BTEC Inc.

Formaldehyde Emissions Test Report

Revised

Prepared for:

Powertrain Integration, LLC

Powertrain Integration
32505 Industrial Drive
Madison Heights, Michigan 48071

Project No. 14-4539.00
February 13, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
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BTEC Inc.

EXECUTIVE SUMMARY

Revised

BT Environmental Consulting, Inc. (BTEC) was retained by Powertrain Integration, LLC (PI) to conduct a compliance emissions test program on one source at the PI facility in Madison Heights, Michigan. This emissions testing program included evaluation of formaldehyde from one dynamometer exhaust stack. The emissions test program was conducted on July 1, 2014.

Testing of FGTESTCELLS consisted of triplicate 60-minute test runs. The emissions test program was required by MDEQ Air Quality Division PTI No. 76-13. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: July 1st, 2014

Source	Pollutant	Emission Limit (lb/gallon GGE)	Emission Rate (lb/gallon GGE)
Engine Cell 3	Formaldehyde	5.93×10^{-3}	5.34×10^{-4}

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Powertrain Integration, LLC (PI) to conduct a compliance emissions test program on one source at the PI facility in Madison Heights, Michigan. This emissions testing program included evaluation of formaldehyde from one dynamometer exhaust stack. The emissions test program was conducted on July 1, 2014. The purpose of this report is to document the results of the test program.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on July 1, 2014 at the PI facility located in Madison Heights, Michigan. The test program included evaluation of formaldehyde emissions from one dynamometer exhaust stack.

1.b Purpose of Testing

Permit To Install 76-13.

Table 1
Permit To Install 76-13 Emission Limitations

Equipment ID	Formaldehyde Permit Limit
FGTESTCELLS	0.31 tpy
	0.686 lb/8-hr shift
	5.93×10^{-3} lb/gallon GGE[1]

1:GGE = Gasoline gallon equivalent.

1.c Source Description

LPG dynamometer test cells.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. Brad Shantry
Powertrain Integration
32505 Industrial Drive
Madison Heights, MI 48071
248-556-6205

Mr. Barry P. Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, MI 48073
313-449-2361

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

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Brad Shantry	Powertrain Integration 32505 Industrial Drive Madison Heights, MI 48071	(248)-556-6205
Mr. Matthew Young Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 744-9133
Mr. Paul Draper Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mark Dziadosz Technical Programs Unit	MDEQ Air Quality Division	(586) 753-3745

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 to be monitored during the emissions test program includes continuous monitoring of the fuel usage to the engine. The emissions test cell will also monitor horsepower and torque.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit To Install 76-13.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a).

3. Source Description

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

3.a Process Description

Engine dynamometer test cell used for development and testing of internal combustion engines. The engines tested will be fueled by unleaded gasoline, LPG, and CNG. The cell is exhausted through a joint exhaust stack, SVA1.

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

The raw material supplied to the engine is liquefied petroleum gas (LPG).

3.d Process Capacity

Rated capacity of the process is limited by the fuel usage in gallons per 8 hour shift (The CNG and LPG usage together for FGTESTCELLS shall not exceed 315 gallons per 8-hour shift. Of the 315 gallons, the permittee shall not burn more than 31.5 gallons of uncontrolled LPG per 8-hour shift).

3.e Process Instrumentation

Process data to be monitored during the emissions test program includes continuous monitoring of the fuel usage to the engine. The emissions test cell will also monitor horsepower and torque.

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

The emissions test program utilized the following test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 1 - "Sample and Velocity Traverses for Stationary Sources"
- Method 2 - "Determination of Stack Gas Velocity and Volumetric Flowrate"
- Method 3 - "Determination of Molecular Weight of Dry Stack Gas"(Fyrite)
- Method 4 - "Determination of Moisture Content in Stack Gases"
- Method 323 - "Measurement of Formaldehyde Emissions From Natural Gas-Fired Stationary Sources – Acetyle Acetone Derivitization Method"

A single representative sample point for flowrate measurements was determined for the sampling location. Exhaust gas flowrate was measured using a stationary pitot tube and differential pressure transmitter assembly. Using this assembly, duct velocity pressure readings were data logged at ten-second intervals for the duration of the 60-minute test runs.

