



**EMISSIONS COMPLIANCE STUDY**

**RECEIVED**  
**FEB 01 2017**  
**AIR QUALITY DIVISION**

*Performed At The*  
**Pharmacia & Upjohn Company, LLC**  
**A subsidiary of Pfizer, Inc**  
**Building 43**  
**Gas Stream 1 (Combined Boilers EUEBLR43-1-S1 & EUEBLR43-6-S1)**  
**Gas Stream 2 (Boiler EUEBLR43-5-S1)**  
**Kalamazoo, Michigan**

*Test Date(s)*  
**December 13 through 16, 2016**

*Report No.*  
**TRC Environmental Corporation Report 264764A**

*Report Submittal Date*  
**January 25, 2017**

TRC Environmental Corporation  
7521 Brush Hill Road  
Burr Ridge, Illinois 60527  
USA

T (312) 533-2042  
F (312) 533-2070



## Report Certification

I certify that to the best of my knowledge:

- Testing data and all corresponding information have been checked for accuracy and completeness.
- Sampling and analysis have been conducted in accordance with the approved protocol and applicable reference methods (as applicable).
- All deviations, method modifications, or sampling and analytical anomalies are summarized in the appropriate report narrative(s).

*Karl F. Cole*

---

Mr. Paul Coleman  
Project Manager

January 25, 2017  
Date

TRC was operating in conformance with the requirements of ASTM D7036-04 during this test program.

*Jeffrey W. Burdette*  
Jeffrey W. Burdette  
TRC Air Measurements Technical Director

**RECEIVED**

FEB 01 2017

**AIR QUALITY DIV.****EMISSIONS COMPLIANCE STUDY****1.0 INTRODUCTION**

TRC Environmental Corporation (TRC) performed a particulate and gaseous emission compliance test program on gas streams (GS) associated with the three (3) coal-fired boilers (EUEBLR43-1-S1, EUEBLR43-5-S1 and EUEBLR43-6-S1) at the Building 43 facility of Pharmacia & Upjohn Company, LLC (Pfizer) in Kalamazoo, Michigan on December 13 through 16, 2016. The tests were authorized by and performed for Pharmacia & Upjohn Company, LLC, a subsidiary of Pfizer, Inc.

The purpose of this test program was to determine particulate matter (PM), mercury (Hg), carbon monoxide (CO) and hydrochloric acid (HCl) emission rates during normal operating conditions. The results of the test program will be used in order to determine compliance with Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) No. MI-ROP-B3610-2014c, and National Emission Standards for Hazardous Air Pollutants (NESHAP) for Major Sources, 40CFR63, Subpart DDDDD (the Boiler MACT rule). The test program was conducted according to the TRC Test Protocol 264764A dated October 7, 2016.

**1.1 Project Contact Information**

<b>Participants</b>		
Test Facility	Pharmacia & Upjohn Company, LLC Building 43 7000 Portage Road Kalamazoo, Michigan 49001	Mr. Jeffrey Robey Manager, EHS 269-833-3842 (phone) <a href="mailto:jeffrey.robey@pfizer.com">jeffrey.robey@pfizer.com</a>
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Mr. Jeremy Miller AMS Senior Project Manager 312-533-2030 (phone) 312-533-2070 (fax) <a href="mailto:jsmiller@trcsolutions.com">jsmiller@trcsolutions.com</a>
State Representatives	MDEQ, Constitution Hall 525 West Allegan Street Lansing, Michigan 48909	Mr. David Patterson Technical Programs Unit 517-284-6782 (phone) <a href="mailto:pattersond2@michigan.gov">pattersond2@michigan.gov</a>  Mr. Dennis Dunlop Ms. Monica Brothers

The tests were conducted by Ryan Novosel, Thomas Dunder, Gavin Lewis and Jeremy Miller of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) can be located in the appendix to this report.



## 1.2 Facility and Process Description

Pharmacia & Upjohn Company, LLC owns and operates five (5) coal-fired boilers in Building 43 (B43) at its pharmaceutical manufacturing facility in Kalamazoo, Michigan.

