EMISSION TESTING PROTOCOL

NORTH THERMAL OXIDIZER & REGENERATIVE THERMAL OXIDIZER

Prepared For:

DENSO MANUFACTURING TENNESSEE INC.

Athens, Tennessee

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC. KNOXVILLE, TN

CEC Project:
195-872

Proposed Test Date:
December 9-11, 2019

Civil & Environmental Consultants, Inc.

Knoxville | 2704 Cherokee Farm Way | Knoxville, TN 37920 | p: 865-977-9997 | f: 865-977-9919 | www.cecinc.com

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

Civil & Environmental Consultants, Inc. (CEC) has been retained by DENSO Manufacturing Tennessee Inc. (DENSO) to perform emission performance testing on the north thermal oxidizer (N-TO) and the regenerative thermal oxidizer (RTO) located at the DENSO facility located in Athens, Tennessee.

The purpose of this test program is to determine the removal efficiency (RE) of volatile organic compounds (VOCs) for both of the oxidizers.

1.1 Project Contact Information

Location	Address	Contact
Test Facility	DENSO Manufacturing Athens Tennessee 2400 DENSO Drive Athens, TN 37303	Mr. Eddie Franks Manager Safety Health and Environment Phone (423) 746-0000 Eddie_Franks@DENSO-Diam.com
Testing Company Representative	CEC, Inc. 2704 Cherokee Farm Way Knoxville, Tennessee 37920	Todd Gregg Project Manager Phone: (865) 977-9997 Mobile: (865) 250-9067 tgregg@cecinc.com

The tests will be performed by the CEC Knoxville, TN Source Testing Group.

2.0 TEST PROGRAM

Table 1 provides a list of the test methods proposed for the performance demonstration tests on each thermal oxidizer in this test protocol.

Table 1. Proposed Performance Demonstration Test Methods

Parameter	40CFR Part 60 EPA Test Method	Comments
Exhaust Gas Flow Rate	M1, M2	Exhaust only
Exhaust Gas Moisture Content	M4	Inlet & Exhaust
Removal Efficiency (RE)	-	Calculation
O_2 / CO_2	M3	For gas composition
VOC (as propane)	M25A[(1)]	Inlet & Exhaust
Hydrogen Fluoride	M320	Exhaust

[(1)]The total VOC will be measured by FID using M25A as a total hydrocarbon without methane removal being considered.

Provided below is a detailed description of how the testing will be performed on each of these two sources.

2.1 Thermal Oxidizer – Removal Efficiency (RE)

Because the RE is calculated on a comparative basis, there is not a requirement to speciate individual volatile organics present in the gas streams. The performance demonstration tests will be performed by measuring the concentration of total volatile organic carbon (VOC) at the inlet and exhaust of the thermal oxidizer simultaneously.

The VOCs will be measured at each sampling location with a JUM Engineering heated flame ionizing detector (FID) continuous emission monitor (CEM) according to procedures in 40 CFR Part 60, Appendix A, Method 25A.

The sampling will be performed by extracting a sample of the gas stream from the inlet and exhaust of the thermal oxidizer and transporting the sample gas through a heated Teflon sample line to the VOC CEMs located in a thermally controlled sampling trailer. A continuous sample will be extracted and measured for a 60 minute period. A total of three test runs will be completed. The concentrations measured by the VOC CEMs will be

recorded on an electronic datalogger.

The thermal oxidizer inlet gas flow rate is a combined flow rate for the complete system. Due to the inability to separate individual process line exhaust to a single thermal oxidizer, all test runs will capture concentrations (reported as propane) to be used to calculate the removal efficiency's. The test runs will be performed on a mixture of process exhaust.

In order to calculate the emission concentrations on a dry basis, the moisture content of the inlet and exhaust gas streams will be measured by 40 CFR Part 60, Appendix A, Method 4 regulations.

The percent reduction in VOC will be calculated using the following equation;

$$R = \frac{E_i - E_o}{E_i}(100)$$

Where:
R = Control efficiency of control device, percent.
E_i = Mass rate of VOC (minus methane and ethane) at the inlet to the control device, kilograms VOC per hour. E_o = Mass rate of VOC (minus methane and ethane) at the exhaust of the control device, kilograms VOC per hour.

2.2 Hydrogen Fluoride Emissions (HF)

The vapor phase HF will be determined according to EPA Method 320 sampling procedures using an MKS MultiGas™ 2030 extractive Fourier transform infrared spectrometer (FTIR). The FTIR contains a 2102 Process FTIR Spectrometer, a patented, high-optical-throughput sampling cell, applications-specific analysis software, and an instrument-independent, quantitative spectral library. It incorporates a novel long wavelength liquid nitrogen (LN2) cooled detector for more accurate, highly sensitive measurement of most gases and vapors even in high moisture streams (up to 40%), producing high resolution spectra (0.5 cm-1) without removing the moisture.

