FINAL REPORT

GENERAL MOTORS, LLC (GM)

SAGINAW, MICHIGAN

SAGINAW METAL CASTINGS OPERATIONS (SMCO): PARTICULATE TESTING - EU-SPMPROCESSAND (BH4)

RWDI #2407194

September 28, 2024

SUBMITTED TO

Jeff Hummel
General Motors
Senior Environmental Project Engineer
Sustainable Workplaces
Jeffrey.Hummel@gm.com

David Thibeault
General Motors
Senior Environmental Leader
David.Thibeault@gm.com

General Motors
SMCO Plant
1629 North Washington Avenue
Saginaw, Michigan 48601

Jeremy Howe
Michigan Dept. of EGLE
Air Quality Division Technical Programs Unit (TPU)
Constitution Hall 2nd Floor, South
525 West Allegan Street

SUBMITTED BY

Steve Smith, QSTI
Project Manager | Associate
Steve.Smith@rwdi.com | ext. 3706

Brad Bergeron, A.Sc.T., d.E.T.
Technical Director | Principal
Brad.Bergeron@rwdi.com | ext. 2428

Mason Sakshaug, QSTI
Supervisor, Source | Associate Principal
Mason.Sakshaug@rwdi.com | ext. 3703

RWDI USA LLC
Consulting Engineers & Scientists
24445 Forterra Drive
Warren, Michigan 48089

T: 248.841.8442
F: 519.823.1316

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by General Motors, LLC (GM) to complete source testing at the Saginaw Metal Casting Operations (SMCO) plant located at 1629 North Washington Avenue, Saginaw, Michigan. The purpose of the source testing was to show compliance with emissions of filterable particulate matter (PM) emissions from EU-SPMPROCESSAND which is controlled by SV-Z02-BH-4 Fabric Filter Collector (Baghouse). The testing is required under the State of Michigan Department of Environment, Great Lakes and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B1991-2021c and as outlined in the Consent Order (AQD No. 2022-11). The consent order requests the performance testing of PM emissions from EU-SPMPROCESSAND within 24 to 30 months from the effective date (7/28/22) of the consent order.

RWDI has completed flue gas velocity measurements, moisture content and filterable particulate matter testing from the SV-Z02-BH-4 Fabric Filter Collector (Baghouse). RWDI utilized the methods outlined by the United States Environmental Protection Agency (U.S. EPA) Methods 1, 2, 3, 4, and 5. Testing program included:

- Three (3) 120-minute tests for filterable particulate matter emissions.

This emissions testing program has evaluated the total particulate matter (TPM) from the outlet of SV-Z02-BH-4. The results are provided as TPM (filterable only). The test program was completed on August 13th, 2024.

Executive Table i: Results Summary – EU-SPMPROCESSAND Particulate Matter Results

Parameter	Source	Parameter	Units	Test 1	Test 2	Test 3	Test 4	Average[1]	Permit Limit
TPM Emission Rate	Baghouse 4 (SV-Z02-BH-4)	TPM (Filterable Only)	lb/hr	0.22	0.08	0.05	0.06	0.06	1.65

[1] Due to a differential pressure monitoring device fault, Test 1 was aborted and is not included in the averaged results.

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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by General Motors, LLC (GM) to complete source testing at the Saginaw Metal Casting Operations (SMCO) plant located at 1629 North Washington Avenue, Saginaw, Michigan. The purpose of the source testing was to show compliance with emissions of filterable particulate matter (PM) emissions from EU-SPMPROCESSAND which is controlled by SV-Z02-BH-4 Fabric Filter Collector (Baghouse). The testing is required under the State of Michigan Department of Environment, Great Lakes and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B1991-2021c and as outlined in the Consent Order (AQD No. 2022-11). The consent order requests the performance testing of PM emissions from EU-SPMPROCESSAND within 24 to 30 months from the effective date (7/28/22) of the consent order.

RWDI has completed flue gas velocity measurements, moisture content and filterable particulate matter testing from the SV-Z02-BH-4 Fabric Filter Collector (Baghouse). RWDI utilized the methods outlined by the United States Environmental Protection Agency (U.S. EPA) Methods 1, 2, 3, 4, and 5. Testing program included:

- Three (3) 120-minute tests for filterable particulate matter emissions.

This emissions testing program has evaluated the total particulate matter (TPM) from the outlet of SV-Z02-BH-4. The results are provided as TPM (filterable only). The test program was completed on August 13th, 2024.

