# H & H MONITORING, INC.

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# DETERMINATION OF VOC CAPTURE AND DESTRUCTION EFFICIENCY SPRAY WAX BOOTH

**PREPARED FOR:**

**THE WOODBRIDGE GROUP**
**ROMULUS PLANT**
**ROMULUS, MICHIGAN**

**SUBMITTED:**

**FEBRUARY 16, 2017**
**HHMI PROJECT NO. 1610-001**

**PREPARED BY:**

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## EXECUTIVE SUMMARY

H & H Monitoring, Inc. (HHMI) was retained by The Woodbridge Group (TWG) to perform an emissions evaluation on the volatile organic compounds (VOC) emissions abatement system at their Romulus, Michigan facility. This study was performed in accordance with the MDEQ-approved test plan dated December 26, 2016. The purpose of the study was to demonstrate compliance with testing requirements detailed in the Permit to Install No. 126-99B.

HHMI personnel performed the field services for the study on January 18, 2017. MDEQ was present during the testing.

Since the source associated with this testing program is not subject to federally mandated requirements, a full temporary total enclosure is not required. This was confirmed during a meeting on December 16, 2016, by Mr. Tom Maza with MDEQ. Smoke tubes were used to verify that air flow in the Spray Wax Booth area and subsequent production areas, was inward toward the fume hoods and RTO control system. This verification was performed on December 16, 2016 and again during the testing on January 18, 2017.

### SUMMARY OF AVERAGE RESULTS

| | |
|---|---|
| **ABATEMENT SYSTEM CAPTURE EFFICIENCY** | |
| Total VOC Input During Test Run (lbs) | 73.19 |
| Total VOC Captured During Test Run (lbs) | 71.74 |
| **VOC Removal Efficiency (% by weight)** | **98.0%** |
| **RTO DESTRUCTION EFFICIENCY** | |
| VOC Entering the Abatement System (lbs/hr) | 35.8 |
| VOC Exiting the Abatement System (lbs/hr) | 0.57 |
| **VOC Destruction Efficiency (% by weight)** | **98.4%** |

# 1.0 INTRODUCTION

HHMI conducted a volatile organic material (VOC) capture and destruction efficiency study on the abatement system for the Mold Release Agent coating process at the The Woodbridge Group (TWG) facility located in Romulus, Michigan. This study was performed in accordance with the approved test plan dated December 26, 2016.

TWG operates a foam seat molding process at the Romulus Plant in Romulus Michigan. In accordance with Michigan Department of Environmental Quality (MDEQ) Permit to Install 126-99B, TWG was required to demonstrate, by testing, that the VOC capture and destruction efficiency of the VOC abatement system is in compliance with stipulated permit requirements. The abatement system includes a spray booth, fume hoods, duct work, and fans, which direct the VOC emissions from the Spray Wax Booth to a regenerative thermal oxidizer (RTO).

Messrs. Daniel L. Hassett, Brad Wallace and Troy Manning performed the field services for the study January 18, 2017. Additionally, TWG representatives recorded production counts, MRA material usage and RTO combustion chamber temperature during the testing.

This report presents the results obtained as well as describes the techniques used in the performance of this testing study. A description of the coating processes and the abatement system 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 a summary of the testing data. Figures 1 through 5 present information regarding duct dimensions, traverse point locations and sampling trains. Appendix A presents example calculations using Run 1 data. Appendix B includes quality assurance information. Appendix C presents calculation data spreadsheets and copies of original field data sheets. Appendix D contains graphs of raw analyzer concentration data. Appendix E contains the process operating data recorded during the testing. Appendix F contains the process, RTO and smoke tube verification data.

## 2.0 PROCESS DESCRIPTION

The abatement system controls VOC emissions from the spray wax booth. VOC emitted from the booth is controlled by a Turner Envirologic RTO. The open mold enters a small spray wax booth enclosure supported by stack SV-RTO (controlled) or SV-S2 (by-pass). A solvent based mold release agent (MRA) is applied to the bowl and lid portion of the mold via a spray applicator in a pre-programmed pattern. The spray booth emissions are controlled by the RTO.

## 3.0 SAMPLING AND ANALYTICAL PROCEDURES

Per Mr. Tom Maza with MDEQ, the spray wax booth does not require a federal permit and is not subject to the requirements for a temporary total enclosure. However, smoke tubes were used to verify that air flow in the Spray Wax Booth area and subsequent production areas, was inward toward the fume hoods and RTO control system. This verification was performed on December 16, 2016, and again during the testing on January 18, 2017.

