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# Compliance Emission Sampling

Performed for...

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DEC 29 2016

**Great Lakes Castings LLC** AIR QUALITY DIV.

Ludington, Michigan

On the...

## Cupola Scrubber Exhaust

November 9 – 10, 2016

Project#: 013.29

Network Environmental, Inc.  
Grand Rapids, MI



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY  
AIR QUALITY DIVISION

### RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

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Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Great Lakes Castings LLC County Mason  
Source Address 800 N. Washington Avenue City Ludington  
AQD Source ID (GRN) A3934 ROP No. 199700044 ROP Section No. \_\_\_\_\_

Please check the appropriate box(es):

**Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From \_\_\_\_\_ To \_\_\_\_\_

1. During the entire reporting period, this source was in compliance with ALL terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, EXCEPT for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

**Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From \_\_\_\_\_ To \_\_\_\_\_

1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, EXCEPT for the deviations identified on the enclosed deviation report(s).

**Other Report Certification**

Reporting period (provide inclusive dates): From 07/01/16 To 12/31/16

Additional monitoring reports or other applicable documents required by the ROP are attached as described:  
ROP Stack Testing Results

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Robert E. Killips President & CEO 231-843-2501  
Name of Responsible Official (print or type) Title Phone Number  
Robert E. Killips Signature of Responsible Official 12/21/16 Date

## **I. INTRODUCTION**

Network Environmental, Inc. was retained by Great Lakes Castings LLC of Ludington, Michigan, to conduct an emission study at their facility. The purpose of the study was to meet the cupola ROP emission testing requirements of Renewable Operating Permit (ROP) No. MI-ROP-A3934-2015.

The following is a list of the applicable emission limits for the cupola:

Emission Limit(s)
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**Particulate:** 0.25 Lbs/1000 Lbs on a Dry Basis, 28.0 Lbs/Hr, 50.8 Tons/Year & 1.4 Lbs/Ton of Metal Charged

**PM-10:** 21.6 Lbs/Hr, 39.2 Tons/Year & 1.08 Lbs /Ton of Metal Charged

**SO<sub>2</sub>:** 30.0 Lbs/Hr, 54.4 Tons/Year & 1.5 Lbs/Ton of Metal Charged

**CO:** 225.0 Lbs/Hr, 408.0 Tons/Year & 11.25 Lbs/Ton of Metal Charged

**VOC:** 8.4 Lbs/Hr, 13.6 Tons/Year & 0.42 Lbs/Ton of Metal Charged

**Pb:** 0.4 Lbs/Hr, 0.76 Tons/Year & 0.02 Lbs/Ton of Metal Charged

**As:** 0.0036 Lbs/Hr

**Mn:** 0.87 Lbs/Hr

The following is a list of the parameters (compounds) sampled and the test methods used for the sampling:

- Particulate w/ Back Half Condensables – U.S. EPA Methods 17 & 202 (Front Half Filterable to be used to document compliance with the Particulate emission limits; Front Half Filterable and Back Half Condensables to be used to document compliance with the PM-10 emission limits)
- Sulfur Dioxide (SO<sub>2</sub>) – U.S. EPA Method 6C
- Carbon Monoxide (CO) – U.S. EPA Method 10
- Total Hydrocarbons (VOC) – U.S. EPA Method 25A

The Lead (Pb), Arsenic (As) and Manganese (Mn) emissions were determined in November 2015 as part of the Area Source Standard (40 CFR Part 63 Subpart ZZZZZ) compliance sampling. The November 2015

results for these compounds demonstrated compliance with MI-ROP-A3934-2015. Sampling for Pb, As & Mn was not required at this time.

The sampling was performed over the period of November 9-10, 2016 by R. Scott Cargill, Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting with the study were Mr. Bob Ellis of Great Lakes Castings LLC and the operating staff of the facility. Mr. Jeremy Howe and Ms. Caryn Owens of the Michigan Department of Environmental Quality (MDEQ) – Air Quality Division were present to observe the sampling and source operation.

