# DETERMINATION OF VOC DESTRUCTION EFFICIENCY

## PROCESS VOC ABATEMENT SYSTEM

PREPARED FOR:

PLASTI-PAINT, INC.
801 WOODSIDE DRIVE
SAINT LOUIS, MICHIGAN

SUBMITTED:

OCTOBER 15, 2019
HHMI PROJECT NO. 1907-001

PREPARED BY:

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## EXECUTIVE SUMMARY

H & H Monitoring, Inc. (HHMI) was retained by Plasti-Paint, Inc. to perform an emissions evaluation of the manufacturing process VOC Abatement System at the Plasti-Paint, Inc. facility in Saint Louis, Michigan. HHMI performed the evaluation to establish DE data for VOC emission reporting to demonstrate compliance with the VOC emission limit of 70 tons per year as detailed in the air use Permit No.586-97D. The testing was performed in accordance with the procedures stipulated in USEPA Reference Methods. HHMI professionals conducted the field services on September 17, 2019. Representatives of Plasti-Paint, Inc. and Durr Systems, Inc. coordinated the testing with plant operations. Mr. Tom Gasloli with EGLE provided observation of the testing. A summary of the results is presented below.

### SUMMARY OF RESULTS

| **VOC DESTRUCTION EFFICIENCY (as propane)** | **Value** |
|---|---|
| VOC Entering the system (Main Inlet lbs/hr) | 34.43 |
| VOC Entering the system (Oven Inlet lbs/hr) | 0.28 |
| VOC Exiting the system (RTO Outlet lbs/hr) | 2.12 |
| **VOC Destruction Efficiency (% by weight)** | **93.9** |

# 1.0 INTRODUCTION

HHMI conducted a volatile organic compounds (VOC) destruction efficiency (DE) study on the coating processes VOC abatement system at the Plasti-Paint, Inc. facility located in Saint Louis, Michigan. HHMI performed the evaluation to develop DE data to demonstrate compliance with the DE limitation and VOC emission limit of 70 tons per year as detailed in the air use Permit No.586-97D.

Messrs. Daniel Hassett, Troy Manning and Brad Wallace on September 17, 2019, performed field services for this project. Mr. Jameson Evitts with Plasti-Paint, Inc. provided coordination of the testing with production operations and abatement system operations.

This report presents the results obtained as well as describes the techniques used in the performance of this testing study. A description of the processes and the abatement systems are presented in Section 2.0. A discussion of sampling and analytical procedures used during the test program is provided in Section 3.0. A discussion of the project results is presented in Section 4.0. A summary of the quality assurance procedures used in the performance of this study is presented in Section 5.0. The Results Table provides detailed summaries of the testing data. Figures 1 through 4 present test locations and USEPA Method 25A sampling train. Appendix A presents example calculations for Run 1. Appendix B includes quality assurance information. Appendix C presents calculation data spreadsheets and copies of original field data sheets. Appendix D contains copies of raw analyzer concentration data. Appendix E presents abatement system operating data.

## 2.0 PROCESS DESCRIPTION

Plasti-Paint, Inc. operates a coating facility located in Saint Louis, Michigan. Various plastic parts are coated using a robotic spray coating process and curing oven. Various plastic parts are coated using a robotic spray coating process. Finished goods are plastic and metal exterior and interior trim parts. Parts are all molded by suppliers.

Process exhaust gases are exhausted from the coating operations and transferred to the abatement system via a series of fans and ductwork. The abatement system controls VOC emissions from the coating processes. VOCs emitted from the coating processes is controlled by a Durr Systems Model RL 25 RTO.

## 3.0 SAMPLING AND ANALYTICAL PROCEDURES

Procedures employed for this study were conducted in accordance with the following applicable USEPA reference methodologies:

- Methods 1 and 2 to determine exhaust gas volumetric flow rates.
- Method 3 to determine exhaust gas molecular weights.
- Method 4 (wet-bulb procedure) to determine exhaust gas moisture content.
- Method 25A to determine VOC emissions

Detailed descriptions of the procedures and methodologies performed to complete this testing project are presented individually in the following sub-sections.

