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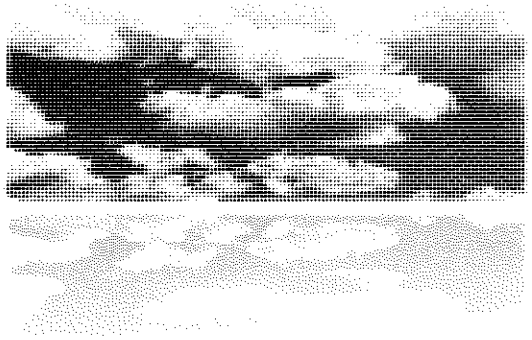

REPORT ON COMPLIANCE & RATA TESTING

Detroit Refinery
Coker Heater Stack

Marathon Petroleum Company LP
1300 South Fort Street
Detroit, MI 48217
Client Reference No. 4101004604

CleanAir Project No. 13362-1
STAC Certificate No. 2007.002.0113.1217
Revision 0, Final Report
October 23, 2017

1. PROJECT OVERVIEW

Test Program Summary

Marathon Petroleum Company LP (MPC) contracted CleanAir Engineering (CleanAir) to successfully complete testing at the Coker Heater (EU70-COKERHTR-S1) at the Detroit Refinery located in Detroit, Michigan. The test program included the following objectives:

- Perform particulate matter (PM), volatile organic compounds (VOCs) and sulfuric acid (H_2SO_4) testing to demonstrate compliance with the Michigan Department of Environmental Quality (DEQ) Permit No. MI-ROP-A9831-2012c.
- Perform a relative accuracy test audit (RATA) on the facility's continuous emissions monitoring system (CEMS) for oxygen (O_2) and nitrogen oxides (NO_X).

A summary of the test program results is presented below. Section 2 Results provides a more detailed account of the test conditions and data analysis. Test program information, including the test parameters, on-site schedule and a project discussion, begins on page 2.

Table 1-1:
Summary of Compliance Results

Source Constituent	Sampling Method	Average Emission	Permit Limit[1]
Coker Heater Stack			
PM (lb/MMBtu)	USEPA 5	0.0009	0.0019
PM_{10} (lb/MMBtu)	USEPA 5 / 202	0.0038	0.0076
NSFPM (lb/MMBtu)	USEPA 5B	0.0005	N/A
H_2SO_4 (lb/MMBtu)	ASTM Draft CCM	0.0010	N/A
VOC (lb/MMBtu)	USEPA 18 / 25A	< 0.0007	0.0055

[1] Permit limits obtained from MDEQ Renewable Operation Permit No. MI-ROP-A9831-2012c.

Table 1-2:
Summary of RATA Results

Source Constituent (Units)	Reference Method	Relative Accuracy (%)[1]	Applicable Specification	Specification Limit[2]
Coker Heater Stack				
O_2 (% dv)	USEPA 3A	0.18	PS3	±1.0% of RM
NO_X (lb/MMBtu)	USEPA 7E / 3A / 19	6.0	PS2	20% of RM
NO_X (ppmdv @0%O2)	USEPA 7E / 3A	2.7	PS2	20% of RM

[1] Relative Accuracy is expressed in terms of comparison to the reference method (% RM).

[2] Specification limits obtained from 40 CFR 60, Appendix B, Performance Specifications.

Schedule

Testing was performed on September 12 and 13, 2017. The on-site schedule followed during the test program is outlined in Table 1-3.

Table 1-3:
Test Schedule

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	Coker Heater Stack	USEPA Method 5/202	FPM/CPM	09/12/17	08:40	10:53
2	Coker Heater Stack	USEPA Method 5/202	FPM/CPM	09/12/17	11:44	13:57
3	Coker Heater Stack	USEPA Method 5/202	FPM/CPM	09/12/17	14:48	16:59
1	Coker Heater Stack	USEPA Method 5B	NSFPM	09/12/17	08:40	10:53
2	Coker Heater Stack	USEPA Method 5B	NSFPM	09/12/17	11:44	13:57
3	Coker Heater Stack	USEPA Method 5B	NSFPM	09/12/17	14:48	16:59
1	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	08:47	09:08
2	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	09:17	09:38
3	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	09:47	10:08
4	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	10:22	10:43
5	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	10:52	11:13
6	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	11:25	11:46
7	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	12:02	12:23
8	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	12:37	12:58
9	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	13:08	13:29
10	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	13:43	14:04
11	Coker Heater Stack	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/12/17	14:13	14:34
1	Coker Heater Stack	USEPA Method 25A/18	VOC	09/12/17	08:47	10:08
2	Coker Heater Stack	USEPA Method 25A/18	VOC	09/12/17	10:22	11:46
3	Coker Heater Stack	USEPA Method 25A/18	VOC	09/12/17	13:08	14:34
0	Coker Heater Stack	Draft ASTM CCM	Sulfuric Acid	09/13/17	08:09	09:09
1	Coker Heater Stack	Draft ASTM CCM	Sulfuric Acid	09/13/17	09:33	10:33
2	Coker Heater Stack	Draft ASTM CCM	Sulfuric Acid	09/13/17	11:01	12:01
3	Coker Heater Stack	Draft ASTM CCM	Sulfuric Acid	09/13/17	12:25	13:25

Discussion

Test Scope Synopsis

FPM & PM_{10} Testing

A total of three (3) 120-minute EPA Method 5/202 test runs were performed. FPM/CPM emission results were calculated in units of pounds per million Btu (lb/MMBtu). The final result was expressed as the average of the three (3) valid runs.

PM_{10} is assumed equivalent to the sum of FPM less than 10 micrometers (µm) in diameter (FPM_{10}) and CPM. The Method 5/202 sample train yields a front-half, FPM result and a back-half, CPM result. The total PM result (FPM plus CPM) from Method 5/202 can be used as a worst-case estimation of total PM_{10} since Method 5 collects all FPM present in the flue gas (regardless of particle size).

