

TEST REPORT

PARTICULATE AND METALS EMISSION TEST

ROTARY FURNACE 1 NORTH BAGHOUSE (B) STACK

ROTARY FURNACE 2 SOUTH BAGHOUSE (A) STACK

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REPORT CERTIFICATION

STATEMENT OF CONFORMANCE AND TEST REPORT CERTIFICATION

I certify, to the best of my knowledge, that this test program was conducted in a manner conforming to the criteria set forth in ASTM D7036-04: Standard Practice for Competence of Air Emission Testing Bodies, and that project management and supervision of all project related activities were performed by qualified individuals as defined by this practice.

I further certify that this test report and all attachments were prepared under my direction or supervision in accordance with the ARI Environmental, Inc. quality management system designed to ensure that qualified personnel gathered and evaluated the test information submitted. Based on my inquiry of the person or persons who performed the sampling and analysis relating to this performance test, the information submitted in this test report is, to the best of my knowledge and belief, true, accurate, and complete.

A handwritten signature in black ink, appearing to read 'Larry Goldfine', is written over a horizontal line.

Larry Goldfine, QSTI
President
ARI Environmental, Inc.



SECTION ONE

Introduction and Summary

This report details the particulate matter (PM) and metals compliance emission test conducted by ARI Environmental, Inc. (ARI) at the H. Kramer & Company (H. Kramer) facility in Chicago, Illinois.

Testing was conducted to comply with the sampling requirements specified in H. Kramer's Consent Decree and Illinois Environmental Protection Agency (IEPA) Construction Permit No. 1111 045. Testing was conducted pursuant to a stack test protocol reviewed and approved by IEPA.

Three 3-hour test runs were performed on each baghouse stack for PM, metals and visible emissions (VE):

Test Dates	Source
9/17 & 9/18/13	New North Baghouse (B) Stack serving Rotary Furnace (RF) 1
9/19 & 9/20/13	New South Baghouse (A) Stack serving RF-2

Test methods followed those as detailed in the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, USEPA Methods 1-4, 5, 22 and 29; 40 CFR 51, Appendix M, USEPA Method 202; and the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods.

PM sampling was conducted in accordance with USEPA Method 5 for front-half filterable PM combined with back-half condensable PM in accordance with USEPA Method 202. The allowable PM concentration is 0.015 gr/dscf for both furnaces. There is also a PM emission limit of 3.77 lb/hr for RF-1 and 4.48 lb/hr for RF-2.

Metals sampling was conducted in a separate sampling train for the metals listed in USEPA Method 29 (except mercury). That list includes:

Antimony (Sb)	Cobalt (Co)	Phosphorus (P)
Arsenic (As)	Copper (Cu)	Selenium (Se)
Barium (Ba)	Lead (Pb)	Silver (Ag)
Beryllium (Be)	Manganese (Mn)	Thallium (Tl)
Cadmium (Cd)	Nickel (Ni)	Zinc (Zn)
Chromium (Cr)		

Testing was conducted by Messrs. Larry Goldfine, Rob Burton, Steve Flaherty, Jeff Goldfine and Tim Martch of ARI. Mr. Kailash Purohit of H. Kramer coordinated the process operations and collected process data. The test was witnessed by Mr. Kevin Mattison of the IEPA Compliance Section.

The average PM and lead test results are provided in Table 1-1. The results for the other metals tested are included in Section 4 of this report.

The Method 22 VE observations conducted during the first hour of each initial test run indicated no VE on either baghouse. The results are summarized in Table 1-2. The field data sheets for those observations are provided in Appendix A and Appendix B.



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SECTION ONE

Introduction and Summary

TABLE 1-1. SUMMARY OF AVERAGE PM AND LEAD TEST RESULTS

Process	Source	Test Dates	Particulate Matter		Lead	
			Conc. (gr/dscf)	Emission Rate (lb/hr)	Conc. (gr/dscf)	Emission Rate (lb/hr)
RF-1	North Baghouse	9/17/ & 9/18/13	0.0005	0.253	<0.000001	<0.00043
RF-2	South Baghouse	9/19 & 9/20/13	0.0007	0.351	<0.000003	<0.00157

TABLE 1-2. SUMMARY OF VISIBLE EMISSIONS TEST RESULTS

Process	Source	Test Date	Visible Emissions Duration
			Min:Sec
RF-1	North Baghouse	9/17/13	0:00
RF-2	South Baghouse	9/19/13	0:00



SECTION TWO

Testing and Analytical Procedures

2.1 OVERVIEW

Three 3-hour test runs were conducted on the North Baghouse controlling emissions from the RF-1 on September 17 and 18, 2013. Three 3-hour test runs were conducted on the South Baghouse controlling emissions from the RF-2 on September 19 and 20, 2013.

The purpose of the testing was to determine the concentrations and mass emission rates of PM, lead and other metals as well as VE.

2.2 METHODOLOGY

Test methods followed those as detailed in 40 CFR 60, Appendix A, USEPA Methods 1-4, 5, 22 and 29; 40 CFR 51, Appendix M, USEPA Method 202; and the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods.

2.2.1 Sampling and Velocity Traverse Locations (USEPA Method 1)

The velocity sampling points at each stack location listed below were determined following USEPA Method 1 procedures:

Source	Duct Diameter (inches)	No. of Ports	Port Location Downstream from Flow Disturbance (diameters)	Port Location Upstream from Flow Disturbance (diameters)	Sampling Points per Port	Total Points
North Baghouse & South Baghouse	59.5	2	4.8	1.7	12	24

A cyclonic flow check was conducted prior to the beginning of the test to demonstrate that cyclonic flow conditions did not exist at each sampling location.

2.2.2 Velocity and Volume Flow Rate Determination (USEPA Method 2)

Stack gas velocity and volume flow rate were determined following USEPA Method 2 procedures. Velocity traverses were performed using a Type-S pitot tube with the velocity head pressure measured on a Dwyer oil gauge inclined manometer to the nearest 0.01-in. H₂O. Temperature measurements were performed with a Chromel-Alumel thermocouple connected to a digital direct read-out potentiometer.

2.2.3 CO₂, O₂ and N₂ Concentration and Molecular Weight (USEPA Method 3)

The stack gas molecular weight was determined following USEPA Method 3. Gas samples were collected in 16-liter Tedlar bags using ARI's integrated bag collection system and analyzed for carbon dioxide (CO₂), oxygen (O₂) and nitrogen (N₂) (by difference) using a Hays Orsat type analyzer.



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2.2.4 Flue Gas Moisture Content (USEPA Method 4)

The stack gas moisture content was determined following USEPA Method 4. This method was performed as part of the USEPA Methods 5/202 and 29 sample trains. Moisture was collected in a series of chilled impingers containing methodology-specific liquids and silica gel. The volume gain in the water impingers and weight gain in the silica gel impinger were used to calculate the moisture content. The psychrometric equations in the method were used to calculate the moisture content in percent by volume.

2.2.5 PM Determination (USEPA Methods 5 and 202)

Sampling was conducted in accordance with USEPA Methods 5 and 202 using an Apex Instruments, Inc. PM sampling train (see Figure 2-1). The front-half probe and filter assemblies were analyzed for filterable PM using USEPA Method 5. All filterable PM was assumed to be <PM₁₀. The back-half impinger catch was analyzed for condensable PM in accordance with USEPA Method 202 procedures.

2.2.5.1 Sampling Apparatus

Assembled by ARI personnel, the sampling train consisted of the following:

Nozzle - Borosilicate glass with sharp, tapered leading edge.

Probe - Borosilicate glass with a heating system capable of maintaining a probe exit temperature of 248°F ±25°F.

Pitot Tube - Type-S, attached to probe for monitoring stack gas velocity.

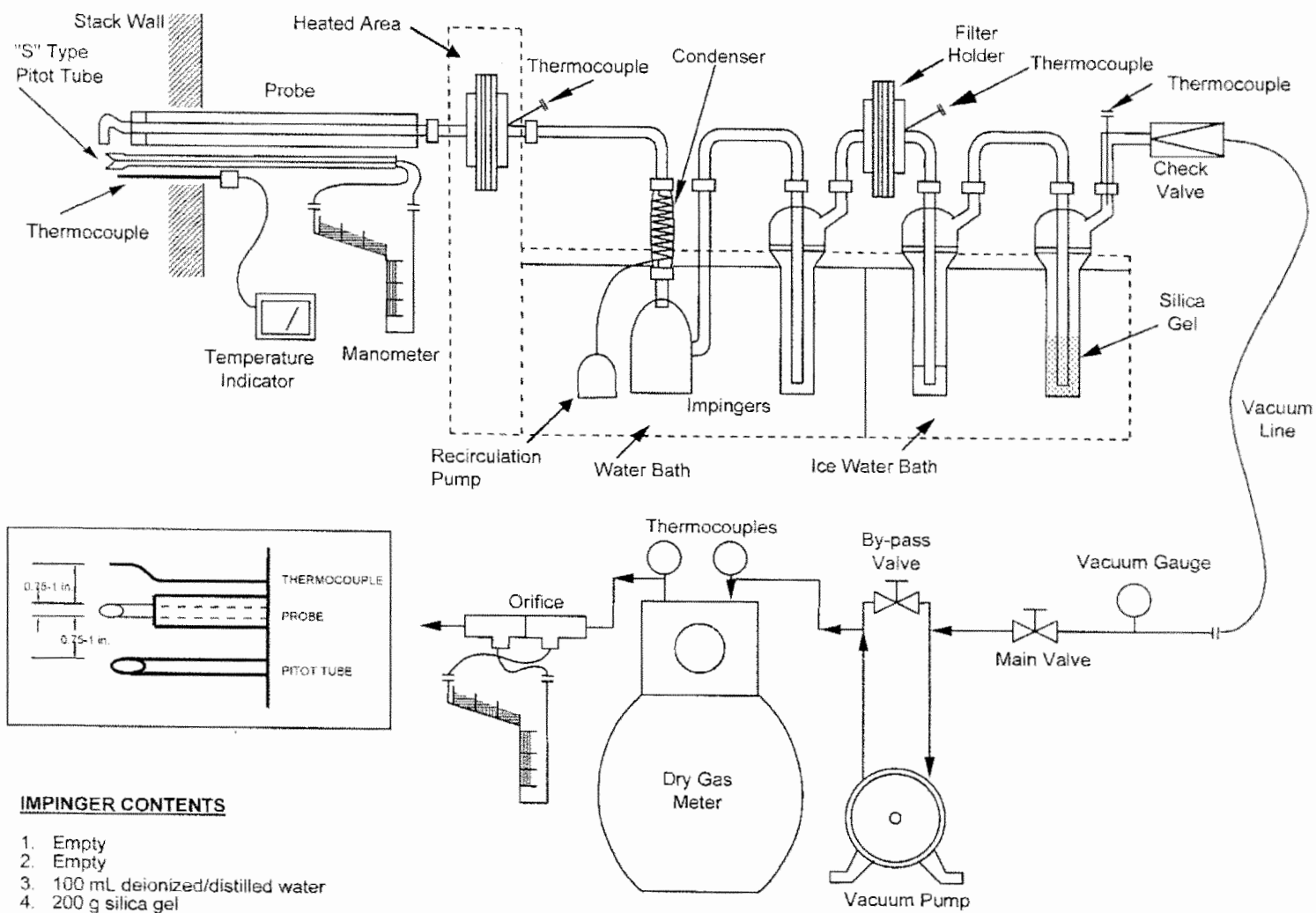
Heated Filter Holder - Borosilicate glass with a 4-in. Teflon frit filter support and a silicone rubber gasket. The holder design provided a positive seal against leakage from the outside or around the filter. The filter holder was heated to 248°F ±25°F during sampling. A thermocouple was placed in the back-half of the filter support in direct contact with the sample stream. A quartz fiber filter that met the requirements of USEPA Method 5 was used.

Ambient Filter Holder - Unheated borosilicate glass with a 3-in. Teflon frit filter support and a silicone rubber gasket. A thermocouple was placed in the back-half of the filter holder to measure sample gas temperature by direct contact with the sample stream. Temperature was maintained between 65 and 85°F. A Teflon filter disc was placed in the filter holder.

Draft Gauge - Inclined manometer with a readability of 0.01-in. H₂O in the 0 to 10-in. range.

Condenser - Glass, coil type with compatible fittings.

840-18



IMPINGER CONTENTS

1. Empty
2. Empty
3. 100 mL deionized/distilled water
4. 200 g silica gel

FIGURE 2-1. USEPA METHODS 5/202 PARTICULATE MATTER SAMPLING TRAIN

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Impingers – Four (4) impingers connected in series with glass ball joints. The first impinger was a custom glass jar designed with a shortened stem to act as a moisture knockout and allowed the condenser coil to set atop the inlet in a vertical position. The second, third and fourth impingers were of the Greenburg-Smith design, but modified by replacing the standard tip with a ½-in. i.d. glass tube extending to within ½-in. of the bottom of the impinger flask. The second and third impingers were connected using the ambient filter holder.

Metering System - Apex Model 522. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with ±2 percent accuracy and related equipment as required to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Mercury barometer capable of measuring atmospheric pressure to within ±0.1-in. Hg.

2.2.5.2 Sampling Procedures

After the minimum number of traverse points was selected, the stack pressure, temperature, moisture and range of velocity head were measured according to procedures described in USEPA Methods 1 through 4. The first and second impingers were initially empty. The third impinger contained 100 milliliters (mL) of deionized/distilled water. The fourth impinger contained 200 grams of silica gel.

The impingers were placed in a container that had two compartments. The first two impingers were placed in the first compartment, and the third and fourth impingers were placed in the second compartment. The first compartment contained water that was circulated through the condenser to reduce the sample gas to between 65 and 85°F at the exit of the ambient filter. The second compartment contained ice water to reduce the sample gas to ≤68°F upon exiting the last impinger. Both temperatures were recorded at each traverse point interval throughout each test run.

The sampling train was leak-checked at the sampling site by plugging the inlet to the nozzle and pulling a vacuum of 15-in. Hg. A leak rate of less than 0.02 ft³/min at a vacuum of 15-in. Hg was considered acceptable. At the completion of each test run (and at the mid-way point through the test), the sampling train was again leak-checked by the same procedure, but at the highest vacuum attained during the test run. Both pre and post-test leak checks of the pitot tube were made for each test run. Ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at less than 68°F.

During sampling, stack gas and sampling train data were recorded at specified intervals. Isokinetic sampling rates were set throughout the sampling period with the aid of a programmable calculator.



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2.2.5.3 Sample Recovery Procedures

After sampling was completed, a post-test nitrogen purge was conducted with the impingers still on ice at the meter $\Delta H@$ for 60 minutes. Before the purge step began, the short stem of the first impinger was replaced with a long stem that was within 1/2-inch of the bottom of the impinger. If the stem did not extend below the water level in the impinger by 1 cm, a measured amount of degassed, deionized, distilled water was added to adjust the level.

Method 5

The sample fractions were recovered as follows:

Container 1 - The heated filter was removed from the holder and placed in a petri dish.

Container 2 - Loose PM and acetone washings from all sample-exposed surfaces prior to the filter were placed in a glass bottle, sealed and labeled. PM was removed from the probe with the aid of a brush and acetone rinsing. The liquid level was marked after the container was sealed.

Container 3 - 150 mL of acetone was taken for blank analysis. The blank was obtained and treated in a similar manner as the contents of Container 2.

Method 202

The sample fractions were recovered as follows:

Container 4 - The contents from the first two impingers were placed into a glass container. The impingers (including the short stem), connecting glassware and front-half of the ambient filter holder were quantitatively rinsed twice with distilled/deionized water, and the rinse was added to this container. The liquid level was marked after the container was sealed.

Container 5 - The first two impingers (including the short stem), connecting glassware and front-half of the ambient filter holder were rinsed with acetone, followed by two rinses with hexane, and placed in a glass container. The liquid level was marked after the container was sealed.

Container 6 - The ambient filter was removed and placed in a petri dish.

Containers 7 & 8 - 150 mL of distilled/deionized water and hexane were taken for blank analysis. The blanks were obtained and treated in a similar manner as the contents of Containers 4 and 5.

The contents of the third impinger were weighed and discarded. The contents of the fourth impinger (silica gel) were weighed to the nearest gram.

2.2.5.4 Analytical Procedures

Method 5

The analytical procedures followed those described in USEPA Method 5.



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Container 1 - The filter and any loose PM from this sample container were placed in a tared glass weighing dish, dried at 105°C for 3 hours, desiccated for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

Container 2 - The acetone washings were transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure. Then the contents were placed in a dessicator for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

Container 3 - The acetone blank was transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure. The contents were then desiccated for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

Method 202

The analytical procedures followed those described in USEPA Method 202.

Container 4 - The liquid in this container was measured volumetrically and placed into a separatory funnel. Approximately 30 mL of hexane was added, mixed well and the lower organic phase drained off. This procedure was repeated twice, leaving a small amount of the organic/hexane phase in the separatory funnel each time to yield approximately 90 mL of organic extract. This organic extract was combined with Container 5. The aqueous fraction from Container 4 was transferred to a tared beaker and evaporated in an oven at 105°C to no less than 10 mL and allowed to air dry at ambient temperature. If a dried constant weight could not be achieved, the residue was redissolved in 100 mL of water and titrated with 0.1N ammonium hydroxide to a pH of 7.0. The aqueous phase was evaporated in an oven at 105°C to approximately 10 mL, transferred to a pre-weighed tin, evaporated to dryness in a fume hood at ambient temperature and pressure, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg. The gain in mass represents the inorganic PM collected in the sampling train back-half.

Container 5 - The contents of this container were combined with the organic extract from Container 4, placed in a tared beaker and evaporated at ambient temperature and pressure in a fume hood to no less than 10 mL. The beaker contents were then transferred to a pre-weighed tin, evaporated to dryness at ambient temperature and pressure in a fume hood, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg. The gain in mass represents the organic PM collected in the sampling train back-half.

Container 6 - The ambient filter was folded in quarters and placed into a 50 mL extraction tube. Sufficient deionized/distilled water was used to cover the filter. The extraction tube was placed in a sonication bath and the water soluble material was extracted for a minimum of 2 minutes. The aqueous extract was combined with the contents of Container 4. This step was completed a total of three times. After completion of the aqueous extraction, the filter was covered with a sufficient amount of hexane. The extraction tube was placed in a sonication bath, and the organic material was extracted for a minimum of 2 minutes. The organic extract was combined with the contents of Container 5. This step was completed a total of three times. The procedures for Container 6 were completed prior to any procedures for Containers 4 and 5.



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Container 7 - The water blank was transferred to a tared beaker and evaporated to approximately 10 mL in an oven at 105°C, transferred to a pre-weighed tin, evaporated to dryness at ambient temperature and pressure in a fume hood, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

Container 8 - The hexane blank was transferred to a tared beaker, evaporated to approximately 10 mL at ambient temperature and pressure in a fume hood, transferred to a pre-weighed tin, evaporated to dryness at ambient temperature and pressure in a fume hood, placed in a desiccator for 24 hours and weighed to a constant weight to the nearest 0.1 mg.

The term "constant weight" means a difference of no more than 0.5 mg or 1 percent of the total weight less tare weight, whichever is greater between two consecutive readings, with no less than 6 hours of desiccation between weighings.

2.2.6 Visible Emissions Measurements (USEPA Method 22)

The determination of compliance with the VE requirements for this test was conducted following the procedures described in 40 CFR 60, Appendix A, USEPA Method 22, Visible Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares.

