CleanAir

CleanAir Engineering
500 W. Wood Street
Palatine, IL 60067-4975
800-627-0033
www.cleanair.com

Marathon Petroleum Company LP
1300 South Fort Street
Detroit, MI 48217

REPORT ON COMPLIANCE TESTING

Performed for:
MARATHON PETROLEUM COMPANY LP
DETROIT REFINERY

FCCU REGENERATOR STACK (SVFCCU)

Client Reference No: 4100665755
CleanAir Project No: 12993-1
Revision 0: September 29, 2016

To the best of our knowledge, the data presented in this report are accurate, complete, error free, legible and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Submitted by,

Andy Obuchowski
Midwest Engineering Group Leader
aobuchowski@cleanair.com
(800) 627-0033 ext. 4537

Reviewed by,

Bill Ansell
Midwest Engineering Group
Technical Leader
bansell@cleanair.com
(800) 627-0033 ext. 4545

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RECEIVED
OCT 0 3 2016
AIR QUALITY DIV.

RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: Marathon Petroleum Company LP County: Wayne

Source Address: 1300 South Fort Street City: Detroit

AQD Source ID (SRN): A9831 ROP No.: MI-ROP-A9831-2012c ROP Section No.:

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 08/02/2016 To 08/02/2016

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Submittal of Stack Test results.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

David T. Roland	MPC Investment LLC, its General Partner Deputy Assistant Secretary	313-843-9100
Name of Responsible Official (print or type)	Title	Phone Number
Signature of Responsible Official		9/30/2016 Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

REVISION HISTORY

REPORT ON COMPLIANCE TESTING

DRAFT REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
D0a	09/06/16	All	Draft version of original document.

FINAL REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
0	09/29/2016	All	Final version of original document.

PROJECT OVERVIEW

INTRODUCTION

Marathon Petroleum Company LP (MPC) contracted Clean Air Engineering (CleanAir) to perform emission measurements at the Detroit Refinery for compliance purposes.

All testing was conducted in accordance with the regulations set-forth by the United States Environmental Protection Agency (USEPA) and the Michigan Department of Environmental Quality (DEQ). The permit limits are referenced in Michigan Department of Environmental Quality, Air Quality Division Permit to Install No. 63-08D, issued May 12, 2014.

Key Project Participants

Individuals responsible for coordinating and conducting the test program were:

Crystal Davis – MPC
Joe Reidy – MPC
Thomas Gasloli – Michigan DEQ
Chad Eilering – CleanAir

Test Program Parameters

The testing was performed at the FCCU Regenerator Stack (Emission Unit ID No. EU11-FCCU-S1; Stack ID No. SVFCCU) on August 2, 2016, and included the following emissions measurements:

- sulfuric acid (H_2SO_4)
- volatile organic compounds (VOCs), assumed equivalent to total hydrocarbons (THC) minus the following constituents:
  - methane (CH_4)
  - ethane (C_2H_6)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas flow rate

PROJECT OVERVIEW

TEST PROGRAM SYNOPSIS

Test Schedule

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

Table 1-1:
Schedule of Activities

Run Number	Location	Method	Analyte	Date	Start Time	End Time
0	FCCU Regenerator Stack	Draft ASTM CCM	Sulfuric Acid	08/01/16	16:05	17:05
1	FCCU Regenerator Stack	Draft ASTM CCM	Sulfuric Acid	08/02/16	10:20	11:20
2	FCCU Regenerator Stack	Draft ASTM CCM	Sulfuric Acid	08/02/16	12:05	13:06
3	FCCU Regenerator Stack	Draft ASTM CCM	Sulfuric Acid	08/02/16	13:37	14:37
1	FCCU Regenerator Stack	USEPA Method 3A/18/25A	$O_2/CO_2/CH_4/C_2H_6$/THC	08/02/16	10:19	11:30
2	FCCU Regenerator Stack	USEPA Method 3A/18/25A	$O_2/CO_2/CH_4/C_2H_6$/THC	08/02/16	12:06	13:09
3	FCCU Regenerator Stack	USEPA Method 3A/18/25A	$O_2/CO_2/CH_4/C_2H_6$/THC	08/02/16	13:36	14:42
1	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/02/16	10:19	11:44
2	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/02/16	12:12	12:43
3	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/02/16	01:36	02:25

090116 114749

Results Summary

Table 1-2 summarizes the results of the test program. A more detailed presentation of the test conditions and results of analysis are shown on pages 2-1 and 2-2.