**II. PRESENTATION OF RESULTS**

**II.1 TABLE 1  
TOTAL PARTICULATE (PM-10) EMISSION RESULTS <sup>(1)</sup>  
CUPOLA SCRUBBER EXHAUST  
GREAT LAKES CASTINGS LLC  
LUDINGTON, MICHIGAN**

Sample	Date	Time	Air Flow Rate DSCFM <sup>(2)</sup>	Concentration Lbs/1000 Lbs, Dry <sup>(3)</sup>	Total Particulate Mass Emission Rates		
					Lbs/Hr <sup>(4)</sup>	Lbs/Ton of Charge <sup>(5)</sup>	Tons/Year <sup>(6)</sup>
1	11/9/16	09:29-10:36	15,970	0.177	13.23	0.846	30.71
2	11/9/16	11:10-12:18	16,480	0.187	14.37	1.082	39.28
3	11/10/16	08:38-09:45	15,869	0.204	15.06	1.029	37.35
<b>Average</b>			<b>16,106</b>	<b>0.190</b>	<b>14.22</b>	<b>0.986</b>	<b>35.78</b>

- (1) Total Particulate (PM-10) Emissions (Including Back Half Condensables)
- (2) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 Inches Hg)
- (3) Lbs/1000 Lbs, Dry = Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On A Dry Basis
- (4) Lbs/Hr = Pounds Of Particulate Per Hour
- (5) Lbs/Ton of Charge = Pounds Of Particulate Per Ton of Metal Charged. Calculated using charge rates of 15.63 Tons/Hr for Sample 1, 13.28 Tons/Hr for Sample 2 and 14.64 Tons/Hr for Sample 3. Charge Rates were supplied by Great Lakes Castings LLC.
- (6) Tons/Year = Tons Per Year calculated using the maximum rate of 72,600 tons of metal charged per year (6,050 tons per month as established in MI-ROP-A3934-2015).

**II.2 TABLE 2  
 FILTERABLE PARTICULATE EMISSION RESULTS <sup>(1)</sup>  
 CUPOLA SCRUBBER EXHAUST  
 GREAT LAKES CASTINGS LLC  
 LUDINGTON, MICHIGAN**

Sample	Date	Time	Air Flow Rate DSCFM <sup>(2)</sup>	Concentration Lbs/1000 Lbs, Dry <sup>(3)</sup>	Filterable Particulate Mass Emission Rates		
					Lbs/Hr <sup>(4)</sup>	Lbs/Ton of Charge <sup>(5)</sup>	Tons/Year <sup>(6)</sup>
1	11/9/16	09:29-10:36	15,970	0.167	12.42	0.795	28.86
2	11/9/16	11:10-12:18	16,480	0.178	13.67	1.029	37.35
3	11/10/16	08:38-09:45	15,869	0.193	14.18	0.969	35.17
<b>Average</b>			<b>16,106</b>	<b>0.179</b>	<b>13.43</b>	<b>0.931</b>	<b>33.79</b>

- (1) Filterable (Front Half) Particulate
- (2) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 Inches Hg)
- (3) Lbs/1000 Lbs, Dry = Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On A Dry Basis
- (4) Lbs/Hr = Pounds Of Particulate Per Hour
- (5) Lbs/Ton of Charge = Pounds Of Particulate Per Ton of Metal Charged. Calculated using charge rates of 15.63 Tons/Hr for Sample 1, 13.28 Tons/Hr for Sample 2 and 14.64 Tons/Hr for Sample 3. Charge Rates were supplied by Great Lakes Castings LLC.
- (6) Tons/Year = Tons Per Year calculated using the maximum rate of 72,600 tons of metal charged per year (6,050 tons per month as established in MI-ROP-A3934-2015).