In regards to the five coal-fired boiler exhausts, in two instances, the exhausts from two boilers are combined into a common exhaust duct (Gas Stream) and share a common baghouse and common lime injection system. The table below describes how the boilers are paired together ductwork and baghouses:

Boiler	Design Capacity, lbs/hr steam	Normal Steam Output, lbs/hr	Year Placed in Service	Gas Stream (GS)
1	60,000	45,000	1948	1
3*	60,000	45,000	1948	3
4**	60,000	45,000	1951	3
5	90,000	75,000	1960	2
6	90,000	75,000	1962	1

\* Boiler 3 has not operated during 2016 and in accordance with 40CFR63.7515(g) it is not required to be tested. The boiler will be tested within 180 days of starting Boiler 3.

\*\*Boiler 4 is classified as a Limited-Use as defined in 40 CFR 63.7575 and stack testing is not required.

## 2.0 SUMMARY OF RESULTS

The results of this test program are summarized in the table below. Detailed individual run results are presented in Section 6.0.

GS1 (EUEBLR43-1-S1 & EUEBLR43-6-S1)			
Pollutant Tested		Measured Emissions	Boiler MACT Emission Limit
PM	lb/MMBtu	$8.53 \times 10^{-4}$	$4.0 \times 10^{-2}$
Hg	lb/MMBtu	$2.56 \times 10^{-6}$	$5.7 \times 10^{-6}$
CO	ppmvd @ 3% O <sub>2</sub>	29.8	160
HCl	lb/MMBtu	$1.5 \times 10^{-2}$	$2.2 \times 10^{-2}$

GS2 (EUEBLR43-5-S1)			
Pollutant Tested		Measured Emissions	Boiler MACT Emission Limit
PM	lb/MMBtu	$2.61 \times 10^{-4}$	$4.0 \times 10^{-2}$
Hg	lb/MMBtu	$3.33 \times 10^{-7}$	$5.7 \times 10^{-6}$
CO	ppmvd @ 3% O <sub>2</sub>	62.5	160
HCl	lb/MMBtu	$3.2 \times 10^{-3}$	$2.2 \times 10^{-2}$



The table below summarizes the test methods used, as well as the number and duration of each at each test location:

Unit ID/ Sample Location	Parameter Measured	Test Method	No. of Runs	Run Duration (minutes)
GS-1 (EUEBLR43-1-S1, EUEBLR43-6-S1) Stack	Filterable Particulate	USEPA 1, 2, 3A, and 5	3	120
	Mercury	USEPA Method 30B	3	90
	Carbon Monoxide	USEPA Method 10	3	60
	HCl	USEPA Method 320	3	60

Unit ID/ Sample Location	Parameter Measured	Test Method	No. of Runs	Run Duration (minutes)
GS-2 (EUEBLR43-5-S1) Stack	Filterable Particulate	USEPA 1, 2, 3A, and 5	3	120
	Mercury	USEPA Method 30B	4	90
	Carbon Monoxide	USEPA Method 10	3	60
	HCl	USEPA Method 320	3	60

### 3.0 DISCUSSION OF RESULTS

On December 14, the Test Run Number 1 on GS-2 (EUEBLR43-5-S1) for mercury was discarded due to a high vacuum that formed in the test train during the test run. The high vacuum was the result ice formation in the sample line prior to the sample chiller. It was decided to also discard the Test Run Number 1 HCl test run, in an attempt to continue the sample test runs concurrently. Test Run Number 2 HCl test run was also discarded due to loss of heat to the sample line. In total, there were four (4) mercury test runs performed on December 14, with the first test run discarded, and there were a total of five (5) HCl test runs performed, with the first two test runs discarded.

Source operation appeared normal during the entire test program. No changes or problems were encountered that required modification of any procedures presented in the test plan.



## **4.0 SAMPLING AND ANALYSIS PROCEDURES**

All testing, sampling, analytical, and calibration procedures used for this test program were performed in accordance with the methods presented in the following sections. Where applicable, the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, USEPA 600/R-94/038c, September 1994 was used to supplement procedures.

