erthwrks
AIR EMISSIONS TESTING FOR INDUSTRY

Relative Accuracy Test Audit and Performance Testing

for

Marathon Petroleum Company LP

at the

Marathon Detroit Refinery in Detroit, MI

on the

CCR Charge Heater (CCRPLCHARHTR)
Unit: EU14-CCRPLCHARHTR-S1
Permit No. MI-ROP-A9831-2012c

Prepared for:

MARATHON
Marathon Petroleum Company LP

Test Date: June 1, 2022
Erthwrks Project No. 9049.1.B3

A9831_test_20220601

STAC STACK TESTING ACCREDITATION COUNCIL
ACCREDITED TO ASTM D7036 ONLY CERT #6147.01
Louisiana Environmental Lab Accreditation Program LELAP
CARB

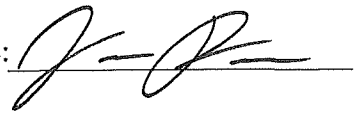
Endorsement Page

This report was developed in accordance with the requirements designated in the applicable regulatory permit(s) and or regulatory rules. To the best of my knowledge the techniques, instrumentation, and calculations presented in this report will serve to accurately and efficiently detail the results of the test campaign requirements.

Erthwrks, Inc.

Name: Jason Dunn

Title: QC Specialist

Signature: 

This report has been reviewed for accuracy and completeness. The actions presented in this report are, to the best of my knowledge, an accurate representation of the results and findings of the test campaign. Erthwrks, Inc. operates in conformance with the requirements on ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies and is accredited as such by the Stack Testing Accreditation Council (STAC) and the American Association for Laboratory Accreditation (A2LA).

Erthwrks, Inc.

Name: Trey Chapman

Title: CEO

Signature: 

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1.0 INTRODUCTION

1.1 Identification, location and dates of tests

Erthwrks, Inc. was contracted to conduct emission testing on the CCR Charge Heater (CCRPLCHARHTR) in operation at the Marathon Detroit Refinery, located in Detroit Michigan. The testing program was conducted on June 1, 2022.

1.2 Purpose of Testing

The exhaust from Crude/Vac Heater Stack was sampled and analyzed to determine the relative accuracy of the associated carbon monoxide (CO), oxides of nitrogen (NOx), and oxygen (O_2) continuous emissions monitoring system (CEMS) in accordance with the requirements in the Marathon Permit No. MI-ROP-A9831-2012c and the Title 40 CFR Part 60, Appendix F. In addition, compliance testing was conducted to determine the compliance status of the units' emission for sulfuric acid (H_2SO_4), and particulate matter (PM). The carbon dioxide (CO_2) concentration was also measured in order to determine stack gas molecular weight.

1.3 Description of Source

Marathon Petroleum Company LP operates the CCR Charge Heater designated as EU14-CCRPLCHARHTR-S1 in the refinery. This report addresses the RATA for the CEMS associated with the unit as well as the required compliance test for H_2SO_4 and PM. Table 1.1 below details the CEMS analyzer information.

Table 1.1—Marathon CCR Charge Heater Stack CEMS Details

Crude/Vac Heater Stack CEMS	Manufacturer	Model No.	S/N	Install Date
NOx	ABB	Uras 26	3.345725.1	2012
CO	ABB	Uras 26	3.248567.4	2012
O_2	ABB	Magnos 106	3.248610.4	2012

1.4 Contact Information

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Facility Location:
Marathon Petroleum Company LP
Detroit Refinery
1300 South Fort Street
Detroit, MI 48217

2.0 SUMMARY OF RESULTS

Table 2.1—Marathon Crude/Vac Heater Stack (SV04-H1-05-H1) CEMS RATA Results

Pollutant Measured	Performance Specification	Relative Accuracy	Applicable Limit	Pass/Fail
NOx	Performance Spec. 2	13.5% RA_{RM}	20%	Pass
CO	Performance Spec. 4A	0.5 ppm RA_{4A}	<5 ppm	Pass
O_2	Performance Spec. 3	0.3% *MD*	1%	Pass

Table 2.2—Marathon Crude/Vac Heater Stack (SV04-H1-05-H1) Compliance Test Results

Pollutant Measured	Methodology	Measured Results	Applicable Limit	Pass/Fail
PM	EPA Method 5	0.0012lb/MMBtu	0.0019 lb/MMBtu	Pass
PM/PM_{10}	EPA Method 5/202	0.0040 lb/MMBtu	0.0076 lb/MMBtu	Pass
H_2SO_4	EPA Method CTM-013	0.02 ppm	n/a	n/a
H_2SO_4	EPA Method CTM-013	0.0001 lb/MMBtu	n/a	n/a

3.0 SOURCE DESCRIPTION

3.1 Description of the process

Marathon Petroleum Company LP produces refined petroleum products from crude oil and is required to demonstrate that select process emission sources are operating in compliance with permitted emissions limits.

The Naphtha Hydrotreater unit uses hydrogen to remove sulfur and nitrogen from straight-run and coker naphthas. This process, known as hydrotreating, uses a catalyst to promote the desulfurization reaction. The desulfurized or sweet naphtha is blended into gasoline or used for platformer feed. The NHT unit consists of process vessels (including exchangers, reactors, receivers, separators, and a stripper column), heaters, tanks, containers, pumps, piping, drains, and various components (pump seals, process valves, pressure relief valves, flanges, connectors, etc.).

The CCR Charge Heater (CCRPLCHARHTR) (EU14-CCRPLCHARHTR-S1) heats the liquid from the bottom of the stripper column. The vapors that form are returned to the top of the stripper column; the liquid vapor is removed as a product stream.

3.2 Applicable permit and source designation

Marathon Petroleum Company LP operates the CCR Charge Heater (CCRPLCHARHTR) (EU14-CCRPLCHARHTR-S1) under EGLE Renewable Operating Permit No. MI-ROP-A9831-2012c.

3.3 Type and quantity of materials processed during tests

During the emission testing on June 1, 2022, at the Marathon Petroleum Company LP Refinery, the CCR Charge Heater (CCRPLCHARHTR) was tested while operating at the maximum achievable load condition. This operational data was provided by MPC and is located in Attachment G of this report.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Gaseous Emissions – NOx, CO, O_2, and CO_2

For the gaseous sampling, Erthwrks utilized a stainless-steel probe, of sufficient length to reach all sampling points, inserted into a sampling port that is located on the stack in accordance with EPA Method 1. The sample is extracted through the probe, a heated Teflon sampling line, to a heating filter. The sample then enters a minimum contact sample conditioner that cools and removes moisture from the gas matrix prior to entering the Erthwrks sampling manifold.

Erthwrks followed all quality assurance and quality control procedures as defined in US EPA 40 CFR 60 Appendix A. The Calibration Error (CE) Test was conducted as specified in EPA Method 7E §8.2.3. In accordance with this requirement, a three-point analyzer calibration error test was conducted prior to sampling. The CE test was conducted by introducing the low, mid, and high-level calibration gasses (as defined in EPA Method 7E §3.3.1-3) sequentially and the response was recorded. The results of the CE test are acceptable if the calculated calibration error is within ±2.0% of calibration span (or ≤ 0.5 ppmv).

The Initial System Bias and System Calibration Error Check was conducted in accordance with EPA Method 7E §8.2.5. The upscale calibration gas was introduced at the probe upstream of all sample system components and the response recorded. The procedure will was repeated with the low-level gas and the response recorded. During this activity, the sample system response time was also be recorded. This specification is acceptable if the calculated values of the system calibration error check are within ±5.0% of the calibration span value (or ≤0.5 ppmv).

After each test run, the sample system bias check is conducted to validate the run data. The low-level and upscale drift are calculated using Equation 7E-4. The run data is valid if the calculated drift is within ±3.0% of the calibration span value (or ≤0.5 ppmv).

After each test run, the corrected effluent gas concentration was calculated as specified in EPA Method 7E §12.6. The arithmetic average of all valid concentration values are adjusted for bias using equation 7E-5B.

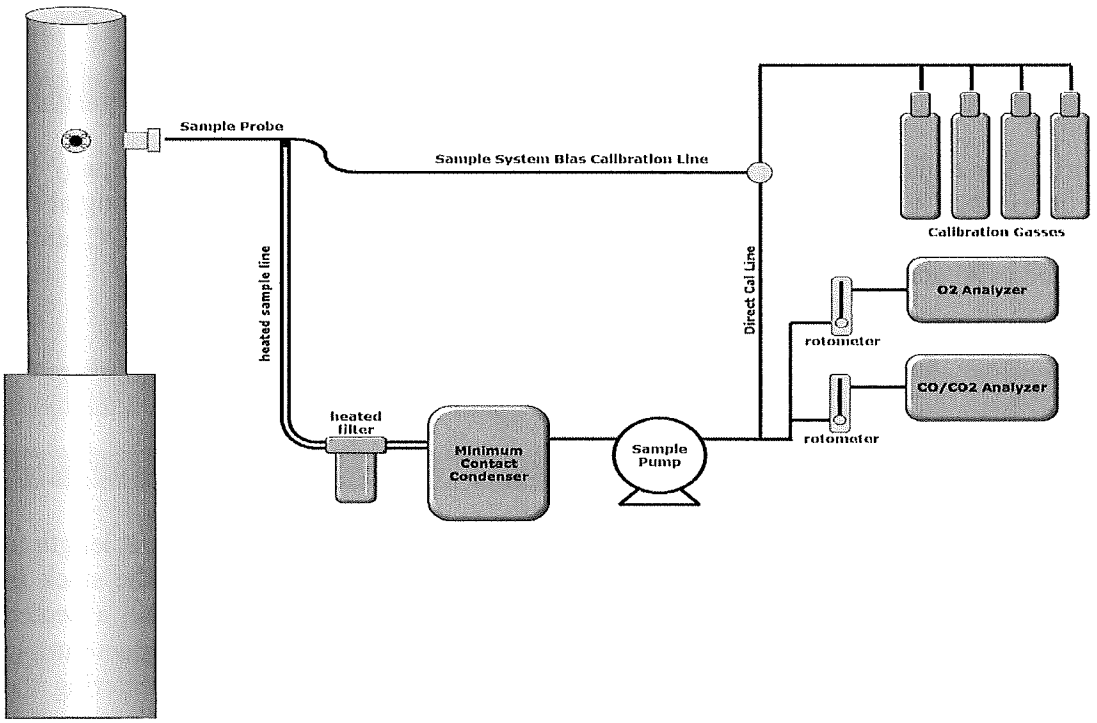


Figure 1: Example Erthwrks Gaseous Sampling System Diagram

4.2 Filterable Particulate Matter Sampling – EPA Method 5

EPA Test Method 1 will be used for the selection of sampling points. Stack dimensions, number of sample ports and sample port locations were confirmed prior to testing to determine the appropriate number of traverse points for the test.

EPA Test Method 5 was used to determine filterable particulate matter emission rates. Method 5 is the method at which particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter and on the lining of the isokinetic probe maintained at a temperature of 120 ± 14°C. Upon completion of each test run, the nozzle and probe liner were rinsed and brushed with acetone. The acetone rinse catch will be collected and combined with the filter holder rinse and labeled as "front half rinse". The total PM mass, which includes any material that condenses at or above the filtration temperature, is determined gravimetrically. Filterable PM will be calculated by combining the net gravimetric gain of the filter and the net gravimetric gain of the evaporated front half rinse. Figure 2 below shows the Method 5 sampling system components.

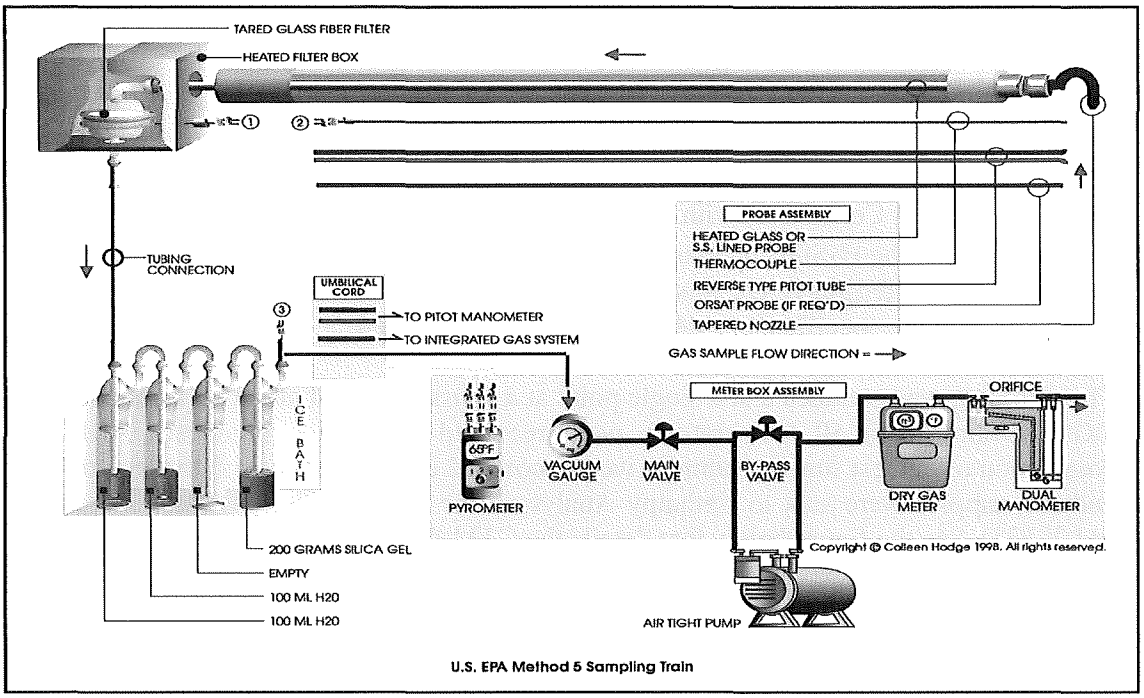


Figure 2: Example Erthwrks PM System Diagram

4.3 Condensible Particulate Matter Sampling – EPA Method 202

For the determination of PM/PM_{10}, condensable particulate matter (CPM) was measured via EPA Method 202. The Method 202 components begin at the back half of the Method 5 filter housing. The filterable particulate matter is removed in these "front half" components. The condensable particulate matter is then collected by drawing the filtered gas through a water jacketed, spiral condenser maintained at 65° – 85° F. The cooled effluent gas is then passed through two empty impingers and finally through a hexane extracted Teflon filter. Upon completion of each test run, the moisture collected in this portion of the sampling train is purged with ultra-high purity (UHP) nitrogen gas for one hour to remove any dissolved sulfur dioxide. The moisture is collected in a container and combined with the deionized water used to rinse all Method 202 sampling glassware two times.

The glassware is next rinsed with hexane and acetone. These rinses are collected and combined in an additional container. The Teflon filter is removed from the filter housing, labeled, and collected. Gravimetric analysis is then conducted on the extracted, evaporated samples for each run.

4.4 EPA Method CTM-013 (ALT-133 Analysis) H_2SO_4 Determination

The H_2SO_4 emissions were determined utilizing the conditional test method 13 (CTM-013). The sample was extracted at a constant rate through a quartz lined heated probe (>350 ˚F), A heated quartz filter holder and filter (>500 ˚F), and through a Modified Grahm condenser (H_2SO_4 Condenser) with Type C glass frit and 200 cm of 5-mmID glass tubing condenser coil. The H_2SO_4 condenser is maintained between 167 to 185 ˚F. Because SO_2 was not to be determined via this method, the sample was then passed through four impingers with the specifications delineated in EPA Method 4.

The sampling was conducted at a single point at a constant rate of about 10 L/min and the DGM readings and all temperatures were recorded every five minutes. After the completion of the test run, the samples were recovered in accordance with the test method and the samples were sent to Enthalpy Analytical for analysis via Ion Chromatography (ALT-133). See the figure below that details the CTM-013 Sampling Train.

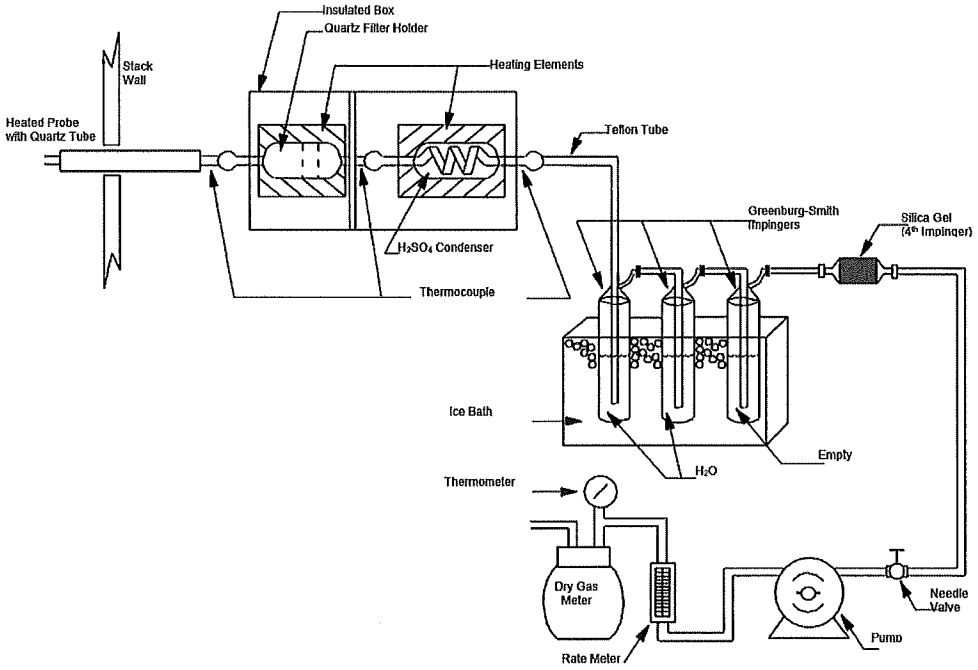


Figure 3: Example Erthwrks H_2SO_4 System Diagram

4.5 RATA Procedures

The RATA testing was conducted following the sampling and measurement procedures found in the EPA Part 60, Appendix B, Performance Specifications which requires that EPA Reference Methods, from EPA Part 60, Appendix A, be utilized to conduct independent stack emissions measurements for comparison with installed CEMS readings. The following performance specifications will be used during this testing program.

- EPA Performance Specification 2 for NOx relative accuracy
- EPA Performance Specification 3 for O_2 relative accuracy
- EPA Performance Specification 4/4A for CO relative accuracy

As required by these methods, the use EPA Protocol 1 gases are mandatory and were used for this portion of the project.

A minimum of nine (9) RATA test runs were conducted at each exhaust stack for a minimum duration of twenty-one (21) minutes for each run. A 3-point traverse located at 16.7%, 50.0%, and 83.3% of the way across the stack (or 0.4, 1.2, and 2.0 meters from the stack wall) was conducted during each RATA test run (7 minutes per point). A maximum of twelve (12) RATA test runs will be conducted and up to three test runs may be discarded and not used to determine relative accuracy. The results of the reference method tests were compared to CEMS measurement data from the same time periods to determine the relative accuracy of the CEMS.

For NOx, the results of the RATA test are considered acceptable if the calculated relative accuracy does not exceed 20.0% as calculated by Equation 2-6 in Performance Specification 2. Alternatively, for affected units where the average of the reference method measurements is less than 50 percent of the emission standard (emission limit), the relative accuracy must not exceed 10% when the applicable emission standard is used in the denominator of Eq. 2-6.

For O_2, the results of the RATA test are considered acceptable if the calculated relative accuracy does not exceed 20.0% as calculated by Equation 3.1 in Performance Specification 3. The results are also acceptable if the result of Equation 3-2 is less than or equal to 1.0 percent.

For CO, the results of the RATA test are considered acceptable if the calculated relative accuracy does not exceed 10.0% as calculated by Equation 2-6 in Performance Specification 2. Alternatively, for affected units where the average of the reference method measurements is less than 50 percent of the emission standard (emission limit), the relative accuracy must not exceed 5% when the applicable emission standard is used in the denominator of Eq. 2-6. Performance Specification 4A criteria may be used to determine relative accuracy for CEMS with low emission standards (less than 200 ppmv). In these cases, the results of the RATA test are considered acceptable if the absolute average difference between the RM and CEMS is within 5 ppmv.

4.6 Discussion of sampling procedure or operational variances

Erthwrks, Inc. conducted the emissions testing with no sampling or procedural variances.

Attachment A
Detailed Results of Emission Test

Erthwrks Relative Accuracy Test Audit--NOx RATA
Performance Specification 2

CCR Charge Htr									NO_X CEMS RATA - lb/MMBtu	
							Fuel F-Factor	8604	scf/MMBtu	
Test Run	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
Date	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**
Start Time	10:11	10:39	11:11	14:56	15:25	15:55	16:28	17:14	17:46	18:17
End Time	10:32	11:00	11:32	15:17	15:46	16:16	16:49	17:35	18:07	18:38
RM NOx (ppmvd)	24.23	23.79	23.91	23.04	23.74	23.53	23.86	23.71	24.74	23.77
RM O_2 Results (%vd)	6.71	6.63	6.55	6.80	6.70	6.79	6.85	6.82	6.85	6.96
RM NOx (lb/MMBtu)	**0.0367**	**0.0358**	**0.0358**	**0.0351**	**0.0359**	**0.0357**	**0.0365**	**0.0362**	**0.0378**	**0.0366**
CEMS NOx (lb/MMBtu)	**0.0408**	**0.0409**	**0.0404**	**0.0404**	**0.0403**	**0.0402**	**0.0406**	**0.0416**	**0.0422**	**0.0410**
Difference	-0.0041	-0.0051	-0.0046	-0.0053	-0.0044	-0.0045	-0.0041	-0.0054	-0.0044	-0.0044
Accept or Reject	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Reject*	*Accept*	*Accept*

Applicable Standard (lb/MMBtu)	0.05	
Mean of the Difference (d_{avg})	-0.0046	
Standard Deviation (S_d)	0.0004	
Confidence Coefficient (CC)	0.0003	
Relative Accuracy via RM, RA_{RM}*	**13.45%**	← ***Pass***

**RA_RM (Reference Method) must be less than 20%*

Erthwrks Relative Accuracy Test Audit--CO RATA
Performance Specification 4A

CCR Charge Htr								CO CEMS RATA at Stack Conditions		
Test Run	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
Date	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**
Start Time	10:11	10:39	11:11	14:56	15:25	15:55	16:28	17:14	17:46	18:17
End Time	10:32	11:00	11:32	15:17	15:46	16:16	16:49	17:35	18:07	18:38
RM CO Result (ppmvd)	**-0.32**	**0.04**	**0.23**	**-0.03**	**-0.07**	**0.18**	**0.05**	**0.16**	**0.15**	**0.03**
CEMS CO Data (ppmvd)	**-0.37**	**-0.35**	**-0.35**	**-0.35**	**-0.35**	**-0.33**	**-0.35**	**-0.35**	**-0.34**	**-0.34**
Difference	0.05	0.39	0.58	0.32	0.28	0.51	0.40	0.51	0.49	0.37
Accept or Reject	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Reject*

Mean of the Difference (d_{avg})	0.39	
Standard Deviation (S_d)	0.16	
Confidence Coefficient (CC)	0.12	
Relative Accuracy via M.4A, *RA* $_{4A}$ ‡	**0.52**	← ***Pass***

‡*RA* $_{4A}$ *must be less than 5 ppmv*

Erthwrks Relative Accuracy Test Audit--O_2 RATA
Performance Specification 3

CCR Charge Htr									O_2 CEMS RATA	
Test Run	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
Date	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**	**6/1/2022**
Start Time	10:11	10:39	11:11	14:56	15:25	15:55	16:28	17:14	17:46	18:17
End Time	10:32	11:00	11:32	15:17	15:46	16:16	16:49	17:35	18:07	18:38
RM O_2 Result (%vd)	**6.71**	**6.63**	**6.55**	**6.80**	**6.70**	**6.79**	**6.85**	**6.82**	**6.85**	**6.96**
CEMS O_2 Data (%vd)	**7.05**	**7.06**	**6.91**	**7.00**	**6.96**	**7.04**	**7.07**	**7.03**	**7.06**	**7.16**
Difference	-0.34	-0.43	-0.36	-0.20	-0.26	-0.25	-0.22	-0.21	-0.21	-0.20
Accept or Reject	*Accept*	*Reject*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*	*Accept*

Mean of the Difference (d_{avg})	-0.25
Standard Deviation (S_d)	0.06
Confidence Coefficient (CC)	0.05
Relative Accuracy via RM, $RA_{RM\text{-}CEMS}$ *	**0.25%** ← Pass

$RA_{RM\text{-}CEMS}$ (Reference Method - CEMS) Absolute difference must be less than 1.0%

Erthwrks Particulate Matter Summary of Results

Project: Marathon Petroleum Company
Facility: Detroit Refinery
Location: Detroit, MI
Unit ID: CCR Charge Heater

Run Designation						
Run Number		1	2	3	Average	
Date		6/1/2022	6/1/2022	6/1/2022		mm:dd:yyyy
Run Start Time		10:04	14:52	17:08		hh:mm
Run End Time		11:38	16:25	18:42		hh:mm
Operating Conditions						
Firing Rate (MMbtu/hr)		125.98	128.59	129.48	128.02	MMbtu/hr
Stack Gas Composition						
Oxygen Concentration	($\%O_2$)	6.63	6.76	6.88	6.76	%
Carbon Dioxide Concentration	($\%CO_2$)	8.56	8.59	8.46	8.54	%
Stack Moisture Content	(B_{ws})	14.57	14.76	13.93	14.42	%
Stack Dry Molecular Weight	(M_d)	29.63	29.64	29.63	29.64	lb/lb-mole
Stack Wet Molecular Weight	(M_s)	27.94	27.93	28.01	27.96	lb/lb-mole
Stack Gas Volumetric Flow Calculations						
Absolute Stack Pressure	(P_s)	29.30	29.30	29.30	29.30	in Hg
Average Stack Temperature	($t_s)_{avg}$	840.5	841.2	840.5	840.7	°R
Average Square Root of ΔP's	$(\Delta p^{1/2})_{avg}$	0.2909	0.3004	0.3052	0.2988	%
Average Stack Gas Velocity	(v_s)	1269.89	1312.37	1330.55	1304.27	ft/min
Average Stack Gas Flow	(Q_{aw})	5.61E+04	5.80E+04	5.88E+04	5.76E+04	acfm
Wet Standard Stack Flow Rate	(Q_{sw})	2.07E+06	2.14E+06	2.17E+06	2.13E+06	wscfh
Dry Standard Stack Flow Rate	(Q_{sd})	1.77E+06	1.82E+06	1.87E+06	1.82E+06	dscfh
Particulate Matter Emission Rate Calculations						
Mass of Filterable PM (M.5)	mg	3.01	2.39	2.80	2.73	mg
Mass of Condensible PM (M.202)	mg	7.75	5.77	5.10	6.21	mg
Total Mass of Particulates	mg	10.76	8.16	7.90	8.94	mg
Filterable PM Mass Concentration	lb/dscf	9.71E-08	7.52E-08	8.58E-08	8.60E-08	lb/dscf
Total PM Mass Concentration	lb/dscf	3.47E-07	2.57E-07	2.42E-07	2.82E-07	lb/dscf
Filterable PM Mass Emission Rate	lb/hr	0.17	0.14	0.16	0.16	lb/hr
Total PM Mass Emission Rate	lb/hr	0.61	0.47	0.45	0.51	lb/hr
Filterable PM Mass Emission Rate	lb/day	4.12	3.29	3.85	3.75	lb/day
Total PM Mass Emission Rate	lb/day	14.74	11.24	10.85	12.27	lb/day
Filterable PM Mass Emission Rate	lb/MMbtu	0.0014	0.0011	0.0012	0.0012	lb/MMbtu
Total PM Mass Emission Rate	lb/MMbtu	0.0049	0.0036	0.0035	0.0040	lb/MMbtu

Detailed Summary of Results

Client: Marathon
Facility: Detroit Refinery
Unit ID: CCR Charge Heater
Erthwrks Tech: John Wood, Luke Morrison

Run Information				
Run Number	**Run 1**	**Run 2**	**Run 3**	
Date	6/1/2022	6/1/2022	6/1/2022	
Run Start Time	10:04	14:52	17:08	
Run End Time	11:04	15:52	18:08	
Unit Fuel Flow Data				**Averages**
Fuel F Factor (F_d) (scf/MMBtu)	8604.0	8604.0	8604.0	**8604.0**
Emission Concentrations				
H_2SO_4 (ug)	122	30.6	12.6	**55.07**
Train volume (scf)	19.91	20.09	20.60	**20.20**
O_2 (%vd)	6.63	6.76	6.88	**6.76**
Emission Rates				
H_2SO_4 (lb/scf)	1.35E-08	3.36E-09	1.35E-09	**6.07E-09**
H_2SO_4 (ppm)	0.05	0.01	0.01	**0.02**
H_2SO_4 (lb/MMBtu)	0.0002	0.0000	0.0000	**0.0001**

Attachment B
Quality Control Documentation

Erthwrks Method 1 Traverse Point Location Worksheet

Client:	MPC
Project #:	9049.1.B3
Facility:	Detroit
Unit ID:	CCR Charge Htr
Technician:	0

Stack ID Measurements

Stack ID + Port (inches):	101.5
Port Extension (inches):	11.5
Stack Diameter (inches):	90

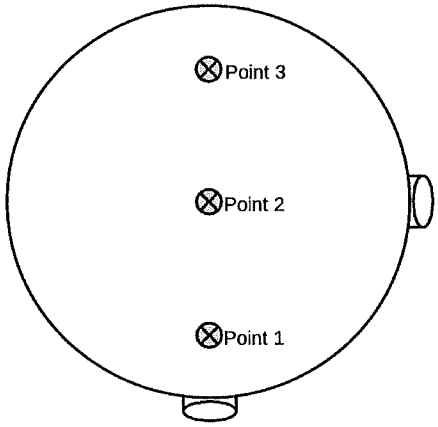
Port Location Measurements

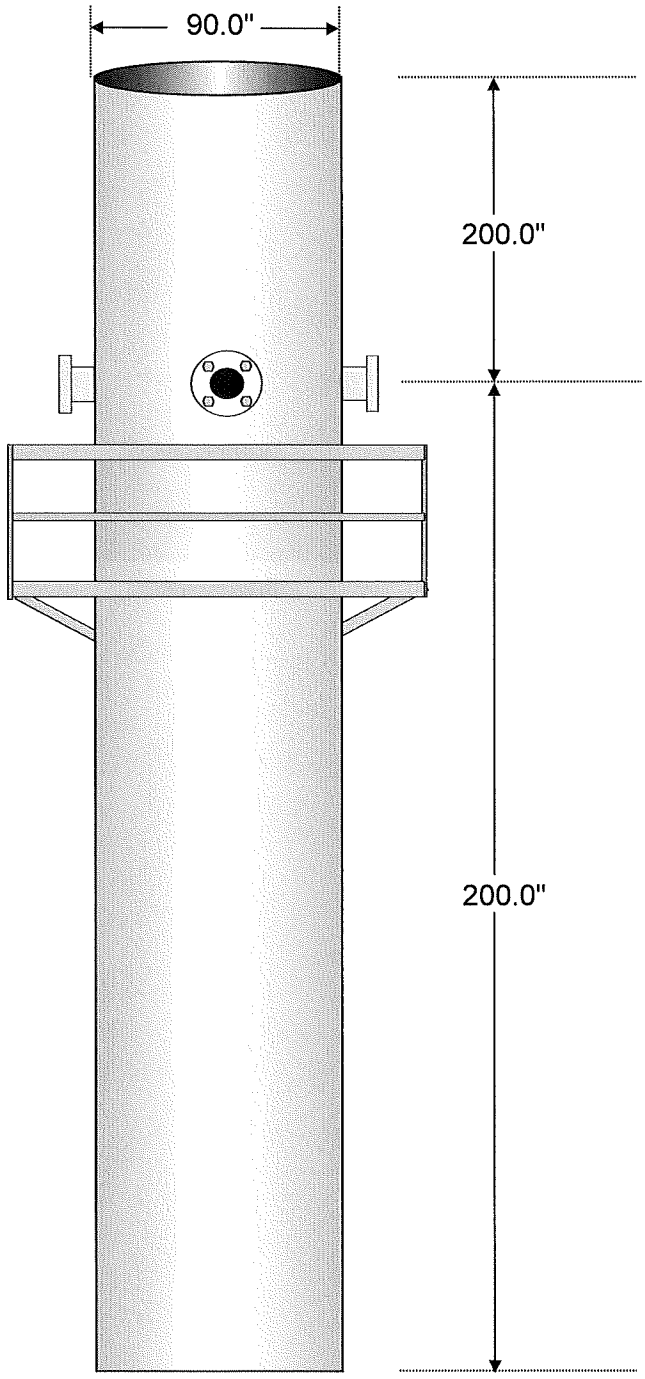
Distance Upstream (A) (inches):	200
Distance Downstream (B) (inches):	200
Stack Diameters Upstream (A):	2.2
Stack Diameters Downstream (B):	2.2

Total Traverse Points to be used:	3
Traverse Points per Diameter:	3

Traverse Point Locations[1][2]	
Point 1:	15.03"
Point 2:	45.00"
Point 3:	74.97"

Stack Cross Section View





[1]For stack diameter >4.0" and <2.4 meters, stratification is measured at 16.7%, 50.0%, and 83.3" of stack diameter (M7E, §8.1.2).