**II.3 TABLE 3  
SULFUR DIOXIDE (SO<sub>2</sub>) EMISSION RESULTS  
CUPOLA SCRUBBER EXHAUST  
GREAT LAKES CASTINGS LLC  
LUDINGTON, MICHIGAN**

Sample	Date	Time	Air Flow Rate DSCFM <sup>(1)</sup>	Concentration PPM <sup>(2)</sup>	SO <sub>2</sub> Mass Emission Rates		
					Lbs/Hr <sup>(3)</sup>	Lbs/Ton of Charge <sup>(4)</sup>	Tons/Year <sup>(5)</sup>
1	11/9/16	09:31-10:38	15,970	0.5	0.079	0.0051	0.185
2	11/9/16	11:11-12:19	16,480	0.8	0.131	0.0099	0.359
3	11/10/16	08:39-09:46	15,869	2.3	0.363	0.0248	0.900
<b>Average</b>			<b>16,106</b>	<b>1.2</b>	<b>0.191</b>	<b>0.0133</b>	<b>0.481</b>

- (1) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 Inches Hg)
- (2) PPM = Parts Per Million (v/v) On A Dry Basis
- (3) Lbs/Hr = Pounds Of SO<sub>2</sub> Per Hour
- (4) Lbs/Ton of Charge = Pounds Of SO<sub>2</sub> Per Ton of Metal Charged. Calculated using charge rates of 15.63 Tons/Hr for Sample 1, 13.28 Tons/Hr for Sample 2 and 14.64 Tons/Hr for Sample 3. Charge Rates were supplied by Great Lakes Castings LLC.
- (5) Tons/Year = Tons Per Year calculated using the maximum rate of 72,600 tons of metal charged per year (6,050 tons per month as established in MI-ROP-A3934-2015).

**II.4 TABLE 4  
CARBON MONOXIDE (CO) EMISSION RESULTS  
CUPOLA SCRUBBER EXHAUST  
GREAT LAKES CASTINGS LLC  
LUDINGTON, MICHIGAN**

Sample	Date	Time	Air Flow Rate DSCFM <sup>(1)</sup>	Concentration PPM <sup>(2)</sup>	CO Mass Emission Rates		
					Lbs/Hr <sup>(3)</sup>	Lbs/Ton of Charge <sup>(4)</sup>	Tons/Year <sup>(5)</sup>
1	11/9/16	09:31-10:38	15,970	1,758.1	122.08	7.81	283.50
2	11/9/16	11:11-12:19	16,480	1,061.9	76.09	5.73	208.00
3	11/10/16	08:39-09:46	15,869	1,142.0	78.80	5.38	195.29
<b>Average</b>			<b>16,106</b>	<b>1,320.7</b>	<b>92.32</b>	<b>6.31</b>	<b>228.93</b>

- (1) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 Inches Hg)  
(2) PPM = Parts Per Million (v/v) On A Dry Basis  
(3) Lbs/Hr = Pounds Of CO Per Hour  
(4) Lbs/Ton of Charge = Pounds Of CO Per Ton of Metal Charged. Calculated using charge rates of 15.63 Tons/Hr for Sample 1, 13.28 Tons/Hr for Sample 2 and 14.64 Tons/Hr for Sample 3. Charge Rates were supplied by Great Lakes Castings LLC.  
(5) Tons/Year = Tons Per Year calculated using the maximum rate of 72,600 tons of metal charged per year (6,050 tons per month as established in MI-ROP-A3934-2015).

**II.5 TABLE 5  
TOTAL HYDROCARBON (VOC) EMISSION RESULTS  
CUPOLA SCRUBBER EXHAUST  
GREAT LAKES CASTINGS LLC  
LUDINGTON, MICHIGAN**

Sample	Date	Time	Air Flow Rate SCFM <sup>(1)</sup>	Concentration PPM <sup>(2)</sup>	VOC Mass Emission Rates		
					Lbs/Hr <sup>(3)</sup>	Lbs/Ton of Charge <sup>(4)</sup>	Tons/Year <sup>(5)</sup>
1	11/9/16	09:31-10:38	20,013	2.7	0.37	0.024	0.871
2	11/9/16	11:11-12:19	21,105	1.7	0.25	0.019	0.690
3	11/10/16	08:39-09:46	19,688	2.6	0.35	0.024	0.871
<b>Average</b>			<b>20,269</b>	<b>2.3</b>	<b>0.32</b>	<b>0.022</b>	<b>0.811</b>

