



Carbon Monoxide Emissions Test Report

Prepared for:

Packaging Corporation of America

Packaging Corporation of America
2246 Udell Street
Filer City, Michigan 49634

Project No. 14-4522.01
April 30, 2014

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MAY 15 2014

EXECUTIVE SUMMARY

AIR QUALITY DIV.

BT Environmental Consulting, Inc. (BTEC) was retained by Packaging Corporation of America (PCA) to evaluate carbon monoxide (CO) emission rates from Boiler No. 4A while operating at maximum routine load conditions at the PCA facility located in Filer City, Michigan. The emissions test program was conducted on April 1, 2014.

Testing of the boiler consisted of triplicate 60-minute test runs. The emissions test program was required by MDEQ Air Quality Division Renewable Operating Permit (ROP) No. MI-ROP-B3692-2009. The results of the emission test program are summarized by Table I.

Table I
Boiler 4 Overall Emission Summary
Test Date: April 1, 2014

Boiler 4 (EUBOILER4A)			
Compound	Concentration	Emission Rate	Permit Limit
Carbon Monoxide	42.7 ppmv	5.2 lb/hr	22.7 lb/hr

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Appendix B	Equipment Calibration and Span Gas Documents
Appendix C	Example Calculations
Appendix D	Raw CEM Data
Appendix E	Process Data



1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Packaging Corporation of America (PCA) to evaluate carbon monoxide (CO) emission rates from Boiler No. 4A while operating at maximum routine load conditions at the PCA facility located in Filer City, Michigan. The emissions test program was conducted on April 1, 2014. The purpose of this report is to document the results of the test program.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on April 1, 2014 at the PCA facility located in Filer City, Michigan. The test program included evaluation of CO emissions rates from Boiler No. 4A.

1.b Purpose of Testing

AQD issued Renewable Operating Permit No. MI-ROP-B3692-2009 to PCA on October 27, 2009. This permit limits emissions from the boiler as summarized by Table 1.

Table 1
CO Emission Limitations
Packaging Corporation of America

Facility	Permit No.	CO Emission Limit
Packaging Corporation of America	MI-ROP-B3692-2009	22.7 lbs/hr

1.c Source Description

PCA operates a Babcock & Wilcox boiler unit, designated as EUBOILER4A, to provide steam for various mill processes and for use in electrical generation while burning natural gas or biogas. EUBOILER4A is rated at 227 MMBtu/hr and is equipped with low-NO_x burners. The maximum steam load for the boiler is 150,000 pounds of steam. The boiler was operated at a steam load of 109 Klb/hr for test run one and a steam load of 125 Klb/hr for tests two and three or 83% of designed load capacity.



1.d Test Program Contacts

The contact for the source and test report is:

Ms. Sara Kaltunas
Environmental Manager
Packaging Corporation of America
2246 Udell St
Filer City, Michigan 49634
(231) 723-9951

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Ms. Sara Kaltunas Environmental Manager	PCA 2246 Udell St Filer City, Michigan 49634	(231) 723-9951
Mr. Jeremy Howe Environmental Quality Analyst	MDEQ Cadillac Distric Office 120 West Chapin Street Cadillac, Michigan 49601	(231)-876-4416
Mr. Todd Wessel Sr. Project Manager	BT Environmental Consulting Inc. 4949 Fernlee Ave Royal Oak, Michigan 48073	(616) 885-4013
Mr. Paul Draper Environmental Technician	BT Environmental Consulting Inc. 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8070

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

Process data monitored during the emissions test program included natural gas combusted, and steam produced. The boiler was operated at steam load of 109 Klb/hr for test run one and a steam load of 125 Klb/hr for tests two and three.

A copy of the steam load and natural gas flow can be found in Appendix E of this report.



2.b Applicable Permit

The applicable permit for this emissions test program is Renewable Operating Permit (ROP) No. MI-ROP-B3692-2009.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). CO emissions from the boiler were below the corresponding limit of 22.7 lbs/hr.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

See section 1c.