[2] For stack diameter >2.4 meters, stratification is measured at 0.4, 1.2, and 2.0 meters from stack wall (M7E, §8.1.2).

Erthwrks Gaseous Sample Collection and Quality Assurance Worksheet

Date: 6/1/2022
Client: MPC
Facility: Detroit
Project No: 9049.1.B3
Unit ID: CCR Charge Htr
Erthwrks Tech:

Calibration Gas Verification

Pollutant	Low-Level Gas Conc. (C_V)	Cylinder Serial #	Mid-Level Gas Conc. (C_V)	Cylinder Serial #	High-Level Gas Conc. (C_V/CS)	Cylinder Serial #	Dilutor Root Gas
NO_X	n/a	n/a	24.77	CC446268	53.76	CC339873	NA
CO	n/a	n/a	25.43	CC446268	50.83	CC339873	NA
O_2	n/a	n/a	10.13	CC287657	19.92	ALM038955	NA
CO_2	n/a	n/a	10.00	CC287657	19.69	ALM038955	NA

Reference Method Analyzer Info

Make	Model	Serial No.
Teledyne	T200H	802
Teledyne	T300M	734
Teledyne	T200H	802
Teledyne	T300M	734

Direct Calibration Error Test

Pollutant	Zero Gas Response (C_{Dir})	Calibration Error (ACE)*	Low-Level Response (C_{Dir})	Calibration Error (ACE)*	Mid-Level Response (C_{Dir})	Calibration Error (ACE)*	High-Level Response (C_{Dir})	Calibration Error (ACE)*
NO_X	0.02	0.04%	n/a	n/a	24.36	-0.76%	53.76	0.01%
CO	0.07	0.14%	n/a	n/a	25.78	0.68%	50.94	0.21%
O_2	0.03	0.17%	n/a	n/a	9.96	-0.84%	19.95	0.17%
CO_2	0.00	0.01%	n/a	n/a	10.08	0.38%	19.61	-0.43%

*Unless otherwise noted in protocol or report, THC's calibration error test is conducted using the entire sample system and must be less than 5% of applicable calibration gas
** ACE must either be within ± 2.0% or ≤ 0.5 ppmv absolute difference*

NO_2 to NO Conversion Efficiency Test	
NO_2 Cal Gas Cyl. Number	CC502181
NO_2 Cal Gas Concentration	60.52
NO_X Analyzer Response	54.92
NO_2-NO Conv. Efficiency (Eff_{NO2})[(1)]	90.8%

[(1)] Eff_{NO2} must be ≥ 90%

Method 7E Traverse Point Determination			
Stack ID (inches)		Trav. Location	Inside ID + Port
90	Point 1	15.03	26.53
Port Ext. (inches)	Point 2	45	56.50
11.5	Point 3	74.97	86.47

Erthwrks Gaseous Sample Collection and Quality Assurance Worksheet

Initial Sample System Bias and Response Time

Pollutant	Upscale Gas Cert. Conc. ($C_{V,v}$)	Upscale Gas Direct ($C_{V,m}$)	Upscale Response (C_v)	Sample System Bias (SB)*	Response Time (sec)	Downscale Response (C_v)	Sample System Bias (SB)*	Response Time (sec)
NO_X	24.77	24.36	24.08	-0.52%	60	0.47	0.84%	60
CO	25.43	25.78	25.03	-1.48%	60	-0.30	-0.74%	60
O_2	10.13	9.96	9.97	0.03%	60	0.21	0.89%	60
CO_2	10.00	10.08	9.91	-0.84%	60	0.01	0.02%	60

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*

Sample Collection Raw Data--Pre and Post Sample System Calibration (SSC) and Raw Run Results

Run #: **Run 1**
Start Time: 10:11
End Time: 10:32

Pollutant	Initial Zero SSC ($C_{S,i}$)	Initial Upscale SSC ($C_{S,i}$)	Raw Results ($C_{V,m}$)	Final Zero SSC ($C_{S,f}$)	Final Upscale SSC ($C_{S,f}$)
NO_X	0.47	24.08	24.08	0.15	25.16
CO	-0.30	25.03	-0.74	-0.53	25.13
O_2	0.21	9.97	6.62	-0.01	9.92
CO_2	0.01	9.91	8.52	0.00	10.07

Run #: **Run 2**
Start Time: 10:39
End Time: 11:00

Initial Zero SSC ($C_{S,i}$)	Initial Upscale SSC ($C_{S,i}$)	Raw Results ($C_{V,m}$)	Final Zero SSC ($C_{S,f}$)	Final Upscale SSC ($C_{S,f}$)
0.15	25.16	24.16	0.23	25.15
-0.53	25.13	-0.22	0.02	25.66
-0.01	9.92	6.51	0.05	9.96
0.00	10.07	8.63	0.03	9.99

Sample Collection Raw Data--Pre and Post Sample System Calibration (SSC) and Raw Run Results

Run #: **Run 3**
Start Time: 11:11
End Time: 11:32

Pollutant	Initial Zero SSC ($C_{S,i}$)	Initial Upscale SSC ($C_{S,i}$)	Raw Results ($C_{V,m}$)	Final Zero SSC ($C_{S,f}$)	Final Upscale SSC ($C_{S,f}$)
NO_X	0.23	25.15	24.28	0.03	25.15
CO	0.02	25.66	-0.06	-0.61	25.52
O_2	0.05	9.96	6.42	0.00	9.89
CO_2	0.03	9.99	8.57	0.00	10.06

Run #: **Run 4**
Start Time: 14:56
End Time: 15:17

Initial Zero SSC ($C_{S,i}$)	Initial Upscale SSC ($C_{S,i}$)	Raw Results ($C_{V,m}$)	Final Zero SSC ($C_{S,f}$)	Final Upscale SSC ($C_{S,f}$)
-0.27	25.70	23.91	-0.23	25.74
-0.46	25.34	-0.54	-0.57	25.10
-0.05	9.92	6.66	-0.03	9.94
0.01	10.07	8.65	0.02	10.07

Sample Collection Raw Data--Pre and Post Sample System Calibration (SSC) and Raw Run Results

Run #: **Run 5**
Start Time: 15:25
End Time: 15:46

Pollutant	Initial Zero SSC ($C_{S,i}$)	Initial Upscale SSC ($C_{S,i}$)	Raw Results ($C_{V,m}$)	Final Zero SSC ($C_{S,f}$)	Final Upscale SSC ($C_{S,f}$)
NO_X	-0.23	25.74	24.19	-0.20	24.77
CO	-0.57	25.10	-0.55	-0.39	25.44
O_2	-0.03	9.94	6.59	0.16	9.93
CO_2	0.02	10.07	8.70	0.01	10.04

Run #: **Run 6**
Start Time: 15:55
End Time: 16:16

Initial Zero SSC ($C_{S,i}$)	Initial Upscale SSC ($C_{S,i}$)	Raw Results ($C_{V,m}$)	Final Zero SSC ($C_{S,f}$)	Final Upscale SSC ($C_{S,f}$)
-0.20	24.77	23.57	-0.57	24.89
-0.39	25.44	-0.30	-0.58	25.30
0.16	9.93	6.69	-0.04	9.95
0.01	10.04	8.60	0.00	10.08

Erthwrks Gaseous Sample Collection and Quality Assurance Worksheet

Sample Collection Raw Data--Pre and Post Sample System Calibration (SSC) and Raw Run Results

Run #: **Run 7**
Start Time: 16:28
End Time: 16:49

Pollutant	Initial Zero SSC (C_{SZ})	Initial Upscale SSC (C_{SS})	Raw Results (C_{AVG})	Final Zero SSC (C_{SZ})	Final Upscale SSC (C_{SS})
NO_X	-0.57	24.89	24.07	0.32	25.10
CO	-0.58	25.30	-0.55	-0.62	25.18
O_2	-0.04	9.95	6.72	-0.01	9.94
CO_2	0.00	10.08	8.55	0.03	10.05

Run #: **Run 8**
Start Time: 17:14
End Time: 17:35

Initial Zero SSC (C_{SZ})	Initial Upscale SSC (C_{SS})	Raw Results (C_{AVG})	Final Zero SSC (C_{SZ})	Final Upscale SSC (C_{SS})
0.32	25.10	23.82	0.18	24.64
-0.62	25.18	-0.39	-0.48	25.55
-0.01	9.94	6.69	-0.03	9.95
0.03	10.05	8.60	0.00	10.10

Sample Collection Raw Data--Pre and Post Sample System Calibration (SSC) and Raw Run Results

Run #: **Run 9**
Start Time: 17:46
End Time: 18:07

Pollutant	Initial Zero SSC (C_{SZ})	Initial Upscale SSC (C_{SS})	Raw Results (C_{AVG})	Final Zero SSC (C_{SZ})	Final Upscale SSC (C_{SS})
NO_X	0.18	24.64	24.90	0.20	25.22
CO	-0.48	25.55	-0.42	-0.65	25.34
O_2	-0.03	9.95	6.74	-0.03	9.99
CO_2	0.00	10.10	8.59	0.01	10.11

Run #: **Run 10**
Start Time: 18:17
End Time: 18:38

Initial Zero SSC (C_{SZ})	Initial Upscale SSC (C_{SS})	Raw Results (C_{AVG})	Final Zero SSC (C_{SZ})	Final Upscale SSC (C_{SS})
0.20	25.22	24.18	0.34	25.15
-0.65	25.34	-0.58	-0.56	25.44
-0.03	9.99	6.86	-0.02	10.00
0.01	10.11	8.43	0.01	10.10

Sample Collection Raw Data--Pre and Post Sample System Calibration (SSC) and Raw Run Results

Run 1 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_{SZ})	Avg. Upscale Sys. Bias (C_{SS})	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{GAS})
NO_X	0.84%	-0.52%	0.24%	1.48%	0.31	24.62	0.60%	2.00%	**24.23**
CO	-0.74%	-1.48%	-1.18%	-1.28%	-0.42	25.08	0.44%	0.20%	**-0.32**
O_2	0.89%	0.03%	-0.23%	-0.21%	0.10	9.94	1.12%	0.24%	**6.71**
CO_2	0.02%	-0.84%	0.00%	-0.02%	0.00	9.99	0.02%	0.82%	**8.52**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Run 2 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_{SZ})	Avg. Upscale Sys. Bias (C_{SS})	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{GAS})
NO_X	0.24%	1.48%	0.39%	1.47%	0.19	25.15	0.15%	0.01%	**23.79**
CO	-1.18%	-1.28%	-0.10%	-0.23%	-0.26	25.39	1.07%	1.05%	**0.04**
O_2	-0.23%	-0.21%	0.08%	-0.01%	0.02	9.94	0.31%	0.20%	**6.63**
CO_2	0.00%	-0.02%	0.14%	-0.43%	0.02	10.03	0.14%	0.41%	**8.60**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Erthwrks Gaseous Sample Collection and Quality Assurance Worksheet

Run 3 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_{v0})	Avg. Upscale Sys. Bias (C_{vd})	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{avg})
NO_X	0.39%	1.47%	0.02%	1.47%	0.13	25.15	0.38%	0.01%	**23.91**
CO	-0.10%	-0.23%	-1.33%	-0.50%	-0.30	25.59	1.23%	0.27%	**0.23**
O_2	0.08%	-0.01%	-0.16%	-0.35%	0.03	9.93	0.24%	0.34%	**6.55**
CO_2	0.14%	-0.43%	0.00%	-0.07%	0.02	10.03	0.14%	0.37%	**8.55**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Run 4 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_{v0})	Avg. Upscale Sys. Bias (C_{vd})	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{avg})
NO_X	-0.53%	2.49%	-0.47%	2.56%	-0.25	25.72	0.06%	0.07%	**23.04**
CO	-1.04%	-0.86%	-1.25%	-1.33%	-0.51	25.22	0.21%	0.47%	**-0.03**
O_2	-0.40%	-0.22%	-0.31%	-0.11%	-0.04	9.93	0.09%	0.11%	**6.80**
CO_2	0.02%	-0.01%	0.11%	-0.04%	0.01	10.07	0.09%	0.03%	**8.59**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Run 5 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_{v0})	Avg. Upscale Sys. Bias (C_{vd})	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{avg})
NO_X	-0.47%	2.56%	-0.41%	0.75%	-0.22	25.25	0.07%	1.80%	**23.74**
CO	-1.25%	-1.33%	-0.91%	-0.66%	-0.48	25.27	0.34%	0.67%	**-0.07**
O_2	-0.31%	-0.11%	0.61%	-0.18%	0.06	9.93	0.92%	0.07%	**6.70**
CO_2	0.11%	-0.04%	0.06%	-0.16%	0.02	10.06	0.05%	0.13%	**8.65**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Run 6 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_{v0})	Avg. Upscale Sys. Bias (C_{vd})	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{avg})
NO_X	-0.41%	0.75%	-1.10%	0.98%	-0.39	24.83	0.69%	0.23%	**23.53**
CO	-0.91%	-0.66%	-1.29%	-0.95%	-0.49	25.37	0.38%	0.29%	**0.18**
O_2	0.61%	-0.18%	-0.36%	-0.04%	0.06	9.94	0.96%	0.14%	**6.79**
CO_2	0.06%	-0.16%	0.01%	0.02%	0.01	10.06	0.05%	0.18%	**8.54**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Erthwrks Gaseous Sample Collection and Quality Assurance Worksheet

Run 7 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_0)	Avg. Upscale Sys. Bias (C_V)	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{gas})
NO_X	-1.10%	0.98%	0.56%	1.37%	-0.13	25.00	1.65%	0.39%	**23.86**
CO	-1.29%	-0.95%	-1.36%	-1.18%	-0.60	25.24	0.07%	0.23%	**0.05**
O_2	-0.36%	-0.04%	-0.23%	-0.11%	-0.02	9.95	0.13%	0.07%	**6.85**
CO_2	0.01%	0.02%	0.15%	-0.12%	0.02	10.06	0.14%	0.14%	**8.49**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Run 8 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_0)	Avg. Upscale Sys. Bias (C_V)	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{gas})
NO_X	0.56%	1.37%	0.31%	0.52%	0.25	24.87	0.25%	0.85%	**23.71**
CO	-1.36%	-1.18%	-1.08%	-0.45%	-0.55	25.36	0.28%	0.72%	**0.16**
O_2	-0.23%	-0.11%	-0.31%	-0.04%	-0.02	9.95	0.09%	0.07%	**6.82**
CO_2	0.15%	-0.12%	0.01%	0.11%	0.02	10.07	0.14%	0.23%	**8.54**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Run 9 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_0)	Avg. Upscale Sys. Bias (C_V)	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{gas})
NO_X	0.31%	0.52%	0.34%	1.59%	0.19	24.93	0.03%	1.06%	**24.74**
CO	-1.08%	-0.45%	-1.41%	-0.87%	-0.56	25.44	0.33%	0.41%	**0.15**
O_2	-0.31%	-0.04%	-0.32%	0.12%	-0.03	9.97	0.01%	0.16%	**6.85**
CO_2	0.01%	0.11%	0.03%	0.16%	0.01	10.10	0.03%	0.06%	**8.51**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Run 10 **Sample Collection Calculations--Pre- and Post-Run Sample System Bias Check, Drift Assessment, Corrected Results**

Pollutant	Initial Zero Sys. Bias (SB)*	Initial Upscale Sys. Bias (SB)*	Final Zero Sys. Bias (SB)*	Final Upscale Sys. Bias (SB)*	Avg. Zero Sys. Bias (C_0)	Avg. Upscale Sys. Bias (C_V)	Zero Drift Assessment (D)†	Upscale Drift Assessment (D)†	Corrected Results (C_{gas})
NO_X	0.34%	1.59%	0.59%	1.47%	0.27	25.18	0.25%	0.12%	**23.77**
CO	-1.41%	-0.87%	-1.24%	-0.67%	-0.61	25.39	0.17%	0.20%	**0.03**
O_2	-0.32%	0.12%	-0.26%	0.21%	-0.02	10.00	0.06%	0.09%	**6.96**
CO_2	0.03%	0.16%	0.04%	0.14%	0.01	10.10	0.01%	0.03%	**8.34**

** SB must either be within ± 5.0% or ≤ 0.5 ppmv absolute difference*
† D must either be within ± 3.0% or the pre- and post-run bias responses are ≤ 0.5 ppmv absolute difference

Attachment C
Sampling Datasheets

Erthwrks Method 2 Traverse Point Location Worksheet

Client: Marathon Petroleum Company
Project #: 9049.1.B3
Facility: Detroit Refinery
Unit ID: CCR Charge Heater
Technician: John Wood, Adam Loes, Luke Morrison

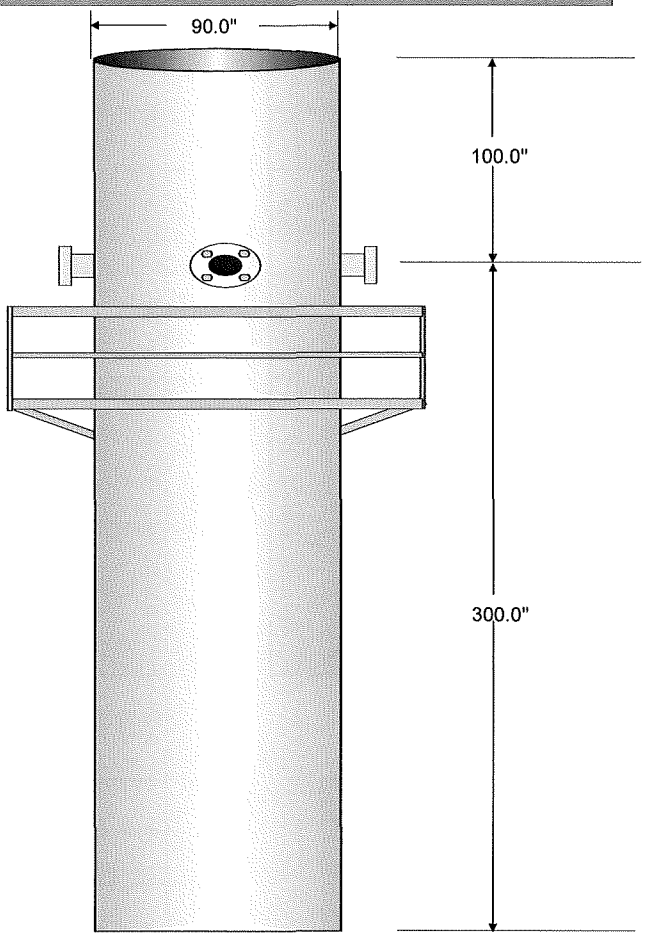
Stack ID Measurements

Stack ID + Port (inches):	101.5
Port Extension (inches):	11.5
Stack Diameter (inches):	90

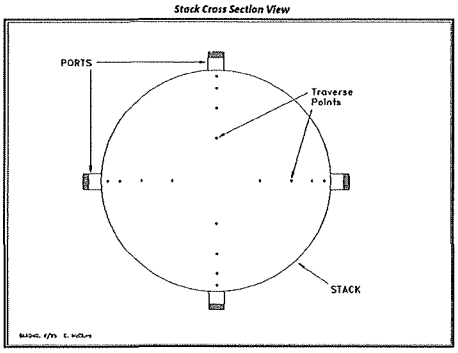
Port Location Measurements

Distance Upstream (A) (inches):	100
Distance Downstream (B) (inches):	300
Stack Diameters Upstream (A):	1.1
Stack Diameters Downstream (B):	3.3

Total Traverse Points to be used:	24
Traverse Points per Diameter:	12



Stack Cross Section View



Calculated Traverse Point Locations per Diameter

Traverse Point Number per Diameter	Total Number of Traverse Points Used					
	4	8	12	16	20	24
	Traverse Point Location per Diameter (inches from outside of port)					
1	24.64	17.53	15.46	14.38	13.84	**13.39**
2	88.36	34.00	24.64	20.95	18.88	**17.53**
3		79.00	38.14	28.96	24.64	**22.12**
4		95.47	74.86	40.57	31.84	**27.43**
5			88.36	72.43	42.28	**34.00**
6			97.54	84.04	70.72	**43.54**
7				92.05	81.16	**69.46**
8				98.62	88.36	**79.00**
9					94.12	**85.57**
10					99.16	**90.88**
11						**95.47**
12						**99.61**

Measurements in bold will be the traverse points used for the emission test

Traverse Point Location Table From EPA Method 1, Table 1-2

Traverse Point Number per Diameter	Total Number of Traverse Points to be Used (from EPA M.1 Table 1-2)					
	4	8	12	16	20	24
	Traverse Point Location per Diameter (percent of stack ID)					
1	14.60	6.70	4.40	3.20	2.60	2.10
2	85.40	25.00	14.60	10.50	8.20	6.70
3		75.00	29.60	19.40	14.60	11.80
4		93.30	70.40	32.30	22.60	17.70
5			85.40	67.70	34.20	25.00
6			95.60	80.60	65.80	35.60
7				89.50	77.40	64.40
8				96.80	85.40	75.00
9					91.80	82.30
10					97.40	88.20
11						93.30
12						97.90

Erthwrks Isokenetic Sampling Field Data and Calculation Worksheet

Client:	Marathon Petroleum Company	**Run ID:**	1	**Meterbox ID:**	M5-2
Facility:	Detroit Refinery	**Date:**	6/1/22	**DGM Y Factor:**	0.989
Location:	Detroit, MI	**Amb Temp:**	62	**DGM ΔH @:**	1.816
Unit ID:	CCR Charge Heater	**Baro. Press:**	29.31		

Pre and Post DGM Leak Checks				
Pre	0.00	**ft3/min @**	15	**inHg**
Post	0.00	**ft3/min @**	16	**inHg**
Pitot Not Damaged & Leak Checks Good?				
Pre	Yes	**Post**	Yes	

Isokinetic Sampling Data			
Meter K Factor	(NA)	21.75	unitless
Pitot Tube Factor	(C_{ps})	0.84	unitless
Stack Static Pressure	(P_{static})	-0.12	in H2O
Dry Gas Fraction	(NA)	0.850	unitless
Stack Gas Wet MW	(Ms)	27.89	lb/lb-mole
Actual Nozzle Area	(NA)	1.15E-03	ft^2
Total Sample Time	(NA)	90	min
Number of Traverse Points	(NA)	24	points
Time per Traverse Point	(NA)	0:03:45	time

Post Sample Moisture Determination			
Impinger Weights (g)			
Impinger ID	**contents**	**Pre Run**	**Post Run**
Impinger 1	Empty	365.1	554.3
Impinger 2	Empty	611.9	615.5
Impinger 3	DI H2O	690.8	712.9
Impinger 4	Silica Gel	873.0	905.4
Total Weights		**2540.8**	**2788.1**

Filter ID:	51321

Post Sampling Moisture and MW Determination			
O_2 Concentration	($\%O_2$)	6.63	%
CO_2 Concentration	($\%CO_2$)	8.56	%
Sample Volume Metered	(V_m)	73.04	dcf
Standard Volume at STP	(V_{std})	68.35	dscf
Moisture Content	(B_{ws})	14.574	%
Final Dry Gas Fraction	(B_{ws})	0.854	unitless
Stack Gas Wet MW	(Ms)	27.94	lb/lb-mole
Stack Gas Velocity	(v_s)	21.16	ft/sec
Stack Gas Vol. Flow Rate	(Qd)	**1.77E+06**	**dscfh**
Final Isokinetic Calc.	(%iso)	**98.6**	%
Post -Test Meter Cal (M.5 §16.3)	(Y_{qa})	0.957	

	End Time	Stack Temp	Probe Temp	M.5 Filter Temp	202 Filter Temp	Exit Temp	DGM Temp	Pump Vacuum	ΔP	ΔH	Target DGM Reading	Obs. DGM Reading	% ISO Point	% ISO Total
Port 1 Start →	10:04:00	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(inHg)	in H2O	in H2O	ft^3	639.588	unitless	unitless
Point 1	10:07:45	382	253	260	80	64	81	5	0.07	**1.56**	**642.342**	642.385	**101.6**	**101.6**
Point 2	10:11:30	381	252	268	79	62	81	6	0.08	**1.78**	**645.329**	645.195	**95.4**	**98.4**
Point 3	10:15:15	381	252	260	80	63	83	7	0.08	**1.79**	**648.150**	648.008	**95.2**	**97.3**
Point 4	10:19:00	381	252	257	80	61	83	7	0.08	**1.79**	**650.963**	650.889	**97.5**	**97.4**
Point 5	10:22:45	381	252	258	79	64	84	7	0.09	**2.02**	**654.027**	653.912	**96.3**	**97.1**
Point 6	10:26:30	382	254	266	83	65	85	8	0.09	**2.02**	**657.054**	656.975	**97.5**	**97.2**
Point 7	10:30:15	381	252	266	82	65	86	8	0.08	**1.80**	**659.946**	660.121	**105.9**	**98.4**
Point 8	10:34:00	382	254	268	84	64	87	7	0.07	**1.58**	**662.905**	663.145	**108.6**	**99.6**
Point 9	10:37:45	382	247	262	82	65	87	7	0.07	**1.58**	**665.929**	665.788	**94.9**	**99.1**
Point 10	10:41:30	382	242	255	83	65	88	7	0.08	**1.81**	**668.768**	668.527	**91.9**	**98.4**
Point 11	10:45:15	381	241	248	82	65	89	7	0.07	**1.58**	**671.323**	671.214	**96.1**	**98.2**
Point 12	10:49:00	381	245	247	83	65	89	7	0.07	**1.58**	**674.010**	674.087	**102.7**	**98.6**
Port 2 Start →	10:53:00													
Point 13	10:56:45	380	243	245	82	66	90	7	0.09	**2.04**	**677.262**	677.054	**93.5**	**98.1**
Point 14	11:00:30	380	244	243	83	66	91	7	0.09	**2.04**	**680.234**	680.087	**95.4**	**97.9**
Point 15	11:04:15	379	245	242	84	66	91	7	0.09	**2.04**	**683.269**	683.251	**99.4**	**98.0**
Point 16	11:08:00	379	244	241	83	65	91	8	0.10	**2.27**	**686.604**	686.628	**100.7**	**98.2**
Point 17	11:11:45	379	245	242	83	64	92	8	0.11	**2.50**	**690.149**	690.150	**100.0**	**98.3**
Point 18	11:15:30	379	244	240	82	65	93	8	0.10	**2.28**	**693.515**	693.487	**99.2**	**98.4**
Point 19	11:19:15	380	245	239	83	66	94	8	0.10	**2.28**	**696.856**	696.875	**100.6**	**98.5**
Point 20	11:23:00	379	242	239	82	65	95	8	0.10	**2.29**	**700.252**	700.204	**98.6**	**98.5**
Point 21	11:26:45	379	244	242	82	64	96	8	0.09	**2.06**	**703.415**	703.405	**99.7**	**98.6**
Point 22	11:30:30	380	246	247	82	65	96	8	0.09	**2.06**	**706.614**	706.610	**99.9**	**98.6**
Point 23	11:34:15	380	244	254	83	66	96	8	0.08	**1.83**	**709.637**	709.654	**100.6**	**98.7**
Point 24	11:38:00	380	243	251	84	65	96	8	0.07	**1.60**	**712.487**	712.629	**105.0**	**99.0**
Average Values		**380.5**	**246.9**	**251.7**	**82.1**	**64.6**	**89.3**	**7.3**	**0.09**	**1.92**		**73.041**		**99.0**

Erthwrks Isokenetic Sampling Field Data and Calculation Worksheet

Client:	Marathon Petroleum Company	**Run ID:**	2	**Meterbox ID:**	M5-2
Facility:	Detroit Refinery	**Date:**	6/1/22	**DGM Y Factor:**	0.989
Location:	Detroit, MI	**Amb Temp:**	72	**DGM ΔH @:**	1.816
Unit ID:	CCR Charge Heater	**Baro. Press:**	29.31		

Pre and Post DGM Leak Checks				
Pre	0.00	**ft3/min @**	15	**inHg**
Post	0.00	**ft3/min @**	15	**inHg**
Pitot Not Damaged & Leak Checks Good?				
Pre	Yes	**Post**	Yes	

Isokinetic Sampling Data			
Meter K Factor	(NA)	21.75	unitless
Pitot Tube Factor	(C_{pt})	0.84	unitless
Stack Static Pressure	(P_{static})	-0.12	in H2O
Dry Gas Fraction	(NA)	0.850	unitless
Stack Gas Wet MW	(Ms)	27.89	lb/lb-mole
Actual Nozzle Area	(NA)	1.15E-03	ft^2
Total Sample Time	(NA)	90	min
Number of Traverse Points	(NA)	24	points
Time per Traverse Point	(NA)	0:03:45	time

Post Sample Moisture Determination			
Impinger Weights (g)			
Impinger ID	**contents**	**Pre Run**	**Post Run**
Impinger 1	Empty	358.8	572.3
Impinger 2	Empty	614.6	616.9
Impinger 3	DI H2O	732.4	741.8
Impinger 4	Silica Gel	819.0	851
Total Weights		**2524.8**	**2782.0**

Filter ID:	51320

Post Sampling Moisture and MW Determination			
O_2 Concentration	($\%O_2$)	6.76	%
CO_2 Concentration	($\%CO_2$)	8.59	%
Sample Volume Metered	(V_m)	74.64	dcf
Standard Volume at STP	(V_{std})	70.04	dscf
Moisture Content	(B_{ws})	14.760	%
Final Dry Gas Fraction	(B_{ws})	0.852	unitless
Stack Gas Wet MW	(Ms)	27.93	lb/lb-mole
Stack Gas Velocity	(v_s)	21.87	ft/sec
Stack Gas Vol. Flow Rate	(Qd)	**1.82E+06**	**dscfh**
Final Isokinetic Calc.	(%iso)	**98.1**	%
Post -Test Meter Cal (M.5 §16.3)	(Y_{qa})	0.963	

