

RECEIVED

AUG 01 2022

AIR QUALITY DIVISION

erthwrks

AIR EMISSIONS TESTING FOR INDUSTRY

Relative Accuracy Test Audit

for

Marathon Petroleum Company LP

at the

Marathon Detroit Refinery in Detroit, MI

on the

FCCU Charge Heater

Unit: EU11-FCCUCHARHTR-S1

Permit No. MI-ROP-A9831-2012c

Prepared for:



**Marathon
Petroleum Company LP**

Test Date: June 8, 2022

Erthwrks Project No. 9049.1.B4

A9831-test-20220608



1.0 INTRODUCTION

1.1 Identification, location and dates of tests

Erthwrks, Inc. was contracted to conduct a relative accuracy test audit (RATA) on a continuous emissions monitor system (CEMS) installed on the FCCU Charge Heater in operation at the Detroit Refinery in Detroit, Michigan. The RATA test was conducted on June 8, 2022.

1.2 Purpose of Testing

This RATA was conducted to demonstrate the accuracy and reliability of the CEMS monitors installed on the FCCU Charge Heater. The purpose of this test program was to evaluate the relative accuracy of the carbon monoxide (CO) and oxygen (O₂) CEMS. All testing and audit procedures were conducted in accordance with the requirements set forth in the 40, CFR, Part 60, Appendix B and F, which defines the CEMS performance specifications and testing procedures.

1.3 Contact Information

Marathon Petroleum Company LP

Addie Koerner
Michigan Refining Division
330-479-5662 office
419-306-5162 cell
akoerner@marathonpetroleum.com

Erthwrks, Inc.

John Wood
Technical Director
P.O. Box 150549
Austin, TX 78745
512-585-1685 office
jwood@erthwrks.com

Erthwrks, Inc.

Jason Dunn
QC Specialist
P.O. Box 150549
Austin, TX 78745
614-565-9177 office
jdunn@erthwrks.com

Facility Location:

1300 South Fort Street
Detroit, MI 48217

2.0 SUMMARY OF RESULTS

Table 2.1: GBR FCCU Charge Heater exhaust CEMS RATA Results

Pollutant Measured	Performance Specification	Relative Accuracy	Applicable Limit	Pass/Fail
O ₂ (%vd)	Performance Spec. 3	0.2% <i>R_{AMD}</i>	<1%	Pass
CO (ppmvd)	Performance Spec. 4	1.70 ppm	<5 ppm	Pass

3.0 SOURCE DESCRIPTION

3.1 Description of the process

The FCCU Charge Heater preheats the feed to the FCCU. The unit can be fired by a combination of refinery fuel gas, disulfide off-gas and natural gas. Emission are vented to the atmosphere at the FCCU Charge Heater Stack (SV11-H1).

Table 3.1: GBR FCCU Charge Heater Exhaust CEMS Description

Pollutant Measured	Analyzer Manufacturer	Analyzer Model	Serial Number	Install Date
O ₂	ABB	Magnos 106	3.343209.1	2006
CO	ABB	Uras 14	3.343232.1	2006

3.2 Applicable permit and source designation

Marathon Petroleum Company LP operates the FCCU Charger Heater (EU11-FCCUCHARHTR-S1) under EGLE Renewable Operating Permit No. MI-ROP-A9831-2012c and is required to conduct an annual RATA to demonstrate the relative accuracy of the CEMS associated with this unit.

3.3 Type and quantity of materials processed during tests

During the emission testing on June 8, 2022 at the Marathon Petroleum Company LP Refinery, the FCCU Charge Heater was tested while operating at the maximum achievable load condition. NOTE: For this testing program, the average Crude Charge was approximately 41,000 BPD and the fuel flow was approximately 2494 MSCFD. This operational data was provided by MPC and is located in Attachment F of this report.

RECEIVED

AUG 01 2022



4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Gaseous Sampling – O₂, CO

The following EPA reference methods were utilized to complete this testing program:

- EPA Method 3A for the determination of O₂ concentration
- EPA Method 10 for the determination of CO concentration

A calibration error (CE) test was conducted as specified in US EPA Method 7E §8.2.3. In accordance with this requirement, a three-point analyzer calibration error test was conducted prior to exhaust sampling. The CE test was conducted by introducing the low, mid, and high-level calibration gasses (as defined by EPA Method 7E §3.3.1-3) sequentially and the response was recorded.

The initial system bias and system calibration error check were conducted in accordance with EPA Method 7E §8.2.5. The upscale calibration gas will be introduced at the probe upstream of all sample system components and the response will be recorded. The procedure was repeated with the low-level gas concentration and response recorded.

After each test run, the sample system bias check was conducted to validate the run data. The low-level and upscale drift was calculated using equation 7E-4. The arithmetic average of all valid concentration values was adjusted for bias using equation 7E-5B.

All gaseous sampling was done utilizing three appropriate traverse points. The three traverse points were selected to ensure acquisition of a representative sample over the stack cross section as required by 40 CFR Part 60, Appendix B, Performance Specification 2 §8.1.3.2.

See Figure 1 below for a sample system diagram.

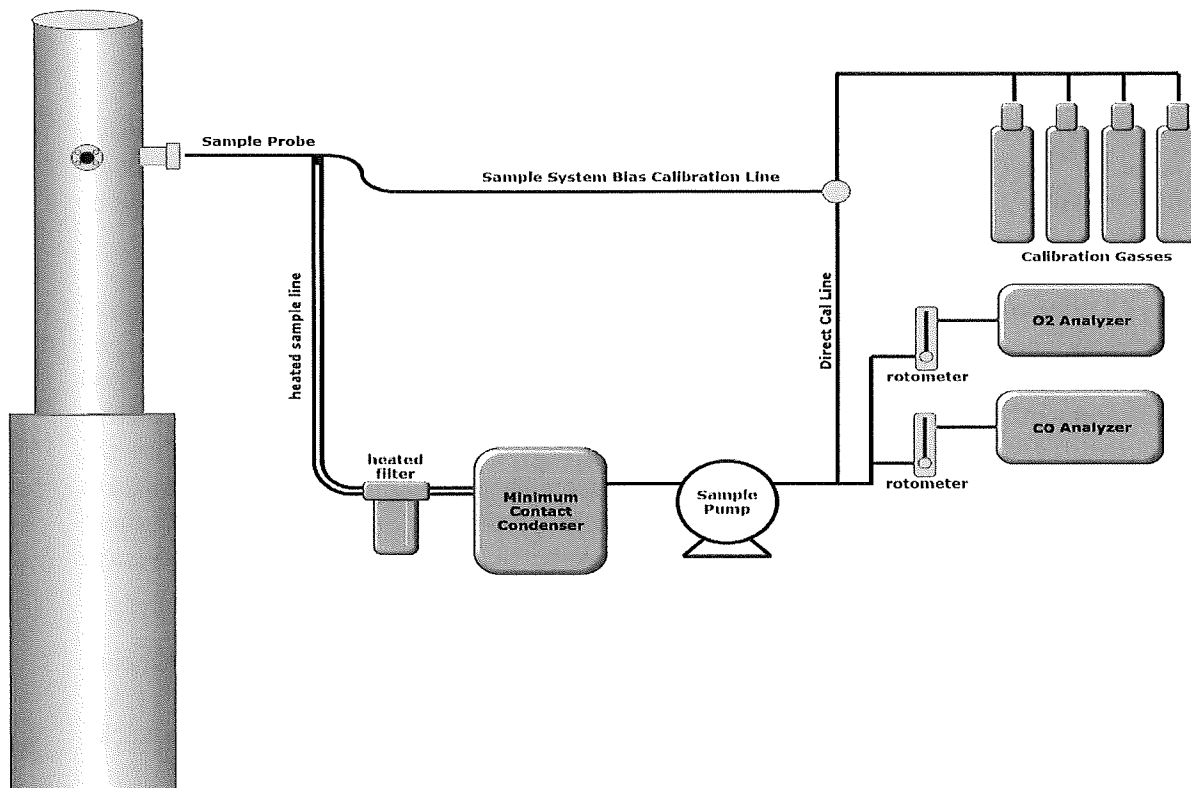


Figure 1: Example Erthwrks Gaseous Sampling System Diagram

4.2 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 3 for O₂ relative accuracy
- EPA Performance Specification 4 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 O₂, 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.

The reference method sampling locations are defined in the Erthwrks QA/QC worksheet located in Attachment B. Three sampling points were used in accordance with the EPA Performance Specification 2, §8.1.3.2, located at 16.7, 50.0 and 83.3 percent of the stack inner diameter from the port location. Erthwrks sampled at each traverse point individually for 7-minutes per point for each 21-minute test run.

