BTEC Inc.

VOC Destruction Efficiency Emissions Test Report

Prepared for:

Denso Manufacturing Michigan, Inc.

Denso Manufacturing Michigan, Inc.
One Denso Road
Battle Creek, Michigan 49037

Project No. 15-4750.00
December 22, 2015

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EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Denso Manufacturing Michigan, Inc. (Denso) to conduct a volatile organic compound (VOC) Destruction Efficiency (DE) emissions test program on two Thermal Oxidizers (TO) at the Denso facility located in Battle Creek, Michigan. The emissions test program was conducted on November 12 and 13, 2015.

Testing of R540 oven degreaser and C1150A oven degreaser consisted of triplicate 60-minute test runs. The emissions test program was required by MDEQ Air Quality Division Permit To Install (PTI) Numbers 48-15B and 190-14. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: November 12th, 2015

R540			
Pollutant	**Destruction Efficiency (%)**	**Average Emission Rate (pph)**	**Emission Limit**
VOC	88.9	0.28	95% DE -OR- 0.54 pph

Test Date: November 13th, 2015

C1150A			
Pollutant	**Destruction Efficiency (%)**	**Average Emission Rate (pph)**	**Emission Limit**
VOC	98.8	0.03	95% DE -OR- 0.54 pph

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Denso Manufacturing Michigan, Inc. (Denso) to evaluate Volatile Organic Compounds (VOC) Destruction Efficiency (DE) from the R540 Thermal Oxidizer (TO) and C1150A TO at the Denso facility located in Battle Creek, Michigan. The emissions test program was conducted on November 12th and 13th, 2015. 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 November 12th and 13th, 2015 at the Denso facility located in Battle Creek, Michigan. The test program included evaluation of VOC DE emissions from R540 TO and C1150A TO.

1.b Purpose of Testing

AQD issued Permit To Install No. 48-15B and 190-14 to Denso. The permits limit emissions from the oxidizers as summarized by Table 1.

Table 1
VOC DE Emission Limitations
Denso Manufacturing Michigan, Inc.

Pollutant	Emission Limit
VOC	95% DE or 0.54 pph

1.c Source Description

The oven degreaser is used to remove machining oils (containing VOCs) from assembled cores. The cores consist of aluminum tubes, fins, and other small parts which have been assembled to make the core. The machining oils are used in the stamping of small aluminum pieces and to facilitate the formation of fins from strips of aluminum. Therefore, the main raw material used in making the cores is aluminum.

1.d Test Program Contacts

The contact for the source and test report is:

Ms. Jody Smith, P.E.
Advanced Environmental Engineering
Denso Manufacturing Michigan, Inc.
One Denso Road
Battle Creek, Michigan 49037
(269) 565-8562

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. Barry Boulianne Senior Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Steve Smith Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Shane Rabideau Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

R540 TO

- Temperature- Minimum 1292 degrees F; setpoint = 720+/- 20 degrees C
- Minimum of 0.5 second gas retention time
- 95% DE or maximum VOC emission rate of 0.54 pph.

C1150A TO

- Temperature- Minimum 1292 degrees F; setpoint = 720+/- 20 degrees C
- Minimum of 0.5 second gas retention time
- 95% DE or maximum VOC emission rate of 0.54 pph.

2.b Applicable Permit

The applicable permits for this emissions test program are Permit To Install (PTI) No. 48-15B and 190-14.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). The VOC DE for C1150A TO was above the permit level of 95%. The VOC DE for C1150A was 98.8%.

The VOC DE for R540 TO was below the permit level of 95%, but below 0.54 pph. The pph for R540 was 0.28 pph.

3. Source Description

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

3.a Process Description

Oily cores are transported into the oven degreaser on a conveyor, which moves at a continuous speed through the degreaser. Therefore, the VOC load to the TOs from the degreasers will be constant as long as cores are loaded onto the entrance conveyor.

The operating parameter used to regulate the oven degreaser is the temperature. Oven degreaser C1150A operates at 225 degrees C in Zone 1 and 240 degrees C in Zone 2; and R540 operates at 220 degrees C in Zone 1 and 260 degrees C in Zone 2.

The oven degreaser is equipped with a thermal oxidizer as pollution control.

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

The raw material used by the process is aluminum and VOC.

