EXECUTIVE SUMMARY

Chase Young Environmental Testing Inc (CYET) was retained by Thermaseal, Incorporated (Thermaseal) [SRN:P1198] to conduct a compliance VOC destruction efficiency (DE) emissions test program on the Thermal Oxidizer (TO) controlling emissions from EUPRINTINGLABELS at the Thermaseal facility located in Romeo, MI. The emissions test program was conducted on August 23, 2023, and was performed in accordance with CYET project number 231654 Emission Test Plan as well as the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Air Quality Division (AQD) acceptance letter.

The test program was conducted to determine compliance with Permit to Install (PTI) No. 55-22 issued by the Michigan department of Environment, Great Lakes, and Energy (EGLE). The results of the test program are presented in Table 1.

Table 1
Overall Emission Summary
Test Date: August 23, 2023

Source	Parameter	Test Result	Limit
Thermal Oxidizer	VOC DE	98.2%	>95%

RECEIVED
OCT 17 2023
AIR QUALITY DIVISION

CYET ChaseYoung Environmental Testing

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

APPENDIX A – EMISSION RESULTS TABLES

APPENDIX B - FIGURES

ADDITIONAL APPENDICES

1. Introduction

Chase Young Environmental Testing Inc (CYET) was retained by Thermaseal, Incorporated (Thermaseal) [SRN:P1198] to conduct a compliance VOC destruction efficiency (DE) emissions test program on the Thermal Oxidizer (TO) controlling emissions from EUPRINTINGLABELS at the Thermaseal facility located in Romeo, MI. The emissions test program was conducted on August 23, 2023, and was performed in accordance with CYET project number 231654 Emission Test Plan as well as the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Air Quality Division (AQD) acceptance letter.

The test program was conducted to determine compliance with Permit to Install (PTI) No. 55-22 issued by the Michigan department of Environment, Great Lakes, and Energy (EGLE). The results of the test program are presented in Table 1.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on August 23, 2023, at the Thermaseal facility located in Romeo, MI

1.b Purpose of Testing

AQD issued Permit to Install (PTI) No. 55-22 to Thermaseal on May 10, 2022. PTI No. 55-22 also requires Thermaseal to achieve a minimum VOC destruction efficiency (DE) of 95% by weight on the TO controlling EUPRINTINGLABELS.

1.c Source Description

EUPRINTINGLABELS - Manufacturing of high-end quality labels by using rotogravure printing line controlled by non-fugitive enclosure (NFE) and a Thermal Oxidizer (TO). These labels will adhere to leather, industrial garments, and other materials that may need to function in abrasive or harsh environments (e.g., personal protective equipment).

Figures 1-2 present the test port and traverse/sampling point locations used.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. David Denhart
Thermaseal, Incorporated
Vice President of Manufacturing
586-336-9415
ddenhart@thermasealinc.com

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

Table 2
Test Personnel

Name, Title, and Email	Affiliation	Telephone
Mr. David Denhart Vice President of Manufacturing ddenhart@thermasealinc.com	Thermaseal, Incorporated 141 Peyerk Court Romeo, Michigan 48065	(586) 336-9415
Mr. Brandon Chase Senior Environmental Engineer bchase@cyetinc.com	CYET 28744 Groveland Street Madison Heights, MI 48071	(248) 506-0107
Mr. Matthew Young Senior Project Manager myoung@cyetinc.com	CYET 28744 Groveland Street Madison Heights, MI 48071	(586) 744-9133

Mr. Andrew Riley from the AQD/Warren District Office was on site at the anticipated start time to witness the test program, however mechanical issues prevented the TO from being operated properly. Mr. Riley left site at approximately 1:00 PM. Around 5 PM Thermaseal was able to get a technician on site who was able to correct the problem and the test program was started at 5:50 PM and completed at 9:48 PM.

