INTRODUCTION

An emission test was conducted by Comprehensive Emission Services Inc. on the CHP Boiler and Turbine at The Andersons Marathon Holdings LLC – Albion Ethanol facility located in Albion, Michigan. Three Method 5 with 202 backhalf particulate sampling runs; three Method 7E (NO_X) runs; three Method 10 (CO) runs; three Method 25A (VOC) and three Method 320 (FTIR) runs were performed on this source. The testing was performed at three different test conditions. PM_{10} and $PM_{2.5}$ Emission will have to be derived from the PM samples for this source. The testing was performed on April 2 and 3, 2024.

Coordinating the field tests:

Doug Ostrander - Comprehensive Emission Services, Inc. Evan Dankert - The Andersons Marathon Holdings LLC

Conducting the field tests:

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The appendices to this report contain the following information and data:

Appendix A:	Example Calculations
Appendix B:	Laboratory Data Forms
Appendix C:	Field Data Forms
Appendix D:	Pretest Calibrations
Appendix E:	Post-test Calibrations
Appendix F:	Process Data
Appendix G:	CEM Data
Appendix H:	Gas Protocols

Table 1 summarizes the test results for testing performed on the CHP Boiler and Turbine (Duct Burning Only). Three Method 5 with 202 backhalf particulate sampling runs; three Method 7E (NO_X) runs; three Method 10 (CO) runs; three Method 25A (VOC) and three Method 320 (FTIR) runs were performed on this source. PM_{10} and $PM_{2.5}$ Emission will have to be derived from the PM samples for this source.

The allowable limit for $PM_{2.5}$ and PM_{10} is 2.9 lb/hr. The allowable limit for Nitrogen Oxides (NO_x) is 35.0 lb/hr. The allowable limit for Nitrogen Oxides (NO_x) at 15% Oxygen (O₂) is 54 ppm. The allowable limit for Carbon Monoxide (CO) is 42.8 lb/hr. The allowable limit for Volatile Organic Compounds (VOC) as Methane is 3.2 lb/hr.

CHP Boller and Turbine (Duct Burning Only)					
	units	Run 1	Run 2	Run 3	
PM Net Weight	g	0.0050	0.0056	0.0040	
PM Emission	gr/dscf	0.0018	0.0019	0.0013	
PM Emission Rate	lb/hr	0.4663	0.5279	0.3763	
Actual	acfm	53,218	56,632	56,282	
Standard Conditions	scfm	36,887	39,152	38,957	
Dry Standard Conditions	dscfm	31,008	33,240	32,989	
Isokinetics	%	101.7	100.6	100.8	
Run Start Time	HH:MM	12:57	14:53	16:34	
Run Stop Time	HH:MM	13:59	16:00	17:36	
Date of Test	mm/dd/yr	04/02/24	04/02/24	04/02/24	
CO Emissions	ppm	5.2	2.5	1.0	
CO Emissions Rate	lb/hr	0.70	0.36	0.14	
NO _x Emissions	ppm	83.5	83.8	79.6	
NO _x Emission Rate @ 15% O ₂	. ppm	31.2	31.6	30.7	
NO _x Emission Rate	lb/hr	18.55	19.96	18.82	
VOC as Methane Emissions	ppm	0.28	-0.40	0.58	
VOC as Methane Emission Rate	lb/hr	0.02	-0.03	0.05	
Oxygen Emissions	%	5.1	5.3	5.6	
Flow Rate	dscfm	31,008	33,240	32,989	
Run Start Time	HH:MM	12:57	14:53	16:33	
Run Stop Time	HH:MM	13:58	15:55	17:36	
Date of Test	mm/dd/yr	04/02/24	04/02/24	04/02/24	

Table 1 Summary of Test Results CHP Boiler and Turbine (Duct Burning Only

Table 2 summarizes the test results for testing performed on the CHP Boiler and Turbine (Turbine Only). Three Method 5 with 202 backhalf particulate sampling runs; three Method 7E (NO_X) runs; three Method 10 (CO) runs; three Method 25A (VOC) and three Method 320 (FTIR) runs were performed on this source. PM_{10} and $PM_{2.5}$ Emission will have to be derived from the PM samples for this source.

