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Assessment of the Revised 3410 Building filtered exhaust stack Sampling Probe Location

X-Y Yu
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December 2013



Pacific Northwest
NATIONAL LABORATORY

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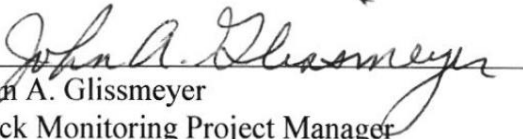
Prepared for the U.S. Department of Energy
under Contract DE-AC05-76FL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

Completeness of Testing

This report describes the results of work and testing specified by test plan TP-STMON-026. The work and any associated testing followed the quality assurance requirements outlined in the test specification/plan. The descriptions provided in this test report are an accurate account of both the conduct of the work and the data collected. Test plan results are reported. Also reported are any unusual or anomalous occurrences that are different from expected results. The test results and this report have been reviewed and verified.

Approved:



John A. Glissmeyer
Stack Monitoring Project Manager

Date 12/4/13

Summary

In order to support the radioactive air emissions permit for the 3410 Building, Pacific Northwest National Laboratory performed a series of tests in the exhaust air discharge from the reconfigured 3410 Building filtered exhaust stack (EP-3410-01-S). The objective was to determine whether the location of the air sampling probe for emissions monitoring meets the applicable regulatory criteria governing such effluent monitoring systems. In particular, the capability of the air sampling probe location to meet the acceptance criteria of ANSI/HPS N13.1-2011^a, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stack and Ducts of Nuclear Facilities* was determined. The qualification criteria for these types of stacks address 1) uniformity of air velocity, 2) sufficiently small flow angle with respect to the axis of the duct, 3) uniformity of tracer gas concentration, and 4) uniformity of tracer particle concentration. Testing was performed to conform to the quality requirements of NQA-1-2000. Fan configurations tested included all fan combinations of any two fans at a time. Most of the tests were conducted at the normal flow rate, while a small subset of tests was performed at a slightly higher flow rate achieved with the laboratory hood sashes fully open.

The qualification criteria for an air monitoring probe location are taken from ANSI/HPS N13.1-2011 and are paraphrased as follows with key results summarized:

1. Uniform Air Velocity: The acceptance criterion is that the coefficient of variation (COV)^b of the air velocity must be $\leq 20\%$ across the center two-thirds of the area of the stack. Our results show that the COVs of the air velocity across the center two-thirds of the stack are smaller than 2.9% for all testing conditions.
2. Angular Flow: The average air velocity angle must not deviate from the axis of the stack or duct by more than 20° . Test results show that the mean angular flow angles at the center two-thirds of the ducts are smaller than 4.0° for all testing conditions.
3. Uniform Concentration of Tracer Gases: The uniformity of the concentration of potential contaminants is first tested using a tracer gas to represent gaseous effluents. The tracer is injected downstream of the fan outlets and at the junction downstream fan discharges meet. The acceptance criteria are that 1) the COV of the measured tracer gas concentration is $\leq 20\%$ across the center two-thirds of the sampling plane and 2) at no point in the sampling plane does the concentration vary from the mean by $>30\%$. Our test results show that 1) the COV of the measured tracer gas concentration is $< 2.8\%$ for all test conditions and 2) at no point in the sampling plane does the concentration vary from the mean by $> 6.7\%$.
4. Uniform Concentration of Tracer Particles: Tracer particles of 10- μm aerodynamic diameter are used for the second demonstration of concentration uniformity. The acceptance criterion is that the COV of particle concentration is $\leq 20\%$ across the center two-thirds of the sampling plane. Test results indicate that the COV of particle concentration is $<9.9\%$ across the center two-thirds of the sampling plane among all testing conditions.

The reconfigured 3410 Building filtered exhaust stack was determined to meet the qualification criteria given in the ANSI/HPS N13.1-2011 standard. Changes to the system configuration or operations

^a ANSI/HPSN13.1-2011 and ANSI/HPSN13.1-1999 have essentially the same technical content. ANSI/HPS13.1-2011 contained some editorial revisions that were not included in ANSI/HPS N13.1-1999.

^b *Coefficient of variation (COV)* is considered “dated” terminology. The modern terminology is *percent relative standard deviation*. However, because the standard uses the older terminology, it will likewise be used here.

outside the bounds described in this report (e.g., exhaust stack velocity changes, relocation of sampling probe, and addition of fans) may require re-testing or re-evaluation to determine compliance.

Acronyms

acfm	actual cubic feet per minute
AD	aerodynamic diameter
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
COV	coefficient of variation
DIA	number of duct diameters, distance divided by duct diameter
DOE	U.S. Department of Energy
DV	hydraulic diameter and the mean velocity
EPA	U.S. Environmental Protection Agency
EMSL	Environmental Molecular Sciences Laboratory (EMSL)
FA	flow angle test run
HDI	“How Do I...?”
HPS	Health Physics Society
M&TE	materials and testing equipment
NQA	Nuclear Quality Assurance
PNNL	Pacific Northwest National Laboratory
PSF	Physical Sciences Facility
QA	quality assurance
R&D	research and development
scfm	standard cubic feet per minute
STMON	Stack Monitoring Project
TI	Test Instruction
VT	velocity uniformity test run

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Preparing and executing these tests involved a number of PNNL staff members. We would like to particularly acknowledge the support of our quality engineer, Kirsten Meier, and administrative support from Mona Champion and Chrissy Charron. Yin-Fong Su, Bradley Fritz, Mikhail Pekour, Julia Flaherty, and Matthew Barnett provided technical support for these tests. We also like to thank Curtis Nichols, Douglas McManamon, Brian Greenaway, Mark Hartzell, Josh Byrd, and Angelo Genetti for providing programmatic and logistical support. In addition, Carmen Arimescu and Matthew Barnett provided technical reviews. Meredith Willingham provided editorial support for this report.

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1.0 Introduction

The new construction of the Physical Sciences Facility (PSF) at the Pacific Northwest National Laboratory (PNNL) incorporated three laboratory buildings that house PNNL radiological capabilities, namely 3410, 3420, and 3420 Buildings. After the initial stack qualification tests in 2010, a third fan was added to augment the effluent capability as a result of newly expanded laboratory needs in the 3410 Building. This physical change made the previous stack qualification assumption and results invalid due to the fact that new configuration deviates largely from the scale model stack and verification tests used to qualify the original stack in the 3410 Building.

As a result, the purpose of this series of tests was to document the extent to which the location of the stack sampling probe on the air exhaust stack of the 3410 Building would meet the applicable regulatory criteria^c governing such effluent monitoring systems. In particular, the capability of the air sampling probe location to meet the acceptance criteria of ANSI/HPSN13.1-2011, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stack and Ducts of Nuclear Facilities*,^d was determined. This was accomplished through a series of tests as described in the standard. This standard requires that a series of tests be performed to demonstrate the acceptability of the location of the air sampling probe in the system. Full scale testing on the actual exhaust system was performed. The data reported here will be used to support the air emissions permit for the 3410 Building.

Work has been performed to meet the quality requirements of American Society of Mechanical Engineers (ASME) NQA-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, Part 1, *Requirements for Quality Assurance Programs for Nuclear Facilities*, and ASME NQA-1-2000, Part IV, Subpart 4.2, *Graded Approach Application of Quality Assurance Requirements for Research and Development*. These quality requirements were implemented through the *Stack Monitoring Project (STMON) QA Plan* (QA-STMON-0001, QAP). This project was graded as technology level “Development Work” in accordance with the quality assurance (QA) program. This project has developed a detailed project plan (PP-STMON-031) and a test plan (TP-STMON-026). Testing was executed according to these plans and detailed technical instructions (TIs).

1.1 Background

One of the following three approaches may be chosen to demonstrate compliance with the federal standards: 1) perform a full test series on the actual exhaust system; 2) perform the full test series on a scale model of the exhaust system, followed by a partial test of the actual exhaust system to verify the validity of the model results, or 3) adopt the results from previously performed full test series for a system with similar configuration, followed by a partial test of the actual exhaust system to verify the applicability of the previous test results.

In the first stack qualification testing for 3410 Building in 2010, the third approach was selected to evaluate the acceptability of the location of the air sampling probe in the 3410 Building filtered exhaust stack and to monitor discharged air for radionuclides because of the similarity between the old

^c Washington Administrative Code 246-247.

^d The American National Standards Institute delegates the writing, publication and maintenance of this standard to the Health Physics Society, McLean, Virginia.

configuration and a scale model that had been thoroughly tested for a different project. Consequently, a limited series of tests was performed on the actual exhaust system using the criteria for qualifying the location of a stack monitoring probe and the configuration of the 3410 Building filtered exhaust stack, as described in the report PNNL-19562.^e

For the 3410 Building re-testing project, a full scale test was performed because of 1) lack of existing scale model or results, 2) comparable cost effectiveness between scale model and full scale testing, and 3) extended time necessary to build a scale model. Tests on the 3410 Building, also known as the Materials Science and Technology Laboratory, were conducted between April and June 2013. Test data sheets reporting velocity uniformity, flow angle, gas tracer uniformity, and particle tracer uniformity tests are included in this report.

Also included in this report is a technical summary reporting computational fluid dynamics (CFD) modeling results, evaluating whether the stack would meet the qualification criteria prior to conducting full scale testing. The preliminary CFD results indicated insufficient mixing at the probe location especially for the simulated particle tracer uniformity tests after adding the third fan. After careful technical discussions, an air mixer was chosen as an engineering solution that would not require extensive reconfiguration or construction of the stack, which could further delay the unobstructed operation of the 3410 Building. Additional CFD calculations were done to understand the effect of the recommended change and whether sufficient mixing was achieved after adding the air mixer. More detailed description of the CFD results was included in Appendix A: The CFD Model Report.

1.2 Qualification Criteria

The qualification criteria for a stack air monitoring probe location are taken from ANSI/HPSN13.1-2011 and are paraphrased as follows:

1. Uniform Air Velocity: It is important that the gas velocity be fairly uniform across the stack cross-section where the sample is extracted. Consequently, the velocity is measured at several points in the stack at the position of the sampling nozzle. The uniformity is expressed as the variability of the measurements about the mean. This is expressed using the COV, which is the standard deviation divided by the mean and expressed as a percentage. As the COV value becomes lower, the velocity becomes more uniform. The acceptance criterion is that the COV of the air velocity must be $\leq 20\%$ across the center two-thirds of the area of the stack.
2. Angular Flow: Sampling nozzles are usually aligned with the axis of the stack. If the air travels up the stack in cyclonic fashion, the air velocity vector approaching a sampling nozzle could be misaligned with it enough to impair the extraction of particles. Consequently, the flow angle is measured in the stack at the elevation of the sampling nozzle. The average air velocity angle must not deviate from the axis of the stack or duct by more than 20° .
3. Uniform Concentration of Tracer Gases: Uniform contaminant concentration in the sampling plane enables the extraction of samples that represent the true concentration. The uniformity of the concentration is first tested using a tracer gas to represent gaseous effluents. The tracer is injected downstream of the fan and also at the junction of the ducts. The acceptance criteria are that 1) the COV of the measured tracer gas concentration is $\leq 20\%$ across the center two-thirds of

^e Assessment of the 3410 Building filtered exhaust stack Sampling Probe Location, John Glissmeyer and Julia Flaherty, July 2010, PNNL-19562.

the sampling plane and 2) at no point in the sampling plane does the concentration vary from the mean by > 30%.

4. Uniform Concentration of Tracer Particles: A second set of tests addressing contaminant concentration uniformity at the sampling position uses tracer particles large enough to exhibit inertial effects. Tracer particles of 10- μ m aerodynamic diameter (AD) are used by default unless it is known that larger contaminant particles will be present in the airstream. The acceptance criterion is that the COV of particle concentration is $\leq 20\%$ across the center two-thirds of the sampling plane.

Tests were conducted to determine if criteria 1 to 4 are met. They were conducted on the exhaust ductwork and stacks, from the fans to the position of the sampling probe.

1.3 Task Methodology

Compliance with each qualification criterion is demonstrated through performing a specific PNNL test procedure and a TI. The basic series of tests include the following:

- Velocity uniformity test
- Flow angle test
- Gas tracer uniformity test
- Particle tracer uniformity test.

The testing methods were based on the requirements of ANSI/HPS N13.1-2011. A test plan, TP-STMON-026, *3410 Building Stack Monitoring Project Test Plan*, was prepared by the testing team and approved by internal reviewers and EMSL project management. This plan referenced the use of PNNL procedures, which define how the test should be conducted in general. A TI was prepared for each test type. These TIs contain specific instructions pertaining to the tests that are not addressed in the general procedures. Such information includes the following:

- Layout of measurement points
- Location of tracer injection points
- List of equipment and instrumentation
- Safety requirements
- List of test runs
- Test description and measurement data sheets with hand entries
- Table of preliminary results.

The QA program implemented for this project was described in details in the project plan.

1.4 Quality Assurance

The PNNL QA program was based on the requirements defined in the U.S. Department of Energy (DOE) Order 414.1D, *Quality Assurance*, and 10 CFR 830, *Energy/Nuclear Safety Management*, and

Subpart A—*Quality Assurance Requirements* (a.k.a., the Quality Rule). PNNL has chosen to implement the following consensus standards in a graded approach:

- ASME NQA-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, Part I, “Requirements for Quality Assurance Programs for Nuclear Facilities” (ASME 2001).
- ASME NQA-1-2000, Part II, Subpart 2.7, *Quality Assurance Requirements for Computer Software for Nuclear Facility Applications* (ASME 2001).
- ASME NQA-1-2000, Part IV, Subpart 4.2, *Graded Approach Application of Quality Assurance Requirements for Research and Development* (ASME 2001).

The procedures necessary to implement the requirements are documented through PNNL’s “How Do I...?” (HDI), which is a system for managing the delivery of laboratory-level policies, requirements, and procedures.

The STACK MONITORING PROJECT (STMON) implements an NQA-1-2000 QA program, using a graded approach presented in NQA-1-2000, Part IV, Subpart 4.2. The STMON QA manual (QA-STMON-002) describes the technology life cycle stages under the STMON QA plan (QA-STMON-0001). The technology life cycle includes the progression of technology development, commercialization, and retirement in process phases of basic and applied research and development (R&D), engineering and production, and operation until process completion. The life cycle is characterized by flexible and informal QA activities in basic research, which becomes more structured and formalized through the applied R&D stages. The work described in this project plan will be completed under the QA Technology level of Developmental Work as the data will be used for applying air discharge permits.

- **BASIC RESEARCH:** Basic research consists of research tasks that are conducted to acquire and disseminate new scientific knowledge. During basic research, maximum flexibility is desired to allow the researcher the necessary latitude to conduct the research.
- **APPLIED RESEARCH:** Applied research consists of research tasks that acquire data and documentation necessary to confirm the satisfactory reproducibility of results. The emphasis during this stage of a research task is on achieving adequate documentation and controls necessary to be able to reproduce results.
- **DEVELOPMENTAL WORK:** Development work consists of research tasks moving toward technology commercialization. These tasks still require a degree of flexibility, and there is still a degree of uncertainty that exists in many cases. The role of quality on Development Work is to make sure that adequate controls exist to support movement into commercialization.
- **RESEARCH AND DEVELOPMENT SUPPORT ACTIVITIES:** Support activities are those that are conventional and secondary in nature to the advancement of knowledge or development of technology, but allow the primary purpose of the work to be accomplished in a credible manner. An example of a support activity is controlling and maintaining documents and records. The level of quality for these activities is the same as for Development Work.

STMON addresses internal verification and validation activities by conducting an independent technical review of the final data report in accordance with STMON’s procedure QA-STMON-0601,

Document Preparation and Change. This review verifies that the reported results are traceable, that inferences and conclusions are soundly based, and the reported work satisfies the test plan objectives.

1.5 Building 3410 Filtered Exhaust System Geometry and Flow

1.5.1 Physical Arrangements

Figure 1.1 shows the approximate arrangement of the actual stack for Building 3410.^f Each feeder duct, with its exhaust fan and heat recovery coil, is located on the roof of the building. Two existing fans designated as A and B draw air from the heat recovery coil and discharge into a short horizontal duct that connects to another horizontal duct at a 45° angle. The new fan (C) and duct are also shown. The discharge velocity from the fan is 4101 ft./min assuming full airflow. The bottom of the duct is 6'5" above the roof grade. The duct of the new fan merges with the duct of fan B.

The air sampling probe flange is shown located 10 duct diameters downstream from the last duct junction. Two or three duct diameters downstream from this point, the duct turns 90° upward into a short vertical stack that ends 20 ft. above the roofline. The stack used to end in a concentric reducer that increased the discharge velocity; however, it was removed as part of the stack upgrade. A static mixer was installed just downstream of where the discharge from Fan A joins the stack. This was used to increase the mixing of the air from the different ducts. The mixer exacts a small energy and flow rate penalty.

Table 1.1. 3410 Building Stack Operating Parameters.

Operating Parameters	New	Old
Duct diameter at sampling probe (in.)	40	40
No. of duct diameters from upstream disturbance to sampling probe	abt. 7	10
No. duct diameters from sampling probe to downstream disturbance	3	3
Discharge diameter (in.)	40	32
Single fan capacity (actual ft ³ /m, acfm)	21,200	21,200
No. of operating fans	2	1
Total available fans	3	2
Maximum flow rate (acfm)	42,400	19,900
Operating flow rate (acfm)	31,840	17,000
Reynolds number	1.42E+05	6.69E+04
Air temperature at exit (°F)	40–75	40–75

According to the supplied documents, the air exhausted from the 3410 Building via this stack is a combination of building ventilation and laboratory exhaust air.

^f The complete drawings are seen in the Flad Architects Drawing of Mechanical Roof Plan RAD Exhaust Stack for Building 3410.

1.5.2 Flow Parameters

Table 1.1 provides operating information for the new and old configurations of the stack. Table 1.1 shows the range of expected operational flow rates for the 3410 Building stack. This table lists operating parameters such as flow rates (actual cubic feet per minute, e.g., ft³/min, or acfm) and the resulting Reynolds number. Standard conditions were taken as 1 atmosphere and 70°F.

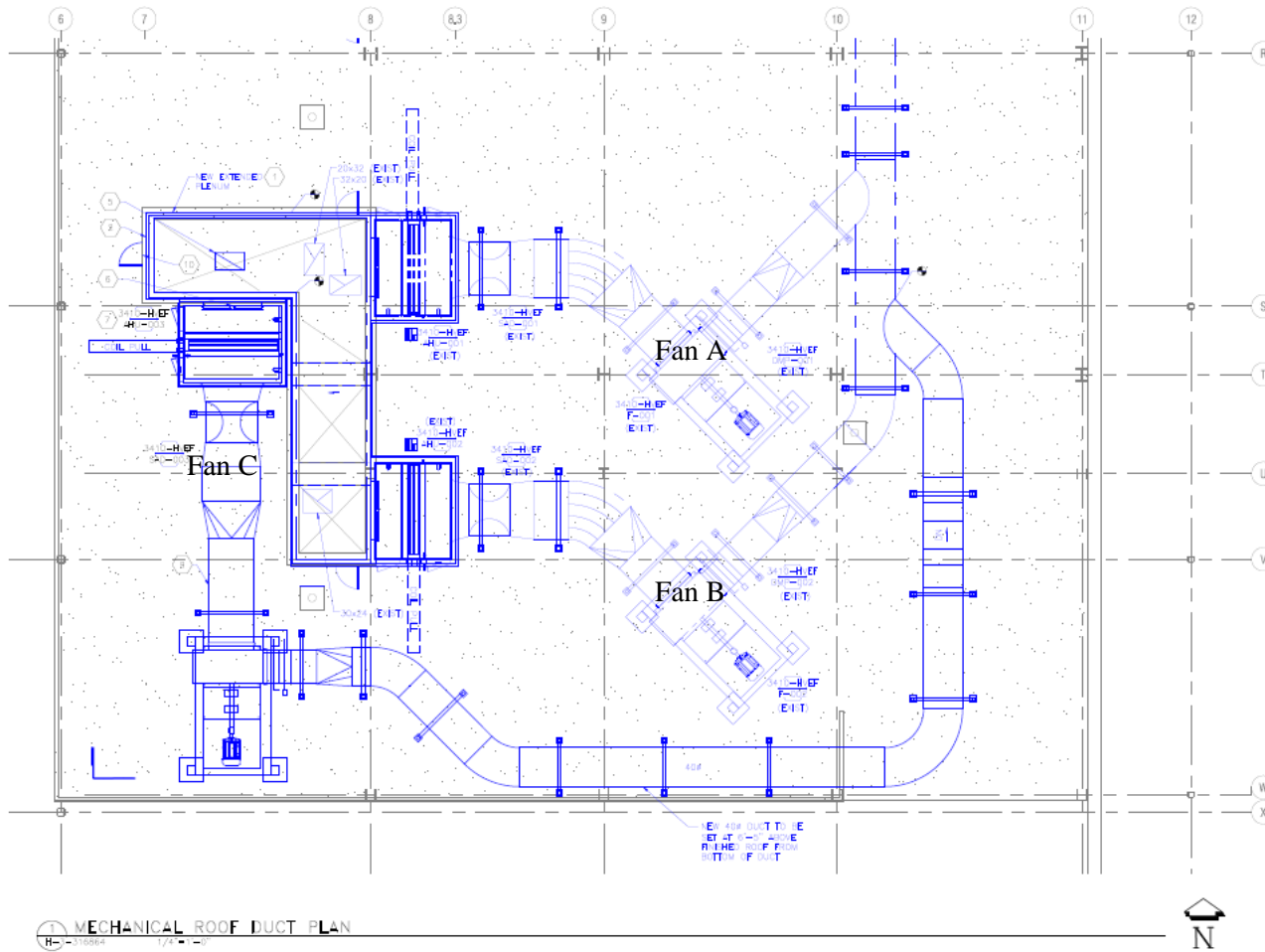


Figure 1.1. The New Stack Layout for Building 3410^g.

^g The mechanical drawing was prepared by the M/E/P Engineer and FLAD ARCHITECTS.

2.0 Testing Strategy

This chapter provides details of the testing strategy including the designed test runs and the testing matrices that were used to guide testing.

2.1 Test Runs

The basic series of tests include velocity uniformity test, flow angle test, gas tracer uniformity test, and particle tracer uniformity test. The applicable instructions on tracer injections in the ANSI/HPSN13.1-2011 (Clause 5.3) are as follows:

“The degree of mixing for aerosol particles shall be tested with particles of 10 $\mu\text{m AD}$, or other selected size if there can be a significant fraction of the aerosol mass or activity associated with sizes larger than 10 $\mu\text{m AD}$. The aerosol may be introduced at only one location, which is at the center of a stack or duct as far upstream as possible of the sampling plane, yet downstream of feeder ducts, fans, and air pollution control equipment. As in the case of a gas, the particles are demonstrated to be well-mixed by sampling over the cross-section at the proposed sampling location.”

If “feeder ducts” are defined as upstream of the fans, then the fan injection points are satisfactory. If “feeder ducts” are defined as those coming from the fans before they join the stack, then the last junction nearest the sampling point would be the injection location. In the 3410 Building stack re-testing project, the injection point was located either at the junction of the ducts from the fans or downstream of the backdraft damper of each fan as illustrated in Figure 2.1. Figure 2.2 depicts a real example of the fan and the damper on the roof of the 3410 Building.

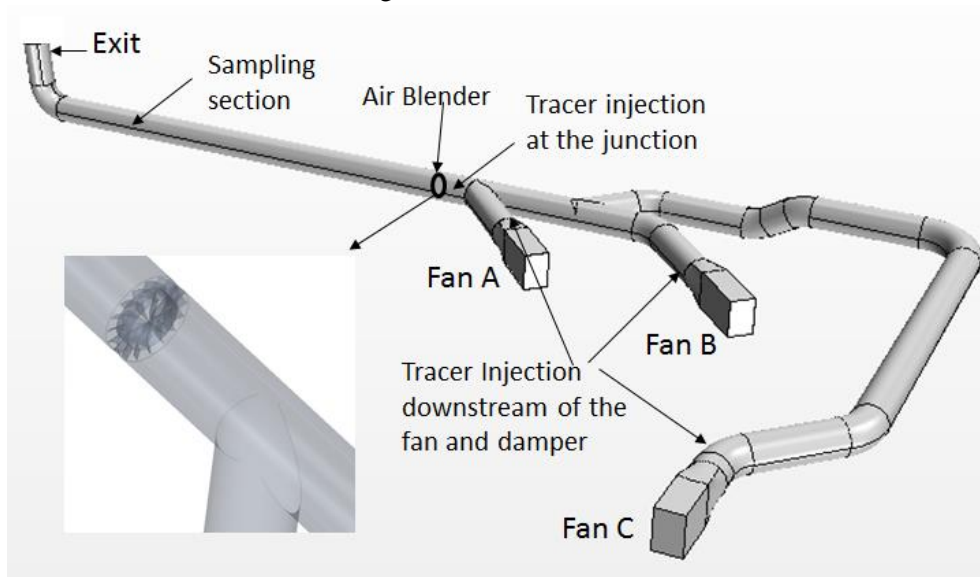


Figure 2.1. The Geometry of the Modified 3410 Building Filtered Exhaust Stack System. Insert shows the details of the air blender.

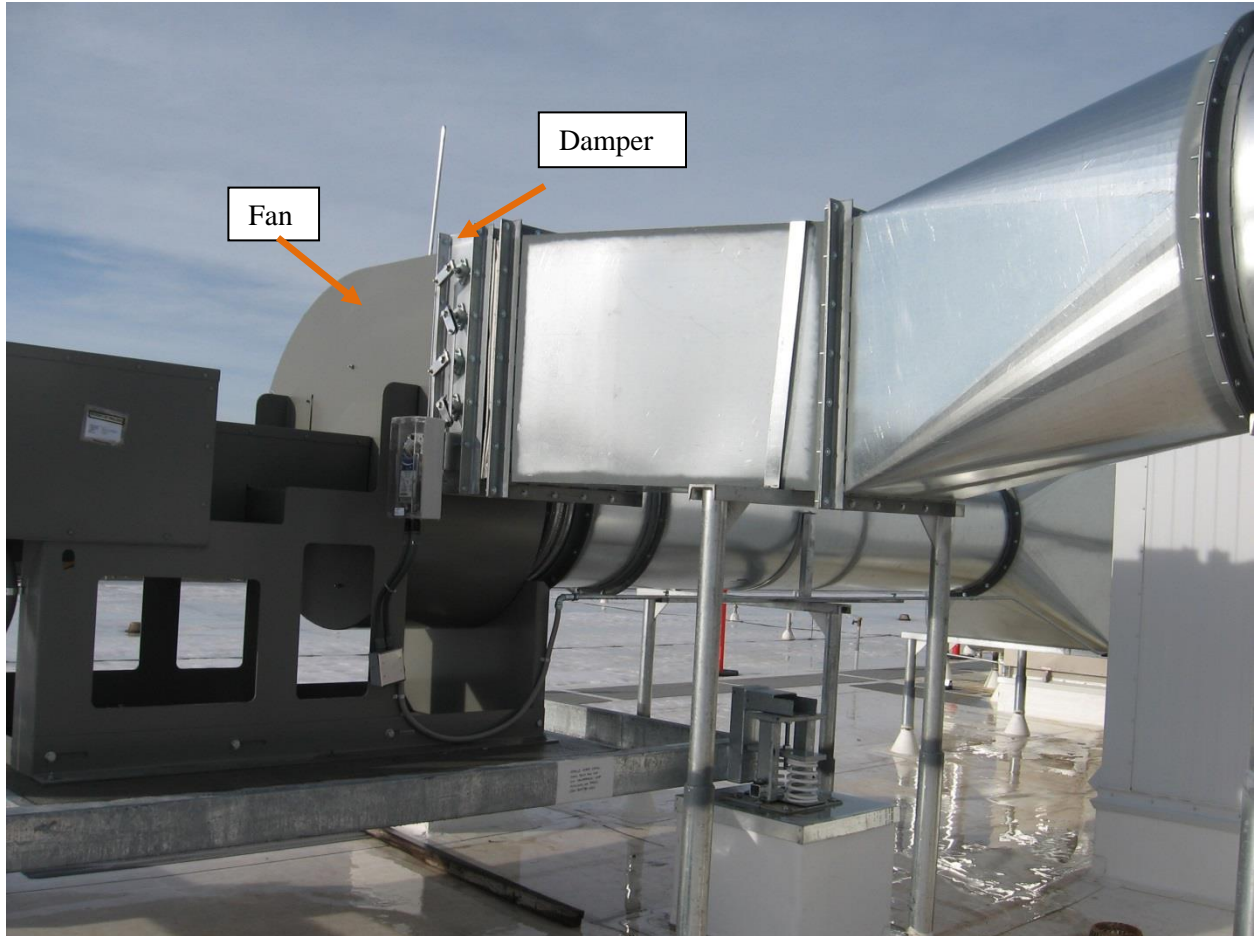


Figure 2.2. A Photo Showing the Fan and the Damper on the Roof of the 3410 Building.

2.2 Test Matrix

Table 2.1. Velocity Uniformity and Flow Angle Test Runs Performed Table 2.1 lists the test runs performed by test type. Some tests were replicated to provide an indication of the variability of the results when needed.

Table 2.1. Velocity Uniformity and Flow Angle Test Runs Performed

Test Configuration			Number of Test Runs	
Fan Pairs	Flow Conditions [#]	No.	Flow Angle	Velocity
Fan A & B	normal	1	3	3
Fan A & C	normal	2	3	3
Fan B & C	normal	3	3	3
Fan A & C	sashes open	4	3	3
Total			12	12
Grand Total			24	

[#]: Normal refers to the planned typical operational flow condition, although some gas tracer repeat runs were performed with sashes open to provide higher flow conditions.

The tracer injection ports were installed just downstream of the fans and dampers, referred to as “Fan” in the test matrix. Another injection port was installed just after the junction of ducts from fans closest to the sampling probe, also referred to as “Junction” (see Figure 2.1).

Table 2.2. Gas and Particle Tracer Test Runs Performed.

Test Configuration					Number of Test Runs	
Fan Pairs	Flow Conditions [#]	No.	Injection Port [†]	Injection Position	Gas Tracer	Particle
Fans A & B	normal	1	Junction	Center*	6	1
	normal	2	Fan A	Center*	5	1
	normal	3	Fan B	Center	1	1
Fans B & C	normal	6	Junction	Center	1	1
	normal	7	Fan B	Center*	5	1
	normal	8	Fan C	Center*	5	1
Fans A & C	normal	11	Junction	Center*	5	1
	normal	12	Fan A	Center	1	1
	normal	13	Fan C	Center*	6	1
Worst Case Fan Pair	normal	16	Junction	Center*	5	1
Worst Case Fan Pair	normal	17	Fan	Center*	5	1
Total					45	11
Grand Total					56	

[#]: Normal refers to the planned typical operational flow condition, although some gas tracer repeat runs were performed with sashes open to provide higher flow conditions.

[†]: The injection port is either downstream of the damper of each fan or at the junction location shown in Figure 2.1.

*: These tests involve injecting the tracer gas at the four perimeter points and center of the cross-section at the injection location.

2.3 Stack Measurements

Before conducting the qualification tests the major features of the stack were measured. The longitudinal distance from the fans to the bends, duct reducers, and ports was determined in addition to the duct diameter at each measurement port. Measurements were made at specific locations within the duct for each of the four qualification criteria tests described in the following sub-sections. The number and distance between measurement points were based on the U.S. Environmental Protection Agency (EPA) procedure 40 CFR 60, Appendix A, Method 1, for circular stacks. For a 40-inch duct diameter, eight traverse points are required and they must be at the relative positions shown in Figure 2.3.

Measurements were made at the center point. The minimum distance from the wall to a measurement point was 0.5 inch. The measurement point closest to the port is Point 1, while the point farthest from the port is Point 8. For each of the tests, measurements were taken at each point along the top traverse and the side traverse. Each traverse point was repeated three times to obtain measurement precision.

The fans would be used in combinations of two, namely, fans A & B, fans A & C, and fans B & C. In the interest of time, most tests were conducted using the center point injection position and at the normal operation flow conditions. Tracers were injected at the junction and downstream of each fan. The junction position was chosen because earlier computational fluid dynamics (CFD) simulations suggest

that tracer injection at the junction point seemed to provide less ideal results unless a static mixer was installed at that point.^h

For the worst case scenarios of the gas tracer tests including both injections at the Junction and the Fans, a more detailed study was conducted that required at least five test runs – each run with the tracer injected at one of the five required injection points in the selected cross-section of the duct. The five injection points were at the centerline and at four perimeter points. For round ducts, the four perimeter points were equally spaced around and near the perimeter. Some test runs were replicated to determine measurement reproducibility. As to the particle uniformity tests, the test matrix was similar to that of the gas tracer tests. The only difference is that only a single injection point at the center of the stack was used for each injection location.

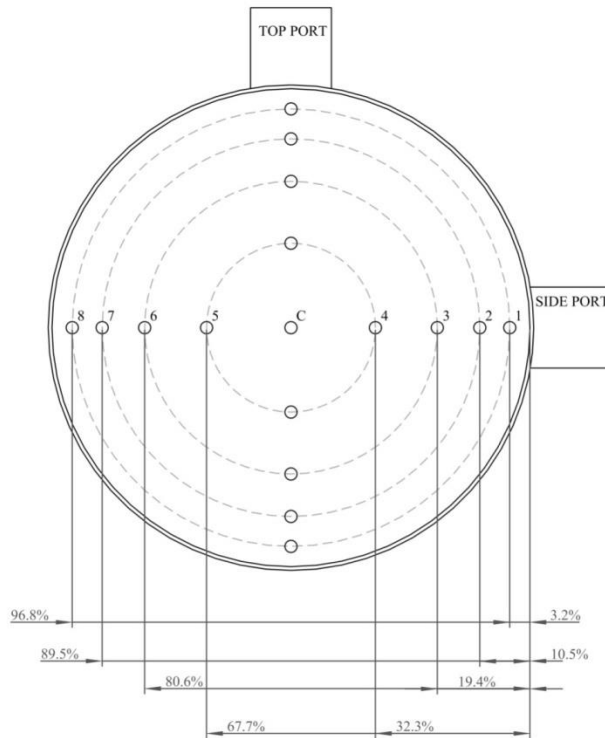


Figure 2.3. Cross-Section of the Duct at the Testing Ports with Measurement Points.

^h Modeling the air flow in the 3410 Building filtered exhaust stack system with three-dimensional computational fluid dynamics models, Kurt Recknagle and Sarah Suffield, Project Report, November, 2012

3.0 Testing Methods

3.1 Testing Platforms and Test Ports

Because of the challenge to conduct the particle tracer and gas tracer uniformity tests at the full scale stack, a temporary platform was constructed to permit physical access to the top sampling port safely. Figure 3.1 and Figure 3.2 show the layout of the 3410 duct at the location of the air sampling probe and test ports used in this testing.

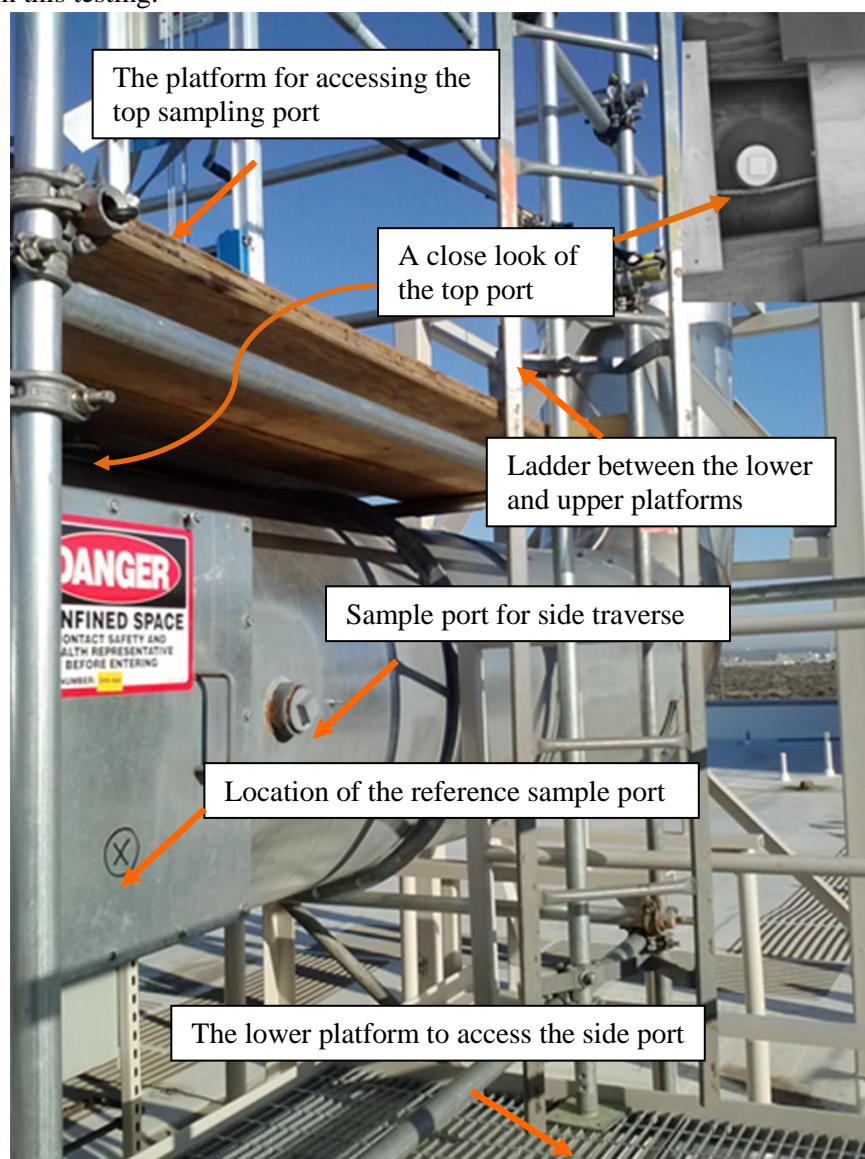


Figure 3.1. Layout of Testing Platforms for the 3410 Stack Testing.

The existing lower level platform was used to provide direct access to the side port as depicted in Figure 3.1.

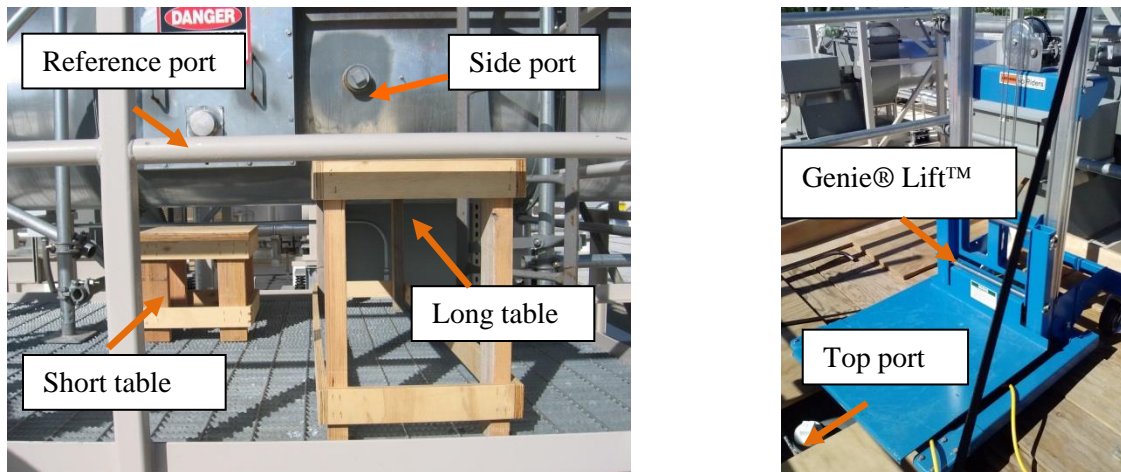


Figure 3.2. a) Layout of the Side Test Ports. b) Layout of the Top Test Port.

Compared to the top port, the access to the side port is simpler. However, unlike the velocity, flow angle, or gas tracer uniformity tests, the particle tracer uniformity tests demand stricter geometry between the sample port, probe and the particle counting instrument due to the following, 1) generally, the sample probe needs to travel throughout the whole diameter (e.g., 40 in) freely; 2) the sampling probe needs to enter the optical particle counter (OPC) inlet either directly or via a 90° bend to reduce particle loss; and 3) the OPC needs to sit stably on a flat surface during measurements.

Figure 3.2 provides a closer look of the side test port and top test port and how these geometry requirements were met. Two benches were made for placing the OPC instruments during testing. The longer table was made to accommodate the full length of the side traverse of the stack for the sampling OPC to slide by. A short table was placed below the reference port, located slightly below the centerline of the stack. This was used to insert a short sampling probe to provide reference particle counts monitored by a second OPC. The reference sample port was designed not to obstruct the flow in the stack yet provide a constant reference measurement point during the particle tracer testing (see Figure 3.2a). To accommodate the geometry at the top port, a Genie® Lift™ with sufficient height extension was stabilized on the scaffolding platform. The sample OPC was placed on the extension arms of the Genie® Lift™ during measurements. Each traverse point from the top sampling port was obtained by cranking the Genie® Lift™ up and down across the stack duct diameter (see Figure 3.2b).

The velocity, flow angle, and gas tracer uniformity testing are relatively simpler for the experiment setup compared to the particle uniformity tests. Among those tests, only the side and top sampling ports were used. In addition, because some flexible tubes were used to make connections between the testing apparatus and the sampling port, the placement of the instrument was not as confined as that in the particle tracer testing. More details for each test are provided below.

3.2 Velocity Uniformity

The uniformity of air velocity at the stack monitoring location indicates whether the momentum in the stack is well-mixed. The method used to conduct the velocity uniformity tests was based on 40 CFR 60, Appendix A, Method 1. The criterion for qualification from the velocity uniformity test is that the

%COV should be less than 20% in the center two-thirds of the duct (measurement points 2-7, see Figure 2.3).

For each run, three air velocity readings were obtained at each of the measurement points across the cross-section of the duct. The measured velocity is the average of the three readings. The measured velocity for each point is used to determine the mean and standard deviation of the velocity across the cross-sectional plane. The %COV (also known as the percent relative standard deviation) is calculated as 100 times the standard deviation divided by the mean.

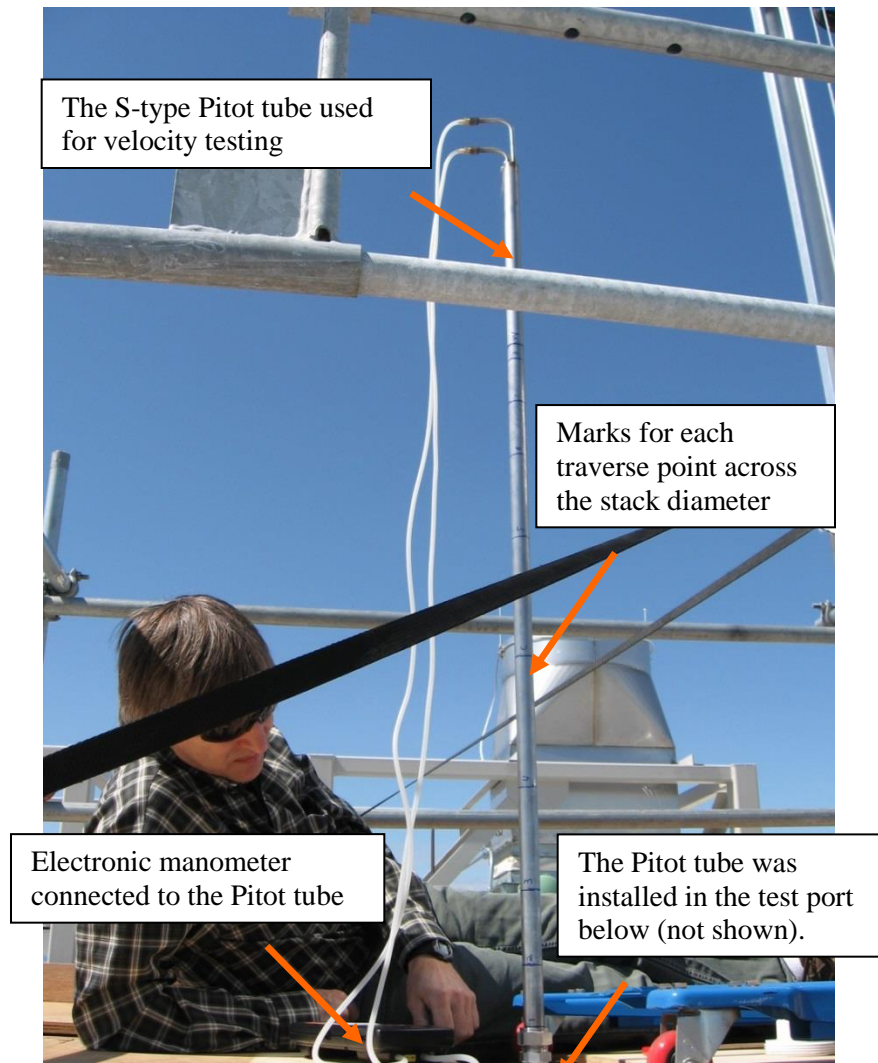


Figure 3.3. The S-Type Pitot Tube and Manometer used on the 3410 Stack for the Top Traverse Velocity Measurements.

Each air velocity measurement was made using an S-type Pitot tube connected to a calibrated electronic manometer (GrayWolf, Zephyr II+, Shelton, CT) by flexible tubing. Duct air temperature measurements were made with a handheld thermal anemometer (TSI, Model 8360, Shoreview, MN). Figure 3.3 shows the equipment and setup used for velocity uniformity testing. In this test, the S-type Pitot tube was positioned so that the planes of the two openings at the tip were parallel with the axis of the duct. Although the principle of operation differs between the Pitot tube and thermal anemometers, they

were used with up-to-date calibrations and no instrument-related biases were encountered in the analysis of testing results. The PNNL operating procedure EMS-JAG-04 and the test instruction TI-STMON-027 were followed to conduct the full scale test in the 3410 Building. The velocity readings obtained from the S-type Pitot tube were corrected according to manufacturer recommendations before they were reduced as final results in this report.

3.3 Flow Angle Test

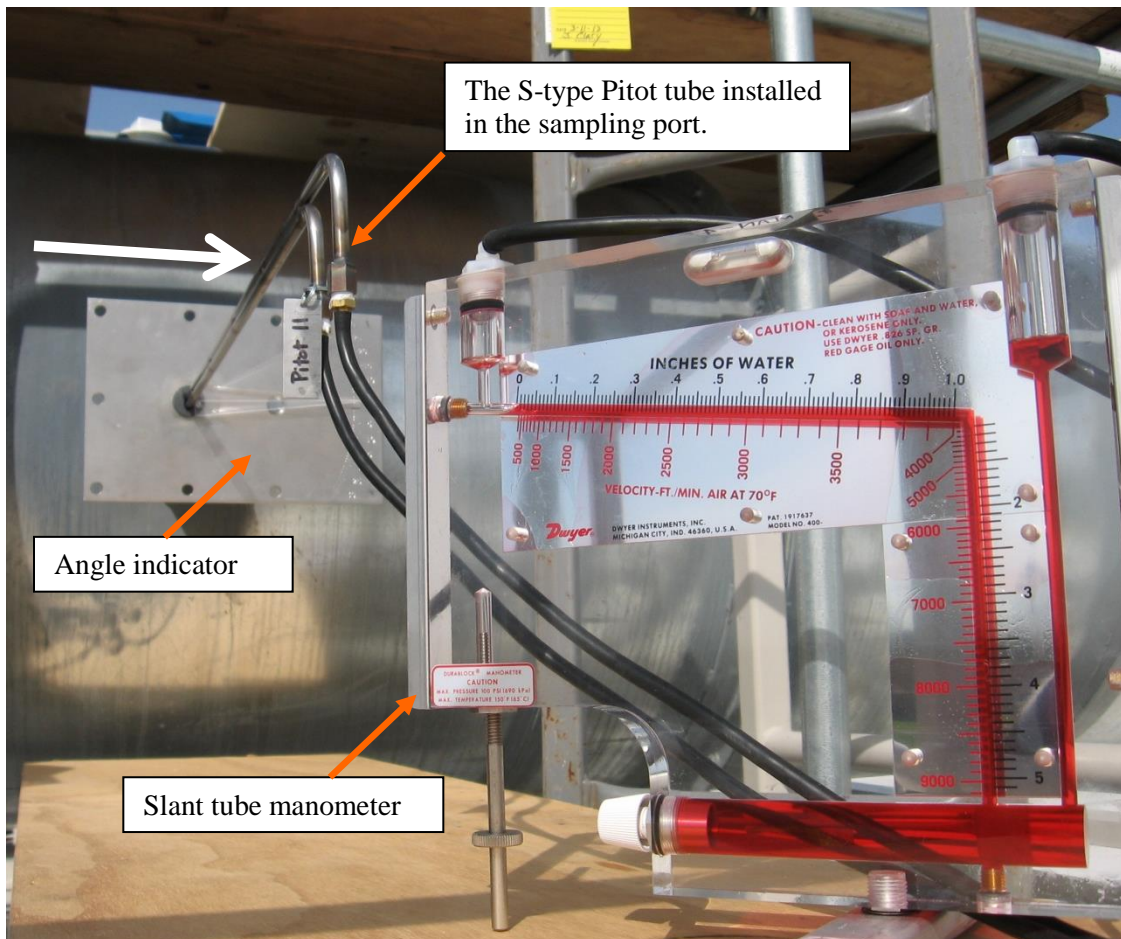


Figure 3.4. Flow Angle Indicator, Dwyer Manometer, and the S-Type Pitot Tube Installed on 3410 Stack for the Side Traverse Measurements. The test port is behind the angle indicator and invisible from the angle that the photo was taken. The white arrow indicates flow direction inside the stack.

The air velocity vector approaching the sample nozzle should be aligned with the axis of the nozzle within an acceptable deviation angle so that the sample extraction performance is not degraded. The test method to determine the air velocity vector is based on 40 CFR 60, Appendix A, Method 1, Section 11.4, “Verification of the Absence of Cyclonic Flow.” The term “flow angle” refers to the average angle between the velocity vector of the flow in the duct and the axis of the sampling nozzle. For the stack testing activities, the flow angle was measured at an array of 17 points in a cross pattern in the cross-section of the duct as illustrated in Figure 2.3. (The layout of points was the same as used for all of the velocity and tracer measurement.) The criterion for acceptance from the flow angle test is that the average angle must be $< 20^\circ$.

The flow angle measurements were made using an S-type Pitot tube (Dwyer Instruments, 160S-72, Michigan City, IN) attached by flexible tubing to a slant-tube manometer (Dwyer Instruments, 400-5, Michigan City, IN) and a custom-made angle-indicating device attached to the sampling port as shown in Figure 3.4. For this test, the S-type Pitot tube was rotated so that the planes of the two openings at the tip of the tube were parallel to the flow in the duct. The Pitot tube was considered perpendicular to the flow in this position. The large metal plate in Figure 3.4 is the angle-indicating device. It has markings at every degree from -30 degrees to 30 degrees. When the pressures on both tubes of the S-type Pitot tube were equal (as indicated by the manometer), the angle shown on the angle-indicating device was recorded as the reading. The manometer was placed on a stable surface to reduce interferences such as vibrations from the fans during testing. The PNNL operating procedure EMS-JAG-05 and the Test Instruction TI-STMON-028 were used to conduct this test.

3.4 Gaseous Tracer Uniformity

The gas tracer uniformity was demonstrated using the tracer gas nitrous oxide (N_2O). A compressed gas cylinder and a flow controller were used to deliver a constant stream of N_2O into the duct. Since N_2O is a component of the earth's atmosphere, its background concentration potentially could make data interpretation difficult. This could be a significant interference, if the injected tracer amount was not enough. The injection volume was chosen to be at least 50 times of the ambient concentration of the N_2O for each test. Pure N_2O (99.5%) were used for tracer gas injection as depicted in Figure 3.5.

Prior to each gas tracer run, the system background was collected and recorded to ensure that there was no interference in the gas tracer measurements. The N_2O ambient background concentration was in the range of 250 – 400 ppb for all test runs. A mass flow controller (ALICAT, MC-20SLPM-D, Tucson, AZ) of up to 20 lpm capacity was used for N_2O injection upstream of the injection port. In order to keep the N_2O delivered at a controlled relative humidity of about 4% and prevent freezing or malfunctioning of cylinder regulators, an electric heater for specialty gases including N_2O and CO_2 (Scott Specialty Gases, Electric Heater, Model 86, Longmont, CO) was used adjacent to the regulator on the compressed air cylinder.

The gaseous tracer was typically injected into the duct at a point just downstream of the fans. Figure 3.5 shows the injection locations with an injection probe positioned in the port.

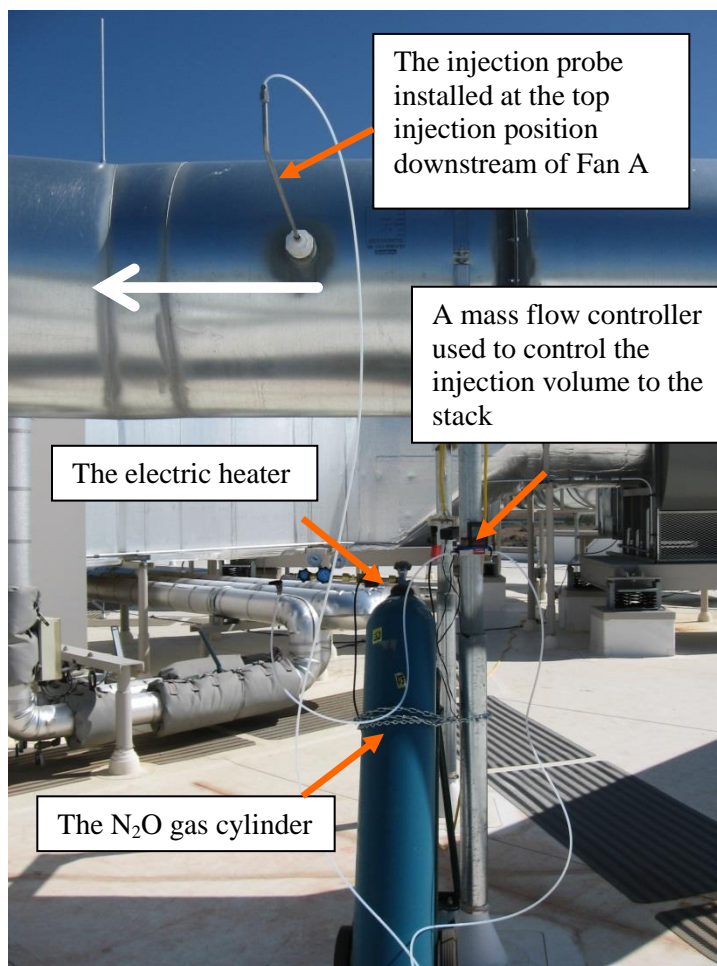
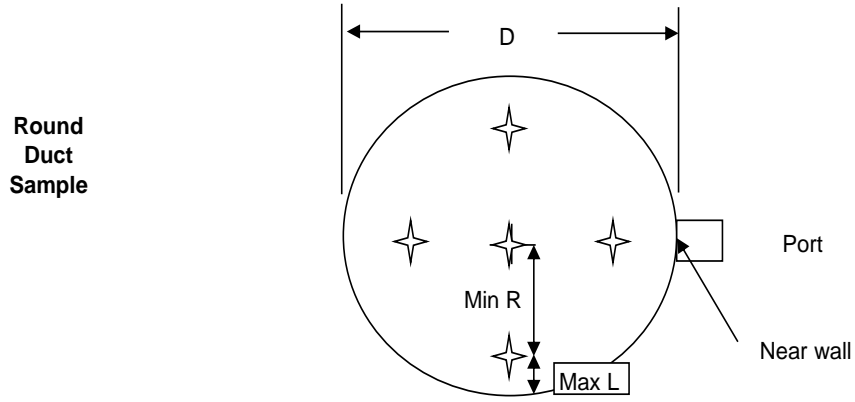


Figure 3.5. Photo Showing Tracer Injection Port Location on the Stack Downstream of Fan A. The injection port was 3” in diameter. An injection port was added to each fan. The white arrow indicates the direction of air flow in the duct.