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

Process data monitored during the emissions test program include:

- Temperature in the combustion chamber of the TO
- TO retention time
- Total gallons of each material used

The TO retention time was set to 150 seconds, which was confirmed to be accurate by CYET and Thermaseal personnel during the test program. The TO temperature was recorded on a chart recorder. The total gallons of each material used were manually tracked by the operator.

Process operating data is included in Appendix E.

2.b Applicable Permit

The applicable permit for this emissions test program is PTI No. 55-22.

2.c Results

The overall results of the emission test program as well as emission limits are summarized by Table 1 (see Section 5.a. and Appendix A). Detailed emission rates are presented in Table 3 in Appendix A.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

EUPRINTINGLABELS - Manufacturing of high-end quality labels by using rotogravure printing line controlled by non-fugitive enclosure (NFE) and a Thermal Oxidizer (TO). These labels will adhere to leather, industrial garments, and other materials that may need to function in abrasive or harsh environments (e.g., personal protective equipment

3.b Process Flow Diagram

Due to the simplicity of the process, a process flow diagram is not necessary.

3.c Raw and Finished Materials

Raw materials include inks, varnish, solvents, and substrate.

3.d Process Capacity

The facility is permitted to have a VOC emission rate from the TO controlling EUPRINTLABELS up to 19.1 tpy, based on a 12-month rolling time period as determined at the end of each calendar month.

3.e Process Instrumentation

Process data monitored during the emissions test program include:

- Temperature in the combustion chamber of the TO
- TO retention time
- Total gallons of each material used

The TO retention time was set to 150 seconds, which was confirmed to be accurate by CYET and Thermaseal personnel during the test program. The TO temperature was recorded on a chart recorder. The total gallons of each material used were manually tracked by the operator.

Process operating data is included in Appendix E.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Sampling and analysis procedures followed the methods codified at 40 CFR 60, Appendix A and 40 CFR 63, Appendix A:

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"* was used to determine the sampling locations and the stack traverse points.
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"* was used to determine average exhaust gas velocity.
- Method 3 - *"Gas Analysis for Determination of Dry Molecular Weight" (Fyrite Method)* was used to evaluate the molecular weight of the exhaust gas.
- Method 4 - *"Determination of Moisture Content in Stack Gases"* was used to determine the moisture content of the exhaust gas.
- Method 25A - *"Determination of Total Gaseous Organic concentration using a flame ionization analyzer" (modified for methane subtraction)* was used to determine the volatile organic compound concentration of the exhaust gas.

USEPA Method 1 was utilized to determine the necessary sampling points in which to collect the air pollutants. This method is applicable to sources that are not cyclonic or swirling, and the duct diameter is greater than 12 inches. The sample locations were verified to meet at least 2 duct diameters downstream, and at least 0.5 duct diameters upstream of any flow disturbances.

The test team verified the absence of cyclonic flow in the field. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the direction of flow and the axis of the duct. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. None of the sources sampled indicated cyclonic flow.

USEPA Method 2 was utilized to measure exhaust gas velocity pressures and temperatures utilizing an S-type pitot tube equipped with a thermocouple, and an inclined manometer.

The S-Type Pitot tube dimensions were verified to be within the specified limits of Method 2 Figure 2-2, Therefore a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned. All thermocouple systems used during testing used the alternative Method 2 thermocouple calibration procedures specified in ALT-011 to ensure that the temperature of each thermocouple and reference thermometer agree to within ±2 °F.

The sampling apparatus was setup onsite, noting that the manometer is level and zeroed continuously throughout sampling. A pre- and post-test leak check of the system was performed by reaching at least 3" H_2O on both the impact and static pressure sides of the S-type pitot tube, and closing off the system. The system leak check passes when the pressure remains stable for a minimum of 15 seconds. The velocity head and temperature are then measured at each sampling point specified by USEPA Method 1.

Molecular weight determinations were evaluated using the Fyrite® procedure. The equipment used for this evaluation consists of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers (O_2 and CO_2). A grab sample of the exhaust gas was analyzed for each test run.

