



Source Test Report

Atlas Molded Products
8240 Byron Center Avenue Southwest
Byron Center, MI 49315

Source Tested: Mold 8 (EUMOLD8)
Test Date: March 23, 2023

Project No. AST-2023-0890-R1

Prepared By
Alliance Technical Group, LLC
20 Parkway View Drive
Pittsburgh, PA 15205

Regulatory Information

EGLE Permit No. PTI 82-21A

Source Information

<i>Source Name</i>	<i>Source ID</i>	<i>Target Parameters</i>
Mold 8	EUMOLD8	VOC, Pentane Content

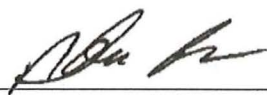
Contact Information

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Alliance Technical Group, LLC (Alliance) has completed the source testing as described in this report. Results apply only to the source(s) tested and operating condition(s) for the specific test date(s) and time(s) identified within this report. All results are intended to be considered in their entirety, and Alliance is not responsible for use of less than the complete test report without written consent. This report shall not be reproduced in full or in part without written approval from the customer.

To the best of my knowledge and abilities, all information, facts and test data are correct. Data presented in this report has been checked for completeness and is accurate, error-free and legible. Onsite testing was conducted in accordance with approved internal Standard Operating Procedures. Any deviations or problems are detailed in the relevant sections in the test report.

This report is only considered valid once an authorized representative of Alliance has signed in the space provided below; any other version is considered draft. This document was prepared in portable document format (.pdf) and contains pages as identified in the bottom footer of this document.



Adam Robinson
Alliance Technical Group, LLC

April 25, 2023

Date

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Introduction

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1.0 Introduction

Alliance Technical Group, LLC (Alliance) was retained by Atlas Molded Products (AMP) to conduct compliance testing at the Byron Center, Michigan facility. Portions of the facility are subject to provisions of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) air permit number PTI 82-21A. Testing was conducted to determine the emission rates of volatile organic compounds (VOC) as pentane and styrene at the Mold 8 (EUMOLD8) exhaust stack.

1.1 Facility Description

The facility produces a variety of expanded polystyrene (EPS) foam products. EPS is produced by the expansion of polystyrene “raw beads” that contains a blowing agent, typically composed of one or more isomers of pentane at a concentration of 3.3% to 7% by weight. A portion of the blowing agent is emitted during the manufacturing process.

EPS is produced in a multi-step process. During the first phase the raw polystyrene beads are partially expanded using steam in a pre-expander. The beads are then dried in a fluidized bed drier. After pre-expansion, the “pre-puff” beads are transferred to bags in the bead storage room where they are kept at elevated temperature for approximately 12 - 24 hours to allow excess blowing agent to diffuse from the beads. In the final step, the aged beads are transferred to a mold, where they are subjected to steam and vacuum cycles until they fuse into a solid block or shaped part. The emission test was conducted on the exhaust controlling this molding process. Based on the nature of the process and length of time between initial pre-expansion and molding, AMP expected that there would be little or no free styrene monomer remaining by the time aged beads reached the molding stage.

1.2 Project Team

Personnel involved in this project are identified in the following table.

Table 1-1: Project Team

Facility Personnel	Tim Van Hoeven
EGLE Personnel	Lindsay Wells
Alliance Personnel	Tim Beam Dennis Haynes Jett Rink

1.3 Site Specific Test Plan & Notification

Testing was conducted in accordance with the Site Specific Test Plan (SSTP) submitted to EGLE.

1.4 Test Program Notes – Dilution Factors and Run Times

Please note that determination of stack gas moisture content was not conducted because emissions were calculated on a wet basis. A Hot Wire anemometer was used to determine gas velocity in the exhaust stack. The anemometer was equipped with a temperature sensor with an upper limit of 200 °F. A secondary thermometer with greater range was to record maximum temperatures. The max temperature data was hand recorded then added to flow temperature data in the emission spreadsheets. This secondary thermometer was for all test runs except for the first part of Run 1, which was when the problem was discovered. Permission to continue Run 1 with partial secondary thermometer data was granted by EGLE inspector, Lindsay Wells.

