INITIAL DEMONSTRATION OF FUGITIVE EMISSIONS CONTROL SYSTEM PERFORMANCE

Becton, Dickinson and Company
8195 Industrial Blvd
Covington, GA 30014

Ramboll US Corporation
1600 Parkwood Circle
Suite 310
Atlanta, Georgia 30339

August 2020

ENVIRONMENT
& HEALTH

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EXECUTIVE SUMMARY

In fulfillment of obligations first set in a Consent Order with the Georgia Environmental Protection Division on October 28, 2019, Becton, Dickinson and Company has installed two dry bed fugitive emission control systems at its Covington, Georgia, medical device sterilization facility for the reduction of potential emissions of ethylene oxide.

Under an EPD-approved Test Plan, these systems have been tested to assess their performance and effectiveness. The testing has found that the emissions to the atmosphere of ethylene oxide from both systems (System One and System Two) are consistent with the levels expected from the dry bed system outlets. The emission rate measured from the System One outlet on June 19, 2020 was 2.2 pounds-per-year if annualized over 8,760 hours. The emission rate measured from the System Two outlet on April 2, 2020 was 43.5 pounds-per-year if annualized over 8,760 hours. The total emission rate from both Systems' outlets combined on an annualized basis would be 45.7 pounds.

System One is achieving the target control device effectiveness of 99 percent reduction in fugitive ethylene oxide emissions from the facility's five Sterilization Vessel Rooms, the Vessel to Aeration Transfer Corridor, and the Ethylene Oxide Dispensing Room.

1. BACKGROUND

Becton, Dickinson and Company (BD) operates a medical device sterilization facility utilizing ethylene oxide (EO) at 8195 Industrial Boulevard in Covington, Georgia (see **Figure 1**). As a condition of a Consent Order with the Georgia Environmental Protection Division (EPD) dated October 28, 2019, BD has installed two systems for the capture and control of fugitive emissions of ethylene oxide (EO) that are not captured by current emissions control equipment. The new equipment includes two systems comprised of multiple Advanced Air Technologies Model DR490 "Dry Bed Scrubbers".

System One (SYS1) captures potential fugitive emissions from the five Sterilization Vessel Rooms (VRM1, VRM2, VRM3, VRM4, VRM5), the Vessel to Aeration Transfer Corridor (NCO1), and the EO Dispensing Room (DRM1). Details regarding the dry bed scrubber system was presented in the air permit application for its installation that was submitted to the EPD on October 31, 2019.

Condition 13 of Attachment A to the October 28, 2019 Consent Order provides the following: "…in accordance with an EPD-approved plan, BD shall conduct an initial demonstration of the fugitive emissions control system upgrades proposed in the permit application for the BD Covington facility…" BD submitted a test plan for the fugitive emissions control system upgrades on March 27, 2020. EPD approved the test plan in a letter dated March 31, 2020. **Appendix A** provides the test plan methodology and EPD approval letter. The testing for SYS1 was performed on June 19, 2020. Both Ray Shen and Marcus Cureton from the EPD Stationary Source Compliance, Source Monitoring Unit were present to observe the testing activities.

2. TESTING ACTIVITES

The testing program for assessing the effectiveness of the SYS1 dry bed fugitive emission control system for fugitive releases captured in the Sterilization Vessel Rooms of the facility was based on two primary elements:

1. Measurement of the airflow rate at the inlet duct to the dry bed system and the stack outlet utilizing EPA standard methods 1, 2, and 4; and,

2. Measurement of the concentration of EO in the inlet duct and outlet stack.

Measurement of the airflow rates was conducted by Advanced Industrial Resources (AIR) of Acworth, Georgia, a qualified stack testing contractor.

Ramboll personnel oversaw and coordinated the EO sample collection during the testing. Air samples were collected in 6-liter Summa canisters individually tested and certified by the laboratory to be free of EO. The samples were analyzed for EO via EPA Method TO-15 modified to achieve sub-part-per-billion detection limits for EO.

The Test Plan presented in **Appendix A** was followed for the flow measurement, and sample collection. **Figure 2** identifies the specific sampling points used for SYS1. As outlined in the Test Plan, a duplicate sample was collected at the SYS1 stack outlet, to allow for precision and repeatability of analyses and the stability of EO samples in the Summa canisters. The original and duplicate samples were collected simultaneously over a 4-hour duration from two separate segments of tubing introduced side-by-side in the sampling port.

3. ANALYTICAL LABORATORY RESULTS AND PERFORMANCE ASSESMENT

The collected samples were transferred to Eurofins Air Toxics, LLC (Eurofins), an independent laboratory in Folsom, California with recognized expertise with EO analytical methods, for analysis using a modified EPA Method TO-15 with GC/MS in the Selective Ion Monitoring (SIM) acquisition mode to obtain detection limits sufficiently low for use in testing the dry bed system performance.

A duplicate sample collected from SYS1 Outlet was analyzed upon receipt at the laboratory to demonstrate the repeatability and precision of the sampling and analytical method.

Table 1 presents the airflow rate and moisture results from the EPA Method 1, 2, and 4 tests performed by AIR. AIR's complete report is provided as **Appendix B.**

Table 2 presents the EO concentration results from Eurofins. The complete laboratory report is provided as **Appendix C,** including results from the quality control assessments described above.

The testing and analytical work met quality assurance and quality control set forth in the test plan. The measured EO concentrations in each sample were above the detection limits of the laboratory method – there were no "non-detect" results.

Table 3 combines the air flow and EO concentration data for an assessment of the performance of the dry bed fugitive emissions control system.

SYS1 Performance Assessment

SYS1 captures and treats fugitive EO releases from the five Sterilization Vessel Rooms, the Vessel to Aeration Transfer Corridor, and the EO Dispensing Room. Fugitive emissions from these operational areas were detected at a concentration of 250 micrograms per cubic meter ($\mu g/m^3$) at the SYS1 inlet duct. The exhaust mass rate from the SYS1 stack was only 0.000247 pounds-per-hour (lb/hour), or 2.16 pounds-per-year (lb/year) if annualized over 8,760 hours. As shown in **Table 3**, SYS1 is performing as designed and intended. In particular, the SYS1 dry bed fugitive control system is reducing the EO emissions by 99 percent as designed.

4. CONCLUSIONS

The following conclusions can be drawn from this testing as an initial assessment of the performance of the SYS1 dry bed fugitive emission control system at the BD Covington facility:

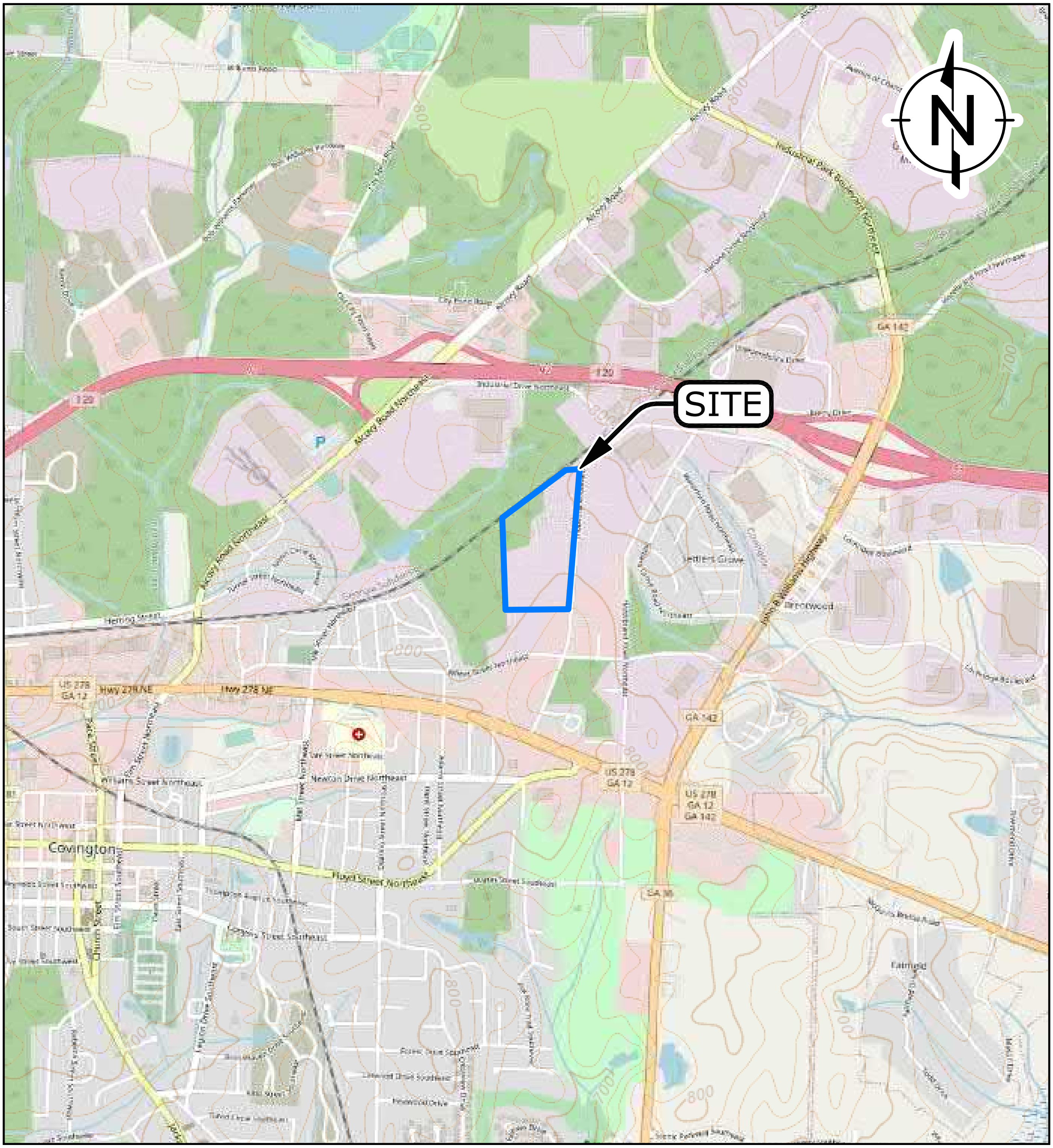
1. Post-control-device emissions of EO from SYS1 are 0.000247 lb/hour.

2. SYS1 is achieving a 99 percent control effectiveness for the reduction in fugitive EO emissions from the five Sterilization Vessel Rooms, the Vessel to Aeration Transfer Corridor, and the EO Dispensing Room.

3. The Summa canister testing and analytical approach applied for this testing successfully allowed monitoring of EO concentrations that allowed calculation of control efficiency from the dry bed treatment system and achieved all stability and precision objectives.