Each stack was visually observed for a period of 60 minutes during the first sampling run on each baghouse stack, with a 5-minute rest period between each 20 minutes of observation. Observation periods and emission durations were recorded by employing two stopwatches. The first stopwatch was started and stopped during each observation period. The second stopwatch was available to record the cumulative emissions during each test if they were to occur. The sum of the timed emissions was the basis for compliance determination. No visible emissions were observed on either stack during the test.

2.2.7 Metals Determination (USEPA Method 29)

Sampling and analysis for the following metals were performed in accordance with USEPA Method 29 using an Apex Instruments, Inc. sampling train:

Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)
Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)
Lead (Pb)	Manganese (Mn)	Nickel (Ni)	Phosphorus (P)
Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)

As shown in Figure 2-2, the samples were withdrawn from the exhaust stack and collected in a heated sample probe, heated filter (front-half catch) and a series of ice cooled impingers containing an acid/peroxide solution (back-half catch).

2.2.7.1 Sampling Apparatus

Assembled by ARI personnel, the sampling train consisted of the following:

Nozzle - Borosilicate glass with sharp, tapered leading edge.

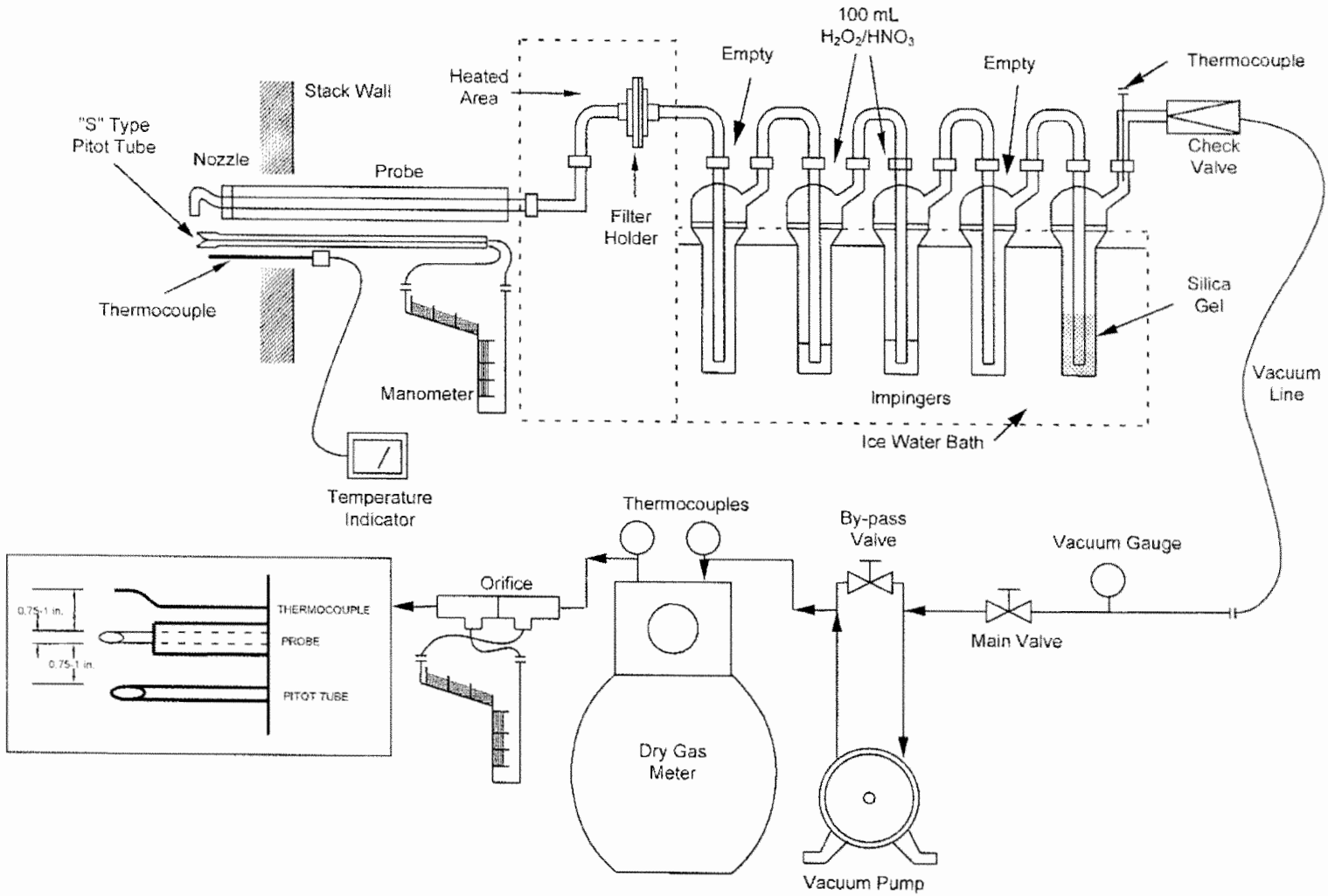


FIGURE 2-2. USEPA METHOD 29 SAMPLING TRAIN



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Probe - Borosilicate glass with a heating system capable of maintaining a probe exit temperature of 248°F ±25°F.

Pitot Tube - Type-S, attached to probe for monitoring stack gas velocity.

Filter Media - 4-in. quartz-fiber filter that met the requirements of Method 29.

Filter Holder - Borosilicate glass with a 4-in. Teflon frit filter support and a Viton O-ring gasket. The holder design provided a positive seal against leakage from the outside or around the filter. The filter holder was heated to 248°F ±25°F during sampling. A thermocouple was placed in the back-half of the filter holder for direct measurement of the sample stream temperature.

Draft Gauge - Inclined manometer with a readability of 0.01-in. H₂O in the 0 to 1-in. range and 0.1-in. H₂O in the 1 to 10-in. range.

Impingers - Five impingers connected in series with glass ball joints. The first impinger was empty with a shortened stem, the second and third impingers contained 100 mL of dilute nitric acid/hydrogen peroxide mixture, the fourth impinger was empty and the fifth impinger contained approximately 200 grams of silica gel.

Metering System - Apex Model 522. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with ±2 percent accuracy and related equipment as required to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Mercury barometer capable of measuring atmospheric pressure to within ±0.1-in. Hg.

2.2.7.2 Sampling Procedures

After the minimum number of traverse points was selected, the stack pressure, temperature, moisture and range of velocity head was measured according to procedures described in USEPA Methods 1 through 4.

The sampling train was leak-checked at the sampling site by plugging the inlet to the nozzle and pulling a vacuum of 15-in. Hg. A leak rate of less than 0.02 ft³/min at a vacuum of 15-in. Hg. was considered acceptable. At the completion of each test run, the sampling train was again leak-checked by the same procedure, but at the highest vacuum attained during the test run. Both pre and post-test leak checks of the pitot tube were made for each test run. Ice was placed around the impingers to keep the temperature of the gases leaving the last impinger at less than 68°F.

During sampling, stack gas and sampling train data were recorded at specified intervals. Isokinetic sampling rates were set throughout the sampling period with the aid of a programmable calculator.



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2.2.7.3 Sample Recovery Procedures

After sampling was completed and the final leak checks were performed, the sampling train was moved carefully from the test site to the recovery area.

The sample fractions were recovered as follows:

Container 1 - The filter was removed from the filter holder, placed in a clean petri dish and labeled.

Container 2 - A brush and acetone were used to clean the probe and other fittings as required. The washings from the inner surfaces of the nozzle and upstream portions of the filter holder were collected in a bottle and labeled.

Container 3 - A brush and 0.1N nitric acid (HNO_3) were used to rinse the probe and other fittings as required. The washings from the inner surfaces of the nozzle and upstream portions of the filter holder were collected in a bottle and labeled. The liquid level was marked after the container was sealed.

Container 4 - The contents of impingers 1, 2 and 3 were placed in a graduated cylinder to measure the total volume collected then rinsed with 0.1N HNO_3 , transferred to a bottle and labeled. The contents of impinger 4 were placed in a graduated cylinder to measure the total volume.

Container 5 - The contents of impinger 5 were transferred to a clean bottle and labeled. The weight of the silica gel was then determined. The difference between this final weight and the initial weight was the total moisture collected by the silica gel.

2.2.7.4 Analytical Procedures

Containers 1 through 4 and associated blanks were transported to DAT Labs in Plain City, Ohio and analyzed for metals by inductively coupled argon plasma (ICAP) in accordance with USEPA Method 29. Two audit samples (one filter and one back-half catch) were also analyzed for the Method 29 metals.

2.3 EMISSION RATE DETERMINATION

The PM emission rate (lb/hr) (front and back half) was calculated for each run by multiplying the measured PM concentration (lb/dscf) for each fraction by the respective volumetric flow rate (dscfh). The metals emission rate (lb/hr) was calculated for each of the speciated metals by multiplying the measured metals concentration for each speciated metal (lb/dscf) by the respective stack gas volumetric flow rate (dscfh).



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2.4 STATIONARY SOURCE AUDIT SAMPLE PROGRAM (SSASP)

The stationary source audit sample program (SSASP) was developed by The NELAC Institute (TNI) and is implemented by USEPA. SSASP audit samples are currently required for specific USEPA reference methods (including USEPA Method 29) for stationary source tests performed to establish degree of compliance with regulatory performance standards. Therefore, USEPA Method 29 metals audit samples (one filter and one impinger solution audit sample) were obtained from an EPA certified audit sample provider (ERA). Since lead is the primary metal of interest, the target concentration in the audit samples was estimated based on the general lead concentration obtained during the previous 2011 stack test on the two furnaces. Because the new baghouses have secondary HEPA filters, the target concentration was based on ~10% of the lead concentration measured during that test. The other metals contained in the audit samples had similar concentration values to the lead. The audit results are provided in Appendix C of this report.



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SECTION THREE

Process Description

H. Kramer operates one (1) 30-ton rotary furnace and one (1) 60-ton rotary furnace.

Two new baghouses with HEPA filters were installed to control emissions from the Rotary 1 furnace (North Baghouse [B]) and Rotary 2 furnace (South Baghouse [A]).

The following production data was provided by Randy Weil, Executive Vice President, H. Kramer & Co. for the test program:

Start Date Time	End Date Time	Furnace No.	Batch	Avg. lb. Charged 24 hr. Cycle	Avg. lb. Charged for Hours Charged	Avg. lb. Poured for Hours Poured	Test Runs
9/16/13 16:15	9/17/13 13:00	RF-1	R7149	3,368	10,430	16,625	North BH 1 & 2
9/17/13 13:20	9/18/13 12:00	RF-1	R7150	3,745	8,170	21,310	North BH 2 & 3
9/18/13 20:00	9/19/13 15:35	RF-2	K4032	5,349	16,565	26,320	South BH 1 & 2
9/19/13 16:10	9/20/13 14:20	RF-2	K4033	4,759	24,460	24,165	South BH 3

Furnace temperatures were held steady from tap-out time throughout pouring cycle:

Small Rotary (RF-1) 1,960°F +/- 10°F
 Large Rotary (RF-2) 1,980°F +/- 15°F

Baghouse / Furnace	Average Baghouse Inlet Temperature			Average Amperage		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
North / RF-1	113	137	135	295	286	283
South / RF-2	155	143	162	268	270	261

	Average Baghouse Pressure Drop, in. H ₂ O					
	North BH			South BH		
	DC3	DC4	NAF	DC1	DC2	NAF
Run 1	5.26	0.0	1.81	0.0	5.87	1.03
Run 2	5.31	0.0	1.84	0.0	5.39	1.04
Run 3	5.27	0.0	1.83	0.0	7.25	1.04

All DP measurements are before and after the filter media. For the DC readings, before is in the mid-section below the tube-sheet, after is in the upper section after the tube-sheet. For the NAF readings, before is in the roof before the filters, after is in the roof after the filters.

During testing, no unusual circumstances were experienced. The furnaces and baghouses operated as expected without incident. Additional production data for the sources tested during this program are presented in Appendix D.



SECTIONFOUR

Test Results

The test results for the North Baghouse serving RF-1 are summarized in Tables 4-1 and 4-2.

The test results for the South Baghouse serving RF-2 are provided in Tables 4-3 and 4-4.

The results indicate that the measured PM (filterable plus condensable) concentrations were less than 10% of the 0.015 gr/dscf limit specified in in the permit. The North Baghouse average PM emission rate of 0.25 lb/hr was well under the allowable limit of 3.77 lb/hr. The South Baghouse average PM emission rate of 0.35 lb/hr was well under the allowable limit of 4.48 lb/hr.

The measured lead concentrations were also very low. For comparison purposes, the results were less than 1% of the proposed 226.14 (b) lead concentration standard for rotary furnaces of 0.0001 gr/dscf.

The calculation summaries, field data, laboratory data, production data, test equipment calibration data and test program qualifications are included in the appendices as detailed in the Table of Contents.



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SECTION FOUR

Test Results

**TABLE 4-1. SUMMARY OF PM TEST RESULTS –
 NORTH BAGHOUSE SERVING ROTARY FURNACE 1**

RUN NO. :	1	2	3	
TEST DATE :	9/17/13	9/17/13	9/18/13	
TEST TIME :	08:15 – 11:32	12:35 – 15:43	07:40 – 10:48	<u>Average</u>
<u>Stack Gas Parameters</u>				
Temperature, °F	111.6	132.5	130.3	124.8
Velocity, av. ft/sec	57.6	58.0	58.3	58.0
Volumetric flow, acfm	66,771	67,142	67,510	67,141
Volumetric flow, scfm	60,922	59,119	59,351	59,797
Volumetric flow, dscfh	3,624,402	3,479,681	3,493,963	3,532,682
Moisture, av. % vol.	0.9	1.9	1.9	1.5
Carbon Dioxide, av. % vol.	0.2	0.3	0.4	0.3
Oxygen, av. % vol.	20.6	20.6	20.4	20.5
<u>Sample</u>				
Time, min.	180	180	180	
Volume, dscf	107.102	110.678	107.094	
Total PM collected, mg	4.22	2.65	3.61	
Filterable PM collected, mg	1.92	0.25	1.11	
Condensable PM collected, mg*	2.30	2.40	2.50	
Isokinetic ratio, %	98.7	106.2	102.3	
<u>Filterable Particulate Matter</u>				
Concentration				
grains/dscf	0.00028	0.00003	0.00016	0.00016
x 10 ⁻⁶ lb/dscf	0.0395	0.0050	0.0229	0.0225
Emission rate				
lb/hr	0.1432	0.0173	0.0798	0.0801
<u>Condensable Particulate Matter</u>				
Concentration				
grains/dscf	0.00033	0.00033	0.00036	0.00034
x 10 ⁻⁶ lb/dscf	0.0474	0.0478	0.0515	0.0489
Emission rate				
lb/hr	0.1716	0.1663	0.1798	0.1726
<u>Total Particulate Matter</u>				
Concentration				
grains/dscf	0.00061	0.00037	0.00052	0.00050
x 10 ⁻⁶ lb/dscf	0.0869	0.0528	0.0743	0.0713
Emission rate				
lb/hr	0.3148	0.1837	0.2596	0.2527
<u>Visible Emissions, min:sec</u>	0.00			

*Corrected for blank



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SECTION FOUR

Test Results

**TABLE 4-2. SUMMARY OF METALS TEST RESULTS –
 NORTH BAGHOUSE SERVING ROTARY FURNACE 1**

RUN NO. :	1	2	3	
TEST DATE :	9/17/13	9/17/13	9/18/13	
TEST TIME :	08:15 – 11:32	12:35 – 15:43	07:40 – 10:48	Average
Stack Gas Parameters				
Temperature, °F	114.0	135.8	133.7	124.9
Velocity, av. ft/sec	55.6	56.6	57.8	56.1
Volumetric flow, acfm	64,445	65,529	66,993	64,987
Volumetric flow, scfm	58,547	57,355	58,562	57,951
Volumetric flow, dscfh	3,463,629	3,392,104	3,455,392	3,427,866
Moisture, av. % vol.	1.4	1.4	1.7	1.4
Carbon Dioxide, av. % vol.	0.2	0.3	0.4	0.3
Oxygen, av. % vol.	20.6	20.6	20.4	20.6
Sample				
Time, min.	180	180	180	
Volume, dscf	99.400	100.595	103.733	
Antimony (Sb)				
Concentration mg/dscm	<0.00111	<0.00088	<0.00268	<0.00156
Emission rate lb/hr	<0.000240	<0.000186	<0.000579	<0.000335
Arsenic (As)				
Concentration mg/dscm	<0.00089	<0.00088	<0.00085	<0.00087
Emission rate lb/hr	<0.000192	<0.000186	<0.000184	<0.000187
Barium (Ba)				
Concentration mg/dscm	<0.00178	<0.00505	<0.00170	<0.00284
Emission rate lb/hr	<0.000384	<0.001070	<0.000367	<0.000607
Beryllium (Be)				
Concentration mg/dscm	<0.00004	<0.00004	<0.00004	<0.00004
Emission rate lb/hr	<0.000009	<0.000009	<0.000009	<0.000009
Cadmium (Cd)				
Concentration mg/dscm	<0.00045	<0.00044	<0.00043	<0.00044
Emission rate lb/hr	<0.000097	<0.000094	<0.000093	<0.000094
Chromium (Cr)				
Concentration mg/dscm	0.00176	<0.00119	0.00191	<0.00162
Emission rate lb/hr	0.000380	<0.000251	0.000413	<0.000348



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SECTION FOUR

Test Results

**TABLE 4-2 (CONTINUED). SUMMARY OF METALS TEST RESULTS –
 NORTH BAGHOUSE SERVING ROTARY FURNACE 1**

RUN NO. :	1	2	3	
TEST DATE :	9/17/13	9/17/13	9/18/13	Average
TEST TIME :	08:15 – 11:32	12:35 – 15:43	07:40 – 10:48	
<u>Cobalt (Co)</u>				
Concentration				
mg/dscm	<0.00045	<0.00044	<0.00043	<0.00044
Emission rate				
lb/hr	<0.000097	<0.000094	<0.000093	<0.000094
<u>Copper (Cu)</u>				
Concentration				
mg/dscm	<0.00117	0.00191	<0.00135	<0.00148
Emission rate				
lb/hr	<0.000252	0.000405	<0.000292	<0.000317
<u>Lead (Pb)</u>				
Concentration				
gr/dscf	<0.0000010	<0.0000004	0.0000013	<0.0000009
mg/dscm	<0.00225	<0.00088	0.00288	<0.00200
Emission rate				
lb/hr	<0.000487	<0.000186	0.000621	<0.000431
<u>Manganese (Mn)</u>				
Concentration				
mg/dscm	<0.00071	0.00066	<0.00074	<0.00070
Emission rate				
lb/hr	<0.000156	0.000140	<0.000159	<0.000151
<u>Nickel (Ni)</u>				
Concentration				
mg/dscm	0.00154	0.00153	0.00167	0.00158
Emission rate				
lb/hr	0.000333	0.000325	0.000360	0.000339
<u>Phosphorus (P)</u>				
Concentration				
mg/dscm	0.16013	0.17024	0.14727	0.15921
Emission rate				
lb/hr	0.034634	0.036062	0.031778	0.034158
<u>Selenium (Se)</u>				
Concentration				
mg/dscm	<0.00488	<0.00088	<0.00417	<0.00331
Emission rate				
lb/hr	<0.001055	<0.000186	<0.000899	<0.000713
<u>Silver (Ag)</u>				
Concentration				
mg/dscm	<0.00045	<0.00044	<0.00047	<0.00045
Emission rate				
lb/hr	<0.000097	<0.000094	<0.000101	<0.000097