### 3.1 USEPA TEST METHODS AND PROCEDURES

Testing procedures employed during the performance of this study were conducted in accordance with USEPA Methods 1, 2, 3, 4 and 25A. A summary of the test procedures is presented below.

Method 1, "*Sample and Velocity Traverses for Stationary Sources*," was used to determine the number of traverse points for flow rate measurement at each sampling location. The number of upstream and downstream stack/duct diameters from the sampling ports to the nearest flow disturbance was determined. Based on these determinations, the appropriate number of traverse points was chosen for the purpose of determining the volumetric flow rate of the flue gas. The sample port locations and the upstream and downstream stack diameters are depicted in Figures 1 through 3.

Method 2, "*Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)*," was used to measure velocity pressures and temperatures at each traverse point. A calibrated Type-S pitot tube equipped with a thermocouple was positioned at each of the traverse points and the exhaust gas temperature and velocity pressure were measured and recorded. The Type-S Pitot tube was calibrated in accordance with the specifications outlined in Method 2. Measurement readings were made on a manometer capable of measuring to the nearest 0.01 inch of water. Temperature readings were made using a calibrated pyrometer.

The average stack gas velocity is a function of velocity pressure, absolute stack pressure, stack temperature, molecular weight of the wet stack gas, and Pitot tube coefficient. Determination of average stack gas velocity was performed in accordance with equations presented in Method 2. Actual exhaust gas flow rate was determined from the average stack gas velocity and stack dimensions. Exhaust gas flow rate data from the stack are presented in Appendix C.

Method 3, (*Gas Analysis for the Determination of Dry Molecular Weight),* was used to determine the molecular weight of the flue gas for the volumetric flow and VOC testing. Grab samples of the exhaust gas were collected and analyzed for oxygen ($O_2$) and carbon dioxide ($CO_2$) concentrations using a Fyrite combustion gas analyzer.

The dry molecular weight of the stack gas was calculated based on the assumption that the primary constituents are oxygen, carbon dioxide, and nitrogen (other compounds present have a negligible relative effect on molecular weight). Having measured the oxygen and carbon dioxide concentrations, the percent stack gas was then equal to the sum of each constituent compound's molecular weight (lb/lb-mole) multiplied by its respective concentration.

Method 4, "*Determination of Moisture Content in Stack Gases*," was used to measure the moisture in the exhaust gases at each of the sampling locations. Test locations that had an exhaust gas wet bulb temperature of 212 °F or less and was measured for moisture content using the wet bulb/dry bulb stoichiometric calculation procedure described in Method 4. The two inlet locations and RTO outlet had wet bulb temperatures of less than 212 °F.

Method 25A (VOC), "*Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer*," was used to measure VOC concentration in the exhaust gas. JUM Engineering flame ionization detectors (FID) were used to conduct testing. Exhaust gas was withdrawn from the sample locations through a probe, heated sample line, and pump prior to being subjected to the ionization flame.

Each FID directs a portion of the sample through a capillary tube to the FID that ionizes the hydrocarbons to carbon. The detector determines carbon response in terms of an analog signal (voltage). The signal is then converted to concentration (ppmv) and recorded, at 2-second intervals over the test period, using a digital data acquisition system. The concentration of VOC is reported as equivalent units of the calibration gas (propane).

## 3.2 SAMPLING LOCATIONS

The RL oxidizer has a capacity of 25,000 CFM and has a 30" X 53" rectangular exhaust stack. Five test ports are installed on the 53-inch side of the stack at approximately 147 inches (4.84 equivalent diameters) downstream from 90-degree elbow and 99 inches (2.58 equivalent diameters) upstream from the stack exit.

The main inlet duct has a diameter of 48 inches with test ports installed in a horizontal section approximately 30 inches (0.625 diameters) downstream from a 45-degree elbow and approximately 30 inches (0.625 diameters) upstream from the oven inlet duct breech.

The oven inlet duct has a diameter of 18 inches with test ports installed in a vertical section approximately 180 inches (10.0 diameters) downstream from a 45-degree elbow and approximately 18 inches (1.0 diameters) upstream from the main inlet duct breech.

