

1. PROJECT OVERVIEW

Test Program Summary

Marathon Petroleum Company LP (MPC) contracted CleanAir Engineering (CleanAir) to complete testing on the GOHT Heater No. 2 (GOHT 2) (EU08-GOHTCHARHTR2-S1) at the Detroit Refinery, located in Detroit, Michigan. The test program included the following objectives:

- Perform filterable particulate matter (FPM), condensable particulate matter (CPM), sulfuric acid mist (H₂SO₄), and volatile organic compounds (VOCs) testing to demonstrate compliance with the Michigan Department of Environmental Quality (DEQ) Permit to Install (PTI) 118-15;
- Perform diagnostic nonsulfuric acid filterable particulate matter (NSFPM) testing to collect supplementary particulate data.

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.

**Table 1-1:
Summary of Results – Compliance Testing**

Source	Constituent	Sampling Method	Average Emission	Permit Limit ¹
<u>GOHT 2 Stack</u>				
	PM (lb/MMBtu)	USEPA 5	0.0008	0.0019
	PM ₁₀ (lb/MMBtu)	USEPA 5 / 202	0.0021	0.0076
	PM _{2.5} (lb/MMBtu)	USEPA 5 / 202	0.0021	0.0076
	H ₂ SO ₄ (lb/MMBtu)	CTM-013 (Mod)	0.0001	N/A
	VOC (lb/MMBtu)	USEPA 25A / 18	<0.0007	0.0055
	NSFPM (lb/MMBtu)	USEPA 5B	0.0003	N/A

¹ Permit limits obtained from MDEQ Permit to Install (PTI) 118-15.

Test Program Details

Parameters

The test program included the following measurements:

- particulate matter (PM), assumed equivalent to filterable particulate matter (FPM)
- total particulate matter less than 10 microns in diameter (PM₁₀), assumed equivalent to the sum of the following constituents:
 - FPM
 - condensable particulate matter (CPM)
- total particulate matter less than 2.5 microns in diameter (PM_{2.5}), assumed equivalent to the sum of the following constituents:
 - FPM
 - CPM
- nonsulfuric acid particulate matter (NSFPM)
- volatile organic compounds (VOCs), assumed equivalent to total hydrocarbons (THCs) minus the following constituents
 - methane (CH₄)
 - ethane (C₂H₆)
- sulfuric acid mist (H₂SO₄)
- flue gas composition (e.g., O₂, CO₂, H₂O)
- flue gas temperature
- flue gas flow rate

Schedule

The on-site schedule followed during the test program is outlined in Table 1-2.

**Table 1-2:
Test Schedule**

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	GOHT 2 Stack	USEPA Method 5 / 202	FPM / CPM	04/09/19	11:00	13:17
2	GOHT 2 Stack	USEPA Method 5 / 202	FPM / CPM	04/09/19	14:29	16:45
3	GOHT 2 Stack	USEPA Method 5 / 202	FPM / CPM	04/09/19	18:04	20:15
4	GOHT 2 Stack	USEPA Method 5 / 202	FPM / CPM	04/10/19	08:16	10:28
1	GOHT 2 Stack	USEPA Method 5B	NSFPM	04/09/19	11:00	13:17
2	GOHT 2 Stack	USEPA Method 5B	NSFPM	04/09/19	14:29	16:45
3	GOHT 2 Stack	USEPA Method 5B	NSFPM	04/09/19	18:05	20:15
4	GOHT 2 Stack	USEPA Method 5B	NSFPM	04/10/19	08:16	10:28
1	GOHT 2 Stack	USEPA Method 25A / 18	VOC	04/10/19	10:59	12:28
2	GOHT 2 Stack	USEPA Method 25A / 18	VOC	04/10/19	12:40	14:11
3	GOHT 2 Stack	USEPA Method 25A / 18	VOC	04/10/19	14:22	15:53
1	GOHT 2 Stack	CTM-013 (mod)	H ₂ SO ₄	04/10/19	13:10	14:10
2	GOHT 2 Stack	CTM-013 (mod)	H ₂ SO ₄	04/10/19	14:30	15:30
3	GOHT 2 Stack	CTM-013 (mod)	H ₂ SO ₄	04/10/19	16:02	17:02

Discussion

Project Synopsis

As outlined above, the compliance test program was conducted over a two-day period. During the first day, three (3) FPM/CPM and three (3) NSFPM runs were conducted. During the second day, one (1) FPM/CPM and one (1) NSFPM run were conducted along with three (3) H₂SO₄ and VOC runs.