NSFPM Testing

A total of three (3) 120-minute EPA Method 5B test runs were performed for diagnostic purposes. NSFPM emission results were calculated in units of pounds per million Btu (lb/MMBtu). The final result was expressed as the average of the three (3) valid runs.

O_2 & NO_X RATA Testing

Minute-average data points for O_2 and NO_X (dry basis) were collected over a period of 21 minutes for each run utilizing EPA Methods 3A and 7E. Relative accuracy was determined based on nine (9) of eleven (11) total runs conducted per procedures outlined in Performance Specification (PS) 2, Section 8.4.4. Run 5 was not included in the final results and deemed invalid. For a portion of Run 5, MPC data acquisition malfunctioned and did not record data.

Sampling occurred at the three (3) points as specified in Section 8.1.3.2 of PS 2 during each run. The average result for each run was converted to identical units of measurement as the facility CEMs and compared for relative accuracy.

VOC Testing

VOC emissions were determined using EPA Method 25A to quantify THC emissions and EPA Method 18 to quantify methane (CH_4) and ethane (C_2H_6) emissions. VOC emissions are assumed equivalent to THC emissions minus CH_4 and C_2H_6.

Nine (9) 21-minute Method 25A test runs were performed concurrently with three (3) 63-minute Method 18 bag collections. Method 25A Runs 1 through 3 were concurrent with Method 18 Run 1. Method 25A Runs 4 through 6 were concurrent with Method 18 Run 2. Method 25A Runs 9 through 11 were concurrent with Method 18 Run 3. The final result for each VOC run was expressed as the average of three (3) consecutive 21-minute runs. Other CEMS methods referencing Method 7E were performed simultaneously using the same sampling system. Data was collected from all of the required Method 7E points rather than from the centroid of the duct as specified by Method 25A.

THC, CH_4 and C_2H_6 emission results were calculated in units of lb/MMBtu as propane. THC data was converted from an actual (wet) basis to a dry basis using moisture data collected from averaging overlapping Method 5/202 runs.

For multiple 21-minute Method 25A runs, the measured concentrations of THC were below the detection limit defined as 'less than 1%' of the calibration span of THC instrument. For all runs, C_2H_6 was below analytical detection limits. For runs resulting in non-detects, the final result is treated as 'less than' the entire value of the detection limit. Assuming worst-case scenario, if the resultant VOC emissions are less than the defined THC detection limit then they are reported as 'less than' the defined THC detection limit corrected to dry conditions.

H_2SO_4 Testing

H_2SO_4 emissions were determined referencing the Draft ASTM Controlled Condensation Method (CCM).

Three (3) 60-minute Draft ASTM CCM test runs were performed. H_2SO_4 emission results were calculated in units of lb/MMBtu. The final results were expressed as the average of three (3) valid runs.

Prior to the first official test run, a 60-minute sample conditioning run (Run 0) was performed in order to minimize the absorption capacity of the front-half components of the sample train (upstream of the H_2SO_4-collecting portion of the sample train). The conditioning run was recovered in the same manner as the official test runs, but the condenser rinse and SAM filter were not analyzed.

Fuel Analysis

Emission results in units of dry volume-based concentration (lb/dscf, ppmdv) were converted into units of pound per million Btu (lb/MMBtu) by calculating an oxygen-based fuel factor (F_d) for refinery gas per EPA Method 19 specifications. The F_d factor was calculated from percent volume composition analytical data provided by MPC and tabulated heating values for each of the measured constituents.

Test Conditions

The unit was operated at the maximum normal operating capacity during each of the emissions compliance test runs and no less than 50% of the maximum normal operating capacity during RATA test runs. MPC was responsible for logging any relevant process-related data and providing it to CleanAir for inclusion in the test reports.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices, specifically Appendix C Parameters.

Table 2-1:
Coker Heater Stack – PM & PM$_{10}$ Emissions

Run No.		**1**	**2**	**3**	**Average**
Date (2017)		Sep 12	Sep 12	Sep 12	
Start Time (approx.)		08:40	11:44	14:48	
Stop Time (approx.)		10:53	13:57	16:59	
Process Conditions					
P_2	Charge rate (bpd)	40,100	40,100	40,100	**40,100**
F_d	Oxygen-based F-factor (dscf/MMBtu)	8,338	8,338	8,338	
H_i	Actual heat input (MMBtu/hr)	233	235	229	**232**
Gas Conditions					
O_2	Oxygen (dry volume %)	5.1	5.2	5.2	**5.2**
CO_2	Carbon dioxide (dry volume %)	9.4	9.3	9.2	**9.3**
T_s	Sample temperature (°F)	391	393	392	**392**
B_w	Actual water vapor in gas (% by volume)	14.9	14.6	14.4	**14.6**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	95,700	96,400	97,700	**96,600**
Q_s	Volumetric flow rate, standard (scfm)	59,100	59,400	60,300	**59,600**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	50,300	50,800	51,600	**50,900**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	67.62	66.60	67.19	**67.14**
%I	Isokinetic sampling (%)	104.5	102.0	101.3	**102.6**
Laboratory Data					
m_{FPM}	Total FPM (g)	0.00265	0.00267	0.00227	
m_{CPM}	Total CPM (g)	0.00872	0.00744	0.00742	
m_{Part}	Total particulate matter (as PM$_{10}$) (g)	0.01137	0.01011	0.00969	
FPM Results					
C_{sd}	Particulate Concentration (lb/dscf)	8.64E-08	8.84E-08	7.45E-08	**8.31E-08**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.261	0.269	0.230	**0.254**
E_{Fd}	Particulate Rate - F_d-based (lb/MMBtu)	0.000953	0.000981	0.000827	**0.000920**
CPM Results					
C_{sd}	Particulate Concentration (lb/dscf)	2.84E-07	2.46E-07	2.44E-07	**2.58E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.859	0.751	0.754	**0.788**
E_{Fd}	Particulate Rate - F_d-based (lb/MMBtu)	0.00314	0.00274	0.00270	**0.00286**
Total Particulate Matter (as PM$_{10}$) Results					
C_{sd}	Particulate Concentration (lb/dscf)	3.71E-07	3.35E-07	3.18E-07	**3.41E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)	1.12	1.02	0.984	**1.04**
E_{Fd}	Particulate Rate - F_d-based (lb/MMBtu)	0.00409	0.00372	0.00353	**0.00378**

