

FINAL REPORT



TOOLING & EQUIPMENT INTERNATIONAL (TEI)

LIVONIA, MICHIGAN

THERMAL SAND RECLAIM UNIT SOURCE TESTING

RWDI #2403191

May 2, 2024

SUBMITTED TO

Oliver Johnson
**Tooling & Equipment International
(TEI)**
President
Oliver.Johnson@teintl.com

Jeremy Howe
TPU Director
Howej1@michigan.gov
Constitution Hall 2nd Floor
525 West Allegan Street
Lansing, MI 48933

**Tooling & Equipment International
(TEI)**
12550 Tech Center Drive
Livonia, MI 48150

SUBMITTED BY

Brad Bergeron, A.Sc.T., d.E.T.
Senior Project Manager | 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
2239 Star Court
Rochester Hills, Michigan 48309

T: 248.841.8442

RECEIVED

MAY 07 2024

EGLE - Mailroom



rwdi.com

©2022 RWDI USA LLC ("RWDI") ALL RIGHTS RESERVED.

This document is intended for the sole use of the party to whom it is addressed and may contain information that is privileged and/or confidential. If you have received this in error, please notify us immediately. Accessible document formats provided upon request
© RWDI name and logo are registered trademarks in Canada and the United States of America.



EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Tooling & Equipment International (TEI) to complete the emission sampling program at their facility located at 12550 Tech Center Drive, Livonia, Michigan. The facility produces the aluminum castings for hundreds of new prototypes and products annually. TEI completes design and build tooling and automation systems to take complex castings into production. The purpose of the testing is to confirm compliance with 40 CFR Part 60, Subpart UUU (Standards of Performance for Calciners and Dryers in Mineral Industries). Note that this system falls under the provisions for a Calciner and therefore the emission limits.

RWDI completed flue gas velocity measurements, moisture content, visible emissions, and filterable particulate matter testing from Thermal Sand Reclaim Unit. RWDI utilized the methods outlined by the United States Environmental Protection Agency (U.S. EPA) Methods 1, 2, 3, 4, 5, and 9. The testing program consisted of:

- Three (3) 60-minute tests were completed for visible emissions.
- Three (3) 120-minute tests were completed for filterable particulate matter emissions.

TEI recorded the required production data during the testing.

The test program was completed on March 19th, 2024.

Executive Table i: Results Summary – Thermal Sand Reclaim Unit

Process	Parameter	Test 1	Test 2	Test 3	Average	UUU Limit
Thermal Sand Reclaim Unit	Filterable Particulate Matter	0.00050 gr/dscf	0.00085 gr/dscf	0.00056 gr/dscf	0.00064 gr/dscf	0.040 gr/dscf 0.092 g/dscm
	Visible Emissions	0% Opacity (Maximum 6-min. average)	0% Opacity (Maximum 6-min. average)	0% Opacity (Maximum 6-min. average)	0% Opacity (Maximum 6-min. average)	10% Opacity

Note: gr/dscf – grains per dry standard cubic foot
g/dscm – grams per dry standard cubic meter



TABLE OF CONTENTS

1	INTRODUCTION.....	1
1.1	Location and Dates of Testing.....	1
1.2	Purpose of Testing.....	1
1.3	Description of Source	1
1.4	Personnel Involved in Testing	2
2	SUMMARY OF RESULTS	3
2.1	Operating Data.....	3
2.2	Applicable Permit Number	3
3	SOURCE DESCRIPTION	3
3.1	Description of Process and Emission Control Equipment.....	3
3.1	Process Flow Sheet or Diagram	3
3.2	Type and Quantity of Raw and Finished Materials.....	3
3.3	Normal Rated Capacity of Process.....	3
4	SAMPLING AND ANALYTICAL PROCEDURES	4
4.1	Stack Velocity, Temperature, and Volumetric Flow Rate	4
4.2	Particulate Matter.....	4
4.2.1	US EPA Method 5.....	4
4.2.2	US EPA Method 9.....	4
4.3	Description of Recovery and Analytical Procedures	5
4.4	Sampling Port Description.....	5
5	TEST RESULTS AND DISCUSSION.....	5
5.1	Detailed Results	5
5.2	Variations in Testing Procedures.....	5
5.3	Process Upset Conditions During Testing.....	5