The oxygen (O₂) and nitrogen oxides (NO_x) relative accuracy test audits (RATAs) results are presented in CleanAir Report No. 13785-4.

PM, PM₁₀, & PM_{2.5} Testing

A total of four (4) 120-minute EPA Method 5/202 test runs were performed. All four runs were deemed valid. PM (FPM) emission results were calculated in units of pounds per million Btu (lb/MMBtu). The final PM result was expressed as the average of the three (3) highest valid test runs (Runs 1, 3, and 4). PM₁₀ and PM_{2.5} (sum of FPM and CPM) emission results were calculated in units of lb/MMBtu. The final PM₁₀ and PM_{2.5} result was expressed as the average of the three (3) highest valid test runs (Runs 1, 3, and 4).

Volatile Organic Compounds Testing

VOC emissions were determined using EPA Method 25A to quantify THC emissions. The results were comprised of three (3) 63-minute test runs. The final result was expressed as the average of the three test runs. VOC emissions were determined concurrently with RATA testing.

O₂ concentrations from concurrent EPA Method 3A test runs were utilized to convert VOC results to lb/MMBtu. THC data was converted from an actual (wet) basis to a dry basis using moisture data collected from nearly concurrent modified Conditional Test Method 013 (CTM-013 (Mod.)) runs. All emissions are reported on a propane basis.

During all Method 25A test runs, the measured concentrations of THC were below the minimum detection limit (MDL) of the analyzer. The MDL is defined as 'less than 1%' of the calibration span of the THC instrument. During this test program, the calibration span was 46.0 ppm. Therefore, 0.460 ppm was substituted for the average drift-corrected concentration for all test runs.

The final results are reported assuming the worst-case scenario; the resultant VOC emissions are less than the defined THC MDL corrected to dry conditions.

An integrated gas sample was collected during each test run for follow-up analysis for CH₄ and C₂H₆. Because all test runs were below the MDL for THC, the follow-up analyses were not conducted.

Sulfuric Acid Mist Testing

H₂SO₄ emissions were determined referencing CTM-013 (mod). Three (3) 60-minute CTM-013 (Mod.) test runs were performed. H₂SO₄ emission results were calculated in units of lb/MMBtu.

Nonsulfuric Filterable Particulate Matter Testing

A total of four (4) 120-minute EPA Method 5B test runs were performed. NSFPM emission results were calculated in units of lb/MMBtu. The final result was expressed as the average of all four (4) test runs.

Fuel F_d Factor

Emission results in units of dry volume-based concentration (lb/dscf, ppm_{dv}) were converted into units of lb/MMBtu by calculating an oxygen-based fuel factor (F_d) for refinery gas for each day of testing 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

Pursuant to Rule 336.2003(3) and consistent with projected operating conditions provided to the AQD in support of PTI No. 118-15, testing of the GOHT 2 heater was conducted under "maximum routine operating conditions", which is approximately 31 pounds per million Btu per hour (MMBtu/hr) per heater. The GOHT 1 and GOHT 2 heaters have individual permit-allowable maximum heat input ratings of 115 MMBtu/hr (daily average) and a combined permit-allowable heat input rating of 100 MMBtu/hr (annual rolling average). However, the design of the GOHT system (two parallel heater/reactor trains) does not require and does not easily accommodate the firing of either heater at a level greater than 90% of the maximum expected one-train operation. Therefore, MPC tested at conditions that were representative of normal operating conditions for GOHT 2. Refer to the GOHT 2 protocol for further explanation.

