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GENERAL MOTORS

SAGINAW, MICHIGAN

SAGINAW METAL CASTINGS OPERATIONS (SMCO): SPM CASTLINES 2 AND 3

RWDI #2205601

November 1, 2022

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by General Motors (GM) to complete the emission sampling program at the Saginaw Metal Casting Operations (SMCO) plant located at 1629 North Washington Avenue, Saginaw, Michigan. The purpose of the emissions test program was to evaluate particulate matter and condensable particulate matter from EU-SPMCASTLINE (Castlines 2 and 3) (Sections #1 and #2) for compliance purposes.

This emissions testing program included evaluation of total particulate matter (TPM) from the outlet of Castline 2 and 3 for EU-SPMCASTLINE. The test program was completed from September 21, 2022.

Executive Table i: Results Summary – EU-SPMCASTLINE (Castline 2 and 3)

Parameter	Units	Units	Test 1	Test 2	Test 3	Average
PM/PM₁₀/PM_{2.5} Emission Rate	Castline 2	lb/hr	0.34	1.53	0.94	0.94
	Castline 3	lb/hr	0.54	0.66	0.65	0.62
	Total EU-SPMCASTLINE	lb/hr	0.88	2.19	1.59	1.56
ROP Limit (lb/hr)						7.07 (Total)



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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by General Motors (GM) to complete the emission sampling program at the Saginaw Metal Casting Operations (SMCO) plant located at 1629 North Washington Avenue, Saginaw, Michigan. The purpose of the emissions test program was to evaluate particulate matter and condensable particulate matter from EU-SPMCASTLINE 2 and 3 (Sections #1 and #2) for compliance purposes.

This emissions testing program included evaluation of total particulate matter (TPM) from the outlet of the EU-SPMCASTLINE2 and EU-SPMCASTLINE3. The test program was completed from September 21, 2022.

1.1 Location and Dates of Testing

The test program was completed on September 21st, 2022 at the GM SMCO facility.

1.2 Purpose of Testing

The emissions test program is required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) for SMCO, SRN B1991, that operates under Permit MI-ROP-B1991-2021b.

1.3 Description of Source

EU-SPMCASTLINE – Three cast lines with nominal maximum combined production rate of 106 castings per hour (2,460 casting per day) and a nominal maximum production rate of 53 casting per hour on any single casting line. The casting line referred to as Castline 1 ceased operations in December 2021 and is no longer operational.

Section #1: (3 modular units) making a final mold; mold filing; initial cooling; extraction; and cut sprue. Making a final mold includes mold and core assembly and mold heating with natural gas-fired 16 MMBtu/hr (total heat input rate) burners/torches. Mold filling is conducted by gravity pour. Initial cooling and solidification of the molten metal occurs inside the mold. Extraction of the casting (including sand cores) from the steel mold is completed by the casting extraction unload robot. Top core and down sprue removal. Additional cooling and complete solidification occur in the casting solidification buffer area. Sprue, risers, runners, and other internal scrap are collected and remelted.

Section #2: (3 identical modular units) extended casting cooling in the cooling garage.

Section #3: (2 identical modular units) Deflash, Decore, Degate. Finishing operations include the removal of excess metal and sand from the casting (EU-FINISH). Metal removed from the casting is collected and remelted. This Section is not being tested.



1.4 Personnel Involved in Testing

Table 1.4.1: Testing Personnel

Jeff Hummel Senior Environmental Project Engineer Jeffrey.Hummel@gm.com	General Motors	(517) 719-9053
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Daniel J Droste Environmental Quality Analyst drosted3@michigan.gov	State of Michigan EGLE Technical Programs Unit	(989) 225-6052

2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing included natural gas usage, total casts produced, and differential pressure of baghouse. This information can be found in **Appendix A**.

2.2 Applicable Permit Number

SRN B1991, operates under Permit MI-ROP-B1991-2021b.