Table 2-2:
Coker Heater Stack – O_2 (% dv) RATA

Run No.	Start Time	Date (2017)	RM Data (%dv)	CEMS Data (%dv)	Difference (%dv)	Difference Percent
1	08:47	Sep 12	4.88	4.97	-0.09	-1.8%
2	09:17	Sep 12	4.82	5.01	-0.19	-3.9%
3 *	09:47	Sep 12	4.80	5.02	-0.22	-4.6%
4	10:22	Sep 12	4.83	4.99	-0.16	-3.3%
5 *	10:52	Sep 12	4.83	5.02	-0.19	-3.9%
6	11:25	Sep 12	4.82	5.00	-0.18	-3.7%
7	12:02	Sep 12	4.70	4.86	-0.16	-3.4%
8	12:37	Sep 12	4.73	4.94	-0.21	-4.4%
9	13:08	Sep 12	4.55	4.76	-0.21	-4.6%
10	13:43	Sep 12	4.66	4.84	-0.18	-3.9%
11	14:13	Sep 12	4.25	4.45	-0.20	-4.7%
Average			**4.69**	**4.87**	**-0.18**	**-3.7%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.0371	
Confidence Coefficient (CC)	0.0285	
t-Value for 9 Data Sets	2.306	
		Limit
Avg. Abs. Diff. (%dv)	**0.18**	**1.0**

RM = Reference Method (CleanAir Data) 100617 115936
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)
RATA calculations are based on 9 of 11 runs. * indicates the excluded runs.

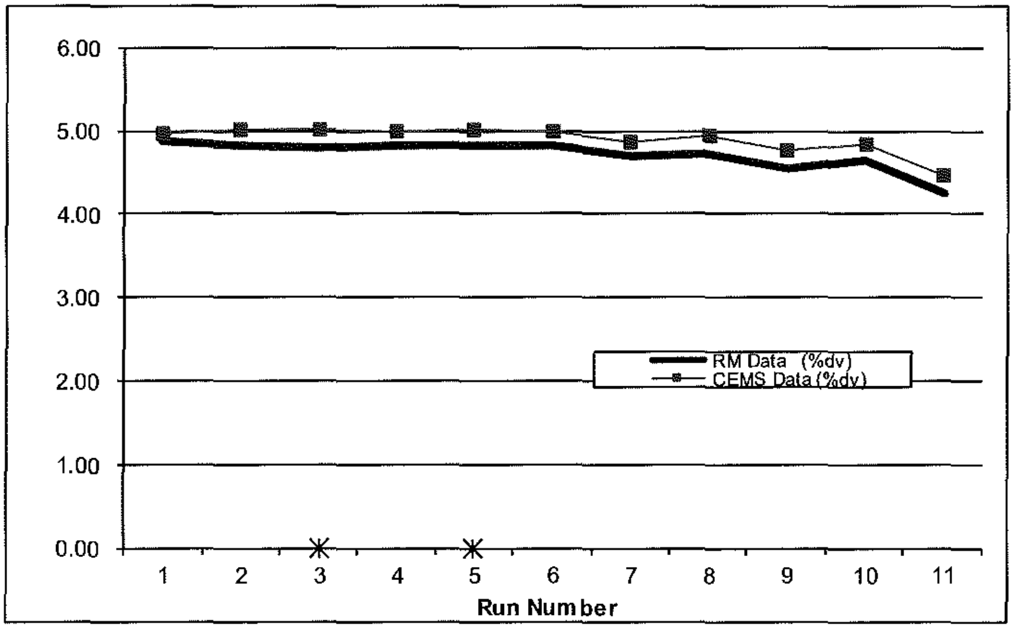

Table 2-3:
Coker Heater Stack – NO$_X$ (lb/MMBtu) RATA

Run No.	Start Time	Date (2017)	RM Data (lb/MMBtu)	CEMS Data (lb/MMBtu)	Difference (lb/MMBtu)	Difference Percent
1 *	08:47	Sep 12	0.03037	0.03282	-0.00245	-8.1%
2	09:17	Sep 12	0.03149	0.03277	-0.00128	-4.1%
3	09:47	Sep 12	0.03188	0.03277	-0.00089	-2.8%
4	10:22	Sep 12	0.03088	0.03288	-0.00200	-6.5%
5 *	10:52	Sep 12	0.03121	N/A	N/A	N/A
6	11:25	Sep 12	0.03133	0.03243	-0.00110	-3.5%
7	12:02	Sep 12	0.03107	0.03256	-0.00149	-4.8%
8	12:37	Sep 12	0.03065	0.03263	-0.00198	-6.5%
9	13:08	Sep 12	0.03024	0.03224	-0.00200	-6.6%
10	13:43	Sep 12	0.03092	0.03257	-0.00165	-5.3%
11	14:13	Sep 12	0.02937	0.03096	-0.00159	-5.4%
Average			**0.03087**	**0.03242**	**-0.00155**	**-5.0%**

Relative Accuracy Test Audit Results

		Limit
Standard Deviation of Differences	0.000406	
Confidence Coefficient (CC)	0.000312	
t-Value for 9 Data Sets	2.306	
Relative Accuracy (as % of RM)	**6.0%**	**20.0%**
Relative Accuracy (as % of Appl. Std.)	**3.7%**	**10.0%**
Appl. Std. = 0.05 lb/MMBtu		

RM = Reference Method (CleanAir Data) 101817 091421
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)
RATA calculations are based on 9 of 11 runs. * indicates the excluded runs.

