EMISSION TEST REPORT
For
CO Reduction Efficiency
Catalyst on Engine EU 5-9
Thumb Electric Co-op - Ubly
Ubly, MI
May 16-18, 2017

Comprehensive Emission Services, Inc
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SECTION 1

INTRODUCTION

An emission test was conducted by Comprehensive Emission Services, Inc. on EU 5 thru 9, at the Thumb Electric Co-op - Ubly, located in Ubly, MI.

Coordinating the field test:

Dallas Braun - Thumb Electric Co-op - Ubly
Tim Titus - Comprehensive Emission Services, Inc.
Kevin DeValkenaere - Farabee Mechanical, Inc.

Conducting the field test:

Joe Bourek - Comprehensive Emission Services, Inc.
Mason Woltz - Comprehensive Emission Services, Inc.

The results were used to evaluate the Generator with regards to the following:

CO Emission reduction efficiency

The appendices contain the following:

Appendix A: Analyzer Data
Appendix B: Plant Process Data
Appendix C: Monitor Calibration Data
Appendix D: Protocol 1 Certification Sheets
Appendix E: Certificates of accreditation

SECTION 2

SUMMARY OF RESULTS

Table 1 summarizes the test results for testing at the Thumb Electric Co-op - Ubly, located in Ubly, MI. The CO results are presented in ppm corrected to 15 percent O_2. The catalyst on the Engines were tested to demonstrate compliance with the outlet concentration limit of ≤ 23 ppm corrected to 15 percent O_2, or a 70% or greater reduction of CO emissions as required in NESHAP ZZZZ, 40 CFR, Part 63.

SUMMARY OF TEST RESULTS

Parameters	CO (ppm @ 15% O_2)	CO (ppm @ 15% O_2)	%
Fairbanks Morse	Inlet	Outlet	CO Reduction (%)
EU 5	172.9	19.6	88.63
EU 6	573.0	32.2	94.38
EU 7	171.5	19.3	88.80
EU 8	59.4	12.5	78.96
EU 9	92.4	15.8	82.89

SECTION 3

SAMPLING AND ANALYTICAL PROCEDURES

Carbon Monoxide

Carbon Monoxide (CO) and Oxygen (O_2) were measured by EPA Methods 10 and 3A. The Diesel Engines were sampled with each test run lasting approximately one hour. A Teflon heated line was used to transfer the sample from the probe to the sampling trailer. At the sampling trailer, the sample was conditioned by a series of refrigeration dryers to remove the moisture from the gas stream. After the refrigeration dryers, the sample was transported through a Teflon line to the analyzers. The flow of the stack gas sample was regulated at a constant rate to minimize drift.

3.3 Calibration Procedure

At the start of the day, the each monitor was checked for calibration error by introducing zero, low, mid, and high-range EPA Protocol 1 gases to the measurement system at a point upstream of the analyzers. Comprehensive Emission Services, Inc. refers to the calibration error test as the instrument calibration. The gas was injected into the sampling valve located at the inlet of the sampling probe. The bias test was conducted before and after each consecutive test condition by introducing zero and upscale calibration gases for each monitor. The upscale calibration gases used for the each monitors bias tests were the calibration gases which most closely approximates the effluent concentration monitored during the test runs.

SECTION 4

TEST RESULTS

Table 2 summarizes the CO emissions and other parameters for Engine EU 5. The raw data is presented in appendix B.

Table 2
Test Results
May 16, 2017
EU 5
Fairbanks Morse 38TD8-1/8
Rating: 1550 KW and 2160 HP

Parameters	Run 1	Run 2	Run 3
Start time	10:03 AM	11:08 AM	12:14 PM
Stop time	11:03 AM	12:08 PM	01:14 PM
O2(%) Inlet	13.4	13.4	13.3
O2(%) Outlet	13.3	13.4	13.3
CO(ppm) Inlet	219.1	212.4	227.6
CO(ppm @ 15% O2) Inlet	173.34	167.65	177.60
CO(ppm) CO(ppm) Outlet	26.0	24.5	25.0
CO(ppm @ 15% O2) Outlet	20.21	19.23	19.48
CO Reduction (%)	88.34	88.53	89.03
HAPS emitted CO tons/hr	6.33E-004		
Average Output (%)	100		
Average Output (KW)	1550		
Average Catalyst Pressure	1.5		
Average Catalyst Inlet Temp	650.6		

Table 3 summarizes the CO emissions and other parameters for Engine EU 6. The raw data is presented in appendix B.

