Source Test Report

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

Source Tested: Mold 8 (EUMOLD8)
Test Date: September 28, 2023

Project No. AST-2023-3895

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

Regulatory Information

EGLE Permit No. PTI 82-21A

Source Information

Source Name	*Source ID*	*Target Parameters*
Mold 8	EUMOLD8	VOC, Styrene, Pentane Content

Contact Information

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

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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

10/25/23
Date

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Introduction

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

EGLE Personnel	Jeremy Howe
Alliance Personnel	Tim Beam Alexander Schutters Jett Rink Rich Trzupek

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

U.S. EPA Reference Test Method 3A was not performed during testing, as oxygen (O_2) and carbon dioxide (CO_2) were not needed for the test calculations. In addition, a stratification check was not performed due to the sample probe being in a fixed location and safety concerns regarding steam pressure.

Summary of Results

2.0 Summary of Results

Alliance conducted compliance testing at the AMP facility in Byron Center, MI on September 28, 2023. Testing consisted of determining the emission rates of VOC as pentane and styrene at the Mold 8 (EUMOLD8) exhaust stack.

Tables 2-1 and 2-2 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 – Mold 8 (EUMOLD8)

Emissions Data				
Run Number	**Run 1**	**Run 2**	**Run 3**	**Average**
Date	**9/28/23**	**9/28/23**	**9/28/23**	**--**
Total Hydrocarbon Data				
Concentration (as pentane), ppmvw	1721	1658	1507	1629
Emission Rate (as pentane), lb/hr	1.6	1.6	1.9	1.7
Emission Rate (as pentane), ton/yr	6.9	6.8	8.1	7.3
Permit Limit, ton/yr	--	--	--	23.9
Percent of Limit, %	--	--	--	**31**
Pentane Data				
Concentration, ppmvw	1660.8	1575.2	1463.7	1566.9
THC % Pentane, %	96.5	95.0	97.1	96.2
Emission Rate, lb/hr	1.5	1.5	1.8	1.6
Emission Rate, ton/yr	6.7	6.5	7.9	7.0
Styrene Data				
Concentration, ppmvw	60.2	82.9	43.7	62.3
THC % Styrene, %	3.5	5.0	2.9	3.8
Emission Rate, lb/hr	0.056	0.078	0.054	0.062
Emission Rate, lb/mo	40.5	56.7	39.2	45.5
Emission Rate, ton/yr	0.24	0.34	0.24	0.27
Permit Limit, lb/mo	--	--	--	80
Percent of Limit, %	--	--	--	**57**

Table 2-2 – Percent Initial Bead VOC (Pentane) Lost

Run Number	Run 1	Run 2	Run 3	Average
Date	**9/28/23**	**9/28/23**	**9/28/23**	**--**
Initial Bead VOC Content, wt%	4.93	4.93	6.33	5.40
Bead Throughput, lb/hr	5,013	4,932	3,782	4,576
VOC Throughput Based on Pentane Content, lb/hr	247.14	243.15	239.40	243.23
VOC Emission Rate, lb/hr	1.6	1.6	1.9	1.7
Percent Initial Bead Lost, wt%	0.65	0.66	0.79	0.70
Permit 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	-	Calculation
Volatile Organic Compounds	25A	Instrumental Analysis
Styrene & Pentane	18	Direct Interface Analysis
Gas Dilution System Certification	205	--

3.1 Calculation of Volumetric Flow Based on Physical Measurements

Previous attempts to measure exhaust gas velocity following Reference Methods 2 and 2D were aborted because the equipment used did not operate properly in an environment that is close to one hundred percent steam. Per a pre-test agreement with EGLE Alliance attempted to measure volumetric flow rate directly using a turbine meter and following Reference Method 2A. This too failed when the turbine meter was damaged and rendered inoperative after attempting to use if for a single steam release event.

EGLE, Atlas and Alliance had agreed that in the event the turbine meter failed the total volume of each steam release event, in wet standard cubic feet, would be calculated based on physical characteristics and measurements available. The formula used to calculate the volume of each steam release is:

$Q_w = V \times 528/(T_s + 460) \times (P_s + 14.7)/14.7$, where:

Q_w = Volume of steam released, in wet standard cubic feet
V = Total empty volume of the mold cavity and all associated steam piping following the system's main steam release valve.
Ts = Steam temperature during release, in degrees Fahrenheit
Ps = Highest pressure observed before steam release, in psig

The volume of each stream release was calculated using the above equation. That volume was then used to calculate the mass of Total Hydrocarbons, pentane and styrene emitted during each release. Finally, measurements of mass emission rates during each event were totaled to determine the mass emission rates of each in pounds per hour.

3.2 U.S. EPA Reference Test Method 18 – Styrene and Pentane

Styrene and 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). East 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.

3.3 U.S. EPA Reference Test Method 25A – Total Hydrocarbons

The total hydrocarbons (THC) testing was 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 3.5

3.4 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 must 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.

3.5 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 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.