4.3 Discussion of sampling procedure or operational variances

Erthwrks, Inc. conducted the emission testing with no sampling or procedural variances. The FCCU Charge Heater exhaust operated with no operational variances during this test program.

Attachment A
Detailed Results of Emission Test

**Erthwrks Relative Accuracy Test Audit--O₂ RATA
Performance Specification 3**

FCCU CHarge Htr **O₂ 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	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022
Start Time	8:51	9:20	9:48	10:17	11:06	11:36	12:05	12:35	13:04	13:35
End Time	9:12	9:41	10:09	10:38	11:27	11:57	12:26	12:56	13:25	13:56
RM O ₂ Result (%vd)	5.51	5.39	5.33	6.93	5.37	5.41	5.33	5.38	5.39	5.56
CEMS O ₂ Data (%vd)	5.06	5.15	5.13	5.18	5.15	5.20	5.13	5.19	5.17	5.35
Difference	0.45	0.24	0.20	1.75	0.22	0.21	0.20	0.19	0.22	0.21
Accept or Reject	Accept	Accept	Accept	Reject	Accept	Accept	Accept	Accept	Accept	Accept

Mean of the Difference (d_{avg})

0.24

Standard Deviation (S_d)

0.08

Confidence Coefficient (CC)

0.06

Relative Accuracy via RM, $RA_{RM-CEMS}^*$

0.24%

← Pass

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

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

FCCU 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	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022	6/8/2022
Start Time	8:51	9:20	9:48	10:17	11:06	11:36	12:05	12:35	13:04	13:35
End Time	9:12	9:41	10:09	10:38	11:27	11:57	12:26	12:56	13:25	13:56
RM CO Result (ppmvd)	0.44	0.23	0.11	0.08	0.10	0.13	0.09	0.12	0.03	0.27
CEMS CO Data (ppmvd)	1.74	1.76	1.77	1.75	1.75	1.76	1.77	1.69	1.70	1.72
Difference	-1.30	-1.53	-1.66	-1.67	-1.65	-1.63	-1.68	-1.57	-1.67	-1.45
Accept or Reject	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Reject

Mean of the Difference (d_{avr})

Standard Deviation (S_d)

Confidence Coefficient (CC)

Relative Accuracy via M.4A, RA_{4A}^\ddagger

$^\ddagger RA_{4A}$ must be less than 5 ppmv

-1.60
0.12
0.09
1.69

← Pass

RECEIVED
 AUG 01 2022
 AIR QUALITY DIVISION

Attachment B
Quality Control Documentation

Erthwriks Method 1 Traverse Point Location Worksheet

Client: Marathon
Project #: 9049.1.B4
Facility: Detroit
Unit ID: FCCU Charge Htr
Technician: 0

Stack ID Measurements

Stack ID + Port (inches):	100.25
Port Extension (inches):	11.25
Stack Diameter (inches):	89

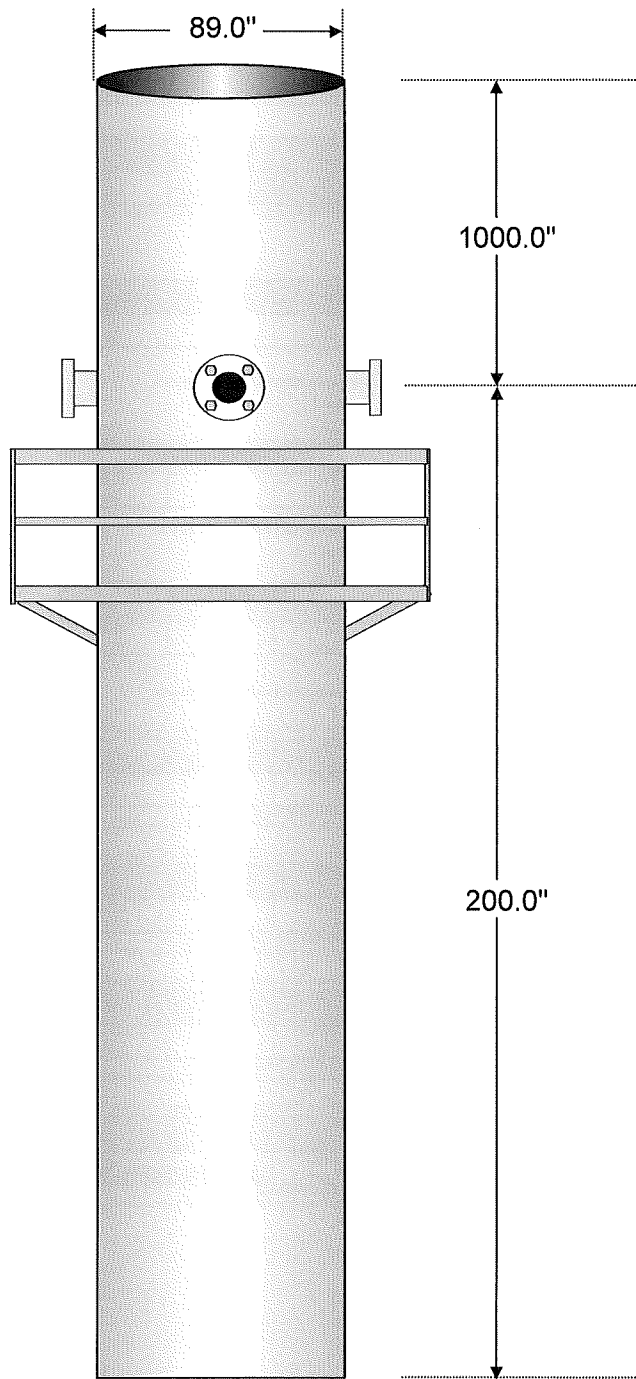
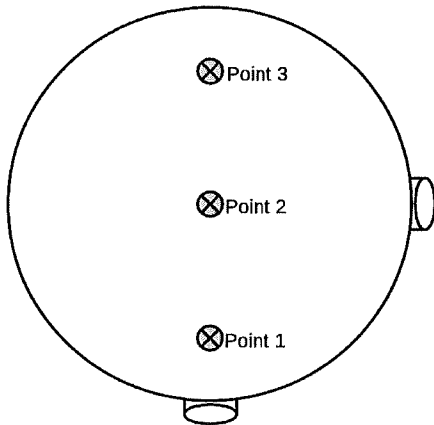
Port Location Measurements

Distance Upstream (A) (inches):	1000
Distance Downstream (B) (inches):	200
Stack Diameters Upstream (A):	11.2
Stack Diameters Downstream (B):	2.2

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

Traverse Point Locations ^{(1)/(2)}	
Point 1:	14.86"
Point 2:	44.50"
Point 3:	74.14"

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: 6/8/2022
 Client: Marathon
 Facility: Detroit
 Project No: 9049.1.B4
 Unit ID: FCCU CHarge Htr

Calibration Gas Verification

Pollutant	Target Level (ppm)	As Found (ppm)	Mid Level (ppm)	CV Inter. Serial #	High Level (ppm)	CV Inter. Serial #	Off Inter. (ppm)
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

Reference Method Analyzer Info

Make	Model	Serial No.
Teledyne	T300M	734
Teledyne	T200H	802

Direct Calibration Error Test

Pollutant	Zero Gas Response (C ₀)	Calibration Error (A/B)	As Found Response (C ₁)	Calibration Error (A/B)	Mid Level Response (C ₂)	Calibration Error (A/B)	High Level Response (C ₃)	Calibration Error (A/B)
CO	-0.05	-0.09%	n/a	n/a	26.19	1.49%	50.90	0.14%
O ₂	-0.01	-0.04%	n/a	n/a	9.93	-1.00%	19.90	-0.10%

* 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

Initial Sample System Bias and Response Time

Pollutant	Up-scale Bias (C ₁)	Up-scale Bias (C ₂)	Up-scale Response (C ₃)	Sample System Bias (SD)†	Response Time (Sec)	Down-scale Response (C ₄)	Sample System Bias (SD)†	Response Time (Sec)
CO	25.43	26.19	25.74	-0.88%	60	0.27	0.62%	60
O ₂	10.13	9.92	9.87	-0.32%	60	0.07	0.41%	60

* SD 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: 8:51
 End Time: 9:12

Pollutant	Initial Zero SSC (C ₁)	Initial Up-scale SSC (C ₂)	Raw Results (C ₃)	Final Zero SSC (C ₄)	Final Up-scale SSC (C ₅)
CO	0.27	25.74	0.63	0.12	25.34
O ₂	0.07	9.87	5.40	0.07	9.86