3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

Refer to Section 1.3 for a description of the process.

Emissions control for Section #1 and Section #2 are two (2) 60,000 scfm fabric filter collectors (one for each castline).

3.2 Process Flow Sheet or Diagram

Each Castline has a single outlet. The figures can be found in the **Figure Section**.

3.3 Type and Quantity of Raw and Finished Materials

The raw material used in this process include molten aluminum and sand. Natural gas is used in the burners to preheat the molds.

3.4 Normal Rated Capacity of Process

Maximum production rate is 106 molds per hour, however, the process typically operates between 25 to 40 molds per hour. The pressure drop (in H₂O) was monitored during testing. Process data is provided in **Appendix A**.

3.5 Process Instrumentation Monitored During the Test

The automotive production line runs at a constant rate. For each castline, GM recorded the number of casts produced, amount of natural gas used and the differential pressure of each of the baghouses.

4 SAMPLING AND ANALYTICAL PROCEDURES

The emission test program utilized the following test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- **Method 1** – Sample and Velocity Traverses for Stationary Sources
- **Method 2** – Determination of Stack Gas Velocity and Volumetric Flowrate
- **Method 3** – Determination of Molecular Weight of Dry Stack Gases (fyrte)
- **Method 4** – Determination of Moisture Content in Stack Gases
- **Method 5** – Determination of Particulate Matter Emissions from Stationary Sources
- **Method 202** – Determination of Condensable Particulate Emissions from Stationary Sources

4.1 Stack Velocity, Temperature, and Volumetric Flow Rate

The exhaust velocities and flow rates were determined following the USEPA Method 2, "Determination of Stack Gas Velocity and Flow Rate (Type S Pitot Tube)". Velocity measurements were taken with a pre-calibrated S-Type pitot tube and incline manometer. Volumetric flow rates were determined following the equal area method as outlined in USEPA Method 2. Temperature measurements were made simultaneously with the velocity measurements and will be conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in USEPA Method 3, "Determination of Molecular Weight of Dry Stack Gas". Stack moisture content was determined through direct condensation and according to USEPA Method 4, "Determination of Moisture Content of Stack Gas". Moisture was collected during each of the Particulate Matter tests.

4.2 Particulate Matter and Condensable Particulate Matter

Particulate matter (PM/PM₁₀/PM_{2.5}) was sampled following procedures outlined in USEPA Modified Method 5/202. A stack sample was withdrawn isokinetically from the source, particulate emissions were collected in the probe and on a heated filter. Since the filtration temperature exceeded 85°F, Method 202 was followed for recovery of condensable. Nitrogen purges were completed post sample to remove sulphates for any of the sampling prior to the Method 202 sample being analyzed for Tests 2 and 3 (see modifications below).

Method 5 acetone rinse and filters were analyzed by RWDI's inhouse laboratory. The Method 202 samples were analyzed by ALS Global Laboratory in Burlington, Ontario.

4.3 Description of Recovery and Analytical Procedures

All sample recovery and analytical procedures following the prescribed methods of USEPA Method 1 to 5 and 202.

4.4 Sampling Port Description

All sampling ports meet USEPA Method 1 locations and can be found in the **Figure Section**.

5 TEST RESULTS AND DISCUSSION

5.1 Detailed Results

Detailed results for PM/PM₁₀/PM_{2.5} are provided in **Appendix B**.

Table 5.1.1: Results Summary – EU-SPMCASTLINE (Castline 2 and 3)

Parameter	Units	Units	Test 1	Test 2	Test 3	Average
PM/PM₁₀/PM_{2.5} Emission Rate	Castline 2	lb/hr	0.34	1.53	0.94	0.94
	Castline 3	lb/hr	0.54	0.66	0.65	0.62
	Total EU-SPMCASTLINE	lb/hr	0.88	2.19	1.59	1.56
					ROP Limit	7.07 (Total)

5.2 Discussion of Results

The detailed results can be found in the following Appendix:

- **Appendix B** – Summary of Particulate Matter Results

5.3 Variations in Testing Procedures

For Test 1, the testing duration was increased to 120 minutes from 60 mins since the M202 was determined to be necessary to complete the testing. At the end of Test 1 for Castline 2 and 3, nearby lightning strikes caused a delay in completing Test 1 for Castline 2 and caused a delay in the retrieval of both Test 1 samples from the sampling platforms. As such, no nitrogen purges were completed for Test 1. For Test 2 and 3, due to the delay with the storm, test durations were decreased to 60-minutes as originally approved.