4. The analytical method has been shown to have good sample stability.

FIGURES



0 0.5 1

SCALE IN MILES

0 2,000 4,000

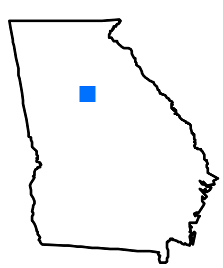
SCALE IN FEET

LEGEND:

PROPERTY BOUNDARY (APPROXIMATE)

SOURCE:
contours: USGS The National Map: 3D Elevation Program. Data Refreshed July, 2020.
OpenStreetMap: © OpenStreetMap (and) contributors, CC-BY-SA
www.openstreetmap.org/key

Map Scale 1:24,000
Spatial Reference: NAD 1983 UTM Zone 17N; Map Center: 83°15'7"W 32°42'41"N



Key Map

SITE LOCATION MAP

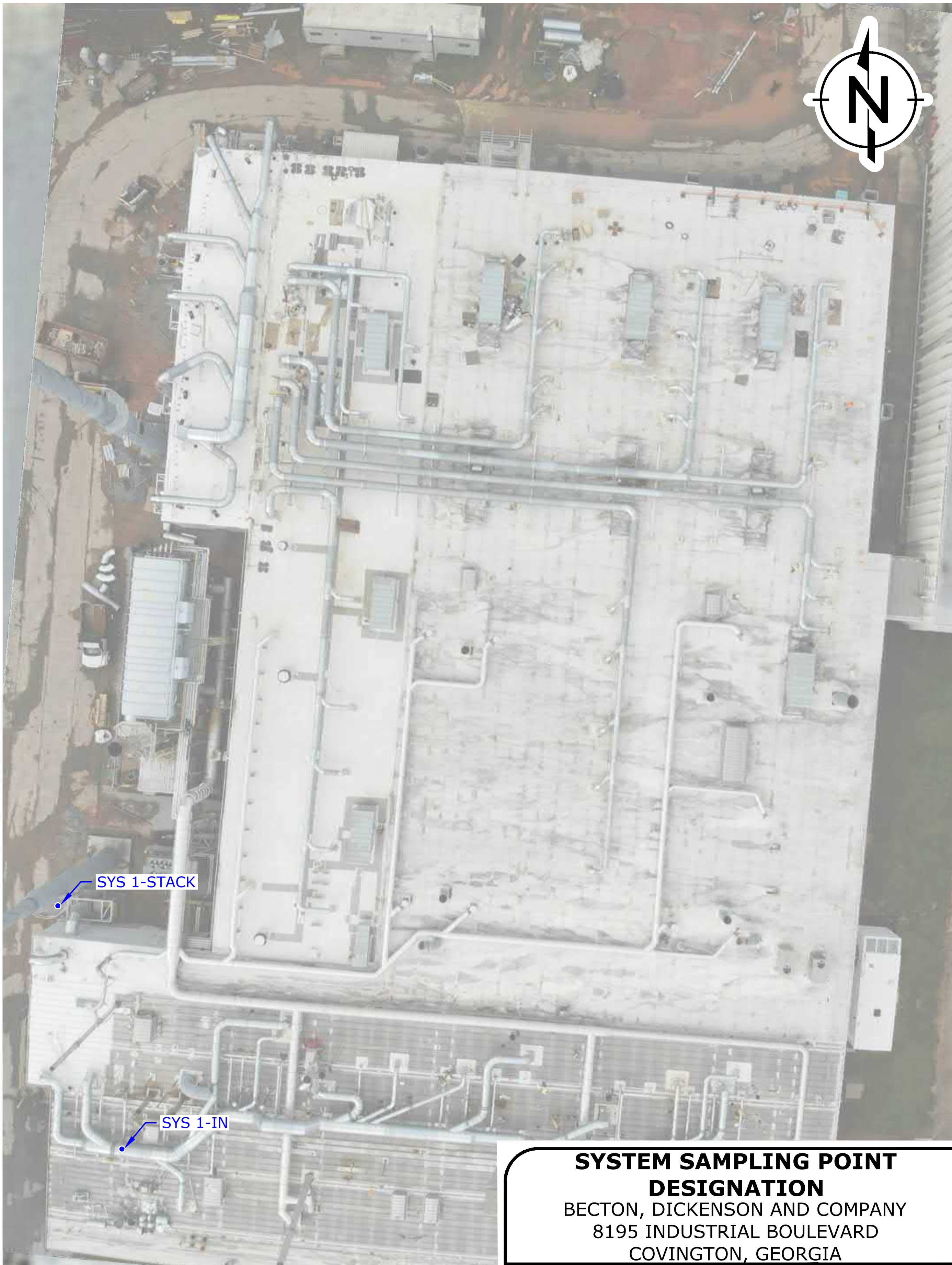
BECTON, DICKENSON AND COMPANY
8195 INDUSTRIAL BOULEVARD
COVINGTON, GEORGIA

RAMBOLL

FIGURE 1

DRAFTED BY: RGM | DATE: 7/24/2020 | PROJECT: 1690014483

F:\Graeme\1690014483\SLM_COVINGTON_GA\SLM_COVINGTON_GA.aprx



SYSTEM SAMPLING POINT DESIGNATION

BECTON, DICKENSON AND COMPANY
8195 INDUSTRIAL BOULEVARD
COVINGTON, GEORGIA

LEGEND:

● SAMPLING LOCATION (APPROXIMATE)

0 40
SCALE IN FEET

SOURCE:
POND March 2020.

RAMBOLL

FIGURE
2

DRAFTED BY: CAD | DATE: 7/24/2020 | PROJECT: 1690014483

GMILES 7/24/20 F:\GRAEME\1690014483 < SYSTEM_1_SAMPLING_LOCATIONS_COVINGTON_GA >

TABLES

TABLE 1
System 1 Airflow Rates
Becton, Dickinson and Company
Covington, Georgia Facility

Sample ID	Sample Location	Pre-Test Flow Rate (dscfm)	Pre-Test Average Temperature (°F)	Post-Test Flow Rate (dscfm)	Post-Test Average Temperature (°F)	Average Flow Rate (dscfm)	Average Temperature (°F)
System 1							
SYS1 - IN 20200619	SYS1 In	20753	93	18321	110	19537	102
SYS1 - Stack 20200619	SYS1 Out	21631	90	20029	96	20830	93

Notes:
Pre and Post-Test average tempertures and airflow rates provided by Advanced Industrial Resources, Inc. (AIR).
dscfm - dry standard cubic feet per minute

RAMBOLL

TABLE 2
System 1 Ethylene Oxide Sample Results
Becton, Dickinson and Company
Covington, Georgia Facility

Sample ID	Sample Location	Date	Start Time	Stop Time	Duration (hours)	Vacuum[1] Initial (In. Hg)	Vacuum[1] Final (In. Hg)	EO Concentration (µg/m³)
System 1								
SYS1 - IN 20200619	SYS1 In	6/19/2020	9:05	13:03	3:58	29.5	7.0	250
SYS1 - STACK 20200619[2]	SYS1 Out	6/19/2020	9:03	13:03	4:00	30.0	8.5	3.2
SYS1 - STACK DUP 202004619[3]	SYS1 Out	6/19/2020	9:03	13:03	4:00	27.5	8.5	3.0

Notes:

[1]Vacuum readings recorded in the field from the regulator gauge.

[2]The listed EO concentration is the average of SYS1 - STACK 20200619 (3.6 µg/m³), SYS1 - STACK DUP 20200619 (2.9 µg/m³), and SYS1-STACK DUP 20200619 Lab Duplicate (3.0 µg/m³) values.

[3]The laboratory conducted a lab duplicate for analytical repeatability; results were 2.9 and 3.0 µg/m3. Listed EO concentration is an average of the two values.

In. Hg - inches of mercury

µg/m³ - micrograms per cubic meter

EO - Ethylene Oxide

RAMBOLL

TABLE 3
System 1 Performance Assessment
Becton, Dickinson and Company
Covington, Georgia Facility

Sample ID	Sample Location	EO Concentration ($\mu g/m^3$)	Duct Flow (dscfm)	EO Rate (lb/hr)
System 1				
SYS1 - IN 20200619	SYS1 In	250	19537	1.83E-02
SYS1 - STACK 20200619	**SYS1 Out**	**3.2**	20830	**2.47E-04**

Notes:
EO - Ethylene Oxide
$\mu g/m^3$ - micrograms per cubic meter
dscfm - dry standard cubic feet per meter
lb/hr - pounds per hour

	System 1
Potential Annual EO emissions (lb/year)	**2.16**
Concentration-based percent removal	98.7
Mass-based percent removal	98.6

APPENDIX A

STACK TESTING SCOPE

Test Plan

for the

Performance Testing of the Fugitive Emissions Control System 1 Upgrades

at

Becton, Dickinson and Company (BD)
Urology and Critical Care Division

Covington, Georgia

Proposed Test Date:

29 May 2020

Submitted By:

Becton, Dickinson and Company
Urology and Critical Care Division
8195 Industrial Blvd
Covington GA 30014

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I. Introduction

Condition 13 of Attachment A to the October 28, 2019 Consent Order provides; "in accordance with an EPD-approved plan, BD shall conduct an initial demonstration of the fugitive emissions control system upgrades proposed in the permit application for the BD Covington facility no later than March 31, 2020." On March 25, 2020, a Second Amendment to the Consent Order was issued by EPD which extended the deadline for the Condition 13 testing to April 15, 2020.

In compliance with Attachment A to the October 28, 2019 Consent Order, BD provided a test plan for the fugitive emissions control system upgrades proposed in the permit application of the BD Covington facility on February 29, 2020 and amended on March 27, 2020. In a letter dated March 31, 2020, EPD approved the test plan submitted March 27, 2020.

Upon completion of the system installations and placement into service, initial efficiency testing was conducted on April 2, 2020, consistent with the outline provided in Attachment F to the air permit application submitted on October 31, 2019 and the EPD approved test plan submitted March 27, 2020.

As provided in the Initial Demonstration of Fugitive Emissions Control System Performance report dated April, 2 2020, there was an unforeseen anomaly with System 1 where both the concentration of ethylene oxide (EO) and the mass rate of EO measured in the dry bed system inlet duct were lower than the concentration and mass measured at the outlet stack. This was not the expected nature of results and made it difficult to draw conclusions regarding the effectiveness (control efficiency) of the System 1 dry beds. Accordingly, BD contacted EPD by email on May 6, 2020 notifying them of the planned re-test of System 1.

Re-testing of System 1 is scheduled to be performed May 29, 2020 at the BD Sterilization Operation in Covington, Georgia. The purpose of the testing is to determine removal efficiency of EO by the dry bed fugitive emissions control systems.

System 1's control efficiency for EO will be tested and demonstrated on a concentration basis by withdrawing exhaust air from the ductwork at the inlet side of the System 1 dry beds and at the outlet stack from System 1's dry beds into Summa Canisters in accordance with EPA Method TO-15.

The air testing services of a reputable contractor will be obtained to conduct the required testing. Mr. John LaMontagne, of BD, and other BD personnel, will provide on-site coordination of the testing.

II. Process and Control Equipment Description and Operating Conditions

The equipment being tested is for the control of fugitive emissions of EO at an existing medical device sterilization facility. The existing regulated process which includes the

Sterilization Chamber Exhaust Vent, Chamber Vent, Aeration Exhaust, and Thermal Oxidizer are not being modified and are excluded from this performance test.