2. RESULTS

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

**Table 2-1:
GOHT 2 Stack – FPM Emissions**

Run No.	1	2*	3	4	Average
Date (2019)	Apr 9	Apr 9	Apr 9	Apr 10	
Start Time (approx.)	11:00	14:29	18:04	08:16	
Stop Time (approx.)	13:17	16:45	20:15	10:28	
Process Conditions					
R _p Production Rate (BPD)	44,300	44,500	44,500	44,500	44,400
P ₁ Fuel Consumption (mscf/day)	1,220	1,270	1,250	1,120	1,210
F _d Oxygen-based F-factor (dscf/MMBtu)	7,575	7,575	7,575	7,838	
H _i Actual heat input (MMBtu/hr)	35.0	36.3	35.8	32.3	34.8
Gas Conditions					
O ₂ Oxygen (dry volume %)	7.1	7.6	7.3	7.7	7.4
CO ₂ Carbon dioxide (dry volume %)	6.3	6.0	6.1	6.2	6.2
T _s Sample temperature (°F)	272	279	276	272	273
B _w Actual water vapor in gas (% by volume)	16.7	16.3	17.3	15.8	16.6
Gas Flow Rate					
Q _a Volumetric flow rate, actual (acfm)	13,600	15,000	14,200	13,500	13,800
Q _s Volumetric flow rate, standard (scfm)	9,550	10,400	9,930	9,530	9,670
Q _{std} Volumetric flow rate, dry standard (dscfm)	7,950	8,730	8,220	8,020	8,060
Sampling Data					
V _{mstd} Volume metered, standard (dscf)	56.31	62.28	59.41	57.06	57.60
%I Isokinetic sampling (%)	99.8	100.6	101.9	100.2	100.6
Laboratory Data					
m _n Total FPM (g)	0.00129	0.00116	0.00127	0.00264	
m _{CPM} Total CPM (g)	0.00333	0.00273	0.00266	0.00276	
m _{Part} Total particulate matter (g)	0.00462	0.00389	0.00393	0.00540	
FPM Results¹					
C _{sd} Particulate Concentration (lb/dscf)	5.05E-08	4.11E-08	4.71E-08	1.02E-07	6.66E-08
E _{lb/hr} Particulate Rate (lb/hr)	0.0241	0.0215	0.0232	0.0491	0.0321
E _{Fd} Particulate Rate - F _d -based (lb/MMBtu)	0.000579	0.000489	0.00055	0.00127	0.000798
CPM Results					
C _{sd} Particulate Concentration (lb/dscf)	1.30E-07	9.67E-08	9.88E-08	1.07E-07	1.12E-07
E _{lb/hr} Particulate Rate (lb/hr)	0.0622	0.0507	0.0487	0.0514	0.0541
E _{Fd} Particulate Rate - F _d -based (lb/MMBtu)	0.00150	0.00115	0.00115	0.00132	0.00132
PM₁₀ & PM_{2.5} Results¹					
C _{sd} Particulate Concentration (lb/dscf)	1.81E-07	1.38E-07	1.46E-07	2.09E-07	1.79E-07
E _{lb/hr} Particulate Rate (lb/hr)	0.0863	0.0722	0.0720	0.1005	0.0863
E _{Fd} Particulate Rate - F _d -based (lb/MMBtu)	0.00208	0.00164	0.00170	0.00259	0.00212

¹ Final FPM and PM₁₀ & PM_{2.5} results are the average of the three (3) highest valid runs (Runs 1, 3, and 4).

* Indicates run is not included in final results.