3.b Process Flow Diagram

Due to the simplicity of the boiler, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The raw material used by the process is natural gas. Boiler natural gas firing rates recorded during the emissions test program are summarized by the process field data sheets included in Appendix E.

3.d Process Capacity

The boiler is rated at 227 MMBtu/hr and the maximum steam load for the boiler is 150,000 pounds of steam.

3.e Process Instrumentation

Process data monitored during the emissions test program included natural gas usage and steam produced.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at 40 CFR 60, Appendix A:

- Method 1 - *“Location of the Sampling Site and Sampling Points”*
- Method 2 - *“Determination of Stack Gas Velocity and Volumetric Flow rate”*
- Method 3A - *“Determination of Oxygen and Carbon Dioxide Emissions from Stationary Sources”*
- Method 4 - *“Determination of Moisture Content in Stack Gases”*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. An S-type pitot tube with a thermocouple assembly, calibrated in accordance with Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

Molecular weight was determined according to USEPA Method 3A, “Determination of Oxygen and Carbon Dioxide Emissions from Stationary Sources”.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the moisture sampling train (see figure 3 for a schematic of the sampling train) and passed through (i) two impingers with 100 ml of water, (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content is then determined gravimetrically.

The CO content of the exhaust gas was evaluated according to procedures outlined in 40 CFR 60, Appendix A, Method 10. The CO content of the gas stream was measured using a TECO 48 CO gas analyzer (see Figure 2 for a schematic of the sampling train). The gas stream was drawn through a stainless-steel probe with a heated in-line filter to remove any particulate, a heated Teflon[®] sample line, through a refrigerated sample conditioner with a peristaltic pump to remove the moisture from the sample before it entered the analyzer.

Data was recorded on a PC equipped with Labview[®] II data acquisition software. Recorded CO concentrations were averaged and reported for the duration of each 60-minute test (as drift corrected per Method 7E). The analyzer was calibrated for a range of 0 to 200 ppm.

In accordance with Method 10, a 3-point (zero, mid, and high) calibration check was performed on the CO analyzer. Calibration drift checks were performed at the completion

of each run. Calibration gases were mixed to desired concentrations using an Enviro-nics Series 4040 Computerized Gas Dilution System. For analyzer calibrations, calibration gases were mixed to desired concentrations using an Enviro-nics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United State's National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A schematic of the sampling train is provided as Figure 2.

4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figure 1.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 1.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 3. Detailed results for the emissions test program are summarized by Table 4.

**Table 3
Boiler 4A Overall Emission Summary
Test Date: April 1, 2014**

Boiler 4A (EUBOILER4A)			
Run #	Pollutant	Average Emission Rate	Emission Limit
1	CO	8.3 lb/hr	22.7 lb/hr
2	CO	2.1 lb/hr	22.7 lb/hr
3	CO	5.2 lb/hr	22.7 lb/hr



5.b Discussion of Results

CO emissions from the boiler (5.2 lbs/hr average) were less than the corresponding emission limit of 22.7 lbs/hr.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

There was no control equipment maintenance performed during the emissions test program.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix C.

5.i Sample Calculations

Sample calculations are provided in Appendix D.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix B

5.k Laboratory Data

There are no laboratory results for this test program. Raw CEM data is provided electronically in Appendix E.