Testing for this equipment is specific to the additional emission control systems being installed to capture and treat fugitive emissions of EO not captured by current emissions control equipment. The equipment to be tested includes one system comprised of multiple Advanced Air Technologies Model DR490 "Dry Bed Scrubbers".

System 1 (SYS1) will capture potential emissions from the five Sterilization Vessel Rooms (VRM1, VRM2, VRM3, VRM4, VRM5), the Vessel to Aeration Transfer Corridor (NCO1), and the EO Dispensing Room (DRM1).

III. <u>Dry Bed Validation Testing Plan</u>

Analytical Methods

The samples will be collected in Summa Canisters and analyzed using EPA Method TO-15 with GC/MS in the Selective Ion Monitoring (SIM) acquisition mode to determine the concentration of ethylene oxide. Analysis will be performed by Eurofins, an independent laboratory. Results will be reported in units of micrograms per cubic meter (ug/m3).

To accommodate the conditions relating to canister placement, sampling probes will be connected using flexible tubing (Teflon FEP, 1/4" OD), with the length not to exceed five (5) feet.

One duplicate sample will be collected at the outlet from the dry bed system and submitted to the laboratory for analysis to evaluate the precision and repeatability of sample collection.

Efficiency Assessment

The performance testing will be performed as follows:

- Sample duration – 4 hours
- System 1: Inlet duct and outlet duct simultaneously across all of System 1.
- Samples will be collected at a single point within each corresponding stack or duct.
- Outlet stack airflow rate and moisture will be measured simultaneously by EPA Methods 1, 2, and 4.

- Velocity traverses of the inlet duct will be performed periodically during the testing.

- Control efficiency will be calculated on the basis of the reduction in concentration of EO across the dry beds for System 1. Mass emission rate of EO (lb/hr) will be determined using the measured outlet concentration and airflow rate.

IV. <u>Plant Entry and Safety</u>

General safety rules must be adhered to when inside the plant area. Visitors must first sign in at the reception area at 8195 Industrial Blvd. prior to admission to the Sterilization Facility.

Entry to the Sterilization Facility is restricted. John LaMontagne is responsible for this project. He can be reached at 770-784-6186 or 770 652-2049 (cell).

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Richard E. Dunn, Director

Air Protection Branch
4244 International Parkway
Suite 120
Atlanta, Georgia 30354
404-363-7000

March 31, 2020

Submitted electronically

Mr. John LaMontagne
Becton, Dickinson and Company
8195 Industrial Blvd
Covington, GA 30014

Re: Performance Test Plan for Fugitive Emissions
Control System Upgrades
Test Date: April 2, 2020

Dear Mr. LaMontagne:

The Environmental Protection Division has completed its review of the test plan for the Fugitive Emissions Control System Upgrades submitted on February 29, 2020, and amended on March 27, 2020. Testing was originally scheduled for March 31, 2020, but has been postponed to April 2, 2020, due to weather concerns. The originally submitted test plan stated that sampling and analysis would be conducted at a single point for each inlet and outlet stack into Summa Canisters and analyzed according to EPA Method TO-15. Each sample would be collected for 4 hours. During sampling, airflow and moisture measurements will be taken.

In addition, the amended test plan included the specifications that duplicate samples will be collected at each outlet stack and one of those duplicate samples will be spiked in the laboratory with a standard concentration of ethylene oxide to ensure precision and accuracy of the analysis. Also, the sample lines will consist of the tubing stock that was tested by Eurofins and demonstrated minimal to no sample loss in the lab. Sample lines will not exceed five feet in length.

Based on the information provided in test plan submitted March 27, 2020, the Division approves the procedures contained therein. If you have any questions regarding test procedures and requirements, please contact Dan McCain at 404-363-7120 or daniel.mccain@dnr.ga.gov.

Sincerely,

Sean Taylor
Program Manager
Stationary Source Compliance Program

AIRS No. 217-00021

APPENDIX B

TESTING SUBCONTRACTOR FINAL REPORT

Advanced Industrial Resources, Inc.
Environmental Engineering
800-224-5007
www.airtest1.com

DRY BED SYSTEM #1
INITIAL DEMONSTRATION
AT
BECTON DICKINSON BARD
COVINGTON FACILITY
PROJECT ID: KR-10518

PREPARED FOR:

BECTON DICKINSON BARD
8195 INDUSTRIAL BLVD
COVINGTON, GEORGIA 30014

PREPARED BY:

ADVANCED INDUSTRIAL RESOURCES, INC.
3407 NOVIS POINTE
ACWORTH, GEORGIA 30101

TEST DATE:
JUNE 19, 2020

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1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Becton Dickinson Bard (BD Bard) operates a medical products sterilization facility located at 8195 Industrial Blvd, Covington, Georgia 30014. Sterilization is completed using ethylene oxide gas. The facility recently installed two (2) dry bed systems designed to control fugitive and process ethylene oxide emissions from the interior of the facility.

An initial performance test of the dry bed system #1 was conducted on June 19, 2020 by Ramboll and Advanced Industrial Resources, Inc. (AIR). The purpose of the initial performance test was to establish the newly installed control system's ethylene oxide removal efficiency. Testing was conducted by quantifying the inlet loading of ethylene oxide to the dry bed system #1 and simultaneously quantifying the emission rate of ethylene oxide at the outlet of the dry bed system #1. U.S. EPA Methods 1, 2, 4, and 18 were used to conduct testing

Testing was conducted by Advanced Industrial Resources, Inc. (*AIR*) in accordance with approved USEPA Methods (i.e. 40 CFR 60 Appendix A, Methods 1, 2, 4, and 18). The data presented herein represents data collected from the initial performance test of System 1 conducted in June 2020.

1.2 KEY PERSONNEL

The key personnel who coordinated the test program and their telephone numbers are:

Keith A. Cole, P.E., *Ramboll*, Sr. Managing Consultant	678-388-1648
Derek Stephens, *AIR*, VP/QA Director	404-843-2100
Stephen Wilson, *AIR*, Chief Operations Officer	404-403-6079
Scott Wilson, *AIR*, Program Director	800-224-5007

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS & CONTROL EQUIPMENT DESCRIPTION

Becton Dickinson Bard (BD Bard) operates a medical products sterilization facility in Covington, Georgia. Sterilization is completed using ethylene oxide gas in various chambers within the facility. The facility recently installed two (2) dry bed systems designed to control fugitive and process ethylene oxide emissions from the interior of the facility.

2.2 SAMPLING LOCATION

Each sampling location has a circular cross section with at least two (2) sampling ports oriented 90 degrees from one another. The sampling locations are located at least two (2) equivalent diameters downstream from the nearest upstream flow disturbance and at least one-half (0.5) equivalent diameters upstream from the nearest downstream flow disturbance. In accordance with EPA Method 1, a minimum of sixteen (16) total traverse points ($\geq$ 8 per port) were used to measure velocities within the respective ducts via EPA Method 2. The centroids of the respective ducts were used to collect the ethylene oxide samples.

The following table summarizes the sampling locations:

Source	**Stack diameter (D_s)**	**Downstream flow disturbance distance (A)**		**Downstream flow disturbance distance (B)**		**Traverse Points (per port)**
	inches	inches	equiv. diameter	inches	equiv. diameter	
System 1 Outlet	73	45	0.62	252	3.45	24 (12)
System 1 Inlet	50.5	27	0.53	> 101	> 2	24 (12)

3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

3.1 OBJECTIVES

The purpose of the initial performance test was to establish the newly installed control system's ethylene oxide removal efficiency. Testing was conducted by quantifying the inlet loading of ethylene oxide to the dry bed system #1 and simultaneously quantifying the emission rate of ethylene oxide at the outlet of the dry bed system #1.

3.2 FIELD TEST CHANGES, PROBLEMS, & ITEMS OF NOTE

No problems were encountered during testing that required deviation from the planned test protocol.

3.3 PRESENTATION OF TEST RESULTS

Volumetric flow rates and associated data are presented in Appendix A. Actual raw field data sheets are presented in Appendix C.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Testing was performed in accordance with 40 *CFR* 60 Appendix A. Specifically:

- EPA Method 1 was used for the qualification of the location of sampling ports and for the determination of the number and positions of stack traverse points, as applicable to sample traverses for EPA Method 2.

- EPA Method 2 was employed for the determination of the stack gas velocity and volumetric flow rate during sampling using Type "S" Pitot tubes. EPA Method 2 was conducted prior to and at the conclusion of the single ethylene oxide sample periods and the average of the traverses, per sample location, were used to determine the volumetric flow rates used for calculating the mass rate (lb/hr) of ethylene oxide.

- EPA Method 3 was used for the calculation of the density and dry molecular weight of the effluent stack gas. The gas streams were assumed to be at ambient conditions (20.9% O2, 0.0% CO2).

- EPA Method 4 was employed for the determination of the stack gas moisture content of the System 1 exhaust stack. A single test run was conducted on each of the stacks which lasted the duration of the test run (240 min.). Wet bulb/dry bulb measurements were conducted on the inlet duct to determine its moisture contents.

5.0 QUALITY ASSURANCE ACTIVITIES

5.1 INTERNAL QUALITY ASSURANCE

The quality assurance/quality control (QA/QC) measures associated with the sampling and analysis procedures given in the noted EPA reference methodologies, in Subparts A of 40 *CFR* 60 and 40 *CFR 63*, and in the *EPA QA/QC Handbook*, Volume III (EPA 600/R-94/038c) were employed, as applicable. Such measures include, but are not limited to, the procedures detailed below.

5.1.1 SAMPLING TRAIN LEAK CHECKS

Determinations of the leakage rate of the Method 4 sampling trains were made before and after each sampling run using the procedure detailed in Section 8.1.3.2 of EPA Method 4. Before the sampling run, after the sampling trains had been assembled and probe and filter box temperatures had time enough to settle at their appropriate operating values, the probe inlet was plugged and the system was evacuated to a pressure of 15 inches of Hg below ambient pressure. The volumetric leakage rate was be measured by the dry gas meter over the course of one (1) minute. The leakage rate was less than 0.020 cfm for each run, thereby meeting the maximum allowable leakage rate.

After the sampling run, before the train was disassembled the probe inlet was plugged and the system depressurized to a vacuum equal to or greater than the maximum value reached during the sampling run. The dry gas meter measured the volumetric leakage rate over the course of one (1) minute. The leakage rate was determined to be less than 0.020 cfm, thereby meeting the maximum allowable leakage rate.

The Type “S” Pitot tube assemblies were also checked for leaks before and after sampling runs using the procedure in Section 8.1 of EPA Method 2. The impact opening of the Pitot tubes were blown through until a pressure of at least 3 inches of water registered on the manometer. The impact opening was quickly plugged and held for at least 15 seconds, during which time the manometer reading held. The same operation was performed on the static pressure side of the Pitot tubes, except suction was used to obtain the pressure differential.