All modifications were discussed with Mr. Droste, EGLE TPU, while on-site.

5.4 Process Upset Conditions During Testing

There were normal process breaks during production.

5.5 Maintenance Performed in Last Three Months

The baghouses were inspected in May of 2022 and the differential pressure gauges were calibrated in August of 2022.



5.6 Re-Test

This was not a retest.

5.7 Audit Samples

This test did not require any audit samples.

5.8 Particulate, Flows and Moisture

Results can be found in **Appendix B**.

5.9 Calibration Data

Calibration can be found in **Appendix C**.

5.10 Process Data

Process data can be found in **Appendix A**.

5.11 Example Calculations

Example calculations can be found in **Appendix D**.

5.12 Laboratory Data

Laboratory data can be found in **Appendix E**.

TABLES



Table 1: PM Results - Castline 2

Company	GM Castline			
Source	Castline 2			
Date	21-Sep-22	21-Sep-22	21-Sep-22	
Test Number	Test 1	Test 2	Test 3	Average
Stack Information				
Flow ft3 (Actual)	53,793	53,735	54,577	54,035
Flow ft3 (Standard Wet)	50,001	49,557	50,123	49,894
Flow ft3 (Standard Dry)	48,704	48,231	48,974	48,637
Flow m3 (Standard Dry)	1,379	1,366	1,387	1,377
Percent Moisture	2.6	2.7	2.3	2.5
Pressure Ps ("Hg)	29.03	29.03	29.03	29.03
Average Stack Temperature Ts (F)	91.1	95.4	97.8	94.8
Molecular Weight of Stack Gas dry (Md)	28.84	28.84	28.84	28.84
Molecular Weight of Stack Gas wet (Ms)	28.56	28.55	28.59	28.57
Stack Gas Specific Gravity (Gs)	1.0	1.0	1.0	1.0
Water Vapor Volume Fraction	0.026	0.027	0.023	0.025
Average Stack Velocity Vs (ft/sec)	59.6	59.6	60.5	59.9
Area of Stack (ft2)	15.0	15.0	15.0	15.0
Percent Carbon Dioxide	0.0	0.0	0.0	0.0
Percent Oxygen	21.0	21.0	21.0	21.0
Percent Carbon Monoxide	0.0	0.0	0.0	0.0
Meter Info				
Isokinetic Variation I	100.4	100.4	100.7	100.5
Meter Pressure Pm ("Hg)	29.2	29.2	29.2	29.2
Meter Temperature Tm (F)	71.5	76.4	81.9	76.6
Measured Sample Volume Vm	96.11	48.04	49.43	64.53
Sample Volume (Vm St ft3)	92.11	45.61	46.46	61.39
Sample Volume (Vm St m3)	2.61	1.29	1.32	1.74
Total Weight of Sampled Gas (m g lbs) wet	6.98	3.46	3.51	4.65
Total Weight of Sampled Gas (m g lbs) dry	6.87	3.40	3.46	4.58
Gas Density Ps wet	0.07	0.07	0.07	0.07
Gas Density Ps dry	0.07	0.07	0.07	0.07
Condensate Volume	2.45	1.25	1.09	1.60
Nozzle Size	0.00024	0.00024	0.00024	0.00
Impinger Gain	28.2	14.0	10.2	17.5
Silica Gel Gain	23.8	12.6	12.9	16.4
Particulate Results				
Nozzle/Probe/Filter Weight (mg)	0.5	5.0	0.5	2.0
Non-Extractable Condensible Particulate (mg)	2.6	4.2	3.9	3.6
Extractable Condensible Particulate (mg)	3.8	3.7	4.3	3.9
Condensible Blank Correction (mg)	2.0	2.0	2.0	2.0
Total Particulate (mg)	4.9	10.9	6.7	7.5
lb/hr	0.34	1.53	0.94	0.94