1.1 Location and Dates of Testing

The test program was completed on August 13th at the GM SMCO facility.

1.2 Purpose of Testing

Testing was completed to show compliance with MI-ROP-B1991-2021c and Consent Order (AQD No. 2022-11).

1.3 Description of Source

EU-SPMPROCESSAND - 120-ton sand storage silo with bin vent filter receives sand via blower truck and a 30 ton pre-reclaim sand silo receives process sand recovered in the facility. Sand from both silos is transported to the natural gas fired fluidized bed sand reclaim process system (sand reclaim furnace, sand cooler, sand screen, and de-duster) (design heat input rate is 4 MMBTU/hr) for cleaning and preparation of sand. From there, sand is transferred to the prepared sand silo. Top core, scrap cores, broken cores and process sand collected from EU-SPMCASTLINE and EU-SPMCASTLINE4 and scrap cores and process sand from EU-SPMCOREROOM are collected in a bin/hopper and taken to a Sand Load Out Station for reclaim or returned to the process by the receiving dump chute of EU-SPMPROCESSAND for transport by conveyor to the hopper/storage silo of EU-SPMPROCESSAND.

1.4 Personnel Involved in Testing

Table 1.4.1: Testing Personnel

David Thibeault Senior Environmental Leader David.Thibeault@gm.com	**General Motors SMCO** 1629 North Washington Avenue Saginaw, MI 48601	(810) 818-9463
Jeff Hummel Senior Environmental Engineer Jeffrey.Hummel@gm.com	**General Motors**	(517) 719-9053
Brad Bergeron Technical Director Brad.Bergeron@rwdi.com	**RWDI USA LLC** 24445 Forterra Drove Warren, MI 48089	(248) 234-3885
Steve Smith Project Manager Steve.Smith@rwdi.com		(971) 751-9701
Mason Sakshaug Supervisor, Source Mason.Sakshaug@rwdi.com		(989) 323-0355
Mike Nummer Senior Field Technician Michael.Nummer@rwdi.com		(248) 841-8441
Kate Strang Field Technician Kate.Strang@rwdi.com		
Roy Zimmer Field Technician Roy.Zimmer@rwdi.com		

2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing included:

- Reclaim furnace temperature (°F);
- Quantity of sand processed (tons/hr);
- Differential pressure readings (H2O);
- Natural gas usage (ft3); and
- Bag leak detection system (BLDS) output.

This information can be found in **Appendix A**.

2.2 Applicable Permit Number

The Facility operates under Permit MI-ROP-B1991-2021c and Consent Order (AQD No. 2022-11).

3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

Refer to Section 1.3 for a description of the process.

EU-SPMPROCESSAND emissions are controlled by one (1) fabric filter baghouse and PM emissions are released through SV-Z02-BH-4.

3.2 Process Flow Sheet or Diagram

The baghouse has a single outlet. A figure indicating diameter, upstream, downstream, and sampling points can be found in the **Figures Section**.

3.3 Type and Quantity of Raw and Finished Materials

The raw material used in this process includes sand. Natural gas is used in the fluidized bed and reclaim systems.

3.4 Normal Rated Capacity of Process

Maximum amount of sand reclaimed is 3 tons per hour, however, the process typically operates between 2.4 and 2.8 tons per hour depending on SPM Castline production. Process data is provided in **Appendix A**.

3.5 Process Instrumentation Monitored During the Test

The SPM production line runs at a constant rate. For each SPM process castline, GM recorded the number of shots multiplied by the weight of sand per shot to calculate the amount of sand reclaimed through the fluidized bed sand reclaim system. The baghouse differential pressure (DP) was monitored by a Dwyer photohelic gauge. The reclaim furnace temperature was monitored utilizing a thermocouple. Baghouse filter leaks were monitored utilizing a FilterSense bag leak detection system (BLDS) (model PM100 PRO Particulate Monitoring System). The SPM shot count, DP, furnace temperature, and BLDS data are recorded electronically in the facility Production Monitoring and Control system. Refer to figures in **Appendix A**. The natural gas usage was monitored from the natural gas meter associated sand reclaim unit.