## 3.3 VOC OXIDIZER SYSTEM DESTRUCTION EFFICIENCY

Destruction efficiency (DE) is expressed as the ratio of the difference between the measured inlet and outlet mass VOC emission rates divided by the mass VOC emission rate measured at the abatement system inlet. Oxidizer DE was measured using applicable USEPA Method 25A procedures. Three 60-minute test runs were performed at the main inlet, oven inlet and exhaust stack of the oxidizer.

HHMI utilized total hydrocarbon analyzers to obtain VOC measurements at the test locations. All VOC raw concentrations were drift corrected using USEPA Method 7E procedures. Based on these measurements, the mass-based VOC destruction efficiency was calculated.

## 4.0 DISCUSSION OF RESULTS

The VOC destruction efficiency is presented in the Result Table. Individual run times and averages are detailed in the table. Supplemental information for each test run is provided with the field data and calculation information in Appendix C. The data results provided in this report may be used to establish DE data for VOC emission reporting to demonstrate compliance with the DE limitation and VOC emission limit of 70 tons per year as detailed in the air use Permit No. 586-97D.

Five test runs were performed for this test series. Run 1 was performed at an oxidizer chamber temperature of 1,425 ˚F which achieved a DE of 91.5%. The oxidizer chamber temperature was then raised to 1,450 ˚F and a second run was performed which achieved a DE of 93.4%. The oxidizer chamber was again raised to 1,465 ˚F and a third run performed which achieved a DE of 93.8%.

With the oxidizer chamber temperature set point at 1,465 ˚F, the 3-Run (Runs 3-5) average of 34.71 pounds per hour (lbs/hr) at the inlet and 2.12 lbs/hr at the outlet yielding an average destruction efficiency of 93.9%.

## 5.0 QUALITY ASSURANCE

Quality assurance (QA) objectives required for this study followed applicable criteria detailed by each method used. The following details specific QA limitations and this study's compliance with those limitations.

Where applicable, reference method QA control procedures were followed to demonstrate creditability of the data developed. Quality assurance information for field equipment is provided in Appendix B. The procedures included, but were not limited to, the following:

- Sampling equipment was calibrated according to procedures contained in the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III," EPA 600/R-94/038c, September 1994.

- The sample trains were configured according to the appropriate test methods.

- Quality control checks of sample trains were performed on-site, including sample train and Pitot tube leak checks.

- VOC FIDs were calibrated in accordance with USEPA Method 25A.

- All data was drift corrected using correction procedures detailed in USEPA Method 7E.

