	.45	962.96	338	259	251	55	91	88	5	70	
3	39.45	.60	.45	967.91	340	249	251	53	96	90	5	70	
4	56	.83	.45	974.17	343	250	247	54	99	92	5	70	
5	72.30	.91	.46	980.13	343	250	251	56	103	96	5	72	CHG ΔH TO .46
6	90.15	1.0	.46	986.80	344	250	250	53	106	99	5	72	PORT CHG. 988.68 - 986.80 = 1.88
2-1	104.15	.64	.46	993.96	345	257	258	58	106	101	5	74	
2	118.45	.71	.46	999.37	345	251	260	54	107	101	5	76	
3	133.30	.73	.46	1004.88	345	249	255	53	107	102	5	77	
4	148.30	.78	.46	1010.49	346	250	250	52	108	102	5	79	
5	163.45	.83	.46	1016.16	346	250	252	52	108	102	5	80	
6	180	.88	.46	1022.25	346	247	259	54	108	102	5	80	
Total	180	10.3521	5.48	69.02	4119				1227	1162			
Average		.8627	.4567	-1.88	343.25				99.54				

67.14

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

MPU04079

AIRTECH ENVIRONMENTAL SERVICES INC.

General Testing Datasheet

TESTING TYPE: PARTICULATE

RUN NO. 2 METHOD NO. 201A / 202

Page 1 of 1

Client	MPU				
Plant	MANITOWOC, WI				
Location	B09				
Date	6-17-14	Project No.	4794		
Meter Operator	BK				
Probe Operator	JD				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84
ΔH@	1.770	Kf	N/A	Leak check	
Pre Leak Check	0.001	[cfm] [lpm] @	18	(InHg)	
Post Leak Check	N/A	[cfm] [lpm] @	N/A	(inHg)	

(IN) [Up]

First point all the way [in] [out]

Gas flow [in] [out] of page

Cross Section of Duct

Barometric (in. Hg)	29.15	Water (ml) (g)	
Ambient Temp. (°F)	100	Silica gel (g)	
Static (In. H_2O)	-.10	Total Vlc	
Probe ID	AE 5-10-6	Liner Type	TEF GLASS
Nozzle ID	.175	Nozzle Dia (in.)	.175
Filter ID	N/A	—	—
Train ID	IB202-6	Train Type	IMP
Duct Dim. (in.)	108"	Port Lgth. (in.)	11"
Start Time	1449	Stop Time	1758

Traverse Point	Min/Point ~~Vacuum~~ Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [ft^3] [l] 22.74	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (In Hg)	CPM ~~Auxiliary~~ Temp (°F)	Notes
1-1	13	.57	.46	27.62	345	256	250	59	99	98	6	72	
2	26	.54	.46	32.49	348	254	252	60	102	99	6	72	
3	39.30	.63	.46	37.53	348	249	251	58	105	99	6	72	
4	55.30	.85	.47	43.62	347	250	258	57	106	100	6	73	CHG. ΔH TO .47
5	72.15	.93	.47	49.98	342	249	251	54	107	101	6	75	
6	90	1.1	.47	56.72	342	249	253	51	107	101	6	76	TOT CHG. 58.26-56.72 = 1.54
2-1	103.45	.67	.47	63.45	339	254	259	54	101	99	6	77	
2	118.15	.72	.47	68.91	339	250	251	50	101	97	6	77	
3	133.15	.77	.46	74.50	339	249	251	52	99	95	6	80	CHG ΔH TO .46
4	148.15	.82	.46	80.05	338	250	251	53	94	92	6	80	
5	164	.86	.46	85.87	338	250	250	54	91	89	6	82	
6	180	.92	.46	91.75	337	252	256	56	88	86	6	83	
Total	180	10.5563	5.57	69.01	4102				1200	1156			
Average		.8796	.4643	-1.54	341.83				98.17				
				67.47									

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

MPU04080

AIRTECH ENVIRONMENTAL SERVICES INC.

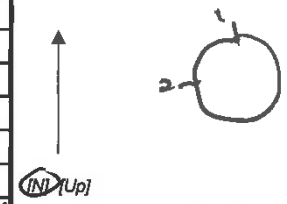
General Testing Datasheet

TESTING TYPE: PARTICULATE

RUN NO. 3 METHOD NO. 001A/202

Page 1 of 1

Client	MPU				
Plant	MANITOWOC, WI				
Location	B09				
Date	6-17-14	Project No.	4794		
Meter Operator	BK				
Probe Operator	JD				
Meter ID	M-30	Yd	1.0024	Pitot Cp	.84
ΔH@	1.770	Kf	N/A	Leak check	✓
Pre Leak Check	0.000	[cfm] [lpm] @	16	(inHg)	
Post Leak Check	N/A	[cfm] [lpm] @	N/A	(inHg)	



First point all the way [in] [out]

Gas flow [in] [out] of page

Cross Section of Duct

Barometric (in. Hg)	29.15	Water (ml) (g)	114.4
Ambient Temp. (°F)	77	Silica gel (g)	15.2
Static (in. H_2O)	.10	Total Vlc	129.6
Probe ID	AE 5-10-6	Liner Type	TEF
Nozzle ID	.175	Nozzle Dia (in.)	.175
Filter ID	N/A	—	—
Train ID	IB 202-1	Train Type	IMP
Duct Dim. (in.)	108"	Port Lgth. (in.)	11"
Start Time	1841	Stop Time	2149

Traverse Point	Min/Point VARIOUS Elapsed Time	Velocity Pressure ΔP (in H_2O)	Orifice Setting ΔH (in H_2O)	Gas Sample Volume Initial [ft^3] [l] 92.00	Stack Temp (°F)	Probe Temp (°F) 250	Filter Temp (°F) 250	Impinger Outlet Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in Hg)	CPM ~~Auxiliary~~ Temp (°F)	Notes
1-1	12.45	.56	.45	96.63	338	256	251	48	75	75	5	68	
2	25.30	.56	.45	101.29	339	253	252	50	80	75	5	68	
3	39.15	.65	.45	106.33	340	256	250	52	82	76	5	68	
4	55	.85	.45	112.08	340	250	251	55	84	77	5	70	
5	71.15	.94	.45	118.01	340	250	254	56	85	80	5	70	
6	88.45	1.0	.45	124.41	340	252	251	56	85	79	5	72	POST CHK 125.83-124.41 = 1.42
2-1	102.45	.65	.45	130.95	339	255	261	58	84	80	5	74	
2	117.15	.72	.45	136.24	341	250	250	55	87	80	5	74	
3	132.15	.79	.45	141.71	341	251	256	54	87	80	5	75	
4	147.45	.84	.45	147.37	341	250	252	55	86	80	5	76	
5	163.30	.86	.45	153.11	341	253	256	56	86	80	5	76	
6	180	.94	.45	159.15	341	251	253	57	87	80	5	76	
Total	180	10.5514	5.40	67.15	4081				1008	942			
Average		.8793	.4500	-1.42	340.08				81.25				
				65.73									

Circle correct bracketed [ ] units

Train Type denotes impingers, knockouts, etc.

MPU04081

AIRTECH ENVIRONMENTAL SERVICES INC.

Impinger Weights Datasheet

PROJECT NO. 4794

Client	MPU		
Plant	MANITOWOC, WI		
Location	B09		
Date	6/16/14	Unit	B09
Operator	RK		

Run No.	1				
Method No.	201A/202	Train ID	1B202-1	Filter No.	N/A
	Contents	Tare with Contents (g)	Final (g)	Total (g)	Notes
Impinger No. 1	EMPTY	636.1	715.0	78.9	
Impinger No. 2	EMPTY	518.8	519.5	0.7	
Impinger No. 3	100ML DI	731.5	749.2	17.7	
Impinger No. 4	SILICA	824.7	846.0	21.3	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse					
			Net Weight (g)	118.6	

Run No.	2				
Method No.	201A/202	Train ID	1B202-6	Filter No.	N/A
	Contents	Tare with Contents (g)	Final (g)	Total (g)	Notes
Impinger No. 1	EMPTY	598.7	686.4	87.7	ADDED 127.3 mL DEGASSED WATER
Impinger No. 2	EMPTY	500.1	501.5	1.4	
Impinger No. 3	100 ML DI	736.0	763.1	27.1	
Impinger No. 4	SILICA	976.6	999.1	22.5	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse					
			Net Weight (g)	116.2	

Run No.	3				
Method No.	201A/202	Train ID	1B202-1	Filter No.	N/A
	Contents	Tare with Contents (g)	Final (g)	Total (g)	Notes
Impinger No. 1	EMPTY	637.8	728.5	90.7	
Impinger No. 2	EMPTY	520.1	520.2	0.1	
Impinger No. 3	100ML DI	754.1	777.7	23.6	
Impinger No. 4	SILICA	846.0	861.2	15.2	
Impinger No. 5					
Impinger No. 6					
Impinger No. 7					
Additional Rinse					
			Net Weight (g)	129.6	

AIRTECH ENVIRONMENTAL SERVICES INC.

Method 3B, Orsat Analyzer Datasheet

PROJECT NO. 4794

Page	1	of	1

Client	M.P.U.		
Plant	MANITOWOC, WI		
Location	BOG	Date	06-17-14
Analyzer Type	ORSAT	Leak Check	✓

$F_O = \frac{(20.9 - O_2\%)}{CO2\%}$

Run No.	Trial No.	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$	F_O	Analyst	Date	Time
Ambient Air	Check							
Run No.	Trial No.	$\%CO_2$	$\%CO_2+\%O_2$	$\%O_2$	F_O	Analyst	Date	Time
1	1	12.8	19.2	6.4		J.D.	06-17-14	~~15:30~~
	2	12.6	19.2	6.6				
	3	12.8	19.2	6.4				
	Average	12.7	19.2	6.5				
2	1	12.6	19.0	6.4		J.D.	06-17-14	~~16:00~~
	2	12.8	19.2	6.4				
	3	12.6	19.0	6.4				
	Average	12.7	19.1	6.4				
3	1	12.6	19.2	6.6		J.D.	06-17-14	~~16:30~~
	2	12.6	19.2	6.6				
	3	12.8	19.2	6.4				
	Average	12.7	19.2	6.5				
	1							
	2							
	3							
	Average							
	1							
	2							
	3							
	Average							
	1							
	2							
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	3							
	Average							
	1							
	2							
	3							
	Average							
	1							
	2							
	3							
	Average							

Notes:

Run an ambient air check to verify Oxsorb.

