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SOURCE TEST REPORT
2021 COMPLIANCE EMISSIONS TESTING

GENERAL MOTORS LLC - SAGINAW METAL CASTING OPERATIONS (SMCO)
SAGINAW, MICHIGAN

EU-PSANDCASTLINE AND EU-PSANDSCCSH

Prepared For:

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For Submittal To:

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B1991

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Document Number: **MW049AS-007179-RT-827**
Test Dates: **September 1-2, 2021**
Submittal Date: **October 21, 2021**

ACCREDITED
TO ASTM D7036 ONLY
CERT #5925.01

MONTROSE
AIR QUALITY SERVICES

REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature: David Trahan Date: 10 / 13 / 2021

Name: David Trahan Title: Field Project Manager

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature: Todd Wessel Date: 10 / 13 / 2021

Name: Todd Wessel Title: Client Project Manager

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1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

General Motors LLC-Saginaw Metal Casting Operations (GM-SMCO) (State Registration No: B1991) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance test program on the EU-PSANDSCCSH and EU-PSANDCASTLINE at the GM-SMCO facility located in Saginaw, Michigan. Testing was performed on September 1-2, 2021, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operation Permit No. MI-ROP-B1991-2021.

The specific objectives were to:

- Verify the emissions of filterable particulate matter (FPM), particulate matter <10µm (PM_{10}), particulate matter <2.5µm ($PM_{2.5}$), nitrogen oxides (NO_x) (as NO_2), and volatile organic compounds (VOC) at the regenerative thermal oxidizer (RTO) exhaust stack serving EU-PSANDCASTLINE
- Verify the emissions of FPM, PM_{10}, $PM_{2.5}$, and VOC at the baghouse exhaust stack serving EU-PSANDSCCSH
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

TABLE 1-1
SUMMARY OF TEST PROGRAM

Test Date	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
9/1/2021	EU-PSANDCASTLINE	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	60
9/1/2021	EU-PSANDCASTLINE	O_2, CO_2	EPA 3A	3	60
9/1/2021	EU-PSANDCASTLINE	Moisture	EPA 4	3	60
9/1/2021	EU-PSANDCASTLINE	FPM	EPA 5	3	60
9/1/2021	EU-PSANDCASTLINE	$PM_{10}/PM_{2.5}$	EPA 5/202	3	60
9/1/2021	EU-PSANDCASTLINE	NO_x	EPA 7E	3	60
9/1/2021	EU-PSANDCASTLINE	VOC	EPA 25A	3	60

TABLE 1-1
SUMMARY OF TEST PROGRAM (CONTINUED)

Test Date	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
9/2/2021	EU-PSANDSCCSH	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	60
9/2/2021	EU-PSANDSCCSH	O_2, CO_2	EPA 3A	3	60
9/2/2021	EU-PSANDSCCSH	Moisture	EPA 4	3	60
9/2/2021	EU-PSANDSCCSH	FPM	EPA 5	3	60
9/2/2021	EU-PSANDSCCSH	$PM_{10}/PM_{2.5}$	EPA 5/202	3	60
9/2/2021	EU-PSANDSCCSH	VOC	EPA 25A	3	60

To simplify this report, a list of Units and Abbreviations is included in Appendix D.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Table 1-2 through 1-3. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-4. The tests were conducted according to the Test Plan notification that was received by EGLE on July 27, 2021 and approved on August 20, 2021.

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EU-PSANDCASTLINE
SEPTEMBER 1, 2021

Parameter/Units	Average Results	Emission Limits
Filterable Particulate Matter (FPM)		
lb/hr*	<0.14	2.85
Particulate Matter (PM_{10}) †		
lb/hr*	<0.57	5.55
Particulate Matter ($PM_{2.5}$) †		
lb/hr*	<0.57	5.55
Nitrogen Oxides (NO_x as NO_2)		
lb/hr	1.10	4.46
Volatile Organic Compounds (VOC), as Propane		
lb/hr	1.38	4.07

* The "<" symbol indicates that compounds were below the Minimum Detection Limit (MDL) of the analytical method. See Section 4.2 for details.