- (1) SCFM = Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 Inches Hg)  
(2) PPM = Parts Per Million (v/v) On An Actual (Wet) Basis As Propane  
(3) Lbs/Hr = Pounds Of VOC Per Hour As Propane  
(4) Lbs/Ton of Charge = Pounds Of VOC Per Ton of Metal Charged. Calculated using charge rates of 15.63 Tons/Hr for Sample 1, 13.28 Tons/Hr for Sample 2 and 14.64 Tons/Hr for Sample 3. Charge Rates were supplied by Great Lakes Castings LLC.  
(5) Tons/Year = Tons Per Year calculated using the maximum rate of 72,600 tons of metal charged per year (6,050 tons per month as established in MI-ROP-A3934-2015).

### **III. DISCUSSION OF RESULTS**

The results of the emission sampling are summarized in Tables 1 through 5 (Sections II.1 through II.5). The results are presented as follows:

#### **III.1 Total Particulate (PM-10) Emission Results (Table 1)**

Table 1 summarizes the total particulate (front half filterable and back half condensable) emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Particulate Concentration (Lbs/1000 Lbs, Dry) – Pounds of Particulate per Thousand Pounds of Exhaust Gas On A Dry Basis
- Mass Emission Rates In Terms Of:
  - ◊ Lbs/Hr – Pounds Per Hour
  - ◊ Lbs/Ton of Charge – Pounds Per Ton Of Metal Charged
  - ◊ Tons/Year – Tons Per Year

The charging rates used to calculate Lbs/Ton of Charge were supplied by Great Lakes Castings LLC. The Tons/Year results were calculated using the maximum rate of 72,600 tons of metal charge per year (6,050 tons per month), as established in MI-ROP-A3934-2015.

A more detailed breakdown of each individual particulate sample can be found in Appendix A.

#### **III.2 Filterable Particulate Emission Results (Table 2)**

Table 2 summarizes the filterable (front half) particulate emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Particulate Concentration (Lbs/1000 Lbs, Dry) – Pounds of Particulate per Thousand Pounds of Exhaust Gas On A Dry Basis
- Mass Emission Rates In Terms Of:

- ◇ Lbs/Hr – Pounds Per Hour
- ◇ Lbs/Ton of Charge – Pounds Per Ton Of Metal Charged
- ◇ Tons/Year – Tons Per Year

The charging rates used to calculate Lbs/Ton of Charge were supplied by Great Lakes Castings LLC. The Tons/Year results were calculated using the maximum rate of 72,600 tons of metal charge per year (6,050 tons per month), as established in MI-ROP-A3934-2015.

A more detailed breakdown of each individual particulate sample can be found in Appendix A.

### **III.3 Sulfur Dioxide (SO<sub>2</sub>) Emission Results (Table 3)**

Table 3 summarizes the SO<sub>2</sub> emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- Mass Emission Rates In Terms Of:
  - ◇ Lbs/Hr – Pounds Per Hour
  - ◇ Lbs/Ton of Charge – Pounds Per Ton Of Metal Charged
  - ◇ Tons/Year – Tons Per Year

All reference method PPM data was calibration corrected using U.S. EPA Equation 7E-5. The charging rates used to calculate Lbs/Ton of Charge were supplied by Great Lakes Castings LLC. The Tons/Year results were calculated using the maximum rate of 72,600 tons of metal charge per year (6,050 tons per month), as established in MI-ROP-A3934-2015.

### **III.4 Carbon Monoxide (CO) Emission Results (Table 4)**

Table 4 summarizes the CO emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)

- Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- Mass Emission Rates In Terms Of:
  - ◊ Lbs/Hr – Pounds Per Hour
  - ◊ Lbs/Ton of Charge – Pounds Per Ton Of Metal Charged
  - ◊ Tons/Year – Tons Per Year

All reference method PPM data was calibration corrected using U.S. EPA Equation 7E-5. The charging rates used to calculate Lbs/Ton of Charge were supplied by Great Lakes Castings LLC. The Tons/Year results were calculated using the maximum rate of 72,600 tons of metal charge per year (6,050 tons per month), as established in MI-ROP-A3934-2015.