Run #: Run 2
 Start Time: 9:20
 End Time: 9:41

Pollutant	Initial Zero SSC (C ₁)	Initial Up-scale SSC (C ₂)	Raw Results (C ₃)	Final Zero SSC (C ₄)	Final Up-scale SSC (C ₅)
CO	0.12	25.34	0.37	0.17	25.18
O ₂	0.07	9.86	5.28	0.09	9.87

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

Run #: Run 3
 Start Time: 9:48
 End Time: 10:09

Pollutant	Initial Zero SSC (C ₁)	Initial Up-scale SSC (C ₂)	Raw Results (C ₃)	Final Zero SSC (C ₄)	Final Up-scale SSC (C ₅)
CO	0.17	25.18	0.24	0.09	25.05
O ₂	0.09	9.87	5.23	0.08	9.86

Run #: Run 4
 Start Time: 10:17
 End Time: 10:38

Pollutant	Initial Zero SSC (C ₁)	Initial Up-scale SSC (C ₂)	Raw Results (C ₃)	Final Zero SSC (C ₄)	Final Up-scale SSC (C ₅)
CO	0.09	25.05	-0.01	-0.26	24.94
O ₂	0.08	9.86	5.43	-1.10	6.51

* Recalibration of O₂ after Run 4

Run 4 invalid for O₂. Accidental span of O₂ during end of run. CO data valid. O₂ recalibrated direct

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 (SD)†	Initial Up-scale Sys. Bias (SD)†	Final Zero Sys. Bias (SD)†	Final Up-scale Sys. Bias (SD)†	Avg Zero Sys. Bias (C ₁)	Avg Up-scale Sys. Bias (C ₂)	Zero Drift Assessment (D)†	Up-scale Drift Assessment (D)†	Corrected Results (C ₃)
CO	0.62%	-0.88%	0.32%	-1.66%	0.19	25.54	0.30%	0.77%	0.44
O ₂	0.41%	-0.32%	0.38%	-0.35%	0.07	9.87	0.03%	0.03%	5.51

* SD 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 (SD)†	Initial Up-scale Sys. Bias (SD)†	Final Zero Sys. Bias (SD)†	Final Up-scale Sys. Bias (SD)†	Avg Zero Sys. Bias (C ₁)	Avg Up-scale Sys. Bias (C ₂)	Zero Drift Assessment (D)†	Up-scale Drift Assessment (D)†	Corrected Results (C ₃)
CO	0.32%	-1.66%	0.42%	-1.99%	0.14	25.26	0.10%	0.33%	0.23
O ₂	0.38%	-0.35%	0.48%	-0.31%	0.08	9.87	0.11%	0.04%	5.39

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

Pollutant	Initial Zero Sys. Bias (SD)†	Initial Up-scale Sys. Bias (SD)†	Final Zero Sys. Bias (SD)†	Final Up-scale Sys. Bias (SD)†	Avg Zero Sys. Bias (C ₁)	Avg Up-scale Sys. Bias (C ₂)	Zero Drift Assessment (D)†	Up-scale Drift Assessment (D)†	Corrected Results (C ₃)
CO	0.42%	-1.99%	0.26%	-2.24%	0.13	25.11	0.16%	0.26%	0.11
O ₂	0.48%	-0.31%	0.42%	-0.38%	0.08	9.86	0.06%	0.07%	5.33

* SD 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 (SD)†	Initial Up-scale Sys. Bias (SD)†	Final Zero Sys. Bias (SD)†	Final Up-scale Sys. Bias (SD)†	Avg Zero Sys. Bias (C ₁)	Avg Up-scale Sys. Bias (C ₂)	Zero Drift Assessment (D)†	Up-scale Drift Assessment (D)†	Corrected Results (C ₃)
CO	0.26%	-2.24%	-0.41%	-2.45%	-0.08	24.99	0.67%	0.20%	0.08
O ₂	0.42%	-0.38%	-5.49%	-17.18%	-0.51	8.18	5.91%	16.90%	6.93

* SD 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

Date: 6/8/2022
 Client: Marathon
 Facility: Detroit
 Project No: 9049.1.B4
 Unit ID: FCCU Charge Htr

Calibration Gas Verification

Pollutant	Low Level Gas Conc. (C ₁)	Cylinder Serial#	Mid Level Gas Conc. (C ₂)	Cylinder Serial#	High Level Gas Conc. (C ₃)	Cylinder Serial#	Dilution Factor
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

Reference Method Analyzer Info

Make	Model	Serial No.
Teledyne	T300M	734
Teledyne	T200H	802

Direct Calibration Error Test

Pollutant	Zero Gas Response (C ₀)	Calibration Error (ADE)	Low Level Response (C ₁)	Calibration Error (ADE)	Mid Level Response (C ₂)	Calibration Error (ADE)	High Level Response (C ₃)	Calibration Error (ADE)
CO	-0.05	-0.09%	n/a	n/a	26.19	1.49%	50.90	0.14%
O ₂	0.01	0.07%	n/a	n/a	9.94	-0.95%	19.92	-0.03%

* 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

Initial Sample System Bias and Response Time

Pollutant	Upscale Bias (C ₁)	Upscale Bias (C ₂)	Upscale Response (C ₁)	Sample System Bias (SB)	Response Time (Sec)	Downscale Response (C ₂)	Sample System Bias (SB)	Response Time (Sec)
CO	25.43	26.19	25.74	-0.88%	60	0.27	0.62%	60
O ₂	10.13	9.94	9.84	-0.51%	60	0.05	0.20%	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 5
 Start Time: 11:06
 End Time: 11:27

Pollutant	Initial Zero SSC (C ₀)	Initial Upscale SSC (C ₁)	Raw Results (C ₁)	Final Zero SSC (C ₀)	Final Upscale SSC (C ₁)
CO	-0.26	24.94	-0.05	-0.06	24.94
O ₂	0.05	9.84	5.26	0.09	9.87

Run #: Run 6
 Start Time: 11:36
 End Time: 11:57

Pollutant	Initial Zero SSC (C ₀)	Initial Upscale SSC (C ₁)	Raw Results (C ₁)	Final Zero SSC (C ₀)	Final Upscale SSC (C ₁)
CO	-0.06	24.94	0.07	-0.07	24.85
O ₂	0.09	9.87	5.30	0.05	9.85

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

Run #: Run 7
 Start Time: 12:05
 End Time: 12:26

Pollutant	Initial Zero SSC (C ₀)	Initial Upscale SSC (C ₁)	Raw Results (C ₁)	Final Zero SSC (C ₀)	Final Upscale SSC (C ₁)
CO	-0.07	24.85	0.00	-0.11	24.95
O ₂	0.05	9.85	5.21	0.06	9.84

Run #: Run 8
 Start Time: 12:35
 End Time: 12:56

Pollutant	Initial Zero SSC (C ₀)	Initial Upscale SSC (C ₁)	Raw Results (C ₁)	Final Zero SSC (C ₀)	Final Upscale SSC (C ₁)
CO	-0.11	24.95	0.00	-0.14	24.75
O ₂	0.06	9.84	5.25	0.07	9.84

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

Run #: Run 9
 Start Time: 13:04
 End Time: 13:25

Pollutant	Initial Zero SSC (C ₀)	Initial Upscale SSC (C ₁)	Raw Results (C ₁)	Final Zero SSC (C ₀)	Final Upscale SSC (C ₁)
CO	-0.14	24.75	-0.19	-0.39	24.57
O ₂	0.07	9.84	5.26	0.06	9.81

Run #: Run 10
 Start Time: 13:35
 End Time: 13:56

Pollutant	Initial Zero SSC (C ₀)	Initial Upscale SSC (C ₁)	Raw Results (C ₁)	Final Zero SSC (C ₀)	Final Upscale SSC (C ₁)
CO	-0.39	24.57	-0.01	-0.16	24.61
O ₂	0.06	9.81	5.41	0.07	9.81

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

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 ₀)	Avg. Upscale Sys. Bias (C ₁)	Zero Drift Assessment (D)	Upscale Drift Assessment (D)	Corrected Results (C ₁)
CO	-0.41%	-2.45%	-0.02%	-2.46%	-0.16	24.94	0.39%	0.01%	0.10
O ₂	0.20%	-0.51%	0.38%	-0.34%	0.07	9.86	0.18%	0.17%	5.37

* 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 ₀)	Avg. Upscale Sys. Bias (C ₁)	Zero Drift Assessment (D)	Upscale Drift Assessment (D)	Corrected Results (C ₁)
CO	-0.02%	-2.46%	-0.04%	-2.64%	-0.06	24.89	0.02%	0.18%	0.13
O ₂	0.38%	-0.34%	0.20%	-0.44%	0.07	9.86	0.18%	0.10%	5.41