† See Section 3.1.8 for details

TABLE 1-3
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EU-PSANDSCCSH
SEPTEMBER 2, 2021

Parameter/Units	Average Results	Emission Limits
Filterable Particulate Matter (FPM)		
lb/hr	0.07	2.36
Particulate Matter (PM_{10})*		
lb/hr	0.22	4.73
Particulate Matter ($PM_{2.5}$)*		
lb/hr	0.22	4.73
Volatile Organic Compounds (VOC), as Propane		
lb/hr	6.46	3.99

* See Section 3.1.8 for details

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	General Motors - Saginaw Metal Casting Operations (SMCO) 1629 N. Washington Ave. Saginaw, MI 48601	
Project Contact:	Ken Fryer	Jeff Hummel
Role:	Sr. Environmental Engineer	Sr. Environmental Project Engineer
Company:	General Motors - SMCO	General Motors
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Agency Information

Regulatory Agency:	EGLE
Agency Contact:	Karen Kajiya-Mills
Telephone:	517-256-0880
Email:	Kajiya-millsk@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC	
Contact:	David Trahan	Todd Wessel
Title:	Field Project Manager	Client Project Manager
Telephone:	248-548-8070	248-548-8070
Email:	dtrahan@montrose-env.com	twessel@montrose-env.com

Laboratory Information

Laboratory:	Montrose Air Quality Services
City, State:	Royal Oak, MI
Method:	EPA 5
Laboratory:	Enthalpy Analytical, LLC
City, State:	Durham, NC
Method:	EPA 202

Test personnel and observers are summarized in Table 1-4.

TABLE 1-4
TEST PERSONNEL AND OBSERVERS

Name	Affiliation	Role/Responsibility
Matthew Young	Montrose	District Manager, QI
Michael Nummer	Montrose	Field Technician
Scott Dater	Montrose	Field Technician
Ken Fryer	GM-SMCO	Observer/Client Liaison/Test Coordinator
Jeff Hummel	General Motors LLC	Observer/Client Liaison/Test Coordinator
Jeremy Howe	EGLE	Observer

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

The PSANDCASTLINE process consists of aluminum pouring and cooling, shakeout, and chill plate cleaning operations. Emissions from pouring, cooling and chill plate removal are controlled through a 30,000 scfm cartridge collector followed by the 60,000 scfm regenerative thermal oxidizer. Emissions from shakeout are controlled through a 30,000 scfm fabric filter collector followed by the same 60,000 scfm regenerative thermal oxidizer. A natural gas-fired duct burner is used to keep the inlet air temperature to the baghouse above 120 degrees F. This is to prevent any organics from condensing in the duct work. The natural gas-fired RTO operates at a minimum temperature of 1,400°F.

PSANDSCCSH consists of sand handling processes downstream of the PS pouring and cooling operations and waste sand handling from the PS core room and finishing. The sand handling consists primarily of sand from PSANDSCCSH shakeout in the form of broken cores and molds that is transferred by conveyor to the didion drum. Scrap cores from the precision sand core room and finishing are transported to the precrusher and then sent to the didion drum on a conveyor for processing. Sand output from the didion drum is transported on a conveyor to the sand transport hopper, and from the hopper, pneumatically transferred to the pre-reclaim sand silo of EU-PSANDPROCESS. Emissions are vented to a 35,000 scfm fabric filter collector.

2.2 FLUE GAS SAMPLING LOCATIONS

Information regarding the sampling locations is presented in Table 2-1.

