



EMISSIONS COMPLIANCE STUDY

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) Gas Stream 3 (Boiler EUEBLR43-3-S1) Kalamazoo, Michigan

Test Date(s)
December 8 through 13, 2015

Report No.
TRC Environmental Corporation Report 231400.1142

Report Submittal Date February 2, 2016

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).

Paul F. Gle

Mr. Paul Coleman Project Manager

February 2, 2016 Date

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

Jeffrey W. Burdette TRC Air Measurements Technical Director



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EMISSIONS COMPLIANCE STUDY

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed a particulate and gaseous emission compliance test program on gas stream (GS) associated with the four (4) coal-fired boilers (EUEBLR43-1-S1, EUEBLR43-3-S1, EUEBLR43-5-S1 and EUEBLR43-6-S1) at Building 43 facility of Pharmacia & Upjohn Company, LLC (Pfizer) in Kalamazoo, Michigan on December 8 through 13, 2015. 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-B3610-2014b, 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 231400.1142 Rev.1 dated September 29, 2015.

Participants		
Test Facility	Pharmacia & Upjohn Company, LLC Building 43 7000 Portage Road Kalamazoo, Michigan 49001	Mr. Jeffrey Robey Manager, EHS 269-833-3842 (phone) jeffrey.robey@pfizer.com
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Mr. Gavin Lewis Field Team Leader 219-613-0163 (phone) 312-533-2070 (fax) glewis@trcsolutions.com
State Representatives	MDEQ, Constitution Hall 525 West Allegan Street Lansing, Michigan 48909	Mr. Tom Gasloli Technical Programs Unit 517-284-6778 (phone) gaslolit@michigan.gov Mr. Dennis Dunlop Ms. Monica Brothers

1.1 Project Contact Information

The tests were conducted by Ryan Novosel, Paul Powell, Thomas Dunder and Gavin Lewis 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 beiters 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, Ibs/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 4 is a limited-use boiler as defined in 40CFR63.7575.

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)							
Pol	Pollutant Tested Measured Emissions Boiler MACT Emission Limit						
PM	ib/MMBtu	1.02 x 10 ⁻²	4.0×10^{-2}				
Hg	lb/MMBtu	6.28 x 10 ⁻⁷	5.7 x 10 ⁻⁶				
со	ppmvd @ 3% O2	32.3	160				
HCI	lb/MMBtu	1.34 x 10 ⁻²	2.2 x 10 ⁻²				

GS2 (EUEBLR43-5-S1)						
Pollutant Tested Measured Emissions Boiler MACT Emission Limi						
PM	lb/MMBtu	1.47 x 10 ⁻²	4.0×10^{-2}			
Hg	lb/MMBtu	3.90 x 10 ⁻⁷	5.7 x 10 ⁻⁶			
со	ppmvd @ 3% O2	26.9	160			
HCI	lb/MMBtu	1.64 x 10 ⁻²	2.2×10^{-2}			





GS3 (EUEBLR43-3-S1)						
Pollutant Tested Measured Emissions Boiler MACT Emission Limit						
PM	lb/MMBtu	1.03 x 10 ⁻²	4.0 x 10 ⁻²			
Hg	lb/MMBtu	8.83 x 10 ⁻⁷	5.7 x 10 ⁻⁶			
со	ppmvd @ 3% O2	40.4	160			
HCI	lb/MMBtu	1.29 x 10 ⁻²	2.2 x 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)
`	Filterable Particulate	USEPA 1, 2, 3A, and 5	3	120
GS-1 (EUEBLR43-1-S1,	Mercury	USEPA Method 30B	3	90
EUEBLR43-6-S1) Stack	Carbon Monoxide	USEPA Method 10	3	60
	HCI	USEPA Method 320	3	60