The allowable limit for $PM_{2.5}$ and PM_{10} is 2.9 lb/hr.

The allowable limit for Nitrogen Oxides (NOx) is 14.0 lb/hr.

The allowable limit for Nitrogen Oxides (NOx) at 15% Oxygen (O₂) is 42 ppm.

The allowable limit for Carbon Monoxide (CO) is 42.8 lb/hr.

The allowable limit for Volatile Organic Compounds (VOC) as Methane is 3.2 lb/hr.

CIII Doner and Turbine (Turbine Only)					
	units	Run 1	Run 2	Run 3	
PM Net Weight	g	0.0031	0.0028	0.0031	
PM Emission	gr/dscf	0.0011	0.0010	0.0011	
PM Emission Rate	lb/hr	0.4714	0.4236	0.4688	
Actual	acfm	82,307	85,110	85,716	
Standard Conditions	scfm	52,802	54,966	55,310	
Dry Standard Conditions	dscfm	49,747	51,166	51,403	
Isokinetics	%	99.3	99.8	99.9	
Run Start Time	HH:MM	18:35	20:02	21:22	
Run Stop Time	HH:MM	19:37	21:04	22:24	
Date of Test	mm/dd/yr	04/02/24	04/02/24	04/02/24	
CO Emissions	ppm	1.3	1.3	1.3	
CO Emissions Rate	lb/hr	0.28	0.29	0.29	
NO _x Emissions	ppm	4.4	4.3	4.2	
NO _x Emission Rate @ 15% O ₂	ppm	4.6	4.5	4.4	
NO _x Emission Rate	lb/hr	1.56	1.59	1.54	
VOC as Methane Emissions	ppm	1.03	0.98	-0.06	
VOC as Methane Emission Rate	lb/hr	0.13	0.13	-0.01	
Oxygen Emissions	%	15.3	15.3	15.2	
Flow Rate	dscfm	49,747	51,166	51,403	
Run Start Time	HH:MM	18:33	20:03	21:22	
Run Stop Time	HH:MM	19:34	21:04	22:23	
Date of Test	mm/dd/yr	04/02/24	04/02/24	04/02/24	

Table 2Summary of Test ResultsCHP Boiler and Turbine (Turbine Only)

Table 3 summarizes the test results for testing performed on the CHP Boiler and Turbine (Turbine and Duct Burner). Three Method 5 with 202 backhalf particulate sampling runs; three Method 7E (NO_X) runs; three Method 10 (CO) runs; three Method 25A (VOC) and three Method 320 (FTIR) runs were performed on this source. PM_{10} and $PM_{2.5}$ Emission will have to be derived from the PM samples for this source.

The allowable limit for $PM_{2.5}$ and PM_{10} is 2.9 lb/hr. The allowable limit for Nitrogen Oxides (NO_x) is 14.0 lb/hr. The allowable limit for Nitrogen Oxides (NO_x) at 15% Oxygen (O₂) is 42 ppm. The allowable limit for Carbon Monoxide (CO) is 42.8 lb/hr. The allowable limit for Volatile Organic Compounds (VOC) as Methane is 3.2 lb/hr.