The Fyrite analyzers are audited monthly by collecting a known concentration of O_2 and CO_2 (protocol 1 gas cylinder) in a tedlar bag and analyzing using the fyrite. Three consecutive samples are measured and must agree with the protocol 1 gas cylinder values within $\pm$0.5%.

Exhaust gas moisture content on the TO outlet was evaluated using USEPA Method 4. Exhaust gas was extracted as part of the Method 4 sampling train and passed through the impinger configuration (see Figure 3). Exhaust gas moisture content was then determined gravimetrically. A single 30-minute moisture run was performed on the TO outlet.

Exhaust gas moisture content on the TO inlet was evaluated with Method 4, approximation method using wet bulb-dry bulb technique. A dry bulb temperature was obtained by using the average stack temperature obtained during flow rate measurements using Method 2. The thermocouple was then wrapped in a wet cloth and placed back at the stack centroid to obtain a wet bulb temperature. Exhaust gas moisture content was then determined using pressure-saturation tables.

USEPA Method 25A was used to measure VOC concentration at the TO inlet and exhaust. The VOC ppm was continuously measured via a flame ionization analyzer calibrated with propane. The gas stream is drawn through a stainless-steel probe with an in-line filter to remove any particulate, and a heated Teflon® sample line (~250°F) before it enters the gas analyzer. Data is recorded on a PC equipped with data acquisition software. Triplicate 60-minute test runs were performed simultaneously at the TO Inlet and Exhaust.

The JUM Model 109A analyzer utilizes two flame ionization detectors (FIDs) to report the average ppmv for total hydrocarbons (THC), as propane, as well as the average ppmv for methane (as methane). Upon entry, the analyzer splits the gas stream. One FID ionizes all of the hydrocarbons in the gas stream sample into carbon, which is then detected as a concentration of total hydrocarbons. Using an analog signal, specifically voltage, the concentration of THC is then sent to the data acquisition system (DAS), where recordings are taken at 4-second intervals to produce an average based on the overall duration of the test. This average is then used to determine the average ppmv for THC reported as the calibration gas, propane, in equivalent units.

The second FID reports methane only. The sample enters a chamber containing a catalyst that destroys all of the hydrocarbons present in the gas stream other than methane. As with the THC sample, the methane gas concentration is sent to the DAS and recorded. The methane concentration, reported as methane, can then be converted to methane, reported as propane, by dividing the measured methane concentration by the analyzer's response factor.

The analyzer's response factor is obtained by introducing a methane calibration gas to the calibrated J.U.M. 109A. The response of the analyzer's THC FID to the methane calibration gas, in ppmv as propane, is divided by the Methane analyzer's response to the methane calibration gas, in ppmv as methane.

An analyzer calibration error test was performed prior to sampling. Zero-, low-, mid- and high-level gases are introduced to the sampling system sequentially, recording the analyzer response. The calibration error must be within 5% of each calibration gas. A drift determination was performed after each test run by introducing the zero and mid-level calibration gases, to determine that the analyzer drift does not exceed 3% of the calibration span during any run. Recorded THC concentrations are averaged and reported for the duration of each test (as drift corrected per Method 7E). A drawing of the sampling train used for the testing program is presented as Figure 4.

4.b Recovery and Analytical Procedures

Recovery and analytical procedures are included in section 4.a.

4.c Sampling Ports

A diagram of the stacks indicating traverse point and sampling locations and stack dimensions is included as Figures 1-2.

4.d Traverse Points

A diagram of the stacks indicating traverse point and sampling locations and stack dimensions is included as Figures 1-2.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 1. Detailed results for the emissions test program are summarized by Table 3 in Appendix A.