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

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



3.0 DISCUSSION OF RESULTS

In order to calculate emission rates in terms of lb/MMBtu, CO_2 concentrations were measured using USEPA Method 3A performed simultaneously with the USEPA Method 320 HCl determinations, with the exception of Test Run 1 on GS-2 (Boiler 5) conducted on December 9, 2015. The Method 320 test time did not correspond with the Method 3A test data, and the CO_2 concentration, as measured by Method 320, was used in the lb/MMBtu determination. As shown in the table below, the Method 320 and Method 3A CO_2 measurements demonstrated an absolute mean difference of 0.07%

Source	Run	Date	Time (M3A)	Time (M320)	%CO₂ (M3A)	%CO ₂ (M320)	% Difference	Absolute Difference
66.2	1	12/9/15	1107-1130	1000-1059	10.4	10.5	1.3%	0.13
(Poilor E)	2	12/9/15	1205-1304	1205-1304	10.3	10.4	0.57%	0.059
	3	12/9/15	1539-1638	1530-1629	10.3	10.3	0.30%	0.031
GS-1	1	12/11/15	925-1024	925-1024	11.1	11.2	1.1%	0.12
(Boilers	2	12/11/15	1115-1214	1115-1214	10.8	10.9	1.2%	0.12
1/6)	3	12/11/15	1315-1414	1315-1414	10.8	10.9	0.56%	0.060
	1	12/12/15	925-1025	925-1024	8.0	8.0	-0.62%	0.050
(Boilor 2)	2	12/12/15	1140-1239	1140-1239	7.9	7.9	0.15%	0.012
(Boner 5)	3	12/12/15	1330-1429	1330-1429	7.9	7.9	-0.34%	0.027

Also, in order to determine emissions as lb/MMBtu, HCl (wet concentration) and CO_2 (dry concentration) need to be on a consistent basis. Therefore, Method 320 was used, as outlined in Method 4 Section 16.3, as an acceptable alternative for determining moisture content of each gas stream.

There were a total of four (4) USEPA Method 30B test runs performed on GS-2 (Boiler 5), since the corresponding USEPA Method 3A test time did not match the Test Run 1 test time. All four test runs are presented in the summary table, but only Test Runs 2, 3 and 4 are averaged together.

There were a total of four (4) USEPA Method 5 test runs performed on GS-3 (Boiler 3) on December 13, 2015. It was noticed after Test Run 3 that the sample filter exhibited signs the vacuum may have been released too quickly from the post-test leak check. All four test runs are presented in the summary table, but only Test Runs 1, 2 and 4 are averaged together.

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 fromFigure 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 (ΔP) and temperature were measured at traverse points defined by USEPA Method 1. The velocity head was measured with a Type S (Stausscheibe 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 CO₂ Determination by USEPA Method 3A

This method is applicable for the determination of CO_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The CO_2 analyzer was equipped with a non-dispersive infrared (IR) detector.

4.3.2 O₂ Determination by USEPA Method 3A

This method is applicable for the determination of O_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The O_2 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 $120 \pm 14^{\circ}$ C (248 \pm 25°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 and GS-3, 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 19.7 meters. The spectral resolution was 0.5 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. This gas standard was also used for the method validation study.



Method 320 Testing Details:

- The sampling system flow rate was ~20 liters/minute. 10 liters/minute were directed to the FTIR and the balance to a vent.
- 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.
- The heated head pump, heated manifold, and the FTIR gas cell were maintained at 365 °F.
- The same sampling equipment was used on all three sources.

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 CTS gas (10 ppm C_2H_4 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 zero measurement was conducted at the start and end of the test day, and a system zero measurement was conducted prior to and after the test runs. Note that Method 320 does not require a zero measurement but is performed by TRC as a best practice for verification of the absence of analytes in the sampling and analytical systems. An acceptable zero calibration is generally defined by detection of analytes (except H_2O and CO_2) below 1 ppm. Acceptable zero calibration values was obtained for all measured compounds.