	End Time	Stack Temp	Probe Temp	M.5 Filter Temp	202 Filter Temp	Exit Temp	DGM Temp	Pump Vacuum	ΔP	ΔH	Target DGM Reading	Obs. DGM Reading	% ISO Point	% ISO Total
Port 1 Start →	14:52:00	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(inHg)	in H2O	in H2O	ft^3	713.274	unitless	unitless
Point 1	14:55:45	383	242	239	82	63	78	7	0.09	**1.99**	**716.374**	716.178	**93.7**	**93.7**
Point 2	14:59:30	382	243	245	81	63	79	7	0.08	**1.78**	**719.110**	719.119	**100.3**	**96.9**
Point 3	15:03:15	382	244	241	83	64	80	7	0.09	**2.00**	**722.233**	722.195	**98.8**	**97.5**
Point 4	15:07:00	381	242	244	81	63	82	7	0.10	**2.23**	**725.489**	725.412	**97.7**	**97.6**
Point 5	15:10:45	381	242	252	79	64	83	7	0.10	**2.24**	**728.712**	728.742	**100.9**	**98.3**
Point 6	15:14:30	382	241	252	76	64	85	7	0.09	**2.02**	**731.884**	731.651	**92.6**	**97.3**
Point 7	15:18:15	381	241	251	76	63	84	7	0.08	**1.79**	**734.612**	734.503	**96.3**	**97.2**
Point 8	15:22:00	381	240	247	78	64	86	7	0.08	**1.80**	**737.474**	737.541	**102.2**	**97.8**
Point 9	15:25:45	381	242	248	79	65	87	8	0.09	**2.03**	**740.697**	740.653	**98.6**	**97.9**
Point 10	15:29:30	382	241	245	80	65	87	7	0.09	**2.03**	**743.807**	743.851	**101.4**	**98.2**
Point 11	15:33:15	381	241	244	81	66	88	7	0.08	**1.81**	**746.833**	746.902	**102.3**	**98.6**
Point 12	15:37:00	380	241	243	80	65	89	7	0.08	**1.81**	**749.891**	749.750	**95.3**	**98.3**
Port 2 Start →	15:40:00													
Point 13	15:43:45	380	239	241	78	65	90	7	0.09	**2.04**	**752.925**	752.751	**94.5**	**98.0**
Point 14	15:47:30	381	240	242	79	66	91	7	0.09	**2.04**	**755.930**	755.832	**96.9**	**98.0**
Point 15	15:51:15	381	246	245	76	65	92	7	0.09	**2.05**	**759.016**	758.832	**94.2**	**97.7**
Point 16	15:55:00	382	248	249	75	65	92	8	0.10	**2.27**	**762.185**	762.060	**96.3**	**97.6**
Point 17	15:58:45	381	246	250	75	65	92	8	0.10	**2.27**	**765.415**	765.427	**100.4**	**97.8**
Point 18	16:02:30	381	245	250	76	63	93	7	0.09	**2.05**	**768.617**	768.654	**101.2**	**98.0**
Point 19	16:06:15	380	245	253	78	64	93	8	0.11	**2.51**	**772.179**	771.987	**94.6**	**97.8**
Point 20	16:10:00	381	251	255	79	64	92	8	0.10	**2.27**	**775.342**	775.412	**102.1**	**98.0**
Point 21	16:13:45	380	241	256	78	63	92	7	0.09	**2.05**	**778.598**	778.854	**108.0**	**98.5**
Point 22	16:17:30	381	244	257	76	65	92	7	0.09	**2.05**	**782.038**	781.835	**93.6**	**98.3**
Point 23	16:21:15	381	239	249	77	65	92	7	0.09	**2.05**	**785.019**	784.925	**97.0**	**98.2**
Point 24	16:25:00	382	245	251	76	65	92	7	0.08	**1.82**	**787.927**	787.913	**99.5**	**98.3**
Average Values		**381.2**	**242.9**	**247.9**	**78.3**	**64.3**	**88.0**	**7.2**	**0.09**	**2.04**		**74.639**		**98.3**

Erthwrks Isokenetic Sampling Field Data and Calculation Worksheet

Client:	Marathon Petroleum Company	**Run ID:**	3	**Meterbox ID:**	M5-2
Facility:	Detroit Refinery	**Date:**	6/1/22	**DGM Y Factor:**	0.989
Location:	Detroit, MI	**Amb Temp:**	79	**DGM ΔH @:**	1.816
Unit ID:	CCR Charge Heater	**Baro. Press:**	29.31		

Pre and Post DGM Leak Checks				
Pre	0.00	**ft3/min @**	17	**inHg**
Post	0.00	**ft3/min @**	15	**inHg**
Pitot Not Damaged & Leak Checks Good?				
Pre	Yes	**Post**	Yes	

Isokinetic Sampling Data			
Meter K Factor	(NA)	21.75	unitless
Pitot Tube Factor	(C_{ps})	0.84	unitless
Stack Static Pressure	(P_{static})	-0.12	in H2O
Dry Gas Fraction	(NA)	0.850	unitless
Stack Gas Wet MW	(Ms)	27.89	lb/lb-mole
Actual Nozzle Area	(NA)	1.15E-03	ft^2
Total Sample Time	(NA)	90	min
Number of Traverse Points	(NA)	24	points
Time per Traverse Point	(NA)	0:03:45	time

Post Sample Moisture Determination			
Impinger Weights (g)			
Impinger ID	**contents**	**Pre Run**	**Post Run**
Impinger 1	Empty	366.0	568.2
Impinger 2	Empty	614.2	616.4
Impinger 3	DI H2O	712.7	732
Impinger 4	Silica Gel	907.0	930.2
Total Weights		**2599.9**	**2846.8**

Filter ID:	51316

Post Sampling Moisture and MW Determination			
O_2 Concentration	($\%O_2$)	6.88	%
CO_2 Concentration	($\%CO_2$)	8.46	%
Sample Volume Metered	(V_m)	76.99	dcf
Standard Volume at STP	(V_{std})	71.95	dscf
Moisture Content	(B_{ws})	13.926	%
Final Dry Gas Fraction	(B_{ws})	0.861	unitless
Stack Gas Wet MW	(Ms)	28.01	lb/lb-mole
Stack Gas Velocity	(v_s)	22.18	ft/sec
Stack Gas Vol. Flow Rate	(Qd)	**1.87E+06**	**dscfh**
Final Isokinetic Calc.	(%iso)	**98.3**	%
Post -Test Meter Cal (M.5 §16.3)	(Y_{qa})	0.953	

	End Time	Stack Temp	Probe Temp	M.5 Filter Temp	202 Filter Temp	Exit Temp	DGM Temp	Pump Vacuum	ΔP	ΔH	Target DGM Reading	Obs. DGM Reading	% ISO Point	% ISO Total
Port 1 Start →	17:08:00	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(inHg)	in H2O	in H2O	ft^3	788.877	unitless	unitless
Point 1	17:11:45	376	237	245	84	67	86	7	0.09	**2.02**	**792.036**	791.958	**97.5**	**97.5**
Point 2	17:15:30	380	239	245	82	66	85	7	0.09	**2.02**	**795.104**	795.121	**100.5**	**99.0**
Point 3	17:19:15	379	243	239	80	65	85	7	0.10	**2.25**	**798.437**	798.289	**95.5**	**97.8**
Point 4	17:23:00	380	252	241	79	65	87	8	0.10	**2.25**	**801.615**	801.384	**93.0**	**96.6**
Point 5	17:26:45	380	256	250	79	65	87	9	0.11	**2.48**	**804.871**	804.780	**97.4**	**96.8**
Point 6	17:30:30	381	252	251	79	66	88	8	0.09	**2.03**	**807.941**	808.021	**102.5**	**97.7**
Point 7	17:34:15	381	245	246	79	66	89	8	0.09	**2.04**	**811.188**	811.241	**101.7**	**98.2**
Point 8	17:38:00	380	248	250	75	66	89	8	0.08	**1.81**	**814.230**	814.288	**101.9**	**98.7**
Point 9	17:41:45	381	249	253	74	66	90	8	0.08	**1.81**	**817.281**	817.321	**101.3**	**98.9**
Point 10	17:45:30	381	248	251	75	67	91	8	0.09	**2.04**	**820.500**	820.324	**94.5**	**98.5**
Point 11	17:49:15	381	252	255	76	63	91	8	0.09	**2.04**	**823.503**	823.485	**99.4**	**98.6**
Point 12	17:53:00	381	242	245	76	76	92	8	0.10	**2.27**	**826.840**	826.712	**96.2**	**98.4**
Port 2 Start →	17:57:00													
Point 13	18:00:45	382	244	246	76	63	92	8	0.10	**2.27**	**830.065**	829.894	**94.9**	**98.1**
Point 14	18:04:30	381	252	253	77	62	91	8	0.09	**2.04**	**833.073**	833.164	**102.9**	**98.4**
Point 15	18:08:15	381	249	249	78	64	92	8	0.11	**2.50**	**836.680**	836.551	**96.3**	**98.3**
Point 16	18:12:00	381	241	245	79	65	92	8	0.11	**2.50**	**840.067**	840.041	**99.3**	**98.4**
Point 17	18:15:45	381	246	244	78	63	93	8	0.10	**2.28**	**843.402**	843.481	**102.4**	**98.6**
Point 18	18:19:30	381	247	246	78	63	93	8	0.09	**2.05**	**846.671**	846.771	**103.1**	**98.8**
Point 19	18:23:15	381	247	249	79	63	93	8	0.09	**2.05**	**849.961**	849.950	**99.7**	**98.9**
Point 20	18:27:00	380	247	248	80	64	92	8	0.08	**1.82**	**852.956**	853.082	**104.2**	**99.1**
Point 21	18:30:45	380	246	247	80	64	92	8	0.08	**1.82**	**856.088**	856.175	**102.9**	**99.3**
Point 22	18:34:30	380	246	249	81	64	92	8	0.09	**2.05**	**859.361**	859.402	**101.3**	**99.4**
Point 23	18:38:15	381	245	250	82	65	92	8	0.09	**2.05**	**862.586**	862.589	**100.1**	**99.4**
Point 24	18:42:00	381	245	251	83	66	92	8	0.10	**2.27**	**865.944**	865.863	**97.6**	**99.3**
Average Values		**380.5**	**246.6**	**247.8**	**78.7**	**65.2**	**90.3**	**7.9**	**0.09**	**2.12**		**76.986**		**99.3**

Erthwrks Method 8A (CTM-013) Sampling Worksheet

Date: 6/1/2022
Client: Marathon
Facility: Detroit Refinery
Unit ID: CCR Charge Heater
Erthwrks Tech: John Wood, Luke Morrison
Run No: 1

DGM Pre-Test Leak Check			DGM Post-Test Leak Check		
Vac ("H_2O)	cubic feet	Time (s)	Vac ("H2O)	cubic feet	Time (s)
14	0.00	60	13	0.000	60

Start Time:	10:04
Meter Box ID:	M5-5
DGM y-fact:	0.9952
Atm Press ("Hg)	29.163

Sampling Point	Sample Time (min:sec)	ΔH	DGM Reading (ft^3)	ΔV_m (ft^3)	DGM Temp (°F)	Probe Temp (°F)	Filter Temp (°F)	H2SO4 Temp (°F)	Imp Exit Temp (°F)	DGM Vac (inHg)
Start: 10:04	10:04		139.223	<--- Starting Reading		(>350 °F)	(>500 °F)	(167-185 °F)	(<68 °F)	
1	10:09:00	0.42	140.942	1.719	78	378	501	169	67	3
2	10:14:00	0.42	142.715	1.773	78	376	502	169	67	3
3	10:19:00	0.42	144.490	1.775	78	376	502	173	65	3
4	10:24:00	0.42	146.252	1.762	78	376	501	172	65	3
5	10:29:00	0.42	148.006	1.754	79	376	502	175	65	3
6	10:34:00	0.42	149.756	1.750	80	375	505	173	66	3
7	10:39:00	0.42	151.505	1.749	81	374	504	172	67	3
8	10:44:00	0.42	153.254	1.749	82	377	503	169	67	3
9	10:49:00	0.42	155.003	1.749	82	376	502	174	63	3
10	10:54:00	0.42	156.753	1.750	83	374	503	173	62	3
11	10:59:00	0.42	158.495	1.742	84	374	502	169	63	3
12	11:04:00	0.42	160.245	1.750	85	374	502	170	64	3
Totals		**0.4**	**21.022**		**80.7**	**375.5**	**502.4**	**171.5**	**65.1**	**3.0**

Sample Gas Volume, $V_{m(std)}$

$V_{m(std)}$ = 19.91

Erthwrks Method 8A (CTM-013) Sampling Worksheet

Date: 6/1/2022
Client: Marathon
Facility: Detroit Refinery
Unit ID: CCR Charge Heater
Erthwrks Tech: John Wood, Luke Morrison
Run No: 2

DGM Pre-Test Leak Check			DGM Post-Test Leak Check		
Vac ("H_2O)	cubic feet	Time (s)	Vac ("H2O)	cubic feet	Time (s)
9	0.00	60	7	0.000	60

Start Time:	14:52
Meter Box ID:	M5-5
DGM y-fact:	0.9952
Atm Press ("Hg)	29.163

Sampling Point	Sample Time (min:sec)	ΔH	DGM Reading (ft^3)	ΔV_m (ft^3)	DGM Temp (°F)	Probe Temp (°F)	Filter Temp (°F)	H2SO4 Temp (°F)	Imp Exit Temp (°F)	DGM Vac (inHg)
Start: 14:52	14:52		167.785	<--- Starting Reading		(>350 °F)	(>500 °F)	(167-185 °F)	(<68 °F)	
1	14:57:00	0.42	169.530	1.745	76	376	501	173	59	3
2	15:02:00	0.42	171.285	1.755	76	376	502	169	59	3
3	15:07:00	0.42	173.045	1.760	78	377	503	169	60	3
4	15:12:00	0.42	174.802	1.757	78	375	500	169	60	3
5	15:17:00	0.42	176.563	1.761	79	376	505	169	60	3
6	15:22:00	0.42	178.327	1.764	80	376	503	169	61	3
7	15:27:00	0.42	180.092	1.765	81	376	503	169	61	3
8	15:32:00	0.42	181.864	1.772	81	377	500	169	62	3
9	15:37:00	0.42	183.635	1.771	82	375	507	169	63	3
10	15:42:00	0.42	185.410	1.775	83	376	504	169	64	3
11	15:47:00	0.42	187.190	1.780	83	377	506	169	65	3
12	15:52:00	0.42	188.970	1.780	83	376	507	169	66	3
Totals		**0.4**	**21.185**		**80.0**	**376.1**	**503.4**	**169.3**	**61.7**	**3.0**

Sample Gas Volume, $V_{m(std)}$

$V_{m(std)}$ = 20.09

Erthwrks Method 8A (CTM-013) Sampling Worksheet

Date: 6/1/2022
Client: Marathon
Facility: Detroit Refinery
Unit ID: CCR Charge Heater
Erthwrks Tech: John Wood, Luke Morrison
Run No: 3

DGM Pre-Test Leak Check			DGM Post-Test Leak Check		
Vac ("H_2O)	cubic feet	Time (s)	Vac ("H2O)	cubic feet	Time (s)
12	0.00	60	9	0.000	60

Start Time:	17:08
Meter Box ID:	M5-5
DGM y-fact:	0.9952
Atm Press ("Hg)	29.163

Sampling Point	Sample Time (min:sec)	ΔH	DGM Reading (ft^3)	ΔV_m (ft^3)	DGM Temp (°F)	Probe Temp (°F)	Filter Temp (°F)	H2SO4 Temp (°F)	Imp Exit Temp (°F)	DGM Vac (inHg)
Start: 17:08	17:08		194.308	<--- Starting Reading		(>350 °F)	(>500 °F)	(167-185 °F)	(<68 °F)	
1	17:13:00	0.42	196.095	1.787	79	374	506	170	54	3
2	17:18:00	0.42	197.895	1.800	80	376	502	173	53	3
3	17:23:00	0.42	199.704	1.809	80	376	511	169	53	3
4	17:28:00	0.42	201.518	1.814	80	375	507	169	54	3
5	17:33:00	0.42	203.333	1.815	81	374	509	169	54	3
6	17:38:00	0.42	205.150	1.817	82	376	510	169	56	3
7	17:43:00	0.42	206.975	1.825	82	375	504	169	57	3
8	17:48:00	0.42	208.800	1.825	83	375	508	169	58	3
9	17:53:00	0.42	210.627	1.827	83	376	507	169	59	3
10	17:58:00	0.42	212.447	1.820	83	375	509	169	61	3
11	18:03:00	0.42	214.268	1.821	83	376	508	169	61	3
12	18:08:00	0.42	216.095	1.827	83	376	502	169	62	3
Totals		**0.4**	**21.787**		**81.6**	**375.3**	**506.9**	**169.4**	**56.8**	**3.0**

Sample Gas Volume, $V_{m(std)}$

$V_{m(std)}$ = 20.60

Attachment D
Example Calculations

Erthwrks QAQC Example Calculations

Example Calculations for System QA : Run 1, CCR Charge Htr

Example Calculations for Pollutant : NOx

Variable:	Description:
C_0	Average of the pre- and post-run system cal bias responses from zero gas, ppmv.
C_{Avg}	Average unadjusted gas concentration for test run, ppmv.
C_{Dir}	Measured concentration of the cal gas when introduced in direct mode, ppmv.
C_M	Average of the pre- and post-run system cal bias responses from the upscale gas, ppmv.
C_{MA}	Actual concentration of the upscale calibration gas, ppmv.
CS	Calibration span, ppmv.
C_S	Measured concentration of the cal gas when introduced in the system cal mode, ppmv.
C_V	Manufacturer certified concentration of calibration gas, ppmv.
SB_f	Post-run system bias, percent of calibration span.
SB_i	Pre-run system bias, percent of calibration span.

Analyzer Calibration Error, ACE — Eq. 7E-1

$$ACE = \frac{C_{Dir} - C_V}{CS} \times 100$$

ACE = -0.76%

C_{Dir} = 24.36 ppmv
C_V = 24.77 ppmv
CS= 53.76 ppmv

Initial Upscale System Bias, SB_i — Eq. 7E-2

$$SB_i = \frac{C_S - C_{Dir}}{CS} \times 100$$

SB_i = -0.52%

CS= 53.76 ppmv
C_S = 24.08 ppmv
C_{Dir} = 24.36 ppmv

Upscale Drift Assessment, D — Eq. 7E-4

$$D = ABS|SB_f - SB_i|$$

D = 2.00%

SBi = -0.52%
SB_f = 1.48%

Effluent Gas Concentration, C_{Gas} — Eq. 7E-5

$$C_{Gas} = (C_{Avg} - C_O)\frac{C_{MA}}{C_M - C_O}$$

C_{Gas} = 24.23

C_{Avg}= 24.08 ppmv
C_o = 0.31 ppmv
C_{MA} = 24.77 ppmv
C_M = 24.62 ppmv

NO_2 - NO Conversion Efficiency, Eff_{NO2} — Eq. 7E-7

$$Eff_{NO_2} = \frac{C_{Dir}}{C_V} x100$$

Eff_{NO2} = 90.8%

C_{Dir} = 54.92 ppmv
C_V = 60.52 ppmv

Erthwrks Emission Rate Example Calculations

Example Calculations for Emissions : Run 1, CCR Charge Htr

Example Calculations for Pollutant : NOx

Variable:	Description:
$\%O_2d$	Oxygen concentration measured on a dry basis, %
F_d	Fuel F Factor for Natural Gas--Method 19 value, scf/MMBtu
MGV	Molar gas volume, volume of gas at standard conditions, scf/lbmol
MW_{NOx}	Molecular Weight of NOx, lb/lbmol
n	Moles, lbmol
PPM_{NOx}	Parts per million, NOx
p_s	Standard Pressure, psi
R	Universal gas constant, ft^3 psi / R lbmol
T_s	Standard Temperature, R
V	Volume, ft^3

Molar Gas Volume (MGV) calculation at standard conditions — Ideal Gas Law

$$MGV = \frac{V}{n} = \frac{R * T_S}{p}$$

T_s = 527.67 R
p = 14.696 psi
R = 10.7316 (ft^3*psi/(R* lbmoll)

MGV= 385.325 scf/lbmol

Emission Concentration, C_d

$$C_d = \frac{PPM * MW}{MGV} / 10^6$$

PPM - NOx = 24.23 parts per million
MW - NOx = 46.0055 lb/lb-mol

C_d= 2.89E-06 lb/scf

Emission Rate Calculation, $E_{(lb/MMBtu)}$ — Eq. 19-1

$$E_{(lb/MMBtu)} = C_d * F_d \frac{20.9}{20.9 - \%O_2d}$$

F_d= 8604 scf/MMBtu
$\%O_2d$= 6.71 %

$E_{(lb/MMBtu)}$= 0.0367 lb/MMBtu

Erthwrks RATA Example Calculations

Example Calculations for Relative Accuracy: CCR Charge Htr

Example Calculations for Pollutant : NOx - lb/MMBtu

Variable:	Description:
d	Absolute difference between reference method and client CEMS
i	Run number
n	Number of runs
d_{avg}	Mean of the difference between reference method and client CEMS
RM_{avg}	Average of the reference method results for each run
AS	The unit's permit limit or applicable standard

Arithmetic Mean, d_{avg} — Eq. 2-3

$$d_{avg} = \frac{1}{n}\sum_{i=1}^{n} d_i$$

d_1 =	-0.0041	d_4 =	-0.0053	d_7 =	-0.0041	d_{10} =	-0.0044
d_2 =	-0.0051	d_5 =	-0.0044	d_8 =	0	d_{11} =	0
d_3 =	-0.0046	d_6 =	-0.0045	d_9 =	-0.0044	d_{12} =	0
				n=	9		

d_{avg} = -0.0046

Standard Deviation, S_d — Eq. 2-4

$$S_d = \sqrt{\frac{\sum_{i=1}^{n} d_i^{\,2} - \frac{\left[\sum_{i=1}^{n} di\right]^2}{n}}{n-1}}$$

S_d = 0.0004

Confidence Coefficient, CC — Eq. 2-5

$$CC = t_{0.975}\,\frac{S_d}{n^{1/2}}$$

$t_{0.975}$ = 2.306

CC = 0.0003

Relative Accuracy, RA_{RM} — Eq. 2-6

$$RA_{RM} = \frac{|d_{avg}| + |CC|}{RM_{avg}} \times 100$$

RM_1 =	0.0367	RM_4 =	0.0351	RM_7 =	0.0365	RM_{10} =	0.0366
RM_2 =	0.0358	RM_5 =	0.0359	RM_8 =	0	RM_{11} =	0
RM_3 =	0.0358	RM_6 =	0.0357	RM_9 =	0.0378	RM_{12} =	0
RM_{avg} =	0.0362						

RA_{RM} = 13.45%

Example Calcs for Run 1 CCR Charge Heater Run 1

Variable:	Description:
B_{ws}	Proportion of water vapor, by volume, in the gas stream
C_f	Conversion factor, sec/hr
C_p	Pilot coefficient, 0.84
K_p	Velocity equation constant, 5129.4 (ft/min) [(lb/lb-mole)(in Hg) / (R)(in H_2O)]$^{0.5}$
M_d	Molecular weight of stack gas, dry
M_s	Molecular weight of stack gas, dry, g/g-mole (lb/lb-mole)
M_w	Molecular weight of water, g/g-mole (lb/lb-mole)
P_m	Absolute pressure at the dry gas meter = Barometric Pressure + Δh_{avg} / 13.6, in Hg
T_m	Absolute Temperature at Meter, °R
V_m	Volume measured by DGM, dcf
$V_{m(std)}$	Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf)
V_s	Measured concentration of the cal gas when introduced in the system cal mode, ppmv
$V_{wc(std)}$	Volume of water vapor condensed, corrected to standard conditions, scm (scf)
W_f	Final imp weight, g
W_i	Initial imp weight, g
Y	Dry gas meter calibration factor, unitless

Dry Molecular Weight of Stack Gas, M_d — Eq. 3-1

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$

M_d = **29.63** **lb/lb-mol**

$\%O_2$ = 6.63
$\%CO_2$ = 8.56
$\%N_2$ = 84.81
%CO = 0.00

Volume of Water Vapor Collected, $V_{wc(std)}$ — Eq. 4-2

$$V_{wc(std)} = K_3(W_f - W_i)$$

$V_{wc(std)}$ = **11.66** **ft^3**

K_3 = 0.04715 (ft^3/g)
W_i = 2540.80 (g)
W_f = 2788.10 (g)

Sample Gas Volume, $V_{m(std)}$ — Eq. 4-3

$$V_{m(std)} = \left(\frac{T_{std}}{P_{std}} * Y\right)\left(\frac{V_m * P_m}{T_m}\right)$$

$V_{m(std)}$ = **68.35** **ft^3**

T_{std} = 528 (°R)
P_{std} = 29.920 (inHg)
V_m = 73.04 (ft^3)
P_m = 29.45 (in H_2O)
T_m = 549.3333 (°R)
Y= 0.989 (unitless)

Moisture Content, B_{ws} — Eq. 4-4

$$B_{ws} = \frac{V_{wc(std)}}{V_{wc(std)} + V_{m(std)}}$$

B_{ws} = **14.57%**

Molecular Weight of Stack Gas, M_s — Eq. 2-6

$$M_S = M_d(1 - B_{ws}) + (M_w * B_{ws})$$

M_s = **27.94**

M_w = 18.00 (lb/lb-mole)

Example Calcs for Run : CCR Charge Heater Run 1

Variable:	Description:
Δp_{avg}	Average velocity head of stack gas, mm H_2O (in H_2O)
A_n	Cross-sectional area of nozzel, ft^2
A	Cross-sectional area of stack, ft^2
B_{ws}	Proportion of water vapor, by volume, in the gas stream
C_f	Conversion factor, sec/hr
C_p	Pilot coefficient, 0.84
K_p	Velocity equation constant, 5129.4 (ft/min) [(lb/lb-mole)(in Hg) / (R)(in H_2O)]$^{0.5}$
K_5	Constant, 0.09450 for English units
ΔH@	Orifice meter calibration coefficient, in H_2O
M_s	Dry molecular weight of stack gas, lb/lb-mole
Q	Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr)
P_s	Stack Pressure (Pbar + Pg)(in Hg)
Y_{qa}	Dry gas meter calibration check value, dimensionless
P_{bar}	Barometric pressure at the sampling site, mm Hg (in. Hg)
P_{std}	Standard absolute pressure, 760 mm Hg (29.92 in. Hg)
T_m	Absolute average DGM temperature, K (°R)
T_s	Absolute average stack gas temperature, 293 °K (528 °R)
$T_{s(abs)}$	Average Stack Temperature (°F) + 460, °R
V_m	Volume of gas sample as measured by dry gas meter, dcm (dcf)
$V_{m(std)}$	Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf)
θ	Total sampling time, min
V_S	Measured concentration of the cal gas when introduced in the system cal mode, ppmv.

Average Stack Gas Velocity, V_s — Eq. 2-7

$$V_S = K_p * C_p * \sqrt{\Delta p_{avg}} * \sqrt{\frac{T_{s(abs)}}{P_s * M_s}}$$

V_S = 1269.89 ft/min

V_S = 21.164856 ft/sec

K_p =	5129.4	
C_p =	0.84	unitless
P_s =	29.30	in H_2O
$T_{s(abs)}$ =	840.4583	°R
$(\Delta p_{avg})^{1/2}$ =	0.2909	
M_s =	27.94	lb/lb-mole

Average Stack Gas Flow, Q_a

$$Q_a = V_s * A$$

Q_a = 5.61E+04 acfm

A =	44.18	ft^2
V_s =	1269.89	ft/min

Wet Standard Stack Gas Flow, Q_{sw}

$$Q_{sw} = Q_a * 60 * \left(\frac{T_{std}}{P_{std}}\right) * \left(\frac{P_s}{T_{s(abs)}}\right)$$

Q_a = 2.07E+06 wscfh

P_s =	29.30	in Hg
P_{std} =	29.92	in Hg
$T_{s(abs)}$ =	840.5	°R
T_{std} =	528	°R

Average Stack Gas Dry Volumetric Flow Rate, Q — Eq. 2-8

$$Q = C_f * B_{ws} * A * V_s * \frac{T_{std} * P_s}{P_{std} * T_{s(abs)}}$$

Q = 1.77E+06 dscfh

C_f =	3600	sec/hr
A=	44.18	ft^2
B_{ws} =	0.854	unitless
P_s =	29.30	in Hg
P_{std} =	29.92	in Hg
$T_{s(abs)}$=	840.5	°R
T_{std} =	528	°R
V_s =	21.16	ft/sec

Percent Isokinetic, I — Eq. 5-8

$$I = \frac{T_s * V_{m(std)} * Ps_{(std)} * 100}{T_{(std)} * vs * \theta * An * Ps * 60 * (1 - Bws)}$$

I = 98.6 %

T_s =	840.4583	°R
$V_{m(std)}$ =	68.35	dscf
P_s =	29.30	in Hg
v_s =	21.16	ft/sec
A_n =	1.15E-03	ft^2
θ =	90	min
B_{ws} =	0.854	unitless

Post-Test Metering Calibration — Eq. 5-15

$$Y_{qa} = \frac{\theta}{V_m}\sqrt{\frac{0.0319 T_m}{\Delta H@\left(P_{bar} + \frac{\Delta H_{avg}}{13.6}\right)}\left(\frac{29}{M_s}\right)}\sqrt{\Delta H_{avg}}$$

$Y_{run\ 1}$ =	0.957
$Y_{run\ 2}$ =	0.963
$Y_{run\ 3}$ =	0.953
$Y_{qa\ (avg)}$ =	0.958
$Y_{pre\text{-}cal}$ =	0.989
%difference =	3.1%

Run 1:	ΔH@ =	1.816	unitless
	T_m =	549.3333	°R
	P_{bar} =	29.31	in H_2O
	V_m =	73.04	dcf
	ΔH_{avg} =	1.92	in H_2O
Run 2:	ΔH@ =	1.816	unitless
	T_m =	547.9583	°R
	P_{bar} =	29.31	in H_2O
	V_m =	74.64	dfc
	ΔH_{avg} =	2.04	in H_2O
Run 3:	ΔH@ =	1.816	unitless
	T_m =	550.25	°R
	P_{bar} =	29.31	in H_2O
	V_m =	76.99	dcf
	ΔH_{avg} =	2.12	in H_2O

Example Calcs for Run : CCR Charge Heater Run 1

Variable:	Description:
m_t	Total mass of particulates, mg
V_{std}	Standard gas volume, %
Q_{sd}	Dry standard stack flow rate, dscfh
Clinker Rate	

Particulate Matter Mass Concentration, C_m

m_t = 10.76 (mg)
V_{std} = 68.35 (dscf)

$$C_m = \frac{m_t}{453592} * \frac{1}{V_{std}}$$

C_m = 3.47E-07 lb/dscf

Particulate Matter Mass Emission Rate per Hour, E_d

Q_{sd} = 1.77E+06 (dscfh)

$$E_h = C_m * Q_{sd}$$

E_h = 0.61 lb/hr

Particulate Matter Mass Emission Rate per Day, E_d

$$E_d = E_h * 24$$

E_d = 14.74 lb/day

Particulate Matter Mass Emission Rate, E_{TC}

Firing Rate = 125.98 (MMbtu/hr)

$$E_{TC} = \frac{E_h}{\text{Firing Rate}}$$

E_{TC} = 0.0049 lb/MMbtu

Erthwrks Emission Rate Example Calculations

Example Calculations for Emissions : Run 1, CCR Charge Heater

Example Calculations for Pollutant : H_2SO_4

Variable:	Description:
$\%O_2d$	Oxygen concentration measured on a dry basis, %
F_d	Fuel F Factor for Natural Gas--Method 19 value, scf/MMBtu
MGV	Molar gas volume, volume of gas at standard conditions, scf/lbmol
MW	Molecular Weight, lb/lbmol
n	Moles, lbmol
PPM	Parts per million
m_t	Weight of H_2SO_4, from lab analysis
p_s	Standard Pressure, psi
R	Universal gas constant, ft^3 psi / R lbmol
T_s	Standard Temperature, R
V	Volume, ft^3