The Method 323 sampling train consisted of: (1) a borosilicate or quartz probe liner, (2) Teflon tubing, (3) one empty midget impinger, (4) one midget impinger containing 20 mL of deionized H_2O, (5) one midget impinger filled with silica gel desiccant; (6) a length of sample line, and (7) a Nutech control case equipped with a pump, dry gas meter, and calibrated orifice. Figure 2 provides an illustration of the Method 323 sample train.

The probe was placed at the center of the stack for non-isokinetic sampling. The sample train was run for 60 minutes at a rate of 0.2 – 0.4 L/min. The mass of liquid condensed in the impingers was measured gravimetrically for moisture analysis. The probe, Teflon tubing, and first two midget impingers were rinsed with reagent water which is recovered into a VOA vile with no headspace.

4.b Recovery and Analytical Procedures

Recovery and analytical procedures were described in Section 4.a.

4.c Sampling Ports

Flow and formaldehyde sampling were both performed using a single fixed sampling location.

4.d Traverse Points

The stack was not traversed. Formaldehyde sampling was performed using a single fixed location.

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 3. Detailed results for the emissions test program are summarized by Tables 4 and 5.

Table 3
Overall Emission Summary
Test Date: July 1st, 2014

Source	Pollutant	Emission Limit (lb/gallon GGE)	Emission Rate (lb/gallon GGE)
Engine Cell 3	Formaldehyde	5.93×10^{-3}	5.34×10^{-4}

5.b Discussion of Results

Emission limitations for Permit To Install 76-13 as well as the average emission rate are summarized by Table 3.

5.c Sampling Procedure Variations

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

5.d Process or Control Device Upsets

Run 3 was paused between 13:40 and 14:21 due to the dynamometer blowing a drive belt. The belt was replaced and testing was resumed.

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 B.

5.i Sample Calculations

Sample calculations are provided in Appendix C.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A

5.k Laboratory Data

Laboratory analytical results for this test program are included as Appendix E.

5.l QA/QC Results

Quality assurance procedures associated with the emissions test program can be separated into four categories as follows:

(1) Analysis of a field train blank sample,
(2) Analysis of a field duplicate sample,
(3) A sampling run with spiked reagent in the first impinger, and
(4) Internal laboratory spike recovery analyses.

Quality assurance results associated with the emissions test program are summarized as follows:

- The field blank sample result was non-detect.
- The field duplicate sample results are outside of Method 323's allowance of +/- 20% deviation from their mean concentration.
- The spiked aliquot used in the spiked run was inadequate to show proper spike recovery and did not meet the acceptable spike recovery of 80% to 120%.
- The internal matrix spike and spiked blank performed by Maxxam had a spike recovery of 98% and 100%, respectively. The method blank performed by Maxxam was non-detect.

Due to field blank result being non-detect, the internal QA/QC performed by Maxxam, the repeatability of the results from all five sample runs, and the low value of the emission rate relative to the emission limit BTEC is confident in the quality of the emission data.