TABLE 2-1
SAMPLING LOCATIONS

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EU-PSANDCASTLINE RTO Exhaust Stack	65.0	540.0 / 8.3	180.0 / 2.8	Isokinetic: 24 (12/port); Gaseous: 3
EU-PSANDSCCSH Baghouse Exhaust Stack	27.0	336.0 / 12.4	120.0 / 4.4	Isokinetic: 12 (6/port); Gaseous: 3

The Sampling locations were verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendix A.1 for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while EU-PSANDCASTLINE and EU-PSANDSCCSH and air pollution control devices were operating at the conditions required by the permit. EU-PSANDCASTLINE and EU-PSANDSCCSH were tested following the process production capacities listed in Section 2.3 Table 1 of the Test Plan in Appendix E.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Machine Names
- Parts Count

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 1, Sample and Velocity Traverses for Stationary Sources

EPA Method 1 is used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into equal areas, and then locating a traverse point within each of the equal areas. Acceptable sample locations must be located at least two stack or duct equivalent diameters downstream from a flow disturbance and one-half equivalent diameter upstream from a flow disturbance.

3.1.2 EPA Method 2, Determination of Stack gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

EPA Method 2 is used to measure the gas velocity using an S-type pitot tube connected to a pressure measurement device, and to measure the gas temperature using a calibrated thermocouple connected to a thermocouple indicator. Typically, Type S (Stausscheibe) pitot tubes conforming to the geometric specifications in the test method are used, along with an inclined manometer. The measurements are made at traverse points specified by EPA Method 1.

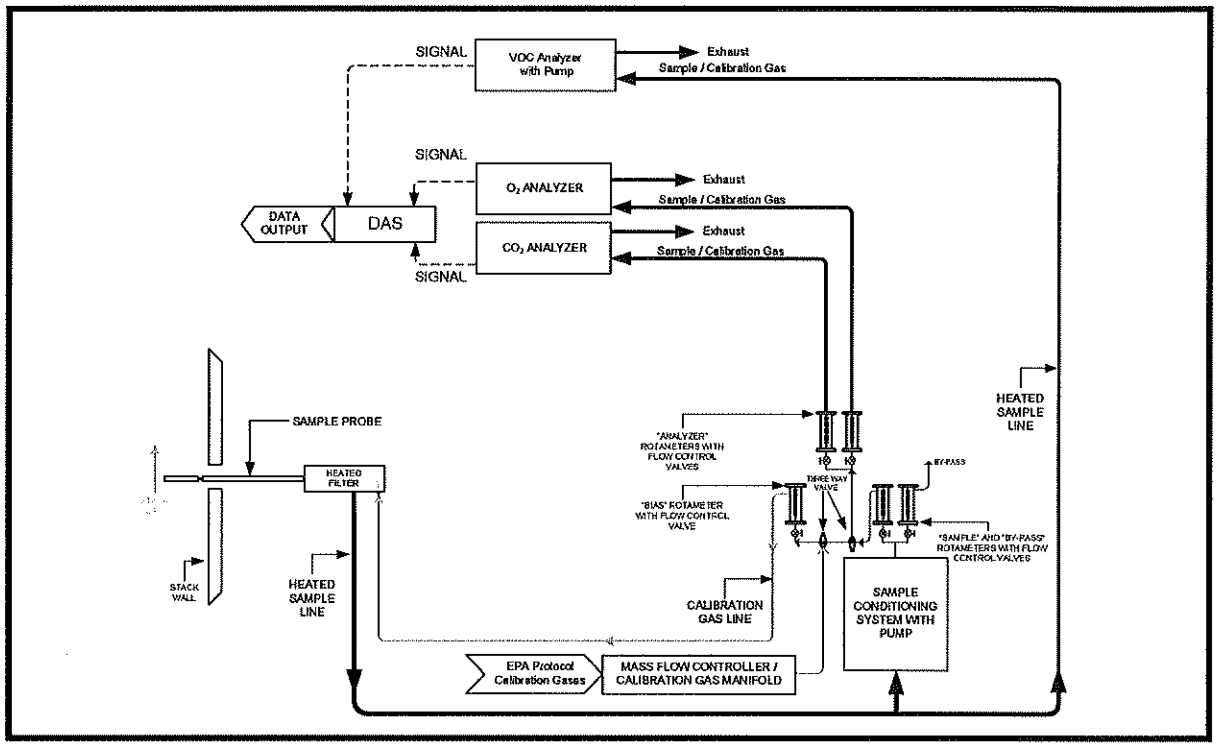
3.1.3 EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 3A is an instrumental test method used to measure the concentration of O_2 and CO_2 in stack gas. Conditioned stack gas is sent to O_2 and CO_2 analyzers to measure the concentration of O_2 and CO_2. The performance requirements of the method must be met to validate data.