The FTIR spectra were analyzed for the gaseous components present in the emissions from the source. Not all compounds were detected. These analytes included: water (H₂O), carbon dioxide (CO₂), hydrogen chloride (HCl), hydrogen fluoride (HF), carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO₂), nitrous oxide (N₂O), sulfur dioxide (SO₂), ammonia (NH₃), methane (CH₄), formaldehyde (CH₂O),



acetaldehyde (C_2H_4O), and sulfur hexafluoride (SF₆, tracer). The primary focus of this test program was the measurement of hydrogen chloride emissions.

The FTIR Classical Least Squares (CLS) analysis determines the concentration, in parts per million wet basis (ppmvw), 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 and demonstrate that additional compounds were not present at detectable concentrations.

As detailed in the EPA letter approving the use of FTIR to measure HCl emissions using EPA Method 320, a Method 301 validation study was conducted as part of the testing. The validation study uses data from twelve pairs of spiked and unspiked measurements to determine data consistency and accuracy. Since the validation study Relative Bias is less than 10%, no bias correction factor was applied to the data, as detailed in Section 10.3 of Method 301. The FTIR QA appendix details how the validation study was conducted and presents the validation data and calculations.

The EPA letter allowing the use of FTIR also required conducting matrix spiking calibrations on each source. Due to an incomplete understanding of this requirement, spiking was only performed on two of the three sources. Because of the following considerations, TRC maintains that the incomplete spiking has no impact on data quality: the spiking was successful on these two sources; the same sampling and analytical equipment was used on all three sources; and the gas matrix was very similar in the three sources.

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_2) 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.



6.0 TEST RESULTS SUMMARY

PARTICULATE TEST RESULTS SUMMARY

Company:	Pfizer
Plant:	Kalamazoo, MI
Unit:	GS1 - Boilers 1 & 6
Location:	Stack

Test Run Number	1	2	3	Average			
Source Condition	High	High	High				
Date	12/10/2015	12/10/2015	12/10/2015				
Start Time	8:10	10:55	13:40				
End Time	10:32	13:15	15:55				
Sample Duration (min):	120.0	120.0	120.0	120.0			
Average Gas Temp, T _s , (°F):	344.2	346.6	347.4	346.0			
Fractional Gas Moisture Content, B _{ws} :	0.055	0.058	0.056	0.056			
Gas CO ₂ Content (%vol):	10.9	10.9	10.9	10.9			
Gas O ₂ Content (%vol):	8.6	8.5	8.4	8.5			
Gas Wet MW, M _s , (lb/lbmole-mole):	29.43	29.38	29.40	29.40			
Average Gas Velocty, V _s , (ft/sec):	58.37	58.65	58.45	58.49			
Measured Volumetric Flow Rate			•				
Q (actual ft ³ /min):	68,762	69,097	68,857	68,905			
Q _{std} (std ft ³ /min):	44,625	44,708	44,509	44,614			
Q _{std(dry)} (dry std ft ³ /min):	42,184	42,101	42,000	42,095			
F _c (dscf/MMBtu):	1,800	1,800	1,800	1,800			
Sample Volume, V _{m(std)} , (dry std ft ³):	89.703	89.997	89.582	89.761			
PM Collected, m _n , (mg):							
Filterable	29.20	22.17	23.85	25.07			
PM Concentration, C _s , (gr/dscf):			<u> </u>				
Filterable	0.0050	0.0038	0.0041	0.0043			
PM Emission Rate, ER _{M2} , (lb/hr based on measured volumetric flow rate):							
Filterable:	1.82	1.37	1.48	1.56			
PM Emission Rate, ER_{Fc} , (Ib/MMBtu using F_c):	PM Emission Rate, ER _{Fe} , (Ib/MMBtu using F _e):						
Filterable	1.18E-02	8.97E-03	9.69E-03	1.02E-02			
Isokinetic Variance (I)	97.4	97.9	97.7	97.7			