For test runs at a specific injection port, the injection probe is usually positioned at five different locations through the port including the centerline and four positions near the corners if the duct is rectangular, or near the wall if the duct is circular as depicted in Figure 3.6. For the 3410 circular stack, injections were performed at the center and four corners. A “wall” location is within 25% of a hydraulic diameter of the wall. For a 40-inch round duct, that means within 8-inches of the wall. Figure 3.6 shows the pattern of injection points. It also shows the calculation for the principal duct sizes as in the 3410 stack. For practical purposes, injection occurred at about 1-inch of the wall. An L-shaped probe was used for gas tracer injection. For the run depicted in Figure 3.5, the injection position was near the top of the duct.

A simple probe was used to extract the sample and deliver it to the gas analyzer. A small pump drew air from within the stack through the probe. The gas analyzers then sampled the air from the sample line for analysis. A photoacoustic gas analyzer (Brüel & Kjær, Model 1302, Ballerup, Denmark) was used to measure tracer gas concentrations at each point for the side and top traverses. Figure 3.7 and Figure 3.8 provide additional setup details for the side and top traverse, respectively, in gas tracer uniformity testing.



	Max L	Min. R	Ln	Lf
Diam	Fr. Side	To Point	Max L fr Near Wall	Min L fr Near Wall
40	8	12	8	32

Figure 3.6. Pattern and Dimensions for Wall Injection Points During Gas Tracer Testing.

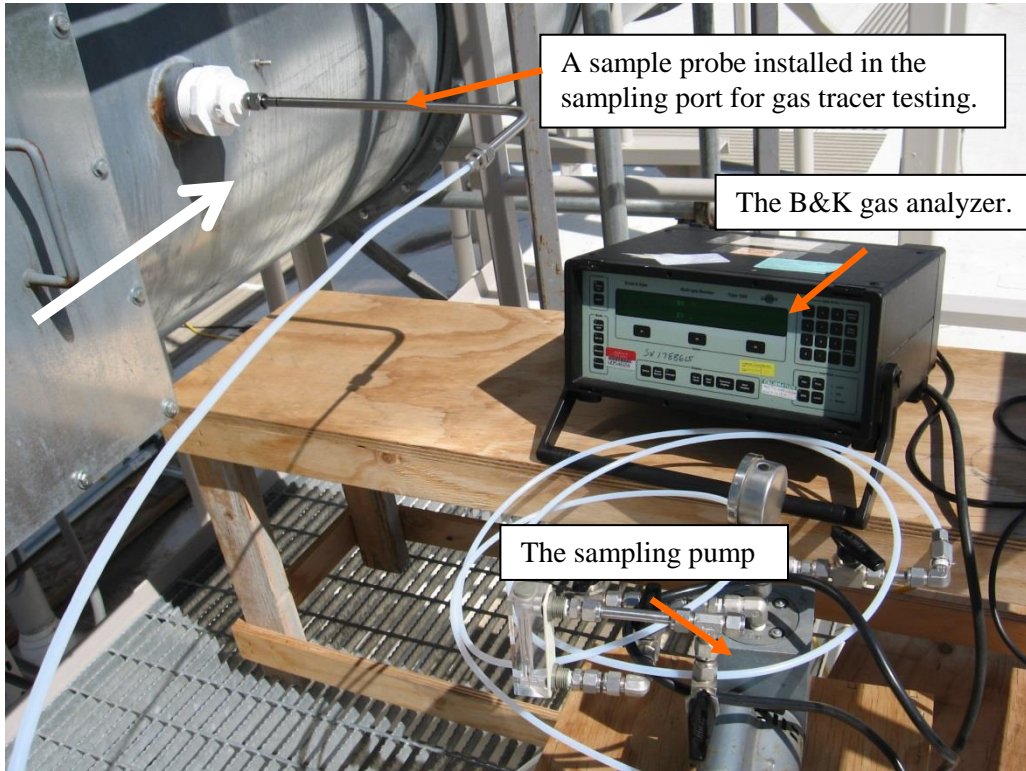


Figure 3.7. Equipment and Setup for the Gaseous Tracer Injection in the 3410 Building Stack Testing for the Side Traverse. The white arrow indicates the flow direction inside the stack.

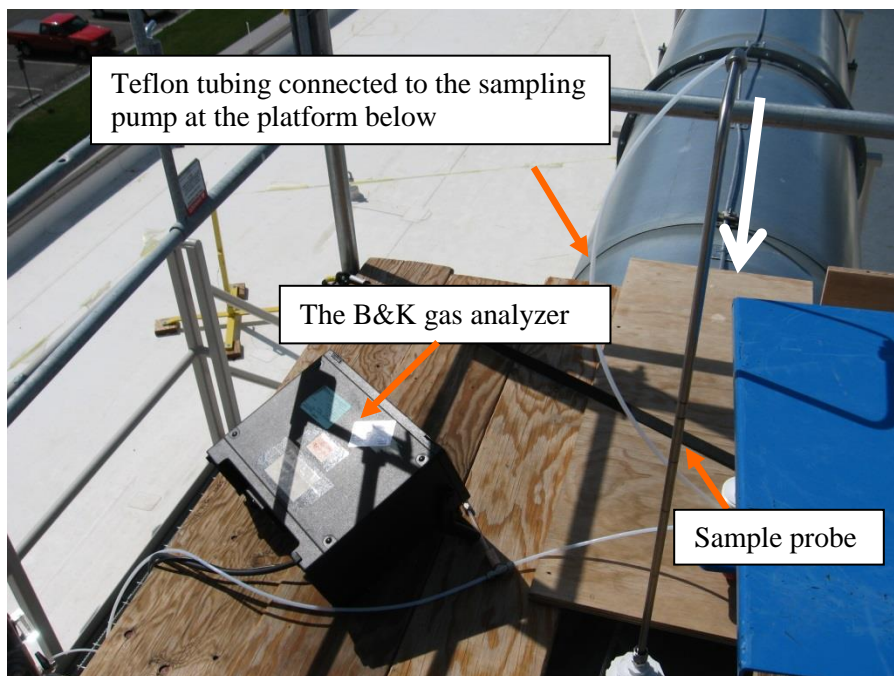


Figure 3.8. Equipment and Setup for the Gaseous Tracer Injection in the 3410 Building Stack Testing for the Top Traverse. The white arrow indicates the flow direction inside the stack.

For each test run, the tracer concentration was measured three times at each of the traverse points across the duct. The measured concentration for each point was the average of the three readings. These measured concentrations were used to calculate the overall mean, standard deviation, and %COV. These calculations were also performed just for the measurement points in the center two-thirds of the duct. The criteria for qualification for the gaseous tracer test are that 1) the %COV should be $\leq 20\%$ within the center two-thirds of the duct, and 2) the concentration at any measurement point should not deviate from the overall mean by more than 30%.

The concentration variation was the important result for this test, so calibration bias was not important in the test results. However, the analyzer response was checked with calibration standards before and after conducting the test series (as well as weekly during the test series) to verify that the instrument provided an adequate instrument response. For N_2O calibration, 2 ppm and 60 ppm certified master class standard gases balanced with air (Air Liquide America Specialty Gases LLC, Longmont, CO) were used. When conducting weekly N_2O calibrations, a Nafion® dryer/humidifier (Perma Pure LLC, Model PD-50T-12MPP, Toms River, NJ) was used to ensure consistent humidity of the N_2O entering the gas analyzer. The instrument response was considered acceptable if the concentration from the instrument was within 10% of the calibration standard.

In addition, the PNNL operating procedure EMS-JAG-01 and the Test Instruction TI-STMON-030 were used to conduct this test.

3.5 Particle Tracer Uniformity

The uniformity of the particulate contaminant concentration was demonstrated using 10- μm AD polydisperse oil particles as a particle tracer. Vacuum pump oil was drawn into a spray nozzle (driven by compressed air) housed in a stainless steel chamber depicted in Figure 3.9.

These aerosol particles were injected into the duct air at an injection point downstream of each fan as well as at the junction. For particle tracer testing, injections were only introduced at the center of the duct. The stainless steel metal chamber and spray nozzle assembly was referred to as the aerosol generator. The aerosol generators were grounded to ensure that static electricity would not cause any potential safety concerns. Two aerosol generators were deployed for the full scale testing. The output of each aerosol generator was merged using a stainless steel Tee to obtain sufficient particle tracer injection into the stack. The particle injection output of the aerosol generator was roughly controlled by tuning the output pressure on the pancake regulator. In order to avoid overwhelming the optics in the OPC, the sampling particle number concentration of the 10 μm particles were controlled to be in the range of 1500 – 2000 particles/ ft^3 . Prior to each particle tracer run, the system background was collected and recorded to ensure that there was no interference in the particle tracer measurements. The stack background particle number concentration was smaller than 20 particles/ ft^3 for all test runs.

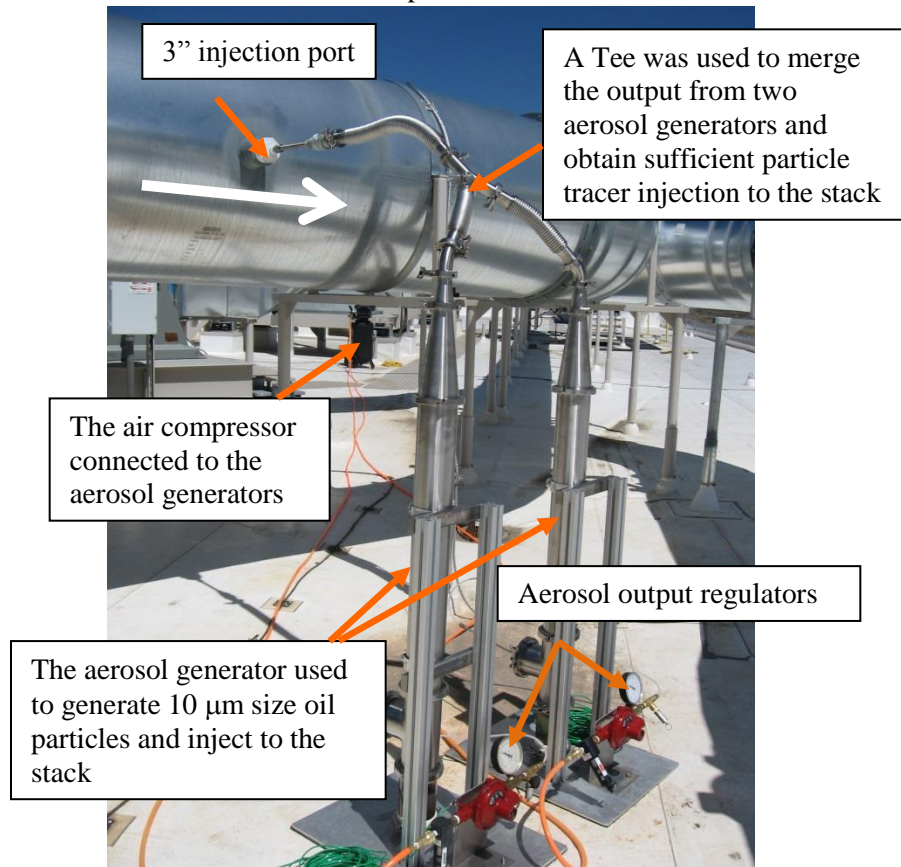


Figure 3.9. Equipment and Setup Used for the Particle Injection Downstream of Fan B. Two aerosol generators were used and their output was merged to increase the particle injection and obtain reasonable measurement sensitivity at the sampling port.

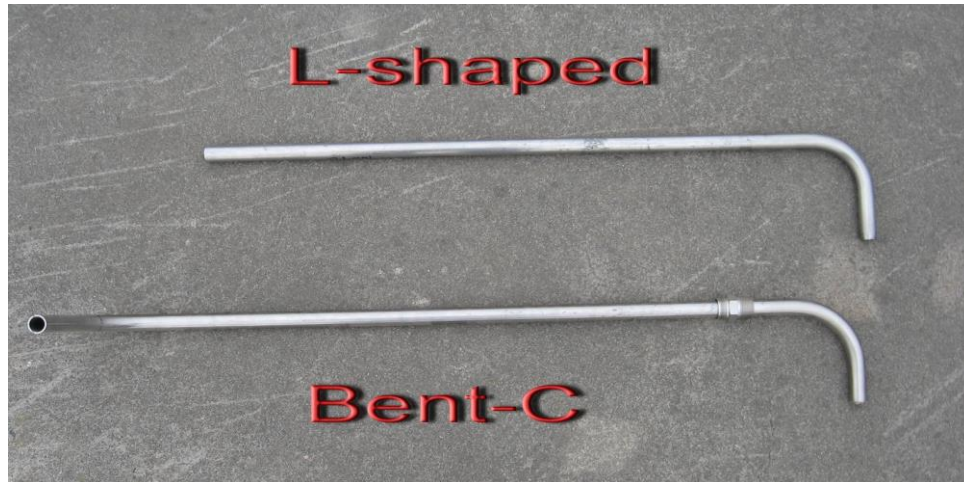


Figure 3.10. Probes Used for the Particle Sampling.

The concentration of the particles was measured at the sampling grid points with a calibrated OPC (Met-One Model 3415, Hach Instruments, Loveland, CO). A simple probe was used to extract the sample and deliver it to the OPC. Figure 3.10 shows the two types of sampling probes used for particle sampling in the 3410 stack testing. The OPC sorts the particles into six size channels. As mentioned in Section 1.1, the particles of interest have an AD of $10\ \mu\text{m}$. Therefore, only data in the 9- to $11\text{-}\mu\text{m}$ channel of the OPC were used.

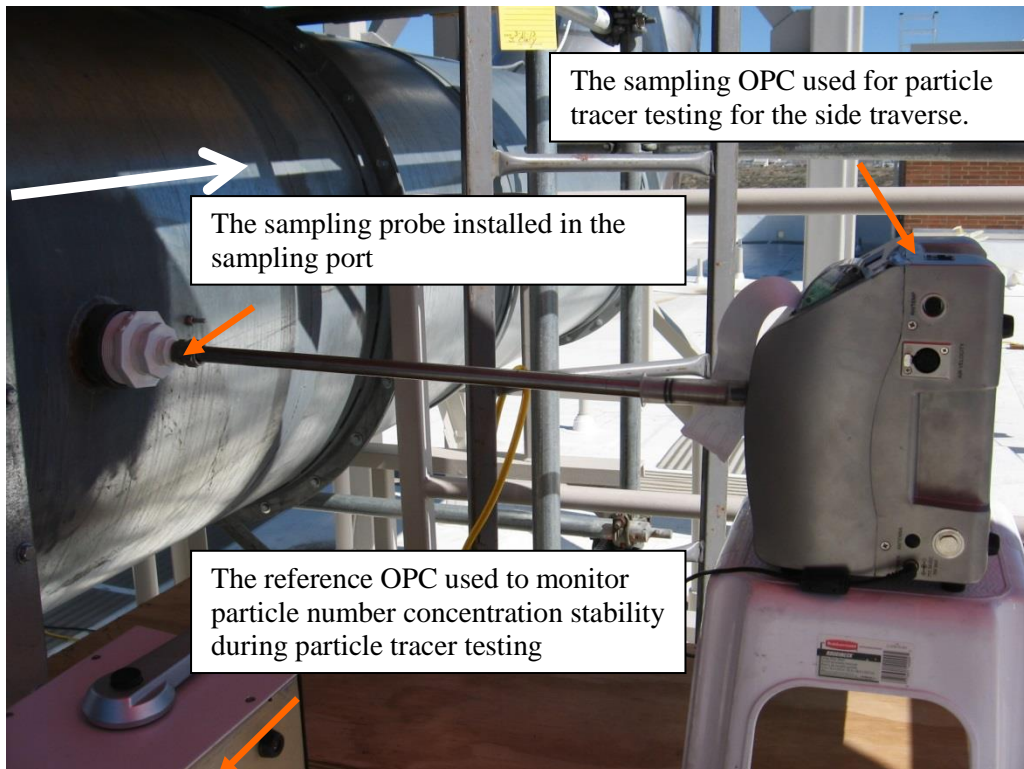


Figure 3.11. Equipment and Setup Used for the Particle Tracer Testing for the Side Traverse. The white arrow indicates the flow direction inside the stack.

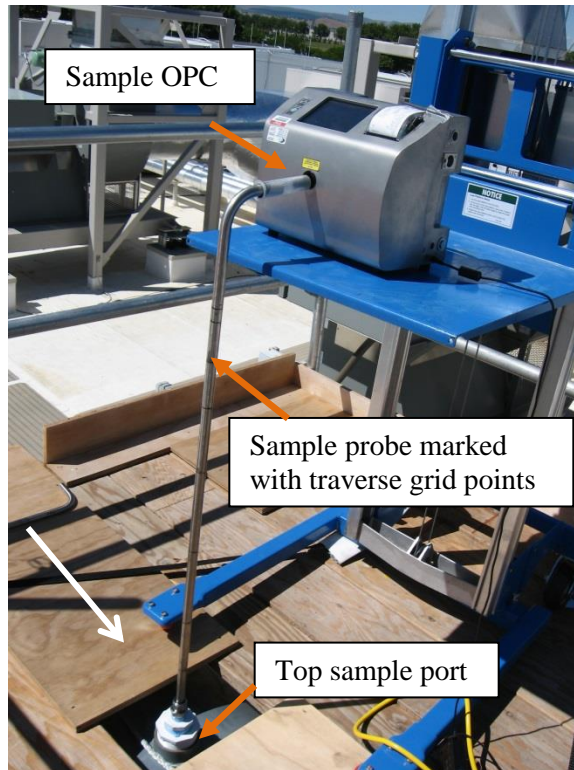


Figure 3.12. Equipment and Setup Used for the Particle Tracer Testing for the Top Traverse. The white arrow indicates the flow direction inside the stack.

Figure 3.11 and Figure 3.12 depict the sampling setup with the simple probe connected to the OPC for side and top traverse measurements, respectively. The particle counter was in its “vertical” position for the side traverse and it was in the “horizontal” position for the top traverse measurements.

A second OPC was simultaneously used to sample from the reference port at a fixed location to monitor the consistency of the aerosol input. This reference port was placed on the access cover near the sampling probe (Figure 3.13).

The particle concentration was read three times at each of the measurement points across the cross-section of the duct. The measured concentration for each point was the average of the three readings. From these measurements, the overall mean standard deviation, and %COV was calculated for all of the points. The same statistics were also calculated for those points within the center two-thirds of the duct. The qualification criterion for the particle tracer test is that the %COV should be less than or equal to 20% within the center two-thirds of the duct. The PNNL operating procedure EMS-JAG-02 and the Test Instruction TI-STMON-029 were used to conduct this test.

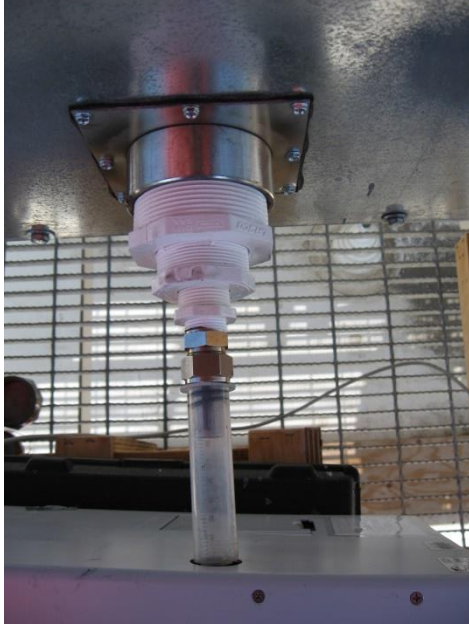


Figure 3.13. a) The sampling port for the reference OPC and connection to the OPC.



b) The reference OPC during testing.

4.0 Stack Testing Results

The duct diameters were measured at the test ports. They were confirmed to be 39.75 in and listed in Table 4.1. The distance from the test ports to the nearest upstream disturbance (the junction of the ducts from the three fans) was 53.5 ft. These test ports were located 16 duct diametersⁱ downstream of the duct junction.

Table 4.1. 3410 Duct Depth Measurements.

Direction across duct	Measured Duct Diameter, in.
Vertical	39.75
Horizontal	39.75

4.1 Velocity Uniformity

Table 4.2 lists the results for the velocity uniformity tests performed on the 3410 Building exhaust duct. The conditions for the velocity uniformity test runs (VT) included a typical normal flow condition with all fume hood sashes closed and a possible higher flow condition with all new fume hood sashes open. The flow rate measured with the Zephyr II+ provided results in actual cubic feet per minute (acfm) whereas the airflow displayed in the air sampling cabinet was in standard cubic feet per minute (scfm). Because the airflow monitor was out of order and was in need of replacement, comparison between the Zephyr manometer and the airflow monitor was not possible during all testing. For convenience of comparisons, the measured velocity in scfm is converted to air flow in acfm.

The acceptance criterion is that the COV of the air velocity must be $\leq 20\%$ across the center two-thirds of the area of the stack. Our results show that the COVs of the air velocity across the center two-thirds of the stack are smaller than 2.9% for all testing conditions.

ⁱ Duct diameter or DIA is defined as linear distance divided by duct diameter.

Table 4.2. Summary of Velocity Uniformity Tests

Test Configuration		Test Results			
Fans	Flow Conditions†	Run No.	Mean Flow*, acfm	Mean Vel, scfm	%COV, center 2/3
Fan A & B	normal	VT-1	25327	2939	2.3
		VT-2	25383	2945	2.9
		VT-3	24836	2882	1.8
Fan A & C	normal	VT-4	25185	2922	2.2
		VT-5	24925	2892	2.0
		VT-6	24812	2879	2.0
Fan B & C	normal	VT-7	24547	2848	2.0
		VT-8	24575	2852	2.3
		VT-9	24771	2874	2.4
Fan A & C	Sashes opened‡	VT-10	27436	3184	2.3
		VT-11	27496	3191	2.4
		VT-12	27463	3187	2.4

*: Mean flow was spot checked approximately at the center of the stack using a calibrated TSI™ VelociCalc digital anemometer. The stack airflow measured by the air monitor was not trustworthy, because the setting was erroneous. This was not fixed until all testing was finished.

†: Normal refers to the operational flow conditions as summarized in Table 1.1.

‡: Sashes in the new laboratory 1604 and 1606 were opened to allow higher flow in the stack.

4.2 Flow Angle

Table 4.3 lists the results for the flow angle test runs (FAs) performed on the 3410 Building exhaust duct. The average flow angle of 4.0° is acceptable as it is well within the criterion of average flow angle values less than 20°.

4.3 Gas Tracer Uniformity

Table 4.4 lists the results for the gas tracer test runs (GTs) performed on the 3410 Building exhaust duct. The uniformity of the concentration is first tested using a tracer gas to represent gaseous effluents. The fan is a good mixer, so injecting the tracer downstream of the fan provides worst case results. Alternately, injections were made at the junction downstream after the ducts from each fan meet. The acceptance criteria are that 1) the COV of the measured tracer gas concentration is $\leq 20\%$ across the center two-thirds of the sampling plane and 2) at no point in the sampling plane does the concentration vary from the mean by $> 30\%$. Test results show that 1) the COV of the measured tracer gas concentration is $< 2.8\%$ for all test conditions and 2) at no point in the sampling plane does the concentration vary from the mean by $> 6.7\%$. The two worst cases for the fan pair and junction injection were repeated. The results were grouped for each test configuration for ease of comparisons.

Table 4.3. Summary of Flow Angle Tests

Test Configuration				Test Runs		
Fans	Flow Conditions [†]	No.	Test Port	Run No.	Mean Flow*, acfm	Mean of abs values (°)
Fan A & B	normal	1	At Probe	FA-1	25561	3.2
		2		FA-2	28017	2.5
		3		FA-3	27345	2.6
Fan A & C	normal	4	At Probe	FA-4	31024	2.6
		5		FA-5	26784	1.9
		6		FA-6	26242	1.4
Fan B & C	normal	7	At Probe	FA-7	26509	4.0
		8		FA-8	29301	1.7
		9		FA-9	29275	1.5
Fan A & C	normal [‡]	10	At Probe	FA-10	28844	2.9
		11		FA-11	27793	2.4
		12		FA-12	30559	1.8

*: Mean flow was spot checked approximately at the center of the stack using a calibrated TSI™ VelociCalc digital anemometer. The stack airflow measured by the air monitor was not trustworthy, because the setting was erroneous. This was not fixed until all testing was finished.

[†]: Normal refers to the operational flow conditions as summarized in Table 1.1.

[‡]: Sashes in the new laboratory 1604 and 1606 were opened to allow higher flow in the stack.

4.4 Particle Tracer Uniformity

Table 4.5 lists the results for the particle concentration uniformity (PTs) performed on the 3410 Building exhaust duct. Tracer particles of 10- μ m aerodynamic diameter were used for the second demonstration of concentration uniformity. The acceptance criterion is that the COV of particle concentration is $\leq 20\%$ across the center two-thirds of the sampling plane. Our test results indicate that the COV of particle concentration is $<9.9\%$ across the center two-thirds of the sampling plane among all testing conditions. The two worst cases for the fan pair and junction injection were repeated. The results were grouped for each test configuration for ease of comparisons.

Table 4.4. Summary of Tracer Gas Uniformity Tests.

Test Configurations					Test Runs		
Fans	Flow Conditions [†]	Run No.	Injection Port ^{††}	Injection Position	Mean Flow*, acfm	Max Dev.	COV%
Fan A & B	normal	GT-1	Junction Center	Center and 4 Perimeter Points*	26267	-2.5%	1.3
		GT-2	Junction Top		26491	1.8%	1.0
		GT-3	Junction Bottom		27918	1.5%	0.6
		GT-4	Junction Far		27586	1.5%	0.8
		GT-5	Junction Near		28883	2.3%	1.3
		GT-D	Junction Center	center	28107	-3.7%	0.6
		GT-6	Fan A Center	Center and 4 Perimeter Points	28137	-1.5%	0.9
		GT-7	Fan A Top		27284	-2.4%	0.8
		GT-8	Fan Bottom		27551	2.8%	0.6
		GT-9	Fan A Far		28370	-3.2%	1.6
GT-10	Fan A Near	29185	-3.0%		1.8		
Worst Case Fan Pair A&B	sashes open [‡]	GT-39	Fan A Center	Center and 4 Perimeter Points	29512	1.8%	0.9
		GT-40	Fan A Bottom		29409	2.3%	0.7
		GT-41	Fan A Top		28228	-1.8%	1.0
		GT-42	Fan A Near		28215	1.6%	0.9
		GT-43	Fan A Far		28008	-2.5%	1.4
Fan A & B	normal	GT-11	Fan B Center	Center	27758	2.2%	1.0
Fan A & C	normal	GT-12	Junction Center	Center and 4 Perimeter Points	28426	-1.9%	1.2
		GT-13	Junction Top		29353	1.6%	0.9
		GT-14	Junction Bottom		27655	1.7%	0.9
		GT-15	Junction Near		28155	2.6%	1.5
		GT-16	Junction Far		26504	1.4%	0.7
Worst Case Fan Pair A&C	sashes open [‡]	GT-34	Junction Center	Center and 4 Perimeter Points	30615	-3.4%	1.5
		GT-35	Junction Top		30744	2.3%	0.9
		GT-36	Junction Bottom		28982	1.5%	0.7
		GT-37	Junction Near		28818	-4.3%	1.6
		GT-38	Junction Far		28577	1.2%	0.6
Fan A & C	normal	GT-17	Fan C Center	Center and 4 Perimeter Points	26220	1.5%	0.8
		GT-18	Fan C Top		28547	1.4%	0.8
		GT-19	Fan C Bottom		26703	-1.9%	0.6
		GT-20	Fan C Far		27146	-2.0%	0.5
		GT-21	Fan C Near		26276	-2.9%	1.9
	normal	GT-22	Fan A Center	Center	26836	-3.0%	1.1
	sashes open [‡]	GT-44	Fan C Near	near	28125	6.7%	2.8
Fan B & C	normal	GT-23	Fan B Center	Center and 4 Perimeter Points	25578	-2.6%	0.9
		GT-24	Fan B Bottom		25720	1.8%	1.0
		GT-25	Fan B Top		26414	2.6%	1.1
		GT-26	Fan B Far		27108	-2.2%	0.9
		GT-27	Fan B Near		27668	2.1%	0.7
		GT-28	Fan C Center	Center and 4 Perimeter	25910	1.8%	1.2
		GT-29	Fan C Bottom	26535	1.4%	0.7	

Test Configurations					Test Runs		
Fans	Flow Conditions [†]	Run No.	Injection Port ^{††}	Injection Position	Mean Flow [*] , acfm	Max Dev.	COV%
		GT-30	Fan C Top	Points	26625	2.8%	1.8
		GT-31	Fan C Near		25974	1.3%	0.7
		GT-32	Fan C Far		28146	-1.3%	0.6
Fan B & C	normal	GT-33	Junction Center	Center	27448	1.8%	0.9

*: Mean flow was spot checked approximately at the center of the stack using a calibrated TSI™ VelociCalc digital anemometer. The stack airflow measured by the air monitor was not trustworthy, because the setting was erroneous. This was not fixed until all testing was finished.

†: normal refers to the operational flow conditions as summarized in **Table 1.1**.

‡: Sashes in the new laboratory 1604 and 1606 were opened to allow higher flow in the stack.

††: The injection port was either downstream of the damper of each fan or at the junction location shown in Figure 2.1.

Table 4.5. Summary of Particle Uniformity Tests.

Test Configurations				Test Runs	
Fans	Flow Conditions [†]	Run No.	Injection Port ^{††}	Mean Flow [*] , acfm	Normalized COV%
Fans A & B	normal	PT-1	Junction	33679	8.28
	normal	PT-2	Fan A	29103	8.93
	normal	PT-3	Fan B	29060	7.77
Fans B & C	normal	PT-4	Junction	28228	7.01
	normal	PT-5	Fan B	28344	8.53
	normal	PT-6	Fan C	28540	9.56
Worst Case (B&C)	normal	PT-11	Fan C	28896	6.52
Fans A & C	normal	PT-7	Junction	29352	9.87
	normal	PT-8	Fan A	29081	9.16
	normal	PT-9	Fan C	28540	8.46
Worst Case (A&C)	normal	PT-10	Junction	29689	7.74

*: Mean flow was spot checked approximately at the center of the stack using a calibrated TSI™ VelociCalc digital anemometer. The stack airflow measured by the air monitor was not trustworthy, because the setting was erroneous. This was not fixed until all testing was finished.

†: Normal refers to the operational flow conditions as summarized in Table 1.1.

††: The injection port was either downstream of the damper of each fan or at the junction location shown in Figure 2.1. Injection was always at the center of the stack.

5.0 Conclusions

In order to support the air emissions permit for the 3410 Building, PNNL performed a series of tests in the exhaust air discharge from the reconfigured 3410 Building filtered exhaust stack. The objective was to determine whether the location of the air sampling probe for emissions monitoring meets the applicable regulatory criteria governing such effluent monitoring systems. In particular, the capability of the air sampling probe location to meet the acceptance criteria of ANSI/HPSN13.1-2011, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stack and Ducts of Nuclear Facilities* was determined. The qualification criteria for these types of stacks include metrics concerning 1) uniformity of air velocity, 2) sufficiently small flow angle with respect to the axis of the duct, 3) uniformity of tracer gas concentration, and 4) uniformity of tracer particle concentration. Testing was performed to conform to the quality requirements of NQA-1-2000. Fan configurations tested included all fan combinations of any two fans at a time. Most of the tests were conducted at the normal flow rate, while a small subset of tests was performed at a slightly higher flow rate achieved with the laboratory hood sashes fully open.

The qualification criteria for an air monitoring probe location are taken from ANSI/HPSN13.1-2011 and are paraphrased as follows with key results summarized:

Uniform Air Velocity: The acceptance criterion is that the COV of the air velocity must be $\leq 20\%$ across the center two-thirds of the area of the stack. Our results show that the COVs of the air velocity across the center two-thirds of the stack are smaller than 2.9% for all testing conditions.

Angular Flow: The average air-velocity angle must not deviate from the axis of the stack or duct by more than 20° . Our test results show that the mean angular flow angles at the center two-thirds of the ducts are smaller than 4.0° for all testing conditions.

Uniform Concentration of Tracer Gases: The uniformity of the concentration is first tested using a tracer gas to represent gaseous effluents. The fan is a good mixer, so injecting the tracer downstream of the fan provides worst case results. Alternately, injections can be made at the junction downstream after the ducts from each fan meet. The acceptance criteria are that 1) the COV of the measured tracer gas concentration is $\leq 20\%$ across the center two-thirds of the sampling plane and 2) at no point in the sampling plane does the concentration vary from the mean by $>30\%$. Our test results show that 1) the COV of the measured tracer gas concentration is $< 2.8\%$ for all test conditions and 2) at no point in the sampling plane does the concentration vary from the mean by $> 6.7\%$.

Uniform Concentration of Tracer Particles: Tracer particles of $10\text{-}\mu\text{m AD}$ are used for the second demonstration of concentration uniformity. The acceptance criterion is that the COV of particle concentration is $\leq 20\%$ across the center two-thirds of the sampling plane. Our test results indicate that the COV of particle concentration is $<9.9\%$ across the center two-thirds of the sampling plane among all testing conditions.

Thus, the reconfigured 3410 Building filtered exhaust stack was determined to meet the qualification criteria given in the ANSI/HPSN13.1-2011 standard. Changes to the system configuration or operations outside the bounds described in this report (e.g., exhaust stack velocity changes, relocation of sampling probe, and addition of fans) may require re-testing or re-evaluation to determine compliance.

6.0 References

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PP-STMON-031, 3410 Building Stack Monitoring Project Plan, Pacific Northwest National Laboratory, Richland, WA 99352.

Appendix A: The CFD Model Report

Modeling the Air flow in the 3410 Building Filtered Exhaust Stack System

KP Recknagle, JM Barnett, SR Suffield
November, 2012

Executive Summary

Additional ventilation capacity has been designed for the 3410 Building filtered exhaust stack system. The updated system will increase the number of fans from two to three, and will include ductwork to incorporate the new fan into the existing stack. Stack operations will involve running various two-fan combinations at any given time. The air monitoring system of the existing two-fan stack was previously found to be in compliance with the ANSI/HPSN13.1-2011 standard, however it is not known that the modified (three fan) system will comply. Subsequently, a full scale three-dimensional (3-D) computational fluid dynamics (CFD) model of the modified stack system has been created to examine the sampling location for compliance with the ANSI/HPSN13.1-2011 standard.

The CFD modeling results show good agreement with testing data collected from the existing 3410 Building stack, and suggest that velocity uniformity and flow angles will remain well within acceptance criteria when the third fan and associated ductwork is installed. This includes two-fan flow rates up to 31,840 cfm, for any of the two-fan combinations. For simulation cases in which tracer gas and particles are introduced in the main duct, the model predicts that both particle and tracer gas COVs may be larger than the acceptable 20% criterion of the ANSI/HPSN13.1-2011 standard for each of the two-fan, 31,840 cfm combinations. Simulations in which the tracers are introduced near the fans result in improved, though marginally acceptable COV values for the tracers.

Due to the remaining uncertainty that the stack will qualify with the addition of the third fan and high flow rates, a stationary air blender from Blender Products, Inc. is considered for inclusion in the stack system. A model of the air blender has been developed and incorporated into the CFD model. Simulation results from the CFD model that includes the air blender show striking improvements in tracer gas mixing and tracer particle dispersion. The results of these simulations suggest the air blender should be included in the stack system to ensure qualification of the stack.

Introduction

The 3410 Building at the Pacific Northwest National Laboratory (PNNL) houses PNNL radiological capabilities. As such, air discharged from the Building filtered exhaust stack system must be monitored for radionuclides. The air monitoring system must comply with applicable federal regulations, which subsequently require a sampling probe in the exhaust stream to conform to the uniformity criteria of the ANSI/HPSN13.1-2011. The criteria include: the uniformity of flow velocity, the average angle between the flow and duct axis, the uniformity of tracer gas, and the uniformity of tracer particles. The uniformity is expressed by the COV, defined as the standard deviation divided by the mean. For a sampling location to be acceptable, COVs for velocity, tracer gas concentration, and tracer particle concentration must be < 20%. Additionally, the average flow angle must be < 20° from the duct axis to ensure the flow is not cyclonic. The ANSI/HPSN13.1-2011 standard requires that testing be performed to demonstrate the compliance of the duct and sampling probe for meeting these uniformity criteria.

An option in the ANSI/HPSN13.1-2011 standard allows the adoption of results from a previously performed full test series for a stack system of similar configuration as the basis of compliance with the standard. Compliance is then confirmed by partial testing performed on the actual stack system. This approach was used to qualify the location of the monitoring probe and configuration of the original two-fan 3410 Building filtered exhaust stack as documented by Glissmeyer and Flaherty, 2010 (PNNL-19562). This testing performed on the actual system included flow velocity uniformity and flow angle measurements. The previous full test series applied as the basis for compliance was that performed on a scale model of the Waste Treatment Plant's HV-C2 air exhaust stack (Glissmeyer and Droppo, 2007). The HV-C2 stack with two fans entering a horizontal main duct, both at 45° angles, is very similar to the original two-fan configuration of the 3410 Building exhaust stack.

The original testing of the HV-C2 scale model by Glissmeyer and Droppo had been performed to establish the sampling probe location for the actual HV-C2 stack. The scale model showed good velocity uniformity and small flow angles. However tracer gas/particle test COV values were greater than 20% at all but the test port furthest downstream. This furthest test port on the HV-C2 scale model is similar in scaled distance to that of the 3410 Building sampling location. Thus in the two-fan stack configuration all of the main duct length, of the 3410 Building exhaust system, would be needed to provide sufficient mixing of tracer gas and tracer particles.

The 3410 Building exhaust stack system will be updated with additional ventilation capacity. The updated system will incorporate a third fan and adjoining ductwork to integrate the new fan into the existing stack. As a result, the stack configuration will be changed substantially. The average overall flow rate will also be increased significantly. In the absence of data from a similar system, it is not well known if the updated three fan system will qualify as readily as the two-fan system. Testing will ultimately be required to prove the stack system and sampling location comply with the ANSI/HPSN13.1-2011 standard. Before making a final decision on installation of the proposed design modeling would be used to gain more insight into the expected performance of the modified stack.

Modeling Approach

The purpose of modeling the 3410 Building stack system is to simulate the stack flow, including the distributions of gas and particle tracers, to assist in determining if the modified system will satisfy the ANSI/HPSN13.1-2011 standard. To provide accurate predictions of flow, tracer gas, and tracer particle distributions (at the sampling location) requires an accurate prediction of the turbulent air flow with mixing and transport of the tracer species within it. The geometry and flow field of the exhaust stack system is complex and highly three-dimensional (3-D). Therefore a representative boundary fitted, 3-D flow model is also required. The commercially available, computational fluid dynamics (CFD) flow simulation code, STAR-CCM+ (CD-Adapco, 2012) was selected for creation of the model geometry and the flow simulations (Recknagle et al., 2009).

Flow Model

The stack sampling methodology assumes isothermal conditions exist within the stack, thus this assumption is adopted in the flow model. Computations for the isothermal, steady state flow solutions in STAR-CCM+ are performed using a traditional formulation for conservation of mass, gas mixture species, and momentum:

$$\frac{\partial}{\partial x_j} (\rho u_j) = 0 \quad (\text{A.1})$$

$$\frac{\partial}{\partial x_j} (\rho u_j Y_k + F_{k,j}) = S \quad (\text{A.2})$$

$$\frac{\partial}{\partial x_j} (\rho u_j u_i - t_{ij}) = - \frac{\partial p}{\partial x_i} \quad (\text{A.3})$$

where u_i is the absolute fluid velocity component in coordinate direction x_i ($i = 1, 2, 3$), repeated subscripts (jj) denote summation, ρ is the gas mixture density, p is the pressure, Y_k is the gas species mass fraction, $F_{k,j}$ is the gas diffusional flux component, and S_k is the gas species source term. The fluid stress tensor τ_{ij} for turbulent flows is represented by

$$t_{ij} = 2\mu S_{ij} - \frac{2}{3}\mu \frac{\partial u_k}{\partial x_k} \delta_{ij} - \overline{\rho u_i u_j} \quad (\text{A.4})$$

Here μ is the dynamic viscosity, S_{ij} is the rate of strain tensor, u_i and u_j are fluctuations about the average velocity, and the overbar indicates the averaging of the fluctuations. The right-most term (in eqn A.4) represents the additional Reynolds stresses due to turbulent motion. These are linked to the mean velocity via the turbulence model being used. In the simulations for this work, the generation and dissipation of turbulence was accounted for using the standard κ - ϵ turbulence model for large Reynolds number flow as described in the STAR-CMM+ User Guide (CD-Adapco, 2012, Bellevue, Washington). In the present work, a turbulence model comparison found the large Reynolds number κ - ϵ model to be the most suitable for use in simulating duct flow, a finding corroborated by (Jenson, 2007).

^j e.g., $\frac{\partial \rho u_j}{\partial x_j} = \frac{\partial \rho u_1}{\partial x_1} + \frac{\partial \rho u_2}{\partial x_2} + \frac{\partial \rho u_3}{\partial x_3}$

Oil Droplet Model

A Lagrangian dispersed two-phase flow model was used for the oil droplet transport simulations. The Lagrangian methodology considers the interactions of mass, momentum, and energy between the continuum and dispersed phases. In general, motion of the dispersed phase is influenced by that of the continuous phase, and vice versa. The strength of the phase interactions depend on the dispersed particle's size, density, and number density. For the present work, droplet concentrations were small, as was the nominal particle size, thus momentum transfer from droplets to air was negligibly small. In the model, the momentum equation for a droplet, given by Newton's second law was:

$$m_d \frac{du_d}{dt} = F_{dr} + F_p + F_b \quad (\text{A.5})$$

where the subscript d refers to the dispersed droplet phase, F_{dr} is the drag force, F_p the pressure force, and F_b is body forces including effect of the gravity and angular velocity vectors. Surface vapor pressure and mass transfer between phases was not considered here. The problem was considered isothermal and did not involve electrically charged flow, therefore thermophoresis and electrostatic effects were not included. Because of the low number density of the oil droplets, separation and coalescence models were left aside as well.

Model Geometry

A design drawing of the 3410 Building exhaust stack system was used to create a 3-D geometry model of the modified stack system. The model geometry for the system is shown in Figure A.1. Air mixing upstream of the fans is not included in the models. Instead, the model domains include the ductwork from just downstream of the fans to the stack exit. To approximate the circumferential motion created by the fans, curved duct segments were added in the orientation of the actual system. The overall computational mesh is sufficiently refined to enable resolution of the turbulent flow field throughout the system. The computational mesh was developed in a process that tested the solution sensitivity for several mesh resolutions. The final computational mesh for the three fan system contains 913,628 elements; Figure A.2a provides a close up view of the mesh near Fan 1, including a rectangular extension of the fan inflow boundary that helps establish flow solution stability. Resolution throughout the volume mesh is similar to that shown in Figure A.2b.

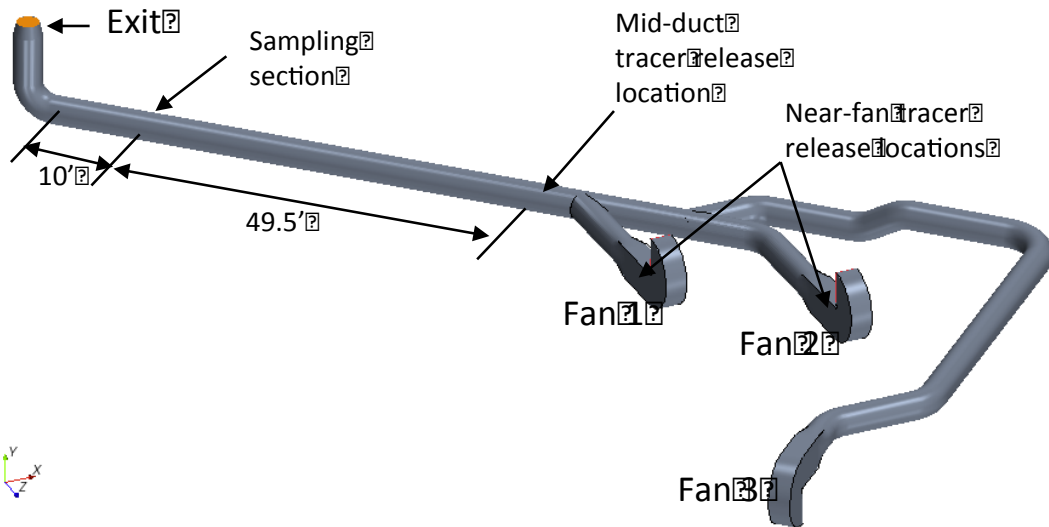
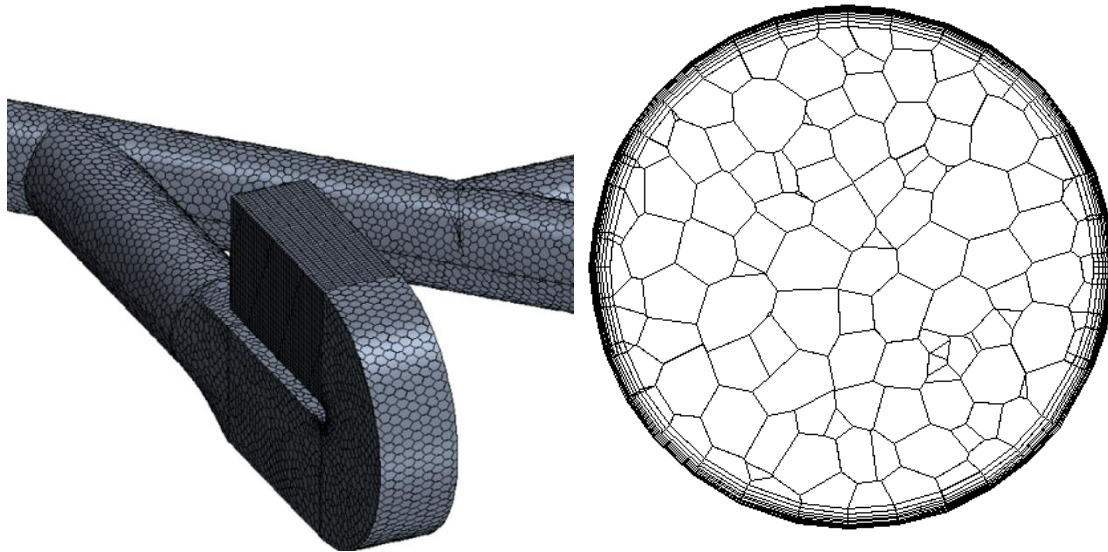


Figure A.1. Model geometry for the modified 3410 Building filtered exhaust stack system.



a) Figure A.2. Detail of computational mesh at the: a) surface mesh near Fan 1, and b) typical cross-section of the volume mesh in the main duct.

Boundary Conditions

Mass inflow boundaries with uniform velocity distributions are established at the duct inlets, including turbulence intensity and turbulent viscosity ratio settings. A pressure boundary with 1 atmosphere absolute pressure is used at the stack exit. Duct walls are modeled as smooth surfaces with zero slip flow boundary conditions.

Stack Model Validation

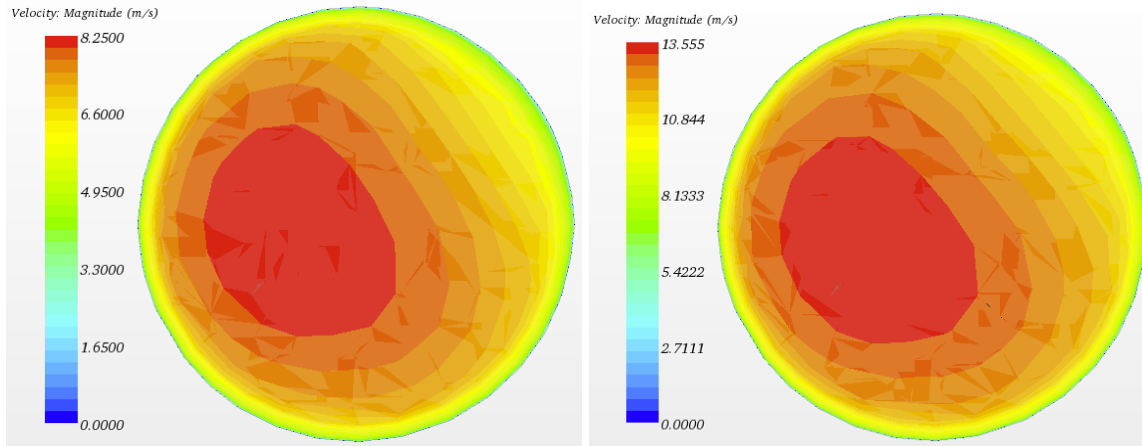
The first simulation cases presented are to validate the capability of the model to replicate flow angle and velocity uniformity measurements taken from the actual 3410 Building stack. As validation, the modeled flow uniformity, as indicated by the COV of velocity uniformity at the side and top sampling ports, is compared to measured data. Per the design drawing of the 3410 Building exhaust stack system, the top and side sampling ports are located 10 ft. 0 in., upstream of the 90° elbow near the stack exit as shown in Figure A.1. This is the location used in the model to extract velocity information for comparison with the measured data. This location is 49.5' (or 15 duct diameters) downstream of main duct release location near the junction of fans 1 with the main duct.

A substantial length of duct is required to achieve a fully developed velocity profile (fully developed flow). For turbulent flow this hydrodynamic flow development length (x_{fd}) is considered to be roughly independent of the Reynolds number, ranges from 10- to 60-diameters, and is typically assumed to be at least 10-diameters (Incropera and DeWitt, 1985). A more conservative relation for x_{fd} considers the Reynolds number dependence such that:

$$\frac{x_{fd}}{D} = 4.4 (Re)^{1/6} \tag{A.6}$$

Using this expression, x_{fd} would range from 37-diameters for a flow (in the 40-inch duct) of 10,000 cfm, to 45-diameters for a flow of 31,840 cfm (2 fans at 15,920 cfm). With this Reynolds number dependence in mind, and the actual length available in the duct for flow development, we sought to gain validation of the model from measured data from a range of flow cases. Glissmeyer and Flaherty (PNNL-19562 RPT-STMON-005, 2010) measured velocity profiles for flows of 20,450 and 12,351 acfm, in tests VT-3 and VT-4 respectively. Simulation cases using the full scale CFD model of the existing system were run to replicate the conditions tested in VT-3 and VT-4.

Figure A.3 shows the modeled velocity magnitude profile at the sampling section for a) VT-4 and b) VT-3. The location of maximum velocity, skewed low and to the left of center, is similar for both flow rate cases. The skewed flow at the sampling location is due to a slight swirling effect in the main duct setup by the circumferential flow introduced by fans 1 and 2, and the confluence of the two streams into the main duct. This effect can be seen in plan view in Figure A.4, which shows the velocity magnitude at the mid-plane of the main duct as the flow swirls in a counter clock-wise direction making about 2/3 of a full rotation along the duct. The location of the sampling section is indicated in Figure A.4 by the vertical line through the duct at left.



a). b).
 Figure A.3. Velocity magnitude at the sampling section for the modeled a) VT-4, and b) VT-3 test cases.

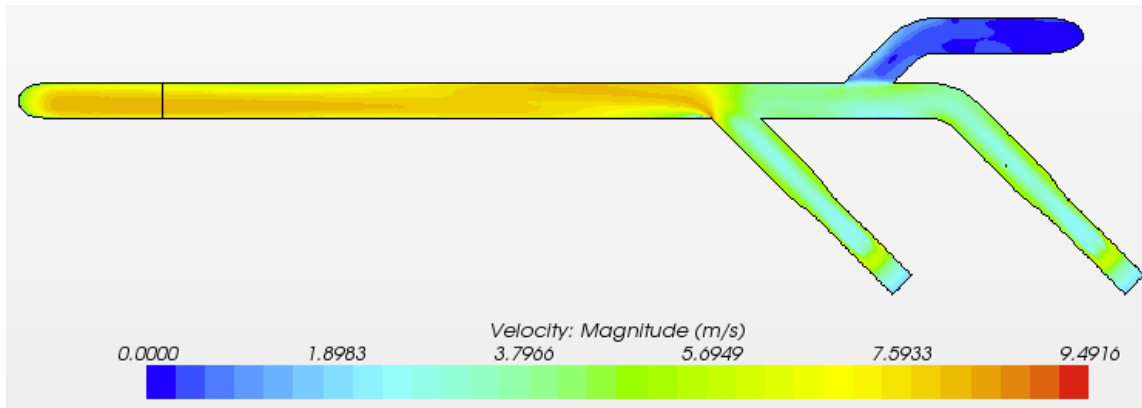


Figure A.4. Velocity magnitude in plan view at mid-plane of the main duct for the modeled VT-4 flow case.

The COV of velocity uniformity for tests VT-3 and VT-4, and the simulation cases representing them are summarized in Table A.1, where it is seen that the COV from testing and from modeling are very similar. Table A.2 summarizes flow angles from tests and the CFD simulations. The modeled flow angles are similar to angles measured in tests with similar flow rates (eg. FA-2 and VT-3, FA-3 and VT-4). As demonstrated by the noise in the flow angle test data (Glissmeyer and Flaherty, 2010) the flow distribution and flow angles are very dynamic, yet the flow angles predicted by the model compare well with the data. These results demonstrate the suitability of the model for simulating flow within the 3410 Building exhaust stack system.