The typical sampling system is detailed in Figure 3-1.

During this test event bag samples collected at EU-PSANDCASTLINE RTO Exhaust Stack on 9/1/2021 were analyzed on 9/2/2021 utilizing the analyzers detailed in Figure 3-1.

FIGURE 3-1
EPA METHOD 3A AND 25A SAMPLING TRAIN



3.1.4 EPA Method 4, Determination of Moisture Content in Stack Gas

EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

3.1.5 EPA Method 5, Determination of Particulate Matter from Stationary Sources

EPA Method 5 is a manual, isokinetic method used to measure FPM emissions. The samples are analyzed gravimetrically. This method is performed in conjunction with EPA Methods 1 through 4. The stack gas is sampled through a nozzle, probe, filter, and impinger train. FPM results are reported in emission concentration and emission rate units.

The typical sampling system is detailed in Figure 3-3.

3.1.6 EPA Method 7E, Determination of Nitrogen Oxides Emissions from Stationary Source (Instrumental Analyzer Procedure)

EPA Method 7E is an instrumental test method used to continuously measure emissions of NO_x as NO_2.in stack gas. Conditioned stack gas is sent to a NO_x analyzer to measure the concentration of NO_x. NO and NO_2 can be measured separately or simultaneously together but,

for the purposes of this method, NO_x is the sum of NO and NO_2. The performance requirements of the method must be met to validate the data.

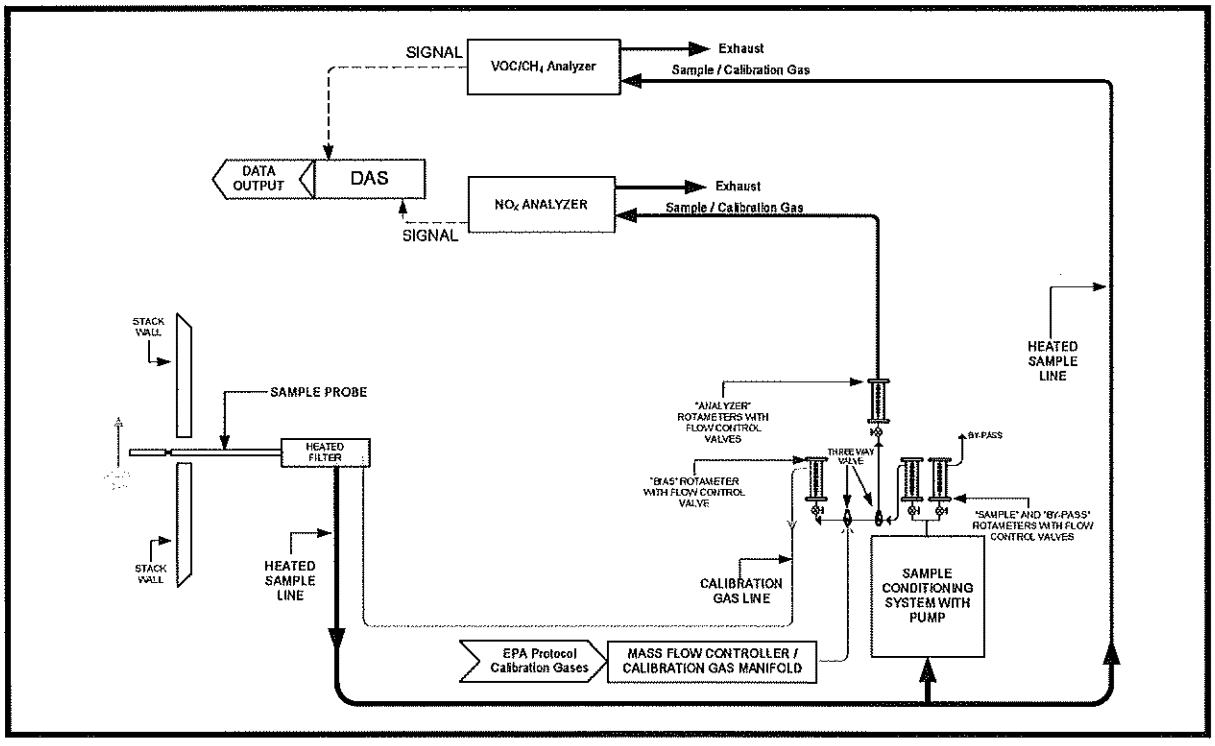
The typical sampling system is detailed in Figure 3-1.