* 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 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 ₁)	Zero Drift Assessment (D)	Upscale Drift Assessment (D)	Corrected Results (C ₁)
CO	-0.04%	-2.64%	-0.12%	-2.43%	-0.09	24.90	0.08%	0.20%	0.09
O ₂	0.20%	-0.44%	0.23%	-0.51%	0.06	9.85	0.03%	0.07%	5.33

* 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 ₁)	Zero Drift Assessment (D)	Upscale Drift Assessment (D)	Corrected Results (C ₁)
CO	-0.12%	-2.43%	-0.18%	-2.83%	-0.12	24.85	0.06%	0.39%	0.12
O ₂	0.23%	-0.51%	0.26%	-0.51%	0.06	9.84	0.04%	0.01%	5.38

* 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 ₁)	Zero Drift Assessment (D)	Upscale Drift Assessment (D)	Corrected Results (C ₁)
CO	-0.18%	-2.83%	-0.68%	-3.17%	-0.26	24.66	0.50%	0.35%	0.07
O ₂	0.26%	-0.51%	0.24%	-0.63%	0.06	9.83	0.02%	0.12%	5.39

* 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 ₁)	Zero Drift Assessment (D)	Upscale Drift Assessment (D)	Corrected Results (C ₁)
CO	-0.68%	-3.17%	-0.21%	-3.11%	-0.27	24.59	0.46%	0.07%	0.27
O ₂	0.24%	-0.63%	0.26%	-0.66%	0.06	9.81	0.02%	0.03%	5.56

* 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
Example Calculations

Erthwrks QAQC Example Calculations

Example Calculations for System QA: Run 1, FCCU CHarge Htr

Example Calculations for Pollutant: CO

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

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

$C_{Dir} = 26.19$ ppmv
 $C_V = 25.43$ ppmv
 $CS = 50.83$ ppmv
ACE = 1.49%

Initial Upscale System Bias, SB_i

Eq. 7E-2

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

$CS = 50.83$ ppmv
 $C_S = 25.74$ ppmv
 $C_{Dir} = 26.19$ ppmv
 $SB_i = -0.88\%$

Upscale Drift Assessment, D

Eq. 7E-4

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

$SB_i = -0.88\%$
 $SB_f = -1.66\%$
D = 0.77%

Effluent Gas Concentration, C_{Gas}

Eq. 7E-5

$$C_{Gas} = (C_{Avg} - C_0) \frac{C_{MA}}{C_M - C_0}$$

$C_{Avg} = 0.63$ ppmv
 $C_0 = 0.19$ ppmv
 $C_{MA} = 25.43$ ppmv
 $C_M = 25.54$ ppmv
 $C_{Gas} = 0.44$



Attachment D
Raw Data Log Records

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 8:05	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.45	20.82
6/8/22 8:06	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.38	20.81
6/8/22 8:07	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.39	20.80
6/8/22 8:08	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.34	20.78
6/8/22 8:09	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.52	2.60
6/8/22 8:10	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.66	-0.09
6/8/22 8:11	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.82	-0.09
6/8/22 8:12	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.90	-0.09
6/8/22 8:13	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.92	-0.08
6/8/22 8:14	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.04	0.00
6/8/22 8:15	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	-0.05	-0.01
6/8/22 8:16	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.01	5.17
6/8/22 8:17	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.14	11.89
6/8/22 8:18	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.46	12.44
6/8/22 8:19	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.58	12.55
6/8/22 8:20	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		13.92	10.51
6/8/22 8:21	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		3.49	3.61
6/8/22 8:22	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		3.72	1.55
6/8/22 8:23	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.12	5.90
6/8/22 8:24	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-1.92	12.59
6/8/22 8:25	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-2.22	12.59
6/8/22 8:26	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-2.13	12.59
6/8/22 8:27	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-2.19	12.59
6/8/22 8:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-1.15	19.66
6/8/22 8:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.04	19.91
6/8/22 8:29	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	0.06	19.90
6/8/22 8:30	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		16.31	9.71
6/8/22 8:31	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		52.38	0.01
6/8/22 8:32	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		53.66	0.01
6/8/22 8:33	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		53.64	0.01
6/8/22 8:34	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		53.48	0.00
6/8/22 8:35	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		53.12	0.00
6/8/22 8:36	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	50.90	0.00
6/8/22 8:37	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		27.96	6.58
6/8/22 8:38	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.36	9.94
6/8/22 8:38	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.99	9.93
6/8/22 8:39	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	0.90	9.93
6/8/22 8:40	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		8.51	2.52
6/8/22 8:40	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.22	0.01
6/8/22 8:41	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	26.19	0.01
6/8/22 8:42	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.30	2.81
6/8/22 8:43	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		6.71	6.16
6/8/22 8:44	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.76	9.82
6/8/22 8:45	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	0.27	9.87
6/8/22 8:46	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		2.04	6.38
6/8/22 8:47	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		20.49	0.14
6/8/22 8:48	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		25.70	0.08
6/8/22 8:49	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	25.74	0.07
6/8/22 8:50	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.84	2.90
6/8/22 8:51	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		4.67	5.49
6/8/22 8:52	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.91	5.47
6/8/22 8:53	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.71	5.52



Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 8:54	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.68	5.42
6/8/22 8:55	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.67	5.34
6/8/22 8:56	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.66	5.35
6/8/22 8:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.70	5.31
6/8/22 8:58	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.64	5.24
6/8/22 8:59	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.57	5.32
6/8/22 9:00	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.58	5.32
6/8/22 9:01	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.66	5.30
6/8/22 9:02	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.63	5.36
6/8/22 9:03	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.63	5.43
6/8/22 9:04	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.67	5.47
6/8/22 9:05	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.64	5.45
6/8/22 9:06	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.52	5.45
6/8/22 9:07	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.52	5.42
6/8/22 9:08	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.58	5.41
6/8/22 9:09	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.58	5.41
6/8/22 9:10	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.60	5.42
6/8/22 9:11	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.58	5.47
6/8/22 9:12	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 1	0.48	5.47
Run 1 Results						0.63	5.40
6/8/22 9:13	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		6.36	1.91
6/8/22 9:13	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		23.25	0.09
6/8/22 9:14	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	25.34	0.07
6/8/22 9:15	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.29	5.25
6/8/22 9:16	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		3.51	9.83
6/8/22 9:17	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	0.12	9.86
6/8/22 9:18	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.34	9.08
6/8/22 9:19	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.49	5.25
6/8/22 9:20	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.49	5.31
6/8/22 9:21	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.45	5.32
6/8/22 9:22	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.46	5.31
6/8/22 9:23	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.44	5.25
6/8/22 9:24	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.44	5.30
6/8/22 9:25	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.39	5.36
6/8/22 9:26	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.41	5.32
6/8/22 9:27	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.38	5.32
6/8/22 9:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.39	5.32
6/8/22 9:29	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.41	5.33
6/8/22 9:30	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.42	5.35
6/8/22 9:31	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.39	5.27
6/8/22 9:32	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.32	5.19
6/8/22 9:33	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.35	5.23
6/8/22 9:34	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.32	5.24
6/8/22 9:35	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.29	5.28
6/8/22 9:36	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.31	5.25
6/8/22 9:37	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.35	5.28
6/8/22 9:38	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.23	5.21
6/8/22 9:39	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.25	5.23
6/8/22 9:40	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.35	5.27
6/8/22 9:41	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 2	0.34	5.31
Run 2 Results						0.37	5.28



Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 9:42	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.80	8.84
6/8/22 9:43	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	0.17	9.87
6/8/22 9:44	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.30	7.79
6/8/22 9:45	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		14.44	0.23
6/8/22 9:45	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.67	0.11
6/8/22 9:46	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	25.18	0.09
6/8/22 9:47	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.82	2.47
6/8/22 9:48	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		4.01	5.22
6/8/22 9:48	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.53	5.26
6/8/22 9:49	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.41	5.28
6/8/22 9:50	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.36	5.35
6/8/22 9:51	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.26	5.28
6/8/22 9:52	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.28	5.34
6/8/22 9:53	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.31	5.29
6/8/22 9:54	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.29	5.35
6/8/22 9:55	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.30	5.36
6/8/22 9:56	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.28	5.19
6/8/22 9:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.22	5.05
6/8/22 9:58	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.18	5.03
6/8/22 9:59	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.18	5.23
6/8/22 10:00	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.25	5.38
6/8/22 10:01	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.21	5.34
6/8/22 10:02	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.24	5.31
6/8/22 10:03	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.19	5.12
6/8/22 10:04	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.13	5.10
6/8/22 10:05	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.14	5.10
6/8/22 10:06	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.21	5.10
6/8/22 10:07	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.22	5.23
6/8/22 10:08	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.17	5.22
6/8/22 10:09	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 3	0.21	5.17
					Run 3 Results	0.24	5.23
6/8/22 10:10	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		4.67	2.25
6/8/22 10:11	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.48	0.10
6/8/22 10:12	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	25.05	0.08
6/8/22 10:13	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.89	4.53
6/8/22 10:14	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		3.93	9.83
6/8/22 10:14	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.29	9.85
6/8/22 10:15	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	0.09	9.86
6/8/22 10:16	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.06	7.77
6/8/22 10:17	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.14	5.33
6/8/22 10:17	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.04	5.33
6/8/22 10:18	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.01	5.62
6/8/22 10:19	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.06	5.52
6/8/22 10:20	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.06	5.55
6/8/22 10:21	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.06	5.46
6/8/22 10:22	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.02	5.53
6/8/22 10:23	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.03	5.59
6/8/22 10:24	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.01	5.65
6/8/22 10:25	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.04	5.66



