Report of a...

Compliance Emission Test

Performed for the...

Zeeland Board of Public Works

Zeeland, Michigan

On...

Various R.I.C.E.

(Reciprocating Internal Combustion Engines)

September 4, 2013 - January 13, 2014

295.01

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I. INTRODUCTION

Network Environmental, Inc. was retained by Zeeland Board of Public Works to conduct emission testing on their Reciprocating Internal Combustion Engines (RICE) at their three Zeeland, Michigan facilities. The purpose of the study was to determine compliance with their Renewable Operating Permit No. MI-ROP-B7977-2012a, their Permit to Install 187-05 and NESHAP Subpart ZZZZ.

The testing was conducted from September 4, 2013 through January 13, 2014. Stephan K. Byrd, R. Scott Cargill, Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc. performed the testing. The testing for Carbon Monoxide (CO) Destruction Efficiency was performed in accordance with EPA Reference Method 10. Mr. Don Muller and the staff of Zeeland Board of Public Works coordinated source operation and Data collection. Mr. Steve LaChance, Mr. Nathan Hude and Mr. Rob Dickman of the MDEQ Air Quality Division were present to observe the testing and source operation.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EU-ENGINE011
SEPTEMBER 4, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	09:36-10:36	457.8	64.8	85.85
2	10:55-11:55	447.6	61.8	86.19
3	12:13-13:13	437.3	62.9	85.62
Average		**447.6**	**63.17**	**85.88**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.2 TABLE 2
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EU-ENGINE010
SEPTEMBER 4, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	14:29-15:29	433.0	59.3	86.30
2	15:44-16:44	421.2	58.2	86.18
3	17:00-18:00	412.9	58.9	85.74
Average		**422.4**	**58.8**	**86.07**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.3 TABLE 3
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EU-ENGINE009
SEPTEMBER 5, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	08:26-09:26	595.2	78.1	86.88
2	09:40-10:40	605.6	78.9	86.97
3	10:50-11:50	610.8	78.3	87.18
Average		**603.9**	**78.4**	**87.01**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.4 TABLE 4
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EU-ENGINE008
SEPTEMBER 5, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	12:56-13:56	205.0	15.8	92.29
2	14:05-15:05	201.0	15.1	92.49
3	15:15-16:16	214.8	16.2	92.46
Average		**206.9**	**15.7**	**92.41**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.5 TABLE 5
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EU-ENGINE007
SEPTEMBER 5, 2013

Sample	Time	CO Concentration PPM[1]		%[2] Destruction Efficiency
		Inlet	Exhaust	
1	17:15-18:15	206.0	33.1	83.93
2	18:25-19:25	202.3	31.5	84.43
3	19:33-20:33	207.4	32.3	84.43
Average		**603.9**	**78.4**	**84.26**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.6 TABLE 6
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EU-ENGINE002
SEPTEMBER 6, 2013

Sample	Time	CO Concentration PPM[1]		%[2] Destruction Efficiency
		Inlet	Exhaust	
1	08:30-09:30	363.7	22.0	93.95
2	09:40-10:40	361.6	19.8	94.52
3	10:50-11:50	357.1	19.1	94.65
Average		**360.8**	**20.3**	**94.37**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.7 TABLE 7
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EU-ENGINE001
SEPTEMBER 6, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	13:32-14:32	389.7	40.4	89.63
2	14:43-15:43	376.6	39.0	89.64
3	15:53-16:53	369.6	38.8	89.50
Average		**378.6**	**39.4**	**89.59**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.8 TABLE 8
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
CAT ENGINE #1 (WEST FACILITY)
OCTOBER 3, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	13:11-14:11	504.4	4.0	99.21
2	14:26-15:26	499.2	3.9	99.22
3	15:36-16:36	517.8	3.7	99.29
Average		**507.1**	**3.9**	**99.24**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.9 TABLE 9
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
CAT ENGINE #2 (WEST FACILITY)
OCTOBER 4, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	08:55-09:55	533.3	4.6	99.14
2	10:05-11:05	537.3	4.9	99.09
3	11:14-12:14	539.0	4.9	99.09
Average		**536.5**	**4.8**	**99.11**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.10 TABLE 10
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EUENGINE1 (RILEY STREET FACILITY)
JANUARY 8, 2014