Mercury Test Results Summary Pfizer Kalamazoo, Ml GS1 - Boilers 1 & 6

	Mercury Emissions Summary											
F _c -Factor	1800											
·				Trap A	Trap B	Average	Average	Unit		Hg		
				Hg Conc.	Hg Conc.	Hg Conc.	Hg Conc.	CO₂	Fuel Factor	Emission		
Run		Start	Finish	C,	Сь	Cd	ε	Concentration	ν.c)	Rate		
No.	Date	Time	Time	µg/dscm	µg/dscm	µg/dscm	lb/dscf	dry, %	scf/MMBtu	Lb/mmBtu		
1	12/11/15	9:25	10:55	0.5322	0,5824	0.56	3.48E-11	11.10	1800	5.64E-07		
2	12/11/15	11:15	12:45	0.6453	0.6063	0.63	3.91E-11	10.80	1800	6.51E-07		
3	12/11/15	13:15	14:45	0.6604	0.6239	0.64	4.01E-11	10.80	1800	6.68E-07		
	Ave	rage		0.6126	0.6042	0.61	3.63E-11	10.90	1800	6.28E-07		



Gaseous Test Results Summary

Project Number:	231400.1142	Start Date:	12/10/15
Customer:	Pfizer	End Date:	12/10/15
Unit Identification:	GS1 - Boilers 1 & 6	Facility:	Kalamazoo, Ml
Sample Location:	Stack	Recorded by:	Gavin Lewis
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	High	Fd Factor:	

	Reference Method Results, As Measured Moisture Basis									
Run		Start	End	со	CO ₂	O ₂				
#	Date	Time	Time	ppmvd	% v/v dry	% v/v dry				
1	12/10/15	8:10	9:09	22.3	10.8	8.7				
2	12/10/15	10:55	11:54	23.4	10.8	8.6				
3	12/10/15	12:15	13:14	20.9	10.9	8.5				
	Av	erage		22.2	10.9	8.6				

Results Corrected to a Reference O ₂ Concentration						
			CO			
			ppmvd			
Run			corrected to			
#	-	-	3% Oxygen			
1	-	-	32.6			
2	-	-	34.1			
3	_	-	30.2			
Average	-	-	32.3			



EMISSION	MISSIONS TEST RESULTS SUMMARY - EPA METHOD 320								
Company	: Pfizer		Date:	12/11/2015					
Plant:	Plant: Kalamazoo, Ml			231400					
Unit:	Boiler 1&6		TRC ENVIRO	NMENTAL					
	Test Run		Run 1	Run 2	Run 3	Average			
	Date		12/11/15	12/11/15	12/11/15				
	Start Time		9:25	11:15	13:15				
Í	End Time		10:24	12:14	14:14				
Outlet	Hydrogen Chloride HCl	ppmvw	7.9	8.3	8.0	8.1			
MW	= 36.46	ppmvd	8.4	8.8	8.5	8.6			
FC	= 1800	lb/MMBtu	1.28E-02	1.38E-02	1.35E-02	1.34E-02			
	Limit=0.022 lb/MMBtu	% of Limit	58.3%	62.8%	61.2%	60.8%			
Outlet	Water H ₂ O	ppm	58033.2	57034.6	56333.2	57133.66			
M320	MW = 18.016	%	5.80%	5.70%	5.63%	5.71%			
ļ		Fraction	0.058	0.057	0.056	0.057			
Outlet	Carbon Dioxide CO ₂	ppmvw	105749.4	103038.5	102494.3	103760.74			
M320	MW = 43.99	ppmvd	112264.5	109270.7	108612.8	110049.34			
M320		%, Dry	11.2%	10.9%	10.9%	11.0%			
	M3A	%, Dry	11.1%	10.8%	10.8%	10.9%			