Table 1
Overall Emission Summary
Test Date: August 23, 2023

Source	Parameter	Test Result	Limit
Thermal Oxidizer	VOC DE	98.2%	>95%

5.b Discussion of Results

All test results are in compliance with permit limits.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

5.d Process or Control Device Upsets

When the T.O. was put into destruct mode the unit would start but immediately shut down. A T.O. service tech was eventually able to come in and troubleshoot the issue. The issue was as follows: When the T.O. is put into destruct mode, the unit performs a series of internal safety checks. One of the checks looks for proper input air flow into the unit. This is done by 2 separate sensors. One of the sensors was found to be defective. The unit was physically tested to ensure proper air flow was being achieved. Once it was determined that it was meeting the required flow, the sensor was bypassed, and a new sensor was ordered to replace the defective one and will be installed asap. The unit performed as it was designed to.

5.e Control Device Maintenance

There was no control equipment maintenance performed during the emissions test program.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix D.

5.i Sample Calculations

Sample calculations are provided in Appendix E.

5.j Field Data Sheets

Field documents and raw CEM data relevant to the emissions test program are presented in Appendix C.

5.k Laboratory Data

There are no laboratory results for this test program.

ChaseYoung Environmental Testing

MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, CYET personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, CYET personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

REPORT SIGNATURES

CYET operated in conformance with the requirements of ASTM D7036-04 during this emissions test project and this emissions test report:

This report was prepared by: Brandon Chase

Brandon Chase
Senior Environmental Engineer

This report was reviewed by: M Young

Matthew Young
Senior Project Manager

Appendix A – Emission Results Tables

Table 1
Overall Emission Summary
Test Date: August 23, 2023

Source	Parameter	Test Result	Limit
Thermal Oxidizer	VOC DE	98.2%	>95%

Table 2
Test Personnel

Name, Title, and Email	Affiliation	Telephone
Mr. David Denhart Vice President of Manufacturing ddenhart@thermasealinc.com	Thermaseal, Incorporated 141 Peyerk Court Romeo, Michigan 48065	(586) 336-9415
Mr. Brandon Chase Senior Environmental Engineer bchase@cyetinc.com	CYET 28744 Groveland Street Madison Heights, MI 48071	(248) 506-0107
Mr. Matthew Young Senior Project Manager myoung@cyetinc.com	CYET 28744 Groveland Street Madison Heights, MI 48071	(586) 744-9133

Table 3
EUPRINTINGLABELS RTO VOC DE%
Thermaseal, Inc.

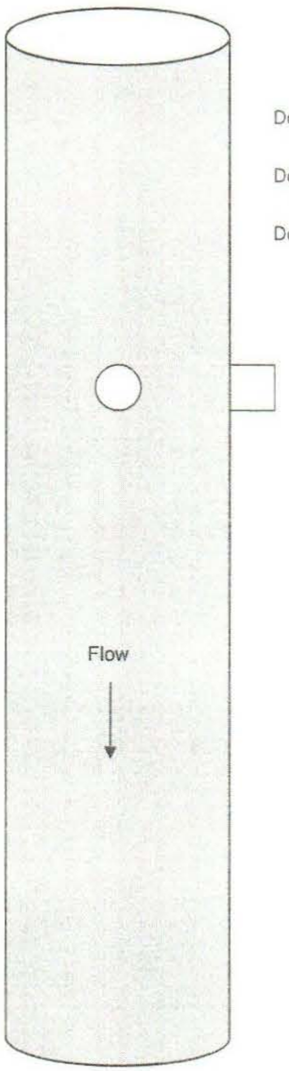
Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	8/23/2023	8/23/2023	8/23/2023	
Sampling Time	17:50-18:50	19:20-20:20	20:48-21:48	
Average Combusition Temp (°F)	1550	1550	1550	
Inlet Flowrate (scfm)	5,387	5,208	5,155	5,250
Outlet Flowrate (scfm)	4,580	4,672	4,741	4,664
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	1011.47	1014.14	979.23	1001.61
Inlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	2.50	2.41	1.29	2.07
Inlet VOC Concentration (- methane)	1010.55	1013.26	978.76	1000.86
Inlet VOC Mass Flowrate (lb/hr)	37.37	36.25	34.65	36.09
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	20.42	20.64	20.95	20.67
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	1.18	1.85	2.11	1.71
Outlet VOC Concentration (- methane)	19.95	19.90	20.10	19.98
Outlet VOC Mass Emission Rate (lb/hr)	0.63	0.64	0.65	0.64
VOC Destruction Efficiency (%)	**98.3**	**98.2**	**98.1**	**98.2**