Table 2: PM Results - Castline 3

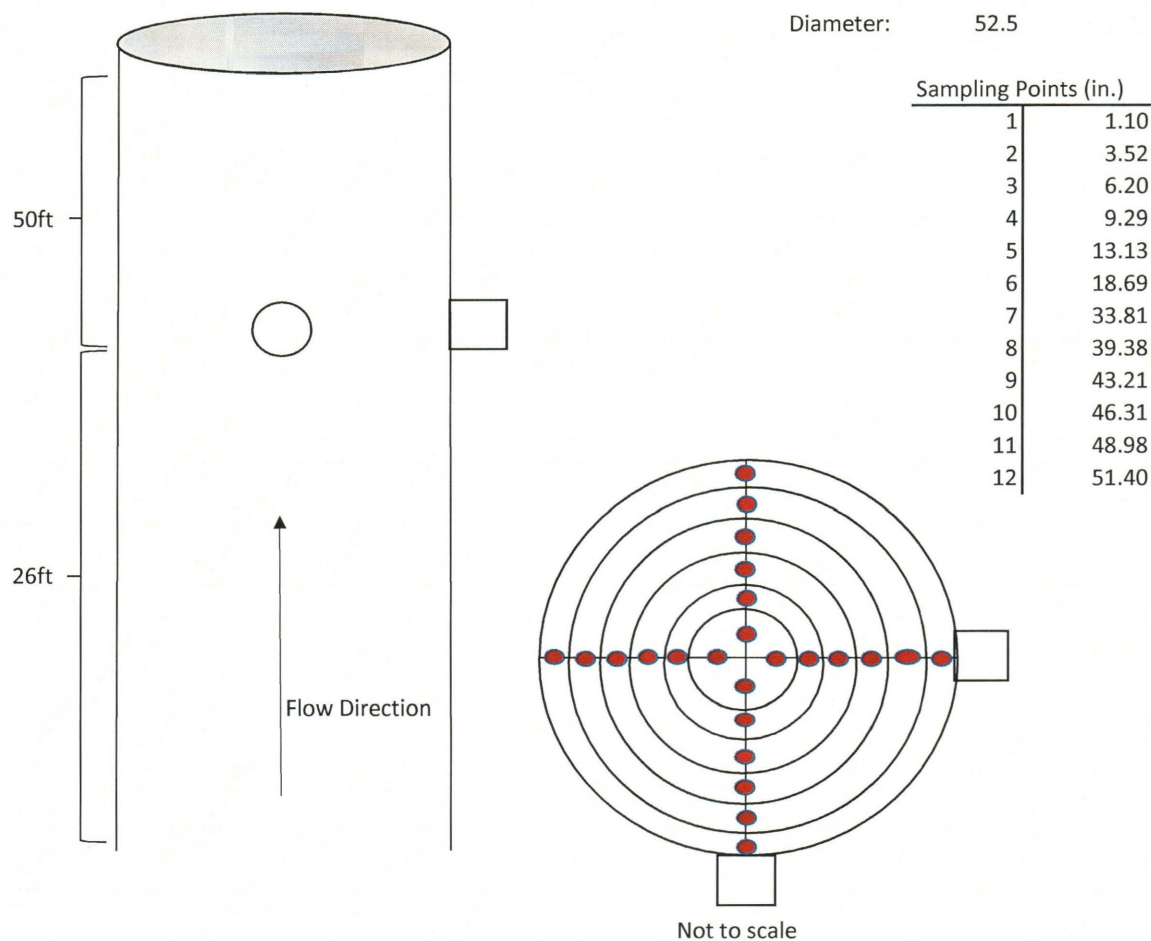
Company	GM SMCO			
Source	Castline 3 Outlet			
Date	21-Sep-22	21-Sep-22	21-Sep-22	
Test Number	Test 1	Test 2	Test 3	Average
Stack Information				
Flow ft3 (Actual)	50,314	50,091	50,222	50,209
Flow ft3 (Standard Wet)	47,061	46,133	46,233	46,476
Flow ft3 (Standard Dry)	46,329	45,114	45,217	45,553
Flow m3 (Standard Dry)	1,312	1,277	1,280	1,290
Percent Moisture	1.6	2.2	2.2	2.0
Pressure Ps ("Hg)	29.06	29.06	29.06	29.06
Average Stack Temperature Ts (F)	88.2	96.8	97.0	94.0
Molecular Weight of Stack Gas dry (Md)	28.84	28.84	28.84	28.84
Molecular Weight of Stack Gas wet (Ms)	28.67	28.60	28.60	28.62
Stack Gas Specific Gravity (Gs)	1.0	1.0	1.0	1.0
Water Vapor Volume Fraction	0.016	0.022	0.022	0.020
Average Stack Velocity Vs (ft/sec)	56.9	56.6	56.8	56.7
Area of Stack (ft2)	14.7	14.7	14.7	14.7
Percent Carbon Dioxide	0.0	0.0	0.0	0.0
Percent Oxygen	21.0	21.0	21.0	21.0
Percent Carbon Monoxide	0.0	0.0	0.0	0.0