Molar Gas Volume (MGV) calculation at standard conditions — Ideal Gas Law

$$MGV = \frac{V}{n} = \frac{R * T_S}{p}$$

T_s =	527.67	R
p =	14.696	psi
R =	10.7316	(ft^3 *psi/(R* lbmoll)

MGV= 385.325 scf/lbmol

Emission Concentration, $C_{d(lb/scf)}$

$$C_{d-lb/scf} = \frac{mt(lb)}{\text{Train Volume}}$$

Train Volume =	19.91	scf
$m_{t-(}$ug) =	122.0	ug
m_t-(lb)	2.69E-07	lb

C_d(lb/scf)= 1.351E-08 lb/scf

Emission Concentration, $C_{d(ppm)}$

$$C_d = \frac{Cd\left(\frac{lb}{scf}\right) * 10^6 * MGV}{MW}$$

Cd-(lb/scf)	1.35E-08	lb/scf
MGV =	385.325	scf/lbmol
MW =	98.079	lb/lb-mol

C_d= 0.05 ppm

Emission Rate Calculation, $E_{(lb/MMBtu)}$ — Eq. 19-1

$$E_{(lb/MMBtu)} = C_{d(\frac{lb}{scf})} * F_d \frac{20.9}{20.9 - \%O_2d}$$

Cd (lb/scf)	1.35E-08	lb/scf
F_d=	8604.0	scf/MMBtu
$\%O_2d$=	6.63	%

$E_{(lb/MMBtu)}$= 0.0002 lb/MMBtu

Attachment E
Raw Data Log Records

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 8:20	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.25	-0.40	20.49	0.00
6/1/22 8:21	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.25	-0.38	20.48	0.00
6/1/22 8:22	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.26	-0.37	20.33	0.09
6/1/22 8:23	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.26	-0.67	19.85	17.19
6/1/22 8:24	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.26	-1.26	19.94	20.26
6/1/22 8:25	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.23	-1.07	19.94	20.33
6/1/22 8:26	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.22	-0.98	19.94	20.27
6/1/22 8:27	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.22	-0.94	19.94	20.23
6/1/22 8:28	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.22	-0.90	19.94	20.34
6/1/22 8:29	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.20	-0.88	19.93	20.42
6/1/22 8:30	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.20	-0.83	19.95	20.36
6/1/22 8:31	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.09	-0.28	19.96	20.28
6/1/22 8:32	9049.1.B3	MPC	Detroit	CCR Charge Htr	Direct Cal	0.02	0.07	19.95	19.61
6/1/22 8:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.46	23.90	5.53	7.39
6/1/22 8:34	9049.1.B3	MPC	Detroit	CCR Charge Htr		61.61	49.06	0.03	0.02
6/1/22 8:34	9049.1.B3	MPC	Detroit	CCR Charge Htr		59.23	49.72	0.02	0.00
6/1/22 8:35	9049.1.B3	MPC	Detroit	CCR Charge Htr	Direct Cal	53.76	50.94	0.03	0.00
6/1/22 8:36	9049.1.B3	MPC	Detroit	CCR Charge Htr		32.08	22.56	7.82	6.15
6/1/22 8:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.33	1.04	9.97	9.69
6/1/22 8:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.26	0.88	9.96	9.73
6/1/22 8:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.19	0.86	9.96	9.74
6/1/22 8:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.15	0.89	9.96	9.73
6/1/22 8:41	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.11	0.89	9.96	9.71
6/1/22 8:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.10	0.87	9.97	9.70
6/1/22 8:43	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.09	0.93	9.96	9.80
6/1/22 8:44	9049.1.B3	MPC	Detroit	CCR Charge Htr	Direct Cal	0.03	0.32	9.96	10.08
6/1/22 8:45	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.19	2.44	5.47	6.48
6/1/22 8:46	9049.1.B3	MPC	Detroit	CCR Charge Htr		12.96	22.22	0.11	0.06
6/1/22 8:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.03	25.79	0.04	0.00
6/1/22 8:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.14	25.78	0.04	0.00
6/1/22 8:48	9049.1.B3	MPC	Detroit	CCR Charge Htr	Direct Cal	24.36	25.78	0.03	0.00
6/1/22 8:49	9049.1.B3	MPC	Detroit	CCR Charge Htr		32.29	19.34	14.92	0.00
6/1/22 8:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		52.96	1.54	20.97	0.00
6/1/22 8:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		54.63	0.44	20.97	0.00
6/1/22 8:51	9049.1.B3	MPC	Detroit	CCR Charge Htr	NOx Conv Eff.	54.92	0.42	20.98	0.00
6/1/22 8:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		55.34	0.42	20.98	0.00
6/1/22 8:53	9049.1.B3	MPC	Detroit	CCR Charge Htr		37.99	7.01	13.62	3.17
6/1/22 8:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		21.40	3.87	6.25	8.46
6/1/22 8:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		14.69	6.53	8.91	8.51
6/1/22 8:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.67	0.52	9.97	9.85
6/1/22 8:56	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.47	-0.30	9.97	9.91
6/1/22 8:57	9049.1.B3	MPC	Detroit	CCR Charge Htr		1.50	0.46	6.96	8.22
6/1/22 8:58	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.82	18.63	0.28	0.36
6/1/22 8:58	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.33	24.81	0.24	0.03
6/1/22 8:59	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	24.08	25.03	0.21	0.01
6/1/22 9:00	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.95	24.39	1.41	1.16
6/1/22 9:01	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.41	6.97	5.74	8.57
6/1/22 9:02	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.10	-0.33	5.95	9.00
6/1/22 9:03	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.82	-0.48	6.29	8.85
6/1/22 9:04	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.60	-0.50	6.35	8.72
6/1/22 9:05	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.64	-0.52	6.35	8.69
6/1/22 9:06	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.77	-0.49	6.33	8.75
6/1/22 9:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.72	-0.52	6.35	8.77

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 9:08	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.71	-0.53	6.39	8.71
6/1/22 9:09	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.78	-0.54	6.36	8.71
6/1/22 9:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.78	-0.55	6.35	8.75
6/1/22 9:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.57	-0.52	6.65	8.62
6/1/22 9:12	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.41	-0.54	6.89	8.45
6/1/22 9:13	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.78	-0.57	7.07	8.38
6/1/22 9:14	9049.1.B3	MPC	Detroit	CCR Charge Htr		21.44	-0.64	7.28	8.22
6/1/22 9:15	9049.1.B3	MPC	Detroit	CCR Charge Htr		21.87	-0.66	7.27	8.17
6/1/22 9:16	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.08	-0.70	7.26	8.17
6/1/22 9:17	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.17	-0.68	7.16	8.22
6/1/22 9:18	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.15	-0.68	7.16	8.27
6/1/22 9:19	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.13	-0.65	7.22	8.25
6/1/22 9:20	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.14	-0.66	7.18	8.24
6/1/22 9:21	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.15	-0.70	7.19	8.24
6/1/22 9:22	9049.1.B3	MPC	Detroit	CCR Charge Htr		21.94	1.02	8.15	8.19
6/1/22 9:23	9049.1.B3	MPC	Detroit	CCR Charge Htr		2.24	0.06	9.91	9.88
6/1/22 9:24	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.21	-0.76	9.94	9.95
6/1/22 9:25	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.18	-0.81	9.95	9.92
6/1/22 9:26	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.15	-0.53	8.38	9.17
6/1/22 9:27	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.45	15.42	0.32	0.75
6/1/22 9:28	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.76	24.51	0.23	0.03
6/1/22 9:29	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.97	24.64	0.24	0.00
6/1/22 9:30	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.17	24.60	0.21	0.00
6/1/22 9:31	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.29	24.19	1.56	0.85
6/1/22 9:32	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.23	7.44	6.92	7.81
6/1/22 9:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.57	-0.51	6.95	8.33
6/1/22 9:34	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.79	-0.67	6.89	8.40
6/1/22 9:35	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.64	-0.62	6.84	8.45
6/1/22 9:36	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.60	-0.59	6.80	8.50
6/1/22 9:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.64	-0.58	6.87	8.46
6/1/22 9:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.65	-0.53	6.85	8.41
6/1/22 9:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.67	-0.58	6.81	8.42
6/1/22 9:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.63	-0.55	6.82	8.44
6/1/22 9:41	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.57	-0.57	6.83	8.43
6/1/22 9:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.49	-0.57	6.83	8.45
6/1/22 9:43	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.44	-0.56	6.80	8.44
6/1/22 9:44	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.42	-0.59	6.80	8.45
6/1/22 9:45	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.45	-0.60	6.79	8.47
6/1/22 9:46	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.56	-0.66	6.72	8.50
6/1/22 9:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.60	-0.64	6.70	8.53
6/1/22 9:48	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.50	-0.64	6.79	8.53
6/1/22 9:49	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.42	-0.58	6.84	8.46
6/1/22 9:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.45	-0.55	6.83	8.45
6/1/22 9:51	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.49	-0.58	6.80	8.47
6/1/22 9:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.52	-0.54	6.73	8.50
6/1/22 9:53	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.51	-0.56	6.79	8.53
6/1/22 9:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.47	-0.55	6.80	8.48
6/1/22 9:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.35	-0.55	6.79	8.45
6/1/22 9:56	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.37	-0.56	6.74	8.49
6/1/22 9:57	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.40	-0.54	6.71	8.53
6/1/22 9:58	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.49	-0.54	6.75	8.55
6/1/22 9:59	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.55	-0.54	6.77	8.51
6/1/22 10:00	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.60	-0.56	6.72	8.49

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 10:01	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.66	-0.55	6.73	8.52
6/1/22 10:02	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.74	-0.56	6.73	8.53
6/1/22 10:03	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.77	-0.57	6.81	8.50
6/1/22 10:04	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.77	-0.58	6.79	8.47
6/1/22 10:05	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.76	-0.64	6.77	8.47
6/1/22 10:06	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.63	-0.66	6.77	8.45
6/1/22 10:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.42	-0.69	6.70	8.45
6/1/22 10:08	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.22	-0.67	6.61	8.50
6/1/22 10:09	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.05	-0.65	6.59	8.55
6/1/22 10:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.98	-0.69	6.60	8.56
6/1/22 10:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.99	-0.70	6.56	8.57
6/1/22 10:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.96	-0.70	6.57	8.54
6/1/22 10:12	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.96	-0.67	6.59	8.52
6/1/22 10:13	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.95	-0.70	6.61	8.53
6/1/22 10:14	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.02	-0.71	6.62	8.52
6/1/22 10:15	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.11	-0.73	6.55	8.54
6/1/22 10:16	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.18	-0.77	6.67	8.52
6/1/22 10:17	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.20	-0.77	6.71	8.46
6/1/22 10:18	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.26	-0.74	6.67	8.47
6/1/22 10:19	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.37	-0.72	6.63	8.49
6/1/22 10:20	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.39	-0.74	6.63	8.51
6/1/22 10:21	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.23	-0.73	6.69	8.51
6/1/22 10:22	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.15	-0.72	6.72	8.46
6/1/22 10:23	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.17	-0.72	6.75	8.43
6/1/22 10:24	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.16	-0.73	6.65	8.50
6/1/22 10:25	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.99	-0.77	6.66	8.52
6/1/22 10:26	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.99	-0.76	6.59	8.53
6/1/22 10:27	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.07	-0.74	6.51	8.56
6/1/22 10:28	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	24.00	-0.72	6.51	8.58
6/1/22 10:29	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.88	-0.78	6.57	8.57
6/1/22 10:30	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.89	-0.77	6.53	8.56
6/1/22 10:31	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.89	-0.76	6.59	8.56
6/1/22 10:32	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 1	23.91	-0.76	6.65	8.51
					Run Average	24.08	-0.74	6.62	8.52
6/1/22 10:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.07	-0.73	7.95	8.73
6/1/22 10:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		11.05	-0.70	9.91	9.91
6/1/22 10:34	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.15	-0.53	9.92	10.07
6/1/22 10:35	9049.1.B3	MPC	Detroit	CCR Charge Htr		11.42	8.43	1.75	2.96
6/1/22 10:36	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.16	25.13	-0.01	0.00
6/1/22 10:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.11	25.81	-0.01	0.00
6/1/22 10:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		26.17	25.87	-0.01	0.00
6/1/22 10:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.22	8.89	-0.01	0.00
						3.00			
6/1/22 10:40	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	25.20	-0.29	6.29	8.76
6/1/22 10:41	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	25.10	-0.28	6.32	8.74
6/1/22 10:42	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.99	-0.27	6.35	8.72
6/1/22 10:43	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.88	-0.27	6.38	8.71
6/1/22 10:44	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.77	-0.26	6.41	8.69
6/1/22 10:45	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.67	-0.25	6.44	8.68
6/1/22 10:46	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.56	-0.24	6.47	8.66
6/1/22 10:47	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.45	-0.23	6.50	8.64

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 10:48	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.34	-0.23	6.53	8.63
6/1/22 10:49	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.24	-0.22	6.56	8.61
6/1/22 10:50	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.11	-0.21	6.62	8.57
6/1/22 10:51	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	24.05	-0.19	6.59	8.60
6/1/22 10:52	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.92	-0.21	6.64	8.58
6/1/22 10:53	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.78	-0.18	6.67	8.56
6/1/22 10:54	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.71	-0.18	6.72	8.51
6/1/22 10:55	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.78	-0.20	6.62	8.53
6/1/22 10:56	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.75	-0.21	6.56	8.56
6/1/22 10:57	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.52	-0.20	6.53	8.60
6/1/22 10:58	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.26	-0.16	6.52	8.63
6/1/22 10:59	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.17	-0.14	6.51	8.62
6/1/22 11:00	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 2	23.15	-0.17	6.45	8.61
					Run Average	24.16	-0.22	6.51	8.63
6/1/22 11:01	9049.1.B3	MPC	Detroit	CCR Charge Htr		18.98	-0.17	6.50	8.53
6/1/22 11:02	9049.1.B3	MPC	Detroit	CCR Charge Htr		18.82	-0.09	6.53	8.49
6/1/22 11:03	9049.1.B3	MPC	Detroit	CCR Charge Htr		18.83	-0.04	6.60	8.48
6/1/22 11:04	9049.1.B3	MPC	Detroit	CCR Charge Htr		9.45	0.02	7.56	9.31
6/1/22 11:05	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.23	0.02	9.96	9.99
6/1/22 11:06	9049.1.B3	MPC	Detroit	CCR Charge Htr		3.35	4.44	4.38	6.27
6/1/22 11:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.61	24.81	0.12	0.23
6/1/22 11:08	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.15	25.66	0.05	0.03
6/1/22 11:09	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.32	18.16	4.42	5.51
6/1/22 11:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		18.89	1.03	6.49	8.54
6/1/22 11:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.94	0.05	6.53	8.54
6/1/22 11:12	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	23.97	0.02	6.62	8.46
6/1/22 11:13	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.06	-0.05	6.63	8.44
6/1/22 11:14	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.21	-0.03	6.69	8.43
6/1/22 11:15	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.36	-0.06	6.59	8.44
6/1/22 11:16	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.55	-0.05	6.46	8.53
6/1/22 11:17	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.65	-0.07	6.42	8.57
6/1/22 11:18	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.61	-0.12	6.42	8.59
6/1/22 11:19	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.53	-0.04	6.44	8.57
6/1/22 11:20	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.49	-0.02	6.40	8.60
6/1/22 11:21	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.40	-0.05	6.37	8.62
6/1/22 11:22	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.27	-0.04	6.40	8.61
6/1/22 11:23	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.12	-0.02	6.46	8.58
6/1/22 11:24	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.09	0.00	6.41	8.58
6/1/22 11:25	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.14	-0.05	6.50	8.53
6/1/22 11:26	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.19	-0.05	6.37	8.55
6/1/22 11:27	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.23	-0.04	6.22	8.68
6/1/22 11:28	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.29	-0.08	6.24	8.71
6/1/22 11:29	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.31	-0.11	6.28	8.66
6/1/22 11:30	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.24	-0.12	6.28	8.64
6/1/22 11:31	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.11	-0.12	6.33	8.64
6/1/22 11:32	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 3	24.06	-0.11	6.40	8.60
					Run Average	24.28	-0.06	6.42	8.57
6/1/22 11:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.16	-0.09	6.41	8.60
6/1/22 11:34	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.25	-0.09	6.55	8.50
6/1/22 11:35	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.29	-0.11	6.54	8.45

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 11:36	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.40	-0.04	6.48	8.52
6/1/22 11:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.44	-0.09	6.45	8.53
6/1/22 11:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.44	-0.12	6.44	8.57
6/1/22 11:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.48	-0.09	6.40	8.58
6/1/22 11:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.50	-0.07	6.39	8.60
6/1/22 11:41	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.48	-0.07	6.35	8.59
6/1/22 11:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.36	-0.11	6.30	8.63
6/1/22 11:43	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.35	-0.12	6.37	8.65
6/1/22 11:44	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.36	-0.15	6.40	8.60
6/1/22 11:45	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.29	-0.15	6.50	8.55
6/1/22 11:46	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.36	-0.18	6.60	8.49
6/1/22 11:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.68	-0.19	6.59	8.48
6/1/22 11:48	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.19	6.61	8.49
6/1/22 11:49	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.00	-0.21	6.55	8.49
6/1/22 11:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.09	-0.17	6.58	8.49
6/1/22 11:51	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.13	-0.17	6.60	8.46
6/1/22 11:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.05	-0.19	6.61	8.42
6/1/22 11:53	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.14	-0.22	6.50	8.49
6/1/22 11:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.27	-0.23	6.39	8.59
6/1/22 11:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.20	-0.19	6.43	8.58
6/1/22 11:56	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.20	-0.17	6.47	8.54
6/1/22 11:57	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.25	-0.21	6.37	8.57
6/1/22 11:58	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.21	-0.20	6.45	8.58
6/1/22 11:59	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.12	-0.23	6.46	8.55
6/1/22 12:00	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.12	-0.23	6.48	8.54
6/1/22 12:01	9049.1.B3	MPC	Detroit	CCR Charge Htr		20.24	-0.26	6.57	8.51
6/1/22 12:02	9049.1.B3	MPC	Detroit	CCR Charge Htr		17.23	-0.21	8.05	8.78
6/1/22 12:03	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.18	-0.44	9.68	9.90
6/1/22 12:04	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.04	-0.58	9.68	9.98
6/1/22 12:05	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.03	-0.58	9.68	9.98
6/1/22 12:06	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.04	-0.57	9.72	9.97
6/1/22 12:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.06	-0.67	9.81	9.96
6/1/22 12:08	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.03	-0.77	9.88	10.02
6/1/22 12:09	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.03	-0.61	9.89	10.06
6/1/22 12:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		7.63	7.12	2.32	3.51
6/1/22 12:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.66	24.58	-0.01	0.01
6/1/22 12:12	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.74	25.46	-0.01	0.00
6/1/22 12:13	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.93	25.50	-0.01	0.00
6/1/22 12:14	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.15	25.52	0.00	0.00
6/1/22 12:15	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.57	19.49	5.23	4.60
6/1/22 12:16	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.12	1.45	6.62	8.43
6/1/22 12:17	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.99	-0.37	6.61	8.52
6/1/22 12:18	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.89	-0.32	6.67	8.47
6/1/22 12:19	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.86	-0.32	6.59	8.44
6/1/22 12:20	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.86	-0.31	6.46	8.51
6/1/22 12:21	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.80	-0.32	6.48	8.57
6/1/22 12:22	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.64	-0.28	6.45	8.54
6/1/22 12:23	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.45	-0.29	6.39	8.56
6/1/22 12:24	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.39	-0.33	6.40	8.63
6/1/22 12:25	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.38	-0.29	6.46	8.57
6/1/22 12:26	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.41	-0.33	6.53	8.53
6/1/22 12:27	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.50	-0.39	6.51	8.51
6/1/22 12:28	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.44	-0.39	6.49	8.54

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 12:29	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.28	-0.35	6.54	8.52
6/1/22 12:30	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.21	-0.39	6.61	8.47
6/1/22 12:31	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.25	-0.35	6.58	8.45
6/1/22 12:32	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.32	-0.34	6.56	8.48
6/1/22 12:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.31	-0.34	6.64	8.47
6/1/22 12:34	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.38	-0.41	6.67	8.42
6/1/22 12:35	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.61	-0.39	6.83	8.35
6/1/22 12:36	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.85	-0.32	7.12	8.17
6/1/22 12:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.14	-0.37	7.36	8.02
6/1/22 12:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.46	-0.44	7.20	8.02
6/1/22 12:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.80	-0.47	6.95	8.18
6/1/22 12:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.62	-0.46	6.77	8.31
6/1/22 12:41	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.12	-0.43	6.86	8.32
6/1/22 12:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.81	-0.44	6.78	8.31
6/1/22 12:43	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.77	-0.42	6.82	8.31
6/1/22 12:44	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.57	-0.42	6.81	8.31
6/1/22 12:45	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.33	-0.39	6.79	8.32
6/1/22 12:46	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.12	-0.35	6.77	8.29
6/1/22 12:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.07	-0.34	6.74	8.28
6/1/22 12:48	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.12	-0.35	6.71	8.28
6/1/22 12:49	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.18	-0.34	6.73	8.29
6/1/22 12:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.15	-0.32	6.76	8.27
6/1/22 12:51	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.18	-0.30	6.82	8.25
6/1/22 12:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.22	-0.34	6.82	8.22
6/1/22 12:53	9049.1.B3	MPC	Detroit	CCR Charge Htr		21.41	-0.35	6.96	8.18
6/1/22 12:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		21.62	-0.25	7.02	8.05
6/1/22 12:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.32	6.71	8.53
6/1/22 12:56	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.50	-0.41	6.69	8.57
6/1/22 12:56	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.24	-0.35	6.66	8.58
6/1/22 12:57	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.95	-0.38	6.66	8.57
6/1/22 12:58	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.86	-0.39	6.69	8.57
6/1/22 12:59	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.85	-0.38	6.71	8.54
6/1/22 13:00	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.92	-0.36	6.65	8.54
6/1/22 13:00	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.96	-0.37	6.63	8.58
6/1/22 13:01	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.06	-0.46	6.65	8.58
6/1/22 13:02	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.17	-0.44	6.68	8.56
6/1/22 13:03	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.77	-0.44	6.65	8.57
6/1/22 13:04	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.71	-0.45	6.65	8.57
6/1/22 13:05	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.64	-0.45	6.65	8.57
6/1/22 13:06	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.58	-0.46	6.64	8.57
6/1/22 13:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.49	-0.31	7.01	8.55
6/1/22 13:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.75	-0.24	7.00	8.41
6/1/22 13:08	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.53	-0.42	6.88	8.43
6/1/22 13:09	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.56	-0.48	6.88	8.43
6/1/22 13:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.29	-0.36	6.88	8.43
6/1/22 13:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.95	-0.35	6.92	8.44
6/1/22 13:12	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.36	6.91	8.45
6/1/22 13:13	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.97	-0.50	6.95	8.45
6/1/22 13:14	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.97	-0.47	6.98	8.39
6/1/22 13:15	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.98	-0.46	6.96	8.38
6/1/22 13:16	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.99	-0.49	6.99	8.39
6/1/22 13:17	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.02	-0.49	6.97	8.39
6/1/22 13:18	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.04	-0.54	6.96	8.41

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 13:19	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.99	-0.51	6.94	8.40
6/1/22 13:20	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.86	-0.40	6.88	8.42
6/1/22 13:21	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.82	-0.37	6.88	8.44
6/1/22 13:22	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.86	-0.36	6.90	8.45
6/1/22 13:23	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.89	-0.40	6.92	8.46
6/1/22 13:24	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.87	-0.49	6.79	8.48
6/1/22 13:25	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.87	-0.52	6.71	8.52
6/1/22 13:26	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.58	6.75	8.54
6/1/22 13:27	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.80	-0.54	6.79	8.52
6/1/22 13:28	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.74	-0.46	6.78	8.53
6/1/22 13:29	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.77	-0.34	7.38	8.55
6/1/22 13:30	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.38	-0.19	7.45	8.15
6/1/22 13:30	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.35	-0.21	7.36	8.19
6/1/22 13:31	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.32	-0.23	7.27	8.23
6/1/22 13:32	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.18	-0.25	7.07	8.36
6/1/22 13:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.26	-0.21	7.12	8.30
6/1/22 13:34	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.31	-0.27	7.08	8.30
6/1/22 13:35	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.27	-0.41	6.98	8.31
6/1/22 13:36	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.16	-0.37	6.88	8.40
6/1/22 13:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.03	-0.33	6.75	8.48
6/1/22 13:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.07	-0.32	6.56	8.58
6/1/22 13:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.49	-0.43	6.86	8.46
6/1/22 13:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.51	-0.41	6.84	8.49
6/1/22 13:41	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.54	-0.39	6.79	8.51
6/1/22 13:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.46	-0.39	6.79	8.53
6/1/22 13:43	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.34	-0.38	6.81	8.51
6/1/22 13:44	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.32	-0.42	6.78	8.53
6/1/22 13:45	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.41	-0.42	6.77	8.55
6/1/22 13:46	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.52	-0.35	6.84	8.54
6/1/22 13:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.47	-0.40	6.79	8.50
6/1/22 13:48	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.39	-0.42	6.78	8.50
6/1/22 13:49	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.42	-0.42	6.78	8.51
6/1/22 13:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.49	-0.41	6.80	8.52
6/1/22 13:51	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.54	-0.47	6.84	8.53
6/1/22 13:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.57	-0.49	6.91	8.49
6/1/22 13:53	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.68	-0.53	6.80	8.51
6/1/22 13:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.79	-0.54	6.71	8.56
6/1/22 13:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.86	-0.49	6.63	8.62
6/1/22 13:56	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.83	-0.48	6.70	8.66
6/1/22 13:57	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.72	-0.55	6.64	8.64
6/1/22 13:58	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.73	-0.57	6.63	8.64
6/1/22 13:59	9049.1.B3	MPC	Detroit	CCR Charge Htr		19.77	1.11	8.05	8.39
6/1/22 13:59	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.20	1.00	9.90	9.92
6/1/22 14:00	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	-0.27	-0.46	9.92	10.07
6/1/22 14:01	9049.1.B3	MPC	Detroit	CCR Charge Htr		-0.36	-0.41	8.73	9.71
6/1/22 14:02	9049.1.B3	MPC	Detroit	CCR Charge Htr		12.55	14.95	0.08	0.77
6/1/22 14:03	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.62	25.18	-0.02	0.03
6/1/22 14:04	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.70	25.34	-0.05	0.01
6/1/22 14:05	9049.1.B3	MPC	Detroit	CCR Charge Htr		27.24	15.95	5.68	5.70
6/1/22 14:06	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.65	0.24	6.72	8.46
6/1/22 14:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.45	-0.47	6.56	8.65
6/1/22 14:08	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.41	-0.56	6.56	8.69
6/1/22 14:09	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.29	-0.53	6.61	8.65

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 14:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.13	-0.49	6.62	8.59
6/1/22 14:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.12	-0.51	6.65	8.61
6/1/22 14:12	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.10	-0.50	6.73	8.57
6/1/22 14:13	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.13	-0.49	6.78	8.55
6/1/22 14:14	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.29	-0.50	6.76	8.57
6/1/22 14:15	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.53	-0.53	6.69	8.59
6/1/22 14:16	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.60	-0.56	6.66	8.63
6/1/22 14:17	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.59	-0.45	6.64	8.64
6/1/22 14:18	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.52	-0.49	6.59	8.68
6/1/22 14:19	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.48	-0.48	6.52	8.70
6/1/22 14:20	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.38	-0.42	6.50	8.72
6/1/22 14:21	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.26	-0.45	6.53	8.73
6/1/22 14:22	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.10	-0.43	6.58	8.70
6/1/22 14:23	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.99	-0.41	6.65	8.64
6/1/22 14:24	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.92	-0.45	6.65	8.62
6/1/22 14:25	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.99	-0.46	6.64	8.63
6/1/22 14:26	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.96	-0.47	6.67	8.59
6/1/22 14:27	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.44	6.61	8.60
6/1/22 14:28	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.92	-0.41	6.55	8.68
6/1/22 14:29	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.86	-0.37	6.61	8.68
6/1/22 14:30	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.76	-0.41	6.72	8.62
6/1/22 14:31	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.41	6.78	8.55
6/1/22 14:32	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.05	-0.44	6.83	8.52
6/1/22 14:33	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.07	-0.43	6.88	8.49
6/1/22 14:34	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.10	-0.43	6.76	8.53
6/1/22 14:35	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.06	-0.52	6.75	8.61
6/1/22 14:36	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.99	-0.51	6.80	8.59
6/1/22 14:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.95	-0.45	6.84	8.55
6/1/22 14:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.05	-0.43	6.86	8.53
6/1/22 14:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.13	-0.44	6.76	8.55
6/1/22 14:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.17	-0.39	6.60	8.65
6/1/22 14:41	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.13	-0.42	6.52	8.74
6/1/22 14:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.01	-0.47	6.59	8.72
6/1/22 14:43	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.47	6.61	8.65
6/1/22 14:44	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.87	-0.55	6.62	8.63
6/1/22 14:45	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.92	-0.47	6.77	8.58
6/1/22 14:46	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.89	-0.48	6.86	8.52
6/1/22 14:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.92	-0.46	6.85	8.52
6/1/22 14:48	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.03	-0.49	6.77	8.52
6/1/22 14:49	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.12	-0.50	6.72	8.57
6/1/22 14:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.08	-0.52	6.71	8.61
6/1/22 14:51	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.03	-0.53	6.66	8.64
6/1/22 14:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.06	-0.56	6.74	8.63
6/1/22 14:53	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.04	-0.56	6.80	8.58
6/1/22 14:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.03	-0.51	6.76	8.58
6/1/22 14:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.07	-0.54	6.60	8.64
6/1/22 14:56	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.15	-0.54	6.57	8.72
6/1/22 14:57	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	24.07	-0.52	6.68	8.69
6/1/22 14:58	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.88	-0.55	6.74	8.60
6/1/22 14:59	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.85	-0.51	6.77	8.59
6/1/22 15:00	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.93	-0.55	6.77	8.58
6/1/22 15:01	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.98	-0.52	6.73	8.60