EPA Method 320 specifies the performance of matrix spiking at each sampling location. This procedure consist of measuring the sample flow rate into the FTIR and the measured flow of spike gas sent thru the sampling system at an approximate rate of less than 10% of the total sample flow rate into the FTIR. The value calculated for the recovery at 100% is compared to the actual value logged by the FTIR to determine the final spike recovery percentage.

During each test run the thermal oxidizer exhaust gas flow rate will be measured with a calibrated S-type pitot tube according to procedures in 40 CFR Part 60, Appendix A, Methods 1 and 2. The HF concentrations will be used along with the exhaust flow data to calculate a mass rate of HF from the exhaust of the two oxidizers and reported in lbs/hour.

2.3 Tentative Schedule

CEC is currently scheduled to perform the performance demonstration testing the week of December 9, 2019. The following table provides a breakdown of the schedule for the testing activities.

Table 2. Proposed Test Schedule

Date	Task	Time
12/9/2019	Test team travels to DENSO facility. CEC test team prepares sampling equipment and performs preliminary measurements.	8:00 – 17:00
12/10/2019	Perform RE & HF Test Runs 1–3 on the first thermal oxidizer.	8:00 – 17:00
12/11/2019	Perform RE & HF Test Runs 1-3 on the second thermal oxidizer	8:00 – 17:00
12/11/2019	Return travel to CEC office.	-

3.0 SOURCE AND SAMPLING LOCATION DESCRIPTIONS

3.1 Source Description

The thermal oxidizers are located on the west side of the facility. The inlet gases are gathered from multiple locations inside the facility and transported to the mixing duct located adjacent to the thermal oxidizer. The gases enter through a rectangle duct connected to the adsorber unit, followed by a desorber unit, then into the oxidizer. The unit has redundant process air blowers to pull the gases from the air mixing duct and push through the unit. The oxidizer temperature will be monitored by DENSO equipment and included in the report.

3.2 Sampling Locations

Sampling on each thermal oxidizer will be performed simultaneously on the inlet and exhaust of the thermal oxidizers. The inlet VOC sampling location for the N-TO will be located in the rectangle duct that is approximately 70 inches x 28 inches. The duct is located between the mixing chamber and the filter box. A single sample tap will be installed in the duct for the inlet gas sample extraction. The RTO inlet sampling location has two ports on a 36-inch duct exiting the facility prior to the RTO through the sample tap. During the testing one port will be utilized for the Method 4 and the other will be used for the CEMs.

The exhaust sampling location for the N-TO is approximately 35 feet from ground level and consist of 3 test ports spaced 90 degrees apart, one will be utilized for the VOC CEMs sampling probe and the remaining two ports will be utilized for the Method 2 and 4 sampling. CEC will perform a 16-point traverse, as required for a non-particulate source. The ports are approximately 3 inches in depth and the diameter of the exhaust stack is 36 inches. The traverse point layout is located in the appendix.

The RTO exhaust stack is 36 inches in diameter and has two ports. CEC will perform the Method 2 sampling prior to starting the CEMs testing and repeat the Method 2 after the CEMs testing is complete for each run. During the test one port will be used for the CEMs and the other one will be used for the Method 4 tests.

4.0 QUALITY ASSURANCE PROGRAM

Specific quality control (QC) procedures will be followed to ensure the continuous production of useful and valid data throughout the course of this test program. The QC checks and procedures described in this section represent an integral part of the overall sampling and analytical scheme. Strict adherence to prescribed procedures is quite often the most applicable QC check. A discussion of both the sampling and analytical QC checks that will be utilized during this program is presented below.

4.1 Equipment Maintenance and Inspection

Each item of field test equipment requiring calibration or measurement will be assigned a unique permanent identification number. The ID number for the nozzles, probes and control consoles will be noted on each sample data sheet.

An effective preventative maintenance program is necessary to ensure data quality. Each item of equipment returning from the field will be inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated where necessary.

Each item of equipment transported to the field for this test program will be inspected again before being packed to detect equipment problems which may originate during periods of storage. This minimizes lost time on the job site due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason, replacement equipment for all critical sampling train components will be transported to the job site.

4.2 Equipment Calibration

Calibrations will be conducted in a manner, and at a frequency, which meets or exceeds U.S. EPA specifications. The calibration procedures referenced in the applicable EPA methods will be followed. When these methods are inapplicable, methods such as those prescribed by the American Society for Testing Materials (ASTM) will be used.