3.d Process Capacity

The maximum possible production capacity of C1150 oven degreaser is 375 cores/hour. The maximum capacity of R540 oven degreaser is 480 cores/hour.

3.e Process Instrumentation

Section 3.d provides summary.

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

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at 40 CFR 60, Appendix A:

- Method 1 -"Location of the Sampling Site and Sampling Points"
- Method 2 -"Determination of Stack Gas Velocity and Volumetric Flow rate"
- Method 3 -"Determination of Molecular Weight of Dry Stack Gas" (Fyrite)
- Method 4 - "Determination of Moisture Content in Stack Gases"
- Method 25A -"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. An S-type pitot tube with a thermocouple assembly, calibrated in accordance with Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

The Molecular Weight of the gas stream was evaluated according to procedures outlined in Title 40, Part 60, Appendix A, Method 3. The O_2 /CO_2 content of the gas stream was measured using an O_2 /CO_2 Fyrite gas analyzer.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the moisture sampling (see Section 3.2) and passed through (i) two impingers, each with 100 ml water, (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content is then determined gravimetrically.

Volatile Organic Compounds (USEPA Method 25A)

Volatile Organic compound (VOC) concentrations were measured according to 40 CFR 60, Appendix A, Method 25A. A sample of the gas stream was drawn through a stainless steel probe with an in-line glass fiber filter to remove any particulate, and a heated Teflon® sample line to prevent the condensation of any moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with

Labview® II data acquisition software. BTEC used a VIG Model 20 THC hydrocarbon analyzer to determine the VOC concentrations at the inlet, and a JUM 109A Methane/Non-Methane THC hydrocarbon analyzer to determine the VOC concentrations at the outlet.

The VIG hydrocarbon analyzer channels a fraction of the gas sample through a capillary tube that directs the sample to the flame ionization detector (FID), where the hydrocarbons present in the sample are ionized into carbon. The carbon concentration is then determined by the detector in parts per million (ppm). This concentration is transmitted to the data acquisition system (DAS) at 4-second intervals in the form of an analog signal, specifically voltage, to produce data that can be averaged over the duration of the testing program. This data is then used to determine the average ppm for total hydrocarbons (THC) using the equivalent units of propane (calibration gas).

The JUM Model 109A analyzer utilizes two flame ionization detectors (FIDs) in order to report the average ppmv for total hydrocarbons (THC), as propane, as well as the average ppmv for methane (as methane). Upon entry, the analyzer splits the gas stream. One FID ionizes all of the hydrocarbons in the gas stream sample into carbon, which is then detected as a concentration of total hydrocarbons. Using an analog signal, specifically voltage, the concentration of THC is then sent to the data acquisition system (DAS), where recordings are taken at 4-second intervals to produce an average based on the overall duration of the test. This average is then used to determine the average ppmv for THC reported as the calibration gas, propane, in equivalent units.

The second FID reports methane only. The sample enters a chamber containing a catalyst that destroys all of the hydrocarbons present in the gas stream other than methane. As with the THC sample, the methane gas concentration is sent to the DAS and recorded. The methane concentration, reported as methane, can then be converted to methane, reported as propane, by dividing the measured methane concentration by the analyzer's response factor.

The JUM analyzer was calibrated for a range of 0 to 100 ppm on each channel and the VIG analyzer was calibrated for a range of 0 to 1,000 ppm.

In accordance with Method 25A, a 3-point (zero, mid, and high) calibration check was performed on the THC analyzer. Calibration drift checks were performed at the completion of each run.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United States National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A field quality assurance check of the system was performed pursuant to Method 205 by setting the diluted concentration to a value identical to a Protocol 1 calibration gas and then verifying that the analyzer response is the same with the diluted gas as with the Protocol 1 gas.

4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figures 3-6.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 3-6.

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: November 12th, 2015

R540			
Pollutant	**Destruction Efficiency (%)**	**Average Emission Rate (pph)**	**Emission Limit**
VOC	88.9	0.28	95% DE -OR- 0.54 pph

Test Date: November 13th, 2015

C1150A			
Pollutant	**Destruction Efficiency (%)**	**Average Emission Rate (pph)**	**Emission Limit**
VOC	98.8	0.03	95% DE -OR- 0.54 pph

5.b Discussion of Results

R540 VOC DE test result is 88.9%, which is lower than the 95% emission limit, but the average emission rate is 0.28 pph, which is lower than the 0.54 pph emission limit.