5.4 Maintenance Performed in Last Three Months 5

5.5 Re-Test..... 5

5.6 Process Data..... 6

5.7 Particulate, Flows and Moisture..... 6

5.8 Calibration Data..... 6

5.9 Laboratory Data 6

5.10 Example Calculations..... 6

5.11 Test Plan and EGLE Correspondence 6

LIST OF TABLES

(Found Within the Report Text)

Executive Table i: Results Summary – Thermal Sand ReclaimExecutive Summary

Table 1.4.1: List of Testing Personnel2

Table 5.1: Results Summary – Thermal Sand Reclaim Unit5

LIST OF TABLES

(Found After the Report Text)

Table 1: Summary of Sampling Parameters and Methodology

Table 2: Sampling Summary and Sample Log

Table 3: Sampling Summary – Flow Characteristics – Thermal Sand Reclaim Unit

Table 4: Filterable Particulate Matter Results

Table 5: Visible Emissions Results



LIST OF FIGURES

- Figure 1:** Schematic of US EPA Method 2
- Figure 2:** Schematic of US EPA Method 3 (Fyrite)
- Figure 3:** Schematic of US EPA Method 5 Sample Train
- Figure 4:** Schematic of Traverse Points – Thermal Sand Reclaim Unit

LIST OF APPENDICES

- Appendix A:** Process Data
- Appendix B:** Filterable Particulate Matter Results
- Appendix C:** Visible Emissions Results
- Appendix D:** Field Data Sheets
- Appendix E:** Calibration Data
- Appendix F:** Laboratory Results
- Appendix G:** Example Calculations
- Appendix H:** Test Plan and EGLE Correspondence



1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by Tooling & Equipment International (TEI) to complete the emission sampling program at their facility located at 12550 Tech Center Drive, Livonia, Michigan. The facility produces the aluminum castings for hundreds of new prototypes and products annually. TEI completes design and build tooling and automation systems to take complex castings into production. The purpose of the testing is to confirm compliance with 40 CFR Part 60, Subpart UUU (Standards of Performance for Calciners and Dryers in Mineral Industries). Note that this system falls under the provisions for a Calciner and therefore the emission limits.

RWDI completed flue gas velocity measurements, moisture content, visible emissions, and filterable particulate matter testing from Thermal Sand Reclaim Unit. RWDI utilized the methods outlined by the United States Environmental Protection Agency (U.S. EPA) Methods 1, 2, 3, 4, 5, and 9. The testing program consisted of:

- Three (3) 60-minute tests were completed for visible emissions.
- Three (3) 120-minute tests were completed for filterable particulate matter emissions.

TEI recorded the required production data during the testing.

1.1 Location and Dates of Testing

The test program was completed on March 19th, 2024, at the Tooling and Equipment International (TEI) 12550 Tech Center Drive Livonia, MI 48150 Location

1.2 Purpose of Testing

The emissions test program was initiated by TEI as an initial validation study to determine the removal efficiency of filterable particulate matter (PM) from the Thermal Sand Reclaimer Unit.

1.3 Description of Source

Sand is used in the aluminum casting process. The sands for casting are mixed with organic binders for the casting process. The sand is reclaimed in the process and cleaned using the Thermal Sand Reclaim Unit. The spent sand is heated to approximately 1,200°F inside the fluidized bed, for both the calcining and cooling stage, to evaporate moisture and oxidizing organic binders. This indirect heat prevents flame impingement on the sand grains. Calcining is the physical and chemical breakdown of volatile materials by heating the material to a temperature just short of fusion for sufficient time to affect the breakdown. The post treatment removes unwanted surface area on the resultant core sand that requires extra resin to coat. Post treatment also includes cooling and classifying of the sand. The emissions from the Thermal Sand Reclaim Unit are controlled by a baghouse for particulate matter.