Measurements must be made to the nearest 0.2%.

Three different trails should be performed for each sample.

The differences between the trials must not be greater than 0.2% overall.

Expected F_o Ranges

Anthracite/Lignite	1.015-1.130	Nat. Gas	1.600-1.836
Bituminous	1.083-1.230	Wood Bark	1.000-1.120
Distillate Oil	1.260-1.413	Municiple	
Residual Oil	1.210-1.370	Garbage	1.043-1.177

Laboratory Data

AIRTECH
Environmental
Services Inc.

Methods 201A/202 Gravimetric Analytical Report

Performed for
MPU

Project No. 4784
July 1, 2014

Analyst: _____
James Christ

The following data has been reviewed for completeness, accuracy, adherence to method protocol and compliance with quality assurance guidelines.

Reviewer: CBusse Date: 7/2/14

1371 BRUMMEL AVE, ELK GROVE VILLAGE, ILLINOIS 60007 - TEL: 630-860-4740
FAX: 847-258-3755

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Table 2. Summary of EPA Methods 201A/202, Unit B28 ..... *3*

APPENDIX

Data Entry
Raw Data
Chain of Custody
Calibration Data

MPU04086

Project Summary

General

Project Information	
Date Received	6/24/14
Analytical Protocol	EPA Methods 201A/202
Number of Samples Received	36
Number of Blanks Received	16

Analytical Equipment

Equipment Information	Manufacturer	Model	Serial No.
Analytical Balance	Ohaus	AV114C	8028031056

Sample Remarks

All samples were analyzed according to the EPA Method 201A Section 11 and EPA Method 202 Section 11.

QA/QC

All sample weights were taken until two consecutive weights were within 0.0005g. The analytical balance was calibrated daily in addition to the yearly full scale calibration that was performed by Automated Scale Corporation. These calibrations can be found in the calibration section of the Appendix.

Condition of Samples When Received

Samples were received in good condition.

MPU04087

Table 1. Summary of EPA Methods 201A/202, Unit B09

	Run 1	Run 2	Run 3
$PM_{>2.5}$			
Front-Half Particulate (g)*	0.0168	0.0176	0.0291
Filterable $PM_{2.5}$			
Filter (g)	0.0001	0.0000	0.0000
Front-Half Wash (g)*	0.0043	0.0062	0.0010
Front-Half Particulate (g)	0.0044	0.0062	0.0010
Condensible $PM_{2.5}$			
Back-Half Inorganic Fraction (g)	0.0497	0.1869	0.1885
Back-Half Organic Fraction (g)*	0.0040	0.0038	0.0041
Back-Half Particulate (g)	0.0517	0.1886	0.1905

Table 2. Summary of EPA Methods 201A/202, Unit B28

	Run 1	Run 2	Run 3
$PM_{>2.5}$			
Front-Half Particulate (g)*	0.0207	0.0162	0.0212
Filterable $PM_{2.5}$			
Filter (g)	0.0001	0.0001	0.0000
Front-Half Wash (g)*	0.0003	0.0015	0.0044
Front-Half Particulate (g)	0.0004	0.0017	0.0044
Condensible $PM_{2.5}$			
Back-Half Inorganic Fraction (g)	0.3819	0.5282	0.1736
Back-Half Organic Fraction (g)*	0.0051	0.0129	0.0063
Back-Half Particulate (g)	0.3850	0.5411	0.1798

"*" Results have been blank corrected

MPU04088

Appendix

Includes the following:

- *Data Entry*
- *Raw Data*
- *Chain of Custody*
- *Calibration Data*

Data Entry

Includes the following:

- *Filter Data Entry*
- *Front-Half-Rinse Data Entry*
- *Organic Fraction Data Entry*
- *Inorganic Fraction Data Entry*

Method 201A and 202 Parameters
B09

EPA Method 201A/202 Parameters		Run 1	Run 2	Run 3	Blank
Filter		4912	4913	4914	
Filter tare weight (g)	Trial 1	0.7878	0.7883	0.7862	
	Trial 2	0.7879	0.7880	0.7865	
	Average	0.7879	0.7882	0.7864	
Filter final weight (g)	Trial 1	0.7879	0.7882	0.7863	
	Trial 2	0.7879	0.7881	0.7861	
	Average	0.7879	0.7882	0.7862	
Filter net weight, m_f (g)		**0.0001**	**0.0000**	**0.0000**	
PM<2.5 Front Half Wash	*Beaker ID*	*K1*	*K2*	*K3*	*405*
Beaker tare weight (g)	Trial 1	4.2720	4.2242	4.2480	3.7357
	Trial 2	4.2722	4.2241	4.2480	3.7359
	Average	4.2721	4.2242	4.2480	3.7358
Beaker final weight (g)	Trial 1	4.2763	4.2301	4.2492	3.7354
	Trial 2	4.2765	4.2306	4.2488	3.7357
	Average	4.2764	4.2304	4.2490	3.7356
Volume of Wash, V_{aw} (ml)		39	28	22	200
Beaker net weight, m_a (g)		**0.0043**	**0.0062**	**0.0010**	**0.0000**
PM>2.5 Front Half Wash	*Beaker ID*	*K5*	*K6*	*K7*	*405*
Filter tare weight (g)	Trial 1	4.2826	4.2367	4.2360	3.7357
	Trial 2	4.2826	4.2363	4.2357	3.7359
	Average	4.2826	4.2365	4.2359	3.7358
Filter final weight (g)	Trial 1	4.2996	4.2542	4.2651	3.7354
	Trial 2	4.2992	4.2539	4.2647	3.7357
	Average	4.2994	4.2541	4.2649	3.7356
Volume of Wash, V_{aw} (ml)		51	45	60	200
Beaker net weight, m_a (g)		**0.0168**	**0.0176**	**0.0291**	**0.0000**
Back-Half Inorganic Fraction	*Beaker ID*	*T1*	*T2*	*T3*	*T4*
Beaker tare weight (g)	Trial 1	4.2677	4.2628	4.2690	4.2479
	Trial 2	4.2676	4.2627	4.2690	4.2479
	Average	4.2677	4.2628	4.2690	4.2479
Beaker final weight (g)	Trial 1	4.3176	4.4498	4.4572	4.2500
	Trial 2	4.3171	4.4494	4.4577	4.2502
	Average	4.3174	4.4496	4.4575	4.2501
Volume of Wash, Vaw (ml)		287	510	293	177
Beaker net weight, ma (g)		**0.0497**	**0.1869**	**0.1885**	**0.0022**
Back-Half Organic Fraction	*Beaker ID*	*T5*	*T6*	*T7*	*T8*
Beaker tare weight (g)	Trial 1	4.2573	4.2488	4.2592	4.2782
	Trial 2	4.2574	4.2487	4.2591	4.2778
	Average	4.2574	4.2488	4.2592	4.2780
Beaker final weight (g)	Trial 1	4.2614	4.2525	4.2632	4.2800
	Trial 2	4.2613	4.2525	4.2632	4.2801
	Average	4.2614	4.2525	4.2632	4.2801
Volume of Wash, Vaw (ml)		385	282	343	247
Beaker net weight, ma (g)		**0.0040**	**0.0038**	**0.0041**	**0.0020**

EPA Method 201A/202 Parameters		Run 1	Run 2	Run 3	Blank
Filter		4915	4916	4917	
Filter tare weight (g)	Trial 1	0.7891	0.7879	0.7900	
	Trial 2	0.7887	0.7875	0.7900	
	Average	0.7889	0.7877	0.7900	
Filter final weight (g)	Trial 1	0.7890	0.7879	0.7900	
	Trial 2	0.7889	0.7878	0.7897	
	Average	0.7890	0.7879	0.7899	
Filter net weight, m_f (g)		**0.0001**	**0.0001**	**0.0000**	
PM<2.5 Front Half Wash	*Beaker ID*	*M1*	*M2*	*M3*	*405*
Beaker tare weight (g)	Trial 1	4.2477	4.2617	4.2086	3.7357
	Trial 2	4.2473	4.2614	4.2087	3.7359
	Average	4.2475	4.2616	4.2087	3.7358
Beaker final weight (g)	Trial 1	4.2477	4.2632	4.2131	3.7354
	Trial 2	4.2480	4.2630	4.2130	3.7357
	Average	4.2479	4.2631	4.2131	3.7356
Volume of Wash, V_{aw} (ml)		38	16	15	200
Beaker net weight, m_a (g)		**0.0003**	**0.0015**	**0.0044**	**0.0000**
PM>2.5 Front Half Wash	*Beaker ID*	*M5*	*M6*	*M7*	*405*
Filter tare weight (g)	Trial 1	4.2137	4.2211	4.2214	3.7357
	Trial 2	4.2133	4.2209	4.2211	3.7359
	Average	4.2135	4.2210	4.2213	3.7358
Filter final weight (g)	Trial 1	4.2345	4.2375	4.2423	3.7354
	Trial 2	4.2340	4.2370	4.2425	3.7357
	Average	4.2343	4.2373	4.2424	3.7356
Volume of Wash, V_{aw} (ml)		55	64	62	200
Beaker net weight, m_a (g)		**0.0207**	**0.0162**	**0.0212**	**0.0000**
Back-Half Inorganic Fraction	*Beaker ID*	*S1*	*S2*	*S3*	*S4*
Beaker tare weight (g)	Trial 1	4.2498	4.2592	4.2600	4.2558
	Trial 2	4.2502	4.2595	4.2605	4.2559
	Average	4.2500	4.2594	4.2603	4.2559
Beaker final weight (g)	Trial 1	4.6317	4.7877	4.4337	4.2578
	Trial 2	4.6320	4.7874	4.4339	4.2579
	Average	4.6319	4.7876	4.4338	4.2579
Volume of Wash, Vaw (ml)		638	665	631	175
Beaker net weight, ma (g)		**0.3819**	**0.5282**	**0.1736**	**0.0020**
Back-Half Organic Fraction	*Beaker ID*	*S5*	*S6*	*S7*	*S8*
Beaker tare weight (g)	Trial 1	4.2474	4.2113	4.2377	4.2419
	Trial 2	4.2478	4.2116	4.2380	4.2417
	Average	4.2476	4.2115	4.2379	4.2418
Beaker final weight (g)	Trial 1	4.2528	4.2241	4.2440	4.2430
	Trial 2	4.2527	4.2245	4.2443	4.2426
	Average	4.2528	4.2243	4.2442	4.2428
Volume of Wash, Vaw (ml)		345	251	331	245
Beaker net weight, ma (g)		**0.0051**	**0.0129**	**0.0063**	**0.0010**