### **4.1 Determination of Sample Point Locations by USEPA Method 1**

This method is applicable to gas streams flowing in ducts, stacks, and flues and is designed to aid in the representative measurement of pollutant emissions and/or total volumetric flow rates from stationary sources. In order to qualify as an acceptable sample location, it must be located at a position at least two stack or duct equivalent diameters downstream and a half equivalent diameter upstream from any flow disturbance.

The cross-section of the measurement site was divided into a number of equal areas, and the traverse points were then located in the center of these areas. The minimum number of points were determined from Figure 1-1 (particulate) of USEPA Method 1.

### **4.2 Volumetric Flow Rate Determination by USEPA Method 2**

This method is applicable for the determination of the average velocity and the volumetric flow rate of a gas stream.

The gas velocity head ( $\Delta P$ ) and temperature were measured at traverse points defined by USEPA Method 1. The velocity head was measured with a Type S (Staustscheibe or reverse type) pitot tube and oil-filled manometer; and the gas temperature was measured with a Type K thermocouple. The average gas velocity in the flue was calculated based on: the gas density (as determined by USEPA Methods 3 and 4); the flue gas pressure; the average of the square roots of the velocity heads at each traverse point, and the average flue gas temperature.

### **4.3 Determination of the Concentration of Gaseous Pollutants Using a Multi-Pollutant Sampling System**

Concentrations of the pollutants in the following sub-sections were determined using one sampling system. The number of points at which sample was collected was determined in accordance with Method 7E specifications.

A straight-extractive sampling system was used. A data logger continuously recorded pollutant concentrations and generated one-minute averages of those concentrations. All calibrations and system checks were conducted using USEPA Protocol 1 gases. Three-point linearity checks were performed prior to sampling, and in the event of a failing system bias or drift test (and subsequent corrective action). System bias and drift checks



were performed using the low-level gas and either the mid- or high-level gas prior to and following each test run.

The Low Concentration Analyzers (those that routinely operate with a calibration span of less than 20 ppm) used by TRC are ambient-level analyzers. Per Section 3.12 of Method 7E, a Manufacturer's Stability Test is not required for ambient-level analyzers. Analyzer interference tests were conducted in accordance with the regulations in effect at the time that TRC placed an analyzer model in service.

#### **4.3.1 CO<sub>2</sub> Determination by USEPA Method 3A**

This method is applicable for the determination of CO<sub>2</sub> concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The CO<sub>2</sub> analyzer was equipped with a non-dispersive infrared (IR) detector.

#### **4.3.2 O<sub>2</sub> Determination by USEPA Method 3A**

This method is applicable for the determination of O<sub>2</sub> concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The O<sub>2</sub> analyzer was equipped with a paramagnetic-based detector.

#### **4.3.3 CO Determination by USEPA Method 10**

This method is applicable for the determination of CO concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The non-dispersive infrared analyzer (NDIR) CO analyzer was equipped with an internal gas correlation filter wheel, which eliminates potential detector interference. As such, use of an interference removal trap was not required.

#### **4.4 Filterable PM Determination by USEPA Method 5**

This method is applicable for the determination of PM emissions from stationary sources. USEPA Methods 2-4 were performed concurrently with, and as an integral part of, these determinations.

Flue gas was withdrawn isokinetically from the source at traverse points determined per USEPA Method 1, and PM was collected in the nozzles, probe liners, and on a glass fiber filter. The probe liner and filter were maintained at a temperature of  $120 \pm 14^{\circ}\text{C}$  ( $248 \pm 25^{\circ}\text{F}$ ) or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. The PM mass, which included any material that condensed at or above the filtration temperature, was determined gravimetrically after the removal of uncombined water. For GS-1, two (2) sample probes, one for each sample port, were used to conduct tests due to clearance issues. Sample trains were leak-checked after sample each port. The acetone probe wash included sample from both sample probes.



#### **4.5 Trace Mercury Determination by USEPA Method 30B**

Method 30B is a reference method for relative accuracy test audits (RATAs) of vapor phase Hg CEMS and sorbent trap monitoring systems installed at coal-fired boilers and is also appropriate for Hg emissions testing at such boilers. It is intended for use only under relatively low particulate conditions (i.e., sampling after all pollution control devices).