**Table 2-2:
GOHT 2 Stack – H₂SO₄ Emissions**

Run No.	1	2	3	Average
Date (2019)	Apr 10	Apr 10	Apr 10	
Start Time (approx.)	13:10	14:30	16:02	
Stop Time (approx.)	14:10	15:30	17:02	
Process Conditions				
R _p Production rate (BPD)	44,500	44,500	44,500	44,500
P ₁ Fuel Consumption (mscf/day)	980	970	910	950
F _d Oxygen-based F-factor (dscf/MMBtu)	7,838	7,838	7,838	
H _i Actual heat input (MMBtu/hr)	29.0	28.4	26.4	27.9
Gas Conditions				
O ₂ Oxygen (dry volume %)	8.3	8.4	9.4	8.7
CO ₂ Carbon dioxide (dry volume %)	6.5	6.1	5.8	6.1
T _s Sample temperature (°F)	271	271	270	271
B _w Actual water vapor in gas (% by volume)	14.9	14.9	14.2	14.7
Sampling Data				
V _{nstd} Volume metered, standard (dscf)	27.85	27.51	27.83	27.73
Laboratory Data (Ion Chromatography)				
m _n Total H ₂ SO ₄ collected (mg)	0.0545	0.0714	0.0800	
Sulfuric Acid Vapor (H₂SO₄) Results				
C _{sd} H ₂ SO ₄ Concentration (lb/dscf)	4.32E-09	5.72E-09	6.33E-09	5.46E-09
C _{sd} H ₂ SO ₄ Concentration (ppmdv)	0.0170	0.0225	0.0249	0.0215
E _{Fd} H ₂ SO ₄ Rate - Fd-based (lb/MMBtu)	0.0000561	0.0000750	0.0000902	0.0000738

**Table 2-3:
GOHT 2 Stack – VOC Emissions**

Run No.		1	2	3	Average
Date (2019)		Apr 10	Apr 10	Apr 10	
Start Time (approx.)		10:59	12:40	14:22	
Stop Time (approx.)		12:28	14:11	15:53	
Process Conditions					
P ₁	Production Rate (BPD)	44,500	44,500	44,500	44,500
P ₂	Fuel Consumption (mscf/day)	950	960	970	960
F _d	Oxygen-based F-factor (dsf/MMBtu)	7,838	7,838	7,838	
H _i	Actual heat input (MMBtu/hr)	27.7	28.4	28.3	28.1
Gas Conditions					
O ₂	Oxygen (dry volume %)	7.2	6.8	7.8	7.3
CO ₂	Carbon dioxide (dry volume %)	7.5	7.6	6.7	7.3
B _w	Actual water vapor in gas (% by volume) ¹	13.4	14.4	14.4	14.1
THC Results²					
C _{sd}	Concentration (ppmdv as C ₃ H ₈)	<0.531	<0.537	<0.541	<0.536
C _{sd}	Concentration (lb/dscf)	<6.08E-08	<6.15E-08	<6.19E-08	<6.14E-08
E _{Fd}	Emission Rate - F _d -based (lb/MMBtu)	<0.000731	<0.000717	<0.000772	<0.000740
VOC Results³					
C _{sd}	Concentration (ppmdv as C ₃ H ₈)	<0.531	<0.537	<0.541	<0.536
C _{sd}	Concentration (lb/dscf)	<6.08E-08	<6.15E-08	<6.19E-08	<6.14E-08
E _{Fd}	Emission Rate - F _d -based (lb/MMBtu)	<0.000731	<0.000717	<0.000772	<0.000740

¹ Moisture data used for ppmw v to ppmdv correction obtained from nearly-concurrent CTM-013 (mod) runs.

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

³ VOC is reported as THC since all THC results were non-detect.