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 (fyrite)
- Method 4 – Determination of Moisture Content in Stack Gases
- Method 5 – Determination of Particulate Matter Emissions from Stationary Sources

4.1 Stack Velocity, Temperature, and Volumetric Flow Rate

The exhaust velocities and flow rates were determined following 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 were 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

Filterable particulate matter (PM) was sampled following procedures outlined in USEPA Method 5. Emissions were drawn isokinetically through a stainless-steel nozzle, a heated glass or stainless-steel probe, and through a heated glass-fiber filter. Following the filter, the sample was drawn through two (2) water impingers, one (1) empty impinger, and one (1) impinger containing silica gel. After each test, the sample was recovered in accordance with USEPA Method 5. All Method 5 samples were hand delivered to RWDI's laboratory for gravimetric analysis.

4.3 Description of Recovery and Analytical Procedures

All sample recovery and analytical procedures following the prescribed methods of USEPA Method 1 to 5. Upon completion of each test, a leak was performed to ensure a leak-free system. The probe, filter, and moisture train are disconnected and capped for transport to a recovery are. The stainless-steel steel probe was rinsed and brushed six (6) times with acetone into a sample jar. The glass probe liner and front half of the filter holder were rinsed and brushed three (3) times with acetone into the same sample jar. The filter was removed from the filter holder and placed into a clean petri-dish. The impingers were weighed to determine moisture content. The acetone sample and filter petri-dish were then sealed shut and transported to RWDI's in-house laboratory where they were analyzed gravimetrically for PM.

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 are provided in **Appendix B**. All four test are shown in the table, but the average is for only tests 2-4.

Table 5.1.1: Results Summary – EU-SPMPROCESSAND Particulate Matter Results

Parameter	Source	Parameter	Units	Test 1	Test 2	Test 3	Test 4	Average[1]	Permit Limit
TPM Emission Rate	Baghouse 4 (SV-Z02-BH-4)	TPM (Filterable Only)	lb/hr	0.22	0.08	0.05	0.06	0.06	1.65

[1] Due to a differential pressure monitoring device fault, Test 1 was aborted and is not included in the averaged results.

5.1.1 Discussion of Results

The SPM castline production during the 3 test runs ranged between 2.3 lb/hr and 2.5 lb/hr. The average PM for test runs 2-4 was 0.06 lb/hr. This is 4% of the permit limit. These particulate levels were also confirmed by the bag leak detection system monitoring results provided in **Appendix A**. The detailed PM results can be found in the following Appendix:

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

5.2 Process Upset Conditions During Testing

There were normal process breaks during production. During Test 1, a baghouse differential pressure monitoring device fault occurred. The test was aborted, and a fourth test was completed.

5.3 Maintenance Performed in Last Three Months

Maintenance in the last three months has been routine.

5.4 Re-Test

This was not a retest.

5.5 Audit Samples

This test did not require any audit samples.

5.6 Process Data

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

5.7 Particulate, Flows and Moisture

Results can be found in **Appendix B** and all field sheets can be found in **Appendix C**.

5.8 Calibration Data

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

5.9 Example Calculations

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

5.10 Laboratory Data

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

5.11 Test Plan and EGLE Correspondence

The submitted test plan and all EGLE correspondence is located in **Appendix G.**

TABLES

Table 1: Summary of Sampling Parameters and Methodology (SV-Z02-BH-4)

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
SV-Z02-BH-4	4	Velocity, Temperature and Flow Rate	U.S. EPA [1] Methods 1-4
	4	PM / PM_{10} / $PM_{2.5}$	U.S. EPA [1] Method 5
	4	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3

Notes:

[1] U.S. EPA - United States Environmental Protection Agency

Table 2: Sampling Summary and Sample Log (Particulate) (SV-Z02-BH-4)

Source and Test #	Sampling Date	Start Time	End Time	Filter ID / Trap ID
SV-Z02-BH-4 - Velocity / Total Particulate				
Blank	13-Aug-24	-	-	A-430
Test #1	13-Aug-24	7:42 AM	7:54 AM	A-433
Test #2	13-Aug-24	9:26 AM	11:28 AM	A-432
Test #3	13-Aug-24	11:51 AM	2:02 PM	A-431
Test #4	13-Aug-24	2:17 PM	4:19 PM	A-429

Table 3: Sampling Summary - Flow Characteristics

SV-Z02-BH-4

Stack Gas Parameter		Test No. 1	Test No. 2	Test No. 3	Test No. 4	Averge
		Total Particulate	Total Particulate	Total Particulate	Total Particulate	
Testing Date		13-Aug-24	13-Aug-24	13-Aug-24	13-Aug-24	
Stack Temperature	°F	129	134	133	133	133
Moisture	%	4.5%	2.3%	1.9%	1.7%	2.0%
Velocity	ft/s	32.60	34.30	33.50	33.00	33.60
Referenced Flow Rate	CFM	26,145	27,467	26,873	26,449	26,930
Sampling Isokinetic Rate	%	8.3	100.2	99.8	100.0	100.0

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

[2] Average is Test 2, 3 and 4.