Flue gas was withdrawn at a constant rate through paired, in-stack sorbent traps. In order to be considered valid, each pair of traps met relative standard deviation specifications that varied depending upon the concentration of Hg in the flue gas. A field recovery test was performed on three sets of paired traps – one trap in each set was spiked with a known mass of Hg. In order to meet method specifications, the average recovery was required to be 85 to 115 percent.

The sorbent traps were analyzed on-site using thermal desorption and Zeeman atomic absorption using high frequency modulation of light polarization (ZAAS-HFM).

#### **4.6 Speciated Pollutant Determination by Extractive FTIR**

The Method 320, 40CFR60, sampling and measurement system meets the requirements for stack sampling of gaseous organic and inorganic compounds set forth by the United States Environmental Protection Agency (USEPA). In particular, it meets the requirements of USEPA Reference Method 320, "Measurement Of Vapor Phase Organic And Inorganic Emissions By Extractive Fourier Transform Infrared (FTIR) Spectroscopy," 40CFR60. This method applies to the analysis of a range of volatile organic compounds (VOCs) and volatile inorganic compounds emitted from an industrial source.

The source emissions were extracted from the single sampling point in the gas stream and transported to the FTIR analyzer via a heated, extractive sampling system. The various components of the matrix were identified and quantified by absorbance of infrared radiation. Data measurements and analytical results were stored on a computer. The data were copied to a flash drive and a second hard drive before departing the test site.

The FTIR spectrometer used was an IMACC (Round Rock, Texas) instrument. The FTIR was outfitted with a liquid nitrogen cooled MCT (mercury cadmium telluride) detector and a heated, adjustable pathlength gas cell operated at a pathlength of 28.6 meters. The spectral resolution was  $0.5\text{ cm}^{-1}$  (wavenumbers). The FTIR instrument was calibrated using a spectral library of reference spectra stored on computer. Calibration was verified on site through direct and system calibration measurements using gas standards. These gases include the method-required CTS (calibration transfer standard, 10 ppm Ethylene) and nitrogen zero gas. Direct and dynamic matrix spiking calibrations were conducted using a hydrogen chloride/sulfur hexafluoride gas standard at both test locations.



Method 320 Testing Details:

- The sampling system flow rate was ~10 liters/minute.
- The sampling system included a heated probe maintained at 365 °F that utilized a heated ceramic filter at the probe exit to remove particulate.
- Calibration and spiking gases were injected into the probe upstream of the heated filter.
- The heated sampling umbilical was 200 feet in length (2x100' heated umbilicals) and was maintained at 365 °F. Connections between the heated umbilicals were heated.
- The heated head pump, heated manifold, and the FTIR gas cell were maintained at 365 °F.
- In order to calculate the lb/MMBtu emission rate, the CO<sub>2</sub> concentration from Method 3A measurements performed simultaneously with the Method 320 testing were used.

The sampling system was checked for leaks after assembling the sampling equipment on-site and allowing all heated equipment to stabilize. The leak-check was performed by capping the end of the sample probe and verifying the absence of sampling system flow as measured by an inline rotameter. The FTIR analyzer was checked for leaks by pressurizing the gas cell and monitoring the pressure drop.

The CTS gas (10.0 ppm C<sub>2</sub>H<sub>4</sub> in nitrogen cylinder) was flowed directly to the FTIR (direct calibration) and through the sampling system (system calibration) prior to and upon completion of testing. The repeatability (%RPD) is also reported as a calculation comparing two successive CTS measurements. Repeatability of <2% indicates the measurement had stabilized. The % Difference calculation compares measurements at the start and end of the test day; the method requirement of < 5% difference was achieved in all measurements. The sampling system response time was determined at the test location using the System CTS calibration. The CTS was measured in a system calibration immediately after a system zero calibration. A response time was measured at the location based on measuring 95% of the calibration cylinder concentration.

A direct and system zero measurement was conducted at the start and end of the test day. An acceptable zero calibration is generally defined by detection of analytes (except H<sub>2</sub>O and CO<sub>2</sub>) below 1 ppm. Acceptable zero calibration values was obtained for all measured compounds.