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	12/8/2015	12/8/2015	12/8/2015	
Start Time	10:05	12:40	15:25	
End Time	12:15	15:05	17:32	
Sample Duration (min):	120.0	120.0	120.0	120.0
Average Gas Temp, T _s , (°F):	301.8	299.1	302.4	301.1
Fractional Gas Moisture Content, B _{ws} :	0.049	0.048	0.053	0.050
Gas CO ₂ Content (%vol):	10.6	10.4	10.3	10.4
Gas O ₂ Content (%vol):	8.8	9.1	9.2	9.0
Gas Wet MW, M _s , (lb/lbmole-mole):	29.45	29.45	29.37	29.42
Average Gas Velocty, V _s , (ft/sec):	35.00	35.88	35.96	35.61
Measured Volumetric Flow Rate				
Q (actual ft ³ /min):	41,230	42,267	42,367	41,954
Q _{std} (std ft ³ /min):	28,552	29,374	29,317	29,081
Q _{std(dry)} (dry std ft ³ /min):	27,139	27,952	27,748	27,613
F _c (dscf/MMBtu):	1,800	1,800	1,800	1,800
Sample Volume, V _{m(std)} , (dry std ft ³):	82.303	81.625	81.753	81.893
PM Collected, m _n , (mg):				-
Filterable	36.00	23.53	35.33	31.62
PM Concentration, C _s , (gr/dscf):				
Filterable	0.0067	0.0044	0.0067	0.0060
PM Emission Rate, ER _{M2} , (lb/hr based on measu	ured volumetric flo	w rate):	· · · · · · · · · · · · · · · · · · ·	
Filterable:	1.57	1.07	1.59	1.41
PM Emission Rate, ER_{Fc} , (lb/MMBtu using F_{c}):	-			-
Filterable	1.64E-02	1.10E-02	1.66E-02	1.47E-02
Isokinetic Variance (I)	100.5	96.8	97.6	98.3



Mercury Test Results Summary Pfizer Kalamazoo GS2 - Boiler 5

Mercury Emissions Summary												
F _c -Factor	1800											
				Trap A	Trap B	Average	Average	Unit		Hg		
				Hg Conc.	Hg Conc.	Hg Conc.	Hg Conc.	CO2	Fuel Factor	Emission		
Run		Start	Finish	C _a	Сь	Cd	E	Concentration	(, C)	Rate		
No.	Date	Time	Time	μg/dscm	µg/dscm	μg/dscm	lb/dscf	dry, %	scf/MM8tu	Lb/mmBtu		
1*	12/9/15	10:00	11:30	0.3827	0.4187	0.40	2.50E-11	10.40	1800	4.33E-07		
2	12/9/15	11:58	13:28	0.3898	0.3514	0.37	2.31E-11	10.30	1800	4.04E-07		
3	12/9/15	13:52	15;22	0.3351	0.3562	0.35	2.16E-11	10.30	1800	3.77E-07		
4	12/9/15	15:39	17:09	0,3661	0,3440	0.36	2.22E-11	10.30	1800	3,87E-07		
	Ave	rage		0,3637	0,3505	0.36	2.23E-11	10.30	1800	3.90E-07		

* Test Run 1 had incomplete Method 3A data, and not included in the average results.



Gaseous Test Results Summary

Project Number:	231400.1142	Start Date:	12/8/15	
Customer:	Pfizer	End Date:	12/8/15	
Unit Identification:	GS2 - Boiler 5	Facility:	Kalamazoo, MI	
Sample Location:	Stack	Recorded by:	Gavin Lewis	
RM Probe Type:	Extractive (Dry)	Fc Factor:	-	
Load Level/Condition:	High	Fd Factor:	-	

	Reference Method Results, As Measured Moisture Basis										
Run Start End CO CO2 O2											
#	Date	Time	Time	ppmvd	% v/v dry	% v/v dry					
1	12/8/15	10:05	11:04	17.2	10.6	8.8					
2	12/8/15	12:40	13:39	18.4	10.6	8.9					
3	12/8/15	14:05	15:04	18.1	10.3	9.2					
		Average		17.9	10.5	9.0					