5.1.2 PROBE NOZZLE DIAMETER CHECKS

No probe nozzles were used during this test program.

5.1.3 PITOT TUBE FACE PLANE ALIGNMENT CHECK

Before field testing, each Type S Pitot tube was examined in order to verify that the face planes of the tube were properly aligned, per Method 2 of 40 *CFR* 60, Appendix A. The external tubing diameter and base-to-face plane distances were measured in order to verify the use of 0.84 as the baseline (isolated) Pitot coefficient. At that time the entire probe assembly (i.e., the sampling probe, nozzle, thermocouple, and Pitot tube) was inspected in order to verify that its components met the interference-free alignment specifications given in EPA Method 2. Because the specifications were met, then the baseline Pitot coefficient was used for the entire probe assembly.

After field testing, the face plane alignment of each Pitot tube was checked. No damage to the tube orifices was noted.

5.1.4 METERING SYSTEM CALIBRATION

Every three months each dry gas meter (DGM) console is calibrated at five orifice settings according to Method 5 of 40 *CFR* 60, Appendix A. From the calibration data, calculations of the values of Y_m and $\Delta H_@$ are made, and an average of each set of values is obtained. The limit of total variation of Y_m values is $\pm$0.02, and the limit for $\Delta H_@$ values is $\pm$0.20.

After field testing, the calibration of the DGM console was checked by performing three calibration runs at a single intermediate orifice setting that is representative of the range used during field-testing. Each DGM was within the limit of acceptable relative variation from Y_m of 5.0%.

5.1.5 TEMPERATURE GAUGE CALIBRATION

After field testing, the temperature measuring instruments on each sampling train was calibrated against standardized mercury-in-glass reference thermometers. Each indicated temperature was within the limit of acceptable variation between the absolute reference temperature and the absolute indicated temperature of 1.5%.

5.1.6 DATA REDUCTION CHECKS

AIR ran an independent check (using a validated computer program) of the calculations with predetermined data before the field test, and the *AIR* Team Leader conducted spot checks on-site to assure that data was being recorded accurately. After the test, *AIR* checked the data input to assure that the raw data had been transferred to the computer accurately. Flow rates, temperatures and moisture levels were relatively constant (variation <5%) during the three test runs, which indicates that data recording and Method 2 and 4 sampling and calculation errors are not likely.

6.0 DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) process is generally a seven-step iterative planning approach to ensure development of sampling designs for data collection activities that support decision making. The seven steps are as follows: (1) defining the problem; (2) stating decisions and alternative actions; (3) identifying inputs into the decision; (4) defining the study boundaries; (5) defining statistical parameters, specifying action levels, and developing action logic; (6) specifying acceptable error limits; and (7) selecting resource-effective sampling and analysis plan to meet the performance criteria. The first five steps are primarily focused on identifying qualitative criteria such as the type of data needed and defining how the data will be used. The sixth step defines quantitative criteria and the seventh step is used to develop a data collection design. In regards to emissions sampling, these steps have already been identified for typical monitoring parameters.

Monitoring methods presented in 40 *CFR* 60 Appendix A indicate the following regarding DQOs: Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods. At a minimum, each method provides the following types of information: summary of method; equipment and supplies; reagents and standards; sample collection, preservation, storage, and transportation; quality control; calibration and standardization; analytical procedures, data analysis and calculations; and alternative procedures. These test methods have been designed and tested according to DQOs for emissions testing and analysis.

APPENDIX A

TEST RESULTS

Volumetric flow rate summary

	Inlet			Outlet	
	Time	dscfm	Difference	dscfm	Time
Pre-test	8:50-9:00	20,753	-878	21,631	9:15 - 9:21
Post-test	14:00 - 14:08	18,321	-1,708	20,029	13:45 - 13:55
Average		19,537	-1,293	20,830	

System 1 Inlet

Input values:

					Metric	Metric
		8:50-9:00	14:00 - 14:08		8:50-9:00	14:00 - 14:08
T_{db}	F	93	110	C	34.0	43.1
T_{wb}	F	66	75	C	18.9	23.9
P_g	in H_20	-2.00	-2.00	kPa	-0.5	-0.5
P_{bar}	in Hg	29.90	29.90	kPa	101.2	101.2
O_2	%	20.9	20.9	%	20.9	20.9
CO_2	%	0.0	0.0	%	0.0	0.0

Calculated values:

P	in Hg	29.75	29.75	kPa	100.7	100.7
MW_{air}	lb/mol	28.84	28.84	g/mol	28.84	28.84
p_{sat}	in Hg	0.64	0.88	kPa	2.18	2.97
p	in Hg	0.34	0.49	kPa	1.16	1.66
H	lb H_2O/lb air	0.0073	0.0104		0.0073	0.0104
B_{ws}		**1.1%**	**1.6%**		**0.0115**	**0.0164**

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BD Bard

Flow Measurements & Calculations

System 1 Inlet

Pre-Test

Test Team:	RB, GSG	**D_s (in.):**	50.50
EPA Methods:	1,2	**P_{bar} (in. Hg):**	29.90
Test Date:	June 19, 2020	**p_g (in. H_2O):**	-2.00
Console ID:	C-16	**O_2 (%):**	20.90
Y_m	0.959	**CO_2 (%):**	0.00
Probe Assembly ID:	P4-03	**B_{ws}(%):**	1.15
Cp:	0.84	**Test Time:**	8:50-9:00

Measured values:

Dry Bulb (F): 93
Wet Bulb (F): 66

Point	Δp (" H_2O)	$(\Delta p)^{1/2}$	t_s (°F)
1	0.17	0.412	93
2	0.18	0.424	93
3	0.21	0.458	93
4	0.24	0.490	93
5	0.24	0.490	93
6	0.23	0.480	93
7	0.18	0.424	93
8	0.15	0.387	93
9	0.16	0.400	93
10	0.19	0.436	93
11	0.20	0.447	94
12	0.25	0.500	94
13	0.25	0.500	94
14	0.24	0.490	93
15	0.26	0.510	93
16	0.24	0.490	93
Average	**0.21**	**0.459**	**93**

Calculations:

Molar weight, M_s =	**28.71**	**lb/mol**	$=\{(\%O_2 \times 32)+(\%CO_2 \times 44)+(\%N_2 \times 28)\} \times (1-B_{ws}/100))/100+B_{ws}/100*18$
Velocity, v_s =	**26.51**	**ft/sec**	$=85.49C_p \times (\Delta p)^{1/2} \times \{(t_s+460)/(P_{bar}+p_g/13.6)/M_s)\}^{1/2}$
Flow Rate, $Q_{s,ds}$ =	**20,753**	**dscfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92 \times (1-B_{ws}/100)$
Flow Rate, $Q_{s,act}$ =	**22,120**	**acfm**	$=v_s\pi D_s^2/4/144 \times 60$
Flow Rate, $Q_{s,std}$ =	**20,994**	**scfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92$

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BD Bard

Flow Measurements & Calculations

System 1 Inlet

Post-Test

			Measured values:	
Test Team:	RB, GSG		**D_s (in.):**	50.50
EPA Methods:	1, 2, 3A & 4		**P_{bar} (in. Hg):**	29.90
Test Date:	June 19, 2020		**p_g (in. H_2O):**	-2.00
Console ID:	C-16		**O_2 (%):**	20.90
Y_m	0.959		**CO_2 (%):**	0.00
Probe Assembly ID:	P4-03		**B_{ws}(%):**	1.64
Cp:	0.84		**Test Time:**	14:00 - 14:08

Dry Bulb (F): 110
Wet Bulb (F): 75

Point	Δp (" H_2O)	$(\Delta p)^{1/2}$	t_s (°F)
1	0.10	0.316	110
2	0.13	0.361	108
3	0.14	0.374	109
4	0.14	0.374	109
5	0.14	0.374	109
6	0.15	0.387	109
7	0.20	0.447	109
8	0.21	0.458	109
9	0.16	0.400	110
10	0.15	0.387	110
11	0.15	0.387	110
12	0.20	0.447	110
13	0.22	0.469	110
14	0.23	0.480	110
15	0.22	0.469	110
16	0.22	0.469	110
Average	**0.17**	**0.413**	**110**

Calculations:

Molar weight, M_s =	**28.66**	**lb/mol**	$=\{(\%O_2 \times 32)+(\%CO_2 \times 44)+(\%N_2 \times 28)\} \times (1-B_{ws}/100))/100+B_{ws}/100*18$
Velocity, v_s =	**24.21**	**ft/sec**	$=85.49C_p \times (\Delta p)^{1/2} \times \{(t_s+460)/(P_{bar}+p_g/13.6)/M_s)\}^{1/2}$
Flow Rate, $Q_{s,ds}$ =	**18,321**	**dscfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92 \times (1-B_{ws}/100)$
Flow Rate, $Q_{s,act}$ =	**20,205**	**acfm**	$=v_s\pi D_s^2/4/144 \times 60$
Flow Rate, $Q_{s,std}$ =	**18,628**	**scfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92$

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Moisture Measurements & Calculations

System 1 Outlet

			Measured values:	
Test Team:	GE, GSG, DZ		**P_{bar} (in. Hg):**	29.90
EPA Methods:	4		**p_g (in. H_2O):**	0.15
Test Date:	June 19, 2020		**Y_m**	0.952
Console ID:	C-015		**Probe Assembly ID:**	P8-02

Moisture Run	Run #1	9:00 - 10:15	
Used for flow runs:	1, 2 & 3		
Water recovery (ml):	29		
Sample volume (cf):	154.590		
Meter temperature (F):	80.0		
Calculations:			
Moisture volume, V_w =	**1.37**	**scf**	= ml x 0.04715
Sample volume, V_s =	**143.86**	**scf**	$=V_m \times Y_m \times \{528 / (T_m + 460)\} \times \{(P_{bar} + P_g / 13.6) / 29.92\}$
Moisture content, B_{ws} =	**0.94**	**%**	$=V_w / (V_w + V_s)$

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Flow Measurements & Calculations

System 1 Outlet

Pre-Test

		Measured values:	
Test Team:	RB, GSG	**D_s (in.):**	73.00
EPA Methods:	1,2	**P_{bar} (in. Hg):**	29.90
Test Date:	June 19, 2020	**p_g (in. H_2O):**	0.15
Console ID:	C-015	**O_2 (%):**	20.90
Y_m	0.952	**CO_2 (%):**	0.00
Probe Assembly ID:	P8-02	**B_{ws}(%):**	0.94
Cp:	0.84	**Start Time:**	9:15 - 9:21

Point	Δp (" H_2O)	$(\Delta p)^{1/2}$	t_s (°F)
1	0.100	0.316	91
2	0.090	0.300	91
3	0.050	0.224	91
4	0.040	0.200	90
5	0.030	0.173	90
6	0.040	0.200	90
7	0.050	0.224	90
8	0.060	0.245	90
9	0.080	0.283	88
10	0.060	0.245	88
11	0.040	0.200	89
12	0.040	0.200	89
13	0.045	0.212	90
14	0.045	0.212	90
15	0.040	0.200	90
16	0.040	0.200	91
Average	**0.053**	**0.227**	**90**