3.1.7 EPA Method 25A, Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

EPA Method 25A is an instrumental test method used to measure the concentration of THC in stack gas. A stack gas sample is extracted from the source through a heated sample line and glass fiber filter to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

The typical sampling system is detailed in Figures 3-1 and 3-2

FIGURE 3-2
EPA METHOD 7E AND 25A SAMPLING TRAIN



3.1.8 EPA Method 202, Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources

Condensable Particulate Matter (CPM) is collected in dry impingers after filterable PM (FPM) has been collected on a filter maintained as specified in either Method 5 of Appendix A-3 to 40 CFR 60, Method 17 of Appendix A-6 to 40 CFR 60, or Method 201A of Appendix M to 40 CFR 51. The organic and aqueous fractions of the impingers and an out-of-stack CPM filter are then taken to dryness and weighed. The total of the impinger fractions and the CPM filter represents

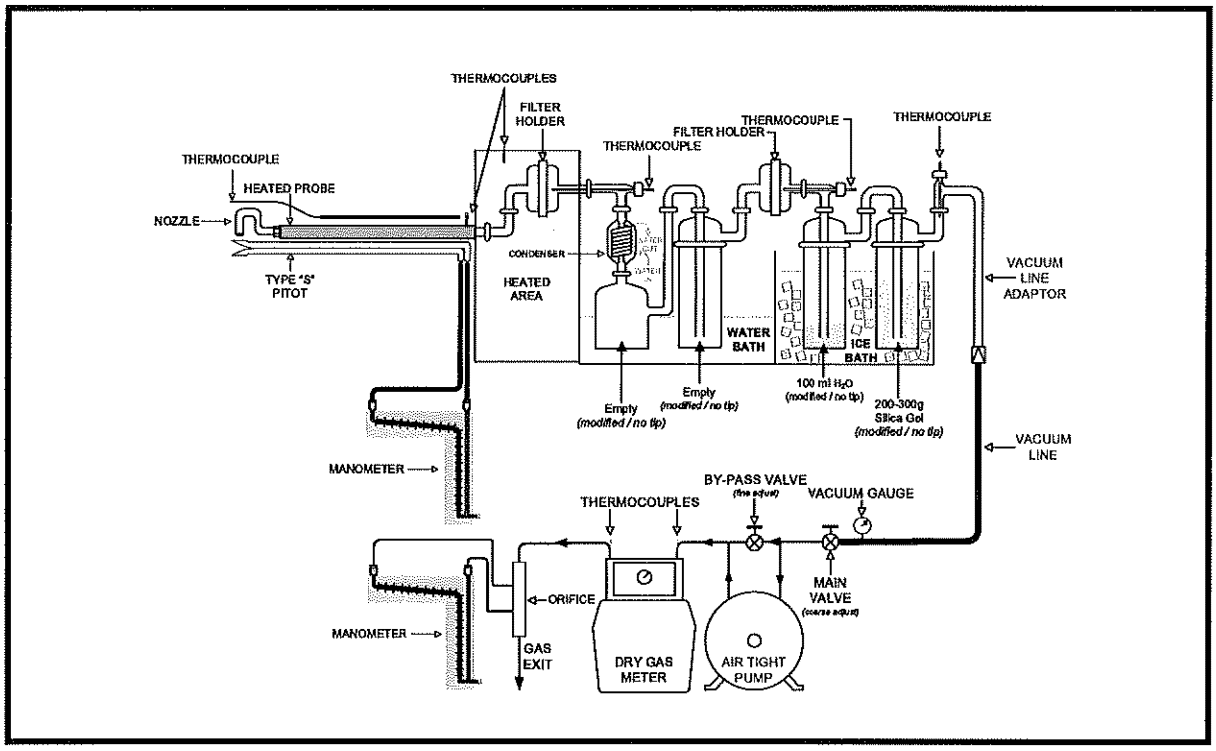
the CPM. Compared to the version of Method 202 that was promulgated on December 17, 1991, this method eliminates the use of water as the collection media in impingers and includes the addition of a condenser followed by a water dropout impinger immediately after the final in-stack or heated filter. This method also includes the addition of one modified Greenburg Smith impinger (backup impinger) and a CPM filter following the water dropout impinger.