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SECTIONFOUR

Test Results

**TABLE 4-2 (CONTINUED). SUMMARY OF METALS TEST RESULTS –
 NORTH BAGHOUSE SERVING ROTARY FURNACE 1**

RUN NO.	1	2	3	
TEST DATE	9/17/13	9/17/13	9/18/13	Average
TEST TIME	08:15 – 11:32	12:35 – 15:43	07:40 – 10:48	
<u>Thallium (Tl)</u>				
Concentration				
mg/dscm	<0.00089	<0.00088	<0.00085	<0.00087
Emission rate				
lb/hr	<0.000192	<0.000186	<0.000184	<0.000187
<u>Zinc (Zn)</u>				
Concentration				
mg/dscm	0.01084	0.00870	0.00835	0.00930
Emission rate				
lb/hr	0.002344	0.001842	0.001802	0.001996



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SECTION FOUR

Test Results

**TABLE 4-3. SUMMARY OF PM TEST RESULTS –
 SOUTH BAGHOUSE SERVING ROTARY FURNACE 2**

RUN NO. :	1	2	3	
TEST DATE :	9/19/13	9/19/13	9/20/13	
TEST TIME :	08:07 – 11:14	12:05 – 15:15	07:30 – 10:40	Average
Stack Gas Parameters				
Temperature, °F	145.7	137.8	150.3	144.6
Velocity, av. ft/sec	58.5	59.9	56.7	58.4
Volumetric flow, acfm	67,762	69,429	65,717	67,636
Volumetric flow, scfm	57,981	60,190	56,208	58,126
Volumetric flow, dscfh	3,392,407	3,437,048	3,283,285	3,370,913
Moisture, av. % vol.	2.5	4.8	2.6	3.3
Carbon Dioxide, av. % vol.	0.3	0.4	0.2	0.3
Oxygen, av. % vol.	20.5	20.4	20.7	20.5
Sample				
Time, min.	180	180	180	
Volume, dscf	104.382	107.350	99.989	
Total PM collected, mg	3.33	6.02	5.36	
Filterable PM collected, mg	1.33	0.92	1.16	
Condensable PM collected, mg*	2.00	5.10	4.20	
Isokinetic ratio, %	102.7	104.3	101.7	
Filterable Particulate Matter				
Concentration				
grains/dscf	0.00020	0.00013	0.00018	0.00017
x 10 ⁻⁶ lb/dscf	0.0281	0.0189	0.0256	0.0242
Emission rate				
lb/hr	0.0953	0.0649	0.0840	0.0814
Condensable Particulate Matter				
Concentration				
grains/dscf	0.00030	0.00073	0.00065	0.00056
x 10 ⁻⁶ lb/dscf	0.0422	0.1048	0.0926	0.0799
Emission rate				
lb/hr	0.1433	0.3599	0.3040	0.2691
Total Particulate Matter				
Concentration				
grains/dscf	0.00049	0.00087	0.00083	0.00073
x 10 ⁻⁶ lb/dscf	0.0703	0.1237	0.1182	0.1041
Emission rate				
lb/hr	0.2386	0.4249	0.3880	0.3505
Visible Emissions, min:sec	0:00			

*Corrected for blank



H. Kramer & Company: Chicago, IL
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SECTION FOUR

Test Results

**TABLE 4-4. SUMMARY OF METALS TEST RESULTS –
 SOUTH BAGHOUSE SERVING ROTARY FURNACE 2**

RUN NO. :	1	2	3	
TEST DATE :	9/19/13	9/19/13	9/20/13	
TEST TIME :	08:07 – 11:14	12:05 – 15:15	07:30 – 10:40	Average
<u>Stack Gas Parameters</u>				
Temperature, °F	149.8	141.5	155.0	145.6
Velocity, av. ft/sec	58.8	59.9	55.3	59.4
Volumetric flow, acfm	68,126	69,403	64,040	68,765
Volumetric flow, scfm	57,906	59,805	54,346	58,855
Volumetric flow, dscfh	3,376,899	3,411,128	3,164,613	3,394,014
Moisture, av. % vol.	2.8	4.9	2.9	3.9
Carbon Dioxide, av. % vol.	0.3	0.4	0.2	0.4
Oxygen, av. % vol.	20.5	20.4	20.7	20.5
<u>Sample</u>				
Time, min.	180	180	180	
Volume, dscf	102.427	104.955	96.051	
<u>Antimony (Sb)</u>				
Concentration mg/dscm	<0.00086	<0.00084	<0.00097	<0.00089
Emission rate lb/hr	<0.000182	<0.000179	<0.000193	<0.000184
<u>Arsenic (As)</u>				
Concentration mg/dscm	<0.00086	<0.00084	<0.00092	<0.00087
Emission rate lb/hr	<0.000182	<0.000179	<0.000182	<0.000181
<u>Barium (Ba)</u>				
Concentration mg/dscm	0.00179	0.00470	<0.00315	<0.00321
Emission rate lb/hr	0.000378	0.000100	<0.000622	<0.000367
<u>Beryllium (Be)</u>				
Concentration mg/dscm	<0.00004	<0.00004	<0.00004	<0.00004
Emission rate lb/hr	<0.000009	<0.000009	<0.000009	<0.000009
<u>Cadmium (Cd)</u>				
Concentration mg/dscm	<0.00043	<0.00128	0.00261	<0.00144
Emission rate lb/hr	<0.000092	<0.000272	0.000516	<0.000293
<u>Chromium (Cr)</u>				
Concentration mg/dscm	<0.00166	0.00081	0.00446	<0.00231
Emission rate lb/hr	<0.000350	0.000172	0.000881	<0.000468



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SECTION FOUR

Test Results

**TABLE 4-4 (CONTINUED). SUMMARY OF METALS TEST RESULTS –
 SOUTH BAGHOUSE SERVING ROTARY FURNACE 2**

RUN NO.	1	2	3	Average
TEST DATE	9/19/13	9/19/13	9/20/13	
TEST TIME	08:07 – 11:14	12:05 – 15:15	07:30 – 10:40	
<u>Cobalt (Co)</u>				
Concentration mg/dscm	<0.00232	<0.00042	0.00689	<0.00321
Emission rate lb/hr	<0.000490	<0.000090	0.001361	<0.000647
<u>Copper (Cu)</u>				
Concentration mg/dscm	0.00142	0.00231	0.00206	0.00193
Emission rate lb/hr	0.000300	0.000493	0.000407	0.000400
<u>Lead (Pb)</u>				
Concentration gr/dscf	<0.0000013	0.0000042	0.0000044	<0.0000033
mg/dscm	<0.00305	0.00964	0.01018	<0.00762
Emission rate lb/hr	<0.000644	0.002053	0.002011	<0.001569
<u>Manganese (Mn)</u>				
Concentration mg/dscm	<0.00077	<0.00135	<0.00113	<0.00108
Emission rate lb/hr	<0.000166	<0.000287	<0.000223	<0.000226
<u>Nickel (Ni)</u>				
Concentration mg/dscm	<0.00114	0.00096	0.00124	<0.00111
Emission rate lb/hr	<0.000240	0.000204	0.000246	<0.000230
<u>Phosphorus (P)</u>				
Concentration mg/dscm	0.16741	0.14277	0.11592	0.14204
Emission rate lb/hr	0.035304	0.030413	0.022909	0.029542
<u>Selenium (Se)</u>				
Concentration mg/dscm	<0.00208	<0.00293	<0.00578	<0.00359
Emission rate lb/hr	<0.000438	<0.000623	<0.001142	<0.000735
<u>Silver (Ag)</u>				
Concentration mg/dscm	<0.00043	<0.00042	<0.00046	<0.00044
Emission rate lb/hr	<0.000092	<0.000090	<0.000092	<0.000091



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SECTION FOUR

Test Results

**TABLE 4-4 (CONTINUED). SUMMARY OF METALS TEST RESULTS –
 SOUTH BAGHOUSE SERVING ROTARY FURNACE 2**

RUN NO. :	1	2	3	
TEST DATE :	9/19/13	9/19/13	9/20/13	Average
TEST TIME :	08:07 – 11:14	12:05 – 15:15	07:30 – 10:40	
<u>Thallium (Tl)</u>				
Concentration				
mg/dscm	<0.00086	<0.00084	<0.00092	<0.00087
Emission rate				
lb/hr	<0.000182	<0.000179	<0.000182	<0.000181
<u>Zinc (Zn)</u>				
Concentration				
mg/dscm	0.01728	0.01173	0.03813	0.02238
Emission rate				
lb/hr	0.003644	0.002500	0.007535	0.004560



APPENDIX A

H. Kramer & Company: Chicago, IL
North and South Baghouse Stacks
Test Dates: 9/17 - 9/20/13

Rotary Furnace 1: North Baghouse Stack Calculation Summaries and Field Data

SUMMARY OF PARTICULATE MATTER TEST RESULTS

Company : H. Kramer
 Location : Chicago, IL
 Source : North Baghouse

Test Run	1	2	3	
Test Date	9/17/2013	9/17/2013	9/18/2013	
Test Time	08:15 - 11:32	12:35 - 15:43	7:40 - 10:48	Average

STACK GAS

Temperature, av. °F	111.6	132.5	130.3	124.8
Velocity, av. ft/sec	57.634	57.954	58.271	57.953
Volume flow, acfm	66,771	67,142	67,510	67,141
Volume flow, scfm	60,922	59,119	59,351	59,797
Volume flow, dscfm	60,407	57,995	58,233	58,878
Volume flow, scfh	3,655,304	3,547,162	3,561,072	3,587,846
Volume flow, dscfh	3,624,402	3,479,681	3,493,963	3,532,682
Moisture, av. % vol	0.85	1.90	1.88	1.54
CO ₂ , av. % vol, db	0.2	0.3	0.4	0.3
O ₂ , av. % vol, db	20.6	20.6	20.4	20.5

Sample Train Data

Time, min	180.0	180.0	180.0	
Volume, dscf	107.102	110.678	107.094	
Volume, dscm	3.033	3.134	3.033	
Isokinetic Ratio, %	98.7	106.2	102.3	

Filterable PM collected, mg

Filterable PM collected, mg	1.92	0.25	1.11	1.09
Concentration				
gr/dscf	0.00028	0.00003	0.00016	0.00016
lb/dscf x 10 ⁻⁶	0.0395	0.0050	0.0229	0.0225
Emission rate				
lb/hr	0.1432	0.0173	0.0798	0.0801

Condensable PM collected, mg

Condensable PM collected, mg	2.30	2.40	2.50	2.40
Concentration				
gr/dscf	0.00033	0.00033	0.00036	0.00034
lb/dscf x 10 ⁻⁶	0.0474	0.0478	0.0515	0.0489
Emission rate				
lb/hr	0.1716	0.1663	0.1798	0.1726

Total PM collected, mg

Total PM collected, mg	4.22	2.65	3.61	3.49
Concentration				
gr/dscf	0.00061	0.00037	0.00052	0.00050
lb/dscf x 10 ⁻⁶	0.0869	0.0528	0.0743	0.0713
Emission rate				
lb/hr	0.3148	0.1837	0.2596	0.2527

ARI ENVIRONMENTAL, INC.
USEPA METHODS 5/202 - TOTAL PM CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/17/13
RUN NUMBER: 1

INPUT

V _m :	110.805 ft ³	Q _s :	60,407 dscfm
γ FACTOR:	0.988	T _s :	111.6 °F
P _{bar} :	29.6 in.Hg	Runtime:	180 minutes
ΔH:	1.19 in.H ₂ O	V _s :	57.634 ft/sec
T _m :	75.5 °F	P _s :	29.55 in.Hg
V _{lc} :	19.4 mL	Noz. diam:	0.188 inches
M _n total:	4.2 mg		
CO ₂ :	0.20 % by volume		
O ₂ :	20.60 % by volume		

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS			
$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right] = 107.102 \text{ dscf}$			
γ = 0.988			
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS			
$V_{wstd} = 0.04707 \times V_{lc} = 0.913 \text{ scf}$			
FRACTIONAL MOISTURE CONTENT OF STACK GAS			
$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100 = 0.85 \%$			
PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS			
$C_s = (0.01543) \left(\frac{M_n}{V_{mstd}} \right)$		Total	= 0.00061 gr/dscf
$C'_s = (2.205 \times 10^{-6}) \left(\frac{M_n}{V_{mstd}} \right)$		C' _s Total	= 0.0869 x 10 ⁻⁶ lbs/dscf
EMISSION RATE			
$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$		Total	= 0.3148 lbs/hr 1.379 ton/yr
ISOKINETIC SAMPLING RATE			
$\%ISO = \frac{(100)(T_s) \left[(0.002669 \times V_{lc}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)} = 98.66 \%$			
A _n = 0.000193 ft ²		Runtime =	180 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 5 - FILTERABLE PARTICULATE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/17/13
RUN NUMBER: 1

INPUT

V_m :	110.805	ft ³	Q_s :	60,407	dscfm
γ FACTOR:	0.988		T_s :	111.6	°F
P_{bar} :	29.6	in.Hg	Runtime:	180	minutes
ΔH :	1.19	in.H ₂ O	V_s :	57.634	ft/sec
T_m :	75.5	°F	P_s :	29.55	in.Hg
V_{ic} :	19.4	mL	Noz. diam:	0.188	inches
M_n front:	1.92	mg			
CO_2 :	0.20	% by volume			
O_2 :	20.60	% by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS		
$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$	=	107.102 dscf
$\gamma = 0.988$		
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS		
$V_{wstd} = 0.04707 \times V_{ic}$	=	0.913 scf
FRACTIONAL MOISTURE CONTENT OF STACK GAS		
$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$	=	0.85 %
PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS		
$C_s = (0.01543) \left(\frac{M_n}{V_{mstd}} \right)$	Total	= 0.00028 gr/dscf
$C'_s = (2.205 \times 10^{-6}) \left(\frac{M_n}{V_{mstd}} \right)$	C'_s Total	= 0.0395 x 10 ⁻⁶ lbs/dscf
EMISSION RATE		
$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$	=	0.1432 lbs/hr 0.6273 ton/yr
ISOKINETIC SAMPLING RATE		
$\%ISO = \frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$	=	98.66 % I
$A_n = 0.0001928 \text{ ft}^2$	Runtime =	180 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 202 - CONDENSIBLE PARTICULATE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/17/13
RUN NUMBER: 1

INPUT		Q_s:	60,407	dscfm
V _m :	110.805	T _s :	111.6	°F
γ FACTOR:	0.988	Runtime:	180	minutes
P _{bar} :	29.6	V _s :	57.634	ft/sec
ΔH:	1.19	P _s :	29.55	in.Hg
T _m :	75.5	Noz. diam:	0.188	inches
V _{ic} :	19.4	m _{lb} :	2.15	mg
N:	0.0000	m _{ob} :	0.90	mg
V _i :	0.00			
m _r :	2.90			
m _o :	1.40			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS				
	$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$		=	107.102 dscf
MASS OF AMMONIA CORRECTION				
Equation #1	$m_c = 17.03 \times V_T \times N$		=	0.00 mg
MASS OF THE FIELD BLANK				
Equation #2	$m_{fb} = m_{lb} + m_{ob}$		=	3.05 mg 2.00 mg @ max allowable
MASS OF INORGANIC CONDENSIBLE PM				
Equation #3	$m_i = m_r - m_c$		=	2.90 mg
TOTAL MASS OF CONDENSIBLE PM				
Equation #4	$m_{cpm} = m_i + m_o - m_{fb}$		=	2.30 mg @ max. blank
TOTAL CONCENTRATION OF CONDENSIBLE PM - METRIC UNITS				
Equation #5	$C_{cpm} = \frac{m_{cpm}}{V_{m(std)}}$		=	0.0215 mg/dscf
TOTAL CONCENTRATION OF CONDENSIBLE PM - ENGLISH UNITS				
	$C_s = (0.01543)(C_{cpm})$	Total	=	0.00033 gr/dscf
	$C'_s = (2.205 \times 10^{-6})(C_{cpm})$	C' _s Total	=	0.0474 x 10 ⁻⁷ lbs/dscf
EMISSION RATE				
	$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$	Total	=	0.1716 lbs/hr 0.7515 ton/yr
ISOKINETIC SAMPLING RATE				
%ISO =	$\frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$		=	98.66 % I
	A _n = 0.00019 ft ²	Runtime =	180	minutes

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
RUN NUMBER: 1

SOURCE: North Baghouse
TEST DATE: 9/17/2013

BAROMETRIC:	29.6 in. Hg	STACK DIAM:	59.50 inches
STATIC PRES:	-0.65 in.H ₂ O	CO ₂ :	0.20 % by volume
STACK TEMP:	111.6 °F	O ₂ :	20.60 % by volume
SQ.RT ΔP:	0.9787 in.H ₂ O		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.86	lb/lb-mole
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	28.76	lb/lb-mole
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H₂O			
$\sqrt{\Delta P} = \frac{1}{n} \sum_{i=1}^n \sqrt{\Delta p_i}$	=	0.9787	in. H ₂ O
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s = 111.6 \text{ °F} + 460$	=	571.6	°R
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	29.55	in.Hg
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(avg \sqrt{\Delta P}) \sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	57.634	ft/sec
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	66,771	acfm
Stack Area =	19.309 ft ²		
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s) \left(\frac{P_s}{T_s}\right)$	=	60,922 3,655,304	scfm, wb scfh, wb
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s) \left(\frac{P_s}{T_s}\right) (1 - B_{ws})$	=	60,407 3,624,402	dscfm dscfh

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/17/2013
RUN NUMBER: 1

γ FACTOR:	0.988	STACK DIAM:	59.50 inches
BAROMETRIC:	29.60 in. Hg	METER VOLUME:	110.805 ft ³
STATIC PRES:	-0.65 in.H ₂ O	METER TEMP:	75.5 °F
STACK TEMP:	111.6 °F	LIQUID COLL:	19.4 milliliters
SQ.RT ΔP:	0.9787 in.H ₂ O	CO ₂ :	0.20 % by volume
ΔH:	1.19 in.H ₂ O	O ₂ :	20.60 % by volume

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS	
$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right] =$	107.102 dscf
$\gamma = 0.988$	
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS	
$V_{wstd} = 0.04707 \times V_{lc} =$	0.913 scf
$V_{lc} = 19.4 \text{ mL}$	
FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED	
$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} =$	0.0085
FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION	
$B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} =$	0.0930
$S.V.P. = 2.749 \text{ in. Hg}$	
FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS	
$B_{ws} =$	0.0085

ARI ENVIRONMENTAL, INC.
USEPA METHODS 5/202 - TOTAL PM CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/17/13
RUN NUMBER: 2