Table 4
Engine Cell 3 Detailed Emission Test Results Summary

Company	**Powertrain Integration**			
Source Designation	**Engine Cell 3**			
Test Date	**7/1/2014**	**7/1/2014**	**7/1/2014**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	81.2	85.3	90.9	85.8
Meter Pressure - Pm (in. Hg)	29.0	29.0	29.0	29.0
Measured Sample Volume (Vm)	0.73	0.74	0.69	0.72
Sample Volume (Vm-Std ft3)	0.66	0.67	0.61	0.65
Sample Volume (Vm-Std m3)	0.02	0.02	0.02	0.02
Condensate Volume (Vw-std)	0.118	0.193	0.127	0.146
Gas Density (Ps(std) lbs/ft3) (wet)	0.0734	0.0710	0.0710	0.0718
Gas Density (Ps(std) lbs/ft3) (dry)	0.0782	0.0782	0.0761	0.0775
Total weight of sampled gas (m g lbs) (wet)	0.06	0.06	0.05	0.06
Total weight of sampled gas (m g lbs) (dry)	0.05	0.05	0.05	0.05
Stack Data				
Average Stack Temperature - Ts (F)	589.9	535.8	557.6	561.1
Molecular Weight Stack Gas- dry (Md)	30.2	30.2	29.4	30.0
Molecular Weight Stack Gas-wet (Ms)	28.4	27.5	27.5	27.8
Stack Gas Specific Gravity (Gs)	0.980	0.949	0.949	0.959
Percent Moisture (Bws)	15.11	22.48	17.21	18.27
Water Vapor Volume (fraction)	0.1511	0.2248	0.1721	0.1827
Pressure - Ps ("Hg)	29.0	29.0	29.0	29.0
Area of Stack (ft2)	0.5	0.5	0.5	0.5
Fuel Usage				
Gallon Gasoline Equivalent (gal/hr)	19.559	18.327	15.639	17.842
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	892	870	923	895
Flowrate ft^3 (Standard Wet)	435	448	465	449
Flowrate ft^3 (Standard Dry)	369	347	385	367
Flowrate m^3 (standard dry)	10	10	11	10
Total Formaldehyde Weights (µg)				
Sample Catch	180.00	110.00	96.00	128.67
Total Formaldehyde Concentration				
lb/1000 lb (wet)	0.00693	0.00397	0.00403	0.00498
lb/1000 lb (dry)	0.00767	0.00465	0.00454	0.00562
mg/dscm (dry)	9.60	5.83	5.54	6.99
Total Formaldehyde Emission Rate				
lb/ hr	1.33E-02	7.57E-03	7.97E-03	9.61E-03
lb/ gallon GGE	6.79E-04	4.13E-04	5.10E-04	5.34E-04

Table 5
Engine Cell 3 Field Duplicate and Spiked Train Emission Test Results Summary

Company	**Powertrain Integration**	
Source Designation	**Engine Cell 3**	
Test Date	**7/1/2014**	**7/1/2014**
	Field Duplicate	Spiked Train
Meter/Nozzle Information	P-1	P-2
Meter Temperature Tm (F)	81.4	86.6
Meter Pressure - Pm (in. Hg)	29.0	29.0
Measured Sample Volume (Vm)	0.77	0.77
Sample Volume (Vm-Std ft3)	0.84	0.83
Sample Volume (Vm-Std m3)	0.02	0.02
Condensate Volume (Vw-std)	0.132	0.137
Gas Density (Ps(std) lbs/ft3) (wet)	0.0739	0.0737
Gas Density (Ps(std) lbs/ft3) (dry)	0.0782	0.0782
Total weight of sampled gas (m g lbs) (wet)	0.07	0.07
Total weight of sampled gas (m g lbs) (dry)	0.07	0.06
Stack Data		
Average Stack Temperature - Ts (F)	589.9	535.8
Molecular Weight Stack Gas- dry (Md)	30.2	30.2
Molecular Weight Stack Gas-wet (Ms)	28.6	28.5
Stack Gas Specific Gravity (Gs)	0.987	0.984
Percent Moisture (Bws)	13.60	14.15
Water Vapor Volume (fraction)	0.1360	0.1415
Pressure - Ps ("Hg)	29.0	29.0
Area of Stack (ft2)	0.5	0.5
Fuel Usage		
Gallon Gasoline Equivalent (gal/hr)	19.559	18.327
Exhaust Gas Flowrate		
Flowrate ft^3(Actual)	892	870
Flowrate ft^3 (Standard Wet)	435	448
Flowrate ft^3 (Standard Dry)	369	347
Flowrate m^3 (standard dry)	10	10
Total Formaldehyde Weights (µg)		
Sample Catch	110.00	110.00
Total Formaldehyde Concentration		
lb/1000 lb (wet)	0.00338	0.00341
lb/1000 lb (dry)	0.00370	0.00374
mg/dscm (dry)	4.632	4.682
Total Formaldehyde Emission Rate		
lb/ hr	6.41E-03	6.09E-03
lb/ gallon GGE	3.28E-04	3.32E-04