Results Corrected to a Reference O ₂ Concentration						
Run #			CO ppmvd corrected to 3% Oxygen			
1	-	-	25.4			
2	-	-	27.5			
3	-	-	27.8			
Average	-	-	26.9			



EMISSION	EMISSIONS TEST RESULTS SUMMARY - EPA METHOD 320								
Company	: Pfizer		Date:	12/9/2015					
Plant:	Kalamazoo, MI		TRC Project	231400					
Unit:	Boiler 5		TRC ENVIRO	NMENTAL					
	Test Run		Run 1	Run 2	Run 3	Average			
	Date		12/09/15	12/09/15	12/09/15				
	Start Time		10:00	12:05	15:30				
	End Time		10:59	13:04	16:29				
Outlet	Hydrogen Chloride HCl	ppmvw	9.5	9.8	8.9	9.4			
MW:	= 36.46	ppmvd	10.1	10.4	9.4	10.0			
Fc:	= 1800	lb/MMBtu	1.63E-02	1.73E-02	1.56E-02	1.64E-02			
,	Limit = 0.022 lb/MMBtu	% of Limit	73.9%	78.5%	70.8%	74.4%			
Outlet	Water H ₂ O	ppm	57839.8	57078.8	56199.1	57039.23			
M320	MW = 18.016	%	5.78%	5.71%	5.62%	5.70%			
		Fraction	0.058	0.057	0.056	0.057			
Outlet	Carbon Dioxide CO ₂	ppmvw	99272.8	97681.0	97520.7	98158.16			
M320	MW = 43.99	ppmvd	105367.2	103594.0	103327.6	104096.28			
M320	Note Run 1 uses M320	%, Dry	10.5%	10.4%	10.3%	10.4%			
	МЗА	%, Dry	10.4%	10.3%	10.3%	10.3%			



PARTICULATE TEST RESULTS SUMMARY

-	
Company:	Pfizer
Plant:	Kalamazoo, MI
Unit:	GS3 - Boiler 3
Location:	Stack

Test Run Number	1	2	3*	4	Average		
Source Condition	High	High	High	High			
Date	12/13/2015	12/13/2015	12/13/2015	12/13/2015			
Start Time	7:50	10:35	13:20	16:30			
End Time	10:10	12:55	16:05	18:50			
Sample Duration (min):	120.0	120.0	120.0	120.0	120.0		
Average Gas Temp, T _s , (°F):	332.4	329.1	326.6	324.4	328.6		
Fractional Gas Moisture Content, B _{ws} :	0.047	0.052	0.050	0.051	0.050		
Gas CO ₂ Content (%vol):	8.0	7.9	8.0	8.0	8.0		
Gas O₂ Content (%vol):	11.8	11.9	11.9	11.8	11.8		
Gas Wet MW, M _s , (lb/lbmole-mole):	29.19	29.13	29.16	29.15	29.16		
Average Gas Velocty, V _s , (ft/sec):	37.87	37.76	37.74	37.77	37.80		
Measured Volumetric Flow Rate							
Q (actual ft ³ /min):	36,814	36,703	36,682	36,714	36,743		
Q _{std} (std ft ³ /min):	24,247	24,275	24,337	24,426	24,316		
Q _{std(dry)} (dry std ft ³ /min):	23,096	23,008	23,110	23,175	23,093		
F _c (dscf/MMBtu):	1,800	1,800	1,800	1,800	1,800		
Sample Volume, V _{m(std)} , (dry std ft ³):	89.346	89.555	89.835	89.846	89.582		
PM Collected, m _n , (mg):							
Filterable	20.14	24.85	29.12	10.49	18.49		
PM Concentration, C _s , (gr/dscf):							
Filterable	0.0035	0.0043	0.0050	0.0018	0.0032		
PM Emission Rate, ER _{M2} , (lb/hr based on measured volumetric flow rate):							
Filterable:	0.69	0.84	0.99	0.36	0.63		
PM Emission Rate, ER _{Fc} , (Ib/MMBtu using F _c):							
Filterable	1.12E-02	1.39E-02	1.61E-02	5.79E-03	1.03E-02		
Isokinetic Variance (I)	95.9	96,5	96.4	96.2	96.2		

* Note - Run 3 is not included in the average results.