Raw Data

Includes the following:

- *Filter Gravimetric Data Sheets*
- *Beaker Gravimetric Data Sheets*

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Filter Gravimetric Datasheet

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
		Tare	0.7859	5/15 10:01	0.7857	5/16 10:50	0.7856	5/17 9:35	✓
		Tech		RK		RK		RK	
Filter ID		Final							
4909		Tech							
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
		Tare	0.7870	5/15 9:59	0.7855	5/16 8:48	0.7856	5/17 9:36	✓
		Tech		RK		RK		RK	
Filter ID		Final							
4910		Tech							
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
		Tare	0.7872	5/15 9:59	0.7869	5/16 8:43			✓
		Tech		RK		RK			
Filter ID		Final							
4911		Tech							
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	4744	Tare	0.7878	5/15 9:57	0.7879	5/16 8:42			✓
	B09	Tech		RK		RK			
Filter ID		Final	0.7879	6/30 6:59	0.7879	7/1 7:13			✓
4912		Tech		/		/			
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	4744	Tare	0.7883	5/15 9:56	0.7880	5/16 8:41			✓
	B09	Tech		RK		RK			
Filter ID		Final	0.7882	6/30 6:58	0.7881	7/1 7:14			✓
4913		Tech		/		/			
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	4744	Tare	0.7862	5/15 9:56	0.7865	5/16 8:40			✓
	B09	Tech		RK					
Filter ID		Final	0.7863	6/30 6:58	0.7861	7/1 7:14			✓
4914		Tech		/		/			
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	4744	Tare	0.7891	5/15 9:54	~~0.78887~~	5/15 15:54			✓
	B28	Tech		RK	0.7887	RK			
Filter ID		Final	0.7890	6/30/6:56	0.7889	7/1 7:11			✓
4915		Tech		/		/			
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	4744	Tare	0.7872	5/15 9:53	0.7879	5/15 15:53	0.7875	5/16 11:00	✓
	B28	Tech		RK		RK		RK	
Filter ID		Final	0.7879	6/30 6:57	0.7878	7/1 7:12			✓
4916		Tech		/		/			
		Notes							

Run No.	Project #/Location		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	4744	Tare	0.7911	5/15 9:52	0.7900	5/15 15:52	0.7900	5/16 11:01	✓
	B28	Tech		RK		RK		RK	
Filter ID		Final	0.7900	6/30 6:56	0.7897	7/1 7:13			✓
4917		Tech		/		/			
		Notes							

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Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B09	201A	Tare	4.2720	6/19 12:35	4.2722	6/20 10:35			✓
		PM≤	Tech		BHZ		BHZ			
Beaker ID	28.8 +10	2.5	Final	4.2770	6/27 14:02	4.2763	6/30 6:55	4.2765	6/30 14:31	✓
K1	38.8 mls	ACE	Tech		✓		✓		✓	
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B09	201A	Tare	4.2242	6/19 12:36	4.2241	6/20 10:36			✓
		PM≤	Tech		BHZ		BHZ			
Beaker ID	18.3+10	2.5	Final	4.2309	6/27 14:04	4.2308	6/30 6:53	4.2306	6/30 14:31	✓
K2	28.3 mls	ACE	Tech		✓	TC	✓		✓	
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B09	201A	Tare	4.2480	6/19 12:36	4.2480	6/20 10:36			✓
		PM≤	Tech		BHZ		BHZ			
Beaker ID	12 +10	2.5	Final	4.2492	6/27 14:03	4.2488	6/30 6:54			✓
K3	22 mls	ACE	Tech		✓		✓			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
FB	B09	201A	Tare	4.2620	6/19 12:37	4.2618	6/20 10:37			✓
		PM≤	Tech		BHZ		BHZ			
Beaker ID	17.1 +10	2.5	Final	4.2626	6/27 14:05	4.2625	6/30 6:52			✓
K4	27.1 mls	ACE	Tech		✓		✓			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B09	201	Tare	4.2826	6/19 12:37	4.2826	6/20 10:37			✓
		A	Tech		BHZ		BHZ			
Beaker ID	41 ~~28~~+10		Final	4.2996	6/27 14:04	4.2992	6/30 6:52			✓
K5	~~38~~ 51 mls	ACE	Tech		✓		✓			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B09	201	Tare	4.2367	6/19 12:38	4.2363	6/20 10:38			✓
		A	Tech		BHZ		BHZ			
Beaker ID	35.3 +10		Final	4.2542	6/27 14:03	4.2539	6/30 6:51			✓
K6	45.3 mls	ACE	Tech		✓		✓			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B09	201 A	Tare	4.2360	6/19 12:39	4.2357	6/20 10:38			✓
			Tech		BHZ		BHZ			
Beaker ID	50 +10		Final	4.2651	6/27 14:02	4.2647	6/30 6:54			✓
K7	60 mls	ACE	Tech		✓		✓			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
FB	B09	201 A	Tare	4.2175	6/19 12:39	4.2171	6/20 10:39			✓
			Tech		BHZ		BHZ			
Beaker ID	58.1 +10		Final	4.2183	6/27 14:01	4.2179	6/30 6:53			✓
K8	68.1 mls	ACE	Tech		✓		✓			
			Notes							

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Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B09	202 DI	Tare	4.2677	6/19 12:30	4.2676	6/20 10:39			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.3176	6/30 7:05	4.3171	6/30 14:39			✓
T1	287 mls		Tech		/		/			
			Notes	544						
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B09	202 DI	Tare	4.2628	6/19 12:31	4.2627	6/20 10:40			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.4585	6/30 7:06	4.4498	6/30 14:40	4.4494	7/1 6:45	✓
T2	510 mls		Tech		/		/		/	
			Notes	201						
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B09	202 DI	Tare	4.2690	6/19 12:31	4.2690	6/20 10:40			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.4623	6/30 7:07	4.4572	6/30 14:38	4.4577	7/1 6:46	✓
T3	293 mls		Tech		/		/		/	
			Notes	152						
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
FB	B09	202 DI	Tare	4.2479	6/19 12:32	4.2479	6/20 10:41			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.2500	6/30 7:08	4.2502	6/30 14:38			✓
T4	177 mls		Tech		/		/			
			Notes	150						
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B09	202 HCl	Tare	4.2573	6/19 12:32	4.2574	6/20 10:42			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.2614	6/30 7:05	4.2613	6/30 14:40			✓
T5	385 mls		Tech		/		/			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B09	202 HCl	Tare	4.2488	6/19 12:33	4.2487	6/20 10:42			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.2525	6/30 7:06	4.2525	6/30 14:41			✓
T6	282 mls		Tech		/		/			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B09	202 HCl	Tare	4.2592	6/19 12:34	4.2591	6/20 10:43			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.2632	6/30 7:04	4.2632	6/30 14:39			✓
T7	343 mls		Tech		/		/			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
FB	B09	202 HCl	Tare	4.2782	6/19 12:34	4.2778	6/20 10:43			✓
			Tech		BH2		BH2			
Beaker ID			Final	4.2800	6/30 7:06	4.2801	6/30 14:41			✓
T8	247 mls		Tech		/		/			
			Notes							

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Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B28	201A	Tare	4.2477	6/19 12:41	4.2473	6/20 10:30			✓
		PM≤	Tech		BH2		BH2			
Beaker ID	28.2+10	2.5	Final	4.2486	6/27 14:01	4.2477	6/30 6:50	4.2480	6/30 14:32	✓
M1	38.2 mls	ACE	Tech		/		/		/	
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B28	201A	Tare	4.2617	6/19 12:41	4.2614	6/20 10:31			✓
		PM≤	Tech		BH2		BH2			
Beaker ID	6+10	2.5	Final	4.2632	6/27 14:00	4.2630	6/24 6:49			✓
M2	16 mls	ACE	Tech		/		30 /			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B28	201A	Tare	4.2086	6/19 12:42	4.2087	6/20 10:32			✓
		PM≤	Tech		BH2		BH2			
Beaker ID	5+10	2.5	Final	4.2131	6/27 13:59	4.2130	6/30 6:50			✓
M3	15 mls	ACE	Tech		/		/			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
FB	B28	201A	Tare	4.2156	6/19 12:43	4.2153	6/20 10:32			✓
		PM≤	Tech		BH2		BH2			
Beaker ID	21+10	2.5	Final	4.2163	6/27 13:58	4.2163	6/30 6:50			✓
M4	32 mls	ACE	Tech		/		/			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B28	201A	Tare	4.2137	6/19 12:43	4.2133	6/20 10:33			✓
			Tech		BH2		BH2			
Beaker ID	45.3+10		Final	4.2345	6/27 13:58	4.2340	6/30 6:49			✓
M5	55.3 mls	ACE	Tech		/		/			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B28	201A	Tare	4.2211	6/19 12:44	4.2209	6/20 10:33			✓
			Tech		BH2		BH2			
Beaker ID	53.5+10		Final	4.2375	6/27 13:57	4.2370	6/30 6:50			✓
M6	63.5 mls	ACE	Tech		/		/			
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B28	201A	Tare	4.2214	6/19 12:44	4.2211	6/20 10:34			✓
			Tech		BH2		BH2			
Beaker ID	52.1+10		Final	4.2432	6/27 13:59	4.2423	6/30 6:48	4.2425	6/30 14:32	✓
M7	62.1 mls	ACE	Tech		/		/		/	
			Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
FB	B28	201A	Tare	4.2341	6/19 12:45	4.2336	6/20 10:34			✓
			Tech		BH2		BH2			
Beaker ID	60+10		Final	4.2344	6/24 14:00	4.2340	6/30 6:48			✓
MB	70 mls	ACE	Tech		/		/			
			Notes							