INPUT

V_m :	115.745	ft ³	Q_s :	57,995	dscfm
γ FACTOR:	0.988		T_g :	132.5	°F
P_{bar} :	29.6	in.Hg	Runtime:	180	minutes
ΔH :	1.26	in.H ₂ O	V_s :	57.954	ft/sec
T_m :	81.40	°F	P_s :	29.56	in.Hg
V_{ic} :	45.6	mL	Noz. diam:	0.188	inches
M_n total:	2.7	mg			
CO ₂ :	0.30	% by volume			
O ₂ :	20.60	% by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS			
$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$		=	110.678 dscf
$\gamma = 0.988$			
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS			
$V_{wstd} = 0.04707 \times V_{ic}$		=	2.146 scf
FRACTIONAL MOISTURE CONTENT OF STACK GAS			
$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$		=	1.90 %
PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS			
$C_s = (0.01543) \left(\frac{M_n}{V_{mstd}} \right)$		Total =	0.00037 gr/dscf
$C'_s = (2.205 \times 10^{-6}) \left(\frac{M_n}{V_{mstd}} \right)$		C'_s Total =	0.0528 x 10 ⁻⁶ lbs/dscf
EMISSION RATE			
$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$		Total =	0.1837 lbs/hr 0.804 ton/yr
ISOKINETIC SAMPLING RATE			
$\%ISO = \frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$		=	106.20 % I
$A_n = 0.000193 \text{ ft}^2$		Runtime =	180 minutes

ARI ENVIRONMENTAL, INC.
 USEPA METHOD 5 - FILTERABLE PARTICULATE CALCULATION SUMMARY

COMPANY: H. Kramer
 LOCATION: Chicago, IL
 SOURCE: North Baghouse
 TEST DATE: 9/17/13
 RUN NUMBER: 2

INPUT

V_m :	115.745	ft ³	Q_s :	57.995	dscfm
γ FACTOR:	0.988		T_s :	132.5	°F
P_{bar} :	29.6	in.Hg	Runtime:	180	minutes
ΔH :	1.26	in.H ₂ O	V_s :	57.954	ft/sec
T_m :	81.4	°F	P_s :	29.56	in.Hg
V_{ic} :	45.6	mL	Noz. diam:	0.188	inches
M_n front:	0.25	mg			
CO ₂ :	0.30	% by volume			
O ₂ :	20.60	% by volume			

ENGLISH UNITS
 (29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS		
$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$	=	110.678 dscf
$\gamma = 0.988$		
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS		
$V_{wstd} = 0.04707 \times V_{ic}$	=	2.146 scf
FRACTIONAL MOISTURE CONTENT OF STACK GAS		
$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$	=	1.90 %
PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS		
$C_s = (0.01543) \left(\frac{M_n}{V_{mstd}} \right)$	Total =	0.00003 gr/dscf
$C'_s = (2.205 \times 10^{-6}) \left(\frac{M_n}{V_{mstd}} \right)$	C'_s Total =	0.0050 x 10 ⁻⁶ lbs/dscf
EMISSION RATE		
$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$	=	0.0173 lbs/hr 0.0759 ton/yr
ISOKINETIC SAMPLING RATE		
$\%ISO = \frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$	=	106.20 % I
$A_n = 0.0001928 \text{ ft}^2$	Runtime =	180 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 202 - CONDENSIBLE PARTICULATE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/17/13
RUN NUMBER: 2

INPUT		Q_s:	57,995	dscfm
V _m :	115.745 ft ³	T _s :	132.5	°F
γ FACTOR:	0.988	Runtime:	180	minutes
P _{bar} :	29.6 in.Hg	V _s :	57.954	ft/sec
ΔH:	1.26 in.H ₂ O	P _s :	29.56	in.Hg
T _m :	81.40 °F	Noz. diam:	0.188	inches
V _{ic} :	45.6 mL	m _{ib} :	2.15	mg
N:	0.0000	m _{ob} :	0.90	mg
V _t :	0.00 mL			
m _r :	3.40 mg			
m _o :	1.00 mg			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS				
	$V_{std} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$		=	110.678 dscf
MASS OF AMMONIA CORRECTION				
Equation #1	$m_c = 17.03 \times V_T \times N$		=	0.00 mg
MASS OF THE FIELD BLANK				
Equation #2	$m_{fb} = m_{ib} + m_{ob}$		=	3.05 mg 2.00 mg @ max allowable
MASS OF INORGANIC CONDENSIBLE PM				
Equation #3	$m_i = m_r - m_c$		=	3.40 mg
TOTAL MASS OF CONDENSIBLE PM				
Equation #4	$m_{cpm} = m_i + m_o - m_{fb}$		=	2.40 mg @ max. blank
TOTAL CONCENTRATION OF CONDENSIBLE PM - METRIC UNITS				
Equation #5	$C_{cpm} = \frac{m_{cpm}}{V_{m(std)}}$		=	0.0217 mg/dscf
TOTAL CONCENTRATION OF CONDENSIBLE PM - ENGLISH UNITS				
	$C_s = (0.01543)(C_{cpm})$	Total	=	0.00033 gr/dscf
	$C'_s = (2.205 \times 10^{-6})(C_{cpm})$	C' _s Total	=	0.0478 x 10 ⁻⁷ lbs/dscf
EMISSION RATE				
	$p_{mr} = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$	Total	=	0.1663 lbs/hr 0.7285 ton/yr
ISOKINETIC SAMPLING RATE				
%ISO =	$\frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$		=	106.20 % I
	A _n = 0.00019 ft ²	Runtime =	180	minutes

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
RUN NUMBER: 2

SOURCE: North Baghouse
TEST DATE: 9/17/2013

BAROMETRIC:	29.6 in. Hg	STACK DIAM:	59.50 inches
STATIC PRES:	-0.5 in.H ₂ O	CO ₂ :	0.30 % by volume
STACK TEMP:	132.5 °F	O ₂ :	20.60 % by volume
SQ.RT ΔP:	0.9652 in.H ₂ O		

DRY MOLECULAR WEIGHT OF STACK GAS			
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	=	28.87	lb/lb-mole
MOLECULAR WEIGHT OF STACK GAS, wet basis			
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	=	28.67	lb/lb-mole
PITOT TUBE COEFFICIENT			
C_p (from calibration curve or geometric specifications)	=	0.84	
AVERAGE VELOCITY HEAD OF STACK GAS, in. H₂O			
$\sqrt{\Delta P} = \frac{1}{n} \sum_{i=1}^n \sqrt{\Delta p_i}$	=	0.9652	in. H ₂ O
AVERAGE ABSOLUTE STACK GAS TEMPERATURE			
$T_s = 132.5 \text{ °F} + 460$	=	592.5	°R
ABSOLUTE STACK GAS PRESSURE			
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	=	29.56	in.Hg
STACK GAS VELOCITY			
$V_s = (85.49)(C_p)(avg \sqrt{\Delta P}) \sqrt{\frac{T_s}{(P_s)(M_s)}}$	=	57.954	ft/sec
STACK GAS VOLUMETRIC FLOW RATE, actual			
$Q_s = 60 \times V_s \times A_s$	=	67,142	acfm
Stack Area =		19.309	ft ²
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis			
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	=	59,119	scfm, wb
		3,547,162	scfh, wb
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis			
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	=	57,995	dscfm
		3,479,681	dscfh

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/17/2013
RUN NUMBER: 2

γ FACTOR:	0.988	STACK DIAM:	59.50 inches
BAROMETRIC:	29.60 in. Hg	METER VOLUME:	115.745 ft ³
STATIC PRES:	-0.50 in.H ₂ O	METER TEMP:	81.4 °F
STACK TEMP:	132.5 °F	LIQUID COLL:	45.6 milliliters
SQ.RT Δ P:	0.9652 in.H ₂ O	CO ₂ :	0.30 % by volume
Δ H:	1.26 in.H ₂ O	O ₂ :	20.60 % by volume

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS $V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right] = 110.678 \text{ dscf}$ $\gamma = 0.988$	
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS $V_{wstd} = 0.04707 \times V_{lc} = 2.146 \text{ scf}$ $V_{lc} = 45.6 \text{ mL}$	
FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED $B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.0190$	
FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION $B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.1657$ $S.V.P. = 4.9 \text{ in. Hg}$	
FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS $B_{ws} = 0.0190$	

ARI ENVIRONMENTAL, INC.
USEPA METHODS 5/202 - TOTAL PM CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/18/13
RUN NUMBER: 3

INPUT

V_m :	111.685 ft ³	Q_s :	58,233	dscfm
γ FACTOR:	0.988	T_s :	130.3	°F
P_{bar} :	29.45 in.Hg	Runtime:	180	minutes
ΔH :	1.17 in.H ₂ O	V_s :	58.271	ft/sec
T_m :	77.04 °F	P_s :	29.41	in.Hg
V_{ic} :	43.7 mL	Noz. diam:	0.188	inches
M_n total:	3.6 mg			
CO ₂ :	0.40 % by volume			
O ₂ :	20.40 % by volume			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS			
$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$		=	107.094 dscf
$\gamma = 0.988$			
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS			
$V_{wstd} = 0.04707 \times V_{ic}$		=	2.057 scf
FRACTIONAL MOISTURE CONTENT OF STACK GAS			
$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$		=	1.88 %
PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS			
$C_s = (0.01543) \left(\frac{M_n}{V_{mstd}} \right)$		Total =	0.00052 gr/dscf
$C'_s = (2.205 \times 10^{-6}) \left(\frac{M_n}{V_{mstd}} \right)$		C'_s Total =	0.0743 x 10 ⁻⁶ lbs/dscf
EMISSION RATE			
$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$		Total =	0.2596 lbs/hr 1.137 ton/yr
ISOKINETIC SAMPLING RATE			
$\%ISO = \frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$		=	102.34 % I
$A_n = 0.000193 \text{ ft}^2$		Runtime =	180 minutes

ARI ENVIRONMENTAL, INC.
 USEPA METHOD 5 - FILTERABLE PARTICULATE CALCULATION SUMMARY

COMPANY: H. Kramer
 LOCATION: Chicago, IL
 SOURCE: North Baghouse
 TEST DATE: 9/18/13
 RUN NUMBER: 3

INPUT

V_m :	111.685	ft ³	Q_s :	58,233	dscfm
γ FACTOR:	0.988		T_s :	130.3	°F
P_{bar} :	29.45	in.Hg	Runtime:	180	minutes
ΔH :	1.17	in.H ₂ O	V_s :	58.271	ft/sec
T_m :	77.0	°F	P_s :	29.41	in.Hg
V_{ic} :	43.7	mL	Noz. diam:	0.188	inches
M_n front:	1.11	mg			
CO ₂ :	0.40	% by volume			
O ₂ :	20.40	% by volume			

ENGLISH UNITS
 (29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS		
$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$	=	107.094 dscf
$\gamma = 0.988$		
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS		
$V_{wstd} = 0.04707 \times V_{ic}$	=	2.057 scf
FRACTIONAL MOISTURE CONTENT OF STACK GAS		
$B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} \times 100$	=	1.88 %
PARTICULATE CONCENTRATION IN STACK GAS ON A DRY BASIS		
$C_s = (0.01543) \left(\frac{M_n}{V_{mstd}} \right)$	Total	= 0.00016 gr/dscf
$C'_s = (2.205 \times 10^{-6}) \left(\frac{M_n}{V_{mstd}} \right)$	C'_s Total	= 0.0229 x 10 ⁻⁶ lbs/dscf
EMISSION RATE		
$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$	=	0.0798 lbs/hr 0.3496 ton/yr
ISOKINETIC SAMPLING RATE		
$\%ISO = \frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$	=	102.34 % I
$A_n = 0.0001928 \text{ ft}^2$	Runtime =	180 minutes

ARI ENVIRONMENTAL, INC.
USEPA METHOD 202 - CONDENSIBLE PARTICULATE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/18/13
RUN NUMBER: 3

INPUT		Q_s:	58,233	dscfm
V _m :	111.685 ft ³	T _s :	130.3	°F
γ FACTOR:	0.988	Runtime:	180	minutes
P _{bar} :	29.45 in.Hg	V _s :	58.271	ft/sec
ΔH:	1.17 in.H ₂ O	P _s :	29.41	in.Hg
T _m :	77.04 °F	Noz. diam:	0.188	inches
V _{ic} :	43.7 mL	m _{ib} :	2.15	mg
N:	0.0000	m _{ob} :	0.90	mg
V _i :	0.00 mL			
m _r :	3.55 mg			
m _o :	0.95 mg			

ENGLISH UNITS
(29.92 in.Hg & 68 °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS				
	$V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right]$		=	107.094 dscf
MASS OF AMMONIA CORRECTION				
Equation #1	$m_c = 17.03 \times V_T \times N$		=	0.00 mg
MASS OF THE FIELD BLANK				
Equation #2	$m_{fb} = m_{ib} + m_{ob}$		=	3.05 mg 2.00 mg @ max allowable
MASS OF INORGANIC CONDENSIBLE PM				
Equation #3	$m_i = m_r - m_c$		=	3.55 mg
TOTAL MASS OF CONDENSIBLE PM				
Equation #4	$m_{cpm} = m_i + m_o - m_{fb}$		=	2.50 mg @ max. blank
TOTAL CONCENTRATION OF CONDENSIBLE PM - METRIC UNITS				
Equation #5	$C_{cpm} = \frac{m_{cpm}}{V_{m(std)}}$		=	0.0233 mg/dscf
TOTAL CONCENTRATION OF CONDENSIBLE PM - ENGLISH UNITS				
	$C_s = (0.01543)(C_{cpm})$	Total	=	0.00036 gr/dscf
	$C'_s = (2.205 \times 10^{-6})(C_{cpm})$	C' _s Total	=	0.0515 x 10 ⁻⁶ lbs/dscf
EMISSION RATE				
	$pmr = \left(\frac{C_s}{7000} \right) (Q_{std})(60)$	Total	=	0.1798 lbs/hr 0.7875 ton/yr
ISOKINETIC SAMPLING RATE				
%ISO =	$\frac{(100)(T_s) \left[(0.002669 \times V_{ic}) + \left(\frac{V_m}{T_m} \right) (\gamma) \left(P_{bar} + \left(\frac{\Delta H}{13.6} \right) \right) \right]}{(60)(\theta)(V_s)(P_s)(A_n)}$		=	102.34 % I
	A _n = 0.00019 ft ²	Runtime =	180	minutes

ARI ENVIRONMENTAL, INC.
FLOW RATE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
RUN NUMBER: 3

SOURCE: North Baghouse
TEST DATE: 9/18/2013

BAROMETRIC: 29.45 in. Hg	STACK DIAM: 59.50 inches
STATIC PRES: -0.55 in.H ₂ O	CO ₂ : 0.40 % by volume
STACK TEMP: 130.3 °F	O ₂ : 20.40 % by volume
SQ. RT ΔP: 0.9699 in.H ₂ O	

DRY MOLECULAR WEIGHT OF STACK GAS	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$	= 28.88 lb/lb-mole
MOLECULAR WEIGHT OF STACK GAS, wet basis	
$M_s = M_d(1 - B_{ws}) + 18B_{ws}$	= 28.67 lb/lb-mole
PITOT TUBE COEFFICIENT	
C_p (from calibration curve or geometric specifications)	= 0.84
AVERAGE VELOCITY HEAD OF STACK GAS, in. H₂O	
$\sqrt{\Delta P} = \frac{1}{n} \sum_{i=1}^n \sqrt{\Delta p_i}$	= 0.9699 in. H ₂ O
AVERAGE ABSOLUTE STACK GAS TEMPERATURE	
$T_s = 130.3 \text{ °F} + 460$	= 590.3 °R
ABSOLUTE STACK GAS PRESSURE	
$P_s = P_{bar} + \frac{P_{static}}{13.6}$	= 29.41 in.Hg
STACK GAS VELOCITY	
$V_s = (85.49)(C_p)(\text{avg } \sqrt{\Delta P}) \sqrt{\frac{T_s}{(P_s)(M_s)}}$	= 58.271 ft/sec
STACK GAS VOLUMETRIC FLOW RATE, actual	
$Q_s = 60 \times V_s \times A_s$	= 67,510 acfm
Stack Area = 19.309 ft ²	
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, wet basis	
$Q_{stdw} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)$	= 59,351 scfm, wb 3,561,072 scfh, wb
STACK GAS VOLUMETRIC FLOW RATE, standard conditions, dry basis	
$Q_{std} = \left(\frac{528}{29.92}\right)(Q_s)\left(\frac{P_s}{T_s}\right)(1 - B_{ws})$	= 58,233 dscfm 3,493,963 dscfh

ARI ENVIRONMENTAL, INC.
MOISTURE CALCULATION SUMMARY

COMPANY: H. Kramer
LOCATION: Chicago, IL
SOURCE: North Baghouse
TEST DATE: 9/18/2013
RUN NUMBER: 3

γ FACTOR:	0.988	STACK DIAM:	59.50 inches
BAROMETRIC:	29.45 in. Hg	METER VOLUME:	111.685 ft ³
STATIC PRES:	-0.55 in.H ₂ O	METER TEMP:	77.0 °F
STACK TEMP:	130.3 °F	LIQUID COLL:	43.7 milliliters
SQ. RT Δ P:	0.9699 in.H ₂ O	CO ₂ :	0.40 % by volume
Δ H:	1.17 in.H ₂ O	O ₂ :	20.40 % by volume

ENGLISH UNITS
(29.92 in.Hg & °F)

VOLUME OF SAMPLE @ STANDARD CONDITIONS, DRY BASIS $V_{mstd} = \left(\frac{528}{29.92} \right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \right] = 107.094 \text{ dscf}$ $\gamma = 0.988$	
VOLUME OF WATER IN SAMPLE @ STANDARD CONDITIONS $V_{wstd} = 0.04707 \times V_{lc} = 2.057 \text{ scf}$ $V_{lc} = 43.7 \text{ mL}$	
FRACTIONAL MOISTURE CONTENT OF STACK GAS AS MEASURED $B_{ws} = \frac{V_{wstd}}{V_{wstd} + V_{mstd}} = 0.0188$	
FRACTIONAL MOISTURE CONTENT OF STACK GAS @ SATURATION $B_{ws@saturation} = \frac{S.V.P.}{P_{bar} + \frac{P_{static}}{13.6}} = 0.1539$ $S.V.P. = 4.525 \text{ in. Hg}$	
FRACTIONAL MOISTURE CONTENT USED IN CALCULATIONS $B_{ws} = 0.0188$	

SUMMARY OF TEST RESULTS

TABLE : Lead Emission Summary
 COMPANY : H. Kramer
 LOCATION : Chicago, IL
 SOURCE : North Baghouse

TEST DATE : 9/17/2013 9/17/2013 9/18/2013
 RUN NO : 1 2 3
 TEST TIME : 08:15 - 11:32 12:35 - 15:43 07:40 - 10:48 Average

Stack Gas Parameters

Temperature, °F	114.0	135.8	133.7	124.9
Velocity, av. ft/sec	55.6	56.6	57.8	56.1
Volumetric flow, acfm	64,445	65,529	66,993	64,987
Volumetric flow, scfm	58,547	57,355	58,562	57,951
Volumetric flow, dscfh	3,463,629	3,392,104	3,455,392	3,427,866
Moisture, av. % vol	1.4	1.4	1.7	1.4
Carbon Dioxide, av. % vol	0.2	0.3	0.4	0.3
Oxygen, av. % vol	20.6	20.6	20.4	20.6

Sample

Time, min	180.0	180.0	180.0	
Volume, dscf	99.400	100.595	103.733	101.242
Volume, dscm	2.815	2.849	2.938	2.867
Front Half Lead, ug	5.088	<1.250	5.760	<4.033
Back Half Lead, ug	<1.250	<1.250	2.690	<1.730
Total Lead, ug	<6.338	<2.500	8.450	<5.763
Isokinetic Ratio, %	96.9	100.1	101.4	99.5

Lead Emissions

Concentration				
gr/dscf	<0.000010	<0.0000004	0.0000013	<0.0000009
mg/dscm	<0.00225	<0.00088	0.00288	<0.00200
x 10 ⁻⁶ lb/dscf	<0.00014	<0.00005	0.00018	<0.00013
Emission Rate				
lb/hr	<0.000487	<0.000186	0.000621	<0.000431