Table 4: Summary of Results - Particulate Matter

Company	GM SMCO				
Source	SPM Process Sand				
Date	13-Aug-24	13-Aug-24	13-Aug-24	13-Aug-24	
Test Number	**Test 1*Void**	**Test 2**	**Test 3**	**Test 4**	**Average Test 2 to 4 Only**
Start Time	7:42	9:26	11:51	14:17	--
End Time	7:54	11:28	14:02	16:19	--
Stack Information					
Flow Rate (ft^3/min) (Actual)	26,145	27,467	26,873	26,449	26,930
Flow (ft^3/min) (Standard Wet)	23,053	23,996	23,514	23,159	23,556
Flow (ft^3/min) (Standard Dry)	22,015	23,456	23,061	22,764	23,094
Flow (m^3/min) (Standard Dry)	623	664	653	645	654
Percent Moisture (%)	4.5	2.3	1.9	1.7	2.0
Pressure Ps ("Hg)	29.41	29.41	29.41	29.41	29.41
Average Stack Temperature (T_s) (°F)	128.7	134.1	133.2	132.8	133.4
Molecular Weight of Stack Gas dry (M_{sd}) (g/mole)	28.84	28.84	28.84	28.84	28.84
Molecular Weight of Stack Gas wet (M_s) (g/mole)	28.35	28.60	28.63	28.63	28.62
Stack Gas Specific Gravity (G_s) (kg/L)	1.0	1.0	1.0	1.0	1.0
Water Vapor Volume Fraction (%)	0.0	0.0	0.0	0.0	0.0
Average Stack Velocity (V_s) (ft/sec)	32.6	34.3	33.5	33.0	33.6
Cross Section Area of Stack (ft^2)	13.4	13.4	13.4	13.4	13.4
Percent Carbon Dioxide (%)	0.0	0.0	0.0	0.0	0.0
Percent Oxygen (%)	21.0	21.0	21.0	21.0	21.0
Percent Carbon Monoxide (%)	0.0	0.0	0.0	0.0	0.0
Percent Excess Air at Test Location (%)	-	-	-	-	-
Meter Info					
Isokinetic Variation I (%)	100.0	100.2	99.8	100.0	100.0
Meter Pressure Pm ("Hg)	29.5	29.6	29.6	29.6	29.6
Meter Temperature Tm (°F)	58.0	81.2	93.2	91.4	88.6
Measured Sample Volume Vm (ft^3)	6.75	90.29	90.41	89.10	89.93
Sample Volume (Vm St ft^3)	6.79	87.04	85.26	84.28	85.53
Sample Volume (Vm St m^3)	0.19	2.46	2.41	2.39	2.42
Total Weight of Sampled Gas (lbs) wet	0.52	6.58	6.43	6.35	6.45
Total Weight of Sampled Gas (lbs) dry	0.51	6.49	6.36	6.28	6.38
Gas Density Ps wet ("Hg)	0.07	0.07	0.07	0.07	0.07
Gas Density Ps dry ("Hg)	0.07	0.07	0.07	0.07	0.07
Condensate Volume (ft^3)	0.32	2.00	1.67	1.46	1.71
Nozzle Size (in^2)	0.00041	0.00041	0.00041	0.00041	0.00
Impinger Gain (g)	4.2	24.6	20.8	15.2	20.2
Silica Gel Gain (g)	2.6	17.9	14.7	15.8	16.1
Total Gas Sampled (vm st ft^3 + condensate volume)	7.12	89.04	86.93	85.74	87.24
Particulate Results					
Nozzle/Probe/Filter Weight (mg)	0.5	2.2	1.5	1.6	1.8
Total Particulate (mg)	0.5	2.2	1.5	1.6	1.8
Total Particulate Emission Rate (lb/hr)	0.22	0.08	0.05	0.06	0.06
Total Particulate Concentration (gr/dscf)	1.14E-03	3.90E-04	2.72E-04	2.93E-04	3.18E-04