Calculations:	**Outlet**		
Molar weight, M_s =	**28.73**	**lb/mol**	$=\{(\%O_2 \times 32)+(\%CO_2 \times 44)+(\%N_2 \times 28)\} \times (1-B_{ws}/100))/100+B_{ws}/100*18$
Velocity, v_s =	**13.04**	**ft/sec**	$=85.49C_p \times (\Delta p)^{1/2} \times \{(t_s+460)/(P_{bar}+p_g/13.6)/M_s)\}^{1/2}$
Flow Rate, $Q_{s,ds}$ =	**21,631**	**dscfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92 \times (1-B_{ws}/100)$
Flow Rate, $Q_{s,act}$ =	**22,748**	**acfm**	$=v_s\pi D_s^2/4/144 \times 60$
Flow Rate, $Q_{s,std}$ =	**21,836**	**scfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92$

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BD Bard

Flow Measurements & Calculations

System 1 Outlet

Post-Test

Test Team:	RB, GSG		
		Measured values:	
EPA Methods:	1,2	**D_s (in.):**	73.00
Test Date:	June 19, 2020	**P_{bar} (in. Hg):**	29.90
Console ID:	C-015	**p_g (in. H_2O):**	0.11
Y_m	0.952	**O_2 (%):**	20.90
Probe Assembly ID:	P8-02	**CO_2 (%):**	0.00
Cp:	0.84	**B_{ws}(%):**	0.94
		Start Time:	13:45 - 13:55

Point	Δp (" H_2O)	$(\Delta p)^{1/2}$	t_s (°F)
1	0.070	0.265	95
2	0.060	0.245	95
3	0.040	0.200	95
4	0.035	0.187	95
5	0.045	0.212	95
6	0.050	0.224	96
7	0.040	0.200	96
8	0.050	0.224	95
9	0.060	0.245	97
10	0.055	0.235	96
11	0.040	0.200	96
12	0.030	0.173	96
13	0.035	0.187	96
14	0.035	0.187	97
15	0.040	0.200	96
16	0.040	0.200	96
Average	**0.045**	**0.211**	**96**

Calculations:

Molar weight, M_s =	**28.73**	**lb/mol**	$=\{(\%O_2 \times 32)+(\%CO_2 \times 44)+(\%N_2 \times 28)\} \times (1-B_{ws}/100))/100+B_{ws}/100*18$
Velocity, v_s =	**12.21**	**ft/sec**	$=85.49C_p \times (\Delta p)^{1/2} \times \{(t_s+460)/(P_{bar}+p_g/13.6)/M_s)\}^{1/2}$
Flow Rate, $Q_{s,ds}$ =	**20,029**	**dscfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92 \times (1-B_{ws}/100)$
Flow Rate, $Q_{s,act}$ =	**21,292**	**acfm**	$=v_s\pi D_s^2/4/144 \times 60$
Flow Rate, $Q_{s,std}$ =	**20,220**	**scfm**	$=v_s\pi D_s^2/4/144 \times 60 \times (t_{std}+460)/(t_s+460) \times (P_{bar}+p_g/13.6)/29.92$

APPENDIX B

EXAMPLE CALCULATIONS

AND

NOMENCLATURE

EXAMPLE CALCULATIONS

$A_n = D_n^2 \pi / 4$

$A_s = D_s^2 \pi / 4$

$B_{ws} = V_{w(std)} / (V_{m(std)} + V_{w(std)})$

$c_{analyte} = (m_{analyte} / V_{m(std)})$ (35.31466 ft^3/m^3)

$`c_{analyte} = (m_{analyte} / V_{m(std)})$ (0.015432 gr/mg)

$c_{analyte} = `c_{analyte}\ MW_{analyte}$ / 24.04 l/mol

$CC = t_{0.975} (S_d / n^{1/2})$

$d = 1/n (\Sigma d_i)$

$DE = (E_{Inlet} - E_{Outlet}) / E_{,Inlet} \times 100\%$

$E_{analyte} = (m_{analyte} / V_{m(std)})\ Q_{sd}$ (60 min/hr) (2.2046×10^{-6} lb./mg)

$E_{analyte} = c_{analyte}\ Q_{sd}$ (60 min/hr) (2.2046×10^{-6} lb./mg)

$I = 100\ T_s (K_3 V_{lc} + Y_m V_m P_m / T_m) / (60\ \theta\ v_s P_s A_n)$

where K_3 = 0.002669 (in. Hg ft^3) / (mL °R)

$K_I = [(2.0084 \times 10^7\ \Delta H_@)\ A_n (1 - B_{ws})]^2 (M_d / M_s) (T_m / T_s) (P_s / P_m)$

$M_d = 0.44 (\%\ CO_2) + 0.32 (\%\ O_2) + 0.28 (\%\ N_2 + \%\ CO)$

$M_s = M_d (1 - B_{ws}) + M_w B_{ws}$

$P = Qsd / \text{F-Factor} \times 60 \times (20.9 - O_2) / 20.9$

$P_m = P_{bar} + \Delta H / 13.6$

$P_s = P_{bar} + p_g / 13.6$

$Q_a = (60\ s/min)\ v_s A_s$

$Q_{sd} = (60\ s/min) (1 - B_{ws})\ v_s A_s (T_{std} / T_s) (P_s / P_{std})$

$RA = [Abs(d) + Abs(CC)]/RM$

$S_d = [(\Sigma d_i^2 - (\Sigma di)^2/n)/(n-1)]^{1/2}$

$T_m = t_m + 460°$

$T_s = t_s + 460°$

$V_{m(std)} = V_m Y_m (T_{std} / T_m) (P_m / P_{std})$

$V_{w(std)} = (V_{lc}\ \rho_w\ R\ T_{std}) / (M_w P_{std})$

$v_s = K_p C_p [\Delta p]^{1/2} [T_s / (P_s M_s)]^{1/2}$

NOMENCLATURE

Symbol	Units	Description
Abs(x)	dimensionless	Absolute value of parameter x
A_n	ft^2	Area of the nozzle
A_s	ft^2	Area of the stack
B_{ws}	dimensionless	Volume proportion of water in the stack gas stream
C_p	dimensionless	Type S pitot tube coefficient
$c_{analyte}$	mg/dscm	Concentration of analyte in dry stack gas, standardized
$'c_{analyte}$	gr./dscf	Concentration of analyte in dry stack gas, standardized
$'c_{analyte}$	ppm	Concentration of analyte in dry stack gas, standardized
CC	dimensionless	One-tailed 2.5% error confidence coefficient
d	ppm	Arithmetic mean of differences
d_i	ppm	Difference between individual CEM and reference method concentration value
D_n	inches	Internal diameter of the nozzle at the entrance orifice
D_s	inches	Internal diameter of the stack at sampling location
DE	percent	Destruction efficiency
ΔH	inches H_2O	Average pressure differential across the meter orifice
$\Delta H_@$	inches H_2O	Orifice pressure differential that corresponds to 0.75 cfm of air at 68 °F and 29.92 inches of Hg
Δp	inches H_2O	Velocity head of stack gas
$E_{analyte}$	lb./hour	Emission rate of analyte, time basis
I	percent	Isokinetic sampling ratio expressed as percentage
K_I	dimensionless	K-factor, ratio of DH to DP, ideal
K_p	$ft[(lb/lb\text{-}mol)(in. Hg)]^{1/2}$	Type S pitot tube constant,
	$s[(°R)(in. H_2O)]^{1/2}$	= 85.49
L_p	cfm	Measured post-test leakage rate of the sampling train
M_d	lb./lb.-mole	Molecular weight of gas at the DGM
M_s	lb./lb.-mole	Molecular weight of gas at the stack

NOMENCLATURE

Symbol	Units	Description
M_w	lb./lb.-mole	Molecular weight of water,
		= 18.0
$m_{analyte}$	mg	Mass of analyte in the sample
n	dimensionless	Number of data points
P	MMBtu	Fuel firing rate
P_{bar}	inches Hg	Barometric pressure at measurement site
P_{input}	tons/hour	Process dry mass input rate
p_g	inches H_2O	Gauge (static) pressure of stack gas
P_m	inches Hg	Absolute pressure of meter gases
P_s	inches Hg	Absolute pressure of stack gases
P_{std}	inches Hg	Standard absolute pressure
		= 29.92
Q_a	cfm	Volumetric flow rate of actual stack gas
Q_{sd}	dscfm	Volumetric flow rate of dry stack gas, standardized
R	(in. Hg)(ft^3)	Ideal gas constant,
	(lb-mole)(°R)	= 21.85
RA	percent	Relative accuracy
RE	percent	Removal efficiency
RM	ppm	Average reference method concentration
r_w	lb/mL	Density of water,
		= 0.002201
r_a	g/mL	Density of acetone,
		= 0.7899
S_d	dimensionless	Standard deviation
T_m	°R	Absolute temperature of dry gas meter
T_s	°R	Absolute temperature of stack gas
T_{std}	°R	Standard absolute temperature,
		= 528
$t_{0.975}$	dimensionless	2.5 percent error t-value
t_m	°F	Temperature of DGM
t_s	°F	Temperature of stack gas
θ	minutes	Total sampling time

NOMENCLATURE

Symbol	Units	Description
V_{lc}	mL	Total volume of liquid collected
V_m	dcf	Volume of gas sample as measured by the DGM
$V_{m(std)}$	dscf	Volume of gas sample as measured by the DGM, standardized
$V_{w(std)}$	scf	Volume of water vapor in the gas sample, standardized
v_s	ft./sec	Velocity of stack gas
Y_m	dimensionless	DGM calibration coefficient
Y_c	dimensionless	DGM calibration check value
Y_w	dimensionless	Reference (wet) gas meter calibration coefficient
% CO_2	percent	Percent CO_2 by volume, dry basis
% O_2	percent	Percent O_2 by volume, dry basis
% N_2	percent	Percent N_2 by volume, dry basis

APPENDIX C

FIELD DATA

System 1

Inlet

Advanced Industrial Resources
Duct Velocity & Flow Calculation Sheet

Client: BD Bard
Location: Covington, GA
Source: Unit 1 Inlet
Test Team: RB/ SG
EPA Methods: 1,2,3,4
Test Date: 6/19/2020
Console ID: C-16
Probe Assembly ID: P4-03

Measured values:
D_s (in.): 50.50
Y_m / $\Delta H_@$: 0.959/ 1.919
C_p: 0.84
t_{amb} (°F): 80
Assumed B_{ws} (%): 1
O_2 (%): 21
CO_2 (%): 0

static = - 2.0
wet bulb =

Start time: 8:50	Start time: 13:05	Start time: 14:00	Start time:
Stop time: 9:00	Stop time: 13:10	Stop time: 14:08	Stop time:

	Pre-1		Post-1; Pre-2		Post-2; Pre-3		Post-3	
P_{bar} (in. Hg):	29.90		29.90		29.90			
p_g (in. H_2O):	-2.0		-1.9"		-2.0			
Traverse Point	Δp ("H_2O)	t_s (°F)	Δp ("H_2O)	t_s (°F)	Δp ("H_2O)	t_s (°F)	Δp ("H_2O)	t_s (°F)
1	0.17	93	~~0.08~~ 0.1	99°F	0.10	110		
2	0.18	93	0.11	99	0.13	108		
3	0.21	93	0.12	99	0.14	109		
4	0.24	93	0.13	99	0.14	109		
5	0.24	93	0.14	100	0.14	109		
6	0.23	93	0.14	99	0.15	109		
7	0.18	93	0.16	99	0.20	109		
8	0.15	93	0.12	99	0.21	109		
9	0.16	93	0.11	99	0.16	110		
10	0.19	93	0.12	99	0.15	110		
11	0.20	94	0.14	100	0.15	110		
12	0.25	94	0.13	100	0.20	110		
13	0.25	94	0.16	99	0.22	110		
14	0.24	93	0.16	99	0.23	110		
15	0.26	93	0.15	99	0.22	110		
16	0.24	93	0.17	99	0.22	110		
Average						110		

wb 66 70 75

Test Team Leader Review:
Data Entry Review: [signature]

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Source Description Sheets

Client: BD Bard
Location: Covington, GA
Source: Unit 1 Inlet

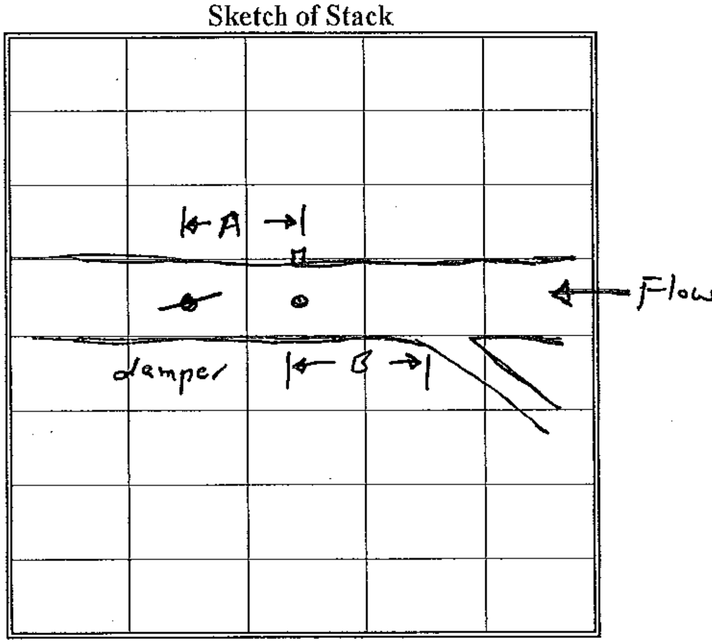
Date: 6/19/2020
Test Team: RB/SG

D_n (in.): N/A
A_n (ft^2): N/A
D_s (in.): 56.50
A_s (ft^2):
Length A (in.): 45
Length B (in.): 102

t_{amb} (°F): 85
Assumed B_{ws}: 1
P_{bar} (in. Hg): 29.90
P_g (in. H_2O): 2.0
% O_2: 21
% CO_2: 0
Console ID: C-16
Y: 0.959
$\Delta H_@$: 1.918
C_p: 0.84
K-Factor: N/A

Point	Δp (in. H_2O)	t_s (°F)
1	0.17	93
2	0.18	93
3	0.21	93
4	0.24	93
5	0.24	93
6	0.23	93
7	0.18	93
8	0.15	93
9		
10		
11		
12		
Change Ports		
1	0.16	93
2	0.19	93
3	0.20	94
4	0.25	94
5	0.25	94
6	0.24	93
7	0.26	93
8	0.24	93
9		
10		
11		
12		

Sketch of Stack



Test Team Leader Review:
Data Entry Review:

System 1
Outlet

Advanced Industrial Resources, Inc.

Field Data Sheet

Client:	BN Bond	Test Date:	6/19/2020
Location:	Covington GA	Console ID:	C-15
Source:	Unit 1 Exhaust Stack	Y_m / $\Delta H_@$:	0.952 / 1.791
Test Team:	RB/TG	Sampling Box ID:	B-4
EPA Methods:	1,2,3,4	Probe Assembly ID:	PB-02
D_s (in.):	73.0	D_n (in.):	N/A
% O_2	21	Assumed B_{ws}:	1
% CO_2	0	P_{bar} (in. Hg):	29.90
Start Run:	9:00	p_g (in. H_2O):	+ 0.15
End Run:	10:15	Minutes/Point:	
Run Number:	1	K-Factor:	N/A

Point	Meter (dcf)	Δp (Inches H_2O)	ΔH (Inches H_2O)	t_s (Temperature Readings (°F))	Probe	Filter Box	Last Impinger	t_m Inlet	t_m Outlet	Filter Exit (M5 or CPM)	Vacuum (in. Hg)
1	180.871		1.0	90	N/A	N/A	53	70	70	N/A	7
2											
3											
4				91			55				7
5								80	80		
6											
7				92			57				7
8											
9				93			60	82	82		7
10											
11											
12				94			61	85	85		7
Change Ports											
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
End	335.461										

Moisture Collected (g)

	Initial	Final	Net
Body:	200	227	27
Silica Gel:	200.0	202	2
Gel Number:		Total:	29

Pre-Run Leak Checks (dcfm @ "Hg)

Sampling Line: ✓ @ ✓

Pitot A: ✓

Pitot B: ✓

Post-Run Leak Checks (dcfm @ "Hg)

Sampling Line: 0.003 @ 10

Pitot A: 4.5

Pitot B: 6.0

Silica Gel Desc. (initial): Blue

Silica Gel Desc. (final): Lt. Blue

Test Team Leader Review:

Data Entry Review: [initials]

Reagent 1: Lot No:

Reagent 2: Lot No:

REV021717

Advanced Industrial Resources

Duct Velocity & Flow Calculation Sheet

Client:	BD Bard	**Measured values:**	
Location:	Covington, GA	**D_s (in.):**	73.0
Source:	Unit 1 Exh. Stack	**Y_m / $\Delta H_@$:**	0.952 / 1.791
Test Team:	RB/SG	**C_p:**	0.84
EPA Methods:	1,2,3,4	**t_{amb} (°F)**	80
Test Date:	6/19/2020	**Assumed B_{ws} (%):**	1
Console ID:	C-15	**O_2 (%):**	21
Probe Assembly ID:	PS-02	**CO_2 (%):**	0

	Pre-1		Post-1; Pre-2		Post-2; Pre-3		Post-3			
Start time:	9:15		10:30		12:45		12:45		13:48	
Stop time:	9:21		10:35		12:50		12:50		13:55	
P_{bar} (in. Hg):	29.90		29.90		29.90		29.90		29.90	
p_g (in. H_2O):	+0.15		+0.15		+0.14		+0.14		+0.11	
Traverse Point	**Δp (" H_2O)**	**t_s (°F)**	**Δp (" H_2O)**	**t_s (°F)**	**Δp (" H_2O)**	**t_s (°F)**	**Δp (" H_2O)**	**t_s (°F)**	ΔP	t_s
1	0.10	91	0.10	92	0.07	93	0.09	93	0.07	95
2	0.09	91	0.10	92	0.06	94	0.08	94	0.06	95
3	0.05	91	0.06	92	0.05	94	0.07	94	0.04	95
4	0.04	90	0.04	92	0.035	94	0.045	94	0.035	95
5	0.03	90	0.03	92	0.030	94	0.045	94	0.045	95
6	0.04	90	0.03	93	0.04	94	0.05	94	0.05	96
7	0.05	90	0.05	92	0.04	94	0.06	94	0.04	96
8	0.06	90	0.05	93	0.035	93	0.055	94	0.05	95
9	0.08	88	0.08	93	RB		0.09	94	0.06	97
10	0.06	88	0.05	92			0.07	94	0.055	96
11	0.04	89	0.04	92			0.055	94	0.04	96
12	0.04	89	0.04	93			0.04	94	0.03	96
13	0.045	90	0.04	93			0.04	94	0.035	96
14	0.045	90	0.04	93			0.05	94	0.035	97
15	0.04	90	0.04	92			0.04	94	0.04	96
16	0.04	91	0.04	92			0.05	94	0.04	96
Average										

Test Team Leader Review: RB

Data Entry Review: ___________

APPENDIX D

CALIBRATION DATA

Advanced Industrial Resources, Inc.

Dry Gas Meter Calibration Data

Dry Gas Meter	
Console ID:	C-15
Serial Number:	1011030

Reference Meter	
Meter ID:	M5RFM1
Calibration Factor, Y_w:	0.998

Date: 12/13/19

Barometric Pressure, P_b (in. Hg): 29.45

Performed By: RB

Reviewed By:

Data								
				Temperatures (°F)				Time Elapsed
		Reference Meter Volume	Dry Gas Meter Volume	Reference Meter	Dry Gas Meter			
Vacuum (in. Hg)	ΔH (in. H_2O)	V_w (ft^3)	V_m (ft^3)	t_w	init. t_i	final t_f	avg. t_m	θ (min.)
5.0	0.50	7.430	7.752	61	60.0	60.0	60.0	19.00
5.0	1.00	5.617	5.859	61	60.0	60.0	60.0	10.00
5.0	1.50	6.933	7.241	61	61.0	61.0	61.0	10.00
5.0	2.00	7.127	7.454	62	63.0	63.0	63.0	9.00
5.0	2.50	6.230	6.542	62	65.0	65.0	65.0	7.00

Calculations						
ΔH (inches H_2O)	Y_m (dimensionless)	Variation (dimensionless)		$\Delta H_@$ (inches H_2O)	Variation (dimensionless)	
0.50	0.954	0.002	**PASS**	1.845	0.053	**PASS**
1.00	0.953	0.001	**PASS**	1.788	-0.003	**PASS**
1.50	0.952	0.000	**PASS**	1.757	-0.034	**PASS**
2.00	0.951	-0.001	**PASS**	1.796	0.005	**PASS**
2.50	0.950	-0.002	**PASS**	1.770	-0.021	**PASS**
Averages:	**0.952**	**PASS**		**1.791**	**PASS**	

Where:

Y_m is the ratio of the reading of the reference meter to that of the dry gas meter (DGM); variance limit: ±0.02.

$$Y_m = \frac{Y_w\, V_w\, P_b\, (t_m + 460)}{V_m\, (P_b + \Delta H/13.6)\, (t_w + 460)}$$

$\Delta H_@$ is the orifice pressure differential (inches H_2O) that corresponds to 0.75 cfm of air at 68 °F and 29.92 inches of mercury; variance limit: ±0.20.

$$\Delta H_@ = \frac{0.0317\, \Delta H\, ((t_w + 460)\, \theta)^2}{P_b\, (t_m + 460)\, (Y_w\, V_w)^2}$$

Advanced Industrial Resources, Inc.