Meter Info				
Isokinetic Variation I	99.5	99.9	99.9	99.8
Meter Pressure Pm ("Hg)	29.3	29.3	29.3	29.3
Meter Temperature Tm (F)	72.1	77.0	82.7	77.3
Measured Sample Volume Vm	108.16	53.35	54.03	71.85
Sample Volume (Vm St ft3)	105.44	51.52	51.64	69.53
Sample Volume (Vm St m3)	2.99	1.46	1.46	1.97
Total Weight of Sampled Gas (m g lbs) wet	7.94	3.89	3.90	5.25
Total Weight of Sampled Gas (m g lbs) dry	7.86	3.84	3.85	5.18
Gas Density Ps wet	0.07	0.07	0.07	0.07
Gas Density Ps dry	0.07	0.07	0.07	0.07
Condensate Volume	1.66	1.16	1.16	1.33
Nozzle Size	0.00028	0.00028	0.00028	0.00
Impinger Gain	9.9	13.9	12.2	12.0
Silica Gel Gain	25.4	10.8	12.4	16.2
Particulate Results				
Nozzle/Probe/Filter Weight (mg)	0.5	0.5	0.5	0.5
Non-Extractable Condensable Particulate (mg)	7.8	4.2	4.8	5.6
Extractable Condensable Particulate (mg)	2.9	3.0	2.3	2.7
Condensable Blank Correction (mg)	2.0	2.0	2.0	2.0
Total Particulate (mg)	9.2	5.7	5.6	6.8
lb/hr	0.54	0.66	0.65	0.62