1.4 Personnel Involved in Testing

Table 1.4.1: Testing Personnel

Oliver Johnson President Oliver.Johnson@teintl.com	Tooling & Equipment International (TEI) 12550 Tech Center Drive Livonia, MI 48150	(734) 522-1422
Jessica Alderton Senior Environmental Project Engineer Jessica.Alderton@gm.com		(586) 863-8490
Madisyn Collins Environmental Engineer Madisyn.Collins@gm.com		(734) 406-4446
Steve Smith Project Manager Steve.Sakshaug@rwdi.com	RWDI USA LLC 2239 Star Court Rochester Hills, MI 48309	(734) 751-9701
Brad Bergeron Technical Director Brad.Bergeron@rwdi.com		(248) 234-3885
Mike Nummer Senior Field Technician Mike.nummer@rwdi.com		(586) 863-8237
Roy Zimmer Field Technician Roy.zimmer@rwdi.com		(810) 956-7478
Shane Rabideau Field Technician Shane.rabideau@rwdi.com		(810) 656-3986

2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing included:

- Temperature of Thermal Reclaim (°F)
- Temperature of Calcine Unit (°F)
- Quantity of Sand (lbs)
- Differential pressure readings ("H₂O) in 15-minute intervals during testing (collected manually)

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

2.2 Applicable Permit Number

No applicable permit. The Thermal Sand Reclaim unit meets the exemption requirements of MI Rule 291(2).

3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

Refer to Section 1.3 for a description of the process.

The Thermal Reclaim Sand Unit is controlled via a baghouse for particulate emissions.

3.1 Process Flow Sheet or Diagram

A process flow diagram can be supplied upon request.

3.2 Type and Quantity of Raw and Finished Materials

The thermal process unit using natural gas for reclaim and calcine units. Sand is treated and recycled in the process.

3.3 Normal Rated Capacity of Process

The Thermal Sand Reclaim unit is rated to process spent sand at a rate of 6,000 lb/hr. Process data is provided in **Appendix A**.

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
- Method 9 – Determination of the Opacity of 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” using a fyrite. 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 test as part of the Particulate Matter testing train.

4.2 Particulate Matter

4.2.1 US EPA Method 5

Filterable Particulate matter from the outlet was sampled following procedures outlined in USEPA Method 5. A stack sample was withdrawn isokinetically from the source and particulate emissions were collected in the probe and on a filter.

Method 5 filters and acetone rinses were analyzed gravimetrically by RWDI’s inhouse laboratory.

4.2.2 US EPA Method 9

Visible emissions were determined in accordance with U.S. EPA Reference Method 9, “Visual Determination of the Opacity of Emissions from Stationary Sources”. Three (3), 60-minute visible emission observation periods were taken. For the visible emission observation periods, observations were taken every 15 seconds over each 60-minute continuous minute period. The visible emissions were determined by a certified observer.

4.3 Description of Recovery and Analytical Procedures

All sample recovery and analytical procedures following the prescribed methods of USEPA Methods 1-5 & 9.

4.4 Sampling Port Description

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

5 TEST RESULTS AND DISCUSSION

5.1 Detailed Results

Detailed results for filterable PM are provided in **Appendix B**.

Table 5.1: Results Summary – Thermal Sand Reclaim Unit

Process	Parameter	Test 1	Test 2	Test 3	Average	UUU Limit
Thermal Sand Reclaim Unit	Filterable Particulate Matter	0.00050 gr/dscf	0.00085 gr/dscf	0.00056 gr/dscf	0.00064 gr/dscf	0.040 gr/dscf 0.092 g/dscm
	Visible Emissions	0% Opacity (Maximum 6-min. average)	0% Opacity (Maximum 6-min. average)	0% Opacity (Maximum 6-min. average)	0% Opacity (Maximum 6-min. average)	10% Opacity

Note: gr/dscf – grains per dry standard cubic foot
g/dscm – grams per dry standard cubic meter

5.2 Variations in Testing Procedures

No variations from methods used.

5.3 Process Upset Conditions During Testing

There were no process breaks during testing.

5.4 Maintenance Performed in Last Three Months

Routine maintenance was performed over the last three (3) months.

5.5 Re-Test

This was not a re-test.



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 Laboratory Data

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

5.10 Example Calculations

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

5.11 Test Plan and EGLE Correspondence

The test plan and EGLE Correspondence can be found in **Appendix H**.