Inlet CH4 Response Factor	**2.73**
Outlet CH4 Response Factor	**2.49**

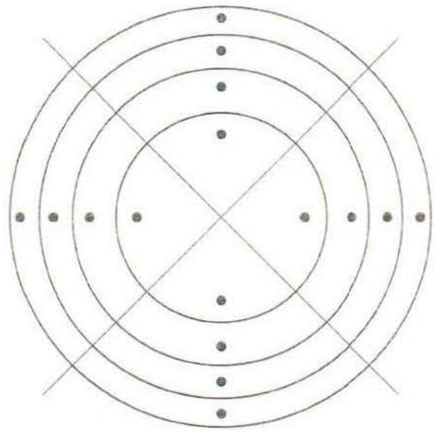
scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
VOC: volatile organic compound
MW = molecular weight (C_3H_8 = 44.10)
24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31: ft^3 per m^3
453600: mg per lb

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Appendix B – Figures



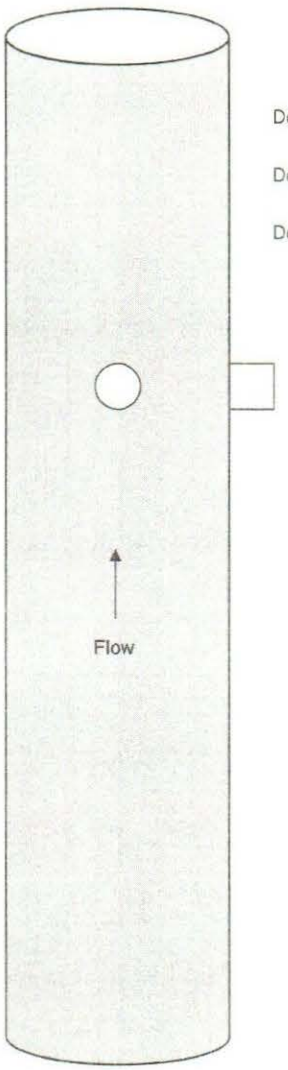
Diameter	15.75	inches
Upstream		feet
Downstream		feet
Upstream	44	inches
Downstream	62	inches
Upstream	2.8	diameters
Downstream	3.9	diameters



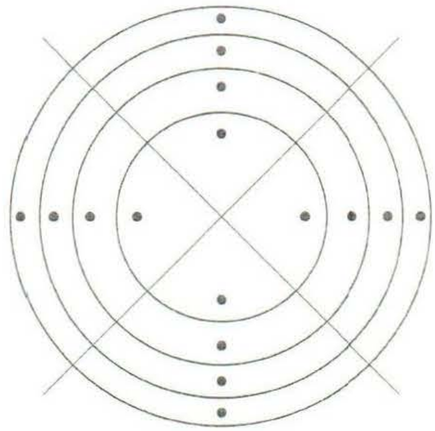
Traverse Point #	Distance (inches)
1	0.5
2	1.7
3	3.1
4	5.1
5	10.7
6	12.7
7	14.1
8	15.2

Figure 1
Thermal Oxidizer Inlet Stack Diagram

ChaseYoung Environmental Testing



Diameter	17.75 inches
Upstream	15 feet
Downstream	7 feet
Upstream	180 inches
Downstream	84 inches
Upstream	10.1 diameters
Downstream	4.7 diameters



Traverse Point #	Distance (inches)
1	0.6
2	1.9
3	3.4
4	5.7
5	12.0
6	14.3
7	15.9
8	17.2