Visible Emissions (Method 22)

of minutes:sec with visible emissions 0:00

SUMMARY OF TEST RESULTS

TABLE USEPA Method 29 Metals Emissions Summary
 COMPANY H. Kramer
 LOCATION Chicago, IL
 SOURCE North Baghouse
 TEST DATE

RUN NO TEST DATE Metals Sample Time, min Volume, dscf Isokinetic Ratio, % Metals Emissions	9/17/2013				9/17/2013				9/18/2013				Average	
	1 08:15 - 11:32				2 12:35 - 15:43				3 07:40 - 10:48				Average	Average
	Mass	Concentration	Concentration	Emission Rate	Mass	Concentration	Concentration	Emission Rate	Mass	Concentration	Concentration	Emission Rate	Concentration	Emission Rate
Analyte	ug	mg/dscm	x10 ⁻⁸ lb/dscf	lb/hr	ug	mg/dscm	x10 ⁻⁸ lb/dscf	lb/hr	ug	mg/dscm	x10 ⁻⁸ lb/dscf	lb/hr	mg/dscm	lb/hr
Antimony	<3.120	<0.00111	<0.069	<0.000240	<2.500	<0.00088	<0.055	<0.000186	<7.880	<0.00268	<0.168	<0.000576	<0.00156	<0.000335
Arsenic	<2.500	<0.00089	<0.055	<0.000192	<2.500	<0.00088	<0.055	<0.000186	<2.500	<0.00085	<0.053	<0.000184	<0.00087	<0.000187
Barium	<5.000	<0.00178	<0.111	<0.000384	<14.390	<0.00505	<0.315	<0.001070	<5.000	<0.00170	<0.108	<0.000387	<0.00284	<0.000607
Beryllium	<0.120	<0.00004	<0.003	<0.000009	<0.120	<0.00004	<0.003	<0.000009	<0.120	<0.00004	<0.003	<0.000009	<0.00004	<0.000009
Cadmium	<1.260	<0.00045	<0.028	<0.000097	<1.260	<0.00044	<0.028	<0.000094	<1.260	<0.00043	<0.027	<0.000093	<0.00044	<0.000094
Chromium	4.950	0.00176	0.110	0.000380	<3.380	<0.00119	<0.074	<0.000251	5.620	0.00191	0.119	0.000413	<0.00162	<0.000348
Cobalt	<1.260	<0.00045	<0.028	<0.000097	<1.260	<0.00044	<0.028	<0.000094	<1.260	<0.00043	<0.027	<0.000093	<0.00044	<0.000094
Copper	<3.280	<0.00117	<0.073	<0.000252	5.450	0.00191	0.119	0.000405	<3.980	<0.00135	<0.085	<0.000292	<0.00148	<0.000317
Lead	<6.338	<0.00225	<0.141	<0.000487	<2.500	<0.00088	<0.055	<0.000186	8.450	0.00288	0.180	0.000621	<0.00200	<0.000431
Manganese	<2.030	<0.00071	<0.045	<0.000158	1.880	0.00066	0.041	0.000140	<2.160	<0.00074	<0.046	<0.000159	<0.00070	<0.000151
Nickel	4.340	0.00154	0.096	0.000333	4.370	0.00153	0.096	0.000325	4.900	0.00167	0.104	0.000360	0.00158	0.000339
Phosphorus	450.766	0.16013	9.999	0.034634	465.002	0.17024	10.631	0.036062	432.645	0.14727	9.197	0.031778	0.15921	0.034158
Selenium	<13.730	<0.00469	<0.305	<0.001055	<2.500	<0.00088	<0.055	<0.000186	<12.240	<0.00417	<0.260	<0.000899	<0.00331	<0.000713
Silver	<1.260	<0.00045	<0.028	<0.000097	<1.260	<0.00044	<0.028	<0.000094	<1.380	<0.00047	<0.029	<0.000101	<0.00045	<0.000097
Thallium	<2.500	<0.00089	<0.055	<0.000192	<2.500	<0.00088	<0.055	<0.000186	<2.500	<0.00085	<0.053	<0.000184	<0.00087	<0.000187
Zinc	30.510	0.01084	0.677	0.002344	24.780	0.00870	0.543	0.001842	24.540	0.00835	0.522	0.001802	0.00930	0.001996



USEPA Method 29
Metals Emissions Calculation Summary

Client: H. Kramer
Location: Chicago, IL
Source: North Baghouse
Date: 9/17/2013
Run #: 1

Test Data Input		Metals Laboratory Analysis Weights (M _t) < Values = Below MDL	
Barometric pressure (P _{bar}):	29.80 inches Hg	Antimony (Sb):	<3.12 ug
Stack pressure (P _s):	29.55 inches Hg Abs.	Arsenic (As):	<2.50 ug
Test length (l):	180.0 minutes	Barium (Ba):	<5.00 ug
Sample nozzle diameter (D _{sn}):	0.1870 inches	Beryllium (Be):	<0.12 ug
Sample nozzle area (A _{sn}):	0.000191 ft ²	Cadmium (Cd):	<1.26 ug
Stack temperature (T _{st}):	114.0 °F	Chromium (Cr):	4.95 ug
Volume metered (V _{met}):	99,400 dscf	Cobalt (Co):	<1.26 ug
Stack gas velocity (V _{st}):	55.626 ft/sec	Copper (Cu):	<3.26 ug
Stack gas volumetric flow (Q _{st}):	3,463,629 dscfh	Lead (Pb):	<6.34 ug
Fractional Moisture content (B _{wa}):	0.0140 %	Manganese (Mn):	<2.03 ug
		Nickel (Ni):	4.34 ug
		Phosphorus (P):	450.77 ug
		Selenium (Se):	<13.73 ug
		Silver (Ag):	<1.26 ug
		Thallium (Tl):	<2.50 ug
		Zinc (Zn):	30.51 ug

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Percent isokinetic:

$$\% \text{isokinetic} = \frac{0.0945 \times V_{\text{met}} \times (T_s + 460)}{P_s \times V_s \times 0 \times A_{\text{sn}} \times (1 - B_{\text{wa}})} = 96.91 \% \text{ isokinetic}$$

Metals concentration (mg/dscm):

C _s = $\frac{M_t}{\left(\frac{V_{\text{met}}}{35.31 \text{ dscf / dscm}} \right)}$			
=	<0.00071	mg/dscm	Manganese (Mn)
=	<0.00111	mg/dscm	Antimony (Sb)
=	<0.00089	mg/dscm	Arsenic (As)
=	<0.00178	mg/dscm	Barium (Ba)
=	<0.00004	mg/dscm	Beryllium (Be)
=	<0.00045	mg/dscm	Cadmium (Cd)
=	0.00176	mg/dscm	Chromium (Cr)
=	<0.00117	mg/dscm	Copper (Cu)
=	<0.00225	mg/dscm	Lead (Pb)
=	<0.00045	mg/dscm	Cobalt (Co)
			0.00154 mg/dscm Nickel (Ni)
			0.16013 mg/dscm Phosphorus (P)
			<0.00488 mg/dscm Selenium (Se)
			<0.00045 mg/dscm Silver (Ag)
			<0.00089 mg/dscm Thallium (Tl)
			0.01084 mg/dscm Zinc (Zn)

Metals concentration (x10⁻⁹ lb/dscf):

C _s = $\frac{\left(\frac{2.205 \times 10^{-9} \text{ lb}}{\mu\text{g}} \times M_t \right)}{V_{\text{met}}}$			
=	<0.069	x 10 ⁻⁹ lb/dscf	Antimony (Sb)
=	<0.055	x 10 ⁻⁹ lb/dscf	Arsenic (As)
=	<0.111	x 10 ⁻⁹ lb/dscf	Barium (Ba)
=	<0.003	x 10 ⁻⁹ lb/dscf	Beryllium (Be)
=	<0.028	x 10 ⁻⁹ lb/dscf	Cadmium (Cd)
=	0.110	x 10 ⁻⁹ lb/dscf	Chromium (Cr)
=	<0.073	x 10 ⁻⁹ lb/dscf	Copper (Cu)
=	<0.141	x 10 ⁻⁹ lb/dscf	Lead (Pb)
=	<0.028	x 10 ⁻⁹ lb/dscf	Cobalt (Co)
			<0.045 x 10 ⁻⁹ lb/dscf Manganese (Mn)
			0.096 x 10 ⁻⁹ lb/dscf Nickel (Ni)
			9.999 x 10 ⁻⁹ lb/dscf Phosphorus (P)
			<0.305 x 10 ⁻⁹ lb/dscf Selenium (Se)
			<0.028 x 10 ⁻⁹ lb/dscf Silver (Ag)
			<0.055 x 10 ⁻⁹ lb/dscf Thallium (Tl)
			0.677 x 10 ⁻⁹ lb/dscf Zinc (Zn)

Metals emission rate (lb/hr):

E _m = C _s × Q _{st}			
=	<0.000240	lb/hr	Antimony (Sb)
=	<0.000192	lb/hr	Arsenic (As)
=	<0.000384	lb/hr	Barium (Ba)
=	<0.000009	lb/hr	Beryllium (Be)
=	<0.000097	lb/hr	Cadmium (Cd)
=	0.000380	lb/hr	Chromium (Cr)
=	<0.000252	lb/hr	Copper (Cu)
=	<0.000487	lb/hr	Lead (Pb)
=	<0.000097	lb/hr	Cobalt (Co)
			<0.000156 lb/hr Manganese (Mn)
			0.000333 lb/hr Nickel (Ni)
			0.034634 lb/hr Phosphorus (P)
			<0.001055 lb/hr Selenium (Se)
			<0.000097 lb/hr Silver (Ag)
			<0.000192 lb/hr Thallium (Tl)
			0.002344 lb/hr Zinc (Zn)



Metals Laboratory Data Summary

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/17/2013
 Run #: 1
 Time: 08:15 - 11:32
 Filter Diam 110.00 mm
 Filter Diam 4.33 in.
 "A value"= 20.62 ug/in.

ND=Value Below Minimum Detection Limit - listed by DAT as ND
 J=Value below LOQ but above MDL
 (Sample - Blank) less than MDL: use MDL
 FH = Front half, BH = Back half

Front Half Metal Calculation

Metal	FH Sample (M _{fh}) (micrograms)	FH Blank (M _{fbh}) (micrograms)	<u>I Value</u>	<u>II Values</u>			Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)	Final* Blank Corrected Sample Mass (micrograms)	Sample	MDL
			A Value (filter) (micrograms)	5 % of FH Sample (micrograms)	Lesser value (M _{fbh}) vs 5% (micrograms)	Greater Value I vs II (micrograms)					
Antimony	1.29	7.15	20.62	0.06	0.06	20.62	7.15	-5.86	<1.25	J	1.25
Arsenic	<1.25	0.00	20.62	0.06	0.00	20.62	0.00	1.25	<1.25	ND	1.25
Barium	8.96	11.02	20.62	0.45	0.45	20.62	11.02	-2.06	<2.50	J	2.50
Beryllium	<0.06	0.00	20.62	0.00	0.00	20.62	0.00	0.06	<0.06	ND	0.06
Cadmium	<0.63	0.00	20.62	0.03	0.00	20.62	0.00	0.63	<0.63	ND	0.63
Chromium	7.87	5.44	20.62	0.39	0.39	20.62	5.44	2.43	2.43		0.25
Cobalt	<0.63	1.01	20.62	0.03	0.03	20.62	1.01	-0.38	<0.63	ND	0.63
Copper	1.41	1.55	20.62	0.07	0.07	20.62	1.55	-0.14	<0.32		0.32
Lead	25.71	21.09	20.62	1.29	1.29	20.62	20.62	5.09	5.09		1.25
Manganese	0.78	1.26	20.62	0.04	0.04	20.62	1.26	-0.48	<0.63	J	0.63
Nickel	4.07	2.12	20.62	0.20	0.20	20.62	2.12	1.95	1.95	J	0.63
Phosphorus	179.14	171.49	20.62	8.96	8.96	20.62	20.62	158.52	158.52		2.50
Selenium	12.13	11.63	20.62	0.61	0.61	20.62	11.63	0.50	<1.25		1.25
Silver	<0.63	0.00	20.62	0.03	0.00	20.62	0.00	0.63	<0.63	ND	0.63
Thallium	<1.25	0.00	20.62	0.06	0.00	20.62	0.00	1.25	<1.25	ND	1.25
Zinc	12.93	5.24	20.62	0.65	0.65	20.62	5.24	7.69	7.69		0.63

*Use MDL if the blank corrected value is <MDL

Back Half Metal Calculation

Metal	BH Sample (M _{bh}) (micrograms)	BH Blank (M _{bbh}) (micrograms)	<u>I Value</u>	<u>II Values</u>			Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)	Final Blank Corrected Sample Mass (micrograms)	Sample	MDL
			A Value (micrograms)	5 % of BH Sample (micrograms)	Lesser value (M _{bbh}) vs 5% (micrograms)	Greater Value I vs II (micrograms)					
Antimony	2.87	17.76	1.00	0.14	0.14	1.00	1.00	1.87	1.87	J	1.25
Arsenic	<1.25	0.00	1.00	0.06	0.00	1.00	0.00	1.25	<1.25	ND	1.25
Barium	<2.50	0.00	1.00	0.13	0.00	1.00	0.00	2.50	<2.50	ND	2.50
Beryllium	0.15	0.43	1.00	0.01	0.01	1.00	0.43	-0.28	<0.06	J	0.06
Cadmium	<0.63	3.51	1.00	0.03	0.03	1.00	1.00	-0.37	<0.63	ND	0.63
Chromium	2.52	0.00	1.00	0.13	0.00	1.00	0.00	2.52	2.52		0.25
Cobalt	<0.63	0.00	1.00	0.03	0.00	1.00	0.00	0.63	<0.63	ND	0.63
Copper	3.96	5.16	1.00	0.20	0.20	1.00	1.00	2.96	2.96		0.32
Lead	<1.25	8.25	1.00	0.06	0.06	1.00	1.00	0.25	<1.25	ND	1.25
Manganese	1.40	0.00	1.00	0.07	0.00	1.00	0.00	1.40	1.40	J	0.63
Nickel	2.39	0.00	1.00	0.12	0.00	1.00	0.00	2.39	2.39	J	0.63
Phosphorus	307.63	322.35	1.00	15.38	15.38	15.38	15.38	292.25	292.25		2.50
Selenium	12.48	0.00	1.00	0.62	0.00	1.00	0.00	12.48	12.48		1.25
Silver	<0.63	0.00	1.00	0.03	0.00	1.00	0.00	0.63	<0.63	ND	0.63
Thallium	<1.25	0.00	1.00	0.06	0.00	1.00	0.00	1.25	<1.25	ND	1.25
Zinc	22.82	0.00	1.00	1.14	0.00	1.00	0.00	22.82	22.82		0.63

*Use MDL if the blank corrected value is <MDL



Metals Laboratory Data Summary
Total Front Half Plus Back Half Metal Calculation

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/17/2013
 Run #: 1
 Time: 08:15 - 11:32

ND-Value Below Minimum Detection Limit - listed by DAT as ND
 J-Value below LOQ but above MDL
 (Sample - Blank) less than MDL: use MDL
 FH = Front half, BH = Back half

Metal	Final FH Blank Corrected Sample Mass	Final BH Blank Corrected Sample Mass	BH Blank	Total Metal (M _t) (micrograms)	MDL	Front half J or ND	Back half J or ND
Antimony	<1.25	1.87		<3.12	1.25	J	J
Arsenic	<1.25	<1.25		<2.50	1.25	ND	ND
Barium	<2.50	<2.50		<5.00	2.50	J	ND
Beryllium	<0.06	<0.06		<0.12	0.06	ND	J
Cadmium	<0.63	<0.63		<1.26	0.63	ND	ND
Chromium	2.43	2.52		4.95	0.25		
Cobalt	<0.63	<0.63		<1.26	0.63	ND	ND
Copper	<0.32	<2.96		<3.28	0.32		
Lead	5.09	<1.25		<6.34	1.25		ND
Manganese	<0.63	1.40		<2.03	0.63	J	J
Nickel	1.95	2.39		4.34	0.63	J	J
Phosphorus	158.52	292.25		450.77	2.50		
Selenium	<1.25	12.48		<13.73	1.25		
Silver	<0.63	<0.63		<1.26	0.63	ND	ND
Thallium	<1.25	<1.25		<2.50	1.25	ND	ND
Zinc	7.69	22.82		30.51	0.63		



USEPA Method 2
Volumetric Flow Rate Sample Calculations (Circular Ducts)

Client: H. Kramer
Location: Chicago, IL
Source: North Baghouse
Date: 9/17/2013
Run #: 1

Data Input

Carbon Dioxide (CO ₂):	0.2 %
Oxygen (O ₂):	20.6 %
Nitrogen (N ₂):	79.2 %
Fractional Moisture Content (B _{ws})	0.0140 dimensionless
Stack Temperature (T _s):	114.0 °F
Pitot Coefficient (C _p):	0.84 dimensionless
Average square root of ΔP	0.9416 inches H ₂ O
Barometric Pressure (P _{bar}):	29.60 inches Hg
Static Pressure (S _i)	-0.65 inches H ₂ O
Stack diameter:	59.50 inches
Stack area (A _s):	19,3091 ft ²

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):**Dry molecular weight of stack gas:**

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2) = 28.856 \text{ lb/lb-mole}$$

Molecular weight of stack gas, wet basis:

$$M_s = (M_d \times (1 - B_{ws})) + (18 \times B_{ws}) = 28.704 \text{ lb/lb-mole}$$

Absolute stack gas pressure:

$$P_s = P_{bar} + \left(\frac{S_i}{13.6} \right) = 29.552 \text{ inches H}_2\text{O}$$

Stack gas velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{(T_s + 460)}{(P_s \times M_s)}} = 55.626 \text{ feet/second}$$

Stack gas volumetric flow rate:

$$Q_s = A_s \times V_s \times 60 = 64,445 \text{ acfm}$$

Stack gas volumetric flow rate, wet basis:

$$Q_{sw} = Q_s \times \left[\left(\frac{528^\circ R}{29.92 \text{ in. Hg}} \right) \times \left(\frac{P_s}{T_s + 460} \right) \right] = 58,547 \text{ scfm}$$

$$Q_{sw} = Q_s \times \left[\left(\frac{528^\circ R}{29.92 \text{ in. Hg}} \right) \times \left(\frac{P_s}{T_s + 460} \right) \right] \times 60 = 3,512,835 \text{ scfh}$$

Stack gas volumetric flow rate, dry basis:

$$Q_{std} = Q_{sw} \times (1 - B_{ws}) = 57,727 \text{ dscfm}$$

$$Q_{std} = Q_{sw} \times (1 - B_{ws}) \times 60 = 3,463,629 \text{ dscfh}$$



**USEPA Method 4
Moisture Determination Sample Calculations**

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/17/2013
 Run #: 1

Data Input:

Volume metered (V_m):	100.990 ft ³
Meter calibration coefficient (Y_d):	1.002 dimensionless
Barometric pressure (P_{bar}):	29.60 inches Hg
Meter sample rate (ΔH):	1.09 inches H ₂ O
Meter inlet/outlet temperature (T_m):	73.2 °F
Volume of moisture collected (V_{ic}):	30.0 milliliters
Stack Temperature (T_s):	114.0 °F
Static Pressure (St):	-0.7 inches H ₂ O