Appendix A

Alliance TECHNICAL GROUP

Location: Altas Molded Products - Bryon Center, MI
Source: Mold 8 (EUMOLD8)
Project No.: AST-2023-3895
Run No. /Method Run 1 / Method 25A

THC - Outlet Concentration (as C5H12) (C_{THC}), ppmvw

$$C_{THC} = C_{THC} * 3/5 * RF$$

where,

C_{THC}	2958	= THC - average outlet concentration (as C3H8), ppmvw
RF	1.02	= response factor, unitless
C_{THC}	1810	= THC - outlet concentration (as C5H12), ppmvw

THC - Outlet Emission Rate (as C5H12) (ER_{THC-b}), lb/block

$$ER_{THC-b} = \frac{C_{THC} * V_M * (P_M + 14.7_{psi}) * 528\,^{\circ}R * MW}{1.0E06 * 14.7_{psi} * (T_M + 460) * 385.3}$$

where,

C_{THC}	1810	= THC - outlet concentration (as C5H12), ppmvw
V_M	618	= mold volume, cf
P_M	0.657	= peak mold pressure, psig
T_M	220	= mold temperature, °F
MW	72	= molecular weight, g/g-mole
ER_{THC-b}	0.169	= THC - outlet emission rate (as C5H12), lb/block

$$\frac{lb}{cf} = ppmv * \frac{MW}{385.3E06}$$

THC - Outlet Emission Rate (as C5H12) (ER_{THC}), lb/hr

$$ER_{THC} = \frac{ER_{THC-b}}{T_t / 60\ min/hr}$$

where,

ER_{THC-b}	1.613	= THC - total outlet emission rate (as C5H12), lb/block
T_t	61	= total run time, minutes
ER_{THC}	1.6	= THC - outlet emission rate (as C5H12), lb/hr

THC - Outlet Emission Rate (as C3H8) (ER_{THC}), lb/mo

$$ER_{THC} = \frac{ER_{THC} \times 8{,}760\ \frac{hr}{yr}}{12\ \frac{mo}{yr}}$$

where,

ER_{THC}	1.6	= THC - Outlet Emission Rate (as C3H8), lb/hr
ER_{THC}	1158.3	= lb/mo

THC - Outlet Emission Rate (as C5H12) (ER_{THCTPY}), ton/yr

$$ER_{THCTPY} = \frac{ER_{THC} * 8{,}760\ \frac{hr}{yr}}{2{,}000\ \frac{lb}{ton}}$$

where,

ER_{THC}	1.6	= THC - outlet emission rate (as C5H12), lb/hr
ER_{THCTPY}	6.9	= THC - outlet emission rate (as C5H12), ton/yr

Pentane - Outlet Emission Rate (ER_{C5H12}), lb/hr

$$ER_{C5H12} = ER_{THC} * \%$$

where,

ER_{THC}	1.6	= THC - outlet emission rate (as C5H12), lb/hr
%	96.5	= % Pentane, % of M18 Total
ER_{C5H12}	1.5	= Pentane Emission Rate, lb/hr

Styrene - Outlet Emission Rate (ER_{C8H8}), lb/hr

$$ER_{C8H8} = ER_{THC} * \%$$

where,

ER_{THC}	1.6	= THC - outlet emission rate (as C5H12), lb/hr
%	3.5	= % Styrene, % of M18 Total
ER_{C8H8}	0.056	= Styrene Emission Rate, lb/hr

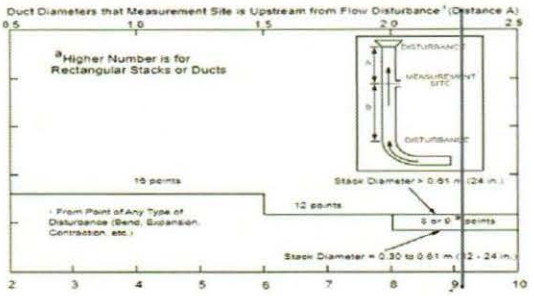
Appendix B

Method 1 Data

Location: Altas Molded Products - Bryon Center, MI
Source: Mold 8 (EUMOLD8)
Project No.: AST-2023-3895
Date: 09/28/23

Stack Parameters

Duct Orientation:	Vertical	
Duct Design:	Circular	
Distance from Far Wall to Outside of Port:	13.50	in
Nipple Length:	1.50	in
Depth of Duct:	12.00	in
Cross Sectional Area of Duct:	0.79	ft^2
No. of Test Ports:	2	
Number of Readings per Point:	1	
Distance A:	15.0	ft
Distance A Duct Diameters:	15.0	(must be ≥ 0.5)
Distance B:	9.0	ft
Distance B Duct Diameters:	9.0	(must be ≥ 2)
Minimum Number of Traverse Points:	12	
Actual Number of Traverse Points:	3	
Measurer (Initial and Date):	TWB/9/28/23	
Reviewer (Initial and Date):	TWB/9/28/23	