RECEIVED

AUG 01 2022

Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 10:26	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.00	5.61
6/8/22 10:27	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.03	5.53
6/8/22 10:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.11	5.44
6/8/22 10:29	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.06	5.42
6/8/22 10:30	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.02	5.43
6/8/22 10:31	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.02	5.39
6/8/22 10:32	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.04	5.29
6/8/22 10:33	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.05	5.31
6/8/22 10:34	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.00	5.28
6/8/22 10:35	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.01	5.20
6/8/22 10:36	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	0.05	5.20
6/8/22 10:37	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.02	5.15
6/8/22 10:38	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 4	-0.08	5.28
Run 4 Results						-0.01	5.43
6/8/22 10:39	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.02	4.61
6/8/22 10:40	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.38	6.42
6/8/22 10:41	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.18	6.49
6/8/22 10:42	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	-0.26	6.51
6/8/22 10:43	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		2.34	2.58
6/8/22 10:44	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		21.12	-1.10
6/8/22 10:45	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	24.94	-1.10
6/8/22 10:46	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.41	-1.10
6/8/22 10:47	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		3.75	-1.10
6/8/22 10:48	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.77	-0.71
6/8/22 10:49	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.81	0.01
6/8/22 10:50	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.84	0.02
6/8/22 10:51	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.83	0.01
6/8/22 10:52	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	0.90	0.01
6/8/22 10:53	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.38	14.15
6/8/22 10:53	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.71	19.92
6/8/22 10:54	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	-0.75	19.92
6/8/22 10:55	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.49	12.52
6/8/22 10:56	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.14	9.95
6/8/22 10:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Direct Cal	0.18	9.94
6/8/22 10:58	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		14.70	4.42
6/8/22 10:59	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		6.93	0.47
6/8/22 10:59	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.66	0.06
6/8/22 11:00	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	1.29	0.05
6/8/22 11:01	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		3.48	0.07
6/8/22 11:02	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		21.74	0.19
6/8/22 11:03	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		14.07	9.13
6/8/22 11:04	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	0.50	9.84
6/8/22 11:05	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.07	7.88
6/8/22 11:06	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.27	5.28
6/8/22 11:07	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	0.08	5.22
6/8/22 11:08	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.07	5.12
6/8/22 11:09	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.03	5.09
6/8/22 11:10	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.02	5.11
6/8/22 11:11	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.03	5.21
6/8/22 11:12	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.07	5.34
6/8/22 11:13	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.11	5.31



Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 11:14	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.11	5.23
6/8/22 11:15	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.12	5.20
6/8/22 11:16	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.13	5.13
6/8/22 11:17	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.14	5.27
6/8/22 11:18	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.18	5.41
6/8/22 11:19	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.15	5.31
6/8/22 11:20	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.12	5.25
6/8/22 11:21	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.10	5.22
6/8/22 11:22	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.20	5.35
6/8/22 11:23	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	-0.07	5.31
6/8/22 11:24	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	0.13	5.17
6/8/22 11:25	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	0.09	5.33
6/8/22 11:26	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	0.14	5.36
6/8/22 11:27	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 5	0.10	5.46
Run 5 Results						-0.05	5.26
6/8/22 11:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.33	8.11
6/8/22 11:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.31	9.86
6/8/22 11:29	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	-0.06	9.87
6/8/22 11:30	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.44	6.25
6/8/22 11:31	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		19.93	0.14
6/8/22 11:32	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.85	0.10
6/8/22 11:33	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	24.94	0.09
6/8/22 11:34	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		23.65	2.10
6/8/22 11:35	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		5.53	5.31
6/8/22 11:35	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.41	5.32
6/8/22 11:36	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.23	5.36
6/8/22 11:37	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.16	5.41
6/8/22 11:38	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.04	5.30
6/8/22 11:39	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.02	5.33
6/8/22 11:40	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.04	5.41
6/8/22 11:41	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.05	5.35
6/8/22 11:42	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.10	5.28
6/8/22 11:43	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.01	5.32
6/8/22 11:44	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.03	5.09
6/8/22 11:45	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.05	5.23
6/8/22 11:46	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.05	5.20
6/8/22 11:47	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.10	5.21
6/8/22 11:48	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.06	5.25
6/8/22 11:49	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.03	5.24
6/8/22 11:50	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.07	5.34
6/8/22 11:51	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.10	5.33
6/8/22 11:52	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.09	5.37
6/8/22 11:53	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.07	5.47
6/8/22 11:54	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.06	5.28
6/8/22 11:55	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.06	5.28
6/8/22 11:56	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 6	0.07	5.22
Run 6 Results						0.07	5.30
6/8/22 11:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.37	4.38
6/8/22 11:58	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		16.36	0.12
6/8/22 11:58	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.55	0.06



Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 11:59	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	24.85	0.05
6/8/22 12:00	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.32	4.79
6/8/22 12:01	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		3.32	9.79
6/8/22 12:01	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.04	9.84
6/8/22 12:02	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	-0.07	9.85
6/8/22 12:03	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.09	8.07
6/8/22 12:04	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.00	5.46
6/8/22 12:05	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.00	5.32
6/8/22 12:06	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.01	5.22
6/8/22 12:07	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.01	5.09
6/8/22 12:08	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.06	4.99
6/8/22 12:09	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.05	4.94
6/8/22 12:10	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.02	5.24
6/8/22 12:11	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.03	5.27
6/8/22 12:12	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.01	5.44
6/8/22 12:13	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.01	5.57
6/8/22 12:14	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.02	5.54
6/8/22 12:15	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.02	5.55
6/8/22 12:16	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.09	5.40
6/8/22 12:17	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.04	5.17
6/8/22 12:18	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.02	5.06
6/8/22 12:19	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.02	4.90
6/8/22 12:20	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.02	4.86
6/8/22 12:21	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.04	4.85
6/8/22 12:22	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.00	5.03
6/8/22 12:23	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.02	5.11
6/8/22 12:24	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	0.01	5.29
6/8/22 12:25	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.06	5.41
6/8/22 12:26	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 7	-0.05	5.47
					Run 7 Results	0.00	5.21
6/8/22 12:27	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.21	7.51
6/8/22 12:27	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.44	9.81
6/8/22 12:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	-0.11	9.84
6/8/22 12:29	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		2.38	5.21
6/8/22 12:30	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		21.40	0.11
6/8/22 12:30	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.83	0.07
6/8/22 12:31	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	24.95	0.06
6/8/22 12:32	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.99	0.16
6/8/22 12:33	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		13.72	4.80
6/8/22 12:34	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.62	5.18
6/8/22 12:35	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.09	5.25
6/8/22 12:36	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.08	5.30
6/8/22 12:37	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.09	5.16
6/8/22 12:38	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.06	5.03
6/8/22 12:39	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.01	4.90
6/8/22 12:40	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.01	4.82
6/8/22 12:41	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.01	4.91
6/8/22 12:42	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.00	5.19
6/8/22 12:43	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.04	5.49
6/8/22 12:44	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.03	5.73



Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 12:45	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.01	5.62
6/8/22 12:46	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.03	5.64
6/8/22 12:47	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.01	5.51
6/8/22 12:48	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.02	5.38
6/8/22 12:49	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	0.01	5.16
6/8/22 12:50	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.02	5.10
6/8/22 12:51	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.04	4.97
6/8/22 12:52	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.04	4.95
6/8/22 12:53	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.07	5.13
6/8/22 12:54	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.05	5.29
6/8/22 12:55	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.04	5.43
6/8/22 12:56	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 8	-0.08	5.61
Run 8 Results						0.00	5.25
6/8/22 12:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.44	7.68
6/8/22 12:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.11	9.81
6/8/22 12:58	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	-0.14	9.84
6/8/22 12:59	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.06	8.37
6/8/22 13:00	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		15.53	0.18
6/8/22 13:01	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.44	0.09
6/8/22 13:02	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	24.75	0.07
6/8/22 13:03	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.48	1.08
6/8/22 13:04	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		8.85	5.28
6/8/22 13:04	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.22	5.41
6/8/22 13:05	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.11	5.44
6/8/22 13:06	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.16	5.36
6/8/22 13:07	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.19	5.39
6/8/22 13:08	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.16	5.30
6/8/22 13:09	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.16	5.26
6/8/22 13:10	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.15	5.25
6/8/22 13:11	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.20	5.24
6/8/22 13:12	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.19	5.25
6/8/22 13:13	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.12	5.34
6/8/22 13:14	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.14	5.36
6/8/22 13:15	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.14	5.47
6/8/22 13:16	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.21	5.45
6/8/22 13:17	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.25	5.45
6/8/22 13:18	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.24	5.44
6/8/22 13:19	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.20	5.36
6/8/22 13:20	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.22	5.21
6/8/22 13:21	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.25	4.98
6/8/22 13:22	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.27	4.78
6/8/22 13:23	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.26	4.75
6/8/22 13:24	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.24	4.99
6/8/22 13:25	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 9	-0.24	5.31
Run 9 Results						-0.19	5.26
6/8/22 13:26	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		5.18	2.08
6/8/22 13:27	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		22.85	0.07
6/8/22 13:28	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	24.57	0.06
6/8/22 13:29	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.11	2.22
6/8/22 13:30	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		7.59	9.73

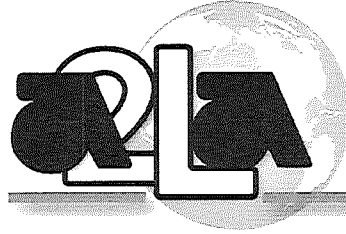


Erthwrks Datalog Records

TimeStamp	Project Number	Client	Facility	Unit	Test Period	CO	O ₂
6/8/22 13:31	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.12	9.80
6/8/22 13:32	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	-0.39	9.81
6/8/22 13:33	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.43	8.27
6/8/22 13:34	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.19	5.03
6/8/22 13:35	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.02	4.73
6/8/22 13:36	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.05	4.66
6/8/22 13:37	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.01	4.66
6/8/22 13:38	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.02	4.91
6/8/22 13:39	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.01	5.28
6/8/22 13:40	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.02	5.72
6/8/22 13:41	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.03	6.26
6/8/22 13:42	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.05	6.45
6/8/22 13:43	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.01	6.27
6/8/22 13:44	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.05	5.89
6/8/22 13:45	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.03	5.57
6/8/22 13:46	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.02	5.19
6/8/22 13:47	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.00	4.70
6/8/22 13:48	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.01	4.54
6/8/22 13:49	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.01	4.60
6/8/22 13:50	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.02	4.88
6/8/22 13:51	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.04	5.19
6/8/22 13:52	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	0.02	5.43
6/8/22 13:53	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.01	5.80
6/8/22 13:54	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.07	5.86
6/8/22 13:55	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.05	5.85
6/8/22 13:56	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Run 10	-0.08	5.88
Run 10 Results						-0.01	5.41
6/8/22 13:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.32	8.43
6/8/22 13:57	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		0.17	9.80
6/8/22 13:58	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	-0.16	9.81
6/8/22 13:59	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.21	9.81
6/8/22 14:00	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.24	9.81
6/8/22 14:01	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.22	9.82
6/8/22 14:02	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.14	9.82
6/8/22 14:03	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.15	9.83
6/8/22 14:04	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.17	9.82
6/8/22 14:05	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.17	9.82
6/8/22 14:06	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.19	9.82
6/8/22 14:07	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		-0.17	9.81
6/8/22 14:08	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		1.45	6.10
6/8/22 14:09	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		19.82	0.13
6/8/22 14:10	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.61	0.08
6/8/22 14:11	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr		24.62	0.07
6/8/22 14:12	9049.1.B4	Marathon	Detroit	FCCU CHarge Htr	Sys Bias	24.61	0.07



Attachment E
Calibrations and Certifications



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.

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

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

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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

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

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

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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

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

Attachment F
CEMS and Operational Data

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge	FCCU Fuel Gas	Disulfide Off Gas	O2	CO
		Heater(BPD)	Flow(MSCFD)	Flow(MSCFD)	11AI0026	11AI0909
		11FC0118	11FI0971	11FI0957	%	ppm
	6/8/2022 8:52	40978	2507.934232	105.4715471	5.12	1.66
	6/8/2022 8:53	40977	2507.669989	105.4717721	5.20	1.70
	6/8/2022 8:54	40965	2507.405745	105.4719971	5.08	1.70
	6/8/2022 8:55	40967	2507.141501	105.4722221	5.04	1.79
	6/8/2022 8:56	40976	2506.877257	105.4724471	5.00	1.83
	6/8/2022 8:57	40971	2506.613013	105.4726721	4.95	1.85
	6/8/2022 8:58	40983	2506.348769	105.4728971	4.93	1.78
	6/8/2022 8:59	41001	2506.084525	105.4731221	4.99	1.57
	6/8/2022 9:00	41005	2505.820281	105.473347	4.98	1.80
	6/8/2022 9:01	41005	2504.629598	105.473572	4.98	1.65
	6/8/2022 9:02	41036	2498.652816	105.473797	5.04	1.82
	6/8/2022 9:03	40993	2493.161381	105.474022	5.00	1.77
1	6/8/2022 9:04	41044	2493.699263	105.474247	5.00	1.76
	6/8/2022 9:05	41020	2495.09584	105.474472	5.00	1.76
	6/8/2022 9:06	41016	2496.492417	105.474697	5.13	1.73
	6/8/2022 9:07	41031	2497.888994	105.474922	5.13	1.64
	6/8/2022 9:08	41042	2499.285571	105.475147	5.08	1.71
	6/8/2022 9:09	41033	2500.682147	105.475372	5.13	1.67
	6/8/2022 9:10	41040	2502.078724	105.475597	5.09	1.78
	6/8/2022 9:11	41018	2503.475301	105.475822	5.16	1.76
	6/8/2022 9:12	41035	2505.998967	105.476047	5.17	1.83
	6/8/2022 9:13					
	Run average	41006	2502.53	105.47	5.06	1.74

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge Heater(BPD) 11FC0118	FCCU Fuel Gas Flow(MSCFD) 11FI0971	Disulfide Off Gas Flow(MSCFD) 11FI0957	O2	CO
					11AI0026 %	11AI0909 ppm
	6/8/2022 9:21	41030	2510.704907	105.4780719	5.17	1.83
	6/8/2022 9:22	41044	2505.057034	105.4782969	5.12	1.81
	6/8/2022 9:23	41012	2499.409162	105.4785219	5.13	1.75
	6/8/2022 9:24	41004	2495.338538	105.4787469	5.23	1.72
	6/8/2022 9:25	41006	2495.788983	105.4789719	5.23	1.69
	6/8/2022 9:26	41014	2496.520405	105.4791969	5.17	1.86
	6/8/2022 9:27	41028	2497.251828	105.479375	5.17	1.80
	6/8/2022 9:28	41023	2497.98325	105.4755919	5.25	1.82
	6/8/2022 9:29	40983	2498.717911	105.4692743	5.13	1.75
	6/8/2022 9:30	40974	2502.105508	105.4629566	5.24	1.72
	6/8/2022 9:31	40974	2507.79729	105.456639	5.12	1.72
	6/8/2022 9:32	40987	2513.48498	105.4503214	5.04	1.79
2	6/8/2022 9:33	40992	2515.762568	105.4440037	5.14	1.81
	6/8/2022 9:34	40988	2515.074766	105.4376861	5.07	1.74
	6/8/2022 9:35	40965	2514.386965	105.4313685	5.15	1.70
	6/8/2022 9:36	40983	2513.699163	105.4250509	5.12	1.68
	6/8/2022 9:37	40982	2513.011361	105.4187332	5.15	1.78
	6/8/2022 9:38	40983	2512.323559	105.4124156	5.05	1.81
	6/8/2022 9:39	40976	2511.635758	105.406098	5.11	1.75
	6/8/2022 9:40	40990	2510.947956	105.3997803	5.11	1.74
	6/8/2022 9:41	40964	2510.260154	105.3934627	5.17	1.73
	6/8/2022 9:42					
	Run average	40995	2506.54	105.45	5.15	1.76