The FTIR Classical Least Squares (CLS) analysis determines the concentration, in parts per million wet basis (ppmw), for each analyzed compound as well as the residual, which is the error associated with each measured concentration. When the residual error exceeds the measured concentration, the compound is considered a non-detect, and the residual



is reported as the detection limit. Therefore if the measured concentration is 0.05 ppmvw and the residual error is 0.10 ppmvw, the concentration is reported as "<0.10".

Calibration data can be found in Appendix. The report appendix includes summaries of QA data collected during the test program. QA procedures included system leak checks, direct and system calibration and zero measurements, detector linearity checks, and verification of analysis accuracy by manual subtraction. The analysis was confirmed by manual subtraction of the measured compounds from a representative spectrum. This confirmation served to validate the computerized FTIR analysis.

As required in the EPA letter allowing the use of FTIR to measure HCl emissions using EPA Method 320 (see Appendix), a Method 301 validation study was previously conducted using the IMACC FTIR analyzer and a comparable sampling system. The validation study uses data from twelve pairs of spiked and unspiked measurements to determine data consistency and accuracy. The FTIR QA appendix details how the validation study was conducted and presents the validation data and calculations.

#### **4.7 Determination of F-Factors by USEPA Method 19**

This method is applicable for the determination of the pollutant emission rate using carbon dioxide (CO<sub>2</sub>) concentrations and the appropriate F factor (the ratio of combustion gas volumes to heat inputs) and the pollutant concentration. The appropriate F-Factor used, selected from Table 19-2 of Method 19, is 1800 scf/MMBtu.



## 5.0 QUALITY ASSURANCE PROCEDURES

TRC integrates our Quality Management System (QMS) into every aspect of our testing service. We follow the procedures specified in current published versions of the test Method(s) referenced in this report. Any modifications or deviations are specifically identified in the body of the report. We routinely participate in independent, third party audits of our activities, and maintain:

- Accreditation from the Louisiana Environmental Laboratory Accreditation Program (LELAP);
- Accreditation from the Stack Testing Accreditation Council (STAC) and the American Association for Laboratory Accreditation (A2LA) that our operations conform with the requirements of ASTM D 7036 as an Air Emission Testing Body (AETB).

These accreditations demonstrate that our systems for training, equipment maintenance and calibration, document control and project management will fully ensure that project objectives are achieved in a timely and efficient manner with a strict commitment to quality.

All calibrations are performed in accordance with the test Method(s) identified in this report. If a Method allows for more than one calibration approach, or if approved alternatives are available, the calibration documentation in the appendices specifies which approach was used. All measurement devices are calibrated or verified at set intervals against standards traceable to the National Institute of Standards and Technology (NIST). NIST traceability information is available upon request.

ASTM D7036-04 specifies that: *"AETBs shall have and shall apply procedures for estimating the uncertainty of measurement. Conformance with this section may be demonstrated by the use of approved test protocols for all tests. When such protocols are used, reference shall be made to published literature, when available, where estimates of uncertainty for test methods may be found."* TRC conforms with this section by using approved test protocols for all tests.



# PARTICULATE TEST RESULTS SUMMARY

Company: Pfizer  
Plant: Kalamazoo, MI  
Unit: GS 1 - Boiler 1/6  
Location: Stack