Dry Gas Meter Calibration Data

Dry Gas Meter	
Console ID:	C-15
Serial Number:	

Reference Meter	
Meter ID:	MSRFM1
Calibration Factor, Y_w:	0.9980

Date:	06/19/20	**Accepted Y_m:**	0.952
Barometric Pressure, P_b (in. Hg):	29.81	**Performed By:**	JG

Data

Vacuum (in. Hg)	ΔH (in. H_2O)	Net Reference Meter Volume V_w (ft^3)	Net Dry Gas Meter Volume V_m (ft^3)	Temperatures (°F) Reference Meter t_w	Dry Gas Meter init. t_i	Dry Gas Meter final t_f	Dry Gas Meter avg. t_m	Time Elapsed θ (min.)
5.0	3.00	6.148	6.259	76	75	75	75.0	6.00
5.0	3.00	6.219	6.375	77	76	76	76.0	6.00
5.0	3.00	6.105	6.288	81	79	79	79.0	6.00

Calculations

ΔH (inches H_2O)	Y_m	Variation (dimensionless)		$\Delta H_@$ (inches H_2O)	Variation (dimensionless)	
3.00	0.971	0.0066	**PASS**	1.638	-0.003	**PASS**
3.00	0.965	-0.0001	**PASS**	1.604	-0.037	**PASS**
3.00	0.958	-0.0064	**PASS**	1.680	0.039	**PASS**
Averages:	**0.965**	**PASS**		**1.641**	**PASS**	

Calculations

	Low Tolerance	High Tolerance	% diff	Pass or Fail?
****Note: Avg Y_m cannot be (< or >) 5% of the Accepted Y_M**	**0.904**	**1.000**	**1%**	**PASS**

Where:

Y_m is the ratio of the reading of the reference meter to that of the dry gas meter (DGM); variance limit: ±0.02.

$$Y_m = \frac{Y_w \, V_w \, P_b \, (t_m + 460)}{V_m \, (P_b + \Delta H/13.6) \, (t_w + 460)}$$

$\Delta H_@$ is the orifice pressure differential (inches H_2O) that corresponds to 0.75 cfm of air at 68 °F and 29.92 inches of mercury; variance limit: ±0.20.

$$\Delta H_@ = \frac{0.0317 \, \Delta H \, ((t_w + 460) \, \theta)^2}{P_b \, (t_m + 460) \, (Y_w \, V_w)^2}$$

Advanced Industrial Resources, Inc.

Dry Gas Meter Calibration Data

Dry Gas Meter	
Console ID:	C16
Serial Number:	

Reference Meter	
Meter ID:	MSRFM - 1
Calibration Factor, Y_w:	0.998

Date: 12/12/19

Barometric Pressure, P_b (in. Hg): 29.45

Performed By: RB

Reviewed By:

Data

				Temperatures (°F)				Time
		Reference	Dry Gas	Reference	Dry Gas Meter			Elapsed
Vacuum	ΔH	Meter Volume	Meter Volume	Meter	init.	final	avg.	θ
(in. Hg)	(in. H_2O)	V_w (ft^3)	V_m (ft^3)	t_w	t_i	t_f	t_m	(min.)
7.0	0.50	5.772	5.904	76	67.0	67.0	67.0	15.00
7.0	1.00	5.512	5.636	76	68.0	68.0	68.0	10.00
7.0	1.50	6.833	6.993	76	69.0	69.0	69.0	10.00
7.0	2.00	6.270	6.431	76	71.0	71.0	71.0	8.00
7.0	2.50	7.057	7.242	76	72.0	72.0	72.0	8.00

Calculations

ΔH (inches H_2O)	Y_m	Variation (dimensionless)		$\Delta H_@$ (inches H_2O)	Variation (dimensionless)	
0.50	0.958	-0.001	**PASS**	1.989	0.072	**PASS**
1.00	0.959	0.000	**PASS**	1.935	0.018	**PASS**
1.50	0.959	0.000	**PASS**	1.886	-0.032	**PASS**
2.00	0.959	0.000	**PASS**	1.904	-0.014	**PASS**
2.50	0.959	0.000	**PASS**	1.875	-0.043	**PASS**
Averages:	**0.959**	**PASS**		**1.918**	**PASS**	

Where:

$\mathbf{Y_m}$ is the ratio of the reading of the reference meter to that of the dry gas meter (DGM); variance limit: ±0.02.

$$Y_m = \frac{Y_w V_w P_b (t_m + 460)}{V_m (P_b + \Delta H/13.6)(t_w + 460)}$$

$\mathbf{\Delta H_@}$ is the orifice pressure differential (inches H_2O) that corresponds to 0.75 cfm of air at 68 °F and 29.92 inches of mercury; variance limit: ±0.20.

$$\Delta H_@ = \frac{0.0317 \Delta H ((t_w + 460)\theta)^2}{P_b (t_m + 460)(Y_w V_w)^2}$$

Advanced Industrial Resources, Inc.

Dry Gas Meter Calibration Data

Dry Gas Meter	
Console ID:	C-16
Serial Number:	

Reference Meter	
Meter ID:	MSRFM1
Calibration Factor, Y_w:	0.9980

Date:	06/19/20	**Accepted Y_m:**	0.959
Barometric Pressure, P_b (in. Hg):	29.81	**Performed By:**	SS

Data

Vacuum (in. Hg)	ΔH (in. H_2O)	Net Reference Meter Volume V_w (ft^3)	Net Dry Gas Meter Volume V_m (ft^3)	Temperatures (°F) Reference Meter t_w	Dry Gas Meter init. t_i	Dry Gas Meter final t_f	Dry Gas Meter avg. t_m	Time Elapsed θ (min.)
5.0	3.00	5.913	5.948	68	66	68	67.0	6.00
5.0	3.00	5.883	5.942	69	68	70	69.0	6.00
5.0	3.00	5.866	5.944	70	70	72	71.0	6.00

Calculations

ΔH (inches H_2O)	Y_m	Variation (dimensionless)		$\Delta H_@$ (inches H_2O)	Variation (dimensionless)	
3.00	0.983	0.0019	**PASS**	1.745	-0.015	**PASS**
3.00	0.981	-0.0003	**PASS**	1.762	0.003	**PASS**
3.00	0.980	-0.0016	**PASS**	1.773	0.013	**PASS**
Averages:	**0.981**	**PASS**		**1.760**	**PASS**	

Calculations

****Note: Avg Y_m cannot be (< or >) 5% of the Accepted Y_M**	Low Tolerance	High Tolerance	% diff	Pass or Fail?
	0.911	**1.007**	**2%**	**PASS**

Where:

Y_m is the ratio of the reading of the reference meter to that of the dry gas meter (DGM); variance limit: ±0.02.

$$Y_m = \frac{Y_w V_w P_b (t_m + 460)}{V_m (P_b + \Delta H/13.6)(t_w + 460)}$$

$\Delta H_@$ is the orifice pressure differential (inches H_2O) that corresponds to 0.75 cfm of air at 68 °F and 29.92 inches of mercury; variance limit: ±0.20.

$$\Delta H_@ = \frac{0.0317 \Delta H ((t_w + 460)\theta)^2}{P_b (t_m + 460)(Y_w V_w)^2}$$

Advanced Industrial Resources, Inc.

Thermocouple Calibration Data

Thermometer ID: RT-01 ; RT-03 **Date:** 06/22/20

Bias: 0 **Performed By:** AG

Apparatus ID	Apparatus Description	Reference Temperature Reading		Indicated Temperature		Relative Variation
		°F	°R	°F	°R	%
P8-02	Stack Temp.	32	492	32	492	0.0
P8-02	Stack Temp.	210	670	210	670	0.0
P8-02	Stack Temp.	32	492	32	492	0.0
P8-02	Stack Temp.	210	670	210	670	0.0
B-4	Filter Temp.	32	492	32	492	0.0
B-4	Filter Temp.	210	670	210	670	0.0
B-4	Exit Imp. Temp.	32	492	32	492	0.0
B-4	Exit Imp. Temp.	210	670	210	670	0.0
C-015	Meter In Temp.	32	492	32	492	0.0
C-015	Meter In Temp.	210	670	210	670	0.0
C-015	Meter Out Temp.	32	492	32	492	0.0
C-015	Meter Out Temp.	210	670	210	670	0.0
B-4	Filter Exit Temp.	32	492	32	492	0.0
B-4	Filter Exit Temp.	210	670	210	670	0.0
P8-02	Probe Temp.	32	492	33	493	0.2
P8-02	Probe Temp.	210	670	211	671	0.1
P8-02	Probe Temp.	32	492	33	493	0.2
P8-02	Probe Temp.	210	670	210	670	0.0

Thermocouple Calibration Procedure

A. References

1. Mercury-in-glass refernce thermometer, calibrated against thermometric fixed points.
2. Thermometric fixed points, including ice bath and boiling water (corrected for barometric pressure)

B. Measurement

1. Compare field temperature sensors against the reference thermometer. Agreement must be within ±1.5% of the absolute reference temperature.

Advanced Industrial Resources, Inc.

Thermocouple Calibration Data

Thermometer ID: RT-01 ; RT-03 **Date:** 06/22/20
Bias: 0 **Performed By:** AG

Apparatus ID	Apparatus Description	Reference Temperature Reading		Indicated Temperature		Relative Variation
		°F	°R	°F	°R	%
P4-03	Stack Temp.	32	492	32	492	0.0
P4-03	Stack Temp.	210	670	210	670	0.0
P4-03	Stack Temp.	32	492	32	492	0.0
P4-03	Stack Temp.	210	670	212	672	0.3
C-016	Meter In Temp.	32	492	33	493	0.2
C-016	Meter In Temp.	210	670	210	670	0.0
C-016	Meter Out Temp.	32	492	32	492	0.0
C-016	Meter Out Temp.	210	670	211	671	0.1
P4-03	Probe Temp.	32	492	32	492	0.0
P4-03	Probe Temp.	210	670	211	671	0.1

Thermocouple Calibration Procedure

A. References

1. Mercury-in-glass refernce thermometer, calibrated against thermometric fixed points.
2. Thermometric fixed points, including ice bath and boiling water (corrected for barometric pressure)

B. Measurement

1. Compare field temperature sensors against the reference thermometer. Agreement must be within ±1.5% of the absolute reference temperature.

Advanced Industrial Resources, Inc.
Type-S Pitot Tube Assembly Inspection Data Sheet

Date: 6/19/2020
Pitot Tube Assembly: P4-03   Caliper ID: CL-04
Performed by: SS

Pitot tube assembly level? x yes ____ no

Pitot tube openings damaged? ____ yes (explain below) x no

α_1= 1 ^{o}(<10^o) β_1= 1 ^{o}(<5^o)

α_2= 1 ^{o}(<10^o) β_2= 1 ^{o}(<5^o)

γ = 1 ^{o} θ = 1 ^{o} A= 0.96 in.

z = A sin γ = 0.0167 in.   <1/8 in. (0.125 in.)

w = A sin θ = 0.0167 in.   <1/32 in. (0.03125 in.)