Table 1-2:
Summary of H_2SO_4 and VOC Results (Draft ASTM CCM & USEPA 18/25A)

Source Constituent	(Units)	Sampling Method	Average Emission	Permit Limit[1]
FCCU Regenerator Stack				
H_2SO_4	(lb/Mlb coke)	Draft ASTM CCM	1.2E-02	N/A
H_2SO_4	(ppmdv)	Draft ASTM CCM	0.24	N/A
VOC	(Ton/yr)	USEPA 25A / 18	4.2	21
VOC	(lb/Mlb coke)	USEPA 25A / 18	0.048	N/A

[1] Permit limit obtained from MDEQ Permit To Install No. 63-08D.

092916 172109

PROJECT OVERVIEW

Discussion of Test Program

Flow Rate Measurements

3-D flow traverses per Method 2F were performed during each Draft ASTM CCM test runs.

H_2SO_4 Testing - Draft ASTM Controlled Condensation Method

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 and analyzed in the same manner as the official test runs, but was not included in the final results.

Following the conditioning run, three (3) official 60-minute test runs were performed. The final results were expressed as the average of three (3) official runs.

VOC Testing - USEPA Method 25A and Method 18

Three (3) approximately 60-minute Method 25 test runs for THC were performed concurrently with three (3) approximately 60-minute Method 18 bag collections for CH_4 and C_2H_6.

VOC emission rate is normally equivalent to THC emission rate, minus CH_4, and C_2H_6 emission rate (units of lb/hr, Ton/yr, or lb/MMBtu for all constituents). For CH_4 and C_2H_6, a non-detectable result was obtained for Run 1 and Run 3, so no correction was made to the THC results. Therefore, VOC emissions for Run 1 and Run 3 was equivalent to THC emissions only. The final VOC results were expressed as the average of three (3) runs.

Calculation of Final Results

Mass-based emission rates in units of pounds per hour (lb/hr) for Draft ASTM CCM and Method 18/25A were calculated using the concurrently measured flow rate determined by Method 2F.

Emission rates in units of tons per year (Ton/yr) were calculated using an assumed capacity factor of 8,760 operating hours per year. Emission rates in units of pounds per 1,000 pounds of coke burn (lb/Mlb coke) were calculated using coke burn rate data provided by MPC.

Ammonia (NH_3) injection rates shown in Tables 2-1 and 2-2 is the aqueous ammonia, (11FC2032), multiplied by a factor of 0.2.

End of Section 1 – Project Overview

RESULTS

Table 2-1:
H_2SO_4 Emissions (Draft ASTM CCM)

Run No.		1	2	3	Average
Date (2016)		Aug 2	Aug 2	Aug 2	
Start Time (approx.)		10:20	12:05	13:37	
Stop Time (approx.)		11:20	13:06	14:37	
Process Conditions					
R_P	Coke burn rate (lb/hr)	21,621	19,143	19,072	
P_1	FCC charge rate (bpd)	39,483	35,013	35,002	
P_2	NH3 Injection (lb/hr)	4.7	4.6	4.4	
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	
Gas Conditions					
O_2	Oxygen (dry volume %)	2.0	2.0	1.9	**2.0**
CO_2	Carbon dioxide (dry volume %)	16.0	16.1	16.2	**16.1**
T_s	Sample temperature (°F)	525	514	509	**516**
B_w	Actual water vapor in gas (% by volume)	10.2	12.4	11.1	**11.3**
Gas Flow Rate					
Q_{std}	Volumetric flow rate, dry standard (dscfm)[1]	71,200	61,400	63,300	**65,300**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	24.26	23.17	24.15	**23.86**
Laboratory Data (Ion Chromatography)					
m_n	Total H2SO4 collected (mg)	1.4749	0.3699	0.1560	
Sulfuric Acid Vapor (H2SO4) Results					
C_{sd}	H2SO4 Concentration (lb/dscf)	1.34E-07	3.52E-08	1.42E-08	**6.12E-08**
C_{sd}	H2SO4 Concentration (ppmdv)	0.527	0.138	0.0560	**0.240**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	0.573	0.130	0.0541	**0.252**
$E_{T/yr}$	H2SO4 Rate (Ton/yr)	2.51	0.568	0.237	**1.10**
E_{Rp}	H2SO4 Rate - Production-based (lb/Mlb coke)	2.65E-02	6.78E-03	2.84E-03	**1.20E-02**

Average includes 3 runs.