Test Run Number:	1	2*	3	Average
Source Condition:	High	High	High	
Date:	12/15/2016	12/15/2016	12/15/2016	
Start Time:	9:30	13:00	16:30	
End Time:	11:55	16:00	18:55	
Sample Duration (min):	120.0	120.0	120.0	120.0
Average Gas Temp, $T_s$ , ( $^{\circ}$ F):	345.8	346.0	349.2	347.0
Fractional Gas Moisture Content, $B_{ws}$ :	0.05	0.05	0.05	0.05
Gas CO <sub>2</sub> Content (%vol):	8.5	9.9	10.2	9.5
Gas O <sub>2</sub> Content (%vol):	11.3	9.8	9.4	10.1
Gas Wet MW, $M_s$ , (lb/lbmole-mole):	29.25	29.39	29.40	29.35
Average Gas Velocity, $V_s$ , (ft/sec):	59.42	59.35	59.40	59.39
Measured Volumetric Flow Rate:				
Q (actual ft <sup>3</sup> /min):	70,002	69,915	69,982	69,966
Q <sub>std</sub> (std ft <sup>3</sup> /min):	44,521	44,461	44,325	44,436
Q <sub>std(dry)</sub> (dry std ft <sup>3</sup> /min):	42,386	42,325	42,086	42,266
F <sub>c</sub> (scf/MMBtu):	1,800	1,800	1,800	1,800
Sample Volume, V <sub>m(std)</sub> , (dry std ft <sup>3</sup> ):	84.425	84.374	84.284	84.361
PM Collected, m <sub>n</sub> , (mg):				
Filterable:	2.20	0.50	2.40	1.70
PM Concentration, C <sub>s</sub> , (gr/dscf):				
Filterable:	0.0004	0.0001	0.0004	0.0003
PM Emission Rate, ER <sub>M2</sub> , (lb/hr based on measured volumetric flow rate):				
Filterable:	0.15	0.03	0.16	0.11
PM Emission Rate, ER <sub>Fc</sub> , (lb/MMBtu using F <sub>c</sub> ):				
Filterable:	1.21E-03	2.39E-04	1.11E-03	8.53E-04
Isokinetic Variance (I)	97.6	97.7	98.1	97.8

\*Minimum detection limit of method is 0.5 milligram.

**RECEIVED**

FEB 01 2017

**AIR QUALITY DIV.****Gaseous Test Results Summary**

Project Number:	264764	Start Date:	12/15/16
Customer:	Pfizer	End Date:	12/15/16
Unit Identification:	GS 1 - Boiler 1/6	Facility:	Kalamazoo, MI
Sample Location:	Stack	Recorded by:	Jeremy S. Miller
RM Probe Type:	Extractive (Dry)	Fc Factor:	1800
Load Level/Condition:	High	Fd Factor:	-

Reference Method Results, As Measured Moisture Basis					
Run #	Date	Start Time	End Time	CO ppmvd	O <sub>2</sub> % v/v dry
1	12/15/16	9:30	10:29	17.8	9.8
2	12/15/16	13:00	13:59	18.5	9.9
3	12/15/16	16:30	17:29	19.4	9.5
Average				18.6	9.7

Results Corrected to a Reference O <sub>2</sub> Concentration			
Run #	-	-	CO ppmvd corrected to 3% Oxygen
1	-	-	28.7
2	-	-	30.1
3	-	-	30.5
Average	-	-	29.8



## Mercury Test Results Summary

Pfizer

Kalamazoo Mi

GS1 - Boiler 1/6

### Mercury Emissions Summary

F <sub>c</sub> -Factor		1800								
Run No.	Date	Start Time	Finish Time	Trap A Hg Conc. C <sub>a</sub> μg/dscm	Trap B Hg Conc. C <sub>b</sub> μg/dscm	Average Hg Conc. C <sub>d</sub> μg/dscm	Average Hg Conc. E lb/dscf	Unit CO <sub>2</sub> Concentration dry, %	Fuel Factor (F <sub>o</sub> ) scf/MMBtu	Hg Emission Rate Lb/mmBtu
Pre	12/16/16	7:53	8:53	2.4375	2.3932	2.42	1.51E-10	9.5	1800	2.86E-06
1	12/16/16	9:50	10:50	2.3445	2.4216	2.38	1.49E-10	9.9	1800	2.70E-06
2	12/16/16	11:08	12:08	2.2900	2.5406	2.42	1.51E-10	10.1	1800	2.69E-06
3	12/16/16	12:30	13:30	1.9984	2.1253	2.06	1.29E-10	10.1	1800	2.29E-06
Average				2.2110	2.3625	2.287	1.43E-10	10.0	1800	2.56E-06

Note: pre run not included in average.