**Table 2-4:
GOHT 2 Stack – NSFPM Emissions**

Run No.		1	2	3	4	Average
Date (2019)		Apr 9	Apr 9	Apr 9	Apr 10	
Start Time (approx.)		11:00	14:29	18:04	08:16	
Stop Time (approx.)		13:17	16:45	20:15	10:28	
Process Conditions						
R _P	Production Rate (BPD)	44,300	44,500	44,500	44,500	44,400
P ₁	Fuel Consumption (mscf/day)	1,220	1,270	1,250	1,120	1,210
F _d	Oxygen-based F-factor (dscf/MMBtu)	7,575	7,575	7,575	7,838	
H _i	Actual heat input (MMBtu/hr)	35.0	36.3	35.8	32.3	34.8
Gas Conditions						
O ₂	Oxygen (dry volume %)	7.1	7.6	7.3	7.7	7.4
CO ₂	Carbon dioxide (dry volume %)	6.3	6.0	6.1	6.2	6.2
T _s	Sample temperature (°F)	272	279	276	272	275
B _w	Actual water vapor in gas (% by volume)	16.7	16.3	17.3	15.8	16.5
Gas Flow Rate						
Q _a	Volumetric flow rate, actual (acfm)	13,600	15,000	14,200	13,500	14,100
Q _s	Volumetric flow rate, standard (scfm)	9,550	10,400	9,930	9,530	9,860
Q _{std}	Volumetric flow rate, dry standard (dscfm)	7,950	8,730	8,220	8,020	8,230
Sampling Data						
V _{mstd}	Volume metered, standard (dscf)	56.31	62.28	59.41	57.06	58.77
%I	Isokinetic sampling (%)	99.8	100.6	101.9	100.2	100.6
Laboratory Data						
m _n	Total NSFPM (g)	0.00061	0.00061	0.00077	0.00068	
NSFPM Results						
C _{sd}	Particulate Concentration (lb/dscf)	2.39E-08	2.16E-08	2.86E-08	2.63E-08	2.51E-08
E _{lb/hr}	Particulate Rate (lb/hr)	0.0114	0.0113	0.0141	0.0126	0.0124
E _{Fd}	Particulate Rate - F _d -based (lb/MMBtu)	0.000274	0.000257	0.000333	0.000326	0.000297

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 Gas Oil Hydrotreater Unit (EU08-GOHT-S1) reacts sour gas oil streams with hydrogen over a catalyst bed to remove sulfur. The GOHT unit consists of process vessels (reactors, distillation tower, absorbing towers, stripper tower), two charge heaters (EU08-GOHTCHARHTR-S1 and EU08-GOHTCHARHTR2-S1), cooling tower, flare, compressors, pumps, piping, drains and various components (pumps and compressor seals, process valves, pressure relief valves, flanges, connectors, etc.).

The GOHT Heater No. 2 (EU08-GOHTCHARHTR2-S1) is fired by refinery fuel gas. Emissions are vented to the atmosphere via the GOHT Heater No. 2 Stack (SV08-H2), where testing was performed.

Test Location

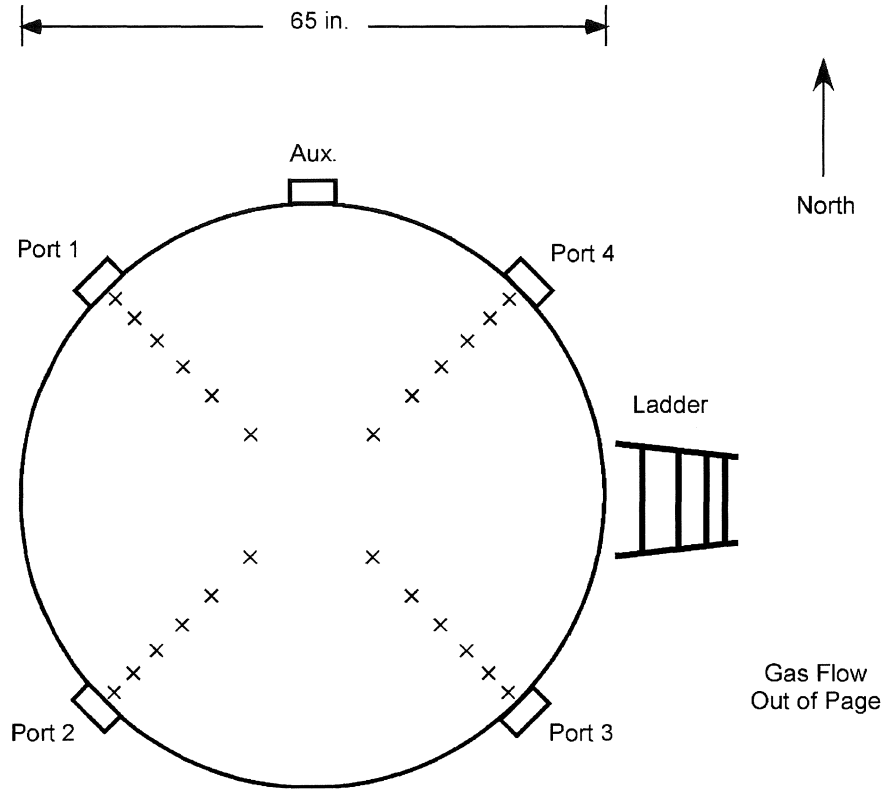
The sample point locations were determined by EPA Method 1 and Performance Specification 2. Table 3-1 presents the sampling information for the test location. The figures shown on pages 10 and 11 represent the layout of the test location.