Table A.1. COV for velocity uniformity tests VT-3 and VT-4

Test	Flow rate, acfm	COV from test, %			COV from model, %		
		Side	Top	All	Side	Top	All
VT-3	20,450	4.3	3.6	4.1	6.1	3.9	5.0
VT-4	12,351	2.4	3.7	3.4	7.0	3.6	5.4

Table A.2. Maximum flow angles from tests and models

Case	Flow rate, cfm	Data source	Maximum flow angle	
			Side	Top
FA-1	17,975	measured	3.3°	11°
FA-2	18,350	measured	4.3°	5.7°
FA-3	10,800	measured	4.3°	5.7°
VT-3	20,450	modeled	5.4°	6.4°
VT-4	12,351	modeled	6.2°	5.2°

Stack Modeling Results

Flow Angle and Velocity Uniformity

Operations of the modified three fan exhaust system will involve running two of the three fans at any given time for an expected maximum total flow rate of 31,840 cfm. Modeling cases were run to simulate the two-fan operations to determine the relative performance of each case, and how well each case will meet ANSI/HPSN13.1-2011 standards. Figure A.5 shows velocity magnitude distributions at the sampling section for the three two-fan operation cases. The color scales of the three contour plots match with flow velocities up to 21.25 m/s (3650 ft/min mean). Due to a swirl component in the duct flow, the velocity profiles at the sampling/test section are skewed similarly to those of the VT-3 and VT-4 simulation cases. When operating fans 1 and 2 (Figure A.5a), or 1 and 3 (Figure A.5b) the velocity distributions are more skewed and less developed as when operating with fans 2 and 3 (Figure A.5c). The flow is more developed in the latter case due to greater main duct length available with this fan combination. Although the distribution of velocity appears to be more uniform for the case running fans 2 and 3, all cases have similar velocity uniformity COV and maximum flow angles as summarized in Table A.3.

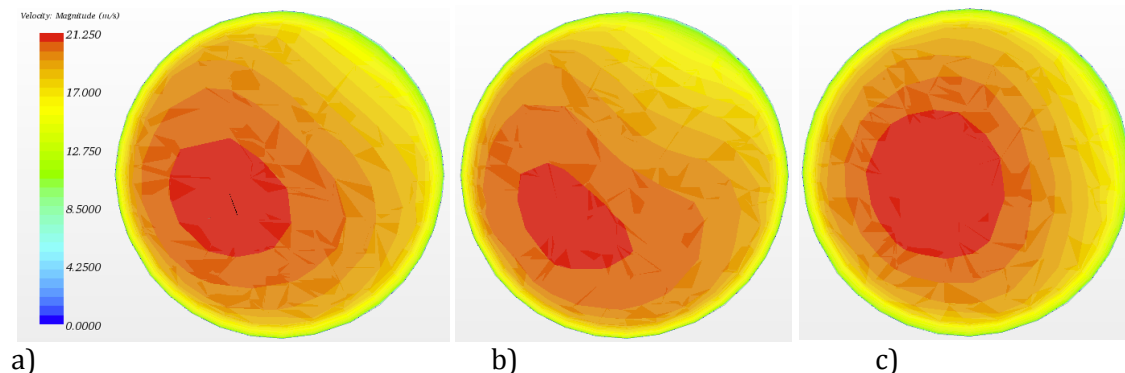


Figure A.5. Velocity magnitude at the sampling section for the modeled flow rate of 31,840 cfm, running: a) fans 1 and 2, b) fans 1 and 3, and c) fans 2 and 3. Color scale: BLUE = 0 to RED = 21.25 m/s.

Table A.3. COV for velocity uniformity and maximum flow angles from CFD modeling.

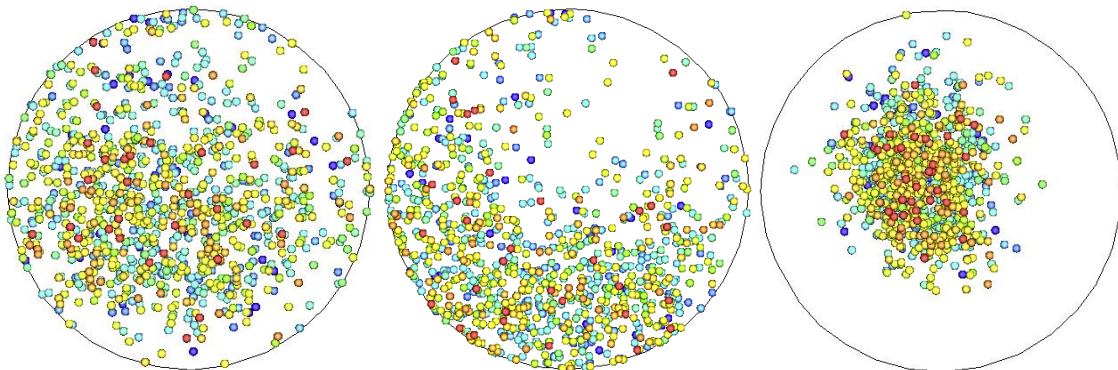
Fans operating	Flow rate, cfm	Velocity uniformity COV, %			Maximum flow angle	
		Side	Top	All	Side	Top
1-2	31,840	5.7	4.4	4.9	5.8	6.7
1-3	31,840	4.0	6.6	5.4	7.3	7.0
2-3	31,840	7.2	4.0	5.6	6.8	7.5

Particle and Tracer Gas Distributions (mid-duct release location)

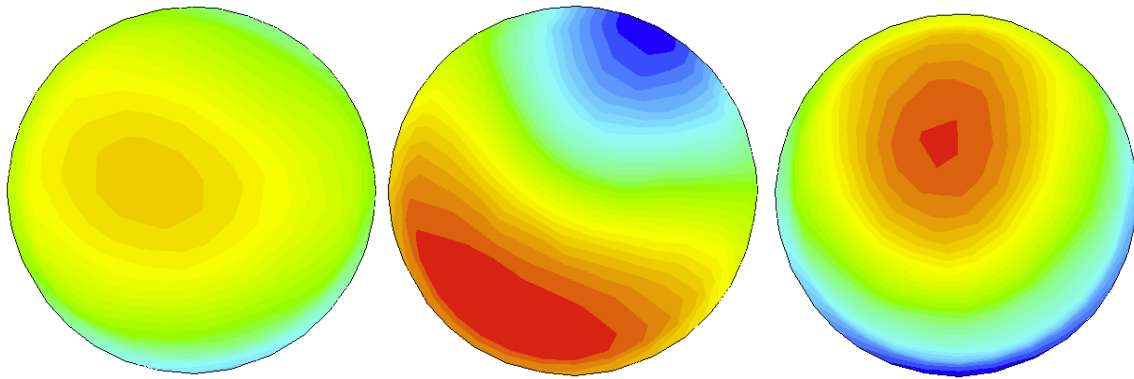
Particle and tracer gas transport simulations were performed as a part of the 31,840 cfm, two-fan cases. Particles were modeled as oil droplets of nominal 10-micron AD, and the SF6 gas was modeled as a gas component in a mixture with the air stream. Tracer particles and tracer gas species were both introduced separately at the release location just downstream of the confluence of the fan ducts (See mid-duct location in Figure A.1).

Figure A.6 shows the particle distributions at the sampling location for the three fan combination cases. The case running fans 1 and 2 (Figure A.6a) has the greatest rotational flow component - due to the close proximity of fan 1 - and the most particle dispersion at the sampling location. The case running fans 1 and 3 (Figure A.6b) has less particle dispersion than with fans 1 and 2, apparently due to minimal swirl introduced by fan 3. The case running fans 2 and 3 (Figure A.6c) has the least swirl and the least particle dispersion of the three cases. Figure A.7 shows the tracer gas distributions at the sampling section for the three fan combination cases. The tracer gas distributions show similar spatial distributions as the particles. The case running fans 1 and 2 (Figure A.6c) is the most mixed. The results presented in Figures A.6 and A.7 indicate an improvement in tracer mixing and dispersion with greater rotational flow in the main duct.

COVs calculated from the distributions of particles and tracer gas are summarized in Table A.4 where it is seen that in many instances the COVs are greater than the maximum acceptable COV of 20% across the sampling location. Thus with the stack system operating on two fans at 31,840 cfm total flow, the modeling predicts that when injecting tracer gas and/or particles at the mid-duct location, the stack and sampling location will not be in compliance with the ANSI/HPSN13.1-2011 standard with respect to particle distribution and tracer gas mixing.



a) b) c)
Figure A.6. Particle distributions at the sampling section for a total modeled flow rate of 31,840 cfm, running: a) fans 1 and 2, b) fans 1 and 3, and c) fans 2 and 3.



a) b) c)
 Figure A.7. Tracer gas concentration contours at the sampling section for a total modeled flow rate of 31,840 cfm, running: a) fans 1 and 2, b) fans 1 and 3, and c) fans 2 and 3. Highest concentration (red) is 2.7 times larger than lowest concentration (dark blue).

Table A.4. COV for particle and tracer gas distributions at the sampling section.

Fans operating	Flow rate, cfm	Particle COV, %			Tracer gas COV, %		
		Side	Top	All	Side	Top	All
1-2	31,840	35	39	36	5.0	7.2	6.2
1-3	31,840	64	28	50	15.1	30.7	24.0
2-3	31,840	62	54	58	11.6	14.5	12.8

Particle and Tracer Gas Distributions (near fan release locations)

Insufficient mixing and large COV values suggest the tracer release points would be best placed at locations that provide greater duct length for mixing of the tracers within the air streams. The maximum flow case (31,840 cfm) was rerun with tracer injection locations just downstream of the fans. This configuration gives greater duct length for mixing of the tracers than with the mid-duct release location. Three cases were run to examine the effect of using various tracer release locations. The cases included:

1. Operating fans 1 and 2 with a tracer injection location near fan 1.
2. Operating fans 1 and 2 with tracer injection locations near both fans 1 and 2.
3. Operating fan 1 only (15,920 cfm) with a tracer injection location near fan 1.

The calculated COV results from these three cases are summarized in Table A.5. With a single tracer injection point located near fan 1 (Case 1) the insufficient mixing seen with the mid-duct release location persists for both the tracer particles and tracer gas. Case 2, with injection locations near both fans, shows acceptable tracer gas and particle uniformity with overall COVs of 4.1 and 16 respectively. These results indicate that mixing of the tracers within the stream of each fan is achieved, and that blending of the two streams together in the main duct is more challenging. When running only fan 1 at full speed and injecting tracers near fan 1, as in Case 3, the mixing of tracers

within the single fan stream is similar to that of Case 2. The overall tracer gas COV is 5.0, and the overall COV for tracer particles is 18.

These tracer release location simulation results are supported by the testing of Glissmeyer and Droppo, which yielded tracer COV values greater than 20% at all but the test port furthest downstream, and which showed that tracer gas and particle COVs were smaller when operating one fan than when operating two fans. As shown in Table A.5 the velocity COV for Case 3 was the highest of the three cases. This is another result supported by the testing of Glissmeyer and Droppo, which showed that velocity uniformity was less for one fan operations and improved for two-fan operations.

While the Case 2 simulation results show good velocity COVs, the ANSI/HPSN13.1-2011 standard does not allow simultaneous injection of tracer gas/particles at multiple locations. Additionally, the particle COVs of the best cases presented here are marginally acceptable at best, indicating that additional blending would be desirable to ensure compliance.

Table A.5. COV for velocity, particle, and tracer distributions at the sampling section.

Case	Total Flow, cfm	Velocity COV, %			Particle COV, %			Tracer gas COV, %		
		Side	Top	All	Side	Top	All	Side	Top	All
1	31,840	5.4	4.4	4.7	32	51	29	15	39	29
2	31,840	5.4	4.4	4.7	19	17	16	2.5	4.6	4.1
3	15,920	8.6	2.4	6.3	20	18	18	3.4	6.0	5.0

Duct with Air Blender

The addition of an air blender in the main duct is being considered to ensure low COV values at the sampling location for all expected flow operations. The air blender being considered is from Blender Products, Inc. It is a static mixer of 40-inch diameter to match the diameter of the 3410 Building duct. Figure A.8a is a photo of the device, and Figure A.8b shows the CFD model of the device created for and used in the greater stack model that generated the results presented in this section. This section compares modeled results of the duct with total flow rate of 31,840 cfm delivered by two-fan operations, with and without the air blender.

Figure A.9 shows the effect of the air blender on the distribution of velocity magnitude within the 3410 Building stack with fans 1 and 2 operating. Figure A.9a shows the contours of velocity magnitude in the plan view of the main duct with the air blender installed near the previous location of the mid-duct release point. Within a few duct diameters downstream of the blender, the velocity magnitude is symmetric across the duct and roughly uniform. Figure A.9b shows the contours of velocity magnitude without the air blender. In this latter case the flow swirls slowly downstream and is non-symmetric and non-uniform at the test section.

Figure A.10 shows the effect of the air blender on the distribution of SF₆ tracer gas within the 3410 Building stack system. As with the velocity magnitude, the tracer gas concentration is symmetric across the duct and roughly uniform within a few duct diameters downstream of the blender as

shown in Figure A.10a. Without the air blender the tracer gas follows the air flow pattern and is non-symmetric and non-uniform at the test section (Figure A.10b). At the project planning stage, SF₆ tracer was considered to be used. However, after the new tracer nitrous oxide (N₂O) was validated prior to the beginning of the retesting project, it was decided that N₂O would be used for stack testing. Details of the N₂O tracer method was incorporated in the revised PNNL procedure (Glissmeyer, 2013). An article is being prepared to report new findings.

The counter-rotating inner and outer flows through the air blender serve to mix the air within just a few duct diameters, downstream of which the flow settles into a non-circulating pattern. This effect can be seen in Figure A.11a which shows tracer particle paths through the air blender being quickly dispersed downstream of the device. Figure A.11b shows the same particle paths in plan view. In this expanded view the particle paths within about 3 to 5 duct diameters have been dispersed and are traveling straight down the duct. The particle dispersion is illustrated by Figure A.12, which shows particle distributions at several stations downstream of the air blender. At 1 duct diameter the particles are somewhat scattered, but by 5 diameters the particles are well dispersed. Likewise at 10 diameters and at 14 diameters, where the sampling section is located, the particles are well dispersed within the duct.

Maximum flow angles and velocity, tracer gas, and tracer particle COVs at various stations downstream of the air blender inlet are shown in Figure A.13. The maximum flow angle at 1 duct diameter downstream of the air blender is quite large at 43°, the angle then decreases to about 1° at 5 diameters, and is less than 1° at greater distances downstream. Similarly, tracer gas and velocity COVs decrease to quite small values within 5 diameters downstream of the air blender. And COV for the tracer particles are well within compliance values as well. These results indicate that addition of the Blender Products, Inc. air blender to the 3410 Building filtered exhaust stack system will ensure compliance with the ANSI/HPSN13.1-2011 standard.

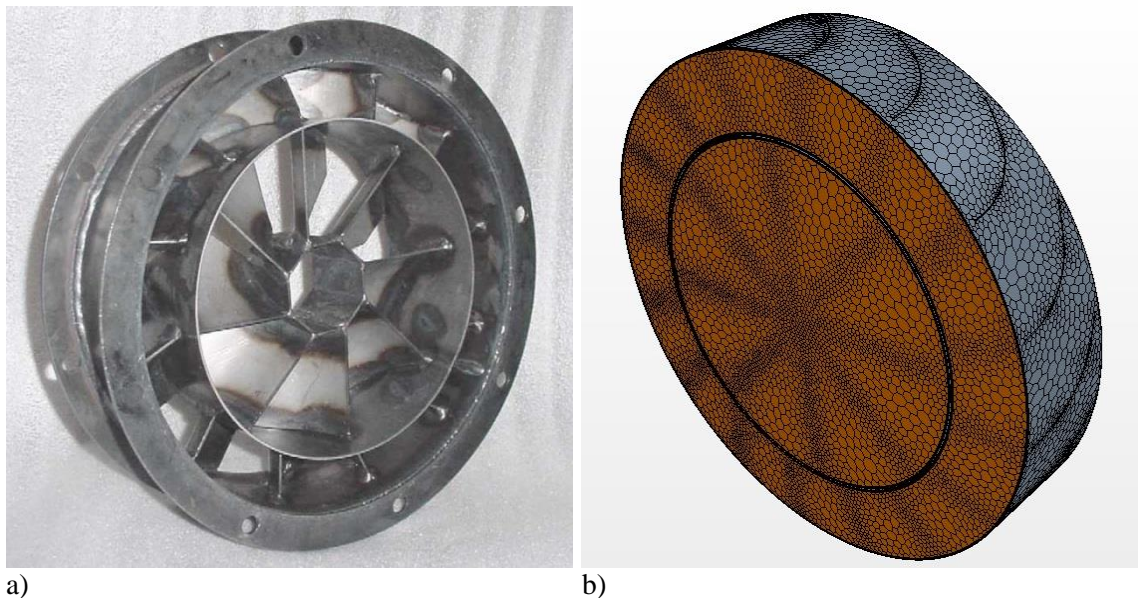
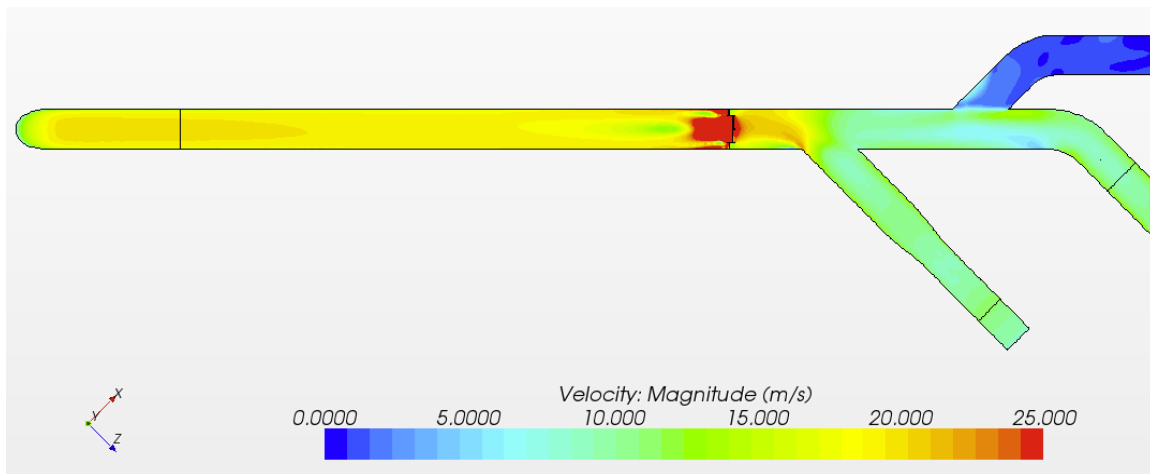
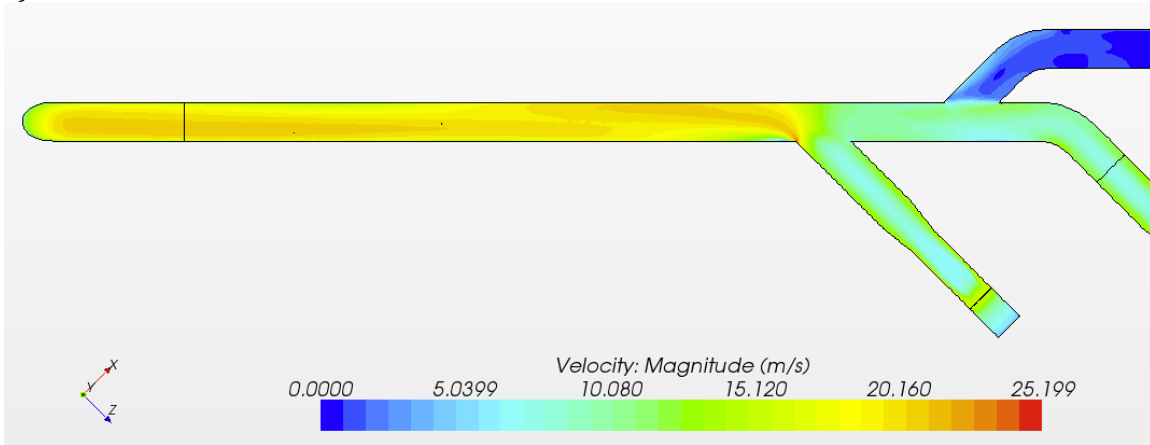


Figure A.8. Static air blender S40C3S: a) photograph of sample device, b) CFD model.

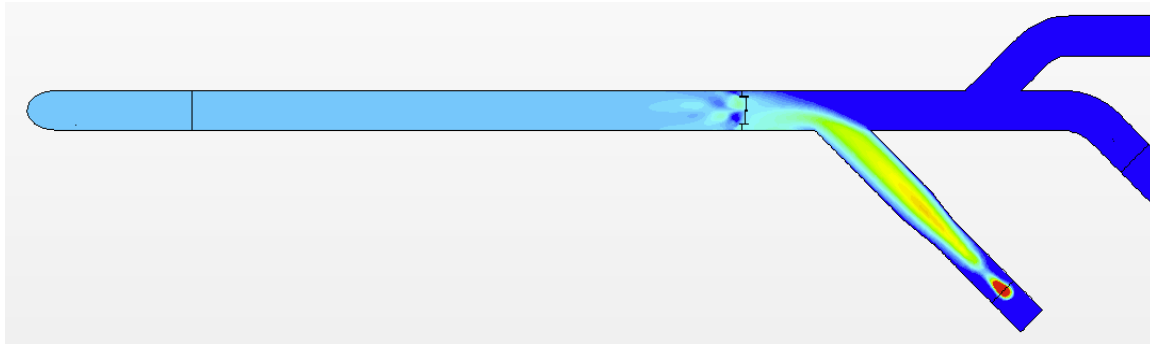


a)

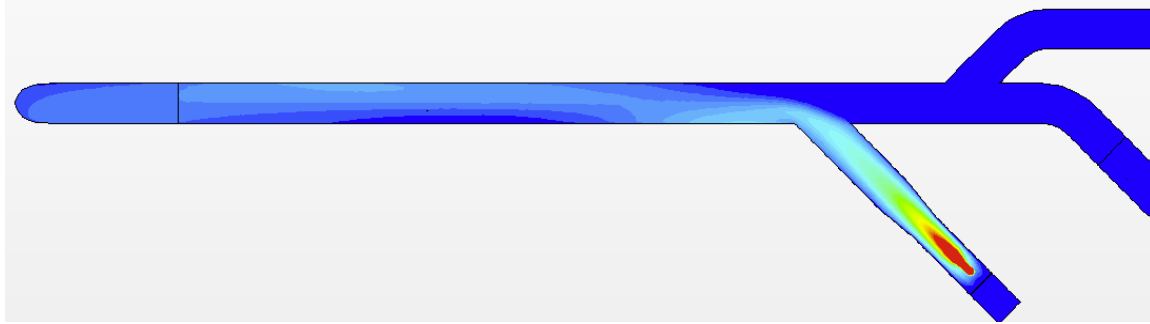


b)

Figure A.9. Contours of velocity magnitude in the plan view for: a) the duct with the air blender installed, b) no air blender.

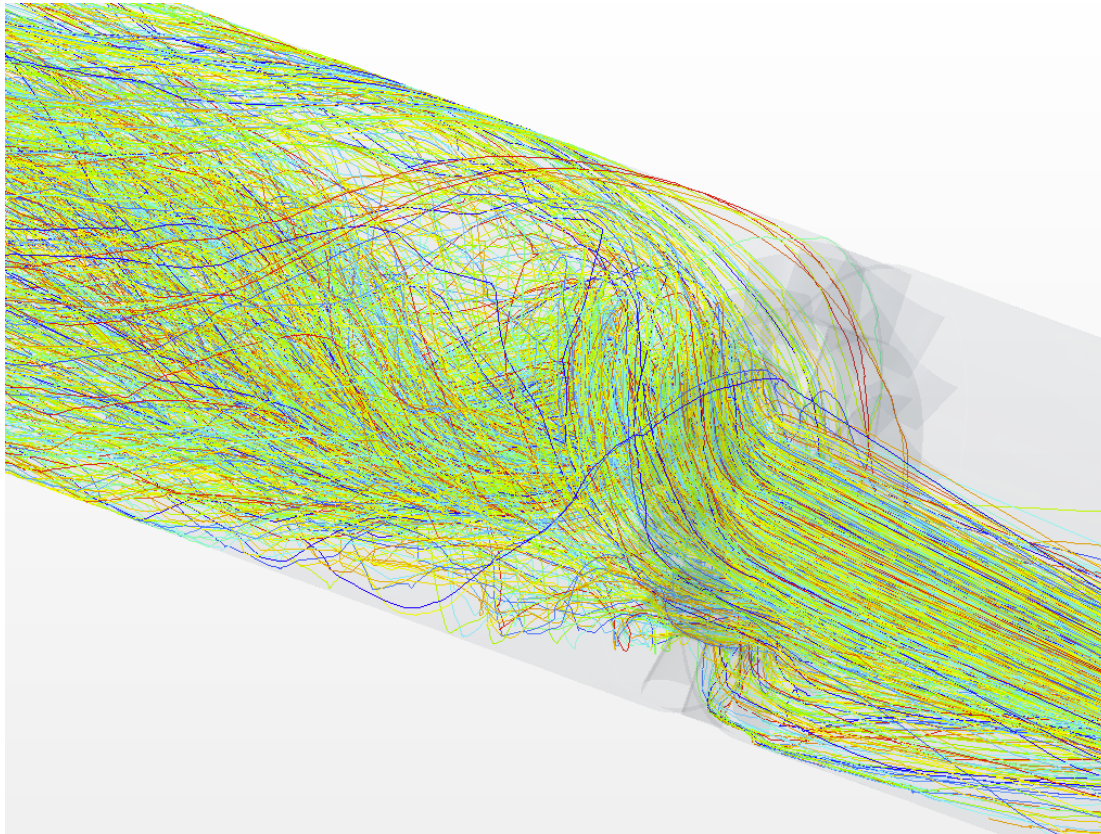


a)

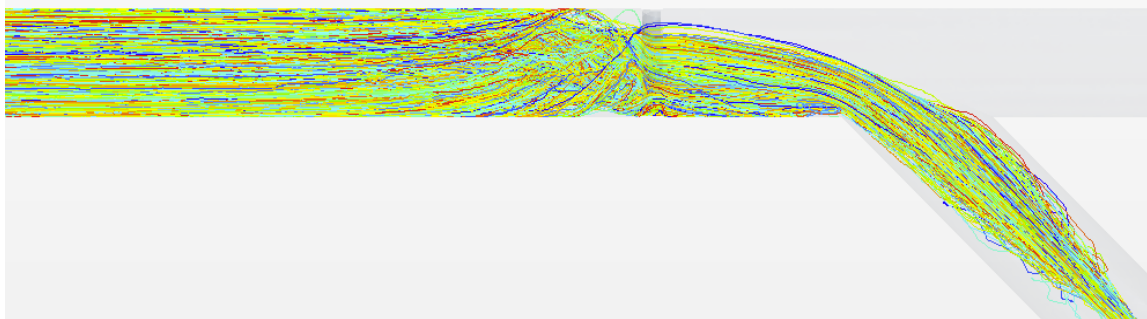


b)

Figure A.10. Contours of SF₆ tracer gas concentration in plan view for the duct with: a) the air blender installed, and b) no air blender.



a)



b)

Figure A.11. Tracer particle paths through the air blender: a) 3-D view, and b) plan view.

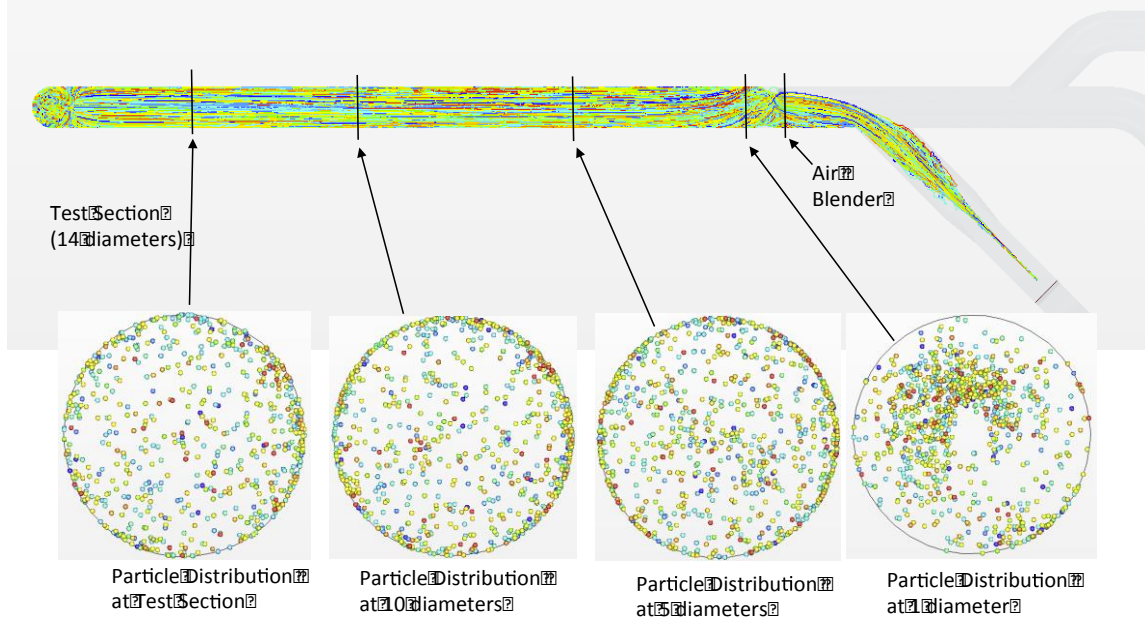


Figure A.12. Tracer particle distributions at several stations downstream of the air blender.

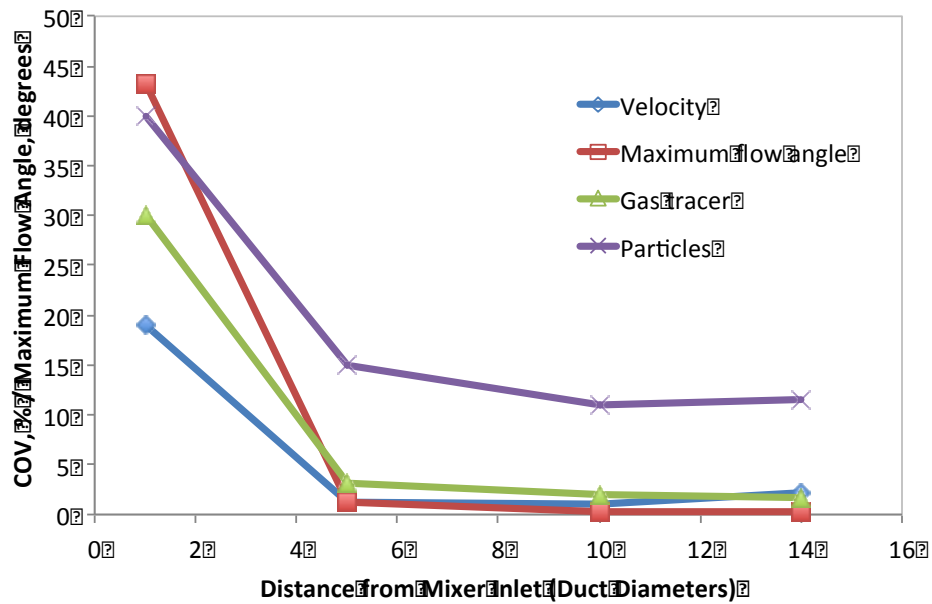


Figure A.13. Maximum flow angle (degrees) and COV for velocity, tracer gas, and tracer particles.

Conclusions

Based on the CFD modeling of the 3410 Building filtered exhaust stack system the following conclusions are drawn:

- The CFD model provides flow angle and velocity uniformity COV values that are in good agreement with those derived from testing of the actual stack.

- Modeling results for the maximum total flow of 31,840 cfm predict that differences in the flow distributions at the sampling location will exist depending upon the fan combination used, but that the velocity uniformity COV values should remain well within compliance.
- Simulations of tracer gas mixing and tracer particle dispersion within the duct show that tracer release points are best placed at locations that provide greater duct length for mixing of the tracers within the air streams.
- Simulations examining the effect of using various tracer release locations show that mixing of tracers within the stream of each fan is achieved much more readily than blending of the two fans streams together in the main duct. These simulations also show that tracer COV values are smaller when operating one fan than when operating two fans, and they show that velocity uniformity is less for one fan than for two fans. These results are supported by experimental data.
- Modeling results of the duct with total flow rate of 31,840 cfm delivered by two-fan operations, predict that velocity uniformity, tracer concentrations, and flow angle criteria established by the ANSI/HPSN13.1-2011 standard will be met with the addition of the Blender Products, Inc. air blender.

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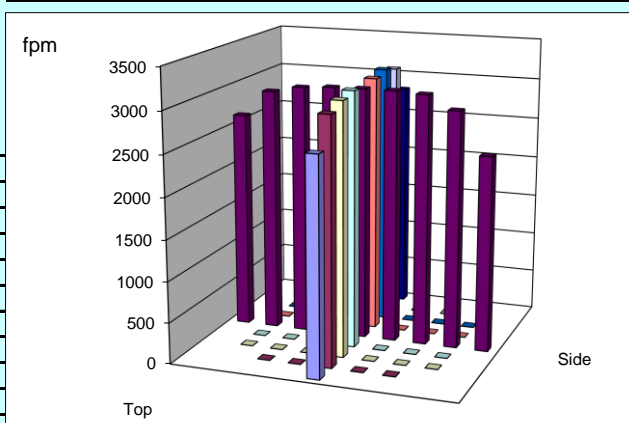
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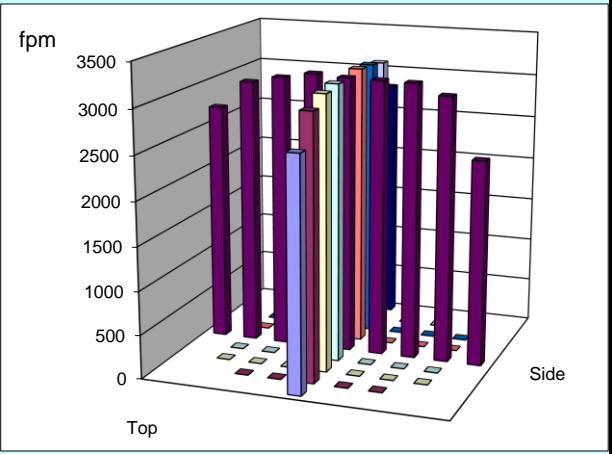
Appendix B: Data Sheets

Velocity

	A	B	C	D	E	F	G	H	I	J		
1	VELOCITY TRAVERSE DATA FORM											
2	Site EP-3410-01-S				Run No. VT-1 Corrected							
3	Date 4/9/13				Fan Configuration 1&2 (A&B)							
4	Testers MSP, XYY, JEF				Fan Setting normal (max)							
5	Stack Dia. 39.75 in.				Stack Temp 74.4 deg F							
6	Stack X-Area 1241.0 in.2				Start/End Time 11:15/13:10							
7	Test Port NEAREST TO PROBE				Center 2/3 from 3.65		to: 36.10					
8	Distance to disturbance 53.5 ft.				Points in Center 2/3 2		to: 7					
9	Velocity units ft/min				Pitot Correction 0.84							
10	Order --> 1st				2nd							
11	Traverse-->				Side			Top				
12	Trial ---->				1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	Velocity				Velocity					
14	1	1.27	2378	2378	2377	2377.8	2580	2580	2652	2604.0		
15	2	4.17	2822	2944	2898	2887.9	2943	3028	2936	2968.8		
16	3	7.71	3021	3071	3067	3052.8	3041	3062	3061	3054.5		
17	4	12.84	3030	3111	3083	3074.4	3083	3101	3118	3100.7		
18	Center	19.875	3032	3114	3074	3073.3	3001	3075	3087	3054.5		
19	5	26.91	3038	3083	3077	3066.0	3105	3105	3130	3113.3		
20	6	32.04	2990	3074	3063	3042.2	3136	3180	3165	3160.4		
21	7	35.58	2992	2960	2958	2970.2	3078	3111	3140	3109.7		
22	8	38.48	2649	2632	2670	2650.5	2751	2766	2851	2789.4		
23	Averages ----->		2883.6	2929.5	2918.5	2910.6	2968.5	3001.1	3015.5	2995.0		
24												
25	All		ft/min		Dev. from mean		Center 2/3		Side		Top	All
26	Mean		2952.8				Mean		3023.8		3080.3	3052.1
27	Min Point		2377.8		-19.5%		Std. Dev.		69.9		61.3	69.6
28	Max Point		3160.4		7.0%		COV as %		2.3		2.0	2.3
29	Flow w/o C-Pt		25327 acfm		Instruments Used:						Cal Due	
30	Vel Avg w/o C-Pt		2939 fpm		Dewe point pen/thermomete: SN 122277883						5/16/2014	
31					Zephyr II+						SN 80355	1/6/2014
32			Start Finish		Dwyer Pitot Tube, #17						PN 160S-60	Cert. of Conf.
33	Stack temp		22.8 24.3		TSI VelociCalc						9545A1205003	2/3/2014
34	Equipment temp		N.A. N.A.									
35	Ambient temp		67.8 68.5									
36	Stack static		-- --									
37	Ambient pressure		1011 1010									
38	Total Stack pressure		-- --									
39	Ambient humidity		28.4% 28.5%									
40												
41	Notes:		RAES readings, scfm									
42	start		21,997 scfm									
43	end		21,997 scfm									
44	Fan setting can't be changed. The normal will be the											
45	maximal. We used the S-type pitot tube.											
46												
47												
48	XYY 4/9/13											
49												
50												
51												
52												
53	Entries made by:		XYY/Xiao-Ying Yu				Technical Data Review performed by:		Carmen Arimescu			
54	Signature/date		on file with originals/4-9-13				Signature/date		7/9/2013			
55									On file with originals			

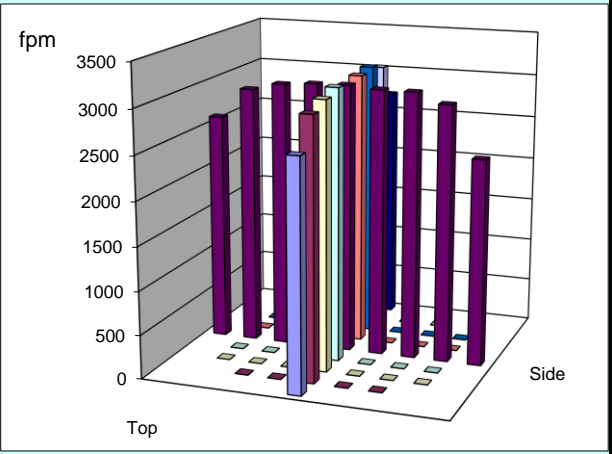


	A	B	C	D	E	F	G	H	I	J
1	VELOCITY TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	VT-2 Corrected			
3	Date	4/9/13				Fan Configuration	1&2 (A&B)			
4	Testers	MSP, XYY, JEF				Fan Setting	normal (max)			
5	Stack Dia.	39.75 in.				Stack Temp	73.0	deg F		
6	Stack X-Area	1241.0 in.2				Start/End Time	13:10/14:22			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7	
9	Velocity units	ft/min				Pitot Correction	0.84			
10	Order -->	2nd				1st				
11	Traverse-->	Side				Top				
12	Trial ---->	1 2 3 Mean				1 2 3 Mean				
13	Point	Depth, in.	Velocity				Velocity			
14	1	1.27	2281	2180	2317	2259.3	2567	2552	2796	2638.4
15	2	4.17	2941	2928	2890	2919.6	2923	3004	3079	3001.9
16	3	7.71	3065	3020	3017	3034.1	3068	3132	3154	3117.8
17	4	12.84	3066	3042	3012	3040.2	3094	3171	3208	3157.6
18	Center	19.875	3061	3057	3017	3045.0	3107	3161	3200	3156.2
19	5	26.91	3075	3095	3037	3069.1	3121	3210	3255	3195.4
20	6	32.04	3032	2973	3014	3006.4	3127	3239	3179	3181.6
21	7	35.58	2948	2925	2931	2934.4	3145	3157	3132	3144.4
22	8	38.48	2676	2594	2617	2629.2	2849	2776	2767	2797.5
23	Averages ----->		2905.1	2868.2	2872.4	2881.9	3000.2	3044.5	3085.5	3043.4
24										
25	All	ft/min	Dev. from mean			Center 2/3	Side	Top	All	
26	Mean	2962.7				Mean	3007.0	3136.4	3071.7	
27	Min Point	2259.3	-23.7%			Std. Dev.	57.8	64.4	89.3	
28	Max Point	3195.4	7.9%			COV as %	1.9	2.1	2.9	
29	Flow w/o C-Pt	25383 acfm				Instuments Used:				Cal Due
30	Vel Avg w/o C-Pt	2945 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014
31						Zephyr II+ SN 80355				1/6/2014
32		Start	Finish		Dwyer Pitot Tube, #17 PN 160S-60				Cert. of Conf.	
33	Stack temp	24.2	21.4		TSI VelociCalc 9545A1205003				2/3/2014	
34	Equipment temp	N.A.	N.A.							
35	Ambient temp	65.9	69.4							
36	Stack static	--	--		mbars					
37	Ambient pressure	1010	1010		mbars					
38	Total Stack pressure	--	--		mbars					
39	Ambient humidity	31.4%	29.6%		RH					
40										
41	Notes:	RAES readings, scfm								
42	start	21,997 scfm								
43	end	21,997 scfm								
44	Fan A or Fan 1 is	3410-HVEF-F-001								
45	Fan B or Fan 2 is	3410-HVEF-F-002								
46	Fan C or Fan 3 is	3410-HVEF-F-003								
47										
48	XYY 4/9/13									
49										
50										
51										
52										
53	Entries made by:	XYY/Xiao-Ying Yu				Technical Data Review performed by:		Carmen Arimescu		
54	Signature/date	on file with originals/4-9-13				Signature/date		7/9/2013		
55					On file with originals					



	A	B	C	D	E	F	G	H	I	J
1	VELOCITY TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	VT-3 Corrected			
3	Date	4/9/13				Fan Configuration	1&2 (A&B)			
4	Testers	MSP, XYY, JEF				Fan Setting	normal (max)			
5	Stack Dia.	39.75 in.				Stack Temp	70.3	deg F		
6	Stack X-Area	1241.0 in.2				Start/End Time	14:25/15:30			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7	
9	Velocity units	ft/min				Pitot Correction	0.84			
10	Order -->	1st				2nd				
11	Traverse-->	Side				Top				
12	Trial ---->	1 2 3 Mean				1 2 3 Mean				
13	Point	Depth, in.	Velocity				Velocity			
14	1	1.27	2322	2376	2251	2316.2	2567	2544	2582	2564.2
15	2	4.17	2944	2890	2876	2903.6	2922	2912	2944	2926.3
16	3	7.71	3019	2985	3027	3010.0	2988	3027	3022	3012.2
17	4	12.84	3045	3033	3011	3029.6	3102	3033	3038	3057.9
18	Center	19.875	3035	3028	3027	3029.9	3040	3026	3021	3028.8
19	5	26.91	2993	3011	3008	3003.8	3059	3076	3052	3062.4
20	6	32.04	2985	3002	2942	2976.4	3080	3084	3053	3072.4
21	7	35.58	2910	2890	2927	2908.9	3058	3010	3048	3038.6
22	8	38.48	2607	2580	2601	2596.2	2573	2666	2656	2631.7
23	Averages ----->		2873.3	2866.1	2852.2	2863.8	2932.3	2930.9	2935.1	2932.7
24										
25	All	ft/min	Dev. from mean			Center 2/3	Side	Top	All	
26	Mean	2898.3				Mean	2980.3	3028.4	3004.3	
27	Min Point	2316.2	-20.1%			Std. Dev.	53.7	49.6	55.6	
28	Max Point	3072.4	6.0%			COV as %	1.8	1.6	1.8	
29	Flow w/o C-Pt	24836 acfm				Instuments Used:				Cal Due
30	Vel Avg w/o C-Pt	2882 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014
31						Zephyr II+ SN 80355				1/6/2014
32		Start	Finish			Dwyer Pitot Tube, #17 PN 160S-60				Cert. of Conf.
33	Stack temp	21.4	21.1			TSI VelociCalc 9545A1205003				2/3/2014
34	Equipment temp	N.A.		N.A.						
35	Ambient temp	67		63.6						
36	Stack static	--		--			mbars			
37	Ambient pressure	1009		1009			mbars			
38	Total Stack pressure	--		--			mbars			
39	Ambient humidity	29.8%		34.0%			RH			
40										
41	Notes:	RAES readings, scfm								
42	start	21,997 scfm								
43	end	21,997 scfm								
44										
45										
46										
47	XYY 4/9/13									
48										
49										
50										
51										
52										
53	Entries made by:	XYY/Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu			
54	Signature/date	on file with originals/4-9-13				Signature/date	7/9/2013			
55					On file with originals					

	A	B	C	D	E	F	G	H	I	J
1	VELOCITY TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	VT-4 Corrected			
3	Date	4/12/13				Fan Configuration	1&3 (A&C)			
4	Testers	BGF, XYY				Fan Setting	normal			
5	Stack Dia.	39.75 in.				Stack Temp	74.7	deg F		
6	Stack X-Area	1241.0 in.2				Start/End Time	11:53/13:05			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7	
9	Velocity units	ft/min				Pitot Correction	0.84			
10	Order -->	1st				2nd				
11	Traverse-->	Side				Top				
12	Trial ---->	1	2	3	Mean	1	2	3	Mean	
13	Point	Depth, in.	Velocity				Velocity			
14	1	1.27	2360	2411	2256	2342.5	2585	2628	2621	2611.0
15	2	4.17	2907	2915	2933	2918.4	2958	2986	2958	2967.4
16	3	7.71	2999	3037	3053	3029.6	3076	3058	3030	3054.8
17	4	12.84	3022	2990	3083	3031.8	3111	3129	3111	3117.2
18	Center	19.875	3028	3070	3080	3059.6	3095	3078	3056	3076.4
19	5	26.91	3025	3049	3076	3050.0	3121	3148	3087	3118.6
20	6	32.04	2983	3041	3046	3023.2	3145	3174	3143	3153.9
21	7	35.58	2922	2946	2955	2940.8	3106	3090	3078	3091.5
22	8	38.48	2556	2655	2583	2598.1	2713	2722	2692	2709.0
23	Averages ----->		2866.9	2901.5	2896.2	2888.2	2990.0	3001.4	2975.2	2988.9
24										
25		All	ft/min		Dev. from mean	Center 2/3	Side	Top	All	
26		Mean	2938.6			Mean	3007.6	3082.8	3045.2	
27		Min Point	2342.5		-20.3%	Std. Dev.	55.1	60.2	67.8	
28		Max Point	3153.9		7.3%	COV as %	1.8	2.0	2.2	
29	Flow w/o C-Pt	25185 acfm				Instuments Used:				Cal Due
30	Vel Avg w/o C-Pt	2922 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014
31						Zephyr II+ SN 80355				1/6/2014
32		Start	Finish		Dwyer Pitot Tube, #17 PN 160S-60				Cert. of Conf.	
33	Stack temp	24.1	23.3		TSI VelociCalc 9545A1205003				2/3/2014	
34	Equipment temp	N.A.	N.A.							
35	Ambient temp	69.1	69.6							
36	Stack static	--	--		mbars					
37	Ambient pressure	998	997		mbars					
38	Total Stack pressure	--	--		mbars					
39	Ambient humidity	25.5%	21.9%		RH					
40										
41	Notes:	RAES readings, scfm								
42	start	21,997 scfm								
43	end	21,997 scfm								
44	20.6 C ambient temp. Fan setting change confirmed at									
45	12:00 noon. XYY 4/12/13									
46										
47	XYY 4/12/13									
48										
49										
50										
51										
52										
53	Entries made by:	XYY/Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu			
54	Signature/date	on file with originals/4-9-13				Signature/date	7/9/2013			
55							On file with originals			

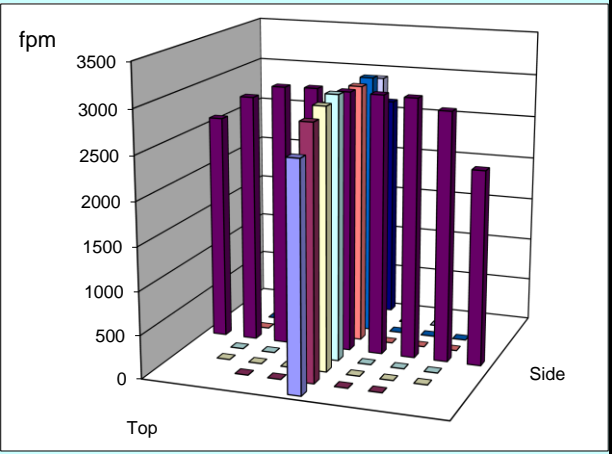


	A	B	C	D	E	F	G	H	I	J
1	VELOCITY TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	VT-5 Corrected			
3	Date	4/12/13				Fan Configuration	1&3 (A&C)			
4	Testers	MSP, YFS				Fan Setting	normal			
5	Stack Dia.	39.75 in.				Stack Temp	75.7	deg F		
6	Stack X-Area	1241.0 in.2				Start/End Time	13:21/14:28			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7	
9	Velocity units	ft/min				Pitot Correction	0.84			
10	Order -->	1st				2nd				
11	Traverse-->	Side				Top				
12	Trial ---->	1 2 3 Mean				1 2 3 Mean				
13	Point	Depth, in.	Velocity				Velocity			
14	1	1.27	2220	2279	2319	2272.8	2608	2538	2649	2598.4
15	2	4.17	2937	2943	2979	2952.6	2964	2817	2965	2915.6
16	3	7.71	3126	3041	3161	3109.4	3045	2930	3067	3013.9
17	4	12.84	3099	3047	3126	3090.6	3003	2963	3076	3013.9
18	Center	19.875	3040	3014	3056	3036.6	2979	2953	3030	2987.3
19	5	26.91	3043	3019	3071	3044.4	3014	3053	3074	3046.7
20	6	32.04	2974	2954	3050	2992.9	3012	3075	3121	3069.4
21	7	35.58	2882	2863	2994	2912.8	2992	2984	3000	2992.1
22	8	38.48	2529	2642	2659	2609.9	2570	2651	2700	2640.1
23	Averages ----->		2872.3	2866.7	2935.0	2891.3	2909.7	2884.8	2964.6	2919.7
24										
25		All	ft/min	Dev. from mean	Center 2/3	Side	Top	All		
26		Mean	2905.5		Mean	3019.9	3005.6	3012.7		
27		Min Point	2272.8	-21.8%	Std. Dev.	71.4	49.2	59.4		
28		Max Point	3109.4	7.0%	COV as %	2.4	1.6	2.0		
29	Flow w/o C-Pt	24925 acfm				Instuments Used:				Cal Due
30	Vel Avg w/o C-Pt	2892 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014
31						Zephyr II+ SN 80355				1/6/2014
32		Start	Finish		Dwyer Pitot Tube, #17 PN 160S-60				Cert. of Conf.	
33	Stack temp	24.6	24		TSI VelociCalc 9545A1205003				2/3/2014	
34	Equipment temp	N.A.	N.A.							
35	Ambient temp	67.4	64.4							
36	Stack static	--	--		mbars					
37	Ambient pressure	996	995		mbars					
38	Total Stack pressure	--	--		mbars					
39	Ambient humidity	23.7%	27.3%		RH					
40										
41	Notes:	RAES readings, scfm								
42	start	21,997 scfm								
43	end	21,997 scfm								
44										
45										
46										
47										
48		YFS 4/12/13								
49										
50										
51										
52										
53	Entries made by:	Yin-Fong Su				Technical Data Review performed by:	Carmen Arimescu			
54	Signature/date	on file with originals/4/12/2013				Signature/date	7/9/2013			
55							On file with originals			

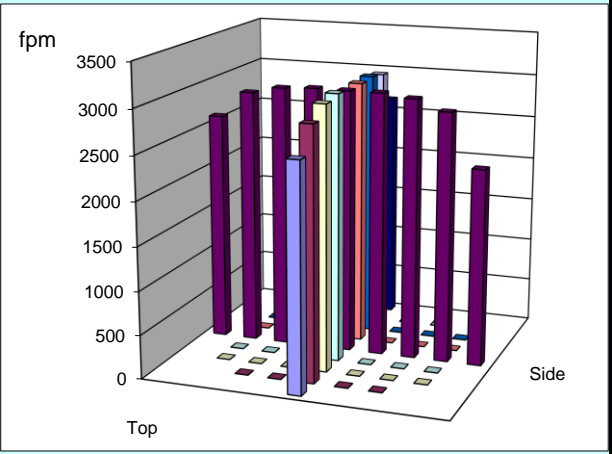
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1	VELOCITY TRAVERSE DATA FORM										
2	Site	EP-3410-01-S				Run No.	VT-6 Corrected				
3	Date	4/12/13				Fan Configuration	1&3 (A&C)				
4	Testers	BGF, XYY				Fan Setting	normal				
5	Stack Dia.	39.75 in.				Stack Temp	74.5	deg F			
6	Stack X-Area	1241.0 in.2				Start/End Time	14:34/15:31				
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10		
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7		
9	Velocity units	ft/min				Pitot Correction	0.84				
10	Order -->	1st				2nd					
11	Traverse-->	Side				Top					
12	Trial ---->	1 2 3 Mean				1 2 3 Mean					
13	Point	Depth, in.	Velocity				Velocity				
14	1	1.27	2274	2238	2403	2305.0	2614	2576	2626	2605.4	
15	2	4.17	2969	2884	2871	2908.1	2934	2913	2918	2921.8	
16	3	7.71	3060	3005	3016	3027.1	2973	2978	2998	2982.8	
17	4	12.84	3050	3026	3027	3034.4	3030	3045	3042	3039.1	
18	Center	19.875	3021	3018	3038	3025.7	3005	3004	3028	3012.2	
19	5	26.91	3008	3011	3019	3012.5	3072	3039	3055	3055.4	
20	6	32.04	2992	2959	3007	2986.2	3080	3078	3065	3074.4	
21	7	35.58	2864	2853	2900	2872.2	3048	3032	3008	3029.3	
22	8	38.48	2527	2529	2541	2532.3	2695	2645	2698	2679.3	
23	Averages ----->		2862.8	2835.7	2869.3	2855.9	2938.9	2923.4	2937.7	2933.3	
24											
25	All	ft/min	Dev. from mean			Center 2/3	Side	Top	All		
26	Mean	2894.6				Mean	2980.9	3016.4	2998.7		
27	Min Point	2305.0	-20.4%			Std. Dev.	64.7	51.1	59.0		
28	Max Point	3074.4	6.2%			COV as %	2.2	1.7	2.0		
29	Flow w/o C-Pt	24812 acfm				Instuments Used:				Cal Due	
30	Vel Avg w/o C-Pt	2879 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014	
31						Zephyr II+				SN 80355	1/6/2014
32		Start	Finish		Dwyer Pitot Tube, #17				PN 160S-60	Cert. of Conf.	
33	Stack temp	24.0	23.2		TSI VelociCalc				9545A1205003	2/3/2014	
34	Equipment temp	N.A.	N.A.								
35	Ambient temp	64.4	62.2								
36	Stack static	--	--								
37	Ambient pressure	995	994								
38	Total Stack pressure	--	--								
39	Ambient humidity	27.3%	27.0%								
40											
41	Notes:	RAES readings, scfm									
42	start	21,997 scfm									
43	end	21,997 scfm									
44											
45											
46											
47	YFS 4/12/13										
48											
49											
50											
51											
52											
53	Entries made by:	Yin-Fong Su				Technical Data Review performed by:		Carmen Arimescu			
54	Signature/date	on file with originals/4/12/2013				Signature/date		7/9/2013			
55					On file with originals						