FIGURES





Figure No. #1: EU-SPMCASTLINE (Castline 2) Traverse Points



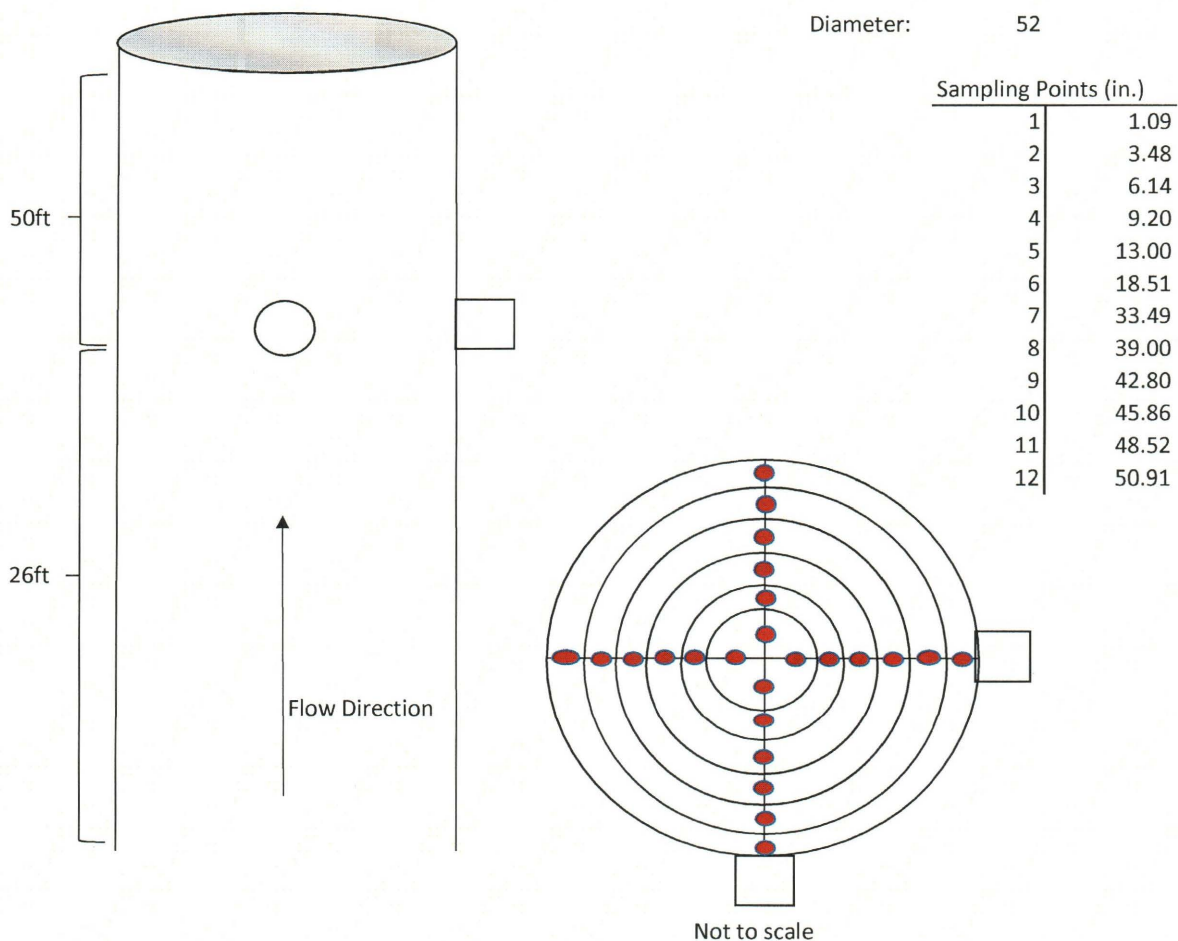
EU-SPMCASTLINES (Castline 2)
General Motors
Saginaw Metal Casting Operations
Saginaw, MI