TABLES



Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests	Sampling Parameter	Sampling Method
Thermal Sand Reclaim Unit	3	Velocity, Temperature and Flow Rate	U.S. EPA [1] Methods 1-4
	3	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3 (Fyrite)
	3	PM / PM10 / PM2.5	U.S. EPA [1] Method 5
	3	Visible Emissions	U.S. EPA [1] Method 9

Notes:

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

Table 2: Sampling Summary

Source and Test #	Sampling Date	Start Time	End Time
Thermal Sand Reclaim Unit			
Test #1	19-Mar-24	7:34	9:40
Test #2	19-Mar-24	9:57	12:01
Test #3	19-Mar-24	12:21	14:24

Table 3: Sampling Summary - Flow Characteristics - Thermal Sand Reclaim Unit

Thermal Sand Reclaim Unit		Test No. 1	Test No. 2	Test No. 3	TOTAL AVERAGE
Testing Date		19-Mar-24	19-Mar-24	19-Mar-24	-
Stack Temperature	°F	142	147	155	148
Moisture	%	1.3%	1.2%	1.5%	1.4%
Velocity	ft/s	34.3	32.1	29.9	32.1
Dry Referenced Flow Rate	CFM	12,469	11,592	10,624	11,562

Company Source Date	19-Mar-24	TEI Sand Reclaim 19-Mar-24	19-Mar-24	
Test Number	Test 1	Test 2	Test 3	Average
Start Time	7:34	9:57	12:21	--
Stop Time	9:40	12:01	14:24	--
Stack Information				
Flow ft3 (Actual)	14,949	14,000	13,017	13,989
Flow ft3 (Standard Wet)	12,639	11,737	10,785	11,720
Flow ft3 (Standard Dry)	12,469	11,592	10,624	11,562
Flow m3 (Standard Dry)	353	328	301	327

Percent Moisture	1.3	1.2	1.5	1.4
Pressure Ps (”Hg)	28.85	28.85	28.85	28.85
Average Stack Temperature Ts (F)	142.2	147.3	154.5	148.0
Molecular Weight of Stack Gas dry (Md)	28.84	28.84	28.84	28.84
Molecular Weight of Stack Gas wet (Ms)	28.69	28.71	28.68	28.69
Stack Gas Specific Gravity (Gs)	1.0	1.0	1.0	1.0
Water Vapor Volume Fraction	0.0	0.0	0.0	0.0
Average Stack Velocity Vs (ft/sec)	34.3	32.1	29.9	32.1
Area of Stack (ft2)	7.3	7.3	7.3	7.3
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
Percent Excess Air at Test Location	-	-	-	-

Meter info				
Isokinetic Variation I	99.6	99.7	100.4	99.9
Meter Pressure Pm ("Hg)	29.4	29.4	29.3	29.4
Meter Temperature Tm (F)	65.6	75.7	77.9	73.0
Measured Sample Volume Vm	105.54	100.17	92.92	99.54
Sample Volume (Vm St ft3)	102.04	94.95	87.65	94.88
Sample Volume (Vm St m3)	2.89	2.69	2.48	2.69
Total Weight of Sampled Gas (m g lbs) wet	7.67	7.13	6.60	7.13
Total Weight of Sampled Gas (m g lbs) dry	7.61	7.08	6.53	7.07
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	1.39	1.19	1.33	1.30
Nozzle Size	0.00050	0.00050	0.00050	0.00
Impinger Gain	13.8	12.0	13.2	13.0
Silica Gel Gain	15.7	13.2	15.1	14.7
Total Gas Sampled (vm st ft3 + condensate volume)	103.43	96.14	88.98	96.18

Particulate Results				
Nozzle/Probe/Filter Weight (mg)	3.3	5.2	3.2	3.9
Total Particulate (mg)	3.3	5.2	3.2	3.9
lb/hr	0.054	0.084	0.052	0.063
mg/dscm (dry)	1.14	1.93	1.29	1.46
g/dscm (dry)	0.0011	0.0019	0.0013	0.0015
gr/dscf	0.00050	0.00085	0.00056	0.00064

Revision 1 - SS
3/7/2022

Table 5: Visible Emissions Results

SOURCE: Thermal Sand Reclaim Unit

Test ID	Source	Date	Time			Average Daily Opacity	Maximum 6 min. average
Thermal Sand Reclaim Unit							
Test 1	Thermal Sand Reclaim Unit	March 19, 2024	8:00	to	8:59	0	0
Test 2			9:57	to	10:56	0	0
Test 3			12:22	to	13:21	0	0
Total						0	0