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):**Volume of sample, dry basis:**

$$Vm_{std} = V_m \times Y_d \times \left(\frac{528.0^\circ R}{29.92 \text{ Hg}} \right) \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m + 460} \right) = 99.400 \text{ dscf}$$

Volume of water vapor in sample:

$$V_{wstd} = \frac{0.04707 \text{ ft}^3}{\text{ml}} \times V_{ic} = 1.412 \text{ scf}$$

Fractional moisture content of stack gas:

$$B_{ws} = \frac{V_{wstd}}{(V_{mstd} + V_{wstd})} = 0.0140 B_{wo}$$

Percent Moisture:

$$\% \text{moisture} = B_{ws} \times 100 = 1.40 \%$$

Fractional moisture content of stack gas at saturated conditions:

$$T_{s(K)} = ((T_s - 32) \times 0.5556) + 273 = 318.6 \text{ Kelvin}$$

$$P_{s(\text{mmHg})} = \left(P_{bar} + \frac{S_i}{13.6} \right) \times 25.401 = 751.87 \text{ mm Hg}$$

$$B_{wos} = \frac{\sqrt{\left(10^{\left(\frac{A \left(\frac{B}{(T_{s(K)} - C) \right)} \right)} \right)}}{P_{s(\text{mmHg})}} \quad \begin{array}{l} \text{where:} \\ A = 8.361 \\ B = 1893.5 \\ C = 27.65 \end{array} = 0.0941 \%$$

Percent moisture at saturated conditions:

$$\% \text{moisture}_{\text{saturated}} = B_{wos} \times 100 = 9.41 \%$$

Percent moisture used for emissions calculations:

$$= 1.40 \%$$



USEPA Method 29
Metals Emissions Calculation Summary

Client: H. Kramer
Location: Chicago, IL
Source: North Baghouse
Date: 9/17/2013
Run #: 2

Test Data Input		Metals Laboratory Analysis Weights (M)	
Barometric pressure (P _{amb}):	29.60 Inches Hg	Manganese (Mn):	1.88 ug
Stack pressure (P _s):	29.55 Inches Hg Abs.	Antimony (Sb):	<2.50 ug
Test length (t):	180.0 minutes	Arsenic (As):	<2.50 ug
Sample nozzle diameter (D _s):	0.1670 inches	Barium (Ba):	<14.39 ug
Sample nozzle area (S _b):	0.000191 ft ²	Beryllium (Be):	<0.12 ug
Stack temperature (T _s):	135.8 °F	Cadmium (Cd):	<1.26 ug
Volume metered (V _{meas}):	100.595 dscf	Chromium (Cr):	<3.38 ug
Stack gas velocity (V _s):	56.562 ft/sec	Cobalt (Co):	<1.26 ug
Stack gas volumetric flow (Q _{std}):	3,392.104 dscfh	Copper (Cu):	5.45 ug
Fractional Moisture content (B _{ws}):	0.0143 %	Lead (Pb):	<2.50 ug
		Nickel (Ni):	4.370 ug
		Phosphorus (P):	495.002 ug
		Selenium (Se):	<2.50 ug
		Silver (Ag):	<1.26 ug
		Thallium (Tl):	<2.50 ug
		Zinc (Zn):	24.780 ug

Sample calculations @ standard conditions (29.92 Inches Hg, 68.0 °F):

Percent Isokinetic:

$$\% \text{Isokinetic} = \frac{0.0945 \times V_{\text{meas}} \times (T_s + 460)}{P_s \times V_s \times 6 \times A_s \times (1 - B_{ws})} = 100.14 \% \text{ isokinetic}$$

Metals concentration (mg/dscm):

$$C_s = \frac{M_i}{\left(\frac{V_{\text{meas}}}{35.3 \text{ dscf / dscm}} \right)}$$

=	<0.00088	mg/dscm Antimony (Sb)	=	0.00066	mg/dscm Manganese (Mn)
=	<0.00088	mg/dscm Arsenic (As)	=	0.00153	mg/dscm Nickel (Ni)
=	<0.00505	mg/dscm Barium (Ba)	=	0.17024	mg/dscm Phosphorus (P)
=	<0.00004	mg/dscm Beryllium (Be)	=		
=	<0.00044	mg/dscm Cadmium (Cd)	=	<0.00088	mg/dscm Selenium (Se)
=	<0.00119	mg/dscm Chromium (Cr)	=	<0.00044	mg/dscm Silver (Ag)
=	0.00191	mg/dscm Copper (Cu)	=	<0.00088	mg/dscm Thallium (Tl)
=	<0.00088	mg/dscm Lead (Pb)	=	0.00870	mg/dscm Zinc (Zn)
=	<0.00044	mg/dscm Cobalt (Co)	=		

Metals concentration (x10⁻⁶ lb/dscf):

$$C'_s = \frac{\left(\frac{2.205 \times 10^{-6} \text{ lb}}{\mu\text{g}} \times M_i \right)}{V_{\text{meas}}}$$

=	<0.055	x 10 ⁻⁶ lb/dscf Antimony (Sb)	=	0.041	x 10 ⁻⁶ lb/dscf Manganese (Mn)
=	<0.055	x 10 ⁻⁶ lb/dscf Arsenic (As)	=	0.096	x 10 ⁻⁶ lb/dscf Nickel (Ni)
=	<0.315	x 10 ⁻⁶ lb/dscf Barium (Ba)	=	10.631	x 10 ⁻⁶ lb/dscf Phosphorus (P)
=	<0.003	x 10 ⁻⁶ lb/dscf Beryllium (Be)	=		
=	<0.028	x 10 ⁻⁶ lb/dscf Cadmium (Cd)	=	<0.055	x 10 ⁻⁶ lb/dscf Selenium (Se)
=	<0.074	x 10 ⁻⁶ lb/dscf Chromium (Cr)	=	<0.028	x 10 ⁻⁶ lb/dscf Silver (Ag)
=	0.119	x 10 ⁻⁶ lb/dscf Copper (Cu)	=	<0.055	x 10 ⁻⁶ lb/dscf Thallium (Tl)
=	<0.055	x 10 ⁻⁶ lb/dscf Lead (Pb)	=	0.543	x 10 ⁻⁶ lb/dscf Zinc (Zn)
=	<0.028	x 10 ⁻⁶ lb/dscf Cobalt (Co)	=		

Metals emission rate (lb/hr):

$$E_m = C'_s \times Q_{\text{std}}$$

=	<0.000186	lb/hr Antimony (Sb)	=	0.000140	lb/hr Manganese (Mn)
=	<0.000186	lb/hr Arsenic (As)	=	0.000325	lb/hr Nickel (Ni)
=	<0.001070	lb/hr Barium (Ba)	=	0.036062	lb/hr Phosphorus (P)
=	<0.000009	lb/hr Beryllium (Be)	=		
=	<0.000094	lb/hr Cadmium (Cd)	=	<0.000186	lb/hr Selenium (Se)
=	<0.000251	lb/hr Chromium (Cr)	=	<0.000094	lb/hr Silver (Ag)
=	0.000405	lb/hr Copper (Cu)	=	<0.000186	lb/hr Thallium (Tl)
=	<0.000186	lb/hr Lead (Pb)	=	0.001842	lb/hr Zinc (Zn)
=	<0.000094	lb/hr Cobalt (Co)	=		



Metals Laboratory Data Summary

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/17/2013
 Run #: 2
 Time: 12:35 - 15:43

ND-Value Below Minimum Detection Limit - listed by DAT as ND
 J-Value below LOQ but above MDL
 (Sample - Blank) less than MDL: use MDL
 FH = Front half, BH = Back half

Front Half Metal Calculation

Metal	FH Sample (M _{fh}) (micrograms)	FH Blank (M _{fb}) (micrograms)	I Value		II Values			Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)	Final* Blank Corrected Sample Mass (micrograms)	Sample	MDL
			A Value (4 inch filter) (micrograms)	5 % of FH Sample (micrograms)	Lesser value (M _{fb}) vs 5% (micrograms)	Greater Value I vs II (micrograms)						
Antimony	2.02	7.15	20.62	0.10	0.10	20.62	7.15	-5.13	<1.25	J	1.25	
Arsenic	<1.25	0.00	20.62	0.06	0.00	20.62	0.00	1.25	<1.25	ND	1.25	
Barium	6.60	11.02	20.62	0.33	0.33	20.62	11.02	-4.42	<2.50	J	2.50	
Beryllium	<0.06	0.00	20.62	0.00	0.00	20.62	0.00	0.06	<0.06	ND	0.06	
Cadmium	<0.63	0.00	20.62	0.03	0.00	20.62	0.00	0.63	<0.63	ND	0.63	
Chromium	5.05	5.44	20.62	0.25	0.25	20.62	5.44	-0.39	<0.25		0.25	
Cobalt	<0.63	1.01	20.62	0.03	0.03	20.62	1.01	-0.38	<0.63	ND	0.63	
Copper	3.59	1.55	20.62	0.18	0.18	20.62	1.55	2.04	2.04		0.32	
Lead	20.56	21.09	20.62	1.03	1.03	20.62	20.62	-0.06	<1.25		1.25	
Manganese	2.26	1.26	20.62	0.11	0.11	20.62	1.26	1.00	1.00	J	0.63	
Nickel	4.46	2.12	20.62	0.22	0.22	20.62	2.12	2.34	<2.34		0.63	
Phosphorus	206.46	171.49	20.62	10.32	10.32	20.62	20.62	185.84	185.84		2.50	
Selenium	6.36	11.63	20.62	0.32	0.32	20.62	11.63	-5.27	<1.25		1.25	
Silver	<0.63	0.00	20.62	0.03	0.00	20.62	0.00	0.63	<0.63	ND	0.63	
Thallium	<1.25	0.00	20.62	0.06	0.00	20.62	0.00	1.25	<1.25	ND	1.25	
Zinc	19.88	5.24	20.62	0.99	0.99	20.62	5.24	14.64	14.64		0.63	

*Use MDL if the blank corrected value is <MDL

Back Half Metal Calculation

Metal	BH Sample (M _{bh}) (micrograms)	BH Blank (M _{bhb}) (micrograms)	I Value		II Values			Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)	Final* Blank Corrected Sample Mass (micrograms)	Sample	MDL
			A Value (micrograms)	5 % of BH Sample (micrograms)	Lesser value (M _{bhb}) vs 5% (micrograms)	Greater Value I vs II (micrograms)						
Antimony	<1.25	17.76	1.00	0.06	0.06	1.00	1.00	0.25	<1.25	ND	1.25	
Arsenic	<1.25	0.00	1.00	0.06	0.00	1.00	0.00	1.25	<1.25	ND	1.25	
Barium	11.89	0.00	1.00	0.59	0.00	1.00	0.00	11.89	11.89		2.50	
Beryllium	<0.10	0.43	1.00	0.01	0.01	1.00	0.43	-0.33	<0.06	J	0.06	
Cadmium	0.92	3.51	1.00	0.05	0.05	1.00	1.00	-0.08	<0.63	J	0.63	
Chromium	3.13	0.00	1.00	0.16	0.00	1.00	0.00	3.13	3.13		0.25	
Cobalt	<0.63	0.00	1.00	0.03	0.00	1.00	0.00	0.63	<0.63	ND	0.63	
Copper	4.41	5.16	1.00	0.22	0.22	1.00	1.00	3.41	3.41		0.32	
Lead	<1.25	8.25	1.00	0.06	0.06	1.00	1.00	0.25	<1.25	ND	1.25	
Manganese	0.88	0.00	1.00	0.04	0.00	1.00	0.00	0.88	0.88	J	0.63	
Nickel	2.03	0.00	1.00	0.10	0.00	1.00	0.00	2.03	2.03	J	0.63	
Phosphorus	314.91	322.35	1.00	15.75	15.75	15.75	15.75	299.16	299.16		2.50	
Selenium	<1.25	0.00	1.00	0.06	0.00	1.00	0.00	1.25	<1.25	ND	1.25	
Silver	<0.63	0.00	1.00	0.03	0.00	1.00	0.00	0.63	<0.63	ND	0.63	
Thallium	<1.25	0.00	1.00	<0.06	0.00	1.00	0.00	1.25	<1.25	ND	1.25	
Zinc	10.14	0.00	1.00	0.51	0.00	1.00	0.00	10.14	10.14		0.63	

*Use MDL if the blank corrected value is <MDL

2-1-13
CS



Metals Laboratory Data Summary
Total Front Half Plus Back Half Metal Calculation

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/17/2013
 Run #: 2
 Time: 12:35 - 15:43

ND-Value Below Minimum Detection Limit - listed by DAT as ND
 J-Value below LOQ but above MDL
 (Sample - Blank) less than MDL: use MDL
 FH = Front half, BH = Back half

Metal	Final FH Blank Corrected Sample Mass	Final BH Blank Corrected Sample Mass	BH Blank	Total Metal (M _t) (micrograms)	MDL	Front half J or ND	Back half J or ND
Antimony	<1.25	<1.25		<2.50	1.25	J	ND
Arsenic	<1.25	<1.25		<2.50	1.25	ND	ND
Barium	<2.50	11.89		<14.39	2.50	J	0.00
Beryllium	<0.06	<0.06		<0.12	0.06	ND	J
Cadmium	<0.63	<0.63		<1.26	0.63	ND	J
Chromium	<0.25	3.13		<3.38	0.25		
Cobalt	<0.63	<0.63		<1.26	0.63	ND	ND
Copper	2.04	3.41		5.45	0.32		
Lead	<1.25	<1.25		<2.50	1.25		ND
Manganese	1.00	0.88		1.88	0.63	J	J
Nickel	2.34	2.03		4.37	0.63		J
Phosphorus	185.84	299.16		485.00	2.50		
Selenium	<1.25	<1.25		<2.50	1.25		ND
Silver	<0.63	<0.63		<1.26	0.63	ND	ND
Thallium	<1.25	<1.25		<2.50	1.25	ND	ND
Zinc	14.64	10.14		24.78	0.63		



**USEPA Method 2
Volumetric Flow Rate Sample Calculations (Circular Ducts)**

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/17/2013
 Run #: 2

Data Input

Carbon Dioxide (CO ₂):	0.3 %
Oxygen (O ₂):	20.6 %
Nitrogen (N ₂):	79.1 %
Fractional Moisture Content (B _{ws})	0.0143 dimensionless
Stack Temperature (T _s):	135.8 °F
Pitot Coefficient (C _p):	0.84 dimensionless
Average square root of ΔP	0.9400 inches H ₂ O
Barometric Pressure (P _{bar}):	29.60 inches Hg
Static Pressure (S _t):	-0.65 inches H ₂ O
Stack diameter:	59.50 inches
Stack area (A _s):	19.3091 ft ²

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):**Dry molecular weight of stack gas:**

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2) = 28.872 \text{ lb/lb-mole}$$

Molecular weight of stack gas, wet basis:

$$M_s = (M_d \times (1 - B_{ws})) + (18 \times B_{ws}) = 28.717 \text{ lb/lb-mole}$$

Absolute stack gas pressure:

$$P_s = P_{bar} + \left(\frac{S_t}{13.6} \right) = 29.552 \text{ inches H}_2\text{O}$$

Stack gas velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{(T_s + 460)}{(P_s \times M_s)}} = 56.562 \text{ feet/second}$$

Stack gas volumetric flow rate:

$$Q_a = A_s \times V_s \times 60 = 65,529 \text{ acfm}$$

Stack gas volumetric flow rate, wet basis:

$$Q_{sw} = Q_a \times \left[\left(\frac{528^\circ\text{R}}{29.92 \text{ in. Hg}} \right) \times \left(\frac{P_s}{T_s + 460} \right) \right] = 57,355 \text{ scfm}$$

$$Q_{sw} = Q_a \times \left[\left(\frac{528^\circ\text{R}}{29.92 \text{ in. Hg}} \right) \times \left(\frac{P_s}{T_s + 460} \right) \right] \times 60 = 3,441,308 \text{ scfh}$$

Stack gas volumetric flow rate, dry basis:

$$Q_{std} = Q_{sw} \times (1 - B_{ws}) = 56,535 \text{ dscfm}$$

$$Q_{std} = Q_{sw} \times (1 - B_{ws}) \times 60 = 3,392,104 \text{ dscfh}$$



**USEPA Method 4
Moisture Determination Sample Calculations**

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/17/2013
 Run #: 2

Data Input:

Volume metered (V _m):	103.290 ft ³
Meter calibration coefficient (Y _d):	1.002 dimensionless
Barometric pressure (P _{bar}):	29.60 inches Hg
Meter sample rate (ΔH):	1.12 inches H ₂ O
Meter inlet/outlet temperature (T _m):	78.9 °F
Volume of moisture collected (V _{ic}):	31.0 milliliters
Stack Temperature (T _s):	135.8 °F
Static Pressure (St):	-0.7 inches H ₂ O

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):**Volume of sample, dry basis:**

$$V_{m_{std}} = V_m \times Y_d \times \left(\frac{528.0^\circ R}{29.92 \text{ Hg}} \right) \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m + 460} \right) = 100.595 \text{ dscf}$$

Volume of water vapor in sample:

$$V_{wstd} = \frac{0.04707 \text{ ft}^3}{\text{ml}} \times V_{ic} = 1.459 \text{ scf}$$

Fractional moisture content of stack gas:

$$B_{ws} = \frac{V_{wstd}}{(V_{mstd} + V_{wstd})} = 0.0143 B_{wo}$$

Percent Moisture:

$$\% \text{moisture} = B_{ws} \times 100 = 1.43 \%$$

Fractional moisture content of stack gas at saturated conditions:

$$T_{s(K)} = ((T_s - 32) \times 0.5556) + 273 = 330.7 \text{ °Kelvin}$$

$$P_{s(\text{mmHg})} = \left(P_{bar} + \frac{S_1}{13.6} \right) \times 25.401 = 751.87 \text{ mm Hg}$$

$$B_{ws} = \frac{\sqrt{\left(10^{A \left(\frac{B}{(T_s(K) - C)} \right)} \right)}}{P_{s(\text{mmHg})}} \quad \begin{array}{l} \text{where:} \\ A = 6.361 \\ B = 1893.5 \\ C = 27.65 \end{array} = 0.1717 \%$$

Percent moisture at saturated conditions:

$$\% \text{moisture}_{\text{saturated}} = B_{ws} \times 100 = 17.17 \%$$

Percent moisture used for emissions calculations:

$$= 1.43 \%$$



USEPA Method 29
Metals Emissions Calculation Summary

Client: H. Kramer
Location: Chicago, IL
Source: North Baghouse
Date: 9/16/2013
Run #: 3

Test Data Input

Metals Laboratory Analysis Weights (Mt)

Barometric pressure (P _{bar}):	29.45 inches Hg	Antimony (Sb):	<7.68 ug	Manganese (Mn):	<2.16 ug
Stack pressure (P _s):	29.41 inches Hg Abs.	Arsenic (As):	<2.50 ug	Nickel (Ni):	4.90 ug
Test length (t):	180.0 minutes	Barium (Ba):	<5.00 ug	Phosphorus (P):	432.64 ug
Sample nozzle diameter (D _n):	0.1870 inches	Beryllium (Be):	<0.12 ug	Selenium (Se):	<12.24 ug
Sample nozzle area (S _b):	0.000191 ft ²	Cadmium (Cd):	<1.26 ug	Silver (Ag):	<1.35 ug
Stack temperature (T _s):	133.7 °F	Chromium (Cr):	5.62 ug	Thallium (Tl):	<2.50 ug
Volume metered (V _{meas}):	103.733 dscf	Cobalt (Co):	<1.26 ug	Zinc (Zn):	24.54 ug
Stack gas velocity (V _s):	57.825 ft/sec	Copper (Cu):	<3.96 ug		
Stack gas volumetric flow (Q _{gas}):	3,455,392 dscfh	Lead (Pb):	8.45 ug		
Fractional Moisture content (B _{ws}):	0.0166 %				