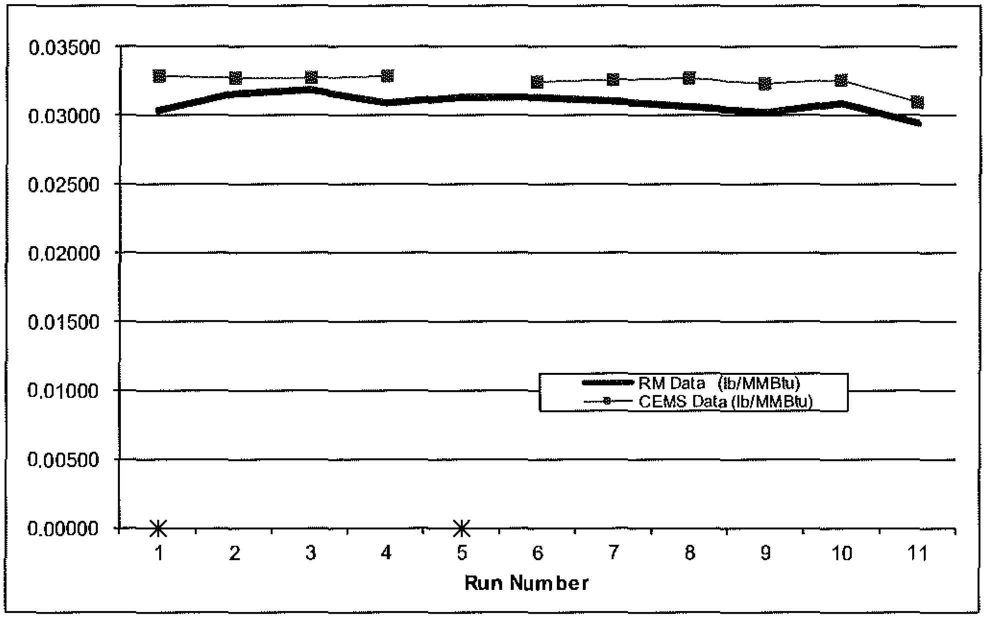

Table 2-4:
Coker Heater Stack – NO_X (ppm @ $0\%O_2$) RATA

Run No.	Start Time	Date (2017)	RM Data (ppm@0%O2)	CEMS Data (ppm@0%O2)	Difference (ppm@0%O2)	Difference Percent
1 *	08:47	Sep 12	30.51	31.91	-1.40	-4.6%
2	09:17	Sep 12	31.63	31.86	-0.23	-0.7%
3	09:47	Sep 12	32.02	31.86	0.16	0.5%
4	10:22	Sep 12	31.02	31.97	-0.95	-3.1%
5 *	10:52	Sep 12	31.35	32.05	-0.70	-2.2%
6	11:25	Sep 12	31.47	31.53	-0.06	-0.2%
7	12:02	Sep 12	31.21	31.66	-0.45	-1.4%
8	12:37	Sep 12	30.78	31.73	-0.95	-3.1%
9	13:08	Sep 12	30.37	31.34	-0.97	-3.2%
10	13:43	Sep 12	31.06	31.69	-0.63	-2.0%
11	14:13	Sep 12	29.50	30.10	-0.60	-2.0%
Average			**31.01**	**31.53**	**-0.52**	**-1.7%**

Relative Accuracy Test Audit Results

		Limit
Standard Deviation of Differences	0.4114	
Confidence Coefficient (CC)	0.3162	
t-Value for 9 Data Sets	2.306	
Relative Accuracy (as % of RM)	**2.7%**	**20.0%**
Relative Accuracy (as % of Appl. Std.)	**1.4%**	**10.0%**
Appl. Std. = 60 ppm@0%O2		

RM = Reference Method (CleanAir Data) 100617 115936
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)
RATA calculations are based on 9 of 11 runs. * indicates the excluded runs.