### **III.5 Total Hydrocarbon (VOC) Emission Results (Table 5)**

Table 5 summarizes the VOC emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Concentration (PPM) – Parts Per Million (v/v) On A Wet (Actual) Basis As Propane
- Mass Emission Rates In Terms Of:
  - ◊ Lbs/Hr – Pounds Per Hour As Propane
  - ◊ Lbs/Ton of Charge – Pounds Per Ton Of Metal Charged
  - ◊ Tons/Year – Tons Per Year

All reference method PPM data was calibration corrected using U.S. EPA Equation 7E-5. The charging rates used to calculate Lbs/Ton of Charge were supplied by Great Lakes Castings LLC. The Tons/Year results were calculated using the maximum rate of 72,600 tons of metal charge per year (6,050 tons per month), as established in MI-ROP-A3934-2015.

## **IV. SOURCE DESCRIPTION**

The source sampled is the exhaust of the cupola. The exhaust gases from the cupola pass through a afterburner, quencher and then a wet scrubber system (venturi scrubber & demister) before being emitted to atmosphere. Process operation information during the testing can be found in Appendix G.

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**V. SAMPLING AND ANALYTICAL PROTOCOL**

A schematic diagram of the sampling location can be found in Appendix F. The sampling location was on the 45 inch I.D. exhaust stack at a location approximately 8 duct diameters downstream and 9 duct diameters upstream from the nearest disturbances. A total of 12 sample points were used for the sample traversing (6 points per port). The sample point dimensions were as follows:

<u>Sample Point</u>	<u>Dimension (Inches)</u>
1	1.98
2	6.57
3	13.32
4	31.68
5	38.43
6	43.02

**V.1 Particulate Including Back Half Condensables** – The Particulate (including back half condensable) emission sampling was conducted in accordance with U.S. EPA Methods 17 and 202. Method 17 is an in-stack filtration method. Three (3) samples were collected from the exhaust. Each sample was sixty (60) minutes in duration and had a minimum sample volume of thirty (30) dry standard cubic feet. The samples were collected isokinetically and analyzed for Particulate by gravimetric analysis.

In addition to the standard front half analysis, the back half condensable particulate matter was determined in accordance with U.S. EPA Method 202 (Dry Impinger Technique). A sixty (60) minute nitrogen purge (as specified in Method 202) was conducted for the back half condensables immediately following each sample. The back half samples were extracted and analyzed for condensable particulate in accordance with Method 202. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. Figure 1 is a diagram of the particulate sampling train.

**V.2 Sulfur Dioxide (SO<sub>2</sub>)** – The Sulfur Dioxide (SO<sub>2</sub>) emission sampling was conducted in accordance with U.S. EPA Reference Method 6C. The sample gas was extracted from the source through a heated teflon sample line which led to a VIA MAK 2 sample gas conditioner and then to a Bovar Model 721M portable stack gas monitor. This analyzer is capable of giving instantaneous readouts of the SO<sub>2</sub>

concentrations (PPM).

Three (3) samples were collected from the exhaust. Each sample was sixty (60) minutes in duration. The analyzer was calibrated with EPA protocol SO<sub>2</sub> calibration gases. A span gas of 97.1 PPM was used to establish the initial instrument calibration. Calibration gases of 50.3 PPM and 25.5 PPM were used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 25.5 PPM gas to determine the system bias. After each sample, a system zero and system injection of 25.5 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ. 7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the SO<sub>2</sub> sampling train is shown in Figure 2.

**V.3 Carbon Monoxide (CO)** – The Carbon Monoxide (CO) emission sampling was conducted in accordance with U.S. EPA Reference Method 10. The sample gas was extracted from the source through a heated teflon sample line which led to a VIA MAK 2 sample gas conditioner and then to a Thermo Environmental Model 48C portable stack gas monitor. This analyzer is capable of giving instantaneous readouts of the CO concentrations (PPM).