Figure 2
Thermal Oxidizer Exhaust Stack Diagram

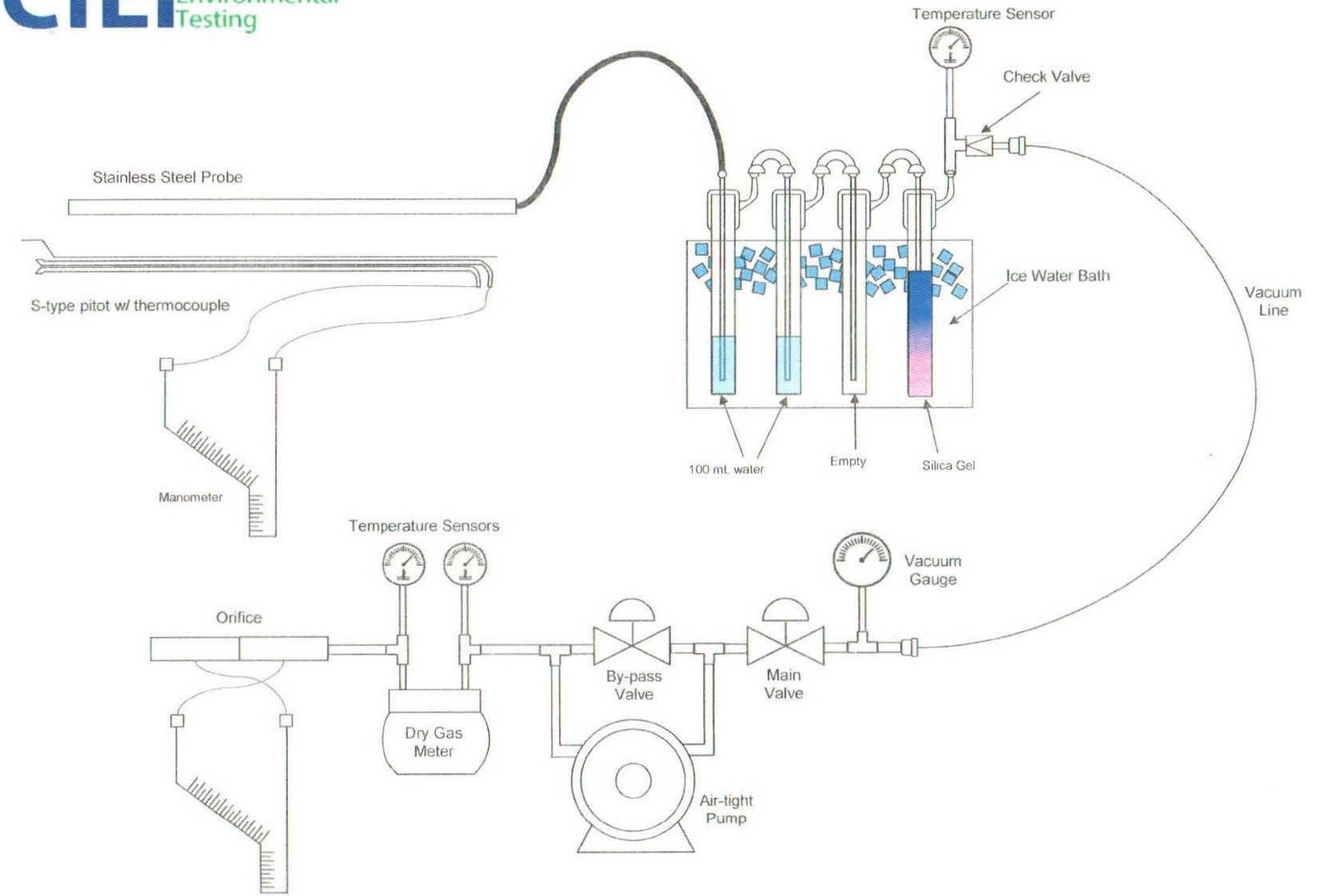


Figure 3

USEPA Method 4 Sampling Train