Mercury Test Results Summary Pfizer Kalamazoo GS3 - Boiler 3

Mercury Emissions Summary										
F _c -Factor	1800									
				Trap A	Trap B	Average	Average	Unit		Hg
				Hg Conc.	Hg Conc.	Hg Conc.	Hg Conc.	CO2	Fuel Factor	Emission
Run		Start	Finish	C,	Сь	Cd	E	Concentration	(6)	Rate
No.	Date	Time	Time	µg/dscm	µg/dscm	µg/dscm	lb/dscf	dry, %	scf/MM8tu	Lb/mmBlu
1	12/12/15	9:25	10:55	0.6597	0.6449	0.65	4.07E-11	7.98	1800	9.18E-07
2	12/12/15	11:40	13:10	0.6678	0.6549	0.66	4.13E-11	7.89	1800	9.42E-07
3	12/12/15	13:30	15:00	0.5098	0.5995	0.55	3.46E-11	7.89	1800	7.90E-07
Average			0.6124	0.6331	0.62	3.89E-11	7.92	1800	8.83E-07	



Gaseous Test Results Summary

Project Number: Customer: Unit Identification: Sample Location: RM Probe Type: Load Level/Condition: 231400.1142 Pfizer GS3 - Boiler 3 Stack Extractive (Dry) High

Start Date: End Date: Facility: Recorded by: Fc Factor: Fd Factor: 12/13/15 12/13/15 Kalamazoo, MI Gavin Lewis

	Reference Method Results, As Measured Moisture Basis							
Run Start End CO						02		
#	Date	Time	Time	ppmvd	% v/v dry	% v/v dry		
1	12/13/15	7:50	8:49	22.2	8.2	11.6		
· 2	12/13/15	9:10	10:09	22.3	7.9	11.9		
3	12/13/15	10:35	11:34	17.2	8.0	11.8		
	Average				8.0	11.8		

Results Corrected to a Reference O ₂ Concentration					
			CO		
Run	:		corrected to		
#	-	~	3% Oxygen		
1	-	-	42.9		
2	-	-	44.5		
3	-	-	33.9		
Average	-	-	40.4		



EMISSIONS TEST RESULTS SUMMARY - EPA METHOD 320							
Company:	Pfizer		Date:	12/12/2015			
Plant:	Kalamazoo, MI		TRC Project	231400			
Unit:	Boiler 3		TRC ENVIRONMENTAL				
	Test R <mark>u</mark> n		Run 1	Run 2	Run 3	Average	
	Date		12/12/15	12/12/15	12/12/15		
	Start Time		9:25	11:40	13:30		
	End Time		10:24	12:39	14:29		
Outlet	Hydrogen Chloride HCl	ppmvw	5.6	5.3	6.1	5.7	
Í Ń₩=	36.46	ppmvd	5.9	5.6	6.5	6.0	
Fc=	1800	lb/MMBtu	1.27E-02	1.20E-02	1.40E-02	1.29E-02	
	Limit=0.022 lb/MMBtu	% of Limit	57.5%	54.5%	63.6%	58.5%	
Outlet	Water H ₂ O	ppm	52778.4	52831.9	51667.1	. 52425.80	
M320	MW = 18.016	%	5.28%	5.28%	5.17%	5.24%	
		Fraction	0.053	0.053	0.052	0.052	
Outlet	Carbon Dioxide CO ₂	ppmvw	75301.5	74932.5	74678.0	74970.67	
M320	MW = 43.99	ppmvd	79497.3	79112.1	78746.6	79118.67	
M320		%, Dry	7.9%	7.9%	7.9%	7.9%	
	МЗА	%, Dry	8.0%	7.9%	7.9%	7.9%	