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_x	CO	O_2	CO_2
6/1/22 15:02	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	24.02	-0.53	6.73	8.60
6/1/22 15:03	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	24.00	-0.51	6.71	8.60
6/1/22 15:04	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.97	-0.50	6.63	8.65
6/1/22 15:05	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.98	-0.56	6.60	8.68
6/1/22 15:06	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.92	-0.55	6.62	8.67
6/1/22 15:07	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.64	-0.55	6.78	8.61
6/1/22 15:08	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.63	-0.53	6.73	8.57
6/1/22 15:09	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.86	-0.53	6.65	8.65
6/1/22 15:10	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	24.00	-0.56	6.65	8.66
6/1/22 15:11	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.97	-0.54	6.58	8.70
6/1/22 15:12	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.88	-0.54	6.53	8.71
6/1/22 15:13	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.79	-0.53	6.42	8.76
6/1/22 15:14	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.77	-0.56	6.45	8.81
6/1/22 15:15	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	23.84	-0.56	6.69	8.70
6/1/22 15:16	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	24.02	-0.58	6.65	8.59
6/1/22 15:17	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 4	24.09	-0.55	6.66	8.64
					Run Average	23.91	-0.54	6.66	8.65
6/1/22 15:18	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.39	0.58	7.44	8.09
6/1/22 15:19	9049.1.B3	MPC	Detroit	CCR Charge Htr		2.18	1.80	9.91	9.80
6/1/22 15:20	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	-0.23	-0.57	9.94	10.07
6/1/22 15:21	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.97	0.25	7.13	8.28
6/1/22 15:21	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.95	17.97	0.03	0.35
6/1/22 15:22	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.74	25.10	-0.03	0.02
6/1/22 15:23	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.79	24.76	1.28	0.86
6/1/22 15:24	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.24	7.97	6.50	8.04
6/1/22 15:25	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.88	-0.38	6.58	8.66
6/1/22 15:26	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	17.40	-0.53	6.27	8.73
6/1/22 15:27	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.92	-0.57	6.42	8.81
6/1/22 15:28	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.94	-0.53	6.47	8.82
6/1/22 15:29	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.82	-0.57	6.54	8.78
6/1/22 15:30	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.75	-0.56	6.53	8.79
6/1/22 15:31	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.82	-0.54	6.59	8.75
6/1/22 15:32	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.75	-0.54	6.65	8.71
6/1/22 15:33	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.45	-0.54	6.79	8.61
6/1/22 15:34	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.36	-0.53	6.89	8.56
6/1/22 15:35	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.58	-0.53	6.97	8.51
6/1/22 15:36	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.72	-0.54	7.07	8.45
6/1/22 15:37	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.80	-0.52	7.20	8.39
6/1/22 15:38	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.97	-0.52	7.18	8.34
6/1/22 15:39	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	25.27	-0.55	6.91	8.45
6/1/22 15:40	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	25.30	-0.59	6.61	8.62
6/1/22 15:41	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.93	-0.61	6.27	8.84
6/1/22 15:42	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.49	-0.60	6.11	8.98
6/1/22 15:43	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	24.10	-0.57	6.06	9.01
6/1/22 15:44	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	23.64	-0.54	6.19	8.96
6/1/22 15:45	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	23.19	-0.50	6.32	8.86
6/1/22 15:46	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 5	22.81	-0.48	6.38	8.76
					Run Average	24.19	-0.55	6.59	8.70
6/1/22 15:47	9049.1.B3	MPC	Detroit	CCR Charge Htr		22.58	-0.44	6.33	8.71
6/1/22 15:48	9049.1.B3	MPC	Detroit	CCR Charge Htr		11.53	1.88	9.25	8.76

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_x	CO	O_2	CO_2
6/1/22 15:48	9049.1.B3	MPC	Detroit	CCR Charge Htr		-0.11	0.23	9.92	10.00
6/1/22 15:49	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	-0.20	-0.39	9.93	10.04
6/1/22 15:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		-0.26	-0.24	8.69	9.52
6/1/22 15:51	9049.1.B3	MPC	Detroit	CCR Charge Htr		19.16	15.14	0.09	0.79
6/1/22 15:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.15	25.13	-0.02	0.04
6/1/22 15:53	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	24.77	25.44	0.16	0.01
6/1/22 15:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.18	25.36	0.57	0.29
6/1/22 15:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.27	10.73	6.70	7.39
6/1/22 15:56	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.25	0.00	6.60	8.56
6/1/22 15:57	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.22	-0.26	6.45	8.74
6/1/22 15:58	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.19	-0.26	6.44	8.78
6/1/22 15:59	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.14	-0.27	6.46	8.81
6/1/22 16:00	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.15	-0.25	6.56	8.74
6/1/22 16:01	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.20	-0.30	6.68	8.61
6/1/22 16:02	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.22	-0.31	6.70	8.59
6/1/22 16:03	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.23	-0.33	6.82	8.54
6/1/22 16:04	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.34	-0.27	6.79	8.51
6/1/22 16:05	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.46	-0.28	6.74	8.54
6/1/22 16:06	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.53	-0.32	6.70	8.55
6/1/22 16:07	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.59	-0.31	6.67	8.57
6/1/22 16:08	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.71	-0.31	6.66	8.63
6/1/22 16:09	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.72	-0.28	6.81	8.58
6/1/22 16:10	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.80	-0.30	6.84	8.51
6/1/22 16:11	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	23.96	-0.34	6.88	8.48
6/1/22 16:12	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	24.07	-0.39	6.86	8.47
6/1/22 16:13	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	24.07	-0.37	6.85	8.48
6/1/22 16:14	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	24.05	-0.38	6.75	8.54
6/1/22 16:15	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	24.02	-0.37	6.61	8.63
6/1/22 16:16	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 6	24.00	-0.43	6.56	8.66
					Run Average	23.57	-0.30	6.69	8.60
6/1/22 16:17	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.01	-0.15	6.36	8.29
6/1/22 16:18	9049.1.B3	MPC	Detroit	CCR Charge Htr		13.82	1.74	9.82	9.36
6/1/22 16:19	9049.1.B3	MPC	Detroit	CCR Charge Htr		-0.35	-0.51	9.94	10.06
6/1/22 16:20	9049.1.B3	MPC	Detroit	CCR Charge Htr		-0.53	-0.59	9.95	10.09
6/1/22 16:21	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	-0.57	-0.58	9.95	10.08
6/1/22 16:22	9049.1.B3	MPC	Detroit	CCR Charge Htr		-0.30	0.15	7.29	8.37
6/1/22 16:23	9049.1.B3	MPC	Detroit	CCR Charge Htr		18.96	18.10	0.03	0.38
6/1/22 16:24	9049.1.B3	MPC	Detroit	CCR Charge Htr		26.22	25.29	-0.02	0.03
6/1/22 16:25	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	24.89	25.30	-0.04	0.00
6/1/22 16:26	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.02	24.53	1.82	1.20
6/1/22 16:27	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.48	6.41	6.82	7.98
6/1/22 16:28	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.71	-0.40	6.91	8.42
6/1/22 16:29	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.25	-0.50	6.90	8.45
6/1/22 16:30	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.27	-0.47	6.86	8.48
6/1/22 16:31	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.24	-0.35	6.77	8.53
6/1/22 16:32	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.11	-0.40	6.75	8.58
6/1/22 16:33	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.01	-0.48	6.72	8.56
6/1/22 16:34	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.91	-0.62	6.68	8.57
6/1/22 16:35	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.86	-0.61	6.69	8.56
6/1/22 16:36	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.87	-0.67	6.72	8.55

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 16:37	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.87	-0.60	6.67	8.56
6/1/22 16:38	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.86	-0.57	6.65	8.59
6/1/22 16:39	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.69	-0.57	6.68	8.58
6/1/22 16:40	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.67	-0.56	6.67	8.55
6/1/22 16:41	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.82	-0.56	6.68	8.55
6/1/22 16:42	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	23.95	-0.54	6.69	8.55
6/1/22 16:43	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.01	-0.61	6.71	8.54
6/1/22 16:44	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.10	-0.62	6.74	8.54
6/1/22 16:45	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.33	-0.60	6.67	8.56
6/1/22 16:46	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.53	-0.68	6.62	8.58
6/1/22 16:47	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.48	-0.56	6.73	8.59
6/1/22 16:48	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.42	-0.54	6.73	8.55
6/1/22 16:49	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 7	24.31	-0.51	6.85	8.52
					Run Average	24.07	-0.55	6.72	8.55
6/1/22 16:50	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.36	-0.54	6.89	8.45
6/1/22 16:51	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.08	0.99	7.94	8.24
6/1/22 16:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		1.44	0.32	9.91	9.96
6/1/22 16:52	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.34	-0.64	9.93	10.02
6/1/22 16:53	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.32	-0.62	9.94	10.05
6/1/22 16:54	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.28	-0.43	8.84	9.68
6/1/22 16:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		19.15	14.69	0.11	0.81
6/1/22 16:55	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.86	24.53	0.00	0.07
6/1/22 16:56	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.10	25.18	-0.01	0.03
6/1/22 16:57	9049.1.B3	MPC	Detroit	CCR Charge Htr		26.50	24.21	2.10	1.60
6/1/22 16:58	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.88	5.53	6.81	8.11
6/1/22 16:59	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.93	-0.32	6.70	8.51
6/1/22 17:00	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.89	-0.50	6.69	8.55
6/1/22 17:01	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.79	-0.50	6.52	8.62
6/1/22 17:02	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.65	-0.47	6.51	8.65
6/1/22 17:03	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.56	-0.49	6.50	8.66
6/1/22 17:04	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.38	-0.48	6.57	8.67
6/1/22 17:05	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.22	-0.51	6.67	8.60
6/1/22 17:06	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.26	-0.52	6.71	8.54
6/1/22 17:07	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.51	-0.53	6.72	8.53
6/1/22 17:08	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.57	-0.54	6.77	8.52
6/1/22 17:09	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.53	-0.54	6.71	8.54
6/1/22 17:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.42	-0.54	6.74	8.54
6/1/22 17:11	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.23	-0.47	6.76	8.54
6/1/22 17:12	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.21	-0.51	6.80	8.54
6/1/22 17:13	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.26	-0.41	6.78	8.53
6/1/22 17:14	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.25	-0.41	6.87	8.49
6/1/22 17:14	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.23	-0.42	6.88	8.46
6/1/22 17:15	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	24.26	-0.41	6.81	8.49
6/1/22 17:16	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	24.31	-0.48	6.77	8.53
6/1/22 17:17	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	24.25	-0.55	6.77	8.55
6/1/22 17:18	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	24.05	-0.54	6.68	8.57
6/1/22 17:19	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.86	-0.50	6.67	8.62
6/1/22 17:20	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.69	-0.45	6.66	8.60
6/1/22 17:21	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.63	-0.38	6.64	8.62
6/1/22 17:22	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.53	-0.34	6.71	8.63
6/1/22 17:23	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.48	-0.34	6.79	8.54

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 17:24	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.58	-0.33	6.71	8.57
6/1/22 17:25	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.66	-0.27	6.68	8.60
6/1/22 17:26	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.72	-0.34	6.57	8.65
6/1/22 17:27	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.77	-0.39	6.60	8.68
6/1/22 17:28	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.73	-0.41	6.66	8.64
6/1/22 17:29	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.72	-0.42	6.67	8.59
6/1/22 17:30	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.81	-0.44	6.62	8.64
6/1/22 17:31	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.89	-0.39	6.69	8.63
6/1/22 17:32	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.90	-0.32	6.62	8.63
6/1/22 17:33	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.85	-0.34	6.70	8.66
6/1/22 17:34	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.75	-0.28	6.69	8.61
6/1/22 17:35	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.74	-0.25	6.74	8.60
6/1/22 17:35	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 8	23.82	-0.39	6.69	8.60
6/1/22 17:36	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.90	0.01	6.66	8.22
6/1/22 17:37	9049.1.B3	MPC	Detroit	CCR Charge Htr		7.63	1.90	9.85	9.42
6/1/22 17:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.21	-0.38	9.95	10.06
6/1/22 17:38	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.22	-0.49	9.97	10.09
6/1/22 17:39	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.18	-0.48	9.95	10.10
6/1/22 17:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.27	-0.04	8.09	9.13
6/1/22 17:41	9049.1.B3	MPC	Detroit	CCR Charge Htr		17.47	16.58	0.07	0.65
6/1/22 17:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.59	25.43	-0.02	0.03
6/1/22 17:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.64	25.51	-0.02	0.01
6/1/22 17:43	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	24.64	25.55	-0.03	0.00
6/1/22 17:44	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.98	25.37	0.80	0.43
6/1/22 17:45	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.75	9.81	6.60	7.73
6/1/22 17:46	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.34	0.08	6.63	8.58
6/1/22 17:47	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.45	-0.27	6.68	8.59
6/1/22 17:48	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.66	-0.38	6.63	8.65
6/1/22 17:49	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.85	-0.41	6.72	8.63
6/1/22 17:50	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.83	-0.48	6.69	8.61
6/1/22 17:51	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.83	-0.47	6.72	8.61
6/1/22 17:52	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.88	-0.38	6.67	8.60
6/1/22 17:53	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.88	-0.44	6.67	8.63
6/1/22 17:54	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.82	-0.41	6.75	8.61
6/1/22 17:55	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.80	-0.34	6.78	8.57
6/1/22 17:56	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.87	-0.34	6.79	8.56
6/1/22 17:57	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.98	-0.38	6.75	8.57
6/1/22 17:58	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.98	-0.38	6.81	8.56
6/1/22 17:59	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.97	-0.43	6.82	8.54
6/1/22 18:00	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	25.01	-0.50	6.81	8.58
6/1/22 18:01	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	25.01	-0.45	6.86	8.56
6/1/22 18:02	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.99	-0.43	6.82	8.53
6/1/22 18:03	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	25.04	-0.47	6.72	8.58
6/1/22 18:04	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	25.01	-0.46	6.76	8.61
6/1/22 18:05	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	25.01	-0.40	6.71	8.60
6/1/22 18:06	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	25.07	-0.46	6.66	8.64
6/1/22 18:07	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	25.04	-0.47	6.68	8.65
6/1/22 18:07	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 9	24.90	-0.42	6.74	8.59
6/1/22 18:08	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.94	-0.16	6.53	8.29
6/1/22 18:09	9049.1.B3	MPC	Detroit	CCR Charge Htr		5.06	1.89	9.84	9.32

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	NO_X	CO	O_2	CO_2
6/1/22 18:10	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.22	-0.53	9.98	10.12
6/1/22 18:11	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.20	-0.65	9.99	10.11
6/1/22 18:12	9049.1.B3	MPC	Detroit	CCR Charge Htr		3.12	2.80	4.54	6.12
6/1/22 18:13	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.02	22.49	0.01	0.15
6/1/22 18:13	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.17	25.29	-0.02	0.03
6/1/22 18:14	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.22	25.34	-0.03	0.01
6/1/22 18:15	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.28	25.27	0.79	0.38
6/1/22 18:16	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.25	9.92	6.90	7.57
6/1/22 18:17	9049.1.B3	MPC	Detroit	CCR Charge Htr		24.72	-0.20	7.11	8.32
6/1/22 18:18	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.74	-0.52	7.18	8.31
6/1/22 18:19	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.93	-0.65	7.19	8.25
6/1/22 18:20	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	25.13	-0.69	7.12	8.28
6/1/22 18:21	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	25.13	-0.72	7.01	8.34
6/1/22 18:22	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	25.04	-0.73	6.91	8.40
6/1/22 18:23	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.86	-0.67	6.87	8.44
6/1/22 18:24	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.61	-0.61	6.84	8.43
6/1/22 18:25	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.44	-0.55	6.73	8.46
6/1/22 18:26	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.25	-0.59	6.72	8.49
6/1/22 18:27	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.01	-0.56	6.76	8.50
6/1/22 18:28	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.76	-0.59	6.82	8.48
6/1/22 18:29	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.60	-0.59	6.82	8.44
6/1/22 18:30	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.56	-0.63	6.81	8.46
6/1/22 18:31	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.56	-0.64	6.81	8.45
6/1/22 18:32	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.61	-0.59	6.83	8.45
6/1/22 18:33	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.72	-0.48	6.77	8.47
6/1/22 18:34	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.77	-0.46	6.74	8.50
6/1/22 18:35	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.75	-0.43	6.72	8.53
6/1/22 18:36	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.72	-0.45	6.80	8.49
6/1/22 18:37	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.73	-0.46	6.84	8.45
6/1/22 18:38	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	23.88	-0.51	6.73	8.47
6/1/22 18:38	9049.1.B3	MPC	Detroit	CCR Charge Htr	Run 10	24.18	-0.58	6.86	8.43
6/1/22 18:39	9049.1.B3	MPC	Detroit	CCR Charge Htr		23.93	-0.22	6.65	8.11
6/1/22 18:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		5.66	1.59	9.92	9.56
6/1/22 18:40	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.35	-0.41	9.99	10.08
6/1/22 18:41	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	0.34	-0.56	10.00	10.10
6/1/22 18:42	9049.1.B3	MPC	Detroit	CCR Charge Htr		0.28	-0.33	8.65	9.53
6/1/22 18:43	9049.1.B3	MPC	Detroit	CCR Charge Htr		16.03	15.21	0.10	0.84
6/1/22 18:44	9049.1.B3	MPC	Detroit	CCR Charge Htr		25.05	25.31	-0.01	0.04
6/1/22 18:45	9049.1.B3	MPC	Detroit	CCR Charge Htr	Sys Bias	25.15	25.44	-0.02	0.01

Attachment F
Calibrations and Certifications

STACK TESTING ACCREDITATION COUNCIL

American Association for Laboratory Accreditation

Accredited Air Emission Testing Body

A2LA has accredited

ERTHWRKS, INC.

In recognition of the successful completion of the joint A2LA and Stack Testing Accreditation Council (STAC) evaluation process, this laboratory is accredited to perform testing activities in compliance with ASTM D7036:2004 - Standard Practice for Competence of Air Emission Testing Bodies.

Presented this 29th day of March 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 6147.01
Valid to March 31, 2023

This accreditation program is not included under the A2LA ILAC Mutual Recognition Arrangement.

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
9810 BAY AREA BLVD
Pasadena, TX 77507
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	ERTHWRKS		
Part Number:	E04NI99E15A7104	Reference Number:	163-402284893-1
Cylinder Number:	CC446268	Cylinder Volume:	144.4 CF
Laboratory:	124 - Pasadena (SG06) - TX	Cylinder Pressure:	2015 PSIG
PGVP Number:	A32021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,PPN,BALN	Certification Date:	Dec 09, 2021

Expiration Date: Dec 09, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	25.00 PPM	24.77 PPM	G1	+/- 1.4% NIST Traceable	11/23/2021, 12/09/2021
CARBON MONOXIDE	25.00 PPM	25.43 PPM	G1	+/- 0.6% NIST Traceable	11/23/2021
NITRIC OXIDE	25.00 PPM	24.59 PPM	G1	+/- 1.7% NIST Traceable	11/23/2021, 12/09/2021
PROPANE	25.00 PPM	25.93 PPM	G1	+/- 1.2% NIST Traceable	11/29/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062106	CC366820	25.24 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	May 26, 2024
PRM	12402	APEX1324263	10.01 PPM NOx/NITROGEN	+/-0.5%	Dec 23, 2022
NTRM	16101	KAL004115	9.95 PPM NITRIC OXIDE/NITROGEN	+/-1.0%	Oct 16, 2022
GMIS	16101	KAL004115-NOX	9.95 PPM NOx/NITROGEN	+/-0.5%	Oct 16, 2022
NTRM	17061006	ND61234	49.13 PPM PROPANE/AIR	+/-0.4%	Jul 24, 2023

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRA CO 6 M2-529	NDIR	Nov 02, 2021
NO-CAI 600 CLD A12005	CHEMI	Nov 02, 2021
NOX-CAI CLD A12005	CHEMI	Nov 02, 2021
C3H8-XL-NICOLET iS50 AUP2010248	FTIR	Nov 04, 2021

Triad Data Available Upon Request

Signature on file

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
9810 BAY AREA BLVD
Pasadena, TX 77507
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	ERTHWRKS		
Part Number:	E04NI99E15A51Y5	Reference Number:	163-402274216-1
Cylinder Number:	CC339873	Cylinder Volume:	144.4 CF
Laboratory:	124 - Pasadena (SG06) - TX	Cylinder Pressure:	2015 PSIG
PGVP Number:	A32021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,PPN,BALN	Certification Date:	Nov 23, 2021

Expiration Date: Nov 23, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	53.00 PPM	53.76 PPM	G1	+/- 1.2% NIST Traceable	11/15/2021, 11/23/2021
CARBON MONOXIDE	50.00 PPM	50.83 PPM	G1	+/- 0.8% NIST Traceable	11/15/2021
PROPANE	50.00 PPM	52.60 PPM	G1	+/- 0.5% NIST Traceable	11/15/2021
NITRIC OXIDE	53.00 PPM	53.64 PPM	G1	+/- 1.2% NIST Traceable	11/15/2021, 11/23/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062103	CC366817	25.24 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	May 26, 2024
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
NTRM	17061006	ND61234	49.13 PPM PROPANE/AIR	+/-0.4%	Jul 24, 2023
NTRM	20061119	CC708066	49.82 PPM NITRIC OXIDE/NITROGEN	+/-1.0%	Feb 02, 2025
GMIS	401648677102	CC506986	15.21 PPM NITROGEN DIOXIDE/NITROGEN	+/-2.1%	Feb 10, 2023

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO-XL-NICOLET iS50 AUP2010248	FTIR	Oct 28, 2021
NO-XL-NICOLET iS50 AUP2010248	FTIR	Nov 11, 2021
NO2-NICOLET iS50 AUP2010248	FTIR	Nov 11, 2021
C3H8-XL-NICOLET iS50 AUP2010248	FTIR	Nov 04, 2021

Triad Data Available Upon Request

Signature on file
Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
9810 BAY AREA BLVD
Pasadena, TX 77507
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI80E15A0138	Reference Number:	163-402334056-1
Cylinder Number:	CC287657	Cylinder Volume:	150.9 CF
Laboratory:	124 - Pasadena (SG06) - TX	Cylinder Pressure:	2015 PSIG
PGVP Number:	A32022	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jan 26, 2022

Expiration Date: Jan 26, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	10.00 %	10.13 %	G1	+/- 0.8% NIST Traceable	01/26/2022
OXYGEN	10.00 %	10.00 %	G1	+/- 0.7% NIST Traceable	01/26/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12010106	K005090	17.97 % CARBON DIOXIDE/NITROGEN	+/-0.5%	Jan 11, 2024
NTRM	10010917	K015369	20.89 % OXYGEN/NITROGEN	+/-0.5%	Jun 27, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
HORIBA VIA 510 CO2 19GYCXEG	NDIR	Jan 12, 2022
O2 SIEMENS OXYMAT 6 DD550	PARAMAGNETIC	Dec 30, 2021

Triad Data Available Upon Request

Signature on file

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
9810 BAY AREA BLVD
Pasadena, TX 77507
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI60E15A0286	Reference Number:	163-402126105-1
Cylinder Number:	ALM038955	Cylinder Volume:	159.6 CF
Laboratory:	124 - Pasadena (SG06) - TX	Cylinder Pressure:	2015 PSIG
PGVP Number:	A32021	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jun 02, 2021

Expiration Date: Jun 02, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	20.00 %	19.69 %	G1	+/- 1.0% NIST Traceable	06/02/2021
OXYGEN	20.00 %	19.92 %	G1	+/- 0.6% NIST Traceable	06/02/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12010106	K005090	17.97 % CARBON DIOXIDE/NITROGEN	+/-0.5%	Jan 11, 2024
NTRM	09060239	CC263131	9.961 % OXYGEN/NITROGEN	+/-0.3%	Nov 05, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
HORIBA VIA-510 CO2 19GYCXEG	NDIR	May 24, 2021
O2-SIEMENS OXYMAT 6 DD550	PARAMAGNETIC	May 21, 2021

Triad Data Available Upon Request

Signature on file
Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
12722 S. Wentworth Ave.
Chicago, IL 60628
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E02AI99E15W0020	Reference Number:	54-402196543-1
Cylinder Number:	CC502181	Cylinder Volume:	146.2 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12021	Valve Outlet:	660
Gas Code:	NO2,BALA	Certification Date:	Aug 30, 2021

Expiration Date: Aug 30, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NITROGEN DIOXIDE	60.00 PPM	60.52 PPM	G1	+/- 1.9% NIST Traceable	08/23/2021, 08/30/2021
AIR	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS	1534002020505	EB0130067	59.76 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.4%	Apr 30, 2024
PRM	12397	D887665	74.2 PPM NITROGEN DIOXIDE/AIR	+/- 1.3%	Feb 02, 2022

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR NO2 017707558	FTIR	Aug 19, 2021

Triad Data Available Upon Request

Signature on file

Approved for Release

ACCREDITED
A2LA Certificate No. 1750.01
Calibration

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 6530-11347485

Traceable® Certificate of Calibration for Digital Barometer

Manufactured for and distributed by : Traceable® Products 12554 Galveston Rd B230, Webster, TX 77598

Instrument Identification:

Model: 6530,68000-49 S/N: 200355570 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	01 Nov 2020	1000447551
Digital Thermometer	130070752	10 Mar 2021	4000-11170557
Chilled Mirror Hygrometer	44654/2H3737	25 Nov 2021	17811
Climate Chamber	W619.0019		

Certificate Information:

Technician: 57 Procedure: CAL-31 Cal Date: 14 Jun 2020 Cal Due Date: 14 Jun 2022

Test Conditions: 48.54%RH 23.44°C 1017mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
%RH	N.A.	N.A.		50.14	52	Y	47	53	0.74	>4:1
°C	N.A.	N.A.		25.22	24.9	Y	24.82	25.62	0.05	>4:1
mb/hPa	N.A.	N.A.		805.50	805	Y	802	810	0.62	>4:1
mb/hPa	N.A.	N.A.		910.10	911	Y	906	914	0.62	>4:1
mb/hPa	N.A.	N.A.		1013.50	1014	Y	1010	1018	0.62	>4:1

This certificate indicates Traceability to standards provided by (NIST) National Institute of Standards and Technology and/or a National Standards Laboratory.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement : (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ± U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min=As Left Nominal(Rounded) – Tolerance; Max= As Left Nominal(Rounded) + Tolerance;

Nicol Rodriguez, Quality Manager

Marisa Elms, Technical Manager

Note :

Maintaining Accuracy:

In our opinion once calibrated your Digital Barometer should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Barometer change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

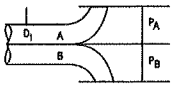
For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

Issue Date : 14 Jun 2020

CONTROL COMPANY 12554 Galveston RD Suite B230 Webster TX USA 77598
Phone 281 482-1714 Fax 281 482-9448 sales@control3.com www.traceable.com

S-TYPE PITOT TUBE INSPECTION

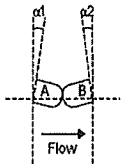
Pitot tube No:	2824	Date:	11/3/2020	Technician	TAS
Pitot tube assembly level?		Yes	Pitot tube openings damaged?		NO
					If yes, explain below



D_t (")[1]: 0.375 (3/16"<D_t<3/8")

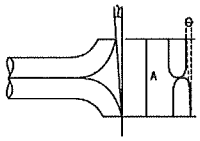
P_A (")[2]: 0.472 P_A = 1.26 *Dt (1.05*D_t<P_A<1.5*D_t)

P_B (")[2]: 0.472 P_B = 1.26 *Dt (1.05*D_t<P_B<1.5*D_t)



α_1[3] : 1.4°

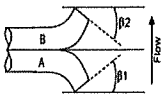
α_2[3] : 1.7°



γ : .9°

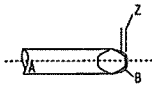
θ : 1.9°

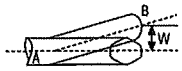
A ("): 0.944



β_1[3] : .3°

β_2[3] : .8°





z = (A sin γ): .015' (< 0.125) w = (A sin θ): .03' (< 0.03125)

[1] D_t must be between 0.48 and .95 cm (3/16 and 3/18") per EPA Method 2 Section 10.1

[2] P_A and P_B must be equal and between 0.41 and 0.59" per EPA Method 2 Section 10.1

[3] The types of misalignment will not affect the baseline value of C_p(s) so long as a1 and a2 <10°, b1 and b2 <5° per EPA Method 2 Figure 2-3

Calibration Required? No

Pitot tube No. 2824 meets Method 2 specifications and is assigned a calibration factor of 0.84.

Comments:

APEX INSTRUMENTS METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING CALIBRATED CRITICAL ORIFICES
5-POINT ENGLISH UNITS

Meter Console Information	
Console Model Number	522
Console Serial Number	M5-2
DGM Model Number	S-110
DGM Serial Number	1308030

Calibration Conditions			
Date	Time	30-Nov-21	15:04
Barometric Pressure		30.1	in Hg
Theoretical Critical Vacuum[1]		14.2	in Hg
Calibration Technician		AM	

Factors/Conversions		
Std Temp	528	°R
Std Press	29.92	in Hg
K_1	17.647	oR/in Hg

[1]For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.

[2]The Critical Orifice Coefficient, K', must be entered in English units, $(ft^3*°R^{1/2})/(in.Hg*min)$.