## 6.0 LIMITATIONS

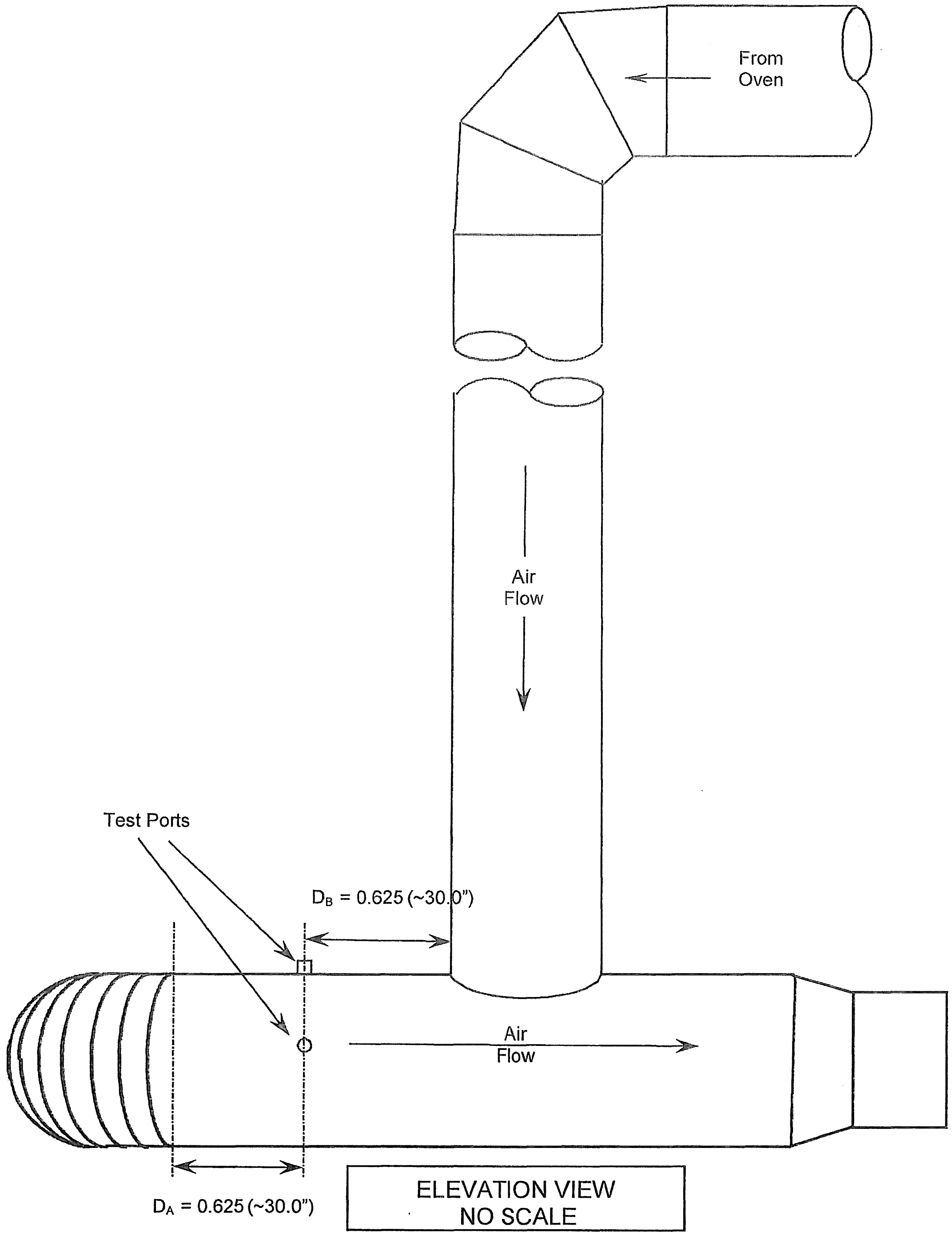
This report is provided to Plasti-Paint, Inc. in response to a limited assignment. HHMI will not provide any information contained in, or associated with, this report to any unauthorized party without expressed written consent from Plasti-Paint, Inc., unless required to do so by law or court order. HHMI accepts responsibility for the performance of the work, specified by the limited assignment, which is consistent with others in the industry, but disclaims any consequential damages arising from the information contained in this report.

This report is intended solely for the use of Plasti-Paint, Inc. The scope of services performed for this assignment may not be appropriate to comply with the requirements of other similar process operations, facilities, or regulatory agencies. Any use of the information or conclusions presented in this report, for purposes other than the defined assignment, is done so at the sole risk of the user.

This emission testing survey was conducted and report developed by the following H & H Monitoring, Inc. personnel:

| | | |
|---|---|---|
| Troy Manning<br>Technician | Brad Wallace<br>Site Leader | Daniel L. Hassett<br>President |

# RESULTS TABLE




| Traverse Point Locations | |
|---|---|
| Stack Dia.: | 48" |
| Point # | Distance from Stack wall |
| 1 | 1.54 |
| 2 | 5.04 |
| 3 | 9.31 |
| 4 | 15.50 |
| 5 | 32.50 |
| 6 | 38.69 |
| 7 | 42.96 |
| 8 | 46.46 |