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge	FCCU Fuel Gas	Disulfide Off Gas	O2	CO
		Heater(BPD)	Flow(MSCFD)	Flow(MSCFD)	11AI0026	11AI0909
		11FC0118	11FI0971	11FI0957	%	ppm
	6/8/2022 9:49	40921	2495.993566	105.3429217	5.17	1.75
	6/8/2022 9:50	40956	2493.833211	105.336604	5.26	1.81
	6/8/2022 9:51	40947	2491.675061	105.3302864	5.20	1.77
	6/8/2022 9:52	40942	2491.395251	105.3239688	5.19	1.74
	6/8/2022 9:53	40930	2492.751319	105.3176512	5.17	1.74
	6/8/2022 9:54	40929	2494.107388	105.3113335	5.23	1.73
	6/8/2022 9:55	40981	2498.677607	105.3050159	5.27	1.72
	6/8/2022 9:56	41021	2507.121779	105.2986983	5.10	1.80
	6/8/2022 9:57	41013	2512.988356	105.2923806	4.96	1.85
	6/8/2022 9:58	41045	2514.526751	105.286063	4.85	1.83
	6/8/2022 9:59	41015	2512.111944	105.2797454	5.09	1.82
	6/8/2022 10:00	41026	2511.973601	105.2734278	5.24	1.74
3	6/8/2022 10:01	41021	2512.106084	105.2671101	5.24	1.75
	6/8/2022 10:02	41014	2512.238568	105.2607925	5.21	1.76
	6/8/2022 10:03	41023	2512.371052	105.2544749	5.05	1.75
	6/8/2022 10:04	41007	2512.503536	105.2481572	5.00	1.76
	6/8/2022 10:05	41017	2512.63602	105.2418396	5.04	1.75
	6/8/2022 10:06	41024	2511.23611	105.235522	5.00	1.78
	6/8/2022 10:07	41054	2507.920394	105.2292043	5.14	1.73
	6/8/2022 10:08	41046	2507.512783	105.2228867	5.08	1.78
	6/8/2022 10:09	41003	2507.526524	105.2165691	5.11	1.81
	6/8/2022 10:10					
	Run average	40997	2505.39	105.28	5.12	1.77

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge Heater(BPD) 11FC0118	FCCU Fuel Gas Flow(MSCFD) 11FI0971	Disulfide Off Gas Flow(MSCFD) 11FI0957	O2	CO
					11AI0026 %	11AI0909 ppm
	6/8/2022 10:19	41024	2506.916844	105.1533928	5.14	1.67
	6/8/2022 10:20	41007	2506.808516	105.1470752	5.11	1.71
	6/8/2022 10:21	41038	2506.700188	105.1407575	5.16	1.76
	6/8/2022 10:22	41064	2506.591861	105.1344399	5.12	1.81
	6/8/2022 10:23	41041	2506.483533	105.1281223	5.27	1.82
	6/8/2022 10:24	41037	2506.375206	105.1218047	5.22	1.79
	6/8/2022 10:25	41010	2506.266878	105.115487	5.33	1.71
	6/8/2022 10:26	41010	2506.15855	105.1091694	5.26	1.74
	6/8/2022 10:27	41006	2506.34025	105.1028518	5.36	1.66
	6/8/2022 10:28	41039	2509.558726	105.0965341	5.26	1.82
	6/8/2022 10:29	41031	2511.354776	105.0902165	5.18	1.77
	6/8/2022 10:30	41023	2512.064351	105.0838989	5.22	1.75
4	6/8/2022 10:31	41018	2512.773927	105.0775812	5.17	1.71
	6/8/2022 10:32	40999	2513.483502	105.0712636	5.17	1.76
	6/8/2022 10:33	40995	2514.193077	105.064946	5.18	1.72
	6/8/2022 10:34	40974	2514.901275	105.0586284	5.15	1.73
	6/8/2022 10:35	41003	2514.511325	105.0523107	5.10	1.82
	6/8/2022 10:36	41026	2513.169403	105.0459931	5.10	1.78
	6/8/2022 10:37	41017	2511.82748	105.0396755	5.09	1.72
	6/8/2022 10:38	41015	2510.485558	105.0333578	5.09	1.74
	6/8/2022 10:39	41036	2509.143635	105.0270402	5.11	1.71
	6/8/2022 10:40					
	Run average	41020	2509.81	105.09	5.18	1.75

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge Heater(BPD) 11FC0118	FCCU Fuel Gas Flow(MSCFD) 11FI0971	Disulfide Off Gas Flow(MSCFD) 11FI0957	O2	CO
					11AI0026 %	11AI0909 ppm
	6/8/2022 11:07	40980	2500.487717	104.8501466	5.10	1.77
	6/8/2022 11:08	40991	2500.481772	104.843829	4.98	1.81
	6/8/2022 11:09	41011	2500.371765	104.8375113	5.00	1.75
	6/8/2022 11:10	40990	2500.261759	104.8311937	5.02	1.73
	6/8/2022 11:11	40996	2500.151753	104.8248761	5.07	1.72
	6/8/2022 11:12	41002	2500.041747	104.8185585	5.26	1.70
	6/8/2022 11:13	41037	2499.931741	104.8122408	5.18	1.75
	6/8/2022 11:14	41018	2499.821735	104.8059232	5.10	1.79
	6/8/2022 11:15	41009	2499.711729	104.7996056	5.11	1.79
	6/8/2022 11:16	41001	2499.550698	104.7932879	5.01	1.80
	6/8/2022 11:17	41012	2498.836509	104.7869703	5.19	1.75
	6/8/2022 11:18	41043	2497.971308	104.7806527	5.29	1.74
5	6/8/2022 11:19	41007	2497.104112	104.774335	5.18	1.69
	6/8/2022 11:20	41011	2494.451382	104.7680174	5.18	1.75
	6/8/2022 11:21	41007	2490.238253	104.7616998	5.11	1.76
	6/8/2022 11:22	41008	2487.708696	104.7553822	5.19	1.75
	6/8/2022 11:23	41027	2487.929924	104.7490645	5.25	1.71
	6/8/2022 11:24	41051	2488.190383	104.7427469	5.08	1.76
	6/8/2022 11:25	41025	2488.450841	104.7364293	5.23	1.70
	6/8/2022 11:26	40998	2488.711299	104.7301116	5.25	1.74
	6/8/2022 11:27	41026	2487.973187	104.723794	5.35	1.75
	6/8/2022 11:28					
	Run average	41012	2495.64	104.79	5.15	1.75

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge Heater(BPD) 11FC0118	FCCU Fuel Gas Flow(MSCFD) 11FI0971	Disulfide Off Gas Flow(MSCFD) 11FI0957	O2	CO
					11AI0026 %	11AI0909 ppm
	6/8/2022 11:36	41033	2492.568664	104.6669354	5.26	1.74
	6/8/2022 11:37	41036	2493.691608	104.6606177	5.34	1.78
	6/8/2022 11:38	41024	2494.814552	104.6543001	5.19	1.81
	6/8/2022 11:39	41017	2495.937496	104.6479825	5.27	1.74
	6/8/2022 11:40	41027	2497.06044	104.6416648	5.36	1.69
	6/8/2022 11:41	41007	2498.183384	104.6353472	5.21	1.78
	6/8/2022 11:42	41032	2499.306328	104.6290296	5.19	1.83
	6/8/2022 11:43	41042	2500.429272	104.6227119	5.13	1.83
	6/8/2022 11:44	41035	2501.522419	104.6163943	5.00	1.78
	6/8/2022 11:45	41023	2500.04695	104.6100767	5.14	1.75
	6/8/2022 11:46	41006	2496.919993	104.6037591	5.08	1.75
	6/8/2022 11:47	41010	2493.793035	104.5974414	5.08	1.70
6	6/8/2022 11:48	40996	2490.666077	104.5911238	5.15	1.70
	6/8/2022 11:49	41009	2487.539119	104.5848062	5.13	1.75
	6/8/2022 11:50	40995	2484.412162	104.5784885	5.24	1.78
	6/8/2022 11:51	41006	2481.285204	104.5721709	5.26	1.77
	6/8/2022 11:52	41016	2478.158246	104.5658533	5.29	1.74
	6/8/2022 11:53	41005	2477.023938	104.5595357	5.36	1.74
	6/8/2022 11:54	40993	2478.297951	104.553218	5.19	1.82
	6/8/2022 11:55	41023	2479.577247	104.5469004	5.16	1.73
	6/8/2022 11:56	41013	2480.106902	104.5405828	5.10	1.73
	6/8/2022 11:57					
	Run average	41017	2490.54	104.60	5.20	1.76