Calibration Data

Run Time	Metering Console					Critical Orifice				
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Serial Number	Coefficient	Amb Temp Initial	Amb Temp Final	Actual Vacuum
(Θ)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})		K'	(t_{amb})	(t_{amb})	
min	in H_2O	cubic feet	cubic feet	°F	°F		see above2	°F	°F	in Hg
7.0	3.50	883.000	890.543	81	82	RU-73	0.8110	73	73	17
7.0	1.90	875.700	881.192	79	80	RU-63	0.5888	73	73	20
10.0	1.10	868.600	874.626	79	79	RU-55	0.4519	73	73	21
17.0	0.65	859.800	867.520	78	78	RU-48	0.3396	73	73	23
21.4	0.32	851.400	858.100	78	78	RU-40	0.2349	74	73	24

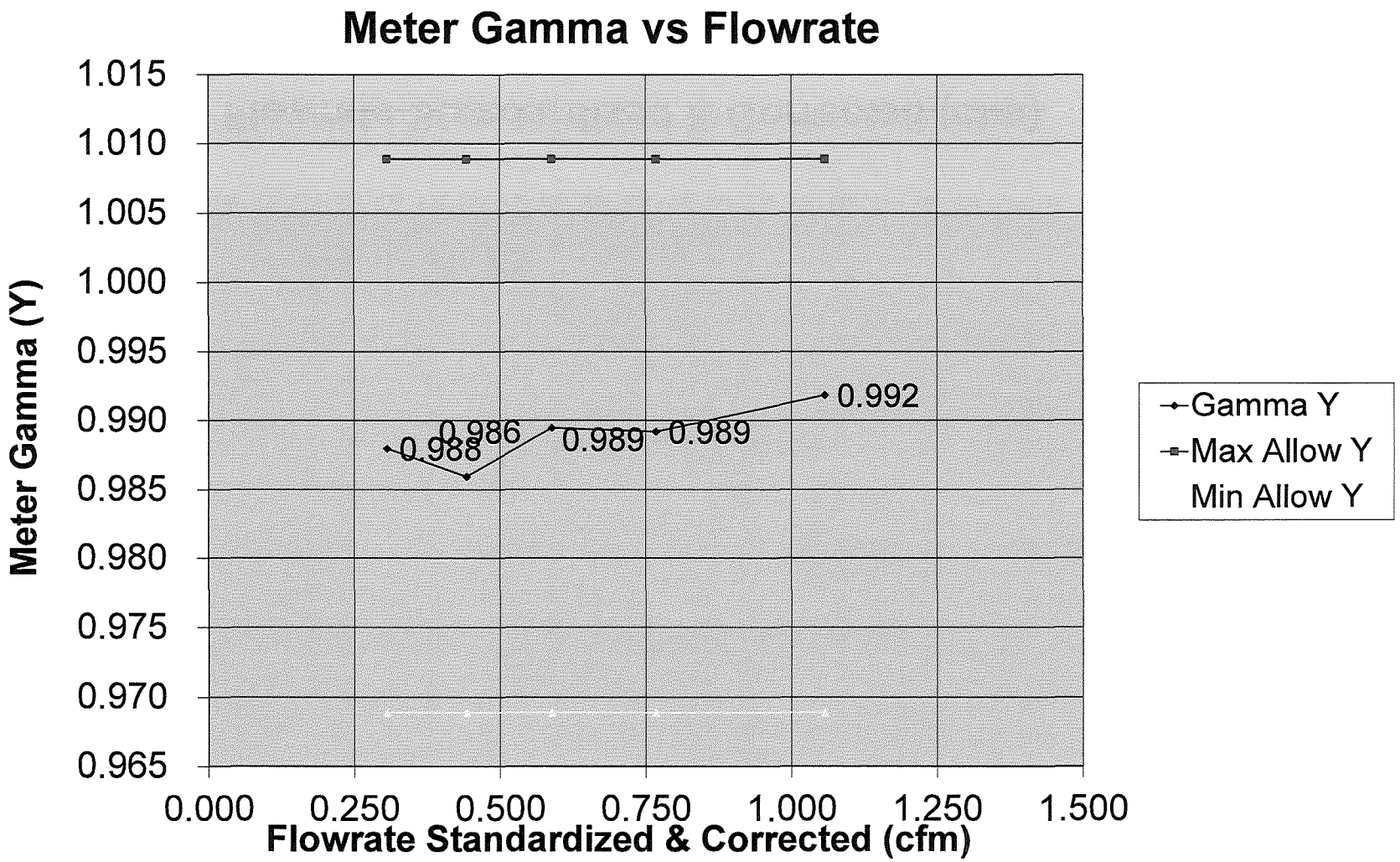
Results

Standardized Data				Dry Gas Meter				
				Calibration Factor		Flowrate	ΔH @	
Dry Gas Meter		Critical Orifice		Value	Variation	Std & Corr	0.75 SCFM	Variation
($V_{m(std)}$)	($Q_{m(std)}$)	($Vcr_{(std)}$)	($Q_{cr(std)}$)	(Y)	(ΔY)	($Q_{m(std)(corr)}$)	(ΔH@)	(ΔΔH@)
cubic feet	cfm	cubic feet	cfm			cfm	in H2O	
7.462	1.066	7.402	1.057	0.992	0.003	1.057	1.758	-0.057
5.432	0.776	5.374	0.768	0.989	0.000	0.768	1.804	-0.012
5.954	0.595	5.892	0.589	0.989	0.001	0.589	1.767	-0.048
7.634	0.449	7.527	0.443	0.986	-0.003	0.443	1.849	0.033
6.620	0.310	6.541	0.306	0.988	-0.001	0.306	1.901	0.085
Dry Gas Meter				**0.989**	Y Average		**1.816**	ΔH@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

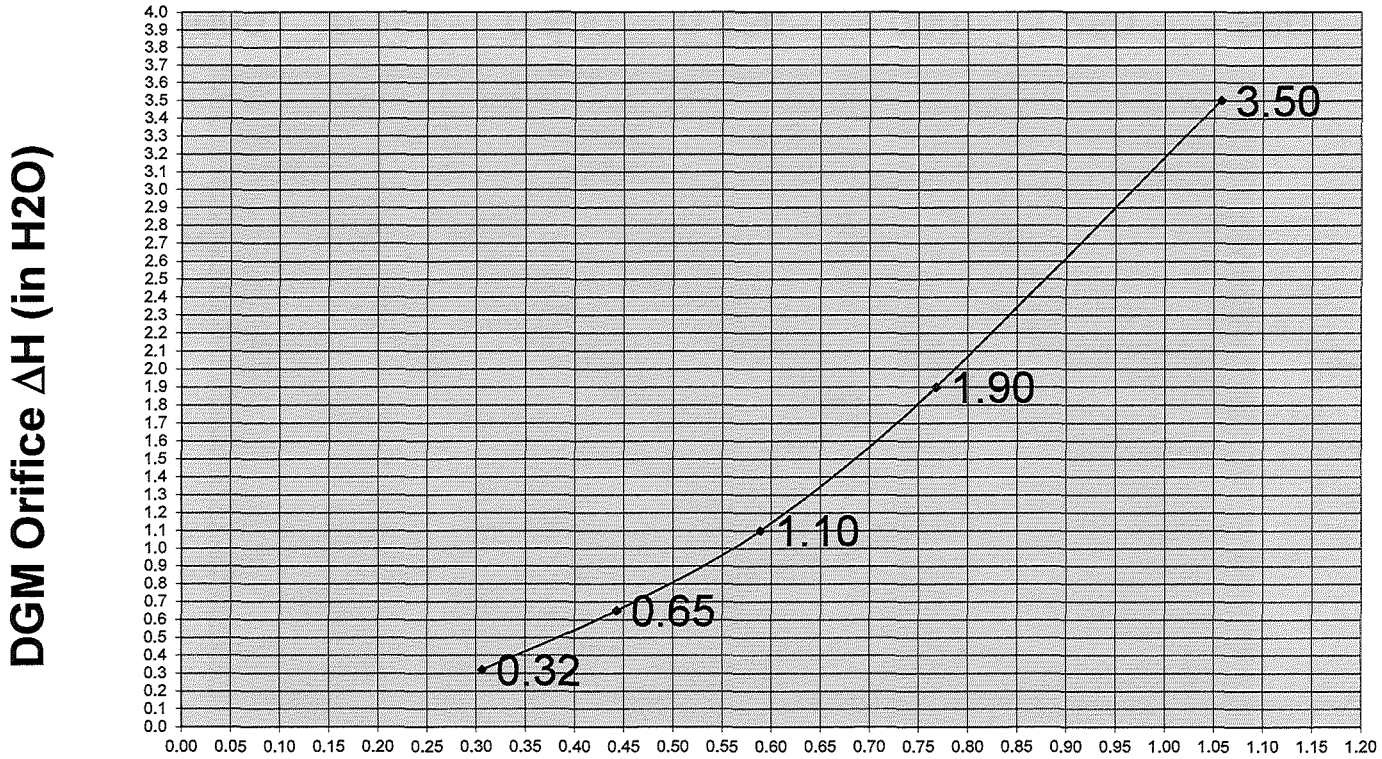
Signature _____ Date 11/30/2021



Console Model: MC-522-O

Calibration Date: 11-30-2021 Calibration Technician: AM

Meter Pressure vs Flowrate



Console Model: MC-522-

Erthwrks Meterbox Thermocouple Calibration Datasheet

Meterbox ID No. M5-2 Serial No. 1308030

Thermocouple Check		Meter Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
5	5	258	258	0.00	Average Difference must be +/- 1.5%
45	45	280	280	0.00	
65	66	291	292	0.19	
85	86	303	303	0.18	
120	121	322	323	0.17	
150	152	339	340	0.33	

Thermocouple Check		Exit Impinger Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
0	0	255	255	0.00	Average Difference must be +/- 1.5
10	12	261	262	0.42	
20	22	266	268	0.42	
40	43	278	279	0.60	
50	52	283	284	0.39	
70	73	294	296	0.56	

Thermocouple Check		Probe Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
5	5	258	258	0.00	Average Difference must be +/- 1.5%
45	45	280	280	0.00	
100	98	311	310	0.36	
250	249	394	394	0.14	
300	301	422	423	0.13	
500	499	533	533	0.10	

Thermocouple Check		Gas Inlet Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
0	1	255	256	0.22	Average Difference must be +/- 1.5
10	11	261	261	0.21	
20	20	266	266	0.00	
40	41	278	278	0.20	
50	49	283	283	0.20	
70	71	294	295	0.19	

Thermocouple Check		Filter Oven Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
5	4	258	258	0.22	Average Difference must be +/- 1.5%
50	53	283	285	0.59	
100	99	311	310	0.18	
250	253	394	396	0.42	
300	299	422	421	0.13	
500	502	533	534	0.21	

Thermocouple Check		Stack Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
0	2	255	256	0.43	Average Difference must be +/- 1.5
80	82	300	301	0.37	
250	254	394	396	0.56	
550	555	561	564	0.49	
750	754	672	674	0.33	
1000	1003	811	813	0.21	

Signature _____ Date 5/25/2022

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

Revised: 2019/12/18

Certificate of Calibration

Method 5 Pre-Test Console Calibration - Cubic Feet (ft^3)

UUT Meter Console Information

Model #:	XC-522
Serial #:	1404013
DGM Model #:	S-110
DGM Serial #:	626997

Calibration Conditions

Bar. Pressure (in Hg):	30.23
Ambient Temp. (°F):	80.6
Relative Humidity (%):	53
Altitude (ft):	414.0
Bar. Pressure (Corr.) (In Hg):	29.82

Factors/Conversions

Std. Temp. (°R):	527.67
Std. Press. (in Hg):	29.92
K_1 (°R/in Hg):	17.636

Reference Equipment

WTM Model:	W-NKoDa-5B	Serial #:	546258
WTM Cal. Due Date:	Aug. 2021	Gamma:	1.0000
WTM Thermometer:	Internal		

UUT Meter (DGM)

Run Time (minutes)	Orifice, ΔH (in. H_2O)	Volume (ft^3)			Outlet Temperature (°F)	
		Initial	Final	Total	Initial	Final
Θ	$P_{m(g)}$	V_{mi}	V_{mf}	V_m	t_{mi}	t_{mf}
5.0	5.0	606.335	612.599	6.264	76.0	78.0
6.0	3.0	618.402	624.257	5.855	78.0	80.0
7.0	2.0	624.257	629.784	5.527	80.0	81.0
10.0	1.0	629.784	635.337	5.553	81.0	82.0
15.0	0.5	612.599	618.402	5.803	78.0	78.0

Reference Meter (WTM)

Meter Pressure (mm H_2O)	Volume (L)			Outlet Temperature (°C)	
	Initial	Final	Total	Initial	Final
P_w	V_{wi}	V_{wf}	V_w	t_{wi}	t_{wf}
-6.0	487.772	667.119	179.347	24.7	24.9
-4.5	830.243	996.008	165.765	25.0	25.2
-3.0	996.008	1151.585	155.577	25.2	25.3
-1.5	1151.585	1307.128	155.543	25.3	25.4
-0.5	667.119	830.243	163.124	24.9	25.0

Standardized Data

Test Meter		Reference Meter		Correction Factor		Flow Rate
Std. Volume	Std. Flow Rate	Std. Volume	Std. Flow Rate	"Gamma"	Variation	Std. & Corr.
Vm_{std} (ft^3)	Qm_{std} (ft^3/min)	Vw_{std} (ft^3)	Qw_{std} (ft^3/min)	(Y)	(ΔY)	$Qm_{std/corr}$
6.213	1.243	6.206	1.241	0.9989	0.004	1.237
5.758	0.960	5.731	0.955	0.9954	0.000	0.955
5.407	0.772	5.377	0.768	0.9945	-0.001	0.769
5.409	0.541	5.375	0.538	0.9937	-0.001	0.538
5.682	0.379	5.645	0.376	0.9935	-0.002	0.377
				0.9952	= Y Avg.	

Calibration Results

ΔH@ (in H_2O)	
0.75 SCFM	Variance
ΔH@	ΔΔH@
1.81	-0.06
1.82	-0.05
1.86	0.00
1.90	0.03
1.94	0.08
1.87	= ΔH@ Avg.

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

Note: For $\Delta H_@$, orifice pressure differential that equates to 0.75cfm (0.0212m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2inches (5.1mm) H_2O.

Pass/Fail Result: Pass

Technician: Jake Bush Signature: Jake Bush Date: June 1, 2021

The instruments listed and described on this certificate have been calibrated against standards traceable to the National Institute of Standards and Technology (N.I.S.T.) and in reference to EPA Method 5, Section 10.3.1.

Apex Instruments - Address: 204 Technology Park Ln., Fuquay-Varina, NC 27526 USA | Tel: (919) 557-7300 Web: www.apexinst.com

APEX SOURCE TESTING EQUIPMENT INSTRUMENTS

Certificate of Calibration - Supplemental

Method 5 Pre-Test Console Calibration - Cubic Feet (ft^3)

Nomenclature

- ΔH@ - Orifice press. Diff. that equates to 0.75 CFM (0.0212 CMM) at STP
- DGM - Dry Gas Meter
- K_1 - Constant based on standard temperature and pressure
- Θ - Run time, in minutes
- $P_{m(g)}$ - ΔH (Meter Pressure, gauge)
- $V_{m(std)}$ - Volume collected by test meter, corrected for STP
- $Q_{m(std)}$ - Calculated flow rate of test meter
- K' - Critical orifice coefficient
- P_w - Measured pressure of reference meter
- t_w - Temperature measured in reference meter
- t_m - Temperature measured in test meter
- Y - Ratio of volume collected from test meter and orifice
- $Vw_{(std)}$ - Volume collected by reference meter, corrected for STP
- $Qw_{(std)}$ - Calculated flow rate of reference meter/standard
- corr - Volume or flow rate for a meter corrected by the scaling factor

Equations

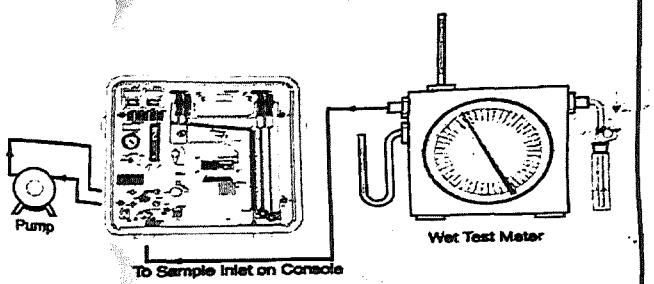
$$V_{m(std)} = K_1 * \frac{V_m * \left(P_{bar} + \frac{\Delta H}{13.6}\right)}{T_m} \qquad Q_{m(std)} = \frac{V_{m(std)}}{\Theta}$$

$$V_{w(std)} = Y * K_1 \frac{V_w * \left(P_{bar} + \frac{P_{m(g)}}{13.6}\right)}{T_w} \qquad Q_{w(std)} = \frac{V_{w(std)}}{\Theta}$$

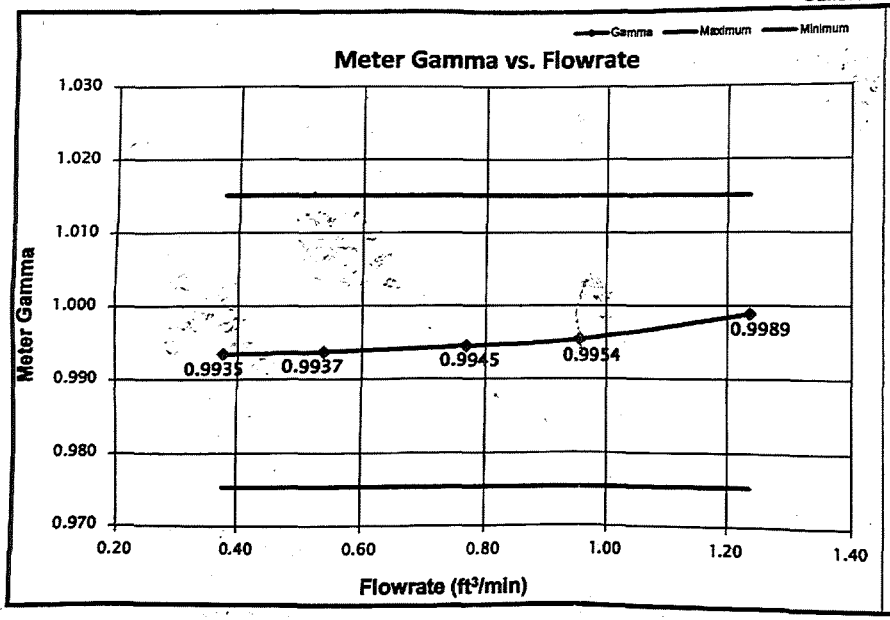
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{w(std)}}{V_{m(std)}}$$

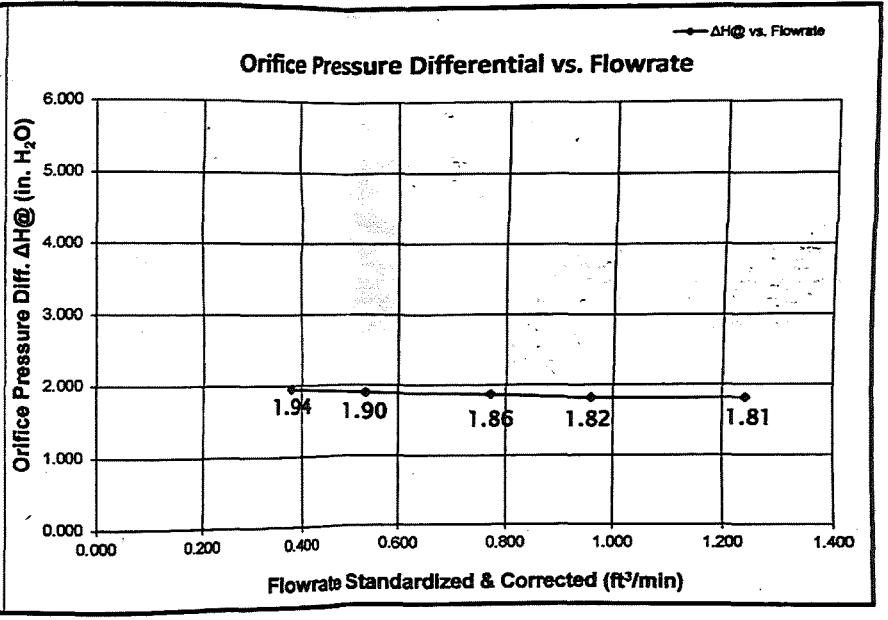
$$English\ \Delta H@ = \frac{\Delta H * 0.0319 * \left(P_{bar} + \frac{\Delta H}{13.6}\right)}{T_m} * \left(\frac{T_w * \Theta}{V_w * P_{bar}}\right)^2$$

Calibration Train



Calibration Graphs





APEX SOURCE TESTING EQUIPMENT INSTRUMENTS

Revised: 2019/12/18

Certificate of Calibration

Method 5 Pre-Test Console Calibration - Cubic Feet (ft^3)

UUT Meter Console Information		Calibration Conditions		Factors/Conversions		Reference Equipment			
Model #:	XC-522	Bar. Pressure (in Hg):	29.96	Std. Temp. (°R):	527.67	WTM Model:	W-NKoDa-5B	Serial #:	546258
Serial #:	1404013	Ambient Temp. (°F):	78.0	Std. Press. (in Hg):	29.92	WTM Cal. Due Date:	Aug. 2022	Gamma:	1.0019
DGM Model #:	S-110	Relative Humidity (%):	53	K_1 (°R/in Hg):	17.636	WTM Thermometer:	Internal		
DGM Serial #:	626997	Altitude (ft):	414.0						
		Bar. Pressure (Corr.) (in Hg):	29.55						

UUT Meter (DGM)

Run Time (minutes)	Orifice, ΔH (in. H_2O)	Volume (ft^3)			Outlet Temperature (°F)	
		Initial	Final	Total	Initial	Final
Θ	$P_{m(g)}$	V_{mi}	V_{mf}	V_m	t_{mi}	t_{mf}
5.0	5.0	289.575	295.851	6.276	75.0	76.0
6.0	3.0	301.631	307.440	5.809	77.0	78.0
7.0	2.0	307.440	312.992	5.552	78.0	80.0
10.0	1.0	312.992	318.564	5.572	80.0	80.0
15.0	0.5	295.851	301.631	5.780	76.0	77.0

Reference Meter (WTM)

Meter Pressure (mm H_2O)	Volume (L)			Outlet Temperature (°C)	
	Initial	Final	Total	Initial	Final
P_w	V_{wi}	V_{wf}	V_w	t_{wi}	t_{wf}
-5.5	240.940	420.430	179.490	24.9	25.1
-4.0	582.959	748.139	165.180	25.3	25.6
-3.0	748.139	905.104	156.965	25.6	25.8
-2.0	905.104	1061.779	156.675	25.8	26.0
-1.0	420.430	582.959	162.529	25.1	25.3

Standardized Data

Test Meter		Reference Meter		Correction Factor		Flow Rate
Std. Volume	Std. Flow Rate	Std. Volume	Std. Flow Rate	"Gamma"	Variation	Std. & Corr.
Vm_{std} (ft^3)	Qm_{std} (ft^3/min)	Vw_{std} (ft^3)	Qw_{std} (ft^3/min)	(Y)	(ΔY)	$Qm_{std/corr}$
6.187	1.237	6.163	1.233	0.9961	0.001	1.232
5.677	0.946	5.664	0.944	0.9977	0.002	0.942
5.397	0.771	5.378	0.768	0.9964	0.001	0.768
5.393	0.539	5.365	0.537	0.9948	-0.001	0.537
5.624	0.375	5.579	0.372	0.9920	-0.003	0.373
				0.9954	= Y Avg.	

Calibration Results

ΔH@ (in H_2O)	
0.75 SCFM	Variance
ΔH@	ΔΔH@
1.83	-0.06
1.86	-0.03
1.86	-0.03
1.90	0.01
1.99	0.10
1.89	= ΔH@ Avg.

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

Note: For $\Delta H_@$, orifice pressure differential that equates to 0.75cfm (0.0212m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2inches (5.1mm) H_2O.

Pass/Fail Result: Pass

Technician: Tracy Wilson Signature: Date: July 6, 2022

The instruments listed and described on this certificate have been calibrated against standards traceable to the National Institute of Standards and Technology (N.I.S.T.) and in reference to EPA Method 5, Section 10.3.1.

Apex Instruments - Address: 204 Technology Park Ln., Fuquay-Varina, NC 27526 USA | Tel: (919) 557-7300 Web: www.apexinst.com

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

Certificate of Calibration - Supplemental

Method 5 Pre-Test Console Calibration - Cubic Feet (ft^3)

Nomenclature

ΔH@ - Orifice press. Diff. that equates to 0.75 CFM (0.0212 CMM) at STP
DGM - Dry Gas Meter
K_1 - Constant based on standard temperature and pressure
Θ - Run time, in minutes
$P_{m(g)}$ - ΔH (Meter Pressure, gauge)
$V_{m(std)}$ - Volume collected by test meter, corrected for STP
$Q_{m(std)}$ - Calculated flow rate of test meter
K' - Critical orifice coefficient
P_w - Measured pressure of reference meter
t_w - Temperature measured in reference meter
t_m - Temperature measured in test meter
Y - Ratio of volume collected from test meter and orifice
$Vw_{(std)}$ - Volume collected by reference meter, corrected for STP
$Qw_{(std)}$ - Calculated flow rate of reference meter/standard
corr - Volume or flow rate for a meter corrected by the scaling factor

Equations

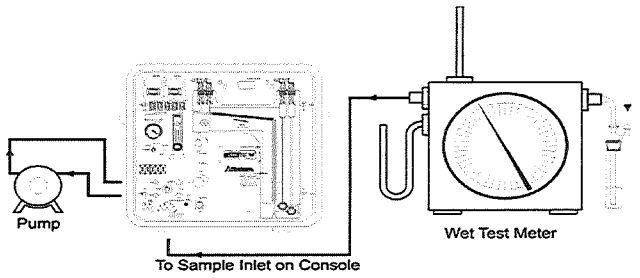
$$V_{m(std)} = K_1 * \frac{V_m * \left(P_{bar} + \frac{\Delta H}{13.6}\right)}{T_m} \qquad Q_{m(std)} = \frac{V_{m(std)}}{\Theta}$$

$$V_{w(std)} = Y * K_1 \frac{V_w * \left(P_{bar} + \frac{P_{m(g)}}{13.6}\right)}{T_w} \qquad Q_{w(std)} = \frac{V_{w(std)}}{\Theta}$$

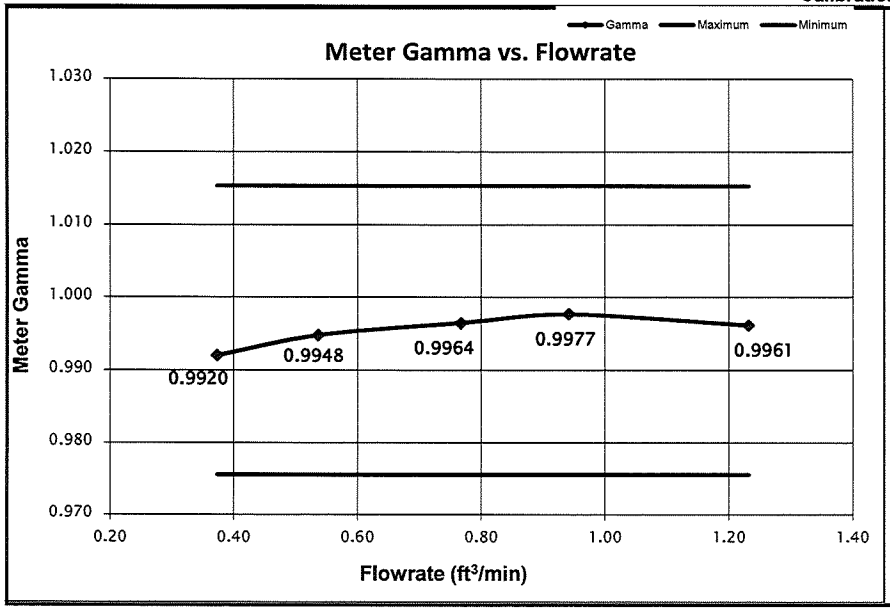
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{w(std)}}{V_{m(std)}}$$

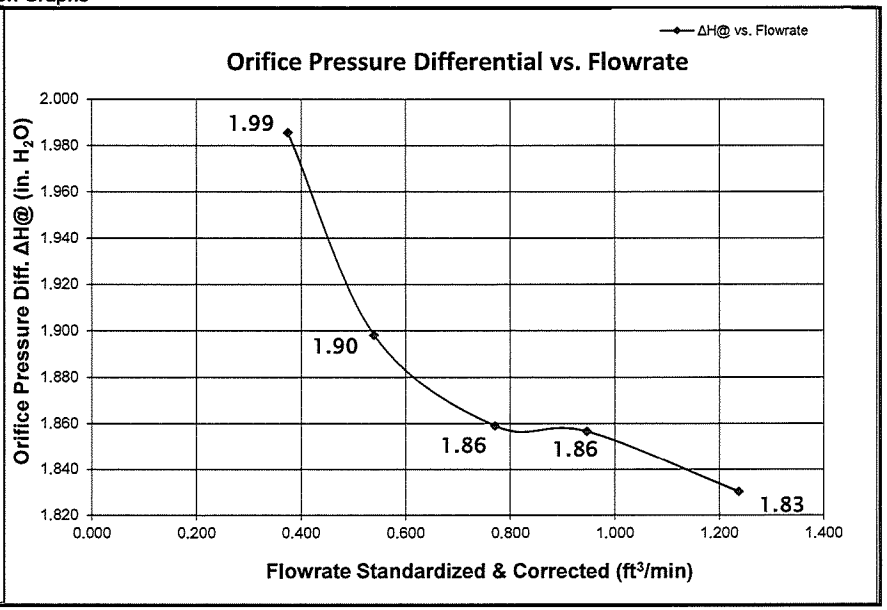
$$English\ \Delta H_@ = \frac{\Delta H * 0.0319 * \left(P_{bar} + \frac{\Delta H}{13.6}\right)}{T_m} * \left(\frac{T_w * \Theta}{V_w * P_{bar}}\right)^2$$

Calibration Train



Calibration Graphs





Erthwrks Meterbox Thermocouple Calibration Datasheet

Meterbox ID No. M5-5 Serial No. 626997

Thermocouple Check		Meter Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
5	5	258	258	0.00	Average Difference must be +/- 1.5%
45	46	280	281	0.20	
65	66	291	292	0.19	
85	88	303	304	0.55	
120	123	322	324	0.51	
150	154	339	341	0.65	

Thermocouple Check		Exit Impinger Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
0	0	255	255	0.00	Average Difference must be +/- 1.5%
10	9	261	260	0.21	
20	19	266	266	0.21	
40	44	278	280	0.79	
50	53	283	285	0.59	
70	72	294	295	0.38	

Thermocouple Check		Probe Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
5	7	258	259	0.43	Average Difference must be +/- 1.5%
45	46	280	281	0.20	
100	103	311	313	0.53	
250	255	394	397	0.70	
300	304	422	424	0.52	
500	505	533	536	0.52	

Thermocouple Check		Gas Inlet Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
0	2	255	256	0.43	Average Difference must be +/- 1.5%
10	12	261	262	0.42	
20	23	266	268	0.62	
40	43	278	279	0.60	
50	52	283	284	0.39	
70	76	294	298	1.12	

Thermocouple Check		Filter Oven Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
5	6	258	259	0.21	Average Difference must be +/- 1.5%
50	53	283	285	0.59	
100	103	311	313	0.53	
250	255	394	397	0.70	
300	301	422	423	0.13	
500	503	533	535	0.31	

Thermocouple Check		Stack Temp			
Meter Box T.C. °F	Standard	Meter Box T.C. °K	Standard °K	% Average Difference	
0	3	255	257	0.65	Average Difference must be +/- 1.5%
80	84	300	302	0.74	
250	255	394	397	0.70	
550	553	561	563	0.30	
750	752	672	673	0.17	
1000	1004	811	813	0.27	

Signature  Date 5/25/2022

Attachment G
CEMS Logs and Operational Data

Sample ID			6031430
Sample Date			6/1/2021 9:18
Unit Description			D Gas Con
Sample Point Description			D Fuel Drum, Cracking Plant
Analysis	Component	UoM	
Fuel Gas Calculations	Specific Gravity		0.6535
Fuel Gas Calculations	Gross BTU per Cubic Foot	BTU/scf	1123.1
Fuel Gas Calculations	Net BTU per Cubic Foot	BTU/scf	1019.1
Fuel Gas Calculations	Gross BTU per Pound	BTU/lb	22519
Fuel Gas Calculations	Net BTU per Pound	BTU/lb	20434
Fuel Gas Calculations	F-Value	dscf/mmBtu	8604
Fuel Gas Calculations	Average Molecular Weight	g/mol	18.93
Fuel Gas Calculations	Carbon	wt. %	73.8
Fuel Gas Calculations	Hydrogen	wt. %	22.09
Fuel Gas Calculations	Oxygen	wt. %	0.24
Fuel Gas Calculations	Nitrogen	wt. %	3.88
Fuel Gas Calculations	Sulfur	wt. %	0
Refinery Gas (Normalized, mol%), GC D7833	Un-Normalized Total (raw)		97.1104
Refinery Gas (Normalized, mol%), GC D7833	Hydrogen (mole%)	mol %	11.97
Refinery Gas (Normalized, mol%), GC D7833	Carbon Dioxide (mole%)	mol %	0.1
Refinery Gas (Normalized, mol%), GC D7833	Carbon Monoxide (mole%)	mol %	0
Refinery Gas (Normalized, mol%), GC D7833	Methane (mole%)	mol %	60.08
Refinery Gas (Normalized, mol%), GC D7833	Ethane (mole%)	mol %	16.26
Refinery Gas (Normalized, mol%), GC D7833	Ethylene (mole%)	mol %	4.46
Refinery Gas (Normalized, mol%), GC D7833	Hydrogen Sulfide (mole%)	mol %	0
Refinery Gas (Normalized, mol%), GC D7833	Oxygen (mole%)	mol %	0.04
Refinery Gas (Normalized, mol%), GC D7833	Nitrogen (mole%)	mol %	2.62
Refinery Gas (Normalized, mol%), GC D7833	Propane (mole%)	mol %	2.19
Refinery Gas (Normalized, mol%), GC D7833	Propylene (mole%)	mol %	1.32
Refinery Gas (Normalized, mol%), GC D7833	i-Butane (mole%)	mol %	0.33
Refinery Gas (Normalized, mol%), GC D7833	n-Butane (mole%)	mol %	0.23
Refinery Gas (Normalized, mol%), GC D7833	1-Butene (mole%)	mol %	0.06
Refinery Gas (Normalized, mol%), GC D7833	t-2-Butene (mole%)	mol %	0.07
Refinery Gas (Normalized, mol%), GC D7833	c-2-Butene (mole%)	mol %	0.05
Refinery Gas (Normalized, mol%), GC D7833	Isobutylene (i-Butene) (mole%)	mol %	0.07
Refinery Gas (Normalized, mol%), GC D7833	1,3-Butadiene (mole%)	mol %	0
Refinery Gas (Normalized, mol%), GC D7833	i-Pentane (mole%)	mol %	0.05
Refinery Gas (Normalized, mol%), GC D7833	n-Pentane (mole%)	mol %	0.01
Refinery Gas (Normalized, mol%), GC D7833	Pentene-1 (mole%)	mol %	0
Refinery Gas (Normalized, mol%), GC D7833	>=C6 (mole%)	mol %	0.1
Refinery Gas (Normalized, mol%), GC D7833	Propane+Propylene (mole%)	mol %	3.51
Refinery Gas (Normalized, mol%), GC D7833	Hydrogen Sulfide (ppmw)	ppm (wt.)	0