Table 4

Boiler No. 4A CO Emission Rates

Packaging Corporation of America

Filer City, Michigan

BTEC Project No. 14-4522.01

Sampling Dates: April 1, 2014

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	4/1/2014	4/1/2014	4/1/2014	
Test Run Time	13:36-14:36	15:37-16:37	17:05-18:05	
Outlet Flowrate (dscfm)	25,674	31,459	31,216	29,450
Outlet Flowrate (scfm)	30,638	37,318	36,768	34,908
Moisture (%)	16.2	15.7	15.1	15.7
Oxygen Concentration (%)	4.08	4.49	4.28	4.28
Oxygen Concentration (%), drift corrected as per USEPA 7E)	4.06	4.47	4.26	4.26
Carbon Dioxide Concentration (%)	9.58	9.35	9.47	9.47
Carbon Dioxide Concentration (%), drift corrected as per USEPA 7E)	9.75	9.49	9.64	9.63
Outlet Carbon Monoxide Concentration (ppmv)	75.18	16.22	38.62	43.3
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	74.64	15.65	37.92	42.7
CO Emission Rate (lb/hr)	8.39	2.22	5.24	5.3
CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	8.33	2.14	5.15	5.2
CO Permit Limit Emission Rate (lb/hr)	22.7	22.7	22.7	22.7

scfm = standard cubic feet per minute

dscfm = dry standard cubic feet per minute

ppmv = parts per million on a volume-to-volume basis

lb/hr = pounds per hour

MW = molecular weight (CO = 28.01)

24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)

35.31 = ft³ per m³

453600 = mg per lb

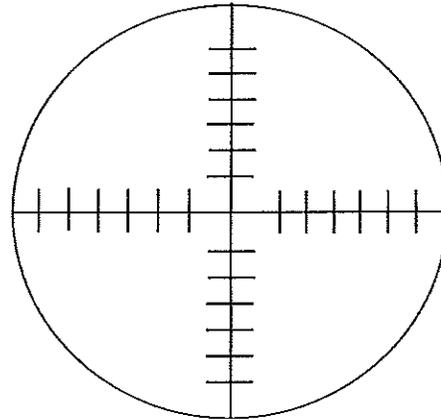
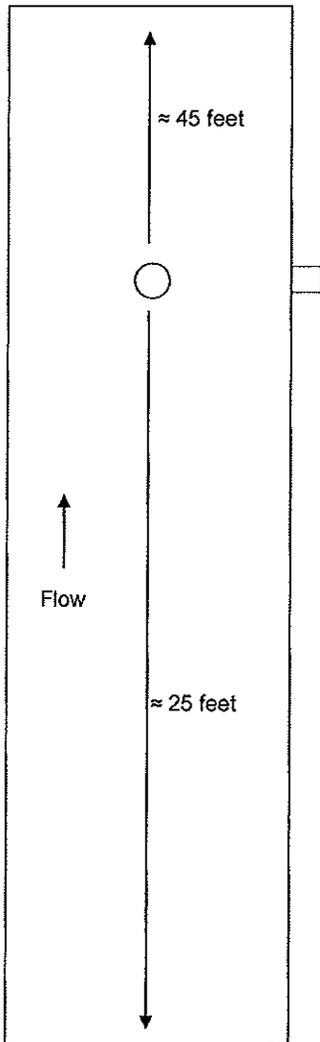
Equations

$$\text{lb/hr} = \text{ppmv} * \text{MW}/24.14 * 1/35.31 * 1/453,600 * \text{dscfm} * 60$$

Figures



diameter = 67.5 inches



Not to Scale

Points	Flow	CO
	Distance "	Distance "
1	1.4	11.25
2	4.5	33.75
3	8.0	56.25
4	11.9	
5	16.9	
6	24.0	
7	43.5	
8	50.6	
9	55.6	
10	59.5	
11	63.0	
12	66.1	

Note: CO sampling was extracted at three points through a stainless steel probe positioned at approximately 16.7%, 50% and 83.3% of the sample stream diameter (20 minutes at each point).