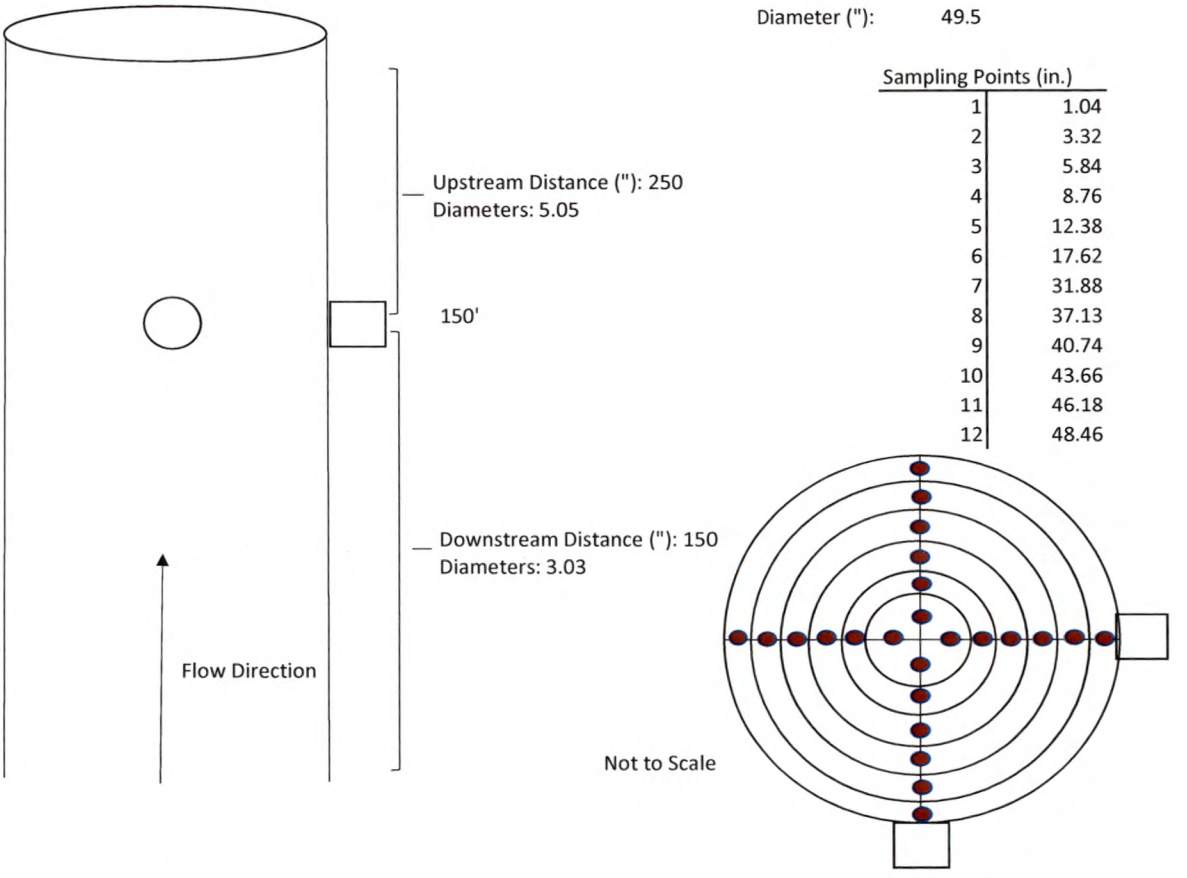
Limit	% of Limit
1.65	3.84%

Test 1 was aborted due to and upset in process conditions and is not included in the averaged results.