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Percent Isokinetic:

$$\% \text{ Isokinetic} = \frac{0.0945 \times V_{meas} \times (T_s + 460)}{P_s \times V_s \times 6 \times A_n \times (1 - B_{ws})} = 101.37 \% \text{ Isokinetic}$$

Metals concentration (mg/dscm):

$$C_s = \frac{M_i}{\left[\frac{V_{meas}}{35.31 \text{ dscf} / \text{dscm}} \right]}$$

=	<0.00268	mg/dscm Antimony (Sb)	=	<0.00074	mg/dscm Manganese (Mn)
=	<0.00085	mg/dscm Arsenic (As)	=	0.00167	mg/dscm Nickel (Ni)
=	<0.00170	mg/dscm Barium (Ba)	=	0.14727	mg/dscm Phosphorus (P)
=	<0.00004	mg/dscm Beryllium (Be)	=	<0.00417	mg/dscm Selenium (Se)
=	<0.00043	mg/dscm Cadmium (Cd)	=	<0.00047	mg/dscm Silver (Ag)
=	0.00191	mg/dscm Chromium (Cr)	=	<0.00085	mg/dscm Thallium (Tl)
=	<0.00135	mg/dscm Copper (Cu)	=	0.00835	mg/dscm Zinc (Zn)
=	0.00288	mg/dscm Lead (Pb)			
=	<0.00043	mg/dscm Cobalt (Co)			

Metals concentration (x 10⁻⁹ lb/dscf):

$$C'_s = \frac{\left(\frac{2,205 \times 10^{-9} \text{ lb}}{\mu\text{g}} \times M_i \right)}{V_{meas}}$$

=	<0.168	x 10 ⁻⁹ lb/dscf Antimony (Sb)	=	<0.046	x 10 ⁻⁹ lb/dscf Manganese (Mn)
=	<0.053	x 10 ⁻⁹ lb/dscf Arsenic (As)	=	0.104	x 10 ⁻⁹ lb/dscf Nickel (Ni)
=	<0.106	x 10 ⁻⁹ lb/dscf Barium (Ba)	=	9.197	x 10 ⁻⁹ lb/dscf Phosphorus (P)
=	<0.003	x 10 ⁻⁹ lb/dscf Beryllium (Be)	=	<0.260	x 10 ⁻⁹ lb/dscf Selenium (Se)
=	<0.027	x 10 ⁻⁹ lb/dscf Cadmium (Cd)	=	<0.029	x 10 ⁻⁹ lb/dscf Silver (Ag)
=	0.119	x 10 ⁻⁹ lb/dscf Chromium (Cr)	=	<0.053	x 10 ⁻⁹ lb/dscf Thallium (Tl)
=	<0.085	x 10 ⁻⁹ lb/dscf Copper (Cu)	=	0.522	x 10 ⁻⁹ lb/dscf Zinc (Zn)
=	0.180	x 10 ⁻⁹ lb/dscf Lead (Pb)			
=	<0.027	x 10 ⁻⁹ lb/dscf Cobalt (Co)			

Metals emission rate (lb/hr):

$$E_m = C'_s \times Q_{gd}$$

=	<0.000579	lb/hr Antimony (Sb)	=	<0.000159	lb/hr Manganese (Mn)
=	<0.000184	lb/hr Arsenic (As)	=	0.000360	lb/hr Nickel (Ni)
=	<0.000367	lb/hr Barium (Ba)	=	0.031778	lb/hr Phosphorus (P)
=	<0.000009	lb/hr Beryllium (Be)	=	<0.000899	lb/hr Selenium (Se)
=	<0.000093	lb/hr Cadmium (Cd)	=	<0.000101	lb/hr Silver (Ag)
=	0.000413	lb/hr Chromium (Cr)	=	<0.000184	lb/hr Thallium (Tl)
=	<0.000292	lb/hr Copper (Cu)	=	0.001802	lb/hr Zinc (Zn)
=	0.000621	lb/hr Lead (Pb)			
=	<0.000093	lb/hr Cobalt (Co)			



Metals Laboratory Data Summary

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/18/2013
 Run #: 3
 Time: 07:40 - 10:48

ND-Value Below Minimum Detection Limit - listed by DAT as ND
 J-Value below LOQ but above MDL
 (Sample - Blank) less than MDL: use MDL
 FH = Front half, BH = Back half

Front Half Metal Calculation

Metal	FH Sample (M _{fh}) (micrograms)	FH Blank (M _{fhb}) (micrograms)	<u>I Value</u>	<u>II Values</u>		Greater Value I vs II (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)	Final* Blank Corrected Sample Mass (micrograms)	Sample	MDL
			A Value (4 inch filter) (micrograms)	5 % of FH Sample (micrograms)	Lesser value (M _{fhb}) vs 5% (micrograms)						
Antimony	1.41	7.15	17.59	0.07	0.07	17.59	7.15	-5.74	<1.25	J	1.25
Arsenic	<1.25	0.00	17.59	0.06	0.00	17.59	0.00	1.25	<1.25	ND	1.25
Barium	8.22	11.02	17.59	0.41	0.41	17.59	11.02	-2.80	<2.50	J	2.50
Beryllium	<0.06	0.00	17.59	0.00	0.00	17.59	0.00	0.06	<0.06	ND	0.06
Cadmium	<0.63	0.00	17.59	0.03	0.00	17.59	0.00	0.63	<0.63	ND	0.63
Chromium	6.57	5.44	17.59	0.33	0.33	17.59	5.44	1.13	1.13		0.25
Cobalt	<0.63	1.01	17.59	0.03	0.03	17.59	1.01	-0.38	<0.63	ND	0.63
Copper	1.18	1.55	17.59	0.06	0.06	17.59	1.55	-0.37	<0.32		0.32
Lead	23.35	21.09	17.59	1.17	1.17	17.59	17.59	5.76	5.76		1.25
Manganese	<0.63	1.26	17.59	0.03	0.03	17.59	1.26	-0.63	<0.63	ND	0.63
Nickel	4.92	2.12	17.59	0.25	0.25	17.59	2.12	2.80	2.80		0.63
Phosphorus	145.94	171.49	17.59	7.30	7.30	17.59	17.59	128.35	128.35		2.50
Selenium	12.48	11.63	17.59	0.62	0.62	17.59	11.63	0.85	<1.25		1.25
Silver	0.75	0.00	17.59	0.04	0.00	17.59	0.00	0.75	0.75	J	0.63
Thallium	<1.25	0.00	17.59	0.06	0.00	17.59	0.00	1.25	<1.25	ND	1.25
Zinc	17.24	5.24	17.59	0.86	0.86	17.59	5.24	12.00	12.00		0.63

*Use MDL if the blank corrected value is <MDL

Back Half Metal Calculation

Metal	BH Sample (M _{bh}) (micrograms)	BH Blank (M _{bhb}) (micrograms)	<u>I Value</u>	<u>II Values</u>		Greater Value I vs II (micrograms)	Blank Value Used (micrograms)	Blank Corrected Sample Mass (micrograms)	Final* Blank Corrected Sample Mass (micrograms)	Sample	MDL
			(micrograms)	5 % of BH Sample (micrograms)	Lesser value (M _{bhb}) vs 5% (micrograms)						
Antimony	7.63	17.76	1.00	0.38	0.38	1.00	1.00	6.63	6.63		1.25
Arsenic	<1.25	0.00	1.00	0.06	0.00	1.00	0.00	1.25	<1.25	ND	1.25
Barium	<2.50	0.00	1.00	0.13	0.00	1.00	0.00	2.50	<2.50	ND	2.50
Beryllium	<0.06	0.43	1.00	0.00	0.00	1.00	0.43	-0.37	<0.06	ND	0.06
Cadmium	1.23	3.51	1.00	0.06	0.06	1.00	1.00	0.23	<0.63	J	0.63
Chromium	4.49	0.00	1.00	0.22	0.00	1.00	0.00	4.49	4.49		0.25
Cobalt	<0.63	0.00	1.00	0.03	0.00	1.00	0.00	0.63	<0.63	ND	0.63
Copper	4.66	5.16	1.00	0.23	0.23	1.00	1.00	3.66	3.66		0.32
Lead	3.69	8.25	1.00	0.18	0.18	1.00	1.00	2.69	2.69	J	1.25
Manganese	1.53	0.00	1.00	0.08	0.00	1.00	0.00	1.53	1.53	J	0.63
Nickel	2.10	0.00	1.00	0.11	0.00	1.00	0.00	2.10	2.10	J	0.63
Phosphorus	320.31	322.35	1.00	16.02	16.02	16.02	16.02	304.29	304.29		2.50
Selenium	10.99	0.00	1.00	0.55	0.00	1.00	0.00	10.99	10.99		1.25
Silver	<0.63	0.00	1.00	0.03	0.00	1.00	0.00	0.63	<0.63	ND	0.63
Thallium	<1.25	0.00	1.00	0.06	0.00	1.00	0.00	1.25	<1.25	ND	1.25
Zinc	12.54	0.00	1.00	0.63	0.00	1.00	0.00	12.54	12.54		0.63

*Use MDL if the blank corrected value is <MDL



Metals Laboratory Data Summary
Total Front Half Plus Back Half Metal Calculation

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/18/2013
 Run #: 3
 Time: 07:40 - 10:48

ND-Value Below Minimum Detection Limit - listed by DAT as ND
 J-Value below LOQ but above MDL
 (Sample - Blank) less than MDL: use MDL
 FH = Front half, BH = Back half

Metal	Final FH Blank Corrected Sample Mass	Final BH Blank Corrected Sample Mass	BH Blank	Total Metal (M _t) (micrograms)	MDL	Front half J or ND	Back half J or ND
Antimony	<1.25	6.63		<7.88	1.25	J	
Arsenic	<1.25	<1.25		<2.50	1.25	ND	ND
Barium	<2.50	<2.50		<5.00	2.50	J	ND
Beryllium	<0.06	<0.06		<0.12	0.06	ND	ND
Cadmium	<0.63	<0.63		<1.26	0.63	ND	J
Chromium	1.13	4.49		5.62	0.25		
Cobalt	<0.63	<0.63		<1.26	0.63	ND	ND
Copper	<0.32	3.66		<3.98	0.32		
Lead	5.76	2.69		8.45	1.25		J
Manganese	<0.63	1.53		<2.16	0.63	ND	J
Nickel	2.80	2.10		4.90	0.63		J
Phosphorus	128.35	304.29		432.64	2.50		
Selenium	<1.25	10.99		<12.24	1.25		
Silver	0.75	<0.63		<1.38	0.63	J	ND
Thallium	<1.25	<1.25		<2.50	1.25	ND	ND
Zinc	12.00	12.54		24.54	0.63		



**USEPA Method 2
Volumetric Flow Rate Sample Calculations (Circular Ducts)**

Client: H. Kramer
Location: Chicago, IL
Source: North Baghouse
Date: 9/18/2013
Run #: 3

Data Input

Carbon Dioxide (CO ₂):	0.4 %
Oxygen (O ₂):	20.4 %
Nitrogen (N ₂):	79.2 %
Fractional Moisture Content (B _{ws})	0.0166 dimensionless
Stack Temperature (T _s):	133.7 °F
Pitot Coefficient (C _p):	0.84 dimensionless
Average square root of ΔP	0.9601 inches H ₂ O
Barometric Pressure (P _{bar}):	29.45 inches Hg
Static Pressure (S _t)	-0.55 inches H ₂ O
Stack diameter:	59.50 inches
Stack area (A _s):	19.3091 ft ²

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Dry molecular weight of stack gas:

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2) = 28.880 \text{ lb/lb-mole}$$

Molecular weight of stack gas, wet basis:

$$M_s = (M_d \times (1 - B_{ws})) + (18 \times B_{ws}) = 28.699 \text{ lb/lb-mole}$$

Absolute stack gas pressure:

$$P_s = P_{bar} + \left(\frac{S_t}{13.6} \right) = 29.410 \text{ inches H}_2\text{O}$$

Stack gas velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{(T_s + 460)}{(P_s \times M_s)}} = 57.825 \text{ feet/second}$$

Stack gas volumetric flow rate:

$$Q_s = A_s \times V_s \times 60 = 66,993 \text{ acfm}$$

Stack gas volumetric flow rate, wet basis:

$$Q_{sw} = Q_s \times \left[\left(\frac{528^\circ\text{R}}{29.92 \text{ in. Hg}} \right) \times \left(\frac{P_s}{T_s + 460} \right) \right] = 58,562 \text{ scfm}$$

$$Q_{sw} = Q_s \times \left[\left(\frac{528^\circ\text{R}}{29.92 \text{ in. Hg}} \right) \times \left(\frac{P_s}{T_s + 460} \right) \right] \times 60 = 3,513,719 \text{ scfh}$$

Stack gas volumetric flow rate, dry basis:

$$Q_{std} = Q_{sw} \times (1 - B_{ws}) = 57,590 \text{ dscfm}$$

$$Q_{std} = Q_{sw} \times (1 - B_{ws}) \times 60 = 3,455,392 \text{ dscfh}$$



**USEPA Method 4
Moisture Determination Sample Calculations**

Client: H. Kramer
 Location: Chicago, IL
 Source: North Baghouse
 Date: 9/18/2013
 Run #: 3

Data Input:

Volume metered (V_m):	105.835 ft ³
Meter calibration coefficient (Y_d):	1.002 dimensionless
Barometric pressure (P_{bar}):	29.45 inches Hg
Meter sample rate (ΔH):	1.16 inches H ₂ O
Meter inlet/outlet temperature (T_m):	72.8 °F
Volume of moisture collected (V_{ic}):	37.2 milliliters
Stack Temperature (T_s):	133.7 °F
Static Pressure (St):	-0.6 inches H ₂ O

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):**Volume of sample, dry basis:**

$$V_{m_{std}} = V_m \times Y_d \times \left(\frac{528.0^\circ R}{29.92 \text{ Hg}} \right) \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m + 460} \right) = 103.733 \text{ dscf}$$

Volume of water vapor in sample:

$$V_{wstd} = \frac{0.04707 \text{ ft}^3}{\text{ml}} \times V_{ic} = 1.751 \text{ scf}$$

Fractional moisture content of stack gas:

$$B_{ws} = \frac{V_{wstd}}{(V_{mstd} + V_{wstd})} = 0.0166 B_{ws}$$

Percent Moisture:

$$\% \text{moisture} = B_{ws} \times 100 = 1.66 \%$$

Fractional moisture content of stack gas at saturated conditions:

$$T_{s(K)} = ((T_s - 32) \times 0.5556) + 273 = 329.5 \text{ Kelvin}$$

$$P_{s(\text{mmHg})} = \left(P_{bar} + \frac{St}{13.6} \right) \times 25.401 = 748.06 \text{ mm Hg}$$

$$B_{ws} = \frac{\sqrt{\left(10^{\left(\frac{A \left(\frac{B}{T_{s(K)} - C} \right) \right)} \right)}}{P_{s(\text{mmHg})}} \quad \begin{array}{l} \text{where:} \\ A=5.361 \\ B=1893.5 \\ C=27.65 \end{array} = 0.1631 \%$$

Percent moisture at saturated conditions:

$$\% \text{moisture}_{\text{saturated}} = B_{ws} \times 100 = 16.31 \%$$

Percent moisture used for emissions calculations:

$$= 1.66 \%$$



TRAVERSE POINT LOCATIONS FOR CIRCULAR AND RECTANGULAR STACKS AND DUCTS

A-34

Facility H. Kiger
 Date 9-16-13
 Sampling Location North Bayhacker
 Inside of Far Wall to
 Outside of Port (Distance C) 61.75 in.
 Inside of Near Wall to
 Outside of Port (Distance D) 2.25 in
 Stack ID (Distance C- Distance D) 59.50 in.
 Port Distance Downstream From Disturbance (B) 288 in.
 Port Distance Upstream From Disturbance (A) 102 in.
 Equivalent Diameters Downstream From Disturbance (B) 484 (≥ 2.0)
 Equivalent Diameters Upstream From Disturbance (A) 171 (≥ 0.5)
 Number of Ports Used 2 Traverse Points / Port 12

Note: Sketch Stack/Ports/Control Device on Back of Form

Equivalent Diameters Downstream From Disturbance (B) =
 [Distance B / Stack ID]

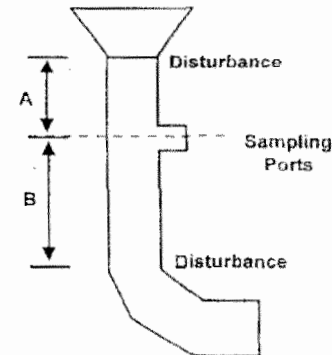
Equivalent Diameters Upstream From Disturbance (A) =
 [Distance A / Stack ID]

Equivalent Diameter For a Square or Rectangular Stack =
 [(2 x L x W) / (L + W)]

Port ID 6 in. (for monorail bracket specs.)

Port Length Outside of Stack < 2 in. (for monorail bracket specs.)