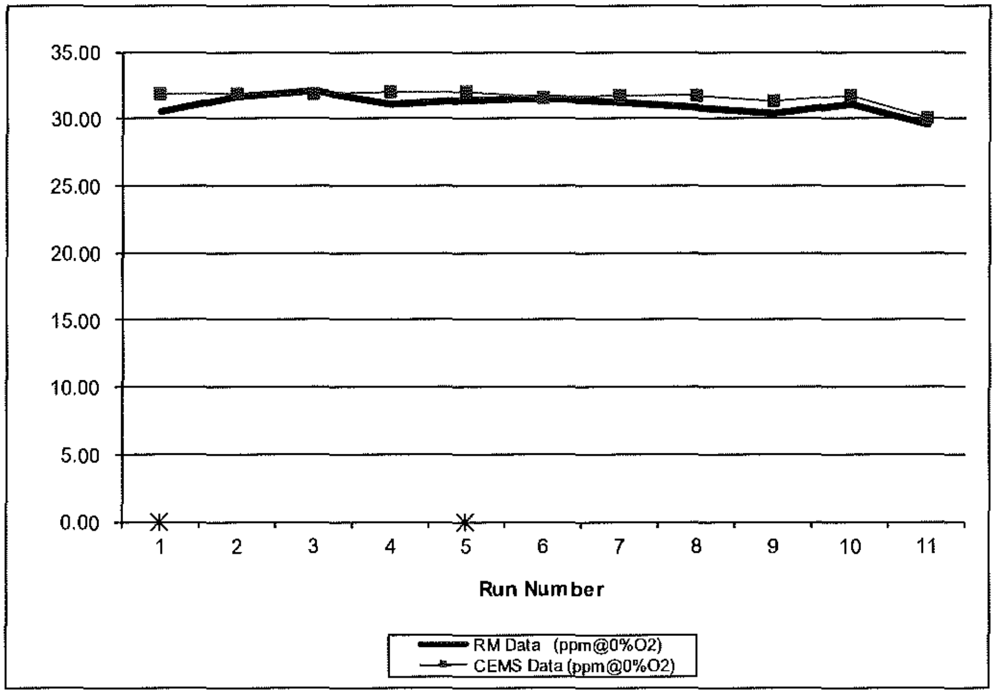

Table 2-5:
Coker Heater Stack – VOCs Emissions

Run No.		**1**	**2**	**3**	**Average**
Date (2017)		Sep 12	Sep 12	Sep 12	
Start Time (approx.)		08:47	10:22	13:08	
Stop Time (approx.)		10:08	11:46	14:34	
Process Conditions					
P_2	Charge rate (bpd)	40,100	40,100	40,100	**40,100**
F_d	Oxygen-based F-factor (dscf/MMBtu)	8,338	8,338	8,338	**8,338**
H_i	Actual heat input (MMBtu/hr)	233	233	242	**236**
Gas Conditions					
O_2	Oxygen (dry volume %)	4.8	4.8	4.5	**4.7**
CO_2	Carbon dioxide (dry volume %)	9.6	9.6	9.8	**9.7**
B_w	Actual water vapor in gas (% by volume)[1]	14.9	14.8	14.5	**14.7**
THC Results[1]					
C_{sd}	Concentration (ppmdv as C_3H_8)	<0.568	<0.534	<0.532	**<0.545**
C_{sd}	Concentration (lb/dscf)	<6.50E-08	<6.11E-08	<6.09E-08	**<6.24E-08**
E_{Fd}	Emission Rate - F_d-based (lb/MMBtu)	< 0.000706	< 0.000662	< 0.000647	**< 0.000672**
Methane Results[3]					
C_{sd}	Concentration (ppmdv)	4.43	4.91	4.94	**4.76**
C_{sd}	Concentration (lb/dscf)	1.84E-07	2.04E-07	2.06E-07	**1.98E-07**
E_{Fd}	Emission Rate - F_d-based (lb/MMBtu)	0.00200	0.00222	0.00218	**0.00213**
Ethane Results[3]					
C_{sd}	Concentration (ppmdv)	<0.23	<0.23	<0.23	**<0.23**
C_{sd}	Concentration (lb/dscf)	<1.79E-08	<1.79E-08	<1.79E-08	**<1.79E-08**
E_{Fd}	Emission Rate - F_d-based (lb/MMBtu)	< 0.000195	< 0.000195	< 0.000191	**< 0.000193**
VOC Results[4]					
C_{sd}	Concentration (ppmdv as C_3H_8)	< 0.568	< 0.534	< 0.532	**< 0.545**
C_{sd}	Concentration (lb/dscf)	<6.50E-08	<6.11E-08	<6.09E-08	**<6.24E-08**
E_{Fd}	Emission Rate - F_d-based (lb/MMBtu)	< 0.000706	< 0.000662	< 0.000647	**< 0.000672**

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[1] Moisture data used for ppmwv to ppmdv correction obtained from nearly-concurrent M-5/202 runs.

[2] For THC, '<' indicates a measured response below the detection limit (assumed to be 1% of the instrument calibration span).

[3] For methane and ethane, '<' indicates a measured response below the analytical detection limit determined by the laboratory.

Table 2-6: Coker Heater Stack – H_2SO_4 Emissions

	Run No.	**1**	**2**	**3**	**Average**
	Date (2017)	Sep 13	Sep 13	Sep 13	
	Start Time (approx.)	09:33	11:01	12:25	
	Stop Time (approx.)	10:33	12:01	13:25	
Process Conditions					
P_2	Charge rate (bpd)	40,100	40,100	40,100	**40,100**
F_d	Oxygen-based F-factor (dscf/MMBtu)	8,349	8,349	8,349	
H_i	Actual heat input (MMBtu/hr)	243	227	225	**232**
Gas Conditions					
O_2	Oxygen (dry volume %)	5.3	6.0	4.6	**5.3**
CO_2	Carbon dioxide (dry volume %)	9.2	8.9	9.6	**9.2**
T_s	Sample temperature (°F)	393	393	394	**393**
B_w	Actual water vapor in gas (% by volume)	15.6	15.1	15.8	**15.5**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	28.29	28.40	27.90	**28.20**
Laboratory Data (Ion Chromatography)					
m_n	Total H2SO4 collected (mg)	0.9712	1.1215	1.1724	
Sulfuric Acid Vapor (H_2SO_4) Results					
C_{sd}	H_2SO_4 Concentration (lb/dscf)	7.57E-08	8.71E-08	9.27E-08	**8.51E-08**
C_{sd}	H_2SO_4 Concentration (ppmdv)	0.297	0.342	0.364	**0.335**
E_{Fd}	H_2SO_4 Rate - Fd-based (lb/MMBtu)	0.000847	0.00102	0.000992	**0.000953**