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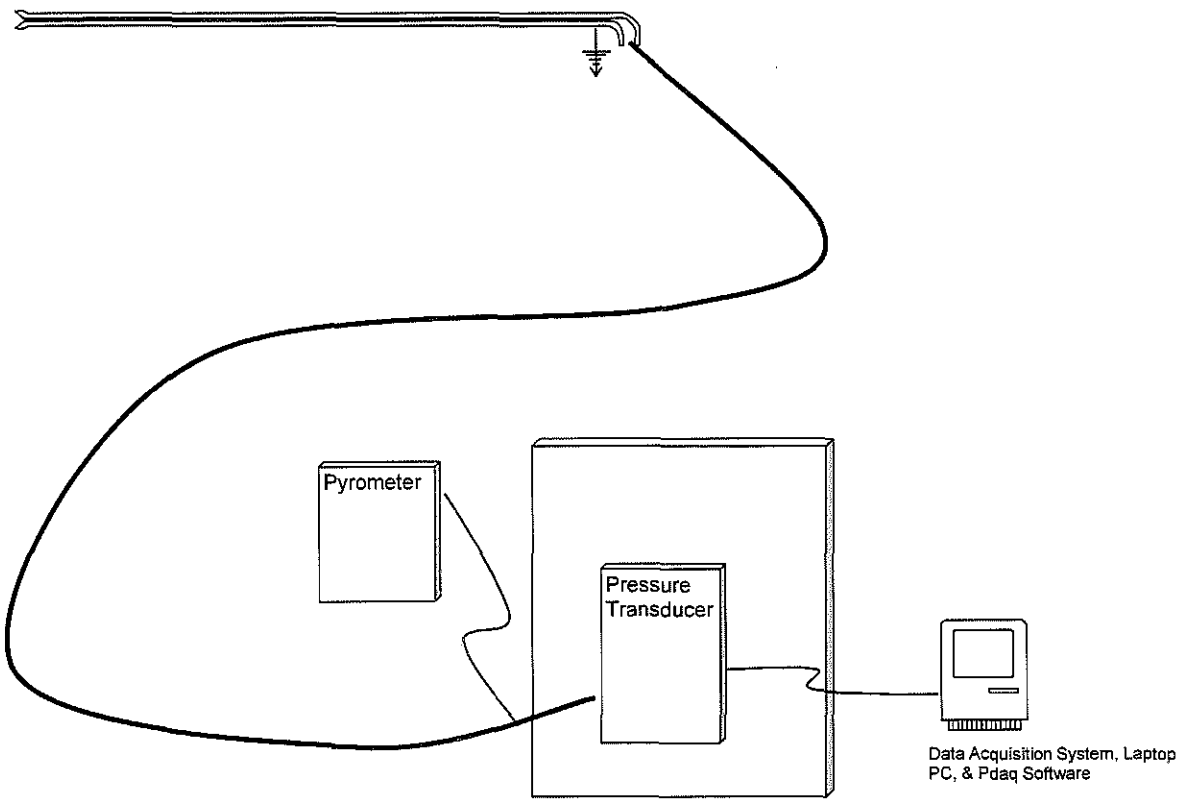

Figure No. 1

Site: **USEPA Method 2** **Powertrain Integration** **Madison Heights, Michigan**	**Sampling Date:** **July 1, 2014**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