CEMS/PROCESS DATA

CCR Charge Heater 14H8&9

Run #	Date/Time	NOx (raw) 14AI2016 (ppm)	NOx (at 0% O2) (ppm)	F-Factor 14SFFVAL.LD	NOx lb/dscf	NOx (at 0% O2) lb/MMBtu	O2 14AI0966 (%)	CO (raw) 14AI0965 (ppm)	CO (at 0% O2) (ppm)	CO lb/dscf	F-Factor 14SFFVAL.LD	CO (at 0% O2) (lb/MMBtu)	Heat Input (mmBtu/hr) 14JI0761 Fuel Gas To CCR Charge Htr Limit	Fuel Gas Flow 14FI0761 Fuel Gas To CCR Charge Htr	Fuel Gas Flow 14FI0764 Fuel Gas To Inthtr 2	Total Fuel Gas =0761+0764 MSCFD	Unit Charge Rate 14FR0001 B/D
1	6/1/2022 10:11	26.16	39.39	8604	3.12E-06	0.0405	7.02	-0.37	-0.55	-2.67E-08	8604.00	-0.0003	125.81	2157.58	809.18	2966.76	19479.70
	6/1/2022 10:12	26.07	39.30	8604	3.11E-06	0.0404	7.04	-0.40	-0.61	-2.92E-08	8604.00	-0.0004	125.83	2153.87	804.26	2958.14	19532.11
	6/1/2022 10:13	26.24	39.60	8604	3.13E-06	0.0407	7.05	-0.35	-0.53	-2.54E-08	8604.00	-0.0003	125.85	2154.63	798.68	2953.31	19493.85
	6/1/2022 10:14	26.21	39.30	8604	3.13E-06	0.0404	6.96	-0.35	-0.53	-2.57E-08	8604.00	-0.0003	125.87	2156.72	796.56	2953.27	19461.93
	6/1/2022 10:15	26.34	39.83	8604	3.15E-06	0.0409	7.08	-0.36	-0.54	-2.61E-08	8604.00	-0.0003	125.89	2158.67	794.90	2953.57	19472.02
	6/1/2022 10:16	26.37	40.04	8604	3.15E-06	0.0411	7.13	-0.38	-0.58	-2.79E-08	8604.00	-0.0004	125.91	2158.96	794.13	2953.09	19514.05
	6/1/2022 10:17	26.57	40.22	8604	3.17E-06	0.0413	7.10	-0.38	-0.57	-2.75E-08	8604.00	-0.0004	125.93	2161.43	793.98	2955.41	19564.89
	6/1/2022 10:18	26.60	40.21	8604	3.18E-06	0.0413	7.07	-0.36	-0.54	-2.62E-08	8604.00	-0.0003	125.95	2166.04	798.01	2964.05	19526.14
	6/1/2022 10:19	26.57	40.09	8604	3.17E-06	0.0412	7.05	-0.37	-0.56	-2.69E-08	8604.00	-0.0003	125.97	2174.84	801.15	2975.99	19482.68
	6/1/2022 10:20	26.38	39.96	8604	3.15E-06	0.0411	7.10	-0.39	-0.59	-2.81E-08	8604.00	-0.0004	125.99	2183.59	804.20	2987.78	19487.37
	6/1/2022 10:21	26.53	40.29	8604	3.17E-06	0.0414	7.14	-0.35	-0.53	-2.55E-08	8604.00	-0.0003	125.99	2194.00	806.46	3000.46	19513.11
	6/1/2022 10:22	26.48	40.37	8604	3.16E-06	0.0415	7.19	-0.33	-0.51	-2.42E-08	8604.00	-0.0003	125.99	2199.86	809.67	3009.54	19513.60
	6/1/2022 10:23	26.35	39.83	8604	3.15E-06	0.0409	7.07	-0.35	-0.53	-2.53E-08	8604.00	-0.0003	125.99	2196.05	812.81	3008.86	19460.82
	6/1/2022 10:24	26.15	39.54	8604	3.12E-06	0.0406	7.08	-0.36	-0.55	-2.65E-08	8604.00	-0.0003	125.99	2184.01	814.31	2998.32	19450.70
	6/1/2022 10:25	26.48	39.88	8604	3.16E-06	0.0410	7.02	-0.38	-0.58	-2.79E-08	8604.00	-0.0004	125.99	2177.76	815.91	2993.67	19505.45
	6/1/2022 10:26	26.50	39.69	8604	3.16E-06	0.0408	6.95	-0.42	-0.63	-3.05E-08	8604.00	-0.0004	125.99	2170.80	812.89	2983.69	19471.76
	6/1/2022 10:27	26.12	39.05	8604	3.12E-06	0.0401	6.92	-0.36	-0.54	-2.62E-08	8604.00	-0.0003	125.99	2171.84	807.97	2979.81	19511.32
	6/1/2022 10:28	26.37	39.60	8604	3.15E-06	0.0407	6.98	-0.33	-0.49	-2.36E-08	8604.00	-0.0003	125.99	2171.84	804.82	2976.66	19520.82
	6/1/2022 10:29	26.31	39.49	8604	3.14E-06	0.0406	6.98	-0.36	-0.54	-2.60E-08	8604.00	-0.0003	125.99	2174.42	802.69	2977.12	19510.69
	6/1/2022 10:30	26.15	39.33	8604	3.12E-06	0.0404	7.00	-0.41	-0.62	-2.99E-08	8604.00	-0.0004	125.99	2177.28	801.23	2978.52	19528.19
	6/1/2022 10:31	26.39	39.87	8604	3.15E-06	0.0410	7.07	-0.32	-0.49	-2.34E-08	8604.00	-0.0003	125.99	2178.72	801.08	2979.80	19510.05
	Run 1 Average	**26.35**	**39.76**	**8604.00**	**3.15E-06**	**0.0408**	**7.05**	**-0.37**	**-0.55**	**-2.66E-08**	**8604.00**	**-0.0003**	**125.95**	**2172.52**	**804.04**	**2976.56**	**19500.54**
2	6/1/2022 10:39	26.18	39.97	8604	3.13E-06	0.0411	7.21	-0.35	-0.54	-2.57E-08	8604.00	-0.0003	125.99	2138.26	812.48	2950.74	19537.54
	6/1/2022 10:40	26.54	40.60	8604	3.17E-06	0.0417	7.24	-0.34	-0.53	-2.50E-08	8604.00	-0.0003	125.99	2140.43	816.33	2956.76	19501.28
	6/1/2022 10:41	26.57	40.66	8604	3.17E-06	0.0418	7.24	-0.32	-0.49	-2.34E-08	8604.00	-0.0003	125.99	2146.97	818.48	2965.45	19477.05
	6/1/2022 10:42	26.35	40.03	8604	3.15E-06	0.0411	7.14	-0.35	-0.53	-2.55E-08	8604.00	-0.0003	125.99	2152.79	820.64	2973.44	19522.96
	6/1/2022 10:43	26.23	39.73	8604	3.13E-06	0.0408	7.10	-0.29	-0.43	-2.08E-08	8604.00	-0.0003	125.99	2154.43	823.01	2977.44	19518.60
	6/1/2022 10:44	26.23	39.73	8604	3.13E-06	0.0408	7.10	-0.35	-0.53	-2.52E-08	8604.00	-0.0003	125.99	2153.23	822.56	2975.79	19470.12
	6/1/2022 10:45	26.23	39.73	8604	3.13E-06	0.0408	7.10	-0.37	-0.56	-2.71E-08	8604.00	-0.0004	125.99	2154.94	818.32	2973.25	19442.37
	6/1/2022 10:46	26.42	40.05	8604	3.15E-06	0.0411	7.11	-0.39	-0.59	-2.82E-08	8604.00	-0.0004	125.99	2158.28	814.41	2972.69	19487.58
	6/1/2022 10:47	26.34	39.88	8604	3.15E-06	0.0410	7.09	-0.31	-0.47	-2.26E-08	8604.00	-0.0003	125.99	2161.33	811.33	2972.66	19497.03
	6/1/2022 10:48	26.57	40.26	8604	3.17E-06	0.0414	7.11	-0.31	-0.48	-2.29E-08	8604.00	-0.0003	125.99	2165.38	809.78	2975.16	19434.34
	6/1/2022 10:49	26.48	39.86	8604	3.16E-06	0.0410	7.02	-0.35	-0.53	-2.54E-08	8604.00	-0.0003	125.99	2171.92	809.74	2981.66	19432.07
	6/1/2022 10:50	26.49	39.75	8604	3.16E-06	0.0408	6.97	-0.37	-0.56	-2.72E-08	8604.00	-0.0004	125.99	2174.54	809.56	2984.09	19492.89
	6/1/2022 10:51	26.48	39.77	8604	3.16E-06	0.0409	6.99	-0.37	-0.56	-2.69E-08	8604.00	-0.0003	125.99	2175.95	810.33	2986.28	19495.11
	6/1/2022 10:52	26.32	39.62	8604	3.14E-06	0.0407	7.01	-0.35	-0.53	-2.56E-08	8604.00	-0.0003	125.99	2182.42	813.25	2995.67	19520.23
	6/1/2022 10:53	26.35	39.90	8604	3.15E-06	0.0410	7.10	-0.40	-0.60	-2.89E-08	8604.00	-0.0004	125.99	2188.40	814.55	3002.95	19566.00
	6/1/2022 10:54	26.57	40.07	8604	3.17E-06	0.0412	7.04	-0.36	-0.55	-2.64E-08	8604.00	-0.0003	125.99	2193.07	814.47	3007.53	19560.97
	6/1/2022 10:55	26.39	39.63	8604	3.15E-06	0.0407	6.98	-0.35	-0.52	-2.52E-08	8604.00	-0.0003	125.99	2196.24	814.20	3010.45	19491.46
	6/1/2022 10:56	26.38	39.49	8604	3.15E-06	0.0406	6.94	-0.37	-0.56	-2.72E-08	8604.00	-0.0004	125.99	2198.82	813.74	3012.56	19462.43
	6/1/2022 10:57	26.19	39.11	8604	3.13E-06	0.0402	6.91	-0.37	-0.55	-2.68E-08	8604.00	-0.0003	125.99	2197.27	812.92	3010.19	19497.46
	6/1/2022 10:58	26.15	39.10	8604	3.12E-06	0.0402	6.92	-0.36	-0.55	-2.65E-08	8604.00	-0.0003	125.99	2200.00	812.65	3012.64	19509.79
	6/1/2022 10:59	26.23	39.09	8604	3.13E-06	0.0402	6.87	-0.34	-0.50	-2.45E-08	8604.00	-0.0003	125.99	2201.33	811.83	3013.17	19522.07
	Run 2 Average	**26.37**	**39.81**	**8604.00**	**3.15E-06**	**0.0409**	**7.06**	**-0.35**	**-0.53**	**-2.56E-08**	**8604.00**	**-0.0003**	**125.99**	**2171.71**	**814.50**	**2986.22**	**19497.11**

CEMS/PROCESS DATA

CCR Charge Heater 14H8&9

Run #	Date/Time	NOx (raw) 14AI2016 (ppm)	NOx (at 0% O2) (ppm)	F-Factor 14SFFVAL_LD	NOx lb/dscf	NOx (at 0% O2) lb/MMBtu	O2 14AI0966 (%)	CO (raw) 14AI0965 (ppm)	CO (at 0% O2) (ppm)	CO lb/dscf	F-Factor 14SFFVAL_LD	CO (at 0% O2) (lb/MMBtu)	Heat Input (mmBtu/hr) 14JI0761 Fuel Gas To CCR Charge Htr Limit	Fuel Gas Flow 14FI0761 Fuel Gas To CCR Charge Htr	Fuel Gas Flow 14FI0764 Fuel Gas To Inthtr 2	Total Fuel Gas =0761+0764 MSCFD	Unit Charge Rate 14FR0001 B/D
3	6/1/2022 11:11	26.13	39.43	8604	3.12E-06	0.0405	7.05	-0.38	-0.57	-2.73E-08	8604.00	-0.0004	125.99	2149.53	794.41	2943.93	19486.80
	6/1/2022 11:12	26.37	39.95	8604	3.15E-06	0.0410	7.10	-0.35	-0.54	-2.57E-08	8604.00	-0.0003	125.99	2155.43	796.39	2951.82	19488.42
	6/1/2022 11:13	26.49	40.20	8604	3.16E-06	0.0413	7.13	-0.37	-0.56	-2.70E-08	8604.00	-0.0004	125.99	2160.16	799.75	2959.91	19489.20
	6/1/2022 11:14	26.65	40.47	8604	3.18E-06	0.0416	7.14	-0.34	-0.52	-2.49E-08	8604.00	-0.0003	125.99	2169.74	801.36	2971.10	19507.90
	6/1/2022 11:15	26.78	40.31	8604	3.20E-06	0.0414	7.01	-0.36	-0.54	-2.59E-08	8604.00	-0.0003	125.99	2176.46	803.73	2980.19	19517.94
	6/1/2022 11:16	26.72	39.91	8604	3.19E-06	0.0410	6.91	-0.35	-0.52	-2.51E-08	8604.00	-0.0003	125.99	2179.09	802.53	2981.62	19551.97
	6/1/2022 11:17	26.46	39.44	8604	3.16E-06	0.0405	6.88	-0.33	-0.50	-2.43E-08	8604.00	-0.0003	125.99	2179.09	802.95	2982.04	19538.64
	6/1/2022 11:18	26.38	39.47	8604	3.15E-06	0.0405	6.93	-0.34	-0.51	-2.46E-08	8604.00	-0.0003	125.99	2180.36	803.41	2983.78	19464.10
	6/1/2022 11:19	26.24	39.18	8604	3.13E-06	0.0402	6.90	-0.38	-0.57	-2.78E-08	8604.00	-0.0004	125.99	2183.83	803.85	2987.68	19426.71
	6/1/2022 11:20	26.21	39.06	8604	3.13E-06	0.0401	6.88	-0.33	-0.49	-2.41E-08	8604.00	-0.0003	125.99	2187.19	804.70	2991.89	19496.95
	6/1/2022 11:21	26.22	39.02	8604	3.13E-06	0.0401	6.86	-0.34	-0.50	-2.45E-08	8604.00	-0.0003	125.99	2192.52	806.61	2999.13	19496.62
	6/1/2022 11:22	26.08	39.00	8604	3.11E-06	0.0401	6.92	-0.34	-0.50	-2.45E-08	8604.00	-0.0003	125.99	2196.85	806.62	3003.47	19482.41
	6/1/2022 11:23	26.28	39.30	8604	3.14E-06	0.0404	6.92	-0.36	-0.53	-2.58E-08	8604.00	-0.0003	125.99	2195.18	805.37	3000.55	19469.45
	6/1/2022 11:24	26.24	39.30	8604	3.13E-06	0.0404	6.94	-0.36	-0.54	-2.63E-08	8604.00	-0.0003	125.99	2200.44	809.11	3009.55	19490.93
	6/1/2022 11:25	26.36	39.44	8604	3.15E-06	0.0405	6.93	-0.36	-0.54	-2.62E-08	8604.00	-0.0003	125.99	2211.84	812.58	3024.42	19552.85
	6/1/2022 11:26	26.27	38.84	8604	3.14E-06	0.0399	6.77	-0.34	-0.50	-2.47E-08	8604.00	-0.0003	125.99	2217.49	810.34	3027.83	19490.21
	6/1/2022 11:27	26.12	38.44	8604	3.12E-06	0.0395	6.69	-0.40	-0.59	-2.90E-08	8604.00	-0.0004	125.99	2208.14	804.83	3012.97	19467.94
	6/1/2022 11:28	26.34	38.82	8604	3.14E-06	0.0399	6.72	-0.38	-0.56	-2.75E-08	8604.00	-0.0003	125.99	2192.53	802.65	2995.18	19443.41
	6/1/2022 11:29	26.32	38.88	8604	3.14E-06	0.0399	6.75	-0.37	-0.54	-2.68E-08	8604.00	-0.0003	125.99	2176.26	801.44	2977.69	19528.18
	6/1/2022 11:30	26.10	38.61	8604	3.12E-06	0.0397	6.77	-0.32	-0.48	-2.36E-08	8604.00	-0.0003	125.99	2167.27	797.15	2964.42	19555.25
	6/1/2022 11:31	26.13	38.99	8604	3.12E-06	0.0401	6.89	-0.30	-0.44	-2.17E-08	8604.00	-0.0003	125.99	2160.70	796.24	2956.94	19504.59
	Run 3 Average	**26.33**	**39.33**	**8604.00**	**3.14E-06**	**0.0404**	**6.91**	**-0.35**	**-0.53**	**-2.56E-08**	**8604.00**	**-0.0003**	**125.99**	**2182.86**	**803.15**	**2986.01**	**19497.64**
4	6/1/2022 14:56	26.02	39.13	8604	3.11E-06	0.0402	7.00	-0.37	-0.56	-2.70E-08	8604.00	-0.0003	128.31	2175.43	805.51	2980.95	19543.79
	6/1/2022 14:57	26.06	39.43	8604	3.11E-06	0.0405	7.09	-0.34	-0.51	-2.44E-08	8604.00	-0.0003	128.32	2177.31	808.54	2985.85	19533.37
	6/1/2022 14:58	26.26	39.81	8604	3.14E-06	0.0409	7.11	-0.34	-0.52	-2.50E-08	8604.00	-0.0003	128.32	2186.96	812.42	2999.38	19493.22
	6/1/2022 14:59	26.23	39.76	8604	3.13E-06	0.0408	7.11	-0.37	-0.57	-2.72E-08	8604.00	-0.0004	128.33	2199.60	814.29	3013.89	19510.16
	6/1/2022 15:00	26.36	39.87	8604	3.15E-06	0.0410	7.08	-0.35	-0.53	-2.53E-08	8604.00	-0.0003	128.34	2209.62	815.38	3025.00	19514.25
	6/1/2022 15:01	26.29	39.75	8604	3.14E-06	0.0408	7.08	-0.34	-0.52	-2.50E-08	8604.00	-0.0003	128.35	2217.64	816.79	3034.43	19515.82
	6/1/2022 15:02	26.08	39.42	8604	3.11E-06	0.0405	7.07	-0.31	-0.47	-2.27E-08	8604.00	-0.0003	128.35	2220.91	818.61	3039.52	19514.98
	6/1/2022 15:03	26.34	39.58	8604	3.15E-06	0.0407	6.99	-0.36	-0.54	-2.61E-08	8604.00	-0.0003	128.36	2214.52	821.23	3035.75	19490.18
	6/1/2022 15:04	26.26	39.35	8604	3.14E-06	0.0404	6.95	-0.38	-0.57	-2.75E-08	8604.00	-0.0004	128.37	2198.86	820.74	3019.60	19476.20
	6/1/2022 15:05	26.01	39.00	8604	3.11E-06	0.0401	6.96	-0.37	-0.55	-2.68E-08	8604.00	-0.0003	128.38	2182.09	817.75	2999.84	19456.64
	6/1/2022 15:06	25.73	39.02	8604	3.07E-06	0.0401	7.12	-0.37	-0.56	-2.71E-08	8604.00	-0.0004	128.38	2189.92	820.13	3010.05	19499.96
	6/1/2022 15:07	26.22	39.73	8604	3.13E-06	0.0408	7.10	-0.36	-0.54	-2.59E-08	8604.00	-0.0003	128.39	2201.96	820.94	3022.91	19496.75
	6/1/2022 15:08	26.23	39.43	8604	3.13E-06	0.0405	7.00	-0.34	-0.52	-2.50E-08	8604.00	-0.0003	128.40	2212.71	820.33	3033.05	19500.84
	6/1/2022 15:09	26.28	39.53	8604	3.14E-06	0.0406	7.00	-0.34	-0.51	-2.48E-08	8604.00	-0.0003	128.40	2221.22	818.31	3039.53	19461.42
	6/1/2022 15:10	26.11	39.05	8604	3.12E-06	0.0401	6.93	-0.35	-0.52	-2.52E-08	8604.00	-0.0003	128.41	2227.56	816.32	3043.88	19488.25
	6/1/2022 15:11	26.02	38.81	8604	3.11E-06	0.0399	6.89	-0.32	-0.47	-2.29E-08	8604.00	-0.0003	128.42	2231.54	808.58	3040.12	19506.76
	6/1/2022 15:12	26.09	38.64	8604	3.11E-06	0.0397	6.79	-0.33	-0.48	-2.37E-08	8604.00	-0.0003	128.43	2209.39	797.50	3006.89	19479.77
	6/1/2022 15:13	26.01	38.50	8604	3.11E-06	0.0396	6.78	-0.35	-0.51	-2.51E-08	8604.00	-0.0003	128.43	2171.01	789.70	2960.71	19472.17
	6/1/2022 15:14	26.17	39.38	8604	3.12E-06	0.0405	7.01	-0.32	-0.48	-2.34E-08	8604.00	-0.0003	128.44	2149.27	794.52	2943.79	19498.49
	6/1/2022 15:15	26.41	39.74	8604	3.15E-06	0.0408	7.01	-0.34	-0.51	-2.47E-08	8604.00	-0.0003	128.45	2140.51	799.03	2939.54	19549.87
	6/1/2022 15:16	26.26	39.48	8604	3.14E-06	0.0406	7.00	-0.35	-0.53	-2.56E-08	8604.00	-0.0003	128.46	2135.47	796.55	2932.02	19523.16
	Run 4 Average	**26.16**	**39.35**	**8604.00**	**3.12E-06**	**0.0404**	**7.00**	**-0.35**	**-0.52**	**-2.53E-08**	**8604.00**	**-0.0003**	**128.38**	**2193.98**	**811.10**	**3005.08**	**19501.24**

CEMS/PROCESS DATA

CCR Charge Heater 14H8&9

Run #	Date/Time	NOx (raw) 14AI2016 (ppm)	NOx (at 0% O2) (ppm)	F-Factor 14SFFVAL.LD	NOx lb/dscf	NOx (at 0% O2) lb/MMBtu	O2 14AI0966 (%)	CO (raw) 14AI0965 (ppm)	CO (at 0% O2) (ppm)	CO lb/dscf	F-Factor 14SFFVAL.LD	CO (at 0% O2) (lb/MMBtu)	Heat Input (mmBtu/hr) 14JI0761 Fuel Gas To CCR Charge Htr Limit	Fuel Gas Flow 14FI0761 Fuel Gas To CCR Charge Htr	Fuel Gas Flow 14FI0764 Fuel Gas To Inthtr 2	Total Fuel Gas =0761+0764 MSCFD	Unit Charge Rate 14FR0001 B/D
5	6/1/2022 15:25	26.13	38.98	8604	3.12E-06	0.0400	6.89	-0.37	-0.55	-2.66E-08	8604.00	-0.0003	128.52	2152.56	787.54	2940.10	19461.31
	6/1/2022 15:26	26.29	39.00	8604	3.14E-06	0.0401	6.81	-0.33	-0.48	-2.38E-08	8604.00	-0.0003	128.53	2144.90	784.52	2929.42	19468.65
	6/1/2022 15:27	26.26	38.93	8604	3.14E-06	0.0400	6.80	-0.34	-0.51	-2.48E-08	8604.00	-0.0003	128.54	2141.83	782.92	2924.75	19507.48
	6/1/2022 15:28	26.16	38.90	8604	3.12E-06	0.0400	6.84	-0.36	-0.53	-2.60E-08	8604.00	-0.0003	128.54	2138.15	782.19	2920.34	19502.39
	6/1/2022 15:29	26.17	38.99	8604	3.13E-06	0.0401	6.87	-0.35	-0.52	-2.54E-08	8604.00	-0.0003	128.55	2136.36	783.85	2920.21	19534.39
	6/1/2022 15:30	26.36	39.36	8604	3.15E-06	0.0404	6.91	-0.30	-0.44	-2.16E-08	8604.00	-0.0003	128.56	2127.67	787.71	2915.38	19518.39
	6/1/2022 15:31	26.22	39.22	8604	3.13E-06	0.0403	6.93	-0.35	-0.53	-2.56E-08	8604.00	-0.0003	128.57	2113.28	792.38	2905.66	19540.00
	6/1/2022 15:32	25.99	39.20	8604	3.10E-06	0.0403	7.04	-0.34	-0.52	-2.49E-08	8604.00	-0.0003	128.57	2112.83	801.80	2914.63	19503.64
	6/1/2022 15:33	25.84	39.30	8604	3.09E-06	0.0404	7.16	-0.34	-0.51	-2.46E-08	8604.00	-0.0003	128.58	2125.11	810.28	2935.40	19495.67
	6/1/2022 15:34	26.39	40.38	8604	3.15E-06	0.0415	7.24	-0.35	-0.54	-2.55E-08	8604.00	-0.0003	128.59	2141.99	815.66	2957.65	19517.91
	6/1/2022 15:35	26.36	40.67	8604	3.15E-06	0.0418	7.35	-0.33	-0.52	-2.43E-08	8604.00	-0.0003	128.59	2163.42	819.02	2982.44	19501.57
	6/1/2022 15:36	26.38	40.98	8604	3.15E-06	0.0421	7.45	-0.35	-0.54	-2.54E-08	8604.00	-0.0003	128.60	2189.68	827.57	3017.26	19480.75
	6/1/2022 15:37	26.48	41.49	8604	3.16E-06	0.0426	7.56	-0.34	-0.53	-2.45E-08	8604.00	-0.0003	128.61	2228.72	840.65	3069.37	19492.07
	6/1/2022 15:38	26.84	41.69	8604	3.20E-06	0.0428	7.44	-0.35	-0.54	-2.52E-08	8604.00	-0.0003	128.62	2277.74	853.24	3130.98	19536.36
	6/1/2022 15:39	26.75	40.76	8604	3.19E-06	0.0419	7.18	-0.35	-0.54	-2.56E-08	8604.00	-0.0003	128.62	2310.39	854.63	3165.02	19572.11
	6/1/2022 15:40	26.45	39.31	8604	3.16E-06	0.0404	6.83	-0.37	-0.55	-2.70E-08	8604.00	-0.0003	128.63	2315.81	840.36	3156.17	19557.43
	6/1/2022 15:41	26.02	37.89	8604	3.11E-06	0.0389	6.55	-0.39	-0.56	-2.81E-08	8604.00	-0.0004	128.64	2307.25	830.17	3137.42	19450.48
	6/1/2022 15:42	25.74	37.13	8604	3.07E-06	0.0381	6.41	-0.35	-0.50	-2.53E-08	8604.00	-0.0003	128.65	2281.61	820.51	3102.12	19454.09
	6/1/2022 15:43	25.66	37.17	8604	3.06E-06	0.0382	6.47	-0.34	-0.49	-2.46E-08	8604.00	-0.0003	128.65	2247.85	810.80	3058.65	19490.10
	6/1/2022 15:44	25.42	37.20	8604	3.03E-06	0.0382	6.62	-0.37	-0.54	-2.70E-08	8604.00	-0.0003	128.66	2214.63	801.34	3015.97	19486.95
	6/1/2022 15:45	25.62	37.78	8604	3.06E-06	0.0388	6.73	-0.32	-0.48	-2.36E-08	8604.00	-0.0003	128.67	2181.16	795.57	2976.72	19537.11
	Run 5 Average	**26.17**	**39.25**	**8604.00**	**3.12E-06**	**0.0403**	**6.96**	**-0.35**	**-0.52**	**-2.52E-08**	**8604.00**	**-0.0003**	**128.59**	**2193.00**	**810.60**	**3003.60**	**19505.18**
6	6/1/2022 15:55	26.23	39.43	8604	3.13E-06	0.0405	7.00	-0.31	-0.46	-2.23E-08	8604.00	-0.0003	128.74	2212.37	811.77	3024.14	19534.42
	6/1/2022 15:56	26.01	38.53	8604	3.11E-06	0.0396	6.79	-0.32	-0.47	-2.31E-08	8604.00	-0.0003	128.75	2210.18	800.33	3010.51	19473.90
	6/1/2022 15:57	25.81	38.28	8604	3.08E-06	0.0393	6.81	-0.32	-0.47	-2.31E-08	8604.00	-0.0003	128.75	2191.94	792.40	2984.33	19471.39
	6/1/2022 15:58	25.86	38.36	8604	3.09E-06	0.0394	6.81	-0.32	-0.48	-2.35E-08	8604.00	-0.0003	128.76	2170.76	789.04	2959.79	19462.10
	6/1/2022 15:59	25.82	38.55	8604	3.08E-06	0.0396	6.90	-0.30	-0.46	-2.22E-08	8604.00	-0.0003	128.77	2159.30	788.29	2947.59	19509.22
	6/1/2022 16:00	25.76	38.78	8604	3.08E-06	0.0398	7.02	-0.33	-0.49	-2.38E-08	8604.00	-0.0003	128.78	2154.88	788.73	2943.61	19548.02
	6/1/2022 16:01	25.83	38.91	8604	3.08E-06	0.0400	7.03	-0.36	-0.54	-2.60E-08	8604.00	-0.0003	128.78	2154.08	789.90	2943.98	19495.61
	6/1/2022 16:02	25.75	39.20	8604	3.07E-06	0.0403	7.17	-0.33	-0.50	-2.38E-08	8604.00	-0.0003	128.79	2159.36	791.88	2951.24	19476.06
	6/1/2022 16:03	25.94	39.41	8604	3.10E-06	0.0405	7.14	-0.31	-0.47	-2.24E-08	8604.00	-0.0003	128.80	2166.11	793.08	2959.18	19458.33
	6/1/2022 16:04	25.89	39.18	8604	3.09E-06	0.0403	7.09	-0.35	-0.54	-2.57E-08	8604.00	-0.0003	128.81	2169.66	792.28	2961.94	19523.07
	6/1/2022 16:05	25.98	39.22	8604	3.10E-06	0.0403	7.06	-0.33	-0.49	-2.37E-08	8604.00	-0.0003	128.81	2165.49	790.17	2955.66	19517.03
	6/1/2022 16:06	25.95	39.14	8604	3.10E-06	0.0402	7.04	-0.36	-0.54	-2.59E-08	8604.00	-0.0003	128.82	2161.31	787.47	2948.78	19510.20
	6/1/2022 16:07	25.92	38.91	8604	3.10E-06	0.0400	6.98	-0.37	-0.55	-2.67E-08	8604.00	-0.0003	128.83	2153.94	788.66	2942.60	19526.12
	6/1/2022 16:08	25.91	39.34	8604	3.09E-06	0.0404	7.14	-0.35	-0.54	-2.56E-08	8604.00	-0.0003	128.83	2161.95	799.38	2961.34	19495.90
	6/1/2022 16:09	26.10	39.72	8604	3.12E-06	0.0408	7.17	-0.37	-0.56	-2.68E-08	8604.00	-0.0004	128.84	2181.66	806.30	2987.97	19469.51
	6/1/2022 16:10	26.11	39.91	8604	3.12E-06	0.0410	7.23	-0.30	-0.46	-2.19E-08	8604.00	-0.0003	128.85	2198.86	810.38	3009.24	19496.57
	6/1/2022 16:11	26.11	39.85	8604	3.12E-06	0.0409	7.21	-0.33	-0.50	-2.39E-08	8604.00	-0.0003	128.86	2212.77	814.57	3027.33	19508.04
	6/1/2022 16:12	26.02	39.75	8604	3.11E-06	0.0408	7.22	-0.31	-0.48	-2.28E-08	8604.00	-0.0003	128.86	2231.53	818.23	3049.76	19516.37
	6/1/2022 16:13	26.00	39.44	8604	3.10E-06	0.0405	7.12	-0.30	-0.46	-2.22E-08	8604.00	-0.0003	128.87	2242.96	819.70	3062.66	19539.23
	6/1/2022 16:14	25.91	38.91	8604	3.09E-06	0.0400	6.98	-0.32	-0.48	-2.31E-08	8604.00	-0.0003	128.88	2255.97	821.57	3077.54	19506.48
	6/1/2022 16:15	25.85	38.64	8604	3.09E-06	0.0397	6.92	-0.33	-0.49	-2.37E-08	8604.00	-0.0003	128.89	2264.32	823.10	3087.43	19496.02
	Run 6 Average	**25.94**	**39.12**	**8604.00**	**3.10E-06**	**0.0402**	**7.04**	**-0.33**	**-0.50**	**-2.39E-08**	**8604.00**	**-0.0003**	**128.81**	**2189.49**	**800.82**	**2990.32**	**19501.60**