[1] Gas flow rates obtained from concurrent Method 2F test runs.

092916 172109

RESULTS

Table 2-2:
THC, CH_4, C_2H_6, and VOC Emissions (USEPA 25A/18)

Run No.		1	2	3	Average
Date (2016)		Aug 2	Aug 2	Aug 2	
Start Time (approx.)		10:19	12:06	13:36	
Stop Time (approx.)		11:30	13:09	14:42	
Process Conditions					
R_P	Coke burn rate (lb/hr)	21,601	19,124	19,066	
P_1	FCC charge rate (bpd)	39,482	35,012	35,003	
P_2	NH_3 injection (lb/hr)	4.7	4.6	4.4	
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	
Gas Conditions					
O_2	Oxygen (dry volume %)	1.8	2.0	1.9	**1.9**
CO_2	Carbon dioxide (dry volume %)	16.3	16.1	16.2	**16.2**
B_w	Actual water vapor in gas (% by volume)[1]	10.2	12.4	11.1	**11.3**
Gas Flow Rate[2]					
Q_{std}	Volumetric flow rate, dry standard (dscfm)	71,200	61,400	63,300	**65,300**
THC Results					
C_{sd}	Concentration (ppmdv as C_3H_8)	2.34	1.97	2.24	**2.18**
C_{sd}	Concentration (lb/dscf)	2.68E-07	2.25E-07	2.56E-07	**2.50E-07**
$E_{lb/hr}$	Emission Rate (lb/hr)	1.14	0.830	0.973	**0.982**
$E_{T/yr}$	Emission Rate (Ton/yr)	5.01	3.63	4.26	**4.30**
E_{Rp}	Emission Rate - Production-based (lb/Mlb coke)	5.30E-02	4.34E-02	5.11E-02	**4.91E-02**
Methane Results					
C_{sd}	Concentration (ppmdv)	<0.210	0.480	<0.210	**<0.300**
C_{sd}	Concentration (lb/dscf)	<8.74E-09	2.00E-08	<8.74E-09	**<1.25E-08**
$E_{lb/hr}$	Emission Rate (lb/hr)	< 0.0373	0.0737	< 0.0332	**< 0.0481**
$E_{T/yr}$	Emission Rate (Ton/yr)	< 0.164	0.323	< 0.145	**< 0.211**
E_{Rp}	Emission Rate - Production-based (lb/Mlb coke)	<1.73E-03	3.85E-03	<1.74E-03	**<2.44E-03**
Ethane Results					
C_{sd}	Concentration (ppmdv)	<0.390	<0.390	<0.390	**<0.390**
C_{sd}	Concentration (lb/dscf)	<3.04E-08	<3.04E-08	<3.04E-08	**<3.04E-08**
$E_{lb/hr}$	Emission Rate (lb/hr)	< 0.130	< 0.112	< 0.116	**< 0.119**
$E_{T/yr}$	Emission Rate (Ton/yr)	< 0.569	< 0.491	< 0.506	**< 0.522**
E_{Rp}	Emission Rate - Production-based (lb/Mlb coke)	<6.02E-03	<5.87E-03	<6.06E-03	**<5.98E-03**
VOC Results					
$E_{lb/hr}$	Emission Rate (lb/hr)	1.14	0.756	0.973	**0.958**
$E_{T/yr}$	Emission Rate (Ton/yr)	5.01	3.31	4.26	**4.20**
E_{Rp}	Emission Rate - Production-based (lb/Mlb coke)	5.30E-02	3.95E-02	5.11E-02	**4.79E-02**

Average includes 3 runs.

[1] Moisture data used for ppmwv to ppmdv correction obtained from nearly-concurrent Draft ASTM CCM runs.

[2] Flow data used in lb/hr calculations was obtained from nearly-concurrent M-2F test runs.