Following fume hood smoke tube verification, total VOC was measured concurrently in the stack/duct work concurrently at three individual test locations. These test locations included, a fugitive exhaust identified as stack SV-3, the RTO inlet ductwork (captured gas stream) to the RTO and outlet exhaust stack of the RTO identified as stack SV-RTO.

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 to determine exhaust gas moisture content.
- Method 25A to determine VOC emissions in the exhaust gases during destruction efficiency testing.
- Method 204 to determine air flow verification.

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

### 3.1 <u>FUME HOOD AIR FLOW VERIFICATION</u>

Since the source associated with this testing program is not subject to federally mandated requirements, a full temporary total enclosure is not required. This was confirmed during a meeting on December 16, 2016, by Mr. Tom Maza with MDEQ. Smoke tubes were used to verify that air flow in the Spray Wax Booth area and subsequent production areas, was inward toward the fume hoods and RTO control system. This verification was performed on December 16, 2016 and again during the testing on January 18, 2017.

## 3.2 VOC ABATEMENT SYSTEM CAPTURE EFFICIENCY

Since the exhaust gases coming from the MRA are not all captured and sent to the RTO, the assumption of 100% CE cannot be made, therefore, measurement of CE was required. Capture efficiency (CE) is expressed as the captured mass of VOC in the captured air stream, determined during each test, divided by the total mass of VOC emitted by the MRA coating process, during each test. The gas-to-gas phase VOC protocol was used. Capture efficiency parameters are calculated in terms of propane.

The CE of VOC emissions by the abatement system was conducted in accordance with USEPA Reference Methods. Corresponding exhaust gas volumetric flow rate and moisture content determinations were made for each test run at the RTO inlet and fugitive exhaust duct sampling locations. Air flow and moisture content measurements corresponding to each VOC test run were performed.

HHMI utilized total hydrocarbon analyzers (JUM VE-7) at the test locations to obtain VOC measurements. Based on these measurements, the CE of the abatement system was calculated.

## 3.3 VOC ABATEMENT 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 inlet.

The abatement system DE determination of VOC emissions was performed in accordance with USEPA Reference Methods. Three 120-minute test runs were conducted on the abatement system. Corresponding exhaust gas volumetric flow rate and moisture content determinations were made for each test run.

HHMI utilized total hydrocarbon analyzers (JUM VE-7) at the test locations to obtain VOC measurements. Based on these measurements, the DE of the abatement system was calculated.

## 3.4 SAMPLING LOCATIONS

Test ports were installed on the 28-inch diameter inlet duct up-stream of the RTO. The inlet ports were installed in accordance with USEPA Method 1. The RTO inlet test ports are installed in vertical duct exiting the dust collector. The ports are located 120 inches (4.3 equivalent duct diameters) downstream from 90 degree elbow and 28 inches (1.0 equivalent duct diameters) upstream from a 90 degree elbow.

The outlet test ports are installed on the freestanding exhaust stack located on a concrete pad next to the RTO. The ports are located 252 inches (7.2 equivalent duct diameters) downstream from duct entry into the stack and 192 inches (5.5 equivalent duct diameters) upstream from the exit of the stack.

The fugitive emission duct includes an exhaust stack that removes air from the process at a point immediately downstream of the spray booth. The test ports on the 34.5 inch diameter fugitive stack are located approximately 96 inches (2.8 equivalent duct diameters) downstream from a 90-degree elbow and 35 inches (1.0 equivalent duct diameters) upstream from the fan inlet.

## 3.4 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, 25A and 204. 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 measurement 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 thermocouple and pyrometer.

The average stack gas velocity is a function of average velocity pressure, absolute stack pressure, average 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 velocity and stack dimensions. Three measurements were made at each measurement location during each of the three VOC test runs. Exhaust gas flow rate data from 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. 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. Three measurements were made at each measurement location during each of the three VOC test runs.

Method 4, "*Determination of Moisture Content in Stack Gases,*" was used to measure the moisture in the exhaust gases at the RTO outlet location. A gas sample was extracted from the stack and moisture present in the gas sample was condensed in a series of impingers. The impingers each contained a known weight of water or silica gel prior to the start of each moisture test run. At the conclusion of each moisture test run, the post-test weights of the impingers were recorded.