CEMS/PROCESS DATA

CCR Charge Heater 14H8&9

Run #	Date/Time	NOx (raw) 14AI2016 (ppm)	NOx (at 0% O2) (ppm)	F-Factor 14SFFVAL.LD	NOx lb/dscf	NOx (at 0% O2) lb/MMBtu	O2 14AI0966 (%)	CO (raw) 14AI0965 (ppm)	CO (at 0% O2) (ppm)	CO lb/dscf	F-Factor 14SFFVAL.LD	CO (at 0% O2) (lb/MMBtu)	Heat Input (mmBtu/hr) 14JI0761 Fuel Gas To CCR Charge Htr Limit	Fuel Gas Flow 14FI0761 Fuel Gas To CCR Charge Htr	Fuel Gas Flow 14FI0764 Fuel Gas To Inthtr 2	Total Fuel Gas =0761+0764 MSCFD	Unit Charge Rate 14FR0001 B/D
7	6/1/2022 16:28	26.24	40.16	8604	3.13E-06	0.0413	7.24	-0.35	-0.54	-2.58E-08	8604.00	-0.0003	128.98	2163.96	807.58	2971.54	19534.07
	6/1/2022 16:29	26.21	40.00	8604	3.13E-06	0.0411	7.20	-0.35	-0.53	-2.51E-08	8604.00	-0.0003	128.99	2178.89	808.29	2987.18	19522.48
	6/1/2022 16:30	26.20	39.71	8604	3.13E-06	0.0408	7.11	-0.38	-0.57	-2.76E-08	8604.00	-0.0004	128.99	2193.53	808.82	3002.34	19483.43
	6/1/2022 16:31	26.10	39.54	8604	3.12E-06	0.0406	7.10	-0.37	-0.56	-2.68E-08	8604.00	-0.0003	129.00	2204.01	809.17	3013.18	19452.45
	6/1/2022 16:32	26.07	39.36	8604	3.11E-06	0.0404	7.06	-0.34	-0.52	-2.48E-08	8604.00	-0.0003	129.01	2207.75	813.22	3020.97	19459.37
	6/1/2022 16:33	26.03	39.21	8604	3.11E-06	0.0403	7.02	-0.38	-0.57	-2.75E-08	8604.00	-0.0004	129.02	2200.55	816.71	3017.26	19478.17
	6/1/2022 16:34	25.81	38.93	8604	3.08E-06	0.0400	7.04	-0.38	-0.57	-2.75E-08	8604.00	-0.0004	129.02	2194.27	819.73	3014.00	19467.47
	6/1/2022 16:35	25.98	39.27	8604	3.10E-06	0.0403	7.07	-0.35	-0.54	-2.58E-08	8604.00	-0.0003	129.03	2189.66	821.81	3011.47	19492.18
	6/1/2022 16:36	25.90	38.96	8604	3.09E-06	0.0400	7.01	-0.36	-0.55	-2.65E-08	8604.00	-0.0003	129.04	2184.04	823.12	3007.16	19534.70
	6/1/2022 16:37	25.84	38.86	8604	3.08E-06	0.0399	7.00	-0.31	-0.47	-2.28E-08	8604.00	-0.0003	129.05	2175.98	820.33	2996.31	19553.07
	6/1/2022 16:38	25.62	38.66	8604	3.06E-06	0.0397	7.05	-0.38	-0.58	-2.77E-08	8604.00	-0.0004	129.05	2166.46	817.43	2983.89	19495.98
	6/1/2022 16:39	25.97	39.12	8604	3.10E-06	0.0402	7.03	-0.35	-0.53	-2.57E-08	8604.00	-0.0003	129.06	2158.98	811.89	2970.87	19449.61
	6/1/2022 16:40	25.99	39.15	8604	3.10E-06	0.0402	7.03	-0.34	-0.52	-2.50E-08	8604.00	-0.0003	129.07	2159.30	807.60	2966.90	19484.35
	6/1/2022 16:41	26.00	39.29	8604	3.10E-06	0.0404	7.07	-0.38	-0.57	-2.75E-08	8604.00	-0.0004	129.07	2164.35	806.19	2970.54	19529.84
	6/1/2022 16:42	26.15	39.46	8604	3.12E-06	0.0405	7.05	-0.35	-0.53	-2.57E-08	8604.00	-0.0003	129.08	2173.44	805.69	2979.13	19510.77
	6/1/2022 16:43	26.51	40.05	8604	3.16E-06	0.0411	7.07	-0.32	-0.48	-2.32E-08	8604.00	-0.0003	129.09	2177.92	801.08	2979.00	19454.44
	6/1/2022 16:44	26.80	40.35	8604	3.20E-06	0.0414	7.02	-0.36	-0.54	-2.63E-08	8604.00	-0.0003	129.10	2169.93	797.87	2967.80	19480.31
	6/1/2022 16:45	26.66	39.99	8604	3.18E-06	0.0411	6.97	-0.32	-0.48	-2.32E-08	8604.00	-0.0003	129.10	2157.07	794.63	2951.70	19525.60
	6/1/2022 16:46	26.51	40.13	8604	3.17E-06	0.0412	7.09	-0.32	-0.48	-2.30E-08	8604.00	-0.0003	129.11	2151.16	799.70	2950.86	19541.90
	6/1/2022 16:47	26.56	40.16	8604	3.17E-06	0.0413	7.07	-0.35	-0.52	-2.52E-08	8604.00	-0.0003	129.12	2141.54	805.84	2947.39	19493.52
	6/1/2022 16:48	26.23	40.01	8604	3.13E-06	0.0411	7.20	-0.39	-0.60	-2.84E-08	8604.00	-0.0004	129.13	2135.70	810.88	2946.59	19507.39
	Run 7 Average	**26.16**	**39.54**	**8604.00**	**3.12E-06**	**0.0406**	**7.07**	**-0.35**	**-0.54**	**-2.58E-08**	**8604.00**	**-0.0003**	**129.05**	**2173.74**	**809.89**	**2983.62**	**19497.67**
8	6/1/2022 17:14	26.92	41.06	8604	3.21E-06	0.0422	7.20	-0.35	-0.54	-2.56E-08	8604.00	-0.0003	129.69	2136.69	812.03	2948.72	19520.95
	6/1/2022 17:15	26.97	40.90	8604	3.22E-06	0.0420	7.12	-0.34	-0.52	-2.49E-08	8604.00	-0.0003	129.69	2145.79	814.75	2960.53	19477.25
	6/1/2022 17:16	26.75	40.55	8604	3.19E-06	0.0417	7.12	-0.35	-0.54	-2.57E-08	8604.00	-0.0003	129.69	2155.37	817.24	2972.61	19447.24
	6/1/2022 17:17	26.98	40.74	8604	3.22E-06	0.0419	7.06	-0.31	-0.46	-2.24E-08	8604.00	-0.0003	129.69	2168.04	816.29	2984.33	19511.48
	6/1/2022 17:18	26.97	40.55	8604	3.22E-06	0.0417	7.00	-0.40	-0.60	-2.88E-08	8604.00	-0.0004	129.69	2179.98	818.61	2998.60	19505.21
	6/1/2022 17:19	26.99	40.62	8604	3.22E-06	0.0417	7.01	-0.35	-0.53	-2.56E-08	8604.00	-0.0003	129.69	2186.59	818.20	3004.79	19470.26
	6/1/2022 17:20	26.95	40.56	8604	3.22E-06	0.0417	7.01	-0.31	-0.47	-2.27E-08	8604.00	-0.0003	129.69	2193.97	818.46	3012.44	19465.25
	6/1/2022 17:21	26.85	40.42	8604	3.21E-06	0.0415	7.01	-0.32	-0.48	-2.29E-08	8604.00	-0.0003	129.69	2194.36	817.85	3012.21	19503.24
	6/1/2022 17:22	26.90	40.78	8604	3.21E-06	0.0419	7.11	-0.36	-0.55	-2.63E-08	8604.00	-0.0003	129.69	2196.23	816.87	3013.10	19518.61
	6/1/2022 17:23	26.93	40.75	8604	3.22E-06	0.0419	7.09	-0.33	-0.51	-2.43E-08	8604.00	-0.0003	129.69	2197.50	815.91	3013.41	19490.33
	6/1/2022 17:24	26.90	40.56	8604	3.21E-06	0.0417	7.04	-0.38	-0.57	-2.74E-08	8604.00	-0.0004	129.69	2196.63	813.91	3010.54	19533.73
	6/1/2022 17:25	26.99	40.44	8604	3.22E-06	0.0415	6.95	-0.35	-0.53	-2.57E-08	8604.00	-0.0003	129.69	2196.78	813.09	3009.87	19505.86
	6/1/2022 17:26	26.92	40.19	8604	3.21E-06	0.0413	6.90	-0.38	-0.56	-2.73E-08	8604.00	-0.0004	129.69	2191.50	810.06	3001.56	19513.61
	6/1/2022 17:27	26.90	40.33	8604	3.21E-06	0.0414	6.96	-0.35	-0.53	-2.56E-08	8604.00	-0.0003	129.69	2185.01	806.77	2991.79	19506.16
	6/1/2022 17:28	26.87	40.52	8604	3.21E-06	0.0416	7.04	-0.36	-0.54	-2.59E-08	8604.00	-0.0003	129.69	2181.82	805.28	2987.09	19480.23
	6/1/2022 17:29	27.05	40.58	8604	3.23E-06	0.0417	6.97	-0.30	-0.45	-2.17E-08	8604.00	-0.0003	129.69	2178.95	803.65	2982.60	19463.48
	6/1/2022 17:30	26.83	40.31	8604	3.20E-06	0.0414	6.99	-0.33	-0.50	-2.40E-08	8604.00	-0.0003	129.69	2169.18	803.63	2972.81	19490.29
	6/1/2022 17:31	26.97	40.55	8604	3.22E-06	0.0417	7.00	-0.35	-0.53	-2.57E-08	8604.00	-0.0003	129.69	2156.98	808.07	2965.05	19509.83
	6/1/2022 17:32	26.66	39.97	8604	3.18E-06	0.0411	6.96	-0.36	-0.53	-2.59E-08	8604.00	-0.0003	129.69	2145.56	811.01	2956.57	19577.98
	6/1/2022 17:33	26.50	39.98	8604	3.16E-06	0.0411	7.05	-0.34	-0.52	-2.50E-08	8604.00	-0.0003	129.69	2137.91	812.37	2950.29	19563.98
	6/1/2022 17:34	26.68	40.24	8604	3.19E-06	0.0413	7.04	-0.39	-0.58	-2.80E-08	8604.00	-0.0004	129.69	2132.57	814.15	2946.72	19500.06
	Run 8 Average	**26.88**	**40.51**	**8604.00**	**3.21E-06**	**0.0416**	**7.03**	**-0.35**	**-0.52**	**-2.53E-08**	**8604.00**	**-0.0003**	**129.69**	**2172.73**	**812.77**	**2985.51**	**19502.62**

CEMS/PROCESS DATA

CCR Charge Heater 14H8&9

Run #	Date/Time	NOx (raw) 14AI2016 (ppm)	NOx (at 0% O2) (ppm)	F-Factor 14SFFVAL.LD	NOx lb/dscf	NOx (at 0% O2) lb/MMBtu	O2 14AI0966 (%)	CO (raw) 14AI0965 (ppm)	CO (at 0% O2) (ppm)	CO lb/dscf	F-Factor 14SFFVAL.LD	CO (at 0% O2) (lb/MMBtu)	Heat Input (mmBtu/hr) 14JI0761 Fuel Gas To CCR Charge Htr Limit	Fuel Gas Flow 14FI0761 Fuel Gas To CCR Charge Htr	Fuel Gas Flow 14FI0764 Fuel Gas To Inthtr 2	Total Fuel Gas =0761+0764 MSCFD	Unit Charge Rate 14FR0001 B/D
9	6/1/2022 17:46	27.08	40.69	8604	3.23E-06	0.0418	6.99	-0.33	-0.49	-2.38E-08	8604.00	-0.0003	129.69	2166.63	818.60	2985.23	19501.37
	6/1/2022 17:47	27.08	40.61	8604	3.23E-06	0.0417	6.96	-0.33	-0.49	-2.40E-08	8604.00	-0.0003	129.69	2163.22	815.21	2978.43	19498.02
	6/1/2022 17:48	27.13	40.91	8604	3.24E-06	0.0420	7.04	-0.37	-0.55	-2.67E-08	8604.00	-0.0003	129.69	2162.47	812.82	2975.28	19474.15
	6/1/2022 17:49	27.05	40.71	8604	3.23E-06	0.0418	7.01	-0.37	-0.55	-2.67E-08	8604.00	-0.0003	129.69	2166.08	809.73	2975.81	19493.51
	6/1/2022 17:50	27.23	41.05	8604	3.25E-06	0.0422	7.04	-0.35	-0.53	-2.54E-08	8604.00	-0.0003	129.69	2166.33	807.86	2974.19	19528.76
	6/1/2022 17:51	27.28	40.96	8604	3.26E-06	0.0421	6.98	-0.32	-0.48	-2.34E-08	8604.00	-0.0003	129.69	2164.44	806.01	2970.45	19502.48
	6/1/2022 17:52	27.21	40.91	8604	3.25E-06	0.0420	7.00	-0.34	-0.52	-2.49E-08	8604.00	-0.0003	129.69	2165.22	806.61	2971.83	19496.50
	6/1/2022 17:53	27.07	40.92	8604	3.23E-06	0.0420	7.08	-0.36	-0.54	-2.59E-08	8604.00	-0.0003	129.69	2165.55	807.82	2973.37	19448.18
	6/1/2022 17:54	27.14	41.14	8604	3.24E-06	0.0423	7.11	-0.33	-0.49	-2.37E-08	8604.00	-0.0003	129.69	2164.46	811.34	2975.80	19492.07
	6/1/2022 17:55	27.36	41.46	8604	3.27E-06	0.0426	7.11	-0.33	-0.49	-2.37E-08	8604.00	-0.0003	129.69	2165.49	814.13	2979.62	19511.03
	6/1/2022 17:56	27.26	41.24	8604	3.26E-06	0.0424	7.08	-0.31	-0.47	-2.28E-08	8604.00	-0.0003	129.69	2167.02	813.31	2980.33	19492.84
	6/1/2022 17:57	27.12	41.18	8604	3.24E-06	0.0423	7.14	-0.33	-0.51	-2.42E-08	8604.00	-0.0003	129.69	2171.36	812.01	2983.37	19480.53
	6/1/2022 17:58	27.29	41.44	8604	3.26E-06	0.0426	7.14	-0.35	-0.53	-2.54E-08	8604.00	-0.0003	129.69	2173.63	810.35	2983.99	19462.19
	6/1/2022 17:59	27.21	41.36	8604	3.25E-06	0.0425	7.15	-0.31	-0.47	-2.26E-08	8604.00	-0.0003	129.69	2179.51	810.60	2990.11	19516.22
	6/1/2022 18:00	27.30	41.63	8604	3.26E-06	0.0428	7.19	-0.37	-0.57	-2.70E-08	8604.00	-0.0004	129.69	2184.41	813.55	2997.96	19489.31
	6/1/2022 18:01	27.35	41.53	8604	3.27E-06	0.0427	7.13	-0.36	-0.55	-2.63E-08	8604.00	-0.0003	129.69	2189.34	814.03	3003.37	19491.40
	6/1/2022 18:02	27.21	41.03	8604	3.25E-06	0.0421	7.04	-0.35	-0.53	-2.55E-08	8604.00	-0.0003	129.69	2194.77	815.42	3010.19	19495.29
	6/1/2022 18:03	27.18	41.13	8604	3.25E-06	0.0423	7.09	-0.31	-0.47	-2.28E-08	8604.00	-0.0003	129.69	2199.11	817.24	3016.35	19535.07
	6/1/2022 18:04	27.37	41.26	8604	3.27E-06	0.0424	7.04	-0.34	-0.51	-2.46E-08	8604.00	-0.0003	129.69	2201.53	817.80	3019.32	19503.70
	6/1/2022 18:05	27.25	40.93	8604	3.25E-06	0.0420	6.99	-0.33	-0.49	-2.39E-08	8604.00	-0.0003	129.69	2205.08	816.89	3021.97	19458.27
	6/1/2022 18:06	27.13	40.76	8604	3.24E-06	0.0419	6.99	-0.35	-0.53	-2.56E-08	8604.00	-0.0003	129.69	2206.71	816.80	3023.51	19484.28
	Run 9 Average	**27.20**	**41.09**	**8604.00**	**3.25E-06**	**0.0422**	**7.06**	**-0.34**	**-0.51**	**-2.47E-08**	**8604.00**	**-0.0003**	**129.69**	**2177.25**	**812.77**	**2990.02**	**19493.10**
10	6/1/2022 18:17	26.48	41.19	8604	3.16E-06	0.0423	7.47	-0.35	-0.54	-2.53E-08	8604.00	-0.0003	129.77	2179.68	842.42	3022.10	19459.10
	6/1/2022 18:18	26.89	41.91	8604	3.21E-06	0.0431	7.49	-0.36	-0.57	-2.64E-08	8604.00	-0.0004	129.78	2201.59	849.50	3051.08	19452.55
	6/1/2022 18:19	26.69	41.43	8604	3.19E-06	0.0426	7.43	-0.33	-0.51	-2.37E-08	8604.00	-0.0003	129.79	2225.59	853.32	3078.90	19502.15
	6/1/2022 18:20	26.82	41.26	8604	3.20E-06	0.0424	7.31	-0.33	-0.51	-2.39E-08	8604.00	-0.0003	129.79	2243.55	852.99	3096.54	19572.50
	6/1/2022 18:21	26.68	40.76	8604	3.19E-06	0.0419	7.22	-0.37	-0.56	-2.66E-08	8604.00	-0.0004	129.80	2260.26	850.80	3111.05	19521.77
	6/1/2022 18:22	26.46	40.29	8604	3.16E-06	0.0414	7.18	-0.31	-0.47	-2.25E-08	8604.00	-0.0003	129.81	2268.73	848.14	3116.86	19486.95
	6/1/2022 18:23	26.41	40.08	8604	3.15E-06	0.0412	7.13	-0.35	-0.53	-2.52E-08	8604.00	-0.0003	129.82	2269.81	843.95	3113.76	19486.00
	6/1/2022 18:24	26.15	39.42	8604	3.12E-06	0.0405	7.03	-0.34	-0.52	-2.49E-08	8604.00	-0.0003	129.82	2269.91	840.39	3110.30	19461.31
	6/1/2022 18:25	26.01	39.18	8604	3.11E-06	0.0402	7.02	-0.34	-0.51	-2.46E-08	8604.00	-0.0003	129.83	2263.77	836.29	3100.06	19486.21
	6/1/2022 18:26	26.08	39.38	8604	3.11E-06	0.0405	7.06	-0.38	-0.58	-2.78E-08	8604.00	-0.0004	129.84	2255.28	834.26	3089.54	19495.46
	6/1/2022 18:27	25.96	39.39	8604	3.10E-06	0.0405	7.13	-0.33	-0.50	-2.39E-08	8604.00	-0.0003	129.85	2251.99	835.03	3087.03	19475.03
	6/1/2022 18:28	25.99	39.42	8604	3.10E-06	0.0405	7.12	-0.34	-0.52	-2.49E-08	8604.00	-0.0003	129.85	2252.08	833.41	3085.49	19520.12
	6/1/2022 18:29	25.92	39.31	8604	3.09E-06	0.0404	7.12	-0.38	-0.57	-2.73E-08	8604.00	-0.0004	129.86	2249.51	832.03	3081.54	19520.16
	6/1/2022 18:30	25.94	39.31	8604	3.10E-06	0.0404	7.11	-0.31	-0.47	-2.24E-08	8604.00	-0.0003	129.87	2244.04	829.78	3073.83	19485.58
	6/1/2022 18:31	25.99	39.45	8604	3.10E-06	0.0405	7.13	-0.33	-0.51	-2.43E-08	8604.00	-0.0003	129.87	2238.66	827.78	3066.43	19506.62
	6/1/2022 18:32	26.05	39.38	8604	3.11E-06	0.0405	7.08	-0.33	-0.49	-2.37E-08	8604.00	-0.0003	129.88	2233.34	825.06	3058.40	19518.77
	6/1/2022 18:33	25.92	39.09	8604	3.09E-06	0.0402	7.04	-0.35	-0.52	-2.51E-08	8604.00	-0.0003	129.89	2227.89	823.21	3051.10	19474.44
	6/1/2022 18:34	25.92	39.07	8604	3.10E-06	0.0401	7.03	-0.34	-0.52	-2.49E-08	8604.00	-0.0003	129.90	2224.69	822.65	3047.33	19477.17
	6/1/2022 18:35	25.85	39.18	8604	3.09E-06	0.0402	7.11	-0.37	-0.56	-2.68E-08	8604.00	-0.0003	129.90	2221.90	822.96	3044.86	19490.22
	6/1/2022 18:36	26.05	39.58	8604	3.11E-06	0.0407	7.14	-0.33	-0.51	-2.42E-08	8604.00	-0.0003	129.91	2221.30	824.67	3045.96	19470.58
	6/1/2022 18:37	26.13	39.41	8604	3.12E-06	0.0405	7.04	-0.33	-0.49	-2.37E-08	8604.00	-0.0003	129.92	2212.57	820.93	3033.49	19462.83
	Run 10 Average	**26.21**	**39.88**	**8604.00**	**3.13E-06**	**0.0410**	**7.16**	**-0.34**	**-0.52**	**-2.49E-08**	**8604.00**	**-0.0003**	**129.85**	**2238.86**	**835.69**	**3074.56**	**19491.69**

Attachment H
Laboratory Analysis

Erthwrks, Inc.

P.O. Box 150549
Austin, TX 78715

MPC Detroit

CCR Charge Heater May 2022
Client Project # 9049.1.B3

Analytical Report (0622-914)

EPA Method 5

Particulate Matter

EPA Method 202

Condensable Particulate Matter

EPA Method 8A

Sulfuric acid mist

Enthalpy Analytical, LLC

Phone: (281) 984 - 7021 / www.enthalpy.com
931 Seaco Ct. Deer Park, TX 77536-3187

I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains 61 pages.

QA Review Performed by: James Haynes, Quality Assurance Director

Report Issued: 06/28/2022

ENTHALPY
ANALYTICAL

Summary of Results

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-1 EPA Method 5 Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

Summary Report

Sample ID	Net Filter Catch (mg)	Net Front Rinse (mg)	Total Particulate (mg)
CCR Charge Htr Run 1	0.44	2.56	3.01
CCR Charge Htr Run 2	-0.15	2.39	2.39
CCR Charge Htr Run 3	0.69	2.11	2.80

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-3 EPA Method 202 Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

Summary Report

Sample ID	Net Organic Catch (mg)	Net Inorganic Catch (mg)	CPM (mg)	TB Corrected CPM (mg)
CCR Charge Htr Run 1	1.89	7.79	9.68	7.75
CCR Charge Htr Run 2	1.09	6.61	7.70	5.77
CCR Charge Htr Run 3	1.48	5.56	7.04	5.10

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-5 EPA Method CTM-013 (EPA Method 8A / ALT-133) Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

Summary Table

Sample ID	Sulfuric Acid Catch Weight (ug)
CCR Charge Htr Run 1	122
CCR Charge Htr Run 2	30.6
CCR Charge Htr Run 3	12.6
Reagent Blank	4.40 ND

Results

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-1 EPA Method 5 Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

Results

	CCR Charge Htr Run 1		CCR Charge Htr Run 2		CCR Charge Htr Run 3	
Filter ID	51321		51320		51316	
Final Weight 1 (g)	0.342858	6/20/22 12:12	0.339747	6/20/22 12:10	0.342110	6/20/22 12:09
Final Weight 2 (g)	0.342808	6/21/22 10:32	0.339858	6/21/22 10:34	0.342060	6/21/22 10:33
Tare (g)	0.342364	2/22/22 09:44	0.340009	2/22/22 09:47	0.341369	2/22/22 09:58
Net Filter Catch (mg)	0.44		-0.15		0.69	
Beaker No.	DP0400		DP0401		DP0402	
Weight 1 (g)	2.321666	6/20/22 12:03	2.300052	6/20/22 12:05	2.322224	6/20/22 12:07
Weight 2 (g)	2.321657	6/21/22 10:26	2.299946	6/21/22 10:28	2.322143	6/21/22 10:30
Tare (g)	2.319094	6/6/22 10:27	2.297555	6/7/22 14:13	2.320033	6/7/22 14:17
Acetone Volume (mL)	130		152		130	
Acetone Blank (g)	0.00000		0.00000		0.00000	
Net Front Rinse (mg)	2.56		2.39		2.11	
Total Particulate (mg)	3.01		2.39		2.80	

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-1 EPA Method 5 Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

In-House Blank

	Acetone	
Beaker	DP0366	
Weight 1 (g)	2.285907	6/20/22 11:56
Weight 2 (g)	2.285728	6/21/22 10:11
Tare	2.285903	5/20/22 17:27
Residue (g)	-0.00018	
Vol. (mL)	200	
Max. Residue	0.00158	

Reagent Blank

	Acetone	
Beaker	DP0395	
Weight 1 (g)	2.329307	6/20/22 12:00
Weight 2 (g)	2.329112	6/21/22 10:17
Tare	2.329220	6/5/22 13:36
Residue (g)	-0.00011	
Vol. (mL)	132	
Max. Residue	0.00104	

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-3 EPA Method 202 Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

Results

	CCR Charge Htr Run 1		CCR Charge Htr Run 2		CCR Charge Htr Run 3		FTRB	
Organic Beaker Number	DP0404		DP0406		DP0408		DP0410	
Initial Solvent Volume (mL)	224		220		218		158	
Org. Final Weight 1 (g)	2.293508	6/20/22 12:27	2.309305	6/20/22 12:18	2.320741	6/20/22 13:28	2.325472	6/20/22 12:21
Org. Final Weight 2 (g)	2.293348	6/21/22 10:38	2.309343	6/21/22 10:40	2.320581	6/21/22 10:43	2.325472	6/21/22 10:47
Tare (g)	2.291461	6/7/22 14:22	2.308249	6/7/22 17:02	2.319105	6/7/22 17:10	2.324203	6/7/22 17:17
Organic Catch (mg)	1.89		1.09		1.48		1.27	
Inorganic Beaker Number	DP0403		DP0405		DP0407		DP0409	
Weight 1 (g)	2.305409	6/20/22 13:21	2.308669	6/21/22 14:52	2.350356	6/20/22 13:16	2.322621	6/20/22 13:26
Weight 2 (g)	2.305464	6/21/22 10:37	2.308369	6/22/22 11:21	2.350157	6/21/22 10:41	2.322574	6/21/22 10:45
Tare (g)	2.297671	6/7/22 14:19	2.301762	6/7/22 14:24	2.344597	6/7/22 17:05	2.321909	6/7/22 17:13
Initial Water Vol. (mL)	467		395		389		290	
Net Inorganic Catch (mg)	7.79		6.61		5.56		0.67	
Condensable Particulate (mg)	9.68		7.70		7.04		1.93	
TB Corrected CPM (mg)	7.75		5.77		5.10			

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-3 EPA Method 202 Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

	FTPB	
Organic Beaker Number	DP0412	
Initial Solvent Volume (mL)	176	
Org. Final Weight 1 (g)	2.327357	6/20/22 12:23
Org. Final Weight 2 (g)	2.327455	6/21/22 10:52
Tare (g)	2.327408	6/7/22 17:23
Organic Catch (mg)	0.05	
Inorganic Beaker Number	DP0411	
Weight 1 (g)	2.309880	6/20/22 13:23
Weight 2 (g)	2.309882	6/21/22 10:49
Tare (g)	2.309601	6/7/22 17:20
Initial Water Vol. (mL)	145	
Net Inorganic Catch (mg)	0.28	
Condensable Particulate (mg)	0.33	
TB Corrected CPM (mg)	0.00	

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-3 EPA Method 202 Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

In-House Blank

	Water		Acetone		Hexane	
Beaker	DP0393		DP0366		DP0394	
Weight 1 (g)	2.304660	6/20/22 11:02	2.285907	6/20/22 11:56	2.295949	6/20/22 11:04
Weight 2 (g)	2.304695	6/21/22 09:36	2.285728	6/21/22 10:11	2.296000	6/21/22 09:38
Tare (g)	2.304652	6/5/22 13:30	2.285903	5/20/22 17:27	2.295877	6/5/22 13:33
Residue (g)	0.00004		-0.00018		0.00012	
Vol. (mL)	200		200		200	
Max. Residue (g)	0.00020		0.00016		0.00013	

Reagent Blank

	Water		Acetone		Hexane	
Beaker	DP0396		DP0395		DP0397	
Weight 1 (g)	2.314811	6/20/22 12:14	2.329307	6/20/22 12:00	2.320653	6/20/22 12:02
Weight 2 (g)	2.314743	6/21/22 10:20	2.329112	6/21/22 10:17	2.320518	6/21/22 10:23
Tare (g)	2.314548	6/5/22 13:39	2.329220	6/5/22 13:36	2.320601	6/6/22 10:17
Residue (g)	0.00020		-0.00011		-0.00008	
Vol. (mL)	127		132		156	
Max. Residue (g)	0.00013		0.00010		0.00010	

Enthalpy Analytical

Company: Erthwrks, Inc

Job No.: 0622-914-5 EPA Method CTM-013 (EPA Method 8A / ALT-133) Analysis

Client No.: 9049.1.B3 MPC Detroit May 2022 Site: CCR Charge Heater

Sulfuric Acid as Sulfate

Sample ID	Filename #1	Filename #2	MDL (ug/mL)	Ret. Time (min.)	Ret. Time (min.)	%diff. RT	Conc. # 1 (ug/mL)	Conc. # 2 (ug/mL)	%diff. conc.	Avg. Conc. (ug/mL)	DF	Liquid Vol. (mL)	Conv. Factor	Catch Weight (ug)	Flag
CCR Charge Htr Run 1	042	043	0.0525	12.11	12.11	0.0	2.48	2.49	0.2	2.48	1	48	1.021	122	
CCR Charge Htr Run 2	044	045	0.0525	12.12	12.12	0.0	0.463	0.472	1.0	0.468	1	64	1.021	30.6	
CCR Charge Htr Run 3	060	061	0.0525	12.10	12.11	0.0	0.220	0.239	4.1	0.229	1	54	1.021	12.6	
Reagent Blank	040	041	0.0525				0.0525	0.0525		0.0525	1	82	1.021	4.40	ND

Narrative Summary

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