Traverse	Point	Depth (in)	Velocity (fpm)
Side	1	1.27	2274
	2	4.17	2969
	3	7.71	3060
	4	12.84	3050
	Center	19.875	3021
	5	26.91	3008
	6	32.04	2992
	8	38.48	2527
Top	1	1.27	2238
	2	4.17	2884
	3	7.71	3005
	4	12.84	3026
	Center	19.875	3018
	5	26.91	3011
	6	32.04	2959
	8	38.48	2529

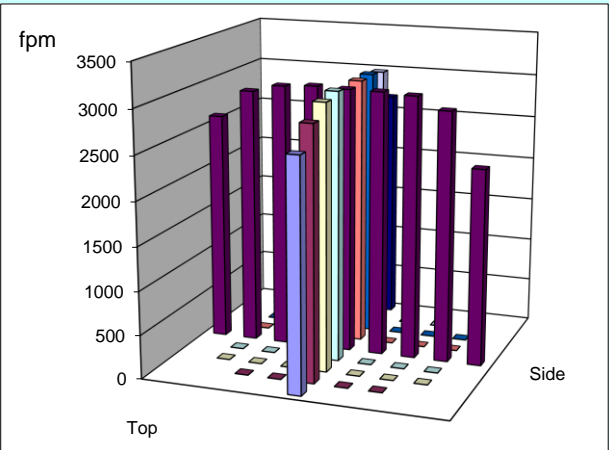
	A	B	C	D	E	F	G	H	I	J
1	VELOCITY TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	VT-7 Corected			
3	Date	4/15/13				Fan Configuration	2&3 (B&C)			
4	Testers	BGF, XYY				Fan Setting	normal			
5	Stack Dia.	39.75 in.				Stack Temp	68.8	deg F		
6	Stack X-Area	1241.0 in.2				Start/End Time	10:50/12:00			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7	
9	Velocity units	ft/min				Pitot Correction	0.84			
10	Order -->	1st				2nd				
11	Traverse-->	Side				Top				
12	Trial ---->	1 2 3 Mean				1 2 3 Mean				
13	Point	Depth, in.	Velocity				Velocity			
14	1	1.27	2354	2096	2230	2226.6	2575	2622	2560	2585.5
15	2	4.17	2885	2845	2823	2851.2	2909	2871	2881	2887.1
16	3	7.71	3011	2971	2928	2970.0	2978	2982	2995	2984.8
17	4	12.84	3012	2972	2956	2980.0	3052	3041	3033	3041.9
18	Center	19.875	3010	2977	2979	2988.7	3020	3016	2971	3002.4
19	5	26.91	3018	2994	3000	3003.8	2996	2999	2999	2998.0
20	6	32.04	3016	2988	2979	2994.6	3038	3032	3027	3032.4
21	7	35.58	2904	2785	2874	2854.3	2966	2946	2977	2963.0
22	8	38.48	2580	2610	2566	2585.5	2586	2642	2619	2615.5
23	Averages ----->		2865.6	2804.1	2815.2	2828.3	2902.1	2905.6	2895.9	2901.2
24										
25	All	ft/min	Dev. from mean			Center 2/3	Side	Top	All	
26	Mean	2864.7				Mean	2949.0	2987.1	2968.0	
27	Min Point	2226.6	-22.3%			Std. Dev.	66.6	51.6	60.6	
28	Max Point	3041.9	6.2%			COV as %	2.3	1.7	2.0	
29	Flow w/o C-Pt	24547 acfm				Instuments Used:				Cal Due
30	Vel Avg w/o C-Pt	2848 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014
31						Zephyr II+ SN 80355				1/6/2014
32		Start	Finish		Dwyer Pitot Tube, #17 PN 160S-60				Cert. of Conf.	
33	Stack temp	20.1	20.8		TSI VelociCalc 9545A1205003				2/3/2014	
34	Equipment temp	N.A.	N.A.							
35	Ambient temp	54.8	54.4							
36	Stack static	--	--		mbars					
37	Ambient pressure	998.7	999.0		mbars					
38	Total Stack pressure	--	--		mbars					
39	Ambient humidity	41.7%	34.3%		RH					
40										
41	Notes:	RAES readings, scfm								
42	start	21,997 scfm								
43	end	21,997 scfm								
44	10:50 am fan setting change to fan 2 and fan 3 was									
45	confirmed.									
46										
47	XYY 4/15/13									
48										
49										
50										
51										
52										
53	Entries made by:	XYY/Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu			
54	Signature/date	on file with originals/4/15/13				Signature/date	7/9/2013			
55					On file with originals					



	A	B	C	D	E	F	G	H	I	J		
1	VELOCITY TRAVERSE DATA FORM											
2	Site	EP-3410-01-S				Run No.	VT-8 Corrected					
3	Date	4/16/13				Fan Configuration	2&3 (B&C)					
4	Testers	BGF, XYY				Fan Setting	normal					
5	Stack Dia.	39.75 in.				Stack Temp	67.4	deg F				
6	Stack X-Area	1241.0 in.2				Start/End Time	9:30/10:10					
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10			
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7			
9	Velocity units	ft/min				Pitot Correction	0.84					
10	Order -->	1st				2nd						
11	Traverse-->	Side				Top						
12	Trial ---->	1 2 3 Mean				1 2 3 Mean						
13	Point	Depth, in.	Velocity				Velocity					
14	1	1.27	2218	2260	2190	2222.4	2596	2531	2580	2569.3		
15	2	4.17	2818	2824	2826	2822.7	2831	2937	2834	2867.2		
16	3	7.71	2958	2939	2931	2942.8	3001	3041	2982	3008.0		
17	4	12.84	2978	2992	2976	2982.0	3062	3064	3025	3050.3		
18	Center	19.875	2980	2990	2979	2983.1	3017	3023	3002	3014.2		
19	5	26.91	2995	2986	2976	2985.6	3039	3030	3021	3030.2		
20	6	32.04	2997	2944	2955	2965.5	3053	3051	3031	3044.7		
21	7	35.58	2885	2884	2902	2890.2	3022	3016	2982	3006.6		
22	8	38.48	2603	2599	2580	2594.2	2625	2686	2622	2644.6		
23	Averages ----->		2825.8	2824.2	2812.9	2820.9	2916.3	2930.9	2897.8	2915.0		
24												
25	All		ft/min		Dev. from mean		Center 2/3		Side		Top	All
26	Mean		2868.0				Mean		2938.8		3003.0	2970.9
27	Min Point		2222.4		-22.5%		Std. Dev.		61.4		62.3	68.1
28	Max Point		3050.3		6.4%		COV as %		2.1		2.1	2.3
29	Flow w/o C-Pt	24575 acfm				Instuments Used:				Cal Due		
30	Vel Avg w/o C-Pt	2852 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014		
31					Zephyr II+				SN 80355		1/6/2014	
32					Dwyer Pitot Tube, #17				PN 160S-60		Cert. of Conf.	
33	Stack temp	Start	Finish		TSI VelociCalc				9545A1205003		2/3/2014	
34	Equipment temp	18.8	20.5								C	
35	Ambient temp	N.A.	N.A.								F	
36	Stack static	55.7	61.3								F	
37	Ambient pressure	--	--								mbars	
38	Total Stack pressure	1010	1009								mbars	
39	Ambient humidity	--	--								mbars	
40		23.5%	19.8%								RH	
41	Notes:	RAES readings, scfm										
42	start	21,997 scfm										
43	end	21,997 scfm										
44												
45												
46												
47	XYY 4/16/13											
48												
49												
50												
51												
52												
53	Entries made by:	XYY/Xiao-Ying Yu				Technical Data Review performed by:		Carmen Arimescu				
54	Signature/date	on file with originals/4/16/13				Signature/date		7/9/2013				
55									On file with originals			

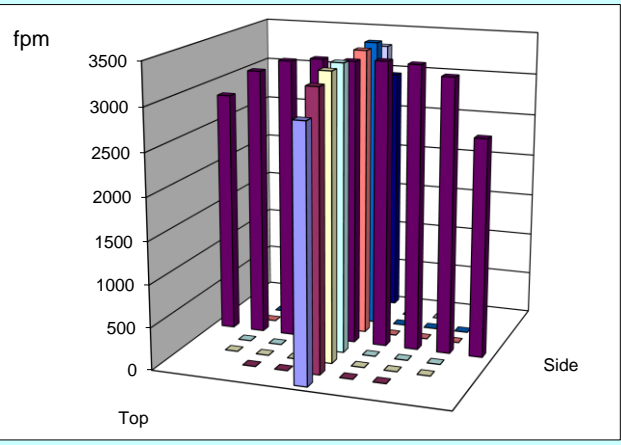


	A	B	C	D	E	F	G	H	I	J
1	VELOCITY TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	VT-9 Corrected			
3	Date	4/16/13				Fan Configuration	2&3 (B&C)			
4	Testers	BGF, XYY				Fan Setting	normal			
5	Stack Dia.	39.75 in.				Stack Temp	68.4	deg F		
6	Stack X-Area	1241.0 in.2				Start/End Time	10:10/11:10			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7	
9	Velocity units	ft/min				Pitot Correction	0.84			
10	Order -->	2nd				1st				
11	Traverse-->	Side				Top				
12	Trial ---->	1	2	3	Mean	1	2	3	Mean	
13	Point	Depth, in.	Velocity				Velocity			
14	1	1.27	2276	2103	2306	2228.2	2596	2629	2636	2620.2
15	2	4.17	2839	2833	2841	2837.8	2869	2958	2790	2872.5
16	3	7.71	2977	2970	2985	2977.2	3000	3032	3046	3026.2
17	4	12.84	2996	2985	3014	2998.2	3063	3103	3064	3076.6
18	Center	19.88	2992	2996	3018	3002.2	3033	3031	3027	3030.2
19	5	26.91	3013	3011	3018	3014.2	3055	3069	3059	3061.2
20	6	32.04	2982	2980	3014	2992.1	3078	3075	3061	3071.3
21	7	35.58	2902	2916	2907	2908.6	3062	3019	3027	3036.0
22	8	38.48	2573	2533	2683	2596.4	2676	2668	2674	2672.6
23	Averages ----->		2838.9	2814.4	2865.1	2839.4	2936.8	2953.9	2931.6	2940.8
24										
25		All	ft/min		Dev. from mean	Center 2/3	Side	Top	All	
26		Mean	2890.1			Mean	2961.5	3024.9	2993.2	
27		Min Point	2228.2		-22.9%	Std. Dev.	64.6	70.1	72.7	
28		Max Point	3076.6		6.5%	COV as %	2.2	2.3	2.4	
29	Flow w/o C-Pt	24771 acfm				Instuments Used:				Cal Due
30	Vel Avg w/o C-Pt	2874 fpm				Dewe point pen/thermomete SN 122277883				5/16/2014
31						Zephyr II+	SN 80355	1/6/2014		
32			Start	Finish		Dwyer Pitot Tube, #17	PN 160S-60	Cert. of Conf.		
33	Stack temp		20.5	19.9	C	TSI VelociCalc	9545A1205003	2/3/2014		
34	Equipment temp		N.A.	N.A.	F					
35	Ambient temp		55.7	54.8	F					
36	Stack static		--	--	mbars					
37	Ambient pressure		1009	1009	mbars					
38	Total Stack pressure		--	--	mbars					
39	Ambient humidity		22.5%	21.4%	RH					
40										
41	Notes:	RAES readings, scfm								
42	start	21,997 scfm								
43	end	21,997 scfm								
44										
45										
46										
47		XYY 4/16/13								
48										
49										
50										
51										
52										
53	Entries made by:	XYY/Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu			
54	Signature/date	on file with originals/4/16/13				Signature/date	7/9/2013			
55							On file with originals			

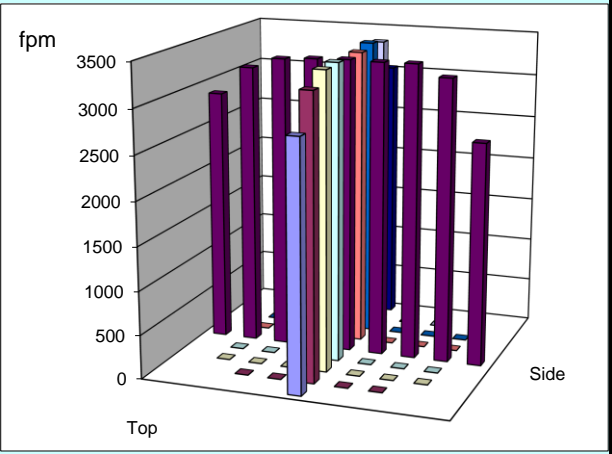


	A	B	C	D	E	F	G	H	I	J		
1	VELOCITY TRAVERSE DATA FORM											
2	Site	EP-3410-01-S				Run No.	VT-10 Corrected					
3	Date	5/16/13				Fan Configuration	A&C (1&3)					
4	Testers	YFS, XYY				Fan Setting	Normal, sashes open					
5	Stack Dia.	39.75 in.				Stack Temp	76.6 deg F					
6	Stack X-Area	1241.0 in.2				Start/End Time	9:30/11:23					
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10			
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7			
9	Velocity units	ft/min				Pitot Correction	0.84					
10	Order -->	1st				2nd						
11	Traverse-->	Side				Top						
12	Trial ---->	1 2 3 Mean				1 2 3 Mean						
13	Point	Depth, in.	Velocity				Velocity					
14	1	1.27	2515	2612	2532	2553.0	3018	2936	3012	2988.7		
15	2	4.17	3132	3191	3189	3171.0	3230	3226	3244	3233.4		
16	3	7.71	3292	3294	3289	3291.7	3329	3334	3331	3331.2		
17	4	12.84	3316	3304	3311	3310.4	3378	3373	3378	3376.8		
18	Center	19.875	3303	3223	3277	3267.6	3333	3312	3371	3338.7		
19	5	26.91	3305	3317	3299	3307.1	3399	3393	3426	3406.2		
20	6	32.04	3291	3238	3279	3269.3	3411	3406	3424	3413.8		
21	7	35.58	3145	3175	3170	3163.4	3341	3347	3326	3338.2		
22	8	38.48	2872	2836	2829	2845.6	2931	2921	2963	2938.0		
23	Averages ----->		3130.2	3132.4	3130.5	3131.0	3263.4	3249.9	3275.1	3262.8		
24												
25	All		ft/min		Dev. from mean		Center 2/3		Side		Top	All
26	Mean		3196.9				Mean		3254.4		3348.3	3301.3
27	Min Point		2553.0		-20.1%		Std. Dev.		61.8		60.7	76.4
28	Max Point		3413.8		6.8%		COV as %		1.9		1.8	2.3
29	Flow w/o C-Pt	27436 acfm				Instuments Used:				Cal Due		
30	Vel Avg w/o C-Pt	3184 fpm				Dewe point pen/thermomete SN 122277875				5/16/2014		
31					Zephyr II+				SN 80355		1/6/2014	
32			Start		Finish		Dwyer Pitot Tube, #17				PN 160S-60	Cert. of Conf.
33	Stack temp	26.0		23.6		TSI VelociCalc				9545A1205003		2/3/2014
34	Equipment temp	N.A.		N.A.								
35	Ambient temp	22.3		21.5								
36	Stack static	--		--		mbars						
37	Ambient pressure	997.8		997.1		mbars						
38	Total Stack pressure	--		--		mbars						
39	Ambient humidity	29.4%		31.4%		RH						
40												
41	Notes:	RAES readings, scfm										
42	start	XYY 5/16/13										
43	end											
44	Sashes up in 1604 and 1606. Additional tests to											
45	characterize flow.											
46												
47	XYY 5/16/13											
48												
49												
50												
51												
52												
53	Entries made by:	XYY/Xiao-Ying Yu				Technical Data Review performed by:		Carmen Arimescu				
54	Signature/date	on file with originals/4/16/13				Signature/date		7/9/2013				
55									On file with originals			

	A	B	C	D	E	F	G	H	I	J						
1	VELOCITY TRAVERSE DATA FORM															
2	Site	EP-3410-01-S				Run No.	VT-11 Corrected									
3	Date	5/16/13				Fan Configuration	A&C (1&3)									
4	Testers	YFS, XYX				Fan Setting	Normal, sashes open									
5	Stack Dia.	39.75 in.				Stack Temp	76.9 deg F									
6	Stack X-Area	1241.0 in.2				Start/End Time	11:25/13:20									
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10							
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7							
9	Velocity units	ft/min				Pitot Correction	0.84									
10	Order -->	2nd				1st										
11	Traverse-->	Side					Top									
12	Trial ---->	1			2		3		Mean		1	2		3		Mean
13	Point	Depth, in.	Velocity				Velocity									
14	1	1.27	2554	2548	2538	2546.6	2970	2951	2943	2954.8						
15	2	4.17	3216	3212	3200	3209.4	3282	3214	3250	3248.6						
16	3	7.71	3331	3315	3328	3324.7	3364	3334	3365	3354.4						
17	4	12.84	3352	3330	3342	3341.0	3399	3372	3375	3382.1						
18	Center	19.875	3320	3316	3318	3318.0	3336	3329	3348	3337.9						
19	5	26.91	3348	3303	3313	3321.4	3395	3404	3418	3405.6						
20	6	32.04	3294	3272	3272	3279.4	3433	3441	3447	3440.4						
21	7	35.58	3141	3140	3134	3138.2	3353	3319	3351	3341.0						
22	8	38.48	2817	2844	2828	2829.7	2893	2955	2948	2932.2						
23	Averages ----->		3152.5	3142.2	3141.4	3145.4	3269.7	3257.5	3271.8	3266.3						
24																
25			All	ft/min	Dev. from mean	Center 2/3	Side	Top	All							
26			Mean	3205.8		Mean	3276.0	3358.6	3317.3							
27			Min Point	2546.6	-20.6%	Std. Dev.	75.1	61.0	78.5							
28			Max Point	3440.4	7.3%	COV as %	2.3	1.8	2.4							
29	Flow w/o C-Pt	27496 acfm				Instuments Used:				Cal Due						
30	Vel Avg w/o C-Pt	3191 fpm				Dew point pen/thermometer SN 122277875				5/16/2014						
31						Zephyr II+ SN 80355				1/6/2014						
32			Start	Finish		Dwyer Pitot Tube, #17 PN 160S-60				Cert. of Conf.						
33	Stack temp		23.6	26.3	C	TSI VelociCalc 9545A1205003				2/3/2014						
34	Equipment temp		N.A.	N.A.	F											
35	Ambient temp		22.0	22.9	C											
36	Stack static		--	--	mbars											
37	Ambient pressure		997.3	995.9	mbars											
38	Total Stack pressure		--	--	mbars											
39	Ambient humidity		31.2%	28.3%	RH											
40																
41	Notes:	RAES readings, scfm														
42	start	XYX 5/16/13														
43	end															
44																
45																
46																
47		YFS 5/16/13														
48																
49																
50																
51																
52																
53	Entries made by:	XYX/Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu						
54	Signature/date	on file with originals/4/16/13				Signature/date				7/9/2013						
55										On file with originals						

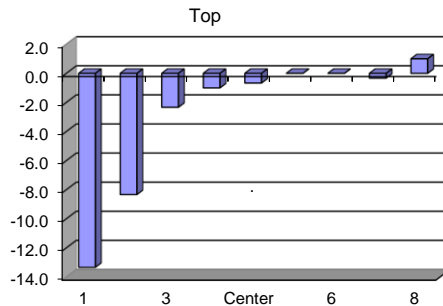
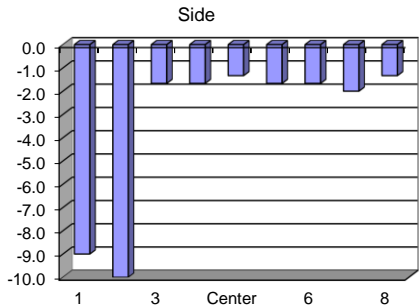


	A	B	C	D	E	F	G	H	I	J
1	VELOCITY TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	VT-12 Corrected			
3	Date	5/16/13				Fan Configuration	A&C (1&3)			
4	Testers	YFS, JEF				Fan Setting	Normal, sashes open			
5	Stack Dia.	39.75 in.				Stack Temp	79.6 deg F			
6	Stack X-Area	1241.0 in.2				Start/End Time	13:25/14:35			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 ft.				Points in Center 2/3	2	to:	7	
9	Velocity units	ft/min				Pitot Correction	0.84			
10	Order -->	1st				2nd				
11	Traverse-->	Side				Top				
12	Trial ---->	1 2 3 Mean				1 2 3 Mean				
13	Point	Depth, in.	Velocity				Velocity			
14	1	1.27	2535	2528	2470	2510.8	2802	2768	2869	2813.2
15	2	4.17	3244	3166	3158	3189.5	3200	3247	3212	3219.7
16	3	7.71	3337	3339	3286	3320.8	3372	3407	3341	3373.2
17	4	12.84	3328	3299	3322	3316.3	3393	3391	3386	3390.0
18	Center	19.875	3326	3322	3322	3323.6	3390	3350	3342	3360.8
19	5	26.91	3298	3318	3318	3311.3	3385	3373	3390	3383.0
20	6	32.04	3291	3301	3276	3289.4	3450	3414	3435	3432.8
21	7	35.58	3160	3189	3160	3169.9	3402	3384	3384	3390.2
22	8	38.48	2850	2866	2840	2852.1	3013	3051	3011	3025.1
23	Averages ----->		3152.2	3147.6	3128.1	3142.6	3267.5	3265.0	3263.5	3265.3
24										
25		All	ft/min			Dev. from mean	Center 2/3	Side	Top	All
26		Mean	3204.0				Mean	3274.4	3364.2	3319.3
27		Min Point	2510.8			-21.6%	Std. Dev.	65.9	67.5	79.3
28		Max Point	3432.8			7.1%	COV as %	2.0	2.0	2.4
29	Flow w/o C-Pt	27463 acfm				Instruments Used:				Cal Due
30	Vel Avg w/o C-Pt	3187 fpm				Dewe point pen/thermomete SN 122277875				5/16/2014
31						Zephyr II+ SN 80355				1/6/2014
32			Start	Finish		Dwyer Pitot Tube, #17 PN 160S-60				Cert. of Conf.
33	Stack temp		26.3	26.6	C	TSI VelociCalc 9545A1205003				2/3/2014
34	Equipment temp		N.A.	N.A.	F					
35	Ambient temp		22.9	24.7	C					
36	Stack static		--	--	mbars					
37	Ambient pressure		995.9	994.6	mbars					
38	Total Stack pressure		--	--	mbars					
39	Ambient humidity		28.3%	28.1%	RH					
40										
41	Notes:	RAES readings, scfm								
42	start									
43	end									
44										
45										
46										
47		YFS 5/16/13								
48										
49										
50										
51										
52										
53	Entries made by:	YYY/Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu			
54	Signature/date	on file with originals/4/16/13				Signature/date	7/9/2013			
55							On file with originals			

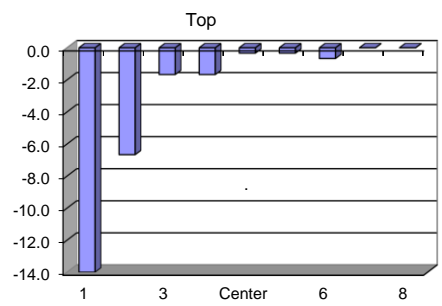
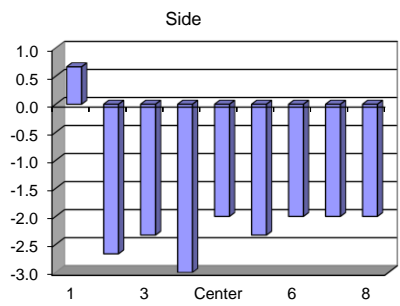


Flow Angle

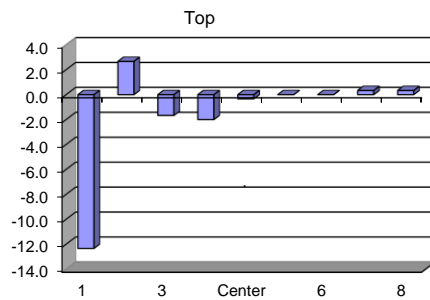
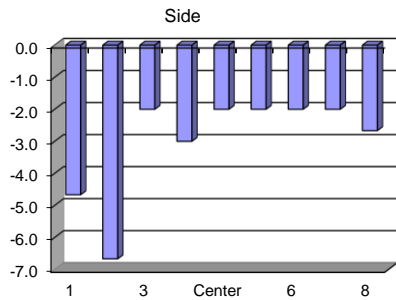
	A	B	C	D	E	F	G	H	I	J
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls				
2	Site EP-3410--01-S					Run No. FA-1				
3	Date 4/12/2013					Fan Setting 1 & 2 (A&B)				
4	Tester BGF, XYY					Fan configuration normal				
5	Stack Dia. 39.75 in					Approx. air vel. 2966 sfpm at center				
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)				
7	Elevation N.A. ft					Port nearest to probe				
8	Distance to disturbance 53.5 ft.					Stack Temp 62.5 F				
9	Start/End Time 10:00/10:40									
10	Order -->					2nd				
11	1st					2nd				
11	Side					Top				
12	Trial ---->					Trial ---->				
13	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.
14	1	1.27	-7	-10	-10	-9.0	-14	-13	-13	-13.3
15	2	4.17	-10	-9	-11	-10.0	-9	-8	-8	-8.3
16	3	7.71	-1	-1	-3	-1.7	-3	-2	-2	-2.3
17	4	12.84	-2	-1	-2	-1.7	-1	-1	-1	-1.0
18	Center	19.875	-1	-1	-2	-1.3	-1	0	-1	-0.7
19	5	26.91	-1	-2	-2	-1.7	0	0	0	0.0
20	6	32.04	-1	-2	-2	-1.7	0	0	0	0.0
21	7	35.58	-2	-2	-2	-2.0	0	0	-1	-0.3
22	8	38.48	-1	-1	-2	-1.3	1	1	1	1.0
23	Mean of absolute values of all data:					3.4	3.0			
24	w/o points by wall:					2.9	1.8			
25							all 3.2			
26	Instruments Used:					Cal. Due				
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance		w/o wall pts 2.3			
28	Velocity sensor	TSI VelociCalc			SN 305039					
29	Angle indicator	Shop built			Cat. 3					
30	Manometer	Dwyer 400-5, S36N			Cat. 3 Man-3					
31						Notes: RAES reading, scfm				
32	Note:					start 29,997				
33	To assure similar hose connections					end 29,997 FIO 4/12/13				
34	between the manometer and pitot tube, rotating					Ambinet P: 1001 mbar, stack temp: 62.5F, stack velocity, 2966 fpm.				
35	the pitot tube assembly clockwise drives the					XYY 4/12/13				
36	meniscus to the right (to higher pos. numbers).									
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										
55	Entries made by:	Xiao-Ying Yu			Technical Data Review performed by:		Carmen Arimescu			
56	Signature/date	Signature on file with original 4/12/2013			Signature/date		7/9/2013			
57					Signature on file with original		TI-STMON-28			
58										



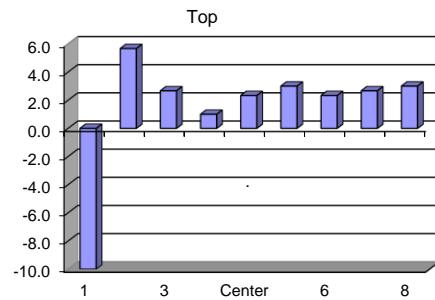
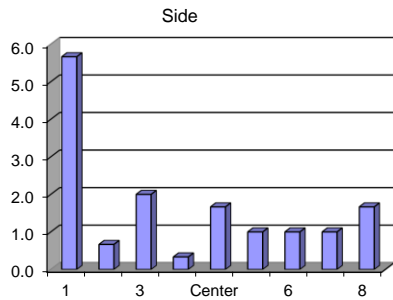
	A	B	C	D	E	F	G	H	I	J										
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls														
2	Site EP-3410-01-S					Run No. FA-2														
3	Date 4/12/2013					Fan Setting 1 & 2 (A&B)														
4	Tester BGF, XYY					Fan configuration normal														
5	Stack Dia. 39.75 in					Approx. air vel. 3251 sfpm at center														
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)														
7	Elevation N.A. ft					Port nearest to probe														
8	Distance to disturbance 53.5 ft.					Stack Temp 61.1 F														
9	Start/End Time 10:40/11:05																			
10	Order --> 2nd					1st														
11	Traverse-->					Side					Top									
12	Trial ---->					1					2					3				
13	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.						
14	1	1.27	2	4	-4	0.7	-15	-13	-14	-14.0										
15	2	4.17	3	-8	-3	-2.7	-5	-7	-8	-6.7										
16	3	7.71	-3	-2	-2	-2.3	0	-2	-3	-1.7										
17	4	12.84	-3	-3	-3	-3.0	-2	-1	-2	-1.7										
18	Center	19.875	-2	-2	-2	-2.0	0	0	-1	-0.3										
19	5	26.91	-2	-2	-3	-2.3	0	0	-1	-0.3										
20	6	32.04	-2	-2	-2	-2.0	0	-2	0	-0.7										
21	7	35.58	-2	-2	-2	-2.0	0	0	0	0.0										
22	8	38.48	-1	-2	-3	-2.0	0	0	0	0.0										
23	Mean of absolute values of all data:					2.1	2.8													
24	w/o points by wall:					2.3	1.6													
25							all 2.5													
26	Instruments Used:					Cal. Due					w/o wall pts 2.0									
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance															
28	Velocity sensor	TSI VelociCalc			SN 305039															
29	Angle indicator	Shop built			Cat. 3															
30	Manometer	Dwyer 400-5, S36N			Cat. 3 Man-3															
31						Notes: RAES reading, scfm														
32	Note:					start 29,997														
33	To assure similar hose connections					end 29,997 FIO 4/12/13														
34	between the manometer and pitot tube, rotating					Ambinet P: 29.52 inHg, (1000 mbar), stack temp: 61.1 F, stack velocity, 3257 fpm.														
35	the pitot tube assembly clockwise drives the					XYY 4/12/13														
36	meniscus to the right (to higher pos. numbers).																			
37																				
38																				
39																				
40																				
41																				
42																				
43																				
44																				
45																				
46																				
47																				
48																				
49																				
50																				
51																				
52																				
53																				
54																				
55	Entries made by: Xiao-Ying Yu					Technical Data Review performed by: Carmen Arimescu														
56	Signature/date					Signature/date														
57	Signature on file with original 4/12/2013					Signature on file with original 7/9/2013														
58						TI-STMON-28														



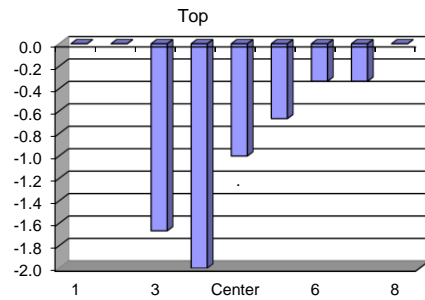
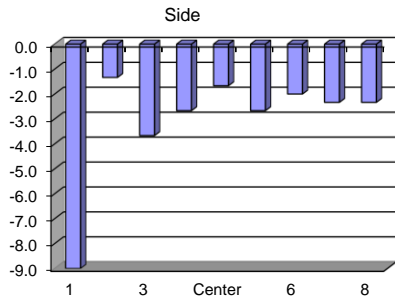
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1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls				
2	Site EP-3410-01-S					Run No. FA-3				
3	Date 4/12/2013					Fan Setting 1 & 2 (A&B)				
4	Tester BGF, XYY					Fan configuration normal				
5	Stack Dia. 39.75 in					Approx. air vel. 3173 sfpm at center				
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)				
7	Elevation N.A. ft					Port nearest to probe				
8	Distance to disturbance 53.5 ft.					Stack Temp 75.6 F				
9	Start/End Time 11:05/11:35									
10	Order --> 1st					2nd				
11	Traverse-->									
12	Trial ---->									
13			Side			Top				
14	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.
15	1	1.27	4	-5	-13	-4.7	-13	-12	-12	-12.3
16	2	4.17	0	-10	-10	-6.7	2	3	3	2.7
17	3	7.71	-2	-2	-2	-2.0	-2	-2	-1	-1.7
18	4	12.84	-3	-3	-3	-3.0	-2	-2	-2	-2.0
19	Center	19.875	-2	-2	-2	-2.0	0	0	-1	-0.3
20	5	26.91	-2	-2	-2	-2.0	0	0	0	0.0
21	6	32.04	-2	-2	-2	-2.0	0	0	0	0.0
22	7	35.58	-2	-2	-2	-2.0	0	1	0	0.3
23	8	38.48	-3	-3	-2	-2.7	1	0	0	0.3
24	Mean of absolute values of all data:					3.0				2.2
25	w/o points by wall:					2.8				1.0
26	Instruments Used:					Cal. Due				all 2.6
27	S-type pitot					Dwyer 60-inch S-type Pitot, #17				cert. of conformance
28	Velocity sensor					TSI VelociCalc				SN 305039
29	Angle indicator					Shop built				Cat. 3
30	Manometer					Dwyer 400-5, S36N				Cat. 3 Man-3
31						Notes:				RAES reading, scfm
32	Note:					start				29,997
33	To assure similar hose connections					end				29,997 FIO 4/12/13
34	between the manometer and pitot tube, rotating					Ambinet P: 29.49 inHg, amb. Temp: 66.6F, stack temp: 24.4 C, velocity, 3173 fpm.				
35	the pitot tube assembly clockwise drives the					XYY 4/12/13				
36	meniscus to the right (to higher pos. numbers).									
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										
55	Entries made by:		Xiao-Ying Yu			Technical Data Review performed by:		Carmen Arimescu		
56	Signature/date		Signature on file with original 4/12/2013			Signature/date		7/9/2013		
57						Signature on file with original		TI-STMON-28		
58										



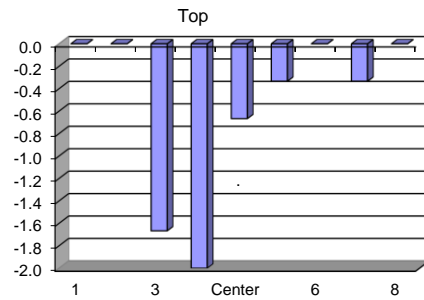
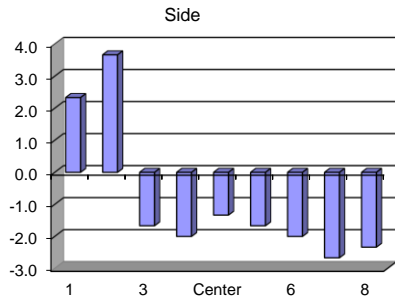
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1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls					
2	Site EP-3410-01-S					Run No. FA-4					
3	Date 4/12/2013					Fan Setting 1 & 3 (A&C)					
4	Tester MSP, YFS					Fan configuration normal					
5	Stack Dia. 39.75		in		Approx. air vel. 3600					sfpm at center	
6	Stack X-Area 1241.0		in ²		Units degrees (clockwise > pos. nos.)					Port nearest to probe	
7	Elevation N.A.		ft		Stack Temp 73.8 F						
8	Distance to disturbance 53.5		ft.								
9	Start/End Time 15:42/16:03										
10	Order -->		2nd			1st					
11	Traverse-->		Side			Top					
12	Trial ---->		1	2	3	1	2	3			
13	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.	
14	1	1.27	6	5	6	5.7	-13	-9	-8	-10.0	
15	2	4.17	6	-2	-2	0.7	5	6	6	5.7	
16	3	7.71	1	2	3	2.0	3	2	3	2.7	
17	4	12.84	0	1	0	0.3	1	1	1	1.0	
18	Center	19.875	2	2	1	1.7	2	2	3	2.3	
19	5	26.91	1	1	1	1.0	3	4	2	3.0	
20	6	32.04	1	1	1	1.0	3	2	2	2.3	
21	7	35.58	1	1	1	1.0	2	3	3	2.7	
22	8	38.48	2	1	2	1.7	3	3	3	3.0	
23	Mean of absolute values of all data:					1.7				3.6	
24	w/o points by wall:					1.1				2.8	
25									all	2.6	
26	Instuments Used:					Cal. Due					
27	S-type pitot		Dwyer 60-inch S-type Pitot, #17		Cert. of conformance					w/o wall pts	2.0
28	Velocity sensor		TSI VelociCalc		SN 305039						
29	Angle indicator		Shop built		Cat. 3						
30	Manometer		Dwyer 400-5, S36N		Cat. 3 Man-3						
31						Notes: RAES reading, scfm					
32	Note:					start 29,997					
33	To assure similar hose connections					end 29,997					
34	between the manometer and pitot tube, rotating					FIO 4/12/13					
35	the pitot tube assembly clockwise drives the					YFS 4/12/13					
36	meniscus to the right (to higher pos. numbers).										
37											
38											
39											
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41											
42											
43											
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47											
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49											
50											
51											
52											
53											
54											
55	Entries made by:		Xiao-Ying Yu		Technical Data Review performed by:		Carmen Arimescu				
56	Signature/date		Signature on file with original		4/12/2013		Signature/date		7/9/2013		
57							Signature on file with original		TI-STMON-28		
58											



	A	B	C	D	E	F	G	H	I	J	
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls					
2	Site EP-3410-01-S					Run No. FA-5					
3	Date 4/15/2013					Fan Setting 1 & 3 (A&C)					
4	Tester BGF, XYY					Fan configuration normal					
5	Stack Dia. 39.75 in					Approx. air vel. 3108 sfpm at center					
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)					
7	Elevation N.A. ft					Port nearest to probe					
8	Distance to disturbance 53.5 ft.					Stack Temp 64.4 F					
9	Start/End Time 9:40/10:12										
10	Order --> 1st					2nd					
11	1st Traverse-->					2nd Traverse-->					
12	Trial ---->					Trial ---->					
13											
14	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.	
15	1	1.27	-8	-10	-9	-9.0	0	0	0	0.0	
16	2	4.17	3	2	-9	-1.3	1	-1	0	0.0	
17	3	7.71	-3	-4	-4	-3.7	-1	-2	-2	-1.7	
18	4	12.84	-2	-3	-3	-2.7	-2	-2	-2	-2.0	
19	Center	19.875	-1	-2	-2	-1.7	-1	-1	-1	-1.0	
20	5	26.91	-3	-2	-3	-2.7	0	-1	-1	-0.7	
21	6	32.04	-2	-2	-2	-2.0	0	-1	0	-0.3	
22	7	35.58	-2	-3	-2	-2.3	-1	0	0	-0.3	
23	8	38.48	-2	-2	-3	-2.3	0	0	0	0.0	
24	Mean of absolute values of all data:					3.1					0.7
25	w/o points by wall:					2.3					0.9
26	Instruments Used:					Cal. Due					all 1.9
27	S-type pitot Dwyer 60-inch S-type Pitot, #17					Cert. of conformance					w/o wall pts 1.6
28	Velocity sensor TSI VelociCalc					SN 305039					
29	Angle indicator Shop built					Cat. 3					
30	Manometer Dwyer 400-5, S36N					Cat. 3 Man-3					
31						Notes: RAES reading, scfm					
32	Note:					start 29,997					
33	To assure similar hose connections					end 29,997 FIO 4/15/13					
34	between the manometer and pitot tube, rotating					Ambient Pressure: 999.2 hPa (29.50 inHg), ambient Temp: 48.8 F; RH: 49.5%					
35	the pitot tube assembly clockwise drives the					stack temp: 18.0 C, stack velocity: 3108 fpm.					
36	meniscus to the right (to higher pos. numbers).					XYY 4/12/13					
37											
38											
39											
40											
41											
42											
43											
44											
45											
46											
47											
48											
49											
50											
51											
52											
53											
54											
55	Entries made by: Xiao-Ying Yu					Technical Data Review performed by: Carmen Arimescu					
56	Signature/date					Signature/date					
57	Signature on file with original 4/12/2013					Signature on file with original 7/9/2013					
58						TI-STMON-28					



	A	B	C	D	E	F	G	H	I	J	
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls					
2	Site EP-3410-01-S					Run No. FA-6					
3	Date 4/15/2013					Fan Setting 1 & 3 (A&C)					
4	Tester BGF, XYY					Fan configuration normal					
5	Stack Dia. 39.75 in					Approx. air vel. 3045 sfpm at center					
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)					
7	Elevation N.A. ft					Port nearest to probe					
8	Distance to disturbance 53.5 ft.					Stack Temp 65.5 F					
9	Start/End Time 10:12/10:35										
10	Order --> 2nd					1st					
11	Traverse-->					Traverse-->					
12	Trial ---->					Trial ---->					
13			Side			Top					
14	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.	
15	1	1.27	2	1	4	2.3	0	0	0	0.0	
16	2	4.17	4	4	3	3.7	0	0	0	0.0	
17	3	7.71	-2	-1	-2	-1.7	-2	-2	-1	-1.7	
18	4	12.84	-2	-2	-2	-2.0	-2	-2	-2	-2.0	
19	Center	19.875	-1	-1	-2	-1.3	-1	0	-1	-0.7	
20	5	26.91	-2	-2	-1	-1.7	0	-1	0	-0.3	
21	6	32.04	-2	-2	-2	-2.0	0	0	0	0.0	
22	7	35.58	-3	-2	-3	-2.7	-1	0	0	-0.3	
23	8	38.48	-3	-2	-2	-2.3	0	0	0	0.0	
24	Mean of absolute values of all data:					2.2	0.6				
25	w/o points by wall:					2.1	0.7				
26	Instruments Used:					Cal. Due				all	1.4
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance			w/o wall pts			1.4
28	Velocity sensor	TSI VelociCalc			SN 305039						
29	Angle indicator	Shop built			Cat. 3						
30	Manometer	Dwyer 400-5, S36N			Cat. 3			Man-3			
31	Notes:					RAES reading, scfm					
32	Note:					start 29,997					
33	To assure similar hose connections					end 29,997					
34	between the manometer and pitot tube, rotating					FIO 4/15/13					
35	the pitot tube assembly clockwise drives the					ambinet pressure: 29.50 inHg, ambient temp: 50.5 F, amb. RH: 47.1%					
36	meniscus to the right (to higher pos. numbers).					stack velocity, 3245 fpm, stack temp: 18.6 C.					
37						XYY 4/15/13					
38											
39											
40											
41											
42											
43											
44											
45											
46											
47											
48											
49											
50											
51											
52											
53											
54											
55	Entries made by:		Xiao-Ying Yu			Technical Data Review performed by:		Carmen Arimescu			
56	Signature/date		Signature on file with original 4/12/2013			Signature/date		7/9/2013			
57						Signature on file with original		TI-STMON-28			
58											

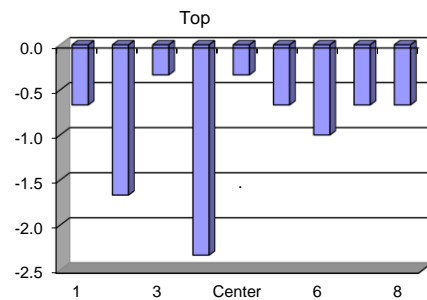
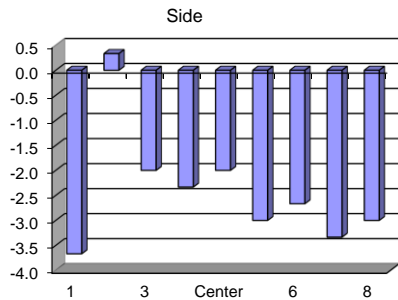


	A	B	C	D	E	F	G	H	I	J	
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls					
2	Site EP-3410-01-S					Run No. FA-7					
3	Date 4/16/2013					Fan Setting 2 & 3 (A&C)					
4	Tester BGF, XYY					Fan configuration normal					
5	Stack Dia. 39.75		in			Approx. air vel. 3076		sfpm at center			
6	Stack X-Area 1241.0		in ²			Units degrees (clockwise > pos. nos.)					
7	Elevation N.A.		ft			Port nearest to probe					
8	Distance to disturbance 53.5		ft.			Stack Temp 68		F			
9	Start/End Time 11:10/11:50										
10	Order -->		1st			2nd					
11	Traverse-->		Side			Top					
12	Trial ---->		1			2			3		
13	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.	
14	1	1.27	-10	-11	-11	-10.7	2	8	3	4.3	
15	2	4.17	-11	-11	-11	-11.0	-8	-9	-9	-8.7	
16	3	7.71	-3	-4	-4	-3.7	-2	-3	-3	-2.7	
17	4	12.84	-4	-4	-4	-4.0	-2	-3	-3	-2.7	
18	Center	19.875	-3	-2	-3	-2.7	-1	-2	-2	-1.7	
19	5	26.91	-4	-3	-4	-3.7	-2	-1	-2	-1.7	
20	6	32.04	-3	-3	-4	-3.3	-1	-2	-3	-2.0	
21	7	35.58	-3	-4	-3	-3.3	-1	-1	-2	-1.3	
22	8	38.48	-3	-3	-3	-3.0	-2	-2	-2	-2.0	
23	Mean of absolute values of all data:					5.0				3.0	
24	w/o points by wall:					4.5				3.0	
25									all	4.0	
26	Instuments Used:					Cal. Due		w/o wall pts			3.7
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance						
28	Velocity sensor	TSI VelociCalc			SN 305039						
29	Angle indicator	Shop built			Cat. 3						
30	Manometer	Dwyer 400-5, S36N			Cat. 3 Man-3						
31						Notes: RAES reading, scfm					
32	Note:					start 29,997					
33	To assure similar hose connections					end 29,997 FIO 4/16/13					
34	between the manometer and pitot tube, rotating					Ambinet pressure: 1009 mbar (29.80 inHg), RH: 17.6%, Ambient temp: 67.0 F					
35	the pitot tube assembly clockwise drives the					Stack temp: 20.0 C, stack velocity, 3076 fpm					
36	meniscus to the right (to higher pos. numbers).					XYY 4/16/13					
37											
38											
39											
40											
41											
42											
43											
44											
45											
46											
47											
48											
49											
50											
51											
52											
53											
54											
55	Entries made by:		Xiao-Ying Yu			Technical Data Review performed by:		Carmen Arimescu			
56	Signature/date		Signature on file with original 4/16/2013			Signature/date		7/9/2013			
57						Signature on file with original		TI-STMON-28			
58											

Side

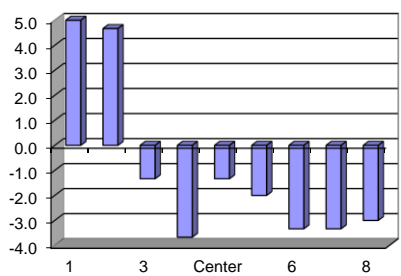
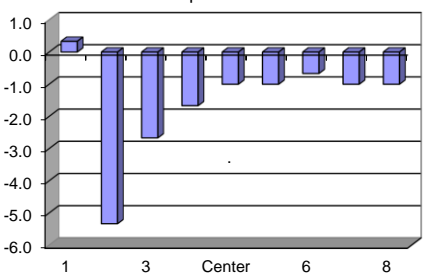
Top

	A	B	C	D	E	F	G	H	I	J	
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls					
2	Site EP-3410-01-S					Run No. FA-8					
3	Date 4/17/2013					Fan Setting 2 & 3 (A&C)					
4	Tester JEF, XYZ					Fan configuration normal					
5	Stack Dia. 39.75 in					Approx. air vel. 3400 sfpm at center					
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)					
7	Elevation N.A. ft					Port nearest to probe					
8	Distance to disturbance 53.5 ft.					Stack Temp 70.7 F					
9	Start/End Time 10:20/11:17										
10	Order --> 1st					2nd					
11	Traverse-->										
12	Trial ---->										
13											
14	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.	
15	1	1.27	3	-5	-9	-3.7	0	-1	-1	-0.7	
16	2	4.17	4	-4	1	0.3	-3	-2	0	-1.7	
17	3	7.71	-1	-3	-2	-2.0	0	1	-2	-0.3	
18	4	12.84	-2	-3	-2	-2.3	-2	-2	-3	-2.3	
19	Center	19.875	-1	-2	-3	-2.0	0	0	-1	-0.3	
20	5	26.91	-3	-3	-3	-3.0	-1	0	-1	-0.7	
21	6	32.04	-2	-3	-3	-2.7	-1	-1	-1	-1.0	
22	7	35.58	-3	-4	-3	-3.3	-1	0	-1	-0.7	
23	8	38.48	-3	-3	-3	-3.0	0	-1	-1	-0.7	
24	Mean of absolute values of all data:					2.5					0.9
25	w/o points by wall:					2.2					1.0
26	Instuments Used:					Cal. Due					all 1.7
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance						w/o wall pts 1.6
28	Velocity sensor	TSI VelociCalc			SN 305039						
29	Angle indicator	Shop built			Cat. 3						
30	Manometer	Dwyer 400-5, S36N			Cat. 3		Man-3				
31						Notes: RAES reading, scfm					
32	Note:					start 29,997					
33	To assure similar hose connections					end 29,997					
34	between the manometer and pitot tube, rotating					Ambinet pressure: 29.98 inHg, RH: 19.6%, temp: 61.7 F					
35	the pitot tube assembly clockwise drives the					Stack temp: 21.5 C, stack velocity, 3400 fpm FIO 4/17/13					
36	meniscus to the right (to higher pos. numbers).					YYY 4/17/13					
37											
38											
39											
40											
41											
42											
43											
44											
45											
46											
47											
48											
49											
50											
51											
52											
53											
54											
55	Entries made by:		Xiao-Ying Yu			Technical Data Review performed by:		Carmen Arimescu			
56	Signature/date		Signature on file with original 4/17/2013			Signature/date		7/9/2013			
57						Signature on file with original		TI-STMON-28			
58											

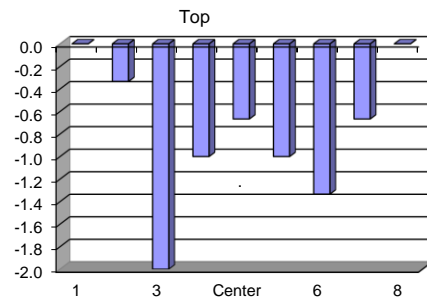
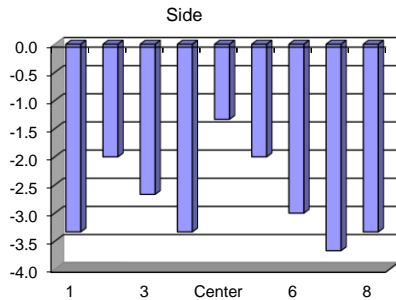


	A	B	C	D	E	F	G	H	I	J
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls				
2	Site EP-3410-01-S					Run No. FA-9				
3	Date 4/17/2013					Fan Setting 2 & 3 (A&C)				
4	Tester JEF, XYY					Fan configuration normal				
5	Stack Dia. 39.75 in					Approx. air vel. 3397 sfpm at center				
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)				
7	Elevation N.A. ft					Port nearest to probe				
8	Distance to disturbance 53.5 ft.					Stack Temp 72.3 F				
9	Start/End Time 11:20/11:45									
10	Order --> 2nd					1st				
11	Traverse-->					Side				
12	Trial ---->					Top				
13	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.
14	1	1.27	8	7	7	7.3	0	0	0	0.0
15	2	4.17	7	8	8	7.7	-2	5	4	2.3
16	3	7.71	1	1	1	1.0	0	-1	0	-0.3
17	4	12.84	-1	0	0	-0.3	-2	-2	-2	-2.0
18	Center	19.875	0	0	1	0.3	0	-1	0	-0.3
19	5	26.91	0	-1	0	-0.3	-1	-1	-1	-1.0
20	6	32.04	-1	-1	1	-0.3	-1	-1	-1	-1.0
21	7	35.58	-1	-2	1	-0.7	-1	-1	-1	-1.0
22	8	38.48	-1	-1	1	-0.3	-2	-1	-1	-1.3
23	Mean of absolute values of all data:					2.0				
24	w/o points by wall:					1.5				
25						all 1.5				
26	Instruments Used:					Cal. Due				
27	S-type pitot Dwyer 60-inch S-type Pitot, #17					Cert. of conformance				
28	Velocity sensor TSI VelociCalc					SN 305039				
29	Angle indicator Shop built					Cat. 3				
30	Manometer Dwyer 400-5, S36N					Cat. 3 Man-3				
31						Notes: RAES reading, scfm				
32	Note:					start 29,997				
33	To assure similar hose connections					end 29,997				
34	between the manometer and pitot tube, rotating					Ambinet pressure: 29.98 inHg; Ambient temp: 58.1 F; RH: 24.4%				
35	the pitot tube assembly clockwise drives the					Stack temp: 22.4 C, stack velocity, 3397 fpm FIO 4/17/13				
36	meniscus to the right (to higher pos. numbers).					XYY 4/17/13				
37										
38										
39	Side					Top				
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										
55	Entries made by: Xiao-Ying Yu					Technical Data Review performed by: Carmen Arimescu				
56	Signature/date: Signature on file with original 4/16/2013					Signature/date: 7/9/2013				
57						Signature on file with original TI-STMON-28				
58										

	A	B	C	D	E	F	G	H	I	J
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls				
2	Site EP-3410-01-S					Run No. FA-10				
3	Date 5/16/2013					Fan Setting A&C (1&3)				
4	Tester YFS, JEF					Fan configuration Normal sash open				
5	Stack Dia. 39.75 in					Approx. air vel. 3347 sfpm at center				
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)				
7	Elevation N.A. ft					Port nearest to probe				
8	Distance to disturbance 53.5 ft.					Stack Temp 26.1 C/79.0 F				
9	Start/End Time 15:00/15:37									
10	Order --> 2nd					1st				
11	Traverse-->					Side				
12	Trial ---->					Top				
13	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.
14	1	1.27	6	4	6	5.3	-2	15	13	8.7
15	2	4.17	4	4	5	4.3	8	7	8	7.7
16	3	7.71	-2	-1	-1	-1.3	1	1	-1	0.3
17	4	12.84	-3	-4	-2	-3.0	1	0	0	0.3
18	Center	19.875	-1	-1	-1	-1.0	2	1	1	1.3
19	5	26.91	-2	-2	-2	-2.0	1	2	1	1.3
20	6	32.04	-3	-4	-3	-3.3	1	1	1	1.0
21	7	35.58	-3	-4	-4	-3.7	1	2	1	1.3
22	8	38.48	-4	-4	-4	-4.0	2	1	2	1.7
23	Mean of absolute values of all data:					3.1	2.6			
24	w/o points by wall:					2.7	1.9			
25						all 2.9				
26	Instruments Used:					Cal. Due				w/o wall pts 2.3
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance					
28	Velocity sensor	TSI VelociCalc			SN 305039					
29	Angle indicator	Shop built			Cat. 3					
30	Manometer	Dwyer 400-5, S36N			Cat. 3 Man-3					
31						Notes: RAES reading, scfm				
32	Note:					start N/A				
33	To assure similar hose connections					end				
34	between the manometer and pitot tube, rotating					Ambinet pressure: 29.35 inHg, Temperature: 28.4 C				
35	the pitot tube assembly clockwise drives the					RH 22.6%. Stack velocity 3347 ft/min FIO 5/16/13				
36	meniscus to the right (to higher pos. numbers).					YFS 5/16/13				
37										
38										
39	Side					Top				
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										
55	Entries made by:	Julia Flaherty			Technical Data Review performed by:			Carmen Arimescu		
56	Signature/date	Signature on file with original 5/16/2013			Signature/date			7/9/2013		
57						Signature on file with original				
58						TI-STMON-28				