CPM is collected in the water dropout impinger, the modified Greenburg Smith impinger, and the CPM filter of the sampling train as described in this method. The impinger contents are purged with nitrogen immediately after sample collection to remove dissolved SO_2 gases from the impinger. The CPM filter is extracted with water and hexane. The impinger solution is then extracted with hexane. The organic and aqueous fractions are dried and the residues are weighed. The total of the aqueous and organic fractions represents the CPM.

The potential artifacts from SO_2 are reduced using a condenser and water dropout impinger to separate CPM from reactive gases. No water is added to the impingers prior to the start of sampling. To improve the collection efficiency of CPM, an additional filter (the "CPM filter") is placed between the second and third impingers. For this test, PM_{10} and $PM_{2.5}$ were assumed to be the sum of the FPM and CPM fraction.

The typical sampling system is detailed in Figure 3-3.

FIGURE 3-3
EPA METHOD 5/202 SAMPLING TRAIN



3.2 PROCESS TEST METHODS

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

4.0 TEST DISCUSSION AND RESULTS

4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

O_2 concentrations measured from bag samples obtained at the EU-PSANDCASTLINE RTO Exhaust Stack for Runs 1 through 3 exceeded the span of the EPA Method 3A analyzer for the duration of the sampling period.

O_2 concentrations measured at the EU-PSANDSCCSH Baghouse Exhaust Stack for Runs 1 through 3 exceeded the span of the EPA Method 3A analyzer for the duration of the sampling period.

4.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Tables 1-2 and 1-3. The results of individual compliance test runs performed are presented in Tables 4-1 and 4-2. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

Concentration values in Tables 1-2 and 4-1 denoted with a '<' were measured to be below the minimum detection limit (MDL) of the applicable analytical method. Emissions denoted with a '<' in Table 1-2 and 4-1 were calculated utilizing the applicable MDL concentration value instead of the "as measured" concentration value.

Emissions in Tables 1-2, 1-3, 4-1, and 4-2 utilized O_2 concentrations that were above the span of the analyzer. See Section 4.1 for details.

TABLE 4-1
FPM, PM_{10}, $PM_{2.5}$, NO_X, AND VOC EMISSIONS RESULTS - EU-PSANDCASTLINE

Run Number	1	2	3	Average
Date	9/1/2021	9/1/2021	9/1/2021	--
Time	9:30-10:36	11:55-13:01	13:28-14:30	--
Flue Gas Parameters				
O_2, % volume dry	20.92	20.70	20.74	20.79
CO_2, % volume dry	0.14	0.25	0.25	0.21
flue gas temperature, °F	219.1	222.6	225.5	222.4
moisture content, % volume	2.29	2.02	1.97	2.09
volumetric flow rate, dscfm	44,609	43,988	44,701	44,432
Filterable Particulate Matter (FPM)				
gr/dscf*	<0.00034	<0.00034	0.00041	<0.00036
lb/hr*	<0.13	<0.13	0.16	<0.14
Condensable Particulate Matter (CPM)				
gr/dscf	0.00093	0.00146	0.00101	0.00114
lb/hr	0.36	0.55	0.39	0.43
Particulate Matter < 10 µm (PM_{10}) †				
gr/dscf*	<0.00127	<0.00181	0.0014	0.0015
lb/hr*	<0.48	<0.68	0.54	0.57
Particulate Matter < 2.5 µm ($PM_{2.5}$) †				
gr/dscf*	<0.00127	<0.00181	<0.00142	<0.00150
lb/hr*	<0.48	<0.68	<0.54	<0.57
Nitrogen Oxides (NO_x as NO_2)				
ppmvd	3.47	3.25	3.63	3.45
lb/hr	1.11	1.03	1.16	1.10
Total Gaseous Organic Compounds (TGO), as Propane				
ppmvd	5.39	4.71	5.35	5.15
Methane (CH_4), as Propane				
ppmvd	0.66	0.66	0.57	0.63
Volatile Organic Compounds (VOC), as Propane				
ppmvd	4.71	4.04	4.77	4.51
lb/hr	1.44	1.22	1.47	1.38