Table 2-7:
Coker Heater Stack – NSFPM Emissions

Run No.		1	2	3	Average
Date (2017)		Sep 12	Sep 12	Sep 12	
Start Time (approx.)		08:40	11:44	14:48	
Stop Time (approx.)		10:53	13:57	16:59	
Process Conditions					
P_2	Charge rate (bpd)	40,100	40,100	40,100	**40,100**
F_d	Oxygen-based F-factor (dscf/MMBtu)	8,338	8,338	8,338	
H_i	Actual heat input (MMBtu/hr)	233	235	229	**232**
Gas Conditions					
O_2	Oxygen (dry volume %)	5.1	5.0	4.8	**5.0**
CO_2	Carbon dioxide (dry volume %)	9.4	9.4	9.5	**9.4**
T_s	Sample temperature (°F)	386	389	390	**388**
B_w	Actual water vapor in gas (% by volume)	14.4	14.8	14.6	**14.6**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	103,000	102,000	106,000	**104,000**
Q_s	Volumetric flow rate, standard (scfm)	63,900	63,000	65,500	**64,200**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	54,800	53,700	56,000	**54,800**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	71.81	71.55	75.27	**72.88**
%I	Isokinetic sampling (%)	102.0	103.6	104.6	**103.4**
Laboratory Data					
m_{FPM}	Total NSFPM (g)	0.00135	0.00162	0.00121	
NSFPM Results					
C_{sd}	Particulate Concentration (lb/dscf)	4.15E-08	4.99E-08	3.54E-08	**4.23E-08**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.136	0.161	0.119	**0.139**
E_{Fd}	Particulate Rate - F_d-based (lb/MMBtu)	0.000457	0.000547	0.000384	**0.000463**

End of Section

3. DESCRIPTION OF INSTALLATION

Process Description

MPC's facility in Detroit, Michigan, produces refined petroleum products from crude oil. MPC must continue to demonstrate that select process units are in compliance with permitted emission limits.

The Coker unit (EU70-COKER) converts Vacuum Resid (Crude Vacuum Tower Bottoms), a product normally sold as asphalt or blended into residual fuel oil, into lighter, more valuable products. The Vacuum Resid feedstock is heated before it enters the main fractionator, where lighter material vaporizes. The fractionator bottoms are routed through a fired heater and then into a coke drum. This emission unit consists of process vessels (fractionators), coke drums, heater (EU70-COKERHTR-S1), cooling tower, compressors, pumps, piping, drains and various components (pumps and compressor seals, process valves, pressure relief valves, flanges, connectors, etc.). This emission group includes the Coke Handling System, which will collect, size and transport the petroleum coke created during the coking process. The system consists of a coke pit, storage pad, enclosed crusher, enclosed conveyors and surge bins.

The Coker Heater is fired by refinery fuel gas. Emissions are vented to the atmosphere via the Coker Heater Stack (SV70-H1), where testing was performed.

Test Location

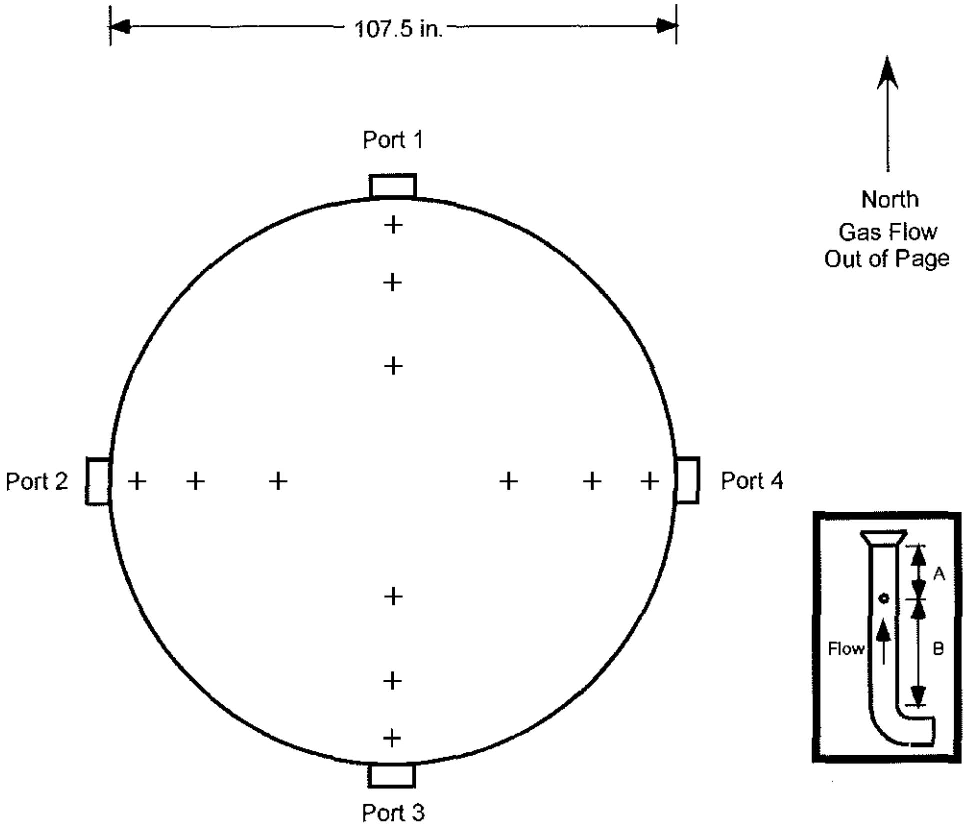
The sample point locations were determined by EPA Methods 1 and 7E specifications. Table 3-1 presents the sampling information for the test location described in this report. The figures shown on pages 14 and 15 represent the layout of the test location.

Table 3-1:
Sampling Point Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Coker Heater Stack							
FPM / CPM	5 / 202	1-3	4	3	10	120	3-1
NSFPM	5B	1-3	4	3	10	120	3-1
H_2SO_4	Draft ASTM CCM	1-3	1	1	60	60	N/A[1]
O_2 / CO_2 / NO_X	3A / 7E	1-11	1	3	7	21	3-2
O_2 / CO_2 / CH_4 / C_2H_6 / THC	3A / 18 / 25A	1-3	1	3	21	63	3-2

[1] Draft ASTM CCM sampling occurred at a single point near the center of the duct.