$\mathbf{P_A}$= 0.480 in. $\mathbf{P_B}$= 0.480 in.

D_t = 0.335 cm (in.) $\mathbf{P / D_t}$ = 1.43 (1.05 </= and </= 1.50)
$P_a = P_b = P$

X = 0.82 (>0.75 in.) (Dist. between pitot and nozzle)
Y = 3.85 (>3.0 in.) (Dist. from nozzle union to pitot tube openings)
Z = 0.81 (>0.75 in.) (Dist. between pitot and stack thermocouple)

Does the pitot tube assembly meet the Method 2 requiremnets? ____ yes
____ no (explain below)

If the Method 2 requirements are met then a coefficient of **0.84** is assigned to the pitot tube assembly being inspected.

Advanced Industrial Resources, Inc.
Type-S Pitot Tube Assembly Inspection Data Sheet

Date: 6/19/2020

Pitot Tube Assembly: P8-02 Caliper ID: CL-04

Performed by: SS

Pitot tube assembly level? x yes ___ no

Pitot tube openings damaged? ___ yes (explain below) x no

α_1= 1 ^{o}(<10^o) β_1= 1 ^{o}(<5^o)

α_2= 1 ^{o}(<10^o) β_2= 1 ^{o}(<5^o)

γ = 1 ^{o} θ = 1 ^{o} A= 0.98 in.

z = A sin γ = 0.0171 in. <1/8 in. (0.125 in.)

w = A sin θ = 0.0171 in. <1/32 in. (0.03125 in.)

P_A= 0.490 in. **P_B=** 0.490 in.

D_t = 0.405 cm (in.) **P / D_t =** 1.21 (1.05 </= and </= 1.50)

$P_a = P_b = P$

X = 1.11 (>0.75 in.) (Dist. between pitot and nozzle)

Y = 3.61 (>3.0 in.) (Dist. from nozzle union to pitot tube openings)

Z = 2.67 (>0.75 in.) (Dist. between pitot and stack thermocouple)

Does the pitot tube assembly meet the Method 2 requiremnets? x yes

___ no (explain below)

If the Method 2 requirements are met then a coefficient of **0.84** is assigned to the pitot tube assembly being inspected.

APPENDIX C

LABORATORY ANALYTICAL REPORT

eurofins | Air Toxics

6/29/2020
Mr. Robert DeMott
Ramboll Environ
10150 Highland Manor Drive
Suite 440
Tampa FL 33610

Project Name: K&S Bard
Project #:
Workorder #: 2006566

Dear Mr. Robert DeMott

The following report includes the data for the above referenced project for sample(s) received on 6/22/2020 at Air Toxics Ltd.

The data and associated QC analyzed by Modified TO-15 SIM are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Eurofins Air Toxics Inc. for your air analysis needs. Eurofins Air Toxics Inc. is committed to providing accurate data of the highest quality. Please feel free to contact the Project Manager: Brian Whittaker at 916-985-1000 if you have any questions regarding the data in this report.

Regards,

Brian Whittaker

Brian Whittaker
Project Manager

eurofins | Air Toxics

WORK ORDER #: 2006566

Work Order Summary

CLIENT:	Mr. Robert DeMott Ramboll 10150 Highland Manor Drive Suite 440 Tampa, FL 33610	**BILL TO:**	Accounts Payable Ramboll 10150 Highland Manor Drive Suite 440 Tampa, FL 33610
PHONE:	813-628-4325	**P.O. #**	1690014483
FAX:	813-628-4983	**PROJECT #**	K&S Bard
DATE RECEIVED:	06/22/2020	**CONTACT:**	Brian Whittaker
DATE COMPLETED:	06/29/2020		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	FINAL PRESSURE
01A	SYS1-STACK 20200619	Modified TO-15 SIM	10.5 "Hg	5 psi
02A	SYS1-STACK DUP 20200619	Modified TO-15 SIM	9.5 "Hg	5 psi
02AA	SYS1-STACK DUP 20200619 Lab Duplic	Modified TO-15 SIM	9.5 "Hg	5 psi
03A	SYS1-IN 20200619	Modified TO-15 SIM	8.0 "Hg	5 psi
04A	Lab Blank	Modified TO-15 SIM	NA	NA
04B	Lab Blank	Modified TO-15 SIM	NA	NA
05A	CCV	Modified TO-15 SIM	NA	NA
05B	CCV	Modified TO-15 SIM	NA	NA
06A	LCS	Modified TO-15 SIM	NA	NA
06AA	LCSD	Modified TO-15 SIM	NA	NA
06B	LCS	Modified TO-15 SIM	NA	NA
06BB	LCSD	Modified TO-15 SIM	NA	NA

CERTIFIED BY: Heidi Hayes DATE: 06/29/20

Technical Director

Air Toxics

LABORATORY NARRATIVE
EPA TO-15 Ethylene oxide (SIM)
Ramboll Environ
Workorder# 2006566

Three 6 Liter Summa Canister (EO) samples were received on June 22, 2020. The laboratory performed analysis via EPA Method TO-15 using GC/MS in the SIM acquisition mode for the measurement of Ethylene oxide in ambient air.

Receiving Notes

There were no receiving discrepancies.

Analytical Notes

Ethylene Oxide is not included on the laboratory's NELAP scope of accreditation for TO-15 SIM. However, TO-15 method and NELAP quality requirements were met.

As per project specific client request the laboratory has reported estimated values for target compound hits that are below the Reporting Limit but greater than the Method Detection Limit. The canisters used for this project have been certified to the Reporting Limit for Ethylene Oxide. Concentrations that are below the level at which the canister was certified may be false positives.

Definition of Data Qualifying Flags

Nine qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit, LOD, or MDL value. See data page for project specific U-flag definition.

UJ- Non-detected compound associated with low bias in the CCV

N - The identification is based on presumptive evidence.

CN - See Case Narrative

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	SYS1-STACK 20200619		
Lab ID:	2006566-01A	**Date/Time Analyzed:**	6/25/20 02:27 AM
Date/Time Collected:	6/19/20 01:03 PM	**Dilution Factor:**	2.06
Media:	6 Liter Summa Canister (EO)	**Instrument/Filename:**	msd19.i / 19062423sim

Compound	**CAS#**	**MDL (ug/m3)**	**LOD (ug/m3)**	**Rpt. Limit (ug/m3)**	**Amount (ug/m3)**
Ethylene Oxide	75-21-8	0.038	D	0.18	3.6

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	SYS1-STACK DUP 20200619		
Lab ID:	2006566-02A	**Date/Time Analyzed:**	6/25/20 03:22 PM
Date/Time Collected:	6/19/20 01:03 PM	**Dilution Factor:**	1.96
Media:	6 Liter Summa Canister (EO)	**Instrument/Filename:**	msd19.i / 19062510sim

Compound	CAS#	MDL (ug/m3)	LOD (ug/m3)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Ethylene Oxide	75-21-8	0.036	D	0.18	2.9

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

eurofins | Air Toxics

Client ID:	SYS1-STACK DUP 20200619 Lab Duplic		
Lab ID:	2006566-02AA	**Date/Time Analyzed:**	6/25/20 04:01 PM
Date/Time Collected:	6/19/20 01:03 PM	**Dilution Factor:**	1.96
Media:	6 Liter Summa Canister (EO)	**Instrument/Filename:**	msd19.i / 19062511sim

Compound	CAS#	MDL (ug/m3)	LOD (ug/m3)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Ethylene Oxide	75-21-8	0.036	D	0.18	3.0

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	SYS1-IN 20200619		
Lab ID:	2006566-03A	**Date/Time Analyzed:**	6/25/20 04:40 PM
Date/Time Collected:	6/19/20 01:03 PM	**Dilution Factor:**	1.83
Media:	6 Liter Summa Canister (EO)	**Instrument/Filename:**	msd19.i / 19062512sim

Compound	CAS#	MDL (ug/m3)	LOD (ug/m3)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Ethylene Oxide	75-21-8	0.034	D	0.16	250

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	Lab Blank		
Lab ID:	2006566-04A	**Date/Time Analyzed:**	6/24/20 12:21 PM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062406sim

Compound	CAS#	MDL (ug/m3)	LOD (ug/m3)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Ethylene Oxide	75-21-8	0.018	D	0.090	Not Detected

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

eurofins | Air Toxics

Client ID:	Lab Blank		
Lab ID:	2006566-04B	**Date/Time Analyzed:**	6/25/20 12:18 PM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062506sim

Compound	CAS#	MDL (ug/m3)	LOD (ug/m3)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Ethylene Oxide	75-21-8	0.018	D	0.090	Not Detected

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	CCV		
Lab ID:	2006566-05A	**Date/Time Analyzed:**	6/24/20 09:40 AM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062402sim

Compound	CAS#	%Recovery
Ethylene Oxide	75-21-8	91

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	CCV		
Lab ID:	2006566-05B	**Date/Time Analyzed:**	6/25/20 09:47 AM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062502sim

Compound	CAS#	%Recovery
Ethylene Oxide	75-21-8	88

D: Analyte not within the DoD scope of accreditation.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	LCS		
Lab ID:	2006566-06A	**Date/Time Analyzed:**	6/24/20 10:21 AM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062403sim

Compound	CAS#	%Recovery
Ethylene Oxide	75-21-8	95

D: Analyte not within the DoD scope of accreditation.

* % Recovery is calculated using unrounded analytical results.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	LCSD		
Lab ID:	2006566-06AA	**Date/Time Analyzed:**	6/24/20 11:02 AM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062404sim

Compound	CAS#	%Recovery
Ethylene Oxide	75-21-8	96

D: Analyte not within the DoD scope of accreditation.

* % Recovery is calculated using unrounded analytical results.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	LCS		
Lab ID:	2006566-06B	**Date/Time Analyzed:**	6/25/20 10:25 AM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062503sim

Compound	CAS#	%Recovery
Ethylene Oxide	75-21-8	89

D: Analyte not within the DoD scope of accreditation.

* % Recovery is calculated using unrounded analytical results.

MODIFIED EPA METHOD TO-15 GC/MS SIM
K&S Bard

Client ID:	LCSD		
Lab ID:	2006566-06BB	**Date/Time Analyzed:**	6/25/20 11:03 AM
Date/Time Collected:	NA - Not Applicable	**Dilution Factor:**	1.00
Media:	NA - Not Applicable	**Instrument/Filename:**	msd19.i / 19062504sim

Compound	CAS#	%Recovery
Ethylene Oxide	75-21-8	92

D: Analyte not within the DoD scope of accreditation.

* % Recovery is calculated using unrounded analytical results.

APPENDIX D

SYSTEM 1 PROCESS LOG

Becton, Dickinson and Company
Covington Georgia Facility
June 19, 2020 - Activity Log

Vessel #2	
Time	**Activity**
9:55	Vented vessel
10:15	Transferred product to Post A
10:25	Drum change on 2A
Vessel #5	
12:15	Vented vessel
12:30	Transferred product Post A