Table 3
Test Results
May 18, 2017
EU 6
Fairbanks Morse 38TDD8-1/8
Rating: 1542 KW and 2160 HP

Parameters	Run 1	Run 2	Run 3
Start time	08:00 AM	09:06 AM	10:12 AM
Stop time	09:00 AM	10:06 AM	11:12 AM
O2(%) Inlet	12.1	12.0	11.9
O2(%) Outlet	12.0	12.0	11.9
CO(ppm) Inlet	855.1	870.5	871.3
CO(ppm @ 15% O2) Inlet	574.76	573.87	570.40
CO(ppm) CO(ppm) Outlet	49.1	49.3	48.0
CO(ppm @ 15% O2) Outlet	32.55	32.62	31.46
CO Reduction (%)	94.34	94.32	94.48
HAPS emitted CO tons/hr	1.35E-003		
Average Output (%)	100		
Average Output (KW)	1542		
Average Catalyst Pressure	0.80		
Average Catalyst Inlet Temp	819.3		

Table 4 summarizes the CO emissions and other parameters for Engine EU 7. The raw data is presented in appendix B.

Table 4
Test Results
May 16, 2017
EU 7
Fairbanks Morse 38TD8-1/8
Rating: 2750 KW and 3930 HP

Parameters	Run 1	Run 2	Run 3
Start time	03:30 PM	04:36 PM	05:41 PM
Stop time	04:30 PM	05:36 PM	06:41 PM
O2(%) Inlet	12.2	12.0	11.9
O2(%) Outlet	12.0	11.8	11.8
CO(ppm) Inlet	261.8	254.5	257.8
CO(ppm @ 15% O2) Inlet	176.79	168.10	169.66
CO(ppm) CO(ppm) Outlet	34.8	28.1	25.3
CO(ppm @ 15% O2) Outlet	22.99	18.31	16.47
CO Reduction (%)	87.00	89.11	90.29
HAPS emitted CO tons/hr	9.78E-004		
Average Output (%)	100		
Average Output (KW)	2750		
Average Catalyst Pressure	0.60		
Average Catalyst Inlet Temp	781.4		

Table 5 summarizes the CO emissions and other parameters for Engine EU 8. The raw data is presented in appendix B.

Table 5
Test Results
May 17, 2017
EU 8
Fairbanks Morse 38TDD8-1/8
Rating: 2250 KW and 3142 HP

Parameters	Run 1	Run 2	Run 3
Start time	07:46 AM	08:55 AM	10:01 AM
Stop time	08:46 AM	09:55 AM	11:01 AM
O2(%) Inlet	14.0	14.0	13.9
O2(%) Outlet	14.0	13.9	13.9
CO(ppm) Inlet	65.5	69.6	74.1
CO(ppm @ 15% O2) Inlet	55.88	59.59	62.83
CO(ppm) CO(ppm) Outlet	15.2	14.4	14.6
CO(ppm @ 15% O2) Outlet	12.94	12.16	12.29
CO Reduction (%)	76.85	79.60	80.44
HAPS emitted CO tons/hr	3.13E-004		
Average Output (%)	100		
Average Output (KW)	2250		
Average Catalyst Pressure	1.6		
Average Catalyst Inlet Temp	617.1		

Table 6 summarizes the CO emissions and other parameters for Engine EU 9. The raw data is presented in appendix B.

Table 6
Test Results
May 17, 2017
EU 9
Fairbanks Morse 38TDD8-1/8
Rating: 1500 KW and 2101 HP

Parameters	Run 1	Run 2	Run 3
Start time	12:19 PM	01:24 PM	02:29 PM
Stop time	01:19 PM	02:24 PM	03:29 PM
O2(%) Inlet	13.7	13.6	13.5
O2(%) Outlet	13.5	13.5	13.6
CO(ppm) Inlet	115.7	114.1	113.7
CO(ppm @ 15% O2) Inlet	94.44	92.28	90.60
CO(ppm) CO(ppm) Outlet	23.2	18.6	17.6
CO(ppm @ 15% O2) Outlet	18.50	14.91	14.11
CO Reduction (%)	80.42	83.84	84.42
HAPS emitted CO tons/hr	3.07E-004		
Average Output (%)	100		
Average Output (KW)	1500		
Average Catalyst Pressure	1.3		
Average Catalyst Inlet Temp	656.5		