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Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B28	202	Tare	4.2498	6/19 12:25	4.2502	6/20 10:49			✓
			Tech		BH2		BH2			
Beaker ID		DI	Final	4.6317	6/30 7:03	4.6320	6/30 14:35			✓
			Tech		✓		✓			
S1	638 mls		Notes	151						

Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B28	202	Tare	4.2592	6/19 12:25	4.2595	6/20 10:50			✓
		DI	Tech		BH2		BH2			
Beaker ID			Final	4.7890	6/30 7:03	4.7877	6/30 14:36	4.9874	7/16:45	✓
			Tech		✓		✓		✓	
S2	665 mls		Notes	147						

Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B28	202	Tare	4.2600	6/19 12:26	4.2605	6/20 10:51			✓
		DI	Tech		BH2		BH2			
Beaker ID			Final	4.4346	6/30 7:02	4.4337	7/1 6:44	4.4339	7/1 14:17	✓
			Tech		✓		✓		✓	
S3	631 mls		Notes	144						

Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
4 FB	B28	202	Tare	4.2558	6/19 12:27	4.2559	6/20 10:52			✓
		DI	Tech		BH2		BH2			
Beaker ID			Final	4.2578	6/30 7:07	4.2579	6/30 14:35			✓
			Tech		✓		✓			
S4	175 mls		Notes	143						

Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
1	B28	202	Tare	4.2474	6/19 12:28	4.2478	6/20 10:52			✓
		HA	Tech		BH2		BH2			
Beaker ID			Final	4.2488	6/30 7:08	4.2528	6/30 14:34	4.2527	7/16:44	✓
			Tech	SJC	✓		✓		✓	
S5	345 mls		Notes							

Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
2	B28	202	Tare	4.2113	6/19 12:28	4.2116	6/20 10:53			✓
		Hex	Tech		BH2		BH2			
Beaker ID			Final	4.2241	6/30 7:01	4.2245	6/30 14:36			✓
			Tech		✓		✓			
S6	251 mls		Notes							

Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
3	B28	202	Tare	4.2377	6/19 12:29	4.2380	6/20 10:53			✓
		Hex	Tech		BH2		BH2			
Beaker ID			Final	4.2440	6/30 7:01	4.2443	6/30 14:36			✓
			Tech		✓		✓			
S7	331 mls		Notes							

Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
FB	B28	202	Tare	4.2419	6/19 12:29	4.2417	6/20 10:54			✓
		Hex	Tech		BH2		BH2			
Beaker ID			Final	4.2430	6/30 7:04	4.2426	6/30 14:37			—
			Tech		✓		✓			
S8	245 mls		Notes							

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Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
RB			Tare	3.7357	6/12 24:05	3.7359	6/13 8:45			✓
			Tech		RK		RK			
Beaker ID			Final	3.7354	6/16 22:41	3.7357	6/17 5:47			✓
			Tech		/		/			
405	200 mls		Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
			Tare							
			Tech							
Beaker ID			Final							
			Tech							
	mls		Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
			Tare							
			Tech							
Beaker ID			Final							
			Tech							
	mls		Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
			Tare							
			Tech							
Beaker ID			Final							
			Tech							
	mls		Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
			Tare							
			Tech							
Beaker ID			Final							
			Tech							
	mls		Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
			Tare							
			Tech							
Beaker ID			Final							
			Tech							
	mls		Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
			Tare							
			Tech							
Beaker ID			Final							
			Tech							
	mls		Notes							
Run No.	Location/Volume	Method/ Reagent		Weight	Date / Time	Weight	Date / Time	Weight	Date / Time	Good
			Tare							
			Tech							
Beaker ID			Final							
			Tech							
	mls		Notes							

Chain of Custody

Includes the following:

- *Chain of Custody*

AIRTECH ENVIRONMENTAL SERVICES INC.
Chain of Custody

No. 5118

Project Number	4784	Location	B09	Analysis Requested								Page	1	of	2
Client	MPU	Date	6/20/14												
Plant	MANITOWOC, WI	Completed By	RILEY KLOSS												
Comments:				M-5	2014/202										
ID No.	Run No.	Date	Sample Description									Notes			
	1	6/17/14	F1/2 ACETONE RINSE		X										
	1	6/17/14	DI + IMP CATCH		X										
	1	6/17/14	ACE + HEX RINSE		X										
	1	6/17/14	CPM FILTER		X										
	1	6/17/14	PM ≤2.5 ACE RINSE		X										
	2	6/17/14	F1/2 ACETONE RINSE		X										
	2	6/17/14	DI + IMP CATCH		X										
	2	6/17/14	ACE + HEX RINSE		X										
	2	6/17/14	CPM FILTER		X										
	2	6/17/14	PM ≤2.5 ACE RINSE		X										
	3	6/17/14	F1/2 ACETONE RINSE		X										
	3	6/17/14	DI + IMP CATCH		X										
	3	6/17/14	ACE + HEX RINSE		X										
	3	6/17/14	CPM FILTER		X										
	3	6/17/14	PM ≤2.5 ACE RINSE		X										
	FB	6/17/14	F1/2 ACETONE RINSE		X										

Relinquished By (signature)		Relinquished By (signature)		Carrier	
(printed)	RILEY KLOSS	(printed)		Laboratory	
Date/Time	6/20/14 16:45	Date/Time		Contact	
Accepted By (signature)		Accepted By (signature)		Address	
(printed)	RILEY KLOSS	(printed)		Phone	
Date/Time	6/24/14 14:05	Date/Time		Fax	
				Date/Time	

MPU04101

AIRTECH Environmental Services Inc.

Airtech Environmental Services Inc.
1371 Brummel Ave
Elk Grove Village, IL 60007
Phone: (630) 860-4740 • Fax: (847) 258-3755

AIRTECH ENVIRONMENTAL SERVICES INC.
Chain of Custody

№ 1872

Project Number	4784	Location	B09	Page	2 of 2
Client	MPU	Date	6/20/14		
Plant	MANITOWOC, WI	Completed By	RILEY KLOSS		
Comments:					

Analysis Requested: 201A/202

ID No.	Run No.	Date	Sample Description	201A/202	Notes
	FB	6/17/14	DI + IMP CATCH	X	
	FB	6/17/14	ACE + HEX RINSE	X	
	FB	6/17/14	CPM FILTER	X	
	FB	6/17/14	PM ≤2.5 ACE RINSE	X	
	RB	6/19/14	DI 1 of 2		
	RB	6/19/14	DI 2 of 2		
	RB	6/19/14	ACETONE 1 of 2		
	RB	6/19/14	ACETONE 2 of 2		
	RB	6/19/14	HEXANE 1 of 2		
	RB	6/19/14	HEXANE 1 of 2		
	1	6/17/14	GELMAN FILTER	X	
	2	6/17/14	GELMAN FILTER	X	
	3	6/17/14	GELMAN FILTER	X	

Relinquished By (signature)	[signature]	Relinquished By (signature)		Carrier	
(printed)	RILEY KLOSS	(printed)		Laboratory	
Date/Time	6/20/14 16:45	Date/Time		Contact	
Accepted By (signature)	[signature]	Accepted By (signature)		Address	
(printed)	RILEY KLOSS	(printed)		Phone	
Date/Time	6/24/14 14:05	Date/Time		Fax	
				Date/Time	

AIRTECH Environmental Services Inc.

Airtech Environmental Services Inc.
601A Country Club Drive
Bensenville, IL 60106
Phone: (630) 860-4740, Fax: (630) 860 4745

MPU04102

AIRTECH ENVIRONMENTAL SERVICES INC.
Chain of Custody

№ 1870

Project Number	4784	Location	B28	Page	1 of 2
Client	MPU	Date	6/20/14		
Plant	MANITOWOC, WI	Completed By	RILEY KLOSS		
Comments:					

ID No.	Run No.	Date	Sample Description	Analysis Requested: 201A/202	Notes
	1	6/19/14	F1/2 ACETONE RINSE	X	
	1	6/19/14	DI + IMP CATCH	X	
	1	6/19/14	ACE + HEX RINSE	X	
	1	6/19/14	CPM FILTER	X	
	1	6/19/14	PM ≤2.5 ACE RINSE	X	
	2	6/19/14	F1/2 ACETONE RINSE	X	
	2	6/19/14	DI + IMP CATCH	X	
	2	6/19/14	ACE + HEX RINSE	X	
	2	6/19/14	CPM FILTER	X	
	2	6/19/14	PM ≤2.5 ACE RINSE	X	
	3	6/19/14	F1/2 ACETONE RINSE	X	
	3	6/19/14	DI + IMP CATCH	X	
	3	6/19/14	ACE + HEX RINSE	X	
	3	6/19/14	CPM FILTER	X	
	3	6/19/14	PM ≤2.5 ACE RINSE	X	
	FB	6/19/14	F1/2 ACETONE RINSE	X	

Relinquished By (signature)	[signature]	Relinquished By (signature)		Carrier	
(printed)	RILEY KLOSS	(printed)		Laboratory	
Date/Time	6/20/14 16:45	Date/Time		Contact	
Accepted By (signature)	[signature]	Accepted By (signature)		Address	
(printed)	RILEY KLOSS	(printed)		Phone	
Date/Time	6/24/14 14:05	Date/Time		Fax	
				Date/Time	

AIRTECH Environmental Services Inc.

Airtech Environmental Services Inc.
601A Country Club Drive
Bensenville, IL 60106
Phone: (630) 860-4740, Fax: (630) 860 4745

MPU04103

AIRTECH ENVIRONMENTAL SERVICES INC.
Chain of Custody

№ 1871

Project Number	4784	Location	B28
Client	MPU	Date	6/20/14
Plant	MANITOWOC, WI	Completed By	RILEY KLOSS

Comments:

Analysis Requested: 201A/202

Page 2 of 2

ID No.	Run No.	Date	Sample Description	201A/202								Notes
	FB	6/19/14	DI + IMP CATCH	X								
	FB	6/19/14	ACE + HEX RINSE	X								
	FB	6/19/14	CPM FILTER	X								
	FB	6/19/14	PM ≤2.5 ACE RINSE	X								
	1	6/19/14	GELMAN FILTER	X								
	2	6/19/14	GELMAN FILTER	X								
	3	6/19/14	GELMAN FILTER	X								

Relinquished By (signature)	Riley Kloss	Relinquished By (signature)		Carrier	
(printed)	RILEY KLOSS	(printed)		Laboratory	
Date/Time	6/20/14 16:45	Date/Time		Contact	
Accepted By (signature)	Riley Kloss	Accepted By (signature)		Address	
(printed)	RILEY KLOSS	(printed)		Phone	
Date/Time	6/24/14 14:05	Date/Time		Fax	
				Date/Time	

AIRTECH Environmental Services Inc.