Figure No. 1

Site: EUBOILER4A Exhaust
Packaging Corporation of America
Filer City, Michigan

Sampling Date:
April 1, 2014

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073

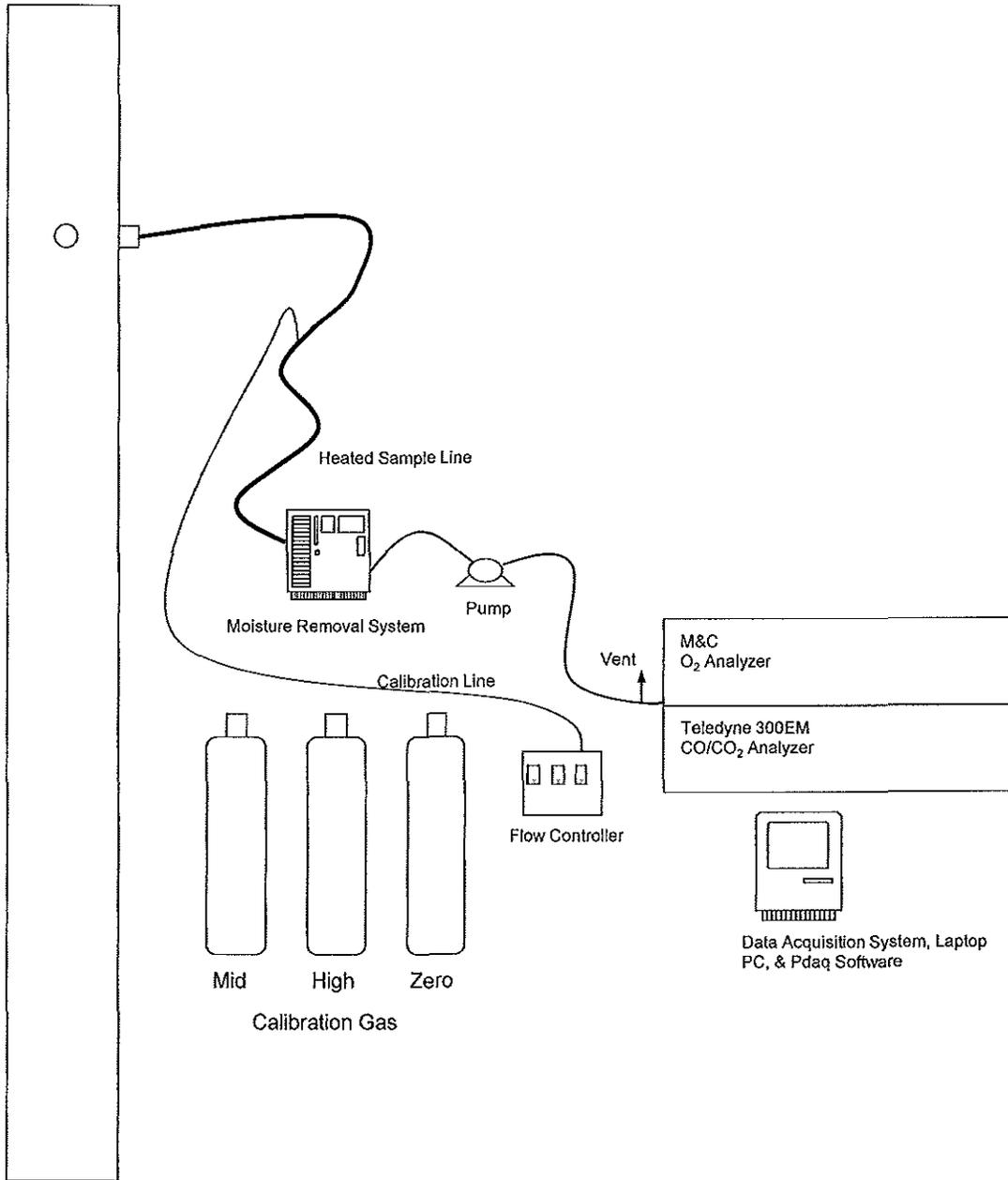


Figure No. 2

Site:
USEPA Method 3A and 10
Packaging Corporation of America
Filer City, Michigan