EMISSIONS TEST RESULTS SUMMARY - EPA METHOD 320						
Company: Pfizer			Date: 12/16/2016		Page 1 of 1	
Plant: Kalamazoo, MI			TRC Project 264764			
Unit: Boiler 1&6			TRC ENVIRONMENTAL			
	Test Run		Run 1	Run 2	Run 3	Average
	Date		12/16/16	12/16/16	12/16/16	
	Start Time		9:50	11:08	12:30	
	End Time		10:49	12:07	13:29	
Outlet Hydrogen Chloride HCl MW= 36.46 Fc= 1800 Limit=0.022 lb/MMBtu	ppmvw		7.6	8.3	8.8	8.3
	ppmvd		8.0	8.8	9.3	8.7
	lb/MMBtu		1.4E-02	1.5E-02	1.6E-02	1.5E-02
	% of Limit		62.6%	67.0%	71.3%	67.0%
Outlet Water H <sub>2</sub> O M320 MW = 18.016	ppm		50039.5	50447.0	50160.0	50215.53
	%		5.0%	5.0%	5.0%	5.0%
	Fraction		0.050	0.050	0.050	0.050
Outlet Carbon Dioxide CO <sub>2</sub> M3A MW = 43.99	% Dry		9.9	10.1	10.1	10.0
Example Calculations: Method 320						
ppmvd as HCl =		Hydrogen Chloride ppmvw x 1/(1-Water Fraction)				
		7.62	1/(1-0.050)			8.02
lb/MMBtu as HCl =		ppmvd x F <sub>c</sub> x HCl MW x 1/3.853x10 <sup>8</sup> x 1/ M3A CO <sub>2</sub> (%)				
	8.0	1800.0	36.46	1/3.853x10 <sup>8</sup>	1/(9.9%)	1.38E-02



# PARTICULATE TEST RESULTS SUMMARY

Company: Pfizer  
Plant: Kalamazoo, MI  
Unit: GS2 - Boiler 5  
Location: Stack

Test Run Number:	1	2	3*	Average
Source Condition:	High	High	High	
Date:	12/13/2016	12/13/2016	12/13/2016	
Start Time:	8:50	11:35	15:18	
End Time:	11:05	14:37	17:30	
Sample Duration (min):	120.0	120.0	120.0	120.0
Average Gas Temp, $T_{s1}$ ( $^{\circ}$ F):	290.3	296.2	299.3	295.3
Fractional Gas Moisture Content, $B_{ws}$ :	0.05	0.05	0.05	0.05
Gas CO <sub>2</sub> Content (%vol):	10.0	9.8	9.7	9.9
Gas O <sub>2</sub> Content (%vol):	9.6	9.8	9.9	9.7
Excess Air (%):	82.5	84.9	87.3	84.9
Gas Wet MW, $M_s$ , (lb/lbmole-mole):	29.38	29.35	29.36	29.37
Average Gas Velocity, $V_{s1}$ (ft/sec):	36.71	37.57	37.90	37.40
Measured Volumetric Flow Rate:				
Q (actual ft <sup>3</sup> /min):	43,253	44,265	44,655	44,058
Q <sub>std</sub> (std ft <sup>3</sup> /min):	29,456	29,909	30,050	29,805
Q <sub>std(dry)</sub> (dry std ft <sup>3</sup> /min):	27,976	28,385	28,567	28,309
F <sub>c</sub> (scf/MMBtu):	1,800	1,800	1,800	1,800
Sample Volume, $V_{m(std)}$ , (dry std ft <sup>3</sup> ):	85.641	88.036	88.636	87.438
PM Collected, $m_p$ , (mg):				
Filterable	0.70	0.50	0.50	0.57
PM Concentration, $C_s$ , (gr/dscf):				
Filterable	0.0001	0.0001	0.0001	0.0001
PM Emission Rate, $ER_{M2}$ , (lb/hr based on measured volumetric flow rate):				
Filterable:	0.03	0.02	0.02	0.02
PM Emission Rate, $ER_{Fc}$ , (lb/MMBtu using F <sub>c</sub> ):				
Filterable:	3.25E-04	2.29E-04	2.30E-04	2.61E-04
Isokinetic Variance (l)	99.4	100.7	100.8	100.3

\*Minimum detection limit of method is 0.5 milligram.