FIGURES



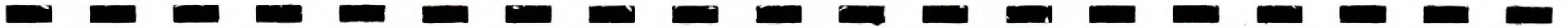
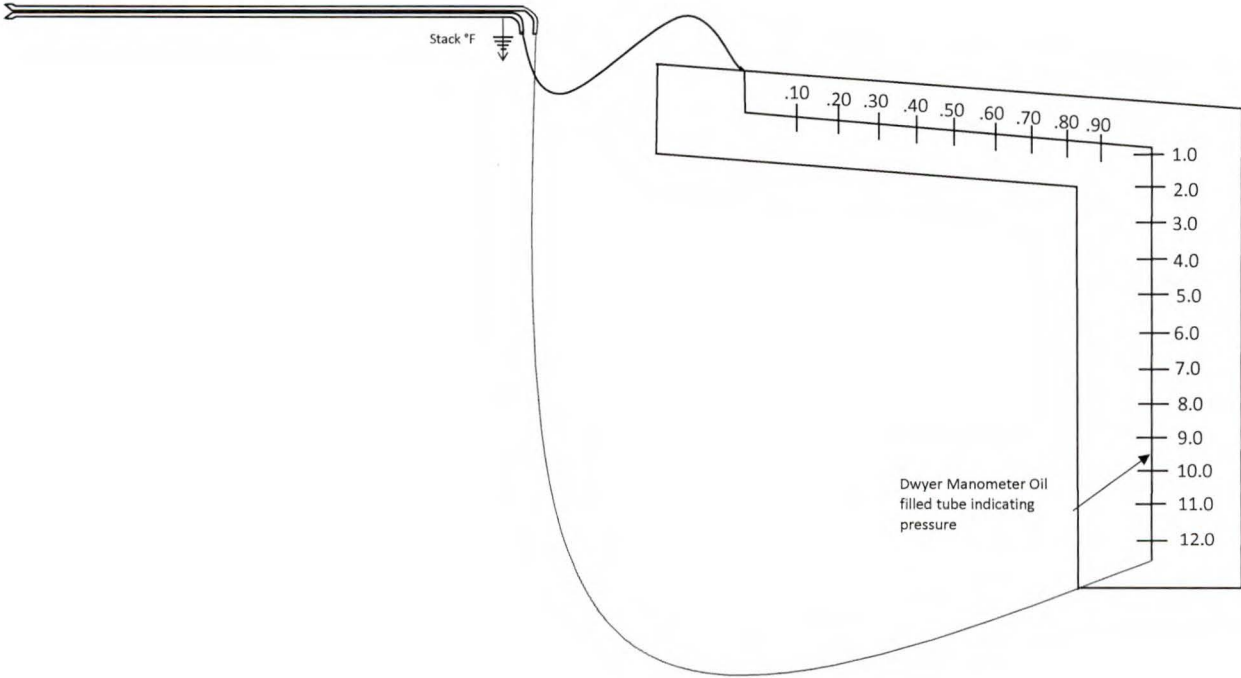




Figure 1: Schematic of US EPA Method 2



USEPA Method 2

Tooling & Equipment International (TEI)

Thermal Sand Reclaim Unit
Livonia, MI

Project #2403191

Figure No. 1

Date: March 19th, 2024



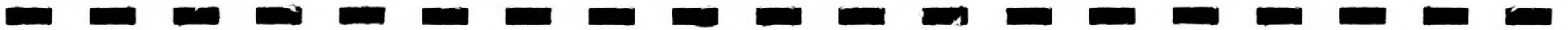
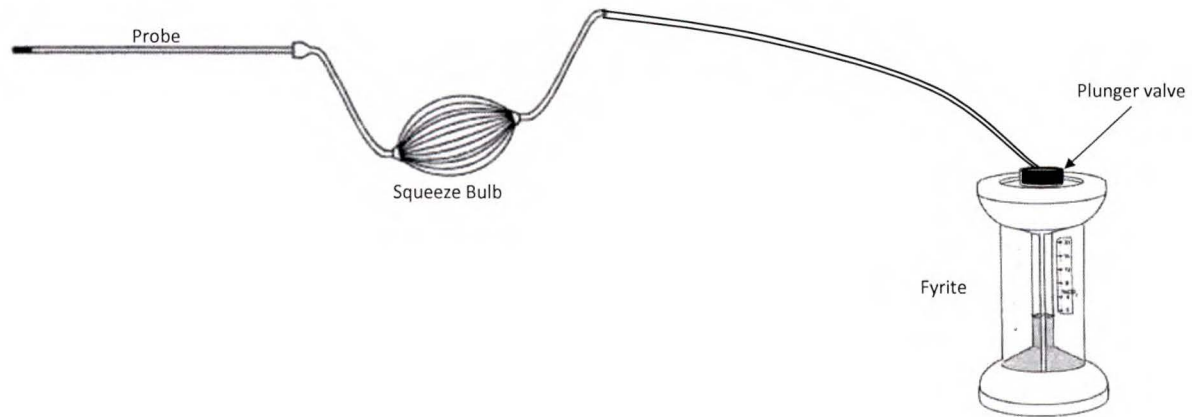