Three (3) samples were collected from the exhaust. Each sample was sixty (60) minutes in duration. The analyzer was calibrated with EPA protocol CO calibration gases. A span gas of 4,509 PPM was used to establish the initial instrument calibration. Calibration gases of 2,215 PPM, 985.3PPM, 492.5 PPM and 249.4 PPM were used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 985.3 PPM gas to determine the system bias. After each sample, a system zero and system injection of 985.3 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ. 7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the CO sampling train is shown in Figure 2.

**V.4 Total Hydrocarbons (VOC)** – The VOC sampling was conducted in accordance with U.S. EPA Reference Method 25A. A J.U.M. Model 3-500 flame ionization detector (FID) analyzer was used to monitor the source sampled. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to the analyzer. The analyzer produces instantaneous readouts of the VOC concentrations (PPM).

The analyzer was calibrated by system injection (from the back of the stack probe to the analyzer) prior to the testing. A span gas of 96.49 PPM Propane was used to establish the initial instrument calibration. Calibration gases of 29.17 PPM & 50.19 PPM Propane were used to determine the calibration error of the analyzer. After each sample, a system zero and system injection of 29.17 PPM Propane were performed to establish system drift and system bias during the test period. All calibration gases used were EPA Protocol Calibration Gases. Three (3) samples were collected from the source. Each sample was sixty (60) minutes in duration.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. Figure 3 is a diagram of the VOC sampling train.

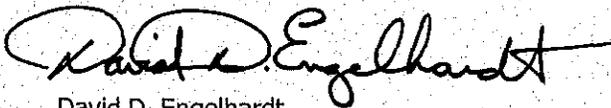
**V.5 Oxygen & Carbon Dioxide** – The O<sub>2</sub> & CO<sub>2</sub> sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the exhaust. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzers produce instantaneous readouts of the O<sub>2</sub> & CO<sub>2</sub> concentrations (%).

Three (3) samples were collected from the exhaust. Each sample was sixty (60) minutes in duration. The analyzers were calibrated by direct injection prior to the testing. Span gases of 20.96% O<sub>2</sub> and 20.1% CO<sub>2</sub> were used to establish the initial instrument calibrations. Calibration gases of 12.1% O<sub>2</sub>/5.97% CO<sub>2</sub> and 5.96% O<sub>2</sub>/12.1% CO<sub>2</sub> were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzers) was injected using the 12.1% O<sub>2</sub>/5.97% CO<sub>2</sub> gas to determine the system bias. After each sample, a system zero and system injection of 12.1% O<sub>2</sub>/5.97% CO<sub>2</sub> 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. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 2.

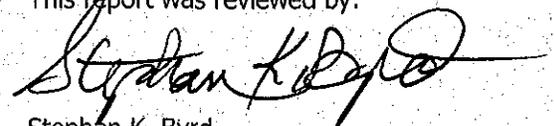
**V.6 Exhaust Gas Parameters** – The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined in conjunction with the other sampling by employing U.S. EPA Methods 1 through 4. Air flow rates, temperatures and moistures were determined using the Method 17/202 sampling trains. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

This report was prepared by:

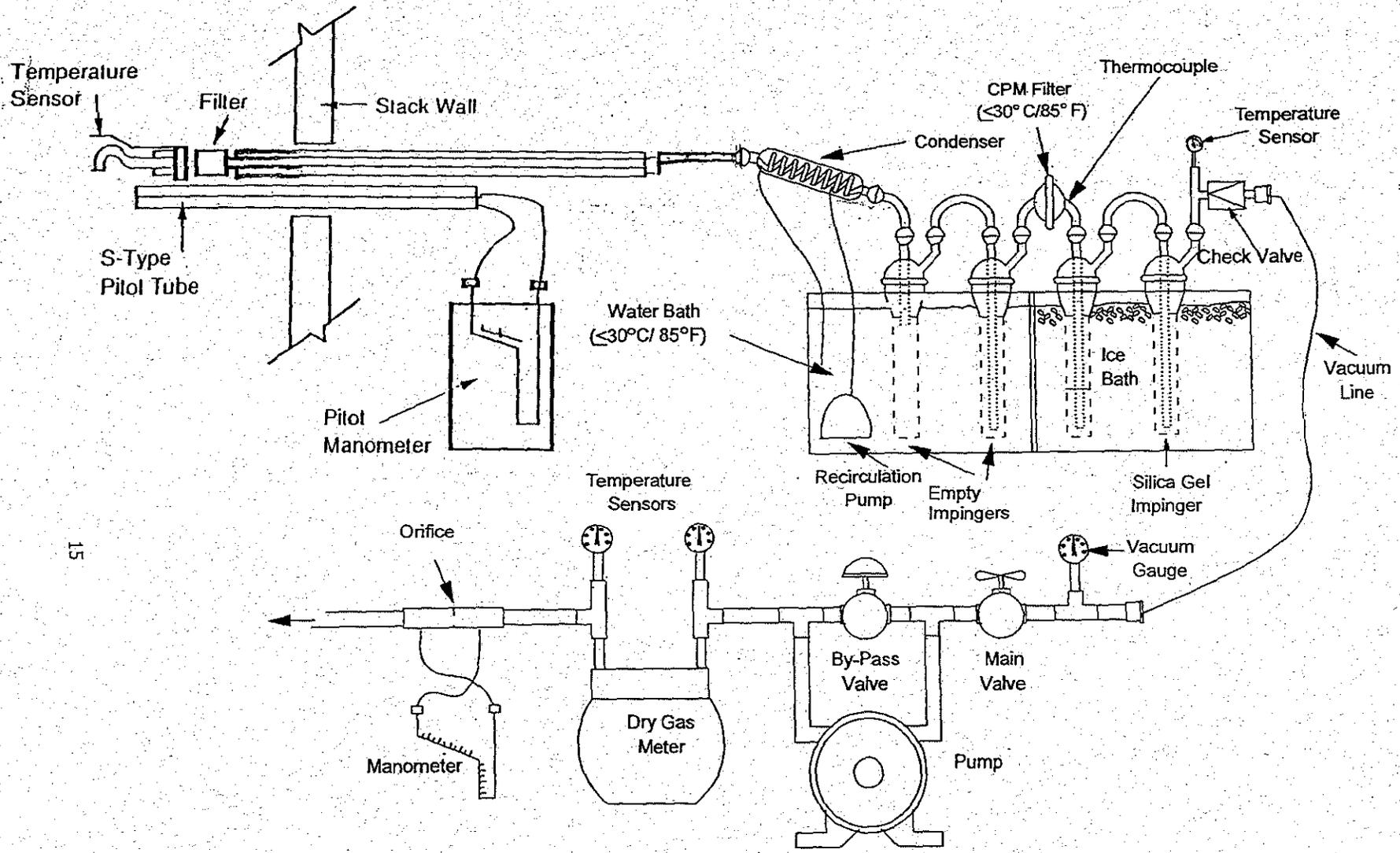


David D. Engelhardt  
Vice President

This report was reviewed by:



Stephan K. Byrd  
President



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**Figure 1**  
**Particulate Sampling Train**