Date:
21-Sept-22

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309



Figure No. #2: EU-SPMCASTLINE (Castline 3) Traverse Points



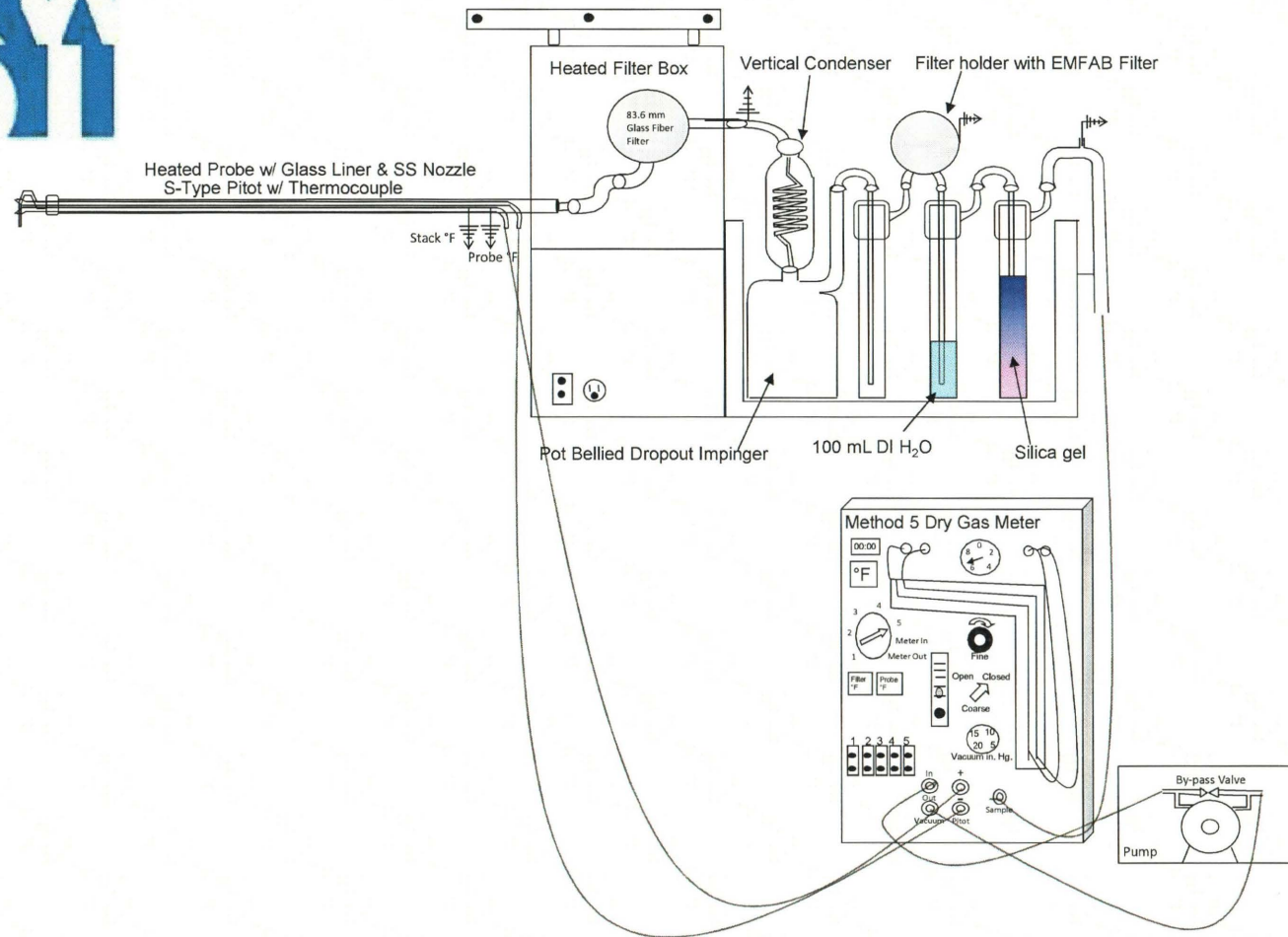
EU-SPMCASTLINES (Castline 3)
General Motors
Saginaw Metal Casting Operations
Saginaw, MI

Date:
21-Sep-22

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Rochester Hills, MI 48309



Figure No. # 3 - US EPA Method 5/202 (Alternative)



USEPA Method 5/202

General Motors

Saginaw Metal Castings Operations (SMCO)
Castlines 2 and 3
Saginaw, Michigan

Project 2205601

Date: September 21, 2022