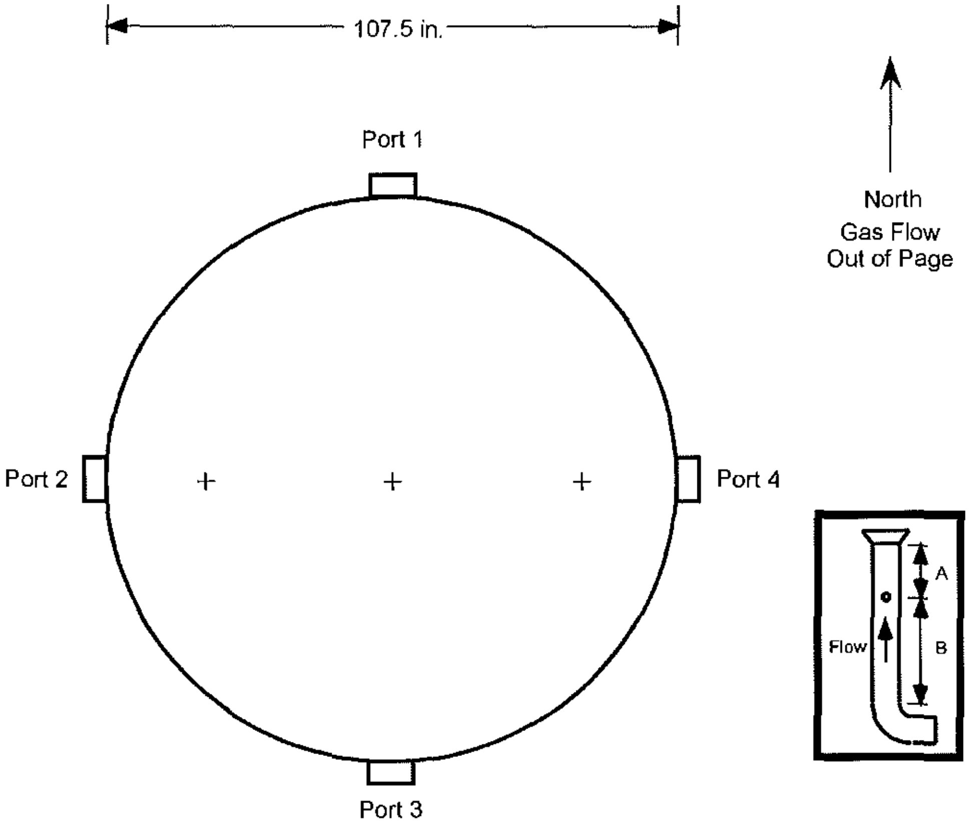
Figure 3-1:
PM, PM_{10} & NSFPM Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	29.6	31.8
2	14.6	15.5
3	4.4	4.7

Duct diameters upstream from flow disturbance (A): 5.2 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 8.3 Limit: 2.0

Figure 3-2:
O_2, NO_X & THC Sample Point Layout (EPA Method 7E)



Sampling Point	Port to Point Distance (meters)	Port to Point Distance (inches)
1	2.0	78.7
2	1.2	47.2
3	0.4	15.7

Duct diameters upstream from flow disturbance (A): 5.2 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 8.3 Limit: 2.0

End of Section

4. *METHODOLOGY*

Procedures and Regulations

The test program sampling measurements followed procedures and regulations outlined by the United States Environmental Protection Agency (USEPA) and the DEQ. These methods appear in detail in Title 40 of the CFR and at https://www.epa.gov/emc. Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery and analytical procedures.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

Title 40 CFR Part 60, Appendix A

Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
Method 3A	"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 5B	"Determination of Nonsulfuric Acid Particulate Matter Emissions from Stationary Sources"
Method 5	"Determination of Particulate Matter Emissions from Stationary Sources"
Method 7E	"Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrumental Analyzer
Method 19	"Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide and Nitrogen Oxide Emission Rates"
Method 18	"Measurement of Gaseous Organic Compound Emissions by Gas Chromatography"
Method 25A	"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"

Title 40 CFR Part 60, Appendix B Performance Specifications

PS2	"Specifications and Test Procedures for SO_2 and NOx Continuous Emission Monitoring Systems in Stationary Sources"
PS3	"Specifications and Test Procedures for O_2 and CO_2 Continuous Emission Monitoring Systems in Stationary Sources"

Title 40 CFR Part 51, Appendix M

Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"

CTM-013 (Mod.)/Draft ASTM Controlled Condensation Method (Draft ASTM CCM)

"Determination of Sulfur Oxides Including Sulfur Dioxide, Sulfur Trioxide and Sulfuric Acid Vapor and Mist from Stationary Sources Using a Controlled Condensation Sampling Apparatus"

Methodology Discussion

PM and PM_{10} Testing – USEPA Method 5/202

The front-half (Method 5 portion) of the sampling train consisted of a glass nozzle, glass liner and filter holder heated to 248°F ± 25°F and a quartz fiber filter. Flue gas samples were extracted isokinetically per Method 5 requirements.

The back-half (Method 202 portion) of the sampling train is designed to mimic ambient conditions and collect only the particles that would truly form CPM in the atmosphere by minimizing the sulfur dioxide (SO_2) and NO_X interferences observed with earlier versions of the method, in which flue gas was bubbled through cold water, and SO_2 and NO_X were absorbed and partially oxidized before they could be purged out with nitrogen (N_2).

Flue gas exiting the front-half heated filter passed through a coiled condenser and dry impinger system jacketed by water continually circulated at ambient temperature. Moisture was removed from the flue gas without bubbling through the condensed water. Flue gas then passed through a tetrafluoroethane (TFE) membrane filter at ambient temperature. The temperature of the flue gas at the exit of the filter was directly measured with an in-line thermocouple and maintained in the temperature range of 65°F to 85°F.