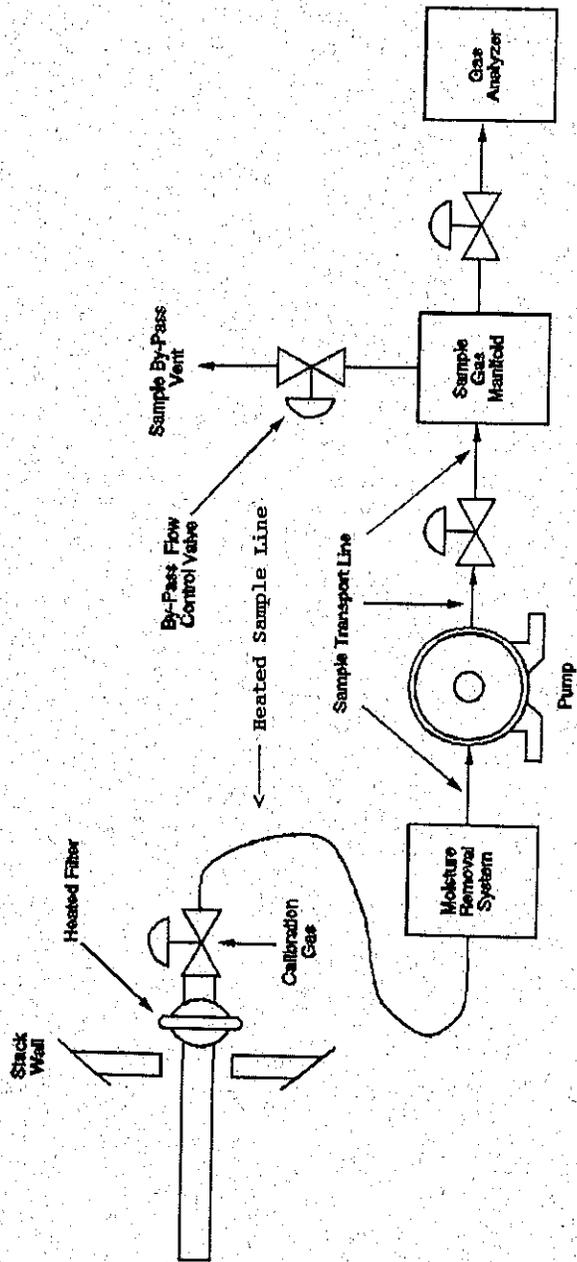


Figure 2

SO<sub>2</sub>, CO, O<sub>2</sub> & CO<sub>2</sub> Sampling Train

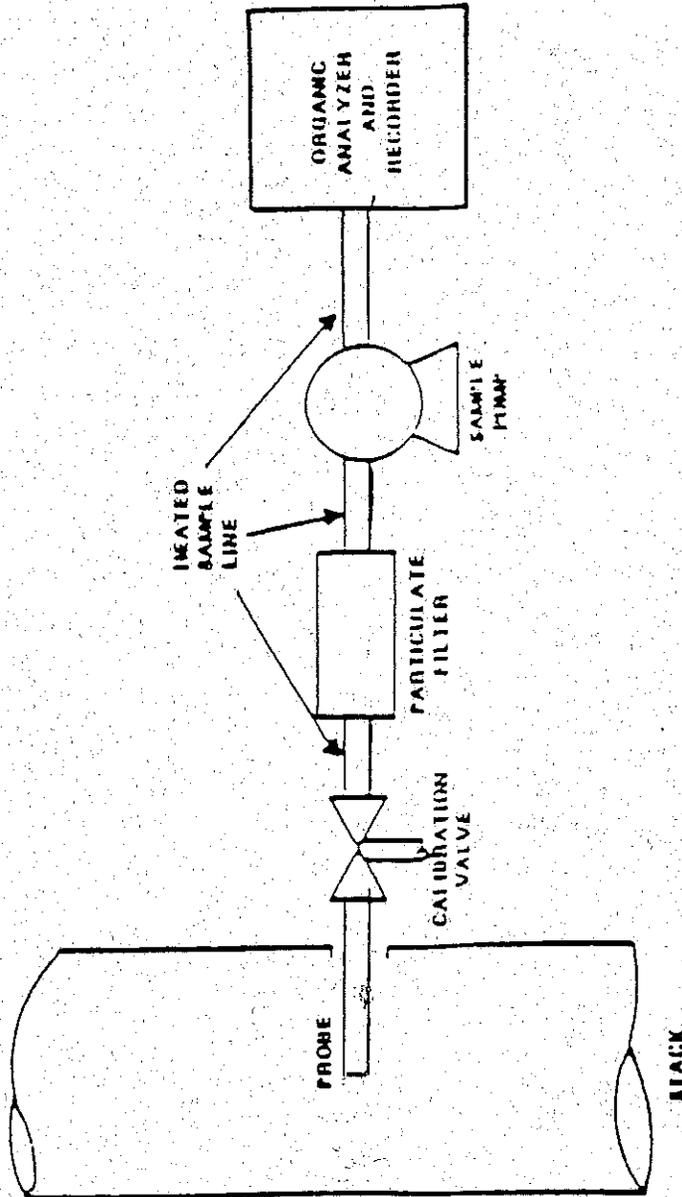


Figure 3  
VOC Sampling Train