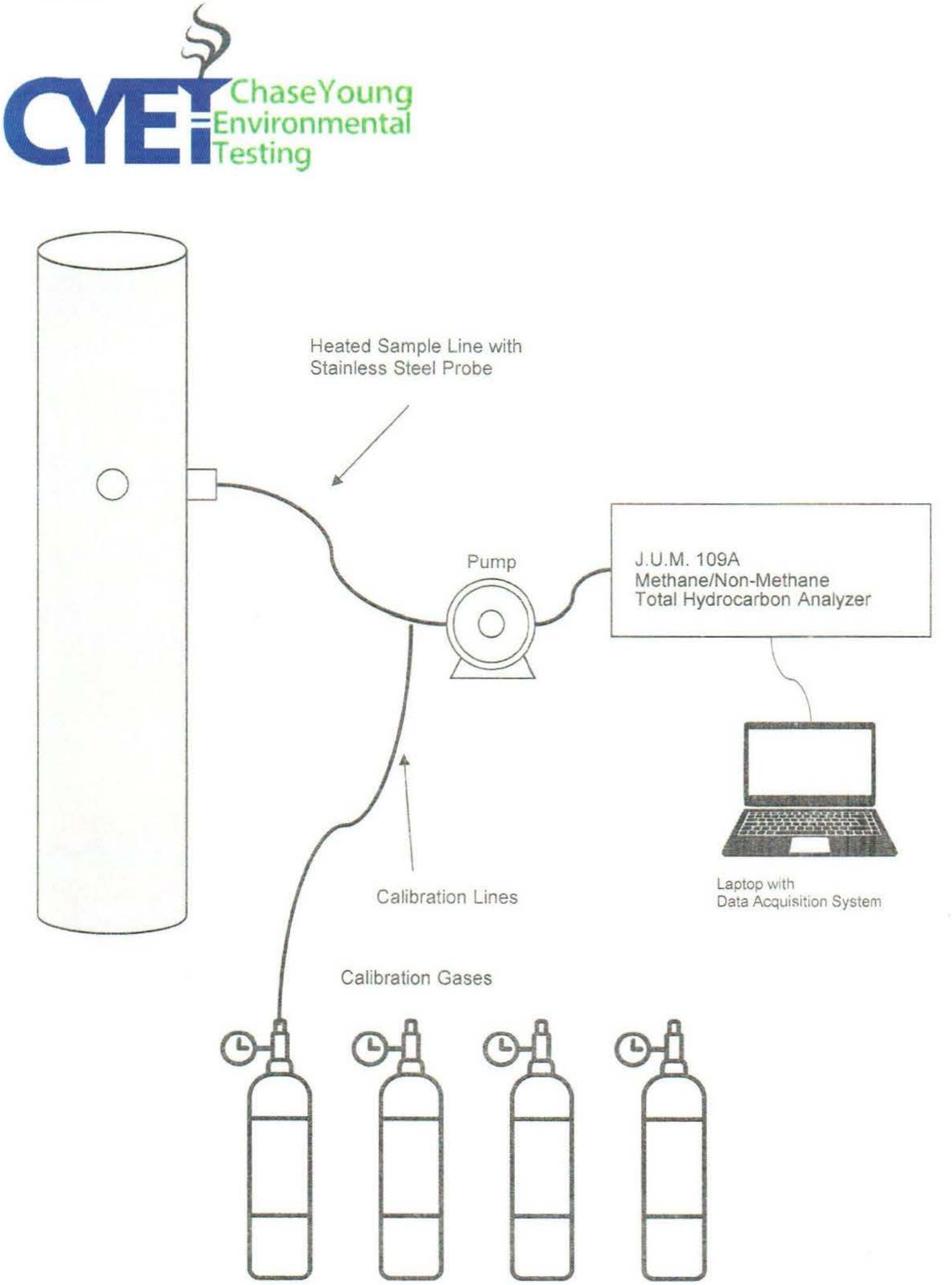


Figure 4

USEPA Method 25A Sampling Train

RECEIVED

OCT 17 2023

AIR QUALITY DIVISION