**Table 3-1:
Sampling Information**

Source Constituent	Method (USEPA)	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
<u>GOHT 2 Stack</u>							
FPM / CPM	5 / 202	1-4	4	6	5	120	3-1
NSFPM	5B	1-4	4	6	5	120	3-1
H ₂ SO ₄	CTM-013 (Mod)	1-3	1	1	60	60	N/A ¹
O ₂ / CO ₂ / CH ₄ / C ₂ H ₆ / THC	3A / 18 / 25A	1-3	1	3	21	63	3-2

¹ CTM-013 (Mod) sampling was conducted from a single point near the center of the duct.

**Figure 3-1:
 FPM/CPM & NSFPM Sample Point Layout (EPA Method 1)**



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	35.6	23.1
2	25.0	16.3
3	17.7	11.5
4	11.8	7.7
5	6.7	4.4
6	2.1	1.4

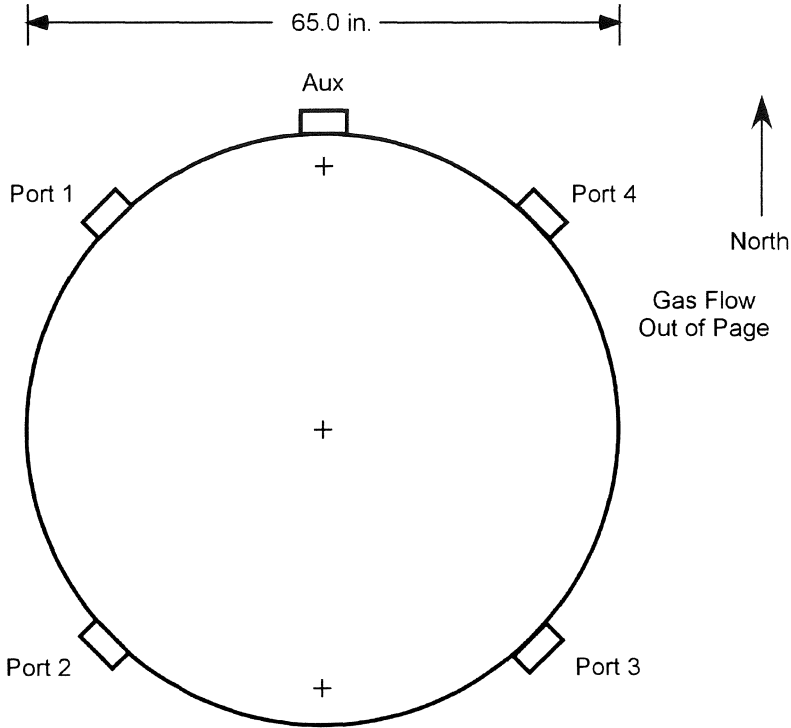
Duct diameters upstream from flow disturbance (A): 9.5

Limit: 0.5

Duct diameters downstream from flow disturbance (B): 2.3

Limit: 2.0

**Figure 3-2:
 VOC Sample Point Layout (EPA Method 1)**



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	83.3	54.1
2	50.0	32.5
3	16.7	9.6