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

For all calcuated averages, "<" values are treated as the entire value of the detection limit.

080410 154528

End of Section 2 – Results

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 Fluid Catalytic Cracking Unit (EU11-FCCU-S1) utilizes a primary reactor, a distillation column and a catalyst regeneration unit to continuously generate light hydrocarbon products from heavy crude oil feeds. The FCCU is equipped with an ESP with two (2) bays and variable aqueous NH_3 injection to control emissions. Emissions are vented to the atmosphere via the FCCU Regenerator Stack (SVFCCU).

The testing described in this document was performed at the FCCU Regenerator Stack.

DESCRIPTION OF SAMPLING LOCATIONS

Sampling point locations were determined according to USEPA Method 1.

Table 3-1 outlines the sampling point configurations. The figures shown on pages 3-2 and 3-3 illustrate the sampling points and orientation of sampling ports.

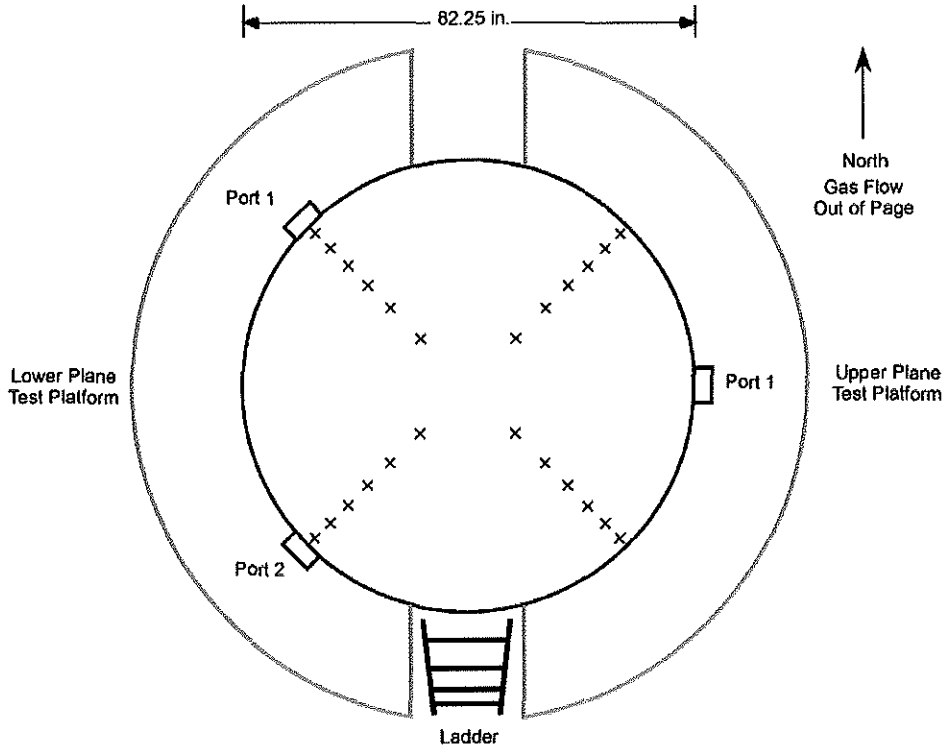
Table 3-1:
Sampling Points

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
FCCU Regenerator Stack							
Flow Rate	USEPA 2F	1-3	2	12	varied	varied	3-1
H_2SO_4	Draft ASTM CCM	1-3	1	1	60	60	N/A[1]
O_2 / CO_2 / CH_4 / C_2H_6 / THC	USEPA 3A / 18 / 25A	1-3	1	1	60	60	N/A[1]

[1] Sampling occured at a single point near the center of duct.

090116 152100

DESCRIPTION OF INSTALLATION



Note: Ports on the lower plane were used for these points.

Traverse Point	Port to Point Distance (in.)
1	80.5
2	76.7
3	72.5
4	67.7
5	61.7
6	53.0
7	29.3
8	20.6
9	14.6
10	9.7
11	5.5
12	1.7

Duct diameters upstream from flow disturbance (A):	2.2	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	3.4	Limit: 2.0

Figure 3-1: USEPA Method 2F Traverse Points

End of Section 3 – Description of Installation

METHODOLOGY

Clean Air Engineering followed procedures as detailed in USEPA Methods 1, 2, 2F, 3, 3A, 4, 18, 25A, and the Draft ASTM Controlled Condensation Method (CCM). The following table summarizes the methods and their respective sources.