The percent of moisture in the exhaust gas was determined based on the volume of gas sampled and water condensed. The percent moisture by volume of the exhaust gas, at standard temperature and pressure (68 degrees Fahrenheit and 29.92 inches of mercury), was determined in accordance with equations presented in Method 4. Moisture data from each source is shown in Appendix C.

The remaining test locations including the RTO inlet and the fugitive exhaust were measured for moisture using the wet bulb stoichiometric calculation procedure described in Method 4.

One moisture measurement was made at each measurement location during each of the three VOC test runs.

Method 25A, "*Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer*," was used to measure VOC emissions concentrations each of the sampling locations. JUM Engineering Model VE7 flame ionization detectors (FID) were used to conduct testing. Continuous samples were withdrawn from the sample locations through a probe, heated sample line, and pump before 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 the carbon concentration in terms of parts per million (ppm). The concentration of VOC was then converted to an analog signal (voltage) and recorded on a computerized data acquisition system at 2-second intervals. The data were then averaged over the test period to determine the concentration for VOC reported as equivalent units of the calibration gas (propane). A sketch depicting the JUM VE-7 VOC measurement train is presented in Figure 7.

Method 204, *"Criteria for and Verification of a Permanent or Temporary Total Enclosure,"* was used to verify the air flow into the fume hood system. Smoke tubes were used to generate visible fumes that were observed during this process. A simple yes or no determination was recorded for inward air flow into the hood system.

## 4.0 DISCUSSION OF RESULTS

The VOC capture and destruction efficiency is shown in the Results Table. Supplemental information for each VOC 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 demonstrate compliance with testing requirements detailed in the Permit to Install No. 126-99B.

## 5.0 QUALITY ASSURANCE

Quality assurance (QA) objectives required for this study followed applicable criteria detailed by each method used and approved by the facility's test plan dated December 26, 2016. 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 600/4-72-b, 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. Calibration error was within the allowable limit of 5% of calibration gas value. Zero and calibration drift were both within the allowable limit of 3% of analyzer span for all test runs. FID response times (0-95% of span) were within the allowable 30 seconds, as required.

- Capture efficiency data was validated using the lower confidence limit (LCL) approach detailed in USEPA's GD-35.

## 6.0 LIMITATIONS

This report is provided to The Woodbridge Group 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 The Woodbridge Group, 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 The Woodbridge Group. 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.

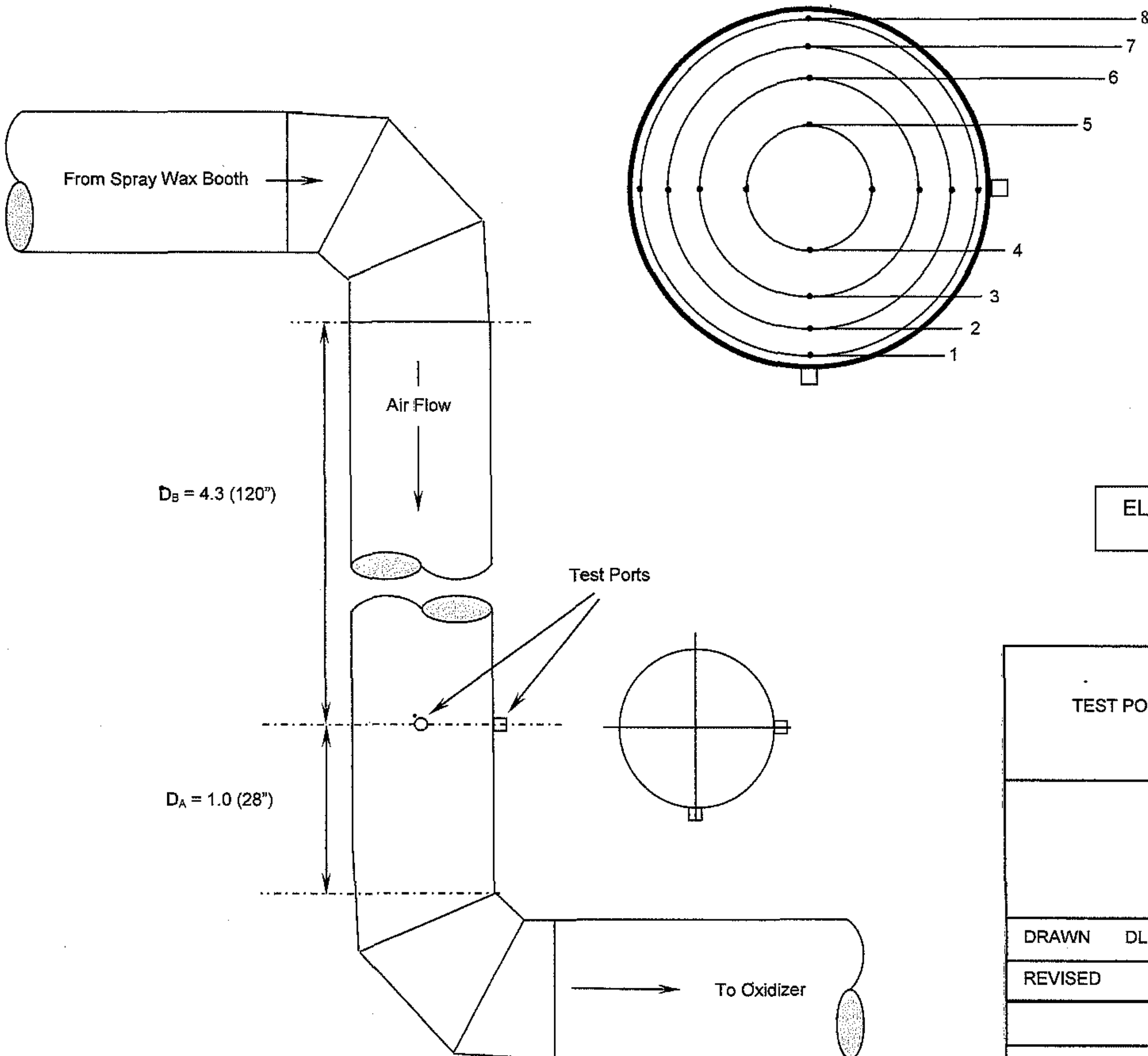
This emission testing survey was conducted and report developed by the following H & H Monitoring, Inc. personnel:

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

# RESULTS TABLE

## VOC CAPTURE AND DESTRUCTION EFFICIENCY
## SPRAY WAX BOOTH
## THE WOODBRIDGE GROUP
## ROMULUS, MI
## January 18, 2017

| Run No. | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Date | 1/18/2017 | 1/18/2017 | 1/18/2017 | |
| Start Time | 6:40:00 | 9:22 | 1:11 | |
| Stop Time | 8:40:00 | 11:22 | 3:11 | |
| Test Duration (min.) | 120.0 | 120.0 | 120.0 | |
| **Fugitive Stack** | | | | |
| SCFM | 12,413 | 12,515 | 12,239 | **12,389** |
| VOC concentration (ppm) | 8.1 | 8.3 | 9.3 | **8.57** |
| VOC emission rate (lb/hr) | 0.69 | 0.71 | 0.78 | **0.73** |
| **Total Fugitive VOC (lb)** | 1.39 | 1.42 | 1.56 | **1.46** |
| **RTO Inlet** | | | | |
| SCFM | 13,007 | 12,575 | 12,724 | **12,769** |
| VOC concentration (ppm) | 414.3 | 413.8 | 399.1 | **409.07** |
| VOC emission rate (lb/hr) | 37.00 | 35.73 | 34.87 | **35.87** |
| **Total Inlet VOC (lb)** | **74.01** | **71.46** | **69.74** | **71.74** |
| **RTO Outlet** | | | | |
| SCFM | 11,978 | 12,361 | 11,934 | **12,091** |
| VOC concentration (ppm) | 7.27 | 6.89 | 6.37 | **6.84** |
| VOC emission rate (lb/hr) | 0.60 | 0.58 | 0.52 | **0.57** |
| **VOC DESTRUCTION EFFICIENCY** | **98.4%** | **98.4%** | **98.5%** | **98.4%** |
| Total VOC Input During Test Run (lbs) | 75.39 | 72.88 | 71.30 | **73.19** |
| Total VOC Captured During Test Run (lbs) | 74.01 | 71.46 | 69.74 | **71.74** |
| **VOC CAPTURE EFFICIENCY** | **98.2%** | **98.1%** | **97.8%** | **98.0%** |




| Traverse Point Locations | |
|---|---|
| Stack Dia.: | 28.0" |
| Point # | Distance from Stack wall |
| 1 | 0.90 |
| 2 | 2.94 |
| 3 | 5.43 |
| 4 | 9.04 |
| 5 | 18.96 |
| 6 | 22.57 |
| 7 | 25.06 |
| 8 | 27.10 |