CIRCULAR DUCT

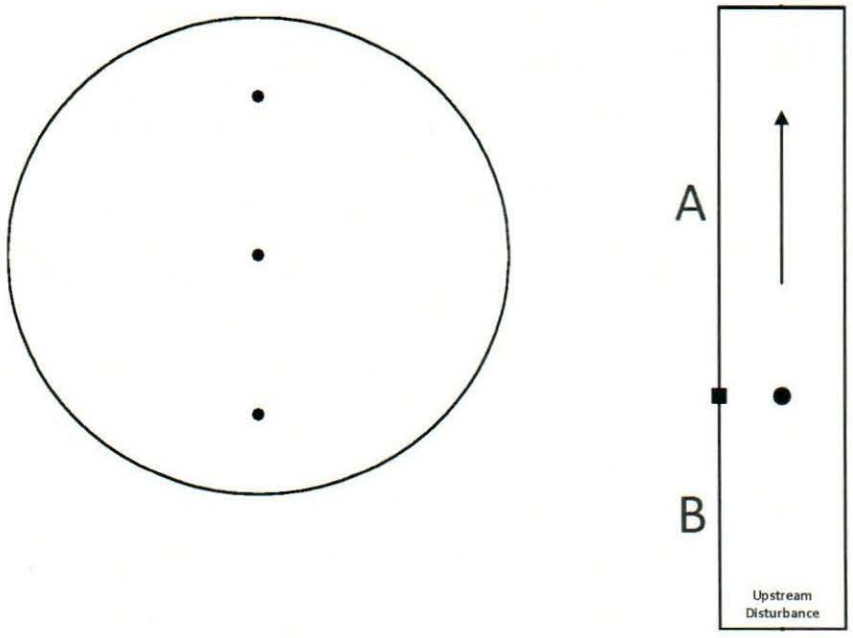
LOCATION OF TRAVERSE POINTS
Number of traverse points on a diameter

	2	3	4	5	6	7	8	9	10	11	12
1	14.6	16.7	6.7	--	4.4	--	3.2	--	2.6	--	2.1
2	85.4	50.0	25.0	--	14.6	--	10.5	--	8.2	--	6.7
3	--	83.3	75.0	--	29.6	--	19.4	--	14.6	--	11.8
4	--	--	93.3	--	70.4	--	32.3	--	22.6	--	17.7
5	--	--	--	--	85.4	--	67.7	--	34.2	--	25.0
6	--	--	--	--	95.6	--	80.6	--	65.8	--	35.6
7	--	--	--	--	--	--	89.5	--	77.4	--	64.4
8	--	--	--	--	--	--	96.8	--	85.4	--	75.0
9	--	--	--	--	--	--	--	--	91.8	--	82.3
10	--	--	--	--	--	--	--	--	97.4	--	88.2
11	--	--	--	--	--	--	--	--	--	--	93.3
12	--	--	--	--	--	--	--	--	--	--	97.9

**Percent of stack diameter from inside wall to traverse point.*

Traverse Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	16.7	2.00	3.50
2	50.0	6.00	7.50
3	83.3	10.00	11.50
4	--	--	--
5	--	--	--
6	--	--	--
7	--	--	--
8	--	--	--
9	--	--	--
10	--	--	--
11	--	--	--
12	--	--	--

Stack Diagram
A = 15 ft.
B = 9 ft.
Depth of Duct = 12 in.



Alliance TECHNICAL GROUP

Location Altas Molded Products - Bryon Center, MI
Source Mold 8 (EUMOLD8)
Project No. AST-2023-3895

Run Number		Run 1	Run 2	Run 3	Average
Date		9/28/23	9/28/23	9/28/23	--
Start Time		10:29	11:45	13:55	--
Stop Time		11:30	12:45	15:08	--
Total Run Time, minutes	T_t	61	60	73	--
Calculated Data - Outlet					
THC (as C5H12) Concentration, ppmvw	C_{THCw}	1721	1658	1507	1629
THC (as C5H12) Emission Rate, lb/hr	ER_{THC}	1.6	1.6	1.9	1.7
THC (as C5H12) Emission Rate, lb/mo	ER_{THC}	1158.3	1134.9	1352.4	1215.2
THC (as C5H12) Emission Rate, ton/yr	ER_{THCTPY}	6.9	6.8	8.1	7.3
THC % Pentane, %	C_{C5H12}	96.5	95.0	97.1	96.2
Pentane Concentration, ppmvw	C_{C5H12}	1660.8	1575.2	1463.7	1566.9
Pentane Emission Rate, lb/hr	ER_{C5H12}	1.5	1.5	1.8	1.6
Pentane Emission Rate, lb/mo	ER_{C5H12}	1117.7	1078.1	1313.2	1169.7
Pentane Emission Rate, ton/yr	ER_{C5H12}	6.7	6.5	7.9	7.0
THC % Styrene, %	C_{C8H8}	3.5	5.0	2.9	3.8
Styrene Concentration, ppmvw	C_{C5H12}	60.2	82.9	43.7	62.3
Styrene Emission Rate, lb/hr	ER_{C8H8}	0.056	0.078	0.054	0.062
Styrene Emission Rate, lb/mo	ER_{C8H8}	40.5	56.7	39.2	45.5
Styrene Emission Rate, ton/yr	ER_{C8H8}	0.24	0.34	0.24	0.27