At the beginning of Run 2 the flow rate of gas through the sampling system was observed to have decreased significantly. The flow rate through the system was then increased, which in altered the dilution factor on the THC analyzer. This caused the dilution to be reset after the post Run 2 calibration checks. The increase in dilution flow on Run 2 caused the O₂ dilution to change for Run 3. Accordingly, a post Run 3 dilution factor check was performed to determine the dilution factor for the O₂. The dilution factor for Run 1 and 2 for O₂ was the same as the THC.

Also note that test run times were increased to two (2) hours per run, per the direction of EGLE.

1.5 Test Program Notes – Styrene Determination

After testing was completed, Alliance was notified by the cylinder gas vendor, that a certified standard of 100 ppmv of Styrene (balance air) we purchased from them contains no Styrene, but instead contains other organic compounds unrelated to styrene. Unfortunately, this cylinder was used to calibrate the instrument used to determine concentrations of Styrene in the exhaust of Molding Line 8 during the emissions testing program.

In Appendix F please find copies of the e-mail record between Alliance and our gas supplier for this project. We have also included a copy of the certificate that we received when the cylinder was delivered.

Alliance believes that correction of this error should be considered a purely technical exercise intended to fulfill the exacting requirements of applicable permit conditions and regulations. This process should not be viewed in terms of correcting a non-compliance situation. Other valid data points collected during the March 23rd test program shows that Molding Line 8 did not, and does not, exceed applicable emissions limits. We offer the following two discussion points in support of that proposition.

- 1) The technique used to measure pentane and styrene was Gas Chromatography/Flame Ionization Detection (GC/FID). An FID will respond to virtually any organic compound present in detectable quantities after each compound separates in a chromatographic column. Had styrene been present in detectable quantities, it would have caused the FID to respond as it passed through the detector, either following the pentane peak or during the backflush procedure performed at the end of each GC/FID analysis. (The backflush passes through the FID; therefore, any organic compounds present will elicit an FID response during each backflush). Other than pentane, no additional FID responses were observed during sampling runs or during backflushes. Since an FID will respond to any organic carbon passing through the detector and since styrene contains organic carbon, this strongly suggests that styrene was not present in detectable quantities.
- 2) The average Total Hydrocarbon (THC) emissions, as measured by Method 25A, were 0.50 pounds per hour, as pentane. Assuming an average 730-hour month, this equates to a maximum monthly THC emission rate of 365 pounds per month. Process knowledge and previous testing show that styrene will be no more than approximately 3% of the total THC load. $365 \times 0.03 = 11.0$ pounds per month of styrene, which is far below the 80 pounds per calendar month allowed by Atlas' permit.

1.6 Test Program Notes – Special Considerations

The direct interface option of Method 18 was used to determine the relative amount of styrene and pentane in the stack gas, but not to determine the absolute emission rate of either. The intent of the Method 18 analysis was to calibrate at the appropriate ranges to determine styrene and pentane concentrations in the stack gas by direct

injection. The field crew timed each injection to coincide with peak emissions events associated with each steam curing event. These brief emissions events occur approximately 6 to 9 minutes depending on the product being produced. There is residual VOC in the exhaust between steam curing events that could not be measured by direct injection into the GC/FID. However, those emissions were captured in the Method 25A data, which continuously recorded THC concentrations. The Method 18 data was to be used only to determine the fraction of the Total Hydrocarbon (THC) stream that is styrene and the fraction that is pentane. Since no styrene emissions were measured, the pentane emission rate is presented as equal to the overall THC emission rate.

1.7 Report Revision Notes

This revision includes adding the loss of initial bead VOC content to the summary of results and associate plant data, including lab report to Appendix D.

Summary of Results

2.0 Summary of Results

Alliance conducted compliance testing at the AMP facility in Byron Center, MI on March 23, 2023. Testing consisted of determining the emission rates of VOC as pentane and styrene at the Mold 8 (EUMOLD8) exhaust stack.