Sampling Date:
April 1, 2014

BT Environmental Consulting Inc.
4949 Fernlee Avenue
Royal Oak, MI 48073

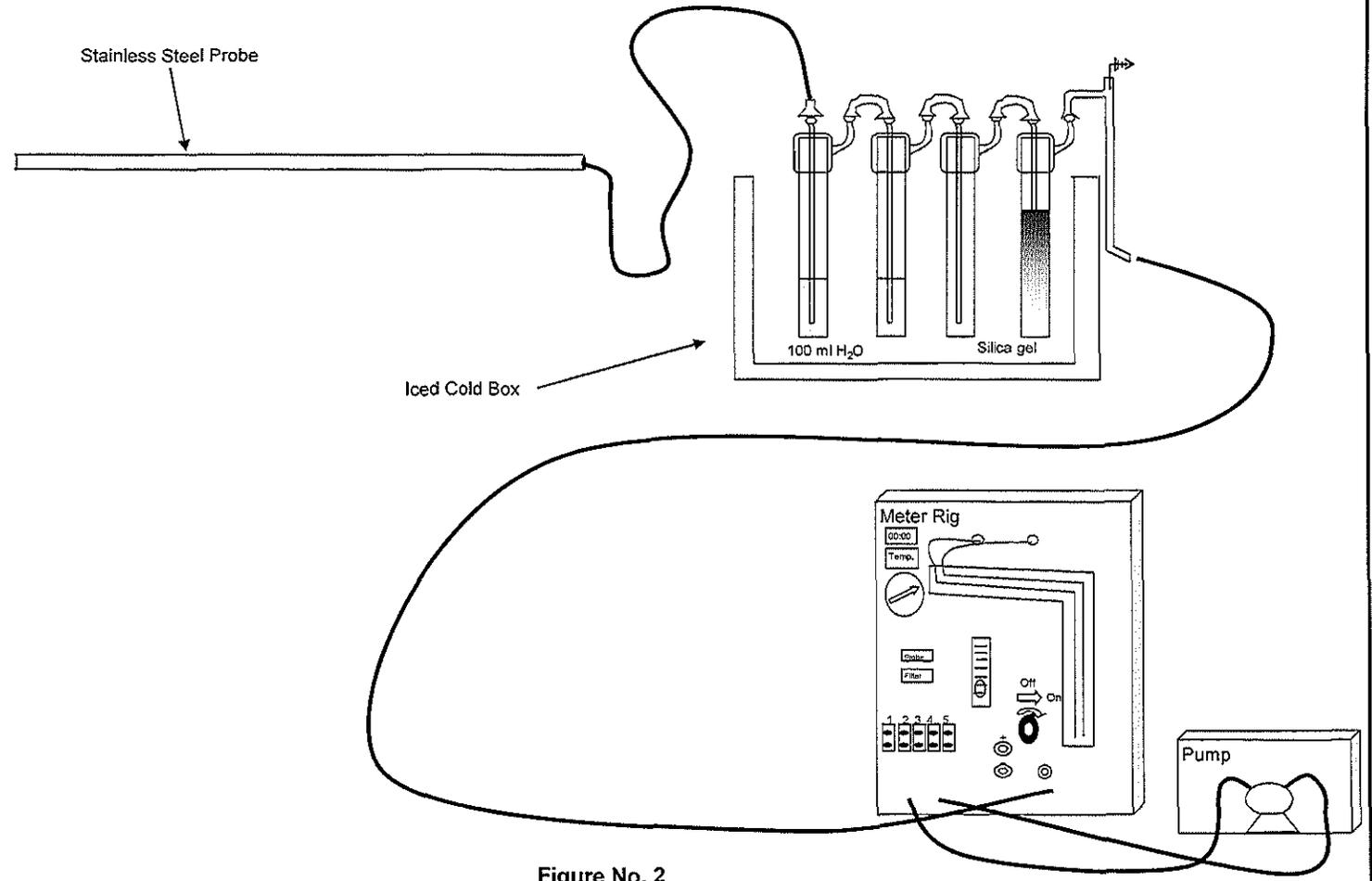


Figure No. 2

Site:
USEPA Method 4
Packaging Corporation of America
Filer City, Michigan

Sampling Date:
April 1, 2014

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073