RECEIVED

AUG 01 2022

AIR QUALITY DIVISION

CEMS/PROCESS DATA

FCC Charge Heater

					O2	CO
		Feed to Charge Heater(BPD)	FCCU Fuel Gas Flow(MSCFD)	Disulfide Off Gas Flow(MSCFD)	11AI0026	11AI0909
Run #	Date/Time	11FC0118	11FI0971	11FI0957	%	ppm
	6/8/2022 12:06	40962	2504.159014	104.4774065	5.10	1.77
	6/8/2022 12:07	40945	2515.637155	104.4710889	4.93	1.80
	6/8/2022 12:08	40934	2517.98046	104.4647712	4.91	1.77
	6/8/2022 12:09	40941	2515.895688	104.4584536	4.94	1.81
	6/8/2022 12:10	40947	2511.363346	104.452136	5.16	1.75
	6/8/2022 12:11	40928	2504.683994	104.4447081	5.27	1.74
	6/8/2022 12:12	40922	2498.010116	104.3391361	5.44	1.73
	6/8/2022 12:13	40974	2496.621967	104.1701046	5.45	1.69
	6/8/2022 12:14	40993	2499.876372	104.0010731	5.49	1.75
	6/8/2022 12:15	40966	2504.332533	103.8320415	5.45	1.76
	6/8/2022 12:16	40986	2521.143981	103.66301	5.22	1.77
	6/8/2022 12:17	41006	2533.191828	103.4977594	5.06	1.78
7	6/8/2022 12:18	41008	2542.94328	103.4584213	4.94	1.80
	6/8/2022 12:19	41029	2550.571444	103.4803403	4.77	1.85
	6/8/2022 12:20	41012	2541.973106	103.5022593	4.77	1.84
	6/8/2022 12:21	40994	2521.725559	103.5241782	4.81	1.81
	6/8/2022 12:22	40985	2499.073192	103.5460972	4.96	1.81
	6/8/2022 12:23	40979	2483.952204	103.5680162	5.09	1.72
	6/8/2022 12:24	41009	2471.184821	103.5899351	5.22	1.75
	6/8/2022 12:25	41031	2463.726037	103.6118541	5.35	1.73
	6/8/2022 12:26	41039	2463.727461	103.6337731	5.39	1.69
	6/8/2022 12:27					
	Run average	40980	2507.70	103.91	5.13	1.77

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge	FCCU Fuel Gas	Disulfide Off Gas	O2	CO
		Heater(BPD)	Flow(MSCFD)	Flow(MSCFD)	11AI0026	11AI0909
		11FC0118	11FI0971	11FI0957	%	ppm
	6/8/2022 12:36	41063	2492.840279	103.8529627	5.24	1.68
	6/8/2022 12:37	41034	2505.182994	103.8748817	5.04	1.67
	6/8/2022 12:38	41047	2516.809741	103.8968007	4.95	1.70
	6/8/2022 12:39	41031	2514.930497	103.9187196	4.75	1.79
	6/8/2022 12:40	41048	2501.688418	103.9406386	4.75	1.82
	6/8/2022 12:41	41036	2473.082975	103.9625576	4.92	1.79
	6/8/2022 12:42	41001	2449.355761	103.9844765	5.22	1.74
	6/8/2022 12:43	41019	2437.301762	104.0063955	5.47	1.69
	6/8/2022 12:44	41042	2435.562507	104.0283145	5.69	1.64
	6/8/2022 12:45	41056	2448.10369	104.0502334	5.56	1.66
	6/8/2022 12:46	41030	2470.016295	104.0721524	5.51	1.68
	6/8/2022 12:47	41024	2489.257208	104.0940714	5.41	1.69
8	6/8/2022 12:48	40984	2514.215667	104.1159904	5.23	1.59
	6/8/2022 12:49	40945	2520.212761	104.1379093	5.00	1.62
	6/8/2022 12:50	40987	2523.629856	104.1598283	4.99	1.64
	6/8/2022 12:51	40963	2521.863264	104.1817473	4.90	1.71
	6/8/2022 12:52	40949	2515.109404	104.2036662	4.95	1.72
	6/8/2022 12:53	40970	2495.230169	104.2255852	5.16	1.66
	6/8/2022 12:54	40972	2476.628321	104.2475042	5.23	1.65
	6/8/2022 12:55	40976	2465.615831	104.2694231	5.44	1.61
	6/8/2022 12:56	40978	2461.582436	104.2913421	5.50	1.64
	6/8/2022 12:57					
	Run average	41007	2487.06	104.07	5.19	1.69

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge Heater(BPD) 11FC0118	FCCU Fuel Gas Flow(MSCFD) 11FI0971	Disulfide Off Gas Flow(MSCFD) 11FI0957	O2	CO
					11AI0026 %	11AI0909 ppm
	6/8/2022 13:05	40998	2474.218056	104.4886128	4.97	1.69
	6/8/2022 13:06	40976	2474.633588	104.5105318	5.26	1.63
	6/8/2022 13:07	40958	2479.101176	104.5324507	5.29	1.64
	6/8/2022 13:08	40979	2485.56288	104.5543697	5.31	1.65
	6/8/2022 13:09	40988	2491.966615	104.5762887	5.21	1.66
	6/8/2022 13:10	40998	2492.805437	104.5982076	5.15	1.64
	6/8/2022 13:11	41005	2489.980661	104.6201266	5.20	1.66
	6/8/2022 13:12	41006	2487.155884	104.6420456	5.19	1.71
	6/8/2022 13:13	41016	2483.724309	104.6639645	5.25	1.71
	6/8/2022 13:14	41002	2477.900956	104.6858835	5.29	1.63
	6/8/2022 13:15	41004	2471.833158	104.7078025	5.32	1.66
	6/8/2022 13:16	41001	2466.603898	104.7297214	5.36	1.67
9	6/8/2022 13:17	41015	2467.692998	104.7516404	5.43	1.68
	6/8/2022 13:18	41017	2473.454652	104.7735594	5.42	1.70
	6/8/2022 13:19	41013	2484.834053	104.7954783	5.40	1.67
	6/8/2022 13:20	41035	2496.299955	104.8173973	5.20	1.70
	6/8/2022 13:21	41049	2506.811372	104.8393163	4.95	1.75
	6/8/2022 13:22	41054	2511.831974	104.8612352	4.77	1.74
	6/8/2022 13:23	41033	2504.315026	104.8831542	4.64	1.85
	6/8/2022 13:24	41009	2473.360991	104.9050732	4.78	1.82
	6/8/2022 13:25	41010	2448.301995	104.9269921	5.11	1.83
	6/8/2022 13:26					
	Run average	41008	2482.97	104.71	5.17	1.70

CEMS/PROCESS DATA

FCC Charge Heater

Run #	Date/Time	Feed to Charge Heater(BPD) 11FC0118	FCCU Fuel Gas Flow(MSCFD) 11FI0971	Disulfide Off Gas Flow(MSCFD) 11FI0957	O2	CO
					11AI0026 %	11AI0909 ppm
	6/8/2022 13:36	40980	2466.394115	105.1679274	4.52	1.84
	6/8/2022 13:37	41002	2426.416143	105.1733883	4.67	1.81
	6/8/2022 13:38	40997	2387.748127	105.1681781	4.96	1.80
	6/8/2022 13:39	40995	2350.096626	105.162968	5.34	1.74
	6/8/2022 13:40	41022	2319.54632	105.1577579	5.90	1.68
	6/8/2022 13:41	41072	2321.565237	105.1525477	6.22	1.60
	6/8/2022 13:42	41066	2371.613003	105.1473376	6.37	1.53
	6/8/2022 13:43	41056	2427.492781	105.1421274	6.10	1.57
	6/8/2022 13:44	41035	2485.444843	105.1369173	5.68	1.63
	6/8/2022 13:45	41027	2536.809423	105.1317072	5.34	1.64
	6/8/2022 13:46	41032	2573.795779	105.126497	4.90	1.80
	6/8/2022 13:47	41045	2583.271618	105.1212869	4.51	1.87
10	6/8/2022 13:48	41037	2569.250861	105.1160768	4.46	1.93
	6/8/2022 13:49	41007	2521.054702	105.1108666	4.60	1.91
	6/8/2022 13:50	40989	2480.275205	105.1056565	4.90	1.83
	6/8/2022 13:51	40983	2451.789044	105.1004463	5.20	1.70
	6/8/2022 13:52	40994	2425.950117	105.0952362	5.52	1.73
	6/8/2022 13:53	41002	2412.961402	105.0900261	5.72	1.66
	6/8/2022 13:54	41003	2412.198464	105.0848159	5.75	1.63
	6/8/2022 13:55	41004	2419.860057	105.0796058	5.83	1.62
	6/8/2022 13:56	40979	2443.217749	105.0743957	5.79	1.61
	6/8/2022 13:57					
	Run average	41016	2446.99	105.13	5.35	1.72