After exiting the ambient filter, the flue gas passed through two (2) additional impingers surrounded by ice in a "cold" section of the impinger bucket. The moisture collected in these impingers were not analyzed for CPM and was only collected to determine the flue gas moisture and thoroughly dry the gas. The sample gas then flowed into a calibrated dry gas meter where the collected sample gas volume was determined.

The front-half portion of the sample train (nozzle, probe and heated filter) was recovered per Method 5 requirements, using acetone as the recovery solvent. The back-half of the sample train (heated filter outlet, condenser, dry impingers and TFE membrane filter) was recovered per Method 202 requirements. The impinger train was purged with N_2 at a rate of 14 liters per minute (lpm) for one (1) hour following each test run and prior to recovery.

A field train blank was assembled, purged and recovered as if it were an actual test sample; analysis of the field train blank was used to blank-correct the test run results. Reagent blanks were also collected to quantify background contamination. All samples and blanks were returned to CleanAir Analytical Services for gravimetric analysis. Method 202 samples were maintained at a temperature < 85°F during transport to the laboratory.

NSFPM Testing – USEPA Method 5B

The front-half (Method 5 portion) of the sampling train consisted of a glass nozzle, glass liner and filter holder heated to 320°F ± 25°F and a quartz fiber filter. Flue gas samples were extracted isokinetically per Method 5B requirements.

The back-half of the sample train consisted of a series of knockout jars. The moisture collected in these knockout jars were only collected to determine the flue gas moisture and thoroughly dry the gas. The sample gas then flowed into a calibrated dry gas meter where the collected sample gas volume was determined.

The front-half portion of the sample train (nozzle, probe and heated filter) was recovered per Method 5B requirements, using acetone as the recovery solvent.

All samples and blanks were returned to CleanAir Analytical Services for gravimetric analysis.

O_2, CO_2 and NO_X Testing – USEPA Methods 3A and 7E

Reference method O_2 and CO_2 emissions were determined using a paramagnetic/NDIR analyzer per EPA Method 3A. Reference method NO_X emissions were determined using a chemiluminescent analyzer per EPA Method 7E.

Sample gas was extracted at a constant rate, conditioned to remove moisture, and delivered to an analyzer bank which measured concentration on a dry basis (units of %dv or ppmdv).

Calibration error checks were performed by introducing zero N_2, high range and mid-range calibration gases to the inlet of each analyzer during calibration error checks. Bias checks were performed before and after each sampling run by introducing calibration gas to the inlet of the sampling system's heated filter. Per Methods 3A and 7E, the average results for each run were drift-corrected.

VOCs Testing – USEPA Methods 25A and 18

The Method 25A sampling system consists of a heated probe, heated filter and heated sample line. Flue gas was delivered at 250°F to a flame ionization analyzer (FIA), which continuously measures minute-average THC concentration expressed in terms of propane (C_3H_8) on an actual (wet) basis. FIA calibration was performed by introducing zero air, high, mid- and low range C_3H_8 calibration gases to the inlet of the sampling system's heated filter. Bias checks were performed before and after each sampling run in a similar manner.

The Method 18 sampling system consists of a gas conditioner (for moisture removal), TFE sample lines, TFE-coated diaphragm pump and a mass flow meter ("Direct Pump Sampling Procedure"). This system pulled a slipstream of the flue gas from the Method 25A sample delivery system and delivered it into a FlexFoil bag at a constant rate. The moisture condensate was not collected for analysis as CH_4 and C_2H_6 are insoluble in water.

Analysis for CH_4 and C_2H_6 was performed off-site by CleanAir Analytical Services using gas chromatography (GC). Since moisture was removed from the sample prior to collection, the GC analyzer measured concentration on a dry basis. At least five (5) sample injections were analyzed for each run.

Analyzer calibration was performed by generating a calibration curve from triplicate injections of three (3) distinct CH_4 and C_2H_6 concentrations introduced directly into the GC. Upon completion of calibration, a recovery study was performed by spiking one of the bag samples with a known concentration of CH_4 and C_2H_6, storing the bags for the same period of time prior to analysis as the field samples, and analyzing the bags to determine percent recovery.

H_2SO_4 Testing – Draft ASTM CCM

A gas sample was extracted from the source at a constant flow rate from the source using a quartz-lined probe maintained at a temperature of 650°F ± 25°F (depending on the required probe length) and a quartz fiber filter maintained at the same temperature as the probe to remove particulate matter.

The sample then passed through a glass coil condenser for collection of sulfuric acid vapor and/or mist. A second quartz fiber filter (referred to as the sulfuric acid mist (SAM) filter) was located at the condenser outlet for the collection of residual SAM not collected by the condenser. The condenser temperature was regulated by a water jacket and the SAM filter was regulated by a closed oven. Both the water jacket and SAM filter oven were maintained at 140°F ± 9°F. After exiting the SAM filter, the sample gas continued through a series of four (4) glass knock-out jars; two (2) containing water, one (1) empty and one (1) containing silica gel for residual moisture removal. The exit temperature from the knock-out jar set was maintained below 68°F. The sample gas then flowed into a dry gas meter, where the collected sample gas volume was determined by means of a calibrated, dry gas meter or an orifice-based flow meter.

The H_2SO_4-collecting portion of the sample train (condenser and SAM filter) was recovered into a single fraction using deionized (DI) H_2O as the recovery/extraction solvent; any H_2SO_4 disassociates into sulfate ion (SO_4^{2-}) and is stabilized in the H_2O matrix until analysis.

Samples and blanks were returned to CleanAir Analytical Services for ion chromatography (IC) analysis.

End of Section