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	10:14-11:14	453.5	5.7	98.74
2	11:24-12:24	459.5	5.8	98.74
3	12:33-13:33	457.5	5.7	98.75
Average		**456.8**	**5.7**	**98.74**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.11 TABLE 11
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EUENGINE2 (RILEY STREET FACILITY)
JANUARY 13, 2014

Sample	Time	CO Concentration PPM(1)		% Destruction Efficiency(2)
		Inlet	Exhaust	
1	08:44-09:44	469.3	3.9	99.17
2	09:53-10:53	473.8	4.4	99.07
3	11:02-12:02	478.2	4.6	99.04
Average		**473.8**	**4.3**	**99.09**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.12 TABLE 12
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EUENGINE3 (RILEY STREET FACILITY)
JANUARY 9, 2014

Sample	Time	CO Concentration PPM(1)		% Destruction Efficiency(2)
		Inlet	Exhaust	
1	11:32-12:32	471.4	4.8	98.98
2	12:41-13:41	472.9	5.2	98.90
3	13:52-14:52	477.3	4.8	98.99
Average		**473.9**	**4.9**	**98.96**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.13 TABLE 13
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EUENGINE4 (RILEY STREET FACILITY)
JANUARY 10, 2013

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	09:20-10:20	453.8	3.9	99.14
2	10:30-11:30	470.5	4.4	99.06
3	11:41-12:41	471.1	4.8	98.98
Average		**465.1**	**4.4**	**99.06**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

II.14 TABLE 14
CO DESTRUCTION EFFICIENCY RESULTS
ZEELAND BOARD OF PUBLIC WORKS
EUENGINE5 (RILEY STREET FACILITY)
JANUARY 10, 2014

Sample	Time	CO Concentration PPM(1)		%(2) Destruction Efficiency
		Inlet	Exhaust	
1	13:09-14:09	488.8	3.9	99.20
2	14:17-15:17	490.5	4.3	99.12
3	15:26-16:26	493.5	4.3	99.13
Average		**490.9**	**4.2**	**99.15**

(1) PPM = Parts Per Million (v/v) on an dry basis
(2) Destruction Efficiencies were calculated using the concentrations

III. DISCUSSION OF RESULTS

The results of the CO Reduction efficiency sampling are presented in Section II., Tables 1 through 14. The destruction efficiency was calculated using the concentration at the inlet and outlet of the engine catalyst.

The CO Reduction efficiency requirement is as follows:
Engines EU-ENGINE001 – EUENGINE011 AT THE 347 Washington Avenue Facility = 70% CO reduction or 23 PPM CO @15% O_2 on the exhaust.
Engines at 495 Washington Avenue and 8943 Riley Street = 95% CO Reduction or 23 PPM CO @ 15% O_2 on the exhaust.

IV. SOURCE DESCRIPTION

The sources tested were reciprocating internal combustion engines (R.I.C.E.) of various makes, models, capacities and ages. Catalyst was installed on the exhausts to reduce emissions from the engines. The engines were operated at a level greater than 90% of maximum load during the testing. Source operating data can be found in Appendix B

V. SAMPLING AND ANALYTICAL PROTOCOL

The CO reduction sampling was conducted on the inlet and exhaust of the catalyst on each of the engine exhausts.

The following reference test methods were employed to conduct the sampling:

* CO Reduction Efficiency - U.S. EPA Method 10
* Exhaust O_2 - U.S. EPA Method 3A

V.1 CO Reduction Efficiency - The CO sampling was conducted in accordance with U.S. EPA Reference Method 10. The sample gas was extracted from the inlet and outlet of the catalyst through heated Teflon sample lines which led to a Thermo Environmental Model 48H or 48C on the inlet and Model 48 on the outlet. These analyzers produce instantaneous readouts of the CO concentrations (PPM). Three (3) samples

were collected from each of the sources. Each sample was sixty (60) minutes in duration. The sampling on the inlet and exhaust was conducted simultaneously.