Figure No. 2: USEPA Method 3 Schematic (Fyrite)



USEPA Method 3

Tooling & Equipment International (TEI)
Thermal Sand Reclaim Unit

Livonia, MI

Project # 2403191

Figure No. 2

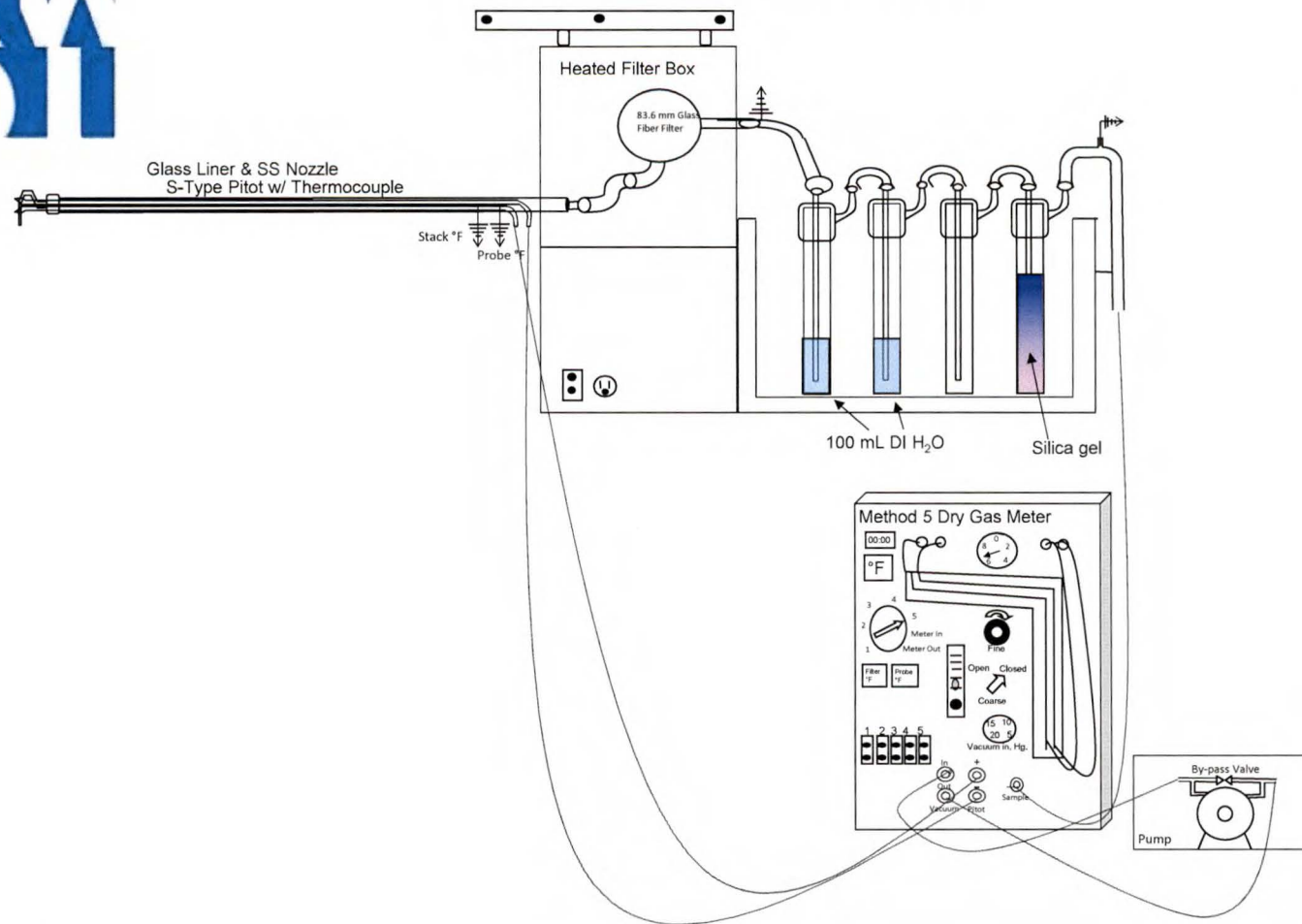
Date: March 19th, 2024







Figure No. 3: Schematic of US EPA Method 5



USEPA Method 5

Tooling & Equipment International TEI

Thermal Sand Reclaim Unit