ELEVATION VIEW
NO SCALE

FIGURE 1

TEST PORT AND TRAVERSE POINT LOCATION
RTO INLET

PREPARED FOR

THE WOODBRIDGE GROUP
ROMULUS, MICHIGAN

| | | |
|---|---|---|
| DRAWN | DLH 1/30/17 | DRAWING NUMBER 1610001-1 |
| REVISED | | |

JOB NO. 1610-001

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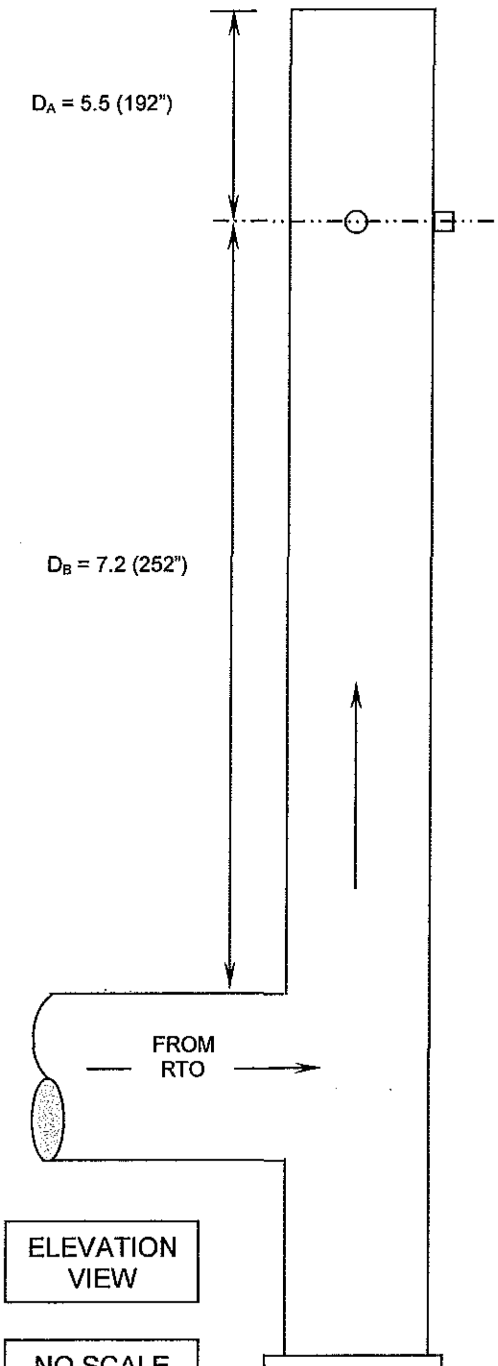
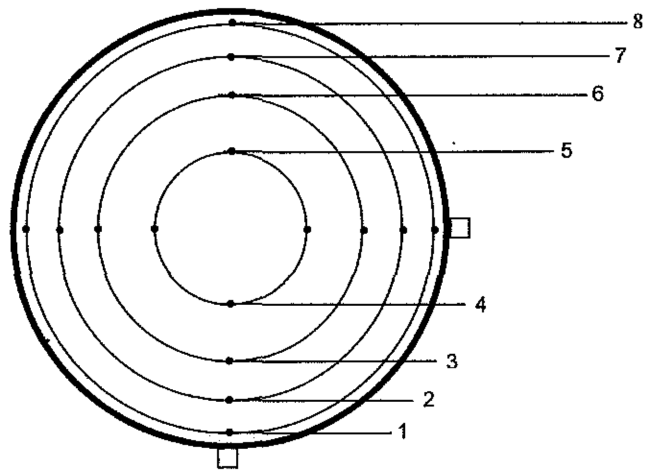
| Traverse Point Locations | |
|---|---|
| Stack Dia.: | 35.0 |
| Point # | Distance from Stack wall |
| 1 | 1.12 |
| 2 | 3.68 |
| 3 | 6.79 |
| 4 | 11.31 |
| 5 | 23.70 |
| 6 | 28.21 |
| 7 | 31.33 |
| 8 | 33.88 |