## Gaseous Test Results Summary

Project Number:	264764	Start Date:	12/13/16
Customer:	Pfizer	End Date:	12/13/16
Unit Identification:	GS 2 - Boiler 5	Facility:	Kalamazoo, MI
Sample Location:	Stack	Recorded by:	Jeremy S. Miller
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	High	Fd Factor:	-

Reference Method Results, As Measured Moisture Basis					
Run #	Date	Start Time	End Time	CO ppmvd	O <sub>2</sub> % v/v dry
1	12/13/16	8:50	9:49	38.7	9.6
2	12/13/16	11:35	12:34	38.2	9.7
3	12/13/16	15:18	16:17	40.3	9.9
Average				39.1	9.7

Results Corrected to a Reference O <sub>2</sub> Concentration			
Run #	-	-	CO ppmvd corrected to 3% Oxygen
1	-	-	61.3
2	-	-	60.9
3	-	-	65.3
Average	-	-	62.5



**Mercury Test Results Summary**  
Pfizer  
Kalamazoo, MI  
GS2 - Boiler 5

Mercury Emissions Summary										
F <sub>c</sub> -Factor	1800									
Run No.	Date	Start Time	Finish Time	Trap A Hg Conc. C <sub>a</sub> μg/dscm	Trap B Hg Conc. C <sub>b</sub> μg/dscm	Average Hg Conc. C <sub>d</sub> μg/dscm	Average Hg Conc. E lb/dscf	Unit CO <sub>2</sub> Concentration dry, %	Fuel Factor (F <sub>e</sub> ) scf/MMBtu	Hg Emission Rate Lb/mmBtu
Pre	12/14/16	7:53	8:53	0.2709	0.2908	0.28	1.75E-11	9.50	1800	3.32E-07
2	12/14/16	11:04	12:03	0.2957	0.2866	0.29	1.82E-11	9.70	1800	3.37E-07
3	12/14/16	13:40	14:39	0.2894	0.2676	0.28	1.74E-11	9.80	1800	3.19E-07
4	12/14/16	15:05	16:04	0.3059	0.2786	0.29	1.82E-11	9.60	1800	3.42E-07
Average				0.2970	0.2776	0.29	1.79E-11	9.70	1800	3.33E-07

Note: pre run not included in average.  
Run 1 was aborted



EMISSIONS TEST RESULTS SUMMARY - EPA METHOD 320						
Company: Pfizer			Date: 12/14/2016		Page 1 of 1	
Plant: Kalamazoo, MI			TRC Project 264764			
Unit: Boiler 5			TRC ENVIRONMENTAL			
	Test Run		Run 3	Run 4	Run 5	Average
	Date		12/14/16	12/14/16	12/14/16	
	Start Time		13:40	15:05	16:25	
	End Time		14:39	16:04	17:24	
Outlet Hydrogen Chloride HCl MW= 36.46 Fc= 1800 Limit = 0.022 lb/MMBtu	ppmvw		1.9	1.7	1.6	1.7
	ppmvd		2.0	1.8	1.7	1.8
	lb/MMBtu		3.4E-03	3.2E-03	3.0E-03	3.2E-03
	% of Limit		15.5%	14.4%	13.6%	14.5%
Outlet Water H <sub>2</sub> O M320 MW = 18.016	ppm		48028.5	48146.0	47166.8	47780.44
	%		4.8%	4.8%	4.7%	4.8%
	Fraction		0.048	0.048	0.047	0.048
Outlet Carbon Dioxide CO <sub>2</sub> M3A MW = 43.99	% Dry		9.8	9.6	9.6	9.7
Example Calculations: Method 320						
	ppmvd as HCl =	Hydrogen Chloride ppmvw x 1/(1-Water Fraction)				
		1.87	1/(1-0.048)			1.97
	lb/MMBtu as HCl =	ppmvd x F <sub>c</sub> x x HCl MW x 1/3.853x10 <sup>8</sup> x 1/ M3A CO <sub>2</sub> (%)				
	1.97	1800.0	36.46	1/3.853x10 <sup>8</sup>	1/(9.8%)	3.41E-03