	A	B	C	D	E	F	G	H	I	J					
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls									
2	Site EP-3410-01-S					Run No. FA-11									
3	Date 5/16/2013					Fan Setting A&C (1&3)									
4	Tester YFS, JEF					Fan configuration Normal sash open									
5	Stack Dia. 39.75 in					Approx. air vel. 3225 sfpm at center									
6	Stack X-Area 1241.0 in ²					Units degrees (clockwise > pos. nos.)									
7	Elevation N.A. ft					Port nearest to probe									
8	Distance to disturbance 53.5 ft.					Stack Temp 25.3 C/77.5 F									
9	Start/End Time 15:40/16:10														
10	Order --> 1st					2nd									
11	Traverse-->														
12	Trial ---->														
13						Side					Top				
14	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.					
15	1	1.27	4	5	6	5.0	1	1	-1	0.3					
16	2	4.17	3	6	5	4.7	-2	-7	-7	-5.3					
17	3	7.71	-3	-1	0	-1.3	-2	-3	-3	-2.7					
18	4	12.84	-5	-3	-3	-3.7	-1	-2	-2	-1.7					
19	Center	19.875	-2	-1	-1	-1.3	-1	-1	-1	-1.0					
20	5	26.91	-2	-2	-2	-2.0	0	-1	-2	-1.0					
21	6	32.04	-4	-3	-3	-3.3	0	-1	-1	-0.7					
22	7	35.58	-4	-3	-3	-3.3	-1	-1	-1	-1.0					
23	8	38.48	-3	-3	-3	-3.0	-1	-1	-1	-1.0					
24	Mean of absolute values of all data:					3.1					1.6				
25	w/o points by wall:					2.8					1.9				
26	Instruments Used:					Cal. Due					all 2.4				
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance						w/o wall pts 2.4				
28	Velocity sensor	TSI VelociCalc			SN 305039										
29	Angle indicator	Shop built			Cat. 3										
30	Manometer	Dwyer 400-5, S36N			Cat. 3		Man-3								
31						Notes: RAES reading, scfm									
32	Note:					start N/A									
33	To assure similar hose connections					end									
34	between the manometer and pitot tube, rotating					Ambinet pressure: 29.37 inHg, Temperature: 28.1 C									
35	the pitot tube assembly clockwise drives the					RH 22.3%. Stack velocity 3225 ft/min									
36	meniscus to the right (to higher pos. numbers).					FIO 5/16/13									
37						YFS 5/16/13									
38															
39															
40	Side					Top									
41															
42															
43															
44															
45															
46															
47															
48															
49															
50															
51															
52															
53															
54															
55	Entries made by:		Julia Flaherty			Technical Data Review performed by:		Carmen Arimescu							
56	Signature/date		Signature on file with original 5/16/2013			Signature/date		Signature on file with original 7/9/2013							
57						Signature on file with original		TI-STMON-28							
58															

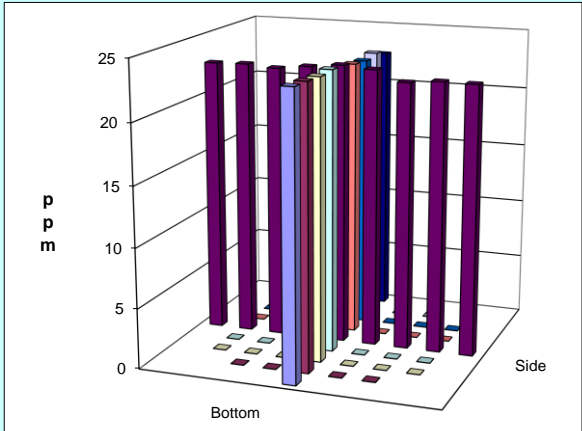
	A	B	C	D	E	F	G	H	I	J
1	FLOW ANGLE DATA FORM					FlowAngleRev0.xls				
2	Site EP-3410-01-S					Run No. FA-12				
3	Date 5/16/2013					Fan Setting A&C (1&3)				
4	Tester YFS, JEF					Fan configuration Normal sash open				
5	Stack Dia. 39.75		in			Approx. air vel. 3546		sfpm at center		
6	Stack X-Area 1241.0		in ²			Units degrees (clockwise > pos. nos.)		Port nearest to probe		
7	Elevation N.A.		ft			Stack Temp 26.7 C/80.0 F				
8	Distance to disturbance 53.5		ft.							
9	Start/End Time 16:10/16:38									
10	Order -->		2nd			1st				
11	Traverse-->		Side				Top			
12	Trial ---->		1	2	3	1	2	3		
13	Point	Depth, in.	deg. cw	deg. cw	deg. cw	Avg.	deg. cw	deg. cw	deg. cw	Avg.
14	1	1.27	-2	-4	-4	-3.3	-2	1	1	0.0
15	2	4.17	2	-4	-4	-2.0	-3	1	1	-0.3
16	3	7.71	-3	-2	-3	-2.7	-2	-3	-1	-2.0
17	4	12.84	-4	-3	-3	-3.3	0	-2	-1	-1.0
18	Center	19.875	-1	-1	-2	-1.3	0	-1	-1	-0.7
19	5	26.91	-2	-2	-2	-2.0	-1	-1	-1	-1.0
20	6	32.04	-3	-3	-3	-3.0	-1	-2	-1	-1.3
21	7	35.58	-3	-4	-4	-3.7	-1	-1	0	-0.7
22	8	38.48	-3	-4	-3	-3.3	0	0	0	0.0
23	Mean of absolute values of all data:					2.7		0.8		
24	w/o points by wall:					2.6		1.0		
25								all 1.8		
26	Instruments Used:					Cal. Due				
27	S-type pitot	Dwyer 60-inch S-type Pitot, #17			Cert. of conformance					
28	Velocity sensor	TSI VelociCalc			SN 305039					
29	Angle indicator	Shop built			Cat. 3					
30	Manometer	Dwyer 400-5, S36N			Cat. 3		Man-3			
31						Notes: RAES reading, scfm				
32	Note:					start N/A				
33	To assure similar hose connections					end				
34	between the manometer and pitot tube, rotating					Ambinet pressure: 29.33 inHg, Tem 25.3 C				
35	the pitot tube assembly clockwise drives the					RH 25.3%. Stack velocity 3546 ft/min				
36	meniscus to the right (to higher pos. numbers).					FIO 5/16/13				
37						YFS 5/16/13				
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										
55	Entries made by:	Julia Flaherty			Technical Data Review performed by:			Carmen Arimescu		
56	Signature/date	Signature on file with original 5/16/2013			Signature/date			7/9/2013		
57					Signature on file with original			TI-STMON-28		
58										



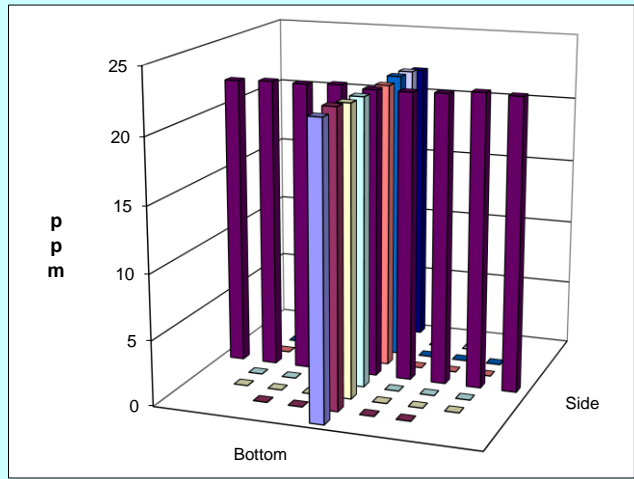
Gas Tracer Uniformity

	A	B	C	D	E	F	G	H	I	J					
1	TRACER GAS TRAVERSE DATA FORM														
2	Site EP-3410-01-S					Run No. GT-D									
3	Date 4/24/13					Fan Configuration A&B (1&2)									
4	Testers XYX, BGF, MSP, YFS					Fan Setting normal Hz									
5	Stack Dia. 39.7500 in.					Stack Temp 78.53 deg F									
6	Stack X-Area 1241.0 in.²					Start/End Time 11:00/15:03									
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10							
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7							
9	Measurement units ppm N₂O					Injection Point Junction, center									
10	Order --> 1st					2nd									
11	Traverse-->					Side					Bottom				
12	Trial ---->					1			2		3			Mean	
13	Point	Depth, in.	ppm				ppm								
14	1	1.27	9.59	9.96	9.53	9.69	9.70	9.55	9.65	9.63					
15	2	4.17	9.59	9.78	9.52	9.63	9.66	9.52	9.66	9.61					
16	3	7.71	9.80	9.67	9.75	9.74	9.75	9.80	9.73	9.76					
17	4	12.84	9.72	9.71	9.60	9.68	9.59	9.65	9.58	9.61					
18	Center	19.88	9.65	9.79	9.65	9.70	9.69	9.70	9.45	9.61					
19	5	26.91	9.75	9.60	9.64	9.66	9.76	9.64	9.57	9.66					
20	6	32.04	9.59	9.69	9.59	9.62	9.69	9.50	9.61	9.60					
21	7	35.58	9.70	9.61	9.67	9.66	9.57	9.34	9.65	9.52					
22	8	38.48	9.61	9.69	9.53	9.61	9.15	9.33	9.34	9.27					
23	Averages ----->		9.67	9.72	9.61	9.67	9.62	9.56	9.58	9.59					
24															
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All						
26			Mean	9.6		Mean	9.7	9.6	9.6						
27			Min Point	9.3	-3.7%	Std. Dev.	0.04	0.07	0.06						
28			Max Point	9.8	1.4%	COV as %	0.4	0.8	0.6						
29	Avg. Conc.		9.623 ppm												
30	Avg. Flow		28107 acfm												
31			Start	Finish											
32	Tracer tank pressure		800	800	psig										
33	Injection flowmeter		6.25	6.25	slpm										
34	Stack Temp		25.8	25.9	°C										
35	Mean stack velocity		3107	3416	fpm										
36	Sampling flowmeter		5	5	lpm										
37	Ambient pressure		1007	1005	mbar										
38	Ambient humidity		20%	16.4%	RH										
39	Ambient Temp		23.6	21.7	°C										
40	B&K vapor correction		Y	Y	Y/N										
41	Back-Gd gas		.42,.47,.45	.38,.41,.38,.4	ppm										
42			.45,.47	0,.37											
43	No. Bk-Gd samples		5	5	n										
44															
45	Gas analyzer checked:		4/24/2013												
46															
47	Notes: Sample flow meter is cubic ft per hr scfph.														
48	1 cfph=0.5 slpm. For sampling 5lpm, use 10 cfph. Background N ₂ O is														
49	~0.45 ppm, Target N ₂ O in stack is ~ 25 ppm, i.e., 50 times of														
50	background.														
51	XYX 4/24/12														
52															
53															
54	Entries made by: Yin-Fong Su					Technical Data Review performed by: Carmen Arimescu									
55	Signature/date On file with original 4/24/13					Signature/date On file with TI-STMON-030 9-Jul-13									
56															
57															

	A	B	C	D	E	F	G	H	I	J
1	TRACER GAS TRAVERSE DATA FORM									
2		Site	EP-3410-01-S			Run No.	GT-1			
3		Date	4/25/13			Fan Configuration	A&B (1&2)			
4		Testers	BGF, XYY			Fan Setting	normal	Hz		
5		Stack Dia.	39.7500 in.			Stack Temp	76.64 deg F			
6		Stack X-Area	1241.0 in. ²			Start/End Time	9:00/11:20			
7		Test Port	NEAREST TO PROBE			Center 2/3 from	3.65	to:	36.10	
8		Distance to disturbance	53.5 inches			Points in Center 2/3	2	to:	7	
9		Measurement units	ppm N2O			Injection Point	Junction, center			
10	Order -->		1st				2nd			
11	Traverse-->		Side				Bottom			
12	Trial ---->		1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm			ppm				
14	1	1.27	22.7	21.4	23.2	22.4	23.4	23.0	23.0	23.1
15	2	4.17	22.8	21.7	22.9	22.5	23.2	23.3	22.7	23.1
16	3	7.71	22.7	21.4	22.6	22.2	23.0	23.1	22.8	23.0
17	4	12.84	22.5	23.5	23.3	23.1	23.6	22.6	23.0	23.1
18	Center	19.88	22.5	23.7	23.7	23.3000	23.0	22.6	23.3	22.9667
19	5	26.91	22.4	23.4	23.3	23.0	22.7	22.7	22.5	22.6
20	6	32.04	22.0	23.3	22.9	22.7	22.4	22.3	22.7	22.46667
21	7	35.58	22.0	23.7	23.1	22.9	22.8	22.7	22.6	22.7
22	8	38.48	21.0	24.0	23.6	22.9	22.7	22.2	21.8	22.2
23	Averages ----->		22.3	22.9	23.2	22.8	23.0	22.7	22.7	22.8
24										
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All	
26			Mean	22.8		Mean	22.8	22.8	22.8	
27			Min Point	22.2	-2.5%	Std. Dev.	0.37	0.24	0.30	
28			Max Point	23.3	2.2%	COV as %	1.6	1.0	1.3	
29	Avg. Conc.	22.754	ppm		Instruments Used:					
30	Avg. Flow	26267	acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE					
31			Start	Finish	TSI VelociCalc SN T95351203001 12/10/2013					
32	Tracer tank pressure		780	780	Dew point pen/thermometer SN 122277883 5/16/2014					
33	Injection flowmeter		12.5	12.5						
34	Stack Temp		24.5	25.1						
35	Mean stack velocity		3057	3039						
36	Sampling flowmeter		5	5						
37	Ambient pressure		999.0	999.1						
38	Ambient humidity		27.2%	18.6%						
39	Ambient Temp		22.0	23.7						
40	B&K vapor correction		Y	Y						
41	Back-Gd gas		.44,.48,.47	.37,.38,.34						
42			.44,.42	.37,.37						
43	No. Bk-Gd samples		5	5						
44										
45	Gas analyzer checked:	4/24/2013								
46										
47	Notes:	Background N2O=0.45 ppm, target N2O @ ~ 25 ppm.								
48		Calm, no wind.								
49										
50		XYY 4/25/12								
51										
52										
53										
54	Entries made by:	Xiao-Ying Yu			Technical Data Review performed by:			Carmen Arimescu		
55	Signature/date	On file with original 4/25/13			Signature/date			On file with TI-STMON-030 9-Jul-13		
56										
57										



	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-2					
3	Date 4/25/13					Fan Configuration A&B (1&2)					
4	Testers BGF, XYY					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 77.45 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 11:20/13:00					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N2O					Injection Point Junction Top					
10	Order --> 2nd					1st					
11	Side					Bottom					
12	Trial ---->					Trial ---->					
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.9	21.7	22.0	21.9	22.0	22.6	21.7	22.1	
15	2	4.17	21.8	22.4	21.7	22.0	22.7	22.1	22.2	22.3	
16	3	7.71	22.1	21.8	21.3	21.7	22.4	21.9	22.0	22.1	
17	4	12.84	21.9	21.4	21.7	21.7	22.2	21.9	22.1	22.1	
18	Center	19.88	21.5	22.0	21.5	21.7	22.2	22.2	21.9	22.1	
19	5	26.91	21.9	21.9	21.8	21.9	21.9	22.1	21.9	22.0	
20	6	32.04	21.6	21.9	21.8	21.8	22.2	22.0	22.4	22.2	
21	7	35.58	21.9	21.7	21.8	21.8	22.3	22.1	22.0	22.1	
22	8	38.48	21.6	21.7	21.8	21.7	21.6	21.6	22.2	21.8	
23	Averages ----->		21.8	21.8	21.7	21.8	22.2	22.1	22.0	22.1	
24											
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All	
26	Mean		21.9			Mean		21.8	22.1	22.0	
27	Min Point		21.7	-1.2%		Std. Dev.		0.11	0.11	0.21	
28	Max Point		22.3	1.8%		COV as %		0.5	0.5	1.0	
29	Avg. Conc.	21.942 ppm		Instruments Used:							
30	Avg. Flow	26491 acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE							
31		Start	Finish	TSI VelociCalc SN T95351203001 1/17/2013							
32	Tracer tank pressure	780	720	Dew point pen/thermometer SN 122277883 5/16/2014							
33	Injection flowmeter	12.5	12.5								
34	Stack Temp	25.1	25.4								
35	Mean stack velocity	3061	3087								
36	Sampling flowmeter	5	5								
37	Ambient pressure	998.9	998.7								
38	Ambient humidity	20.5%	19.5%								
39	Ambient Temp	23.5	23.6								
40	B&K vapor correction	Y	Y								
41	Back-Gd gas	.34,.37,.38	.38,.35,.33								
42		.37,.37	.32,.33								
43	No. Bk-Gd samples	5	5								
44											
45	Gas analyzer checked:	4/24/2013									
46											
47	Notes:	Mild wind and clear.									
48											
49											
50											
51	XYY 4/25/12										
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 4/25/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											



	A	B	C	D	E	F	G	H	I	J									
1	TRACER GAS TRAVERSE DATA FORM																		
2	Site EP-3410-01-S					Run No. GT-3													
3	Date 4/25/13					Fan Configuration A&B (1&2)													
4	Testers JAG & MSP					Fan Setting N.A. Hz													
5	Stack Dia. 39.7500 in.					Stack Temp 79.7 deg F													
6	Stack X-Area 1241.0 in.²					Start/End Time 1330/1507													
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10											
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7											
9	Measurement units ppm N2O					Injection Point Junction Center Bottom													
10	Order --> 1st					2nd													
11	Traverse-->					Side					Bottom								
12	Trial ---->					1		2		3		1		2		3		Mean	
13	Point	Depth, in.	ppm				ppm				ppm				ppm				
14	1	1.27	18.8	18.7	18.6	18.7	18.3	18.6	18.3	18.4	18.5	18.5	18.5	18.4	18.5	18.5	18.5	18.5	
15	2	4.17	18.6	18.8	18.8	18.7	18.7	18.6	18.2	18.5	18.8	18.8	18.8	18.6	18.8	18.8	18.6	18.6	
16	3	7.71	18.6	17.9	18.6	18.4	18.6	18.2	18.2	18.5	18.5	18.5	18.5	18.4	18.5	18.5	18.4	18.4	
17	4	12.84	18.5	18.0	18.6	18.4	18.5	18.5	18.4	18.5	18.5	18.5	18.5	18.4	18.5	18.5	18.4	18.4	
18	Center	19.88	18.6	18.0	18.6	18.4	18.3	18.6	18.5	18.5	18.5	18.5	18.5	18.4	18.5	18.5	18.4	18.4	
19	5	26.91	18.3	17.9	18.5	18.2	18.3	18.8	18.6	18.5	18.8	18.8	18.8	18.6	18.8	18.8	18.6	18.6	
20	6	32.04	18.5	18.3	18.4	18.4	18.4	18.5	18.6	18.5	18.5	18.5	18.5	18.4	18.5	18.5	18.4	18.4	
21	7	35.58	18.4	18.5	18.3	18.4	18.4	18.6	18.5	18.5	18.5	18.5	18.5	18.4	18.5	18.5	18.4	18.4	
22	8	38.48	18.4	18.5	18.6	18.5	18.8	18.2	18.5	18.5	18.5	18.5	18.5	18.4	18.5	18.5	18.4	18.4	
23	Averages ----->		18.5	18.3	18.6	18.5	18.5	18.5	18.4	18.5	18.4	18.5	18.4	18.5	18.4	18.5	18.4	18.5	
24																			
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All										
26	Mean		18.5			Mean	18.4	18.5	18.4										
27	Min Point		18.2		-1.2%	Std. Dev.	0.15	0.07	0.12										
28	Max Point		18.7		1.5%	COV as %	0.8	0.4	0.6										
29	Avg. Conc.	18.467 ppm																	
30	Avg. Flow	27918 acfm																	
31		Start	Finish																
32	Tracer tank pressure	800	800	psig															
33	Injection flowmeter	12.5	12.5	slpm															
34	Stack Temp	26	27	°C															
35	Mean stack velocity	3222	3257	fpm															
36	Sampling flowmeter	5	5	lpm															
37	Ambient pressure	999	999	mbar															
38	Ambient humidity	21%	19%	RH															
39	Ambient Temp	24	25	°C															
40	B&K vapor correction	Y	Y	Y/N															
41	Back-Gd gas	0.4,0.3,0.3,0	0.4,0.4,0.4,0	ppm															
42		.3,0.3	4,0.4																
43	No. Bk-Gd samples	5	5	n															
44																			
45	Gas analyzer checked:	24April 2013																	
46																			
47	Notes:																		
48																			
49																			
50																			
51	MSP 4/25/12																		
52																			
53																			
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:				Carmen Arimescu									
55	Signature/date	On file with original 4/25/13				Signature/date				On file with TI-STMON-030 9-Jul-13									
56																			
57																			

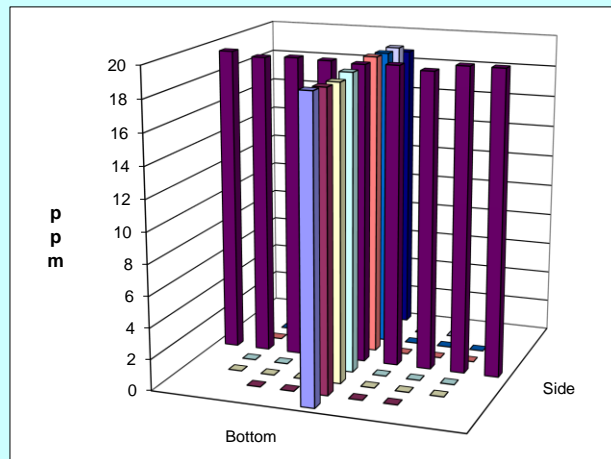
	A	B	C	D	E	F	G	H	I	J			
1	TRACER GAS TRAVERSE DATA FORM												
2	Site EP-3410-01-S					Run No. GT-4							
3	Date 4/25/13					Fan Configuration A&B (1&2)							
4	Testers JAG & MSP					Fan Setting N.A. Hz							
5	Stack Dia. 39.7500 in.					Stack Temp 80.6 deg F							
6	Stack X-Area 1241.0 in.²					Start/End Time 1515/1700							
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65 to: 36.10							
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2 to: 7							
9	Measurement units ppm N2O					Injection Point Junction Far							
10	Order --> 2nd					1st							
11	Traverse-->					Bottom							
12	Trial ---->					1 2 3 Mean							
13	Point	Depth, in.	ppm				ppm						
14	1	1.27	18.7	18.9	18.6	18.7	18.2	18.5	18.8	18.5			
15	2	4.17	18.6	18.8	18.6	18.7	18.3	18.6	18.3	18.4			
16	3	7.71	18.7	18.6	19.0	18.8	18.2	18.7	18.3	18.4			
17	4	12.84	18.5	18.5	18.9	18.6	18.5	18.5	18.5	18.5			
18	Center	19.88	18.8	18.5	18.7	18.7	18.6	18.7	18.6	18.6			
19	5	26.91	18.6	18.7	18.7	18.7	19.0	18.8	18.8	18.9			
20	6	32.04	18.7	18.5	18.3	18.5	18.9	18.7	19.1	18.9			
21	7	35.58	18.5	18.6	18.4	18.5	18.4	18.7	19.1	18.7			
22	8	38.48	18.3	18.4	18.5	18.4	18.9	18.8	18.3	18.7			
23	Averages ----->		18.6	18.6	18.6	18.6	18.6	18.7	18.6	18.6			
24													
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		
26	Mean		18.6				Mean		18.6		18.6		
27	Min Point		18.4		-1.2%		Std. Dev.		0.10		0.21		
28	Max Point		18.9		1.5%		COV as %		0.5		1.1		
29	Avg. Conc.		18.615 ppm										
30	Avg. Flow		27586 acfm										
31			Start		Finish								
32	Tracer tank pressure		800		800		psig						
33	Injection flowmeter		12.5		12.5		slpm						
34	Stack Temp		27		27		°C						
35	Mean stack velocity		3265		3137		fpm						
36	Sampling flowmeter		5		5		lpm						
37	Ambient pressure		999		998		mbar						
38	Ambient humidity		18%		20%		RH						
39	Ambient Temp		25		25		°C						
40	B&K vapor correction		Y		Y		Y/N						
41	Back-Gd gas		0.3,0.4,0.4,0		0.4,0.4,0.4,0.		ppm						
42			.4,0.3		4,0.4								
43	No. Bk-Gd samples		5		5		n						
44													
45	Gas analyzer checked:		24April 2013										
46													
47	Notes:												
48													
49													
50													
51	MSP 4/25/12												
52													
53													
54	Entries made by:		John Glissmeyer			Technical Data Review performed by:					Carmen Arimescu		
55	Signature/date		On file with original			4/25/13		On file with TI-STMON-030					9-Jul-13
56													
57													

	A	B	C	D	E	F	G	H	I	J					
1	TRACER GAS TRAVERSE DATA FORM														
2	Site EP-3410-01-S					Run No. GT-5									
3	Date 4/26/13					Fan Configuration A&B (1&2)									
4	Testers YFS, XYY					Fan Setting normal Hz									
5	Stack Dia. 39.7500 in.					Stack Temp 77.9 deg F									
6	Stack X-Area 1241.0 in.²					Start/End Time 9:15/11:35									
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10							
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7							
9	Measurement units ppm N2O					Injection Point Junction Near									
10	Order --> 1st					2nd									
11	Traverse-->					Side					Bottom				
12	Trial ---->					1			2		3			Mean	
13	Point	Depth, in.	ppm				ppm				Mean				
14	1	1.27	18.5	17.9	17.9	18.1	17.8	17.7	17.5	17.5	17.7				
15	2	4.17	18.6	18.2	18.2	18.3	17.8	17.5	17.8	17.8	17.7				
16	3	7.71	18.0	18.0	18.1	18.0	17.8	17.6	17.4	17.6	17.6				
17	4	12.84	18.1	18.1	18.2	18.1	17.7	17.6	17.7	17.7	17.7				
18	Center	19.88	18.2	18.2	17.9	18.1	17.8	17.7	17.5	17.7	17.7				
19	5	26.91	18.6	18.0	17.9	18.2	17.8	17.8	17.9	17.8	17.8				
20	6	32.04	18.0	17.8	17.9	17.9	18.0	17.9	17.7	17.9	17.9				
21	7	35.58	18.3	17.8	18.1	18.1	17.7	17.7	17.6	17.7	17.7				
22	8	38.48	18.4	17.8	17.7	18.0	17.6	18.2	18.2	18.0	18.0				
23	Averages ----->		18.3	18.0	18.0	18.1	17.8	17.7	17.7	17.7	17.7				
24															
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All		
26	Mean		17.9				Mean		18.1		17.7		17.9		
27	Min Point		17.6		-1.8%		Std. Dev.		0.13		0.10		0.23		
28	Max Point		18.3		2.3%		COV as %		0.7		0.6		1.3		
29	Avg. Conc.		17.919 ppm												
30	Avg. Flow		28883 acfm												
31			Start		Finish										
32	Tracer tank pressure		780		780		psig								
33	Injection flowmeter		12.5		12.5		slpm								
34	Stack Temp		25.5		25.5		°C								
35	Mean stack velocity		3314		3389		fpm								
36	Sampling flowmeter		5		5		lpm								
37	Ambient pressure		1004		1005		mbar								
38	Ambient humidity		27.9%		25.3%		RH								
39	Ambient Temp		26		26.5		°C								
40	B&K vapor correction		Y		Y		Y/N								
41	Back-Gd gas		.40, .38, .37, .37, .38		.3, .31, .30, .32, .33		ppm								
42															
43	No. Bk-Gd samples		5		5		n								
44															
45	Gas analyzer checked:		4/24/13												
46															
47	Notes:		N2O background is 0.4 ppm,												
48			N2O in stack is targeted to be ~ 20 ppm.												
49															
50															
51			XYY 4/26/13												
52															
53															
54	Entries made by:		Xiao-Ying Yu			Technical Data Review performed by:			Carmen Arimescu						
55	Signature/date		On file with original			4/26/13			On file with TI-STMON-030						
56									9-Jul-13						
57															

	A	B	C	D	E	F	G	H	I	J		
1	TRACER GAS TRAVERSE DATA FORM											
2	Site EP-3410-01-S				Run No. GT-6							
3	Date 4/26/13				Fan Configuration A&B (1&2)							
4	Testers YFS, XYY				Fan Setting normal Hz							
5	Stack Dia. 39.7500 in.				Stack Temp 80.96 deg F							
6	Stack X-Area 1241.0 in.²				Start/End Time 11:48/13:15							
7	Test Port NEAREST TO PROBE				Center 2/3 from 3.65		to: 36.10					
8	Distance to disturbance 53.5 inches				Points in Center 2/3 2		to: 7					
9	Measurement units ppm N₂O				Injection Point Fan A Center							
10	Order --> 2nd				1st							
11	Traverse-->				Side			Bottom				
12	Trial ---->				1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm					
14	1	1.27	18.6	18.1	18.4	18.4	18.1	18.3	18.3	18.2		
15	2	4.17	18.6	18.1	18.4	18.4	17.8	18.3	18.2	18.1		
16	3	7.71	18.3	18.6	18.6	18.5	17.8	18.4	18.4	18.2		
17	4	12.84	18.3	18.6	18.6	18.5	17.7	18.4	18.0	18.0		
18	Center	19.88	18.8	18.2	18.5	18.5	18.4	18.1	17.9	18.1		
19	5	26.91	18.7	18.2	18.4	18.4	18.4	18.2	18.4	18.3		
20	6	32.04	18.4	18.2	18.4	18.3	18.2	18.2	18.1	18.2		
21	7	35.58	18.5	18.7	18.1	18.4	18.6	18.1	18.3	18.3		
22	8	38.48	18.1	18.4	18.1	18.2	18.4	18.7	18.2	18.4		
23	Averages ----->		18.5	18.3	18.4	18.4	18.2	18.3	18.2	18.2		
24												
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom	All
26	Mean		18.3				Mean		18.4		18.2	18.3
27	Min Point		18.0		-1.5%		Std. Dev.		0.07		0.11	0.16
28	Max Point		18.5		1.0%		COV as %		0.4		0.6	0.9
29	Avg. Conc.		18.310 ppm									
30	Avg. Flow		28137 acfm									
31			Start		Finish							
32	Tracer tank pressure		750		750		psig					
33	Injection flowmeter		13		13		slpm					
34	Stack Temp		27.3		27.1		°C					
35	Mean stack velocity		3161		3369		fpm					
36	Sampling flowmeter		5		5		lpm					
37	Ambient pressure		1005		1004		mbar					
38	Ambient humidity		25.7%		18.5%		RH					
39	Ambient Temp		25.8		33.8		°C					
40	B&K vapor correction		Y		Y		Y/N					
41	Back-Gd gas		.3,.31,.32,.3		.34,.33,.33,.3		ppm					
42			3,.31		0,.33							
43	No. Bk-Gd samples		5		5		n					
44												
45	Gas analyzer checked:		4/24/13									
46												
47	Notes:											
48												
49												
50												
51	XYY 4/26/13											
52												
53												
54	Entries made by:		Xiao-Ying Yu		4/26/13		Technical Data Review performed by:		Carmen Arimescu			
55	Signature/date		On file with original		4/26/13		Signature/date		On file with TI-STMON-030			
56	9-Jul-13											
57												

Traverse	Point	Depth (in)	ppm
Side	1	1.27	18.6
Side	2	4.17	18.6
Side	3	7.71	18.3
Side	4	12.84	18.3
Side	Center	19.88	18.8
Side	5	26.91	18.7
Side	6	32.04	18.4
Side	7	35.58	18.5
Side	8	38.48	18.1
Bottom	1	1.27	18.1
Bottom	2	4.17	17.8
Bottom	3	7.71	17.8
Bottom	4	12.84	17.7
Bottom	Center	19.88	18.4
Bottom	5	26.91	18.4
Bottom	6	32.04	18.2
Bottom	7	35.58	18.6
Bottom	8	38.48	18.4

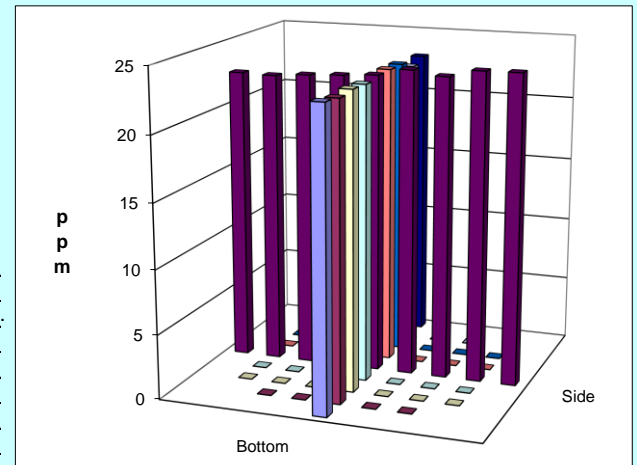
	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S				Run No. GT-7						
3	Date 4/26/13				Fan Configuration A&B (1&2)						
4	Testers JAG, YFS				Fan Setting N.A. Hz						
5	Stack Dia. 39.7500 in.				Stack Temp 83.12 deg F						
6	Stack X-Area 1241.0 in.²				Start/End Time 1320/1520						
7	Test Port NEAREST TO PROBE				Center 2/3 from 3.65		to: 36.10				
8	Distance to disturbance 53.5 inches				Points in Center 2/3 2		to: 7				
9	Measurement units ppm N₂O				Injection Point Fan A Top						
10	Order -->	1st			2nd						
11	Traversal-->	Side			Bottom						
12	Trial ---->	1 2 3 Mean			1 2 3 Mean						
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	19.9	19.2	18.9	19.3	18.6	19.0	19.5	19.0	
15	2	4.17	19.9	19.3	18.8	19.3	18.9	18.8	18.9	18.9	
16	3	7.71	19.2	18.5	19.0	18.9	18.4	18.9	19.1	18.8	
17	4	12.84	19.0	19.2	19.2	19.1	18.9	18.9	19.3	19.0	
18	Center	19.88	18.6	19.4	19.2	19.1	18.9	18.9	19.7	19.2	
19	5	26.91	18.9	19.4	19.2	19.2	19.2	19.4	19.3	19.3	
20	6	32.04	18.9	19.4	19.4	19.2	19.1	19.2	19.3	19.2	
21	7	35.58	18.9	19.2	19.3	19.1	19.1	18.9	19.7	19.2	
22	8	38.48	19.1	19.6	19.5	19.4	18.6	18.7	N.A.	18.7	
23	Averages ----->		19.2	19.2	19.2	19.2	18.9	19.0	19.4	19.0	
24											
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All		
26			Mean	19.1		Mean	19.1	19.1	19.1	19.1	
27			Min Point	18.7	-2.4%	Std. Dev.	0.14	0.19	0.16	0.16	
28			Max Point	19.4	1.5%	COV as %	0.7	1.0	0.8		
29	Avg. Conc.	19.109 ppm		Instruments Used:							
30	Avg. Flow	27284 acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE							
31				TSI VelociCalc SN T95351203001 12/10/2013							
32	Tracer tank pressure	Start	Finish	Dew point pen/thermometer SN 122277875 5/16/2014							
33	Injection flowmeter	770	770	JAG 4/26/13							
34	Stack Temp	12.97	12.97								
35	Mean stack velocity	28.2	28.6								
36	Sampling flowmeter	3152	3180								
37	Ambient pressure	5	5								
38	Ambient humidity	1004	1003								
39	Ambient Temp	23.2%	16.3%								
40	B&K vapor correction	28.8	29.5								
41	Back-Gd gas	Y	Y								
42	No. Bk-Gd samples	.3, .3, .3, .3, .3	.38, .36, .33, .35, .33								
43		5	5								
44											
45	Gas analyzer checked:	4/24/2013									
46											
47	Notes:	1st traverse was repeated because the									
48		instrument display was faulty. Replacement data recorded									
49		in depth column.									
50		JAG 4/26/13									
51											
52											
53											
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 4/26/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											



	A	B	C	D	E	F	G	H	I	J		
1	TRACER GAS TRAVERSE DATA FORM											
2	Site EP-3410-01-S					Run No. GT-8						
3	Date 4/26/13					Fan Configuration Fan A&B (1&2)						
4	Testers JAG, YFS					Fan Setting N.A. Hz						
5	Stack Dia. 39.7500 in.					Stack Temp 82.94 deg F						
6	Stack X-Area 1241.0 in.²					Start/End Time 1525/1700						
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10				
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7				
9	Measurement units ppm N₂O					Injection Point Fan A Bottom						
10	Order --> 2nd					1st						
11	Side					Bottom						
12	Trial ---->				1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm					
14	1	1.27	19.2	19.2	18.6	19.0	19.2	19.1	19.0	19.1	19.1	
15	2	4.17	19.0	19.4	18.9	19.1	18.8	19.0	18.9	18.9	18.9	
16	3	7.71	19.1	18.9	18.6	18.9	19.1	18.8	19.0	19.0	19.0	
17	4	12.84	19.2	19.2	18.7	19.0	19.1	18.9	19.2	19.1	19.1	
18	Center	19.88	19.2	19.0	18.7	19.0	19.4	19.0	18.9	19.1	19.1	
19	5	26.91	18.8	19.1	18.5	18.8	19.1	19.0	19.0	19.0	19.0	
20	6	32.04	19.1	19.3	18.9	19.1	19.4	18.9	19.3	19.2	19.2	
21	7	35.58	19.3	19.5	18.8	19.2	18.9	19.4	19.1	19.1	19.1	
22	8	38.48	18.9	19.1	19.0	19.0	19.6	19.6	19.6	19.6	19.6	
23	Averages ----->		19.1	19.2	18.7	19.0	19.2	19.1	19.1	19.1	19.1	
24												
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All		
26	Mean		19.1			Mean		19.0	19.1	19.0		
27	Min Point		18.8	-1.4%		Std. Dev.		0.14	0.10	0.12		
28	Max Point		19.6	2.8%		COV as %		0.7	0.5	0.6		
29	Avg. Conc.	19.069 ppm										
30	Avg. Flow	27551 acfm										
31			Start	Finish								
32	Tracer tank pressure	770		770	psig							
33	Injection flowmeter	12.97		13.06	slpm							
34	Stack Temp	28.6		28	°C							
35	Mean stack velocity	3180		3214	fpm							
36	Sampling flowmeter	5		5	lpm							
37	Ambient pressure	1003		1003	mbar							
38	Ambient humidity	17.0%		14.1%	RH							
39	Ambient Temp	29.1		29.3	°C							
40	B&K vapor correction	Y		Y	Y/N							
41	Back-Gd gas	.31,.33,.33		.36,.35,.34	ppm							
42		.33,.36		.36,.32								
43	No. Bk-Gd samples	5		5	n							
44												
45	Gas analyzer checked:	4/24/2013										
46												
47	Notes:											
48												
49												
50	JAG 4/26/13											
51												
52												
53												
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:				Carmen Arimescu		
55	Signature/date	On file with original				4/26/13				On file with TI-STMON-030		
56												
57												

Point	Side (ppm)	Bottom (ppm)
1	19.2	19.1
2	19.0	18.9
3	19.1	19.0
4	19.2	18.9
5	18.8	19.0
6	19.1	18.9
7	19.3	19.1
8	18.9	19.6

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-9					
3	Date 4/30/13					Fan Configuration A&B (1&2)					
4	Testers YFS, XYY					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 74.21 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 9:10/11:40					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N2O					Injection Point Fan A Far					
10	Order --> 1st					2nd					
11	Side					Bottom					
12	Trial ---->				1	2	3	Mean	1	2	3
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.9	23.5	23.9	23.4	22.7	23.6	22.9	23.1	
15	2	4.17	23.4	23.5	23.3	23.4	22.3	22.6	23.7	22.9	
16	3	7.71	22.7	22.8	23.0	22.8	22.4	22.9	23.8	23.0	
17	4	12.84	23.3	23.1	23.1	23.2	22.7	22.8	23.3	22.9	
18	Center	19.88	22.5	22.7	22.7	22.6	22.7	22.9	23.9	23.2	
19	5	26.91	22.2	22.5	22.7	22.5	22.9	22.8	23.8	23.2	
20	6	32.04	22.4	22.6	22.0	22.3	23.1	22.6	23.7	23.1	
21	7	35.58	22.7	21.9	21.8	22.1	22.7	22.3	22.6	22.5	
22	8	38.48	21.9	23.2	21.5	22.2	22.7	23.1	23.0	22.9	
23	Averages ----->		22.7	22.9	22.7	22.7	22.7	22.8	23.4	23.0	
24											
25	All		ppm	Dev. from mean		Center 2/3	Side	Bottom	All		
26	Mean		22.9			Mean	22.7	23.0	22.8		
27	Min Point		22.1	-3.2%		Std. Dev.	0.45	0.23	0.37		
28	Max Point		23.4	2.5%		COV as %	2.0	1.0	1.6		
29	Avg. Conc.	22.852 ppm									
30	Avg. Flow	28370 acfm									
31		Start	Finish								
32	Tracer tank pressure	580	450	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	22.9	24	°C							
35	Mean stack velocity	3244	3340	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1006	1006	mbar							
38	Ambient humidity	22.4%	23.6%	RH							
39	Ambient Temp	17.5	18.2	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.45,.49,.45	.43,.40,.41	ppm							
42		.47,.46	.41,.41								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	4/24/2013									
46											
47	Notes:	Background N2O=.47 ppm, target N2O is ~ 23 ppm.									
48											
49											
50	XYY 4/30/13										
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 4/30/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											



	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-10					
3	Date 4/30/13					Fan Configuration A&B (1&2)					
4	Testers YFS, XYY					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 73.76 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 11:40/12:53					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65 to: 36.10					
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2 to: 7					
9	Measurement units ppm N₂O					Injection Point Fan A Near					
10	Order --> 2nd					1st					
11	Side					Bottom					
12	Trial ---->					1 2 3 Mean 1 2 3 Mean					
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.6	22.8	22.6	22.7	21.5	23.1	22.3	22.3	
15	2	4.17	22.1	23.1	22.9	22.7	22.4	22.0	21.6	22.0	
16	3	7.71	22.6	23.2	22.5	22.8	21.6	21.8	22.3	21.9	
17	4	12.84	22.5	23.2	22.8	22.8	22.3	21.8	22.1	22.1	
18	Center	19.88	23.2	22.7	22.7	22.9	22.8	22.0	22.0	22.3	
19	5	26.91	22.8	23.4	22.5	22.9	22.8	22.2	22.4	22.5	
20	6	32.04	23.1	23.4	22.7	23.1	22.8	22.2	22.4	22.5	
21	7	35.58	22.8	23.2	23.2	23.1	23.0	22.7	22.9	22.9	
22	8	38.48	22.9	23.3	22.6	22.9	22.8	22.8	21.8	22.5	
23	Averages ----->		22.7	23.1	22.7	22.9	22.4	22.3	22.2	22.3	
24											
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All	
26	Mean		22.6			Mean		22.9	22.3	22.6	
27	Min Point		21.9	-3.0%		Std. Dev.		0.14	0.34	0.40	
28	Max Point		23.1	2.1%		COV as %		0.6	1.5	1.8	
29	Avg. Conc.	22.592 ppm									
30	Avg. Flow	29185 acfm									
31		Start	Finish								
32	Tracer tank pressure	450	450	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	22.7	23.7	°C							
35	Mean stack velocity	3338	3435	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1006	1006	mbar							
38	Ambient humidity	23.5%	23.4%	RH							
39	Ambient Temp	14.1	14.1	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.41,.43,.40	.44,.44,.42	ppm							
42		.41,.41	.44,.42								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	4/24/2013									
46											
47	Notes:										
48											
49											
50	XYY 4/30/13										
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 4/30/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											

Instuments Used:

B&K 1302 Gas Analyzer	SN 1788615	Cat2 M&TE
TSI VelociCalc	SN T95351203001	12/10/2013
Dew point pen/thermometer	SN 122277875	5/16/2014

JAG 4/26/13

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-11					
3	Date 4/30/13					Fan Configuration A&B (1&2)					
4	Testers MSP, YFS					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 68.63 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 13:23/14:38					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N₂O					Injection Point Fan B Center					
10	Order --> 1st					2nd					
11	Side					Bottom					
12	Trial ---->			1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.0	21.6	22.0	21.5	22.2	22.7	21.9	22.3	
15	2	4.17	21.5	21.1	21.9	21.5	22.6	22.3	22.2	22.4	
16	3	7.71	22.0	21.7	21.9	21.9	22.1	21.5	22.5	22.0	
17	4	12.84	22.1	21.7	21.8	21.9	22.0	21.2	22.5	21.9	
18	Center	19.88	21.9	21.6	22.4	22.0	22.0	20.8	22.4	21.7	
19	5	26.91	21.2	21.8	22.2	21.7	21.8	21.1	22.0	21.6	
20	6	32.04	21.6	21.3	22.1	21.7	22.1	21.5	22.0	21.9	
21	7	35.58	21.5	22.8	22.0	22.1	21.9	21.9	22.0	21.9	
22	8	38.48	21.9	22.1	22.0	22.0	22.0	21.9	21.7	21.9	
23	Averages ----->		21.6	21.7	22.0	21.8	22.1	21.7	22.1	22.0	
24											
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All		
26			Mean	21.9		Mean	21.8	21.9	21.9		
27			Min Point	21.5	-1.7%	Std. Dev.	0.20	0.24	0.22		
28			Max Point	22.4	2.2%	COV as %	0.9	1.1	1.0		
29	Avg. Conc.	21.883 ppm									
30	Avg. Flow	27758 acfm									
31			Start	Finish							
32	Tracer tank pressure		400	300	psig						
33	Injection flowmeter		15.0	15.0	slpm						
34	Stack Temp		20.7	20	°C						
35	Mean stack velocity		3281	3161	fpm						
36	Sampling flowmeter		5	5	lpm						
37	Ambient pressure		1007	1007	mbar						
38	Ambient humidity		21.3%	20.2%	RH						
39	Ambient Temp		14.4	15.7	°C						
40	B&K vapor correction		Y	Y	Y/N						
41	Back-Gd gas		.33,.39,.42	.42,.41,.40	ppm						
42			.40,.43	.41, .42							
43	No. Bk-Gd samples		5	5	n						
44											
45	Gas analyzer checked:	4/24/2013									
46											
47	Notes:										
48											
49											
50	YFS 4/30/13										
51											
52											
53											
54	Entries made by:	Yin-Fong Su				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 4/30/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											

Side	Bottom	ppm
1	1	22.2
1	2	22.7
1	3	21.9
2	1	22.6
2	2	22.3
2	3	22.2
3	1	22.1
3	2	21.5
3	3	22.5
4	1	22.0
4	2	21.2
4	3	22.5
5	1	22.0
5	2	20.8
5	3	22.4
6	1	21.8
6	2	21.1
6	3	22.0
7	1	21.9
7	2	21.9
7	3	22.0
8	1	22.0
8	2	21.9
8	3	21.7

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-12					
3	Date 5/1/13					Fan Configuration A&C (1&3)					
4	Testers YFS, XYY					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 76.73 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 11:20/13:05					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N2O					Injection Point Junction Center					
10	Order --> 2nd					1st					
11	Side					Bottom					
12	Trial ---->				1	2	3	Mean	1	2	3
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.3	21.9	21.6	21.6	21.3	21.8	22.0	21.7	
15	2	4.17	21.2	21.4	21.3	21.3	21.4	21.9	21.7	21.7	
16	3	7.71	21.4	21.6	22.2	21.7	21.4	22.2	22.2	21.9	
17	4	12.84	21.6	21.7	21.8	21.7	21.6	21.6	21.8	21.7	
18	Center	19.88	21.7	21.9	22.1	21.9	21.7	21.8	21.5	21.7	
19	5	26.91	22.1	21.9	22.0	22.0	21.5	21.7	21.8	21.7	
20	6	32.04	21.8	22.2	22.3	22.1	21.5	21.2	21.5	21.4	
21	7	35.58	22.1	22.1	22.0	22.1	21.6	21.3	21.2	21.4	
22	8	38.48	21.6	22.5	22.0	22.0	21.0	21.0	22.0	21.3	
23	Averages ----->		21.6	21.9	21.9	21.8	21.4	21.6	21.7	21.6	
24											
25	All		ppm	Dev. from mean	Center 2/3		Side	Bottom	All		
26	Mean		21.7		Mean		21.8	21.6	21.7		
27	Min Point		21.3	-1.9%	Std. Dev.		0.28	0.19	0.25		
28	Max Point		22.1	1.8%	COV as %		1.3	0.9	1.2		
29	Avg. Conc.	21.704 ppm									
30	Avg. Flow	28426 acfm									
31		Start	Finish								
32	Tracer tank pressure	780	700	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	24.9	24.8	°C							
35	Mean stack velocity	3446	3151	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1019	1019	mbar							
38	Ambient humidity	16.4%	21.6%	RH							
39	Ambient Temp	24.5	17.3	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.38, .41, .38	.41, .42, .41	ppm							
42		.38, .40	.42, .32								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/1/2013									
46											
47	Notes:	Start a new gas cylinder today. N2O background									
48		is ~ .39 ppm, target is 19.5 ppm.									
49											
50	XYY 5/1/13										
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 5/1/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											

Point <th>Side (ppm)</th> <th>Bottom (ppm)</th>	Side (ppm)	Bottom (ppm)
1	21.3	21.7
2	21.2	21.7
3	21.4	21.9
4	21.6	21.8
Center	21.7	21.5
5	22.1	21.8
6	21.8	21.5
7	22.1	21.2
8	21.6	22.0

	A	B	C	D	E	F	G	H	I	J		
1	TRACER GAS TRAVERSE DATA FORM											
2	Site EP-3410-01-S					Run No. GT-13						
3	Date 5/1/13					Fan Configuration A&C (1&3)						
4	Testers MSP, YFS					Fan Setting normal Hz						
5	Stack Dia. 39.7500 in.					Stack Temp 77.36 deg F						
6	Stack X-Area 1241.0 in.²					Start/End Time 13:05/14:30						
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10				
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7				
9	Measurement units ppm N₂O					Injection Point Junction Top						
10	Order --> 1st					2nd						
11	Side					Bottom						
12	Trial ---->				1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm					
14	1	1.27	22.0	22.1	22.0	22.0	22.4	22.7	22.3	22.5		
15	2	4.17	21.8	22.0	22.0	21.9	22.4	22.5	22.0	22.3		
16	3	7.71	21.9	21.7	22.0	21.9	22.3	22.4	22.5	22.4		
17	4	12.84	22.1	22.1	21.9	22.0	22.0	22.3	22.5	22.3		
18	Center	19.88	22.3	22.1	21.9	22.1	22.4	22.2	22.6	22.4		
19	5	26.91	22.2	22.2	22.2	22.2	22.2	21.8	22.2	22.1		
20	6	32.04	21.9	22.0	21.9	21.9	22.0	21.4	22.0	21.8		
21	7	35.58	22.4	22.2	22.2	22.3	21.9	21.8	21.9	21.9		
22	8	38.48	22.1	22.5	22.3	22.3	22.1	21.7	21.8	21.9		
23	Averages ----->		22.1	22.1	22.0	22.1	22.2	22.1	22.2	22.2		
24												
25	All		ppm	Dev. from mean	Center 2/3		Side	Bottom	All			
26	Mean		22.1		Mean		22.0	22.2	22.1			
27	Min Point		21.8	-1.4%	Std. Dev.		0.15	0.25	0.20			
28	Max Point		22.5	1.6%	COV as %		0.7	1.1	0.9			
29	Avg. Conc.	22.100 ppm										
30	Avg. Flow	29353 acfm										
31		Start	Finish									
32	Tracer tank pressure	700	700	psig								
33	Injection flowmeter	15.0	15.0	slpm								
34	Stack Temp	25.1	25.3	°C								
35	Mean stack velocity	3561	3251	fpm								
36	Sampling flowmeter	5	5	lpm								
37	Ambient pressure	1019	1019	mbar								
38	Ambient humidity	16.7%	18.0%	RH								
39	Ambient Temp	20.4	18.6	°C								
40	B&K vapor correction	Y	Y	Y/N								
41	Back-Gd gas	.41,.42,.41,	.41,.39,.39,	ppm								
42		.42,.32	.39,.39									
43	No. Bk-Gd samples	5	5	n								
44												
45	Gas analyzer checked:	5/1/2013										
46												
47	Notes:											
48												
49												
50	YFS 5/1/13											
51												
52												
53												
54	Entries made by:	Yin-Fong Su				Technical Data Review performed by:				Carmen Arimescu		
55	Signature/date	On file with original 5/1/13				Signature/date				On file with TI-STMON-030 9-Jul-13		
56												
57												