CHP Boiler and Turbine (Turbine and Duct Burner)					
	units	Run 1	Run 2	Run 3	
PM Net Weight	g	0.0043	0.0039	0.0051	
PM Emission	gr/dscf	0.0015	0.0014	0.0018	
PM Emission Rate	lb/hr	0.6535	0.5936	0.7801	
Actual	acfm	88,643	86,169	86,303	
Standard Conditions	scfm	58,640	57,003	57,104	
Dry Standard Conditions	dscfm	50,731	49,521	49,750	
Isokinetics	%	99.4	99.2	98.7	
Run Start Time	HH:MM	8:53	10:14	11:31	
Run Stop Time	HH:MM	9:57	11:16	12:33	
Date of Test	mm/dd/yr	04/03/24	04/03/24	04/03/24	
CO Emissions	ppm	6.9	6.5	6.6	
CO Emissions Rate	lb/hr	1.52	1.39	1.44	
NO _x Emissions	ppm	24.9	20.8	20.6	
NO _x Emission Rate @ 15% O ₂	ppm	11.1	9.2	9.2	
NO _x Emission Rate	lb/hr	9.03	7.38	7.36	
VOC as Methane Emissions	ppm	0.60	0.60	0.56	
VOC as Methane Emission Rate	lb/hr	0.08	0.07	0.07	
Oxygen Emissions	%	7.7	7.6	7.6	
Flow Rate	dscfm	50,731	49,521	49,750	
Run Start Time	HH:MM	8:53	10:15	11:33	
Run Stop Time	HH:MM	9:55	11:16	12:34	
Date of Test	mm/dd/yr	04/03/24	04/03/24	04/03/24	

Table 3 Summary of Test Results CHP Boiler and Turbine (Turbine and Duct Burner)

SAMPLING AND ANALYTICAL PROCEDURES

Sampling Procedures

Emissions were determined by U.S. Environmental Protection Agency (EPA) Methods 1, 2, 3, 4, 5, 202, 7E, 10, 25A and 320. These Methods are titled;

Method 1 - "Sample and Velocity Traverse for Stationary Sources"

- Method 2 "Determination of Stack Gas Velocity and Volumetric Flow Rate"
- Method 3 "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air and Dry Molecular Weight"
- Method 4 "Determination for Moisture Content in Stack Gases"
- Method 5 "Determination of Particulate Emission from Stationary Sources"
- Method 202 "Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"
- Method 7E "Determination of Nitrogen Oxides Emissions from Stationary Sources"
- Method 10 "Determination of Carbon Monoxide Emissions from Stationary Sources"

Method 25A - "Determination of total Gaseous Organic Concentration using a Flame Ionization Analyzer"

Method 320 - "Vapor Phase Organic & Inorganic Emissions by Extractive FTIR"

These methods appear in detail in Title 40, Code of Federal Regulations (CFR), Part 60, Appendix A.

The Sampling Apparatus is shown in Figure 1 on Page 8. All equipment was calibrated at Comprehensive Emission Services' office prior to shipment to the test site.

Sampling Locations

A total of 24 sample points were used to determine particulate emissions. The sample time per point was 2.5 minutes, for a total sampling time of 60 minutes per test run. The stack sampling point locations can be found along with the field data sheets in Appendix C.

Analytical Procedures

The emission rates were determined following procedures detailed in EPA Methods 5 and 202.



Schematic of Method 5 Sampling Train

Figure 1

Parameters	Units	Run 1	Run 2	Run 3
Particulate Emissions				
PM Weight Collected	g	0.0050	0.0056	0.0040
PM Actual	gr/dscf	0.0018	0.0019	0.0013
PM Emission Rate	lb/hr	0.4663	0.5279	0.3763
Stack Flow Rates				
Velocity	ft/min	3,346	3,561	3,539
Actual	acfm	53,218	56,632	56,282
Standard Conditions	scfm	36,887	39,152	38,957
Dry Standard Conditions	dscfm	31,008	33,240	32,989
Sampling Results				
Isokinetics	%	101.7	100.6	100.8
Sample Volume	dscf	43.977	46.642	46.381
Ave. Stack Temperature	°F	270	272	271
Ave. ΔP	inches H ₂ O	0.6663	0.7579	0.7446
Ave. Square Root ΔP	inches H ₂ O	0.8113	0.8637	0.8580
Ave. ΔH	inches H ₂ O	1.89	2.16	2.15
Ave. Meter Temperature	°F	78.5	80.7	83.1
Oxygen	%	5.10	5.30	5.60
Carbon Dioxide	%	9.00	8.90	8.60
Moisture Collected	ml	176.0	175.0	177.0
Moisture	% H ₂ O	15.94	15.10	15.32
Sampling Time	minutes	60	60	60
Run Start Time	HH:MM	12:57	14:53	16:34
Run Stop Time	HH:MM	13:59	16:00	17:36
Date of Test	mm/dd/yr	04/02/24	04/02/24	04/02/24