Airtech Environmental Services Inc.
601A Country Club Drive
Bensenville, IL 60106
Phone: (630) 860-4740, Fax: (630) 860 4745

MPU04104

Calibration Data

Includes the following:

- *Daily Analytical Balance Calibration Log*
- *Yearly Analytical Balance Test and Calibration Certificate*

Scale ID	Ohaus AV114C
Units of Measure	grams

Full Cal Test Date	4/4/14

Date	Tech Initials	100.0000g	5.0000g	0.1000g	Barometric Pressure (in. Hg)	Relative Humidity (%)	Ambient Temp (°F)	Notes
4-17-14	BHZ	100.0001	5.0000	0.1000	29.44	23	68	
4-18-14	JC	100.0001	5.0000	0.1000	29.62	31	70	
4-23-14	JC	100.0000	5.0002	0.1001	29.45	31	70	
4-30-14	SH	100.0000	5.0001	0.1000	29.03	39	71	
5-2-14	JC	100.0000	5.0000	0.1000	29.06	40	69	
5-6-14	JC	100.0000	5.000	0.1000	29.21	36	73	
5-19-14	SH	100.0000	5.0000	0.1000	29.50	40	71	
5-22-14	JC	100.0000	5.0000	0.0999	29.38	42	76	
5-23-14	BrK	100.0000	5.0000	0.1001	29.48	44	73	
5-24-14	JC	100.000	5.0000	0.1001	29.44	42	76	
5-27-14	JC	100.0001	5.0002	0.1001	29.23	48	78	
5-28-14	JC	99.9999	4.9999	0.0999	29.24	46	74	
5-29-14	JC	99.9999	4.9999	0.0999	29.38	39	75	
5-30-14	JC	100.0001	5.0002	0.0999	29.42	40	79	
6-4-14	RK	100.0000	4.9999	0.0999	29.14	48	72	
6-5-14	JC	100.0001	4.9999	0.0999	29.25	47	73	
6-6-14	JC	100.0000	5.0001	0.0998	29.30	36	73	
6-8-14	JC	99.9999	5.0002	0.1002	29.30	45	74	
6-9-14	MH	99.9999	4.9999	0.0999	29.29	41	74	
6-10-14	MH	100.0000	4.9999	0.1000	29.21	45	73.9	
6/12/14	JC	100.0000	5.0000	0.0999	29.08	48	74	
6/15/14	JC	100.0001	5.0001	0.1000	29.34	44	75	
6/16/14	JC	100.0001	5.0002	0.1000	29.37	46	73	
6/19/14	JC	100.0000	5.0000	0.0998	29.39	42	73	
6/20/14	JC	99.9999	4.9999	0.1000	29.26	43	73	
6/23/14	BC	100.0001	5.0000	0.1000	29.13	48	73	
6/24/14	JC	100.0001	4.9999	0.1000	29.15	48	73	
6/27/14	JC	99.9999	4.9999	0.1000	29.3	48	73	
6/28/2014	KW	100.0000	4.9999	0.1000	29.33	58	77	
6/30/14	JC	100.0000	5.0001	0.1000	29.15	43	76	
7/1/14	JC	100.0001	5.0000	0.1000	29.02	48	73	

Scale ID	Ohaus AV114C
Units of Measure	grams

Full Cal Test Date	4/3/13

Date	Tech Initials	100.0000g	5.0000g	0.1000g	Barometric Pressure (in. Hg)	Relative Humidity (%)	Ambient Temp (°F)	Notes
12/23/13	RK	100.0001	5.0002	0.1000	28.22	40	67	
12/26/13	RK	100.0002	5.0002	0.1002	28.22	40	69	
12/27/13	JC	100.0001	5.0001	0.1001	29.29	44	69	
12/30/13	RK	99.9998	5.0001	0.1002	29.58	41	72	
1/3/14	RK	100.0001	4.9999	0.1000	29.69	38	66	
1/16/14	SH	99.9997	5.0000	0.1000	28.80	24	70	
1/17/14	SH	99.9999	5.0001	0.1000	29.10	21	71	
1/21/14	JC	100.0000	5.0001	0.1001	29.51	20	69	
1-23-14	AW	100.0001	4.9999	.0998	29.74	19	71	
1/29/14	KW	100.0000	5.0001	0.1000	29.35	19	70.8	
1/30/14	RK	100.0000	5.0001	0.1000	29.06	18	69.6	
1/31/14	SH	100.0002	5.0001	0.0999	29.38	20	69.0	
2/3/14	SH	100.0002	4.9999	0.0999	29.60	8	67	
2/5/14	JC	99.9999	5.0000	0.1001	29.36	21	69	
2/6/14	JC	99.9999	4.9999	0.0999	29.73	21	69	
2/7/14	JC	100.0001	5.0001	0.1000	29.71	20	70	
2/7/14	JC	100.0000	5.0000	0.0999	29.29	18	72	
2/18/14	JC	100.0002	5.0001	0.1000	29.24	21	71	
2/19/14	JC	100.0001	4.9999	0.0998	29.10	23	70	
2/20/14	JC	100.0000	5.0002	0.1002	28.98	28	72	
2/21/14	BH2	99.9999	4.9999	0.0999	28.83	28	69	
2/23/14	JC	99.9999	4.9998	0.0998	29.40	24	62	
2/26/14	BH2	100.0000	5.0000	0.0999	29.30	6	70	
2/27/14	BH2	99.9999	5.0000	0.1000	29.26	9	65	
2/28/14	BH2	100.0001	5.0002	0.1000	29.45	8	68	
3/3/14	JC	100.0001	5.0000	0.1000	29.70	19	69	
3/5/14	BH2	99.9999	5.0000	0.1001	29.65	11	66	
3/6/14	JC	99.9999	5.0000	0.1000	29.25	21	70	
3/9/14	JC	99.9999	5.0002	0.1000	29.23	28	62	
3/10/14	JC	99.9999	5.0000	0.1000	28.99	27	70	
3/21/14	JC	100.0001	5.0002	0.0999	29.23	28	71	
3/22/14	CH	99.9999	5.0000	0.1001	29.40	26	63	
3/28	JC	99.9999	5.0000	0.0999	29.03	32	69	
3/31/14	SH	100.0000	4.9999	0.0998	29.29	25	69	
4/1/14	JC	100.0001	5.0000	0.1001	29.03	30	71	
4/2/14	JC	99.9999	5.0000	0.1000	29.41	26	70	
4/3/14	JC	100.0000	5.0001	0.1000	29.18	25	72	
4/4/14	JC	100.0001	5.0001	0.1001	28.77	30	65	
4/7/14	BH2	99.9999	5.0000	0.0999	29.09	24	70	
4-8-14	BH2	99.9999	5.0001	0.1000	29.02	27	70	

AUTOMATED SCALE CORPORATION

202 W. Fay Ave. Addison, IL 60101 800/498-6650

TEST & CALIBRATION CERTIFICATE

Tests and/or calibrations shall stop when environmental conditions will jeopardize the results. (rain, wind, vibration, temperature, and etc.)

L-A-B Accredited: Certificate #L1053-1

Standards Used: Traceable through NIST to the SI units

Test equipment and weight (s) certificates available on request

Client Name & Address	Location (Plant and / or Dept.)	
Air tech	Lab	Procedure used: 5.4-02 Process Control
601 A Country Club	NA	Uncertainty of measurement (UM) Yes [ ] No [X]
Bensenville	Contact: Jim C	Temperature Yes [X] No [ ]
		Identified metrological reference: NIST Handbook 44

Manufacturer	Model #	Serial #	Capacity X Grad.
Indicator: Ohaus	AV114C	8028031056	110g x .0001
Platform: NA	NA	NA	NA

Inspection Cycle: 365 day

Equipment ID: NA

Scale Platform Corner Test

Parallelogram Side/Front Test

1	Indicator C	2
A	See Shift Test Below	B
3	D	4

Cert# Client Tolerance (.1)% As Found/Left Shift Test

Date		A	B	C	D	Zero	As Found AMT 1	As Found AMT 2	As Left AMT 2	As Left AMT 1	Pass/Fail P/F	UM	Temp. F°	Tech	Traceable Cert. #/ Wt. ID
4.13.10	F	50.0000	50.0000	50.0000	50.0000	0									#1538014
	L	50.0000	50.0000	50.0000	50.0000	0	50.0000	100.0000	100.0000	50.0000	P	NA	74	TJ	ID ASTMOM
4-12-11	F	50.0000	50.0000	50.0000	50.0000	0									#1538014
	L	50.0000	50.0000	50.0000	50.0000	0	50.0000	100.0001	100.0000	50.0000	P	NA	74	GR	ID ASTMOM
4-5-12	F	50.0004	50.0004	50.0004	50.0004	0									#1763044
	L	50.0000	50.0000	50.0000	50.0000	0	50.0004	100.0001	100.0000	50.0000	P	NA	70	AZ	ID ASTMOM
4-3-13	F	50.0006	50.0006	50.0006	50.0006	0									#1763044
	L	50.0000	50.0000	50.0000	50.0000	0	50.0006	100.0012	100.0000	50.0000	P	NA	70	RR	ID ASTMOM
4-7-14	F	50.0001	50.0001	50.0001	50.0001	0									#1763044
	L	50.0000	50.0000	50.0000	50.0000	0	50.0001	100.0002	100.0000	50.0000	P	NA	71	RST	ID ASTMO-M
	F														#
	L														ID
	F														#
	L														ID
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	L														ID

Comments:

Pass/Fail compliance statements are the opinions of Automated Scale Corp. based on data from measurements made, procedure utilized, professional experience, and the uncertainty associated with this calibration. It is the responsibility of the user of this equipment to determine if the results identified meet specific requirements for its intended application. Associated uncertainty (as applicable) is expressed at a confidence level of approximately 95% with a coverage factor of K=2.