	A	B	C	D	E	F	G	H	I	J		
1	TRACER GAS TRAVERSE DATA FORM											
2	Site EP-3410-01-S					Run No. GT-14						
3	Date 5/1/13					Fan Configuration A&C (1&3)						
4	Testers MSP, YFS					Fan Setting normal Hz						
5	Stack Dia. 39.7500 in.					Stack Temp 76.91 deg F						
6	Stack X-Area 1241.0 in.²					Start/End Time 14:31/17:00						
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10				
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7				
9	Measurement units ppm N₂O					Injection Point Junction Bottom						
10	Order --> 2nd					1st						
11	Side					Bottom						
12	Trial ---->				1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm					
14	1	1.27	22.6	23.1	23.0	22.9	22.1	22.6	22.5	22.4		
15	2	4.17	23.0	22.9	23.2	23.0	22.2	22.6	22.7	22.5		
16	3	7.71	23.0	22.9	23.1	23.0	22.3	22.9	22.4	22.5		
17	4	12.84	22.8	22.6	22.9	22.8	22.1	22.7	22.3	22.4		
18	Center	19.88	22.9	22.8	22.6	22.8	22.5	22.8	22.7	22.7		
19	5	26.91	22.4	22.5	22.6	22.5	22.4	22.8	22.9	22.7		
20	6	32.04	22.5	22.8	22.8	22.7	22.6	22.6	22.8	22.7		
21	7	35.58	22.5	22.5	22.2	22.4	22.6	22.7	22.9	22.7		
22	8	38.48	22.2	22.8	22.1	22.4	22.8	22.9	22.9	22.9		
23	Averages ----->		22.7	22.8	22.7	22.7	22.4	22.7	22.7	22.6		
24												
25	All		ppm	Dev. from mean		Center 2/3	Side	Bottom	All			
26	Mean		22.7			Mean	22.7	22.6	22.7			
27	Min Point		22.4	-1.3%		Std. Dev.	0.23	0.13	0.20			
28	Max Point		23.0	1.7%		COV as %	1.0	0.6	0.9			
29	Avg. Conc.	22.652 ppm										
30	Avg. Flow	27655 acfm										
31		Start	Finish									
32	Tracer tank pressure	700	700	psig								
33	Injection flowmeter	15.0	15.0	slpm								
34	Stack Temp	25.3	24.6	°C								
35	Mean stack velocity	3251	3167	fpm								
36	Sampling flowmeter	5	5	lpm								
37	Ambient pressure	1019	1018	mbar								
38	Ambient humidity	18.0%	20.4%	RH								
39	Ambient Temp	18.6	17.9	°C								
40	B&K vapor correction	Y	Y	Y/N								
41	Back-Gd gas	.41, .39, .39	.40, .42, .39	ppm								
42		.39, .39	.43, .37									
43	No. Bk-Gd samples	5	5	n								
44												
45	Gas analyzer checked:	5/1/2013										
46												
47	Notes:											
48												
49												
50	YFS 5/1/13											
51												
52												
53												
54	Entries made by:	Yin-Fong Su				Technical Data Review performed by:				Carmen Arimescu		
55	Signature/date	On file with original 5/1/13				Signature/date				On file with TI-STMON-030 9-Jul-13		
56												
57												

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-15					
3	Date 5/2/13					Fan Configuration A&C (1&3)					
4	Testers YFS, XYY					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 75.11 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 9:30/11:25					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N₂O					Injection Point Junction Near					
10	Order --> 1st					2nd					
11	Side					Bottom					
12	Trial ---->			1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.2	23.0	23.0	22.7	22.4	22.6	21.7	22.2	
15	2	4.17	22.7	23.2	22.8	22.9	22.7	22.3	21.4	22.1	
16	3	7.71	23.0	22.8	22.3	22.7	22.4	22.2	21.7	22.1	
17	4	12.84	22.8	22.7	22.6	22.7	22.4	22.1	21.8	22.1	
18	Center	19.88	23.3	22.8	22.7	22.9	22.7	22.2	21.6	22.2	
19	5	26.91	22.8	22.6	22.4	22.6	22.4	21.6	22.8	22.3	
20	6	32.04	23.6	22.9	22.8	23.1	22.6	22.5	22.1	22.4	
21	7	35.58	23.3	22.0	22.6	22.6	22.7	21.9	22.2	22.3	
22	8	38.48	23.1	23.3	22.6	23.0	22.8	22.2	22.2	22.4	
23	Averages ----->		23.0	22.8	22.6	22.8	22.6	22.2	21.9	22.2	
24											
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All	
26	Mean		22.5			Mean		22.8	22.2	22.5	
27	Min Point		22.1	-1.9%		Std. Dev.		0.19	0.11	0.34	
28	Max Point		23.1	2.6%		COV as %		0.8	0.5	1.5	
29	Avg. Conc.	22.517 ppm									
30	Avg. Flow	28155 acfm									
31		Start	Finish								
32	Tracer tank pressure	620	600	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	23	24.9	°C							
35	Mean stack velocity	3316	3218	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1018	1017	mbar							
38	Ambient humidity	24.2%	28.0%	RH							
39	Ambient Temp	18.5	22.8	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.43,.44,.43	.34,.41,.41	ppm							
42		.44,.42	.34,.35								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/1/2013									
46											
47	Notes:										
48											
49											
50	XYY 5/2/13										
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 5/2/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											

	A	B	C	D	E	F	G	H	I	J		
1	TRACER GAS TRAVERSE DATA FORM											
2	Site EP-3410-01-S					Run No. GT-16						
3	Date 5/2/13					Fan Configuration A&C (1&3)						
4	Testers YFS, XYY					Fan Setting normal Hz						
5	Stack Dia. 39.7500 in.					Stack Temp 78.17 deg F						
6	Stack X-Area 1241.0 in.²					Start/End Time 11:30/12:50						
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10				
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7				
9	Measurement units ppm N₂O					Injection Point Junction Far						
10	Order --> 2nd					1st						
11	Side					Bottom						
12	Trial ---->				1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm					
14	1	1.27	21.6	21.5	21.3	21.5	21.4	21.5	21.4	21.4	21.4	
15	2	4.17	21.1	21.4	21.4	21.3	21.9	21.8	21.7	21.8	21.8	
16	3	7.71	21.9	21.3	21.4	21.5	21.3	21.4	21.4	21.4	21.4	
17	4	12.84	21.2	21.8	21.4	21.5	21.7	21.6	21.9	21.7	21.7	
18	Center	19.88	21.7	21.2	21.5	21.5	21.2	21.5	21.4	21.4	21.4	
19	5	26.91	21.0	21.2	21.5	21.2	21.8	21.4	21.6	21.6	21.6	
20	6	32.04	21.5	21.3	21.4	21.4	21.8	21.6	21.3	21.6	21.6	
21	7	35.58	21.5	21.3	21.3	21.4	21.4	21.7	21.5	21.5	21.5	
22	8	38.48	21.8	21.8	21.3	21.6	21.7	21.9	21.5	21.7	21.7	
23	Averages ----->		21.5	21.4	21.4	21.4	21.6	21.6	21.5	21.6	21.6	
24												
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All		
26	Mean		21.5			Mean		21.4	21.6	21.5		
27	Min Point		21.2	-1.2%		Std. Dev.		0.10	0.17	0.16		
28	Max Point		21.8	1.4%		COV as %		0.5	0.8	0.7		
29	Avg. Conc.	21.508 ppm										
30	Avg. Flow	26504 acfm										
31		Start	Finish									
32	Tracer tank pressure	560	550	psig								
33	Injection flowmeter	15.0	15.0	slpm								
34	Stack Temp	25.7	25.6	°C								
35	Mean stack velocity	3149	3002	fpm								
36	Sampling flowmeter	5	5	lpm								
37	Ambient pressure	1016	1015	mbar								
38	Ambient humidity	18.5%	20.3%	RH								
39	Ambient Temp	29.0	21.9	°C								
40	B&K vapor correction	Y	Y	Y/N								
41	Back-Gd gas	.34,.41,.41,	.37,.36,.36,	ppm								
42		.34,.35	.35,.32									
43	No. Bk-Gd samples	5	5	n								
44												
45	Gas analyzer checked:	5/1/2013										
46												
47	Notes:											
48												
49												
50	XYY 5/2/13											
51												
52												
53												
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu		
55	Signature/date	On file with original				5/2/13				On file with TI-STMON-030		
56												
57												

Point	Side (ppm)	Bottom (ppm)
1	21.5	21.4
2	21.4	21.6
3	21.4	21.4
4	21.4	21.6
5	21.4	21.6
6	21.4	21.6
7	21.4	21.5
8	21.4	21.7

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-17					
3	Date 5/2/13					Fan Configuration A&C (1&3)					
4	Testers BGF, YFS					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 78.17 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 1305/1430					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N₂O					Injection Point Center (C) Fan C					
10	Order --> 1st					2nd					
11	Side					Bottom					
12	Trial ---->				1	2	3	Mean	1	2	3
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.0	21.6	22.0	21.5	22.1	21.6	21.9	21.9	
15	2	4.17	21.0	21.8	22.0	21.6	22.1	21.6	21.2	21.6	
16	3	7.71	21.0	21.6	21.6	21.4	22.1	21.6	21.0	21.6	
17	4	12.84	21.0	21.7	21.9	21.5	22.1	21.8	21.0	21.6	
18	Center	19.88	21.0	21.7	22.0	21.6	22.2	21.7	21.8	21.9	
19	5	26.91	21.2	21.7	22.0	21.6	22.2	21.8	22.1	22.0	
20	6	32.04	21.2	21.7	22.0	21.6	22.0	21.9	21.7	21.9	
21	7	35.58	21.9	22.0	22.0	22.0	21.4	21.9	21.7	21.7	
22	8	38.48	21.6	22.0	22.0	21.9	21.8	21.9	21.7	21.8	
23	Averages ----->		21.2	21.8	21.9	21.6	22.0	21.8	21.6	21.8	
24											
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All	
26	Mean		21.7			Mean		21.6	21.8	21.7	
27	Min Point		21.4	-1.4%		Std. Dev.		0.17	0.18	0.18	
28	Max Point		22.0	1.5%		COV as %		0.8	0.8	0.8	
29	Avg. Conc.	21.702 ppm									
30	Avg. Flow	26220 acfm									
31		Start	Finish								
32	Tracer tank pressure	550	550	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	25.6	25.7	°C							
35	Mean stack velocity	3002	3083	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1015	1013	mbar							
38	Ambient humidity	20.3%	18.5%	RH							
39	Ambient Temp	21.9	21.7	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.37,.36,.32	.48,.48,.40	ppm							
42		.36,.35	.35,.41								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/1/2013									
46											
47	Notes:										
48											
49											
50	BGF 5/2/13										
51											
52											
53											
54	Entries made by:	Brad Fritz				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original				5/2/13				On file with TI-STMON-030	
56											
57											

BGF 5/2/13

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-18					
3	Date 5/3/13					Fan Configuration A&C (1&3)					
4	Testers YFS, XYY					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 77 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 9:30/11:50					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N2O					Injection Point Fan C Top					
10	Order --> 1st					2nd					
11	Side					Bottom					
12	Trial ---->				1	2	3	Mean	1	2	3
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	23.4	23.2	22.8	23.1	23.0	23.1	23.3	23.1	
15	2	4.17	23.4	23.0	22.7	23.0	22.9	22.9	23.0	22.9	
16	3	7.71	23.7	22.9	22.9	23.2	23.2	22.7	22.8	22.9	
17	4	12.84	23.3	23.3	23.4	23.3	23.0	23.1	22.9	23.0	
18	Center	19.88	23.2	23.1	22.8	23.0	22.9	22.7	22.6	22.7	
19	5	26.91	23.1	23.1	22.9	23.0	23.0	22.8	22.5	22.8	
20	6	32.04	23.0	23.3	23.3	23.2	23.1	22.7	22.7	22.8	
21	7	35.58	23.4	23.1	22.7	23.1	22.8	22.8	22.6	22.7	
22	8	38.48	23.0	23.0	23.1	23.0	23.0	22.6	23.3	23.0	
23	Averages ----->		23.3	23.1	23.0	23.1	23.0	22.8	22.9	22.9	
24											
25	All		ppm	Dev. from mean		Center 2/3	Side	Bottom		All	
26	Mean		23.0			Mean	23.1	22.8		23.0	
27	Min Point		22.7	-1.2%		Std. Dev.	0.12	0.10		0.18	
28	Max Point		23.3	1.4%		COV as %	0.5	0.5		0.8	
29	Avg. Conc.	23.017 ppm									
30	Avg. Flow	28547 acfm									
31		Start	Finish								
32	Tracer tank pressure	700	700	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	24.8	25.2	°C							
35	Mean stack velocity	3471	3154	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1009	1009	mbar							
38	Ambient humidity	30.7%	27.2%	RH							
39	Ambient Temp	22.6	22.2	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.39,.39,.39	.38,.37,.36	ppm							
42		.40,.37	.35,.35								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/1/2013									
46											
47	Notes:	N2O is .39ppm target is .19ppm									
48											
49											
50	XYY 5/3/13										
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original				5/2/13				On file with TI-STMON-030	
56											
57											

	A	B	C	D	E	F	G	H	I	J		
1	TRACER GAS TRAVERSE DATA FORM											
2	Site EP-3410-01-S					Run No. GT-19						
3	Date 5/3/13					Fan Configuration A&C (1&3)						
4	Testers YFS, XYY					Fan Setting normal Hz						
5	Stack Dia. 39.7500 in.					Stack Temp 78.26 deg F						
6	Stack X-Area 1241.0 in.²					Start/End Time 11:50/13:10						
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10				
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7				
9	Measurement units ppm N₂O					Injection Point Fan C Bottom						
10	Order --> 2nd					1st						
11	Side					Bottom						
12	Trial ---->				1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm					
14	1	1.27	22.6	22.5	23.2	22.8	22.5	23.3	22.7		22.8	
15	2	4.17	22.8	22.5	22.8	22.7	22.5	22.8	22.4		22.6	
16	3	7.71	22.3	22.9	22.6	22.6	22.9	22.5	22.7		22.7	
17	4	12.84	22.5	22.7	22.6	22.6	22.8	22.8	22.6		22.7	
18	Center	19.88	22.5	22.8	22.8	22.7	22.6	22.6	22.4		22.5	
19	5	26.91	22.8	22.8	22.9	22.8	22.3	22.6	22.6		22.5	
20	6	32.04	22.9	22.8	22.8	22.8	22.7	22.2	22.4		22.4	
21	7	35.58	22.7	22.6	22.6	22.6	22.6	22.3	22.1		22.3	
22	8	38.48	22.9	22.5	22.5	22.6	22.4	22.1	22.1		22.2	
23	Averages ----->		22.7	22.7	22.8	22.7	22.6	22.6	22.4		22.5	
24												
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All		
26	Mean		22.6			Mean		22.7	22.5	22.6		
27	Min Point		22.2	-1.9%		Std. Dev.		0.10	0.14	0.14		
28	Max Point		22.8	0.9%		COV as %		0.4	0.6	0.6		
29	Avg. Conc.	22.619 ppm										
30	Avg. Flow	26703 acfm										
31		Start	Finish									
32	Tracer tank pressure	700	680	psig								
33	Injection flowmeter	15.0	15.0	slpm								
34	Stack Temp	25.6	25.8	°C								
35	Mean stack velocity	3121	3076	fpm								
36	Sampling flowmeter	5	5	lpm								
37	Ambient pressure	1009	1008	mbar								
38	Ambient humidity	26.2%	20.7%	RH								
39	Ambient Temp	22.5	25.5	°C								
40	B&K vapor correction	Y	Y	Y/N								
41	Back-Gd gas	.38,.36,.37,	.30,.38,.36,	ppm								
42		.35,.35	.37,.36									
43	No. Bk-Gd samples	5	5	n								
44												
45	Gas analyzer checked:	5/1/2013										
46												
47	Notes:											
48												
49												
50	XYY 5/3/13											
51												
52												
53												
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu		
55	Signature/date	On file with original				5/2/13				On file with TI-STMON-030		
56												
57												

Point	Side (ppm)	Bottom (ppm)
1	22.8	22.5
2	22.6	22.8
3	22.7	22.5
4	22.6	22.8
5	22.7	22.6
6	22.8	22.2
7	22.6	22.3
8	22.6	22.1

	A	B	C	D	E	F	G	H	I	J						
1	TRACER GAS TRAVERSE DATA FORM															
2	Site EP-3410-01-S				Run No. GT-20											
3	Date 5/3/13				Fan Configuration A&C											
4	Testers JAG, YFS				Fan Setting N/A Hz											
5	Stack Dia. 39.7500 in.				Stack Temp 79.61 deg F											
6	Stack X-Area 1241.0 in.²				Start/End Time 13:15/1500											
7	Test Port NEAREST TO PROBE				Center 2/3 from 3.65		to: 36.10									
8	Distance to disturbance 53.5 inches				Points in Center 2/3 2		to: 7									
9	Measurement units ppm N₂O				Injection Point Fan C Far											
10	Order --> 1st				2nd											
11	Side				Bottom											
12	Trial ---->				1		3		Mean		1		3		Mean	
13	Point	Depth, in.	ppm				ppm									
14	1	1.27	22.5	22.6	22.8	22.6	23.2	23.3	23.2	23.2	23.2	23.2	23.2	23.2	23.2	
15	2	4.17	22.8	22.9	22.9	22.9	23.3	22.8	23.2	23.2	23.2	23.2	23.2	23.2	23.1	
16	3	7.71	22.6	23.0	22.9	22.8	22.9	23.2	23.0	23.0	23.0	23.0	23.0	23.0	23.0	
17	4	12.84	22.7	23.1	23.0	22.9	23.2	22.7	22.9	22.9	22.9	22.9	22.9	22.9	22.9	
18	Center	19.88	22.9	23.3	22.9	23.0	23.1	23.0	22.9	22.9	22.9	22.9	22.9	22.9	23.0	
19	5	26.91	22.8	23.1	22.8	22.9	23.2	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.9	
20	6	32.04	22.6	23.1	23.0	22.9	23.0	22.9	22.6	22.6	22.6	22.6	22.6	22.6	22.8	
21	7	35.58	22.8	22.7	22.9	22.8	22.7	22.5	22.7	22.7	22.7	22.7	22.7	22.7	22.6	
22	8	38.48	22.7	23.0	23.0	22.9	22.4	22.6	22.3	22.3	22.3	22.3	22.3	22.3	22.4	
23	Averages ----->		22.7	23.0	22.9	22.9	23.0	22.9	22.8	22.9	22.9	22.9	22.9	22.9	22.9	
24																
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All							
26	Mean		22.9			Mean	22.9	22.9	22.9	22.9	22.9					
27	Min Point		22.4		-2.0%	Std. Dev.	0.08	0.15	0.12	0.12	0.12					
28	Max Point		23.2		1.5%	COV as %	0.3	0.7	0.5	0.5	0.5					
29	Avg. Conc.	22.869 ppm														
30	Avg. Flow	27146 acfm														
31			Start	Finish												
32	Tracer tank pressure	700	500	psig												
33	Injection flowmeter	15.0	15.0	slpm												
34	Stack Temp	26	26.9	°C												
35	Mean stack velocity	3313	2987	fpm												
36	Sampling flowmeter	5	5	lpm												
37	Ambient pressure	1007	1007	mbar												
38	Ambient humidity	22.5%	20.9%	RH												
39	Ambient Temp	25	25	°C												
40	B&K vapor correction	Y	Y	Y/N												
41	Back-Gd gas	.30,.38,.36	.43,.40,.36	ppm												
42		.37,.36	.37,.37													
43	No. Bk-Gd samples	5	5	n												
44																
45	Gas analyzer checked:	5/1/2013														
46																
47	Notes:															
48																
49																
50	BGF 5/21/13															
51																
52																
53																
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:				Carmen Arimescu						
55	Signature/date	On file with original 5/2/13				Signature/date				On file with TI-STMON-030 9-Jul-13						
56																
57																

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-21					
3	Date 5/6/13					Fan Configuration A & C (1 & 3)					
4	Testers BGF & YFS					Fan Setting Normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 80.87 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 9:35 Am / 10:50 AM					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N2O					Injection Point Fan C Near					
10	Order --> 1st					2nd					
11	Traverse-->										
12	Side					Bottom					
13	Point	Depth, in.	ppm N2O				ppm				
14	1	0.50	23.6	23.2	23.1	23.3	23.1	22.8	22.2	22.7	
15	2	1.24	23.7	23.4	23.1	23.4	23.3	22.6	22.4	22.8	
16	3	2.29	23.6	23.1	23.2	23.3	23.1	22.7	22.2	22.7	
17	4	3.82	23.6	23.3	23.1	23.3	23	22.7	22.6	22.8	
18	Center	5.91	23.5	23.4	23.2	23.4	23.1	22.4	22.3	22.6	
19	5	8.00	24	23.7	22.9	23.5	22.6	22.4	22.3	22.4	
20	6	9.52	23.7	23.5	23.2	23.5	22.4	22.4	22.2	22.3	
21	7	10.57	23.8	23.2	23.1	23.4	22.7	22.3	22.3	22.4	
22	8	11.31	24	23	22.7	23.2	22.4	22.6	21.9	22.3	
23	Averages ----->		23.7	23.3	23.1	23.4	22.9	22.5	22.3	22.6	
24											
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom
26	Mean		23.0				Mean		23.4		22.6
27	Min Point		22.3		-2.9%		Std. Dev.		0.08		0.17
28	Max Point		23.5		2.5%		COV as %		0.3		0.8
29	Avg. Conc.		22.958 ppm								
30	Avg. Flow		26276 acfm								
31			Start Finish								
32	Tracer tank pressure		480 120		psig						
33	Injection flowmeter		15 15		slpm						
34	Stack Temp		26.9 27.4		°C						
35	Mean stack velocity		3092 3006		fpm						
36	Sampling flowmeter		5 5		lpm						
37	Ambient pressure		994.5 994.1		mbar						
38	Ambient humidity		21.4% 16.7%		RH						
39	Ambient Temp		21.2 26.4		°C						
40	B&K vapor correction		Y Y		Y/N						
41	Back-Gd gas		.42,.44,.44 .32,.40,.33		ppm						
42			.45,.43 .35,.35								
43	No. Bk-Gd samples		5 5		n						
44											
45	Gas analyzer checked:		5/1/2013								
46											
47	Notes: Gas cylinder pressure dropped to 230 psi ~10:15.										
48											
49											
50	YFS 5/6/13										
51											
52											
53											
54	Entries made by:		Yin-Fong Su			Technical Data Review performed by:		Carmen Arimescu			
55	Signature/date		On file with original			Signature/date		On file with TI-STMON-030			
56								9-Jul-13			
57											

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-22					
3	Date 5/6/13					Fan Configuration A&C (1&3)					
4	Testers BGF, YFS					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 82.49 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 11:10 AM/12:28 PM					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65 to: 36.10					
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2 to: 7					
9	Measurement units ppm N₂O					Injection Point Fan A Center					
10	Order --> 2nd					1st					
11	Traverse-->					Bottom					
12	Trial ---->					1 2 3 Mean					
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.2	22.5	22.2	22.3	22.6	22.4	22.0	22.3	
15	2	4.17	22.6	21.9	22.1	22.2	22.3	21.0	21.5	21.6	
16	3	7.71	22.2	22.2	21.9	22.1	22.3	22.4	22.1	22.3	
17	4	12.84	22.4	22.1	22.4	22.3	21.9	22.3	22.4	22.2	
18	Center	19.88	22.3	22.0	21.6	22.0	22.3	22.2	22.2	22.2	
19	5	26.91	22.0	22.2	22.4	22.2	22.5	22.7	21.9	22.4	
20	6	32.04	22.2	22.1	22.9	22.4	22.3	22.6	22.7	22.5	
21	7	35.58	22.0	22.3	22.2	22.2	23.0	22.7	22.2	22.6	
22	8	38.48	22.4	22.8	22.3	22.5	22.6	22.0	22.7	22.4	
23	Averages ----->		22.3	22.2	22.2	22.2	22.4	22.3	22.2	22.3	
24											
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom
26	Mean		22.3				Mean		22.2		22.3
27	Min Point		21.6		-3.0%		Std. Dev.		0.14		0.33
28	Max Point		22.6		1.7%		COV as %		0.6		1.5
29	Avg. Conc.		22.283 ppm								
30	Avg. Flow		26836 acfm								
31			Start Finish								
32	Tracer tank pressure		730 750		psig						
33	Injection flowmeter		15.0 15.0		slpm						
34	Stack Temp		27.4 28.7		°C						
35	Mean stack velocity		3006 3222		fpm						
36	Sampling flowmeter		5 5		lpm						
37	Ambient pressure		994.1 993.5		mbar						
38	Ambient humidity		17.0% 16.3%		RH						
39	Ambient Temp		26.4 28.6		°C						
40	B&K vapor correction		Y Y		Y/N						
41	Bk-Gd gas		.35,.40,.33, .32,.35		.36,.36,.27, .35,.33		ppm				
42											
43	No. Bk-Gd samples		5 5		n						
44											
45	Gas analyzer checked:		5/1/2013								
46											
47	Notes: New tank of gas installed.										
48											
49											
50											
51											
52											
53											
54	Entries made by:		Yin-Fong Su		Technical Data Review performed by:		Carmen Arimescu				
55	Signature/date		On file with original		5/7/13		Signature/date		On file with TI-STMON-030		
56											
57											

Instuments Used:

B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE

TSI VelociCalc SN T95351203001 12/10/2013

Dew point pen/thermometer SN 122277875 5/16/2014

yfs 5/6/2013

	A	B	C	D	E	F	G	H	I	J								
1	TRACER GAS TRAVERSE DATA FORM																	
2	Site EP-3410-01-S					Run No. GT-23												
3	Date 5/6/13					Fan Configuration B&C (2&3)												
4	Testers YFS MSp					Fan Setting normal Hz												
5	Stack Dia. 39.7500 in.					Stack Temp 86.09 deg F												
6	Stack X-Area 1241.0 in.²					Start/End Time 12:45/14:10												
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10										
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7										
9	Measurement units ppm N2O					Injection Point B Center												
10	Order --> 1st					2nd												
11	Traverse-->					Bottom												
12	Trial ---->					1		2		3								
13	Point	Depth, in.	Side				Bottom											
			1	2	3	Mean	1	2	3	Mean								
			ppm				ppm											
14	1	1.27	22.7	22.4	22.3	22.5	22.6	21.8	22.2	22.2								
15	2	4.17	22.5	22.5	22.5	22.5	22.0	21.8	21.5	21.8								
16	3	7.71	22.5	22.6	22.4	22.5	22.4	22.4	22.6	22.5								
17	4	12.84	22.3	22.3	22.3	22.3	21.9	22.3	22.4	22.2								
18	Center	19.88	22.5	22.4	22.3	22.4	22.5	22.5	21.9	22.3								
19	5	26.91	22.5	22.4	22.5	22.5	22.5	22.2	21.9	22.2								
20	6	32.04	22.4	22.6	22.7	22.6	22.2	22.3	22.2	22.2								
21	7	35.58	22.1	22.2	22.6	22.3	22.0	21.5	22.8	22.1								
22	8	38.48	22.2	22.8	23.0	22.7	22.8	23.0	22.0	22.6								
23	Averages ----->		22.4	22.5	22.5	22.5	22.3	22.2	22.2	22.2								
24																		
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom							
26	Mean		22.3				Mean		22.4		22.2							
27	Min Point		21.8		-2.6%		Std. Dev.		0.10		0.22							
28	Max Point		22.7		1.4%		COV as %		0.5		1.0							
29	Avg. Conc.		22.346 ppm															
30	Avg. Flow		25578 acfm															
31			Start		Finish													
32	Tracer tank pressure		850		850		psig											
33	Injection flowmeter		15.0		15.0		slpm											
34	Stack Temp		30		30.1		°C											
35	Mean stack velocity		2967		2969		fpm											
36	Sampling flowmeter		5		5		lpm											
37	Ambient pressure		993		992		mbar											
38	Ambient humidity		12.2%		13.7%		RH											
39	Ambient Temp		28.0		29.7		°C											
40	B&K vapor correction		Y		Y		Y/N											
41	Bk-Gd gas		.36,.36,.27, .35,.33		.40,.38,.35, .35,.32		ppm											
42																		
43	No. Bk-Gd samples		5		5		n											
44																		
45	Gas analyzer checked:				5/1/2013													
46																		
47	Notes:																	
48																		
49																		
50					BGF 5/21/13													
51																		
52																		
53																		
54	Entries made by:		Mikhail Pekour				Technical Data Review performed by:		Carmen Arimescu									
55	Signature/date		On file with original		5/2/13		Signature/date		On file with TI-STMON-030									
56									9-Jul-13									
57																		

	A	B	C	D	E	F	G	H	I	J		
1	TRACER GAS TRAVERSE DATA FORM											
2	Site EP-3410-01-S					Run No. GT-22						
3	Date 5/6/13					Fan Configuration A&C (1&3)						
4	Testers BGF, YFS					Fan Setting normal Hz						
5	Stack Dia. 39.7500 in.					Stack Temp 82.49 deg F						
6	Stack X-Area 1241.0 in.²					Start/End Time 11:10 AM/12:28 PM						
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65 to: 36.10						
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2 to: 7						
9	Measurement units ppm N2O					Injection Point Fan A Center						
10	Order --> 2nd					1st						
11	Traverse-->					Bottom						
12	Trial ---->					1 2 3 Mean 1 2 3 Mean						
13	Point	Depth, in.	ppm				ppm					
14	1	1.27	22.2	22.5	22.2	22.3	22.6	22.4	22.0	22.3		
15	2	4.17	22.6	21.9	22.1	22.2	22.3	21.0	21.5	21.6		
16	3	7.71	22.2	22.2	21.9	22.1	22.3	22.4	22.1	22.3		
17	4	12.84	22.4	22.1	22.4	22.3	21.9	22.3	22.4	22.2		
18	Center	19.88	22.3	22.0	21.6	22.0	22.3	22.2	22.2	22.2		
19	5	26.91	22.0	22.2	22.4	22.2	22.5	22.7	21.9	22.4		
20	6	32.04	22.2	22.1	22.9	22.4	22.3	22.6	22.7	22.5		
21	7	35.58	22.0	22.3	22.2	22.2	23.0	22.7	22.2	22.6		
22	8	38.48	22.4	22.8	22.3	22.5	22.6	22.0	22.7	22.4		
23	Averages ----->		22.3	22.2	22.2	22.2	22.4	22.3	22.2	22.3		
24												
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom	All
26	Mean		22.3				Mean		22.2		22.3	22.2
27	Min Point		21.6		-3.0%		Std. Dev.		0.14		0.33	0.25
28	Max Point		22.6		1.7%		COV as %		0.6		1.5	1.1
29	Avg. Conc.		22.283 ppm									
30	Avg. Flow		26836 acfm									
31			Start		Finish							
32	Tracer tank pressure		730		750		psig					
33	Injection flowmeter		15.0		15.0		slpm					
34	Stack Temp		27.4		28.7		°C					
35	Mean stack velocity		3006		3222		fpm					
36	Sampling flowmeter		5		5		lpm					
37	Ambient pressure		994.1		993.5		mbar					
38	Ambient humidity		17.0%		16.3%		RH					
39	Ambient Temp		26.4		28.6		°C					
40	B&K vapor correction		Y		Y		Y/N					
41	Bk-Gd gas		.35,.40,.33,		.36,.36,.27,		ppm					
42			.32,.35		.35,.33							
43	No. Bk-Gd samples		5		5		n					
44												
45	Gas analyzer checked:		5/1/2013									
46												
47	Notes: New tank of gas installed.											
48												
49												
50												
51												
52												
53												
54	Entries made by:		Yin-Fong Su			Technical Data Review performed by:		Carmen Arimescu				
55	Signature/date		On file with original			Signature/date		On file with TI-STMON-030				
56												
57												

Instuments Used:

B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE

TSI VelociCalc SN T95351203001 12/10/2013

Dew point pen/thermometer SN 122277875 5/16/2014

yfs 5/6/2013

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-23					
3	Date 5/6/13					Fan Configuration B&C (2&3)					
4	Testers YFS MSp					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 86.09 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 12:45/14:10					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N2O					Injection Point B Center					
10	Order --> 1st					2nd					
11	Traverse-->					Bottom					
12	Trial ---->					1 2 3 Mean					
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.7	22.4	22.3	22.5	22.6	21.8	22.2	22.2	
15	2	4.17	22.5	22.5	22.5	22.5	22.0	21.8	21.5	21.8	
16	3	7.71	22.5	22.6	22.4	22.5	22.4	22.4	22.6	22.5	
17	4	12.84	22.3	22.3	22.3	22.3	21.9	22.3	22.4	22.2	
18	Center	19.88	22.5	22.4	22.3	22.4	22.5	22.5	21.9	22.3	
19	5	26.91	22.5	22.4	22.5	22.5	22.5	22.2	21.9	22.2	
20	6	32.04	22.4	22.6	22.7	22.6	22.2	22.3	22.2	22.2	
21	7	35.58	22.1	22.2	22.6	22.3	22.0	21.5	22.8	22.1	
22	8	38.48	22.2	22.8	23.0	22.7	22.8	23.0	22.0	22.6	
23	Averages ----->		22.4	22.5	22.5	22.5	22.3	22.2	22.2	22.2	
24											
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All	
26	Mean		22.3			Mean		22.4	22.2	22.3	
27	Min Point		21.8	-2.6%		Std. Dev.		0.10	0.22	0.21	
28	Max Point		22.7	1.4%		COV as %		0.5	1.0	0.9	
29	Avg. Conc.	22.346 ppm									
30	Avg. Flow	25578 acfm									
31		Start	Finish								
32	Tracer tank pressure	850	850	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	30	30.1	°C							
35	Mean stack velocity	2967	2969	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	993	992	mbar							
38	Ambient humidity	12.2%	13.7%	RH							
39	Ambient Temp	28.0	29.7	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.36,.36,.27, .35,.33		.40,.38,.35, .35,.32		ppm					
42											
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/1/2013									
46											
47	Notes:										
48											
49											
50		BGF 5/21/13									
51											
52											
53											
54	Entries made by:	Mikhail Pekour				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original				5/2/13				On file with TI-STMON-030	
56											
57		9-Jul-13									

Instuments Used:

B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE

TSI VelociCalc SN T95351203001 12/10/2013

Dew point pen/thermometer SN 122277875 5/16/2014

yfs 5/6/13

	A	B	C	D	E	F	G	H	I	J								
1	TRACER GAS TRAVERSE DATA FORM																	
2	Site EP-3410-01-S					Run No. GT-24												
3	Date 5/6/13					Fan Configuration B&C (2&3)												
4	Testers MSP, YFS					Fan Setting normal Hz												
5	Stack Dia. 39.7500 in.					Stack Temp 86.54 deg F												
6	Stack X-Area 1241.0 in.²					Start/End Time 14:15/15:35												
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10										
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7										
9	Measurement units ppm N2O					Injection Point B Bottom												
10	Order --> 2nd					1st												
11	Traverse-->					Side					Bottom							
12	Trial ---->					1		2		3		Mean						
13	Point	Depth, in.	ppm				ppm											
14	1	1.27	22.2	22.2	22.4	22.3	22.4	22.8	22.4	22.5								
15	2	4.17	22.1	22.7	22.3	22.4	23.0	21.2	23.1	22.4								
16	3	7.71	22.1	22.4	22.3	22.3	22.7	22.3	22.5	22.5								
17	4	12.84	22.4	22.2	22.0	22.2	22.7	22.3	22.7	22.6								
18	Center	19.88	22.2	22.8	22.2	22.4	23.1	22.5	22.6	22.7								
19	5	26.91	21.9	22.3	22.5	22.2	22.7	22.9	22.4	22.7								
20	6	32.04	22.4	22.7	22.8	22.6	22.5	23.2	23.0	22.9								
21	7	35.58	22.7	22.2	21.9	22.3	22.6	22.1	22.1	22.3								
22	8	38.48	22.8	22.6	22.7	22.7	22.7	23.2	22.8	22.9								
23	Averages ----->		22.3	22.5	22.3	22.4	22.7	22.5	22.6	22.6								
24																		
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All					
26	Mean		22.5				Mean		22.3		22.6		22.5					
27	Min Point		22.2		-1.3%		Std. Dev.		0.15		0.21		0.21					
28	Max Point		22.9		1.8%		COV as %		0.7		0.9		1.0					
29	Avg. Conc.		22.481 ppm															
30	Avg. Flow		25720 acfm															
31			Start		Finish													
32	Tracer tank pressure		850		850		psig											
33	Injection flowmeter		15.0		15.0		slpm											
34	Stack Temp		30.1		30.5		°C											
35	Mean stack velocity		2969		3000		fpm											
36	Sampling flowmeter		5		5		lpm											
37	Ambient pressure		992		991		mbar											
38	Ambient humidity		13.7%		14.9%		RH											
39	Ambient Temp		29.7		29.8		°C											
40	B&K vapor correction		Y		Y		Y/N											
41	Bk-Gd gas		.40,.38,.35,		.40,.38,.36,		ppm											
42			.35,.32		.35,.34													
43	No. Bk-Gd samples		5		5		n											
44																		
45	Gas analyzer checked:		5/1/2013															
46																		
47	Notes:																	
48																		
49																		
50	yfs 5/6/13																	
51																		
52																		
53																		
54	Entries made by:		Yin-Fong Su			5/2/13		Technical Data Review performed by:		Carmen Arimescu								
55	Signature/date		On file with original			5/2/13		Signature/date		On file with TI-STMON-030								
56																		
57																		

Instuments Used:

B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE

TSI VelociCalc SN T95351203001 12/10/2013

Dew point pen/thermometer SN 122277875 5/16/2014

yfs 5/6/2013

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-25					
3	Date 5/6/13					Fan Configuration B&C (2&3)					
4	Testers MSP, YFS					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 86.9 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 15:42/17:00					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N2O					Injection Point Fan B Top					
10	Order --> 1st					2nd					
11	Traverse-->					Bottom					
12	Trial ---->			1		2		3		Mean	
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.3	21.7	22.7	22.2	22.5	21.9	22.6	22.3	
15	2	4.17	21.8	21.8	22.1	21.9	21.8	22.7	22.6	22.4	
16	3	7.71	22.5	22.0	22.1	22.2	22.3	22.8	22.4	22.5	
17	4	12.84	21.9	22.3	22.7	22.3	22.2	21.8	22.6	22.2	
18	Center	19.88	22.4	22.2	22.2	22.3	21.6	22.0	22.7	22.1	
19	5	26.91	22.5	23.1	23.0	22.9	22.2	21.7	22.1	22.0	
20	6	32.04	22.5	22.0	22.2	22.2	22.2	22.6	21.9	22.2	
21	7	35.58	22.3	22.3	22.3	22.3	21.9	22.2	21.6	21.9	
22	8	38.48	23.2	22.9	22.3	22.8	22.4	22.4	22.2	22.3	
23	Averages ----->		22.4	22.3	22.4	22.3	22.1	22.2	22.3	22.2	
24											
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom
26	Mean		22.3				Mean		22.3		22.2
27	Min Point		21.9		-1.7%		Std. Dev.		0.29		0.21
28	Max Point		22.9		2.6%		COV as %		1.3		0.9
29	Avg. Conc.		22.294 ppm								
30	Avg. Flow		26414 acfm								
31			Start		Finish						
32	Tracer tank pressure		850		850		psig				
33	Injection flowmeter		15.0		15.0		slpm				
34	Stack Temp		30.5		30.5		°C				
35	Mean stack velocity		3000		3130		fpm				
36	Sampling flowmeter		5		5		lpm				
37	Ambient pressure		991		990		mbar				
38	Ambient humidity		14.9%		12.4%		RH				
39	Ambient Temp		29.7		30.5		°C				
40	B&K vapor correction		Y		Y		Y/N				
41	Bk-Gd gas		.40, .38, .36, .35, .34		.38, .37, .39, .36, .40		ppm				
42											
43	No. Bk-Gd samples		5		5		n				
44											
45	Gas analyzer checked:				5/1/2013						
46											
47	Notes:										
48											
49											
50	yfs 5/6/13										
51											
52											
53											
54	Entries made by:		Brad Fritz			5/2/13		Technical Data Review performed by:		Carmen Arimescu	
55	Signature/date		On file with original					Signature/date		On file with TI-STMON-030	
56											
57											

Instuments Used:

B&K 1302 Gas Analyzer	SN 1788615	Cat2 M&TE
TSI VelociCalc	SN T95351203001	12/10/2013
Dew point pen/thermometer	SN 122277875	5/16/2014

yfs 5/6/13

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-26					
3	Date 5/7/13					Fan Configuration B&C (2&3)					
4	Testers MSP, YFS					Fan Setting normal Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 86.72 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 13:22/14:58					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10			
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7			
9	Measurement units ppm N₂O					Injection Point Fan B Far					
10	Order --> 1st					2nd					
11	Traverse-->					Bottom					
12	Trial ---->					1 2 3 Mean					
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.4	22.5	22.2	22.4	22.3	22.9	22.2	22.5	
15	2	4.17	21.8	22.5	22.6	22.3	22.3	22.0	21.8	22.0	
16	3	7.71	22.2	22.4	22.8	22.5	22.2	22.2	22.1	22.2	
17	4	12.84	23.3	21.4	22.5	22.4	22.7	22.2	22.2	22.4	
18	Center	19.88	22.5	21.5	22.9	22.3	22.3	22.0	23.1	22.5	
19	5	26.91	21.6	22.1	22.4	22.0	22.7	22.2	22.4	22.4	
20	6	32.04	21.7	22.4	22.5	22.2	22.6	22.1	22.2	22.3	
21	7	35.58	21.4	22.3	21.7	21.8	22.9	22.5	22.2	22.5	
22	8	38.48	21.9	22.4	22.3	22.2	22.0	22.2	22.6	22.3	
23	Averages ----->		22.1	22.2	22.4	22.2	22.4	22.3	22.3	22.3	
24											
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom
26	Mean		22.3				Mean		22.2		22.3
27	Min Point		21.8		-2.2%		Std. Dev.		0.23		0.18
28	Max Point		22.5		1.1%		COV as %		1.0		0.8
29	Avg. Conc.		22.271 ppm								
30	Avg. Flow		27108 acfm								
31			Start Finish								
32	Tracer tank pressure		1000 1000		psig						
33	Injection flowmeter		15.0 15.0		slpm						
34	Stack Temp		30.4 30.4		°C						
35	Mean stack velocity		3218 3073		fpm						
36	Sampling flowmeter		5 5		lpm						
37	Ambient pressure		993 992		mbar						
38	Ambient humidity		21.8% 19.0%		RH						
39	Ambient Temp		29.8 31.7		°C						
40	B&K vapor correction		Y Y		Y/N						
41	Bk-Gd gas		.40,.40,.38, .36,.37		.41,.37,.33, .35,.32		ppm				
42											
43	No. Bk-Gd samples		5 5		n						
44											
45	Gas analyzer checked:		5/1/2013								
46											
47	Notes:										
48											
49											
50	yfs 5/7/13										
51											
52											
53											
54	Entries made by:		Yin-Fong Su			Technical Data Review performed by:		Carmen Arimescu			
55	Signature/date		On file with original			Signature/date		On file with TI-STMON-030			
56											
57	9-Jul-13										

	A	B	C	D	E	F	G	H	I	J										
1	TRACER GAS TRAVERSE DATA FORM																			
2	Site EP-3410-01-S					Run No. GT-27														
3	Date 5/7/13					Fan Configuration B&C (2&3)														
4	Testers MSP, YFS					Fan Setting normal Hz														
5	Stack Dia. 39.7500 in.					Stack Temp 88.07 deg F														
6	Stack X-Area 1241.0 in.²					Start/End Time 15:02/17:00														
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10												
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7												
9	Measurement units ppm N₂O					Injection Point Fan B Near														
10	Order --> 2nd					1st														
11	Traverse-->					Side					Bottom									
12	Trial ---->					1			2			3			Mean					
13	Point	Depth, in.	ppm				ppm				ppm									
14	1	1.27	21.5	21.6	21.0	21.4	21.4	21.3	20.8	21.2										
15	2	4.17	21.5	21.8	21.2	21.5	21.3	21.7	20.5	21.2										
16	3	7.71	21.9	21.2	21.5	21.5	22.4	21.3	21.3	21.7										
17	4	12.84	21.3	21.5	21.7	21.5	22.1	21.0	22.0	21.7										
18	Center	19.88	21.6	21.1	22.0	21.6	21.4	21.6	21.7	21.6										
19	5	26.91	22.0	21.8	21.5	21.8	21.2	22.1	21.4	21.6										
20	6	32.04	21.7	21.8	21.6	21.7	21.9	21.0	22.1	21.7										
21	7	35.58	22.0	21.4	21.8	21.7	21.7	21.1	22.0	21.6										
22	8	38.48	21.8	22.4	21.9	22.0	21.6	21.3	21.8	21.6										
23	Averages ----->		21.7	21.6	21.6	21.6	21.7	21.4	21.5	21.5										
24																				
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All							
26	Mean		21.6				Mean		21.6		21.6		21.6							
27	Min Point		21.2		-1.9%		Std. Dev.		0.12		0.18		0.15							
28	Max Point		22.0		2.1%		COV as %		0.5		0.8		0.7							
29	Avg. Conc.		21.577 ppm																	
30	Avg. Flow		27668 acfm																	
31			Start		Finish															
32	Tracer tank pressure		1000		900		psig													
33	Injection flowmeter		15.0		15.0		slpm													
34	Stack Temp		31		31.3		°C													
35	Mean stack velocity		3073		3348		fpm													
36	Sampling flowmeter		5		5		lpm													
37	Ambient pressure		992		992		mbar													
38	Ambient humidity		19.0%		12.1%		RH													
39	Ambient Temp		31.7		31.2		°C													
40	B&K vapor correction		Y		Y		Y/N													
41	Bk-Gd gas		.41,.37,.33, .35,.32		.40,.34,.35, .35,.35		ppm													
42																				
43	No. Bk-Gd samples		5		5		n													
44																				
45	Gas analyzer checked:				5/1/2013															
46																				
47	Notes:																			
48																				
49																				
50					yfs 5/7/13															
51																				
52																				
53																				
54	Entries made by:		Brad Fritz				Technical Data Review performed by:		Carmen Arimescu											
55	Signature/date		On file with original		5/2/13		Signature/date		On file with TI-STMON-030											
56									9-Jul-13											
57																				

	A	B	C	D	E	F	G	H	I	J
1	TRACER GAS TRAVERSE DATA FORM									
2	Site EP-3410-01-S					Run No. GT-28				
3	Date 5/8/13					Fan Configuration B&C (2, 3)				
4	Testers JAG/YFS					Fan Setting N.A. Hz				
5	Stack Dia. 39.7500 in.					Stack Temp 86.36 deg F				
6	Stack X-Area 1241.0 in.²					Start/End Time 1325/1520				
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10		
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7		
9	Measurement units ppm N2O					Injection Point FanC Center				
10	Order --> 1st					2nd				
11	Traverse-->					Bottom				
12	Trial ---->					1 2 3 Mean				
13	Point	Depth, in.	ppm				ppm			
14	1	1.27	23.1	22.9	22.6	22.9	22.7	22.5	22.7	22.6
15	2	4.17	23.1	22.9	22.9	23.0	23.1	22.5	22.6	22.7
16	3	7.71	23.0	23.0	23.1	23.0	22.7	22.8	22.5	22.7
17	4	12.84	23.2	23.2	23.0	23.1	22.5	22.8	22.8	22.7
18	Center	19.88	23.3	22.8	23.0	23.0	22.6	22.4	22.4	22.5
19	5	26.91	22.7	22.6	22.6	22.6	22.3	22.4	22.5	22.4
20	6	32.04	23.1	22.7	22.6	22.8	22.6	22.3	22.1	22.3
21	7	35.58	23.1	22.8	23.0	23.0	22.4	22.4	22.3	22.4
22	8	38.48	22.7	22.8	22.5	22.7	22.5	22.5	22.6	22.5
23	Averages ----->		23.0	22.9	22.8	22.9	22.6	22.5	22.5	22.5
24										
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All
26	Mean		22.7			Mean		22.9	22.5	22.7
27	Min Point		22.3	-1.7%		Std. Dev.		0.17	0.17	0.27
28	Max Point		23.1	1.8%		COV as %		0.7	0.8	1.2
29	Avg. Conc.		22.715 ppm							
30	Avg. Flow		25910 acfm							
31			Start	Finish						
32	Tracer tank pressure		1000	940	psig					
33	Injection flowmeter		15.0	15.0	slpm					
34	Stack Temp		29.6	30.8	°C					
35	Mean stack velocity		2931	3082	fpm					
36	Sampling flowmeter		5	5	lpm					
37	Ambient pressure		998	997	mbar					
38	Ambient humidity		26.6%	25.6%	RH					
39	Ambient Temp		30.5	30.6	°C					
40	B&K vapor correction		Y	Y	Y/N					
41	Back-Gd gas		.41,.38,.39, .36,.34	.39,.37,.31, .32,.35	ppm					
42										
43	No. Bk-Gd samples		5	5	n					
44										
45	Gas analyzer checked:		5/8/2013							
46										
47	Notes:									
48										
49										
50	JAG 5/8/13									
51										
52										
53										
54	Entries made by:		John Glissmeyer			Technical Data Review performed by:		Carmen Arimescu		
55	Signature/date		On file with original			Signature/date		On file with TI-STMON-030		
56								9-Jul-13		
57										

Instuments Used:

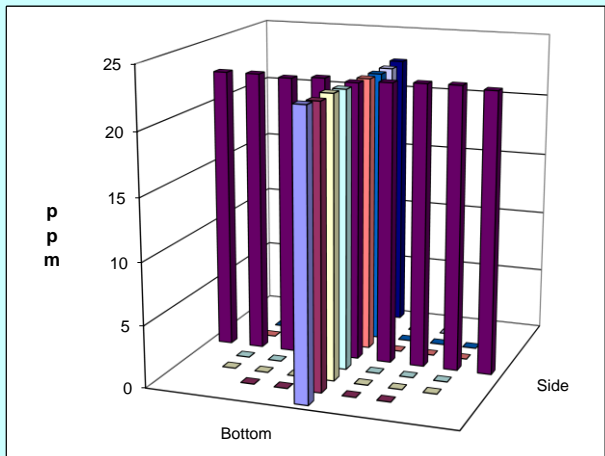
B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE

TSI VelociCalc SN T95351203001 12/10/2013

Dew point pen/thermometer SN 122277875 5/16/2014

JAG 5/8/13

	A	B	C	D	E	F	G	H	I	J
1	TRACER GAS TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	GT-29			
3	Date	5/8/13				Fan Configuration	B&C (2, 3)			
4	Testers	JAG/YFS				Fan Setting	N.A. Hz			
5	Stack Dia.	39.7500 in.				Stack Temp	87.71 deg F			
6	Stack X-Area	1241.0 in. ²				Start/End Time	1525/1755			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7	
9	Measurement units	ppm N2O				Injection Point	FanC Bottom			
10	Order -->	2nd				1st				
11	Traverse-->	Side				Bottom				
12	Trial ---->	1			2		3			Mean
13	Point	Depth, in.	ppm				ppm			
14	1	1.27	22.5	22.7	22.5	22.6	22.2	22.4	22.3	22.3
15	2	4.17	22.2	22.1	22.4	22.2	23.0	22.5	22.6	22.7
16	3	7.71	23.0	22.2	22.2	22.5	22.2	22.5	22.7	22.5
17	4	12.84	22.4	22.5	22.4	22.4	22.4	22.8	22.5	22.6
18	Center	19.88	22.3	22.5	22.2	22.3	22.4	22.5	22.3	22.4
19	5	26.91	22.4	21.8	22.3	22.2	22.5	22.6	22.2	22.4
20	6	32.04	22.3	22.3	22.5	22.4	22.3	22.1	22.5	22.3
21	7	35.58	22.3	22.1	22.2	22.2	22.4	22.2	22.1	22.2
22	8	38.48	22.2	22.3	22.6	22.4	22.3	22.2	22.2	22.2
23	Averages ----->		22.4	22.3	22.4	22.3	22.4	22.4	22.4	22.4
24										
25		All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All		
26		Mean	22.4		Mean	22.3	22.4	22.4		
27		Min Point	22.2	-0.9%	Std. Dev.	0.12	0.16	0.15		
28		Max Point	22.7	1.4%	COV as %	0.5	0.7	0.7		
29	Avg. Conc.	22.377	ppm		Instuments Used:					
30	Avg. Flow	26535	acfm		B&K 1302 Gas Analyzer	SN 1788615	Cat2 M&TE			
31					TSI VelociCalc	SN T95351203001	12/10/2013			
32	Tracer tank pressure	Start	Finish							
33	Injection flowmeter	960	900	psig						
34	Stack Temp	15.0	15.0	slpm						
35	Mean stack velocity	30.8	31.1	°C						
36	Sampling flowmeter	3082	3076	fpm						
37	Ambient pressure	5	5	lpm						
38	Ambient humidity	997	996	mbar						
39	Ambient Temp	25.6%	20.7%	RH						
40	B&K vapor correction	30.6	31	°C						
41	Back-Gd gas	Y	Y	Y/N						
42		.39,.37,.31	.41,.36,.34	ppm						
43		.32,.35	.32,.32							
44	No. Bk-Gd samples	5	5	n						
45	Gas analyzer checked:	5/8/2013								
46										
47	Notes:									
48										
49										
50		JAG 5/8/13								
51										
52										
53										
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:		Carmen Arimescu		
55	Signature/date	On file with original				Signature/date		On file with TI-STMON-030		
56								9-Jul-13		
57										



	A	B	C	D	E	F	G	H	I	J								
1	TRACER GAS TRAVERSE DATA FORM																	
2	Site EP-3410-01-S					Run No. GT-30												
3	Date 5/9/13					Fan Configuration B&C (2&3)												
4	Testers BGF & YFS					Fan Setting N.A. Hz												
5	Stack Dia. 39.7500 in.					Stack Temp 86.18 deg F												
6	Stack X-Area 1241.0 in.²					Start/End Time 9:15am/11:00												
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10										
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7										
9	Measurement units ppm N2O					Injection Point Fan C (top)												
10	Order --> 1st					2nd												
11	Traverse-->					Side					Bottom							
12	Trial ---->					1		2		3		Mean						
13	Point	Depth, in.	ppm				ppm											
14	1	1.27	23.8	23.5	23.2	23.5	23.2	22.2	23.3	22.9								
15	2	4.17	23.9	23.3	23.3	23.5	22.7	22.5	22.8	22.7								
16	3	7.71	24.1	23.4	23.3	23.6	22.8	22.0	23.0	22.6								
17	4	12.84	23.8	23.4	22.9	23.4	22.9	22.4	22.7	22.7								
18	Center	19.88	23.6	23.2	23.2	23.3	22.9	21.9	22.7	22.5								
19	5	26.91	23.6	23.1	22.6	23.1	22.8	22.4	22.2	22.5								
20	6	32.04	23.5	22.9	22.5	23.0	22.6	22.4	22.2	22.4								
21	7	35.58	23.6	23.0	22.8	23.1	22.7	22.6	22.7	22.7								
22	8	38.48	23.1	23.1	23.0	23.1	22.8	22.7	22.7	22.7								
23	Averages ----->		23.7	23.2	23.0	23.3	22.8	22.3	22.7	22.6								
24																		
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All					
26	Mean		23.0				Mean		23.3		22.6		22.9					
27	Min Point		22.4		-2.4%		Std. Dev.		0.23		0.11		0.41					
28	Max Point		23.6		2.8%		COV as %		1.0		0.5		1.8					
29	Avg. Conc.		22.958 ppm															
30	Avg. Flow		26625 acfm															
31			Start Finish															
32	Tracer tank pressure		720 650		psig													
33	Injection flowmeter		15.0 15.0		slpm													
34	Stack Temp		28.4 31.8		°C													
35	Mean stack velocity		3005 3174		fpm													
36	Sampling flowmeter		5 5		lpm													
37	Ambient pressure		1002 1002		mbar													
38	Ambient humidity		38% 28%		RH													
39	Ambient Temp		25 28		°C													
40	B&K vapor correction		Y Y		Y/N													
41	Bk-Gd gas		.483,.44,.40, .40,.41		.40,.40,.40, .35,.41		ppm											
42			5		5		n											
43	No. Bk-Gd samples		5		5		n											
44																		
45	Gas analyzer checked:		5/8/2013															
46																		
47	Notes:																	
48																		
49																		
50			YFS 5/9/13															
51																		
52																		
53																		
54	Entries made by:		Brad Fritz		5/9/13		Technical Data Review performed by:		Carmen Arimescu		9-Jul-13							
55	Signature/date		On file with original		5/9/13		Signature/date		On file with TI-STMON-030		9-Jul-13							
56																		
57																		