Table 2-1 provides a summary of the emission testing results with comparisons to the applicable EGLE permit limits. Any difference between the summary results listed in the following table and the detailed results contained in appendices is due to rounding for presentation.

Table 2-1: Summary of Results

Run Number	Run 1	Run 2	Run 3	Average
Date	3/23/23	3/23/23	3/23/23	--
Total Hydrocarbon Emissions Data – Method 25A				
Concentration (as pentane), ppmvw	669.9	729.0	188.3	529.1
Concentration (as pentane), ppmvw via Dilution Factor	1,534	1,113	387.2	1,011
Emission Rate (as pentane), lb/hr	0.22	1.2	0.055	0.50
Emission Rate (as pentane), ton/yr	0.98	5.3	0.24	2.2
Permit Limit, ton/yr	--	--	--	23.9
Percent of Limit, %	--	--	--	9
Pentane Emissions Data – Method 18				
Concentration, ppmvw	263.1	4,796	755	2,453
Loss of Initial Bead VOC Content (REDUCTION EFFICIENCY)				
Percentage	0.094	0.492	0.032	0.206
Limit, %	--	--	--	4.87

Testing Methodology

3.0 Testing Methodology

The emission testing program was conducted in accordance with the test methods listed in Table 3-1. Method descriptions are provided below while quality assurance/quality control data is provided in Appendix C.

Table 3-1: Source Testing Methodology

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Volumetric Flow Rate	1 & 2	Full Velocity Traverses
Oxygen/Carbon Dioxide	3A	Instrumental Analysis
Volatile Organic Compounds	25A	Instrumental Analysis
Pentane	18	Direct Interface Analysis
Gas Dilution System Certification	205	--

3.1 U.S. EPA Reference Test Methods 1 and 2D – Velocity Measurement

A single traverse at the centroid of the stack diameter was utilized for velocity measurements. A second set of ports that are located right below the main set of ports (method 25A and 18) were used for the velocity measurements. The flow was measured in accordance with U.S. EPA Reference Test Method 2D. A vane anemometer was utilized to measure the velocity of the gas stream. The flow from the source exhaust was intermittent with approximately eight (8) – 15 second flow bursts in a 1-hour period. The velocity was measured continuously to record the intermittent flow bursts.

3.2 U.S. EPA Reference Test Method 3A – Oxygen/Carbon Dioxide

The oxygen (O₂) and carbon dioxide (CO₂) testing was conducted in accordance with U.S. EPA Reference Test Method 3A. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.6.

3.3 U.S. EPA Reference Test Method 18 –Pentane

Pentane concentration measurements were performed in accordance with U.S. EPA Reference Test Method 18 (Direct Interface) approach.

The sampling system consisted of a heated Teflon probe, heated Teflon sample line, heated filter, leak-free pump, and a gas chromatograph (GC) equipped with a flame ionization detector (FID). Each test run consisted of approximately 5 injections which were performed over a period of 1 hour.

The GC/FID was calibrated for target compounds (styrene and pentane) using certified calibration gas diluted with a dilution system validated in accordance with EPA Method 205 to produce three (3) or more concentration levels

spanning the linear range of the FID. Calibration precision and calibration drift test values were maintained in accordance with EPA Method 18 Section 8.2.2.2 requirements.

3.4 U.S. EPA Reference Test Method 25A – Volatile Organic Compounds

The volatile organic compounds (VOC) testing were conducted in accordance with U.S. EPA Reference Test Method 25A. The FID analyzer was calibrated with pentane. A diluted sample was extracted from the source exhaust and analyzed using the Method 25A analyzer. A dilution factor was applied to the measured concentrations. The sample extract needed to be diluted to ensure that the high moisture present in the source gas to not interfere with the Method 25A analysis. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless steel probe, heated Teflon sample line(s) and the identified gas analyzer. The quality control measures are described in Section 3.7.