C1150A VOC DE test result is 98.8%, which is higher than the 95% emission limit, and the average emission rate is 0.03 pph, which is lower than the 0.54 pph emission limit.

5.c Sampling Procedure Variations

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

5.d Process or Control Device Upsets

There were no process upsets during this test.

5.e Control Device Maintenance

C1150A and R540 are both newly installed so no maintenance activities have occurred within the last three months.

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

There are no laboratory results for this test program. Raw CEM data is provided electronically in Appendix D.

Table 4
R540 Destruction Efficiency Summary
Denso
Battle Creek, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	11/12/2015	11/12/2015	11/12/2015	
Sampling Time	8:38-9:38	10:44-11:44	12:40-13:40	
Inlet Flowrate (scfm)	847	787	798	810
Outlet Flowrate (scfm)	2,283	2,060	2,013	2,119
Inlet VOC Concentration (ppmv propane)	370.43	515.22	521.76	469.14
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	373.20	512.61	511.86	465.89
Inlet VOC Mass Flowrate (lb/hr)	2.17	2.77	2.80	2.58
Outlet VOC Concentration (ppmv propane)	39.42	52.91	56.14	49.49
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	39.41	52.09	55.48	48.99
Outlet CH4 Concentration (ppmv methane)	50.42	72.14	75.63	66.06
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	50.85	73.11	75.79	66.58
Outlet VOC Concentration (- methane)	16.61	19.88	22.53	19.67
Outlet VOC Mass Emission Rate (lb/hr)	0.26	0.28	0.31	0.28
VOC Destruction Efficiency (%)	**88.0**	**89.8**	**88.9**	**88.9**

Inlet VOC Correction			
Co	1.97	6.62	9.30
Cma	496	496	496
Cm	491.67	498.74	505.89

Outlet VOC Correction			
Co	-0.32	-0.59	0.14
Cma	49.7	49.7	49.7
Cm	49.79	50.46	50.31

Outlet CH4 Correction			
Co	0.39	0.78	1.01
Cma	49.6	49.6	49.6
Cm	49.19	49.19	49.85

scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
VOC: volatile organic compound
MW = molecular weight (C_3H_8 = 44.10)
24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31: ft^3 per m^3
453600: mg per lb

Equations

lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Response Factor	2.23	2.27	2.30

Table 5
C1150A Destruction Efficiency Summary
Denso
Battle Creek, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	11/13/2015	11/13/2015	11/13/2015	
Sampling Time	8:47-9:47	11:46-12:46	13:10-14:10	
Inlet Flowrate (scfm)	887	889	1,090	955
Outlet Flowrate (scfm)	2,239	2,093	2,170	2,167
Inlet VOC Concentration (ppmv propane)	387.95	335.85	339.61	354.47
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	378.41	320.19	326.17	341.59
Inlet VOC Mass Flowrate (lb/hr)	2.30	1.95	2.44	2.23
Outlet VOC Concentration (ppmv propane)	1.93	3.31	3.09	2.78
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	2.35	3.38	2.98	2.90
Outlet CH4 Concentration (ppmv methane)	3.14	3.01	2.16	2.77
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	2.83	2.69	2.22	2.58
Outlet VOC Concentration (- methane)	1.11	2.20	2.01	1.77
Outlet VOC Mass Emission Rate (lb/hr)	0.02	0.03	0.03	0.03
VOC Destruction Efficiency (%)	**99.3**	**98.4**	**98.8**	**98.8**

Inlet VOC Correction			
Co	11.57	21.06	17.83
Cma	497	497	497
Cm	505.91	509.68	508.15

Outlet VOC Correction			
Co	-0.43	-0.04	0.18
Cma	24.8	24.8	24.8
Cm	24.41	24.57	24.46

Outlet CH4 Correction			
Co	0.35	0.42	0.00
Cma	19.9	19.9	19.9
Cm	19.97	19.57	19.37

scfm: standard cubic feet per minute
ppmv: parts per million on a volume to volume basis
lb/hr: pounds per hour
VOC: volatile organic compound
MW = molecular weight (C_3H_8 = 44.10)

Response Factor= 2.29

24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31: ft^3 per m^3
453600: mg per lb

Equations

lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60