Form: 5.4.02 L-A-B Accredited Process Control Certificate 3/2/10

MPU04108

LAB NO. 2014-667-22

DATE REC'D 06/06/14

DATE SAMPLED --------

SAMPLED BY Client

STANDARD LABORATORIES, INC.

1530 N. Cullen Avenue
Evansville, IN 47715

MANITOWOC PUBLIC UTILITIES
P.O. BOX 1090
MANITOWOC, WI 54221

SAMPLE IDENTIFICATION

Boiler B8 Stack Test
Performed June 19, 2014

Note: Values Calculated

DATE REPORTED: 07/18/14

	% MOISTURE	% ASH	% VOLATILE	% FIXED CARBON	BTU/LBS	% SULFUR
AS REC'D	1.54	4.99	XXXX	XXXX	12868	2.57
DRY BASIS	------	5.07	XXXX	XXXX	13069	2.61
M-A-FREE					13767	

ULTIMATE ANALYSIS

	% As Received	Dry Basis
Carbon	61.23	62.19
Hydrogen	5.97	6.06
Nitrogen	0.72	0.73
Ash	4.99	5.07
Sulfur	2.57	2.61
Oxygen	22.98	23.34
Moisture	1.54	
Chlorine	0.11	0.12

Respectfully Submitted

FORM # 21

MPU04109

LAB NO. 2014-667-21

DATE REC'D 06/06/14

DATE SAMPLED --------

SAMPLED BY Client

STANDARD LABORATORIES, INC.

1530 N. Cullen Avenue
Evansville, IN 47715

MANITOWOC PUBLIC UTILITIES
P.O. BOX 1090
MANITOWOC, WI 54221

SAMPLE IDENTIFICATION

Boiler B9 Stack Test
Performed June 17, 2014

Note: Values Calculated

DATE REPORTED: 07/18/14

	% MOISTURE	% ASH	% VOLATILE	% FIXED CARBON	BTU/LBS	% SULFUR
AS REC'D	1.06	4.21	XXXX	XXXX	13488	3.94
DRY BASIS	------	4.26	XXXX	XXXX	13633	3.98
M-A-FREE					14240	

ULTIMATE ANALYSIS

	% As Received	Dry Basis
Carbon	62.57	63.24
Hydrogen	5.06	5.11
Nitrogen	1.06	1.07
Ash	4.21	4.26
Sulfur	3.94	3.98
Oxygen	22.10	22.34
Moisture	1.06	
Chlorine	0.03	0.04

Respectfully Submitted

FORM # 21

MPU04110

LAB NO. 2014-667-18

DATE REC'D 06/25/14

DATE SAMPLED --------

SAMPLED BY CLIENT

STANDARD LABORATORIES, INC.

1530 N. Cullen Avenue
Evansville, IN 47715

MANITOWOC PUBLIC UTILITIES
P.O. BOX 1090
MANITOWOC, WI 54221

SAMPLE IDENTIFICATION

B8 Paper
06/19/14

DATE REPORTED: 07/18/14

	% MOISTURE	% ASH	% VOLATILE	% FIXED CARBON	BTU/LBS	% SULFUR
AS REC'D	2.28	7.72	XXXX	XXXX	11465	0.07
DRY BASIS	------	7.90	XXXX	XXXX	11733	0.07
M-A-FREE					12739	

ULTIMATE ANALYSIS

	% As Received	Dry Basis
Carbon	57.87	59.22
Hydrogen	7.81	7.99
Nitrogen	0.10	0.10
Ash	7.72	7.90
Sulfur	0.07	0.07
Oxygen	24.15	24.72
Moisture	2.28	
Chlorine	0.21	0.21

Respectfully Submitted

FORM # 21

MPU04111

LAB NO. 2014-667-19

DATE REC'D 06/25/14

DATE SAMPLED --------

SAMPLED BY CLIENT

STANDARD LABORATORIES, INC.

1530 N. Cullen Avenue
Evansville, IN 47715

MANITOWOC PUBLIC UTILITIES
P.O. BOX 1090
MANITOWOC, WI 54221

SAMPLE IDENTIFICATION

B9 Paper
06/17/14

DATE REPORTED: 07/18/14

	% MOISTURE	% ASH	% VOLATILE	% FIXED CARBON	BTU/LBS	% SULFUR
AS REC'D	1.94	10.56	XXXX	XXXX	10862	0.05
DRY BASIS	------	10.77	XXXX	XXXX	11077	0.05
M-A-FREE					12414	

ULTIMATE ANALYSIS

	% As Received	Dry Basis
Carbon	55.63	56.73
Hydrogen	8.27	8.43
Nitrogen	0.07	0.07
Ash	10.56	10.77
Sulfur	0.05	0.05
Oxygen	23.48	23.95
Moisture	1.94	
Chlorine	0.10	0.11

Respectfully Submitted

FORM # 21

LAB NO. 2014-667-20

DATE REC'D 06/25/14

DATE SAMPLED --------

SAMPLED BY CLIENT

STANDARD LABORATORIES, INC.

1530 N. Cullen Avenue
Evansville, IN 47715

MANITOWOC PUBLIC UTILITIES
P.O. BOX 1090
MANITOWOC, WI 54221

SAMPLE IDENTIFICATION

B8/B9 Coke and Charcoal Blend
06/19/14

DATE REPORTED: 07/18/14

	% MOISTURE	% ASH	% VOLATILE	% FIXED CARBON	BTU/LBS	% SULFUR
AS REC'D	0.52	0.57	XXXX	XXXX	14683	6.21
DRY BASIS	------	0.57	XXXX	XXXX	14760	6.24
M-A-FREE					14845	

ULTIMATE ANALYSIS

	% As Received	Dry Basis
Carbon	63.56	63.89
Hydrogen	3.70	3.72
Nitrogen	1.35	1.36
Ash	0.57	0.57
Sulfur	6.21	6.24
Oxygen	24.09	24.22
Moisture	0.52	
Chlorine	0.01	0.01

Respectfully Submitted

FORM # 21

MPU04113

LAB NO. 2014-667-17

DATE REC'D 06/25/14

DATE SAMPLED --------

SAMPLED BY CLIENT

STANDARD LABORATORIES, INC.

1530 N. Cullen Avenue
Evansville, IN 47715

MANITOWOC PUBLIC UTILITIES
P.O. BOX 1090
MANITOWOC, WI 54221

SAMPLE IDENTIFICATION

B8/B9 Coal
06/19/14

DATE REPORTED: 07/18/14

	% MOISTURE	% ASH	% VOLATILE	% FIXED CARBON	BTU/LBS	% SULFUR
AS REC'D	1.82	8.44	XXXX	XXXX	13064	1.23
DRY BASIS	------	8.60	XXXX	XXXX	13306	1.25
M-A-FREE					14558	

ULTIMATE ANALYSIS

	% As Received	Dry Basis
Carbon	70.59	71.90
Hydrogen	5.12	5.21
Nitrogen	1.58	1.61
Ash	8.44	8.60
Sulfur	1.23	1.25
Oxygen	11.22	11.43
Moisture	1.82	
Chlorine	0.03	0.03

Respectfully Submitted

FORM # 21

MPU04114

Calibration Data

Airtech Environmental Services, Inc.
Meter Box Full Test Calibration

Date: 6/10/2014

Operator: C.S

Meter Box ID M-30	Meter Box ΔH@	1.770	Meter Box Y_d	1.0024	Barometric Pressure (in. Hg.)	29.50

Time	Orifice Data				Meter Box Data								Results		
θ (min)	K'	Vacuum	T_{amb}	V_{cr}	$V_{initial}$	V_{final}	V_d	ΔH	T_i	T_o	T_{avg}	V_{mstd}	Q	Y_d	ΔH@
5.0	0.7936	17.0	76	5.056	811.60	816.90	5.30	3.20	103	86	94.5	5.014	1.011	1.0085	1.699
5.0	0.7936	17.0	76	5.056	816.90	822.22	5.32	3.20	104	87	95.5	5.023	1.011	1.0065	1.690
5.0	0.7936	17.0	76	5.056	822.22	827.54	5.32	3.20	105	87	96.0	5.019	1.011	1.0074	1.691
5.0	0.5783	20.0	77	3.681	842.15	846.09	3.94	1.80	103	93	98.0	3.691	0.736	0.9973	1.741
5.0	0.5783	20.0	77	3.681	846.09	850.01	3.92	1.80	104	93	98.5	3.669	0.736	1.0033	1.760
5.0	0.5783	20.0	77	3.681	850.01	853.96	3.95	1.80	104	94	99.0	3.694	0.736	0.9966	1.735
5.0	0.4458	22.0	77	2.838	864.60	867.62	3.02	1.1	102	95	98.5	2.822	0.568	1.0057	1.812
5.0	0.4458	22.0	77	2.838	867.62	870.65	3.03	1.1	102	95	98.5	2.831	0.568	1.0023	1.800
5.0	0.4458	22.0	77	2.838	870.65	873.70	3.05	1.1	102	95	98.5	2.850	0.568	0.9958	1.777
5.0	0.3456	23.0	78	2.198	881.05	883.40	2.35	0.68	103	97	100.0	2.187	0.440	1.0047	1.855
5.0	0.3456	23.0	78	2.198	883.40	885.75	2.35	0.68	103	97	100.0	2.187	0.440	1.0047	1.855
5.0	0.3456	23.0	78	2.198	885.75	888.12	2.37	0.68	103	97	100.0	2.206	0.440	0.9962	1.824
													Average	1.0024	1.770

Nomenclature	
K'	Critical Orifice Coefficient
T_{amb}	Ambient Temperature (°F)
V_{cr}	Volume Through Orifice (scf)
V_d	Gas Meter Volume (ft^3)
ΔH	Orifice Pressure Differential (in. H_2O)
T_i	Meter Inlet Temperature (°F)
T_o	Meter Outlet Temperauture (°F)
T_{avg}	Average Meter Box Temperature (°F)
V_{mstd}	Volume Metered Standardized (scf)
Q	Flow Rate (scfm)
Y_d	Meter Correction Factor (dimensionless)
ΔH@	ΔH yielding 0.75 scfm