A systems (from the back of the stack probe to the analyzer) calibration was conducted for the analyzers prior to the testing. Span gases of 92.97 PPM and 851.2 PPM, 985.3 PPM or 1,890 PPM CO were used to establish the initial instrument calibration for the analyzers. CO calibration gases of 51.06 PPM, 250.2 PPM, 446.0 PPM, 492.5 PPM and 851.2 PPM were used to determine the calibration error of the analyzers. After each sample (60 minute sample period), a system zero and system injections of 446.0 PPM and 51.06 PPM CO were performed to establish system drift of both analyzers during the test period. All calibration gases used were EPA Protocol 1 Certified. All the results were calibration corrected using Equation 7E-1 from U.S. EPA Method 7E.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the incinerator. All quality assurance and quality control requirements specified in the method were incorporated in the performance of this determination. A diagram of the sampling train is shown in Figure 1.

V.2 Oxygen - The O_2 sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Series 1400M gas analyzer was used to monitor the exhaust. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzer produces instantaneous readouts of the O_2 concentrations (%).

The analyzer was calibrated by direct injection prior to the testing. Span gases of 20.9% O_2 (ambient air) and 21.03% O_2 were used to establish the initial instrument calibrations. Calibration gases of 12.11%, 12.15%, 6.041% & 6.038% O_2 were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzer) was injected using the 12.11% O_2 and 6.038% CO_2 gas to determine the system bias. After each sample, a system zero and system injection of 12.11% O_2 & 6.38% O_2 were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. A diagram of the sampling train is shown in Figure 1.

This report was prepared by:

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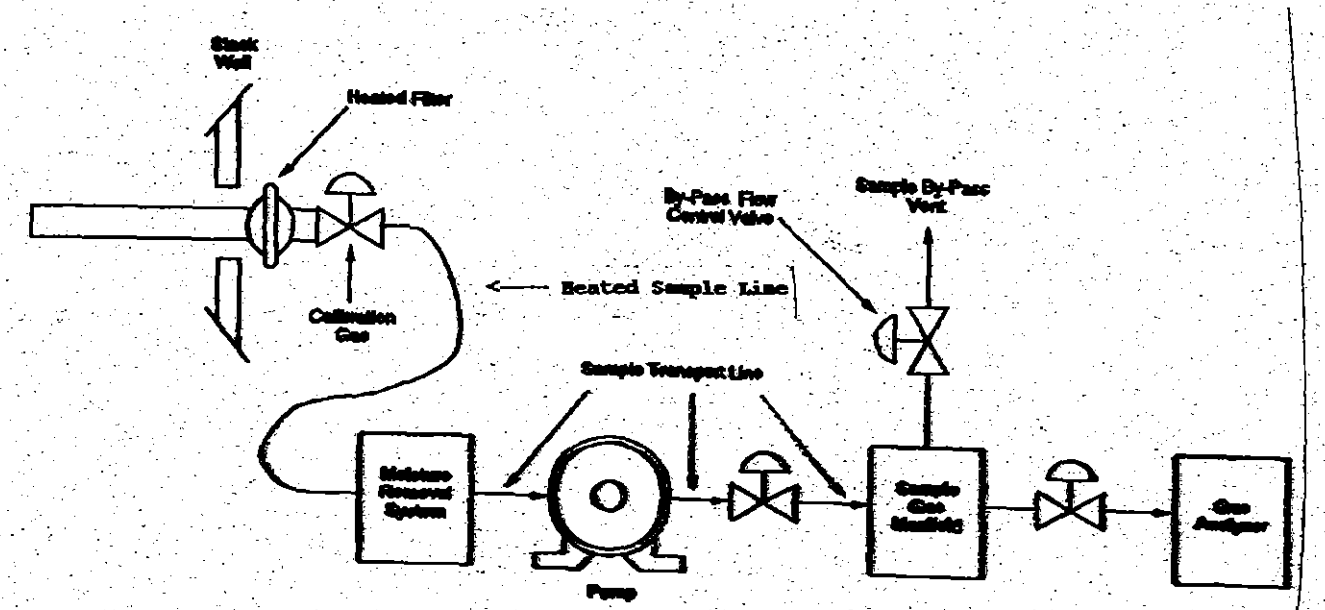

Figure 1

CO & O_2 Sampling Train