FIGURE 1

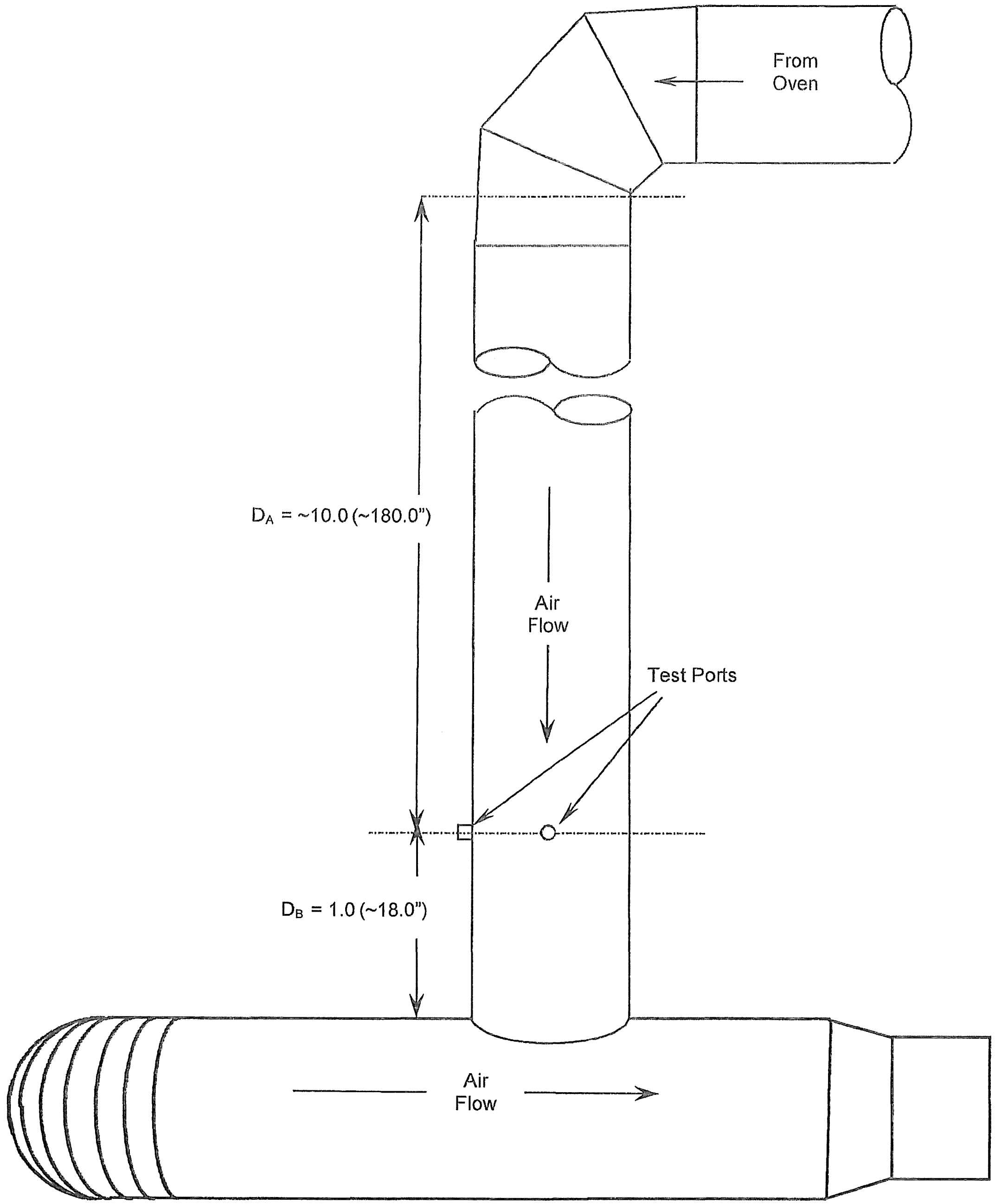
TEST PORT AND TRAVERSE POINT LOCATION
MAIN OXIDIZER INLET

PREPARED FOR

PLASTI-PAINT
ST. LOUIS, MICHIGAN

| | | |
|---|---|---|
| DRAWN | DLH 7/1/19 | DRAWING NUMBER 1907001-01 |
| REVISED | DLH 10/9/19 | |
| JOB NO. 1907-001 | | |

H & H MONITORING, INC.