3.5 U.S. EPA Reference Test Method 205 – Gas Dilution System Certification

A calibration gas dilution system field check was conducted in accordance with U.S. EPA Reference Method 205. Multiple dilution rates and total gas flow rates were utilized to force the dilution system to perform two dilutions on each mass flow controller. The diluted calibration gases were sent directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The analyzer response agree within 2% of the actual diluted gas concentration. A second Protocol 1 calibration gas, with a cylinder concentration within 10% of one of the gas divider settings described above, was introduced directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The cylinder concentration and the analyzer response agreed within 2%. These steps were repeated three (3) times.

3.6 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 3A

EPA Protocol 1 Calibration Gases

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Direct Calibration & Calibration Error Test

Low Level gas was introduced directly to the analyzer. After adjusting the analyzer to the Low-Level gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas. For the Calibration Error Test, Low, Mid, and High Level calibration gases were sequentially introduced directly to the analyzer. All values were within 2.0 percent of the Calibration Span or 0.5% absolute difference.

System Bias and Response Time

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe and the time required for the analyzer reading to reach 95 percent or 0.5% (whichever was less restrictive) of the gas concentration was recorded. The analyzer reading was observed until it reached a stable value, and this value was recorded. Next, Low Level gas was introduced at the probe and the time required for the analyzer reading to decrease to a value within 5.0 percent or 0.5% (whichever was less restrictive) was recorded. If the Low-Level gas was zero gas, the response was 0.5% or 5.0 percent of the upscale gas concentration (whichever was less restrictive). The analyzer reading was observed until it reached a stable value and this value was recorded. The measurement

system response time and initial system bias were determined from these data. The System Bias was within 5.0 percent of the Calibration Span or 0.5% absolute difference.

Post Test System Bias Checks

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe. After the analyzer response was stable, the value was recorded. Next, Low Level gas was introduced at the probe, and the analyzer value recorded once it reached a stable response. The System Bias was within 5.0 percent of the Calibration Span or 0.5% absolute difference or the data was invalidated and the Calibration Error Test and System Bias were repeated.

Post Test Drift Checks

Drift between pre- and post-run System Bias was within 3 percent of the Calibration Span or 0.5% absolute difference. If the drift exceeded 3 percent or 0.5%, the Calibration Error Test and System Bias were repeated.

Stratification Check

To determine the number of sampling points, a gas stratification check was conducted prior to initiating testing. The pollutant concentrations were measured three points (16.7, 50.0 and 83.3 percent of the measurement line). Each traverse point was sampled for a minimum of twice the system response time.

If the diluent concentration at each traverse point did not differ more than 5 percent or 0.3% (whichever was less restrictive) of the average pollutant concentration, then single point sampling was conducted during the test runs. If the pollutant concentration did not meet these specifications but differed less than 10 percent or 0.5% from the average concentration, then three (3) point sampling was conducted (stacks less than 7.8 feet in diameter - 16.7, 50.0 and 83.3 percent of the measurement line; stacks greater than 7.8 feet in diameter - 0.4, 1.0, and 2.0 meters from the stack wall). If the pollutant concentration differed by more than 10 percent or 0.5% from the average concentration, then sampling was conducted at a minimum of twelve (12) traverse points. Copies of stratification check data can be found in the Quality Assurance/Quality Control Appendix.

Data Collection

A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the Alliance server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at Alliance's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.

3.7 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 25A

EPA Protocol 1 Calibration Gases

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Calibration Error Test and Response Time

Within two (2) hours prior to testing, zero gas was introduced through the sampling system to the analyzer. After adjusting the analyzer to the Zero gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas, and the time required for the analyzer reading to

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reach 95 percent of the gas concentration was recorded to determine the response time. Next, Low and Mid-Level gases were introduced through the sampling system to the analyzer, and the response was recorded when it was stable. All values were less than +/- 5 percent of the calibration gas concentrations.

Post Test Drift Checks

Mid Level gas was introduced through the sampling system. After the analyzer response was stable, the value was recorded. Next, Zero gas was introduced through the sampling system, and the analyzer value recorded once it reached a stable response. The Analyzer Drift was less than +/- 3 percent of the span value.

Data Collection

A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the Alliance server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at Alliance's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.