Data obtained during calibrations will be recorded on standardized forms, which will be checked for completeness and accuracy by the quality assurance manager. Data reduction and subsequent calculations will be performed verified Excel spreadsheets. Copies of calibration forms for equipment used in the performance test will be included in the final test report.

5.0 REPORTING OF TEST RESULTS

Upon completion of the performance testing, test results will be documented in a complete report that will included, at a minimum, the following items:

1) A brief description of the process and the air pollution control system;
2) A description of the sampling locations;
3) A description of sampling and analytical procedures and any modifications to standard procedures;
4) Test results;
5) Quality assurance procedures and results;
6) Records of operating conditions during the test, preparation of standards, and calibration procedures;
7) Raw data sheets for field sampling and field and laboratory analyses;
8) Documentation of calculations;
9) All data recorded and used to establish parameters for compliance monitoring;
10) Any other information specifically required by the test method.

Copies of the test report will be submitted to DENSO within 30 days after completion of the field sampling. Once the final test report is delivered to DENSO, it will be the responsibility of DENSO to submit the performance report to the Tennessee Department of Environmental Conservation (TDEC).

APPENDIX

NOTICE TO PROCEED

October 31, 2019

Mr. Todd Gregg
Civil & Environmental Consultants, Inc.
308 Cates Street
Maryville, TN 37801

Dear Mr Gregg:

You are hereby granted permission to proceed with Source Sampling Services for VOC Destruction Efficiency Testing per quote dated.

An official purchase order is in progress with issuance expected within 2 weeks.

Sincerely,

Eddie Franks
Manager, Safety, Health and Environment

Enclosures: Permit No. 464514P

cc: Chattanooga Environmental Field Office Tennessee Division of Air Pollution Control

Probe/Pitot Tube Traverse Layout Calculation Spreadsheet

Stack/duct inside diameter (inches)	36	Project:	**Denso Athens**
Required number of traverse points (stack total)	16	Test Location:	**RTO**
Req. traverse points on a diameter	8	Date:	
Port Length (inches)	3		
Number of test ports	2		

Location of Traverse Point (Measured from Outside Edge of Sample Port)

Traverse Point number on a diameter	2	4	6	8	10	12	14	16	18	20	22	24
1				4.15								
2				6.78								
3				9.98								
4				14.63								
5				27.37								
6				32.02								
7				35.22								
8				37.85								
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

EPA M2/M4 DATA SHEET

Project Name: Denso Athens **Test No.:** _____ **Stack Dimensions:** _____

Project No.: _____ **Location:** _____ **Barometric Pressure:** _____ in. Hg

Date: _____ **Personnel:** _____ **Static Pressure:** _____ in. H_2O

M2 Test Time : **Start :** _____ **Stop :** _____

VELOCITY TRAVERSE

TRAVERSE POINT	VELOCITY PRESSURE (ΔP)	STACK TEMP.
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
Average		

IMPINGER WEIGHTS

Impinger	Initial Wt.	Final Wt.	Total
1			
2			
3			
4			
Total			

PITOT LEAK CHECK (> 3")

INITIAL	(+)	(-)
FINAL	(+)	(-)

TRAIN LEAK CHECK (ft^3 @ in, Hg.)

INITIAL	@
FINAL	@

MOISTURE TRAIN

SAMPLING TIME Clock	SAMPLING TIME Sample	DRY GAS METER	DGM TEMP.	LAST IMPINGER TEMP.	TRAIN VACUUM

M4 Sample Train I.D. : _____ **O2%:** _____ **CO2%:** _____

Control Console I.D.: _____ **ΔH@:** _____ **Y:** _____

Pitot Tube Type: S **I.D. No.:** _____ **Coefficient:** _____

Manometer Type: Oil Incl. **I.D. No.:** _____

Thermometer Type: K **I.D. No.:** _____

NOTES: _____

VELOCITY TRAVERSE DATA SHEET

Project Name: Denso Athens **Test No.:** _____

Project No.: _____ **Location:** _____

Date: _____ **Personnel:** _____

M2 Test Time : **Start :** _____ **Stop :** _____

VELOCITY TRAVERSE			
TRAVERSE POINT	VELOCITY PRESSURE (ΔP)	STACK TEMPERATURE	CYCLONIC FLOW CHECK
1			
2			
3			
4			
1			
2			
3			
4			
1			
2			
3			
4			
1			
2			
3			
4			
Average			

Stack Dimensions: _____

Barometric Pressure: _____ in. Hg

Static Pressure: _____ in. H_2O

O2%: _____

CO2%: _____

PITOT LEAK CHECK (> 3")		
INITIAL	(+)	(-)
FINAL	(+)	(-)

Pitot I.D. No.: _____

T/C I.D. No.: _____

T/C Readout I.D. No.: _____

NOTES: _____