*L-brackets welded
 8' monorails w/ 1/2" E.L. Probes*



Port Traverse Point Number	Fractional % of Stack I.D. (frac. %)	Stack I.D. (inches)	Product of Columns 2 and 3 (inches)	Port Depth (inches)	Traverse Point Location From Outside of Port (Sum of 4 and 5 in inches)
1	0.021	59.5	1.25	2.25	4.50
2	0.067		3.99		6.24
3	0.118		7.02		10.53
4	0.177		10.53		14.88
5	0.250		14.88		19.13
6	0.356		21.18		23.43
7	0.44		26.31		27.56
8	0.50		29.75		31.28
9	0.523		31.47		34.23
10	0.552		32.48		36.43
11	0.933	✓	55.51		57.76
12	0.979		58.25	✓	60.50

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

Pts	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	66.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					87.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS
 CEMS*

Pts	2	3	4	5	6	7	8	9
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8
4			87.5	70.0	58.3	50.0	43.8	38.9
5				80.0	75.0	64.3	56.3	50.0
6					91.7	78.6	68.8	61.1
7						92.9	81.3	72.2
8							93.8	83.3
9								94.4

*3 point CEMS RATA traverse point locations (valid for rectangular and round stacks)

For Stacks / Ducts ≤ 24 inches ID - No traverse point shall be located less than 0.5 inches from stack wall

For Stacks / Ducts > 24 inches ID - No traverse point shall be located less than 1.0 inches from stack wall

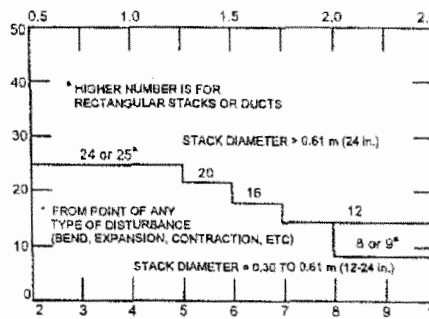
QA/QC Check:

Completeness _____ Legibility _____ Accuracy _____ Specifications _____

Method 1 Calculator Signature/Date [Signature] 9-16-13

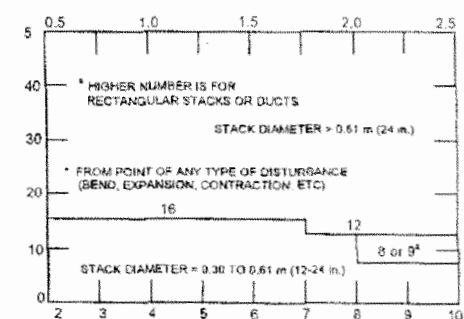
Field Supervisor Signature/Date _____

DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE* (DISTANCE A)



DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE* (DISTANCE B)
 MINIMUM NUMBER OF TRAVERSE POINTS
 ISOKINETIC TESTING

DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE* (DISTANCE A)



DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE* (DISTANCE B)
 MINIMUM NUMBER OF TRAVERSE POINTS
 FOR VELOCITY (NON-ISOKINETIC) TRAVERSES



FIELD DATA

PLANT H. Kramer AMBIENT TEMPERATURE 60
 DATE 1-17-13 BAROMETRIC PRESSURE 29.60
 LOCATION Chicago IL ASSUMED MOISTURE, % 3.5
 OPERATOR R. Deaton PROBE LENGTH, in. 82
 STACK NO. No. 76 Bingham NOZZLE DIAMETER, in. 0.132
 RUN NO. 1-PM-1 STACK DIAMETER, in. 59.5
 SAMPLE BOX NO. ADP-2 MINUTES PER POINT 2.5
 METER BOX NO. 61209 NUMBER OF POINTS 24
 START TIME 0815 NUMBER OF PORTS 2

PROBE HEATER SETTING 250
 HEATER BOX SETTING 230
 METER No. 682
 C. FACTOR 0.84
 Y. FACTOR 0.983
 PITOT NO. 653

WEIGHT OF PARTICULATE, mg	
Filter No.	51997
Sample	
Filter wt.	
Tare wt.	436
W. gain	
TOTAL	



CLOCK TIME (Hrs)	TRAVERSE POINT NUMBER	SAMPLING TIME (B) min.	STATIC PRESSURE (in. Hg)	STACK TEMP (°F)	VELOCITY READ		PRESSURE DIFFERENTIAL ACROSS IMPINGER ORIFICE (in. Hg)		GAS SAMPLE VOLUME (Y) ft ³	GAS SAMPLE TEMP AT DRY GAS METER		FILTER EXIT GAS TEMP. °F	PROBE TEMP °F	CPM MEASUREMENT TEMP °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM (in. Hg)
					(AP)	(BP)	ACTUAL	DESIRED		INLET (in. °F)	OUTLET (in. °F)					
0815	W1	0	-0.65	94	0.90		1.1	1.10	533.050	60	60	235	260	69	64	3
822.5	2	7.5		94	0.92		1.1	1.13	537.45	68	61	260	257	67	61	3
830	3	15		94	0.96		1.2	1.18	541.79	74	62	233	254	65	61	3
837.5	4	22.5		103	0.95		1.2	1.17	546.32	79	63	231	256	66	62	3
845	5	30		106	0.88		1.1	1.08	550.83	80	64	250	258	66	62	3
852.5	6	37.5		117	0.75		0.91	0.91	555.30	82	66	258	260	68	63	2
900	7	45		114	0.98		1.2	1.19	559.32	84	67	252	258	73	64	2
907.5	8	52.5		107	1.1		1.3	1.34	563.95	82	68	242	256	70	61	4
915	9	60		117	1.2		1.5	1.96	569.05	83	69	246	259	73	62	4
922.5	10	67.5		116	1.2		1.5	1.46	574.25	85	69	249	258	73	63	4
930	11	75		111	1.3		1.6	1.60	579.60	85	70	246	258	73	65	4
937.5	12	82.5		110	1.1		1.4	1.35	584.92	87	70	247	255	77	66	4
945 (1:00) N	1	90		129	0.77		0.95	0.95	589.10	80	71	268	254	80	65	3
1009.5	2	97.5		117	0.85		1.0	1.04	594.13	85	71	272	257	84	67	3
1017	3	105		109	0.80		0.99	0.94	598.45	87	72	242	255	85	63	3
1024.5	4	112.5		116	0.83		1.0	1.02	602.75	84	72	251	256	84	67	3
1032	5	120		115	0.86		1.1	1.06	607.14	85	72	245	255	82	56	3
1039.5	6	127.5		112	0.88		1.1	1.08	611.50	85	71	250	256	83	57	3
1047	7	135		112	0.92		1.0	1.01	615.87	86	71	250	249	83	56	3
1054.5	8	142.5		113	0.96		1.2	1.18	620.27	84	70	250	243	76	57	3
1102	9	150		114	1.0		1.2	1.23	624.89	84	72	251	245	70	57	3
1109.5	10	157.5		117	1.0		1.3	1.23	629.47	87	72	248	253	69	57	3
1117	11	165		115	1.1		1.4	1.36	634.23	89	73	250	257	68	57	4
1124.5	12	172.5		127	1.0		1.2	1.23	639.19	90	74	250	251	68	59	4
1132 (2M)		180					0.9787	1.0420	644.020							
AVERAGE	24	180	-0.65	111.58			0.95	1.19	110.905			75.5			68	4

VOLUME OR WEIGHT OF LIQUID COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g)					SILICA GEL WEIGHT
	#1	#2	#3	#4	#5	
INITIAL						
FINAL						
LIQUID COLLECTED						
TOTAL LIQUID COLLECTED (specify ml or g)						

ORSAT DATA	TIME	CO ₂	O ₂
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK
 SYSTEM PRE: 20.00 CFM @ 15" H₂O
 POST: 20.00 CFM @ 15" H₂O
 PITOT PRE: 1.0 @ 3" H₂O
 POST: 1.0 @ 3" H₂O

A-36



IMPINGER RECOVERY DATA SHEET

Company:	<u>H Kramer</u>	Date Set-up:	<u>9-16-13</u>
Location:	<u>Chicago FL</u>	Test Date:	<u>9-17-13</u>
Source:		Date Recovered:	<u>9-17-13</u>
Run No.:	<u>PM-1-North</u>	USEPA Method:	<u>5/302</u>
		Corresponding Filter Wgt:	<u>813.6</u>
		Filter Container No:	<u>51987</u>

Measurement Method: Weight or Volume

Impinger No.	Impinger Contents	Initial wt/vol g/mL	Final wt/vol g/mL	Difference wt/vol g/mL	Sample Container No.
1	<u>MT</u>	<u>348.9</u>	<u>358.0</u>	<u>9.1</u>	
2	<u>MT</u>	<u>598.9</u>	<u>599.1</u>	<u>0.2</u>	
3	<u>~100ml DI</u>	<u>673.7</u>	<u>678.4</u>	<u>4.7</u>	
4	<u>~200ml SG</u>	<u>834.4</u>	<u>839.8</u>	<u>5.4</u>	
5					
6					<u>19.4</u>

* 100ml DI H₂O added to impinger prior to purge.
 Purge started @ 12:15



FIELD DATA

PLANT H. Kline AMBIENT TEMPERATURE 65
 DATE 9-17-13 BAROMETRIC PRESSURE 29.60
 LOCATION North Chicago ASSUMED MOISTURE %
 OPERATOR RJB PROBE LENGTH, in. 72
 STACK NO North NOZZLE DIAMETER, in. 0.875
 RUN NO North-P4-2 STACK DIAMETER, in. 59.5
 SAMPLE BOX NO MINUTES PER POINT 7.5
 METER BOX NO NUMBER OF POINTS 24
 START TIME 1235 NUMBER OF PORTS 62

PROBE HEATER SETTING 250
 HEATER BOX SETTING 250
 METER H₂O 1.82
 C₁ FACTOR 0.89
 Y₁ FACTOR 0.985
 PITOT NO. 655

WEIGHT OF PARTICULATE, mg	
Filter No.	<u>23640</u>
Sample	
Final wt	
Tare wt	<u>316.4</u>
Wt gain	
TOTAL mg	



CLOCK TIME (hr)	TRAVERSE POINT NUMBER	SAMPLING TIME (9) min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMP (°F)	VELOCITY HEAD		PRESSURE DIFFERENTIAL ACROSS METER ORifice (in. H ₂ O)		GAS SAMPLE VOLUME (Vol)'	GAS SAMPLE TEMP AT DRY GAS METER		FILTER EXIT GAS TEMP. °F	PROBE TEMP °F	AUXILIARY TEMP °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM (in. Hg)
					(ΔP)	(ΔP)	ACTUAL	DESIRED		INLET (T _{in}) °F	OUTLET (T _{out}) °F					
1235	1	0	-0.50	146	0.80		0.93	0.93	649.70	76	72	239	252	69	68	2
1242.5	2	7.5		125	0.80		0.98	0.98	652.95	85	73	251	253	70	64	2
1250	3	15		120	0.82		1.1	1.10	659.19	87	74	264	252	71	64	2
1257.5	4	22.5		119	0.88		1.2	1.19	662.88	88	75	248	251	71	63	2
1305	5	30		121	0.85		1.2	1.14	667.47	89	74	249	251	72	64	2
1312.5	6	37.5		127	0.88		1.2	1.23	672.33	87	76	250	252	70	62	2
1320	7	45		121	0.86		1.2	1.20	677.18	86	75	251	252	70	60	2
1327.7	8	52.5		130	0.90		1.3	1.26	681.86	86	75	250	251	70	61	3
1335	9	60		139	0.93		1.3	1.3	688.82	87	75	251	251	70	63	3
1342.5	10	67.5		141	1.0		1.4	1.39	692.05	87	75	255	250	70	63	3
1350	11	75		128	1.1		1.5	1.54	697.32	87	75	253	254	71	62	3
1357.5	12	82.5		121	1.1		1.5	1.54	702.75	87	76	251	249	70	63	3
1405/1413	1	90		128	0.78		1.1	1.09	708.30	83	74	248	244	69	67	2
1420.5	2	97.5		135	0.86		1.2	1.20	712.70	89	76	262	249	68	66	2
1428	3	105		140	0.86		1.2	1.20	717.22	90	77	248	247	69	64	2
1435.5	4	112.5		136	0.89		1.1	1.14	721.62	90	78	251	248	69	65	2
1443	5	120		127	0.91		1.2	1.18	726.35	91	79	252	248	70	64	2
1450.5	6	127.5		146	0.79		1.0	1.02	731.10	90	80	254	250	70	64	2
1458	7	135		145	0.88		1.0	1.13	735.72	89	79	251	251	69	64	2
1505.5	8	142.5		144	0.98		1.3	1.27	739.95	87	78	253	253	70	63	3
1513	9	150		142	1.0		1.3	1.29	745.10	87	77	253	250	70	64	3
1520.5	10	157.5		142	1.2		1.6	1.55	750.20	87	76	251	251	70	64	3
1528	11	165		140	1.2		1.6	1.55	756.02	87	76	251	250	70	66	3
1535.5	12	172.5		122	1.2		1.6	1.55	761.08	86	75	250	253	71	67	3
1543	END	180							765.35							
AVERAGE	24	180	-0.50	132.5		0.9652	1.26		1160.5		81.4					

VOLUME OR WEIGHT OF LIQUID COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g)					SILICA GEL WEIGHT
	#1	#2	#3	#4	#5	
INITIAL						
LIQUID COLLECTED						
TOTAL LIQUID COLLECTED (specify ml or g)						

OBSERVATION DATA	TIME	CO ₂		O ₂	
		1	2	1	2
TRIAL 1					
TRIAL 2					
TRIAL 3					
Average					

V_m = 115.745 V

LEAK CHECK	
SYSTEM PRE:	<u>4000</u> CFM @ 15" H ₂ O
POST:	<u>4000</u> CFM @ 15" H ₂ O
PITOT PRE:	<u>V-2</u> @ 3" H ₂ O
POST:	<u>V-2</u> @ 3" H ₂ O

A-38



IMPINGER RECOVERY DATA SHEET

Company:	<u>H Kramer</u>	Date Set-up:	<u>9-16-13</u>
Location:	<u>Chicago IL</u>	Test Date:	<u>9-17-13</u>
Source:	<u>North BH</u>	Date Recovered:	<u>9-17-13</u>
Run No.:	<u>PM-2 - North</u>	USEPA Method:	<u>51202</u>
		Corresponding Filter Wgt:	<u>816.4</u>
		Filter Container No:	<u>53640</u>

Measurement Method: Weight or Volume

<u>Impinger No.</u>	<u>Impinger Contents</u>	<u>Initial wt/vol g/mL</u>	<u>Final wt/vol g/mL</u>	<u>Difference wt/vol g/mL</u>	<u>Sample Container No.</u>
1	<u>MT</u>	<u>370.2</u>	<u>393.8</u>	<u>23.6</u>	
2	<u>MT</u>	<u>598.1</u>	<u>599.8</u>	<u>1.7</u>	
3	<u>~100ml DF</u>	<u>729.5</u>	<u>734.0</u>	<u>4.5</u>	
4	<u>~200g SG</u>	<u>712.2</u>	<u>728.0</u>	<u>15.8</u>	
5					
6					<u>45.6</u>

* 100ml checked prior to purge
Purge started @ 1607

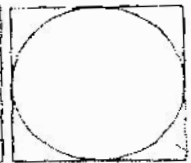


FIELD DATA

PLANT H. Kumer AMBIENT TEMPERATURE 68
 DATE 9-18-13 BAROMETRIC PRESSURE 29.45
 LOCATION Chicago, IL ASSUMED MOISTURE, %
 OPERATOR RB PROBE LENGTH, in.
 STACK NO. N/A NOZZLE DIAMETER, in.
 RUN NO. N/A STACK DIAMETER, in.
 SAMPLE BOX NO. MINUTES PER POINT
 METER BOX NO. 6109 NUMBER OF POINTS
 START TIME 0710 NUMBER OF PORTS 2

PROBE HEATER SETTING 250
 HEATER BOX SETTING 250
 METER No. 182
 C FACTOR 0.821
 Y FACTOR 0.958
 PITOT NO. 055

WEIGHT OF PARTICULATE, mg	
Filter No.	<u>53691</u>
Sample	
Post wt.	
Tare wt.	<u>813.8</u>
Pre-weigh	
TOTAL	mg



CLOCK TIME (H:M)	TRAVERSE POINT NUMBER	SAMPLING TIME (M) min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMP (°F)	VELOCITY HEAD		PRESSURE DIFFERENTIAL ACROSS METER ORIFICE (in. H ₂ O)		GAS SAMPLE VOLUME (ft ³)	GAS SAMPLE TEMP DRY GAS METER		FILTER EXIT GAS TEMP. °F	PROBE TEMP °F	CBM TEMPERATURE °F	LAST IMPINGER OUTLET TEMP. °F	PUMP VACUUM (in. Hg)
					(in. H ₂ O)	(ft/s)	ACTUAL	DESIRED		INLET (in. H ₂ O)	OUTLET (in. H ₂ O)					
740	1	0	-0.55	118	0.93		1.0	1.04	767.90	66	67	251	256	65	64	2
747.5	2	25		141	0.93		1.0	1.04	772.06	74	66	252	259	65	62	2
755	3	15		152	0.96		1.1	1.05	776.45	70	67	230	260	66	62	23
802.5	4	35		157	0.95		1.0	1.03	780.75	82	67	231	257	66	62	3
810	5	30		153	0.96		1.1	1.05	785.31	82	68	231	256	67	62	3
817.5	6	32.5		130	0.79		0.96	0.96	790.01	82	68	235	258	65	63	2
825	7	45		121	0.93		1.1	1.13	794.65	82	69	234	255	66	64	2
832.5	8	52.5		116	1.0		1.2	1.22	799.33	83	69	232	258	65	64	2
840	9	60		114	1.2		1.5	1.46	804.43	84	69	234	259	65	65	3
847.5	10	67.5		113	1.3		1.6	1.58	809.49	83	70	233	257	65	64	3
855	11	75		113	1.2		1.5	1.46	814.60	84	70	233	258	67	66	3
902.5	12	82.5		113	1.2		1.5	1.46	819.94	85	70	225	258	67	66	3
910	1	90		109	0.81		0.99	0.99	825.40	85	70	239	276	69	68	2
915	2	97.5		109	0.85		1.0	1.03	829.70	85	70	270	263	70	67	2
933	3	105		112	0.89		1.1	1.08	833.95	85	71	249	267	70	68	2
940.5	4	112.5		125	0.84		1.0	1.02	838.50	86	71	247	264	71	65	2
948	5	120		137	0.92		1.0	1.01	842.90	87	72	240	262	72	66	2
955.5	6	127.5		139	0.84		1.0	1.03	847.03	87	72	236	264	73	67	2
1003	7	135		141	0.80		0.98	0.98	851.45	89	73	238	263	74	67	2
1010.5	8	142.5		142	0.86		1.1	1.05	855.65	89	74	239	262	73	66	3
1018	9	150		142	0.95		1.2	1.18	860.20	89	74	236	262	72	66	3
1025.5	10	157.5		143	1.01		1.3	1.25	864.33	86	74	237	261	73	67	3
1033	11	165		144	1.1		1.4	1.37	869.25	88	76	239	258	72	66	3
1040.5	12	172.5		145	1.1		1.4	1.37	874.35	89	77	235	259	72	65	3
1048	(END)	180							879.550							
AVERAGE	24	180	-0.55	130.83	0.9699	1.17			116.800						68	≤ 3

VOLUME OR WEIGHT OF LIQUID COLLECTED	IMPINGER VOLUME (ml) OR WEIGHT (g)					SILICA GEL WEIGHT
	#1	#2	#3	#4	#5	
INITIAL						
LIQUID COLLECTED						
TOTAL LIQUID COLLECTED (specify ml or g)						

ORSAF DATA	TIME	CO ₂	O ₂
TRIAL 1			
TRIAL 2			
TRIAL 3			
Average			

LEAK CHECK	
SYSTEM PRE:	0.006 CFM @ 15" Hg
POST:	0.017 CFM @ 15" Hg
PITOT PRE:	4.1 @ 3" H ₂ O
POST:	1.8 @ 3" H ₂ O

A-40



IMPINGER RECOVERY DATA SHEET

Company:	<u>H. Kramer</u>	Date Set-up:	<u>9-16-13</u>
Location:	<u>Chicago IL</u>	Test Date:	<u>9-18-13</u>
Source:	<u>North BH</u>	Date Recovered:	<u>9-18-13</u>
Run No.:	<u>PM-3-North</u>	USEPA Method:	<u>51202</u>
		Corresponding Filter Wgt:	<u>813.8</u>
		Filter Container No:	<u>53641</u>

Measurement Method: Weight or Volume

<u>Impinger No.</u>	<u>Impinger Contents</u>	<u>Initial wt/vol g/mL</u>	<u>Final wt/vol g/mL</u>	<u>Difference wt/vol g/mL</u>	<u>Sample Container No.</u>
1	<u>MT</u>	<u>360.2</u>	<u>369.6</u>	<u>9.4</u>	
2	<u>MT</u>	<u>606.6</u>	<u>606.4</u>	<u>-0.2</u>	
3	<u>~100ml DI</u>	<u>740.4</u>	<u>753.1</u>	<u>12.7</u>	
4	<u>~200g SG</u>	<u>700.7</u>	<u>722.5</u>	<u>21.8</u>	
5					
6					<u>43.7</u>

* 100ml DI added prior to purge
 Purge started @ 11:15