Vacuum Guage (In. Hg.)		Thermometers (°F)			
Standard	Vacuum Gauge	Standard	Chatto. 1	Chatto. 2	Chatto. 3
5	5.0	32	32	32	32
10	10.0	50	50	50	50
15	15.0	100	100	100	100
20	20.0	150	150	150	150
25	25.0	212	212	212	212
		250	250	251	250
		300	300	301	300
		350	351	351	350
		400	400	401	401
		500	500	501	500
		600	600	601	601

Equations

$$V_{cr} = \frac{K' * P_b * \theta}{(T_{amb} + 460)\ \wedge\ 0.5}$$

$$V_{mstd} = \frac{17.64 * V_d * (P_b + (\Delta H/13.6))}{(T_{avg} + 460)}$$

$$Q = V_{cr} / \theta$$

$$Y_d = V_{cr} / V_{mstd}$$

$$\Delta H@ = \frac{.0319 * \Delta H * (T_{avg} + 460) * \theta\wedge 2}{P_b * Y_d\wedge 2 * V_m\wedge 2}$$

MPU04116

Airtech Environmental Services
Meter Post Calibration

Average Field Sample Rate (cfm)	1.000	Date	6/26/2014
Highest Field Vacuum (inches Hg)	8	Client	Manitowoc
Critical Orifice ID	BB-55	Project No.	4794
Orifice Flow Rate (cfm)	0.584	Meter ID	M-30

	Run 1	Run 2	Run 3
Initial Volume (ft^3)	525.50	528.42	531.36
Final Volume (ft^3)	528.42	531.36	534.29
Volume Metered (ft^3)	2.92	2.94	2.93
DGM Inlet Temperature (°F)	81	82	84
DGM Outlet Temperature (°F)	75	76	77
Average DGM Temperature (°F)	78.0	79.0	80.5
Ambient Temperature (°F)	74	74	74
Elapsed Time (min.)	5	5	5
ΔH (inches H_2O)	1.10	1.10	1.10
Barometric Pressure (inches Hg)	29.5	29.5	29.5
Pump Vacuum (inches Hg)	22	22	22
K'	0.4458	0.4458	0.4458
Vcr (ft^3)	2.846	2.846	2.846
Vmstd (ft^3)	2.832	2.846	2.829
Post Test Yc	1.0047	0.9998	1.0060
Full Test Yd	1.0024	1.0024	1.0024
% Difference	-0.23	0.26	-0.35
Average % Difference			-0.11

Airtech Environmental Services, Inc.
S-Type Pitot Tube Inspection Form

Date	February 26, 2014
Pitot ID	AE5-10-6
Operator	j burton

	Measured	Allowed
Outside Tube Diameter - Dt (inches)	0.251	NA
Base To Opening Distance - Pa (inches)	0.356	NA
Base To Opening Distance - Pb (inches)	0.356	NA
Pa/Dt	1.418	1.05-1.50
Pb/Dt	1.418	1.05-1.50
Angle, α1(°)	0.9	10
Angle, α2(°)	0.7	10
Angle, B1(°)	1	5
Angle, B2(°)	4	5
Opening to Opening Distance Pa+Pb (inches)	0.712	NA
Angle, Z (°)	1	NA
z (inches)	0.030	0.125
Angle, W (°)	0.4	NA
w (inches)	0.025	0.031

Note Any Damage, Nicks or Dents to the Pitot Tube

Is the Pitot Tube Part of an Assembly **YES**
If Yes, Complete the Section Below.

Pitot	Measured	Minimum
Distance From Nozzle,X (inches)	NA	0.75
Pitot to Thermocouple Distance,Y(inches)	2.5	≥ 2
Pitot to Sample Probe Distance,Y(inches)	5.75	3

Does the Pitot Tube Meet the Above Requirements **Yes**
Is the Pitot Tube Free of Damage **Yes**

If Yes to Both, a Pitot Tube Coefficient of 0.84 is Assigned
If No to Either, then the Pitot Tube Must be Calibrated

AIRTECH ENVIRONMENTAL SERVICES INC.

Nozzle Calibration Datasheet

Client	M.P.U.	Job No.	4794
Plant	Manitowoc, WI		

	M-5 Nozzle 1	M-201A/202 Nozzle 2	M-5/26A Nozzle 3
Date	06-16-14	06-17-14	06-18-14
Nozzle ID	.230	.175	.230
Operator	J.D.	J.D.	J.D.
Test Location	B09	B09	B09
Run Number (s)	1,2	1,2,3	1,2,3
Diameter 1	.231	.175	.231
Diameter 2	.229	.176	.229
Diameter 3	.230	.174	.230
Average	.230	.175	.230

	M-5/26A Nozzle 4	~~M-201A/202~~ M-26A Nozzle 5	M-201A/202 Nozzle 6
Date	06-18-14	06-18-14	06-19-14
Nozzle ID	.260	.270	.200
Operator	J.D.	J.D	J.D.
Test Location	B08	B08	B08
Run Number (s)	1,X	2	1,2,3
Diameter 1	.260	.269	.200
Diameter 2	.259	.271	.201
Diameter 3	.261	.270	.199
Average	.260	.270	.200

Notes:

Measurements must be made to the nearest 0.001 inches.

Three different diameters should be measured.

The difference between the high and low measurement must be less than 0.004 inches.

B09 – Signed [signature] Date 06-16-14

B08 – [signature] 06-18-14

Process Data

Boiler Stack Test Operating Data

Date:June 19, 2014	Boiler: B-28	Recorded by: Tom Reed and Adam Becker			
Test: PM (2.5) & Total	Run: No. 1	Testing by: Airtech Environmental Services, Inc.			
Methods: USEPA Methods 1, 2, 3, 4, 5, 202, 40CFR Part 60, Appendix A					
Parameter	**Start**	**60 min.**	**120 min.**	**Stop**	**AVG. Net**
Time	8:15	9:13	10:15	11:19	**3:04**
Coal Scale B (lbs.)	9074957			9109419	**34,462**
Paper Scale A (lbs.)	389336			423846	**34,510**
Pounds of Fuel Used					**68,972**
Pounds of fuel per hour					**22,491**
Limestone Scale (lbs)	211379	avg. lbs/hr =	3,398	221798	**10,419**
Steam integrator(Klbs)	855.30			1468.01	**612.71**
Limestone (Klbs/hr)	3.8	3.2	3.1	3.2	3.3
Steam Flow (Klbs/hr)	202.3	203.4	200.1	193.3	**199.8**
Percent of MCR	101%	102%	100%	97%	**100%**
Feeder B (Klbs/hour)	10.66	10.69	10.70	10.66	10.68
Feeder A (Klbs/hour)	10.80	10.72	10.63	10.74	10.72
Percent Bio (%)	49.7%	49.9%	50.2%	49.8%	**50.0%**
Feed Water (Klbs/hr)	189.1	190.5	189.9	182.4	188.0
Differential freeboard	6.62	7.05	6.62	7.23	6.88
Bed Temperature	1585	1595	1590	1587	1589
Bed Level	17.64	17.59	15.35	16.55	16.78
Total Air Flow (Klb/hr)	234.8	235.4	234.2	234.7	234.8
PA Air Flow (Klb/hr)	132	138	143	141	139
Overfire Air (Klbs/hr)	68.8	66.1	62.8	62.2	65.0
Bag house dp (inches)	4.61	4.96	4.80	4.92	4.82
Opacity (%)	3.86	3.84	4.27	4.05	4.01
Oxygen (%)	3.0	3.0	2.9	2.9	3.0
Net MW	19.38	19.41	19.28	19.26	19.33
Gross MWh Generation	70757.4			70825.2	**67.80**
Avg. Production MWh/hr					**22.11**
MPU Fireman:	Mike Powalisz				

NOTES: 1. Steam integrator value from Trend #5,(TST). B8 graphic is 8.

2. Bunker B is 82% coke/charcoal and 18% coal blend. Bunker A is paper pellets.

3. Turbine #5 online. B10 is OFF and B9 is providing steam sales with controlled extraction.

Boiler Stack Test Operating Data

Date:June 19, 2014	Boiler: B-28	Recorded by: Tom Reed and Adam Becker			
Test: PM (2.5) & Total	Run: No. 2	Testing by: Airtech Environmental Services, Inc.			
Methods: USEPA Methods 1, 2, 3, 4, 5, 202, 40CFR Part 60, Appendix A					
Parameter	**Start**	**60 min.**	**120 min.**	**Stop**	**AVG. Net**
Time	11:59	12:58	14:08	15:13	**3:14**
Coal Scale B (lbs.)	9117001			9153285	**36,284**
Paper Scale A (lbs.)	11431444			11467802	**36,358**
Pounds of Fuel Used					**72,642**
Pounds of fuel per hour					**22,467**
Limestone Scale (lbs)	3224017	avg. lbs/hr =	3,474	3235248	**11,231**
Steam integrator(Klbs)	1591.10			2240.48	**649.38**
Limestone (Klbs/hr)	3.7	3.5	3.7	4.0	3.7
Steam Flow (Klbs/hr)	198.3	197.3	200.6	207.7	**200.8**
Percent of MCR	99%	99%	100%	104%	**100%**
Feeder B (Klbs/hour)	10.69	10.69	10.68	10.70	10.69
Feeder A (Klbs/hour)	10.63	10.69	10.72	10.66	10.68
Percent Bio (%)	50.1%	50.0%	49.9%	50.1%	**50.1%**
Feed Water (Klbs/hr)	187.0	186.0	191.0	194.5	189.6
Differential freeboard	7.32	6.96	7.73	7.68	7.42
Bed Temperature	1589	1590	1598	1600	1594
Bed Level	16.91	17.10	14.79	16.51	16.33
Total Air Flow (Klb/hr)	231.7	227.8	229.1	237.8	231.6
PA Air Flow (Klb/hr)	130	134	128	132	131
Overfire Air (Klbs/hr)	66.3	67.0	71.7	68.9	68.5
Bag house dp (inches)	5.04	4.51	4.58	4.79	4.73
Opacity (%)	4.02	4.19	4.39	4.18	4.20
Oxygen (%)	3.0	2.9	3.4	2.9	3.1
Net MW	19.10	19.07	20.35	20.04	19.64
Gross MWh Generation	70839.9			70911.6	**71.70**
Avg. Production MWh/hr					**22.18**
MPU Fireman:	Mike Powalisz				

NOTES: 1. Steam integrator value from Trend #5,(TST). B8 graphic is 8.