ELEVATION VIEW

NO SCALE

FIGURE 2

TEST PORT AND TRAVERSE POINT LOCATION
RTO OUTLET

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ROMULUS, MICHIGAN

| DRAWN | DLH 1/30/17 | DRAWING NUMBER 1610001-2 |
|---|---|---|
| REVISED | | |

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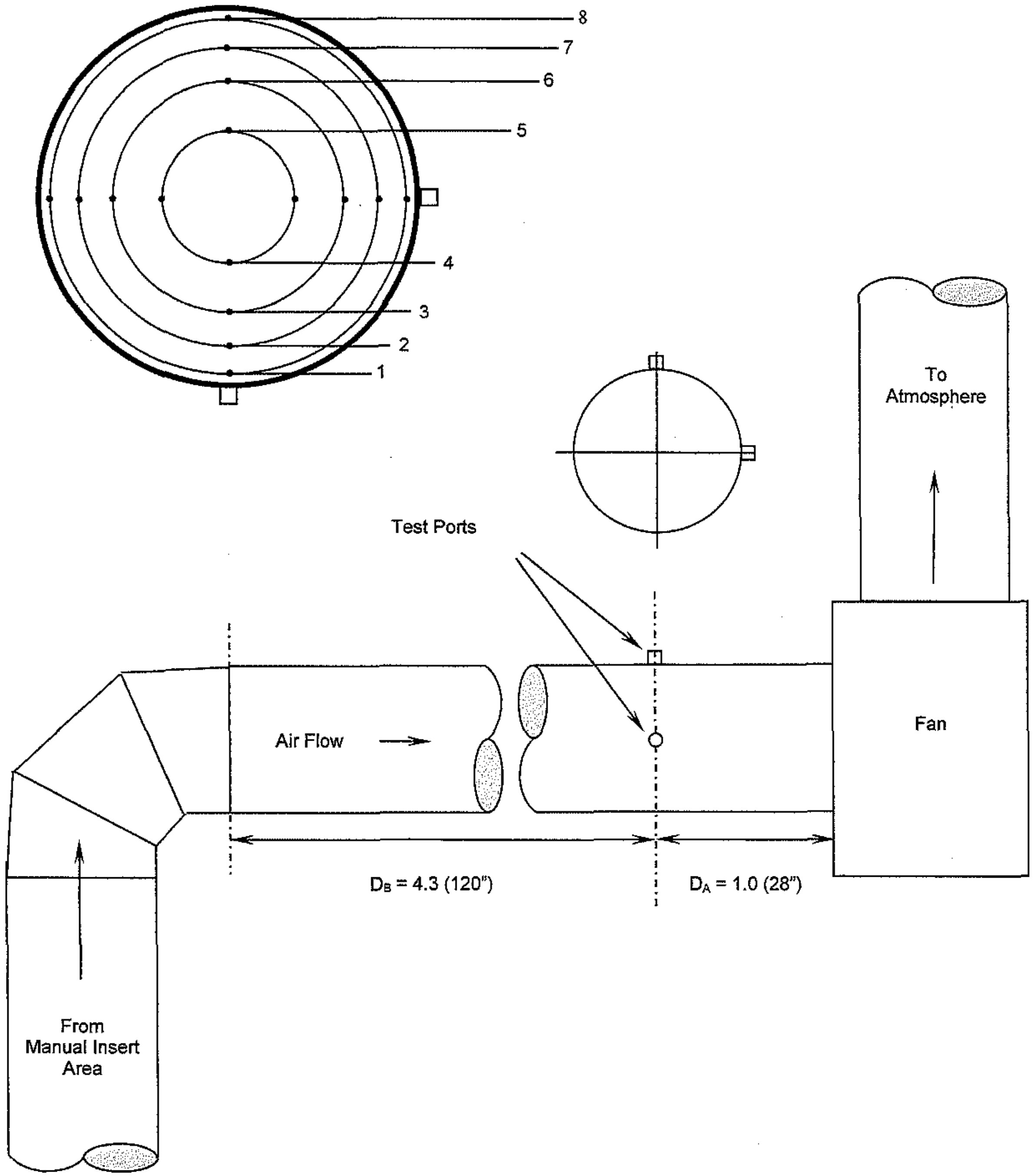


| Traverse Point Locations | |
|---|---|
| Stack Dia.: | 34.5" |
| Point # | Distance from Stack wall |
| 1 | 1.10 |
| 2 | 3.62 |
| 3 | 6.69 |
| 4 | 11.14 |
| 5 | 23.36 |
| 6 | 27.81 |
| 7 | 30.88 |
| 8 | 33.40 |

ELEVATION VIEW
NO SCALE

FIGURE 3

TEST PORT AND TRAVERSE POINT LOCATION
FUGITIVE EXHAUST FROM MANUAL INSERT AREA

PREPARED FOR

THE WOODBRIDGE GROUP
ROMULUS, MICHIGAN

| | |
|---|---|
| DRAWN DLH 1/30/17 | DRAWING NUMBER 1610001-3 |
| REVISED | |

JOB NO. 1610-001

H & H MONITORING, INC.