Duct diameters upstream from flow disturbance (A): 12.9
 Duct diameters downstream from flow disturbance (B): 4.4

Limit: 0.5
 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. Any modifications to standard test methods are explicitly indicated in this appendix. In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

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 5 "Determination of Particulate Matter Emissions from Stationary Sources"
- Method 5B "Determination of Nonsulfuric Acid Particulate Matter Emissions from Stationary Sources"
- Method 18 "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography"
- Method 19 "Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide and Nitrogen Oxide Emission Rates"
- Method 25A "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"

CTM-013 (Modified)

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

Title 40 CFR Part 51, Appendix M

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

Methodology Discussion

PM, PM_{2.5} and PM₁₀ Testing – USEPA Method 5/202

PM, PM_{2.5} and PM₁₀ emissions were determined using EPA Method 5/202. PM is considered equivalent to FPM. PM_{2.5} and PM₁₀ are equivalent to the sum of FPM and CPM. The Method 5/202 sample train yields a front-half, FPM result and a back-half, CPM result. Where appropriate, the total PM result (FPM plus CPM) from Method 5/202 can be used as a worst-case estimation of Total PM_{2.5} and PM₁₀, since Method 5 will collect all FPM present in the flue gas (regardless of particle size).

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 (SO₂) and NO_x interferences observed with earlier versions of the method, in which flue gas is bubbled through cold water, and SO₂ and NO_x are absorbed and partially oxidized before they could be purged out with nitrogen (N₂).

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 was then passed through a tetrafluoromethane (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 was not analyzed for CPM but was only collected to determine the flue gas moisture and to 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 N₂ 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 in Palatine, Illinois, for gravimetric analysis. Method 202 samples were maintained at a temperature < 85°F during transport to the laboratory.

VOC Testing – USEPA Method 25A

VOC emissions were determined using EPA Method 25A to quantify THC emissions as propane. The Method 25A sampling system consists of a heated probe, heated filter, and heated sample line. Flue gas was delivered at $\geq 250^{\circ}\text{F}$ to a flame ionization analyzer (FIA), which continuously measured minute-average THC concentration expressed in terms of propane (C_3H_8) on an actual (wet) basis.

FIA calibration was performed by introducing zero N_2 , high, mid- and low range propane calibration gases to the inlet of the sampling system's heated filter. Drift checks were performed before and after each sampling run in a similar manner.

H_2SO_4 Testing – CTM-013 (Modified)

H_2SO_4 emissions were determined referencing CTM-013.

A gas sample was extracted from the source at a constant flow rate using a quartz-lined probe maintained at a temperature of $650^{\circ}\text{F} \pm 25^{\circ}\text{F}$ (depending on the required probe length) and a quartz fiber filter (to remove particulate matter) maintained at the same temperature as the probe. 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 $140^{\circ}\text{F} \pm 9^{\circ}\text{F}$ plus 2°F for each 1% moisture above 16% flue gas moisture (above the water dew point, which eliminates the oxidation of dissolved SO_2 into the H_2SO_4 -collecting fraction of the sample train).

After exiting the SAM filter, the sample gas then 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 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 in Palatine, Illinois, for ion chromatography (IC) analysis.

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.

Nonsulfuric Filterable Particulate Matter Testing – USEPA Method 5B

NSFPM emissions were determined using EPA Method 5B. The front-half (Method 5 portion) of the sampling train consisted of a glass nozzle, glass liner and filter holder heated to $320^{\circ}\text{F} \pm 25^{\circ}\text{F}$ and a quartz fiber filter. Flue gas samples were extracted isokinetically per Method 5B requirements.

The back-half of the sampling train consisted of 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 moisture collected in the knock-out jars was measured to determine the flue gas moisture. 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. After measuring the moisture gain in the back-half portion of the sample train, the contents were discarded.

Reagent blanks were collected to quantify background contamination. All samples and blanks were returned to CleanAir Analytical Services in Palatine, Illinois, for gravimetric analysis.

End of Section