Table 4Particulate Emission ResultsCHP Boiler and Turbine (Duct Burning Only)

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Parameters	Units	Run 1	Run 2	Run 3	
Particulate Emissions					
PM Weight Collected	g	0.0031	0.0028	0.0031	
PM Actual	gr/dscf	0.0011	0.0010	0.0011	
PM Emission Rate	lb/hr	0.4714	0.4236	0.4688	
Stack Flow Rates					
Velocity	ft/min	5,175	5,351	5,389	
Actual	acfm	82,307	85,110	85,716	
Standard Conditions	scfm	52,802	54,966	55,310	
Dry Standard Conditions	dscfm	49,747	51,166	51,403	
Sampling Results					
Isokinetics	%	99.3	99.8	99.9	
Sample Volume	dscf	43.273	44.735	44.965	
Ave. Stack Temperature	°F	327	322	323	
Ave. ΔP	inches H ₂ O	1.5125	1.6125	1.6333	
Ave. Square Root ΔP	inches H ₂ O	1.2225	1.2655	1.2732	
Ave. ΔH	inches H ₂ O	1.80	1.93	1.97	
Ave. Meter Temperature	°F	79.8	82.7	83.1	
Oxygen	%	15.30	15.30	15.20	
Carbon Dioxide	%	3.30	3.30	3.20	
Moisture Collected	ml	56.0	70.0	72.0	
Moisture	% H ₂ O	5.79	6.91	7.06	
Sampling Time	minutes	60	60	60	
Run Start Time	HH:MM	18:35	20:02	21:22	
Run Stop Time	HH:MM	19:37	21:04	22:24	
Date of Test	mm/dd/yr	04/02/24	04/02/24	04/02/24	

Table 5Particulate Emission ResultsCHP Boiler and Turbine (Turbine Only)

Parameters	Units	Run 1	Run 2	Run 3
Particulate Emissions				
PM Weight Collected	g	0.0043	0.0039	0.0051
PM Actual	gr/dscf	0.0015	0.0014	0.0018
PM Emission Rate	lb/hr	0.6535	0.5936	0.7801
Stack Flow Rates				
Velocity	ft/min	5,574	5,418	5,426
Actual	acfm	88,643	86,169	86,303
Standard Conditions	scfm	58,640	57,003	57,104
Dry Standard Conditions	dscfm	50,731	49,521	49,750
Sampling Results				
Isokinetics	%	99.4	99.2	98.7
Sample Volume	dscf	44.154	43.036	43.022
Ave. Stack Temperature	°F	293	293	292
Ave. ΔP	inches H ₂ O	1.7775	1.6792	1.6875
Ave. Square Root ΔP	inches H ₂ O	1.3242	1.2884	1.2909
Ave. ΔH	inches H ₂ O	1.90	1.85	1.85
Ave. Meter Temperature	°F	74.1	81.5	82.3
Oxygen	%	7.70	7.60	7.60
Carbon Dioxide	%	7.50	7.60	7.50
Moisture Collected	ml	145.0	137.0	134.0
Moisture	% H ₂ O	13.49	13.13	12.88
Sampling Time	minutes	60	60	60
Run Start Time	HH:MM	8:53	10:14	11:31
Run Stop Time	HH:MM	9:57	11:16	12:33
Date of Test	mm/dd/yr	04/03/24	04/03/24	04/03/24

Table 6Particulate Emission ResultsCHP Boiler and Turbine (Turbine and Duct Burner)