Revision 1 - SS
3/7/2022

FIGURES

Figure 1: EU-SPMPROCESSAND/SV-Z02-BH-4 Emissions Stack Schematic

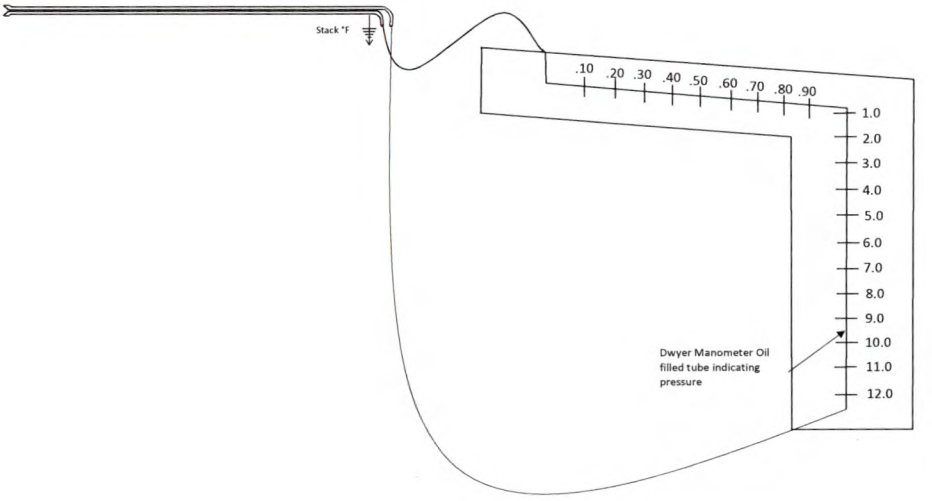


EU-SPMPROCESSAND/SV-Z02-BH-4
General Motors, LLC (GM)
Saginaw Metal Casting Operation (SMCO)
Saginaw, MI

Date:
13-Aug-24

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309

Figure No. 2: USEPA Method 2 Schematic



USEPA Method 2

General Motors, LLC (GM)
Saginaw Metal Casting Operations (SMCO)
EU-SPMPROCESSAND/SV-Z02-BH-4
Saginaw, MI

Date: August 13, 2024

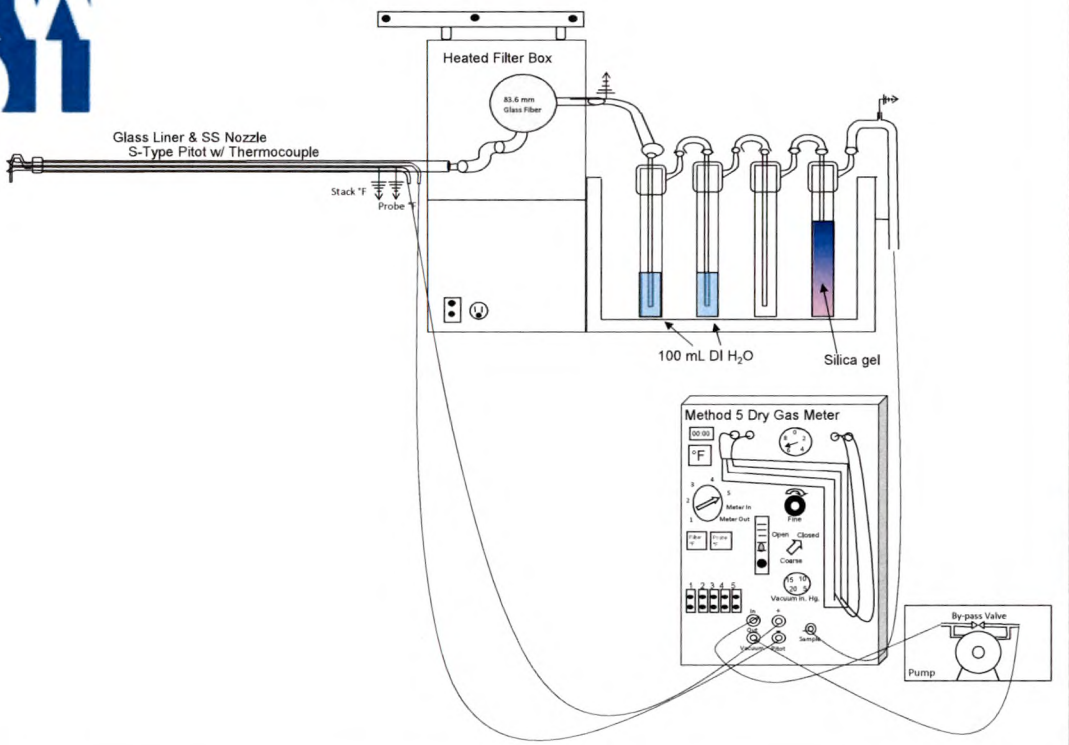
Figure No. 3: USEPA Method 3 Schematic (Fyrite)

USEPA Method 3

General Motors, LLC (GM)
Saginaw Metal Casting Operation (SMCO)
Saginaw, MI
EU-SPMPROCESSAND/SV-Z02-BH-4

Date: August 13, 2024

Figure No. 4: USEPA Method 5 Schematic



USEPA Method 5

EU-SPMPROCESSAND/SV-Z02-BH-4

General Motors, LLC (GM)

Saginaw Metal Casting Operation (SMCO)

Saginaw, MI

Date: August 13, 2024