ELEVATION VIEW
NO SCALE

| Traverse Point Locations | |
|---|---|
| Stack Dia.: | 18" |
| Point # | Distance from Stack wall |
| 1 | 0.58 |
| 2 | 1.89 |
| 3 | 3.49 |
| 4 | 5.81 |
| 5 | 12.19 |
| 6 | 14.51 |
| 7 | 16.11 |
| 8 | 17.42 |

FIGURE 2

TEST PORT AND TRAVERSE POINT LOCATION
OVEN OXIDIZER INLET

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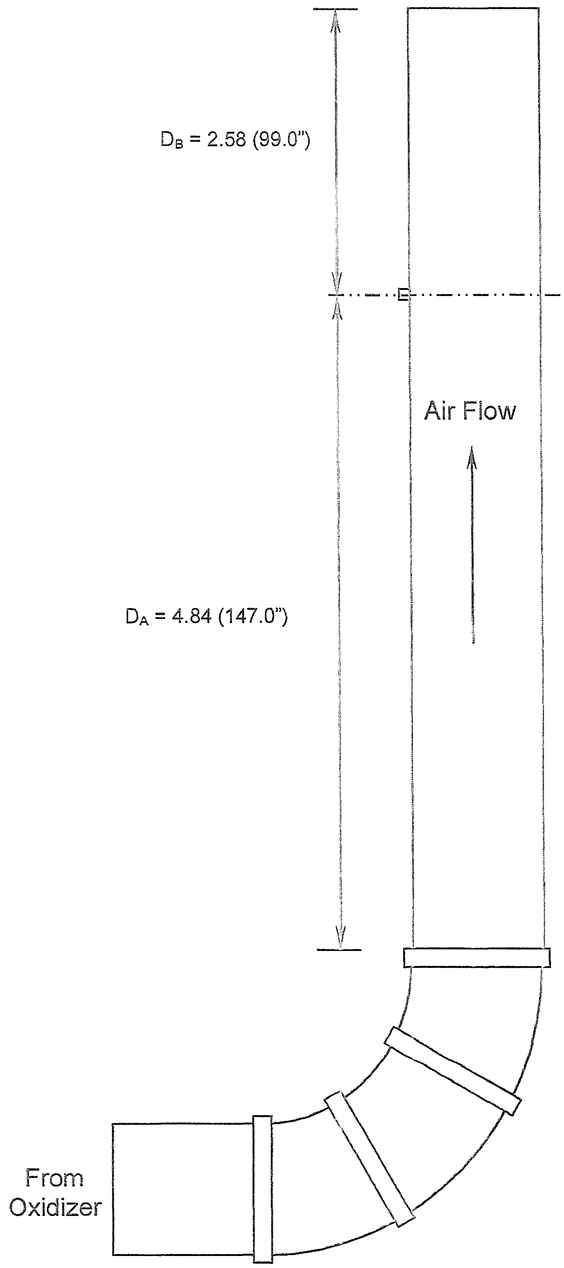
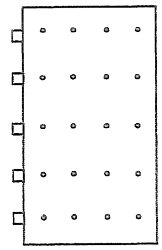
PLASTI-PAINT
ST. LOUIS, MICHIGAN

| | | |
|---|---|---|
| DRAWN | DLH 7/1/19 | DRAWING NUMBER 1907001-02 |
| REVISED | DLH 10/9/19 | |
| JOB NO. 1907-001 | | |

H & H MONITORING, INC.




ELEVATION VIEW
NO SCALE



Traverse Point Matrix

| Traverse Point Locations | |
|---|---|
| Stack Dimensions.: | 53.0 X 30.0 |
| Point # | Distance from Stack wall |
| 1 | 3.72 |
| 2 | 11.16 |
| 3 | 18.60 |
| 4 | 26.03 |