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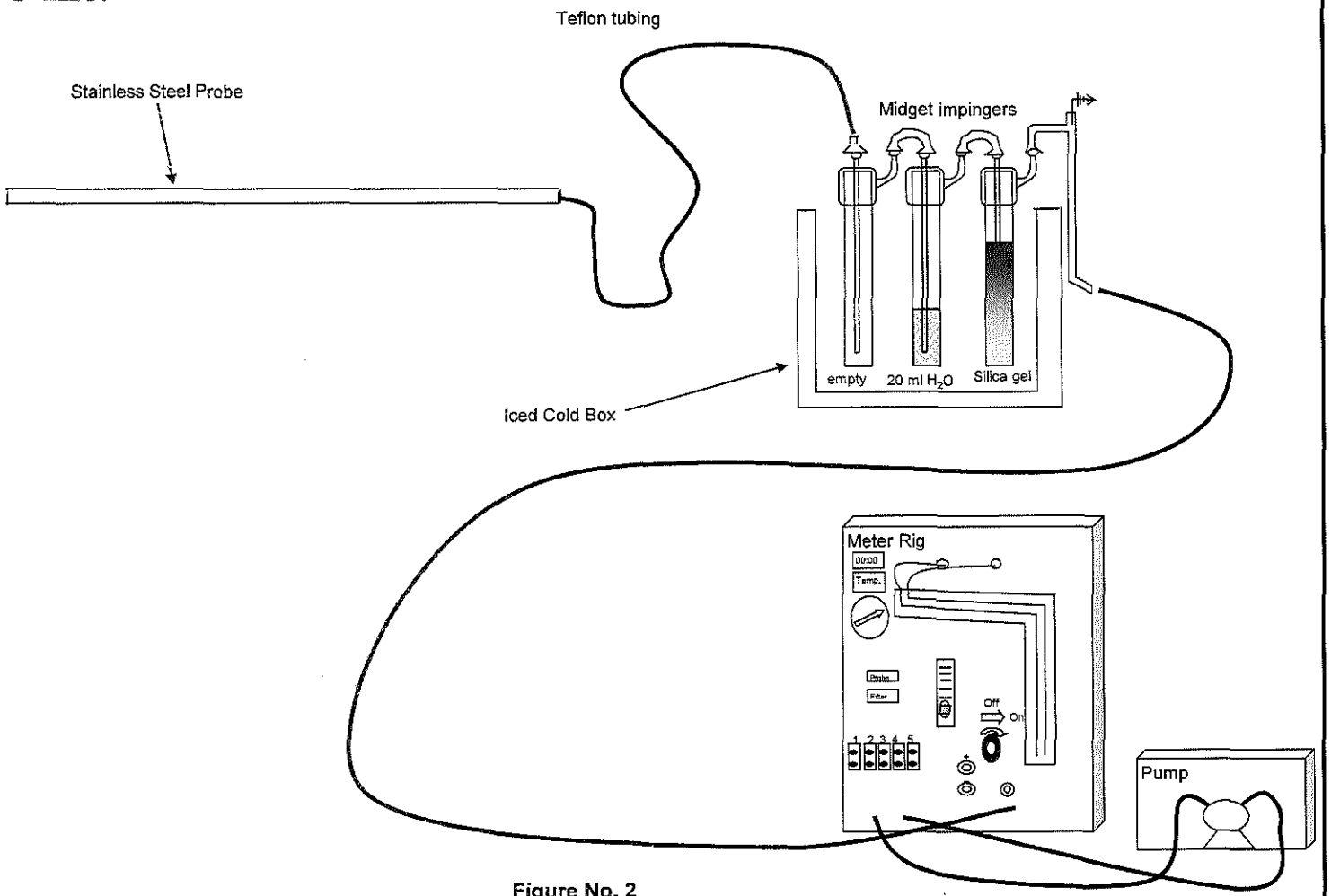

Figure No. 2

Site:	Sampling Date:	
USEPA Method 4 Powertrain Integration Madison Heights, Michigan	July 1, 2014	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan 48073