	A	B	C	D	E	F	G	H	I	J								
1	TRACER GAS TRAVERSE DATA FORM																	
2	Site EP-3410-01-S					Run No. GT-31												
3	Date 5/9/13					Fan Configuration B&C (2&3)												
4	Testers BGF & YFS					Fan Setting N.A. Hz												
5	Stack Dia. 39.7500 in.					Stack Temp 87.44 deg F												
6	Stack X-Area 1241.0 in.²					Start/End Time 11AM/12:25												
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10										
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7										
9	Measurement units ppm N2O					Injection Point Fan C Near												
10	Order --> 2nd					1st												
11	Traverse-->					Side					Bottom							
12	Trial ---->					1		2		3		Mean						
13	Point	Depth, in.	ppm				ppm											
14	1	1.27	22.9	22.8	22.8	22.8	22.3	22.4	23.5	22.7								
15	2	4.17	23.1	23.3	23.0	23.1	22.4	22.7	23.1	22.7								
16	3	7.71	23.1	23.1	23.0	23.1	22.4	22.5	23.4	22.8								
17	4	12.84	22.7	22.9	22.7	22.8	22.1	22.8	23.1	22.7								
18	Center	19.88	23.0	23.2	22.9	23.0	22.8	22.8	22.9	22.8								
19	5	26.91	22.6	22.8	23.0	22.8	22.4	22.9	23.0	22.8								
20	6	32.04	22.8	23.2	23.2	23.1	22.4	22.8	22.6	22.6								
21	7	35.58	22.9	22.7	23.0	22.9	22.5	23.0	22.8	22.8								
22	8	38.48	22.7	23.1	22.7	22.8	22.4	22.5	22.9	22.6								
23	Averages ----->		22.9	23.0	22.9	22.9	22.4	22.7	23.0	22.7								
24																		
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All					
26	Mean		22.8				Mean		23.0		22.7		22.8					
27	Min Point		22.6		-1.0%		Std. Dev.		0.15		0.08		0.16					
28	Max Point		23.1		1.3%		COV as %		0.6		0.3		0.7					
29	Avg. Conc.		22.813 ppm															
30	Avg. Flow		25974 acfm															
31			Start Finish															
32	Tracer tank pressure		650 200		psig													
33	Injection flowmeter		15.0 15.0		slpm													
34	Stack Temp		31.8 29.8		°C													
35	Mean stack velocity		3174 2854		fpm													
36	Sampling flowmeter		5 5		lpm													
37	Ambient pressure		1002 1001		mbar													
38	Ambient humidity		28% 29%		RH													
39	Ambient Temp		28 29		°C													
40	B&K vapor correction		Y Y		Y/N													
41	Bk-Gd gas		.40,.40,.40, .35,.41		.58,.37,.38, .43,.38		ppm											
42																		
43	No. Bk-Gd samples		5 5		n													
44																		
45	Gas analyzer checked:		5/8/2013															
46																		
47	Notes: Need a new tank of gas tomorrow. YFS 5/9/13																	
48																		
49																		
50	YFS 5/9/13																	
51																		
52																		
53																		
54	Entries made by:		Brad Fritz		5/9/13		Technical Data Review performed by:		Carmen Arimescu									
55	Signature/date		On file with original		5/9/13		Signature/date		On file with TI-STMON-030		9-Jul-13							
56																		
57																		

	A	B	C	D	E	F	G	H	I	J
1	TRACER GAS TRAVERSE DATA FORM									
2	Site EP-3410-01-S					Run No. GT-32				
3	Date 5/10/13					Fan Configuration B&C (2&3)				
4	Testers YFS, XYY					Fan Setting N.A. Hz				
5	Stack Dia. 39.7500 in.					Stack Temp 85.46 deg F				
6	Stack X-Area 1241.0 in.²					Start/End Time 9:30/11:45				
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10		
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7		
9	Measurement units ppm N2O					Injection Point Fan C Far				
10	Order --> 1st					2nd				
11	Traverse-->					Bottom				
12	Trial ---->					1 2 3 Mean				
13	Point	Depth, in.	ppm				ppm			
14	1	1.27	20.2	20.1	19.8	20.0	20.1	20.0	20.1	20.1
15	2	4.17	20.1	20.1	20.1	20.1	20.1	19.9	20.2	20.1
16	3	7.71	20.1	20.0	20.2	20.1	20.1	19.7	20.2	20.0
17	4	12.84	20.2	20.2	20.1	20.2	20.1	19.8	20.0	20.0
18	Center	19.88	20.2	20.2	20.1	20.2	20.1	19.7	19.8	19.9
19	5	26.91	19.9	19.9	20.0	19.9	19.8	19.9	20.0	19.9
20	6	32.04	20.3	20.1	19.9	20.1	20.0	20.0	20.1	20.0
21	7	35.58	20.3	19.8	20.2	20.1	20.1	19.5	19.7	19.8
22	8	38.48	20.3	19.9	20.0	20.1	20.0	19.9	19.8	19.9
23	Averages ----->		20.2	20.0	20.0	20.1	20.0	19.8	20.0	20.0
24										
25	All		ppm	Dev. from mean		Center 2/3		Side	Bottom	All
26	Mean		20.0			Mean		20.1	19.9	20.0
27	Min Point		19.8	-1.3%		Std. Dev.		0.08	0.10	0.12
28	Max Point		20.2	0.7%		COV as %		0.4	0.5	0.6
29	Avg. Conc.		20.019 ppm							
30	Avg. Flow		28146 acfm							
31			Start	Finish						
32	Tracer tank pressure		800	900	psig					
33	Injection flowmeter		13.0	13.0	slpm					
34	Stack Temp		29.2	30.2	°C					
35	Mean stack velocity		3492	3040	fpm					
36	Sampling flowmeter		5	5	lpm					
37	Ambient pressure		1004	1003	mbar					
38	Ambient humidity		25.7%	24.8%	RH					
39	Ambient Temp		30.4	30.3	°C					
40	B&K vapor correction		Y	Y	Y/N					
41	Bk-Gd gas		.33,.38,.36	.33,.31,.32	ppm					
42			.35,.34	.31,.31						
43	No. Bk-Gd samples		5	5	n					
44										
45	Gas analyzer checked:		5/8/2013							
46										
47	Notes: Background N2O is ~.35ppm, target N2O is ~18ppm.									
48										
49										
50	XYY 5/10/13									
51										
52										
53										
54	Entries made by: Xiao-Ying Yu					Technical Data Review performed by: Carmen Arimescu				
55	Signature/date: On file with original 5/10/13					Signature/date: On file with TI-STMON-030 9-Jul-13				
56										
57										

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-33					
3	Date 5/10/13					Fan Configuration B&C (2&3)					
4	Testers YFS, XYY					Fan Setting N.A. Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 87.62 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 11:55/13:20					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65 to: 36.10					
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2 to: 7					
9	Measurement units ppm N2O					Injection Point Junction Center					
10	Order --> 2nd					1st					
11	Side					Bottom					
12	Trial ---->			1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	20.0	20.3	19.4	19.9	19.8	19.5	19.4	19.6	
15	2	4.17	20.1	19.9	19.8	19.9	19.3	20.0	19.8	19.7	
16	3	7.71	19.9	19.8	20.0	19.9	19.8	19.4	19.8	19.7	
17	4	12.84	19.7	20.1	19.8	19.9	19.3	20.1	20.0	19.8	
18	Center	19.88	20.0	20.1	20.2	20.1	19.7	19.7	19.9	19.8	
19	5	26.91	19.7	19.8	20.0	19.8	19.7	19.6	19.8	19.7	
20	6	32.04	19.7	19.9	20.1	19.9	19.7	19.6	19.6	19.6	
21	7	35.58	19.8	19.6	19.5	19.6	19.3	19.2	19.7	19.4	
22	8	38.48	19.4	19.7	19.7	19.6	19.8	19.2	20.0	19.7	
23	Averages ----->		19.8	19.9	19.8	19.9	19.6	19.6	19.8	19.7	
24											
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom
26	Mean		19.8				Mean		19.9		19.7
27	Min Point		19.4		-1.8%		Std. Dev.		0.14		0.13
28	Max Point		20.1		1.8%		COV as %		0.7		0.7
29	Avg. Conc.		19.731 ppm								
30	Avg. Flow		27448 acfm								
31			Start Finish								
32	Tracer tank pressure		900 1000		psig						
33	Injection flowmeter		13.0 13.0		slpm						
34	Stack Temp		30.3 31.5		°C						
35	Mean stack velocity		3092 3278		fpm						
36	Sampling flowmeter		5 5		lpm						
37	Ambient pressure		1003 1003		mbar						
38	Ambient humidity		24.2% 26.1%		RH						
39	Ambient Temp		30.3 30.2		°C						
40	B&K vapor correction		Y Y		Y/N						
41	Bk-Gd gas		.33,.31,.32, .31,.31		.32,.31,.31, .36,.30		ppm				
42											
43	No. Bk-Gd samples		5 5		n						
44											
45	Gas analyzer checked:		5/8/2013								
46											
47	Notes:										
48											
49											
50	XYY 5/10/13										
51											
52											
53											
54	Entries made by:		Xiao-Ying Yu			Technical Data Review performed by:		Carmen Arimescu			
55	Signature/date		On file with original 5/10/13			Signature/date		On file with TI-STMON-030 9-Jul-13			
56											
57											

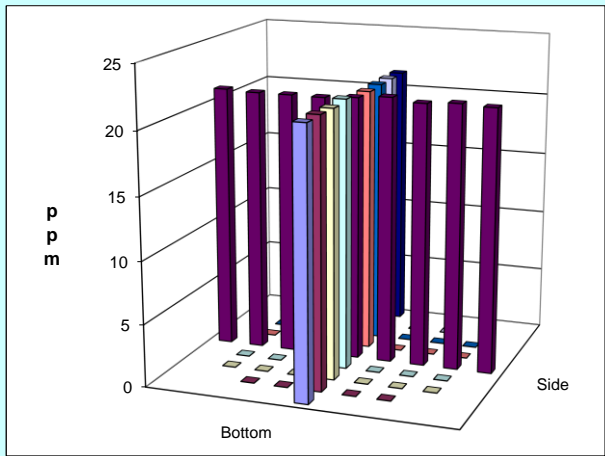
	A	B	C	D	E	F	G	H	I	J								
1	TRACER GAS TRAVERSE DATA FORM																	
2	Site EP-3410-01-S					Run No. GT-34												
3	Date 5/14/13					Fan Configuration A&C (1&3)												
4	Testers BGF, XYY					Fan Setting N.A. Hz												
5	Stack Dia. 39.7500 in.					Stack Temp 78.08 deg F												
6	Stack X-Area 1241.0 in.²					Start/End Time 9:30/11:20												
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10										
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7										
9	Measurement units ppm N2O					Injection Point Junction Center												
10	Order --> 1st					2nd												
11	Traverse-->					Side					Bottom							
12	Trial ---->					1			2			3			Mean			
13	Point	Depth, in.	ppm				ppm											
14	1	1.27	22.0	21.5	21.5	21.7	22.8	22.7	23.3	22.9	23.0	22.7	23.0	22.7	22.7	22.8		
15	2	4.17	22.3	21.9	22.1	22.1	22.9	23.3	22.7	23.0	22.7	23.0	22.7	22.7	22.8	22.8		
16	3	7.71	22.1	21.7	21.6	21.8	22.9	22.6	22.5	22.7	22.7	22.7	22.7	22.7	22.8	22.8		
17	4	12.84	22.4	21.9	21.8	22.0	22.8	22.8	22.7	22.7	22.7	22.7	22.7	22.7	22.8	22.8		
18	Center	19.88	22.1	21.9	22.9	22.3	22.8	22.9	22.7	22.7	22.7	22.7	22.7	22.7	22.8	22.8		
19	5	26.91	22.4	22.2	22.5	22.4	22.6	22.7	22.6	22.6	22.6	22.6	22.6	22.6	22.7	22.7		
20	6	32.04	22.5	21.9	22.6	22.3	22.3	23.1	22.4	22.4	22.4	22.4	22.4	22.4	22.5	22.5		
21	7	35.58	22.7	22.1	23.0	22.6	22.5	22.1	22.6	22.6	22.6	22.6	22.6	22.6	22.7	22.7		
22	8	38.48	22.2	22.0	22.7	22.3	22.1	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.7	22.7		
23	Averages ----->		22.3	21.9	22.3	22.2	22.6	22.8	22.7	22.7	22.7	22.7	22.7	22.7	22.8	22.8		
24																		
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All					
26	Mean		22.4		2.4%		Mean		22.2		22.7		22.5					
27	Min Point		21.7		-3.4%		Std. Dev.		0.26		0.18		0.33					
28	Max Point		23.0		2.4%		COV as %		1.2		0.8		1.5					
29	Avg. Conc.		22.413 ppm															
30	Avg. Flow		30615 acfm															
31			Start Finish															
32	Tracer tank pressure		700 600		psig													
33	Injection flowmeter		15.0 15.0		slpm													
34	Stack Temp		27.1 24.1		°C													
35	Mean stack velocity		3554 3551		fpm													
36	Sampling flowmeter		5 5		lpm													
37	Ambient pressure		1005 1005		mbar													
38	Ambient humidity		25.7% 28.0%		RH													
39	Ambient Temp		21.6 18.8		°C													
40	B&K vapor correction		Y Y		Y/N													
41	Bk-Gd gas		.45,.42,.44, .44,.45		.41,.39,.40, .37,.39		ppm											
42																		
43	No. Bk-Gd samples		5 5		n													
44																		
45	Gas analyzer checked:		5/8/2013															
46																		
47	Notes: Background N2O is ~.44ppm, target N2O is ~22ppm.																	
48	1604, 1606 Sashes are up for a higher flow condition.																	
49																		
50	XYY 5/14/13																	
51																		
52																		
53																		
54	Entries made by: Xiao-Ying Yu					Technical Data Review performed by: Carmen Arimescu												
55	Signature/date: On file with original 5/14/13					Signature/date: On file with TI-STMON-030 9-Jul-13												
56																		
57																		

	A	B	C	D	E	F	G	H	I	J										
1	TRACER GAS TRAVERSE DATA FORM																			
2	Site EP-3410-01-S					Run No. GT-35														
3	Date 5/14/13					Fan Configuration A&C (1&3)														
4	Testers BGF, XYY					Fan Setting N.A. Hz														
5	Stack Dia. 39.7500 in.					Stack Temp 77.09 deg F														
6	Stack X-Area 1241.0 in.²					Start/End Time 11:20/13:10														
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65		to: 36.10												
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2		to: 7												
9	Measurement units ppm N2O					Injection Point Junction Top														
10	Order --> 2nd					1st														
11	Traverse-->					Side					Bottom									
12	Trial ---->					1		2		3		Mean								
13	Point	Depth, in.	ppm				ppm													
14	1	1.27	22.2	22.1	22.2	22.2	22.7	22.7	22.9	22.8										
15	2	4.17	22.7	22.5	22.3	22.5	23.0	23.1	23.1	23.1										
16	3	7.71	22.1	22.4	22.6	22.4	22.9	22.7	22.8	22.8										
17	4	12.84	22.7	22.6	22.2	22.5	22.8	23.0	22.8	22.9										
18	Center	19.88	22.4	22.5	22.6	22.5	22.6	22.7	22.6	22.6										
19	5	26.91	22.6	22.1	22.6	22.4	22.5	22.7	22.6	22.6										
20	6	32.04	22.5	22.7	22.1	22.4	22.4	22.2	22.4	22.3										
21	7	35.58	22.4	22.4	22.6	22.5	22.7	22.3	22.4	22.5										
22	8	38.48	22.7	22.5	23.0	22.7	22.4	22.1	22.4	22.3										
23	Averages ----->		22.5	22.4	22.5	22.5	22.7	22.6	22.7	22.6										
24																				
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All							
26	Mean		22.6				Mean		22.5		22.7		22.6							
27	Min Point		22.2		-1.7%		Std. Dev.		0.05		0.25		0.21							
28	Max Point		23.1		2.3%		COV as %		0.2		1.1		0.9							
29	Avg. Conc.		22.550 ppm																	
30	Avg. Flow		30744 acfm																	
31			Start		Finish															
32	Tracer tank pressure		600		600		psig													
33	Injection flowmeter		15.0		15.0		slpm													
34	Stack Temp		25		25.1		°C													
35	Mean stack velocity		3561		3574		fpm													
36	Sampling flowmeter		5		5		lpm													
37	Ambient pressure		1005		1004		mbar													
38	Ambient humidity		29.0%		25.9%		RH													
39	Ambient Temp		19.3		19.9		°C													
40	B&K vapor correction		Y		Y		Y/N													
41	Bk-Gd gas		.41,.39,.40,		.39,.40,.37,		ppm													
42			.37,.39		.39,.40															
43	No. Bk-Gd samples		5		5		n													
44																				
45	Gas analyzer checked:		5/8/2013																	
46																				
47	Notes:		Light wind and cloudy.																	
48																				
49																				
50	XYY 5/14/13																			
51																				
52																				
53																				
54	Entries made by:		Xiao-Ying Yu		Technical Data Review performed by:		Carmen Arimescu													
55	Signature/date		On file with original		5/14/13		Signature/date		On file with TI-STMON-030											
56																				
57																				

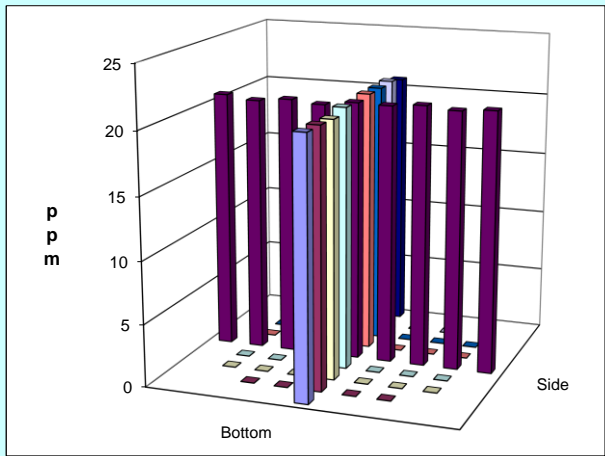
	A	B	C	D	E	F	G	H	I	J					
1	TRACER GAS TRAVERSE DATA FORM														
2	Site EP-3410-01-S					Run No. GT-36									
3	Date 5/15/13					Fan Configuration A&C (1&3)									
4	Testers JAG, XYY					Fan Setting N/A. Hz									
5	Stack Dia. 39.7500 in.					Stack Temp 77.9 deg F									
6	Stack X-Area 1241.0 in.²					Start/End Time 11:00/13:00									
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65 to: 36.10									
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2 to: 7									
9	Measurement units ppm N2O					Injection Point Junction Bottom									
10	Order --> 1st					2nd									
11	Side					Bottom									
12	1			2		3		1		2		3		Mean	
13	Point	Depth, in.	ppm				ppm								
14	1	1.27	21.8	21.9	21.8	21.8	21.5	21.5	21.2	21.4	21.5	21.5	21.6	21.6	21.5
15	2	4.17	21.8	21.5	21.7	21.7	21.6	21.4	21.6	21.5	21.6	21.6	21.6	21.6	21.5
16	3	7.71	21.7	21.7	21.8	21.7	22.1	21.2	21.3	21.5	21.6	21.6	21.6	21.6	21.5
17	4	12.84	21.9	21.5	21.4	21.6	21.6	21.2	21.3	21.4	21.6	21.6	21.6	21.6	21.5
18	Center	19.88	21.6	21.5	21.2	21.4	21.6	21.4	21.6	21.5	21.6	21.6	21.6	21.6	21.5
19	5	26.91	21.4	21.3	21.4	21.4	21.7	21.7	21.6	21.6	21.6	21.6	21.6	21.6	21.7
20	6	32.04	21.5	21.4	21.2	21.4	21.5	21.7	21.6	21.6	21.6	21.6	21.6	21.6	21.6
21	7	35.58	21.1	21.3	21.3	21.2	21.7	21.7	21.8	21.7	21.7	21.7	21.7	21.7	21.7
22	8	38.48	21.3	21.4	21.3	21.3	21.4	21.5	21.1	21.3	21.4	21.5	21.5	21.5	21.3
23	Averages ----->		21.6	21.5	21.5	21.5	21.6	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5
24															
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom		All		
26	Mean		21.5				Mean		21.5		21.6		21.5		21.5
27	Min Point		21.2		-1.3%		Std. Dev.		0.18		0.12		0.15		
28	Max Point		21.8		1.5%		COV as %		0.9		0.5		0.7		
29	Avg. Conc.		21.519 ppm												
30	Avg. Flow		28982 acfm												
31			Start Finish												
32	Tracer tank pressure		700 700		psig										
33	Injection flowmeter		15.0 15.0		slpm										
34	Stack Temp		25.4 25.6		°C										
35	Mean stack velocity		3383 3343		fpm										
36	Sampling flowmeter		5 5		lpm										
37	Ambient pressure		1001 1000		mbar										
38	Ambient humidity		27.2% 29.6%		RH										
39	Ambient Temp		21.8 21.9		°C										
40	B&K vapor correction		Y Y		Y/N										
41	Bk-Gd gas		.38,.40,.43, .41,.37		.39,.40,.39, .38,.37		ppm								
42															
43	No. Bk-Gd samples		5 5		n										
44															
45	Gas analyzer checked:		5/15/2013												
46															
47	Notes: Background N2O is~400ppb, target N2O is~20ppm.														
48	Sashes open.														
49															
50	XYY 5/15/13														
51															
52															
53															
54	Entries made by:		Xiao-Ying Yu			Technical Data Review performed by:					Carmen Arimescu				
55	Signature/date		On file with original			5/15/13					On file with TI-STMON-030				
56	9-Jul-13														
57															

	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site	EP-3410-01-S				Run No.	GT-36				
3	Date	5/15/13				Fan Configuration	A&C (1&3)				
4	Testers	JAG, XYY				Fan Setting	N/A. Hz				
5	Stack Dia.	39.7500 in.				Stack Temp	77.9 deg F				
6	Stack X-Area	1241.0 in. ²				Start/End Time	11:00/13:00				
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10		
8	Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7		
9	Measurement units	ppm N2O				Injection Point	Junction Bottom				
10	Order -->	1st				2nd					
11	Traverse-->	Side				Bottom					
12	Trial ---->	1		2		3		Mean		Mean	
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.8	21.9	21.8	21.8	21.5	21.5	21.2	21.4	
15	2	4.17	21.8	21.5	21.7	21.7	21.6	21.4	21.6	21.5	
16	3	7.71	21.7	21.7	21.8	21.7	22.1	21.2	21.3	21.5	
17	4	12.84	21.9	21.5	21.4	21.6	21.6	21.2	21.3	21.4	
18	Center	19.88	21.6	21.5	21.2	21.4	21.6	21.4	21.6	21.5	
19	5	26.91	21.4	21.3	21.4	21.4	21.7	21.7	21.6	21.7	
20	6	32.04	21.5	21.4	21.2	21.4	21.5	21.7	21.6	21.6	
21	7	35.58	21.1	21.3	21.3	21.2	21.7	21.7	21.8	21.7	
22	8	38.48	21.3	21.4	21.3	21.3	21.4	21.5	21.1	21.3	
23	Averages ----->		21.6	21.5	21.5	21.5	21.6	21.5	21.5	21.5	
24											
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All		
26			Mean	21.5		Mean	21.5	21.6	21.5		
27			Min Point	21.2	-1.3%	Std. Dev.	0.18	0.12	0.15		
28			Max Point	21.8	1.5%	COV as %	0.9	0.5	0.7		
29	Avg. Conc.	21.519 ppm		Instuments Used:							
30	Avg. Flow	28982 acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE							
31		Start	Finish	TSI VelociCalc SN T95351203001 12/10/2013							
32	Tracer tank pressure	700	700	psig	Dew point pen/thermometer SN 122277875 5/16/2014						
33	Injection flowmeter	15.0	15.0	slpm	XYY 5/15/13						
34	Stack Temp	25.4	25.6	°C							
35	Mean stack velocity	3383	3343	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1001	1000	mbar							
38	Ambient humidity	27.2%	29.6%	RH							
39	Ambient Temp	21.8	21.9	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.38, .40, .43,	.39, .40, .39,	ppm							
42		.41, .37	.38, .37								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/15/2013									
46											
47	Notes:	Background N2O is~400ppb, target N2O is~20ppm.									
48	Sashes open.										
49		XYY 5/15/13									
50											
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:		Carmen Arimescu			
55	Signature/date	On file with original 5/15/13				Signature/date		On file with TI-STMON-030 9-Jul-13			
56											
57											

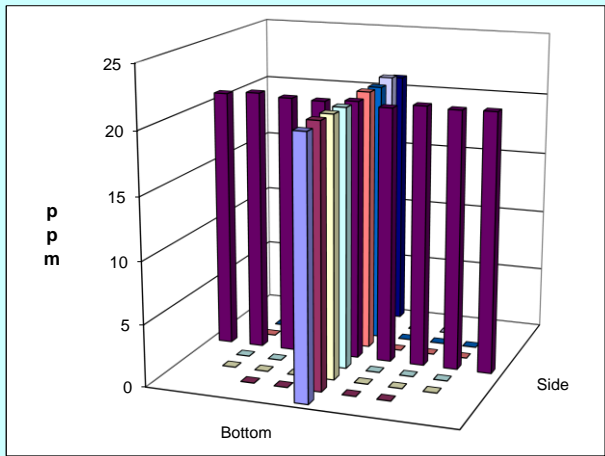
	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site	EP-3410-01-S				Run No.	GT-38				
3	Date	5/15/13				Fan Configuration	A&C (1&3)				
4	Testers	MSP,YFS				Fan Setting	NA	Hz			
5	Stack Dia.	39.7500 in.				Stack Temp	75.56 deg F				
6	Stack X-Area	1241.0 in. ²				Start/End Time	14:38/16:25				
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10		
8	Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7		
9	Measurement units	ppm N2O				Injection Point	Junction Far				
10	Order -->	1st				2nd					
11	Traverse-->	Side				Bottom					
12	Trial ---->	1	2	3	Mean	1	2	3	Mean		
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.5	21.6	21.1	21.4	21.0	20.7	21.7	21.1	
15	2	4.17	21.2	21.1	21.1	21.1	21.1	20.9	21.3	21.1	
16	3	7.71	21.5	21.3	21.0	21.3	21.1	21.0	21.4	21.2	
17	4	12.84	21.1	21.0	21.2	21.1	21.1	20.9	21.4	21.1	
18	Center	19.88	21.6	21.4	21.2	21.4	21.1	21.2	21.7	21.3	
19	5	26.91	21.6	21.0	21.0	21.2	20.7	20.8	21.4	21.0	
20	6	32.04	21.4	20.8	20.9	21.0	20.7	20.8	21.4	21.0	
21	7	35.58	21.0	21.1	21.1	21.1	20.9	20.8	21.5	21.1	
22	8	38.48	21.2	20.8	21.2	21.1	20.9	21.2	21.2	21.1	
23	Averages ----->		21.3	21.1	21.1	21.2	21.0	20.9	21.4	21.1	
24											
25		All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All			
26		Mean	21.1		Mean	21.2	21.1	21.1			
27		Min Point	21.0	-0.8%	Std. Dev.	0.13	0.13	0.13			
28		Max Point	21.4	1.2%	COV as %	0.6	0.6	0.6		0.6	
29	Avg. Conc.	21.119 ppm		Instuments Used:							
30	Avg. Flow	28577 acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE							
31		Start	Finish	TSI VelociCalc SN T95351203001 12/10/2013							
32	Tracer tank pressure	700	600	psig	Dew point pen/thermometer SN 122277875 5/16/2014						
33	Injection flowmeter	15.0	15.0	slpm	YFS 5/15/13						
34	Stack Temp	24.5	23.9	°C							
35	Mean stack velocity	3303	3329	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	999.1	998.5	mbar							
38	Ambient humidity	27.4%	24.4%	RH							
39	Ambient Temp	22.5	22.1	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.37,.38,.37,	.38,.35,.36,	ppm							
42		.37,.36	.39,.35								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/15/2013									
46											
47	Notes:										
48											
49											
50		YFS 5/15/13									
51											
52											
53											
54	Entries made by:	Yin-Fong Su				Technical Data Review performed by:		Carmen Arimescu			
55	Signature/date	On file with original 5/15/13				Signature/date		On file with TI-STMON-030 9-Jul-13			
56											
57											



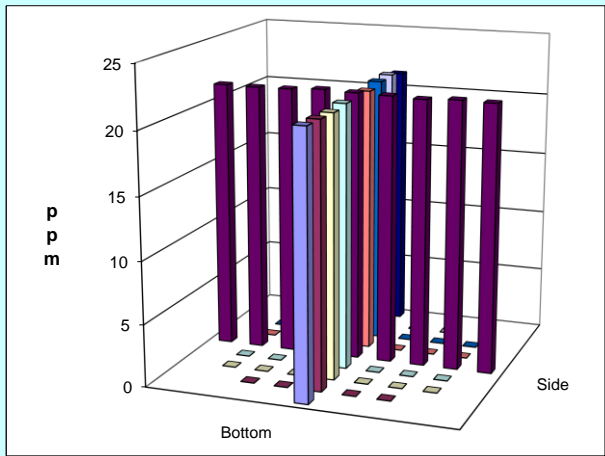
	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S					Run No. GT-39					
3	Date 5/17/13					Fan Configuration A&B (1&2)					
4	Testers BGF, XYY, JAG					Fan Setting N/A Hz					
5	Stack Dia. 39.7500 in.					Stack Temp 78.62 deg F					
6	Stack X-Area 1241.0 in.²					Start/End Time 13:00/1440					
7	Test Port NEAREST TO PROBE					Center 2/3 from 3.65 to: 36.10					
8	Distance to disturbance 53.5 inches					Points in Center 2/3 2 to: 7					
9	Measurement units ppm N2O					Injection Point Fan A Center					
10	Order -->	1st				2nd					
11	Traverse-->	Side			Bottom						
12	Trial ---->	1	2	3	Mean	1	2	3	Mean		
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.7	20.6	20.6	21.0	20.3	20.7	20.5	20.5	
15	2	4.17	21.0	20.9	20.6	20.8	20.8	20.6	20.5	20.6	
16	3	7.71	20.6	20.6	20.7	20.6	20.9	20.7	20.3	20.6	
17	4	12.84	20.8	20.9	20.9	20.9	20.7	20.3	20.6	20.5	
18	Center	19.88	20.5	20.6	20.9	20.7	20.5	21.2	21.1	20.9	
19	5	26.91	20.6	20.6	21.0	20.7	20.8	20.7	20.9	20.8	
20	6	32.04	20.4	20.0	20.8	20.4	21.0	20.5	21.5	21.0	
21	7	35.58	20.8	20.5	20.6	20.6	21.1	21.1	20.8	21.0	
22	8	38.48	20.0	20.2	20.9	20.4	20.8	21.1	21.4	21.1	
23	Averages ----->		20.7	20.5	20.8	20.7	20.8	20.8	20.8	20.8	
24											
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom
26	Mean		20.7				Mean		20.7		20.8
27	Min Point		20.4		-1.8%		Std. Dev.		0.15		0.19
28	Max Point		21.1		1.8%		COV as %		0.7		0.9
29	Avg. Conc.	20.727	ppm		Instuments Used:						
30	Avg. Flow	29512	acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE						
31			Start	Finish	TSI VelociCalc SN T95351203001 12/10/2013						
32	Tracer tank pressure		650	720	Dew point pen/thermometer SN 122277875 5/16/2014						
33	Injection flowmeter		15.0	15.0	JAG 5/17/13						
34	Stack Temp		26.1	25.7							
35	Mean stack velocity		3345	3504							
36	Sampling flowmeter		5	5							
37	Ambient pressure		995.8	995.2							
38	Ambient humidity		28.0%	28.8%							
39	Ambient Temp		27.1	25.4							
40	B&K vapor correction		Y	Y							
41	Back-Gd gas		.31,.35,.34,	.35,.36,.36,							
42			.36,.36	.33,.33							
43	No. Bk-Gd samples		5	5							
44											
45	Gas analyzer checked:	5/15/2013									
46											
47	Notes:										
48											
49											
50	XYY 5/17/13										
51											
52											
53											
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On file with original 5/17/13				Signature/date				On file with TI-STMON-030 9-Jul-13	
56											
57											



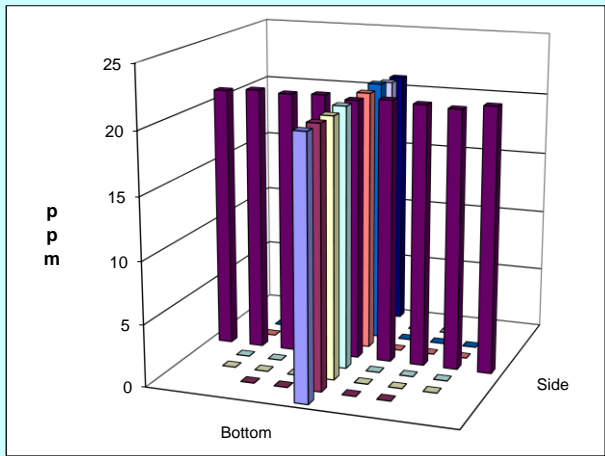
	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site	EP-3410-01-S				Run No.	GT-40				
3	Date	5/17/13				Fan Configuration	A&B (1&2)				
4	Testers	JAG/YFS				Fan Setting	NA	Hz			
5	Stack Dia.	39.7500 in.				Stack Temp	78.26 deg F				
6	Stack X-Area	1241.0 in. ²				Start/End Time	1445/1615				
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10		
8	Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7		
9	Measurement units	ppm N2O				Injection Point	FAN A Bottom				
10	Order -->	2nd					1st				
11	Traverse-->						Bottom				
12	Trial ---->										
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	20.5	21.0	21.0	20.8	20.4	20.5	20.3	20.4	
15	2	4.17	20.9	21.0	20.6	20.8	20.4	20.5	21.0	20.6	
16	3	7.71	20.5	20.8	21.0	20.8	21.0	20.7	21.0	20.9	
17	4	12.84	20.6	21.0	21.1	20.9	20.9	20.8	20.9	20.9	
18	Center	19.88	20.6	20.6	20.5	20.6	20.8	20.9	20.9	20.9	
19	5	26.91	21.1	21.0	20.6	20.9	20.8	20.8	20.9	20.8	
20	6	32.04	20.8	20.5	20.9	20.7	21.0	21.2	21.1	21.1	
21	7	35.58	21.0	20.5	20.9	20.8	20.9	21.2	20.9	21.0	
22	8	38.48	21.2	20.8	21.1	21.0	21.3	21.2	21.5	21.3	
23	Averages ----->		20.8	20.8	20.9	20.8	20.8	20.9	20.9	20.9	
24											
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All		
26			Mean	20.9		Mean	20.8	20.9	20.8		
27			Min Point	20.4	-2.2%	Std. Dev.	0.12	0.15	0.14		
28			Max Point	21.3	2.3%	COV as %	0.6	0.7	0.7		
29	Avg. Conc.	20.867	ppm		Instuments Used:						
30	Avg. Flow	29409	acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE						
31			Start	Finish	TSI VelociCalc SN T95351203001 12/10/2013						
32	Tracer tank pressure		720	700	Dew point pen/thermometer SN 122277875 5/16/2014						
33	Injection flowmeter		15.0	15.0	JAG 5/17/13						
34	Stack Temp		25.7	25.7							
35	Mean stack velocity		3504	3321							
36	Sampling flowmeter		5	5							
37	Ambient pressure		995.2	995.3							
38	Ambient humidity		28.8%	29.0%							
39	Ambient Temp		25.4	24.9							
40	B&K vapor correction		Y	Y							
41	Back-Gd gas		.35,.36,.36	.38,.36,.37							
42			.33,.33	.34,.35							
43	No. Bk-Gd samples		5	5							
44											
45	Gas analyzer checked:		5/15/2013								
46											
47	Notes:										
48											
49											
50		JAG 5/17/13									
51											
52											
53											
54	Entries made by:	John Glissmeyer				Technical Data Review performed by: Carmen Arimescu					
55	Signature/date	On file with original 5/17/13				On file with TI-STMON-030 9-Jul-13					
56											
57											



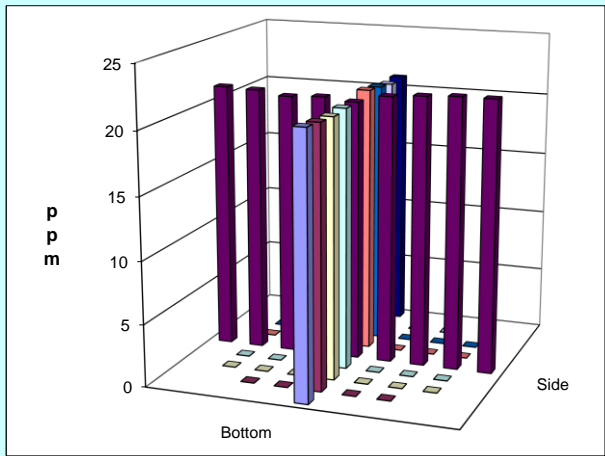
	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site EP-3410-01-S				Run No. GT-41						
3	Date 5/20/13				Fan Configuration A&B (1&2)						
4	Testers YFS, XYY				Fan Setting NA Hz						
5	Stack Dia. 39.7500 in.				Stack Temp 78.08 deg F						
6	Stack X-Area 1241.0 in.²				Start/End Time 10:00/12:00						
7	Test Port NEAREST TO PROBE				Center 2/3 from 3.65 to: 36.10						
8	Distance to disturbance 53.5 inches				Points in Center 2/3 2 to: 7						
9	Measurement units ppm N2O				Injection Point FAN A Top						
10	Order -->	1st			2nd						
11	Traverse-->	Side				Bottom					
12	Trial ---->	1		2		3		Mean		Mean	
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	22.4	21.3	21.4	21.7	21.5	21.2	21.2	21.3	
15	2	4.17	21.5	21.6	21.3	21.5	21.5	20.7	21.1	21.1	
16	3	7.71	21.9	21.5	21.2	21.5	21.2	21.1	20.9	21.1	
17	4	12.84	21.7	21.0	21.5	21.4	21.1	20.9	21.1	21.0	
18	Center	19.88	21.6	21.4	21.5	21.5	21.0	21.4	21.3	21.2	
19	5	26.91	21.9	21.7	21.1	21.6	21.6	21.6	21.5	21.6	
20	6	32.04	22.1	21.5	21.4	21.7	21.3	21.3	21.1	21.2	
21	7	35.58	21.5	21.5	21.6	21.5	21.3	21.6	21.7	21.5	
22	8	38.48	21.6	21.5	21.4	21.5	21.7	21.8	21.4	21.6	
23	Averages ----->		21.8	21.4	21.4	21.5	21.4	21.3	21.3	21.3	
24											
25	All		ppm		Dev. from mean		Center 2/3		Side		Bottom
26	Mean		21.4				Mean		21.5		21.3
27	Min Point		21.0		-1.8%		Std. Dev.		0.08		0.22
28	Max Point		21.7		1.3%		COV as %		0.4		1.0
29	Avg. Conc.	21.427	ppm		Instuments Used:						
30	Avg. Flow	28228	acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE						
31			Start	Finish	TSI VelociCalc SN T95351203001 12/10/2013						
32	Tracer tank pressure		750	700	Dew point pen/thermometer SN 122277875 5/16/2014						
33	Injection flowmeter		15.0	15.0	XYY 5/20/13						
34	Stack Temp		25.8	25.4							
35	Mean stack velocity		3290	3261							
36	Sampling flowmeter		5	5							
37	Ambient pressure		1007	1006							
38	Ambient humidity		34.4%	28.8%							
39	Ambient Temp		21.7	22.9							
40	B&K vapor correction		Y	Y							
41	Back-Gd gas		.41,.40,.41	.38,.36,.35							
42			.41,.40	.36,.37							
43	No. Bk-Gd samples		5	5							
44											
45	Gas analyzer checked:		5/15/2013								
46											
47	Notes: N2O background is ~.40ppm, target N2O is ~20ppm.										
48											
49											
50	XYY 5/20/13										
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by: Carmen Arimescu					
55	Signature/date	On file with original 5/20/13				On file with TI-STMON-030 9-Jul-13					
56											
57											



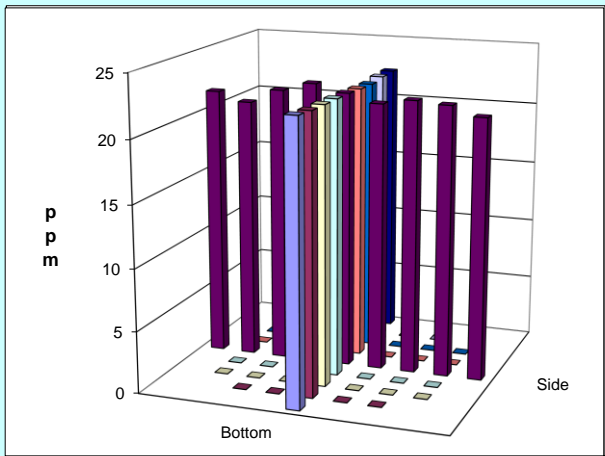
	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site	EP-3410-01-S				Run No.	GT-42				
3	Date	5/20/13				Fan Configuration	A&B (1&2)				
4	Testers	YFS, XYY				Fan Setting	NA	Hz			
5	Stack Dia.	39.7500 in.				Stack Temp	78.08 deg F				
6	Stack X-Area	1241.0 in. ²				Start/End Time	12:00/1325				
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10		
8	Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7		
9	Measurement units	ppm N2O				Injection Point	FAN A Near				
10	Order -->	2nd					1st				
11	Traverse-->						Bottom				
12	Trial ---->	1 2 3 Mean					1 2 3 Mean				
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.1	20.6	20.5	20.7	20.6	20.6	21.1	20.8	
15	2	4.17	21.1	21.1	21.5	21.2	20.9	20.6	20.6	20.7	
16	3	7.71	21.1	20.7	20.7	20.8	20.7	21.0	20.6	20.8	
17	4	12.84	21.0	21.0	21.0	21.0	20.8	20.6	21.0	20.8	
18	Center	19.88	21.0	21.4	21.1	21.2	20.9	21.1	21.1	21.0	
19	5	26.91	20.9	21.1	20.9	21.0	21.0	21.0	20.9	21.0	
20	6	32.04	21.3	21.3	21.1	21.2	21.0	21.1	21.1	21.1	
21	7	35.58	21.0	21.1	21.3	21.1	21.6	21.4	21.0	21.3	
22	8	38.48	21.0	21.6	21.2	21.3	20.9	21.0	21.1	21.0	
23	Averages ----->		21.1	21.1	21.0	21.1	20.9	20.9	20.9	20.9	
24											
25		All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All			
26	Mean	21.0			Mean	21.1	21.0	21.0			
27	Min Point	20.7		-1.4%	Std. Dev.	0.15	0.22	0.19			
28	Max Point	21.3		1.6%	COV as %	0.7	1.0	0.9			
29	Avg. Conc.	20.988	ppm		Instuments Used:						
30	Avg. Flow	28215	acfm		B&K 1302 Gas Analyzer	SN 1788615	Cat2 M&TE				
31		Start	Finish		TSI VelociCalc	SN T95351203001	12/10/2013				
32	Tracer tank pressure	700	700	psig							
33	Injection flowmeter	15.0	15.0	slpm							
34	Stack Temp	25.4	25.8	°C							
35	Mean stack velocity	3246	3302	fpm							
36	Sampling flowmeter	5	5	lpm							
37	Ambient pressure	1006	1004	mbar							
38	Ambient humidity	28.8%	24.1%	RH							
39	Ambient Temp	23	25.5	°C							
40	B&K vapor correction	Y	Y	Y/N							
41	Back-Gd gas	.38,.36,.35,	.37,.34,.33,	ppm							
42		.36,.37	.32,.32								
43	No. Bk-Gd samples	5	5	n							
44											
45	Gas analyzer checked:	5/15/2013									
46											
47	Notes:										
48											
49											
50		XYY 5/20/13									
51											
52											
53											
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu				
55	Signature/date	On file with original 5/20/13				Signature/date	On file with TI-STMON-030 9-Jul-13				
56											
57											



	A	B	C	D	E	F	G	H	I	J	
1	TRACER GAS TRAVERSE DATA FORM										
2	Site	EP-3410-01-S				Run No.	GT-43				
3	Date	5/20/13				Fan Configuration	A&B (1&2)				
4	Testers	JAG/YFS				Fan Setting	NA	Hz			
5	Stack Dia.	39.7500 in.				Stack Temp	79.52 deg F				
6	Stack X-Area	1241.0 in. ²				Start/End Time	1328/1503				
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10		
8	Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7		
9	Measurement units	ppm N2O				Injection Point	FAN A Far				
10	Order -->	2nd					1st				
11	Traverse-->						Bottom				
12	Trial ---->	1 2 3 Mean					1 2 3 Mean				
13	Point	Depth, in.	ppm				ppm				
14	1	1.27	21.2	20.6	21.6	21.1	21.1	21.3	21.2	21.2	
15	2	4.17	21.5	21.6	21.0	21.4	21.2	21.1	20.7	21.0	
16	3	7.71	21.3	21.3	21.5	21.4	20.8	20.6	21.1	20.8	
17	4	12.84	21.3	21.3	21.1	21.2	20.5	21.1	20.6	20.7	
18	Center	19.88	21.0	20.8	21.3	21.0	20.8	20.5	21.3	20.9	
19	5	26.91	20.4	20.6	20.3	20.4	20.9	20.7	20.9	20.8	
20	6	32.04	20.5	20.6	20.9	20.7	21.3	21.4	21.2	21.3	
21	7	35.58	20.5	20.3	20.8	20.5	20.6	21.3	21.4	21.1	
22	8	38.48	20.7	21.3	20.6	20.9	20.9	20.8	20.9	20.9	
23	Averages ----->		20.9	20.9	21.0	21.0	20.9	21.0	21.0	21.0	
24											
25		All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All			
26		Mean	21.0		Mean	20.9	21.0	21.0			
27		Min Point	20.4	-2.5%	Std. Dev.	0.40	0.20	0.30			
28		Max Point	21.4	1.9%	COV as %	1.9	0.9	1.4			
29	Avg. Conc.	20.967	ppm		Instuments Used:						
30	Avg. Flow	28008	acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE						
31				Start	Finish						
32	Tracer tank pressure			700	750	psig					
33	Injection flowmeter			15.0	15.0	slpm					
34	Stack Temp			25.8	27.0	°C					
35	Mean stack velocity			3302	3198	fpm					
36	Sampling flowmeter			5	5	lpm					
37	Ambient pressure			1004	1002	mbar					
38	Ambient humidity			24.1%	24.1%	RH					
39	Ambient Temp			25.5	25.8	°C					
40	B&K vapor correction			Y	Y	Y/N					
41	Back-Gd gas			.32,.33,.31	.30,.36,.30	ppm					
42				.33,.34	.36,.33						
43	No. Bk-Gd samples			5	5	n					
44											
45	Gas analyzer checked:			5/15/2013							
46											
47	Notes:										
48											
49											
50				JAG 5/20/13							
51											
52											
53											
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:	Carmen Arimescu				
55	Signature/date	On file with original 5/20/13				Signature/date	On file with TI-STMON-030 9-Jul-13				
56											
57											



	A	B	C	D	E	F	G	H	I	J
1	TRACER GAS TRAVERSE DATA FORM									
2	Site	EP-3410-01-S				Run No.	GT-44			
3	Date	5/17/13				Fan Configuration	A&C (1&3)			
4	Testers	BGF, XYY				Fan Setting	NA	Hz		
5	Stack Dia.	39.7500 in.				Stack Temp	77.09 deg F			
6	Stack X-Area	1241.0 in. ²				Start/End Time	9:00/13:05			
7	Test Port	NEAREST TO PROBE				Center 2/3 from	3.65	to:	36.10	
8	Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7	
9	Measurement units	ppm N2O				Injection Point	Fan C Near			
10	Order -->	1st				2nd				
11	Traverse-->	Side				Bottom				
12	Trial ---->	1	2	3	Mean	1	2	3	Mean	
13	Point	Depth, in.	ppm				ppm			
14	1	1.27	20.7	21.0	20.9	20.9	21.4	21.3	21.1	21.3
15	2	4.17	21.4	20.1	21.7	21.1	21.3	21.5	21.1	21.3
16	3	7.71	21.5	22.0	22.0	21.8	21.2	21.3	21.0	21.2
17	4	12.84	21.5	21.7	22.9	22.0	21.4	21.0	21.0	21.1
18	Center	19.88	20.6	21.8	22.4	21.6	21.2	21.2	20.9	21.1
19	5	26.91	21.4	22.9	22.5	22.3	21.1	21.5	20.6	21.1
20	6	32.04	22.3	23.7	22.6	22.9	21.0	21.1	20.8	21.0
21	7	35.58	21.7	22.2	22.6	22.2	20.8	21.0	20.9	20.9
22	8	38.48	21.2	20.9	21.0	21.0	20.8	21.1	21.3	21.1
23	Averages ----->		21.4	21.8	22.1	21.7	21.1	21.2	21.0	21.1
24										
25			All	ppm	Dev. from mean	Center 2/3	Side	Bottom	All	
26			Mean	21.4		Mean	22.0	21.1	21.5	
27			Min Point	20.9	-2.6%	Std. Dev.	0.56	0.13	0.60	
28			Max Point	22.9	6.7%	COV as %	2.6	0.6	2.8	
29	Avg. Conc.	21.438	ppm		Instuments Used:					
30	Avg. Flow	28125	acfm		B&K 1302 Gas Analyzer SN 1788615 Cat2 M&TE					
31			Start	Finish	TSI VelociCalc SN T95351203001 12/10/2013					
32	Tracer tank pressure		700	400	psig					
33	Injection flowmeter		26.75	15.0	slpm					
34	Stack Temp		25.6	24.5	°C					
35	Mean stack velocity		3236	3291	fpm					
36	Sampling flowmeter		5	5	lpm					
37	Ambient pressure		996.4	996.2	mbar					
38	Ambient humidity		39.7%	31.1%	RH					
39	Ambient Temp		22	24.9	°C					
40	B&K vapor correction		Y	Y	Y/N					
41	Back-Gd gas		.43,.43,.42,	.32,.32,.32,	ppm					
42			.41,.38	.36,.35						
43	No. Bk-Gd samples		5	5	n					
44										
45	Gas analyzer checked:		5/15/2013							
46										
47	Notes:	N2O background is ~0.42ppm, target N2O is								
48		~20.8ppm. Redo GT-21 because of highest COV%.								
49		Sahses open. At 15 lpm, the N2O @ center is only 12ppm								
50		today. We added a 2nd mass flow controller to increase the flow.								
51		The 1st is set @ 20.5lpm, the 2nd is set @ 6.25 lpm.								
52		Insufficient N2O after side traverse. Have to switch gas cylinder. A leak								
53		is found in the sampling line. Revert back to 15lpm. XYY 5/17/13								
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:		Carmen Arimescu		
55	Signature/date	On file with original 5/17/13				Signature/date		On file with TI-STMON-030 9-Jul-13		
56										
57										



	A	B	C	D	E	F	G	H	I	J	
1	GAS ANALYZER CALIBRATION										
2											
3	Site	EP-3410-01-S			Instrument	B&K Model 1302					
4	Date	4/24/2013			Serial No.	SN1788615					
5	Testers	BGF, XYY			Property No.	WD54624					
6											
7											
8	Setup:	7.8	ft	B&K sample inlet tube length							
9		1027	mbar	station pressure							
10		63.5	deg F	ambient temp	analyzer corrects to 20 deg C						
11		27	percent	RH							
12											
13	Pre-Test background, ppb										
14	Compensating for water vapor, monitoring task 4										
15	496, 498, 477, 471, 494										
16											
17											
18											
19		1.99	ppm							59.9	ppm
20	Cylinder	SV17699			Cylinder	SV17805					
21	start P =	1700	psi							1600	psi
22	end P =	1700	psi							1600	psi
23											
24	B&K					B&K					
25	Calibration					Calibration					
26	readings: (ppm)					readings: (ppm)					
27		2.09								62.1	
28		2.09								62.3	
29		2.11								62.1	
30		2.10								62.2	
31		2.11								62.4	
32		2.08								62.2	
33		2.09								62.3	
34		2.10								62.3	
35		2.06								62.0	
36		2.07								62.0	
37		2.08								62.0	
38		2.09 = avg									62.2 = avg
39											
40											
41	Standards Used:					Expiration date:					
42	Air Liquide	1.99 ppm N2O in air,	SV17699			6/1/2014					
43	Air Liquide	59.6 ppm N2O in air,	SV17805			6/1/2014					
44	Weather Station Used:										
45	Fisher Scientific	S/N 90936818				12/13/2013					
46	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu				
47	Signature/date	On file with original /4/24/13				Signature/date	On file with TI-STMON-030				
48							9-Jul-13				
49											

	A	B	C	D	E	F	G	H	I	J
1	GAS ANALYZER CALIBRATION									
2										
3	Site	EP-3410-01-S			Instrument	B&K Model 1302				
4	Date	5/1/2013			Serial No.	SN1788615				
5	Testers	YFS, XYY			Property No.	WD54624				
6										
7										
8	Setup:	7.8	ft	B&K sample inlet tube length						
9		1036	mbar	station pressure						
10		56.3	deg F	ambient temp	analyzer corrects to 20 deg C					
11		27	percent	RH						
12										
13	Pre-Test background, ppb									
14	Compensating for water vapor, monitoring task 4									
15	472, 465, 472, 461, 434									
16										
17										
18										
19		1.99	ppm				59.9	ppm		
20	Cylinder	SV17699			Cylinder	SV17805				
21	start P =	1700 psi			start P =	1500 psi				
22	end P =	1650 psi			end P =	1480 psi				
23										
24	B&K				B&K					
25	Calibration				Calibration					
26	readings: (ppm)				readings: (ppm)					
27		2.05				60.3				
28		2.06				61.1				
29		2.07				61.5				
30		2.07				61.5				
31		2.07				61.2				
32		2.07				61.6				
33		2.05				61.7				
34		2.06				61.8				
35		2.06				61.4				
36		2.05				61.5				
37		2.06				62.5				
38		2.06 = avg				61.5 = avg				
39										
40										
41	Standards Used:				Expiration date:					
42	Air Liquide	1.99 ppm N2O in air, SV17699				6/1/2014				
43	Air Liquide	59.6 ppm N2O in air, SV17805				6/1/2014				
44	Weather Station Used:									
45	Fisher Scientific	S/N 90936818				12/13/2013				
46	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:	Carmen Arimescu			
47	Signature/date	On file with original /5/1/13				Signature/date	On file with TI-STMON-030			
48						9-Jul-13				
49										