FIGURE 3

TEST PORT AND TRAVERSE POINT LOCATION
RTO OUTLET

PREPARED FOR

PLASTIPAINT
ST. LOUIS, MICHIGAN

| | |
|---|---|
| DRAWN DLH 7/1/19 | DRAWING NUMBER 1907001-03 |
| REVISED | |
| JOB NO. 1907-001 | |

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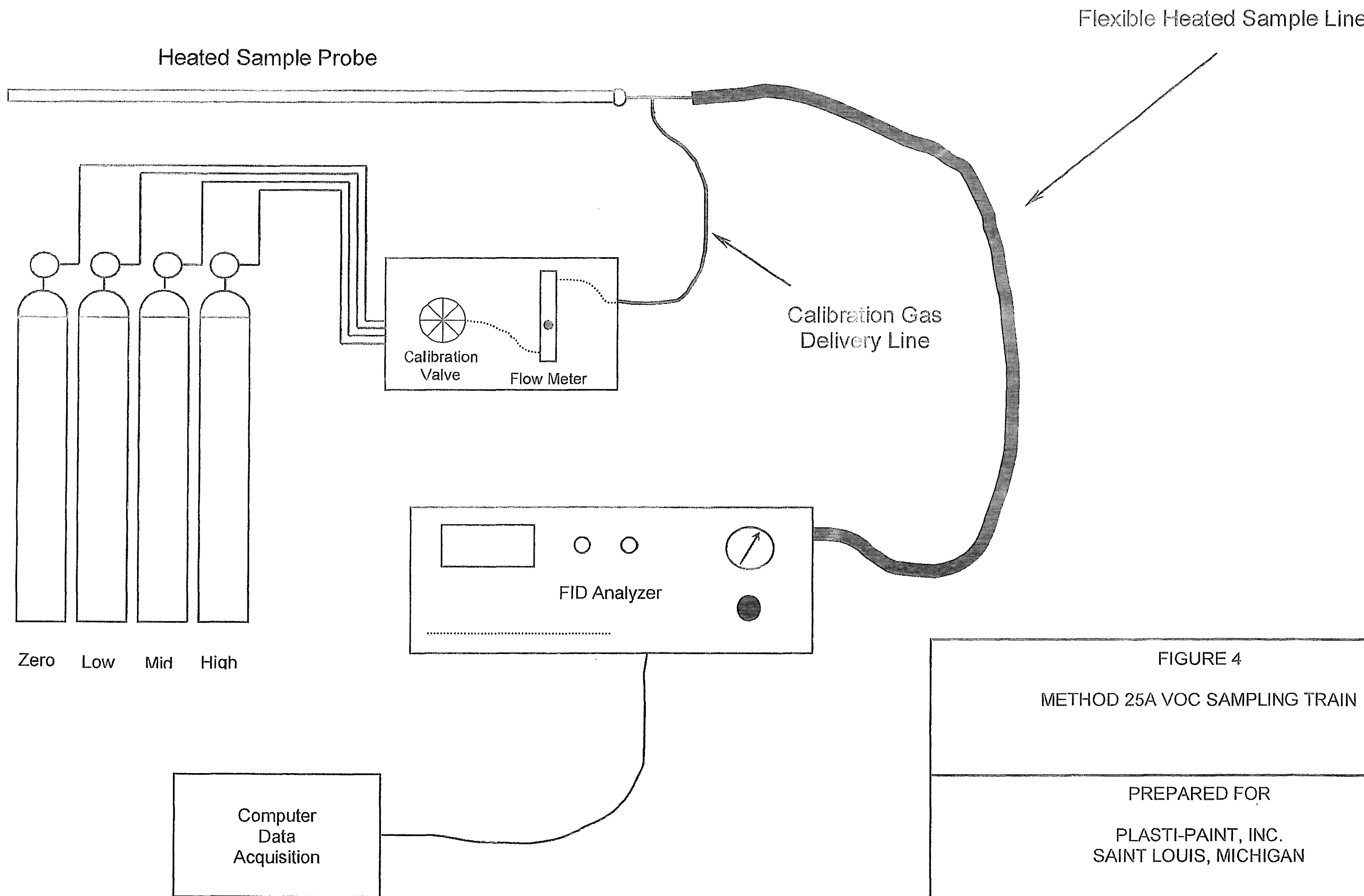


FIGURE 4

METHOD 25A VOC SAMPLING TRAIN

PREPARED FOR

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| | |
|---|---|
| DRAWN DLH 1/1/19 | DRAWING NUMBER 1907001-4 |
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