* The "<" symbol indicates that compounds were below the Minimum Detection Limit (MDL) of the analytical method for Runs 1 and 2. See Section 4.2 for details.

† See Section 3.1.8 for details

TABLE 4-2
FPM, PM_{10}, $PM_{2.5}$, AND VOC EMISSIONS RESULTS - EU-PSANDSCCSH

Run Number	1	2	3	Average
Date	9/2/2021	9/2/2021	9/2/2021	--
Time	13:28-14:33	15:08-16:11	16:41-17:44	--
Flue Gas Parameters				
O_2, % volume dry	21.15	21.08	21.10	21.11
CO_2, % volume dry	0.07	0.00	0.01	0.02
flue gas temperature, °F	98.8	109.3	108.7	105.6
moisture content, % volume	1.32	1.29	1.23	1.28
volumetric flow rate, dscfm	19,823	19,418	19,578	19,606
Filterable Particulate Matter (FPM)				
gr/dscf	0.00041	0.00058	0.00033	0.00044
lb/hr	0.07	0.10	0.06	0.07
Condensable Particulate Matter (CPM)				
gr/dscf	0.0006	0.0012	0.0007	0.0009
lb/hr	0.11	0.21	0.12	0.15
Particulate Matter < 10 µm (PM_{10})*				
gr/dscf	0.0010	0.0018	0.0011	0.0013
lb/hr	0.18	0.30	0.18	0.22
Particulate Matter < 2.5 µm ($PM_{2.5}$)*				
gr/dscf	0.0010	0.0018	0.0011	0.0013
lb/hr	0.18	0.30	0.18	0.22
Total Gaseous Organic Compounds (TGO), as Propane				
ppmvd	23.5	58.2	67.4	49.7
Methane (CH_4), as Propane				
ppmvd	1.76	1.62	1.42	1.60
Volatile Organic Compounds (VOC), as Propane				
ppmvd	21.7	56.5	66.0	48.1
lb/hr	2.96	7.54	8.87	6.46

* See Section 3.1.8 for details

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

The meter boxes and sampling trains used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes, minimum sample durations, and percent isokinetics met the applicable QA/QC criteria.

EPA Method 3A and 7E calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

EPA Method 25A FIA calibration audits were within the measurement system performance specifications for the calibration drift checks and calibration error checks.

The NO_2 to NO converter efficiency check of the analyzer was conducted per the procedures in EPA Method 7E, Section 8.2.4. The conversion efficiency met the criteria.

An EPA Method 205 field evaluation of the calibration gas dilution system was conducted. The dilution accuracy and precision QA specifications were met.

EPA Method 5 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met. An EPA Method 5 reagent blank was analyzed. The maximum allowable amount that can be subtracted is 0.001% of the weight of the acetone blank. The blank did not exceed the maximum residue allowed.

EPA Method 202 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met. An EPA Method 202 Field Train Recovery Blank (FTRB) was performed for each source category. The maximum allowable amount that can be subtracted is 0.002 g (2.0 mg). For this project, the FTRB had a mass of 3.7 mg, and 2.0 mg was subtracted.

5.2 QA/QC DISCUSSION

See Section 4.1.

5.3 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).