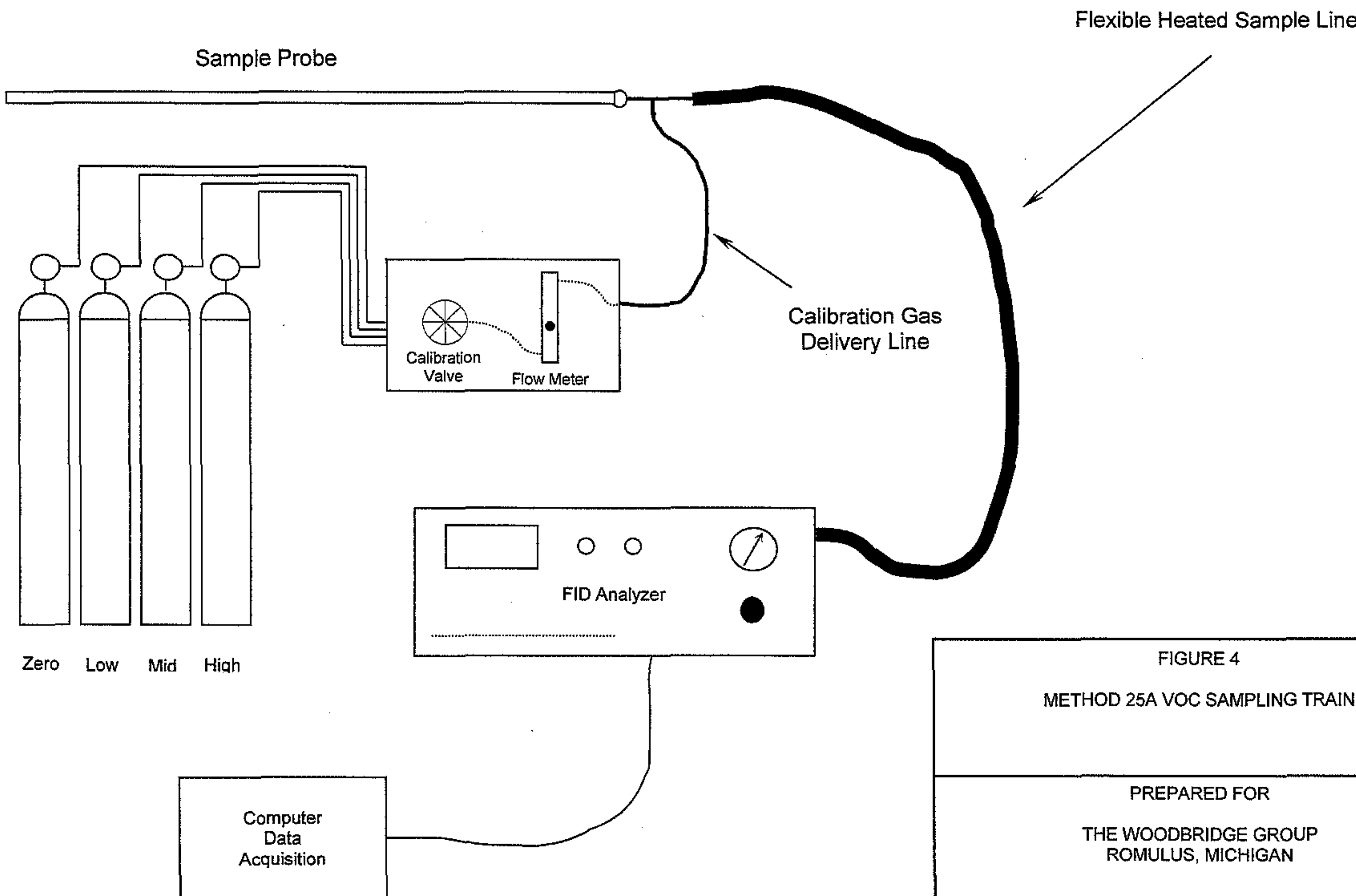


FIGURE 4

METHOD 25A VOC SAMPLING TRAIN

PREPARED FOR

THE WOODBRIDGE GROUP
ROMULUS, MICHIGAN

| | | |
|---|---|---|
| DRAWN | DLH 1/30/17 | DRAWING NUMBER 1610001-4 |
| REVISED | | |

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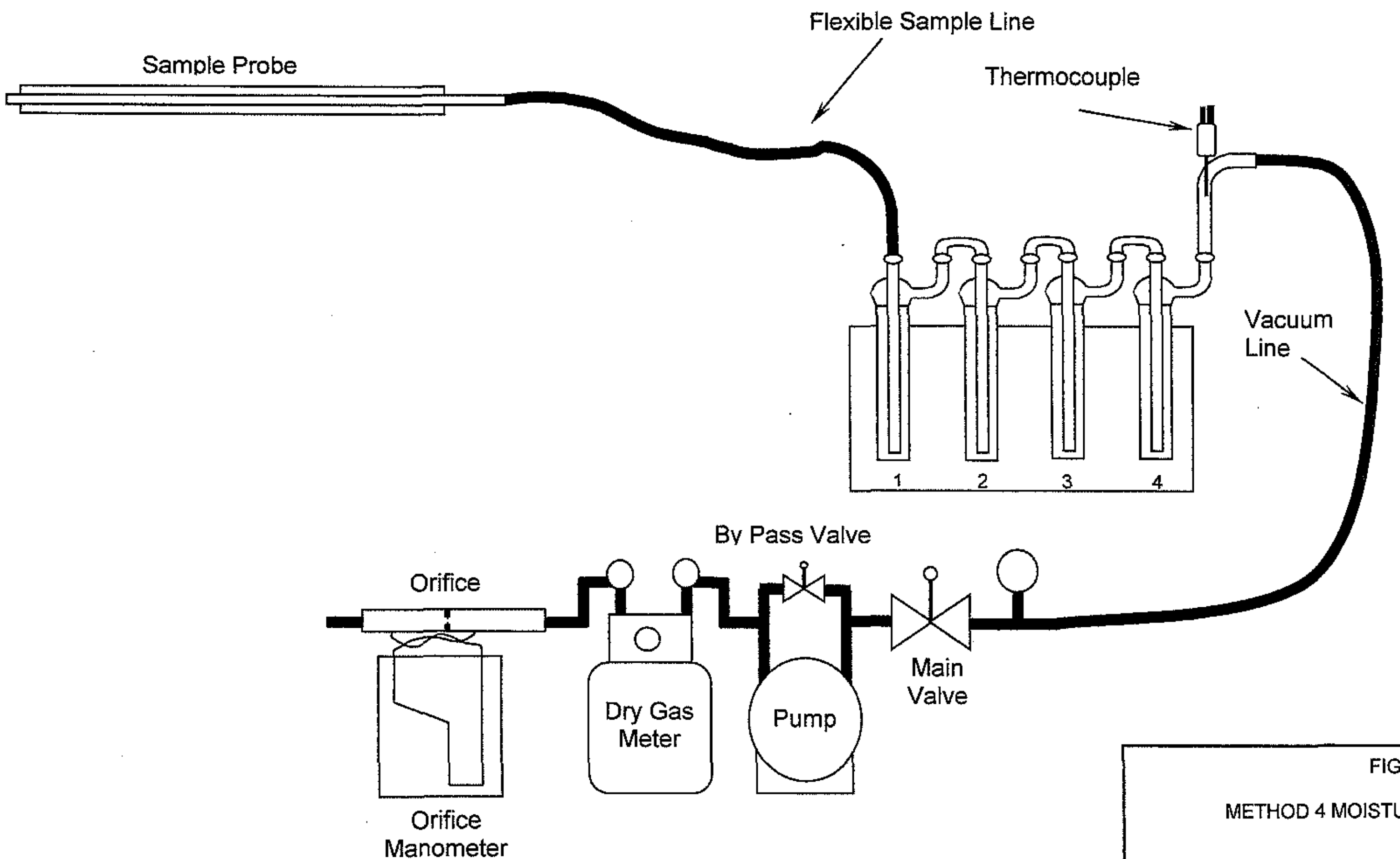


Impinger #1 : 100 ml $H_2O$
Impinger #2 : 100 lm $H_2O$
Impinger #3 : Empty
Impinger #4 : Silica Gel

| | |
|---|---|
| FIGURE 5<br><br>METHOD 4 MOISTURE SAMPLING TRAIN | |
| PREPARED FOR<br><br>THE WOODBRIDGE GROUP<br>ROMULUS, MICHIGAN | |
| DRAWN DLH 1/30/17 | DRAWING NUMBER<br>1610001-5 |
| REVISED | |
| JOB NO. 1610-001 | |
| H & H MONITORING, INC. | |