Livonia, Michigan

Project #2403191

Figure No. 3

Date: March 19th, 2024



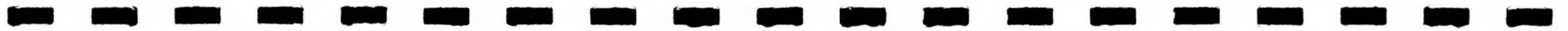
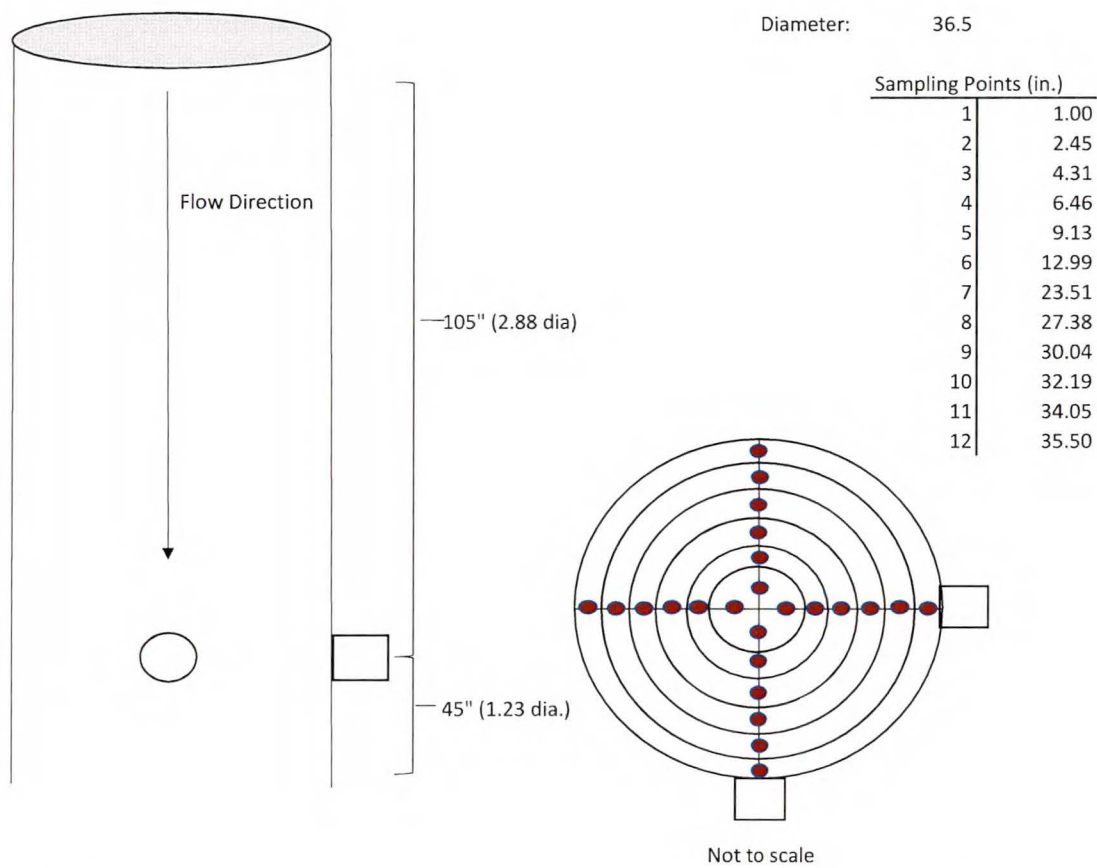




Figure No. 4: Sampling and Traverse Points Thermal Sand Reclaim Unit



Thermal Sand Reclaim Unit
Tooling & Equipment International (TEI)
Livonia, MI

Date:
March 19th, 2024

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309