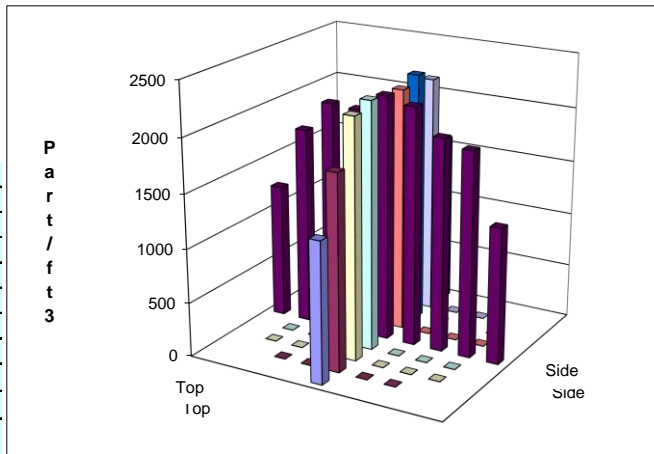
	A	B	C	D	E	F	G	H	I	J
1	GAS ANALYZER CALIBRATION									
2										
3		Site	EP-3410-01-S		Instrument	B&K Model 1302				
4		Date	5/8/2013		Serial No.	SN1788615				
5		Testers	YFS		Property No.	WD54624				
6										
7										
8		Setup:	7.8 ft	B&K sample inlet tube length						
9			1014	mbar station pressure						
10			82.4	deg F ambient temp	analyzer corrects to 20 deg C					
11			28	percent RH						
12										
13		Pre-Test background, ppb								
14		Compensating for water vapor, monitoring task 4								
15		417, 500, 474, 470, 502								
16										
17										
18										
19			1.99	ppm			59.9	ppm		
20		Cylinder	SV17699		Cylinder	SV17805				
21		start P =	1700	psi	start P =	1500	psi			
22		end P =	1700	psi	end P =	1500	psi			
23										
24		B&K			B&K					
25		Calibration			Calibration					
26		readings: (ppm)			readings: (ppm)					
27			2.03			61.1				
28			2.07			61.3				
29			2.07			61.4				
30			2.06			61.4				
31			2.04			61.1				
32			2.05			61.2				
33			2.04			61.1				
34			2.04			61.0				
35			2.04			61.3				
36			2.04			61.6				
37			2.04			61.5				
38			2.05	= avg		61.3	= avg			
39										
40										
41		Standards Used:			Expiration date:					
42		Air Liquide	1.99 ppm N2O in air, SV17699		6/1/2014					
43		Air Liquide	59.6 ppm N2O in air, SV17805		6/1/2014					
44		Weather Station Used:								
45		Fisher Scientific	S/N 90936818		12/13/2013					
46		Entries made by:	Yin-Fong Su		Technical Data Review performed by:	Carmen Arimescu				
47		Signature/date	On file with original /5/8/13		Signature/date	On file with TI-STMON-030				
48						9-Jul-13				
49										

	A	B	C	D	E	F	G	H	I	J
1	GAS ANALYZER CALIBRATION									
2										
3		Site	EP-3410-01-S		Instrument	B&K Model 1302				
4		Date	5/15/2013		Serial No.	SN1788615				
5		Testers	XYX, JAG		Property No.	WD54624				
6										
7		Setup:	7.8 ft	B&K sample inlet tube length						
8			1019	mbar station pressure						
9			67.1	deg F ambient temp	analyzer corrects to 20 deg C					
10			30	percent RH						
11										
12										
13		Pre-Test background, ppb								
14		Compensating for water vapor, monitoring task 4								
15		408, 399, 383, 394, 412								
16										
17										
18										
19			1.99	ppm			59.9	ppm		
20		Cylinder	SV17699		Cylinder	SV17805				
21		start P =	1650	psi	start P =	1480	psi			
22		end P =	1650	psi	end P =	1450	psi			
23										
24	B&K				B&K					
25	Calibration				Calibration					
26	readings: (ppm)				readings: (ppm)					
27		2.01			60.4					
28		2.02			60.8					
29		2.03			60.8					
30		2.02			60.8					
31		2.02			60.6					
32		2.01			60.5					
33		2.01			60.6					
34		1.94			60.3					
35		2.00			59.4					
36		2.00			60.6					
37		2.02			61.1					
38		2.01	= avg		60.5	= avg				
39										
40										
41	Standards Used:				Expiration date:					
42	Air Liquide	1.99 ppm N2O in air, SV17699			6/1/2014					
43	Air Liquide	59.6 ppm N2O in air, SV17805			6/1/2014					
44	Weather Station Used:									
45	Fisher Scientific	S/N 90936818			12/13/2013					
46	Entries made by:	Xiao-Ying Yu			Technical Data Review performed by:	Carmen Arimescu				
47	Signature/date	On file with original /5/15/13			Signature/date	On file with TI-STMON-030				
48						9-Jul-13				
49										

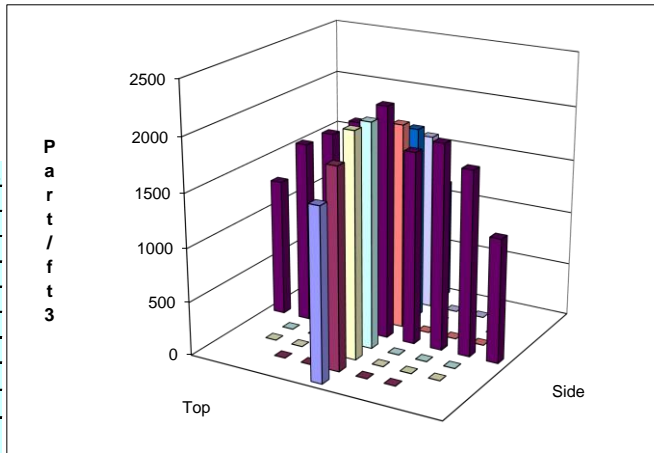
	A	B	C	D	E	F	G	H	I	J
1	GAS ANALYZER CALIBRATION									
2										
3		Site	EP-3410-01-S		Instrument	B&K Model 1302				
4		Date	5/21/2013		Serial No.	SN1788615				
5		Testers	MSP		Property No.	WD54624				
6										
7										
8		Setup:	7.8 ft	B&K sample inlet tube length						
9			1010	mbar station pressure						
10			67.1	deg F ambient temp	analyzer corrects to 20 deg C					
11			51	percent RH						
12										
13		Pre-Test background, ppb								
14		Compensating for water vapor, monitoring task 4								
15		395, 393, 389, 382, 375								
16										
17										
18										
19			1.99	ppm			59.9	ppm		
20		Cylinder	SV17699		Cylinder	SV17805				
21		start P =	1650	psi	start P =	1450	psi			
22		end P =	1650	psi	end P =	1450	psi			
23										
24		B&K			B&K					
25		Calibration			Calibration					
26		readings: (ppm)			readings: (ppm)					
27			2.03			60.3				
28			2.03			61.4				
29			2.03			60.7				
30			2.03			60.6				
31			2.03			60.7				
32			2.03			60.8				
33			2.04			60.8				
34			2.03			60.9				
35			2.03			61.2				
36			2.02			60.8				
37			2.02			60.9				
38			2.03	= avg		60.8	= avg			
39										
40										
41		Standards Used:			Expiration date:					
42		Air Liquide	1.99 ppm N2O in air, SV17699		6/1/2014					
43		Air Liquide	59.6 ppm N2O in air, SV17805		6/1/2014					
44		Weather Station Used:								
45		Fisher Scientific	S/N 90936818		12/13/2013					
46		Entries made by:	Mikhail Pekour		Technical Data Review performed by:	Carmen Arimescu				
47		Signature/date	On file with original /5/21/13		Signature/date	On file with TI-STMON-030				
48						9-Jul-13				
49										

Particle Tracer Uniformity

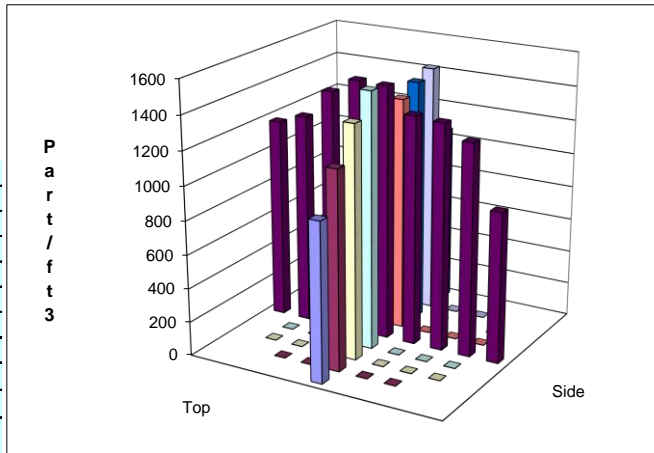
	A	B	C	D	E	F	G	H	I	J	
1	PARTICLE TRACER TRAVERSE DATA FORM										
2	Rev. 0	Site EP-3410-01-S				Run No. PT-1					
3	25 Jan., 2013	Date 5/30/2013				Fan configuration A&B (1&2)					
4		Tester BGF, XYY, MSP				Fan Setting N/A Hz					
5		Stack Dia. 39.75 in.				Stack Temp 25.2 deg C					
6		Stack X-Area 1241.0 in.2				Start/End Time 11:00/13:45					
7		Test Port Nearest to probe				Center 2/3 from 3.65		to: 36.10			
8		Distance to disturbance 53.5 inches				Points in Center 2/3 2		to: 7			
9		Measurement units particles/ft3				Injection Point Junction Center					
10		Order ----> 1st				2nd					
11		Traverse-->				Top					
12		Trial ---->				Mean					
13			Side				Top				
			1	2	3	Mean	1	2	3	Mean	
14	Point	Depth, in.	particles/ft3								
14	1	1.27	1201	1250	1315	1255.3	884	1367	1172	1141.0	
15	2	4.17	1816	1915	1953	1894.7	1412	1622	1722	1585.3	
16	3	7.71	2000	2031	1853	1961.3	2257	1692	1891	1946.7	
17	4	12.84	1999	2254	2336	2196.3	2314	1811	1888	2004.3	
18	Center	19.88	1995	2345	2424	2254.7	2201	1921	1821	1981.0	
19	5	26.91	1774	2185	2313	2090.7	2168	1822	1916	1968.7	
20	6	32.04	1957	2200	2167	2108.0	1911	2060	2117	2029.3	
21	7	35.58	1974	1877	1618	1823.0	1682	2060	2070	1937.3	
22	8	38.48	1254	1187	1289	1243.3	1180	1540	1427	1382.3	
23	Averages ----->		1774.4	1916.0	1918.7	1869.7	1778.8	1766.1	1780.4	1775.1	
24											
25	All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd		
26	Mean	1822.4			Mean	2047.0	1921.8	1984.4	2117.13		
27	Min Point	1141.0	-37.4%		Std. Dev.	159.0	151.7	162.8	175.34		
28	Max Point	2254.7	23.7%		COV as %	7.8	7.9	8.2	8.28		
29	Avg Conc	1785 pt/ft3				Instuments Used:				Cal. Due	
30	Avg. Flow	32515 acfm				TSI SN 9545A1205003				1/6/2014	
31		Start	Finish		Dew point pen/thermometer SN 122277875				5/16/2014		
32	Generator Inlet Press	2.8/2.8	2.8/2.8		Met One OPC 96258675				ref FIO		
33	Stack Temp	24.8	25.6		Met One OPC 1011529009				sample 1/14/2014		
34	Centerline vel.	3856	3690								
35	Ambient pressure	29.58	29.56		psig						
36	Ambient humidity	29.7%	22.6%		C						
37	Ambient temp	20.1	22.1		inHg						
38	Back-Gd aerosol	1,0,0,1	3,1,5,4		RH						
39	No. Bk-Gd samples	4	4		C						
40	Compressor output	18	18		pt/ft3						
41					psig						
42	Notes:										
43											
44											
45		XYY 5/30/13									
46											
47											
48											
49											
50	Oil Used:	Edwards									
51	Ref. Probe Location:	L-shaped at access cover									
52	Probe Type / Configuration:	L-shaped (Side) Bent C (Top)									
53											
54	Entries made by:	Mikhail Pekour				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On File with Originals 5/30/13				Signature/date				7/10/2013	
56						Signature on file with original				TI-STMON-29	
57											



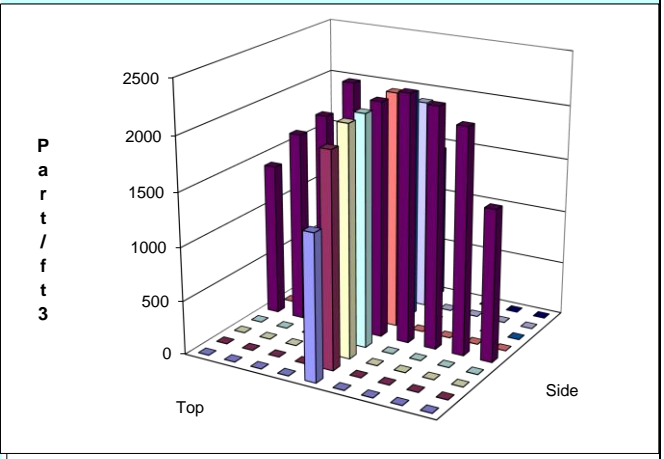
	A	B	C	D	E	F	G	H	I	J	
1	PARTICLE TRACER TRAVERSE DATA FORM										
2	Rev. 0	Site EP-3410-01-S				Run No. PT-2					
3	25 Jan., 2013	Date 5/30/2013			Fan configuration A&B (1&2)						
4		Tester JAG/MSP			Fan Setting N/A			Hz			
5		Stack Dia. 39.75 in.			Stack Temp 24.85 deg C						
6		Stack X-Area 1241.0 in.2			Start/End Time 1354/1600						
7		Test Port Nearest to probe			Center 2/3 from 3.65		to: 36.10				
8		Distance to disturbance 53.5 inches			Points in Center 2/3 2		to: 7				
9		Measurement units particles/ft3			Injection Point Fan A Center						
10		Order ----> 2nd			1st						
11		Traverse-->			Side			Top			
12		Trial ---->			1 2 3 Mean			1 2 3 Mean			
13		Point	Depth, in.	particles/ft3				particles/ft3			
14		1	1.27	1271	1148	1033	1150.7	1160	1914	639	1237.7
15		2	4.17	1854	1961	1338	1717.7	1641	1454	1222	1439.0
16		3	7.71	1701	2045	1980	1908.7	1807	1657	1387	1617.0
17		4	12.84	1675	1953	1727	1785.0	1936	1590	1330	1618.7
18		Center	19.88	2195	2184	2086	2155.0	1837	1789	1393	1673.0
19		5	26.91	1856	1930	2114	1966.7	1813	1906	745	1488.0
20		6	32.04	2005	1862	1590	1819.0	1676	1907	618	1400.3
21		7	35.58	1853	1611	1576	1680.0	1526	1759	577	1287.3
22		8	38.48	1343	1191	1312	1282.0	1189	1077	343	869.7
23	Averages ----->			1750.3	1765.0	1639.6	1718.3	1620.6	1672.6	917.1	1403.4
24											
25		All	pt/ft3	Dev. from mean	Center 2/3		Side	Top	All	Normlzd	
26		Mean	1560.9		Mean	1861.7		1503.3	1682.5	1899.08	
27		Min Point	869.7	-44.3%	Std. Dev.	163.7		139.4	236.5	169.57	
28		Max Point	2155.0	38.1%	COV as %	8.8		9.3	14.1	8.93	
29	Avg Conc	1517 pt/ft3			Instruments Used:					Cal. Due	
30	Avg. Flow	29103 acfm			TSI SN 9545A1205003					1/6/2014	
31		Start	Finish	Dew point pen/thermometer SN 122277875							
32	Generator Inlet Press	2.8/2.8	2.8/2.8	Met One OPC 96258675 ref FIO							
33	Stack Temp	25.4	24.3	Met One OPC 1011529009 sample 1/14/2014							
34	Centerline vel.	3486	3268								
35	Ambient pressure	29.56	29.57								
36	Ambient humidity	23.9%	26.0%								
37	Ambient temp	23.1	21.2								
38	Back-Gd aerosol	0,2,1,1	2,0,1,2								
39	No. Bk-Gd samples	4	4								
40	Compressor output	18	19								
41											
42	Notes:	Top-3rd traverse may be replaced w/ 4th traverse.									
43											
44											
45	MSP 5/30/13										
46											
47											
48											
49											
50	Oil Used:	Edwards 19									
51	Ref. Probe Location:	Access cover									
52	Probe Type / Configuration:										
53	Top-Bent-C Side-L										
54	Entries made by:	Mikhail Pekour				Technical Data Review performed by:			Carmen Arimescu		
55	Signature/date	On File with Originals 5/30/13				Signature/date			7/10/2013		
56						Signature on file with original			TI-STMON-29		
57											



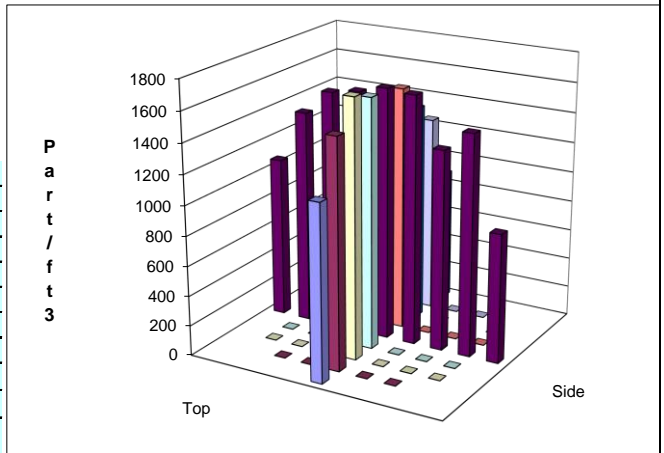
	A	B	C	D	E	F	G	H	I	J	
1	PARTICLE TRACER TRAVERSE DATA FORM										
2	Rev. 0	Site EP-3410-01-S			Run No. PT-3						
3	25 Jan., 2013	Date 5/31/2013			Fan configuration A&B (1&2)						
4		Tester BGF, XYY			Fan Setting N/A			Hz			
5		Stack Dia. 39.75 in.			Stack Temp 24.85 deg C						
6		Stack X-Area 1241.0 in.2			Start/End Time 9:00/11:40						
7		Test Port Nearest to probe			Center 2/3 from 3.65 to: 36.10						
8		Distance to disturbance 53.5 inches			Points in Center 2/3 2 to: 7						
9		Measurement units particles/ft3			Injection Point Fan B Center						
10		Order ----> 1st			2nd						
11		Traverse-->			Side			Top			
12		Trial ---->			1 2 3 Mean			1 2 3 Mean			
13		Point	Depth, in.	particles/ft3				particles/ft3			
14		1	1.27	764	1122	779	888.3	481	1065	724	756.7
15		2	4.17	1203	1258	1294	1251.7	674	1275	888	945.7
16		3	7.71	1273	1327	1405	1335.0	1065	1376	887	1109.3
17		4	12.84	1375	1332	1340	1349.0	1134	1520	1005	1219.7
18		Center	19.88	1476	1471	1529	1492.0	968	1453	1199	1206.7
19		5	26.91	1466	1459	1571	1498.7	768	1295	1269	1110.7
20		6	32.04	1330	1438	1465	1411.0	1027	1311	1130	1156.0
21		7	35.58	1045	1332	1340	1239.0	1284	1227	1055	1188.7
22		8	38.48	1157	1286	1106	1183.0	925	883	746	851.3
23	Averages ----->			1232.1	1336.1	1314.3	1294.2	925.1	1267.2	989.2	1060.5
24											
25		All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd	
26		Mean	1177.4			Mean	1368.0	1133.8	1250.9	1384.98	
27		Min Point	756.7	-35.7%		Std. Dev.	104.8	93.7	154.6	107.61	
28		Max Point	1498.7	27.3%		COV as %	7.7	8.3	12.4	7.77	
29	Avg Conc	1156 pt/ft3			Instruments Used:			Cal. Due			
30	Avg. Flow	29060 acfm			TSI SN 9545A1205003			1/6/2014			
31		Start	Finish	Dew point pen/thermometer SN 122277875			5/16/2014				
32	Generator Inlet Press	2.8	2.8	Met One OPC 96258675 ref			FIO				
33	Stack Temp	24.9	24.8	Met One OPC 1011529009 sample			1/14/2014				
34	Centerline vel.	3453	3291								
35	Ambient pressure	29.8	29.79								
36	Ambient humidity	43.3%	33.2%								
37	Ambient temp	18.6	21.4								
38	Back-Gd aerosol	0,0,0,0	0,1,1,1								
39	No. Bk-Gd samples	4	4								
40	Compressor output	24	24								
41											
42	Notes:	Ref OPC paper jam, could not feed in new									
43		paper, write down records on paper instead.									
44		4th traverse may be used for top port sample analysis.									
45											
46											
47		XYY 5/31/13									
48											
49											
50	Oil Used:	Edwards 19									
51	Ref. Probe Location:	Access cover									
52	Probe Type / Configuration:										
53		Top-Bent-C Side-L									
54	Entries made by:	Mikhail Pekour				Technical Data Review performed by:			Carmen Arimescu		
55	Signature/date	On File with Originals 5/30/13				Signature/date			7/10/2013		
56						Signature on file with original			TI-STMON-29		
57											



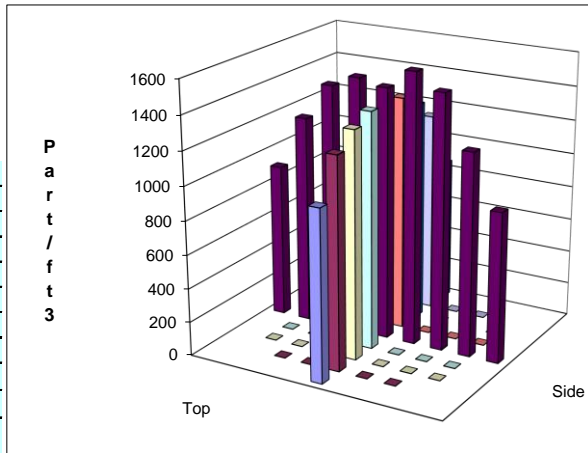
	A	B	C	D	E	F	G	H	I	J	
1	PARTICLE TRACER TRAVERSE DATA FORM										
2	Rev. 0	25 Jan., 2013	Site EP-3410-01-S				Run No. PT-4				
3			Date 5/31/2013				Fan configuration B&C (2&3)				
4			Tester JAG/MSP				Fan Setting N/A				
5			Stack Dia. 39.75 in.				Stack Temp 25.85 deg C				
6			Stack X-Area 1241.0 in.2				Start/End Time 14:20/1630				
7			Test Port Nearest to probe				Center 2/3 from 3.65	to: 36.10			
8			Distance to disturbance 53.5 inches				Points in Center 2/3 2	to: 7			
9			Measurement units particles/ft3				Injection Point Junction Center				
10			Order ---->	1st			2nd				
11			Traverse-->	Side			Top				
12			Trial ---->	1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	particles/ft3				particles/ft3				
14	1	1.27	1363	1457	1400	1406.7	1132	1393	1094	1206.3	
15	2	4.17	2119	2050	2097	2088.7	1684	1889	1740	1771.0	
16	3	7.71	2362	2140	2174	2225.3	1848	2049	1821	1906.0	
17	4	12.84	2420	2304	2173	2299.0	1832	2036	1888	1918.7	
18	Center	19.88	2308	2125	2122	2185.0	1943	2063	1842	1949.3	
19	5	26.91	2507	2200	2231	2312.7	1957	2059	1863	1959.7	
20	6	32.04	2018	1715	2194	1975.7	1799	2056	1837	1897.3	
21	7	35.58	2054	1608	1625	1762.3	1609	1938	1731	1759.3	
22	8	38.48	1535	1213	1505	1417.7	1187	1398	1278	1287.7	
23	Averages ----->		2076.2	1868.0	1946.8	1963.7	1665.7	1875.7	1677.1	1739.5	
24											
25	All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd		
26	Mean	1851.6			Mean	2121.2	1880.2	2000.7	2114.37		
27	Min Point	1206.3	-34.8%		Std. Dev.	197.6	81.7	191.7	148.12		
28	Max Point	2312.7	24.9%		COV as %	9.3	4.3	9.6	7.01		
29	Avg Conc	1825 pt/ft3		Instuments Used:			Cal. Due				
30	Avg. Flow	28228 acfm		TSI			SN 9545A1205003		1/6/2014		
31		Start	Finish	Dew point pen/thermometer SN 122277875			5/16/2014				
32	Generator Inlet Press	2.8/2.8	2.8/2.8	psig			Met One OPC		96258675 ref FIO		
33	Stack Temp	25.8	25.9	C			Met One OPC		1011529009 sample 1/14/2014		
34	Centerline vel.	3240	3311	fpm							
35	Ambient pressure	29.74	29.73	inHg							
36	Ambient humidity	26.9%	27.3%	RH							
37	Ambient temp	24	23.2	C							
38	Back-Gd aerosol	0,1,2,1	1,2,3,1	pt/ft3							
39	No. Bk-Gd samples	4	4								
40	Compressor output	20	20	psig							
41											
42	Notes:										
43											
44											
45	JAG 5/31/13										
46											
47											
48											
49											
50	Oil Used:	Edwards 19									
51	Ref. Probe Location:	Access cover									
52	Probe Type / Configuration:										
53	Side-L shaped Bent-C -Top										
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:		Carmen Arimescu			
55	Signature/date	On File with Originals 5/31/13				Signature/date		7/10/2013			
56					Signature on file with original		TI-STMON-29				
57											



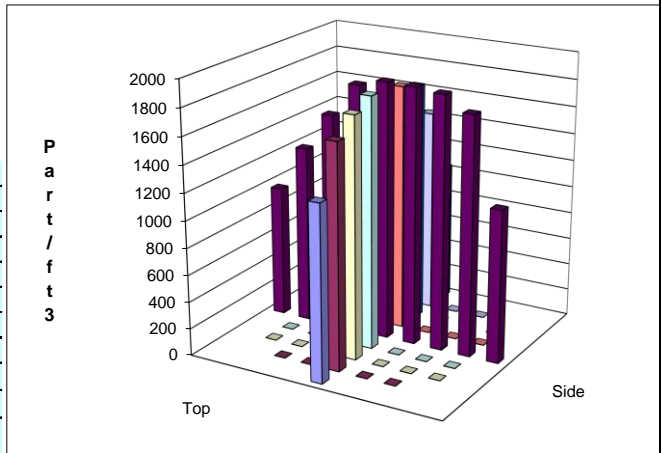
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1	PARTICLE TRACER TRAVERSE DATA FORM										
2	Rev. 0	Site EP-3410-01-S			Run No. PT-5						
3	25 Jan., 2013	Date 5/31/2013			Fan configuration B&C (2&3)						
4		Tester BGF, XYY, JAG			Fan Setting N/A			Hz			
5		Stack Dia. 40 in.			Stack Temp 25.25 deg C						
6		Stack X-Area 1256.6 in.2			Start/End Time 12:00/1355						
7		Test Port Nearest to probe			Center 2/3 from 3.65			to: 36.10			
8		Distance to disturbance 53.5 inches			Points in Center 2/3 2			to: 7			
9		Measurement units particles/ft3			Injection Point Fan B Center						
10		Order ----> 2nd			1st						
11		Traverse-->			Side			Top			
12		Trial ---->			1 2 3 Mean			1 2 3 Mean			
13		Point	Depth, in.	particles/ft3				particles/ft3			
14		1	1.27	882	936	757	858.3	884	832	983	899.7
15		2	4.17	1507	1541	1352	1466.7	1199	1104	1202	1168.3
16		3	7.71	1648	1451	889	1329.3	1332	1249	1363	1314.7
17		4	12.84	1532	1744	1672	1649.3	1298	1192	1334	1274.7
18		Center	19.88	1720	1771	1502	1664.3	1324	1181	1340	1281.7
19		5	26.91	1575	1701	1569	1615.0	1264	1109	1356	1243.0
20		6	32.04	1585	1646	1518	1583.0	1171	948	1204	1107.7
21		7	35.58	1401	1436	1422	1419.7	1017	929	1075	1007.0
22		8	38.48	1106	1100	1006	1070.7	678	619	747	681.3
23	Averages ----->			1439.6	1480.7	1298.6	1406.3	1129.7	1018.1	1178.2	1108.7
24											
25		All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd	
26		Mean	1257.5			Mean	1532.5	1199.6	1366.0	1545.10	
27		Min Point	681.3	-45.8%		Std. Dev.	128.3	111.1	207.7	131.79	
28		Max Point	1664.3	32.4%		COV as %	8.4	9.3	15.2	8.53	
29	Avg Conc	1231 pt/ft3			Instuments Used:			Cal. Due			
30	Avg. Flow	28344 acfm			TSI			SN 9545A1205003			
31		Start	Finish	Dew point pen/thermometer SN 122277875			5/16/2014				
32	Generator Inlet Press	2.8/2.8	2.8/2.8	Met One OPC			96258675 ref FIO				
33	Stack Temp	24.8	25.7	Met One OPC			1011529009 sample 1/14/2014				
34	Centerline vel.	3291	3205								
35	Ambient pressure	29.8	29.8								
36	Ambient humidity	33.2%	26.9%								
37	Ambient temp	21.4	23.1								
38	Back-Gd aerosol	0,1,1,1	2,2,1,3								
39	No. Bk-Gd samples	4	4								
40	Compressor output	26	26								
41											
42	Notes:	Changed paper roll in sampling OPC									
43											
44											
45	XYY 5/30/13										
46											
47											
48											
49											
50	Oil Used:	Edwards									
51	Ref. Probe Location:	L-shaped at access cover									
52	Probe Type / Configuration:										
53	L-shaped (Side) Bent C (Top)										
54	Entries made by:	John Glissmeyer				Technical Data Review performed by:			Carmen Arimescu		
55	Signature/date	On File with Originals 5/31/13				Signature/date			7/10/2013		
56					Signature on file with original			TI-STMON-29			
57											



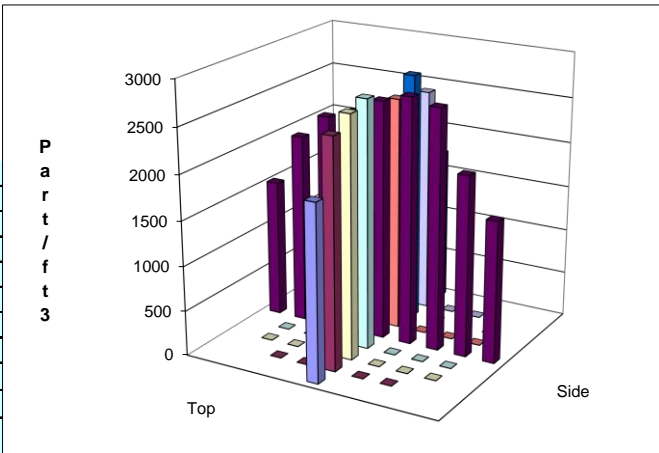
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1	PARTICLE TRACER TRAVERSE DATA FORM										
2	Rev. 0	Site EP-3410-01-S				Run No. PT-6					
3	25 Jan., 2013	Date 6/3/2013				Fan configuration B&C(2&3)					
4		Tester BGF, XYY				Fan Setting N/A				Hz	
5		Stack Dia. 40 in.				Stack Temp 25.6 deg C					
6		Stack X-Area 1256.6 in.2				Start/End Time 9:00/11:30					
7		Test Port Nearest to probe				Center 2/3 from 3.65		to: 36.10			
8		Distance to disturbance 53.5 inches				Points in Center 2/3 2		to: 7			
9		Measurement units particles/ft3				Injection Point Junction Center					
10		Order ----> 1st				2nd					
11		Traverse-->				Top					
12		Trial ---->				1 2 3 Mean					
13		Point	Depth, in.	particles/ft3				particles/ft3			
14		1	1.27	857	880	928	888.3	897	911	915	907.7
15		2	4.17	1245	962	1392	1199.7	1116	1159	1094	1123.0
16		3	7.71	1395	1503	1613	1503.7	1170	1238	1208	1205.3
17		4	12.84	1464	1640	1687	1597.0	1244	1294	1228	1255.3
18		Center	19.88	1517	1582	1347	1482.0	1509	1257	1239	1335.0
19		5	26.91	1449	1552	1545	1515.3	1241	1262	1229	1244.0
20		6	32.04	1403	1368	1570	1447.0	1171	1164	1174	1169.7
21		7	35.58	1191	1195	1305	1230.3	1040	1080	1079	1066.3
22		8	38.48	923	913	897	911.0	720	843	741	768.0
23	Averages ----->			1271.6	1288.3	1364.9	1308.3	1123.1	1134.2	1100.8	1119.4
24											
25		All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd	
26		Mean	1213.8			Mean	1425.0	1199.8	1312.4	1378.46	
27		Min Point	768.0	-36.7%		Std. Dev.	150.7	89.4	166.8	131.78	
28		Max Point	1597.0	31.6%		COV as %	10.6	7.5	12.7	9.56	
29	Avg Conc	1189 pt/ft3				Instruments Used:				Cal. Due	
30	Avg. Flow	28540 acfm				TSI SN 9545A1205003				1/6/2014	
31		Start	Finish			Dew point pen/thermometer SN 122277875				5/16/2014	
32	Generator Inlet Press	2.8	2.8	psig		Met One OPC 96258675				ref FIO	
33	Stack Temp	25.6	25.6	C		Met One OPC 1011529009				sample 1/14/2014	
34	Centerline vel.	3368	3173	fpm							
35	Ambient pressure	29.55	29.53	inHg							
36	Ambient humidity	31.4%	33.5%	RH							
37	Ambient temp	24.2	22.6	C							
38	Back-Gd aerosol	0,0,0,0	1,0,3,1	pt/ft3							
39	No. Bk-Gd samples	4	4								
40	Compressor output	20	20	psig							
41											
42	Notes:										
43											
44											
45	XYY 6/3/13										
46											
47											
48											
49											
50	Oil Used:	Edwards 19									
51	Ref. Probe Location:	Access cover, L-shaped									
52	Probe Type / Configuration:										
53	Side: L-shaped; Top: Bent C										
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu	
55	Signature/date	On File with Originals 6/3/13				Signature/date				7/10/2013	
56						Signature on file with original				TI-STMON-29	
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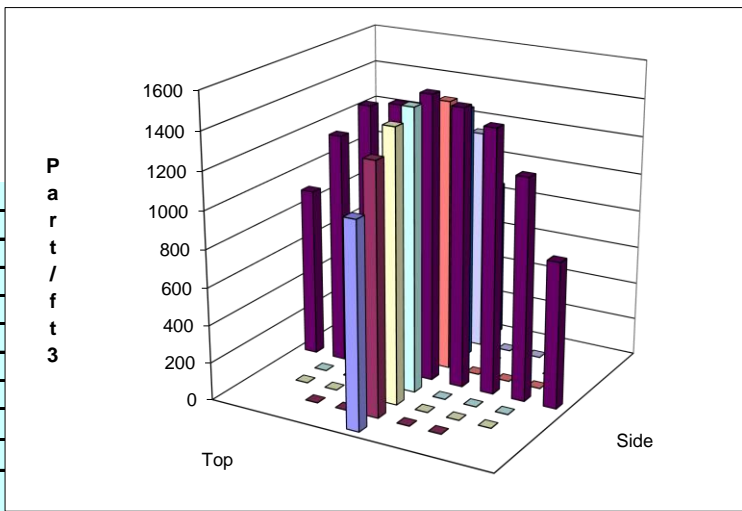
	A	B	C	D	E	F	G	H	I	J
1	PARTICLE TRACER TRAVERSE DATA FORM									
2	Rev. 0	25 Jan., 2013	Site EP-3410-01-S				Run No. PT-7			
3		Date 6/4/2013				Fan configuration A&C(1&3)				
4		Tester BGF, XYY				Fan Setting N/A	Hz			
5		Stack Dia. 40 in.				Stack Temp 26.9 deg C				
6		Stack X-Area 1256.6 in.2				Start/End Time 11:20/13:00				
7		Test Port Nearest to probe				Center 2/3 from 3.65	to: 36.10			
8		Distance to disturbance 53.5 inches				Points in Center 2/3 2	to: 7			
9		Measurement units particles/ft3				Injection Point Junction Center				
10		Order ---->	2nd			1st				
11		Traverse-->	Side				Top			
12		Trial ---->	1	2	3	Mean	1	2	3	Mean
13	Point	Depth, in.	particles/ft3				particles/ft3			
14	1	1.27	1114	1226	971	1103.7	1216	1345	1320	1293.7
15	2	4.17	1806	1762	1606	1724.7	1715	1725	1509	1649.7
16	3	7.71	1884	1873	1733	1830.0	1878	1809	1635	1774.0
17	4	12.84	1976	1875	1695	1848.7	2031	1882	1635	1849.3
18	Center	19.88	1964	1878	1720	1854.0	1990	1974	1715	1893.0
19	5	26.91	2045	1819	1546	1803.3	1829	1856	1742	1809.0
20	6	32.04	1741	1550	1388	1559.7	1798	1790	1688	1758.7
21	7	35.58	1438	1348	1068	1284.7	1553	1513	1437	1501.0
22	8	38.48	1027	1010	823	953.3	1113	1000	977	1030.0
23	Averages ----->		1666.1	1593.4	1394.4	1551.3	1680.3	1654.9	1517.6	1617.6
24										
25	All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd	
26	Mean	1584.5			Mean	1700.7	1747.8	1724.3	1742.15	
27	Min Point	953.3	-39.8%		Std. Dev.	210.6	133.2	171.1	171.97	
28	Max Point	1893.0	19.5%		COV as %	12.4	7.6	9.9	9.87	
29	Avg Conc	1548 pt/ft3				Instruments Used:			Cal. Due	
30	Avg. Flow	28916 acfm				TSI	SN 9545A1205003	1/6/2014		
31		Start	Finish			Dew point pen/thermometer	SN 122277875	5/16/2014		
32	Generator Inlet Press	2.8	2.8	psig		Met One OPC	96258675	ref	FIO	
33	Stack Temp	25.6	28.2	C		Met One OPC	1011529009	sample	1/14/2014	
34	Centerline vel.	3359	3268	fpm						
35	Ambient pressure	29.61	29.58	inHg						
36	Ambient humidity	35.3%	28.6%	RH						
37	Ambient temp	24.4	27.0	C						
38	Back-Gd aerosol	1,0,0,0	1,3,0,0	pt/ft3						
39	No. Bk-Gd samples	4	4							
40	Compressor output	20	20	psig						
41										
42	Notes:									
43										
44										
45	XYY 6/4/13									
46										
47										
48										
49										
50	Oil Used:	Edwards 19								
51	Ref. Probe Location:	Access cover, L-shaped								
52	Probe Type / Configuration:									
53	Side: L-shaped; Top: Bent C									
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:		Carmen Arimescu		
55	Signature/date	On File with Originals 6/4/13				Signature/date		7/10/2013		
56					Signature on file with original		TI-STMON-29			
57										



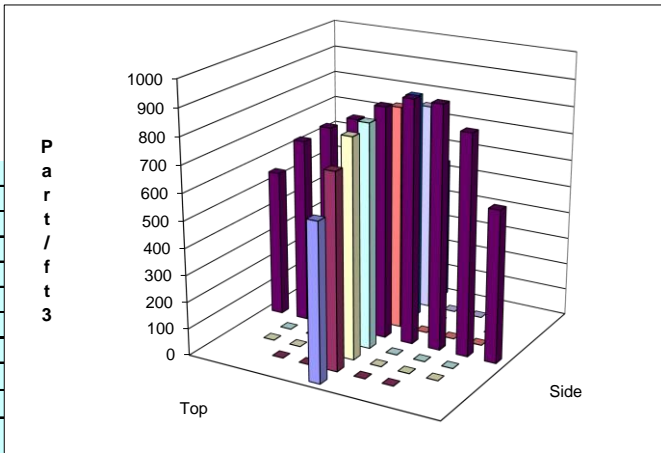
	A	B	C	D	E	F	G	H	I	J		
1	PARTICLE TRACER TRAVERSE DATA FORM											
2	Rev. 0	Site EP-3410-01-S			Run No. PT-8							
3	25 Jan., 2013	Date 6/6/2013			Fan configuration A&C(1&3)							
4		Tester BGF, XYY			Fan Setting N/A			Hz				
5		Stack Dia. 39.75 in.			Stack Temp 30.3 deg C							
6		Stack X-Area 1241.0 in.2			Start/End Time 11:45/13:45							
7		Test Port Nearest to probe			Center 2/3 from 3.65			to: 36.10				
8		Distance to disturbance 53.5 inches			Points in Center 2/3 2			to: 7				
9		Measurement units particles/ft3			Injection Point Fan A Center							
10		Order ----> 2nd			1st							
11		Trial ---->			2nd							
12		Traverse-->			Side			Top				
13				1	2	3	Mean	1	2	3	Mean	
14	Point	Depth, in.	particles/ft3							particles/ft3		
15	1	1.27	1660	1485	1566	1570.3	1533	1630	1387	1516.7		
16	2	4.17	1812	2314	1876	2000.7	1886	1960	2065	1970.3		
17	3	7.71	2671	2520	2801	2664.0	2020	1967	2256	2081.0		
18	4	12.84	2575	2752	2861	2729.3	1910	2134	2367	2137.0		
19	Center	19.88	2542	2677	2692	2637.0	1978	2132	2049	2053.0		
20	5	26.91	2435	2453	2510	2466.0	2092	1571	2355	2006.0		
21	6	32.04	2386	2272	2459	2372.3	2042	2159	2237	2146.0		
22	7	35.58	2054	2138	2107	2099.7	1953	1897	1973	1941.0		
23	8	38.48	1537	1484	1561	1527.3	1314	1257	1418	1329.7		
24	Averages ----->		2185.8	2232.8	2270.3	2229.6	1858.7	1856.3	2011.9	1909.0		
25	All	pt/ft3	Dev. from mean		Center 2/3		Side	Top	All	Normlzd		
26	Mean	2069.3			Mean		2424.1	2047.8	2236.0	2527.21		
27	Min Point	1329.7	-35.7%		Std. Dev.		284.3	79.5	279.9	231.43		
28	Max Point	2729.3	31.9%		COV as %		11.7	3.9	12.5	9.16		
29	Avg Conc	2035 pt/ft3		Instruments Used:						Cal. Due		
30	Avg. Flow	29081 acfm		TSI SN 9545A1205003						1/6/2014		
31		Start	Finish	Dew point pen/thermometer SN 122277875						5/16/2014		
32	Generator Inlet Press	4	4	Met One OPC 96258675 ref						FIO		
33	Stack Temp	30.2	30.4	Met One OPC 1011529009 sample						1/14/2014		
34	Centerline vel.	3500	3249									
35	Ambient pressure	29.46	29.45									
36	Ambient humidity	28.6%	24.6%									
37	Ambient temp	29.4	30.2									
38	Back-Gd aerosol	4,5,5,2	4,1,1,0									
39	No. Bk-Gd samples	4	4									
40	Compressor output	20	20									
41												
42	Notes:											
43												
44												
45		XYY 6/3/13										
46												
47												
48												
49												
50	Oil Used:	Edwards 19										
51	Ref. Probe Location:	Access cover, L-shaped										
52	Probe Type / Configuration:											
53	Side:	L-shaped; Top: Bent C										
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:				Carmen Arimescu		
55	Signature/date	On File with Originals 6/6/13				Signature/date				7/10/2013		
56						Signature on file with original				TI-STMON-29		
57												



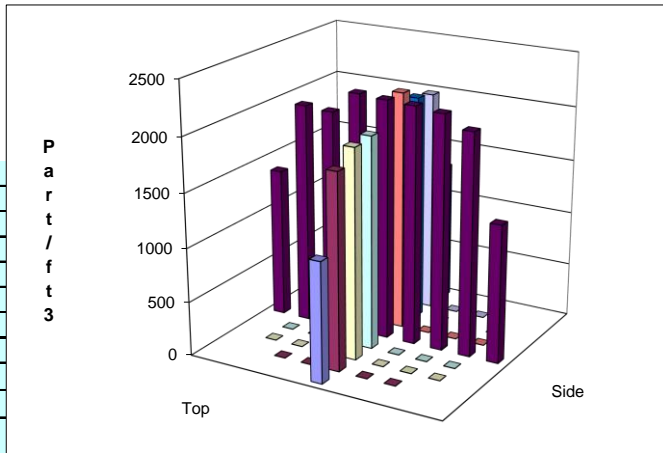
	B	C	D	E	F	G	H	I	J
1	PARTICLE TRACER TRAVERSE DATA FORM								
2	Site	EP-3410-01-S			Run No.	PT-9			
3	Date	6/3/2013			Fan configuration	B&C(2&3)			
4	Tester	BGF, XYY			Fan Setting	N/A		Hz	
5	Stack Dia.	40 in.			Stack Temp	27.5 deg C			
6	Stack X-Area	1256.6 in.2			Start/End Time	9:15/11:20			
7	Test Port	Nearest to probe			Center 2/3 from	3.65	to:	36.10	
8	disturbance	53.5 inches			Points in Center 2/3	2	to:	7	
9	ement units	particles/ft3			Injection Point	Fan C Center			
10	Order ---->	1st			2nd				
11	Traverse-->	Side				Top			
12	Trial ---->	1	2	3	Mean	1	2	3	Mean
13	Depth, in.	particles/ft3				particles/ft3			
14	1.27	695	805	784	761.3	1059	1112	1081	1084.0
15	4.17	1105	1019	1344	1156.0	1358	1370	1234	1320.7
16	7.71	1304	1344	1468	1372.0	1436	1550	1330	1438.7
17	12.84	1416	1387	1538	1447.0	1497	1574	1404	1491.7
18	19.88	1494	1420	1552	1488.7	1496	1643	1402	1513.7
19	26.91	1413	1409	1414	1412.0	1443	1465	1399	1435.7
20	32.04	1331	1372	1445	1382.7	1348	1341	1360	1349.7
21	35.58	1130	1231	1249	1203.3	1091	1241	1208	1180.0
22	38.48	800	1003	850	884.3	758	909	858	841.7
23	-->	1187.6	1221.1	1293.8	1234.1	1276.2	1356.1	1252.9	1295.1
24									
25	All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd
26	Mean	1264.6			Mean	1351.7	1390.0	1370.8	1382.18
27	Min Point	761.3	-39.8%		Std. Dev.	124.6	115.9	117.3	116.94
28	Max Point	1513.7	19.7%		COV as %	9.2	8.3	8.6	8.46
29	1235 pt/ft3				Instruments Used:				Cal. Due
30	30452 acfm				TSI SN 9545A1205003				1/6/2014
31		Start	Finish		Dew point pen/thermometer SN 122277875				5/16/2014
32	Press	2.8	2.8		Met One OPC 96258675				ref FIO
33		29.8	25.2		Met One OPC 1011529009				sample 1/14/2014
34		3697	3282						
35	e	29.64	29.62						
36	y	44.6%	41.9%						
37		21.7	22.6						
38	l	0,1,0,0	0, 0, 3, 1						
39	les	4	4						
40	put	20	20						
41									
42									
43									
44									
45	XYY 6/3/13								
46									
47									
48									
49									
50	Edwards 19								
51	ation: Access cover, L-shaped								
52	Configuration:								
53	; Top: Bent C								
54	: Xiao-Ying Yu				Technical Data Review performed by: Carmen Arimescu				
55	On File with Originals		6/3/13		Signature/date		7/10/2013		
56					Signature on file with original		TI-STMON-29		
57									



	A	B	C	D	E	F	G	H	I	J	
1	PARTICLE TRACER TRAVERSE DATA FORM										
2	Rev. 0	25 Jan., 2013	Site EP-3410-01-S				Run No. PT-10				
3		Date	6/6/2013				Fan configuration A&C(1&3)				
4		Tester	BGF, XYY				Fan Setting N/A	Hz			
5		Stack Dia.	39.75 in.				Stack Temp	28.9 deg C			
6		Stack X-Area	1241.0 in.2				Start/End Time	9:15/11:45			
7		Test Port	Nearest to probe				Center 2/3 from	3.65	to:	36.10	
8		Distance to disturbance	53.5 inches				Points in Center 2/3	2	to:	7	
9		Measurement units	particles/ft3				Injection Point	Junction Center			
10		Order ---->	1st				2nd				
11		Traverse-->	Side				Top				
12		Trial ---->	1	2	3	Mean	1	2	3	Mean	
13		Point	Depth, in.	particles/ft3				particles/ft3			
14		1	1.27	627	493	572	564.0	489	500	487	492.0
15		2	4.17	852	762	837	817.0	662	557	606	608.3
16		3	7.71	1013	789	899	900.3	699	644	707	683.3
17		4	12.84	991	869	848	902.7	699	663	736	699.3
18		Center	19.88	833	856	889	859.3	740	663	767	723.3
19		5	26.91	782	826	786	798.0	745	607	744	698.7
20		6	32.04	802	736	715	751.0	712	665	751	709.3
21		7	35.58	704	680	669	684.3	665	635	664	654.7
22		8	38.48	568	532	540	546.7	437	417	487	447.0
23		Averages ----->		796.9	727.0	750.6	758.1	649.8	594.6	661.0	635.1
24											
25		All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd	
26		Mean	696.6			Mean	816.1	682.4	749.3	813.42	
27		Min Point	447.0	-35.8%		Std. Dev.	80.0	39.2	92.0	62.93	
28		Max Point	902.7	29.6%		COV as %	9.8	5.7	12.3	7.74	
29		Avg Conc	685 pt/ft3			Instruments Used:			Cal. Due		
30		Avg. Flow	29689 acfm			TSI SN 9545A1205003			1/6/2014		
31			Start	Finish		Dew point pen/thermometer SN 122277875			5/16/2014		
32		Generator Inlet Press	2.8	2.8	psig	Met One OPC 96258675 ref			FIO		
33		Stack Temp	28.3	29.5	C	Met One OPC 1011529009 sample			1/14/2014		
34		Centerline vel.	3306	3584	fpm						
35		Ambient pressure	29.47	29.46	inHg						
36		Ambient humidity	31.7%	28.4%	RH						
37		Ambient temp	27.4	28.8	C						
38		Back-Gd aerosol	2,1,0,0	4,5,5,2	pt/ft3						
39		No. Bk-Gd samples	4	4							
40		Compressor output	20	20	psig						
41											
42		Notes:									
43											
44											
45			XYY 6/3/13								
46											
47											
48											
49											
50		Oil Used:	Edwards 19								
51		Ref. Probe Location:	Access cover, L-shaped								
52		Probe Type / Configuration:									
53		Side:	L-shaped; Top: Bent C								
54		Entries made by:	Xiao-Ying Yu			Technical Data Review performed by:			Carmen Arimescu		
55		Signature/date	On File with Originals 6/6/13			Signature/date			7/10/2013		
56						Signature on file with original			TI-STMON-29		
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	A	B	C	D	E	F	G	H	I	J		
1	PARTICLE TRACER TRAVERSE DATA FORM											
2	Rev. 0	Site EP-3410-01-S			Run No. PT-11							
3	25 Jan., 2013	Date 6/7/2013			Fan configuration B&C(2&3)							
4		Tester MSP, XYY			Fan Setting N/A			Hz				
5		Stack Dia. 39.75 in.			Stack Temp 30.05 deg C							
6		Stack X-Area 1241.0 in.2			Start/End Time 9:00/12:30							
7		Test Port Nearest to probe			Center 2/3 from 3.65		to: 36.10					
8		Distance to disturbance 53.5 inches			Points in Center 2/3 2		to: 7					
9		Measurement units particles/ft3			Injection Point Fan C Center							
10		Order ----> 1st			2nd							
11		Traverse-->			Side			Top				
12		Trial ---->			1	2	3	Mean	1	2	3	Mean
13		Point	Depth, in.	particles/ft3				particles/ft3				
14		1	1.27	1163	1275	1390	1276.0	816	1314	725	951.7	
15		2	4.17	1958	1959	2242	2053.0	1556	1632	1463	1550.3	
16		3	7.71	2182	2023	2296	2167.0	1710	1678	1602	1663.3	
17		4	12.84	2191	2036	2361	2196.0	1785	1666	1604	1685.0	
18		Center	19.88	2307	1885	2433	2208.3	1969	1821	1898	1896.0	
19		5	26.91	2154	2171	2353	2226.0	1855	1704	2122	1893.7	
20		6	32.04	1911	1778	2378	2022.3	1850	1616	1924	1796.7	
21		7	35.58	1834	2169	2118	2040.3	1796	1491	1609	1632.0	
22		8	38.48	1239	1547	1363	1383.0	1252	979	1097	1109.3	
23	Averages ----->			1882.1	1871.4	2103.8	1952.4	1621.0	1544.6	1560.4	1575.3	
24												
25		All	pt/ft3	Dev. from mean		Center 2/3	Side	Top	All	Normlzd		
26		Mean	1763.9			Mean	2130.4	1731.0	1930.7	2073.29		
27		Min Point	951.7	-46.0%		Std. Dev.	88.2	133.6	234.1	135.22		
28		Max Point	2226.0	26.2%		COV as %	4.1	7.7	12.1	6.52		
29	Avg Conc	1728 pt/ft3			Instruments Used:			Cal. Due				
30	Avg. Flow	28896 acfm			TSI SN 9545A1205003			Jan, 2014				
31			Start	Finish	Dew point pen/thermometer SN 122277875							
32	Generator Inlet Press		4	4	Met One OPC 96258675 ref FIO							
33	Stack Temp		29.4	30.7	Met One OPC 1011529009 sample 1/14/2014							
34	Centerline vel.		3397	3309								
35	Ambient pressure		29.45	29.46								
36	Ambient humidity		27.4%	22.3%								
37	Ambient temp		28.3	22.7								
38	Back-Gd aerosol		1,0,2,0	1,2,6,0								
39	No. Bk-Gd samples		4	4								
40	Compressor output		24	24								
41												
42	Notes:	Repeat PT-6 (B&C), fan C center injection.										
43		Flow alarm turned on @ side center, count number low.										
44		Checked factory setting, restart, OK. Flow alarm can be										
45		triggered when volume is < 1ft3. Need to check and correct										
46		previous data when flow alarm was activated. Tight connections										
47		b.w, black tubing will ensure consistent count and reduce										
48		particle loss. Redo side 2nd pt 5. Wind picked up at the end.										
49		XYY 6/7/13										
50	Oil Used:	Edwards 19										
51	Ref. Probe Location:	Access cover, L-shaped										
52	Probe Type / Configuration:											
53	Side:	L-shaped; Top: Bent-C										
54	Entries made by:	Xiao-Ying Yu				Technical Data Review performed by:			Carmen Arimescu			
55	Signature/date	On File with Originals 6/7/13				Signature/date			7/10/2013			
56						Signature on file with original			TI-STMON-29			
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