2. Turbine #5 online. B10 is OFF and B9 is providing steam sales with controlled extraction.

Boiler Stack Test Operating Data

Date:June 19, 2014	Boiler: B-28	Recorded by: Tom Reed and Adam Becker				
Test: PM (2.5) & Total	Run: No. 3	Testing by: Airtech Environmental Services, Inc.				
Methods: USEPA Methods 1, 2, 3, 4, 5, 202, 40CFR Part 60, Appendix A						
Parameter	**Start**	**60 min.**	**120 min.**	**Stop**	**AVG.**	**Net**
Time	15:34	16:32	17:29	18:35		**3:01**
Coal Scale B (lbs.)	9157376			9191423		**34,047**
Paper Scale A (lbs.)	11471884			11505972		**34,088**
Pounds of Fuel Used						**68,135**
Pounds of fuel per hour						**22,586**
Limestone Scale (lbs)	3236607	avg. lbs/hr =	3,694	3247750		**11,143**
Steam integrator(Klbs)	2310.78			2928.50		**617.72**
Limestone (Klbs/hr)	3.3	3.8	4.3	3.0	3.6	
Steam Flow (Klbs/hr)	201.9	198.9	198.8	203.2		**204.8**
Percent of MCR	101%	99%	99%	102%		**102%**
Feeder B (Klbs/hour)	10.67	10.66	10.67	10.71	10.68	
Feeder A (Klbs/hour)	10.76	10.75	10.70	10.72	10.73	
Percent Bio (%)	49.8%	49.8%	49.9%	50.0%		**50.0%**
Feed Water (Klbs/hr)	189.5	190.1	188.2	191.7	189.9	
Differential freeboard	6.90	7.18	7.19	7.27	7.14	
Bed Temperature	1599	1602	16.08	1605	1206	
Bed Level	15.77	17.23	16.50	15.35	16.21	
Total Air Flow (Klb/hr)	240.6	234.3	242.8	241.6	239.8	
PA Air Flow (Klb/hr)	142	136	142	143	141	
Overfire Air (Klbs/hr)	66.6	75.6	70.2	70.4	70.7	
Bag house dp (inches)	4.91	4.80	5.08	5.18	4.99	
Opacity (%)	4.13	3.43	3.25	2.79	3.40	
Oxygen (%)	2.7	3.1	3.0	2.7	2.9	
Net MW	19.89	20.11	20.27	20.15	20.11	
Gross MWh Generation	70919.7			70988.2		**68.50**
Avg. Production MWh/hr						**22.71**
MPU Fireman:	Dan Biely					

NOTES: 1. Steam integrator value from Trend #5,(TST). B8 graphic is 8.

2. Turbine #5 online. B10 is OFF and B9 is providing steam sales with controlled extraction.

Boiler Stack Test Operating Data

Test: No. 1 | Run: No. 1, PM2.5 & Total PM

Date: June 17, 2014 Boiler: B09 | Recorded by: Tom Reed & Adam Becker | Testing by: AIRTECH Environmental Services

Parameter	Start	60-minutes	120-minutes	Stop	Avg.	Net
Time	10:59	11:59	13:02	14:11		**3:12**
Boiler Master (psig)	1,457.3	1,457.8	1,459.6	1,456.3	1,457.8	
Steam Flow (turbine) (Klbs/hr)	451	457	467	465	460.00	
Feed Water (Klbs/hr)	434	442	448	451	443.75	
Differential Freeboard	7.0	7.8	7.7	8.0	7.63	
Bed Depth	23.5	25.5	26	27.6	25.65	
Opacity (%)	2.31	2.23	2.89	2.7	2.53	
Furnace Pressure (in.)	-1.47	-1.41	-1.21	-1.02	-1.28	
Bed Temperature (F)	1,623	1,620	1,624	1,621	1,622	
PA Flow (Klbs/hr)	367	368	372	374	370	
SA Flow (Klbs/hr)	177.2	178.2	190.9	187.4	183.4	
Oxygen (%)	2.98	2.97	2.92	3.00	2.97	
MW output (MWh-gross)	58.28	58.53	59.57	58.52	58.73	
MW output (MWh-net)	53.87	54.05	55.01	53.99	54.23	
MW Totals (MWh)	3462.8	avg. MW/hr =	58.9	3651.3		**188.5**
Bag house (Dp "inches")	2.9	3.7	4.3	3.4	3.58	
Exit gas Temperature (F)	328	330	332	333	330.75	
Limestone Feed rate (Klbs/hr)	11.2	14.1	14.2	15.7	13.80	
Limestone Scale	711939	avg. lbs/hr =	13,704	755793		**43,854**
Fuel Master (Klbs/hr)	46.2	46.5	46.4	46.6	46.43	
Coal Scale (A..)	964090			1014351		**50,261**
Coal Scale (B.)	803780			853517		**49,737**
Coal Scale (C.)	162989			212357		**49,368**
Total Pounds Fuel			Fuel Rate =	46,677		**149,366**
BARI (Klbs/hr)	0	0	0	0		
Soot Blow start/stop						
Ammonia Flow	--	--	--	--	--	

NOTES: Fireman was Dan Biely, Use graphic #102 for data, the diesel and B10 were off. 60.8 % coke/charcoal blend plus 25% paper and 14.2% coal

Boiler Stack Test Operating Data

Test: No. 1 | Run: No. 2, PM2.5 & Total PM

Date: June 17, 2014 Boiler: B09 | Recorded by: Tom Reed & Adam Becker | Testing by: AIRTECH Environmental Services

Parameter	Start	60-minutes	120-minutes	Stop	Avg.	Net
Time	14:51	15:52	16:54	18:01		**3:10**
Boiler Master (psig)	1,454.3	1,456.8	1,456.4	1,453.4	1,455.2	
Steam Flow (turbine) (Klbs/hr)	456	456	453	455	455.00	
Feed Water (Klbs/hr)	435	437	432	437	435.25	
Differential Freeboard	8.0	8.0	8.3	8.3	8.13	
Bed Depth	27	27	29	27.75	27.69	
Opacity (%)	2.86	3.03	2.8	3.33	3.01	
Furnace Pressure (in.)	-1.44	-1.39	-1.25	-1.45	-1.38	
Bed Temperature (F)	1,613	1,612	1,608	1,604	1,609	
PA Flow (Klbs/hr)	379	374	375	370	375	
SA Flow (Klbs/hr)	174.2	177	171.9	160.7	171.0	
Oxygen (%)	3.23	3.08	3.14	3.14	3.15	
MW output (MWh-gross)	57.77	58.76	58.33	57.47	58.08	
MW output (MWh-net)	53.16	54.38	53.89	52.9	53.58	
MW Totals (MWh)	3693.5	avg. MW/hr =	57.8	3876.4		**182.9**
Bag house (Dp "inches")	3.9	4.3	4.7	3	3.98	
Exit gas Temperature (F)	335	323	323	324	326.25	
Limestone Feed rate (Klbs/hr)	13.1	13.7	13.2	12.7	13.18	
Limestone Scale	765854	avg. lbs/hr =	13,280	807908		**42,054**
Fuel Master (Klbs/hr)	47.1	46.7	46.9	46.8	46.88	
Coal Scale (A..)	25324			75399		**50,075**
Coal Scale (B.)	864385			913962		**49,577**
Coal Scale (C.)	223159			272393		**49,234**
Total Pounds Fuel			Fuel Rate =	47.017		**148,886**
BARI (Klbs/hr)	0	0	0	0		
Soot Blow start/stop	14:15			15:34		
Ammonia Flow	--	--	--	--	--	

NOTES: Fireman was Derrick Buchner, Use graphic #102 for data, the diesel and B10 were off. B9 providing extraction. Use trend 941 for soot Blower screen.

Boiler Stack Test Operating Data

Test: No. 1 | Run: No. 3, PM2.5 & Total PM

Date: June 17, 2014 Boiler: B09 | Recorded by: Tom Reed & Adam Becker | Testing by: AIRTECH Environmental Services

Parameter	Start	60-minutes	120-minutes	Stop	Avg.	Net
Time	18:44	19:41	20:41	21:52		3:08
Boiler Master (psig)	1,455.3	1,452.8	1,455.3	1,456.8	1,455.1	
Steam Flow (turbine) (Klbs/hr)	452	444	452	457	451.25	
Feed Water (Klbs/hr)	436	430	435	440	435.25	
Differential Freeboard	8.0	8.2	8.3	8.5	8.24	
Bed Depth	27	26	29	25.75	26.94	
Opacity (%)	2.89	2.8	3.19	3.13	3.00	
Furnace Pressure (in.)	-1.12	-1.61	-1.63	-1.44	-1.45	
Bed Temperature (F)	1,599	1,596	1,595	1,596	1,597	
PA Flow (Klbs/hr)	382	373	385	388	382	
SA Flow (Klbs/hr)	157.8	154.8	165.3	167.2	161.3	
Oxygen (%)	3.01	3.16	3.11	3.19	3.12	
MW output (MWh-gross)	57.65	57.2	57.9	58.76	57.88	
MW output (MWh-net)	53.3	52.82	53.55	54.33	53.50	
MW Totals (MWh)	43918.2	avg. MW/hr =	57.8	44099.2		181.0
Bag house (Dp "inches")	3.3	3.8	4.4	3.3	3.70	
Exit gas Temperature (F)	327	327	327	329	327.50	
Limestone Feed rate (Klbs/hr)	12.2	13	13.8	12.3	12.83	
Limestone Scale	816825	avg. lbs/hr =	12,910	857275		40,450
Fuel Master (Klbs/hr)	47.9	47.9	47.7	48.3	47.95	
Coal Scale (A..)	86904			137570		50,666
Coal Scale (B.)	925344			975470		50,126
Coal Scale (C.)	283726			333554		49,828
Total Pounds Fuel			Fuel Rate =	48,070		150,620
BARI (Klbs/hr)	0	0	0	0		
Soot Blow start/stop						
Ammonia Flow	--	--	--	--	--	

NOTES: Fireman was Derrick Buchner, Use graphic #102 for data, the diesel and B10 were off. B9 providing extraction.

End of Report