Table 4-1:
Summary of Sampling Procedures

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 2F	"Determination of Stack Gas Velocity And Volumetric Flow Rate with Three-Dimensional Probes"
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 3B	"Gas Analysis for the Determination of Emission Rate Correction Factor or Excess Air"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 18	"Measurement of Gaseous Organic Compound Emissions by Gas Chromatography"
Method 25A	"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"
Draft Methods	
Draft ASTM CCM	"Standard Test Method for Determination of Sulfur Trioxide and Sulfuric Acid Vapor and Mist, from Stationary Sources Using a Controlled Condensation Sampling System"

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and are located on the internet at http://ecfr.gpoaccess.gov.

Diagrams of the sampling apparatus and major specifications of the sampling, recovery and analytical procedures are summarized for each method in Appendix A.

CleanAir followed specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and as prescribed in CleanAir's internal Quality Manual. Results of all QA/QC activities performed by CleanAir are summarized in Appendix D.

METHODOLOGY

H_2SO_4 Testing - Draft ASTM Controlled Condensation Method

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

A gas sample was extracted from the source at a constant flow rate using a quartz-lined probe maintained at 650°F and a quartz fiber filter maintained at 650°F 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) located at the condenser outlet collected any residual sulfuric acid mist that passed through the condenser. The condenser temperature was regulated by a circulating water jacket; the SAM filter temperature was regulated by a closed oven. Both the water jacket and SAM filter oven were maintained at 140°F ±9°F (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 calibrated dry gas meter where the collected sample gas volume was determined.

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 disassociated into sulfate ion (SO_4^{2-}) was stabilized in the H_2O matrix until analysis.

A field train blank was assembled, transported to the location, heated, leak-checked and recovered as if it were an actual test sample. Reagent blanks were collected to quantify background contamination.

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

O_2, CO_2, and VOC Testing - USEPA Methods, 3A, 18, and 25A

O_2 and CO_2 emissions were determined using a paramagnetic/NDIR analyzer per EPA Method 3A. VOC emissions were determined using USEPA Method 25A to quantify total hydrocarbon emissions (THC) and USEPA Method 18 to quantify methane (CH_4) and ethane (C_2H_6) emissions. VOC emissions are equivalent to THC emissions, minus CH_4 and C_2H_6 emissions.

METHODOLOGY

The Method 3A/18/25A sampling system consisted of a heated probe, heated filter and heated sample line. Flue gas was extracted at a constant rate and delivered at 250°F to a tee at the end of the heated sample line.

- One leg of the tee was connected 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.
- The other leg of the tee was connected to a gas conditioner which removed moisture before delivering the gas to a flow panel and the O_2/CO_2 analyzers which measured concentration on a dry basis (units of %dv or ppmdv).
- The Method 18 gas sample was collected by pulling a slipstream from the flow panel and delivered it into a Tedlar bag at a constant rate. The moisture condensate was not collected for analysis as CH_4 and C_2H_6 are insoluble in water. Each bag was filled over a period of approximately one (1) hour for each test run.

THC analyzer 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.

O_2 / CO_2 calibration error checks were performed by introducing zero nitrogen (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 Method 3A, the average results for each run were drift-corrected.

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 and GC analysis, the concentration results were on a dry basis. At least five (5) sample injections were analyzed for each run.

GC 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 two (2) 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.

METHODOLOGY

General Considerations

A traditional verification of the absence of cyclonic flow following Method 1 specifications was not performed. However, the resultant angle of flow was determined from each Method 2F flow traverse and found to be less than 20° in all instances. Data is included in Appendix G.

H_2O data used for moisture correction of concentration data was obtained (when required) in the following manner during the test program:

- For Method Draft ASTM CCM, Method 4 measurements are incorporated into the sampling train and recovery procedures.
- For Method 3A/18/25A, H_2O data was obtained from most concurrently-operated Draft ASTM CCM sample trains.

O_2, CO_2, H_2O data used for Method 2F flow calculations was obtained from the most concurrently operated Draft ASTM CCM sample trains.

End of Section 4 – Methodology